CHAPTER 3

OUTLINE OF THE PROJECT

CHAPTER 3 OUTLINE OF THE PROJECT

3.1 Objective of the Project

The public infrastructure in Giza City in Giza Governorate, where the Project Site is located, is far below the level of Cairo on the opposite side of the Nile as described in Chapter 1 despite the fact that Giza City is part of the Greater Cairo Region. The situation in Monib District, i.e., the Project Site, which has a present population of some 133,000 is particularly poor because of its omission from urban development programmes and the people are living under poor and unsanitary living conditions.

In an attempt to redress this serious situation, Giza City has prepared the Expansion Plan for Water Supply and Sewer Systems in South Giza, which covers the Project Site, to improve the local living and sanitation conditions. However, it has been found difficulty to implement this plan due to the deterioration of public finance in Egypt. The low prospect of securing a loan due to the limited profitability of this sector has also contributed to the long delay in plan implementation.

Against this background, the Project intends to establish stable life for the local inhabitants and to improve the sanitation conditions in Monib District, Giza City which is by and large a residential area for low income people through the construction of water supply and sewer facilities to provide reliable water supply and sewer services.

3.2 Examination of Requested Contents

3.2.1 Appropriateness and Necessity of the Project

The Project Site has a high concentration of low income people. The high population density and long delay in the provision of public infrastructure, including water supply and sewer facilities, have resulted in extremely poor living and sanitation conditions even though the area is part of the Greater Cairo Region. Therefore, the construction of water supply and sewer facilities, essential components of the public infrastructure, is extremely important in order to improve the local living and sanitation conditions by means of the urgent implementation of the Project following the construction of the water supply and sewer line networks under the Phase 1 Project.

The Project can be described as a subordinate plan of the master plan prepared by the Egyptian authorities but not yet implemented due to the critical financial situation in

Egypt. As implementation of the Project is essential for the overall improvement of the public infrastructure in Giza City and the objectives of the Project are compatible with the targets set by the Third Five-year Plan of the Government of Egypt, the Project is rightly judged as meeting the requirement in Egypt. In view of the present situation of water supply and sewer facilities improvement efforts in Egypt, the expected positive effects of the Project and Egypt's financial situation, the provision of Japan's grant aid for the Project appears highly appropriate.

3.2.2 Project Implementation and Management

(1) Administrative Continuity

As described later in 3.3.1, Giza City will act as the implementation body for the Project, as in the case of the Phase 1 Project, while GCWSA and GOSD will be responsible for technical issues, including the planning, operation and maintenance of the facilities to be constructed under the Project. Sections of GCWSA relating to the Project will be the same as in the case of the Phase 1 Project, i.e., the Network Section and other sections with a total number of staff of some 4,000. The Vice-Chairman for Technical Affairs will be responsible for the smooth implementation of the Project. In the case of GOSD, the Project will be implemented by the West Bank Giza Governorate Section of the Operation and Maintenance Department with some 350 staff members under the supervision of the Chairman.

As the sections responsible for the operation and maintenance of the new facilities have sufficient manpower and the required technical capability due to the following reasons, the present manpower level and organization of GCWSA and GOSD are consequently judged appropriate for the operation and maintenance requirements of the new facilities.

1) They already have similar responsibility for the much larger existing facilities in the Greater Cairo Region.

2) The scale of the new facilities is very small compared to the existing facilities in the Greater Cairo Region.

3) GCWSA has proven capability of operating and maintaining many waterworks of the planned scale (water supply capacity of 35,000m^3/day) or even larger scale.

4) GOSD both operates and maintains many pumping stations using screw pumps, as in the case of Sewer Transfer Pump Station No. 5 (B) planned under the Project,

and conducts technical training on the operation and maintenance of screw pump-type pumping stations at home and abroad with the assistance of USAID to foster a large number of technicians and engineers to work at screw pump-type pumping stations, the operation of which will commence in line with the commencement of the operation of Abu Rawash Wastewater Treatment Plant.

5) As described later in 3.3.4-(2), the required manpower level given below to operate and maintain the planned new facilities is just a fraction of the existing manpower level of GCWSA and GOSD, posing no problems vis-a-vis the necessary manpower level.

- The South Giza Waterworks Expansion Plan : 5
  - Supervisor .... (1)
  - Mechanical Engineer .... (1)
  - Electrical Engineer........... (1)
  - Workers .... (2)

- Sewer Transfer Pump Station No. 5 (B) Construction Plan : 4
  - Supervisor.................... (1)
  - Mechanical Engineer .... (1)
  - Electrical Engineer........... (1)
  - Worker........................ (1)

(2) Financial Continuity

As described later in 3.3.5, the facilities to be constructed under the Project will constitute important parts of the urban public infrastructure to ensure industrial activities in the area as well as the stable and healthy life of local inhabitants. The Egyptian side must conduct proper operation and maintenance to ensure the smooth running of the facilities so that the facilities can continue to perform their functions over a long period of time.

In view of the importance of the systematic operation and maintenance, including preventive maintenance, of the new facilities, continuous operation and maintenance funding by the Egyptian side is essential. The estimated operation and maintenance cost of the new facilities is given below (see 3.3.5 for more detailed discussion).

- Water supply facilities (South Giza Waterworks) annual operation and maintenance cost: approximately 904,000 LE (¥35 million)

- Sewer facilities (Sewer Transfer Pump Station No. 5 (B)) annual operation and maintenance cost: approximately 930,000 LE (¥36 million)

Judging from the planned level of the new service charges (see 2.1.1-(2) and 2.1.2-(2)), the revenue in 1996, the planned year of completion of the Project, is estimated to be some 5.75 million LE, of which 70% (some 4 million LE) will go to GCWSA and the remainder (some 1.72 million LE) to GOSD.

Based on the past performance of GCWSA and GOSD, the ratio of the operation and maintenance cost in the total revenue is some 25% for the water supply facilities and some 80% for the sewer facilities. The resulting operation and maintenance budget for the planned facilities will, therefore, be some 1 million LE (4 million LE × 0.25) for the water supply facilities and some 1.38 million LE (1.72 million LE × 0.8) for the sewer facilities. This estimated budget size will be sufficient to meet the estimated operation and maintenance expenditure of both services.

The Government of Egypt will be required to improve the efficiency of operation and maintenance work through public relations activities in order to obtain the understanding and cooperation of local inhabitants for the appropriate use of the newly constructed facilities in view of their public character and necessary service charge level and should also try to reduce the cost.

3.2.3 Linkage or Overlapping with Similar Projects or Other Aid Projects

(1) Water Supply Facilities

The Project is based on the water supply network improvement programme envisaged in the "Study of Water Supply in City of Giza" which was prepared in 1987 with German assistance (see 2.1.3-(1)). Japan is the only country to which the Government of Egypt has made a request for assistance for the related components of the Project.

(2) Sewer Facilities

GOSD is currently constructing the sewer trunk line (the Abu Nomros Main Collector) to upgrade the sewer network in South Giza (see 2.1.3-(2)) pursuant to the Greater Cairo Wastewater Project Master Plan and the contents of the Project are in line with the present construction plan of the above sewer trunk line. Japan is the only country to which the Government of Egypt has made a request for assistance for the related components of the Project.

(3) Scheduling Requirements

Water Supply Facilities

The South Giza Waterworks Expansion Plan (35,000 m^3/day) (hereinafter referred to as the Expansion Plan) and the water supply trunk line construction plan shall be completed not much later than the completion of the Phase 1 Project, in order to fully achieve the expected positive effects of the improved water supply network by the Phase 1 Project.

One Egyptian plan relating to water supply facilities improvement under the Project is the plan to extend the water supply capacity of South Giza Waterworks to 200,000m^3/day (hereinafter referred to as the overall expansion plan). In fact, the Expansion Plan under which the water supply capacity will be increased to 35,000m^3/day, is part of the overall expansion plan. Although the overall expansion plan is expected to be completed by 2010, no implementation schedule has yet been secured except for the Expansion Plan. As a result, there are no scheduling requirements for the Project vis-a-vis other projects.

Sewer Facilities

With regard to the construction work for Sewer Transfer Pump Station No. 5 (B), the work schedule should be coordinated with the progress of the construction of other pumping stations and sewer trunk lines located in the lowerstream of the sewer trunk line from Sewer Transfer Pump Station No. 5 (B). The completion date of the new Sewer Transfer Pump Station No. 5 (B) should also be as near as possible to the completion date of the Phase 1 Project.

The schedules of projects relating to the water supply and sewer facilities planned under the Project are given in Table 3-1.

Table 3-1 Construction Schedules of Projects Relating to the Project

Project	1989	1990	1991	1992	1993	1994	1995	1996
① Abu Rawash Wastewater Treatment Plant (USAID)		—	—	—				
② Pyramids Culvert (USAID)	—	—	—					
③ Pyramids Collector (USAID)			—	—	—			
④ Pyramids Pump Station (USAID)	—	—						
⑤ Abu Nomros Main Collector (GOSD)		—	—	—	—	—		
⑥ No.5 (A) Pump Station (GOSD)		—	—	—				
⑦ Phase 1 Project (including work to be undertaken by Egyptian side)					—	—	—	
The Project (planned)					—	—	—	—

Of the projects listed in Table 3-1, projects ①-⑥ have been either completed, are in progress or are financially committed to by USAID. The location of each project area and their linkage are shown in Fig. 2-9.

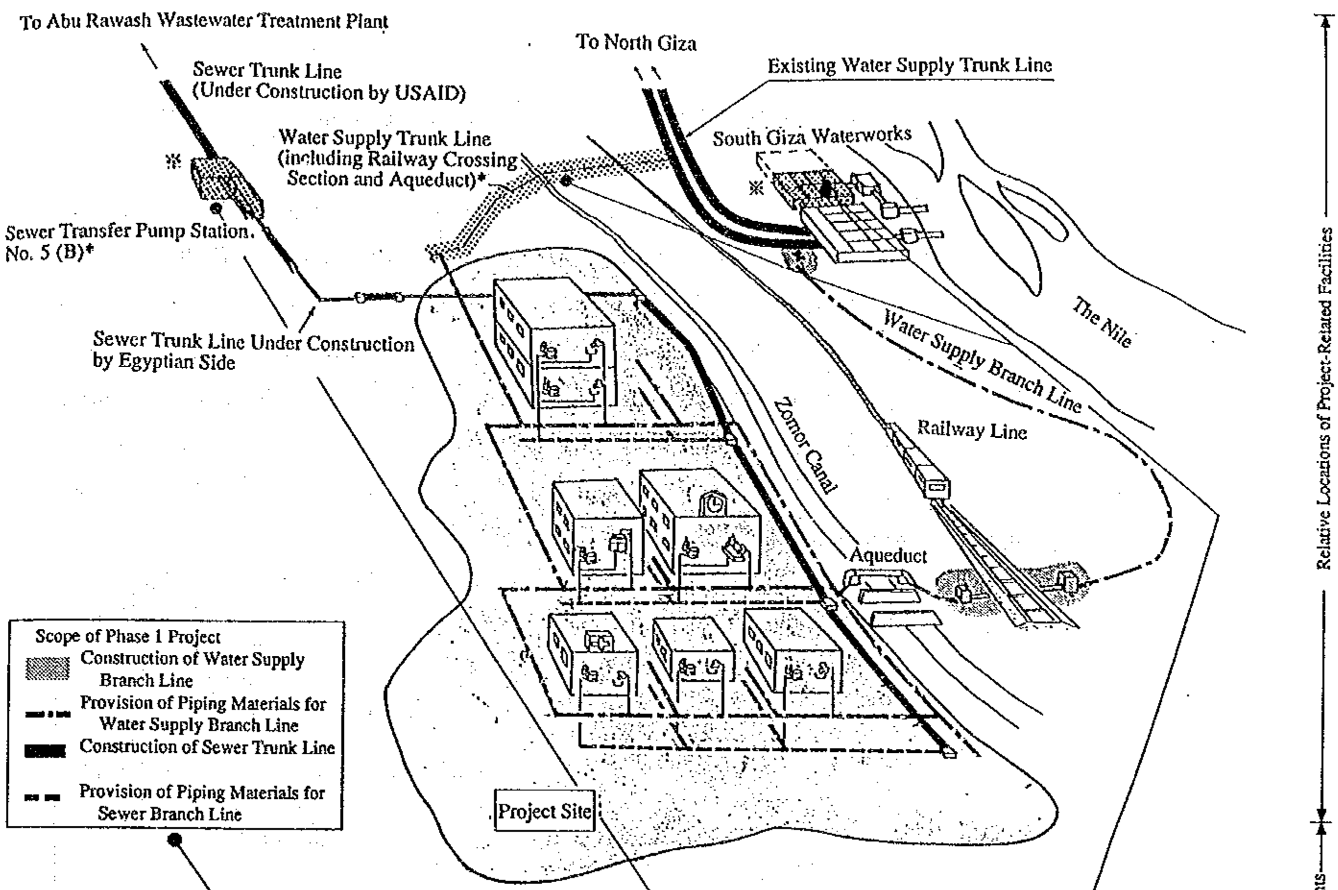
With regard to Sewer Transfer Pump Station No. 5 (B), even if it is constructed with Japanese grant aid, the commencement of the work will be delayed by more than 6 months from the commencement of the Phase 1 Project. Consequently, there is a strong likelihood that Sewer Transfer Pump Station No. 5 (B) will not be completed prior to the completion of the Phase 1 Project.

The completion of Sewer Transfer Pump Station No. 5 (B) after the completion of the Phase 1 Project will not pose any real problems as the initial low level of wastewater from Monib District can be dealt with by the existing Sewer Transfer Pump Station No. 5 (A) which will drain the wastewater in question to Zenein Wastewater Treatment Plant.

With the completion of the expansion work at South Giza Waterworks, the drainage of wastewater from Monib District will increase beyond the handling capacity of Pumping Station No. 5 (A) and, therefore, it is necessary to coordinate the expansion of South Giza Waterworks with the completion of Sewer Transfer Pump Station No. 5 (B).

3.2.4 Project Components

The Project is divided into 3 components, i.e. (1) the Expansion Plan, (2) the Water Supply Trunk Line Construction Plan and (3) the Sewer Transfer Pump Station No. 5 (B) Construction Plan. As these 3 components all relate to each other and also relate to the effects of the Phase 1 Project, the real effects of the Project cannot be materialised without appropriate coordination between the components. The relationship between the Project components is shown in Fig. 3-1.

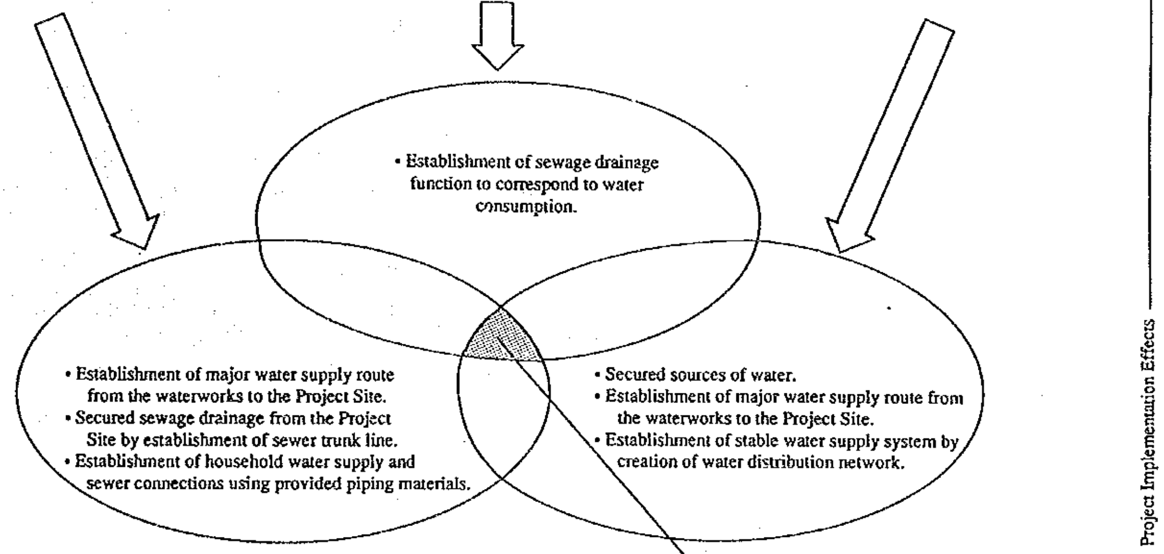


Phase 1 Project	
Water Supply Facilities	Sewer Facilities
Construction of Branch Lines Provision of Piping Materials for Branch Lines	Construction of Trunk Line Provision of Piping Materials for Branch Lines

Phase 2 Project
Sewer Facilities
Construction Plan of Sewer Transfer Pump Station No. 5 (B)

Phase 2 Project	
Water Supply Facilities	
Expansion Plan of South Giza Waterworks	Construction Plan of Trunk Line

Project Components



Positive Effects

The following positive effects can be achieved by the establishment of an integrated water supply and sewer service system through the area improvement of the water supply and sewer line networks, secured water sources and the creation of a reliable sewage drainage function.

① Stable living conditions for local inhabitants.
② Improved sanitation conditions
③ Improved living environment
④ Improvement of disaster prevention system
⑤ Increase of employment opportunities

Note: Items marked with * are the components of the Project.

Fig. 3-1 Relationship Between Project Components

3.2.5 Contents of Requested Facilities and Materials

As described in 3.2.4, the request for the Project consists of 3 construction plans, i.e., (1) the Expansion Plan, (2) the Water Supply Trunk Line Construction Plan and (3) the Sewer Transfer Pump Station No. 5 (B) Construction Plan. The size of the Project is fully compatible with the water supply and sewer line networks planned under the Phase 1 Project. The merging of the functions of the facilities planned under the 2 projects is a requisite for the completion of the water supply and sewer networks in the Project Site. As shown in Table 3-2, the requested contents and the planned size of the facilities appear appropriate.

Table 3-2 Contents of Request and Evaluation of Appropriateness of Planned Size of Facilities

	Contents of Request		Evaluation
	Plan	Facility Size	
Water Supply Facilities	South Giza Waterworks Expansion	Design Water Capacity: maximum 35,000m^3/day	• planned capacity is suitable for the required water supply volume in Monib District • planned contents are compatible with the Master Plan • planned contents are compatible with Egypt's Third Five-year Plan targets
	Water Supply Trunk Line Construction	Dia.: 1,200mm Length: approx. 2.4km	• planned line with form a water distribution loop together with the trunk line to be constructed under the Phase 1 Project and will ensure stable water supply pressure as well as volume for Monib District • planned contents are compatible with the Master Plan • planned contents are compatible with Egypt's Third Five-year Plan targets
Sewer Facilities	Sewer Transfer Pump Station No. 5 (B) Construction	3 pumps (single capacity: 1,650 litres/sec) (the building will have space for an additional pump to be installed in the future)	• planned capacity is compatible with the expected sewage volume from Monib District and the inflow volume from the Abu Nomros sewer trunk line connected to Sewer Transfer Pump Station No. 5 (B) • planned contents are compatible with Egypt's Third Five-year Plan targets

3.2.6 Necessity for Technical Cooperation

The water supply and sewer facilities to be constructed under the Project are of similar sizes to the facilities commonly operated and maintained in Egypt (see 3.2.2-(1)) and, therefore, the related organizations, engineers and workers responsible for these facilities have sufficient knowledge and technical expertise to smoothly conduct the operation and maintenance of the new facilities. The provision of technical cooperation for operation and maintenance purposes of the new facilities is, therefore, deemed unnecessary.

3.2.7 Basic Policies for Cooperation Implementation

Implementation of the Project by Japan's grant aid is deemed appropriate in view of the Project's conformity to the frameworks of master plans, expected positive effects, the organization, capability, budgetary arrangements and operation and maintenance capability of the Egyptian side to implement the Project. Also the expected effects of the Project will satisfy the criteria set by Japan's grant aid system. Consequently, the project outline is examined and the basic design for the Project is conducted in the following sections assuming the provision of Japanese grant aid for the Project. Table 3-3 compares the scope of the original Egyptian request with the actual scope of the Project.

Table 3-3 Comparison Between Scope of Egyptian Request and Scope of the Project

Item	Egyptian Request	Project
(Water Supply Facilities)		
① South Giza Waterworks Expansion: design water supply capacity: 35,000m^3/day	○	○
② Water Supply Trunk Line Construction: 1,200mm in diameter for approximately 2.4km in length	○	approx. 2.3km
(Sewer Facilities)		
③ Sewer Transfer Pump Station No. 5 (B) Construction: 3 pumps (1,650 litres/sec each) with additional space for an extra pump to be installed in the future	○	○
④ Services necessary for construction mentioned in ①~③ and for detailed design thereof	○	○

3.3 Project Outline

3.3.1 Implementation Organization and Operational Structure

The responsible organization and implementation organization for the Project on the Egyptian side are the same as those for the Phase 1 Project.

- Responsible and coordinating organization : Giza Governorate
- Implementation organization : Giza City

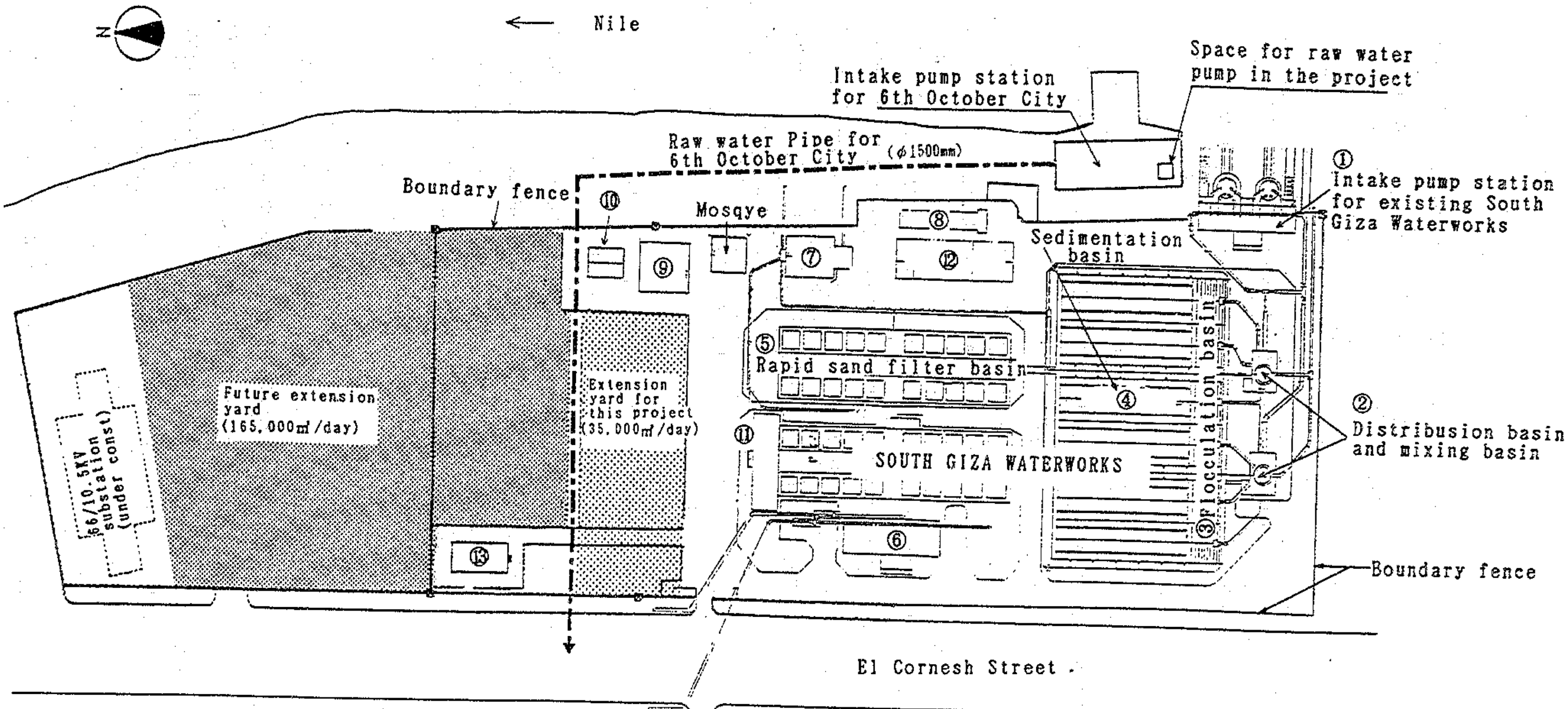
As described earlier in 2.1.1-(2) and 2.1.2-(2), the planning, operation and maintenance of water supply and sewer facilities in the Greater Cairo Region are the responsibility of GCWSA and GOSD. The technical issues involved in the Project must be confirmed and approved by these 2 organizations prior to implementation. Moreover, the authority and responsibility for the operation and maintenance of the facilities to be constructed under the Project will be transferred from Giza City to GCWSA and GOSD after completion.

3.3.2 Location and Current Conditions of Planned Construction Sites

(1) South Giza Waterworks

The construction site for the Expansion Plan (to increase the water supply capacity to 35,000m^3/day) has already been secured on the existing premises of South Giza Waterworks as part of the master plan to increase the water supply capacity to 200,000m^3/day as shown in Fig. 3-2. The site secured for the future extension has a trapezium shape, bordered by El Cornesh Street, the site where a 66/10.5KV substation is currently under construction (to be completed in 1994), and the Nile. It has a total area of approximately 20,000m^2 and is almost flat. The site for the Project (water supply capacity: 35,000m^3/day) is located on the side near the existing waterworks and is currently a green belt with several tall trees. Special attention should be paid to the following points when this site is used.

1) The existing structures on the site include an office building (RC, some 20m long, 10m wide and 10m high), raw water pipe (1,500mm steel pipe) for the 6th October Waterworks and sewer pipe. The raw water pipeline for the 6th October Waterworks is buried at a distance of some 62m from the existing administration building/water quality laboratory to the site for this project.



⑧ Chlorine storage
⑨ Emergency generator
⑩ Fuel tank for emergency generator
⑪ Administration bulding and laboratory
⑫ Workshop and store
⑬ Office

Existing facility

① Intaake pump station for existing South Giza Waterworks
② Distribution basin and mixing basin
③ Flocculation basin
④ Sedimentation basin
⑤ Rapid sand filter basin
⑥ Distribution pump station
⑦ Sludge basin

Fig. 3-2 Existing South Giza Waterworks and Land for Expansion Plan

2) There is space on the dry riverbed of the Nile for further extension. The estimated width of this space is some 40m on the substation side and some 30m of the existing waterworks side.

3) The elevation of the site is AD +21m and its difference between the HWL of the Nile (AD +17.92m) of approximately 3.1m is rather small.

(2) Water Supply Trunk Line

As shown in Fig. 4-13, 3 streets in Monib District are subject to consideration to accommodate the planned water supply trunk line, i.e., Madba Street, 6th October Street and Coldair Street. These streets have the following characteristics.

Madba Street

Madba Street is approximately 15m wide and is the widest of the 3 streets. A pier for the Tersa Flyover is currently being constructed at the centre of the street at the crossing of Madba Street over the Cairo-Aswan Railway line (to be completed in May, 1994). As the existing water supply and sewer lines must be moved to places where their construction will not affect the foundations of the flyover, the construction of the planned water supply trunk line under this street appears very difficult due to the limited space left.

Cordair Street

Cordair Street is approximately 8m wide and both sides are lined with busy shops. 2 sewer lines and one water supply line are buried at a depth of approximately 1.5m to 3m with many manholes. The construction of the planned water supply trunk line under this street also appears very difficult.

6th October Street

2 sewer lines are buried at a depth of approximately 5m under 6th October Street. While there are many manholes at 30-50m intervals, the total number is still less than those of the above 2 streets. 6th October Street is some 10m wide and half of the entire route has no housing on either side, making the construction of the planned water supply trunk line under this street relatively simple.

(3) Sewer Transfer Pump Station No. 5 (B)

The site for Sewer Transfer Pump Station No. 5 (B) has already been secured on the premises of Sewer Transfer Pump Station No. 5 (A). As Fig. 2-14 shows, the site is located some 4km west of Monib District and some 500m south of Pyramids Street. Sewage will be sent to Sewer Transfer Pump Station No. 5 (B) from south Giza via Abu Nomros Main Collector, the part of which will be constructed under the Phase 1 Project.

Fig. 3-3 shows the locations of the facilities of Sewer Transfer Pump Stations No. 5 (A) and (B) and their current conditions are described below.

1) The construction of the open-type Sewer Transfer Pump Station No. 5 (A) is currently in progress to treat sewage from neighbouring areas. The work is almost completed except for the laying of pressure feed pipes and it is expected to commence operation by the end of 1992.

2) The design pumping volume of Sewer Transfer Pump Station No. 5 (A) is approximately 30,000m^3/day and sewage is then sent to the existing Zenein Wastewater Treatment Plant for final treatment via Pumping Station No. 1.

3) Space to install an emergency power generator, which is part of the operational arrangements for Sewer Transfer Pump Station No. 5 (B), has been secured inside the existing building on the premises of Sewer Transfer Pump Station No. 5 (A).

4) At Tersa Street in front of Pumping Stations No. 5 (A) and (B), the construction of a sewer trunk line, including the section connecting to Sewer Transfer Pump Station No. 5 (B), is in progress with USAID assistance (Contract No. 27) and this sewer trunk line is expected to become operational in June, 1994.

(4) Temporary Work Sites

Public land owned or managed by GCWSA, GOSD or Giza Governorate near the subject sites of the Project will be used as temporary work sites to accommodate a material yard and site office, etc. The estimated sizes and location of these work sites are as follows.

1) South Giza Waterworks: approximately 10,000m^2 (on the site earmarked for the future extension of the Waterworks)

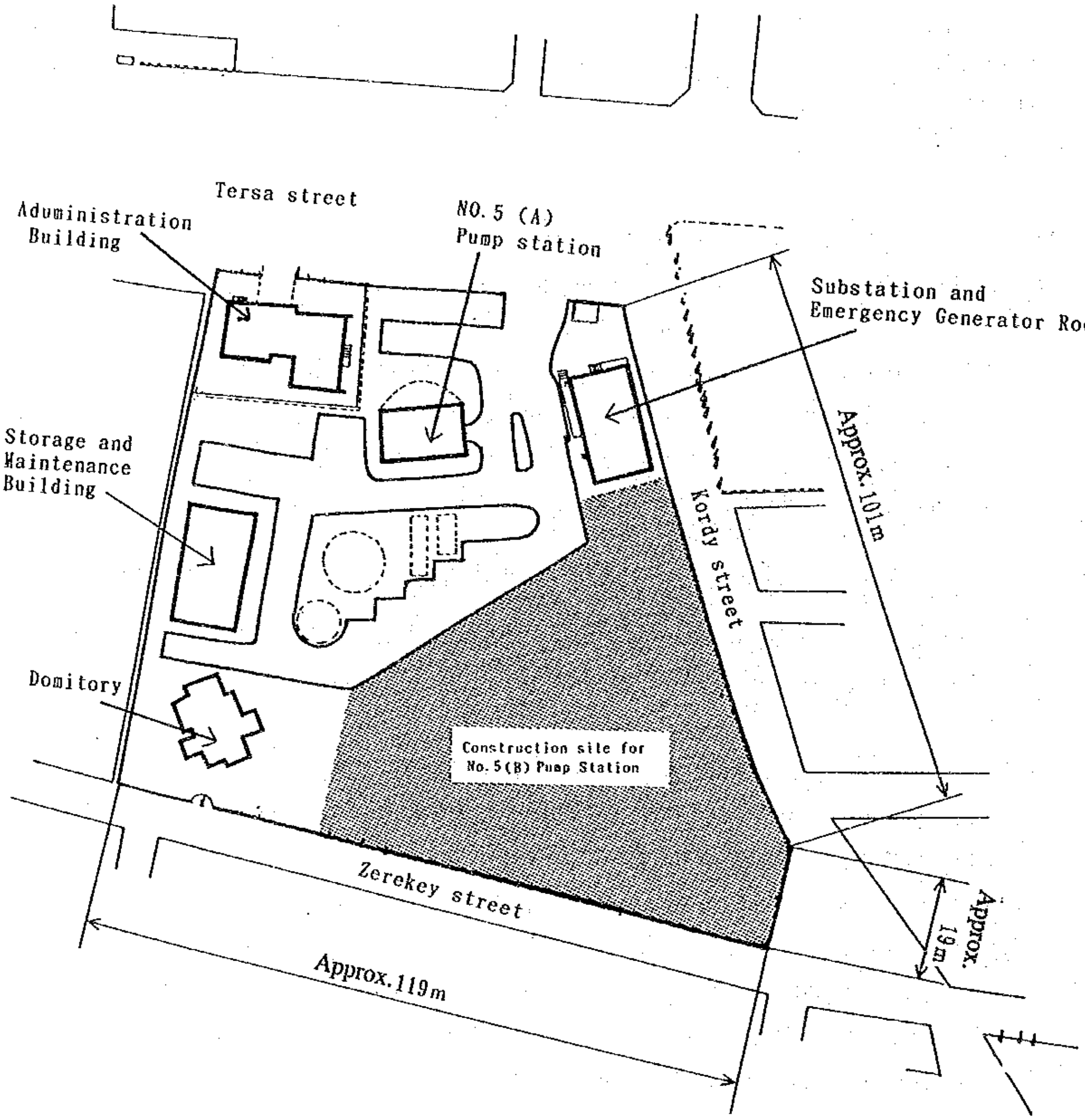


Fig. 3-3 Site Layout of Sewer Transfer Pump Station No. 5

2) Sewer Transfer Pump Station No. 5 (B): approximately 2,500m^2 (on the premises of Sewer Transfer Pump Station No. 5 (A) and in neighbouring areas)

3) Water Supply Trunk Line: approximately 1,500m^2 (land owned by Giza Governorate near the construction site)

3.3.3 Outline of Facilities

The facilities to be constructed under the Project are outlined in Table 3-4.

Table 3-4 Outline of Project Facilities

	Item	Size	Purpose of Use
Water Supply Facilities	South Giza Waterworks Expansion	Design Water Supply Capacity: 35,000m^3/day	To ensure a water supply source for inhabitants of Monib District
	Water Supply Trunk Line Construction	Diameter: 1,200mm Length: approx. 2.3km	To ensure a water supply trunk line from South Giza Waterworks to Monib District and to establish a loop route, combined with the trunk line to be constructed under the Phase 1 Project
Sewer Facilities	Sewer Transfer Pump Station No. 5 (B) Construction	Design Capacity: 1,650 litres/sec (× 3 pumps) (the building will have space for an additional pump to be installed in the future)	To ensure drainage of the sewage generated in Monib District

3.3.4 Operation and Maintenance

(1) Required Operation and Maintenance Scheme

1) Principles

It will be necessary to introduce preventive maintenance measures focusing on reliability, safety and efficiency improvement and to practice appropriate operation and maintenance as shown in Fig. 3-4 to properly maintain the functions of the new facilities over a long period of time. For this purpose, continuous efforts should be made to conduct regular checks on the organization, manpower, operation and maintenance performance and also to improve the technical capability.

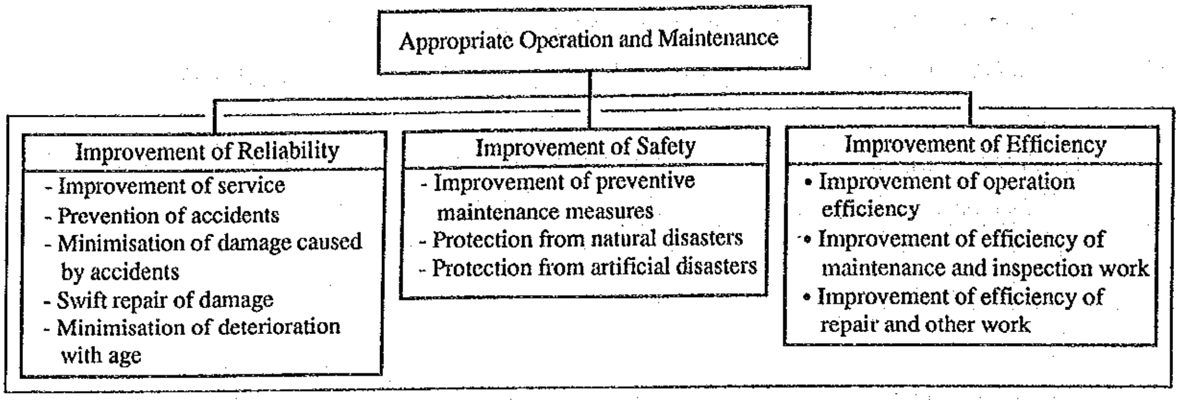


Fig. 3-4 Basic Operation and Maintenance Principles of Water Supply and Sewer Facilities

2) Operation and Maintenance Requirements

Based on the operation and maintenance principles described in 1) above, GCWSA and GOSD should conduct the operation and maintenance of the facilities to be constructed under the Project as described below. Table 3-5 gives the main operational and maintenance requirements of the new facilities.

Operation : to properly conduct the operation and control of the equipment and apparatus under the given conditions

Maintenance : to maintain, repair and prepare the facilities, equipment and apparatus so that they can achieve the maximum performance

GCWSA should use the sludge basin to be constructed under the Project as part of its operation of the new waterworks to properly dispose of the sludge generated by the new facility with a view to conservation of the water quality of the Nile.

GOSD should regularly check and maintain the emergency power generator to improve the reliability of Sewer Transfer Pump Station No. 5 (B) in the case of an emergency (power failure).

Table 3-5 Main Operation and Maintenance Requirements of New Facilities

	Main Requirements	
	South Giza Waterworks	Sewer Transfer Pump Station No. 5 (B)
Operation	① Water flow rate control: to operate/control equipment/apparatus to meet the target water flow rate. ② Water quality control: to check the water quality at each purification process and to regulate the chemical dosage to meet the target water quality. To keep water quality records in order to obtain reliable data for water quality assessment and control.	① Control of operation size: to select and operate the optimal number of pumps to deal with the sewage inflow. ② Operation records: to record the operation duration and frequency, etc. of pumps to obtain data to decide the operation hours of each pump, order of operation and regular inspection programme.
Maintenance	① Inspection/patrol: to patrol or inspect the conditions of facilities, equipment and apparatus, etc. by eye or instruments to check for any damage or failure. To safely store coagulant (aluminium sulphate) and disinfectant (chlorine) and to ensure their constant supply. ② Preventive maintenance: to conduct regular maintenance regardless of the non-existence of an apparent failure of or damage to facilities, equipment or apparatus based on their relative importance and/or characteristics to improve reliability and safety so that operation can be maintained without failure.	① Inspection/patrol: to patrol or inspect the conditions of facilities, equipment and apparatus, etc. by eye or instruments to check for any damage or failure. To monitor the build-up of large objects stopped by the screen and to remove them when removal is deemed necessary. ② Preventive maintenance: see left.

(2) Staff Assignment Plan

The introduction of the systems listed in Table 3-6 appears necessary to ensure the proper operation and maintenance of the new facilities to be constructed under the Project given the operation and maintenance requirements described in (1)-2) above and the size and contents of these facilities.

Table 3-6 Staff Assignment Plan for Operation and Maintenance

	Job	Required Number	
South Giza Waterworks	Supervisor	1*	To supervise engineers and workers and to coordinate operation.
	Mechanical Engineer	1 (3 shifts)	To operate and maintain mechanical equipment and to issue instructions on operation. To check maintain and instruct on water quality.
	Electrical Engineer	1 (3 shifts)	To operate and maintain electrical equipment and to issue instructions on operation. To check, maintain and instruct on water quality.
	Assistant	2 (3 shifts)	To assist engineers and to operate equipment.
Sewer Transfer Pump Station No. 5 (B)	Supervisor	1*	To supervise engineers and workers and to coordinate operation.
	Mechanical Engineer	1*	To operate, maintain and instruct on mechanical equipment.
	Electrical Engineer	1*	To operate, maintain and instruct on electrical equipment.
	Assistant	1 (3 shifts)	To assist engineers and to operate equipment.

Note: Those marked with "*" should always be in communication even outside normal working hours in view of emergencies.

(3) Funding of Operation and Maintenance Through Service Charges

It is imperative that the Government of Egypt urgently responds to the local expectation for the early improvement of the poor living conditions in Monib District. Upon completion of the Project, the Government of Egypt should ensure the appropriate operation and maintenance of the new facilities to guarantee their full and proper functioning over a long period of time.

In order to secure such effective operation and maintenance, however, a constant flow of funds to cover the operation and maintenance cost is essential. The following measures, the introduction of which is expected to take place in fiscal 1992/93, should indeed be implemented without fail.

GCWSA: Continuous implementation of the water tariff increase plan to review the water charge system in order to reflect the actual cost of water purification and distribution as described in 2.1.1-(2)-3).

GOSD: Discussions with GCWSA on "improvement of the water supply service charge system to reflect the produced sewage quantity" as pointed out by the System Management Plan for GOSD prepared by USAID with a view to securing a reasonable share of the water tariff to cover sewer usage (see 2.1.2-(2)-3)).

(4) Water Service Revenue and Operation and Maintenance Cost

1) Water Service Revenue

Following the completion of the Expansion Plan, new revenue based on the new water supply volume of 35,000m^3/day can be expected.

As described earlier in 2.1.1-(2)-3), GCWSA is planning to implement a phased increase of the water tariff with the assistance of USAID. The expected water service revenue in the planned completion year of the Project (1996) based on such increases and the resulting budgetary allocation for GCWSA and GOSD for operation and maintenance purposes are as follows.

① Water Service Revenue

Conditions

a) Design water supply volume : 35,000m^3/day

b) Estimated average water tariff in 1996 : 0.5 LE/m^3

(based on current tariff on 0.22 LE/m^3 in Giza City)

c) Collection rate : 90% (Study Team estimate)

Annual water service revenue

= a × b × c × 365

= 5,748,750 LE/year (5.75 million LE/year)

② Allocation for Operation and Maintenance at GCWSA

a) Share of GCWSA in water service revenue : 70% (past performance)

b) Share of operation and maintenance cost in a) above : 25% (past performance)

Allocation for operation and maintenance

= water service revenue × a × b

= 1,006,031 LE/year (1 million LE/year)

③ Allocation for Operation and Maintenance at GOSD

a) Share of GOSD in water service revenue : 30% (past performance)

b) Share of operation and maintenance cost in a) above : 80% (past performance)

Allocation for operation and maintenance

= water service revenue × a × b

= 1,379,700 LE/year (1.38 million LE/year)

2) Operation and Maintenance Cost

The operation and maintenance cost of each facility to be constructed under the Project is given below. Chemicals and electricity account for some 86% of the entire cost at South Giza Waterworks while the power cost, including electricity (for pumping operation) and fuel for emergency power generation, is expected to account for some 92% of the total cost at Sewer Transfer Pump Station No. 5 (B).

① Estimated Annual Operation and Maintenance Cost at South Giza Waterworks (35,000m^3/day)

Chemicals	300,000 LE	(33.1%)
Electricity	482,000 LE	(53.3%)
Personnel	120,000 LE	(13.3%)
Consumables	2,000 LE	(0.3%)
Total	904,000 LE	(100.0%)

② Estimated Annual Operation and Maintenance Cost at Sewer Transfer Pump Station No. 5 (B)

Power (including fuel)	860,000 LE	(92.5%)
Personnel	65,000 LE	(7.0%)
Consumables	5,000 LE	(0.5%)
Total	930,000 LE	(100.0%)

The above calculation results indicate that the operation and maintenance expenditure of the new facilities will be lower than the expected budgetary allocation covering the operation and maintenance cost at GCWSA and GOSD based on the water service revenue size determined by the operation of the new facilities at South Giza Waterworks. Consequently, there are no foreseeable problems vis-a-vis the financial side of the management of the new facilities.

CHAPTER 4

BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4.1 Design Policies

4.1.1 Policies Relating to Natural Conditions

(1) Temperature and Humidity

The Greater Cairo Region in which the Project Site is located has a mean temperature of approximately 27°C in summer (April-October) as described earlier in 2.3.2-(3). As the daytime temperature can reach 40°C-45°C, the heat is intense. The mean annual humidity of approximately 53% indicates that the Project Site has a very dry climate.

The sewer facilities in the Greater Cairo Region are often clogged by sand transported from the desert and rubbish disposed of by local inhabitants, etc., blocking the flow of wastewater. The high temperature and low humidity create a high density of sulphide in the wastewater, causing much erosion to the concrete surface of pump wells at pumping stations. Consequently, it is standard practice for the concrete surface of pump wells at screw pump-type pumping stations in Egypt to be lined with PVC or epoxy resin to prevent corrosion and this requirement must be incorporated in the basic design for the Project. The basic design for the Project must also pay proper attention to the possible impact of the high temperature on both the mechanical and electrical facilities of the waterworks and pumping station.

(2) Water Temperature of the Nile

The water temperature of the Nile is approximately 15°C in winter and reaches as high as approximately 29°C in summer. As water temperature is an important factor in determining the backwashing speed for the waterworks, this high water temperature must be taken into consideration in the basic design for the Project.

4.1.2 Policies Relating to Construction Work

(1) Project-Related Permits and Approvals

The site for South Giza Waterworks upgrading work is located on the existing premises of South Giza Waterworks owned by GCWSA while the site for the Sewer Transfer Pump Station No. 5 (B) construction work is located on the existing premises of Sewer Transfer Pump Station No. 5 (A) owned by GOSD. The Project Site for the new water supply trunk line is a public road under which such public utilities as a water supply pipeline, sewer pipeline, power line and telephone line, etc. are buried. The planned route also crosses a railway track and a canal. The construction work will, therefore, require a number of permits and approvals prior to its commencement from various organizations, including the Giza City, GCWSA, GOSD, Egyptian Electricity Company, Giza Telephone Exchange, Egyptian State Railway, Giza Irrigation Authority and the Police.

It is essential that the necessary permits and approvals be obtained from the related organizations without delay for the progress of the work in line with the schedule. Moreover, the facility plan must take the technical standards in Egypt relating to water supply and sewer facilities, design criteria and work regulations and customs, etc. into proper consideration. As in the case of the Phase 1 Project, it is important that the Giza City (project implementation body) establish a project promotion committee to coordinate between the Japanese contractor and project-related organizations in Egypt, including government ministries and agencies.

(2) Related Laws and Regulations

The laws and regulations in Egypt relating to the implementation of the Project are listed in Table 4-1 and the basic design must take these laws into proper consideration.

Table 4-1 Laws and Regulations in Egypt Relating to Project Implementation

Title	Description
Import and Export Regulations	stipulate prohibited items for import
Labour Law	law governing work and employment conditions
General Sales Tax Law	law governing taxation on consumption which was introduced in May, 1991

(3) Technical Level of Local Construction Companies

The excavation depth is expected to be as deep as some 10m for the waterworks and pumping station construction work, suggesting fairly large-scale civil engineering work. Together with the fact that most mechanical and electrical equipment for the new facilities will be procured from Japan, it will be necessary for the work to be conducted under the supervision of Japanese engineers specialising in the relevant fields.

There are some 10 large construction companies in the Greater Cairo Region which specialise in or are conversant with water supply and sewer line construction work predominantly using the open-cut method. Even though 2 companies are currently capable of employing the pipe jacking method, their jacking work is limited because of the lack of diverse equipment.

The construction of the new water supply trunk line will use the open-cut method except for those sections crossing the railway track, the canal and trunk roads. As a pipe diameter as large as 1,200mm requires very accurate work, it is preferable that the local construction company conducts the work under the supervision of an expert dispatched by the Japanese contractor.

(4) Quality and Quantity of Labour Force

Egypt has a working population of 15.2 million (as of 1991). In view of the high unemployment rate of some 15%, the Government of Egypt has been continuously introducing measures to create employment opportunities to reduce the unemployment rate.

The technical standard of Egyptian construction workers is fairly high and a large number of engineers and skilled workers are employed abroad, especially in Gulf countries. The gradual return of these engineers and workers to Egypt has, however, been prompted by the employment opportunities created by government measures and the Gulf War situation in 1990-1991.

There is an ample workforce in the construction sector to conduct water supply and sewer facilities construction work and no problems are anticipated in regard to the securing of both engineers and skilled workers for the implementation of the Project.

(5) Quality and Availability of Local Materials and Equipment

The main construction materials, such as reinforcing bars, cement, forms, sand and gravel, are produced in ample quantity in Egypt. While such materials as steel sheet piles and H-shaped steel used for temporary structures are also produced in Egypt, their procurement in sufficient quantity to meet the tight schedule of the planned construction work appears difficult.

Most construction machinery and equipment can be procured locally. Typical exceptions are such special machinery as vibration-less and noise-less sheet pilers, pipe jacking machines, grouting machines and under-pressure drilling and tapping machines.

No ductile cast iron straight pipe or pipe fittings with a diameter of 1,100mm or larger, used for waterworks and water supply trunk lines, are produced in Egypt, necessitating their import from Japan. The filtering sand and gravels used for the rapid sand filters at the waterworks will be procured locally as they are in plentiful supply and have been successfully used by the existing South Giza Waterworks and other waterworks.

The reinforced concrete pipes to be used with the pipe jacking method for the water supply trunk line at the sections crossing the railway track and trunk roads are available locally in ample quantity and with good quality. In view of the fact that the pipe jacking machinery will be imported from Japan as described later, however, a local manufacturer of reinforced concrete pipes should be approached in view of altering the pipe specifications to suit those of the Japanese machinery.

4.1.3 Policies Relating to Utilisation of Local Construction Companies, Materials and Equipment

(1) Local Construction Companies

The general practice in the case of foreign-assisted, large-scale water supply and sewer projects in Egypt is for the foreign contractor to hire local engineers, technicians and workers to conduct the actual construction work. As the civil engineering work to extend South Giza Waterworks and to construct Sewer Transfer Pump Station No. 5 (B) under the Project involves deep excavation of more than 10m, as the work requires a very high degree of water tightness and building finishing due to the expected functions of the facilities and in view of the fact that the main mechanical and electrical equipment will be imported from Japan, the civil engineering work and the installation of both mechanical and electrical equipment will be conducted by a local construction company under the supervision of Japanese engineers.

In the case of small-scale water supply or sewer-related projects which are implemented with domestic funds, the general practice is for local construction companies to conduct the work, mainly using the open-cut method. While 2 companies are currently capable of employing the pipe jacking method, they lack sufficient technical expertise. In addition, they can only work with large pipes with a diameter of 2,200mm or more because of the limited range of their machinery.

Use of the pipe jacking method is planned for the Project at those sections where the water supply trunk line crosses the railway track and trunk roads. As the pipe diameter is 2,000mm, the machinery owned by local companies cannot be used. The appointment of well experienced Japanese engineers to supervise the pipe jacking work is planned in view of (1) the requirement for supervisors to be conversant with the machinery imported from Japan and (2) the very demanding working conditions, such as the limited availability of work space and the requirement not to disrupt train schedules and the heavy traffic in terms of both vehicles and pedestrians, etc. The engineers, skilled workers and ordinary workers to conduct the construction work under the supervision of these Japanese engineers will be recruited locally.

The under-pressure drilling and tapping method will be used at the 3 points where the new water supply trunk line (1,200mm diameter) is connected to the existing trunk line (1,000mm diameter) as described later (4.3.3-(6)). As this technology is not available locally, the machinery and engineers to conduct this particular work will be dispatched from Japan.

(2) Construction Materials and Equipment

In principle, the construction materials and equipment will be procured in Egypt. However, those items (referred to in 4.1.2 and 4.4.4) of which the procurement in Egypt is either difficult or impossible will be procured in Japan. In addition, those items of which the quality is unstable or the price is prohibitively high will also be imported from Japan.

4.1.4 Policies Relating to Operation and Maintenance of Constructed Facilities

Although the implementation body for the Project is Giza City, the operation and maintenance responsibility for the water supply and sewer facilities to be constructed under the Project will be transferred to GCWSA and GOSD respectively following the completion of the said facilities.

Both organizations are very large with more than 10,000 employees (see 2.1.1-(2) and 2.1.2-(2)) and are responsible for the entire Greater Cairo Region in their respective fields of work. Accordingly, both GCWSA and GOSD have sufficient experience and manpower to fulfil the new operation and maintenance responsibilities arising from the new facilities to be constructed under the Project. Nevertheless, clear confirmation of the availability of the necessary funds, systems/principles and regular inspection items for the maintenance and operation work is necessary as described in 3.3.5 to ensure the appropriate operation and maintenance of the new facilities over a long period of time.

4.1.5 Policies Relating to Scope and Level of Facilities, Materials and Equipment

The main water supply and sewer facilities to be constructed under the Project are shown in Fig. 4-1.

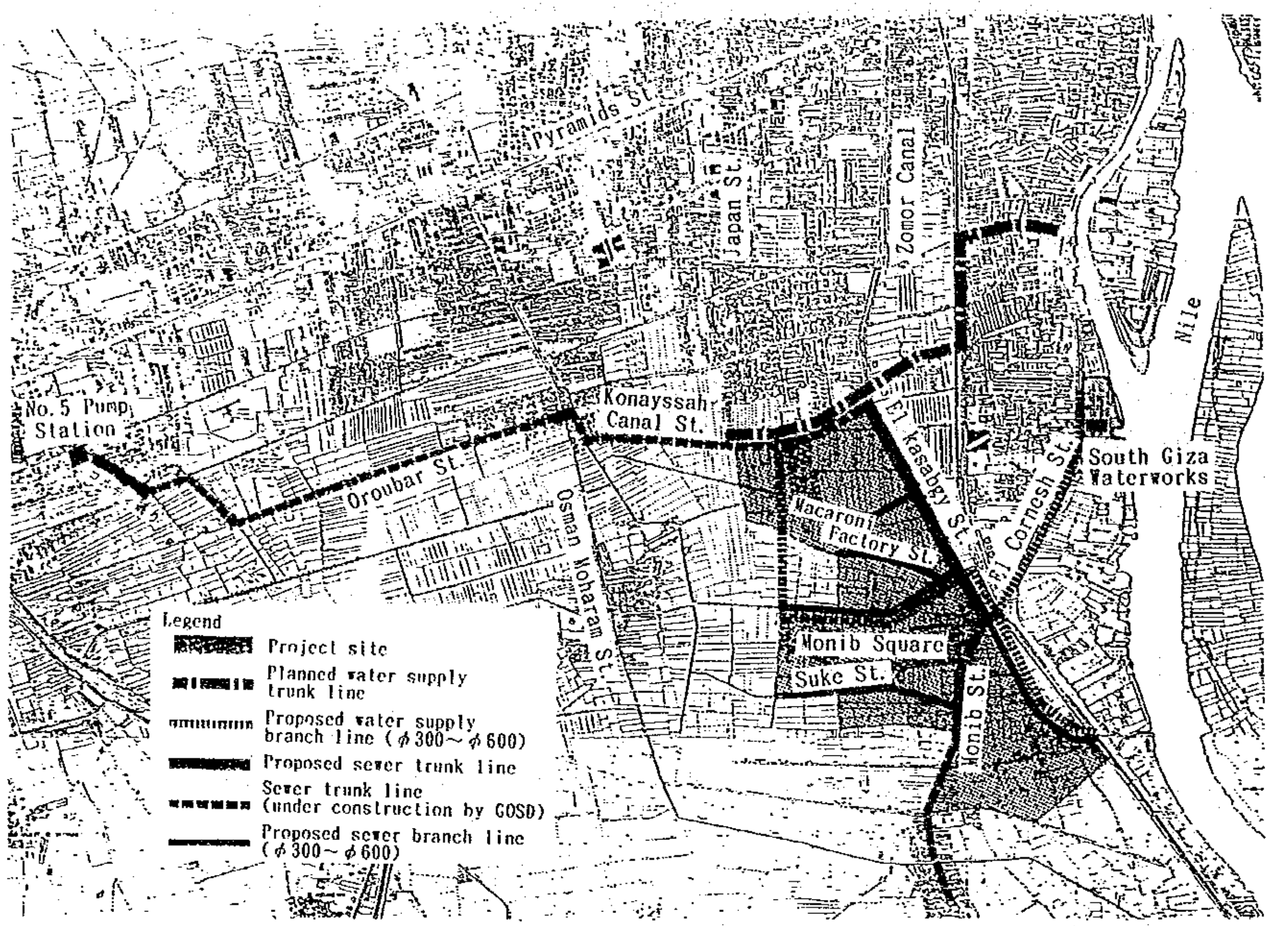


Fig. 4-1 Plan of New Water Supply and Sewer Facilities

(1) General

The basic policies for the basic design of the water supply and sewer facilities to be constructed under the Project are explained below.

1) The facilities plan should be prepared to promote the transfer of technologies, such as those relating to the pipe jacking method, and to encourage the local procurement or leasing of construction materials and equipment as much as possible.

2) The facilities plan should be designed to make the operation and maintenance of the facilities following their transfer to GCWSA and GOSD from Giza City less demanding with low levels of the technical, cost and labour requirements.

3) The facilities plan should be prepared in such a way as to encourage the understanding and cooperation of local inhabitants and others of the importance of implementing the Project.

4) The facilities plan should be prepared while ensuring the safety of buildings, local inhabitants, passersby and transport facilities. The disruption of daily life and commercial activities must be kept to a minimum.

5) The facilities plan should be prepared in view of the Egyptian and Japanese construction companies safely completing their assignments on time while keeping the construction cost to a reasonable level.

(2) Water Supply Facilities Plan

The water supply facilities to be constructed under the Project are a new water purification plant at South Giza Waterworks and a water supply trunk line. The basic design for these facilities will be prepared based on the following policies.

1) The water supply facilities plan for the Project should be prepared to upgrade the relevant facilities in the Project Site with the main purpose of upgrading and improving both the living and sanitation conditions in the Project Site. The water supply facilities plan for the Project should be composed of ① expanding South Giza Waterworks to increase the water supply capacity to meet the water demand in the Project Site, ② constructing a water supply trunk line to ensure a stable water supply volume and sufficient water pressure for households and public buildings which are currently suffering from an inadequate water supply due to the absence of the relevant facilities.

   The provision of such facilities is called for by the "Study of Water Supply for City of Giza" prepared with German assistance, requested by the Government of Egypt to the Government of Japan as a grant aid project and found necessary through the field survey for the Project.

2) The Project Site will be Monib District (185ha) as stipulated by the Expansion Plan for Water Supply and Sewer Systems in South Giza prepared by Giza City.

3) The Expansion Plan should take the following factors into consideration in the basic design.

- The Plan should be in line with the master plan of GCWSA to expand the water supply capacity of South Giza Waterworks by 200,000m^3/day.

- The Plan should take the performance and conditions of the existing facilities of South Giza Waterworks into consideration to present the optimal plan contents.

- The existing facilities of South Giza Waterworks should be used for the Project where possible.

- The operation and maintenance method/system and expertise of the staff of the existing South Giza Waterworks should be taken into consideration to achieve the best functions of the new facilities.

- The water quality of raw water from the Nile should be properly analysed and understood and the Egyptian standards for drinking water should be met.

- Given the local procurement of filtering sand, gravels and chemicals for water purification processes, the quality of these items should be taken into consideration in the basic design.

- The current conditions of similar waterworks and their operation and maintenance method/system should be studied with a view to copying advantageous aspects, if any, for the new facilities.

- The layout, work method and construction machinery, etc. for the new facilities should be planned in view of avoiding any damage to or disruption of the operation of the existing South Giza Waterworks.

- The operation and maintenance system for the new facilities should be planned in such a way as to achieve a low operation and maintenance cost.

- Given the prospect of the temperature in summer reaching as high as 45°C, the necessary arrangements should be made to prevent a performance decline and/or deterioration of the new facilities.

- As quasi-underground type electrical facilities and chemical dosing apparatus facilities will be constructed under the mixing and sedimentation basins, etc., a 100% reliable waterproofing method should be planned for these facilities.

4) The planned water supply trunk line should adopt a route, burying width and depth which will ensure the safe passage of trains, vehicles and pedestrians, guarantee the normal operation of the Zomor Canal and minimise the possible disruption of the existing underground facilities (water supply pipes, sewage pipes, power cables and telephone cables, etc.)

5) The facilities plan should be in line with the contents of the "Study of Water Supply for City of Giza" prepared with German assistance and also with the plan to construct water supply trunk and branch lines under the Phase 1 Project.

6) In principle, the technical standards used in the project planning will be those used in Japan. In view of the fact that many of the materials and equipment are actually produced in Egypt, the material strength and shapes/measurements applicable to the connection points of the trunk line constructed under the Project with existing, as well as future, water supply facilities should conform to Egyptian standards and criteria.

(3) Sewer Facilities Plan

The sewer facility to be constructed under the Project is Sewer Transfer Pump Station No. 5 (B). The basic design for this facility will be prepared based on the following policies.

1) The sewer facilities plan for the Project aims at upgrading and improving both the living and sanitation conditions in the Project Site by means of constructing Sewer Transfer Pump Station No. 5 (B) for households and public buildings which are currently suffering from poor drainage and the outflow of sewage onto roads due to the absence of sewer facilities. The sewer facilities plan of the Project should be on the basis of the Abu Nomros Main Collector Construction Plan which has been planned and is being implemented by GOSD, the contents of the Egyptian request and the findings of the field survey by the Project Study Team.

Sewer Transfer Pump Station No. 5 (B) will pump sewage from the Project Site and feed it to the lowerstream sewer trunk line following the completion of the construction of the above Abu Nomros main collector and other sewer lines under the Phase 1 Project.

2) The Project Site will be Monib District (185ha) as stipulated by the Expansion Plan for Water Supply and Sewer Systems in South Giza prepared by Giza City.

3) The size and quantity of the facilities/equipment and the building for Sewer Transfer Pump Station No. 5 (B) should be planned to provide adequate capacity to handle the expected increase of the sewage volume in the future, taking the objectives of the sewer facility plan described in 1) above and the overall concept of the Egyptian side relating to the construction of Sewer Transfer Pump Station No. 5 (B) into consideration.

4) The specifications of Sewer Transfer Pump Station No. 5 (B) should be in line with those of the sewer trunk line which will be constructed under the Phase 1 Project and which will be connected to this new pumping station and also to those of the lowerstream sewer trunk line, the construction of which is currently in progress by USAID.

5) The basic design for the Sewer Transfer Pump Station No. 5 (B) Construction Plan should take the following factors into consideration.

- As the new Sewer Transfer Pump Station No. 5 (B) will be closely bordered by residential areas, the existing Pumping Station No. 5 (A) and administration building, etc. and as the expected depth of the pump well is as deep as some 12m, the foundation work should be carefully conducted with care taken not to damage the existing buildings through subsidence or other causes.

- As the operation and maintenance engineers of screw pumps, the pump type adopted for Sewer Transfer Pump Station No. 5 (B), are being trained at the Pyramids Pumping Station constructed by USAID, the functions of the latter should be carefully analysed with a view to applying positive aspects to the former.

- The pumping station building should be coordinated as much as possible with the building of Pumping Station No. 5 (A).

- Given the prospect of the temperature in summer reaching as high as 45°C, necessary arrangements should be made to prevent a performance decline, breakdown and deformation, etc. of the pumping facilities due to thermal expansion.

4.1.6 Policies Relating to Construction Period

The Project is a large-scale civil engineering project involving the construction of a waterworks, a water supply trunk line and a sewage pumping station. It also anticipates the employment of such special construction methods as the pipe jacking method and the under-pressure drilling and tapping method as well as the installation of an extensive range of mechanical and electrical facilities and equipment at the new waterworks and pumping station.

The Project will bring about a stable supply of water at a constant water pressure to households and public buildings in the Project Site which are currently suffering from an extremely poor water supply and poor sewage drainage, resulting in the overflow of sewage onto roads due to the absence of adequate facilities, by means of constructing a new water supply facility at South Giza Waterworks, a water supply trunk line and Sewer Transfer Pump Station No. 5 (B) following the improvement of the water supply and sewer facilities to be achieved by the Phase 1 Project. In view of the Project Site's pressing need for improvement of the living and sanitation conditions, the Government of Egypt strongly desires the urgent implementation of the Project. It is, therefore, necessary to plan the completion of the Project in as short a period of time as possible as described below.

Policies relating to construction period

① Detailed Design : 5 months

② Procurement of equipment and materials and site construction work : 33 months

4.2 Examination of Design Conditions

4.2.1 Water Supply Facilities

The design conditions for the water supply facilities (for South Giza Waterworks expansion and water supply trunk line construction) listed in Table 4-2 have been confirmed through a series of consultations with Giza City, GCWSA and other related organizations.

Table 4-2 Design Conditions for Planning of Water Supply Facilities

Item	Design Conditions	Authority
1. General		
1) Project Area	Monib District, Giza City	Upgrading Plan for Water Supply and Sewer Systems in South Giza
2) Target Year	2010	
3) Size of Project Area	185ha	
4) Design Service Population	247,000 persons	
5) Design Maximum Water Consumption/Person/Day	140 litres/person/day	Study on Water Supply for Giza City
6) Design Maximum Water Consumption	35,000m3/day	Based on consultations with GCWSA and study results
7) Climatic Conditions		
- Maximum Temperature	45°C	
- Minimum Temperature	7°C	
- Atmospheric Pressure	758 mmHg	
- Minimum Relative Humidity	43%	
2. South Giza Waterworks Upgrading Plan		
1) Design Water Quality		
- Raw Water	surface water from the Nile (see Table 4-5)	Based on consultations with GCWSA and study results
- Purified Water	to meet drinking water standards in Egypt (see Table 4-5)	
2) Design Water Level		
- HWL	AD +17.92m	
- MWL	AD +17.21m	
- LWL	AD +15.18m	
3) Design Ground Level	AD +21.00m (GL±0)	
4) Types of Pipes Used on Premises		
- Above Ground	steel	
- Below Ground	ductile cast iron	
5) Type of Pipe Joints		
- Standard Sections	T-joint	
- Special Sections	mechanical joint	
3. Water Supply Trunk Line Construction Plan		
1) Pipe Diameter	ø1,200mm	Study on Water Supply for Giza City
2) Type of Pipe	ductile cast iron	Based on consultations with GCWSA and study results
3) Standard Earth Cover	approx. 1.2m	
4) Type of Pipe Joints		
- Standard Sections	T-joint	
- Special Sections (at crossing points with railway track and trunk roads, connection points with gate valves and inverted siphons	mechanical joint	

4.2.2 Sewer Facilities

The design conditions listed in Table 4-3 for Sewer Transfer Pump Station No. 5 (B) to be constructed under the Project have been confirmed through consultations with Giza City and GOSD.

Table 4-3 Design Conditions for Planning of Sewer Facilities

Item	Design Conditions	Authority
1) Project Area	Monib District, Giza City	Upgrading Plan for Water Supply and Sewer Systems in South Giza
2) Target Year	2010	
3) Size of Project Area	185ha	
4) Design Service Population	247,000 persons	
5) Climatic Conditions		Based on consultations with GOSD and study results
- Maximum Temperature	45°C	
- Minimum Temperature	7°C	
- Atmospheric Pressure	758 mmHg	
- Minimum Relative Humidity	43%	
6) Design Mean Sanitary Wastewater Flow/Person/Day	140 litres/person/day	
7) Design Maximum Sanitary Wastewater Flow/Person/Day	190 litres/person/day	
8) Design Pumping Volume		
-1996	approx. 2.1m^3/sec	
-2000	approx. 2.7m^3/sec	
-2010	approx. 4.5m^3/sec	
9) Design Ground Level	AD +18.80m (GL±0)	
10) Design Water Level		
- LWL	GL -8.44m	
- HWL	GL -2.10m	
- Overflow Water Level	GL -2.00m	

4.3 Basic Plans

4.3.1 Outline of Planned Facilities

The construction of the planned facilities aims at the establishment of water supply and sewer systems in Monib District following the construction of water supply and sewer lines under the Phase 1 Project and the facilities are outlined in Table 4-4.

Table 4-4 Outline of Planned Facilities

	Plan	Outline of Facilities
Water Supply Facilities	Expansion Plan	Design water supply capacity: 35,000m^3/day Design water purification capacity: 37,700m^3/day (2,700m^3/day for backwashing at the rapid sand filters and for consumption on the premises) Type of sedimentation basin; sloping horizontal sedimentation Type of filtration: open gravity-flow type rapid sand filtration
	Water Supply Trunk Line Construction Plan	Pipe diameter: 1,200mm Length: approximately 2.3km Type of pipe: standard sections - ductile cast iron special sections - steel
Sewer Facilities	Sewer Transfer Pump Station No. 5 (B) Construction Plan	Design pumping volume: 4.95m^3/sec (2010) 3.30m^3/sec (Project) Type of pump: screw pump Pump capacity: 1,650 litres (1.65m^3)/sec/pump Number of pumps: 3 (one as stand-by) The pump house will have room for an additional pump to be installed in the future

The basic plan for each facility is discussed in the following sections.

4.3.2 Expansion Plan

The basic plan for the Expansion Plan will be prepared in the following manner based on the design policies already discussed in 4.1.5-(2).

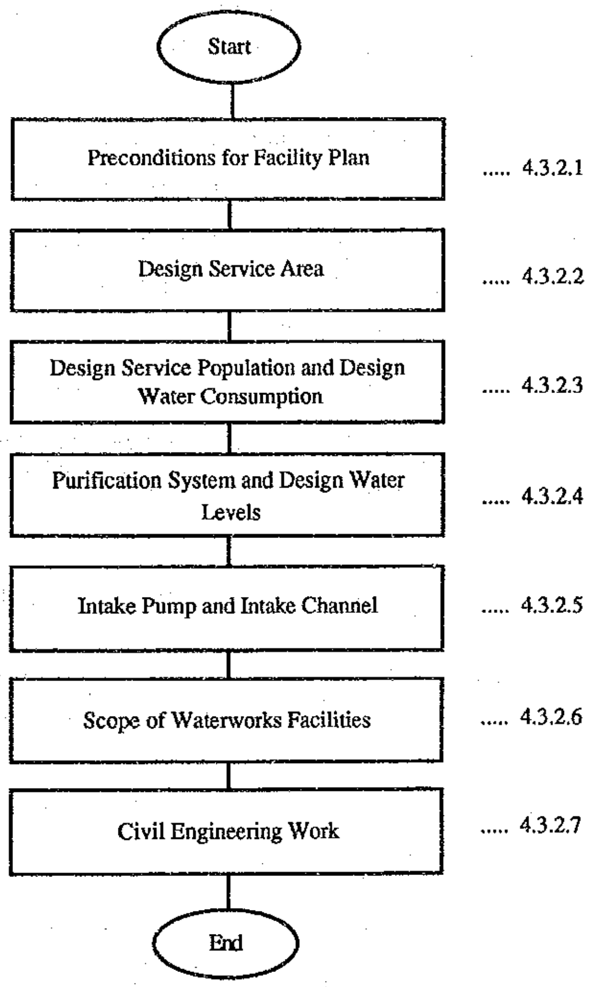


Fig. 4-2 Basic Plan Flow for Expansion Plan

4.3.2.1 Preconditions for Facility Plan

(1) Compatibility with Overall Expansion Plan

As described in 3.2.3-(3), the Expansion Plan of the Project (design water supply capacity: 35,000 m^3/day) is part of the overall expansion plan (design water supply capacity: 200,000m^3/day) for South Giza Waterworks. The construction site earmarked for the Expansion Plan is rather small (approximately 20,000m^2) and has a trapezium shape. Taking these circumstances into consideration, the following points must be noted as preconditions for the basic design.

1) The layout plan must provide optimal path lines for operation, maintenance and materials/equipment transportation purposes to facilitate the operation and maintenance of the entire waterworks upon completion of the overall expansion plan (water supply capacity of 200,000m^3/day).

2) The equipment/facilities (such as intake pumps, raw water pipeline and power substation) which will become part of the overall expansion plan should be designed to facilitate their integration in the overall expansion plan.

(2) Raw Water and Target Purified Water Quality

South Giza Waterworks draws raw water from the Nile and the raw water quality is given in Table 4-5 based on the analysis results for the last 5 years (1988-1992). The purified water must meet Egypt's drinking water standards.

Table 4-5 Water Quality of Raw Water and Purified Water

Item	Raw Water (Based on Statistics for Last 5 Years)	Target Water Quality (Drinking Water Standards in Egypt)
Turbidity	3-16	5 or less
Water Temperature	13°C-29°C	-
pH	7.6-8.4	6.5-9.2
Algae/Microbe Count	2,000-6,000/ml	-
Taste, Odour	-	no abnormality
Fluoride Compounds	0.5mg/litre	0.8 mg/litre or less
Nitrates	not detected	45 mg/litre or less
Evaporation Residue	256 mg/litre	1,500 mg/litre or less
Iron	0.3 mg/litre	1.0 mg/litre or less
Manganese	not detected	0.5 mg/litre or less
Copper	-	1.5 mg/litre or less
Zinc	-	15 mg/litre or less
Magnesium	16.8 mg/litre	150 mg/litre or less
Calcium	44.0 mg/litre	200 mg/litre or less
Total Hardness	160 mg/litre	500 mg/litre or less
Sulphate	38.0 mg/litre	400 mg/litre or less
Chloride	40.0 mg/litre	600 mg/litre or less

Source: GCWSA

4.3.2.2 Design Service Area

The design service area for the Project is the same as the Project Site (185ha) as shown in Fig. 4-1.

4.3.2.3 Design Service Population and Design Water Consumption

As discussed earlier in 4.2.1, the design service population and design water consumption are as follows.

- Design service population	:	247,000 (at the year 2010)
- Maximum water consumption/ person/day	:	140 litres/person/day
- Design water consumption	:	35,000m^3/day (247,000 × 140 litres = 35,000m^3/day)
- Design water purification volume	:	37,700m^3/day (inclusive of some 7.5% of the design water consumption to be used for backwashing at the rapid sand filters and consumption on the premises)

4.3.2.4 Purification System and Design Water Levels

(1) Water Purification Processes

Given the water quality conditions of raw water and purified water described in Table 4-5, the main items to be addressed to create purified water at South Giza Waterworks are the turbidity and the algae/microbe count. The chlorine sterilisation process and the sedimentation-cum-filtration process to reduce the turbidity appear to be sufficient to deal with these items in order to produce water of a satisfactory quality. Consequently, the basic water purification processes at the new facilities will consist of chlorine sterilisation, sedimentation and rapid filtering as in the case of the existing South Giza Waterworks. The design water purification processes are shown in Fig. 4-3.

As Fig. 4-3 shows, raw water from the Nile will be sent to the receiving well by an intake pump under the Expansion Plan. The pre-chlorination process will take place at the receiving well and aluminium sulphide will be injected at the next mixing basin for rapid agitation. Flocs will then be formed at the flocculation basin and removed at the sedimentation basin. The rapid sand filters will further remove minute flocs and the post-chlorination process will take place at the clear water reservoir before the distribution of clear water to the distribution network.

(2) Design Water Levels

The design water levels for the Expansion Plan are shown in Fig. 4-4 with a water level of AD +28m at the receiving well. The relation between the water level of the Nile and the water level of the receiving well is described later in 4.3.2.5 (2).

4.3.2.5 Intake Pump and Raw Water Pipeline

(1) Design Capacity of Intake Pump

1) Main Design Conditions

The following conditions have been adopted to determine the design capacity of the intake pump.

a) The total design water supply capacity of the overall expansion plan (including the Project) for the existing South Giza Waterworks is 215,000m^3/day (including 15,000m^3/day for backwashing at the rapid sand filters and consumption on the premises).

b) The design water production volume under the Project is 37,700m^3/day (including 2,700m^3/day for backwashing and consumption on the premises).

c) 2 places for intake pump installation should be provided to meet the intake demand of the overall expansion plan.

d) The intake pump facility under the Project should be compatible with and part of the overall expansion plan and should be efficiently used in the overall expansion plan.

e) The capacity of pumps to be installed in the future may differ from the capacity of the pump to be installed under the Expansion Plan.

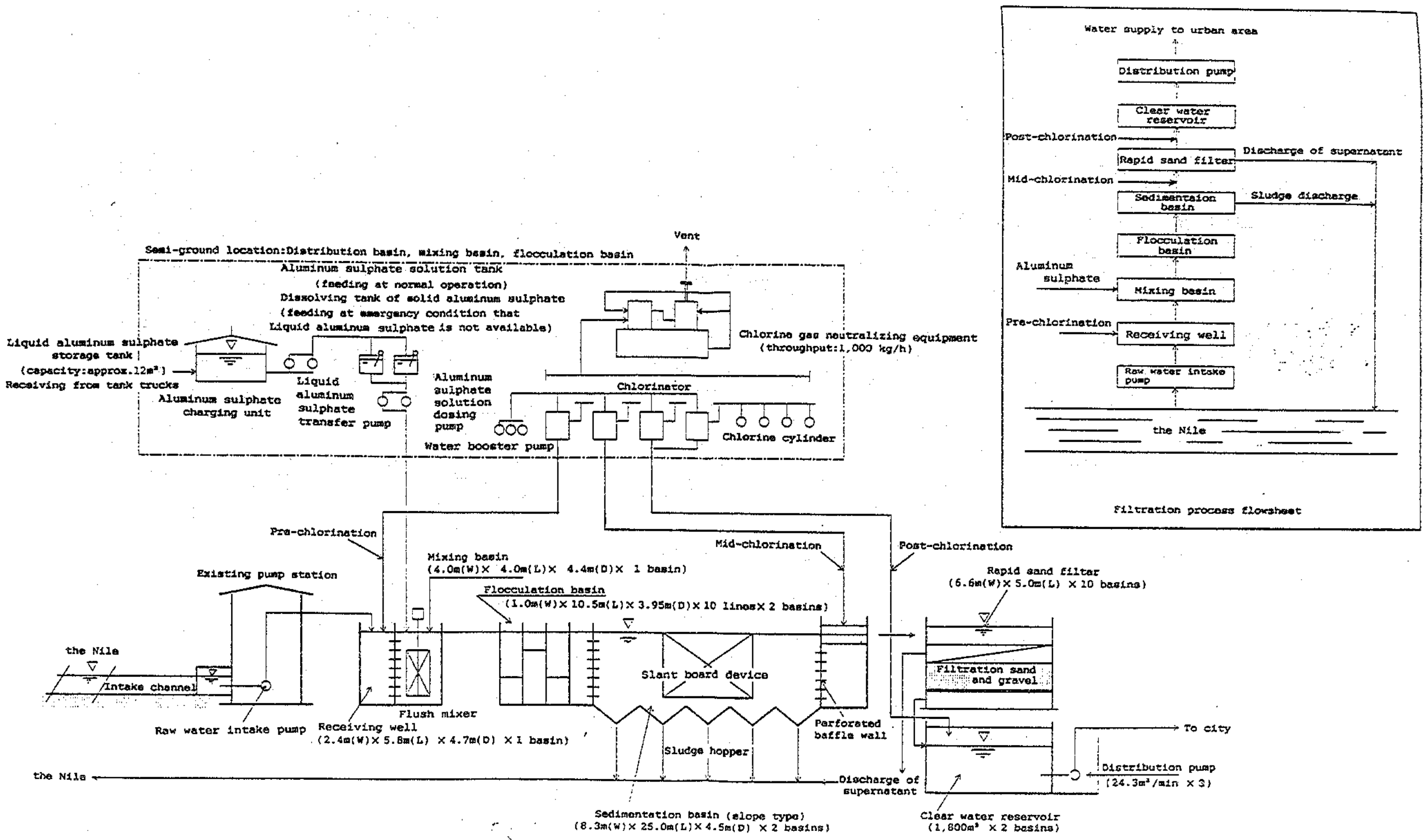


Fig. 4-3 Water Purification Processes Under South Giza Waterworks Expansion Plan

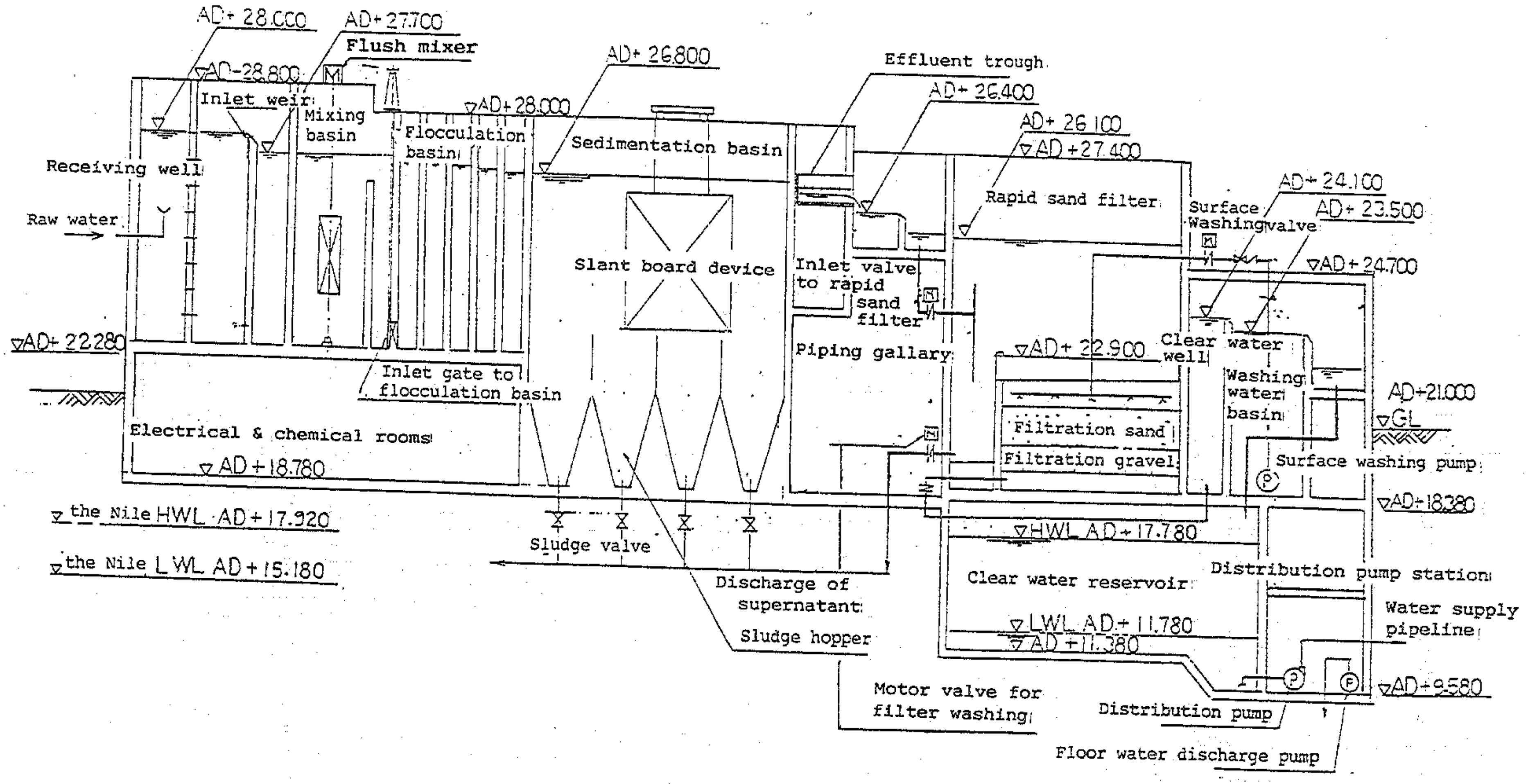


Fig. 4-4 Hydraulic Profile at New Facility Under South Giza Waterworks Expansion Plan

f) The mutual supplementary operation of the intake pump to be installed under the Expansion Plan and the intake pumps of the existing South Giza Waterworks should be feasible for a short period of time (a few days) to avoid a serious or total loss of the intake capacity due to mechanical breakdown or maintenance requirements. However, linked operation over a long period of time will not be considered.

2) Intake Pump Capacity Under the Expansion Plan

As described in 3.2.3-(3), the Expansion Plan (design water supply capacity: 35,000m^3/day, design water purification capacity: 37,700m^3/day) is part of the overall expansion plan (design water supply capacity: 200,000m^3/day, design water purification capacity: 215,000m^3/day) in which the construction of 6 new waterworks is planned by GCWSA. In view of the efficient use of the intake pump to be installed under the Expansion Plan, it is necessary to take the proposed contents of the overall expansion plan into consideration in order to establish compatibility between all the relevant plans.

The available space for intake pump installation for the future expansion of South Giza Waterworks, which is located in the existing intake pump house for the 6th October Waterworks as described in 2.3.4.1-(2)-2) and 3), can only accommodate 2 extra intake pumps.

Given these conditions, the intake pump capacity must be decided in view of responding to the increased design water supply volume following the expected completion of the water purification facilities (No.2 - No.6) during the period from the end of the Project (planned in 1996) and the target completion year of the overall expansion plan of 2010. It is also important to take the expected life of the pumping units (approximately 25 years for the casing and 5 years for the impeller) into consideration when making this decision.

Table 4-6 gives the results of various case studies on different intake pump capacities, i.e., ① equivalent to the design water production volume under the Expansion Plan (37,700m^3/day), ② twice the design water production volume at interim stage with 75,400m^3/day and ③ half the design water production volume at interim stage with 100,000m^3/day. It is apparent that case ③ with an intake pump capacity of half the planned water production volume under the overall expansion plan offers the greatest flexibility vis-a-vis the future plan and is the most cost effective.

Table 4-6 also shows that flow control is required in case ③ until the completion of an additional 2 water purification facilities. In view of the necessity for easy operation and maintenance, the composition of the new intake pump unit under the Expansion Plan should provide scope for efficient operation following its installation as well as space for new facilities to be constructed in the future as described below.

Composition of New Intake Pump Unit

• Number of pumps	:	1
• Pump casing capacity	:	100,000m^3/day
• Pump impeller capacity (real pump discharge)	:	75,400 m^3/day
• Motor capacity	:	100,000m^3/day

Operation System

① The intake pump is characterised by maximum flow control of approximately 70% of the casing capacity. Consequently, an impeller with a pumping capacity of 75,400m^3/day will be installed to a 100,000m^3/day capacity pump (casing and motor sections) to achieve discharge of 75,400m^3/day.

② In addition to ① above, given a flow control possibility of upto 50% of the flow using a valve, the opening angle of the gate valve which is installed at the raw water pipeline to allow maintenance of the pump unit will be narrowed to half of the flow in order to achieve the design water production volume of 37,700m^3/day of the Expansion Plan.

③ By connecting the existing raw water pipelines and the new raw water pipeline of the Expansion Plan with a gate valve between them, the existing South Giza Waterworks will have access to the surplus water intake capacity of the new facility so that some of the 8 existing pumps which are currently operating at almost full capacity can be rested for appropriate maintenance work.

④ In the case of the intake pump installed under the Expansion Plan malfunctioning, the gate valve referred to in ③ above will be opened to allow the flow from the existing intake pumps of South Giza Waterworks to the new facility.

As the capacity and expected life of the casing and impeller to be selected for the Expansion Plan will be compatible with the respective requirements of the overall expansion plan, they will be very cost effective. The motor to run the pump is expected to be capable of operating the pumping unit at a capacity of 100,000m^3/day. As the immediate operation level is below full capacity, the power consumption efficiency will be slightly lower than that of full capacity operation. As the actual power consumption varies in proportion to the impeller capacity, little power will be wasted during the period when pumping operation is conducted by an impeller with a capacity of 75,400m^3/day.

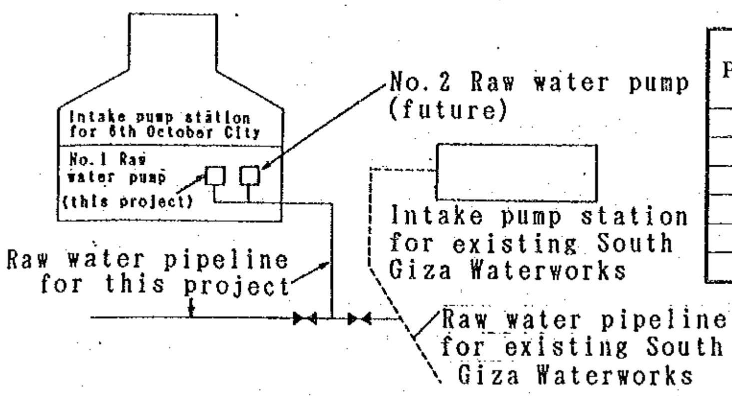
Provision of Spare Impeller

As only one intake pump will be installed without a spare pump under the Project, measures to sustain the water intake operation when the pump is out of action are necessary. Connection with the existing South Giza Waterworks as described in ④ above is the back-up operation designed under the Project. Nevertheless, this back-up operation will have a shortcoming because use of the existing intake pump(s) for supplying water to the new waterworks will cause a reduction in the water supply volume of the existing South Giza Waterworks due to little allowance of pump capacity of the existing intake pump facility. Therefore, it will be necessary to keep any period in which the new intake pump is out of action due to maintenance or breakdown to a minimum with normal operation being resumed as soon as possible. To satisfy this requirement, a reserve impeller will be provided under the Project as repair of the impeller is the most time consuming of all the pump components. This reserve impeller will have a capacity of 100,000m^3/day in line with the ultimate capacity of the intake pump planned under the overall expansion of the waterworks so that it can act as a reserve in future situations when the intake pump is operated at full capacity.

Table 4-6 Comparison Between Design Intake Pump Capacities

Pump Capacity*	37,700m³/day	75,400m³/day (37,700×2)	100,000m³/day
1. Compatibility with Expansion Plan	Fully compatible	Twice the planned capacity of the Expansion Plan and, therefore, overcapacity by one water purification unit	Half the expected capacity under the overall expansion plan and, therefore, overcapacity by approximately 2 water purification units
2. Compatibility with Future Expansion Plan	①Not capable of meeting the requirement of the overall expansion plan ② Construction of a new pumping facility will be necessary as the future pumping requirement for an additional facility cannot be met. Running of the unit under such circumstances will be less cost effective	① Capable of meeting the requirement for upto 2 waterworks units ② Construction of a new pumping facility will be necessary for the third water purification unit onwards. Running of the unit under such circumstances will be less cost effective	① Capable of meeting upto half of the final requirement of the overall expansion plan ② Construction of another pumping unit with the same capacity will meet the final requirement in a cost effective manner
3. Necessity for Flow Control and Surplus Capacity	① No flow control required ② No surplus capacity to assist the existing South Giza Waterworks	① Flow control required until another unit is constructed ② Capacity above 37,700m³/day can be used to assist the existing South Giza Waterworks	① Flow control required until 2 additional units are constructed ② Capacity above 62,300m³/day can be used to assist the existing South Giza Waterworks
4. Flexibility vis-a-vis Future Expansion Plan	None	① Upto the construction of the next unit ② Narrow range of flexibility	① Capable of integration with the overall expansion plan ② Wide range of flexibility
5. Investment Effect	① No waste during Interim Stage ② Total waste when the overall expansion plan is implemented because of inability of unit to integrate	① Medium degree of over investment until the next unit is constructed ② Good investment when 2 new units are in operation	① High degree of over investment until the next 2 units are constructed ② Highly cost effective operation after the capacity of the new units reaches half the total requirement (to allow full capacity operation)
6. General Evaluation	× ① Can only serve for the Expansion Plan with no flexibility vis-a-vis the overall expansion plan ② Initial investment effect is good but will badly deteriorate when additional units are constructed	○ ① Narrow range of flexibility vis-a-vis the overall expansion plan ② Investment effect and scope of efficient operation are rather poor	◎ ① Wide range of flexibility vis-a-vis the overall expansion plan ② When the overall expansion plan is taken into consideration, investment effect and scope of efficient operation are very good

Note: * The capacity figure includes backwashing and other requirements on the premises.



Unit: (10,000m³/day)

Water Purification Unit	Clear Water Production	Design Clear Water Production (Total)
No.1	3.77	3.77
No.2	3.77	7.54
No.3	3.77	11.31
No.4	3.77	15.08
No.5	3.21	18.29
No.6	3.21	21.50

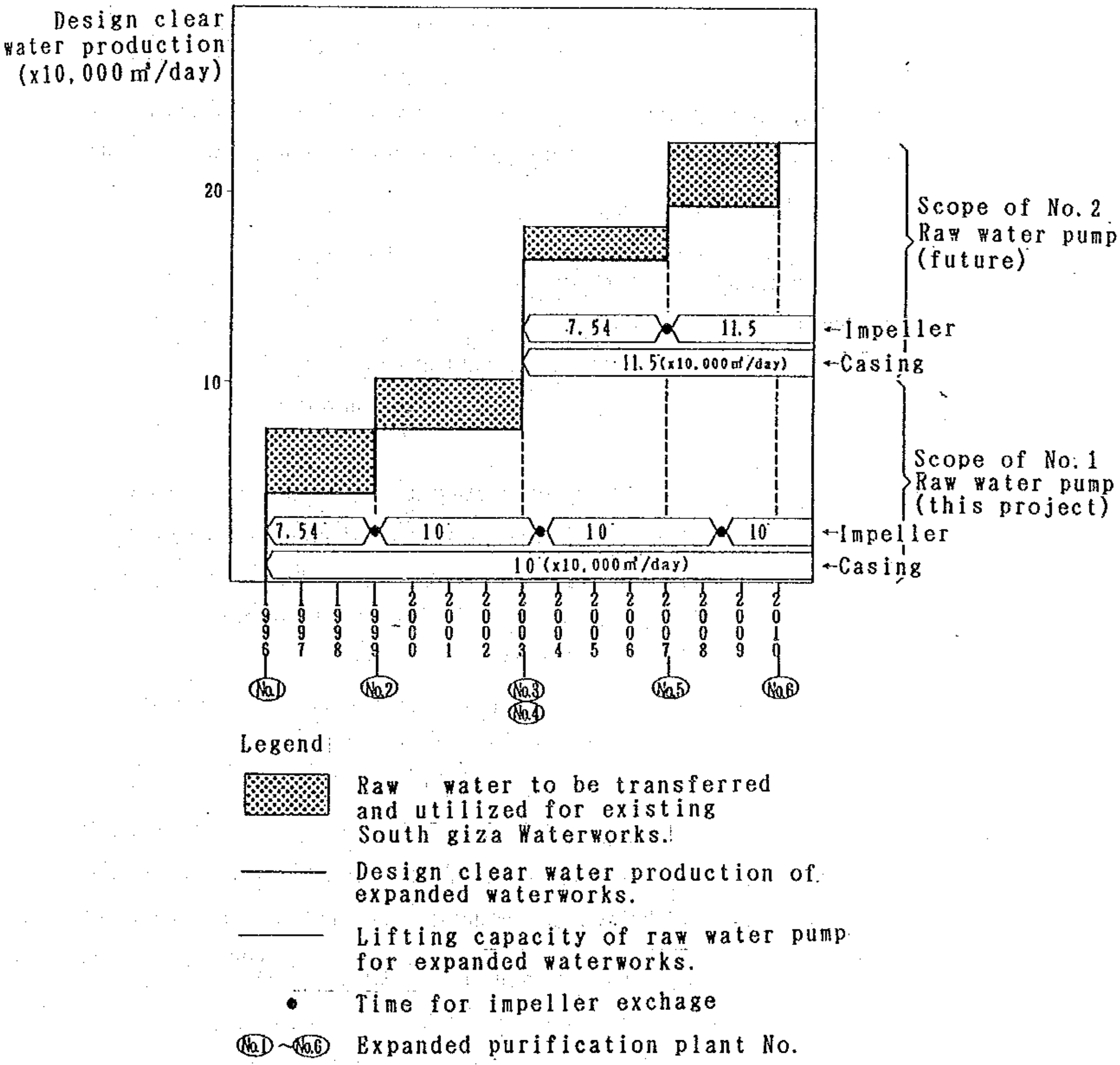


Fig. 4-5 Future Expansion Plan of South Giza Waterworks and Plan to Install Additional Intake Pump

(2) Total Intake Pump Head and Raw Water Pipe Diameter for Expansion Plan and Overall Expansion Plan

1) Design Conditions

The following conditions have been taken into consideration for the design of the total intake pump head and raw water pipe diameter.

a) The design clear water production under the overall expansion plan for South Giza Waterworks is 215,000m^3/day (including 15,000m^3/day for backwashing at the rapid sand filters and consumption on the premises). The Expansion Plan should constitute part of this overall expansion plan.

b) The design clear water production under the Expansion Plan is 37,700m^3/day (including 2,700m^3/day for backwashing and consumption on the premises as in the case of (a) above).

c) In view of the small site available for expansion, the chlorine injection facility, dosing apparatus for coagulation and the power room, etc., for both the Expansion Plan and the overall expansion plan should be constructed as quasi-underground structures below the distribution, mixing and flocculation basins.

d) The intake pump facility and raw water pipeline for the Expansion Plan should fit into the framework of the overall expansion plan and should prove effective as part of the overall expansion plan. Moreover, there should be no temporary stoppage of these facilities during any expansion work in the future.

e) Raw water will be taken from the Nile and the design LWL for the Nile should be AD +15.18m.

f) The water level of the receiving wells to be constructed under the Expansion Plan and the overall expansion plan should be AD +28.0m based on the conditions given in ① - ⑩ below. Consequently, the maximum real head for the intake pump facility for both the Expansion Plan and the overall expansion plan should be 12.82m [(AD +28.0m) - (AD +15.18m)].

① The overall expansion plan will be materialised on a small site.

② Easy and low cost operation and maintenance should be sought.

③ The construction of underground facilities should be kept to a minimum.

④ The total head of the intake pump facility at the existing South Giza Waterworks (14m) and its characteristic curve (total head-capacity curve) should be taken into consideration. See Fig. 4-6 for the characteristic curve of the existing intake pumping facilities at South Giza Waterworks.

⑤ The construction period should be as short as possible to realise the early commencement of the operation of the new facilities.

⑥ The number of intake pumps to be installed under the Expansion Plan and the overall expansion plan should be kept to a minimum.

- Expansion Plan	: 1
- Overall expansion plan (when the design clear water production exceeds 100,000m^3/day)	: 1
(Total	: 2 pumps)

⑦ The risk arising from the small number of intake pumps installed under the Expansion Plan and the overall expansion plan should be dispersed through connection between the raw water pipeline for the new intake pump facility and the raw water pipelines for the existing intake pump facilities of South Giza Waterworks so that raw water can be fed from the former to the latter (and also an intake pump facility to be constructed in the future) to supply raw water to the new water purification facilities at the time when the new intake pump is out of action for maintenance or repair purposes (see Fig. 4-6).

⑧ The height of the new intake pump facility should be some 1-2m above the crown height of the existing South Giza Waterworks. The facility should be neither an eye-sore nor problematic vis-a-vis its operation. Most of the facilities at the existing Embaba Waterworks and Rod El Farag Waterworks are at ground level.

⑨ The construction cost should be kept to a minimum.

⑩ The groundwater level of 2-3m below the ground is fairly high.

g) The risk arising from the long service of the existing intake pump facilities at South Giza Waterworks should be dispersed through arrangements in which the new intake pump facilities to be constructed under the Expansion Plan and the overall expansion plan can feed a quantity of raw water to the existing pump facilities at a time when the former are out of action for maintenance or repair purposes (see Fig. 4-6).

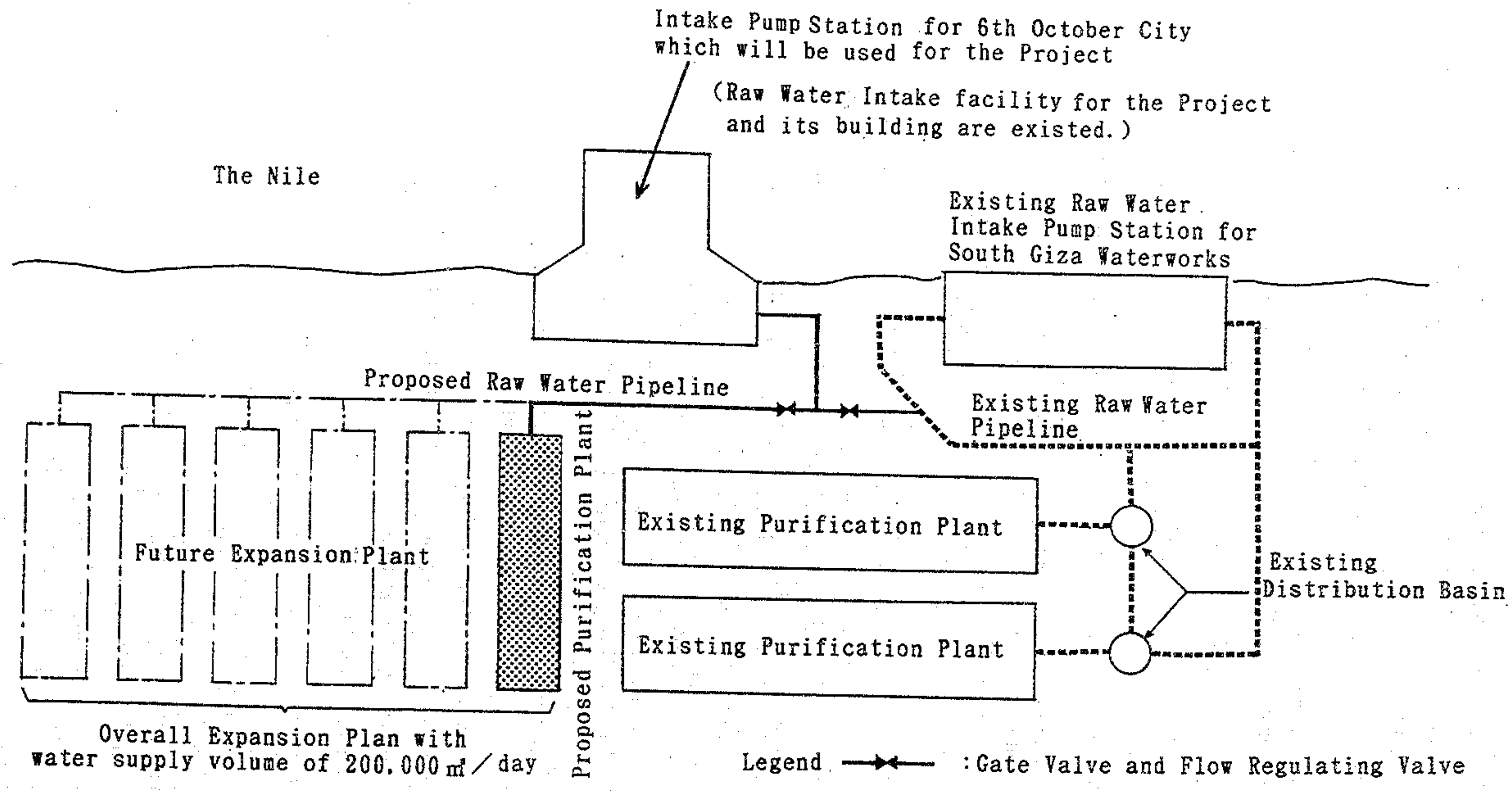


Fig. 4-6 Conceptual Drawing of Intake System for Expansion Plan

h) In the case of the new intake pump facilities to be constructed under the Expansion Plan and the overall expansion plan being connected to the existing intake pump facilities at South Giza Waterworks, careful planning is essential to avoid any occurrence of operational disturbance, such as vibration and noise, or accidents. Linked operation between the 2 facilities should only last for a few days to cover the necessary maintenance/repair period and no continuous linked operation should be anticipated.

i) The characteristic curve of the intake pump facility under the Expansion Plan should be as shown in Fig. 4-7 taking conditions g) and h) above into consideration.

j) Japanese and Czechoslovakian pumps are currently used at the existing intake pump facilities. Given the absence of characteristic curves (such as the total head-capacity curve, the efficiency curve, etc.) for the latter, the characteristic curves of the former, i.e., Japanese pumps, should be assumed to be the same for all the pumps.

① Japanese Pumps

- Design discharge : 600 litres/sec × 2 units
- Design total head : 14m
- Characteristic curves : see Fig. 4-7
- Year of operation commencement : 1981

The efficiency of the pumps is assumed to have declined by approximately 5% because of operation over the last 10 years.

② Czechoslovakian Pumps

- Design discharge : 275 litres/sec × 4 units, 600 litres/sec × 2 units
- Design total head : 14m
- Characteristic curves : assumed to be the same as the Japanese pumps
- Year of operation commencement : 1970

The efficiency of these pumps is also assumed to have declined by approximately 5% as in the case of the Japanese pumps.

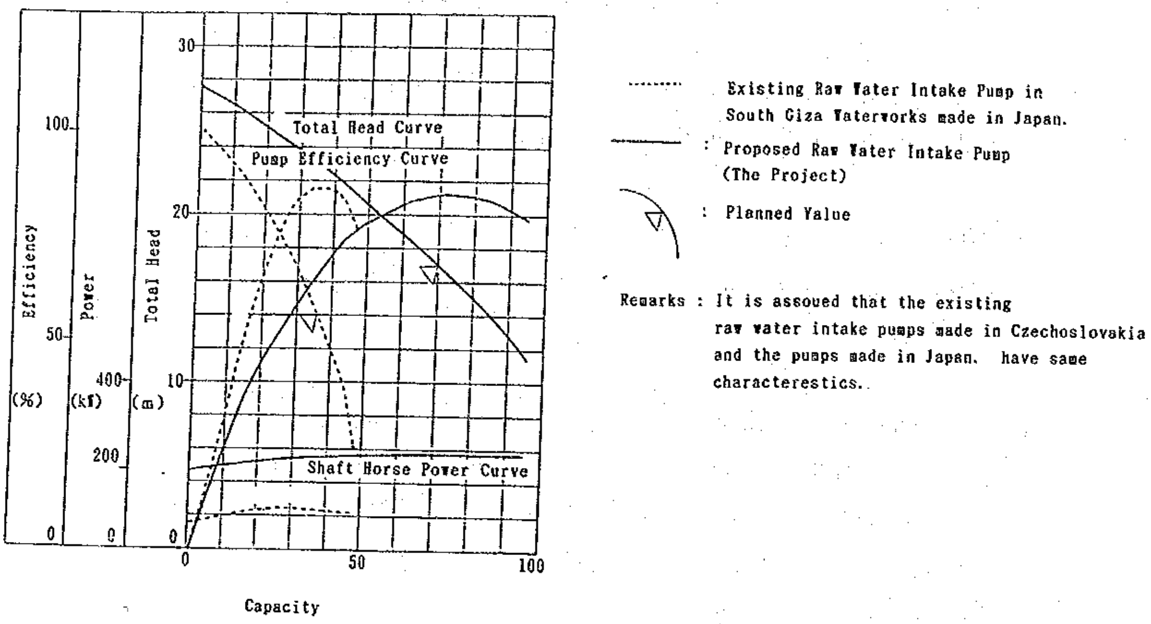


Fig. 4-7 Characteristic Curves of Intake Pumps at Existing South Giza Waterworks and Those of Expansion Plan

k) There will be only 1 raw water pipeline (see Fig. 4-8) for the Expansion Plan as well as the overall expansion plan because of the following reasons.

① To meet the requirement for a low construction cost.

② To fit into a small site.

③ To meet the requirement for easy, low cost operation and maintenance.

l) The route of the raw water pipeline for the Expansion Plan and the overall expansion plan is roughly outlined in Fig. 4-8.

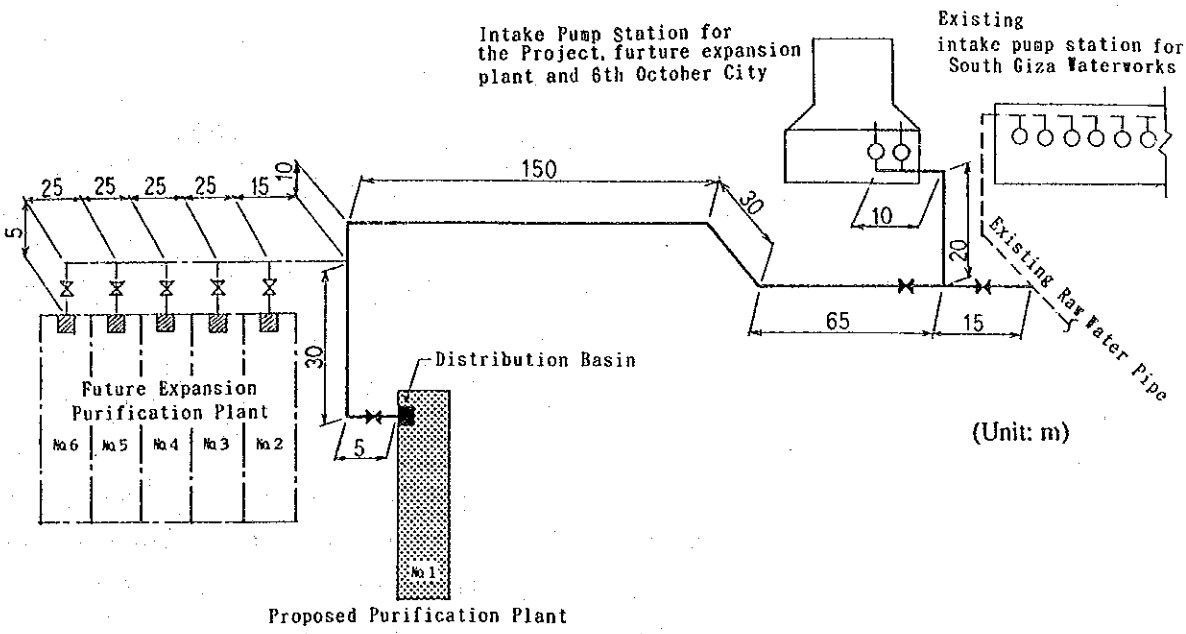


Fig. 4-8 Intake Pump Facilities and Raw Water Pipelines and Their Length

m) The inner face of the raw water pipe should be lined with either concrete or mortar.

n) The friction head of the raw water pipe should be calculated by the Hazen-Williams equation of flow with a velocity coefficient (C) of 120 in view of the aged deterioration of the inner face of the pipe. The Hazen-Williams equation is as follows.

$$V = 0.84935 \times C \times R^{0.63} \times I^{0.54}$$

$$Q = 0.7854 \times D^2 \times V$$

where,
- V : mean velocity inside pipe (m/sec)
- Q : flow rate (m^3/sec)
- C : velocity coefficient
- R : hydraulic mean radius (m)
- I : dynamic water flow gradient (h/ℓ)
- ℓ : length of pipeline (m)
- h : friction head of pipe (m)
- D : pipe diameter (m)

Table 4-7 Comparative Study of Intake Pump Facility and Raw Water Pipe Diameter

	Case 1	Case 2	Case 3
1. Design Discharge (10,000m^3/day)	21.5	21.5	21.5
2. Maximum Diameter of Raw Water Pipeline (mm)	1,000	1,100	1,200
3. Pump Head (ho) (m)	12.82	12.82	12.82
4. Friction Head (hf) (m)	approx. 4.7	approx. 4.2	approx. 3.7
① Around the Pump (m)	approx. 1.4	approx. 1.4	approx. 1.4
② Raw Water Pipeline (m)	approx. 3.3	approx. 2.8	approx. 2.3
5. Total Head (Ho) (=ho+hf) (m)	approx. 17.5	approx. 17.0	approx. 16.5
6. Water Velocity Inside Pipe (m/sec)	approx. 3.2	approx. 2.6	approx. 2.2
7. General Evaluation	×	○	◎
	1. In the case of linked operation with the existing South Giza Waterworks, the higher pump head of approximately 3.5m of the new facility will cause operational disturbance, such as vibration and noise, at South Giza Waterworks. 2. The lower pump head of approximately 3.5m at South Giza Waterworks will make back-up operation to the new facility almost impossible. 3. The fairly fast water velocity inside the pipe will cause a performance decline over time due to internal friction and other reasons.	1. In the case of linked operation, the pump head difference of approximately 3.0m will not cause any operational disturbance to South Giza Waterworks. 2. Despite the lower pump head of approximately 3.0m at South Giza Waterworks, back-up operation for the new facility is feasible to a certain extent. 3. The water velocity inside the pipe is relatively fast but will not damage the inner lining and the channel performance will be maintained.	1. In the case of linked operation, the lower pump head difference than Case 2 will make operation smoother. 2. Same as Case 2. 3. The water velocity is 2.2m/sec, proving the long life operation of the pipes in order to decrease internal friction. 4. The water pipes such as straight pipe and irregular pipe and valves will have interchangeability with the water supply trunk line for the project.

(3) Selection of Pipe

1) Pipe Alternatives

The following 2 types of pipes have been studied in view of the planned raw water pipeline diameter, workability, economy, quality, etc.

- ductile cast iron pipe
- steel pipe

2) Selected Type

Both the straight and pipe fittings such as bent, T-shape, etc. for the raw water pipeline should be ductile cast iron in view of workability, the need to prevent any operational disturbance at the existing waterworks and also the need to ensure the required quality. As locally manufactured ductile cast iron pipes are all less than 1,100mm in diameter, they will be imported from Japan. The results of the detailed comparison between ductile cast iron pipes and steel pipes are given in Table 4-8.

Table 4-8 Results of Comparison of Alternative Pipes for Raw Water Pipeline

Item	Ductile Cast Iron Pipes	Steel Pipes
1. Workability	Workability is good because of the following reasons. 1) The joint type is either insertion or mechanical, requiring no welding work. 2) The pipe joining work can be completed in a short period of time. 3) The pipe joining work can be conducted with simple tools and no advanced skills are required. 4) The pipe joining work can proceed with little difficulty even if there is some spring water from the relatively high groundwater level of approximately 2-3m in the Project Site. 5) The pipe joining work can be conducted in a small space.	Workability is poor because of the following reasons. 1) All joints require welding work. 2) Because of the weight of each pipe (approximately 2 tons), the pipes (6m long) must be welded in an underground position, making welding difficult and a lengthy process. 3) A welding specialist is required to ensure the required accuracy and strength of the welded joints. 4) No welding can be conducted with the presence of groundwater or spring water or on rainy days. A drainage facility must be provided in places where underground water or spring water is present. 5) The welding of a joint requires large space.

Item	Ductile Cast Iron Pipes	Steel Pipes
	6) Due to the short construction period at each work section, the pipe laying work can be conducted with a simple retaining wall.	6) Due to the long construction period at each work section, the pipe laying work requires a strong retaining wall.
	7) The inverted siphon work at crossing points with existing pipes and cables, etc. and the joining work at horizontally bent sections can be conducted with relative ease using irregular pipes.	7) The inverted siphon work or pipe joining work using pipe fittings is difficult because of the welding requirement. Particularly in the case of inverted siphon work, a large volume of spring water can be expected due to the proximity to the Nile, necessitating both drainage and waterproofing work.
	8) The backfilling work can be conducted as soon as the laying and joining work are finished. The disruption of traffic at each work section can be limited, most likely, to one day.	8) Welding work, X-ray inspection and painting work are required for both inside and outside of the welded joints. Some 7-10 days are probably required to complete the work from excavation to backfilling at each welded joint section.
	9) Because the period in which each work section is kept open is short, it is easy to ensure road safety and the control of work vehicles and workers, etc. during the work period.	9) Both the period to keep each work section open and the total construction period for each section are long, making it difficult to ensure the safety of road traffic and workers, etc.
	10) As the pipe laying work can be conducted in a small space and in a short period of time, a relatively simple retaining wall can ensure the proper function of and the prevention of damage to the existing waterworks along the planned route and the intake channel for the 6th October Waterworks.	10) The requirements for a large space, longer work period and deeper burying depth make it necessary to erect a strong retaining wall to ensure the proper function of and to prevent damage to the facilities described in the column on the left.
	11) The pipe laying work at the crossing point of the new intake channel and the existing intake channel for the 6th October Waterworks requires a smaller protective structure (approximately 2.4m wide, 11m long and 5.5m deep) than in the case of steel pipes.	11) Because welding work is necessary, the pipe laying work described in the column on the left requires a longer protective structure (approximately 3.2m wide, 11m long and 6m deep).
	12) The work described in 11) above requires some 10 days from initial excavation and the placing of protective concrete to backfilling.	12) The work for 11) above requires some 20 days for completion which is much longer than the work using ductile cast iron pipes.

Item	Ductile Cast Iron Pipes	Steel Pipes
2. Quality	1) Superior to steel pipes in terms of anti-corrosion (including anti-electrocorrosion, durability and anti-deformation vis-a-vis soil pressure. 2) The joining method is either insertion or mechanical and, therefore, superior to steel pipes. 3) The standard channel water pressure test to check leakage is sufficient to confirm satisfactory quality. 4) After the completion of the pipe joining work, no special lining either inside or outside the channel is required.	1) Inferior to ductile cast iron pipes in the performance fields described in the column on the left. 2) Because the joints are welded, all joints must undergo X-ray testing to check the quality of the welds. 3) Special equipment and an engineer are required for the quality test. These are difficult to secure in Egypt at short notice. 4) Special lining is required for both inside and outside the welded joint sections after the completion of the pipe joining work. 5) The testing of welded sections is both time-consuming and expensive.
3. Construction Period	As short as 2-3 months.	Fairly long at 6-8 months.

4.3.2.6 Capacity and Size of Water Purification Processes

The method employed, capacity and physical size of the water purification processes are explained below. The available methods for each process are compared in Appendix 9.

(1) Distribution Basin

The purpose of the receiving well is to stabilise the water level of the raw water fed by the intake pump facility in order to simplify the water purification work after the receiving well. While the shape of the receiving well at the existing South Giza Waterworks is round, a rectangular shape which is more commonly used will be adopted for the Expansion Plan. The specifications of the planned receiving well are as follows.

- Shape : rectangular
- Size : 2.4m (W) × 5.8m (L) × 4.7m (D)
- Capacity : 65m^3
- Number : 1

(2) Mixing Basin

A mixing basin is required for the rapid mixing of the coagulant which is dosed immediately before the mixing basin to facilitate flocculation. As shown in Appendix 9, there are 2 types of rapid mixing basins, i.e., mechanical mixing and pump mixing. In the case of the mixing basin for the Expansion Plan, the mechanical mixing method is selected because of the better mixing reliability, easy maintenance, higher efficiency and smaller space requirement. The specifications of the planned mixing basin are as follows.

- Method : mechanical mixing
- Size : 4.0m (W) × 4.0m (L) × 4.4m (D)
- Capacity : 70.4m^3
- Number : 1

(3) Flocculation Basins

The formation of flocs commences immediately after the rapid mixing of the coagulant in the mixing basin. The mixing process creates small flocs of impurities which must grow larger, heavier and stronger in order to be removed through the sedimentation and filtering processes. Flocculation basins are required to precisely conduct this work between the mixing basin and the sedimentation basin. The efficient formation of flocs of a desirable size requires a high mixing strength when the flocs are small and a weaker mixing strength in accordance with the growth of the flocs. The tapered flocculation basin which allows a weaker mixing strength towards the lowerstream has, therefore, been selected.

As described in Appendix 9, there are 4 types of flocculation basins depending on the mixing system, i.e., ① mechanical mixing, ② vertical circulation, ③ combined vertical-horizontal circulation and ④ horizontal circulation. The horizontal circulation system is used at the existing South Giza Waterworks as already described in 2.3.4.1-(2)-8). This system appears inferior in that sufficiently large flocs are not formed because of the occurrence of short-circuit currents and the inadequate mixing strength causes the appearance of a fairly large amount of scum on the water surface. The combined vertical-horizontal circulation method is selected for the planned flocculation basins in view of its non-use of mechanical components, easy and low cost maintenance, better prospect of good flocculation and the prevention of the sedimentation of flocs. The specifications of the planned flocculation basins are as follows.

- Method : combined vertical-horizontal circulation
- Size : 1.0m (W) × 10.5m (L) × 3.95m (D) × 10
- Capacity : 415m^3
- Number : 2

(4) Sedimentation Basins

The purpose of the sedimentation basins is to remove the large flocs which are formed in the flocculation basins and which easily sink in order to lighten the burden on the next filtration stage. The existing sedimentation basins at South Giza Waterworks use the standard single layer horizontal sedimentation method as described in 2.3.4.2-(2)-9). Given the irregular, trapezium shape of the small site available for the overall expansion plan (including the Expansion Plan), it will be impossible to construct similar sedimentation basins. Therefore, the sloped horizontal sedimentation method is selected because of the shorter residence time, better sedimentation efficiency, small space requirement and both easy and low cost maintenance.

The maintenance of the sedimentation basins will consist of daily sludge discharge from the sludge hoppers and the annual removal of the residual sludge in the hopper and slopes by emptying the basins.

The planned slant board device have many layers of tilted thin plates (at an angle of some 60°) in the horizontal direction to ensure a large sedimentation area, to reduce the horizontal distance required by the flocs to sink and to stimulate both the upward current of clean water and the sedimentation of the flocs. The overall effect is to make the sedimentation basins more compact. The specifications of the planned sedimentation basins are as follows.

- Method : sloped horizontal sedimentation
- Size : 8.3m (W) × 22.55m (L) × 4.5m (D)
- Capacity : 842m^3
- Number : 2

When the sedimentation basins are emptied for cleaning or maintenance purposes, emptying must be conducted very gently to avoid damage to the tilted plates by water pressure (speed: 0.5m/hour or less). This cleaning should be conducted in winter to avoid unnecessary deterioration of the PVC plates by the strong heat and ultraviolet rays in summer.

(5) Rapid Sand Filters and Filter Washing Method

The purpose of the rapid sand filters is to remove those small flocs which cannot be removed by the sedimentation basins through the filtration effect of filtration sand. The rapid sand filters for the Expansion Plan have a filtering capacity of 37,700m^3/day and are controlled by the semi-automatic system from the control board at the rapid sand filter control room as in the case of the existing South Giza Waterworks to provide a quick response to any operational breakdown.

<u>Filtration Method</u>

There are 2 filtration methods, i.e., the standard open-type gravity filtration which is used by the existing South Giza Waterworks and the self-balanced type backwashing filtration. The latter is selected for the Expansion Plan due to the superior filtration performance, no requirement for such auxiliary equipment as a backwashing pump for washing operation, small number of valves and both easy mechanical and electrical control in order to achieve easy and low cost operation and maintenance.

<u>Filtration Basin Washing Method</u>

There are 2 types of filtration basin washing methods, i.e., a combination of surface water washing and backwashing and a combination of air washing and backwashing. While the latter is employed by the existing South Giza Waterworks, air compressor facilities are required. Moreover, air holes tend to appear during the air washing process in places where the floc membrane formed on the surface of the filtration layer is weak, resulting in inadequate surface washing. This method also has a risk of damage to the air washing nozzle which may lead to an outflow of the filtration sand, in turn causing poor filtration (see 3.3.1-(2)-10)). The combination of surface water washing and backwashing is selected for the Expansion Plan as its reliability has already been proven in Japan as well as in countries in Southeast Asia. This method has a good washing function and is characterised by easy maintenance due to the main sections requiring regular inspection and maintenance being placed above the filtration sand. The backwashing and filtration performance is also superior to the other method. The specifications of the planned filtration facility are as follows.

- Filtration Method : rapid sand filtration
- Filtration Basin Washing Method : self-balanced type backwashing method (surface water washing plus backwashing)
- Size : 6.6m (W) × 5.0m (L)
- Filtration Area : 33m^2/basin
- Number : 10 basins

(6) Dosing Apparatus and Chlorine Neutralisation Apparatus

The planned water purification system under the Expansion Plan uses chlorine to kill algae and microbes and aluminium sulphate as the coagulant as in the case of the existing South Giza Waterworks (see 4.3.2.4). Apparatus to neutralise leaked chlorine and a chlorine injection facility are included in the basic design to ensure safety at the time of handling chlorine.

1) Chlorine Injection Facilities

Given the volume of raw water from the Nile, chlorine injection facilities are required to sterilise the raw water by killing algae and microbes contained in large quantities in the raw water. As in the case of the existing South Giza Waterworks, chlorination is conducted in 3 stages, i.e., pre-chlorination, mid-chlorination and post-chlorination.

The selected injection method is the vacuum wet-type chlorine injection method which is used at the existing South Giza Waterworks. Chlorine will be injected in the form of a chlorine solution. Pressurised water will be fed by water pump to the vacuum wet-type chlorine injector where an appropriate amount of chlorine gas will be mixed to create the above solution. Chlorine gas will be supplied from 1,000kg cylinders using the natural vaporisation method. Together with the chlorine injection facilities, weighing equipment to check the amount of chlorine in the cylinders and chain blocks to ensure the safe handling of the cylinders will also be provided.

2) Aluminium Sulphate Dosing Apparatus

System

As already described in 3.3.3-(3)-6), the existing South Giza Waterworks uses either liquid aluminium sulphate or solid aluminium sulphate as the coagulant depending on the domestic manufacture and supply situation.

Liquid aluminium sulphate will normally be used for the water purification system for the Expansion Plan while solid aluminium sulphate will be used as a back-up as in the case of the existing South Giza Waterworks in view of a stable supply of coagulant. The dosing apparatus will naturally be able to handle both forms of aluminium sulphate and the same dosing pump will be used for both chemicals.

The dosing system currently used at the existing South Giza Waterworks, i.e., storage-dilution-dosing, is selected to minimise strain on maintenance.

Apparatus Material

The material for the liquid aluminium sulphate storage or dilution tank is generally either carbon steel with an inner rubber lining or plastic resin (FRP). While the former is superior in terms of strength and anti-corrosion performance, the proper care or repair of the inner lining is difficult. The latter requires no maintenance or repair inside the tank and has reasonable strength and anti-corrosion performance. Consequently, a FRP storage tank and dilution tank are selected.

Both the solution feed pump and solution dosing pump will be made of resin (glass fibre and polypropylene) to ensure good anti-corrosion performance, strength and easy maintenance. Similarly, PVC pipes and valves are selected for a good anti-corrosion performance both inside and outside.

3) Apparatus to Neutralise Leaked Chlorine Gas

This apparatus is provided as a safety measure to neutralise leaked chlorine gas if such leakage occurs. Give the size of the storage and the number of cylinders to be stored, its capacity should be capable of handling leakage from one 1,000kg chlorine cylinder. It should also be capable of sounding the alarm as soon as a chlorine leak is detected and automatically commence the neutralisation process.

Apparatus Material

Resin materials should be used for the chlorine injection facilities and neutralisation apparatus in view of good anti-corrosion performance, strength and safety.

Safety Kit

At least 2 sets of gas masks, protective clothing, protective gloves and protective boots, etc., should be provided to ensure the safety of repair staff during chlorine gas leakage.

(7) Sludge Discharge Apparatus

This apparatus discharges the flocs deposited at the sludge hoppers at the bottom of the sedimentation basins. In general, there are 3 sludge discharge methods, i.e., ① sludge (diamond) hopper method, ② freight conveyor method and ③ submerged rope traction method. Methods ② and ③ use a mechanical system and the presence of submerged movable sections makes maintenance difficult and expensive.

The sludge (diamond) hopper method ① has no submerged mechanical parts, resulting in easy and low cost maintenance. As described in 2.3.4.1-(2)-9), a similar method is in use at the existing South Giza Waterworks and, therefore, operation and maintenance staff are assumed to be already familiar with this method. Consequently, the sludge (diamond) hopper method is selected for the Expansion Plan. A detailed comparison of the 3 methods is given in Appendix 9. Given the observation that the gentle sloped floor of the sedimentation basins at the existing South Giza Waterworks makes it difficult to collect and discharge sludge, obstructing the operation of the Waterworks, a large number of sludge hoppers will be introduced for the sedimentation basins planned by the Expansion Plan. These sludge hoppers will be tilted some 60° from the level position to improve the sludge collection and discharge performance.

Manual valve operation is selected for sludge discharge as in the case of the existing South Giza Waterworks as this type of operation is less affected by the breakdown of sludge discharge apparatus and also as such valve operation is light work and is only required once a day on average. The sludge is directly discharged to the Nile.

(8) Clear Water Reservoirs

A clear water reservoir is a facility to adjust an imbalance between the rate of filtered water production and the rate of water consumption, particularly during peak consumption periods in the morning and evening, by storing clear water to meet any shortfall in production.

Under the Expansion Plan, 2 reservoirs will be constructed to allow the cleaning of the reservoirs in turn and the total storage capacity will be approximately 3,600m^3 (2.48 x mean hourly water consumption) in line with the requirements of the Study on Water Supply in Giza City. The main specifications of the clear water reservoirs are as follows.

- Size : 10.0m (W) × 32.35m (L) × 6.0m (D)
- Capacity : 1,844m^3 each (total: 3,688m^3)
- Number : 2

(9) Distribution Pump Facility

This facility is designed to supply clear water to the Project Site and has the following specifications.

1) Number of Pumps : 3 (one as reserve)

2) Design Pump Capacity : 15.8 m^3/min (as planned by the Study on Water Supply in City of Giza) (1.3 × average water supply volume/pump in operation)

3) Design Total Head : 60m (as water supply to the Project Site will use the same trunk line serving the existing distribution pump facility at South Giza Waterworks, the total head of the latter is adopted)

(10) Water Quality Laboratory

Changes in the raw water quality significantly affect the operation of water purification facilities. Appropriate water purification arrangements are, therefore, important to detect such changes as soon as possible.

The water quality laboratory at the existing South Giza Waterworks currently conducts water quality tests approximately every hour which is often enough to achieve the target quality for clear water. The test items include turbidity, pH and algae/microbe count, etc. as shown in Table 2-25. Comparison of the last 5 years' findings of these tests with the drinking water standards in Egypt shows that raw water from the Nile fails on 2 items, i.e., turbidity and algae count, suggesting that it will be important to continuously monitor these items in the future. Excluding these 2 items, the quality of raw water from the Nile is satisfactory.

The water quality laboratory at the existing South Giza Waterworks owns the equipment and instruments listed in Table 2-29. While some are old, it appears that the laboratory is capable of conducting the minimum water quality tests, including tests on the above 2 problematic items. Based on this assessment, no new water quality testing equipment or instruments will be provided under the Expansion Plan.

(11) Operation Control Method

The manual operation control method is selected for the new water purification facility as this method is commonly used by the existing South Giza Waterworks, Embaba

Waterworks and Rod El Faraq Waterworks. In view of the fact that the Expansion Plan (with a clear water supply capacity of 35,000m^3/day) is part of the overall expansion plan (with a total clear water supply capacity of 200,000m^3/day), special attention should be paid to the monitoring and control system to allow the smooth transition to a fully automatic control system with the further expansion of South Giza Waterworks in the future.

In principle, the operation control of the new facility will be manual control as in the case of the existing South Giza Waterworks. However, arrangements will be made to allow remote control to cope with the intensified operational demand under the overall expansion plan.

The electric wiring will mainly use cable racks with conduit tubes used for the terminal sections.

(12) Power Supply and Transformation

1) Power Service Entrance

The power supply to the new facilities to be constructed under the Expansion Plan will be made from a new 66/10.5KV substation, the construction of which is currently underway at the future expansion site (200,000 m^3/day) of South Giza Waterworks, using a 10.5KV 50Hz line (2 distribution lines: one in reserve) as described in 2.3.4.1-(2)-17). As the power service entrance will presumably be used under the overall expansion plan, the following points must be carefully noted.

Location

To be located halfway between the project site and the above-mentioned new substation to simplify wiring work under the overall expansion plan.

Future Expansion

The self-standing cubicle type switchboard method is selected to allow the easy installation of additional switchboards in the future for expansion. The bus bar of the switchboard of the Project should have sufficient capacity to meet the increased demand under the overall expansion plan.

2) Transformer and Other Equipment

The transformer and other power supply equipment will be installed in the power room to be constructed below the flocculation and other basins. As this power room will be a quasi-underground structure located near the dosing apparatus (chlorine and aluminium sulphate), equipment with a low fire risk is selected and the specifications are given below.

- Transformer : 10.5KV/380-220V, 50Hz dry transformer (or 10.5/3.3KV)
- High Voltage Switchboard : VCB, self-contained closed-type switchboard
- Low Voltage Switchboard : Molded circuit breaker (MCB)

Because of the long distance (some 400m) between the above power room and intake pump location, power supply to the latter will firstly be made to a transformer to be located near the latter by a 10.5KV line directly from the service entrance facility. From there, lower voltage power will be supplied to the intake pump.

3) Wiring

The wiring on the premises will mainly use cable racks with conduit tubes used for the terminal sections. The power system will be the same as that of the existing South Giza Waterworks as described below.

High Voltage : 10.5KV, 3 phase 3 wire, 50 Hz
3.3KV, 3 phase, 3 wire 50 Hz
Low Voltage : 380-220V, 3 phase 3 wire, 50Hz

4.3.2.7 Civil Engineering Work

(1) Selection of Sheathing Method

The clear water reservoirs planned under the Expansion Plan will be constructed below the rapid sand filters due to the limited available space. These underground structures will be fairly large with a floor level of some 11-13m below ground, covering an area of 1,100m^2 (22m × 50m). Therefore, it is important to select a sheathing method which prevents any disruption of or damage to the operation of the existing South Giza Waterworks as well as buried structures, including the water supply trunk line under the neighbouring El Cornesh Street. In general, the following sheathing methods can be used for large-scale underground construction work.

- soldier beam and breastboard construction method
- vertical steel sheet pile construction method
- underground continuous wall construction method

The vertical steel sheet pile construction method is selected for the Expansion Plan because of its low cost, short construction period and safety as shown in Table 4-9.

Table 4-9 Comparison of Sheathing Methods

	Vertical Steel Sheet Pile	Soldier Beam and Breastboard	Underground Continuous Wall
Outline	Excavation work commences after the vertical steel sheet piles, engaged to each other, are driven to the required depth	Excavation work takes place while the soldier beams (H sections) are driven into the soil at regular intervals and breastboards are placed between them	Holes in the ground are drilled by machine for cast-in-place concrete piles or a continuous wall to act as the shoring wall
Workability	① Durable and good for repeated use ② Water-tight and suitable for deep excavation ③ Driving of sheet piles is virtually vibrationless and noiseless	① Difficult to deal with spring water caused by the high groundwater level ② Unsuitable for deep excavation	① Difficult to deal with slurry ② Vibration and noise
Safety	Commonly used with proven reliability and safety	Careful backing work is required to prevent the collapse of natural ground. Wooden breastboards are weak and less safe	Not commonly used by as safe as the vertical steel sheet pile method
Construction Period	Shortest of the three	Slightly longer than the steel sheet pile method	2-3 times longer than the other methods
Construction Cost	Slightly more expensive than the soldier beam method	Cheapest method	3-4 times more expensive than the other methods
Overall Evaluation	○	×	×

(2) Waterproofing

All the facilities to be constructed under the Expansion Plan require a high degree of water tightness. Emulsion waterproof material which provides perfect waterproofing and which does not cause any problems vis-a-vis potable water will be used for the inner walls of the sedimentation basins, rapid sand filters and clear water reservoirs, etc.

4.3.2.8 Utilisation of Existing South Giza Waterworks Facilities and Relation with Existing Water Supply Network

(1) Utilisation of Existing South Giza Waterworks Facilities

In accordance with the design policies described in 4.1.5-(2), the existing facilities of South Giza Waterworks will, in principle, be utilised by the Expansion Plan where possible. In reality, the following facilities will be utilised in view of the current conditions of South Giza Waterworks (2.3.4.1-(2)), the current conditions of the subject site for the new facilities (3.3.3) and the facilities planned under the Expansion Plan.

1) Intake pump house for the existing 6th October Waterworks (for the installation of the intake pump)

2) Intake pump facility of the existing South Giza Waterworks (to disperse the risk associated with the breakdown of the intake pump facility to be constructed under the Expansion Plan)

3) Existing chlorine cylinder storage (for the storage of chlorine cylinders)

4) Existing solid aluminium sulphate storage (for the storage of solid aluminium sulphate)

5) Existing forklift (for the transportation of chlorine cylinders and solid aluminium sulphate from the respective storages to the new water purification facilities)

6) Existing water quality laboratory and water quality testing equipment/instruments (for water quality tests)

7) Existing office (for administration)

(2) Relation with Existing Water Supply Network

As repeatedly stated earlier (for example, see 2.1.3-(3)), the Expansion Plan is in line with the master plan for Giza City (Study on Water Supply in City of Giza) and water supply from the new waterworks to Monib District will use the new trunk line to be constructed under the Project as well as those to be constructed under the Phase 1 Project.

These trunk lines and branch lines will be connected to the water supply trunk network in Giza City, acting as parts of that network (see Fig. 4-10). In view of such connection, the quality of the clear water from the new facility must continuously satisfy Egypt's drinking water standards (see Table 4-5). The same standards also apply to the clear water to be supplied from other existing waterworks to maintain the general quality standard of Giza's water service.

4.3.2.9 Provision of Spare Parts

In principle, the quantity of spare parts to be provided under the Expansion Plan will be equivalent to 2 years' supply. In addition, the emergency spare parts shall be provided for components and/or equipment which have no stand-by facilities, such as the intake pump, those facilities of which the breakdown immediately disrupts the normal operation of the waterworks, and those facilities of which the repair generally takes a long period of time.

4.3.2.10 Basic Design Drawings

The following basic design drawings have been prepared for the Expansion Plan. (See Appendix 10-1)

EGM-WT-01 General Layout of Waterworks for the Project

EGM-WT-02 Plan and Cross-Section of Intake Pump Facilities

EGM-WT-03 Plan of Water Purification Facilities

EGM-WT-04 Cross-Section of Purification Facilities

EGM-WT-05 Layout of Electrical & Chemical Room

EGM-WT-06 Surface Washing Facility

EGM-WT-07 Plan and Cross-Section of Water Purification Plant

EGM-WT-08 Plan of Sedimentation Basin (1/3)

EGM-WT-09 Plan of Sedimentation Basin (2/3)

EGM-WT-10 Plan of Sedimentation Basin (3/3)

EGM-WT-11 Cross-Section of Sedimentation Basin (1/3)

EGM-WT-12 Cross-Section of Sedimentation Basin (2/3)

EGM-WT-13 Cross-Section of Sedimentation Basin (3/3)

EGM-WT-14 Plan of Rapid Sand Filter Basin and Clear Water Reservoir (1/3)

EGM-WT-15 Plan of Rapid Sand Filter Basin and Clear Water Reservoir (2/3)

EGM-WT-16 Plan of Rapid Sand Filter Basin and Clear Water Reservoir (3/3)

EGM-WT-17 Cross-Section of Rapid Sand Filter Basin and Clear Water Reservoir (1/3)

EGM-WT-18 Cross-Section of Rapid Sand Filter Basin and Clear Water Reservoir (2/3)

EGM-WT-19 Cross-Section of Rapid Sand Filter Basin and Clear Water Reservoir (3/3)

EGM-WT-20 Plan of Distribution Pump Station

EGM-WT-21 Cross-Section of Distribution Pump Station and Connection to Existing Water Supply Trunk Line

EGM-WT-22 Elevation of Operation Building for Rapid Sand Filter Basin

EGM-WT-23 Plan of Operation Building for Rapid Sand Filter Basin

EGM-WT-24 Plan of Operation Building for Rapid Sand Filter Basin

EGM-WT-25 Fitting Detail of Operation Building for Rapid Sand Filter Basin

EGM-WT-26 Instrument System Diagram

EGM-WT-27 Oneline Diagram

4.3.3 Water Supply Trunk Line Construction Plan

The basic plan for the Water Supply Trunk Line Construction Plan is prepared on the basis of the design policies described in 4.1.5 (2) and the field survey findings while trying to coordinate with the master plan of GCWSA. The basic flow for preparation of the basic plan for the water supply trunk line under the Project is shown in Fig. 4-9.

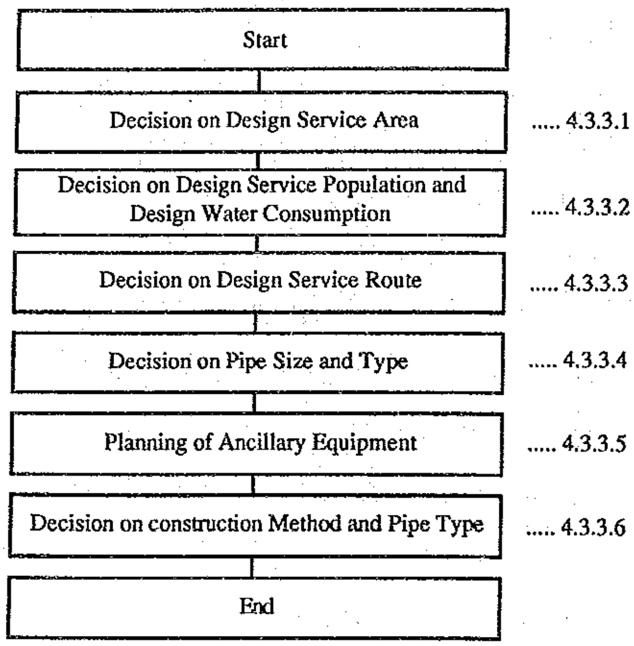


Fig. 4-9 Basic Plan Flow for Water Supply Trunk Line

Each of the above processes of the Water Supply Trunk Line Construction Plan (hereinafter referred to as the Trunk Line Construction Plan) is described below.

4.3.3.1 Design Service Area

The planned service area under the Project is the Project Site (185ha) shown in Fig. 4-1.

4.3.3.2 Design Service Population and Design Water Consumption

The design service population and design water consumption have already been given in 4.2.1 and are as follows.

- Design service population : 247,000 (2010)
- Design water consumption : 140 litres/person/day (maximum consumption)

4.3.3.3 Design Service Route

The design service route of the water supply trunk line (1,200mm in diameter) should be compatible with the route plan of the Study on Water Supply for City of Giza (hereinafter referred to as the Waster Supply Master Plan) while taking the road plan and land use plan in Giza City, the workability of the route and the construction cost, etc. into consideration.

(1) Selection of Optimal Design Route

In the original request of the Government of Egypt, the suggested route branches out from the existing trunk line and runs under Madba Street as shown in Fig. 4-10.

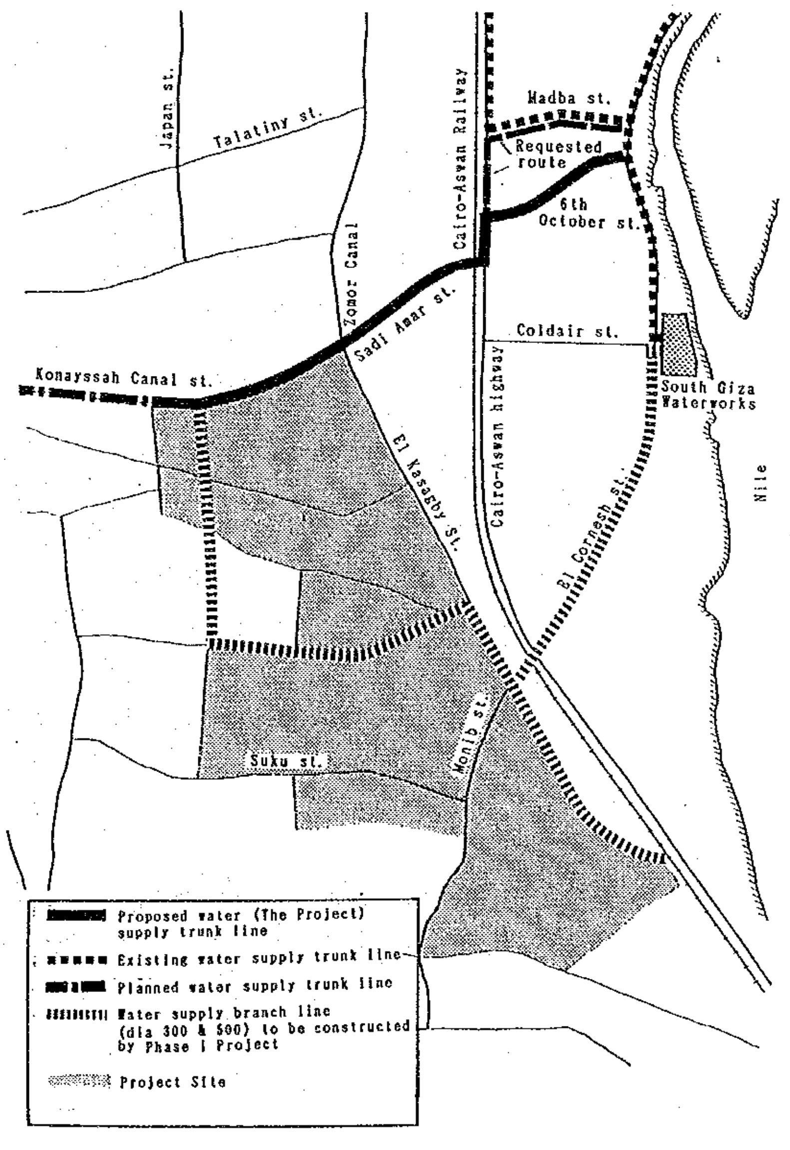


Fig. 4-10 Requested Route and Alternative Routes for Planned Water Supply Trunk Line

The field survey found this suggested route to be unsuitable for the following reasons.

1) A flyover across the Cairo-Aswan Railway line to link Madba Street and Cairo-Aswan Street is currently under construction. As Madba Street will be an access road to this flyover, the pier will be located almost at the centre of the street.

2) A water supply trunk line (1,000mm in diameter), sewer line and power cables, etc., are already buried under Madba Street and those structures which obstruct the construction of the above pier will be moved to other places under the street, leaving no space for the planned water supply trunk line.

Possible alternative routes are 6th October Street and Coldair Street, both to the south of Madba Street and the former has been selected based on the comparison results given in Table 4-10.

Table 4-10 Comparison of Alternative Water Supply Trunk Line Routes

Street	Current Conditions
6th October Street	• The width of 10-15m is relatively wide. • Half of the street is lined by factories on both sides with a relatively small number of houses and shops. • The existing sewer line is buried as deep as 5m and will not obstruct the placement of the new water supply trunk line. • The manhole distance of approximately 40-50m is relatively long and there are few manholes.
Coldair Street	• The width of approximately 8m is relatively narrow. • The entire street is lined by houses and shops. • The existing sewer line is buried at a depth of 3m, making it necessary to bury the new water supply trunk line deeper than that to avoid mutual interference. • The manhole distance of approximately 30m is short and there are many manholes.

Fig. 4-11 shows the water supply network under the Water Supply Master Plan and the planned water supply trunk line route, selected on the basis of the Master Plan and the field survey findings.

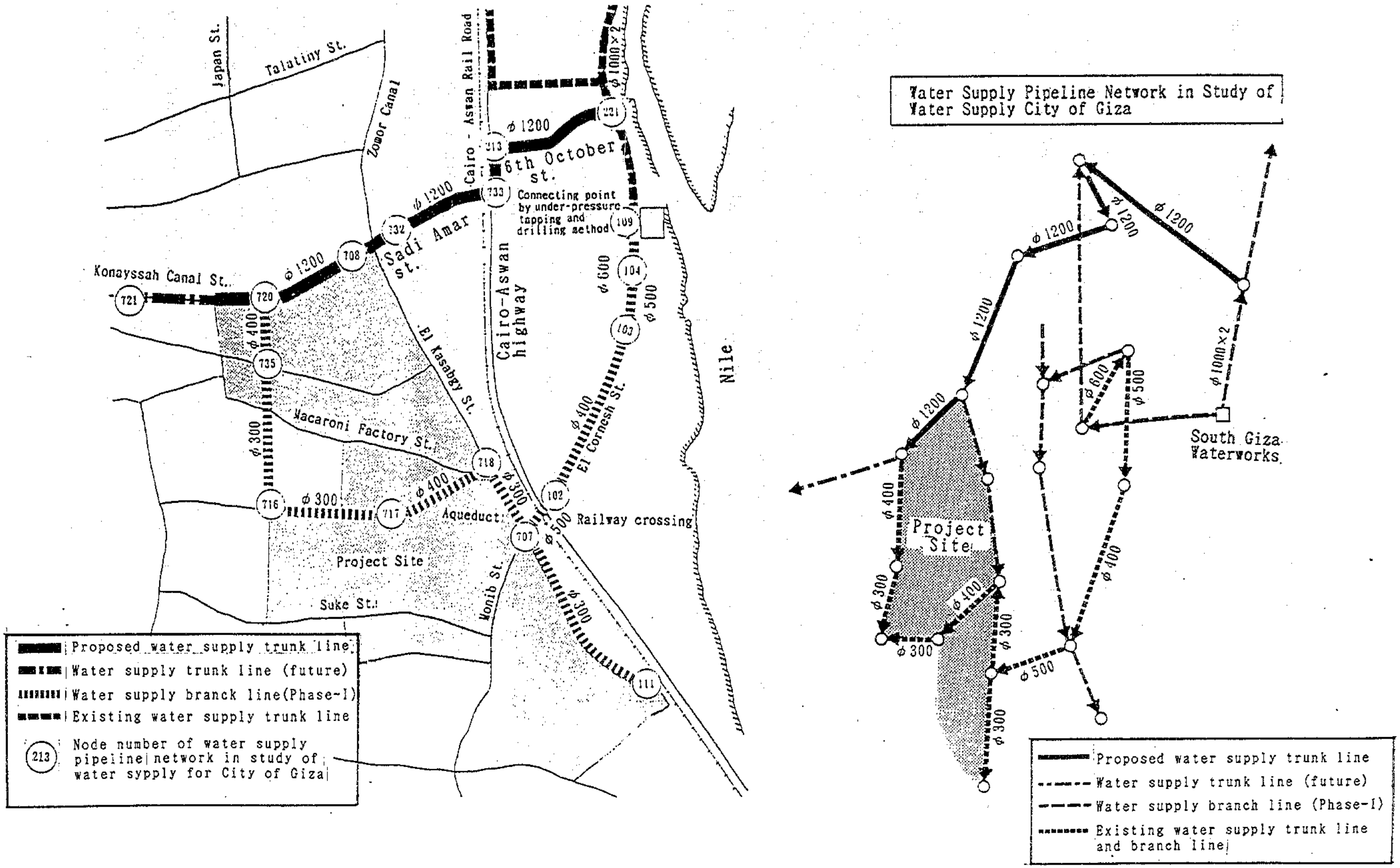


Fig. 4-11 Planned Water Supply Trunk Line Route Under Project

(2) Current Conditions of Design Route and Points to Note

The current conditions of the design route (see Fig. 4-10) and points to note in the planning and actual construction work are described below.

1) El Cornesh Street Section

2 water supply trunk lines (1,000mm in diameter) are buried under both sides of El Cornesh Street from South Giza Waterworks towards central Giza. The water supply trunk line to be constructed under the Project (1,200mm in diameter) will branch out from these 2 existing trunk lines in accordance with the Water Supply Master Plan.

The underpressure drilling and tapping method will be adopted for the branching out from the existing trunk lines to prevent any water supply stoppage during the work. Although El Cornesh Street is one of the main trunk roads in Giza City, the traffic is relatively light. As the street has a width of some 40m, closure of half of the street is feasible without causing a serious traffic flow problem. Consequently, the open-cut method will be adopted for the trunk line construction work to branch out from the existing trunk line along the Nile to cross El Cornesh Street.

2) 6th October Street Section

There is a sewer line running under 6th October Street with manholes provided at some 30-50m intervals. The lateral sewer pipes to households are buried at a depth of some 1.5m and are connected to the manholes. A water supply line is also found at a depth of some 1.7m. The earth covering should be thicker than the standard thickness of approximately 1.2m for this section in order to minimise the size of the inverted siphons to avoid interference with these existing lines.

3) Cairo-Aswan Street Section

2 sewer lines (300mm in diameter) are buried at a depth of some 2.5m in this section. The east side of the street is a residential area while the west side is bordered by the Cairo-Aswan Railway line which runs parallel to the street. As a result, lateral sewer pipes to households run under the east side of the street. The presence of the railway line on the west side of the street has prevented housing or other buildings on that side, resulting in the virtual non-existence of underground structures. In view of these circumstances, the planned trunk line will be buried near the west side kerb of the street.

4) Crossing Sections at Cairo-Aswan Street and Railway Line

Cairo-Aswan Street is one of the most important arteries in Egypt with busy traffic throughout the day. As a sewer line is buried at a depth of some 2.5m, the planned water supply trunk line must have an earth covering of at least 3m. Use of the pipe jacking method is, therefore, suitable at this crossing section because of the lower impact on traffic, little risk of damaging existing underground structures and shorter construction period vis-a-vis the open-cut method. The pipe jacking method using reinforced concrete sleeve pipes which is the standard method adopted by the Egyptian State Railway and also the method adopted for the Phase 1 Project will be employed at the railway line crossing section.

5) Sadi Amar Street Section

A water supply line is buried under the central part of Sadi Amar Street at a depth of some 1.0m. The open-cut method and a standard earth covering of approximately 1.2m will be adopted for the entire section. The relatively wide street width of some 14m, together with the light traffic, will make construction work in this section virtually problem-free.

6) Zomor Canal Crossing Section

The design route will cross the Zomor Canal at the junction between Sadi Amar Street and Konayssah Canal Street. An aqueduct will be introduced here as in the case of the similar crossing section in the Phase 1 Project.

7) Konayssah Street Section

A sewer line is buried under Konayssah Street with manholes at some 50m intervals. The lateral sewer pipes to households run under the street at a depth of some 1.5m and are connected to the manholes. In order to minimise the size of the inverted siphons to avoid clashing with the sewer line, earth covering in this section should be deeper than the standard depth (some 1.2m). In addition, the Abu Nomros sewer trunk line (1,800mm in diameter) of GOSD is buried under the centre of the street at a depth of some 5-6m. Manholes (3m × 3m) for this trunk line are provided at approximately 100m intervals. The design route should not interfere with these manholes.

4.3.3.4 Pipe Diameter and Type

(1) Pipe Diameter

The pipe diameter for the planned water supply trunk line is 1,200mm in line with the Water Supply Master Plan to ensure an adequate supply of potable water.

(2) Pipe Type

The selection of the pipe type is based on the following criteria.

- Safety vis-a-vis internal pressure
- Safety vis-a-vis external pressure
- Suitability vis-a-vis site conditions
- Little adverse impact on traffic during construction work
- No adverse impact on water quality
- High watertightness
- High durability
- Resistance to ground deformation
- Good workability
- Easy maintenance
- Low maintenance cost

1) Types of Pipes Examined

The following pipe types were examined for use in the Trunk Line Construction Plan in view of past use in Egypt, availability, quality, economy and workability, etc.

- ductile cast iron pipe
- steel pipe

2) Type Selected

The ductile cast iron pipe is selected for both straight and pipe fittings such as bends, T-pipes, etc., taking the above-mentioned criteria and the following requirements and facts into consideration.

- The good workability makes it possible to complete the required work (excavation, sheathing, laying of pipes and backfilling) for each section in a few days with the least disruption of traffic during the construction period.

- The construction cost is low because pipe welding work, lining work for both inside and outside welded parts and welding inspection by X-ray are not required.

- The easier joining work than in the case of steel pipes makes the construction period shorter.

- The use of ductile cast iron pipes is standard practice in Egypt for underground pipes with a diameter of 300mm or larger in urban areas.

- Sufficient strength vis-a-vis both internal and external pressure is provided.

- Ductile cast iron pipes are superior to steel pipes in terms of the anti-corrosion performance and workability.

4.3.3.5 Ancillary Equipment

The following basic design of such ancillary equipment as gate valves and air valves, etc. is decided based on agreement with GCWSA and also taking the relevant Japanese standards (as stipulated by the Design Criteria for Waterworks Facilities published by the Japan Waterworks Association) into consideration.

(1) Gate Valves

Gate valves will be installed at the aqueduct, railway line crossing section, trunk road crossing sections and both connection and branching points of existing water supply trunk lines and the water supply branch lines to be constructed under the Phase 1 Project. The main specifications are as follows.

1) Types : butterfly valve (for water supply trunk line with a diameter of 1,200mm)

sluice valve (for pipes with a diameter of upto 400mm)

- connection points with existing water supply trunk line using underpressure drilling and tapping method (diameter: 1,000mm)

- connection points with water supply branch lines (Phase 1 Project) using the above method (diameter: 300mm)

2) Material : ductile cast iron

3) Joint Type : flange joint (for flexible pipes in and out of the valve chamber)

4) Valve Chamber Structure : flexible pipe on both sides of the valve chamber and expansion pipe inside the valve chamber

(2) Wash-Out Valves

Wash-out valves will be installed at some low pipeline sections, including concave sections and the railway line/trunk road crossing sections. The main specifications are as follows.

1) Type : sluice valve

2) Diameter : 200mm

3) Joint Type : flange joint

4) Wash-Out Method : The higher elevation of these wash-out valves than that of the design flood water level of the Zomor Canal (AD +19.25m) makes gravity drainage impossible. A drainage pit will be installed and wash-out operation will be conducted using a mobile submersible pump.

(3) Air Valves

Air valves will be installed at some high pipeline sections, including convex sections and the aqueduct. The main specifications are as follows.

1) Type : dual mouthed air valve

2) Accessory : gate valve to be installed between the trunk line and air inlet to assist repair work in the future

3) Joint Type : flange joint

4) Miscellaneous : steel cover to be provided for air valves at the aqueduct to prevent damage or theft

(4) Protection of Pipe Fittings

Pipe fittings will be protected by concrete blocks, the shape and measurements of which are given in Basic Design Drawing EGM-WL-04.

4.3.3.6 Construction Method and Selection of Pipes

(1) Standard Sections

The open-cut method will be used for the laying of the water supply trunk line pipes at standard sections which exclude those sections crossing the railway line, canal and trunk roads. The use of strong sheathing is necessary for this open cut section to ensure safe work in view of (1) narrow road width with heavy vehicle and pedestrian traffic, (2) large pipe diameter of 1,200mm, substantial excavation depth and presence of housing and other buildings right on the edges of streets. The weakness of the modern sheet pile method which is commonly used in Egypt is shown in the ongoing construction work of the Abu Nomros main collector where wooden sheet piles have failed to provide the necessary soil pressure retailing strength, causing subsidence in neighbouring residential areas, in turn causing cracks in housing. The use of this method for the planned route under the Project appears inappropriate and, therefore, the adoption of the much tougher steel sheet pile method is necessary to ensure safe work under the Project.

T-joints (push-on type) will be used for pipe connection at standard sections in view of easy work, low material and equipment cost, low work cost and satisfactory watertightness.

(2) Trunk Road and Railway Crossing Sections

The pipe jacking method will be employed at the trunk road and railway crossing sections bacause of the lower impact on traffic, little risk of damaging existing underground structures and shorter construction period vis-a-vis the open cut method. The actual method to be used will be the sleeve pipe jacking method, which is the standard method adopted by Egyptian State Railway, for the laying of water supply pipes at the railway crossing point. Reinforced concrete pipes of the same diameter as those used by the Phase 1 Project (2,000mm) will be used for the sewer trunk line to reduce the construction cost by means of using the same pipe jacking machinery used by the Phase 1 Project. The sleeve pipe jacking method is illustrated in Fig. 4-12 and details can be found in Basic Design Drawing: EGM-WL-05 and 06.

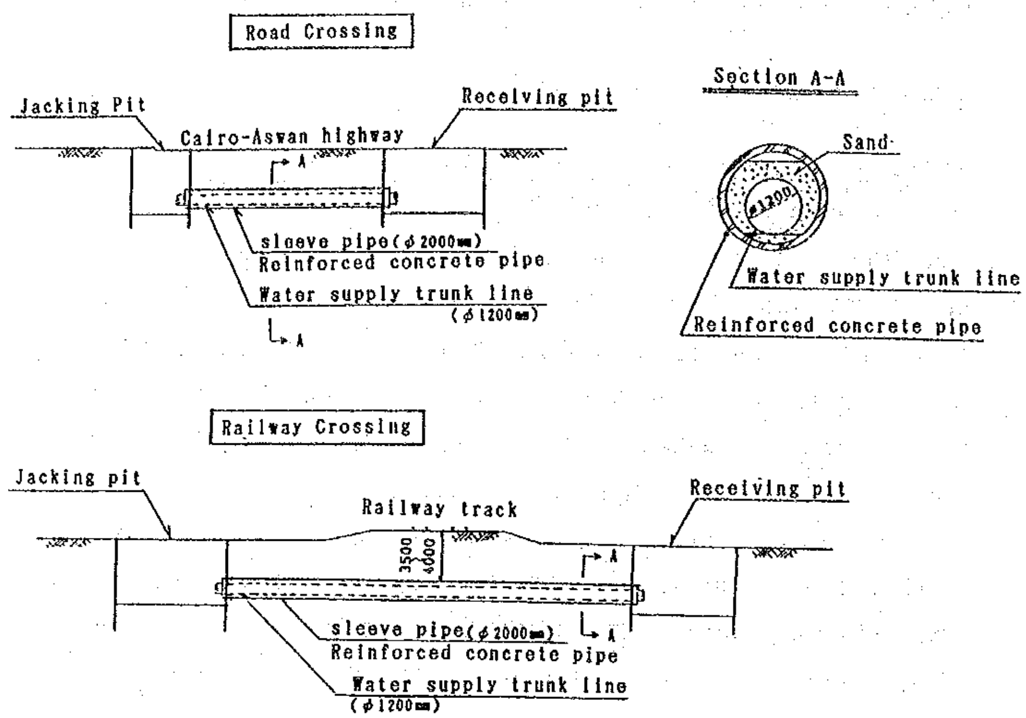


Fig. 4-12 Sleeve Pipe Jacking Method for Trunk Road and Railway Crossing Sections

The following points must be noted in the adoption of the sleeve pipe jacking method.

1) The water supply trunk line (dia. 1,200mm) will be laid inside the sleeve pipe line (reinforced concrete with a diameter of 2,000mm) after the positioning of the latter. A valve chamber accompanied by a gate valve and wash-out valve will be introduced on both sides of the sleeve pipe line.

2) The actual pipe jacking method to be employed will be the slurry semi-shield jacking method which has also been used by previous projects, including the Phase 1 Project, and which is cheaper than other methods. This method is illustrated in Fig. 4-13.

3) Ductile cast iron pipes will be used for the planned water supply trunk line together with mechanical joints to secure undisrupted, safe railway operation and the prevention of leakage and to avoid serious damage caused by possible uneven settlement.

4) The locations of the jacking pit and receiving pit and the depth of earth cover are set as follows based on the construction conditions demanded by the Egyptian State Railway for the Omrania West Project.

   a) The minimum distance from the edge of the railway tracks to the jacking pit or receiving pit will be 15m.

   b) The minimum depth of the upper side of the sleeve pipe from the railway track ground will be 3.5m.

   c) The commissioning of any work to the Egyptian State Railway will be conducted by Giza City, if necessary.

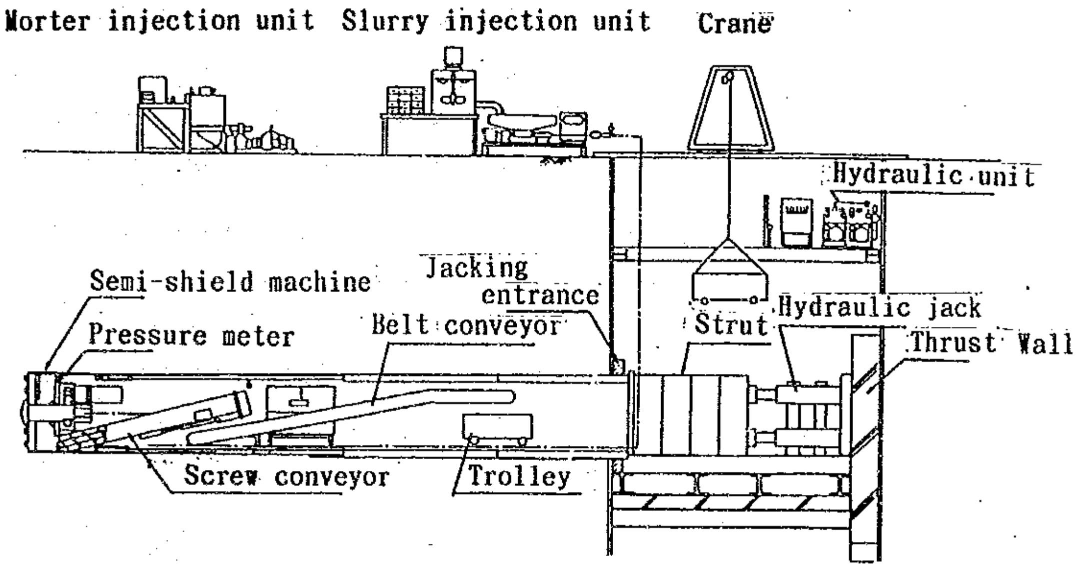


Fig. 4-13 Outline of Slurry Semi-Shield Construction Method

(3) Aqueduct

An aqueduct will be introduced, as in the case of the Phase 1 Project, at the Zomor Canal crossing section in view of the need for the undisrupted use of the canal, difficulty of underground construction work, need to reduce the construction cost, need for easy operation and maintenance and the experience of such aqueducts on the Egyptian side.

The location and design conditions described below have been decided through discussions between the Study Team and the Giza Irrigation Bureau as well as GCWSA. The aqueduct is illustrated in Fig. 4-15 and further details are given in Basic Design Drawing EGM-WL-07.

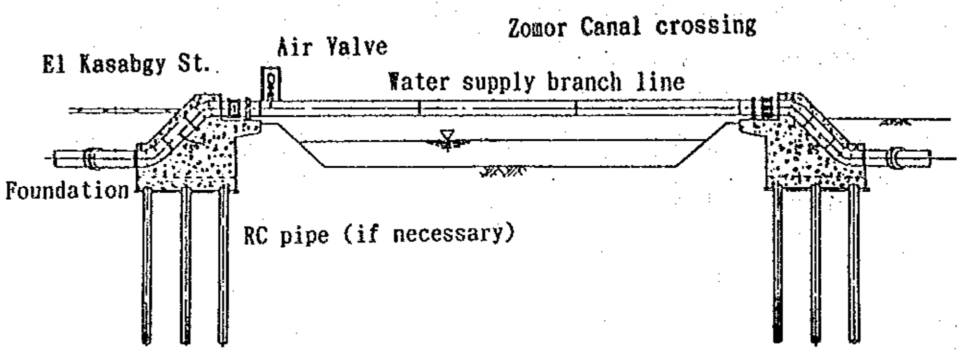


Fig. 4-14 Aqueduct

1) The aqueduct in question will be constructed some 10m in the lowerstream of the existing canal bridge leading to Konayssah Canal Street.

2) The diameter of the aqueduct will be 1,200mm as stipulated by the Water Supply Master Plan.

3) The aqueduct will be made of steel.

4) A minimum margin of 1.0m will be allowed between the design high water level of the canal and the lower face of the aqueduct.

5) Flexible pipes will be used at both ends of the aqueduct in view of possible uneven settlement.

6) An air valve will be installed at the convex section of the aqueduct and will be protected by a steel cover to prevent damage or theft.

7) Expansion pipes will be used at both ends of the aqueduct in view of the expansion and contraction of the steel pipes.

(4) Connection with Existing Trunk Lines by Under-Pressure Drilling and Tapping Method

The water supply trunk line to serve a wide area, including the Project Site, with a stable supply of potable water in terms of both quantity and pressure will branch off from the 2 existing water supply trunk lines (diameter: 1,000mm) originating at South Giza Waterworks and running towards central Giza as stipulated by the Water Supply Master Plan.

If this connection work between the existing trunk lines and the planned trunk line (diameter: 1,200mm) is conducted using a method which temporarily suspends the water supply through the existing trunk lines, a wide area in Giza City will be affected by the suspension of the water supply for a few days. In addition, there is a strong likelihood that muddy water will be supplied with the recommencement of water supply. Therefore, the under-pressure drilling and tapping method as shown in Fig. 4-15 adopted by the Phase 1 Project and highly evaluated by the Egyptian side due to the absence of any disruption to the water supply, the non-occurrence of muddy water and no adverse effects on city functions, industrial activities and the daily life of the public will be adopted for the connection work in question.

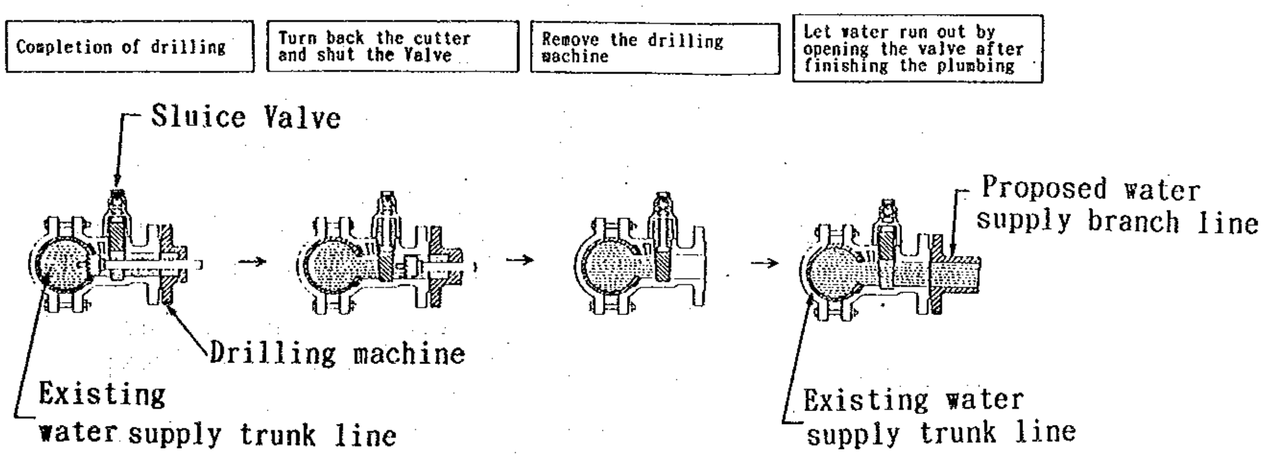


Fig. 4-15 Under-Pressure Drilling and Tapping Method

4.3.3.7 Basic Design Drawings

The basic design drawings for the water supply facilities planned by the Project are listed below. (See Appendix 10-2)

EGM-WL-01 Plan for Water Supply Trunk Line Facilities

EGM-WL-02 Connection to Existing Water Supply Trunk Line

EGM-WL-03 Standard Structure of Ancillary Equipment (1/2)

EGM-WL-04 Standard Structure of Ancillary Equipment (2/2)

EGM-WL-05 Plan and Cross-Section of Trunk Road Crossing Section

EGM-WL-06 Plan and Cross-Section of Railway Crossing Section

EGM-WL-07 Plan and Cross-Section of Canal Crossing Section

4.3.4 Sewer Transfer Pump Station No. 5 (B) Construction Plan

The basic plan for Sewer Transfer Pump Station No. 5 (B) is prepared on the basis of the design policies described in 4.1.5-(3) and follows the flow shown in Fig. 4-16.

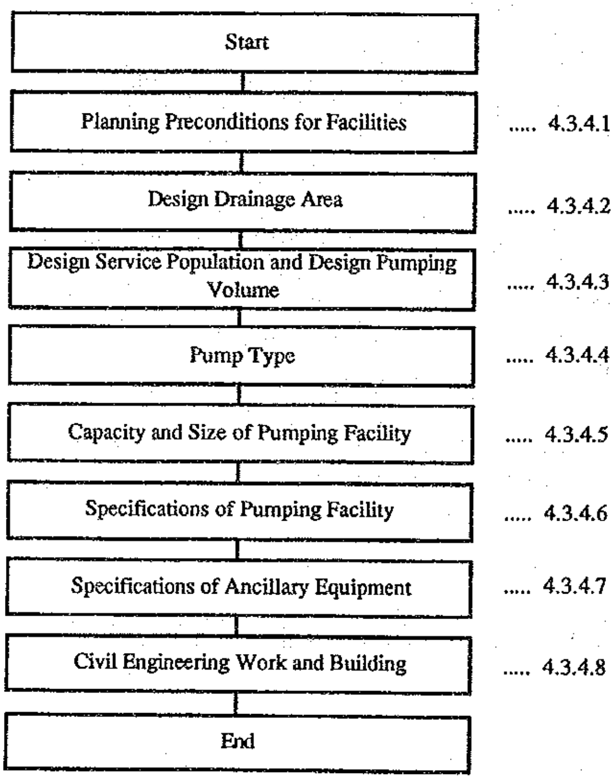


Fig. 4-16 Basic Plan Flow for Sewer Transfer Pump Station No. 5 (B)

Each of the above processes of the Sewer Transfer Pump Station No. 5 (B) Construction Plan (hereinafter referred to as the Pumping Station Construction Plan) is described below.

4.3.4.1 Planning Preconditions for Facilities

The drainage area of Sewer Transfer Pump Station No. 5 (B) will be those areas in south Giza, including Monib District, and suburban Giza where sewer facilities are currently not provided as shown in Fig. 4-18. According to GOSD plan, Sewer Transfer Pump Station No. 5 (B) will be capable of coping with the volume of wastewater drained from the above-mentioned drainage area. However, given the facts that the estimated wastewater drainage in 1996, the year of the pumping station's completion, will be some 47% of the expected drainage level in the target year of 2010 and that the Project Site is only part of the drainage area for Sewer Transfer Pump Station No. 5 (B), the construction of a pumping facility to suit GOSD plan right at the beginning will be rather wasteful and a phased approach to the expansion of the pumping capacity as the actual drainage increases is recommended instead. Table 4-11 compares GOSD plan and the Pumping Station Construction Plan based on consultations with the Egyptian side in terms of the pumping capacity and the number of pumps to be installed.

Table 4-11 Comparison Between GOSD Plan and Pumping Station Construction Plan

Item	GOSD Plan	Pumping Station
Pump Type	screw pump	screw pump
Pumping Capacity	1,650 litres/sec/pump	1,650 litres/sec/pump
Number of Pumps	4 (one as reserve)	3 (one as reserve)
Civil Engineering Work and Building	as required for installation of 4 pumps	as required for installation of 4 pumps (sufficient space to accommodate 4th pump to be installed in the future

4.3.4.2 Design Drainage Area

The subject area of the improved sewer service under the Pumping Station Construction Plan of the Project is Monib District (185ha). Wastewater generated in the Project Site will be drained to Sewer Transfer Pump Station No. 5 (B) via the Abu Nomros sewer trunk line. The design drainage area of this pumping station is some 2,800ha, including the drainage area of the Abu Nomros sewer trunk line (some

1,800ha, including the Project Site of 185ha) and its surrounding areas. Table 4-12 and Fig. 4-17 give details of the drainage area and the extent of the drainage area respectively.

Table 4-12 Drainage Area of Sewer Transfer Pump Station No. 5 (B)

	Area (ha)	Remarks
Drainage Area of Abu Nomros Sewer Trunk Line	1,800	including Project Site (185ha)
Drainage Area of Other Sewer Lines	1,000	including future service improvement area (600ha)

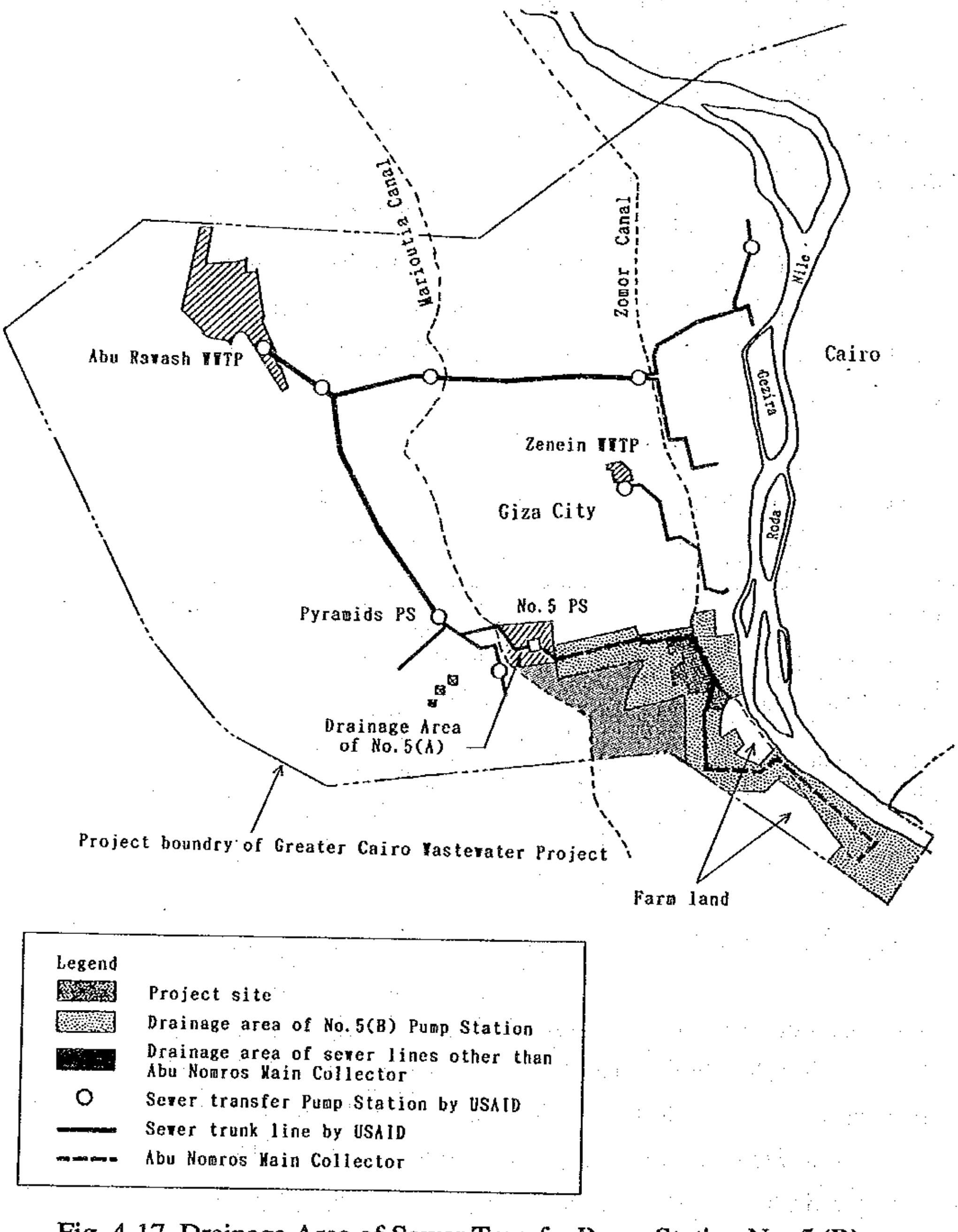


Fig. 4-17 Drainage Area of Sewer Transfer Pump Station No. 5 (B)

4.3.4.3 Design Service Population and Design Pumping Volume

(1) Design Service Population

The design service population in the target year (2010) is 247,000 as stipulated by the Expansion Plan. The population of the entire drainage area of Sewer Transfer Pump Station No. 5 (B) is calculated on the basis of an average population density of 718 persons/ha in the target year.

(2) Design Pumping Volume

1) Design Wastewater Inflow of GOSD

Table 4-13 shows the transition of the design wastewater inflow to Sewer Transfer Pump Station No. 5 (B) planned by GOSD for the period from 1996, the planned year of completion of Sewer Transfer Pump Station No. 5 (B), to 2010, the target year.

Table 4-13 Design Wastewater Inflow to Sewer Transfer Pump Station No. 5 (B)

(Unit: m^3/sec)

Drainage Area	1996	2000	2005	2010
Drainage Area of Abu Nomros Sewer Trunk Line	1.72	2.70	2.78	2.86
Drainage Area of Other Sewer Lines	0.39	0.46	1.03	1.60
Total	2.11	3.16	3.81	4.46

2) Design Pumping Volume

GOSD's design wastewater inflow to Sewer Transfer Pump Station No. 5 (B) in the target year is examined below in the light of the maximum wastewater production volume/person/day and the design service population (population density × drainage area).

Design Wastewater Inflow (m^3/sec)

$$= \frac{\text{Design Maximum Wastewater Production/Person/Day} \times \text{Design Service Population}}{24 \times 60 \times 60}$$

$$= \frac{0.19 \times 718 \times 2{,}800}{86{,}400}$$

$$\fallingdotseq 4.42 m^3/sec$$

where

Design Maximum Wastewater production : 190 litres/person/day = 0.19m^3/person/day

Design Service Population : 718 persons/ha × 2,800ha

In short, the design wastewater inflow level adopted by GOSD is adequate and, therefore, this level is used as the design pumping volume for Sewer Transfer Pump Station No. 5 (B) to plan the pumping capacity and facility size.

4.3.4.4. Pump Type

The following 2 types of pumps are used at pumping stations in Egypt.

- screw pump
- axial flow pump or volute wastewater pump

A screw pump is usually selected to deal with a large pumping requirement of 100,000m^3/day or more per pump while an axial flow pump or volute wastewater pump is selected to act as a medium size pump to deal with a pumping requirement of around 50,000m^3/day. The screw pump has, in fact, been selected for all pumping stations (total of 12) constructed under the Greater Cairo Region Sewer Improvement Project of USAID. The screw pump has the following characteristics.

- Easy operation, maintenance and inspection due to simple structure.
- No clogging by the solids contained in wastewater due to open top half.
- No requirement for such ancillary equipment as a throttle valve due to automatic pumping volume control by pump revolution adjustment in accordance with changing inflow volume.
- No requirement for special operation and maintenance skills due to permitted no-load running and open top half.
- Space efficient and low construction cost due to no requirement for a sand basin or a large pump well.

In view of the anticipated large pumping volume of upto some 140,000m^3/pump/day, the small site, its past use in Egypt and the contents of the request of the Government of Egypt, the screw pump with the above characteristics has been selected for the Pumping Station Construction Plan.

4.3.4.5 Capacity and Size of Pumping Facility

(1) Decision on Pumping Capacity

GOSD plan gives a pumping capacity of 1,650 litres/sec/pump ($1.65m^3$/sec/ pump). The relation between the design wastewater changes in accordance with time set by GOSD and confirmed by the Study Team as described in 4.3.4-(3) and the pumping capacity is shown in Fig. 4-18.

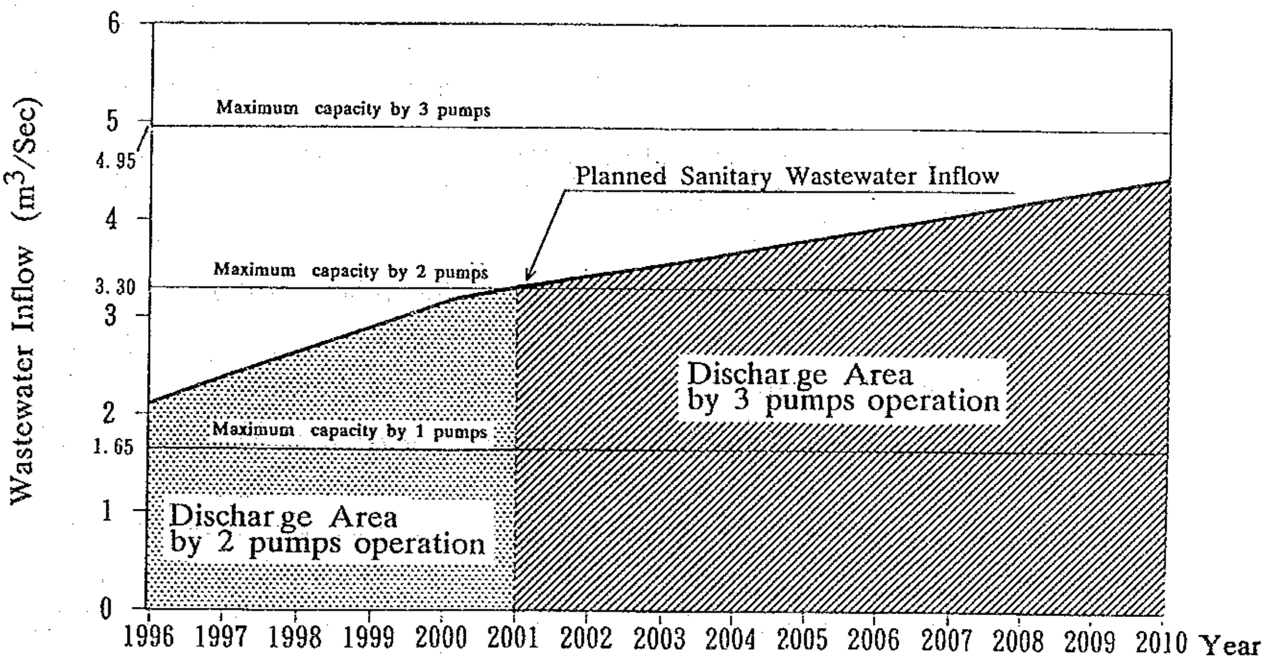


Fig. 4-18 Relation Between Design Wastewater Inflow Changes in Accordance with Time and Pumping Capacity

The number of pumps required for 2010, the target year, is 3 based on the following calculation.

$$\text{Number of Pumps} = \frac{\text{Design Wastewater Inflow Volume } (m^3/sec)}{\text{Pump Capacity } (m^3/sec/pump)} = \frac{4.46}{1.65} \fallingdotseq 2.7$$

At this time, the ratio of the design wastewater inflow volume vis-a-vis the pumping capacity (operation rate) is 90% as calculated below.

$$\frac{\text{Design Wastewater Inflow Volume}}{1.65 \times 3 \text{ (pumps)}} = \frac{4.46m^3/sec}{4.95m^3/sec} \times 100 \fallingdotseq 90\ (\%)$$

As a result, the pumping capacity of a single pump (1.65m^3/sec) planned by GOSD is judged to be appropriate.

(2) Size of Pumping Facility

Fig. 4-19 shows that the design wastewater inflow volume in 1996, the planned year of completion of Sewer Transfer Pump Station No. 5 (B), will be 2.11m^3/sec. Consequently, 2 pumps will be required.

$$\frac{2.11}{1.65} \fallingdotseq 1.3$$

The maximum pumping capacity of the pumps is 3.30m^3/sec (1.65 × 2) which can meet the pumping demand upto 2001.

3.30m^3/sec > 3.29m^3/sec (design wastewater inflow volume in 2001)

From 2002 onwards, a third pump will be required as the design wastewater inflow volume will exceed the maximum pumping capacity of 2 pumps (3.30m^3/sec).

For the Pumping Station Construction Plan of the Project, the number of pumps to be initially installed is 3 (one in reserve) to avoid the provision of an excessively large facility in line with the planning preconditions for the facility described in 4.3.4.1. Table 4-14 shows the number of pumps and the total pumping capacity under the Pumping Station Construction Plan and in the target year.

Table 4-14 Number of Pumps and Pumping Capacity Under Pumping Station Construction Plan and in Target Year

	Number of Pumps		Design Wastewater Inflow Volume (m^3/sec)	Pumping Capacity (m^3/sec)
	Operation	Stand-by		
Pumping Station Construction Plan	2	1	3.29	3.30
Target Year (completion of Master Plan)	3	1	4.46	4.95

4.3.4.6 Specifications of Pumping Facility

The following design conditions have been agreed with GOSD for the pumping facility.

- LWL	: GL -8.44m (AD +10.36m)
- HWL	: GL -2.1m (AD +16.7m)
- Overflow Level	: GL -2.0m (AD +16.8m)
- Pump Diameter	: 2,600mm
- Tilt Angle of Pump	: 38°
- Design Pumping Capacity	: 1,650 litres/sec/pump (99m³/min)

The design specifications of the planned screw pump are shown in Fig. 4-19.

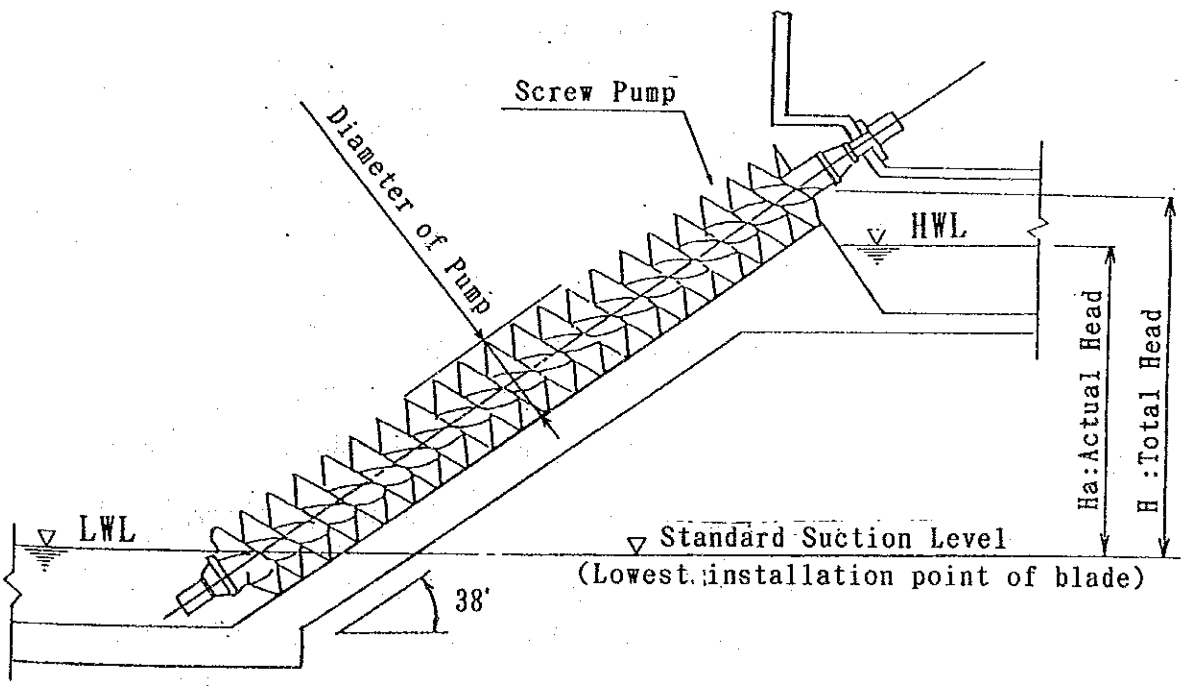


Fig. 4-19 Design Specifications of Screw Pump

(1) Pump Head

The total head is calculated by the following equation.

$$H = Ha + Hf + Hs$$

where Ha : real head (m) = HWL - standard intake level
Hf : nominal head = 0.33 × D (m)
D : pump diameter (m)
Hs : overflow allowance = 0.1m

The total head at the planned pumping facility is approximately 7.3m.

$$H = 16.7 - 10.36 + (0.33 \times 2.6) + 0.1 \fallingdotseq 7.3m$$

(2) Pump Discharge

The discharge per pump is calculated by the following equation.

$$Q = \Phi \times D^3 \times N$$

where Q : pump discharge (m^3/min)
Φ : coefficient = 0.20
D : pump diameter = 2.6m
N : pumping speed (rpm) = $55/\sqrt{D^2} \fallingdotseq 30$

The discharge per pump at the planned pumping facility is approximately 106m^3/min.

$$Q = 0.20 \times 2.6^3 \times 30 = 106m^3/min$$

This pump discharge is sufficient vis-a-vis the design pump discharge of 99m^3/min.

(3) Motor Output

The motor output is calculated by the following equation.

$$P = \frac{\gamma \times Q \times H}{6,120 \times \eta_P \times \eta_G} \times (1 + \alpha)$$

where P : motor output (KW)
γ : unit weight of water (kg/m^3) = 1,000
Q : design pump discharge (m^3/min) = 99
H : total head (m) = 7.3
η_P : pump efficiency = 0.75
η_G : reduction gear efficiency = 0.95
α : allowance = 0.3

$$P = \frac{1,000 \times 99 \times 7.3}{6,120 \times 0.75 \times 0.95} \times 1.3 \fallingdotseq 216\text{kW}$$

Consequently, a motor with an output of some 220KW will be installed at the planned pumping facility. The specifications of the pumping facility, determined on the basis of the above calculations, are shown in Table 4-15.

Table 4-15 Screw Pump Specifications

Item	Specifications
Number of Pumps	3 (one as stand-by)
Design Pump Discharge per Pump	1,650 litres/sec (=99m^3/min)
Diameter	2,600mm
Total Head	7.3mm
Tilting Angle	38°
Motor Output	approximately 220KW
Speed	30 rpm

(4) Operation System of Sewer Transfer Pump Station No. 5 (B)

In principle, Sewer Transfer Pump Station No. 5 (B) will be manually operated as in the case of the existing pumping stations in view of easy repair, reliability and safe operation.

The number of pumps in operation at any given time will depend on the wastewater level at the inflow well which will be visually measured. As back-up, a water level alarm (to send the alarm when the wastewater level reaches the point for the commencement of the operation of the second and third pumps) will be installed to sound the alarm in the control room. Efforts will be made to equalise the operation hours of each pump to prolong the life of the entire pumping facility. An operation hours integrator will be installed for each pump to assist the preparation of an adequate regular inspection programme.

4.3.4.7 Specifications of Ancillary Equipment

(1) Power Facilities

1) GOSD has already constructed the common power service entrance and transformer facilities for Sewer Transfer Pump Stations No. 5 (A) and No. 5 (B) on the premises of the former. These facilities are outlined as follows.

Power Supply	:	10.5KV (from Giza City's power distribution line), 3 phase, 50Hz, 2 cables (one for main line and one for reserve line)
Transformer	:	10.5KV/380-220V, 3 phase, 50Hz, 1,500KVA, oil-immersed self-cooling type
Low Voltage Switchboards	:	380-220V, 3 phase, 4 wire, 2 sets (No. 1 main distribution board and No. 2 main distribution board)

GOSD originally planned to use one of the above transformers for normal use and the other as a reserve. Under the Pumping Station Construction Plan, however, the No. 1 transformer will be used for Pumping Station No. 5 (A) and the No. 2 transformer for Sewer Transfer Pump Station No. 5 (B) because of the following reasons (see Basic Design Drawing EGM-S-10).

a) The total load at the 2 pumping stations will be approximately 1,700KVA which is above the transformer's capacity.

- Sewer Transfer Pump Station No. 5 (A) Load	:	approximately 630KVA (GOSD data)
- Sewer Transfer Pump Station No. 5 (B) Load	:	approximately 1,040 KVA (see Table 4-16)

b) By connecting the reserve circuits of the pumping facilities at the 2 pumping stations to the reserve feeders of the No. 1 and No. 2 low voltage switchboards, the total load can be restricted to below the transformer capacity even if the normal feeder is out of action. In this manner, the 2 pumping stations can be run by one transformer.

c) The secondary sides of the No. 1 and No. 2 transformers are independent of each other. There is no need to conduct parallel operation, allowing the selection of an easy operation system.

Table 4-16 Load List of Sewer Transfer Pump Station No. 5 (B)

No.	Equipment	Rated Capacity (KW)	Number Installed	Number in Operation	Efficiency η (%)	Power Factor (Pf)	$\frac{1}{\eta \times Pf}$	Input Capacity/ Unit (KVA)	Total Input Capacity (KVA)	Capacity at Normal Operation (KVA)
1	Screw Pump	230	4	3	90	0.78	1.42	327.6	982.8	982.8
2	Inlet Gate	5.5	4	4	90	0.72	1.54	8.5	34.0	0
3	Drain pump	3.7	2	1	90	0.72	1.54	5.7	5.7	0
4	Blower	2.2	4	3	90	0.72	1.54	3.4	10.14	10.14
5	Ventilation	1.5	6	1	90	0.72	1.54	2.3	13.8	13.8
6	Lighting	20	1	1	-	-	1	20	20	20
7	Others	10	1	1	-	-	1	10	10	10
	Total									1,036.8

2) The switchboard for Sewer Transfer Pump Station No. 5 (B) will be installed in the control room of the pumping station and its specifications are outlined below.

a) Type : self-stand cubicle type

b) Power : 380-220V, 50Hz, 3 phase, 4 wire

c) Power Entrance : 3 services lines will be provided for the switchboard and each will be controlled by an interlock so that only one line is in operation at any given time

- main line (connected to No. 2 transformer)
- reserve line (connected to No. 1 transformer)
- emergency line (connected to emergency power generating unit to be provided under Pumping Station Construction Plan)

3) Emergency Power Generating Unit

Power supply for the new pumping station will be made from Giza City's commercial power distribution line (10.5KV). GOSD predicts that, despite the 2 lines available to receive power, a power failure lasting for upto 6 hours may occur once a week due to the deterioration and capacity shortage of the old distribution line. As Sewer Transfer Pump Station No. 5 (B) will be an important facility to drain the wastewater carried by the Abu Nomros sewer trunk line, its stoppage due to power failure will severely affect the performance of the sewer trunk line. Therefore, an emergency power generating unit will be provided for Sewer Transfer Pump Station No. 5 (B) to maintain the undisrupted service of the station.

As far as the emergency power generating unit for Pumping Station No. 5 (A) is concerned, GOSD plans to introduce a truck-mounted unit to be shared with other pumping stations. As this mobile unit will be procured through the own efforts of the Egyptian side, it is not included in the list of equipment to be provided under the Project.

The capacity of the planned emergency power generating unit is calculated on the basis of the following 3 equations.

a) Capacity based on required input to cover normal operation of all loads

$$PG1 = \frac{Po}{\eta \times Pf}$$

where PG1 : generator output (KVA)
Po : total loads (KW) (load-demand ratio considered)
η : load efficiency
Pf : power factor

b) Capacity based on declined voltage at the start of generator operation

$$PG2 = Ps \times (\frac{1}{Vd} - 1) \times Xd'$$

where PG2 : generator output (KVA)
Ps : starting rush capacity (KVA)
Vd : allowable voltage decline (generally 20-30%)
Xd' : generator direct-axis transient reactance (generally 0.2-0.3)

c) Capacity based on instantaneous maximum load

$$PG3 = \frac{\Sigma Wo + \{QL_{max} \times \cos\theta QL\}}{KG \times \cos\theta G}$$

where	PG3	:	generator capacity (KVA)
	ΣWo	:	total load already in operation (KW)
	QL_{max}	:	maximum starting rush load (KVA)
	$\cos\theta QL$	:	starting power factor of maximum starting rush load
	KG	:	overload resistance of generator (generally 1.2)
	$\cos\theta G$	:	generator power factor (generally 0.8)

Using the loads listed in Table 4-15, the following values are obtained from the above equations. As the selection of a generator capacity which meets the maximum load, i.e., PG1 (1,036,8KVA) is necessary, the rated capacity of the generator is decided to be 1,050KVA.

PG1 : 1,036.8KVA
PG2 : 737KVA
PG3 : 1,016.9KVA

The emergency power generating unit selected for Sewer Transfer Pump Station No. 5 (B) is outlined below.

Capacity	:	1,050KVA, indoor type
Number	:	1
Power System	:	3 phase, 4 wire, 50Hz
Starter	:	battery assisted manual start
Fuel	:	gas oil
Daily Tank Capacity	:	equivalent to 6 hours' operation (maximum power failure duration)
Fuel Storage Tank Capacity	:	equivalent to 24 hours' operation (maximum power failure duration × 4) underground type

(2) Other Ancillary Equipment

The following ancillary equipment (and facilities) will also be provided to ensure the proper operation and maintenance of Sewer Transfer Pump Station No. 5 (B).

Around Pump House

1) Inlet gates (to stop wastewater inflow during pump maintenance)

cast iron sluice gates (motor operation: 5.5KW) : 3 units

2) Screens for manual scraping (to remove large solids in wastewater)
- No. of unit : 3
- Type: stainless steel removable large mesh screens for manual scraping, 200mm pitch

3) Hoist crane (to transport collected large solids)
- No. of unit : 1
- Hoisting capacity: 2 ton

4) Blowers (to supply air to the pump site during maintenance work)
- No. of unit : 3
- Type and capacity: air supply volume 300m^3/min, blow-down type, output 3.7KW (one as stand-by)

5) Drainage facility (to drain the wastewater intake well for maintenance work)
- No. of unit : 2
- Capacity: drainage capacity 0.9m^3/min, total head 10m, output 3.7KW (one as stand-by)

Inside Pump House

6) Overhead crane (to transport indoor pumping equipment, such as generator)
- No. of unit : 1
- Capacity: 5 tons (motorised and operated from motor room floor)

4.3.4.8 Civil Engineering Work and Building

(1) Selection of Suitable Foundation

According to soil data provided by GOSD, the soil on the site is clayey soil upto 6.5m below the ground surface with a N value ranging from 10 to 15. A sand layer is found further below. The N value is 15-25 between -6.5m GL and -9m GL and more than 50 for deeper than -9m GL. The allowable bearing power of the soil, calculated on the basis of the above data, is as follows.

GL -5.6m : 12.5 tons/m^2 (floor level of pump house)
GL -12.74m : 67.1 tons/m^2 (floor level of pump well)

1) Pump House Foundation

The weight pressure of the pump house is calculated to be 12.6 tons/m^2 which exceeds the bearing power of the soil. The supporting ground will be improved by gravel and good soil.

2) Pump Well

The weight pressure of the pump well is calculated to be 14 tons/m^2 which is well below the bearing power of the soil. A spread foundation will accordingly be used.

(2) Building Size

As described in 4.3.4-5, the size of the pumping facility to be constructed under the Project has been decided on the basis of the phased expansion of the capacity. In contrast, the pump house will be large enough to accommodate an extra pump in view of the requirement in 2002 soon after the commencement of the operation of the currently planned pumping facility.

(3) Selection of Construction Method

As the pump house will be a large building with a foundation floor depth of some 12m below the ground and a foundation floor area of some 40m × 30m (1,200m^2), an appropriate sheathing method must be selected to avoid any disruption of the operation of or damage to Pumping Station No. 5 (A) and also to avoid damage to houses around Pumping Station No. 5 (B) and the existing facilities on the pumping station premises. In general, there are 3 sheathing methods for a large underground structure as described in 4.3.2.7-(1).

- vertical steel sheathing
- soldier beam and breastboard
- underground continuous wall

The vertical steel sheathing method which has been adopted for the Expansion Plan is also selected for the Pumping Station Construction Plan because of the low cost, short construction period and high level of safety.

(4) Anti-Corrosion Measure for Concrete Surfaces

As already described in 2.3.4.2-(3), PVC lining or epoxy resin paint is applied to the concrete surfaces of the wastewater entrance area and the pump suction area of Egypt's pumping stations using screw pumps in order to avoid damage caused by the sulphuric gas generated in wastewater. As the planned Sewer Transfer Pump Station No. 5 (B) faces similar conditions, anti-corrosion paint will be applied to concrete surfaces to prevent corrosion by sulphuric gas.

(5) Pump House

The structure of the pump house will consist of concrete columns and block walls which is common in Egypt and the exterior will be coordinated with the landscape of the site as well as the existing buildings of Pumping Station No. 5 (A). Domestic construction materials will be used as much as possible to minimise the construction cost. The main building services will be as follows.

- ventilation (pump room)
- air-conditioning (control room)
- lighting (pump room, control room and around pumps)

4.3.4.9 Provision of Spare Parts

In principle, the quantity of spare parts to be provided under the Pumping Station Construction Plan will be equivalent to 2 years' supply. In addition, the emergency spare parts shall be provided for components and/or equipment which have no stand-by facilities, those facilities of which the breakdown immediately disrupts the normal operation of the waterworks and those facilities of which the repair generally takes a long period of time. The actual quantity of spare parts to be provided will consist of those for the 2 pumps as one pump is designated as a stand-by pump.

4.3.4.10 Basic Design Drawings

The following basic design drawings have been prepared for the Pumping Station Construction Plan. (See Appendix 10-3)

EGM-S-01 General Layout of Sewer Transfer Pump Station No. 5 (B)

EGM-S-02 Plan of Pumping Facility

EGM-S-03 Cross-Section of Pumping Facility

EGM-S-04 Elevation of Pump House

EGM-S-05 Plan and Cross-Section of Pump House

EGM-S-06 Structural Plan and Cross-Section of Sewer Transfer Pump Station No. 5 (B) (1/4)

EGM-S-07 Structural Plan and Cross-Section of Sewer Transfer Pump Station No. 5 (B) (2/4)

EGM-S-08 Structural Plan and Cross-Section of Sewer Transfer Pump Station No. 5 (B) (3/4)

EGM-S-9 Structural Plan and Cross-Section of Sewer Transfer Pump Station No. 5 (B) (4/4)

EGM-S-10 Oneline Diagram of Sewer Transfer Pump Station No. 5 (B)

4.4 Project Implementation Plan

4.4.1 Project Implementation Policies

The Project will be implemented within the framework of Japan's grant aid system. Actual implementation will commence following the signing of the E/N after approval by the Governments of Egypt and Japan. Following the signing of the E/N, a Japanese consultant will be selected to proceed with the detailed design work. As the Project is an integral part of the current Five-year Plan, it will be only necessary to report the signing of the E/N to the People's Assembly of Egypt upon completion of the said signing.

The procurement of materials and equipment will be conducted by a Japanese contractor to be decided on the open tender basis. The basic issues and important points to note in the implementation of the Project are described below.

(1) Project Implementation Body

Giza Governorate will be responsible for the overall supervision of the Project implementation while Giza City will be assigned to conduct the actual implementation. The Project implementation system within Giza City will involve staff members of sections dealing with administration, civil engineering work, building work and public relations who will work together under the leadership of the technical adviser. The E/N signed by both parties will become immediately valid. Given the requirement to report such signing to the People's Assembly of Egypt, the project implementation body (Giza City) must report the signing of the E/N to the Assembly for the smooth implementation of the Project. The same body should also maintain good communications and hold consultations with both the Japanese consultant and contractor, appoint a person responsible for the Project implementation and establish a committee within Giza City to facilitate the implementation of the Project.

(2) Consultant

The Japanese consultant will enter into a design and supervision agreement with the Project implementation body to prepare the detailed design for the facilities to be constructed and the materials and equipment to be procured with Japanese grant aid for the Project and to supervise the construction work. The same consultant will prepare the tender documents and conduct the tender process on behalf of the Project implementation body.

(3) Contractor

The Japanese contractor, selected on the open tender basis pursuant to Japan's grant aid system, will construct the facilities and procure the necessary materials and equipment. The contractor must have sufficient knowledge of the local market, labour conditions and labour laws, etc. in view of the facts that many local products will be used in the Project and that construction work will be conducted in densely populated areas with heavy urban traffic.

(4) Necessity to Dispatch Engineers from Japan

The construction work envisaged by the Project will require special expertise relating to waterworks construction, pumping station construction, the pipe jacking method and the under-pressure drilling and tapping method, etc. As it will be impossible to secure the services of Egyptian engineers conversant with these technologies, it will be necessary to request the Japanese manufacturers of the machinery involved to dispatch engineers specialising in these technologies to Egypt to complete the relevant construction work in accordance with the schedule.

(5) Important Points to Note for Construction Work

Particular attention should be paid to the following points as the construction work for the Project will be conducted next to an existing pumping station, in densely populated areas and at a railway crossing section. The fact that the Project will be implemented with grant aid should also be noted.

1) The purpose of the work should be fully understood by local inhabitants to secure their assistance and cooperation while measures should be taken to prevent accidents befalling them.

2) Careful consideration should be given to the selection of construction methods and machinery, etc. to minimise such disturbance as noise and vibration, etc. to both local inhabitants and their homes.

3) Every effort should be made not to disrupt the operation of and to avoid damage to the existing waterworks and pumping station.

4) Every effort should be made not to disrupt the operation of and to avoid damage to the existing underground facilities (sewer lines, water supply lines, power cables and telephone lines) in the presence of a large number of such facilities.

5) Every effort should be made to ensure the safe passage of pedestrians, vehicles and trains.

6) In view of the frequent use of heavy machinery, including cranes, and in view of the work being conducted in high places and deep underground, every effort should be made to prevent accidents occurring to all those involved.

4.4.2 Conditions of Local Construction Industry

The current conditions of Egypt's construction industry are outlined below.

(1) The recruitment of engineers, coordinators and workers is not difficult in Egypt excepting engineers conversant with mechanical and electrical work at waterworks and pumping stations, extensive civil engineering work, the pipe jacking method and the under-pressure drilling and tapping method.

(2) The procurement of common construction materials and equipment is not difficult in Egypt excepting special equipment for mechanical and electrical facilities for waterworks and pumping stations and those for the pipe jacking method and the under-pressure drilling and tapping method.

(3) Straight and irregular duct cast iron pipes (1,100mm in diameter or larger), valves, steel pipes for the aqueduct and liner plates, etc. should be imported from Japan as they are unavailable in Egypt.

(4) Port Alexandria is appropriate for the unloading of materials and equipment from Japan as it receives regular calls by Japanese vessels due to its good port facilities and due to it being a free port.

(5) The so-called Desert Road is appropriate for the transportation of materials and equipment from Port Alexandria to the Project Site due to its wide width and low traffic volume.

4.4.3 Work Supervision Plan

In accordance with the general policy of Japan's grant aid system and the main objectives of the basic design, the consultant will organize a consistent project team to conduct the detailed design and supervisory work for the smooth implementation of all the work. At the supervisory stage, the consultant will dispatch technically qualified supervisory personnel to the site for liaison purposes and the provision of guidance on the execution of the work. The field supervisory personnel will be dispatched in accordance with the following schedule.

2 civil engineers	: full-time on site
2 mechanical engineers	: full-time on site
1 electrical engineer	: full-time on site
1 architect	: full-time on site
1 building facility engineer	: as required

(1) Basic Principles for Supervision of Construction Work

The consultant will be required to conduct appropriate supervision throughout the work period in view of the safe execution of the construction work and meeting all the requirements within the set construction period on the basis of the following principles.

1) Progress Control

The construction of the planned facilities, the installation of mechanical and electrical equipment at the waterworks and pumping station and the manufacture and installation of the pipes will be monitored and controlled with constant comparison between the planned schedule and the actual production volume or performance. As there is only one local manufacturer of ductile cast iron pipes and 2 manufacturers of reinforced concrete pipes used with the pipe jacking method, it may be possible that their production schedules for other projects overlap with the schedule of the Project. The consultant should, therefore, provide the contractor with proper guidance on order and delivery control so that the pipes will be delivered in time for each work stage to meet the overall schedule of the Project.

2) Quality Control

Quality control will mainly deal with the quality of the mechanical and electrical equipment to be installed at the waterworks and pumping station, pipe quality and the quality of the pipe jacking work. The function and performance of equipment, the strength of pipes and the accuracy of installation will be tested and controlled as stipulated in the construction agreement to ensure the required quality.

3) Safety Control

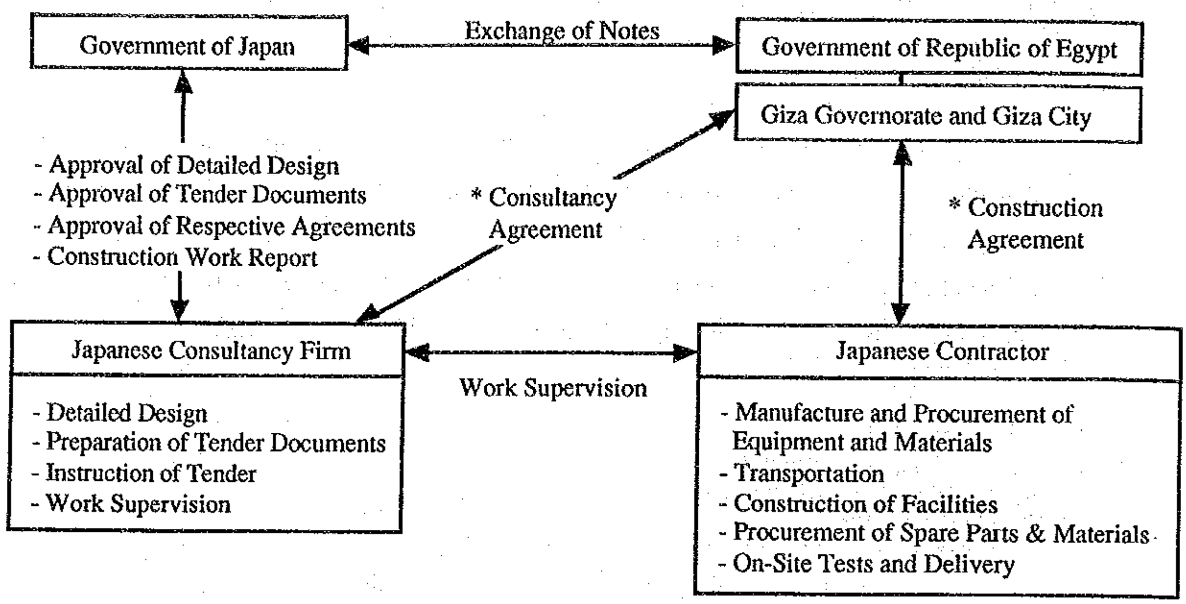
a) Guidance will be provided to the contractor in view of raising the consciousness of all workers, down to those at the lowest level, of the need to prevent accidents while foreman class workers will be trained to foresee any dangers involved in the work.

b) Heavy machinery, including cranes, wires, etc., must be regularly checked to prevent accidents.

c) When transport vehicles and construction machinery, etc. travel on public roads, the local traffic rules must be strictly observed and every precaution taken to prevent traffic accidents resulting in injury or death. Maximum care must also be taken to prevent damage to roads, buildings, existing underground public services, etc.

(2) General Relationships During Supervisory Control

The general relationships of the work supervision system and related organizations during the supervision period are shown in Fig. 4-20.



* Both the consultancy and construction agreements are subject to verification by the Government of Japan.

Fig. 4-20 Processes of Project Implementation

(3) Work Supervisors

In order for the contractor to complete the construction of the facilities conforming to the specifications given in the detailed design documents within the set construction period, work supervisors with the ability to smoothly manage joint work with local contractors and to provide adequate technical guidance to such local contractors are required. In addition, it is desirable that these supervisors have experience in similar projects in order to guarantee a high work quality. In view of the scale and contents of the facilities to be constructed and the expected work schedule, etc., the contractor stationed at the sites may require the following full-time supervisors.

Site Manager	: 1 (to consult and coordinate with related organizations and to obtain work permits from them)
Water Supply Work Supervisors	: 4 (to supervise construction work relating to water supply facilities and work progress - 3 for the waterworks and one for the trunk line)
Sewer Work Supervisor	: 1 (to supervise construction work relating to the pumping station and work progress)

General Work Supervisor : 1 (to survey existing underground public services and to supervise the work to relocate service pipes/cables and pit construction work)

Personnel and Procurement Supervisor : 1 (to conduct labour management and procurement)

Building Services Supervisor : 1 (to supervise building services work and progress control)

4.4.4 Procurement Plan

(1) Sources of Construction Materials and Equipment

The construction materials and equipment to be used in the Project will be procured in Egypt as long as such conditions as the specifications, quality, delivery time and price, etc. are satisfactory. Items which are not available in Egypt or of which local products are not satisfactory will be procured in Japan.

The procurement sources for the main construction materials and equipment to be used in the Project, decided in accordance with the policies described in 4.1.2-(5) and 4.1.3-(2) are listed in Table 4-17.

(2) Transportation Method

Appropriate packing must be provided for the materials and equipment to be imported from Japan to withstand long maritime transportation, unloading at Port Alexandria, land transportation from Port Alexandria to the Project Site and storage.

A regular cargo ship will be used for the maritime transportation of materials and equipment from Japan to Port Alexandria while cargo trucks, which are the main means of transportation in Egypt, will be used to cover the land transportation of some 200km from Port Alexandria to the Project Site.

Table 4-17 Sources of Main Construction Materials and Equipment

Item	Egypt	Japan	Remarks
1. Concrete Aggregate	○		
2. Cement	○		
3. Reinforcing Bars	○		
4. Forms	○		
5. Concrete Bricks and Blocks	○		
6. Anti-Acid Bricks (Blue Bricks)	○		
7. Steel Sheet Piles and H-Steel		○	
8. Concrete Pipes	○		
9. Indoor Lighting Equipment and Cable	○		
10. Indoor Plumbing Installation	○		
11. Aluminium Window Frames	○		
12. Steel Doors	○		
13. Tiles	○		
14. Paint	○		
15. Fire Extinguishers	○		
16. Ventilation Fans	○		
17. Blower		○	for pumping station
18. General Construction Machinery	○		
19. Special Construction Machinery		○	vibrationless, noiseless steel sheet pile driving machine, pipe-jacking machine, under-pressure drilling and tapping machine, grouting machine
20. Straight Ductile Cast Iron Pipes (T-joints, upto 1,000mm in diameter)	○		
21. Straight Ductile Cast Iron Pipes (T-joints, upto 1,100mm in diameter or above)		○	
22. Straight Ductile Cast Iron Pipes (flange joints)		○	
23. Ductile Cast Iron Pipe Fittings		○	
24. Straight Steel Pipes	○		
25. Steel Pipe Pipe Fittings		○	
26. Straight PVC Pipes	○		
27. Stainless Steel Pipes and Accessories		○	
28. Filtration Sand	○		
29. Filtration Gravel	○		
30. Porous Blocks for Rapid Sand Filters		○	
31. Steel Stairs	○		
32. Hand Rails	○		
33. Special Waterproofing Materials		○	for waterworks
34. Waterproofing Mat	○		
35. Bitumen	○		
36. Pumps		○	
37. Motors		○	
38. Hoist Crane		○	
39. Transformer		○	
40. Switchgear		○	
41. Power Cables and Connection Components		○	
42. Flush Mixer		○	
43. Gates and Screen		○	

4.4.5 Implementation Processes

(1) Outline

In the event of the Project being implemented as a grant aid project of the Government of Japan, the facilities will be constructed and the materials and equipment procured in the following 3 stages following the signing of the Exchange of Notes (E/N) by the Governments of Japan and Egypt: (1) preparation of detailed design documents by the Japanese consultant, (2) preparation of the master E/N for the construction of facilities and (3) execution of construction work following the sub-E/N agreed for each year. These processes are illustrated in Fig. 4-21.

1) Detailed Design Work

Following the signing of the E/N, the Japanese consultant will immediately conclude a consultancy agreement with the Government of Egypt and commence the detailed design work upon verification of the agreement by the Government of Japan.

Based on the confirmed results of the basic design as well as field surveys at the time of detailed design, the consultant will prepare the tender documents, including the tender specifications, contract documents and detailed design drawings. The consultant will hold thorough discussions with the responsible organizations in Egypt at both the initial and final stages of the detailed design and proceed with the tender process upon receipt of approval of the prepared tender documents and drawings, etc. by the implementation organization following submission of the E/N to the People's Assembly of Egypt. The required time for the above work will be approximately 5 months.

2) Awarding of Contract

With regard to the E/N relating to the construction of facilities and the installation of mechanical and electrical equipment, the master E/N and sub-E/N for the first year will initially be signed by the Governments of Egypt and Japan. From the second year onwards, the sub-E/N stating the scope of work and cost, etc. will be separately signed for each year. While the construction work will continue over a period of 4 years, the tender covering the entire period will be conducted upon the signing of the master E/N and sub-E/N for the first year.

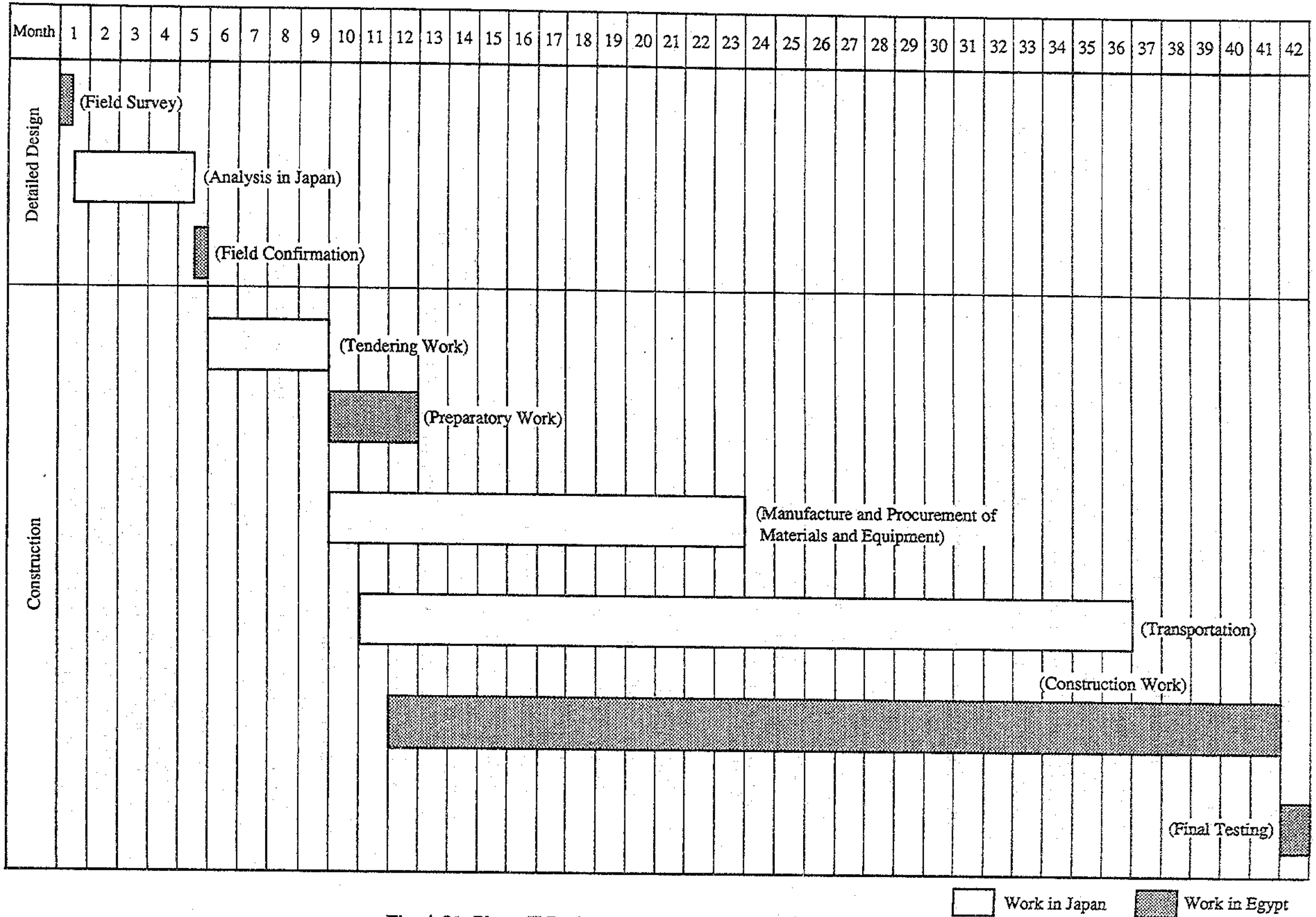


Fig. 4-21 Phase II Project Implementation Schedule

Acting for the Egyptian side, the consultant will announce the tender, accept applications, evaluate the tenderers in terms of the necessary qualifications, hold briefings on the tender and distribute the tender documents. After allowing a certain period of time for the preparation of tenders, the consultant will then accept the tenders, promptly examine them and assist in the quick conclusion of a construction agreement between the Government of Egypt and the successful Japanese contractor.

The bids of the applicants will be opened in the presence of all the parties concerned. The applicant with the lowest price will be selected as the successful bidder if the contents of the tender are found to be appropriate and will conclude a construction agreement with the Government of Egypt.

There will, in fact, be 2 construction agreements. One will be a master agreement covering the entire construction period and stating the contracted amount and work conditions, etc. The other will be a sub-agreement stating the contents, duration and contracted amount for the first year's work. From the second year onwards, a new contract (sub-agreement) covering the contents, duration and contracted amount for the year concerned will be given to the same contractor as the first year following the signing of the sub-E/N for each year.

3) Construction Work and Procurement of Materials and Equipment

Following the signing of the construction agreement, the contractor will commence work upon verification of the agreement by the Government of Japan. In view of the scale of the Project and the contents of the facilities, if the preparatory work for which the Egyptian side is responsible is smoothly conducted and if procurement is smoothly carried out, the construction work and the procurement of materials and equipment are expected to be completed in 33 months.

The supervisory agreement between the consultant and the project implementation body for the second year onwards will be concluded by the same consultant as the first year following the signing of the sub-E/N for each year as in the case of the construction agreement.

In accordance with the above consultancy agreement, the consultant will hold discussions with the contractor prior to the commencement of the work, provide the contractor with guidance and instructions on the transportation of the materials and equipment to the sites, construction methods and construction schedule, conduct process and quality control and ensure that all the work is completed within the period set forth in the E/N.

(2) Scope of Works

The Governments of Japan and Egypt will undertake the following work to complete the Project.

1) Work to be Undertaken by the Government of Japan

a) Water Supply Facilities

- South Giza Waterworks Expansion	:	design water supply capacity - 35,000m^3/day
- Water Supply Trunk Line Construction	:	1,200mm in diameter, approximately 2.3km long

b) Sewer Facility

- Sewer Transfer Pump Station No. 5 (B) Construction	:	design discharge - 1,650 litres/sec/pump 3 pumps (including indoor space for an additional pump to be installed in the future)

2) Work to be Undertaken by the Government of Egypt

a) Recommendations for Undertakings by the Government of the Arab Republic of Egypt in case Japan's Grant is executed:

① to undertake incidental outdoor works such as gardening, fencing, gates and exterior lighting in and around the site.

② to construct the access road to the site prior to the commencement of the construction.

③ to provide facilities for distribution of electricity, water supply, telephone, drainage and other incidental facilities to the Project Site.

④ to ensure prompt unloading and customs clearance at ports of disembarkation in the Arab Republic of Egypt and internal transportation therein of the products purchased under the Grant.

⑤ to secure, with respect to the supply of the products and services under the verified contracts that Japanese nationals shall not be subject to any customs duties, internal taxes and other fiscal levies which may be imposed in the Arab Republic of Egypt.

⑥ to accord Japanese Nationals whose services may be required in connection with the supply of the products and services under the verified contract such facilities as may be necessary for their entry into Egypt and stay therein for the performance of their work in accordance with the relevant laws and regulations of the Arab Republic of Egypt.

⑦ to maintain and use properly and effectively the facilities constructed and equipment under the Grant.

⑧ to bear all the expenses other than those to be borne by the Grant, necessary for the execution of the Project.

b) Required Assistance from Giza Governorate in case Japan's Grant is executed:

① to secure land for water supply and sewer system and other related facilities.

② to provide temporary land for a construction liaison office, warehouse, stockyard, jacking pit plant, etc., during the construction period.

③ to provide necessary data and information for detailed design. These data and information are not eligible to be delivered to third parties or brought to their notice unless there is a written consent by Giza Governorate.

④ to give permission required for test pitting to check underground services at the time of detailed design, if necessary.

⑤ to take necessary actions to expedite the approval for executions of the Project by Giza Governorate.

⑥ to give permission required for all the works related to the project, e.g., opening of manholes, entering into railway and canal lot, surveying on the road, etc.

⑦ to witness and confirm by the authorities concerned when test pitting and, protection and relocation of services are carried out.

⑧ to take necessary measures for inhabitant's cooperation and traffic control.

⑨ to take necessary measures for historical remains which may be encountered during the construction period, if any.

⑩ to provide disposal places of the water including silt, clay, etc., discharged during the construction period.

11 to secure suspension of water supply during the connection works of the proposed water supply trunk line and the existing line.

12 to form a steering committee in Giza City to expedite the Project.

c) Works to be undertaken by related authorities

Undertakings by GCWSA

The following undertakings shall be carried out by GCWSA when the Project is implemented by Japan's Grant Aid.

① Acquisition of the additional land in accordance with the expansion plan

② Relocation of the existing sewer facility in the planned location for the expansion plant of the Project.

③ Relocation of the existing trees in the planned location for the expansion plant of the Project.

④ Relocation of the existing outdoor lighting facilities in the planned location for the expansion plant of the Project.

⑤ Relocation of the existing gate house in the planned location for the expansion plant of the Project.

⑥ Acquisition of temporary construction yard for warehouse, stockyard, site office, etc., in the future expansion yard.

⑦ Chemicals, water and electricity shall be provided by GCWSA.

⑧ Provision of firefighting system

Undertakings by GOSD

The following undertaking shall be carried out by GOSD when the Project is implemented by Japan's Grant Aid.

① Clear up of the land for the Sewer Transfer Pump Station No. 5 (B).

② Providing of temporary construction yard for warehouse, stock yard, site office, etc., in and around the Sewer Transfer Pump Station No. 5.

③ Provision of outdoor lighting, landscaping, plantation, internal road, water supply sources close to the site of Sewer Transfer Pump Station No. 5 (B).

④ Provision of firefighting system

CHAPTER 5

PROJECT EFFECTS AND CONCLUSION

CHAPTER 5 PROJECT EFFECTS AND CONCLUSION

5.1 Effects

Multiple effects can be expected as a result of the implementation of the Project with both water supply and sewer facilities being improved with uniform objectives and the same rationale. The direct beneficial effects for local inhabitants will be a stable supply of potable water which is essential for daily life and the adequate and reliable sanitary drainage of sewage. In addition, implementation of the Project will also have such indirect effects as improved living conditions, improved health and sanitation conditions and the prevention of canal contamination, etc. These direct and indirect effects are described in Table 5-1.

Table 5-1 Current Conditions of Water Supply and Sewer Facilities and Project Effects

Item	Current Conditions and Problems	Remedial Measures Under the Project	Project Effects and Resulting Improvement
Water Supply Facilities	1. In the Project Site, only those inhabitants living along the limited routes of water supply trunk & branch lines, extending from the existing South Giza Waterworks, receive water supply & account for only 5% of all households. Most inhabitants rely on public taps, travelling water wagons & wells & there is a chronic water shortage. 2. Some local inhabitants have wells at their own expense to draw groundwater. As these wells are shallow (5-6m deep), well water tends to be contaminated by seepage water from cesspits, resulting in unsanitary conditions for those using groundwater. 3. Many local inhabitants are obliged to collect a limited volume of domestic water (10-20 litres/person/day) using buckets or similar from public taps located far from their homes in apartment buildings (4-10 storeys). This heavy work is usually the burden of women & children.	Construction of a waterworks & a water supply trunk line to ensure a stable supply of the necessary volume of water to households & public facilities in the Project Site which suffer from an extremely poor water supply due to the absence of supply facilities. Achievement of wide area improvement of the water supply service by means of establishing a wider water supply network together with the water supply network to be constructed under the Phase 1 Project.	1. The construction of new water supply facilities will improve the water supply capacity & will ensure a reliable supply of water to inhabitants of the Project Site. 2. With the construction of a new waterworks & a distribution route designed to supply water to the Project Site, the target maximum water supply volume of 140 litres/person/day suggested by the master plan will be achieved. 3. The improved water supply facilities will improve the living standard in the Project Site & will vitalise social life. 4. The improved water supply facilities will vitalise commercial & industrial activities in the Project Site.

Item	Current Conditions and Problems	Remedial Measures Under the Project	Project Effects and Resulting Improvement
	4. South Giza Waterworks, the water supply source in the Project, is currently operating at some 60% overload capacity &, therefore, has no surplus capacity to increase water supply to the Project Site. 5. There are not enough water supply trunk lines at present to allow the planned water supply volume to the Project Site.		5. The availability of tap water will reduce the labour requirement for water collection, releasing labour for productive activities, in turn contributing to the creation of a stable social life & increased employment opportunities.
Sewer Facilities	1. As no public sewer facilities are provided in the Project Site, a poor sanitary situation is created due to the overflow of sewage & other reasons. 2. Each apartment building or 2-3 buildings has a cesspit by the road & the disposed sewage is collected 2-3 times/week by a vacuum vehicle of GOSD. This sewage collection service has not expanded in line with the population increase. In addition, low income families cannot afford this service for which a charge is imposed, resulting in overflow from their cesspits onto the street. 3. Some sewage collected by vacuum vehicle is dumped into the Zomor Canal in the Project Site, adversely affecting not only the sanitary conditions in areas along the canal but also the water quality of the Nile. 4. There is no prospect of constructing Sewer Transfer Pump Station No. 5 (B) which is crucial to drain sewage from the Project Site to a designated wastewater treatment plant due to financial difficulties, resulting in failure to improve the living conditions in the Project Site in accordance with the relevant plan.	Construction of Pumping Station No.5(B) along the Abu Nomros sewer trunk line to which sewage from the Project Site is drained. Establishment of an adequate drainage route from the Project Site & a designated wastewater treatment plant. Achievement of wide-area improvement of the sewer service by means of establishing a linkage with the sewer network to be constructed under the Phase 1 Project.	1. The construction of Pumping Station No. 5(B) & the improvement of the public sewer system will enable the maximum wastewater discharge of some 190 litres/person/day. 2. The unsanitary situation caused by the contamination of wells by foul water will be resolved & the local health & sanitation conditions will be improved. 3. The construction of new sewer facilities will ensure reliable sewage discharge, preventing the outflow of sewage onto the streets & dumping in open spaces & in the canal, etc., in turn improving the living, natural & sanitation environments in the Project Site. 4. The construction of Pumping Station No.5 (B) in line with the national plan to improve the sewer service will enable the drainage of sewage from the upperstream areas of the Project Site to facilitate the further improvement of the sewer service in a much wider area than the Project Site in the future.

5.2 Conclusion

The provision of public infrastructure in the Project Site has lagged far behind other parts of the Greater Cairo Region because the area has been omitted from urban development programmes. This fact is particularly noticeable in the case of water supply and sewer facilities which are considered facilities for basic human needs (BHN). The water supply service ratio in the Project Site of approximately 5% is extremely low and no public sewer system is provided. As a result, local inhabitants of the Project Site are suffering from a chronic shortage of water and are being forced to live under poor living and health sanitation conditions caused by the poor drainage of sewage and other factors.

The Government of Egypt has prepared a series of master plans to consolidate the water supply and sewer facilities with foreign assistance to improve the living environment. However, it has found it difficult to implement any water supply or sewer improvement work in the Project Site because of the deteriorated financial situation of the Government of Egypt and the low profitability of these services.

Together with the water supply and sewer networks to be constructed under the Phase 1 Project, the Project aims at improving water supply and sewer services over a wide area while maintaining sufficient compatibility with other existing and planned water supply and sewer facilities. As the Project is expected to significantly contribute to the betterment of local life and health as well as the sanitary environment in the densely populated Monib District which has many low income families, to the vitalisation of commercial and industrial activities and to the increase of employment opportunities, the benefits of the Project in the Project Site will be tremendous.

The Project is in line with the relevant master plans prepared by the Government of Egypt and it appears that the Egyptian side has sufficient manpower, technical capability and budget to conduct the operation and maintenance of the new facilities to be constructed under the Project. Consequently, it is judged that the implementation of the Project will not pose any organizational, technical or financial problem for the Egyptian side. In addition, the objectives of the Project are compatible with the targets set by the Third 5-Year Plan of the Government of Egypt and are also in line with the philosophy of Japan's grant aid system.

Given the expected positive effects of the Project, including improved living and sanitation conditions and increased employment opportunities for local inhabitants, the urgent implementation of the Project with Japanese grant aid is judged to be highly significant and appropriate.

5.3 Recommendations

The Egyptian side is required to conduct the following measures to successfully accomplish the objectives of the Project and to maximise its positive effects.

Prior to Project Implementation

(1) To ascertain the will of beneficiaries to pay a water charge and to agree with a higher charge level after the completion of the Project in order to secure a continuous revenue flow to cover the operation and maintenance expenses of the new facilities.

(2) To obtain the agreement of local inhabitants not to dispose of vinyl objects, cloth and paper, etc. into the sewer facilities through public relations activities to maintain their proper functioning and to reduce the operation and maintenance expenses.

(3) To conduct public relations activities in order to secure cooperation for the construction work, particularly possible traffic jams, construction noise, etc.

(4) To secure the necessary budget for the work to be undertaken by the Egyptian side.

(5) To establish a project steering committee to secure smooth project implementation.

During Project Implementation

(6) To appoint several full-time engineers at the initial stage of the Project implementation with a view to improving their expertise which will enable them to be responsible for the future planning, construction, operation and maintenance of water supply and sewer facilities and to learn the technical aspects of the Project for maintenance work in the future.

After Project Completion

(7) To secure an adequate operation and maintenance budget for the facilities by the proper collection of the water service charge based on (1) above.

(8) To take the necessary measures to transfer the property for the new facilities to GCWSA and GOSD.

(9) To ensure that GCWSA and GOSD conduct the operation and maintenance of the transferred facilities in a responsible manner.

Future Environmental Preservation of the Nile

It would be recommended that the wastewater from backwashing at the rapid sand filters and the sludge from the sedimentation basins will be firstly sent to the sludge basin where the sludge is separated and sedimented and then the remaining supernatant should be discharged to the Nile. It would be desired that the environmental health of the Nile as well as sludge discharge method of other waterworks will be considered by Egyptian side synthetically. The gravity flow method which does not require pumping facilities will be recommended as the drainage method to ensure easy and low cost maintenance. The concentrated sludge deposited in the sludge basin will be drawn out by a vacuum vehicle which is locally available and will be transported to a wastewater treatment plant for natural drying. In this case, GCWSA must consult with GOSD in view of obtaining permission to use wastewater treatment plant premises.