JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF HOUSING AND PUBLIC UTILITIES

THE ARAB REPUBLIC OF EGYPT

BASIC DESIGN STUDY REPORT ON THE PROJECT FOR REHABILITATION AND UPGRADING OF AMYRIA WATER TREATMENT PLANT IN THE ARAB REPUBLIC OF EGYPT

MAY 1994

JOINT VENTURE
OF
SANYU CONSULTANTS INC.
AND
TOKYO ENGINEERING CONSULTANTS CO.,LTD.

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PREFACE

In response to a request from the Government of the Arab Republic of Egypt, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation and Upgrading of Amyria Water Treatment Plant and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Egypt a study team headed by Mr. Mitsuru Suemori, Director of the First Basic Design Study Division, Grant-Aid Study & Design Department and constituted by members of Sanyu Consultants Inc. and Tokyo Engineering Consultants Co., Ltd., in a Joint Venture for the study, for the period from January 13 to February 16, 1994.

The team held discussions with the officials concerned of the Government of Egypt and conducted a field survey at the study area. After the team returned to Japan, further studies were made. Then, the mission was sent to Egypt in order to discuss a draft report, and as incorporating the result of the discussion, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the teams.

May, 1994

Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Mr. Kensuke Yanagiya,
President
Japan International Cooperation Agency
Tokyo, Japan

May, 1994

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for Rehabilitation and Upgrading of Amyria Water Treatment Plant in the Arab Republic of Egypt.

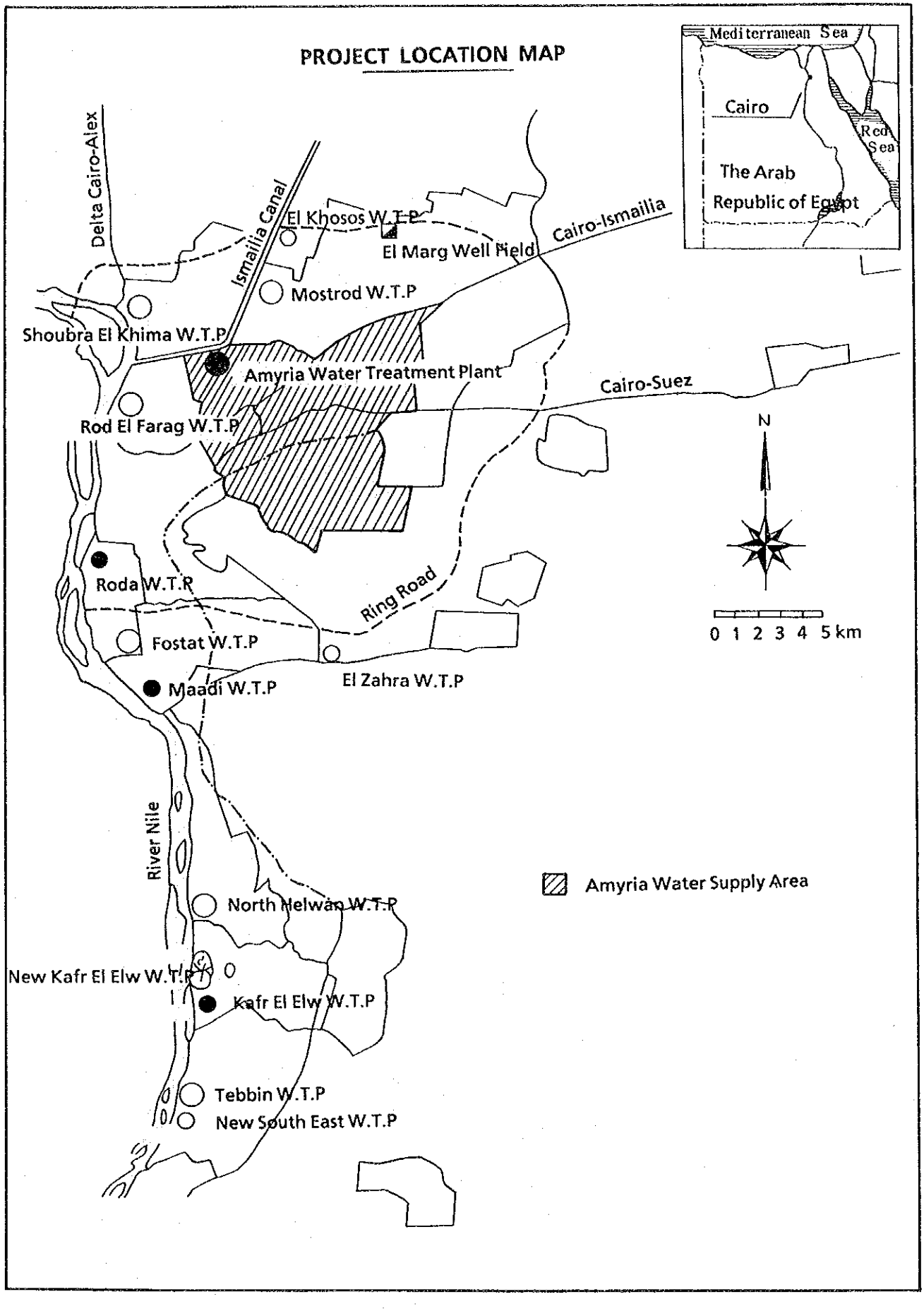
This study was conducted by members of Sanyu Consultants Inc. and Tokyo Engineering Consultants Co., Ltd., in a Joint Venture for the study, under a contract to the Japan International Cooperation Agency (JICA), during the period from December 10, 1993 to May 31, 1994. In conducting the study, we have examined the feasibility and rationale of the Project with due consideration to the present situation of Egypt and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs and Ministry of Health and Welfare. We would also like to express our gratitude to the officials concerned of the Ministry of International Cooperation and General Organization for the Greater Cairo Water Supply, JICA Cairo office and the Embassy of Japan in Egypt for their cooperation and assistance throughout our field survey.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

J. Matsuo
Takumi Matsuo
Project Manager
Basic Design Study Team
on
The Project for Rehabilitation and Upgrading
of Amyria Water Treatment Plant
Joint Venture of Sanyu Consultants Inc.
and Tokyo Engineering Consultants Co., Ltd.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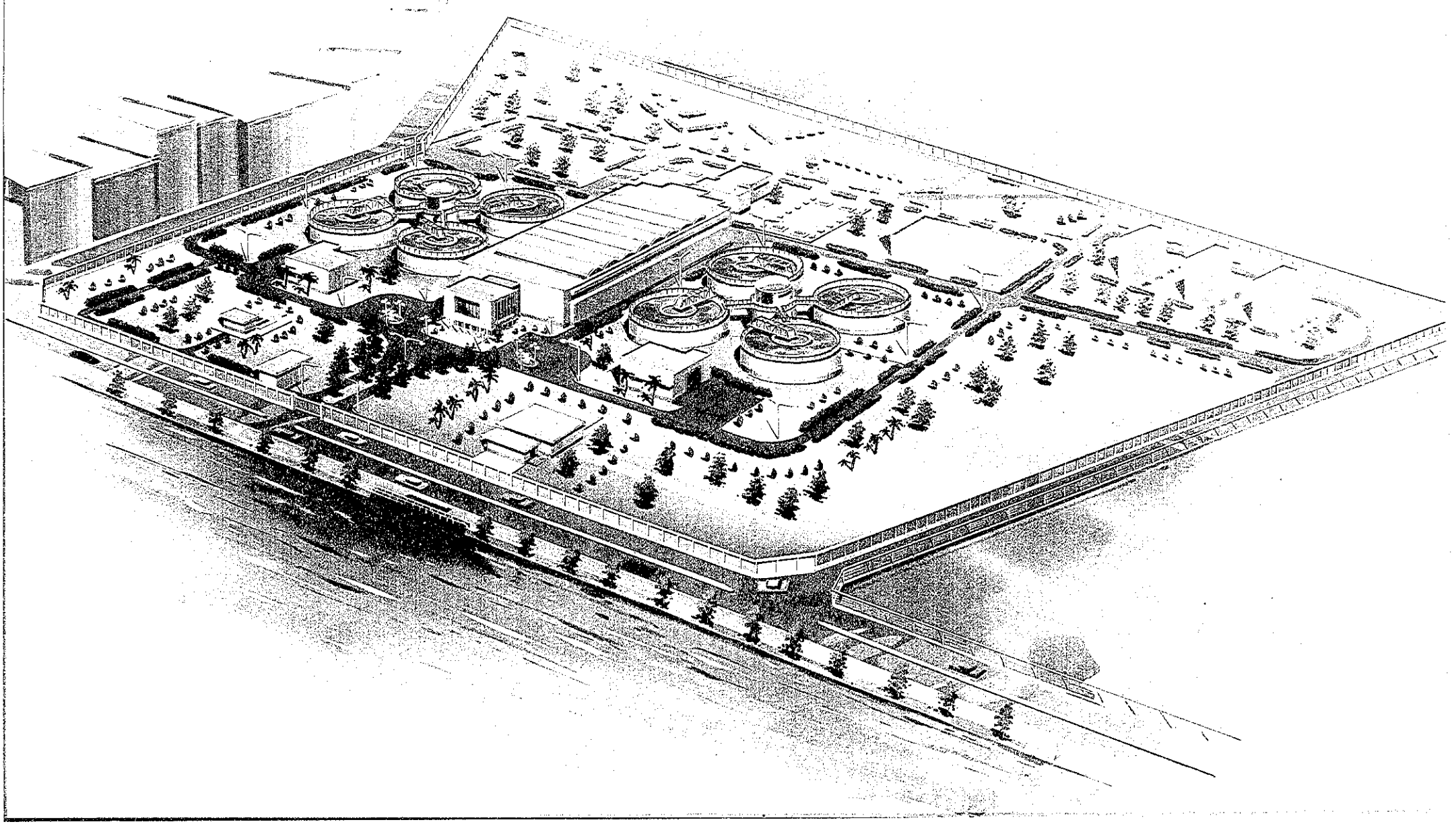
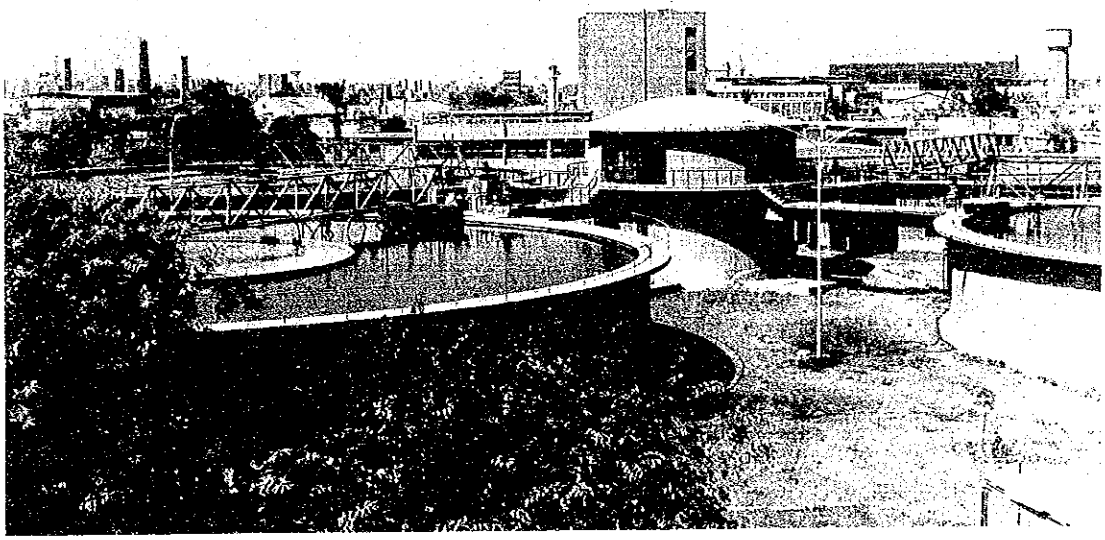
Mediterranean Sea
Cairo
Red Sea
The Arab Republic of Egypt
Delta Cairo-Alex
Ismailia Canal
El Khosos W.T.P
El Marg Well Field
Cairo-Ismailia
Mostrod W.T.P
Shoubra El Khima W.T.P
Amyria Water Treatment Plant
Cairo-Suez
Rod El Farag W.T.P
N
Roda W.T.P
Ring Road
Fostat W.T.P
El Zahra W.T.P
Maadi W.T.P
0 1 2 3 4 5 km
River Nile
Amyria Water Supply Area
North Helwan W.T.P
New Kafr El Elw W.T.P
Kafr El Elw W.T.P
Tebbin W.T.P
New South East W.T.P

BIRD'S EYE VIEW OF AMYRIA WATER TREATMENT PLANT





Sedimentation Basin
of
the Amyria Water Treatment Plant

SUMMARY

The Arab Republic of Egypt, located at the northeastern part of the African continent, is the political, economic and cultural center of the Middle East Region. In particular, the Greater Cairo area holding Cairo, the capital city of Egypt, is the political and economic hub of the country.

It is estimated that the Greater Cairo area contains resident population of 13 million and the daytime population of 15 million. In other words, approximately 1/4 of the total population of the country, that is 53.08 million, is concentrated in the Greater Cairo area. Since one of the basic goals of the present National Development Plan is to realize the appropriate distribution of the population within the country, new urban development plan are being carried out aiming at preventing the excessive concentration of the population in the major urban area, especially in the Greater Cairo. The situation prevailing is, however, that the inflow of population into the Greater Cairo area can not be lowered down in spite of the said measures.

The Greater Cairo area consists of the Governorates of Qualiubiah, Cairo and Giza, and potable water indispensable for the daily life of the inhabitants of this area is being supplied by General Organization for the Greater Cairo Water Supply (hereinafter referred to as "GOGCWS"). It is noted that GOGCWS is serving 12 million persons corresponding to more than 80% of the current population of the Greater Cairo.

The Greater Cairo stretches over the both banks of the Nile River, the East Bank and the West Bank. The East Bank of the Greater Cairo comprises the political and economic centers of the city, presents remarkable demographic growth, and the demand for water is increasing rapidly as a consequence of the improving living standards of the local population. According to the "East Bank Water System Master Plan Update 1990" (hereinafter referred to as the "Master Plan") prepared by the USAID, it is presumed that in the near future the water-served population and the water demand of the East Bank will evolve as shown in the followings.

Year	Water Consuming Population (inhabitants)	Water Demand (m^3/d)
1990	8,160,000	3,090,000
2000	12,780,000	5,750,000
2010	16,040,000	7,050,000

The Amyria Water Treatment Plant (hereinafter referred to as the "Amyria Plant"), which is the object of the request made this time by the Government of Egypt, is a medium-scale water treatment plant among the 11 plants of this kind located in the East Bank. It is located at the right bank of the Ismailia Canal at the northeastern part of Cairo and serves for a population of 1.51 million distributed throughout the districts of Amyria, Zeitun, Heliopolis and Nassur.

The water sources for the Amyria Plant are the surface water of the Ismailia Canal and groundwater. The Amyria Plant was initially designed with the normal capacity of 300,000 m^3/d of surface water and 120,000 m^3/d of groundwater taken from 41 wells, but in fact only 18 of the existing wells are in operation, and the supply capacity of the existing wells altogether is barely 30,000 m^3/d. Since the use of groundwater have to be abandoned when its quality does not meet the standards referring to potable water, the Amyria Plant is currently operated at a capacity of 330,000 m^3/d in total. As more than 30 years have been passed since the water treatment facility was built, the supply capacity is running at levels of the order of 370,000 m^3/d even when it is operated in overloaded condition.

The service area of the Amyria Plant consists of low and medium class residential districts in Cairo, and the Amyria Plant is in need of overloaded operation during the summer season when the demand reaches at its peaks. It is noted that the facilities are of quite old-fashioned, and it would be no wonder even if the Amyria Plant were forced to a sudden stop at any time.

The Amyria Plant is in need of increasing its capacity through the project for rehabilitation and upgrading of the existing facilities by making use of surface water. By doing so, it would be possible to secure the stable supply of potable water of good quality in conformity with the demand, thereby contributing to the social stability and preventing the worsening of the sanitary condition of the population of 1.51 million inhabitants it is serving.

It must be noted with this concern, however, that in view of the financial conditions of the Arab Republic of Egypt in general and GOGCWS in particular, rehabilitation and upgrading of the facilities is impracticable without the aid from foreign countries.

On the other hand, the Government of Japan has been maintaining a close relationship with GOGCWS through such involvement as the study for the Greater Cairo Urban Water Development Project, which was started by the Japan International Cooperation Agency (JICA) in 1975.

In view of the background mentioned above, the Government of Egypt made a request for a grant-aid by the Government of Japan in order to secure the financial resources required by the Project for Rehabilitation and Upgrading of Amyria Water Treatment Plant (hereinafter referred to as the "Project"), which is being regarded as a project with high priority. In response to the request, JICA decided to carry out the Basic Design Study for the purpose of the examination of the scope of the project capable for cooperation, the formulation of the most appropriate cooperation scheme, and the execution of the basic design referring to the contents and the scale of the facilities and equipment that are actually needed.

The first term field survey was conducted by the Basic Design Study Team during the period from January 13 to February 16, 1994, and subsequently, the second term field survey aiming at explanation of draft Basic Design Report was carried out from April 7 to April 17, 1994.

The original request made by the Government of Egypt proposed to increase the surface water treatment capacity from the current 300,000 m^3/d to 375,000 m^3/d through the rehabilitation of the existing facilities of the Amyria Plant. As a result of the field survey, it was found out that the 375,000 m^3/d capacity mentioned in the request has no specific grounds. During the course of the field survey, therefore, the Government of Egypt modified the request to expand the treatment capacity to 430,000 m^3/d with an increase of 100,000 m^3/d in the existing facilities through rehabilitation and upgrading.

It was then defined that the designed treatment capacity of the Amyria Plant shall be 430,000 m^3/d based on the following reasons :

(1) Maximum water volume, capable of treatment by the Amyria Plant through rehabilitation and upgrading works for the existing facilities without new construction of intake gate, intake channel and treatment facilities, is 430,000 m^3/d.

(2) Water demand to be served by the Amyria Plant is expected to increase surely with the projections made as follows:

Year	Population	Demand
2000	1.63 million	447,000 m^3/d
2010	1.81 million	497,000 m^3/d

(3) The request made by the Government of Egypt has been modified from 375,000 m^3/d to 430,000 m^3/d.

(4) According to the Water Treatment Plant Facilities Development Plan as conceived by GOGCWS, the present capacity of the Amyria Plant was confirmed as 330,000 m^3/d and will be increased by 100,000 m^3/d through rehabilitation so as to increase the total capacity to be 430,000 m^3/d.

The nominal capacity of the groundwater facilities of the Amyria Plant is said to be 120,000 m^3/d (41 wells in the plant). In fact, however, use of the wells has been gradually reduced due to the worsening quality of the groundwater as shown below.

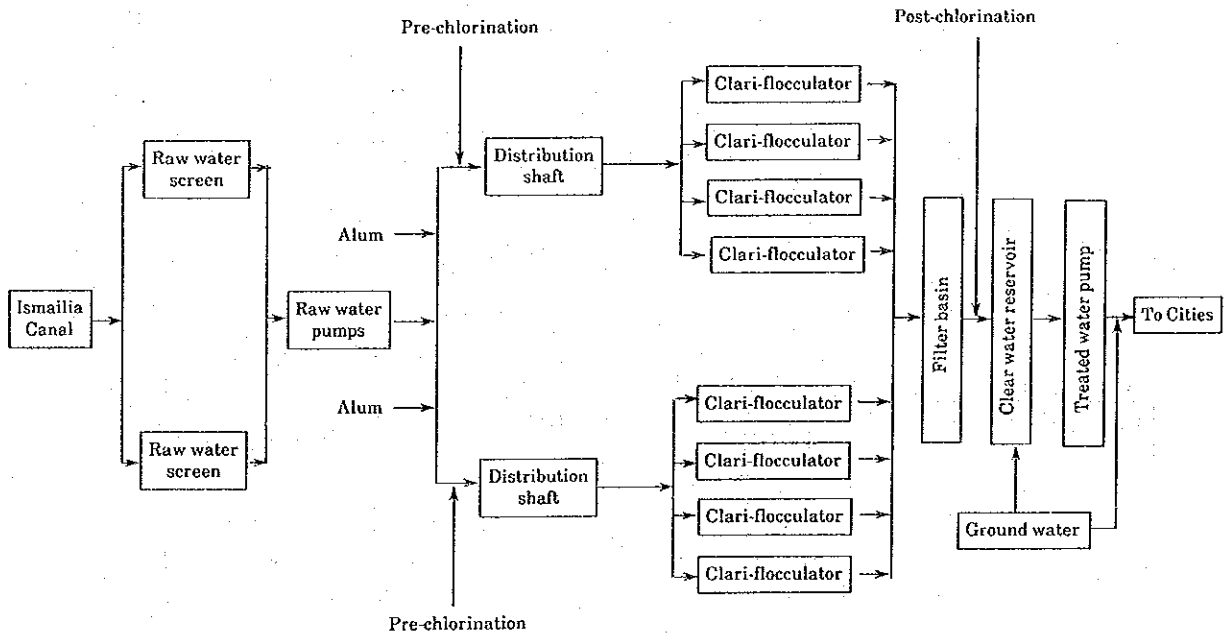
Year	Number	Capacity
1991	27 wells	
1992	24 wells	
1993	18 wells	30,000 m^3/d

Taking into consideration the facts as mentioned above, it is concluded that the pollution is progressing in the wells, and in this project the use of the wells shall be abandoned due to the unsafe and unstable water source both in terms of quality and quantity.

In view of the facts mentioned above, the Amyria Plant will have a treatment capacity (planned maximum daily volume of water) of 430,000 m^3/d,

with the current surface water treatment capacity to be increased to 430,000 m^3/d, and the current groundwater treatment capacity to be reduced to "zero".

In order to expand the total capacity of the facilities to be capable of supplying 430,000 m^3/d, such facilities as raw water pump, connection pipe to distribution tank and connection pipe, to filter basin shall be rehabilitated and improved. Flow-sheet of the Amyria Plant is shown below and the outline of the facilities items to be rehabilitated is indicated in the following page.



CONTENTS OF THE REHABILITATION

Name of facility	Item	A	B	C
Intake and Inlet Facilities	Screen fence		○	
	Waterway	○		
	Raw water screen		○	
	Electric equipment		○	
Raw Water Pump Facilities	Raw water pump	○		
	Floor drainage pump			○
	Electric equipment	○		
Clari-Flocculation Facilities	Connection from distribution basin	○		
	Floor drainage pump			○
	Connection to filter basin	○		
	Electric equipment	○		
Filtration Facilities	Filter media		○	
	Backwashing water main		○	
	Floor drainage pump			○
	Connection to clear water reservoir	○		
	Electric equipment	○		
Treated Water Pump Facilities	Treated water pump			
	Floor drainage pump			○
	Electric equipment			○
Chlorination Facilities	Pre-chlorination	○		
	Post-chlorination		○	
Common Electric Equipment	Water treatment plant central monitoring board			○
	DC switch board & Low-voltage switch board			○
Common Instrumentation Equipment	Raw water flow meter			○
	Treated water flow meter			○
	Clear water reservoir water level			○
	Water quality meter		○	
	Instrumentation panel		○	
Rehabilitation of the Amyria Plant site	Exterior rehabilitation			○
	Indoor area of filter basin			○

A : Rehabilitation for securing the quantity of water

B : Rehabilitation for keeping the quality of water

C : Rehabilitation for facility being obsolete or damaged

Since the Aswan High Dam started its operation, both the water level and the flow rate of the Nile River are stable at the intake point, and moreover the degree of turbidity of the raw water has remained at low levels within the limits of 3.4 ° to 32°. It is noted, however, that the concentration of vegetable plankton contained in the raw water is very high, at the levels ranging from 2,000 units/ml to 27,200 units/ml according to data referring to the period comprehended from 1991 to 1993.

As a general rule for the treatment of this kind of raw water, and appropriate quantity of chlorine is injected in the pre-chlorination process to kill the vegetable plankton, accompanied by the clari-flocculation process with injection of flocculent, and after that water is purified by high-speed filtration. It must be noted, however, that the efficiency of the clari-flocculation process is presumed to be low, because the raw water has low degree of turbidity, and the flocs resulting from the clari-flocculation process have light weight. The filtration process is more effective for purification consequently.

Talking about the present status of filtration facility, single layer filter is being carried out in the Amyria Plant through a filter media consisting exclusively of sand and as the water collecting plate located at the lower part of the filter basin is partially damaged and the filter sand is dropping through the damaged parts and accumulated at the water collecting room. Moreover the backwashing time is regulated because the sand leak out from backwashing troughs during the backwashing process and the backwashing process comes to an end before the waste washing water becomes clear.

As the result of the analytical study carried out in Japan, it was decided not to carry out the rehabilitation and upgrading works for those facilities related to filter basin, such as substitution of water collecting devices, new installation of backwashing troughs and installation of gravel layer, where effects of rehabilitation/upgrading could not be shown clearly in terms of the quantity. While to cope with the gradually worsening filtered water quality, it was decided to carry out the rehabilitation and upgrading works aiming at securing the present quality level of the filtered water, for those items of works as installation of new screen fence, substitution of the new water screen, substitution of filter sand, repair for presently damaged water collecting plate and strainer and installation of backwashing water volume adjustment valve preventing sand leakage.

It was also decided as the result of the study in Japan that rehabilitation and upgrading works will be made on those facilities which are presently damaged and/or to be surely in malfunction in near future due to the obsolescence of the facilities. These facilities include floor drainage pump, central monitoring board and common instrumentation equipment.

Further, such analytical instruments as sterilized incubator and etc. are deteriorated and/or insufficient in the number, and the situation causes the water quality analysis to be improper and insufficient. It is, therefore, necessary to provide required equipment and materials for this purpose under the Project.

GOGCWS is the government office responsible for the execution of the Project. The Amyria Plant is one of the water treatment plant organized under the Water Treatment Department, GOGCWS.

Through the project implementation, the nominal capacity of 420,000 m^3/d of the Amyria Plant (present capacity 330,000 m^3/d) will be increased to 430,000 m^3/d. However, the Plant could be operated and maintained with the present working force as there would be no major alterations and/or additions in the treatment process.

The project implementation will effect in increased water supply and accordingly cause to the increased income. The incremental income is considered to be sufficient to cover required O & M expenditures such as personnel payroll, electricity charge, chemicals as well as repair cost.

The Project will be carried out in two (2) stages and major facilities to be rehabilitated and upgraded are summarized as follows;

First Stage

- Renewal of two (2) units of connection pipe between distribution shaft and clari-flocculator facility (out of 8 pipes in total)
- Renewal of two (2) units of connection pipe between clari-flocculator facility and filter basin (out of 8 pipes in total)
- Renewal of filter media of eight (8) units for filter basin (out of 36 basins in total)

- Renewal of pre-chlorination facility of four (4) units
- Renewal of post-chlorination facility of four (4) units
- Rehabilitation of electric equipment related with filter basin

Second Stage

- Installation of one (1) set of screen fence
- Substitution of two (2) sets of raw water screen
- Change of two (2) units of irrigation pump to the raw water pumps
- Renewal of six (6) units of connection pipe between distribution shaft and clari-flocculator facility (out of 8 pipes in total)
- Renewal of six (6) units of connection pipe between clari-flocculator facility and filter basin (out of 8 pipes in total)
- Renewal of filter media of twenty-eight (28) units for filter basin (out of 36 basins in total)
- Renewal of two (2) sets of backwashing water main pipe
- Rehabilitation of electric equipment accompanying mechanical facilities to be rehabilitated
- Renewal of one (1) set of central monitoring board in water treatment plant
- Renewal of one (1) set of raw water flow meter
- Renewal of one (1) set of treated water flow meter
- Rehabilitation of one (1) set of indoor area of filter basin and exterior of water treatment plant site
- Setting of one (1) set of water analysis equipment

Following equipment shall be installed by GOGCWS.

- Backwashing pumps

Construction period is planned to be 4 mouths for detailed design and 12 months for construction work as the Phase I and 6 months for detailed design and 21 months for construction work as the Phase II.

Through the implementation of the Phase I Project, a part of the deteriorated facilities of the Amyria Plant will be rehabilitated. As the result, the water treatment capacity of the facilities using surface water as raw water

source will be increased by 30,000 m^3/d, totaling 330,000 m^3/d. After the Phase I, another part of the deteriorated facilities of the Amyria Plant will be rehabilitated as a result of the implementation of the Phase II Project. The water treatment capacity of the facilities using surface water as raw water source will be increased by 100,000 m^3/d, totaling 430,000 m^3/d. As a consequence, the 1.51 million water consumers of the Amyria water supply area will be supplied with 66 more liters/person-day of potable water of superior sanitary characteristics compared with the current state of things.

The Project is a part of the Water Treatment Plant Facilities Development Plan being implemented by GOGCWS, the project executing agency and be responsible for water supply in the Greater Cairo area, and it is considered necessary to have a financial assistance by foreign sources, as it will take much longer time if the Government of Egypt would proceed the project implementation with its own financial resources without the assistances. As for the O & M of the project facilities, GOGCWS will be responsible and it is judged that the organization has sufficient number of personnel with due level of techniques, and further, required O & M cost could be covered by the increased income caused by increased water supply.

In the course of the project implementation, it is important to pay careful attention on the followings.

- Securing of surface water newly increased
- Effective utilization of the existing wells
- Avoidance of large scale water supply suspension during the rehabilitation works
- Adequate monitoring/control of washing process

For the environmental conservation on the Ismailia Canal, it may be necessary to install some treatment facilities such as sedimentation basin so that waste water will be drained to the Canal after the proper treatment. Further, it is recommended, as the raw water for the Amyria Plant is of low turbidity with high contact of vegetative plankton, that the Government of Egypt may make further effort in studying possible countermeasures to improve the water quality so as to secure safe and clean water for supply to consumers.

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CHAPTER 1. BACKGROUND OF THE PROJECT

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1 - 1 Background of the Project

The Arab Republic of Egypt (hereinafter referred to as "Egypt"), located at the northeastern part of the African continent, is the political, economic and cultural center of the Middle East Countries. In particular, the Greater Cairo area covers Cairo, the capital city as well as the political and economic hub of Egypt.

The population of the Greater Cairo is estimated to be approx. 13 million residents increasing to approx. 15 million as a daytime population. In other words, approximately 1/4 of the total population of Egypt mounting to 53.08 million, is concentrated in the Greater Cairo area. Since one of the basic goals of the National Development Plan of Egypt is to realize the appropriate distribution of the population throughout the country, new urban plans are being implemented with the object of preventing the excessive concentration of the population in the major urban areas, especially in the Greater Cairo. It is noted, however, that the inflow of the population into the Greater Cairo area is not lowered down in spite of the implementation of said new plans.

The Greater Cairo area consists of the Governorates of Qualiubiah, Cairo and Giza. The potable water indispensable for the daily life of the inhabitants of this area is being supplied by General Organization for the Greater Cairo Water Supply (hereinafter referred to as "GOGCWS"), and presently GOGCWS is serving 12 million persons, corresponding to more than 80% of the current population of the Greater Cairo.

The Greater Cairo area stretches over the both banks of the Nile River, the East Bank and the West Bank. The East Bank of the Greater Cairo is comprised of the political and economic centers of the city, presents remarkable demographic growth, and its demand for water is increasing rapidly with the improvement of the living standards.

According to the East Bank Water System Master Plan Update 1990 (hereinafter referred to as the "Master Plan") conducted by the USAID, it is

presumed that in the near future the water served population and the water demand of the East Bank will be increased as shown in the followings.

Target Year	Water Consuming Population	Water Demand (m^3/d)
1990	8,160,000	3,090,000
2000	12,780,000	5,750,000
2010	16,040,000	7,050,000

The Amyria Water Treatment Plant (hereinafter referred to as the "Amyria Plant"), which is the object of the request made this time by the Government of Egypt, is medium-scale water treatment plant among the 11 plants of this kind located in the East Bank. It is located at the right bank of the Ismailia Canal at the northeastern part of Cairo, serving a population of 1.51 million distributed throughout the districts of Amyria, Zeitun, Heliopolis and Nassur.

The water sources of the Amyria Plant are the surface water from the Ismailia Canal and groundwater. The Amyria Plant was initially designed with nominal capacity of 300,000m^3/d of surface water and 120,000 m^3/d of groundwater taken from 41 wells. But, now only 18 of the existing wells are in operation, and therefore the supply capacity of the existing wells altogether is barely 30,000 m^3/d. Since the use of groundwater will have to be abandoned when its quality does not meet the standards for potable water, the Amyria Plant is currently operating at a capacity of 330,000 m^3/d in total. Though more than 30 years have passed since the water treatment facility was built, the Amyria Plant is forced to be run even at levels of the order of 370,000 m^3/d in overloaded state at a peak period in summer season. It is noted that the facilities are quite old and no wonder there is a possibility of sudden interruption of the Amyria Plant.

Under such circumstances, the Amyria Plant is in need to increase its capacity through the project for rehabilitation and upgrading of the existing facilities by making use of surface water. It would then be possible to secure the stable supply of potable water of good quality even at a peak period, thereby contributing to the social stability and preventing the worsening of the sanitary conditions of 1.51 million inhabitants. Though the project is thus important, in view of the financial aspects of Egypt in general and GOGCWS in

particular, the rehabilitation and upgrading of the facilities would be impracticable without any aid of foreign countries.

On the other hand, the Government of Japan has been maintaining a close relationship with GOGCWS through such involvement in the studies as the master plan for the Greater Cairo Urban Water Development Project, which was carried out by the Japan International Cooperation Agency (JICA) in 1975. Subsequently the first phase of the Greater Cairo Urban Water Development Project was implemented with financial assistance extended by the Overseas Economic Cooperation Fund (OECF) of Japan, and it continued until the third phase which included the revision of the basic plan on the water system of the Greater Cairo to be completed in 1985.

In view of the background as mentioned above, the Government of Egypt made a request for a grant-aid of Japan in order to raise the financial resources required for the Project for Rehabilitation and Upgrading of Amyria Water Treatment Plant (hereinafter referred to as the "Project"), which is regarded as a project with high priority. In response to that request, JICA decided to send to Egypt the Basic Design Study Team in charge of such study subjects as the examination of the scope of the Project capable of cooperation, the formulation of the most appropriate cooperation scheme, and the execution of the basic design referring to the contents and the scale of the facilities and equipment actually needed.

1 - 2 Outline of the Request

(1) Background of the request

The water supply capacity of the Greater Cairo has declined considerably due to such factors as the worsening quality of the raw water and the deterioration of the water treatment plants. Further to worsen the situation, there is a remarkable concentration and increase of the population in this area in the recent years, and the imbalance between the supply and demand of potable water is expanding. Data referring to 1993 indicate that the situation was very severe at that time, because while the demand mounted to 3,870,000 m^3/d, only 2,760,000 m^3/d of water, corresponding to 71% of the required quantity, was supplied.

In view of the said situation, the Government of Egypt decided to revise the Water Supply Master Plan of Greater Cairo (West Bank Master Plan revised in 1987 by German consultants and East Bank Master Plan revised in 1990 by the USAID), and plans for gradually increasing the water supply capacity were prepared as a result. The East Bank of the Greater Cairo area, which comprises the city of Cairo and has the largest demographic concentration, is expected to have a population of 9.5 million and a water demand of 5,750,000 m^3/d by the year 2000. That demand is twice as large as the current one, and an effective water supply improvement plan must be urgently implemented in steady steps in order to make it possible to cope with the situation.

Three water treatment plants, Amyria, Mostrod and Rod El Farag, account for more than 75% of the water supply of the East Bank. Here it must be noted that the said plants present remarkable decline in their processing capacity due to the obsolescence. The rehabilitation of Mostrod and Rod El Farag water treatment plants has been started with aids provided by France and the United States. As for the Amyria Plant, which is left intact, the Government of Egypt has made a request for a grant-aid of Japan as a means for raising the financial resources required for its rehabilitation.

Of the designed treatment capacity of 420,000 m^3/d of the facilities of the Amyria Plant, 120,000 m^3/d were taken from undergroundwater sources, but the use of groundwater has been prohibited by the sanitary authorities (Ministry of Health) of the Government of Egypt in view of the worsening quality that is occurring recently in the groundwater resources. Moreover, also from the quantitative viewpoint, it is not possible to pump up the planned volume of groundwater any more.

Under the circumstances, it is virtually impracticable to cope with the increasing demand of water, and moreover the remaining facilities that can make use of surface water are being heavily loaded, thereby accelerating the pace of malfunction and obsolescence of the Amyria Plant. With the object of solving the difficulty, GOGCWS plans to increase the treatment capacity (330,000 m^3/d) of the existing facilities of the Amyria Plant by 100,000 m^3/d, through a rehabilitation program in conformity with the Greater Cairo Third 5-Year Water Plan and the Water Treatment Plant Facilities Development Plan

(formulated in 1993 with the target year 2010), with the object of attaining 430,000 m^3/d.

(2) Contents of the request

The request for grant aid this time made by the Government of Egypt to Japan, is aimed at rehabilitation and upgrading of the existing facilities and equipments of the Amyria Plant listed below, thereby increasing its processing capacity from 300,000 m^3/d to 375,000 m^3/d.

Existing facilities (facilities making use of surface water)

1) Intake pipe:
   ø 1,100 mm diameter (intake section: 4 lines)
   ø 1,000 mm diameter (water conveyance to the distribution shaft: 4 lines)
2) Raw water screen: 2 units
3) Raw water pump:
   1,100 liter/second (4 units), 550 liter/second (4 units),
   175 liter/second (4 units: for irrigation)
4) Chemical dosing facilities: 4units for pre-/post-chlorination
5) Clari-flocculator: 1,570 m^3/h: (8 units)
6) Filter basin: 420 m^3/h (36 units)
7) Treated water pump: 1,100 liter/second (6 units), 400 liter/second (4 units)
8) Generator facility: 1,100 KVA (4 units), 1,050 KVA (4 units)

1 - 3 Projects Assisted by Other Countries

(1) Trends of the aids from other countries

Bilateral aid coming from the DAC countries increased rapidly since 1974 when Egypt began to break off its relationship with the ex-Soviet Union. In terms of net expenditures, the aids entering Egypt increased from 1,060 million US dollars in 1974 to 1,575 million US dollars in 1986, but after that the growth rate has been slowed down. In 1990, however, aid coming from the United States and other major industrialized countries increased substantially,

and doubled from 1,409 million US dollars in the previous years to 3,170 million US dollars. The total amount of the aids mounted to 4,158 million US dollars as of 1991.

The United States is the most important source of aid by country coming from abroad, and accounts for 71.3% of the total. Statistical data as of 1991 indicate that Japan is the second most important source of foreign aid after the United States in terms of net expenditure.

Aid given by international organizations mounted to 358 million US dollars as of 1991, and the most important donor was the EEC. Table 1-1 indicates trend of ODA given by DAC countries and international organizations as of 1991.

TABLE 1-1 ODA GIVEN BY DAC COUNTRIES AND INTERNATIONAL ORGANIZATIONS

	(Unit: Million US Dollars)
1.Net bilateral ODA	4,158.0
USA	2,963.0
Japan	619.6
Germany	185.3
France	163.6
The Netherlands	0.2
2.Net ODA coming from International Organizations	358.2
EEC	290.0
Arab organizations	36.5
WFP	13.7
UNDP	6.6
IDA	8.0

(Note) Source: Geographical Distribution of Financial Flows to Developing Countries 1993 (OECD)

(2) Similar related plans and relation to other international organizations

1) Relationship with similar projects and international organizations

The projects of various kinds that are being executed in the Greater Cairo area with financial resources raised through foreign aid are listed below. There are other projects related to the Amyria water supply area, but there is no project directly related to the rehabilitation and upgrading of the Amyria Plant.

TABLE 1-2 SIMILAR RELATED PROJECT BY FOREIGN AID

No.	Country	Project	Sum	Type	Contents
1	USA	Cairo II	US$110 million	Grant aid	Improvement of the distribution pipe and construction of the distribution reservoir
2	USA	Cairo II	US$35 million	Grant aid	Technical aid for improvement of water utility operation
3	France	Enlargement of Embaba WTP	US$20 million	Loan	Supply and installation of mechanical and electrical equipment
4	France	Enlargement of Mostrod WTP	US$10 million	Loan	Supply and installation of mechanical and electrical equipment
5	Italy	Information monitoring center	US$10 million	Grant aid	Installation of the information monitoring center (Phase 1)
6	Japan	Enlargement of South Giza WTP	2.3 billion Yens (5.8 billion yens)	Grant aid	Construction of 35,000m^3/d WTP and distribution pipe (including sewage treatment plant)
7	France	Enlargement of South Giza WTP	FF100 million	Loan	Supply and installation of the mechanical and electrical equipment of 200,000m^3/d WTP
8	USA	Fostat central test laboratory	US$35 million	Grant aid	Supply of water test & analysis equipment and training
9	France (planned)	Enlargement of Fostat WTP	FF900 million	Loan	Supply and installation of mechanical and electrical equipment of 300,000m^3/d WTP
10	Italy (planned)	Information monitoring center	14,800 million Lira	Grant aid	Installation of the information monitoring center (Phase 2)

Fostat central test laboratory of Project No. 8 is a technical grant aid of the USA to the Central Water Quality Test Laboratory. The execution period of this project is from 1991 to 1994, and its handing over is scheduled in July 1994. Test equipment and accessories mounting to 1.5 million US dollars are being installed at present.

The Central Water Quality Test Laboratory is outlined as the following.

Location

The Central Water Quality Test Laboratory is located in the Fostat Water Treatment Plant.

Equipment

The equipment of the Central Water Quality Test Laboratory are broadly classified into 3 sections, inorganic chemical analysis section, organic chemical analysis section and microbiological analysis section, and each section is provided with the special weighing room, analytical room, etc., that are required for the sake of the analytical and weighing work. As for the gas required for executing the analyses, 9 different kinds of gas will be provided at the required places. The facilities of this laboratory represents the highest technical level in the Middle East area. The laboratory will be provided with a wide variety of equipment and apparatuses, and some examples are listed in the followings.

- Programmable fluorescence detector
- Chromatograph
- Auto sampler
- Gas chromatograph
- Auto injector for gas chromatograph
- Quadruple G.C. detector with turbo pump

Furthermore, there is a complete line of analytical benches and analytical apparatuses.

Manning scheme

As things now stand, the Central Water Quality Test Laboratory is staffed with 20 chemists, but there are plans to increase to 35 in the future.

Contents of the duties

- Analysis and studies of samples of various kinds brought to the laboratory
- Training of chemists both from Egypt and from abroad

The Information Monitoring Center of Project No.5 and Project No.10 will be installed and equipped with grant aid provided by Italy. The flow rate, the residual chlorine concentration and other relevant parameters of the water treatment plants and the major water supply points will be monitored at this

Information Monitoring Center. (The Information Monitoring Center will be located at the Rod El Farag water treatment plant).

2) Relationship between the Amyria Plant and the related water treatment plants (Fostat, Mostrod, Rod El Farag)

The projects related to the Fostat water treatment plant and the Mostrod water treatment plant are being carried out with French funds, and the project related to the Rod El Farag water treatment plant is being carried out with American fund. These water treatment plants are related with the Amyria Plant as shown in the following table.

(Unit: m^3/day)

Zone	Treatment Plant	1990	2010
Central 63 m zone	Amyria WTP	308,047	447,027
	Rod El Farag WTP	827,914	1,351,304
	Roda WTP	221,419	389,700
	Total	1,357,380	2,188,031
East 100 m zone	Amyria WTP	50,000	50,000
	Mostrod WTP	181,082	390,178
	Total	231,082	440,178

Note: According to the Master Plan

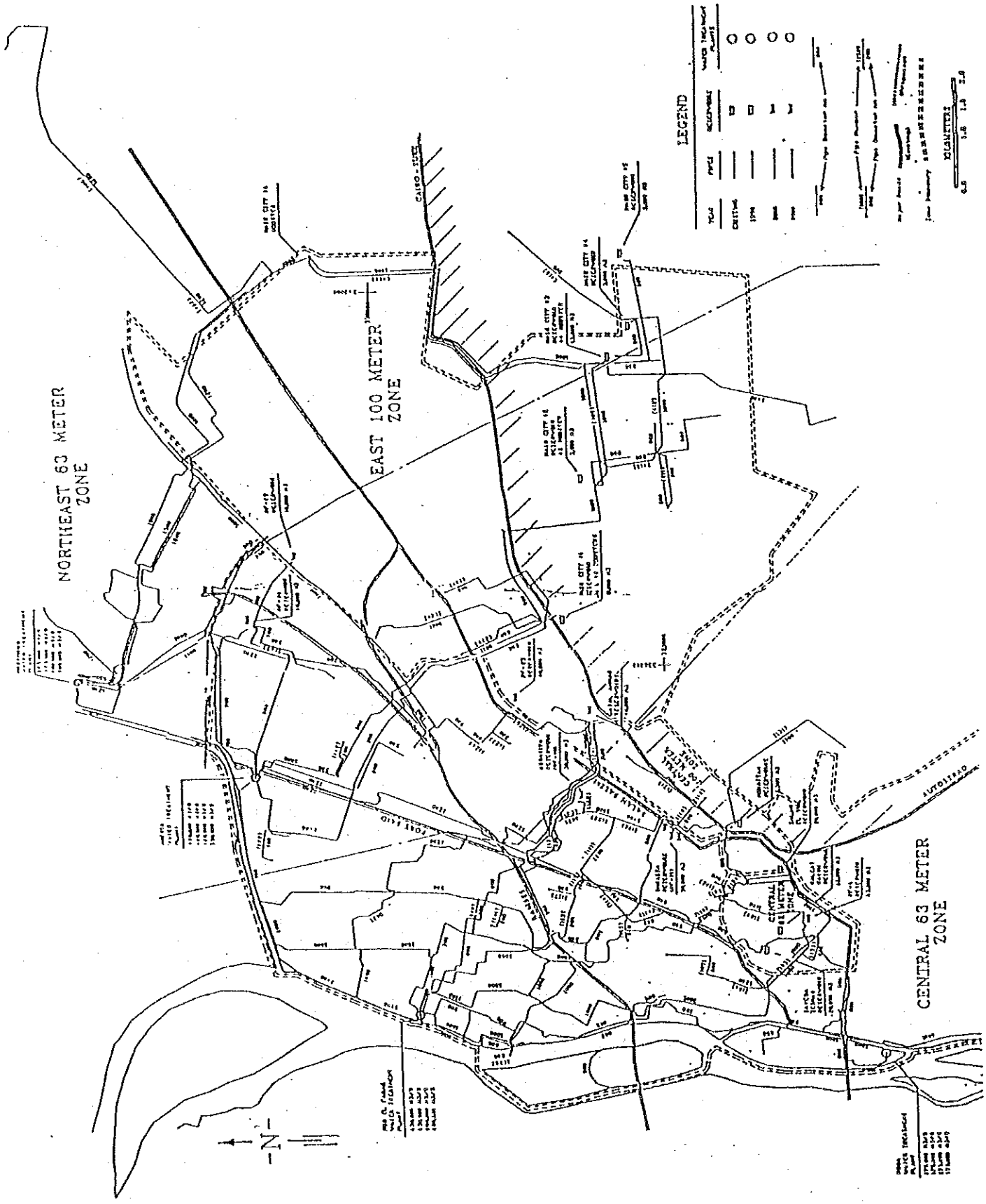
Judging from the distribution pipe network shown in Figure 1-1, it is noted that there are water main pipes making the interconnection between the water supply area of the Amyria Plant and the water supply areas of the other water treatment plants, but in reality they are clearly separated from each other.

(3) Situation of the aids from Japan

The Government of Japan has aided GOGCWS through the Greater Cairo Urban Water Development Project, which was started by the Japan International Cooperation Agency (JICA) in 1975. Subsequently to this project, another Greater Cairo Urban Water Development Project was carried out with financial resources provided by the Overseas Economic Cooperation Fund (OECF) of Japan, from the first to the third phase, which included the revision of the basic plan on the water supply system of the Greater Cairo. This project finished in 1985. As things now stand, the project for the Water Supply and Sewer System Upgrading in Monib, Giza City and the said project for phase

II, which are the construction of the water treatment facilities of 35,000 m^3/d in capacity and distribution pipes including the construction of sewage treatment plant in South Giza area, were executed with Grant-aid by Japan.

FIGURE 1 - 1 GREATER CAIRO WATER MAINS MAP



Chapter 2. Outline of the Project

Chapter 2 Outline of the Project

2 - 1 Objectives of the Project

The Amyria Plant, which is supplying potable water to more than 1.51 million low-and medium-class income level residents of the Amyria water supply district has a nominal capacity of 420,000 m^3/d, consisting of 300,000 m^3/d of surface water sources and 120,000 m^3/d of groundwater sources. In fact, however, the actual capacity has been declined to 330,000 m^3/d, consisting of 300,000 m^3/d of surface water and 30,000 m^3/d of groundwater. According to the Master Plan the demand of the Amyria Plant will reach at 430,000 m^3/d in 1998.

On the other hand, according to the Greater Cairo Third 5-Year Water Plan and the Water Treatment Plant Facilities Development Plan, (planned in December 1993, target year of 2010) the existing facilities of the Amyria Plant have a capacity of 330,000 m^3/d, and will be increased by 100,000 m^3/d through the rehabilitation of the said facilities. In addition to this, if the existing facilities should be reinforced to capacities exceeding 430,000 m^3/d, it would be necessary to construct new intakes and water conveyance mains. Such being the case, the Project is formulated by assuming a treatment capacity of 430,000 m^3/d and the facilities will be rehabilitated and reinforced with the object of increasing the current treatment capacity of 300,000 m^3/d to 430,000 m^3/d with the object of carrying out the treatment of surface water with sufficient reliability.

2 - 2 Study and Examination on the Request

(1) Feasibility and necessity of the Project

According to the Master Plan, the demand for potable water in the Amyria water supply district will be 358,047 m^3/d in 1990, 446,956 m^3/d in 2000 and 497,027 m^3/d in 2010 as shown in Figure 2-9. On the other hand, the volume of potable water supplied by the Amyria Plant mounted to 332,778 m^3/d in 1991, 324,699 m^3/d in 1992 and 326,172 m^3/d in 1993 as shown in Figure 2-4. The said situation is attributable to the insufficient treatment capacity of the

Amyria Plant compared with the demand, and an urgent reinforcement is being required in the water treatment capacity.

Discussions have been made in Egypt about the planned water treatment volume of the Amyria Plant, and the following matters were duly confirmed.

1) In connection with the water treatment capacity including groundwater, the current capacity of the Amyria Plant is insufficient both in terms of the overall water supply and in terms of the supplied water quality. Most of the trouble that are occurring at the present time and attributable to the wells for taking groundwater. These wells involve not only qualitative problems but also quantitative ones.

2) Demographic growth is especially remarkable in the water supply districts being served by the Amyria Plant. Concurrently with the will of the middle income level people to improve their living standards, it is necessary to take urgent and aggressive steps to secure the stable supply of water not only from the quantitative standpoint but also from the qualitative standpoint.

3) The concepts for increasing the potable water supply from 300,000 m^3/d to 375,000 m^3/d mentioned in the request was not clearly indicated. The request to expand the treatment capacity to 430,000 m^3/d with an increase of 100,000 m^3/d in the existing facilities, which is currently operating at a capacity of 330,000 m^3/d was made again according to the Water Treatment Plant Facilities Development Plan in the Greater Cairo area executed by GOGCWS.

4) As a first emergency step, it is urgently necessary to secure the stable supply, both from the quantitative and qualitative standpoint, of 430,000 m^3/d of potable water.

5) An additional step must be taken to increase the processing capacity by 200,000 m^3/d more by the year 2010. The total supply

volume of 630,000 m^3/d to be obtained as a result indicates the maximum treatment capacity of the Amyria Plant.

6) The environmental issue is being given priority all over the world, and it must be borne in mind that the Amyria Plant is in extremely bad conditions from the standpoint of its appearance. The request made this time by the Government of Egypt to Japan is aimed exclusively at securing the stable supply of potable water from the quantitative and qualitative standpoints, but in reality it would be necessary to make improvements in its appearance so as to match the other water treatment plants existing in the Greater Cairo from this latter standpoint.

7) GOGCWS is carrying out a project aimed at realizing the integrated control of all water treatment plants under its jurisdiction. Concurrently with the said project, it will be necessary to properly equip the water quality control facilities of the Amyria Plant, because problems related to this aspect are especially remarkable in the Amyria Plant.

2 - 3 Project Description

2 - 3 - 1 Execution Agency and Operational Structure

(1) Execution Agency of the Project

GOGCWS is the office responsible for the supply of potable water to the inhabitants in Greater Cairo. GOGCWS is under the jurisdiction of the Ministry of Housing and Public Utilities, but it is related to the Ministry of Health, the Ministry of Finance and other government offices as well.

GOGCWS is in charge of the execution of the Project, and it is properly qualified for the task from the standpoints of administrative, technical, financial and project execution capabilities. The Project Department of GOGCWS will take charge of the actual execution. The Project Department has experience in similar aid projects carried out in association with other countries, and has sufficient capacity to take charge of the matter, both from

the technical and the available human resources standpoint. The organization of GOGCWS is shown in Figure 2-4.

(2) Financial evaluation of GOGCWS

Table 2-1 and 2-2 show the budget balance of GOGCWS-1991/1992 and 1992/1993. The income resulting from the water charges are spent in salaries of the workers and ordinary expenses. The expenditures related to the replacement and renewal of the facilities, expansion works, etc., are covered with financial resources raised through loaning from the National Investment Bank, as well as loans and grant aids from abroad.

TABLE 2-1 BUDGET BALANCE OF GOGCWS-1991/1992

	Expenditure	L. E.		Income	L. E.
1	Salary	54,295,217	1		
2	Ordinary expenses and Exchange	263,560,575	2	Water charge and Exchange income	317,855,791
3	Capital expenditure	127,401,147	3	Capital income	255,079,531
4	Capital exchange	265,261,309	4	Loan facilities	137,582,926
	Total expenses	710,518,248		Total income	710,518,248

TABLE 2-2 BUDGET BALANCE OF GOGCWS-1992/1993

	Expenditure	L. E.		Income	L. E.
1	Salary	65,812,296	1		
2	Ordinary expenses and Exchange	325,356,549	2	Water charge and Exchange income	391,168,845
3	Capital expenditure	259,638,817	3	Capital income	382,963,019
4	Capital exchange	293,429,325	4	Loan facilities	170,105,123
	Total expenses	944,236,987		Total income	944,236,987

The strengthening of the financial foundation of GOGCWS is being required through the implementation of the measures listed in the followings :

- Formulation of a rational plan for operation and control of the facilities including appropriate operation, inspection and maintenance, rehabilitation, renewal, reconstruction, expansion, etc.
- Execution of sound administration of the finances and operation of the water supply utility
- Increase of the income through raise-up of the water rates, improvement of the paying user rate (increase of the water charge collection rate, prevention of water leakage and other measures for effective utilization of the water resources), etc.

2-3-2 Plan of Operation

(1) Study of the facilities to be rehabilitated

Meetings with the parties concerned and field studies were conducted with the object of identifying the problematic points to be solved within the context of the present project. The contents of the requested facilities, equipment and materials are summarized in the followings, by taking into consideration the modifications made in the original request presented by the Government of Egypt.

1) Taking into consideration the Master Plan of GOGCWS, urgent steps must be taken in the Amyria Plant so as to make it possible to secure the supply of 430,000 m^3/d of potable water of good quality.

2) Moreover, concurrently with the rehabilitation program in conformity with this Master Plan with the object of realizing a water supply capacity of 430,000 m^3/d, it is also necessary to take into consideration the concept for installing additional facilities for a water supply capacity of 200,000 m^3/d within the site of the Amyria Plant. Since the target year of the Master Plan of GOGCWS is the year 2010, it is regarded as perfectly possible to realize that concept after the completion of the rehabilitation work aimed to boost the treatment capacity of the existing facilities to 430,000 m^3/d.

3) The sources of raw water will be the 430,000 m^3/d of surface water to be taken from the Ismailia Canal, and the use of groundwater will be abolished.

4) The priority should be given to the treatment process for the sake of securing the required water quality.

5) As for the filter basin, it shall be used for the purpose of filtration of the water out of sedimentation basin.

6) The required instrumentation facilities shall be equipped.

7) In connection with the water quality monitoring facilities, they shall include the equipment of the analytical laboratory, as well as the centralized indication of the water volume and basic water quality, not to mention the water quality analysis equipment.

8) From the standpoint of the aesthetic environment as well as from the standpoint of the safety and the hygiene, it will be necessary to take special care with the order and the cleanliness within the Amyria Plant. In this connection it will be necessary to move the workshops of various kinds that are currently located within the site of the Amyria Plant but have nothing to do with the plant itself to other places outside the plant as soon as possible.

(2) Basic plan on the execution of the cooperation

1) Capacity of the facilities

The facilities of the Amyria Plant have a total nominal water treatment capacity of 420,000 m^3/d, consisting of 300,000 m^3/d of surface water and 120,000 m^3/d of groundwater.
It must be remembered, however, that as things now stand the Amyria Plant has the water supply capacity shown in the followings.

- Surface water : 300,000 m^3/d
- Groundwater : 30,000 m^3/d

Total : 330,000 m^3/d

Water demand

In view of the increasing water demand of the Amyria water supply area by the Master Plan, it will be necessary to secure a clear water volume of 430,000 m^3/d.

Definition of the scale of the facilities

The volume of clear water to be supplied by the Amyria Plant will be 430,000 m^3/d, and surface water will be used as water source in view of the worsening quality of the groundwater.

- Surface water to be taken from the Ismailia Canal
  300,000 $m^3/d \rightarrow$ 430,000 m^3/d
- Groundwater to be taken from the wells
  30,000 $m^3/d \rightarrow$ 0

The nominal capacity of the facilities of the Amyria Plant will be increased from 420,000 m^3/d to 430,000 m^3/d as a result of the implementation of the Project.

2) The wells

Comparing the data collected during the period comprehended from 1991 to 1993 about the quality of the well water, which is being used as a source of groundwater, with the WHO standards, that will be adopted in Egypt in the near future, it is observed that the limits referring to iron (Fe) and manganese (Mn) are being surpassed in most of the wells, and that the limits referring to sulfuric acid ions, chlorine ions, etc., are being surpassed by 40% to 80%. Moreover, the limits referring to the turbidity are being surpassed in 70% of the wells according to data of 1993. Making a global judgment by taking into consideration the facts mentioned above, it is concluded that the pollution is

progressing in the wells, and in the Project the use of the wells is not taken into account.

3) Hydraulic study of the Amyria Plant

A hydraulic study was carried out with the object of examining the possibility of increasing the water treatment capacity from the current 300,000 m^3/d to 430,000 m^3/d. The most important point in this case is to examine whether it is possible to take the required volume of 451,000 m^3/d (430,000 $m^3/d \times 1.05$) of water by using the existing intake facilities. As a result of the hydraulic studies carried out, it was concluded that it is possible to take that volume of water from the existing intake facilities.

4) Basic criteria for carrying out the cooperation

The facilities of the Amyria Plant are obsolete, but some parts such as the pumps and other related equipment are in satisfactory conditions of repair, maintenance and control. The sedimentation basin, filter basin and other concrete structures present no problem in particular, but the equipment and facilities associated with them are not operating satisfactorily. Moreover, it must be remembered that the capacities of the connection pipes between the various structures are insufficient. If the existing pumps and related facilities are kept at the current maintenance and control conditions, it will be perfectly possible to use them for 10 or 15 more years in order to secure the planned water treatment capacity of 430,000 m^3/d. Such being the case, the rehabilitation of the facilities will be restricted to the minimum regarded as absolutely indispensable.

2 - 3 - 3 Location and Condition of Project Site

(1) Location

Cairo, the capital city of the Arab Republic of Egypt, is located approximately 10 km to the south of the southern tip of the Nile Delta, at the northern extremity of Egypt. As things now stand, the street area of Cairo consists of the old city, the new city formed in the second half of the 19th century and on, and the suburban residential districts formed after the World

War II. The Amyria Plant is located in the Amyria district, which is part of the new city area spreading throughout the northeastern part of Cairo. The northern side of the Amyria Plant faces with the Ismailia Canal across a road.

(2) Social and economic situation

The Amyria water supply area, located at the vicinity of the Amyria Plant is a residential district occupied by typical low and medium income level people of Egypt. Many shops compose a flourishing commercial district along the arterial streets, but when getting into the back streets, the roads become suddenly narrow. The neighborhood is apparently full of liveliness, but something seems to be missing in terms of cleanliness.

(3) Natural conditions and social environment

1) Topography

The Project area and its surroundings have a flat topography free of undulations.

2) Climate

The climate of Cairo can be divided into 3 distinct seasons. During the period comprehended from March to May both the temperature and the relative humidity are low, and this is the most pleasant season of the year. In April, however, the temperature begins to rise and there are some days with more than 30 degrees centigrade. Moreover, there are intermittent sandstorms called Hamushim that may last 1 or 2 days. The hot season corresponds to the period comprehended from May to September, but the shade is fresh because the humidity is low. The period comprehended from October to March is fresh, and particularly in January and February there are some days that come to be point of being chilly. The rainfall is very scarce, mounting to an annual amount of barely 25 mm. The relative humidity averages approximately 53% during the years, with lows of the order of 40% in May and highs of the order of 62% in November. The table 2-3 shows temperatures and rainy days in Cairo.

TABLE 2 - 3 TEMPERATURES (°C) AND NUMBER OF RAINY DAYS BY MONTH IN CAIRO

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Maximum Temperature	18	21	24	28	33	35	36	35	32	30	26	20
Minimum Temperature	8	9	11	11	17	20	21	22	20	18	14	10
Number of Rainy Days	1	1	1	0	0	0	0	0	0	0	1	1

3) Sewage

The planned sewage area of the Greater Cairo as of 1990 is 15,580 hectares at the East Bank and 5,609 hectares at the West Bank, mounting to 21,189 hectares altogether. The percentage of the areas of the Greater Cairo provided with sewage is 69% at the East Bank and 59% at the West Bank. Sewage projects are currently under way with the object of expanding the planned sewage area to 22,610 hectares at the East Bank and 9,549 hectares at the West Bank, totaling 32,159 hectares altogether by the year 2010, which is the target year of the project. The planned population of the project is 11.42 million at the East Bank and 7.31 million at the West Bank, totaling 18.73 million persons altogether.

Six sewage treatment plants are being planned in the Greater Cairo, including those ones of the peripheral areas. Four of these sewage treatment plants are already in operation, and as things now stand 66% of the Greater Cairo as a whole is equipped with sewage.

The Cairo sewage treatment district, which comprises the Amyria water supply district being served by the Amyria Plant discharges its sewage to the arterial tunnel leading to the Kabal El Asfal Sewage Treatment Plant via Fostat Pumping Station and Amyria Pumping Station.

As things now stand, the Kabal El Asfal Sewage Treatment Plant has a processing capacity of 1,000,000 m^3/d, but there are plans for increasing its capacity to 2,000,000 m^3/d.

It is noted that, approximately 85% of the Amyria water supply district is equipped with sewage.

4) Housing environment

The Amyria water supply district is a residential area, and it is crammed with apartment buildings of 3 to 5 stories. With exception of the arterial roads, there is practically no paved road. Most of the roads have irregular configuration. As mentioned before, cleanliness is not the strong point of this area, both in terms of the roads and in terms of the surroundings of the residential buildings. Since the housing conditions are by no means satisfactory, it may safely be said that the housing environment is generally poor.

(4) Outline of the Amyria Plant

1) Location

The Project site is located in the Amyria district, in the northeastern part of Cairo. At the northern side of the Amyria Plant, which is the Project site, is located at the Kontsakha Street, which is an arterial road with more than 30 meters of width. At the northern side of that street is located the Ismailia Canal. On the other side, at the eastern side of the Amyria Plant is located the Port Said Street, which is another arterial road with more than 30 meters of width. These arterial roads are properly paved, and there is no problem for the sake of transportation of the construction machinery and materials. Within the site of the Amyria Plant there are roads that are satisfactorily paved for traffic of heavy vehicles.

2) Existing facilities

Figure 2-1 shows the layout of the facilities of the Amyria Plant, and Figure 2-2 shows its flow sheet.

The outlines of existing plant are indicated as follows;

-	Intake pipe	ø1,100mm×4 lines
-	Raw water screen	2 units
-	Raw water pumps	$33m^3$/min.× 12m×100kw×4 units
		$66m^3$/min.× 12m×220kw×4 units
-	Raw water conveyance pipe	ø1,000mm×4lines

-	Distribution shaft	ø8m×H8.4m (422m^3)×2tanks
-	Clari-flocculater	1,750m^3/h×8basins
-	Filter basin	100m^2/bed×36 basins
-	Clear water reservoir	2 basins
-	Treated water pumps	66m^3/min.× 60m×900kw×6 units
		24m^3/min.× 30m×165kw×4 units
-	Alum dosing facilities	1 set
-	Chlorination facilities	1 set
-	Generators	1,100 KVA×4 units
		1,050 KVA×4 units

3) Treatment capacity

The Amyria Plant takes surface water from the Ismailia Canal, and it was built in 1962 with a treatment capacity of 300,000 m^3/d.

During the period comprehended from 1968 to 1977, 41 wells were drilled at the site of the Project area with the object of securing the supply of 120,000 m^3/d of groundwater. It must be remembered, however, that water pumped from these wells have high concentrations of such substances as manganese, iron, etc., and the sanitary authorities (Ministry of Health) of the Government of Egypt are impeding the use of wells that have concentrations surpassing the water quality standards. At present, there are 18 wells ready for use, and the actual water supply capacity of these wells is of the order of 30,000 m^3/d. Besides the worsening water quality, the pumping level of the wells is lowering by the year and the quantity of water that can be pumped is unstable. Such being the case, these wells will be abandoned in the future.

FIGURE 2-1 LAYOUT OF THE AMYRIA PLANT

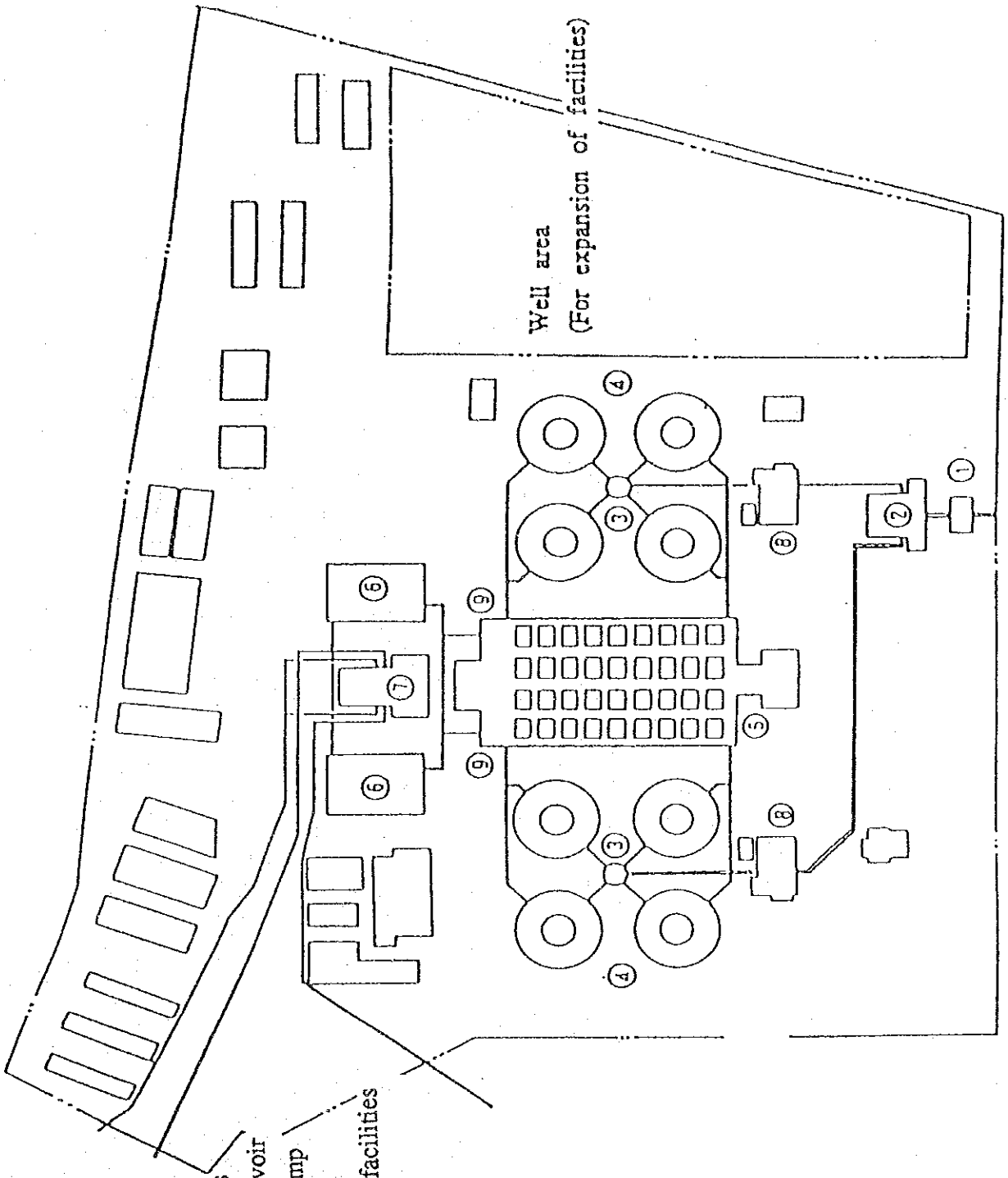
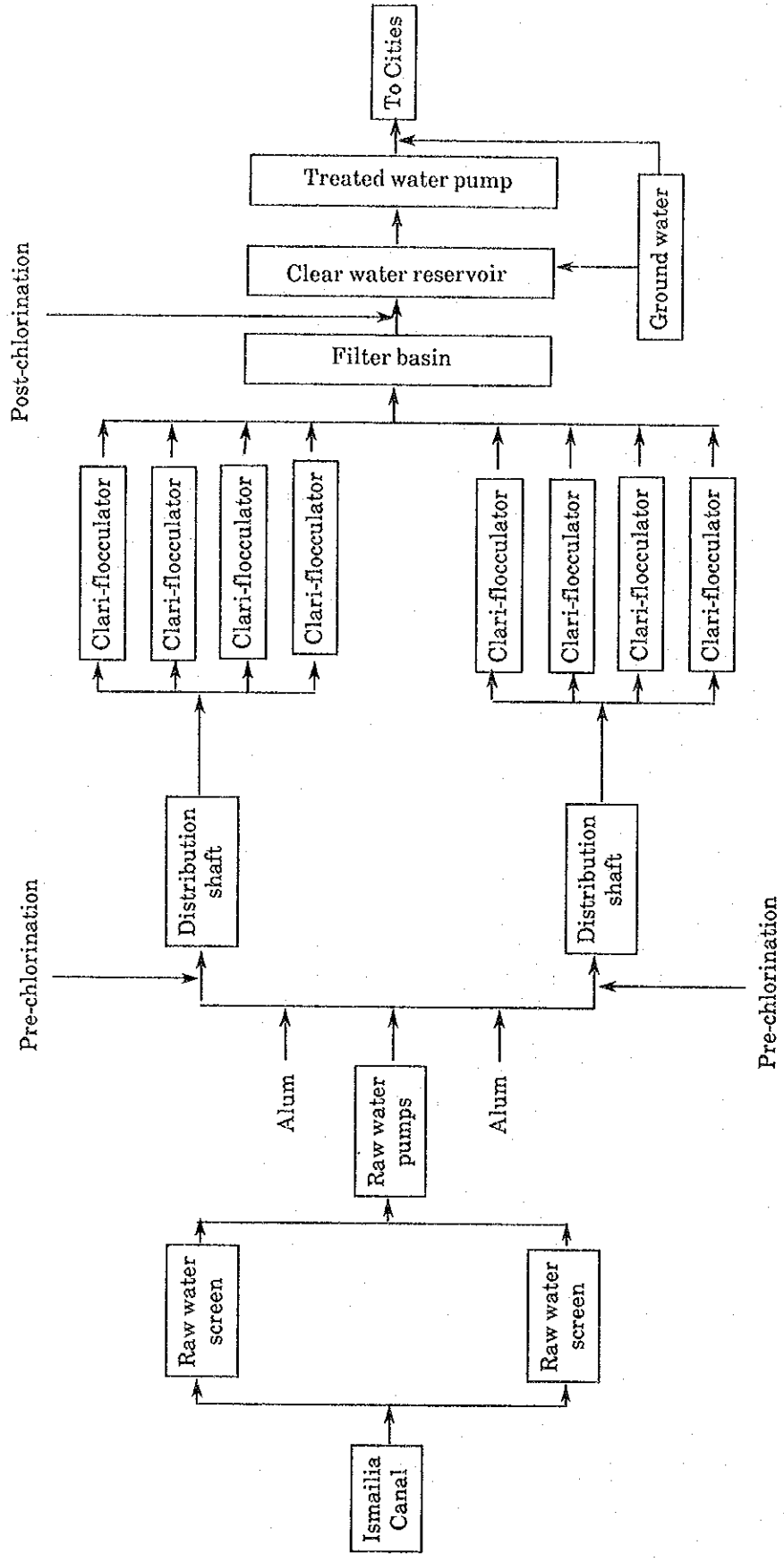


FIGURE 2 - 2 FLOW SHEET OF THE AMYRIA PLANT



4) Water supply record

The table 2-4 shows potable water supply record of the Amyria Plant in the last three years. Besides, the Table 2-5 indicates intakes water records of water sources in 1991.

TABLE 2-4 POTABLE WATER SUPPLY RECORD OF THE AMYRIA PLANT

(Unit : m^3/d)

Month	1991	1992	1993
January	303,510	286,865	280,984
February	281,043	292,366	288,125
March	312,110	287,500	296,806
April	324,813	309,816	310,181
May	349,470	333,610	326,600
June	347,263	352,193	332,532
July	358,037	341,832	359,684
August	372,893	345,945	363,367
September	361,167	356,547	352,027
October	351,933	351,281	353,013
November	318,640	333,293	324,180
December	312,422	305,145	326,568
Annual average	332,778	324,699	326,172

TABLE 2-5 VOLUMES OF WATER TAKEN BY SOURCE (As of 1991)

(Unit: m^3/d)

Month	Surface water	Ground water	Total
January	260,983	42,527	303,510
February	238,203	42,840	281,043
March	262,763	49,347	312,110
April	286,210	38,603	324,813
May	319,523	29,947	349,470
June	321,083	26,180	347,263
July	329,707	28,367	358,037
August	369,430	3,463	372,893
September	358,743	2,424	361,167
October	337,187	14,747	351,933
November	309,647	8,993	318,640
December	293,015	19,407	312,422
Annual average	307,208	25,570	332,778

The personnel of the Amyria Plant is shown in Table 2-6. As can be seen, the organization of the Amyria Plant consists of one superintendent, 12 engineers, 15 foremen, 39 clerks, 276 technicians, 42 guards, 6 scientists, and 14 water quality technicians, totaling 405 persons. The water treatment facilities of the Amyria Plant is operated in 3 shifts, with technicians working around the clock at the raw water pump room, the chlorine & alum dosing room, the filter basin, the treated water pump room to monitor the operation. The water quality inspection is being carried out by 20 specialists, but steps must be taken to improve the water quality test equipment.

Even after the rehabilitation of the facilities by means of the present project, it is presumed that the current organization will be sufficient in taking charge of the maintenance and the control.

TABLE 2-6 PERSONNEL OF THE AMYRIA PLANT
(AS OF JANUARY 1994)

Position		No. of persons
Superintendent	(mechanical)	1
Engineer	(mechanical)	5
Engineer	(electrical)	4
Engineer	(civil)	1
Agronomist		2
Foremen	(mechanical)	11
Foremen	(electrical)	4
Clerk		39
Skilled worker		243
Unskilled worker		33
Guard		42
Chemists		6
Skilled worker	(water quality)	14
Total		405

2 - 3 - 4 Water Supply System in Greater Cairo

(1) General description of the water supply system in Greater Cairo

Potable water indispensable for the daily life of the population of the Greater Cairo is being supplied by GOGCWS which was established in 1969. The water supply system of Cairo was built and expanded gradually since 1903, and as things now stand it is serving approximately 12 million inhabitants, that correspond to more than 80% of the daytime population of the Greater Cairo.

The most important source of water is the surface water of the Nile River, but groundwater is also being used partially. The supply of water to the rapidly-increasing population of the Greater Cairo is being carried out by means of 15 water treatment plants that have a total capacity of 3,555,000 m^3/d. On the other hand, the demand of water is surpassing the supply capacity in view of the population growth and the leveling up of the living standards, and there is a chronic shortage of water.

(2) Summary of water supply system

The outline of the water supply system in the Greater Cairo at present is summarized in the followings.

1) Water supply areas

Governorate	Area (km^2)
Cairo Governorate:	275
Giza Governorate:	75
Qualiubiah Governorate:	30
Total:	380

2) Capacity of the existing water treatment plants

Name of Plant	Capacity (m^3/day)
A. EAST BANK	
Mostrod Water Treatment Plant:	750,000
Amyria Water Treatment Plant:	330,000
Rod El Farag Water Treatment Plant:	730,000
El Roda Water Treatment Plant:	155,000
El Fostat Water Treatment Plant:	420,000
El Maadi Water Treatment Plant:	60,000
North Helwa Water Treatment Plant:	80,000
Kafr El Elw Water Treatment Plant:	75,000
El Tebbin Water Treatment Plant:	100,000
El Marg Well:	45,000
Bahatem Well	10,000
Sub-total	2,755,000
B. WEST BANK	
Embaba Water Treatment Plant:	300,000
Giza Water Treatment Plant:	130,000
South Giza Water Treatment Plant:	355,000
Jorliebileh Well:	15,000
Sub-total	800,000
Total:	3,555,000

3) Water distribution pipes

Diameter	Length (km)
Pipes sized ø300mm or more in diameter:	1,000
Pipes sized less than ø300mm in diameter:	4,000
Total:	5,000

4) Number of water service taps installed

Class	Quality (unit)
Ordinary households:	370,000
Clubs, syndicates:	400

Mosques, churches, schools:	2,650
Large factories:	825
Major hotels, inns:	400
Investment companies:	50
Schools, hospital, government offices:	25,675
Total	400,000

5) Number of water meters installed: 370,000 units in total

6) Capacity of the water distribution reservoirs: 300,000 m^3 in total

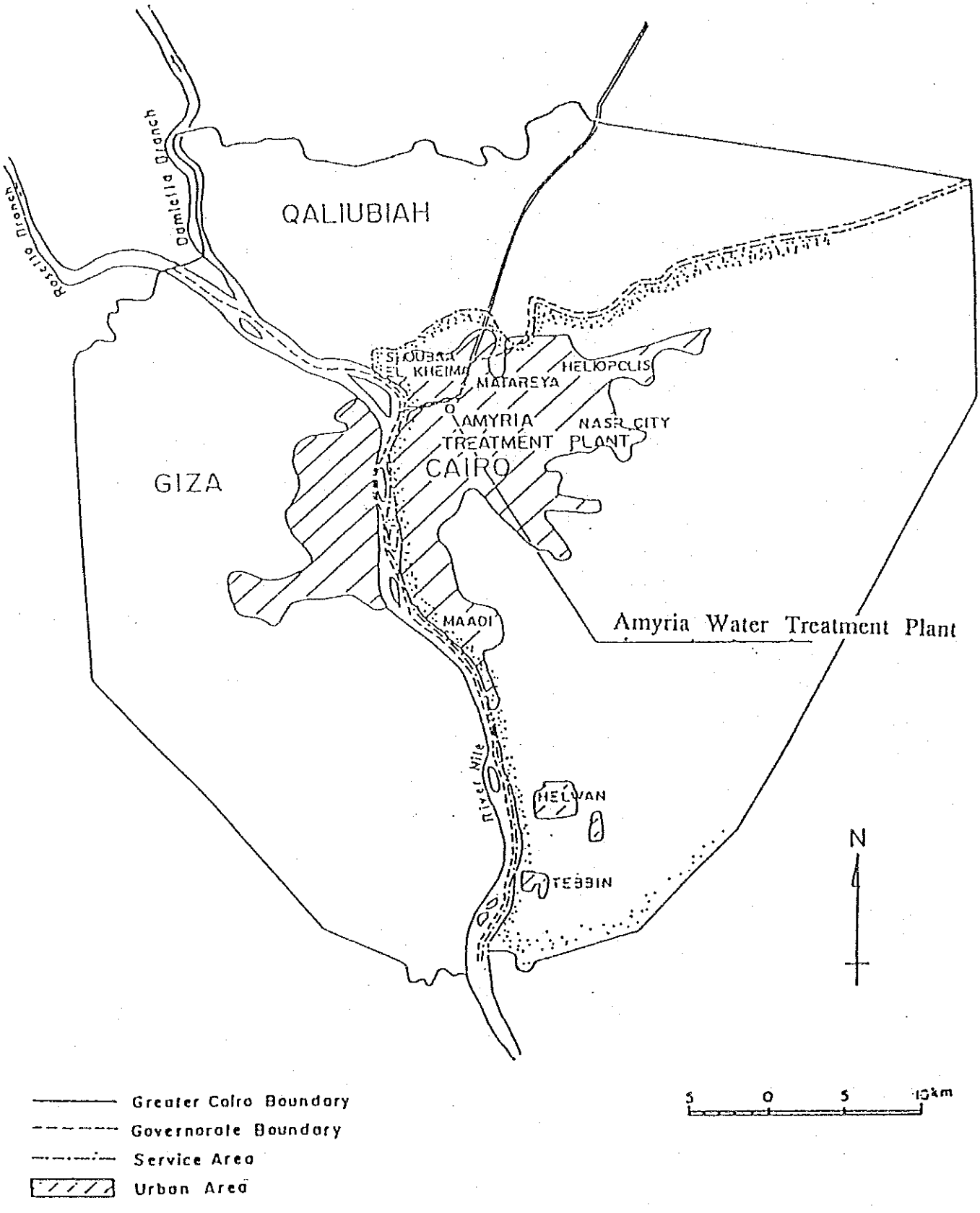
7) Booster pump stations: 34 sites in total

8) Number of water supply facilities

i. Water treatment plants	Surface water:	12 plants
	Groundwater:	3 plants
ii. Maintenance offices:		18 offices
iii. Business offices:		42 offices
iv. Engineering offices:		7 offices

9) Water served ratio: 85% of total population

FIGURE 2 - 3 GREATER CAIRO WATER SUPPLY AREAS

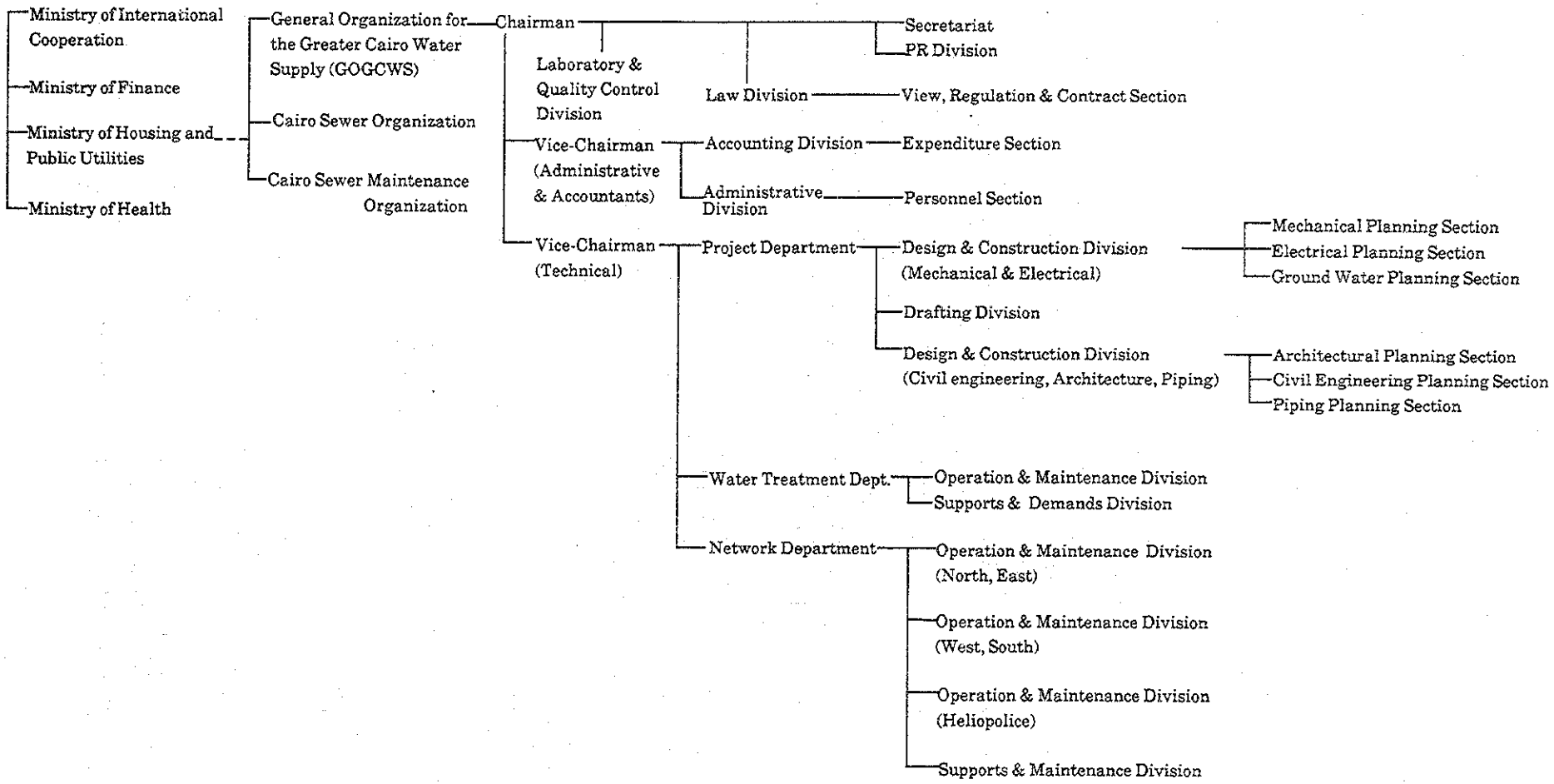


10) Water tariff

TABLE 2 - 7 WATER TARIFF (PER m^3)

No.	Categories of Users	Rate Piasters
1	Domestic Uses	
	A- Up to 30m3	10
	Excess	13
	B- Building Works	28
2	Services Uses	
	A- Religious Buildings, Charity Societies, Mills and Bakeries, Popular Clubs and Youth Centers.	8
	B- Embassies, Sporting Clubs, Syndicates and Political Parties.	13
3	Companies and Commercial Shop	
	A- Small Factories, Small Workshops with 30mm connection or less, Popular Restaurants, Coffee Shops, Gas Stations, Second & Third Class Hotels, Private School, Health Insurance Hospitals and Garages	23
	B- Big Factories with more than 30mm connection	31
4	Investment and Production Uses	
	For Investment and Tourist Uses like Private Hospitals, First Class Hotels, Amusement Places, First Class Restaurants, Investment Companies and Free Zones	55
5	Raw Water	
	For Government and Individuals	8
6	Filtered Water for Non Domestic Uses	
	Government Factories and Government	20
7	Clarified Water	
	All Users	10
8	Monthly Fixed Rates for Houses Built by Government	
	One Room	100
	Two Rooms	125
	Three Rooms	150
	More than Three Rooms	200
	(In all cases the hall is considered as one room)	

FIGURE 2 - 4 ORGANIZATION OF GOGCWS



11) Organization and personnel of GOGCWS.

GOGCWS is the office responsible for the supply of potable water to the Greater Cairo. GOGWCS is under the jurisdiction of the Ministry of Housing and Public Utilities , but it is related to the Ministry of Health, the Ministry of Finance and other government offices as well.

The Chairman and the Vice Chairman are the highest authorities of GOGCWS, which has the organization shown in Figure 2-4, and has more than 12 thousand workers as shown in Table 2-8.

TABLE 2-8 PERSONNEL OF GOGCWS

Category	Post	No. of persons
Sections under direct control of the head office	Chairman	1
	Administrative personnel	29
	Senior technical personnel (Engineering)	368
	Senior Technical personnel (Sciences)	100
	Senior clerical personnel (Law)	31
	Senior clerical personnel (Accounting)	356
	Senior clerical personnel (Development)	146
	Guard	38
	Senior clerical personnel (Sociology)	25
	Senior technical personnel (Agriculture)	10
	Senior technical personnel (Arts)	2
	Assistant engineer	826
	Technician	83
	Agriculture and supply	6
	Culture	2
	General clerk	2,081
	General laborer	15
	Technical water	147
	Services	3,038
	Sub-total	7,304
Water treatment dept.	Engineer	169
	Assistant engineer	291
	Technical worker	2,056
	Technical worker (Agriculture)	3
	Technical worker (Centralized control)	4
	Sub-total	2,523
Project dept.	Engineer	69
	Assistant engineer	61
	Technical worker	10
	Sub-total	140
Network dept.	Engineer	105
	Assistant engineer	466
	Technical worker	1,757
	Technical personnel (Agriculture)	5
	Technical worker (Agriculture)	2
	Sub-total	2,335
	Total	12,302

2 - 3 - 5 Related Development Plans

(1) National Development Plan

The National Development Plan currently under way is the Long-Term Perspective Plan with 20-year duration, that covers the period comprehended from 1983 to 2002.

The basic goals of the Long-Term Perspective Plan are listed in the followings.

1) To develop an independent economic system for the Arab Republic of Egypt
2) To enhance the basic infrastructure
3) To realize adequate distribution of the population

Successive five-year plans are being formulated and executed with the object of attaining the said goals. The major goals of the Second Five-Year Plan (1987/88 to 1991/92) and the Third Five-Year Plan (1992/93 to 1996/97) are the improvement of the living standards and the increase of the productivity.

In connection with the water supply systems, the goal of these Five-Year Plans is to increase the water supply capacity from 8,600,000 m^3/d to 12,400,000m^3/d for the whole country. Of that total, the Five-Year Plans are aiming at increasing the supply capacity of running water in the Greater Cairo from 3,400,000 m^3/d to 5,300,000 m^3/d.

(2) Master plan on water supply for Greater Cairo

The water supply system of the Greater Cairo is divided into two (2), the East Bank and the West Bank area by the Nile River, and separate master plans have been formulated for these two areas.

1) East Bank

A study on the development plan of the water supply system of the Greater Cairo was conducted in 1979 by the consultants of the United States.

The target was set at the year 2000, and according to that study the 5-year period comprehended from 1978 to 1982 was included in the primary emergency plan, and the period comprehended from 1982 to 2000 was included in the secondary improvement plan.

Due to delays in the execution of the works and rapid increase of the population of the Greater Cairo, however, the plan was revised in 1986 by Japanese consultants. The studies referring to the said development plan were conducted by focusing mainly on the East Bank. In reality, also this revised plan was not put into practice because of the remarkable changes that occurred in the social environment of the Middle East.

Later on, the revised development plan formulated by Japanese consultants was revised once again with financial resources provided by grant-aid from the United States, and the most recent version is the East Bank Water System Master Plan Update 1990. According to that last version, in the year 2000 the water served population of the East Bank area will mount to 12.78 million with a demand of 5,750,000m^3/d, and in the year 2010 it will further increase to 16.04 million with a maximum water demand of 7,000,000m^3/d.

2) West Bank

According to the West Bank Water System Master Plan 1987 carried out by German consultants, in the target year of 2000 the water served population of the West Bank area will mount to 4.11 million with a maximum demand of 1,530,000 m^3/d. GOGCWS has estimated that the water demand in the West Bank area will increase to 2,000,000 m^3/d in the year 2010, by making extrapolations from the previous studies.

3) Water demand in the target year (2010)

Based on the Master Plans mentioned above, GOGCWS has set the water demand of 7,000,000m^3/d at the East Bank and 2,000,000 m^3/d at the West Bank. Altogether, it is estimated that there will be a water demand of 9,000,000 m^3/d in the Greater Cairo as a whole.

4) Water demand in the Amyria water supply area

According to the Master Plan, the water demand in the Amyria water supply area is expected to evolve as shown in Table 2-9, and Table 2-10 is tabulated prospected served population in each target year.

TABLE 2-9 WATER DEMAND IN THE AMYRIA WATER SUPPLY AREA

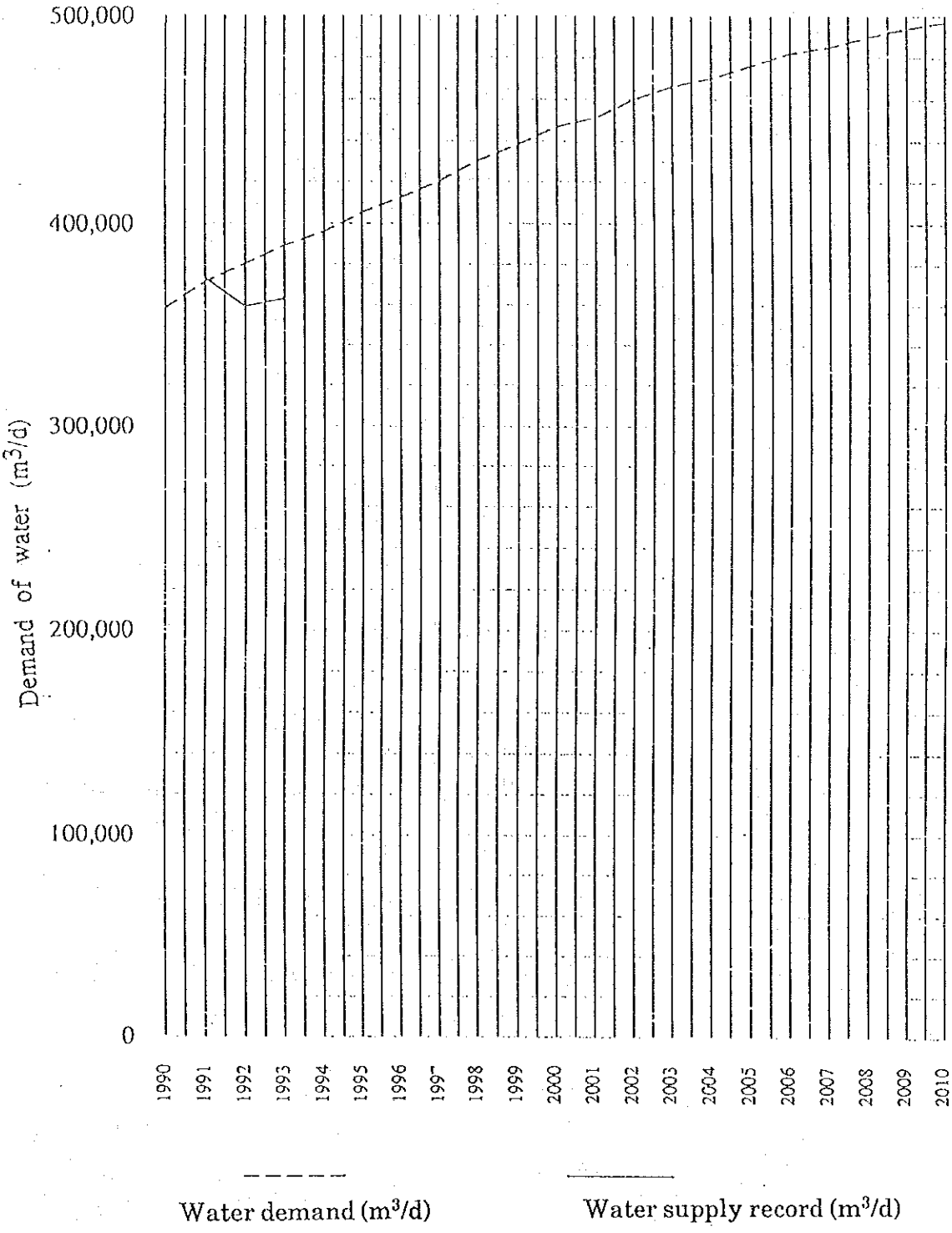
(Unit: m^3/d)

Demand	1990	2000	2010	Remarks
63 m Zone	308,047	396,956	447,027	
100 m Zone	50,000	50,000	50,000	
Total	358,047	446,956	497,027	

TABLE 2-10 WATER SUPPLY POPULATION OF THE AMYRIA WATER SUPPLY AREA

District	Population		
	1990	2000	2010
Zeitoun	280,000	280,000	280,000
Elwaily	117,000	129,000	129,000
Nasr City	137,000	180,000	250,000
Sharabia	53,000	53,000	53,000
Hadiec Koba	330,000	330,000	330,000
Sahel	112,000	120,000	125,000
Shubra	32,000	34,000	38,000
Heliopolise	450,000	500,000	600,000
TOTAL	1,511,000	1,626,000	1,805,000

FIGURE 2-5 WATER DEMAND IN THE AMYRIA WATER SUPPLY AREA



(3) Development plan on water treatment plants for Greater Cairo

1) Greater Cairo Third 5-Year Water Plan

Successive Five-Year Plans based on the Master Plan are being implemented for the water supply system of the Greater Cairo, and the Greater Cairo Third 5-Year Water Plan (92/93 to 96/97) is currently under way by GOGCWS. The current Five-Year Plan is outlined in the followings.

Part 1
Projects carried out under the Second 5-Year Water Plan (1986/87 to 1991/92)

Part 2
Projects that could not be carried out under the Second 5-Year Water Plan

Part 3
Evaluation of the Second 5-Year Water Plan

Part 4
The Third 5-Year Water Plan (92/93 to 96/97)
The following projects related to the Amyria Plant are included in this Third 5-Year Water Plan

Expansion of the Amyria Plant : 200,000 m^3/d
(Code No. 209600)
Rehabilitation of the Amyria Plant : 100,000m3/d
(Code No. 209600)

Part 5
Projects related to the water distribution facilities, pipeline system and water service pipe system.

2) Water treatment plant development project of the Greater Cairo

The water treatment plant development project of the Greater Cairo assumes a water demand of 7,000,000 m^3/d for the East Bank and 2,000,000m3/d for the West Bank at the target year (2010), and comprises the contents of the Third 5-Year Water Plan.

The water treatment plant development plan is outlined in the followings.

a) Under construction

Fostat Water Treatment Plant
The capacity of the Fostat Water Treatment Plant will be boosted through the strengthening of the distribution pipeline and the distribution reservoir (with Egyptian funds): Increase of 180,000m^3/d

Mostrod Water Treatment Plant
Second phase of expansion of the facilities (with financial resources provided by France): Increase of 200,000m^3/d

Shoubra El Kheima Water Treatment Plant
First phase of reinforcement of the facilities (with financial resources provided by France): Increase of 200,000 m^3/d

North Helwan Water Treatment Plant
Rehabilitation of the facilities (with Egyptian funds): Increase of 75,000 m^3/d

b) Construction projects being planned (with the raising of the required financial resources in sight)

Embaba Water Treatment Plant
Reinforcement of the facilities (with French funds) : Increase of 400,000 m^3/d

South Giza Water Treatment Plant
Reinforcement of the facilities (with French funds) : increase of 200,000 m^3/d

Fostat Water Treatment Plant
First phase reinforcement of the facilities (with French funds) : Increase of 300,000 m^3/d

South Giza Water Treatment Plant
Reinforcement of the facilities (grant-aid from Japan) : Increase of 35,000 m^3/d

c) Construction projects being planned (with the raising of the required financial resources not in sight)

Shoubra El Kheima Water Treatment Plant
Second and third phases of the reinforcement of the facilities : Increase of 400,000 m^3/d

Amyria Water Treatment Plant
Reinforcement of the facilities : Increase of 200,000 m^3/d

Amyria Water Treatment Plant
Rehabilitation of the facilities : Increase of 100,000 m^3/d

Rod El Farag Water Treatment Plant
Partial rehabilitation of the north side facilities : Increase of 200,000 m^3/d

Tebbin Water Treatment Plant
First phase of the reinforcement of the facilities : Increase of 200,000 m^3/d

Embaba Water Treatment Plant
Second phase of the reinforcement of the facilities : Increase of 200,000 m^3/d

Kafr El Elw Water Treatment Plant
First and second phases of the reinforcement of the facilities : Increase of 400,000 m^3/d

El Khosos Water Treatment Plant
Construction of the new facilities : Increase of 800,000 m^3/d

El Zahra El Amady Water Treatment Plants

Construction of the new facilities : Increase of 900,000 m^3/d

d) As a result of the reinforcement projects mentioned above, the water supply capacity will be increased by 4,990,000 m^3/d. Since the current facilities have a capacity of 3,640,000 m^3/d, the water supply system of the Greater Cairo will have its total capacity increased to 8,630,000 m^3/d. Therefore, it can be seen that even if all of the water treatment plant reinforcement projects mentioned in the sections a), b) and c) above are carried out, there will be a shortage of 370,000 m^3/d compared with the planned water demand of 9,000,000 m^3/d.

As for the Khafr El Elw Well with 75,000 m^3/d capacity, the El Lemaya Well with 45,000 m^3/d capacity and the El Jorliebileh Well with 15,000 m^3/d capacity will be scrapped by the target year.