2.11 Excreta Disposal Systems

2.11.1 General

Roughly 55 percent of the national population rely for their excreta disposal on either septic tanks or soakaways, but another 35 percent have to do without any appropriate wastewater disposal systems. Although the exact number or percentage of the population receiving different sanitation service levels in Sharqiya Governorate is not available at present, it can be assumed from the observations of the existing sanitation systems that the conditions in the Governorate are superior to the national average.

In both urban and rural areas where sanitary sewerage systems are not available, transh (soakaway) system is most commonly used. Septic tanks are also in use at many locations. In most cases, the two systems accept both toilet and sullage wastes, settle the solids, and dispose of the partially treated wastes through soakaways or drainage trenches.

2.11.2 Transh (Soakaways)

The system consists of, in general, toilet, bath, sink, pipes and transh. Excreta is carried to transh through the pipe, either mixed with the sullage water or separately. The transhes are either rectangular or circular in shape, somewhat similar to septic tanks sited at underground locations, in which excreta is mixed with sullage water and retained for several days. During this time, the solids settle to the bottom of the chamber where they are digested anaerobically.

Rectangular type transh is commonly used for domestic use, with internal sizes from 1 to 2 meters and with a maximum depth of 3 meters. Circular transhes with internal diameters of 1.5 to 2 and maximum depth of 3 meters are commonly used. In rural areas, transhes are pits that are dug up and covered by a concrete slab with a small inspection hole for cleaning or other purposes, and generally unlined. In urban and some rural areas, the pits are commonly lined with stone or concrete blocks down to the bottom, and further if the subsoil is unstable.

For efficient percolation of the liquid into the surrounding subsoil, crushed stones are sometimes placed without any mortar joints. The top of the transh is covered by a concrete slab with a manhole of 60 to 75 cm dia. either circular or rectangular in shape, for cleaning and maintenance of the pits. Typical transh pits are illustrated in Figures 2.30 and 2.31.

When the sidewalls and bottoms of the pits become clogged, permeabilities are greatly reduced, in some cases down to a tenth of their original levels after a few years. Where subsoil permeability is high, digested solids and water in general percolate into soils effectively without much trouble. Salt is said to be used sometimes to redissolve the accumulated scum or sludge on the transh walls.

During the house to house surveys to inspect sanitation facilities during the present study, it was observed that where the groundwater elevations are high and permeable subsoils are saturated by the groundwater, natural biological decomposition in the soil is minimal, and consequently, groundwater contaimination occurs. According to the Health Department of the Governorate, there have been many cases reported of shallow wells polluted by transh wastes.

Wastewater, in excess of the transh's reduced percolation capacity, results in either the pits overflowing or the necessity to have it pumped out. In some areas where the groundwater elevation is high, the transhes are not effective in absorbing the wastes and frequent cleaning of the pit contents are required. It has been estimated that the maximum seepage rate from the transh into the ground soil is between 25 and 100 lcd. This means that where the population density is high and the amount of water consumption is increased, the transhes might be overloaded and measures need to be taken to improve its condition.

The proper maintenance of pits requires pumping its contents out, upto several times a year. Vacuum car collection is practised for emptying transhes. Local municipalities and local councils are in possession of vacuum cars, which are rented out to individuals on request at a cost of LE 1.0 to LE 3.0 each time. The capacity of the vacuum cars rage from 2 to 7 m^3. Transh construction costs about LE 300 if installed by a contractor. The most expensive component is the top cover, which, in many cases, is placed at or just below the ground level and is made of reinforced concrete.

2.11.3 Septic Tanks

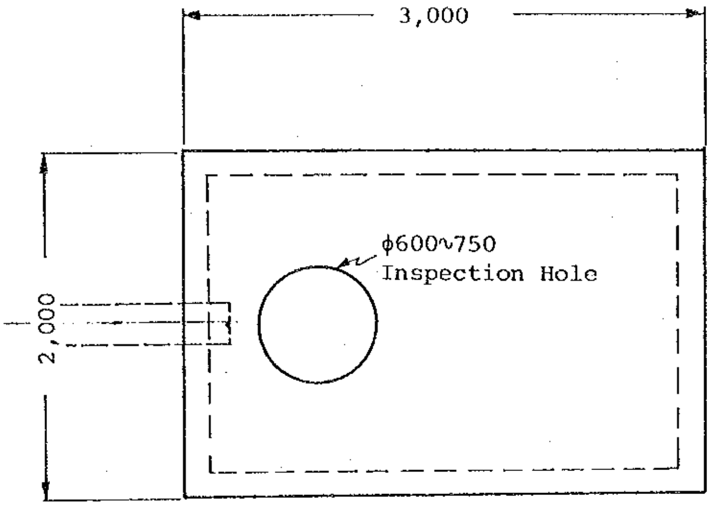
Septic tanks are also used in many locations where indoor toilets and water connections are available. In most cases, the tanks accept both toilet and sullage wastes, settle the solids, and dispose of the partially treated wastes through transhes or a drainage trench.

Figure 2.32 is a sketch of a typical septic tank system.
The conventional design of septic tanks generally used in Egypt are shown in Figure 2.33 (Ref. No. 2)

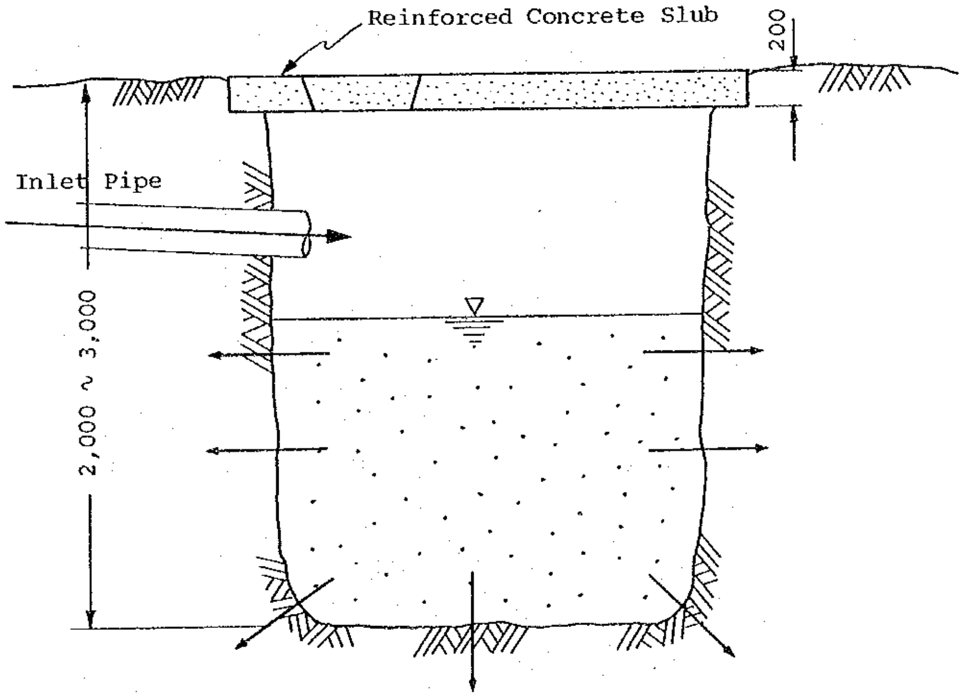
As shown in Figure 2.33, the conventional tanks have only a single chamber which overflows through a pipe into a transh. The wastewater discharged from the household flows into the septic chamber where much of the settlable solids are trapped. The digested sludge is emptied by vacuum truck every two or three years, depending on the number of people contributing. The effluent in most cases percolates into the subsoil through the transh.

Many septic tanks constructed at locations where the groundwater elevation is high are subjected to groundwater infiltration if the tank structure is not sufficiently water tight to prevent the tanks from the groundwater intrusion. Such excessive dilution of the tank contents shorten the detention time of the wastes, thereby resulting in insufficient anaerobic digestion of the contents. In many locations with high water tables, the low points of tank become permanently flooded, further aggravating surface drainage problems. These could be breeding sites for flies and mosquitoes.

Septic tanks may be reasonably estimated to provide 50 percent removal of BOD in the wastes if the tanks are properly maintained. Therefore, the tank effluent still contains high organic loadings and tends to contaiminate the groundwater. Most ineffective septic tanks could be upgraded through pumping and cleanout, but some will have to be improved by adding biological filters and/or chlorination facilities.



PLAN



Dimensions in mm

SECTION

Figure 2.30 Typical Transh (Unlined)

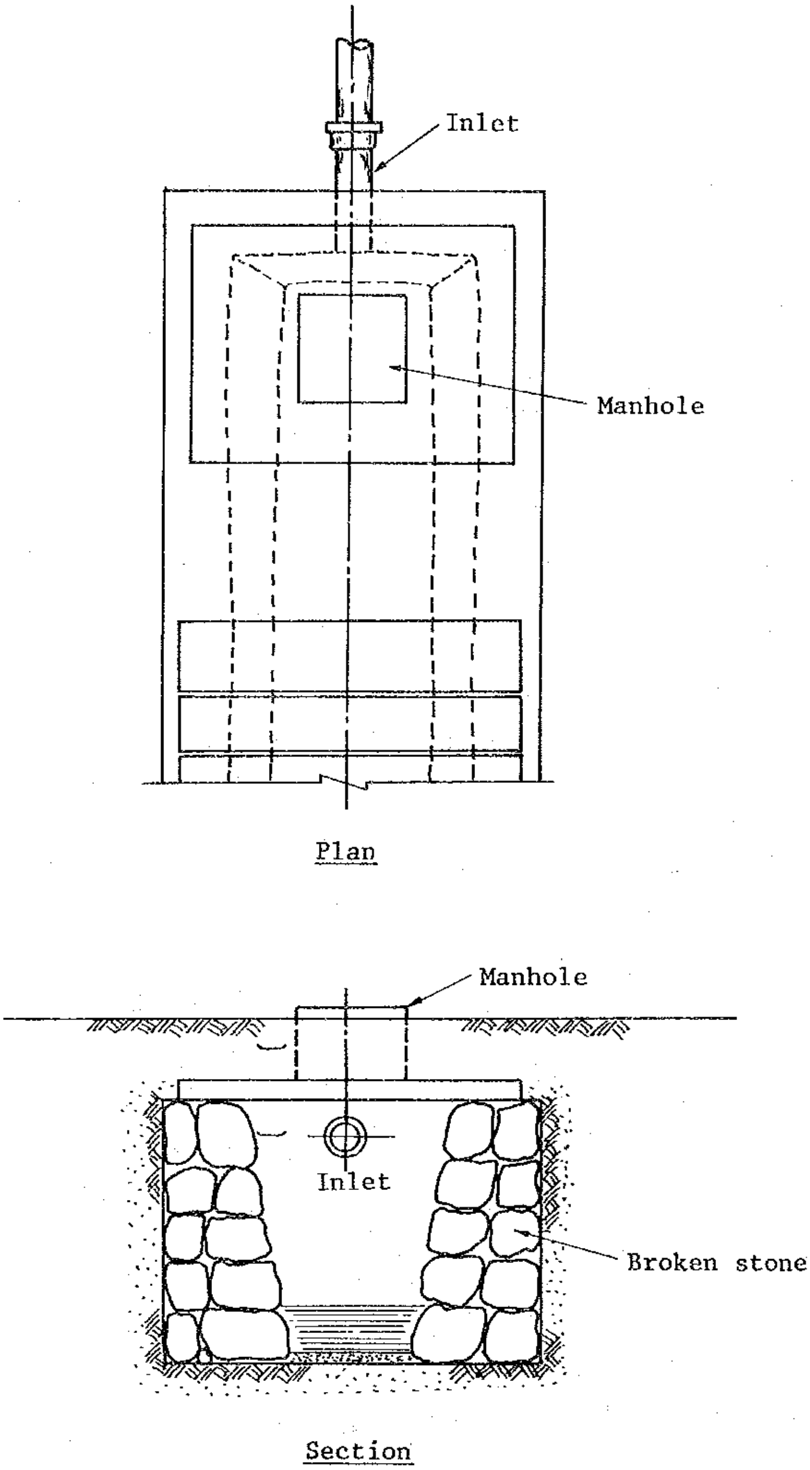


Figure 2.31 Typical Rectangular Transh (Large capacity)

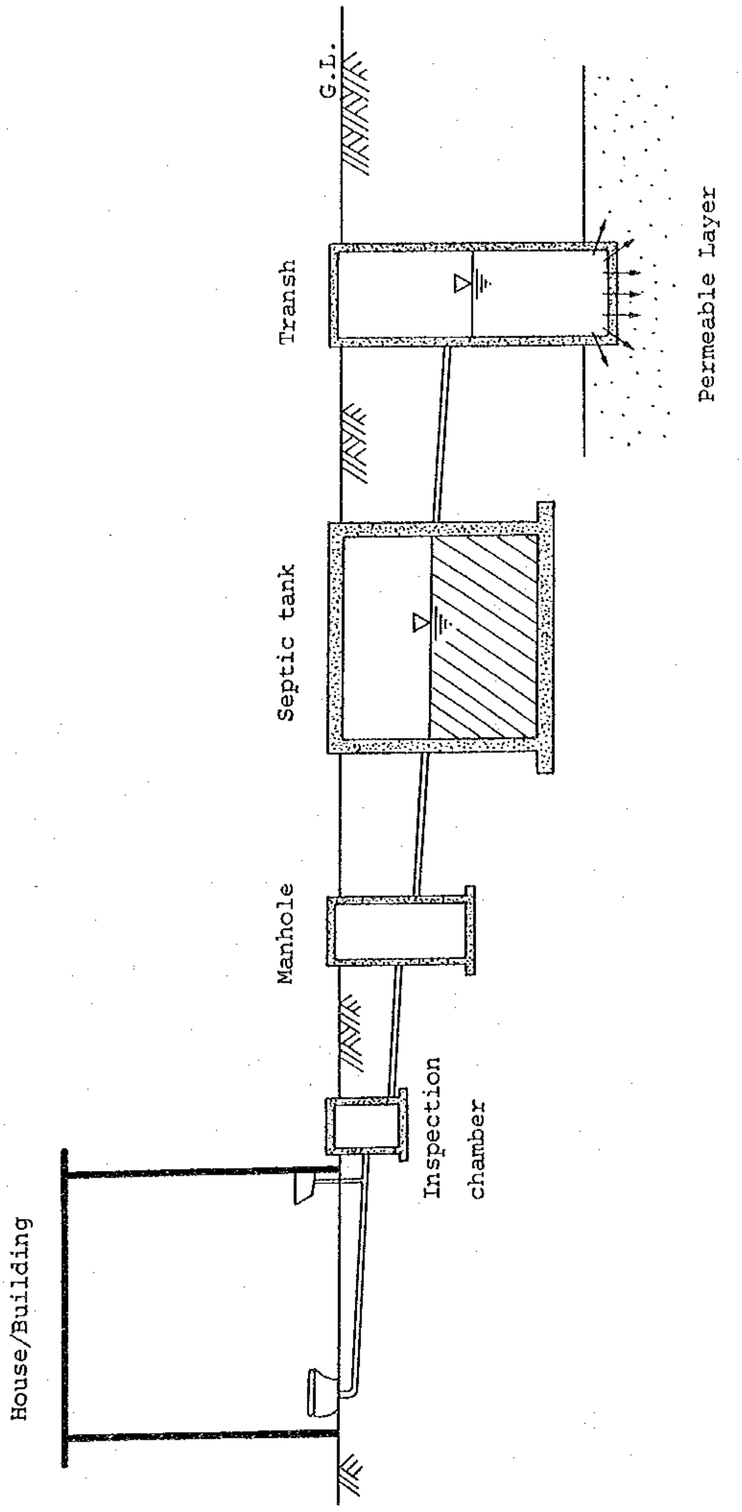
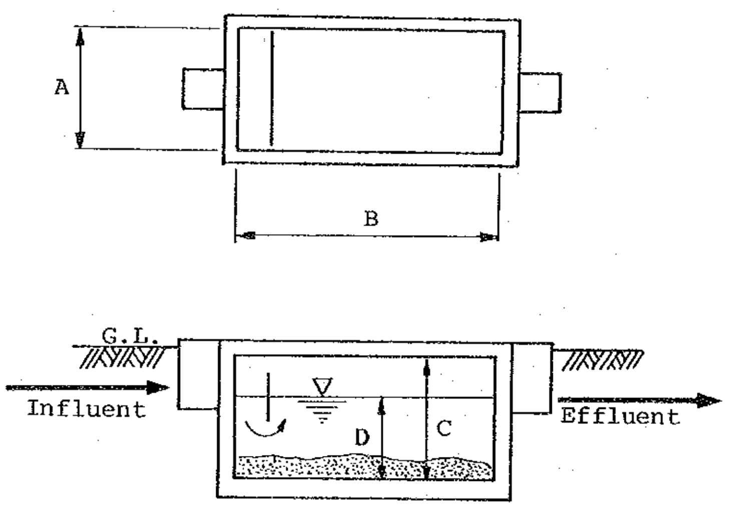


Figure 2.32 <u>Typical Septic Tank System</u>

Septic Tank



Typical Dimensions

	A	B	C	D	Capa. by person
	m	m	m	m	
1	2	3	2.1	1.7	40
2	2	5.5	2.1	1.7	60
3	2	7	2.4	2.0	80
4	2.5	7	2.4	2.0	100
5	2.5	9	2.4	2.0	120

Figure 2.33 Standard Dimensions of Septic Tanks in Egypt

2.12 Environmental Problems

2.12.1 General

Environmental assessment is a new branch of engineering. It is important to give considerations to the environment when planning development projects. It should always be remembered that though development is intended to achieve better living conditions, it also causes some negative effects. These might be come apparent during implementation of a development project or long after it is completed, sometimes even 10 to 20 years later. In recent years, environmental problems are found throughout the world as a result of the failure to consider negative aspects of development, due to an eagerness to view positive aspects only.

In the development of the Sharqiya Governorate-delta, assessment for environmental impacts are vital. Deltas not only have special ecological characteristics, but are also more vulnerable to environmental changes than other geographical areas. Furthermore, there have been rather few large-scale development projects in the tropical and sub-tropical zones. Thus, readily available data are scarce.

Until recently, the principal concern with respect to water in Egypt has been with providing adequate quantities with little concern for quality. A disease called "Schistosomiasis" known to have afflicted Egyptian in old times was perhaps the only water-borne to have concerned the populace though no corrective measures were taken with respect to water qaulity.

Even though schistosomiasis appears to have stabilized, other water quality considerations like eutrophication, pesticide pollution, sanitation, industrial pollution, and domestic pollution need to be examined, because they are assuming increasingly ominous proportions day by day.

In the meantime, after completion of the Aswan High Dam, the incidence of the waterborne diseases has increased in the delta as well as in the upstream areas. Diseases have continued to plague rural inhabitants in the Sharqiya Governorate, and as was mentioned earlier, the threat of the further spread is ever present. The most effective prevention is the provision of good quality water supply and proper and adequate sanitation facilities in urban and rural areas.

2.12.2 Water Pollution

(1) Present Status of Water Pollution

In the Sharqiya Governorate-delta, water pollution is generally attributable to human activites. The biggest culprit is the discharge of domestic effluents into public waters.

There is no sewage treatment plant in the Governorate (even the one treatment plant in Zagazig does not function as designed). Raw sewage has been discharged into nearby drains like the Bahr El Bakar, Bilbeis and Faqus which have now become open channel sewers accompanied by bad odor and sources of waterborne diseases. From the analysis of wastewater, taken at a representative discharge points in the Sharqiya Governorate, the values of BOD, SS, NH_4-N and TP are 372 mg/l, 167 mg/l, 22 mg/l and 5 mg/l respectively. Groundwater taken from some shallow wells exhibited 42 to 114 MPN/100ml of Fecal Coli forms, when in fact, it should not ever exist in drinking water. From these results, its effect on the city water, eutrophication and sanitary problems derivable from wastewater are described below. Details of water analysis are shown in Appendix IV under "Water Quality Analysis".

(2) Effect an Urban Water Supply

The first victim of pollution is urban water supply. Long before visible symptoms of pollution appear, water purifying plants will encounte problems or the water supplied will carry an offensive odor since even a slight increase in nutrient content yields a great deal of plankton. As the pollution increases to include ammoniacal nitrogen and BOD, filtration basin will no longer be sufficient, making it impossible to purify water adequately. If chemical treatment is employed to resolve this, the water will become clear but become high in ionic content, and its commercial value will decrease. Yet another problem is the toxicity and infection resulting from the deleterious materials and bacteria, overloading the water purification system to the point of requiring, emergency measures and costly treatment. In the extreme case, the system will cease to attain its stated objectives, which would be truly tragic, given the amount of devastation it would cause to public health.

Water contamination with urban effluents increases the content ammoniacal nitrogen, pathogens, and other offensive substances. This water can no longer be managed by the slow sand filtration, and chemical treatment is indispensable. Even if dual filters are applied, it must be combination with chlorination, activated charcoal treatment or ozonization. In most cases, polluted water contains iron and manganese, removal of which inevitably requires chlorination and pH control.

(3) Eutrophication

Eutrophication means increase in the nutrient content in the water. It will result in the prolific growth of plankton multitudinous yield of algae. This enters filtration ponds and foul up, putting it in disorder and choking up the water supply from it. This kind of disturbance occurs even when the BOD content of water is as low as 1 to 2 ppm. Effluents of sewage treatment plant, direct discharges from sewers/drains and from slaughter houses contain significant quantities of nitrogen and phosphorus, which are the precursors of eutrophication.

Eutrophication leeds to the proliferation of plankton, which in turn, gives the water offensive odors. Some odors emanate directly from algae, and some others are caused secondarily as a result actinomyces and other bacteria which live on dead algae.

Deodorization is a very difficult process. The use of activated carbon or ozonization are the bestknown methods of deodorization. Most water treatment plants use activated carbon for deodorization, but activated carbon is very expensive, imposing large financial burdens.

Lakes and canals which are filled with planktons turn green or thick brown, forming the so-called flowers of water. Consumers using this water cannot get rid of coloring matters or planktons completely, and must put up this "green water".

(4) Sanitary Problems

Contamination of water sources is accompanied with proliferation of germs and endangering water quality. If colitis germs abound, it would lead to pathogen grwoth. Under such circumstances, if chlorination is insufficient or suspended, people are at a grave risk. Polluted water sometimes contain pathogenous viruses which are comparatively resistant to chlorine, and much attention is being paid on how to inactivate them. Lying this, the pollution of water sources is of grave concern as it directly affects the health of the populace at large, and of inflicting irrevocable damage and losses upon the people.

People served with water from polluted sources often complain about the bad taste of water. The causes are contaminated raw chemicals and traces of chemicals dosed to purify the water. Water services at times deliver "red water" which inflict serious damage on laundry shops, food processing plants, etc. Iron and manganese remaining in water and red rust flaking off incrustations on the inner walls of water pipes are the main causes. Water obtained by processing polluted raw water contains highly active metallic ions, because it contains large amounts of dissolved solids.

(5) Countermeasures against Water Pollution

As the problems mentioned above are mainly caused by eutrophication of water, sewerage construction is a direct countermeasure to prevent it and restore water quality. Removal or reduction of nutrients (Nitrogen and Phosphorus) by treatment is considered to be the best method to prevent eutrophication of water, but, conventional sewage treatment processes cannot remove N and P completely. Therefore advanced treatment processes is necessary for this purpose.

Presently, the Sharqiya Governorate-delta does not have a comprehensive modern sewerage system, and all the domestic and commercial wastewater is being discharged directly into nearby drains without receiving any treatment.

The ever-increasing population and the improvement in the living standards in the area have rapidly increased the water use, and the groundwater contamination by the uncontrolled discharge of wastewater has reached serious levels, requiring immediate actions to prevent further degradation of the groundwater as well as water canals. Further, groundwater contamination in the area will cause serious damage to the environment and development of the area, especially agriculture.

From these observations, it appears that the need for a comprehensive sewerage system construction program cannot be arestated and this shoud be immediately initiated. If no modern sewerage system is provided, the sanitary conditions will become progressively worse. A side-benefit of treatment is that the sewage treatment plant effluent can be fully utilized for agricultural and other purposes as a new water source.

2.12.3 Pollution Control Legislation and Measures

There are numerous Egyptian laws and executive regulations pertaining to environmental protection. A summary of the main laws and decrees is summarized below. Brief descriptions of other pertinent laws and decrees are given in Appendix II.

The basic legislation governing wastewater collection and disposal in Egypt is covered by Law No. 93/1962 as a whole. Law No. 93/1962 was provided replacing three earlier laws, namely No. 35/1946, No. 96/1950 and No. 196/1953 which is modified by No. 33/1954 concerning the drainage of water from buildings and the discharges of public, industrial and commercial wastes to drains. The Ministry of Housing subsequently issued Decree No. 649/1962 concerning the executive regulation for Law No. 93/1962. A brief summary of the major points on this law is described below:

Law No. 93/1962 is divided into three chapters. In the first chapter, it mainly discusses that the government is enpowered to provide sewers and require or restrict connections: it also establishes authority over the types of wastes which can enter the sewer system and the acceptable quality of such wastes. The second chapter deals with types of effluents and their appropriate receiving waters, while the third outlines general rules and penalties for non-compliances with the law.

Industrial wastes can be discharged into the sweet water canal or drainage canals provided the quality is within permissible limits established by the Ministry of Housing and approved by the Ministry of Health. Local representatives of the Ministries of Irrigation and Industry are also consulted in determining acceptable discharges. Monitoring and testing of industrial wastes is performed under the direction of the Ministry of Health.

For discharges found to be in violation of specifications, the offending factory is given six months to bring its wastes into compliance. Failure to comply is punishable by revocation of the discharge permit, fines or imprisonment. In the case of an urgent hazard, the discharges can be stopped by official decree or the agency in charge of drainage can take corrective action at the offending factory's expense.

Domestic sewage can not be discharged into the sweet water canal, but can flow into drains if it meets established specifications. Sewage collected by the Sharqiya wastewater system would be a combination of industrial, commercial, and domestic wastes; in this case, discharge specifications for domestic sewage prevail. Law No. 93/1962 also establishes guidelines for disposal of wastewater by irrigation of agricultural lands. Discharge standards are set according to the type of soils affected.

The provisions of Law No. 93/1962 are strengthened and expanded by Law No. 48/1982, entitled "Protection of the River Nile and the Water Streams against Pollution". Law No. 48/1982 strengthens the measures aimed at protecting the waterways and includes some changes in sampling and analysis procedures. It creates a special fund supplied by fines and fees to assist in the establishment of municipal and industrial wastewater plants. Translation of Law No. 48/1982 and its regulations are included in Appendix III.

2.13 Other Public Facilities

2.13.1 Roads

The cities, towns and villages in the Governorate are linked to each other by road networks. The roads may be classified by their use and scale into two categories, highways and intra-city roads. The highways are constructed by the Central Government to connect cities, towns and villages, while intra-city roads are to serve streets within the cities and towns.

Major highways in the Governorate are as follows :

- Highway between Minyet El Qamh, Banha and Cairo, with a length of 83 km.
- Highway between Zagazig, Meat Gamr, Tanta and Alexandria.
- Highway betwenn Zagazig, Abu Hammad and Ismailia, about 90 km long.
- Highway between Zagazig, El Shalhia and Port Said, about 174 km in length.

Projects for paving the streets and inner roads of cities and towns have been underway in the Governorate. There are also projects to pave roads between construction sites and marketing centers, and connect the cities and towns, for the convenience of residents and to stimulate the local economic activities. Under these projects, more than thirty roads in and out of urban areas have been paved.

The highways may be classified into two types, two-lane and four-lane roads. The four-lane roads are generally provided with a central separation zone and reserved land space at both sides. The pavements have in general a total thickness of 36 cm, consisting of 5 cm thick surface asphalt finish, 6 cm base asphalt layer and a gravel foundation of 25 cm thick.

The inner roads in the cities and towns are also classified into two types, two-lane and four-lane, with widths ranging from 21 m to 25 m. The four-lane roads are generally provided with a central separation belt and footpaths of 2 to 3 m width. The pavement of the roads is in general 30 cm, consisting of a 5 cm surface asphalt finish and a gravel foundation of 25 cm. The second class inner roads have widths from 6 to 10 m. The pavement of the second class roads are same as that for the main roads, but most of the roads of this class are yet to be paved.

2.13.2 Electricity

The electricity supply to the cities and villages in the Governorate is the responsibility of the Electric Company for Suez and Sharqiya. The Company is also responsible for development and operation of the electricity supply projects in the Governorate.

The Company buys the electricity from the Electricity Region of Suez Canal and sells it to the consumers. As of 1987, there were a total of 432,033 electricity connections within the Governorate, of which 427,055 are connected with the public nets, but a total of 129,295 buildings are not yet connected.

The Company has carried out several important projects from 1982 through 1987, including new electricity supplies to both public and private sectors with a capacity of 500 kWh or more. The Company's development plans have been carried out under the Master Plan 1982/87 to meet all the needs for reliable electricity supply in the Governorate.

2.14 Previous Studies and Reports

Studies and reports important to this study, relating to several aspects of the Sharqiya Governorate and Egypt, have been made available, which are crucial to the establishment of strategic sewerage planning and to identify the proposed project. The more important recent reports or studies are discussed here. In addition, various other information and reports used for this study are listed at the end of this report. References are made as needed throughout the body of the reports by reference numbers.

2.14.1 Urban Development

(1) The Regional Office of GOPP for the Third Region in Ismailia planned out the Master Plan for the Sharqiya Governorate on the basis of the following general conception:

(a) To preserve the agricultural land, conversion of farm land to any other purposes is restricted by the Agricultural Land Law, and

(b) The large scale development plan for the future land use is to be developed in the desert area that stretches between Ismailia Canal and Sulheiya Canal.

Based on the above concept, the Regional Office of GOPP has made or is planning the land use plans as follows:

Zagazig City	- The study is under way and will be completed in 1988,
Bilbeis City	- Released in 1985,
Abu Kebir City	- The study is under way and will be completed in 1988,
Faqus City	- Planned by the Physical Planning Section of the City,
Other Cities	- Plan not started yet.

(2) "Comprehensive Planning of Zagazig City 1973 - 2000," Prepared by Dr. Mahmoud Youssry, No. 39, Kasr Nile St. Cairo. (Original in Arabic, partly translated into English).

This report describes basic studies, urban development, future population forecasts, urban structures, public service levels, utilities, economics, and various plans of Zagazig City up to the year 2000. Information regarding water supply, sewerage and other sanitation aspects are reviewed and referred to the master plan of sewerage system for the City.

(3) "Detailed Frame of the Five-Year Plan for Economic and Social Development 1987/88 - 1991/92," Ministry of Planning. A.R.E., December 1986.

2.14.2 Water Supply, Sewerage and Sanitation Systems

(1) "Feasibility Study on Sharqiya Water Supply System in the Arab Republic of Egypt" Government of Egypt, prepared by JICA, December 1984.

This report presents long-term and priority programs for water supply systems in the Sharqiya Governorate up to the year 2005, together with preliminary engineering, construction schedule, and cost estimates. Major features of the plan are as follows:

- Served population by the system in 2005 will be 4.885 million.

- Estimated water requirements in 1995 and 2005 in the Governorate are 495,000 m^3/day and 687,000 m^3/day, respectively.

- The First Priority-Phase water supply system includes the construction of two water treatment plants with a total capacity of 75,000 m^3/day together with distribution systems.

- The emergency works comprises of capacity expansion, rehabilitation of existing water treatment works, groundwater development, and procurement of machines/vehicles for maintenance of the systems.

The data and information presented in this report were used for estimating the future wastewater quantities in the sewerage planning.

(2) "The Preliminary Report, Phase-Two Treatment and Sewerage Project of Zagazig City, "NOPWASD, prepared by Dr. Ahmad Abdel-Warith, 1980. (Arabic, translated in English).

This report describes basic planning and design considerations for Zagazig sewerage systems development project, including basic data on natural conditions, climate, winds, humidity, evaporation, sunlight, wastewater characteristics, population forecasts, etc., and design basis for the new treatment plant. Also included are some historical information on the existing treatment plant. Part of the report is excerpted and translated as shown in Appendix-VI "Zagazig Sewage Treatment Plant."

(3) "Design Report on Zagazig City Sewage Treatment Plant," NOPWASD.

This report describes the design procedures for the new sewage treatment plant facilities, including design criteria used for design of each facility. The estimated served population by the new treatment plant for 2010 and 2030 are 385,000 and 522,000 persons, respectively. The capacities of the treatment plant are 121,275 m^3/day in 2010 (Second stage) and 195,750 m^3/day for 2030 (Final stage). Design criteria for major facilities are indicated in Appendix-XI "Zagazig Sewage Treatment Plant," Volume Three.

(4) "Provincial Water Supplies Project," Ministry of Housing, General Organization for Potable Water, by Binnie & Partners, John Taylor & Sons in association with Dr. A. Abdel-Warith (Consulting Engineer) and Coopers & Lybrand Associates Limited, February 1980.

This documents consist of the following six volumes:

- Volume 1 Report Summary
- Volume 2 Existing Situation
- Volume 3 Future Developments
- Volume 4 Organization and Management
- Volume 5 Finance, Tariffs and Implementation
- Volume 6 Appendices to Volume 4

The purpose of this report is to provide the basis for a long-term program to improve and expand the supply of potable water throughout provincial Egypt. The report describes the existing water supply situation including wastewater disposal, detailed program for water supplies, and recommendations on the future organization, management and staffing of provincial water supply works and on suitable financial arrangements and tariffs. Some recommendations on the urgent need for improved wastewater disposal facilities are also made as the improvement of water supplies will aggravate the present unsatisfactory wastewater disposal situation, particularly in the urban and larger rural communities. Some data and information are used as references for the present sewerage study.

(5) "Existing Situations of Water Supply and Sewerage Systems in Sharqiya Governorate, 1985" Prepared by the Sharqiya Governorate, Information Center (Original in Arbic, portions translated into English).

The documents describe the present situation of water supply and sewerage systems in the Governorate. With regard to the existing sewerage facilities, the documents present some details of seven cities, namely i) Zagazig, ii) Abu Kebir, iii) Qenayat, iv) Huseiniya, v) Ibrahimiya, vi) Hihya, and vii) Kafr Saqr. These data were referred for the survey of existing sewerage systems and for sewerage planning purpose.

(6) "Study Report on Existing Rural Sewage Treatment Facilities," General Authority for Rehabilitation Project and Agricultural Development (GARPAD) Ministry of Agriculture and Land Reclamation, A.R.E., prepared by Eng. N. Tsukihashi, JICA Expert, May 1987.

This report presents the results of field surveys and studies on the existing excreta and wastewater treatment and disposal systems used in rural areas, and recommendations for improvement of existing sanitation facilities are made. The study also includes the possible reuse of the effluent from the sewage treatment systems for land development areas. The data and information in this report were referred to for developing sanitation improvement plans, particularly for transh and septic tank improvement plan.

2.14.3 Incorporation of Previous Studies in the Project

Findings and other information from these reports and studies have been incorporated in this study to establish the plans for sewerage and sanitation systems. In addition to these, many other documents and data obtained from Central Government agencies, Governorate, cities and private enterprises, were used for this study, as listed in the "References" of this report. References to the reports quoted in the references are directly given in the text.

2.15 Need for the Project

At present, twelve cities in the Governorate have sanitary sewerage systems to collect and dispose of the sewage from the urban built-up areas; however, none of these, except Zagazig City, has appropriate sewage treatment system. Even in Zagazig sewerage system, the treatment plant facilities constructed in the 1930s have become obsolete, and only a small portion of the influent sewage is subjected to sedimentation, and almost all the sewage bypass the works and is discharged directly into the nearby drain. To improve the condition, a new treatment plant construction is now under way by NOPWASD, but it may take another few years to complete.

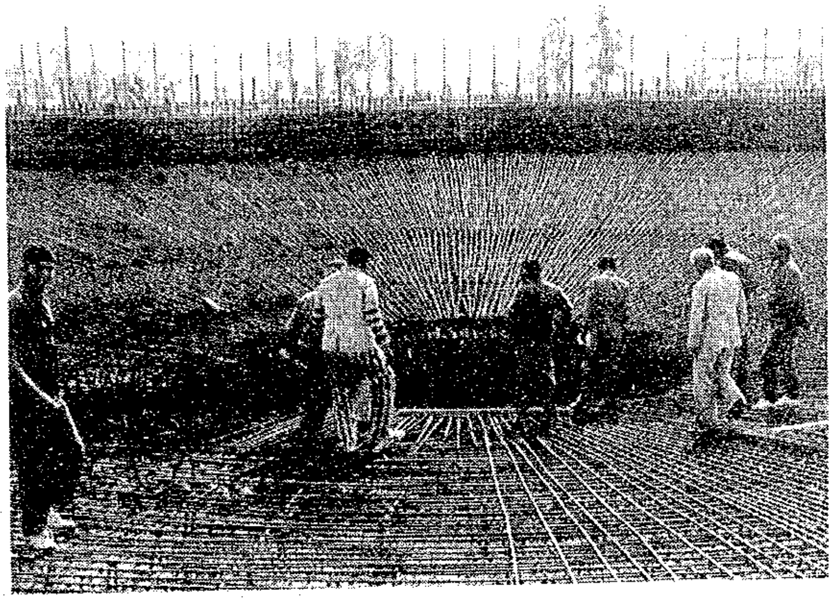
The ever-increasing population and the improvement in the living standards in the areas, together with the urban development, have rapidly increased water demand. Pollution of agricultural irrigation canals, drains and groundwater table by uncontrolled wastewater discharges have reach serious levels, requiring immediate action to prevent further degradation of the region's water sources and pollution of the environment. Contained contamination of surface and ground waters in the area will cause more serious damage to the environment and hamper development of the region, especially agriculture and public health.

The study on the existing sanitary situation of the region indicates that a comprehensive sewerage and sanitation improvement program be immediately initiated. If no action is taken immediately to improve the existing sewerage and sanitation systems, the water pollution and sanitary conditions, which have already been devastated, will become progressively worse.

When the sewerage projects are completed and put into operation, the sewage effluent will no doubt contribute to improving the quality of the irrigation water downstream. If the project is not implemented at this time, the cost escalation due to the inflation might hamper the project implementation at a later stage.

CHAPTER - THREE

PLANNING CONSIDERATIONS



CHAPTER THREE

PLANNING CONSIDERATIONS

3.1 Introduction

This chapter deals with the planning fundamentals for the sewerage and sanitation systems. The planning and design basis for the component facilities have been developed and various alternative plans for possible sanitary systems considered so that the most appropriate system plan can be worked out for the project. Following a review of the alternative technologies, the best solution for each of the components has been selected.

The plan can meet the requirement to alleviate the present water pollution load on the waterways and subsoil, and to improve sanitary conditions in the project area over the next two decades, up to 2005. Analysis made for each of alternatives are described briefly in the following sections, but details of the basic technical and economic informantion, including such computations as hydraulic computations for sewers, pumping stations and sewage treatment plants, are placed in Volume Three - Appendices, and Volume Four - Drawings.

3.2 Definition of the Study Area

As defined under the Scope of Work for the Study (Section 1.3.1), the study area encompasses the entire administrative area of the Sharqiya Governorate covering approximately 4,200 km^2, but excludes the area of the Tenth of Ramadan and other new desert cities. The project implementation areas for Master Plan and The First Phase sewerage programs have been selected on the basis of the results of field survey, review of existing physical and social conditions, and various future development schemes.

3.2.1 Master Planning Area (up to 2005)

In order to determine the project area for the sewerage master planning up to 2005, studies have been made first to select the priority urban areas where sanitary conditions have deteriorated and wastewater discharges to drains are causing serious environmental problems. Small towns and villages, where the priority for the sewerage and sanitation needs is lower than large congested cities, have been screened out after preliminary assessment and evaluation on the conditions in each of the communities.

Thus, the sewerage implementation area up to 2005 has been identified from the present thirteen cities. Other areas of small towns and villages are not included in the present master plan. Areas other than the sewerage implementation area where the sewerage system will not be available until 2005 but sanitation improvements are urgently required, are expected to be covered by sanitation improvement programs which are now being initiated under different schemes in parallel with the sewerage program.

3.2.2 Feasibility Study Area (Up to 1995)

Based on the strategic sewerage planning up to 2005, a staged construction program has been worked out to determine the desired priority of sewerage construction, taking into account various important elements which affect sanitary conditions, such as water pollution, population density, excreta disposal system, availability of water supply and drainage, and other development schemes. The feasibility study area thus selected covers the urban built-up districts of four major cities, namely:

1) Zagazig City
2) Bilbeis City
3) Faqus City
4) Minyet El Qamh City

3.3 Population Projections

The water supply system study in 1984 estimated the future populations in the Governorate. The study report has been reviewed with reference to other reports concerned, and population at Markaz-level in the Governorate has been estimated.

3.3.1 Previous Study

(1) Markaz Population

The population projections in the Sharqiya water supply system project were made based on the 1976 census. The projections of the study may be briefly described as follows:

- The population in the Governorate will grow at the rate of 2.2% per annum up to 1990 and at 2.15% per annum up to 2005.

- The rural population, regardless the Markaz conditions, is assumed to grow at 1.9% per annum throughout the study period, and

- *The cities will have their own different population growth rates.* They are classified into three classes, high level, medium level and low level, as shown below and Table 3.1.

  High Level : 1 city
  Medium Level: 7 cities
  Low level : 5 cities

Table 3.1 Future Population Growth Rates in Urban Areas

Level	City/Town	Period		
		1976-90	1990-95	1995-2005
High	Zagazig	3.4	3.2	3.1
Medium	Huseiniya Kafr Saqr Faqus Hihya Diarb Nigm Bilbeis Minyet el Qamh	3.2	3.0	2.9
Low	Abu Kebir Abu Hammad Ibrahimiya Mashtul El Soak Qenayat	2.8	2.6	2.5

(2) Population in Governorate

The previous reports, in which the population of the Sharqiya Governorate was estimated, are as follows:

- IBRD : Master plan for provincial water supply project,
- CAPMAS: Short-term future population projection,
- GOPP : Population estimation for Governorates in the Third Region, and
- JICA : Feasibility study on Sharqiya water supply system

The estimated population in these reports/studies are tabulated in Table 3.2 and are illustrated with the past census records in Figure 3.1.

The population projection in Markaz level was not conducted in the above reports except for the JICA's water supply feasibility study.

Table 3.2 Population Forecasts by Other Studies

(Unit: thousand person)

Year	Census	IBRD	CAPMAS	GOPP	JICA
1985	-	-	-	-	3,184
1986	3,340	-	-	-	-
1990	-	3,475	3,592	3,374	3,550
1995	-	-	-	4,326	3,948
2000	-	4,276	4,478	4,959	4,391
2005	-	-	-	5,608	4,885

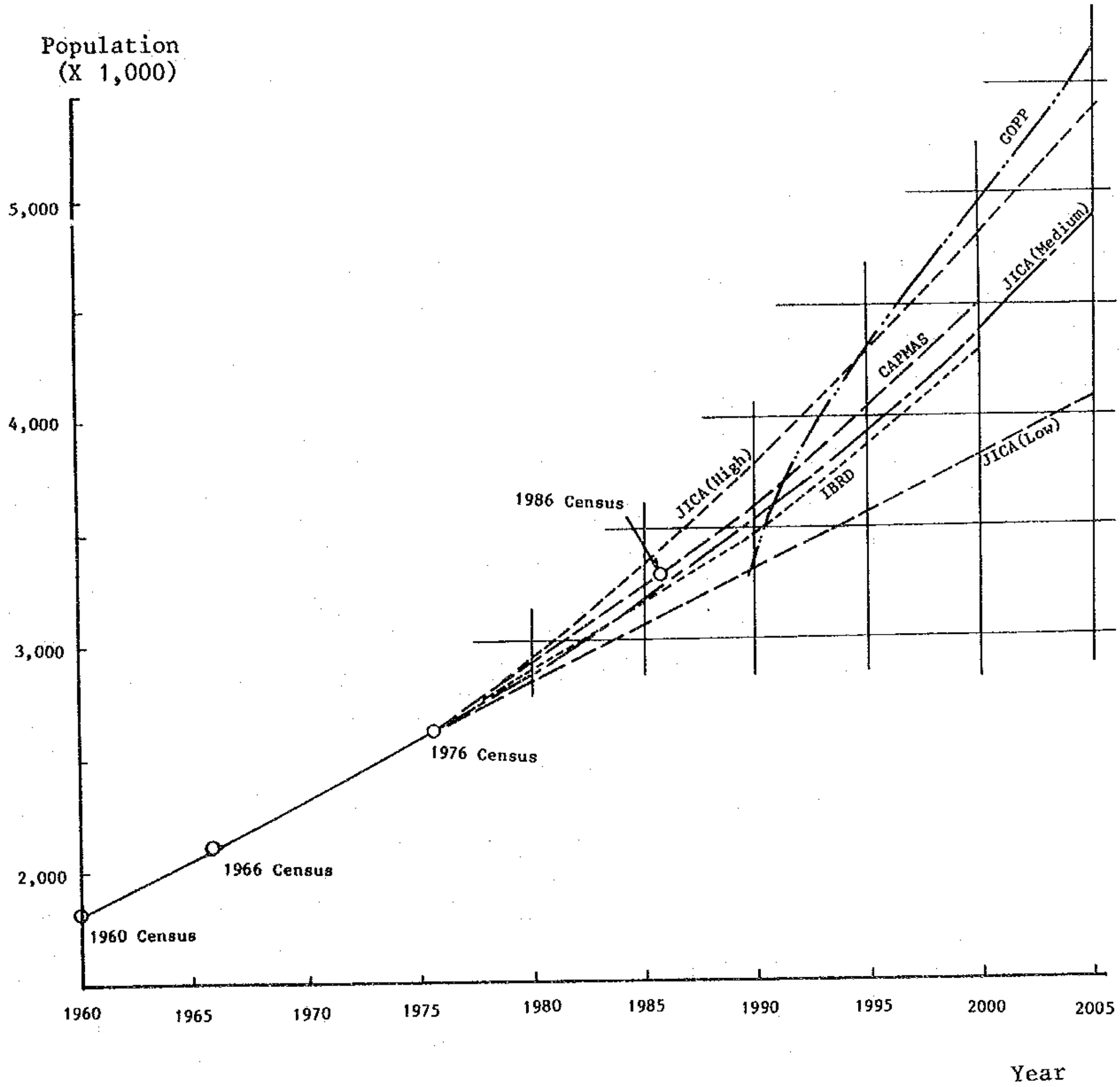


Figure 3.1 Population Forecasts

3.3.2 Review of the Previous Projection

(1) Markaz Population

From the last two census, the recent trends of population increase are shown in Table 3.3. Almost of the increase rates are higher than the estimated figures in the water supply feasibility study. The major features of the study of past trends are as follows:

- The increase rate of Zagazig has been falling since 1960, and this trend is remarkable in between 1976 and 1986 census,
- The growth rate of Bilbeis is in the highest group, and is almost twice the growth rate of Zagazig because of its convenient location with respect to Greater Cairo,
- The population growth has gradually been decreasing from the 1960 census in most Marakaz and capitals, and the trend can be seen even in the cities in the highest rate group, including Bilbeis, Kafr Saqr, etc.
- There are no urban areas belonging to the lowest rate group "1.9 and less", and no rural areas belonging to the highest rate group "4.0 and more".

Table 3.3 Recent Population Growth Rate (1976 - 1986)

Population Growth Rate(%)	Urban Area	Rural Area
4.0 and more	Bilbeis, Kafr Saqr, Diarb Nigm.	-
3.0 - 3.9	Minyet El Qamh, Abu Hammad, Ibrahimiya, Qenayat.	Zagazig, Faqus, Bilbeis, Huseiniya, Mashtul El Soak.
2.0 - 2.9	Zagazig, Abu Kebir, Faqus, Huseiniya, Hihya, Mashtul El Soak	Abu Kebir, Ibrahimiya, Hihya, Diarb Nigm, Minyet El Qamh.
1.9 and less	-	Kafr Saqr, Abu Hammad.

Generally, the increase rates in rural areas are high compared with those forecasted by the water supply feasibility study, in which the rates were estimated at 1.9% for all rural area. The reason for this is the number of seasonal workers who are working away from their home villages.

The 1976 census reported population decrease due to internal migration of about 21,000 persons on an average for a 10 year period, although the last census has not provided such information yet. The decrease rate by internal migration corresponds to about one percent as described below:

Internal Migration : 21,000 persons/annum

Population in 1976 : 2,617,938 (Census record)

Decrease due to
Internal Migration : 21,000/2,617,938 = 0.8%

The statistics yearbook shows a steady decrease in the birth rate not only all over Egypt but in the Sharqiya Governorate, too. The trend will be magnified in the future together with achievements of the national policy targets.

3.3.3 Population Projection for Planning

(1) Markaz Population

Taking into consideration the above, the future population growth rates described in the water supply feasibility study are revised, based on the following:

- The future population growth rates in urban and rural areas are classified into the following groups:

  Urban Area: 4 levels (high, medium, low and lowest)

  Rural Area: 3 levels (high, medium and low)

- It is assumed that internal migration will occur in both urban and rural areas, and the degree of the urban migration will be smaller than rural one.

- The rates will decrease as national policies prevail. For estimation purposes, a step-wise decrease rate is employed.

The adopted future population growth rates in the present study are shown in Table 3.4. On the basis of these assumptions, the future population is projected as shown in Table 3.5.

Table 3.4 Revised Future Population Growth Rates

(Unit: percent per/annum)

Level	Markaz	Period 1986-90	Period 1990-95	Period 1995-2005
Urban				
High	Bilbeis, Kafr Saqr, Diarb Nigm.	3.8	3.5	3.2
Medium	Minyet El Qamh, Abu Hammad, Ibrahimiya, Qenayat.	3.4	3.2	3.0
Low	Abu Kebir, Faqus, Huseiniya, Hihya, Mashtul El Soak.	2.8	2.6	2.5
Lowest	Zgazig	2.2	2.1	2.0
Rural				
High	Zagazig, Faqus, Bilbeis, Hihya, Diarb Nigm, Minyet El Qamh.	3.2	3.0	2.8
Medium	Abu Kebir, Ibrahimiya, Hihya, Diarb Nigm, Minyet El Qamh.	2.2	2.1	2.0
Low	Kafr Saqr, Abu Hammad.	1.5	1.4	1.3

Table 3.5 Projected Population

(Unit: 1,000)

No.	Markaz	Area	1986 Census	1990	1995	2000	2005
1.	Zagazig	U	245.5	268	297	328	362
		R	418.4	475	501	575	661
		T	663.9	743	798	903	1,023
2.	Huseiniya	U	17.8	20	23	26	29
		R	253.4	287	333	382	439
		T	271.2	307	356	408	468
3.	Kafr Saqr	U	19.3	22	26	30	35
		R	131.6	140	150	160	171
		T	150.9	162	176	190	206
4.	Faqus	U	48.6	54	61	69	78
		R	332.7	377	437	502	576
		T	381.3	431	498	571	654
5.	Abu Kebir	U	69.5	78	89	101	114
		R	146.8	160	178	197	218
		T	216.3	238	267	298	332
6.	Abu Hammad	U	24.3	28	33	38	44
		R	190.6	202	217	231	246
		T	214.9	230	250	269	290
7.	Ibrahimiya	U	24.5	28	33	38	44
		R	66.7	73	81	89	98
		T	91.2	101	114	127	142
8.	Hihya	U	29.3	33	38	43	49
		R	111.4	122	135	149	164
		T	140.7	155	173	192	213
9.	Diarb Nigm	U	32.2	37	44	52	61
		R	208.6	228	253	279	308
		T	240.8	265	297	331	369
10.	Bilbeis	U	96.5	112	133	156	183
		R	273.4	310	359	412	473
		T	369.9	422	492	568	656
11.	Minyet El Qamh	U	45.9	52	61	71	82
		R	341.1	372	413	456	503
		T	387.0	424	474	527	585
12.	Mashtul El Soak	U	28.7	32	36	41	46
		R	68.1	77	89	102	117
		T	96.8	109	125	143	163
13.	Qenayat	U	29.4	34	40	46	53
		R	-	-	-	-	-
		T	29.4	34	40	46	53
	Total	U	711.5	798	914	1,039	1,180
		R	2,542.8	2,832	3,146	3,534	3,974
		T	3,253.3	2,621	4,060	4,573	5,154

(Note) * The abbreviation employed in the above table are:

U: Urban; R: Rural; T: Total

* The total population shows the population in the Sharqiya Governorate except for new desert cities.

(2) Population in Governorate

Total populations in the Governorate in the years of 1995 and 2005 are estimated to be 4.06 million and 5.154 million respectively as shown in Table 3.5. The proportion of the urban population to total population will gradually increase from 22 percent in 1986 to reach 30 percent in 2005. Population growth rates by five-year period until 2005 and classified by urban and rural areas are shown in Table 3.6. As can be seen in the table, overall population growth rate will remain at relatively high levels in the year 2005. For comparison, past records of the vital indices in both Egypt and Sharqiya Governorate are shown in Table 3.7

Table 3.6 Population Growth Rates

(Unit: %)

Area	1986-1990	1990-1995	1995-2000	2000-2005
Urban	3.0	2.9	2.7	2.7
Rural	2.8	2.3	2.5	2.5
Total	2.8	2.5	2.5	2.5

Table 3.7 Vital Indices

(Unit: %)

	Egypt			Sharqiya		
Year	IR	DR	BR	IR	DR	BR
1965	2.8	1.4	4.6	3.3	1.2	4.5
1970	2.0	1.5	3.5	2.4	1.5	3.9
1975	2.4	1.2	3.6	2.5	1.3	3.8
1980	2.7	1.0	3.7			
1985	2.9	0.9	3.8			

Note: Source: Regional Office of GOPP
in the Third Region & CAPMAS

IR: Increase Rate
DR: Death Rate
BR: Birth Rate

3.3.4 Population Projection by CAPMAS

CAPMAS showed the estimated future population in Markaz level of the Sharqiya Governorate in response to a request from the Study Team. For reference, the CAPMAS estimation is shown along with the population projection previously stated in Figure 3.2.

As seen in the figure, the CAPMAS estimation is comparatively higher than the estimate arrived at by the present study. The premises and assumptions employed by the CAPMAS for the population projection have not been released so far. In addition, CAPMAS estimated the population up to the year 2040. They are tabulated in Table 3.8, along with estimates for 1995 and 2005, target yars of the Study.

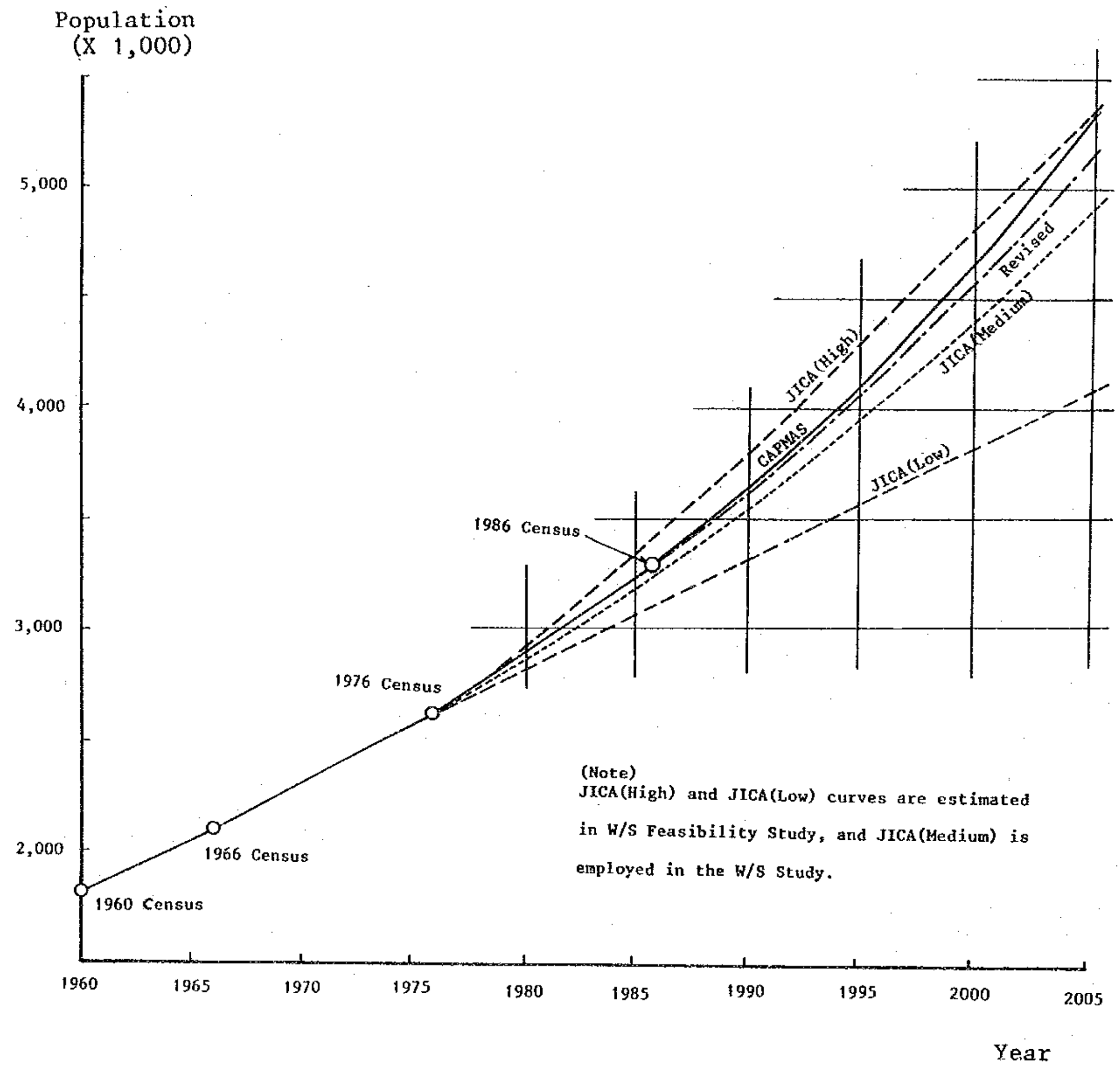


Figure 3.2 Revised Future Population

Table 3.8 Future Population Projected by CAPMAS

(Unit: 1,000)

No.	Markaz	Area	1986 Census	1990	1995	2005	2020	2040
1.	Zagazig	U	245.5	272.0	300.2	363.4	485.9	712.6
		R	418.4	475.5	550.8	737.0	1144.0	2,053.6
		T	663.9	747.5	851.0	1,100.4	1629.9	2,766.2
2.	Huseiniya	U	17.8	20.1	22.3	27.2	38.8	58.8
		R	253.4	290.3	339.7	465.5	745.4	1,396.3
		T	271.2	310.4	362.0	492.7	784.2	1,455.1
3.	Kafr Saqr	U	19.3	22.7	26.4	37.4	62.9	123.0
		R	131.6	146.2	165.7	210.7	302.2	490.5
		T	150.9	168.9	192.1	248.1	365.1	613.5
4.	Faqus	U	48.6	51.0	58.2	72.3	101.5	153.0
		R	332.7	360.2	412.8	544.9	827.3	1,415.5
		T	381.3	411.2	471.0	617.2	928.8	1,568.5
5.	Abu Kebir	U	69.5	73.4	84.2	107.5	153.5	240.8
		R	146.8	156.3	175.6	222.2	317.9	500.7
		T	216.3	229.7	259.8	329.7	471.4	741.5
6.	Abu Hammad	U	24.3	28.3	33.2	45.2	72.2	138.7
		R	190.6	211.0	236.8	296.9	415.4	651.8
		T	214.9	239.3	270.0	342.1	487.6	790.5
7.	Ibrahimiya	U	24.5	28.2	32.5	43.0	65.6	115.0
		R	66.7	74.1	83.3	105.4	149.8	239.7
		T	91.2	102.3	115.8	148.4	215.4	354.7
8.	Hihya	U	29.3	33.3	37.8	48.4	69.3	115.7
		R	111.4	123.8	141.3	181.0	265.2	438.2
		T	140.7	157.1	179.1	229.4	334.5	553.9
9.	Diarb Nigm	U	32.2	34.4	39.7	67.9	124.7	272.3
		R	208.6	222.8	252.3	323.3	450.9	758.7
		T	240.8	257.2	292.0	391.2	575.6	1,031.0
10.	Bilbeis	U	96.5	105.0	127.1	179.1	298.1	567.9
		R	273.4	294.9	336.8	440.3	660.2	1,110.7
		T	369.9	399.9	463.9	619.4	958.3	1,678.6
11.	Minyet El Qamh	U	45.9	49.7	59.6	81.3	130.3	241.3
		R	341.1	365.3	412.0	527.1	764.4	1,226.6
		T	387.0	415.0	471.6	608.4	894.7	1,467.9
12.	Mashtul El Soak	U	28.7	31.5	35.7	46.0	67.3	111.0
		R	68.1	75.2	86.4	113.9	172.3	299.0
		T	96.8	106.7	122.1	159.9	239.6	410.0
13.	Qenayat	U	29.4	33.4	37.9	48.9	71.7	119.7
		R	-	-	-	-	-	-
		T	29.4	33.4	37.9	48.9	71.7	119.7
	Total	U	711.5	783.0	894.8	1,167.6	1,741.8	2,969.8
		R	2,542.8	2,795.6	3,193.5	4,168.2	6,215.0	10,581.3
		T	3,254.3	3,578.6	4,088.3	5,335.8	7,956.8	13,551.1

(Note) * The abbreviation employed in the above table are:

U: Urban; R: Rural; T: Total

* The total population shows the population in the Sharqiya Governorate except for new desert cities.

3.4 Sewage Quantities and Characteristics

3.4.1 Per Capita Sewage Flows by Stage

Based on the discussions and computations as described in Section 2.9 and Appendix V "Wastewater Quantities and Characteristics," Volume Three, the future average per capita sewage flows have been estimated for each of the cities.

(1) Domestic Water Consumption Rate

For the planning of the sewerage systems, the domestic water consumption estimated for each of the cities, is considered to be the domestic sewage production rate.

(2) Commercial Water Consumption Rate

For each of the cities, 10 lcd is considered as the commercial water consumption rate.

(3) Industrial Water Consumption Rate

Industrial water consumption has been estimated to be 10 percent of the domestic and commercial water consumption for cities whose urban population is greater than 75,000. For cities whose population are projected to be less than 75,000, industrial consumption have not been considered.

(4) Institutional Water Consumption Rate

The institutional water consumption is estimated to be 15 percent of the domestic and commercial consumption for Zagazig City, but 10 percent for other cities.

(5) Water Losses

Wastewater flow quantities usually are slightly less than the per capita water consumption rate because water is lost through leakage, sprinkling, cooking, etc. In estimating the per capita sewage flow rates, 90 percent of all the water consumption is considered to reach the sewers.

(6) Estimated Overall Average Per Capita Wastewater Flow Rates

As tabulated in Tables 3.9 through 3.12, the overall average per capita sewage flow rates for the different stage have been calculated, by adding together the domestic, commercial, industrial and institutional water consumption and deducting 10 percent as losses.

Table 3.9 Average Per Capita Sewage Flow Rates in Zagazig City

(lcd)

Year	Domestic	Comm.	Indust.	Inst.	Total	Sewage Flow
1990	118	10	12.8	19.2	160.0	144.0
1995	123	10	13.3	20.0	166.3	150.0
2000	130	10	14.0	21.0	175.0	157.5
2005	134	10	14.4	21.6	180.0	162.0

Table 3.10 Average Per Capita Sewage Flow Rates in Bilbeis, Faqus and Abu Kebir Cities

(lcd)

Year	Domestic	Comm.	Indust.	Inst.	Total	Sewage Flow
1990	108	10	11.8	11.8	141.6	127.4
1995	111	10	12.1	12.1	145.2	130.7
2000	116	10	12.6	12.6	151.2	136.1
2005	120	10	13.0	13.0	156.0	140.4

Table 3.11 Average Per Capita Sewage Flow Rates in Minyet El Qamh City

(lcd)

Year	Domestic	Comm.	Indust.	Inst.	Total	Sewage Flow
1990	108	10	-	11.8	129.8	116.8
1995	111	10	-	12.1	133.1	119.8
2000	116	10	-	12.6	138.6	124.7
2005	120	10	13.0	13.0	156.0	140.4

Table 3.12 Average Per Capita Sewage Flow Rates in Other Cities

(lcd)

Year	Domestic	Comm.	Indust.	Inst.	Total	Sewage Flow
1990	96	10	-	10.6	116.6	104.9
1995	98	10	-	10.8	118.8	106.9
2000	100	10	-	11.0	121.0	108.9
2005	102	10	-	11.2	123.0	110.9

3.4.2 Infiltration

Although the proposed sewer joints are water-tight types which will reduce the quantity of unwanted groundwater infiltration into the sewers, the sewer design value must make an allowance for non-waste components which inevitably become a part of the total flow. The groundwater elevations of the region are, in general high, which are, at many locations, as high as 60 cm below the ground surface.

Since no data are available in the existing sewerage system for the infiltration rates, an effort was made to obtain data regarding infiltration from existing sewerage systems in Egypt that may represent conditions similar to those in the study area. Table 3.13 shows cities in Egypt. As can be seen from the table, the allowances in the cities range widely from 0 to 20 m^3/ha/day: however, it may be reasonable to assume that the sewerage systems in Sharqiya represent the typical condition in the Delta, and that for the planning purpose, an average infiltration of 10 m^3/ha/day is used.

3.4.3 Design Flow Rates

From the foregoing reviews and discussions, design wastewater flow rates for the sewerage system in the region have been determined. For sewer hydraulic computations, the infiltration allowances should be included, according to the sewerage districts to be served.

In general there are two flow rates to the design of any sewerage facilities, the peak flow and the maximum daily flow (or other suitable flow). The peak flow is the absolute maximum flow rate anticipated for the facilities regardless of its duration. The maximum daily flow is a measure of the highest average rate of flow for the specified time period the sewage treatment plant must treat.

The water supply feasibility study estimated the daily maximum demand as 1.25 times of the daily average demand which includes water consumption and system losses. System losses were considered 30 to 40 percent of the total water demand at present and projected to decrease to 18 to 25 percent by 2005. If system losses are assumed constant regardless of the water consumption, maximum daily consumption is calculated to be 1.26 to 1.33 of the daily average consumption.

NOPWASD used monthly maximum sewage flow in the design of the new Zagazig sewage treatment plant, which was considered to occur during summer months and 1.4 times the daily average sewage flow, not including infiltration. Infiltration was assumed to be constant. NOPWASD also estimated monthly minimum sewage flow, which occur in winter months as 0.7 of the daily average flow.

Taking into account the above, daily maximum sewage flow to be used for the design of the treatment plants is determined to be 1.4 times the daily average wastewater flow. Peak flow for the design of pipes, conduits, and pumps is determined to be 2.0 times the daily average flow. Design flow rates, which are daily maximum and peak flow plus infiltration, in 2005 by cities are shown in Table 3.14.

3.4.4 Sewage Characteristics

As there are no records of sewage characteristics in the existing sewerage systems in the Governorate, water quality surveys were performed during the first and the second on-site survey (see Appendix IV of Volume Three). The results of the survey show that the raw sewage strengths are high, ranging from 350 mg/l to 900 mg/l, and 501 mg/l on average in BOD.

Per-capita waste loadings are evaluated based on the second analysis results (see Appendix IV). Among them, a per-capita BOD loading of 54.0 gcd obtained from Bilbeis is considered the most representative figure for the study area, for the reasons mentioned in Appendix IV.

If the annual increment of per capita BOD loading due to upgrading of living standards and other factors up to the year 2005 is assumed to be 1 gcd, per capita BOD loading will increase to 72.0 gcd in 2005. With a total population of 183,000 and a total daily average wastewater flow of 32,363 m^3/day including infiltration in Bilbeis in 2005, average BOD concentration of the influent is estimated as follows:

BOD concentration = 183,000 x 72.0 / 32,363 = 407 mg/l

Making some allowances for extra loadings due to non-domestic wastewaters, design BOD concentration is determined to be 450 mg/l.

Table 3.13 Design Groundwater Infiltration in Sewerage Systems in Egypt

City		Infiltration Allowances	
1.	El Arish	Sewers mostly above groundwater elevations	2 percent of total daily average sewage.
		Sewers in low-lying areas	- 8 m^3/ha/day
2.	Port Said	Existing developed areas	- 12 m^3/ha/day
3.	Ismailia	New areas	- 8 m^3/ha/day
4.	Suez	General areas	- 10 m^3/ha/day
		Low-lying areas adjacent to canal water	- 12 m^3/ha/day
5.	Alexandria		- 0.1 l/ha/sec (8.64 m^3/ha/day)
6.	Helwan	$Q = a.d.h^{2/3}$, where Q = flow per 1,000 m a = constant (5 to 10) d = exterior dia. of pipe in inch h = average depth of pipe below groundwater surface.	
7.	Cairo	Residential and commercial areas	
		For all sewers with invert levles above elevation 25 m A.O.D.	- Nil -
		For sewers with invert levels of elevation 25 m, A.O.D. or less existing prior to 1980 or to be constructed without flexible joints.	- 20 m^3/ha/day
		For sewers with invert levels of elevation 25 m, A.O.D. or less to be constructed with flexible joints.	- 10 m^3/ha/day

Source: 1) Ref. No. 5 2) Ref. No. 17 3) Ref. No. 16 4) Ref. No. 15
5) Ref. No. 19 6) Ref. No. 18 7) Ref. No. 32

Table 3.14 Design Flow Rates in 2005

(m3/day)

City	(1) Daily average	(2) Daily maximum 1.4x(1)	(3) Peak flow 2.0 x (1)	(4) Infiltration	(5) Design flow for treatment (2) + (4)	(6) Design flow for pipes (3) + (4)
Zagazig	58,644	82,102	117,288	27,260	109,362	144,548
Huseiniya	3,216	4,502	6,432	2,530	7,032	8,962
Kafr Saqr	3,882	5,435	7,764	2,480	7,915	10,244
Faqus	10,951	15,331	21,902	5,150	20,481	27,052
Abu Kebir	16,006	22,408	32,012	4,440	26,848	36,452
Abu Hammad	4,880	6,832	9,760	3,100	9,932	12,860
Ibrahimiya	4,880	6,832	9,760	1,700	8,532	11,460
Hihya	5,434	7,608	10,868	2,650	10,258	13,518
Diarb Nigm	6,765	9,471	13,530	2,590	12,061	16,120
Bilbeis	27,097	37,936	54,194	6,670	44,606	60,864
Minyet El Qamh	11,513	16,118	23,026	3,000	19,118	26,026
Mashtul El Soak	5,101	7,141	10,202	2,540	9,681	12,742
Qenayat	5,878	8,229	11,756	2,280	10,509	14,036
Total	164,247	229,945	328,494	66,390	296,335	394,884

Note: Design flows for Bilbeis include flows from army camp.

Other water quality items necessary for the design of the treatment plant are estimated as a proportion of the BOD concentration. Such proportions are obtained from water quality analysis (see Appendices IV and V).

Design parameters relating to water quality are determined as given below in Table 3.15.

Table 3.15 Water Quality Design Parameters

BOD	450 mg/l
SS	460 mg/l
COD	170 mg/l
NH_4-N	30 mg/l
Total-P	13 mg/l

3.5 Basic Concept of Sanitation Improvement

3.5.1 Sanitation Improvement in Rural Areas

At present except for some areas, there do not appear to be any high population density rural areas which are included in the master plan. In most of the rural areas, houses are scattered, including premises with individual toilet facilities. Excreta is mostly disposed of into cesspits, transhes, and septic tanks, from which effluents leach into subsoils or flow to drains. In general, sanitation problems in rural areas are not critical, because of the low density of population.

The conclusion of the field survey under this study is that some measures will be required to solve the shallow well and drainage contamination problems in some locations in rural areas. The improvements should include upgrading of the excreta disposal systems, frequent desludging of septic tanks and transhes, well water protection measures, etc. Cleaning and maintenance of transhes and septic tanks in the rural areas and elsewhere in the urban areas will need to be continued until such time as public sewers are provided.

3.5.2 Feasible Improvement Measures

(1) General Considerations

It is necessary to find technically and economically feasible means of improving the efficiencies of the present sanitary facilities both in rural and urban locations within the study area to be implemented up to the year 2005, in order to improve the sanitary conditions in the area. Any measures for improving the present sanitary systems must provide a basis for the solution of the problems on a regional basis and for the projected future growth of the area and its several components as well as for present. Since no comprehensive sanitation improvement plan exists for the project area, it has been necessary to study existing data, and to project on stated assumptions, the future growth of the region. Also, an economic feasibility must be considered with regard to the relationship between the benefits and the costs and the overall scale of expenditure in relation to expenditures on other relevant public programs in the region.

(2) Technical Measures

Solutions and partial solutions to the problems, regarding the existing excreta disposal may include the following :

- Provision of additional toilet and local excreta disposal facilities, as an interim measure, in the rural and urban areas not to be served by a water-borne system for a prolonged period.
- Improvement of the existing transh and septic tank facilities.
- Periodic cleaning of septic tanks and transhes.

(3) Improvement of Toilet/Excreta Disposal Systems

The private toilets used in rural and urban areas are generally of the water-carriage type, with the excreta discharged either to transhes, septic tanks, or directly into the nearby waterways. The typical transh and septic tank systems widely used in the region are shown in Figures 2.30 through 2.33, Chapter Two.

As previously mentioned, about 55 percent of the national population rely for their excreta disposal on either septic tanks or transhes, but roughly 35 percent are without appropriate disposal systems. Rural areas, where the water supply system has not yet been provided, have depended primarily on wells, either deep or shallow, for their water supply. However, many of these shallow wells, as observed in field inspections, are without tight casings. Being located usually in close proximity to toilets and transhes, they are subjected to continuous contamination from human excreta.

To obtain some information on the extent of well water contamination in the rural areas, sampling and analysis of waters in selected shallow wells have been carried out for ascertaining levels of pollution (see Section 2.12 for details). The results of the water quality tests and observation of the conditions of the wells indicate that all of three wells investigated are contaminated. Those wells, employing manual pumps and bucket scooping, have not been carefully constructed. Many of them do not have satisfactory covering at the top, resulting in the water surface usually being exposed.

The areas surrounding the wells are often near toilets, latrines, transhes, and other wastewater sources, in some cases resulting in ponding of wastewater in the immediate vicinity.

There is a definite relationship between the degree of pollution and the depth at which the groundwater is extracted from. This tends to confirm the observation above that most of the contamination of the wells occuring is from toilets and other wastes.

From the studies relating to well contamination hazards in the region the following are considered the minimum requirements :

Location of transhes and septic tanks : Transhes and septic tanks should not be located too close to buildings, source of water, or trees. Table 3.16 shows general guidelines for location in the form of minimum distances from various features.

Table 3.16 Minimum Required Distances from Various Physical Features for Septic Tanks and Transhes in Common Well-developed Soils

(m)

Physical Feature	Septic Tank	Transh
Building	1.5	3.0
Property boundaries	1.5	1.5
Wells	10.0 (*)	10.0 (*)
Streams	7.5	30.0
Cuts or embankments	7.5	30.0
Water pipes	3.0	3.0
Paths	1.5	1.5
Large trees	3.0	3.0

Source : Appropriate Sanitation Alternatives, A Planning and Design Manual, World Bank.

(*) Up to 30 m for sands and gravels and greater distances for jointed or fissured rocks.

Maintenance requirments : Septic tanks and transhes should be inspected periodically to ensure neither scum particles nor suspended solids are being carried out with the effluent. In any case, tanks must be desludged at regular intervals. If the accumulation rate is 0.04 m3/cap/yr, the scum and sludge accumlation will necessitate a pumping interval of two years for the septic tank with capacity for 40 persons (see Figure 2.33) and one-third of the volume is provided for sludge and scum accumulation.

Effluent disposal : For efficient subsurface disposal of excreta the soil must be sufficiently permeable. At many locations where the groundwater elevations are high, consideration should be given to improve the effluent disposal. A study has been made by JICA on the existing rural sewage treatment facilities (Ref.No.2) which studies the present toilet systems in rural areas and recommends appropriate measures to improve toilet wastes disposal methods.

The possible upgrading and improvement of the existing septic tanks where the groundwater elevation is high will be as follows:

- Provision of chlorination to disinfect the tank effluent. If this method is applied, this will be one of the simplest means to achieve the objective.

- Provision of biological filtration and chlorination. This method will require some financial outlay and is considered suitable for large scale septic tank systems. The tank effluent is trickled over the filter of gravel and then chlorinated, which is finally led to the drain or the penetration well by gravity. This type of septic tank systems, without chlorination, has already been designed for Hafer Shahab El Deen Village. The report also recommends some design guideline that the filter media be uniform size gravel, and maintain the filter bed always under aerobic conditions.

- Effluent disposal by surface soil, where land space is available and the groundwater elevation is 1.5 m or deeper from the ground surface. Drainfield trenches will be one of the most appropriate disposal methods in rural areas. Septic tank effluent will be distributed to a number of drainage trenches connected to a distribution chamber in parallel. Each trench consists of open joint pipes laid on gravel fill. The effluent infiltrates into the soils surrounding the trench.

- Where the groundwater elevation is 1 m or less below the ground surface, the effluent from septic tanks should be disposed of by means of pumping. One of the alternative systems is to provide pump wells prior to the septic tank and all wastewaters are pumped up to the septic tank and then flows down by gravity to a biofilter and a chlorinator. The final effluent may be discharged directly to surface drains. Another possible alternative process is to dispose the effluent to evapotranspiration mounds. In an area where the water table is near the surface or the soil percolation capacity is insufficient, an evapotranspiration mound may be substituted for a drainfield.

Design criteria for these mounds depend on various factors, such as climate, soil type, and native grasses. Pilot studies are therefore required to determine the dimensions of the facilities.

Improvement of Septic Tanks : Septic tanks generally used in the country are single compartment type. Two-compartment septic tank is preferred to one with only a single compartment because the concentration of suspended solids in its effluent is considerably lower. The first compartment should have twice the size of the second compartment. For the two compartment septic tank design, a variety of alternative designs are proposed. Major features to be considered for design are :

- To provide inlet T pipes in each chamber with submerged pipe depth of about one-third of the effective water depth from the liquid level.

- To provide outlet T pipe in each compartment with the submerged depth of about one half of the liquid depeth.

- To arrange the inlet and outlet pipes at the diagonal locations to prevent short circuit flow.

- To provide inspection manholes on the slab just above the inlet and outlet pipes for the easy inspection and cleaning of these pipes.

3.6 Engineering Considerations for System Planning

3.6.1 Alternative Wastewater Systems Considered

For the wastewater collection and disposal, there are many sanitation technology options available for both on-site and off-site sanitation systems that can meet the requirements to alleviate the present wastewater loads to the drains and subsoils in the study area.

A group of the more probable alternative systems was evaluated under the study for the control of the wastewaters which will originate in the study area over the next two decades up to 2005. Technical and economic analyses have been made of each possible alternative system, as briefly discussed in the following paragraphs.

3.6.2 Wastewater Collection and Disposal Systems

Most of the households in the urban districts, where no access to the sewer system is available, have a general flush or pour flush toilets with transh or septic tank facilities to dispose of their excreta. Therefore, such low grade sanitation facilities as pit latrines were excluded from the alternative analysis.

The alternatives considered include :

- On-site sanitation systems, either transh alone or a combination of septic tank and transh. The mixture of sullage and flush toilet excreta enters to the transh, or in case of septic tank, passing through the septic tank, and then soak into ground where the soil is permeable and groundwater elevation is sufficiently low to receive the liquid.
- Small-bore sewers, consisting of a household toilet, an influent pipe to an interceptor tank in which settlable solids are retained, a tank effluent pipe, street laterals and mains, pumping stations, as required, and treatment works.
- Conventional sewerage system, comprising house connections, public sewers, pumping stations, and sewage treatment works.

Each of the above alternative is studied from technical, environmental and economic veiwpoints, to select the most appropriate sanitation system to the region.

(1) On-site Sanitation System

Flush toilets of the existing transh and/or septic tank systems may be used in this system without much modification. The septic tanks are to be installed within the plot in between the flush toilets and the transh. The supernatant of the septic tank, where applied, flows into the transh for leaching to the subsoil.

Because of the high groundwater elevations and low permeability soils in the region, at many a location the soakaway facilities can hardly be effective to absorb the liquid without trouble. The seepage rate from transhes to the soils will be 100 lcd at the maximum but generally lower than this at most of the areas in the Governorate. For these reasons, the septic tank/transh system may not be applied to the high population density built-up urban districts as a new sanitation system.

Moreover, the effluent from the septic tank/transh system is, from a public health viewpoint, as dangerous as the raw sewage and so requires further treatment before the final disposal if the groundwater and drain water pollution is to be prevented. The septic tank/transh may produce odor problems if maintenenace is not properly done.

The cost of septic/transh installation, as well as periodic desludging, make the on-site sanitation inappropriate for the population. There are indications that in urban areas, septic tanks would often cost more on a per capita household basis than the conventional water-borne sewerage system (Ref. No. 31). Septic tanks and leaching fields are the most expensive forms of household waste disposal. Capital, operation and maintenance costs for the system have been found to be almost equal or in particular cases, to exceed the cost of the conventional sewers and sewage treatment.

On account of the conditions mentioned above, it is conceivable that on-site sanitation systems are not appropriate as a new wastewater system for the region, particularly for urban built-up districts.

(2) Small-bore Sewer

The small-bore sewer system, which carries settled effluent only, is one possibility for a less expensive sewerage system. The system is designed to receive only the liquid portion of household sewage for off-site treatment and disposal. Grit, grease and other troublesome solids which might cause obstruction in the sewers are separated from the sewage flow in interceptor tanks installed upstream of every connection to the sewers; and the solids which accumulate in the tanks are removed periodically for safe disposal. A typical small-bore sewer system is shown in Figure 3.3.

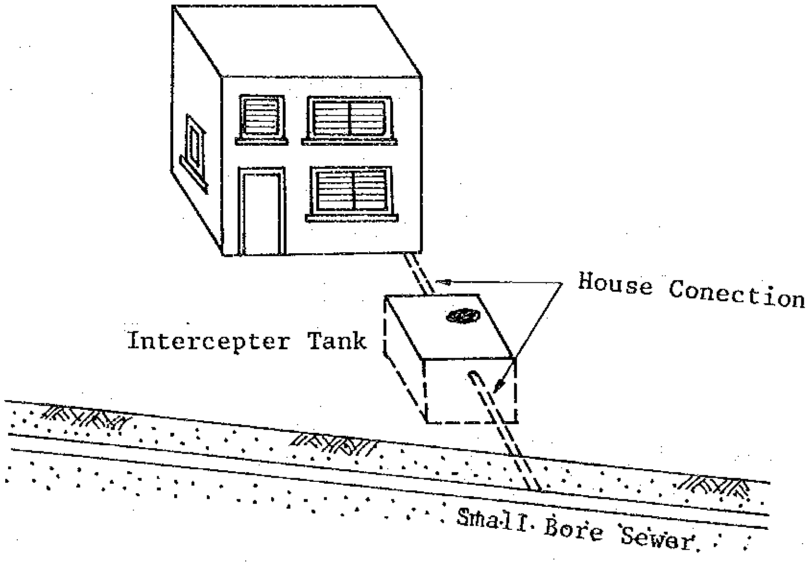


Figure 3.3 Small Bore Sewer System

The system may have the principal advantages, including :

- Reduced water requirements because of the settled effluent and less need for solids transportation, thus reducing the water consumption for the purpose.

- Reduced excavation cost, with low flow velocity for self-cleansing, and possibilities of pipe laying with curvilinear alignment with a variable or inflective gradient.

- Reduced material costs. Because of lowered peak flows by some surge storage of the sewage in the interceptor tanks, the sewer and pumping equipment could be reduced in size. In addition, expensive manholes can be replaced with much less costly cleanouts or flushing points, thus reducing O/M cost.

- Reduced treatment requirements. Preliminary and primary treatment facilities could be excluded in the treatment works.

Thus, small-bore sewer systems may provide an economical way to upgrade existing sanitation facilities to a level of service comparable to conventional sewers. In adopting this system as a new one, the existing septic tank/transh systems may be converted to the interceptor tanks by a minor modification of the structure.

Although this system has many advantages as mentioned above, there may be a grave constraint for the direct adoption of this system to the region as a new sanitation system. From experience in many locations in the existing conventional sewerage systems, sewers are clogged by sand and other solids entered the pipes through manholes or inspection chambers, and frequent cleanings are required to properly maintain the function of the facilities. This is particularly true in the areas like this region where sand and dust tend to enter the sewer systems.

The small-bore sewers of 50 to 100 mm diameter will no doubt necessitate much more frequent cleansing of the pipes than the present conventional sewers, thus, will create significant difficulties in proper operation and maintenance, and make O/M costs tremendously higher than other comparable alternative plans. Furthermore, and perhaps most importantly, the existing sewerage systems in the region have long been planned and constructed as the conventional gravity sewer system, and there is no persuasive reason to change the present system to a different new system without much experience in the region.

In the light of these factors, the system is excluded from further evaluation.

(3) Conventional Sewers

The conventional gravity sewer system is one of the most reliable sewerage systems, and much experience is available in the region in planning, design, construction, and operation and maintenance, and is most widely applied throughout the world, but in general most expensive among the possible alternative sanitation systems available for safe disposal of wastewaters.

Though detailed cost comparison between the small-bore and conventional sewers has not been made, a study undertaken by the World Bank indicates (Ref. No. 31) that the costs of conventional and smallbore sewerage systems planned for about 73 ha district serving a population of 39,420 were in the ratio of 1,581 to 1,013, or the small-bore system costs roughly 60 percent of the conventional system. The major costs of the conventional sewer facilities are the street laterals and manholes, which are sized to facilitate solids cleaning equipment and are therefore larger than peak flows would require.

The submains are designed to accomodate peak flow factors of 2, which means that they are designed to accomodate peak flows that are 2 times greater than average flows. The overall length of pipe between houses and street laterals are somewhat longer in the conventional sewer system than small-bore sewers.

The conventional sewer system has many merits. Firstly, they provide the greater user convenience of all waste disposal systems, for they permit the discharge of large amount of water; secondarily, they do not pose any risks to health when functioning properly; their maintenance is assumed by the municipality; and thirdly, they generally operate with few service interruptions or emergencies.

Yet, this system also has some disadvantages; it is, first of all, expensive to construct; it requires skilled contractors for the construction, a municipal organization for operation and maintenance, and a substantial amount of flushing water, which adds to the operating costs.

Given the high convenience level of the conventional sewerage system and considering the present situation of the area, this system is most appropriate one.

3.6.3 Wastewater Treatment and Disposal System

As described in Section 2.6 and 2.12 of this volume, and Appendix IV of Volume Three, drain and canal waters in the area have already become polluted and are expected to be further degraded in the future if no steps are taken to alleviate waste loads discharged to them. Hence, it is necessary to consider what role treatment should play within a sewerage program and where collected and suitably treated wastewater should be disposed of.

The need for appropriate treatment of wastewaters is obvious to protect public health and environs, but the degree of the treatment required may vary depending on the local conditions. For sewage treatment planning, there are essentially two major alternatives, i) discharge effluent into a drain with a high level of treatment (secondary process), and ii) discharge through an outfall to desert or farmland for land reclamation, with a level of treatment as needed to supplement a purifying action of the land.

(1) Discharge to Drains

At many locations, the drain waters in the study area have been heavily polluted by the uncontrolled discharge of wastewaters either directly or through sewer systems. Most of the drains are now overloaded and no longer have assimilating capacities to purify the organic loads themselves.

The Bahr El Bakar Drain, one of the major drains in the eastern Delta region, receiving most of the wastewaters from the study area, has been seriously polluted by wastewaters. A study indicates that almost 90 percent of the loads are attributable to the wastewater discharged from the eastern part of the Greater Cairo area (Ref. No. 13). A sewage treatment construction project is now under way for the eastern Cairo, scheduled to complete within a few years. Upon completion of the project, most of the waste loads currently flowing into the drain will be cut off and the drain water quality is expected to improve significantly.

Under the circumstances, the implementation of the new sewerage project in the study area keeping pace with the Cairo project will no doubt contribute to the comprehensive improvement of the drain water quality, and there is every reason to provide sewage treatment works for the study area.

Another important factor to be considered for the water pollution control is the water quality standard set forth under the Law No. 48/1982 (Refer to Appendix III, Volume Three), which requires the sewage treatment effluent quality be 60 mg/l or less in terms of BOD. In order to achieve this goal, the level of the treatment will be secondary processes at the final stage.

In view of the above, it is apparent that a high degree of treatment (secondary) of the wastewaters will be neccessary before discharging to the drains. The possible alternative wastewater management techniques to be studied and evaluated will be biological treatment processes, including activated sludge processes, oxidation ditch and other biological processes.

(2) Discharge to Desert or Waste Land

Some of the cities in the study area are situated relatively close to desert and the discharge of the sewage to the land, either in raw or after treatment, is considered as one of the possible pathways for recycling and/or final disposal of wastewater, and are evaluated from technical, economic and environmental viewpoints.

Factors such as competing land uses, public health impact, energy requirements, aesthetics, and biological effects are to be considered as well as side effects, such as groundwater pollution, land pollution, and danger to public health. Each of the problems must be solved, though it requires long and continuous experimental studies before a system is selected.

In the desert regions, the reuse of treated sewage can be a new water source and an economical means to supplement the scarce water resources, e.g. El-Arish sewage reuse project. In the Nile Delta region, however, the water resources situation is better than other regions, and the demand for such water is minimal and therefore sewage reuse is not attractive at present.

Another factor to be considered is the economy of the land disposal system. The rough cost estimates for construction of the system, including a pumping station and a 20 km pressure outfall pipeline, is LE 5 million and annual O/M cost of LE 45,000. The costs are prohibitively high for the expected benfits, hence, it is evident that the application of this method is far inferior to the disposal to drains.

(3) Staged Planning for Treatment/Disposal

The secondary treatment processes are advantageous in that the facilities can be upgraded and extended as required, for example, the primary treatment process at the first stage construction, and additional secondary treatment facilities at a later stage as the situation warrants.

Hence, the best procedure will be to construct primary treatment facilities, comprising of the headworks, primary sedimentation tanks, chlorinators, outfalls, and sludge drying facilities, under the first stage program, and then to add aeration tanks/biofilters, final sedimentation tanks, together with other auxiliary facilities to achieve the final goal of 60 mg/l BOD effluent quality.

3.7 Design Criteria

In general, except for special reasons, the sewerage facilities are planned and desinged on the basis of the following desing criteria.

3.7.1 Sewers

For determining sewer capacities, the Manning equation is used for pipes and conduits, flowing full or partially full to accommodate the peak flows, with 'n' values 0.012 to 0.015, depending upon the pipe material. Some important elements to be considered in designing sewer capacity are reviewed in Appendix IX, Volume Three.

A minimum size of 200 mm is adopted for sanitary sewers, but for service connection pipes, 150 mm may be used. All sanitary sewers are designed to maintain a mean flow velocity, when flowing full or half full, of not less than 60 cm/sec for clay and PVC pipes, based on the Manning equation using an 'n' values 0.013 and 0.012 respectively. For RCP or any cement-bonded pipe material, for an 'n' value of 0.013, a minimum flow velocity of 75 cm/sec is used. For open channels, where ground surface slopes are low and it is determined to be technically and economically reasonable, flatter slopes are used.

Minimum sewer slopes for different sewer pipe sizes are adopted so that the velocity of flow will be not less than 75 cm/sec for cement-bonded pipes, and 60 cm/sec for clay pipes and PVC pipes. The recommended minimum slopes for sanitary sewers are presented in Appendix IX, Volume Three.

All sewers are designed not to exceed a velocity of flow of 3 m/sec to protect against sewer erosion. Where the ground slope is steep and a velocity of more than 3 m/sec may result, special provision is to be made to protect against displacement by erosion and shock.

For sanitary sewer design, full capacity of the design peak flow rate is provided. When the smaller sewer joins a larger sewer, the crown of both sewers are to be placed at the same elevation.

Earth covering of sewer pipe is not to be less 1 m unless special protection measures against the expected loads are provided.

All sewers are designed to flow, at all times, with sufficient velocity to prevent the settlement of solid matter and consequent sulfide generation, but no other measures are considered such as air injection to sewer. Where found necessary to protect cement-bonded sewers from the sulphide build-up, lining may be considered.

3.7.2 Pumping Stations

The design of pumping stations is based on the peak flow rate. All piping and conduits are designed to carry the expected peak flow rate. Substructures of pumping station are designed generally to be circular in plan. Two types of pumps are considered appropirate for use, the submersible type and the centrifugal type with horizontal axis. Enough storage capacity, ranging between 3 minutes and 10 minutes of the peak flow rate, is provided in wet wells, where automatic controls and variable speed drives are not furnished to match pumping rates exactly with inflow rates. For all stations, provision is made to facilitate removing pumps and motors. Structures are designed for the ultimate size, but pumps, accessory mechanical equipment, and electric facilities will be purchased and installed according to the staging of construction. Typical structure of pumping stations are shown in Figures 3.4 and 3.5.

Pumps are electric motor driven, but provision of emergency power supply by diesel engines is considered to insure a continually available internal power source for instrumentation and auxiliaries.

Screening devices are generally provided ahead of pumping to remove solid materials. Where screening is provided, screenings removed from sewage will be disposed of by removal to appropriate disposal sites, with local storage containers used as needed.

3.7.3 Sewage Treatment Plants

Law No.48/1982 stipulates the effluent water quality standards required for treated sewage when discharged to the drains, which are shown in Table 3.17. In terms of BOD and SS, maximum limits are set at 60 mg/l and 50 mg/l respectively. Taking into account that effluent quality shall meet these requirements constantly, and that the estimated BOD and SS concentrations in raw sewage are 450 mg/l and 460 mg/l, secondary treatment process is required for all the treatment plants in the Governorate. Among various applicable secondary treatment processes at present, conventional activated sludge process and oxidation ditch process are recommended for adoption. Conventional activated sludge process is recommended for five medium size cities mainly due to minimum requirement of the land space. For other seven small cities, oxidation ditch process is recommended because of the ease of operation and maintenance.

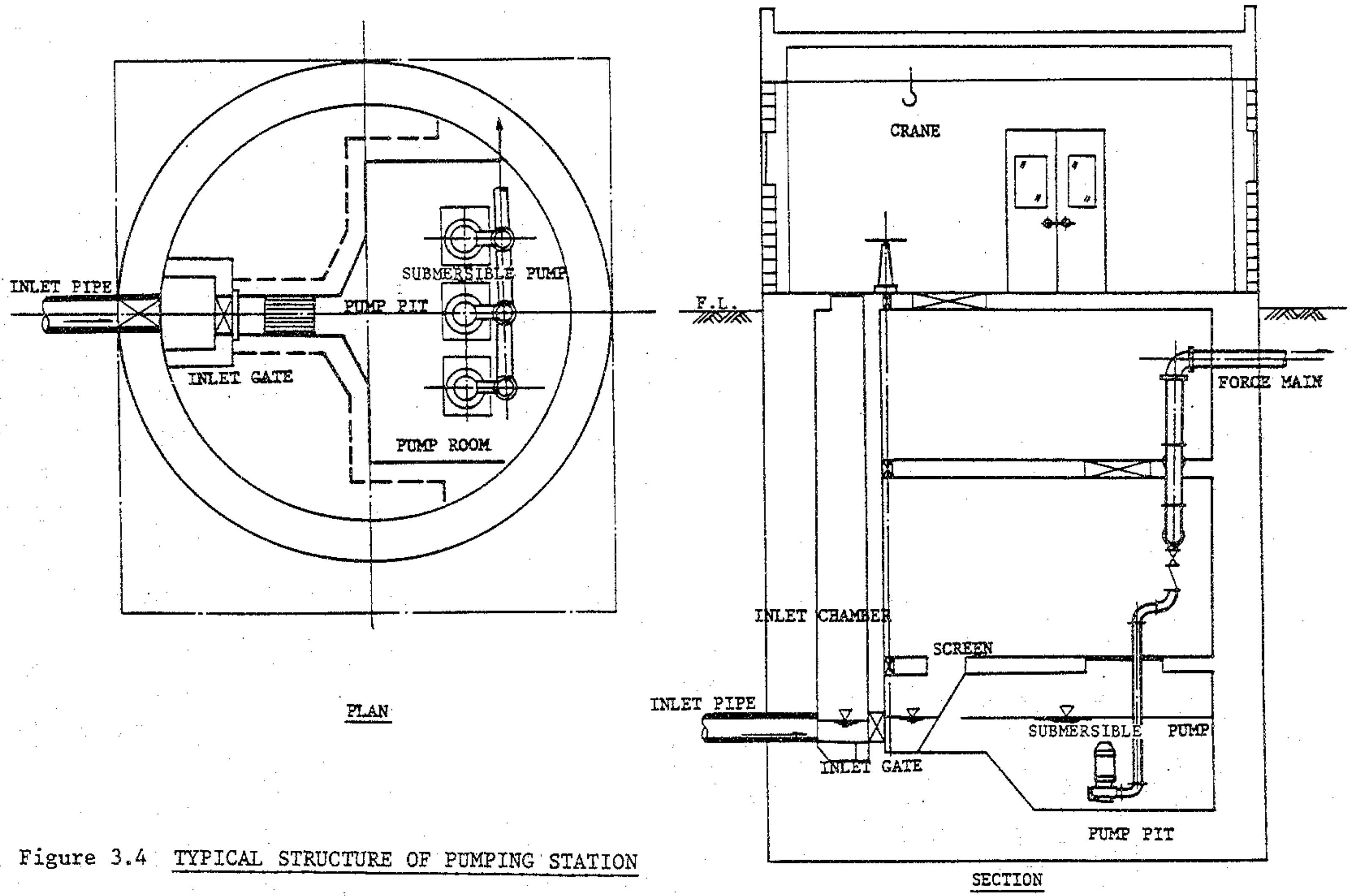


Figure 3.4 TYPICAL STRUCTURE OF PUMPING STATION

(SUBMERSIBLE TYPE PUMP)

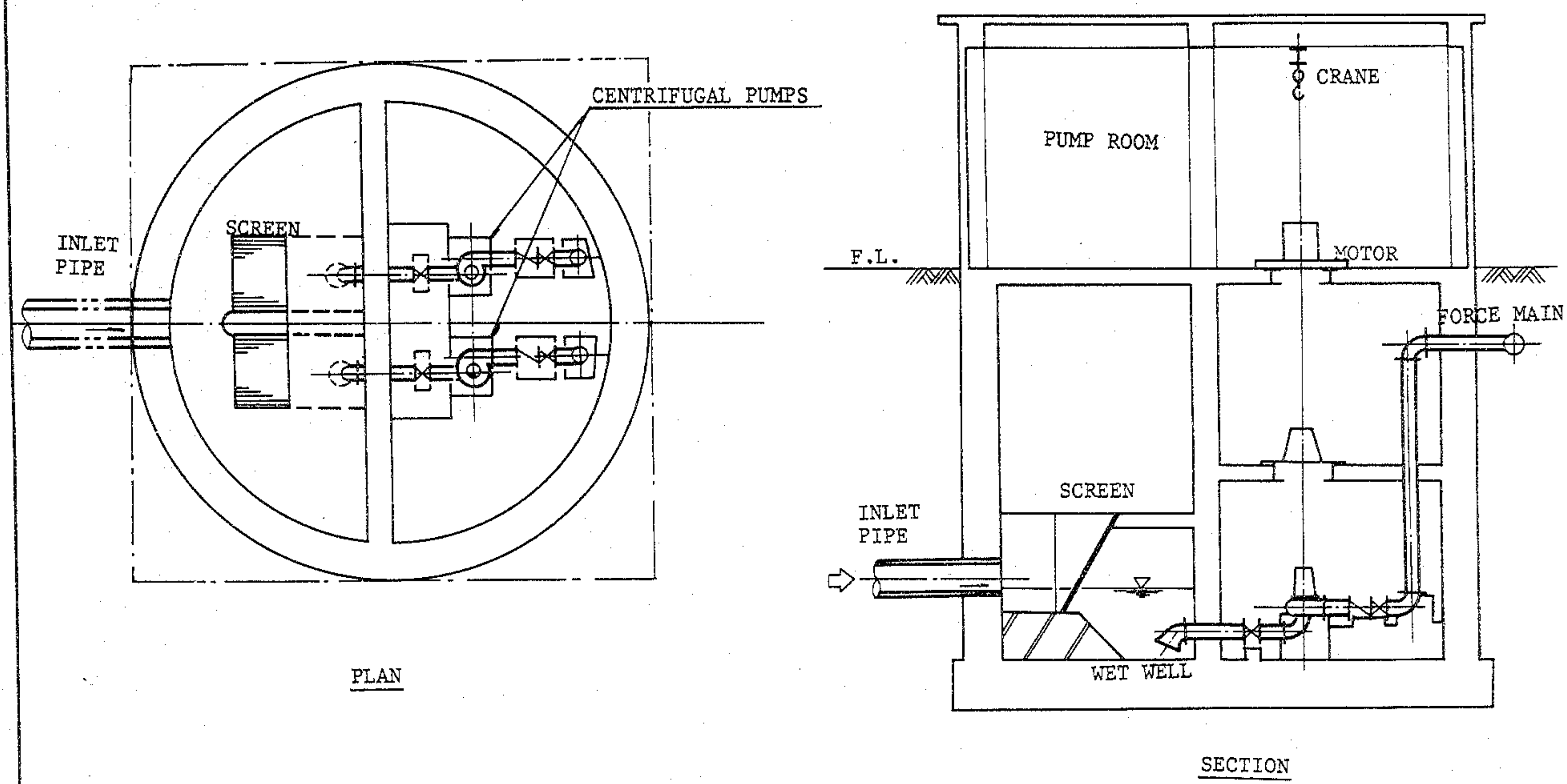


Figure 3.5 TYPICAL STRUCTURE OF PUMPING STATION
(CENTRIFUGAL TYPE PUMP)

More than 90 percent reduction of the BOD and SS can be expected for both processes (see Appendix X). Therefore, the following effluent qualities are set as goal of the treatment.

	Influent	Effluent
BOD (mg/l)	450	30
SS (mg/l)	460	30

Table 3.17 Effluent Quality Criteria for Discharge to Drains

Description	Maximum limit of standards and Specifications (mg/l)	
	Sanitary wastewaters	Industrial liquid wastes
Temprature	35°C	35°C
pH	6-9	6-9
BOD	60	60
COD (dischromate)	80	100
COD (permanganate)	40	50
Dissolved Oxygen	not less than 4	-
Oil and Grease	10	10
Suspended Solids	50	60
Coloring Materials	nil	nil
Sulphides	1	1
Cyanide	-	0.1
Phosphates	-	1.0
Nitrates	50	40
Fluorides	-	0.5
Phenol	-	0.005
Total Heavy Metals	1	1
Insecticides (All types)	nil	nil
MPN E.Coli	5000/100 cc	5000/100 cc

In general, the design of the sewage treatment plant units are based on the daily maximum rate of sewage flow per 24 hours. All pipings and conduits are designed based on the peak flow rate. Design organic loadings are computed in the same manner used in determining design flow.

Component parts of the treatment plant are arranged for the greatest operating convenience, flexibility, economy, and so as to facilitate installation of future units.

Except where duplicate units are available, bypass structures, properly located and arranged, are to be provided so that each unit of the plant can be removed from service independently.

Due considerations should be given to the selection of materials which are to be used in sewage treatment facilities because of the possible presence of hydrogen sulphide and other corrosive gases, greases, oils, and similar constituents frequently present in sewage.

A standby power sources shall be provided to ensure the continuous operation of such important equipment as influent pumps, minimum number of aerators, and emergency lighting.

Necessary facilities for operation and maintenance of the plant shall be provided, including i) water supply, ii) drainage facilities, iii) plant roads and parking facilities, iv) service facilities, and v) connecting conduits.

Adequate provision shall be made to effectively protect the operators and visitors from hazards.

For details of planning and design of each component facilities of the treatment plant, see Appendix VIII of Volume Three.

3.8 Materials and Methods of Construction

3.8.1 General

Presently most construction materials for the sewerage and sanitation programs are available at Sharqiya Governorate except certain equipment required for pumping stations and sewage treatment plants, such as pumps, and mechanical, electrical and instrumentation equipment of treatment plant. The construction methods applied and being used for the sewerage and sewage treatment work construction in Zagazig and other cities in the Governorate are practical, and the local construction industries will play a major role in the construction of the sewerage facilities.

3.8.2 Structural Materials

Sand and gravel suitable for concrete aggregate are available in adequate quantities in and around the Governorate. Portland cement is produced in the country, conforming with internationally accepted standards, suitable for the sewerage construction, such as pressure and non-pressure concrete pipes, and civil and building works for pumping stations and sewage treatment plant facilities.

Since most of the sewerage structures are subject to sulphide attack, high quality sulphate-resisting portland cement is recommended for below-ground structural works. The actual specifications of concrete mixes and strengths are the matter to be decided during the final design; however, in view of the importance of preventing not only structural failure but groundwater infiltration, all concrete for sewerage should be dense and properly cured to obtain the full advantage of quality control.

3.8.3 Pipe Materials

Sewer pipes currently used for the sewer lines are clay and PVC pipes, but concrete pipes are not widely used. PVC pipes are in general used for small diameter pipes. These pipes are limited both in sizes and types. PVC pipes manufactured for sewers conforming with DIN standards are available from 110 to 400 mm in dia. (see Appendix-VII, Volume Three). Clay pipes are manufactured from 4" to 50" in dia. and are widely used for the sewers in the cities of the Governorate.

For the selection of sewer pipe materials, careful considerations are to be given to the problems of corrosion by sulphide build-up in sewers. Because of the relatively high temperature and expected high BOD of the wastewaters, the sulphide problem can be expected to be serious. Preference is therefore given to use of corrosion resistant materials, such as clay pipe and PVC pipe, in order that the sewers to be installed will indeed have a useful life for many decades, as desired. However, due to the limited available sizes for clay and PVC pipes, concrete pipes may have to be used for some large size trunks. In such case, appropriate measures should be considered to protect the pipes from the sulphide attack.

3.8.4 Manhole Materials

The manhole frame and cover should normally be made of cast iron, having adequate strength to support superimposed loads, with a minimum diameter of 600 mm. The frames and covers currently used are, in general, acceptable for the new sewer construction. Other manhole materials such as brick, precast concrete sections can also be produced locally.

3.8.5 Construction Methods

Major construction works of the project may be classified into two categories, sewer pipe laying and construction of pumping stations and sewage treatment works.

There may be two applicable construction methods for pipe laying, the open-cut and the tunneling method. The open-cut method is applicable where the sewer size is small and the traffic conditions allow to do it. Most of the sewers will be laid using this method, but for large and deep sewer construction and where the traffic is heavy and cannot be detoured, the tunneling method may be used. The method includes the various forms of jacking of prefabricated units from shaft or pit locations. Since this requires equipment and skills, the application to sewer construction should be carefully studied for its suitability to the project.

Pumping stations will require a foundation extending approximately 7 to 12 m below the existing ground surface. This construction may pose particular problems because of high groundwater tables and the type of the subsoil at the sites. The normal method of excavation, using the sheet piling, will not be practical for application at some sites with deep foundations, even with a series of wellpoints or sump for drainage.

Construction sites for sewage treatment works are rather isolated from the built-up areas and may have less problem with respect to the impacts to the surrounding area than the pumping stations. The excavation may be carried out in open-cut, in some cases without sheeting as being done at the new treatment works construction site in Zagazig. It is expected that, in general, the groundwater elevations in the area are high, and therefore, appropriate dewatering should be practiced all through the construction works.

3.8.6 Capabilities of Local Contractors and Manufacturers

At present time, most of the construction in the region is accomplished by local contractors. Contractors for heavy utilities such as pumping stations and sewage treatment plant facilities, will have to be left to experienced contractors. However, for most of the sewer construction, the local contractors in the Governorate can carry out the works, if properly supervised by experienced engineers. Although a significant labor force will be needed when the project starts, there will be no serious problem in finding unskilled labor, but skilled labor, tradesmen, foremen and construction manager at a various levels could pose a difficulty.

3.9 Cost Estimates

3.9.1 General

Determination of the estimated capital costs for recommended sewerage system involves many factors peculiar to the time and the area, including availability of materials, equipment, and labor, especially since this is a major project. Local topographic characteristics, soil conditions, and the existing sewerage system also play distinct parts in estimation of capital costs.

3.9.2 Basis of Cost Estimates

For master plan purposes, preliminary design of basic construction items, using concrete, reinforcing steel bars, sewer materials, etc., have been made to obtain appropriate unit prices which are to be used for estimating the total costs of the project components.

3.9.3 Basic Costs

In estimating construction costs of the facilities, unit costs for domestic items such as labor, materials to be purchased in Egypt, power, equipment and transportation, and materials and equipment to be imported, were collected and checked by both Egyptian counterparts and local contractors. For master plan purposes, all costs are estimated at 1987 price levels in Sharqiya Governorate. These procedures are described in Appendix VII, Volume Three.

3.9.4 Sewer Pipes

Construction costs of sewers were estimated, taking into account known and estimated costs of excavation, sheeting, bracing, dewatering, bedding, pipe supplying and laying, concrete placing, forming, reinforcing, restoration of pavement, and contractor's profit and overhead. The cost estimates were developed for normal conditions, excluding such additional costs as required for rock excavation or dewatering for which special techniques are required, and any work required for special conditions. On the basis of basic unit costs, unit costs for sewers were estimated.

3.9.5 Pumping Stations and Sewage Treatment Plants

The costs for the electrical and mechanical works are estimated assuming all major components of equipment would be imported. Costs include contingencies for all large items of equipment, such as pumps, engines, electric metering and controls, which will require manufacturer's representation during installation and for field testing.

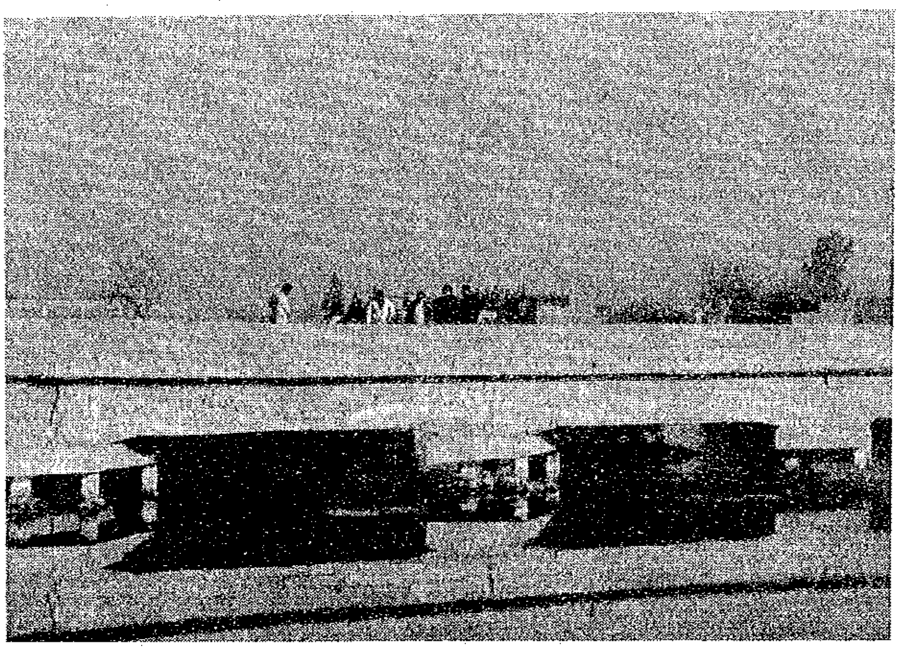
The building and structural costs were arrived at by using local pricing except for such items which cannot be manufactured locally. Shipping and importation allowances have been added to imported items. Foreign currency portion of the costs required for the imported items are indicated in Egyptian Pounds converted from foreign currency by official exchange rate in mid-1987. Exchange rates used in the study are shown below.

Exchange Rates of Egyptian Pound	
US dollar	2.225
Japanese Yen (100)	1.523

These are described in some detail in Appendix VII - Volume Three.

CHAPTER - FOUR

LONG TERM PLAN (UP TO 2005)



CHAPTER FOUR

LONG TERM PLAN (UP TO 2005)

4.1 Introduction

As defined in Section 3.2.1 of the current report, sewerage master plan area up to 2005 is limited to the projected urban areas in 2005 of the thirteen cities in the Governorate. Boundaries of these areas are indicated on the drawings in Volume Four. All urban areas where sewer pipes have already been constructed are included in the planning areas. Thus, for the master plan purpose, the areas are classified into two categories, existing service areas and areas to be served. The existing sewer pipes and pumping stations are considered to be continuously utilizable up to 2005 with necessary improvements and replacements. Sewer pipe systems for presently unserved areas are designed. Trunk sewer lines, pumping stations and treatment plants are designed to accommodate total wastewater flows produced in all urban areas comprising existing service areas and present unserved areas.

Construction cost of the new facilities are estimated. Costs for the rehabilitation and improvements of the existing sewerage systems are also worked out. Total project cost including indirect costs are estimated. Based on the project costs and priority evaluation, implementation program up to the year 2005 is developed and recommended, in which, defining the four cities, namely Zagazig, Bilbeis, Faqus and Minyet El Qamh, as first priority areas for the feasibility study.

Recommendations for organizational set up including staffing requirements to implement projects and for operation and maintenance of the sewerage systems in the Governorate are proposed and presented in this chapter. Financial and economic analysis considering the long time span up to 2005 are conducted, and confirm the feasibility of the sewerage project in the Governorate.

4.2 Sewerage System

4.2.1 Centralized System versus Separate System

Centralized sewerage system which combines two or more cities in one sewerage system is one of the alternative systems other than individual separate system in the Governorate.

In combined centralized system, cost of the sewage treatment generally become lower than that of separated treatment because of economy of scale. On the other hand, centralized system has the disadvantage of longer trunk sewer lines which are inevitable to convey sewage to a remote treatment plant. These two costs are in a trade-off relation. Also in combined system, implementation schedule of the sewerage system is an important element to be taken into account, since two or more cities are involved in the construction of such major facilities as trunk sewers, pumping stations and treatment plant.

From the above considerations, a study was conducted by selecting two most probable cities. Qenayat and Hihya Cities are located nearby to Zagazig City, within 10 km distance. These two cities are small in population compared with Zagazig. Sewage flows in the two cities can readily be conveyed to Zagazig and treated at the new plant, which is now under construction in the City.

Construction costs of the two cases, a) combined to Zagazig and b) separate systems, are compared for each of Qenayat and Hihya Cities. Comparison results are shown below.

1) Qenayat City

a) Combined with Zagazig

Additional costs of force main and pumping station

Force main	LE 1.1 million
Pumping station	LE 1.2 million

Additional costs for Zagazig sewage treatment plant

LE 2.6 million

Total additional costs LE 4.9 million

b) Separate system

Construction cost for Qenayat sewage treatment plant

LE 6.0 million

Therefore, the combined system is less costly by LE 1.1 million than the separate system.

2) Hihya City

a) Combined to Zagazig

Additional costs for force main and pumping station

Force main	LE 2.9 million
Pumping station	LE 1.5 million

Additional costs for Zagazig sewage treatment plant

LE 2.4 million

Total additional costs LE 6.8 million

b) Separete system

Construction cost for Hihya sewage treatment plant

LE 6.0 million

Therefore, the separete system is less costly than the combined case by LE 0.8 million.

As described above, construction cost of the combined system is less expensive in case of Qenayat City, but more expensive for the case of Hihya City. Taking into account the locations of the other cities in the Governorate, any other two cities are not located closer to each other than that of Qenayat or Hihya to Zagazig, and therefore combined system of any other cities will obviously be more costly than separate system. Consequently, Qenayat City sewerage system is recommended to be combined with Zagazig City sewerage system and the other eleven cities shall have their own sewerage systems.

4.2.2 Sewers

All sewer pipes from households to the sewage treatment plant are considered for every planning area. These are classified into the following three categories based on the function, namely house connections, branch and lateral sewers, and trunk sewers. House connection is a facility which connects each household to the public sewerage system. The facility usually consists of house inlet and connection pipes. Branch and lateral sewers are pipeline networks which collects sewage from house connections and convey them to trunk sewers or pumping stations. Trunk sewers are generally large diameter sewers which receive sewage flows from a certain portion of the service area. In the study, trunk sewers are defined as the sewers to which the contributing service areas are 20 ha or more. Necessary numbers of the house connections in new service areas are estimated based on the conditions in the representative existing service area. The average served population of 30 persons per connection is worked out and used for estimation of total number.

Total lengths of branch and lateral sewers are also estimated based on the average length per area. Two representative areas are selected from the existing service areas in Zagazig and Faqus Cities. An average of 400 m/ha obtained from two samples are used uniformly over the service area for estimation purposes (see Appendix VII).

Hydraulic calculations are conducted to design the outline of the trunk sewers in each of 13 cities. Routes of these trunk sewers are illustrated on the drawings in Volume Four, and length of the sewers identified by diameters and depths are shown in Appendix VII.

Planning information of the sewer pipes are tabulated in the following Table 4.1.

Table 4.1 Sewer Pipes Planned

City	Served Population	Service Area (ha)			Number of House Connections	Total Length of Branch and Lateral (km)	Trunk Sewer	
		Existing	New	Total			Diameter*(mm)	Length (km)
Zagazig	362,000	794	1,932	2,726	12,070	1,090	250 - 900	27.99
Huseiniya	29,000	-	253	253	970	101	200 - 600	6.55
Kafr Saqr	35,000	98	150	248	1,170	99	200 - 900	6.38
Faqus	78,000	-	515	515	2,600	206	200 - 1,000	14.62
Abu Kebir	114,000	103	341	444	3,800	178	200 - 900	14.91
Abu Hammad	44,000	144	166	310	1,470	124	250 - 900	7.44
Ibrahimiya	44,000	16	154	170	1,460	68	250 - 900	4.04
Hihya	49,000	30	235	265	1,630	106	200 - 900	6.33
Diarb Nigm	61,000	65	194	259	2,030	104	400 - 1,000	4.14
Bilbeis	183,000	227	440	667	6,100	267	200 - 900	11.07
Minyet El Qamh	82,000	150	150	300	2,740	120	250 - 750	8.10
Mashtul El Soak	46,000	26	228	254	1,540	102	200 - 900	6.86
Qenayat	53,000	5	223	228	1,760	91	250 - 900	6.68
Total	1,180,000	1,658	4,981	6,639	39,340	2,656		125.11

Note: * Diameters are only for gravity sewers.

4.2.3 Pumping Station

Outline of the pumping stations is designed based on the hydraulic calculations of the sewer networks. As mentioned in the previous Section 3.9.3, pumping stations are considered when the sewer pipes in general become lower than 5 m or more in depth except where deep sewers are apparently more economical. Circular type substructures are recommended for all pumping stations considering the present practice in the Governorate and economy of the construction. Two types of pumps are recommended, submersible pumps for smaller stations and centrifugal type for larger stations for the same reasons mentioned above. As a result, a total of 26 new pumping stations are proposed. Table 4.2 shows outline design of pumping stations.

Table 4.2 Design Outline of Pumping Stations

City	P/S No.	Design Peak Flow (m3/sec)	Inlet Depth (m)	Diameter (mm)	Q'ty	Remarks
Zagazig	No.1	0.083	9.3	150	3	
	No.2	0.271	6.2	250	4	
	No.3	0.305	4.3	250	4	
	No.4	0.239	3.8	200	4	
	No.5	0.206	5.9	200	4	
	Main	0.488	4.0	300	4	Existing
Huseiniya	No.1	0.025	5.6	100	2	
	No.2	0.020	4.0	100	2	
Kafr Saqr	No.1	0.011	3.9	100	2	
	No.2	0.015	3.6	100	2	
Faqus	No.1	0.145	6.6	200	3	
	No.2	0.060	3.0	150	3	
	No.3	0.313	4.4	300	3	
Abu Kebir	No.1	0.272	5.4	250	3	
	No.2	0.067	4.0	150	3	
Abu Hammad	No.1	0.102	5.2	200	3	
Ibrahimiya	No.1	0.017	4.3	100	2	
Hihya	No.1	0.033	4.0	150	2	
Diarb Nigm		- None -				
Bilbeis	No.1	0.212	5.3	250	3	
	No.2	0.041	3.0	150	2	
	No.3	0.080	3.0	150	3	Existing
	No.4	0.098	3.0	200	3	Existing
	No.5	0.042	3.0	150	2	
	No.6	0.029	3.0	150	2	Existing
	No.7	0.056	3.0	200	2	Existing
	No.8	0.049	3.0	200	2	
	No.9	0.066	3.0	200	2	
Minyet El Qamh	No.1	0.090	4.3	150	3	Existing
	No.2	0.030	3.0	150	2	Existing
	No.3	0.068	3.1	150	3	Existing
Mashtul El Soak	No.1	0.064	4.4	150	3	
	No.2	0.028	4.4	150	2	
	No.3	0.023	4.6	100	2	
Qenayat	No.1	0.163	5.9	250	3	

Note: Number of pumps includes one standby unit

4.2.4 Treatment Works

As discussed in the Section 3.9.4 in Chapter Three and Appendix X, Volume Three, conventional activated sludge process is recommended for treatment plants in five medium size cities, namely Zagazig, Faqus, Abu Kebir, Bilbeis and Minyet El Qamh. For the other seven cities, oxidation ditch process is recommended. Review of design of the new treatment plant under construction in Zagazig City reveals that the capacity of the present construction is sufficient for combined flows of Zagazig and Qenayat Cities in 2005 to be treated at the plant. Therefore, design of the plant and cost estimation are excluded from the planning of treatment plants.

Layout plans of the treatment plants and design outlines, such as dimensions of the main facilities are shown in Appendix VIII, Volume Three.

Locations of the treatment plants are decided based on the information obtained from interviews with engineers in each Markaz. Factors considered in decision-making are as follows. Locations of treatment plants are indicated on the drawings in Volume Four.

- Proximity to the drains for effluent disposal. This is one of the most important factors to be considered for the selection of the locations. It is strictly prohibited to discharge effluent to the agricultural canals. Therefore, treated effluent should be disposed of to the drains. Size of the drain should also be considered, since the large quantities of water will flow into the drain when the plant is in operation. Assimilative capacity for organic loading is related to the size of a drain. The larger drains which can receive more wastewater are preferable alternatives in this regard.

- Wind direction. Odors from the treatment plant can not be eliminated completely, nevertheless every possible counter measure is provided. Therefore, prevailing wind directions at treatment plant site throughout the year, and especially in summer, shall be considered. In general, south of the urbanized area is considered appropriate for the plant location, since the prevailing wind directions in the Governorate are northeast and northwest.

- Proximity to the service area. If the treatment plant is located far from the service area, long trunk sewers and sometimes pumping stations are required for transmission of the raw sewage. This will result in increased construction costs. Therefore, the nearest location outside the urbanized areas should be selected for the plant.

Since the terrain in the Governorate is generally flat and low lying, topographic features do not form any impediments for the selection of plant location. Large canals and drains and railways, however, are considered as boundaries for service area subdivision, since crossings of these will require special construction method which are generally high in cost.

4.2.5 Effluent and Sludge Disposal

Treated effluent from every treatment plant is to be discharged to nearby drains which have sufficient capacity to receive it. The effluent will be utilized purposely or incidentally through drain and canal systems for agricultural or any other purposes. Although direct reuse of the treated effluent is not recommended in the study, this possibility should be considered when the district is highly developed and water resources become scarce in the future. Agricultural reuse of the effluent, directly or through the drain and canal system is considered as the most probable means of reuse.

For all the treatment plants, sand drying beds with drain pipings are recommended for the sludge treatment to make use of the climatic advantage in the region. Dried sludge can be used for agriculture as fertilizer or soil conditioner. For the reuse of the sludge, however, components of the sludge should be examined and special attention should be paid to such hazardous materials as heavy metals and toxic materials. These hazardous materials generally originate from various kinds of industrial wastes. At present, there are no factories in the Governorate which produce hazardous materials. However, if the industrial wastes are discharged to the public sewerage systems, appropriate countermearsures should be provided or otherwise this will affect not only the sludge but also the treated effluent. On occasions, separate treatment or pretreatment by the factory might be justified technically and economically.

Agricultural reuse of the dried sludge from sewage treatment is already practiced in Egypt and it is considered the most appropriate method of sludge disposal in the immediate and long-term for the Governorate.

4.2.6 Rehabilitation and Improvement

All the cities except one have existing sewerage facilities at various levels of service.

The existing facilities should be utilized as much as possible for the benefit of the sewerage project in the Governorate from various points of view, such as smooth implementation and economy of the project.

Information obtained from each city imply that the sewer pipe systems are, in general, in a good condition and operable without major problems, but there are some difficulties in operation of the pumping stations due to insufficient capacities of pumps and inadequacies of spare parts. One existing treatment plant in Zagazig has totally deteriorated. However, this treatment plant will be abandoned when the new treatment plant is in operation. Although no detailed technical data such as profiles of the pipes, to estimate the degree and extent of rehabilitation by 2005, are available, needs of rehabilitation, improvement and replacement of the existing facilities are estimated on the basis of the following assumptions.

Although the existing sewer pipes are generally in a good condition, some improvements or replacement will be required by 2005, for some reasons. One of them is the increase of the wastewater flows in the area due to higher population density or increase in the per capita wastewater production rate, or both. Therefore, 15 percent of the initial branch and lateral sewer construction costs are estimated to cover all thses kinds costs.

Useful life of the heavy duty mechanical equipment, such as motors and pumps are usually estimated to be less than 15 years. All the pumping units in the existing pumping stations are, therefore, considered to be replaced once by the year 2005. Costs for the replacement are included in the overall cost estimation.

4.2.7 Cost Estimation

Total costs of the project are estimated according to the following classification. Firstly, project costs are divided into direct and indirect cost portions. Direct cost portion includes construction of such new facilities as sewer pipes, pumping stations and treatment plants, and rehabilitation of the existing facilities. Construction costs are estimated, based on the design of the each facility and on the unit costs of the each work item.

Land costs for necessary space for pumping stations and treatment plants are also a part of the direct cost, and are estimated based on the necessary land area calculated from the design of the facilities and on the unit land purchasing costs obtained from each Markaz. Rehabilitation costs are estimated based on the above mentioned assumptions.

Indirect cost portion consists engineering and contingency costs for the project. Engineering costs are estimated to be 10 percent of the construction and rehabilitation costs. Contingency costs both for cost escalation and physical contingency are assumed to be 20 percent of the construction and rehabilitation costs.

Operation and maintenance costs necessary for the proper operation and maintenance of the sewerage system proposed for the year 2005 are also estimated on the manpower, electricity and other requirements.

All costs are divided into local currency and foreign currency portions, according to the nature and origin of goods and services. Bases and details of the cost estimations are described in Appendix VII, Volume Three. Summary of the project cost are tabulated in Table 4.3. Total project cost is estimated to be LE 446.226 million, of which LE 369.751 million or 83 percent is the local currency portion and LE 76.475 million or 17 percent is the foreign currency portion.

Summary of the operation and maintenance costs for the entire sewerage systems in the Governorate is shown in Table 4.4. A total of about LE 3.6 million will be required annually when the proposed sewerage systems come into operation.

Table 4.3 Total Project Costs

(LE 1,000)

City		B/L Sewer	Trunk Sewer	P/S	STP	Sub-total	Land Purchasing Cost	Rehabili. Cost	Contingency	Engineering Cost	TOTAL COST
Zagazig	T	57,960	10,549	4,319	-	72,828	375	5,841	15,734	7,868	102,646
	L/C	57,960	8,967	2,425	-	69,352	375	2,561	14,382	7,192	93,862
	F/C	-	1,582	1,894	-	3,476	-	3,280	1,352	676	8,784
Huseiniya	T	7,590	724	392	5,097	13,803	2,040	-	2,761	1,381	19,985
	L/C	7,590	615	203	2,580	10,988	2,040	-	2,198	1,099	16,325
	F/C	-	109	189	2,517	2,815	-	-	563	282	3,660
Kafr Saqr	T	4,500	899	382	5,594	11,375	2,240	596	2,394	1,197	17,802
	L/C	4,500	764	202	2,831	8,297	2,240	252	1,710	855	13,354
	F/C	-	135	180	2,763	3,078	-	344	684	342	4,448
Faqus	T	15,450	4,153	1,936	12,051	33,590	4,665	592	6,836	3,418	49,101
	L/C	15,450	3,530	1,136	8,580	28,696	4,665	420	5,823	2,912	42,516
	F/C	-	623	800	3,471	4,894	-	172	1,013	506	6,585
Abu Kebir	T	10,230	3,093	1,029	14,070	28,422	5,560	552	5,795	2,898	43,227
	L/C	10,230	2,629	441	9,286	22,586	5,560	294	4,576	2,288	35,304
	F/C	-	464	588	4,784	5,836	-	258	1,219	610	7,923
Abu Hammad	T	4,980	1,405	490	6,690	13,565	2,730	388	2,791	1,396	20,870
	L/C	4,980	1,194	199	3,386	9,759	2,730	130	1,978	989	15,586
	F/C	-	211	291	3,304	3,806	-	258	813	407	5,284
Ibrahimiya	T	4,620	709	194	5,935	11,458	2,320	343	2,360	1,180	17,661
	L/C	4,620	603	101	3,003	8,327	2,320	86	1,683	842	13,258
	F/C	-	106	93	2,932	3,131	-	257	677	338	4,403
Hihya	T	7,050	1,458	296	6,863	15,667	2,720	424	3,218	1,609	23,638
	L/C	7,050	1,239	165	3,473	11,927	2,720	110	2,407	1,204	18,368
	F/C	-	219	131	3,390	3,740	-	314	811	405	5,270
Diarb Nigm	T	5,820	2,349	-	7,797	15,966	3,200	112	3,216	1,608	24,102
	L/C	5,820	1,997	-	3,945	11,762	3,200	112	2,375	1,188	18,637
	F/C	-	352	-	3,852	4,204	-	-	841	420	5,465
Bilbeis	T	11,820	2,716	3,501	22,293	40,330	8,285	942	8,255	4,128	61,940
	L/C	11,820	2,309	1,665	15,556	31,350	8,285	426	6,355	3,178	49,594
	F/C	-	407	1,836	6,737	8,980	-	516	1,900	950	12,346
Minyet El Qamh	T	4,500	1,614	700	12,697	19,511	4,500	930	4,088	2,044	31,073
	L/C	4,500	1,372	140	9,162	15,174	4,500	244	3,083	1,542	24,543
	F/C	-	242	560	3,535	4,337	-	686	1,005	502	6,530
Mashtul El Soak	T	6,840	1,284	931	6,557	15,612	2,670	33	3,129	1,565	23,009
	L/C	6,840	1,091	463	3,318	11,712	2,670	33	2,349	1,175	17,939
	F/C	-	193	468	3,239	3,900	-	-	780	390	5,070
Qenayat	T	6,690	1,270	600	-	8,560	30	11	1,714	857	11,172
	L/C	6,690	1,080	246	-	8,016	30	11	1,605	803	10,465
	F/C	-	190	354	-	544	-	-	109	54	707
TOTAL	T	148,050	32,223	14,770	105,644	300,687	41,335	10,764	62,291	31,149	446,226
	L/C	148,050	27,390	7,386	65,120	247,946	41,335	4,679	50,524	25,267	369,751
	F/C	-	4,833	7,384	40,524	52,741	-	6,085	11,767	5,882	76,475

Note: B/L: Branch and lateral
P/S: Pumping station
STP: Sewage treatment plant
T : Total
L/C: Local currency portion
F/C: Foreign currency portion

Table 4.4 Operation and Maintenance Costs

(LE 1,000/year)

City	Service Area (ha)	Sewer Length (km)	Wastewater Flow (m3/day)	Treatment Process	Operation and Maintenance Costs Sewer	P/S	STP	Total
Zagazig	2,726	1,090	94,062	AS	528	365	395	1,288
Huseiniya	253	101	5,746	OD	48	6	56	110
Kafr Saqr	248	99	6,362	OD	47	26	61	134
Faqus	515	206	16,101	AS	100	130	85	315
Abu Kebir	444	178	20,446	AS	86	95	105	286
Abu Hammad	310	124	7,980	OD	60	35	74	169
Ibrahimiya	170	68	6,580	OD	32	3	63	98
Hihya	265	106	8,084	OD	52	26	75	153
Diarb Nigm	259	104	9,355	OD	50	-	85	135
Bilbeis	667	267	33,767	AS	130	180	162	472
Minyet El Qamh	300	120	14,513	AS	58	45	78	181
Mashtul El Soak	254	102	7,641	OD	50	22	71	143
Qenayat*	228	91	-	-	44	69	-	113
Total	6,639	2,656	230,637	-	1,276	1,002	1,310	3,597

Note: Wastewater flow of Qenayat is included that of Zagazig.
Wastewater flow of Bilbeis includes from army camp.
AS: Conventional Activated sludge process
OD: Oxidation ditch prcess

4.3 Staging of Implementation

Staging of the project implementation to the year 2005 is worked out taking into consideration various factors which will affect or be affected by the project. An arbitrary rating method is adopted to evaluate the priority of the 13 cities. Taking into accout the budgetary provisions in the New Five Year Plan and its constraints, an implementation schedule by a staged program is developed. It is planned that all urban areas of the 13 cities will be provided with sanitary sewerage systems with complete secondary treatment by the year 2005.

4.3.1 Priority Evaluation

Various factors which are to be considered for the implementation of the sewerage project are selected to comprehensively evaluate the priority of each of the 13 cities from engineering, environmental and financial view points. These are described below.

1) Population

Magnitude of the population to be served by the sewerage system is one of the major factors for consideration. Large population generally indicates the importance of the city. If a sewerage project is materialized in a city with a larger population, a larger number of people will benefit from the project. Moreover, waste load in larger quantity which will otherwise cause pollution of the environment will be removed by the treatment of the wastewater. Therefore, population in 2005 is selected as one of the factors for the priority evaluation, and a larger population is given a higher ranks.

2) Present Service Level

Present service level of the sewerage is one of the factors, since most of the 13 cities are provided with the sewerage systems at different levels at present without any treatment or with inadequate treatment. Early implementation of the project, particularly construction of treatment plant, is, therefore, desirable in a city which has high service ratio.

3) Effects on Drains

This factor mostly concerns the geographical conditions of the city. Since the wastewater, whether with or without treatment, discharges into the drains, the city whose wastewater discharges into the larger drain with longer downstreams has greater effects on the drains from environmental and reuse points of view.

4) Priority of Water Supply Project

In the Governorate, the urgent necessity of the water supply project is pointed out and early implementation of the project is recommended by the water supply feasibility study. The priority of the project is also identified in the study. Implementation of the sewerage project in parallel with the implementation of the water supply project is desirable from the engineering point of view. A city with the higher priority of a potable water supply project is ranked higher in this category.

5) Groundwater Contamination

As discussed in Section 2.11, Chapter Two, present excreta disposal systems, such as transh and septic tank, apparently contaminate the shallow wells in the vicinity used for the supply of drinking water. Implementation of the sewerage project in an area where inhabitants heavily depend for their drinking water on shallow wells is desirable from the public health view point. Therefore, higher rank is given to such an area.

6) Reuse Possibility

Reuse of the treated effluent is one of the important factors to be considered in the future by the Governorate. Agricultural reuse for the land reclamation of the presently uncultivated areas is the most probable measure. Possibility of the agricultural reuse of the effluent, suggested by the proximity to the desert land is selected as one of the priority factors.

Each of the 13 cities are evaluated by the 6 above mentioned factors by grading on an A t D scale, and the total of the 6 factors are calculated as an average. The results of the evaluation are shown in Table 4.4. Four Cities, namely Zagazig, Faqus, Bilbeis and Minyet El Qamh are ranked the highest. Other three Cities, Abu Kebir, Hihya and Diarb Higm, have the second highest priority. Then three Cities, Abu Hammad, Mashtul El Soak, follow them. The lowest priority rank is given to four Cities, namely Huseiniya, Kafr Saqr, Ibrahimiya, and Qenayat.

Table 4.5 Priority Evaluation

Marakaz	Evaluation Factors						
	No.1	No.2	No.3	No.4	No.5	No.6	Total
Zagazig	A	A	A	C	A	C	A
Huseiniya	D	D	D	A	D	B	D
Kafr Saqr	D	D	C	A	D	C	D
Faqus	B	A	C	A	D	A	A
Abu Kebir	A	B	C	B	D	C	B
Abu Hammad	D	B	C	C	C	A	C
Ibrahimiya	D	D	C	B	C	D	D
Hihya	C	C	B	B	B	C	B
Diarb Nigm	B	B	B	B	C	D	B
Bilbeis	A	A	A	D	A	A	A
Minyet El Qamh	B	C	A	D	A	B	A
Mashtul El Soak	C	C	B	D	B	B	C
Qenayat	C	D	B	C	B	D	D

Note:

Factor No. 1: Population in 2005
No. 2: Present Service Level
No. 3: Effects on Drain
No. 4: Priority of Water Supply
No. 5: Groundwater Contamination
No. 6: Reuse Possibility

4.3.2 Implementation Schedule

Total project cost necessary for the completion of the sewerage systems construction in the Governorate is estimated in the previous Section 4.2 to be approximately LE 450 million. With this huge amount of investment, commencement of the project in 13 cities at once and early completion of the whole project is almost impossible considering the present financial situation of the Governorate. Staged implementation of the project over a long time span to the year 2005 should, therefore, be developed in this regard.

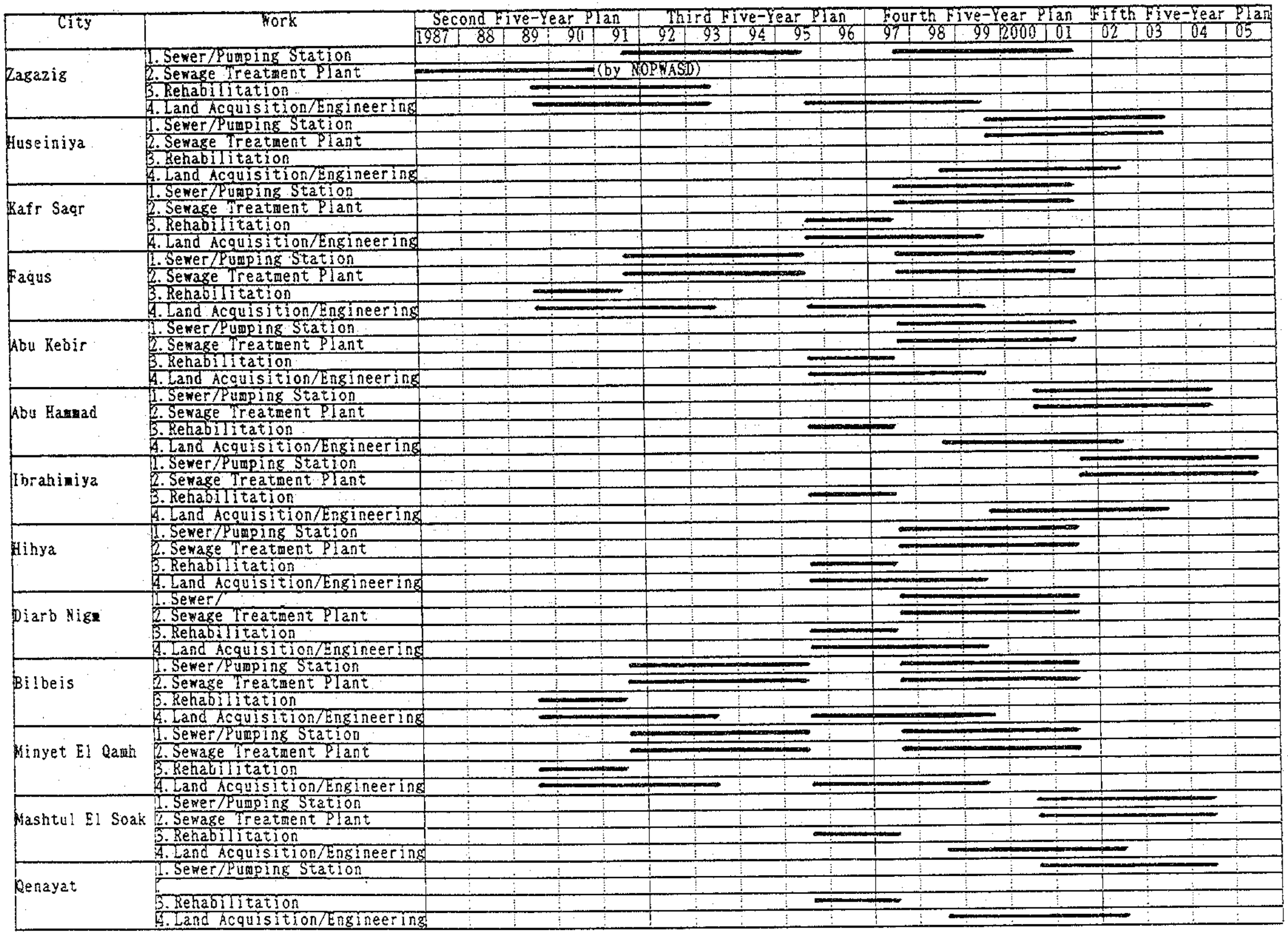
Under the present New Five Year Plan, three Cities in the Governorate are provided with the budget for construction of the treatment plants. These are Zagazig, Faqus and Minyet El Qamh Cities. Implementation of the sewerage project in these three cities within the time range of the Plan has already been assured. According to the priority evaluation in the preceeding section, these three cities are ranked the highest.

The only city among the highest ranked four cities that is not provided with the budget for treatment plant construction under the Plan is Bilbeis City. Considering the high priority compared with the above mentioned three cities, Bilbeis shall be selected for the first phase project up to 1995.

The implementation of the sewerage project in the other 9 cities with lower priority is to be postponed to after 1995, taking into account the present financial condition of the Governorate.

Based on the above considerations, a staged implementation schedule is developed as shown in Figure 4.1.

Figure 4.1 Implementation Schedule



4.4 Proposed Organization

As mentioned in the previous section on Existing Organizations, NOPWASD is still exercising their functions as a central executive agency for sewerage development projects. This organization will be required to perform the executive functions for a considerable period until the local governorates are fully developed and empowered to undertake sizable sewerage system development projects.

The proposed organization in this section is dealt with under the concept that Sharqiya Governorate is to be functionally developed by the year 2005 of the long-term program and ultimately empowered to execute various public sector projects including the sewerage development project as an executive agency under the Ministry of Housing and Public Utilities which has the primary authority for making decisions and responsibility for coordination of the project implementation.

In order that Sharqiya Governorate functions as an executive organization as well as an operating and maintenance organization of the sewerage works, it is required to achieve the following essential objectives;

(1) to establish effective organization for physical and financial management of the sewerage works, staffed with adequate number of the qualified personnel.

(2) to provide dependable services for wastewater collection, treatment and disposal in an efficient manner at the lowest cost, and

(3) to coordinate with other agencies, government and private, and integrate the sewerage development program into overall health and sanitation improvement program.

4.4.1 Evaluation of Alternative Organization

Two alternative organizational set-ups are considered to achieve above mentioned essential objectives as follows.

(1) Establishment of Public Water and Wastewater Company

This alternative is based on the fact that the establishment of Sharqiya Public Water Company was already recommended in detail in the previous study report made by JICA in 1984, the Feasibility Study on Sharqiya Water Supply System.

It is considered adequate to amalgamate the sewerage and drainage functions with functions of above mentioned water company because the demand for sewerage service is closely related to water consumption. By placing water supply, sewerage and drainage works into a unified organization, the desirable procedure to raise revenue by collecting sewer charge as a surcharge on water consumption can be practiced more effectively to achieve a joint objective of a financially sound operation.

(2) Expansion and Modification of Existing Organization in Sharqiya Governorate

This alternative is based on the following concepts.
Sharqiya governorate is legally empowered to undertake the development as well as operation and maintenance of the sewerage and drainage disposal systems and all other sanitary systems within the Governorate's boundary, and the administrative authority has recently been strengthened by the national decentralization policy.

There are established organizational units to control the wastewater disposal and to operate the sewerage and drainage facilities all over the project area. These units are centrally controlled by the sewerage and drainage section in the Sharqiya Governorate office and coordinated more functionally compared with water supply units. The existing responsible units for sewerage works could be expanded and mobilized to satisfy the functions required for the sewerage system development.

The alternative (1) has a significant advantage theoretically because it is to achieve full autonomy, but sewerage service activity is of public nature and not so financially beneficial in comparison with water supply operation. The involvement of the sewerage service management in the benefit oriented public sector water company will impose a financial burden on the company. Further, a possible disadvantage of this alternative is that it may require time consuming efforts for legislative and administrative procedures. Such disadvantages are so overwhelming that alternative (2) is considered more adequate to be selected as a practical approach.

The present organizational proposal is therefore based on the framework of the alternative (2).

Note: During the draft final report meeting, it was informed that the Ministry of Housing and the NOPWASD considered to establish new public sector companies of water supply and sewerage services in July 1989 in order to provide higher level of the services to the consumers and to ensure more financially sound status of the entities.

The basic concept of the public companies is similar to the one which is discussed as one of alternative organizational setups in this report. Yet, the major differences are that 1) the presently proposed public companies would be established not at individual governorate level, but at the Development Region level, 2) they would be responsible for mainly operation and maintenance, and house connection works, while the planning, design and construction of the new projects, research and training would be undertaken by the NOPWASD and 3) they are, in principle, self-financed public entities in covering necessary operation and maintenance costs by their revenues from tariffs and connection charges.

Presently, the national Development Regions are composed of eight regions and Sharqiya Governorate is included in the Third Region together with Ismaliya, Port Said, Suez, North Sinai and South Sinai. The proposed public company at the Third Region, therefore, would cover these six governorates and engineering departments for water and sewerage system of the governorates would be taken over by the proposed public companies.

According to the NOPWASD, it is strongly expected that the establishment of the new public companies throughout the country would contribute to the more effective and efficient operations in the water supply and sewerage sector.

Due to short notice, in-depth examiniation on the recently proposed public companies is not available in this study. However if the tariff rates are substantially raised to ensure the self-financed operation of the companies and the necessary legal procedures for their creation are completed as planned, it seems that the new companies idea appears to be a very appropriate and constructive proposal to the present problematic system.

4.4.2 Basic Functional Units for Proposed Organization

The proposed organizational units would be responsible for the planning, design, construction, operation and maintenance of the entire sewerage and drainage systems of the project area with the objectives of collection, treatment and ultimate disposal of domestic and industrial wastewater including sewage, sullage with minimum hazard or nuisance to the residents and canals in the project area.

In order to achieve the objectives as mentioned above, the proposed organizational units should include the following units and functions.

(1) Administration

(a) Personnel

The personnel recruitment and training as well as salary administration would be included.

(b) Procurement

The procurement and management of local and imported materials.

(c) Finance

This function would include budgeting, accounting, payroll, billing, and collection of bills for the services rendered. The financial reports would be prepared to provide adequate information for evaluation and control of sewerage operation, and for planning of future development of sewerage systems.

(d) Legal

This function would include legal advice or take appropriate measures to ensure proper operation and maintenance of sewerage and drain systems in compliance with the government ordinances including acquisition of right-of-way and land.

(2) Engineering

(a) Design

This function would include detailed designing of all new construction including new service connection with cost estimation, drawing and reproduction of engineering plans, and control of plumbing and service connections through inspection and permits. The maintenance of engineering records would be also included.

(b) Construction

This function would include supervision of all construction work connected with repair, improvement and expansion to assure compliance of the plan and design in accordance with the established regulations.

(3) Operation/Maintenance

(a) Operation

This function would include the efficient operation of the treatment plants and pumping stations on a continuous basis and monitoring of stream, river, drain and illegal effluent from transhes and septic tanks as well as from industries.

(b) Maintenance

This would include keeping the entire sewerage and drainage system in good working order, including plants, pumping, and piping facilities, drains and house connections, and perform necessary repairs of damaged facilities and equipment.

4.4.3 Development of Existing Organization

In order to meet the needs of the sewerage systems development project up to the year 2005, the present organization should also be functionally developed. The present functional units should be expanded or new units should be added as follows in accordance with the sewerage systems development plan and the basic functional units as mentioned in the previous section.

(1) The existing section of Cities & Village, Sewerage and Drainage in the Governorate office is required to be functionally reshuffled into the Sub-sections of (a) Plan & Design, Construction, (b) Central Laboratory and (c) Operation & Maintenance. The other administrative, financial, and legal functions will be performed by the respective departments already existing in the Governorate.

(a) Plan & Design, Construction

- prepare future estimate of the level of the sewerage service within the Governorate area
- identify the appropriate means of improvements of existing sewer networks, treatment plants and pump stations in coordination with the operation and maintenance sub-section
- develop the engineering and investment plan showing scale, timing and order of priority to meet future demand of the sewerage service within the available investment resources in consultation with the Finance and Administration Departments.
- develop design, specifications, tender documents, invitation and awards of contract of the project determined to be implemented
- supervise the implementation of the capital project, with its attendant surveys and inspections to assure compliance with the design specification and standards

(b) Central Laboratory

- perform monitoring and analysis of the quality of domestic and industrial wastewater and sewage discharged directly to the drains and effluents from the wastewater treatment plants
- survey water quality of drains and streams and receiving waters, the data from which will be used to assess the effects and influences of the established sewerage systems on the environmental water quality

(c) Operation & Maintenance

- supervise and coordinate the day-to-day operation and maintenance of the sewerage systems in all Marakaz
- resolve operation and maintenance problems and assist each sewerage unit in Marakaz on the technical performance

The existing Finance Department in Marakaz is required to prepare annual financial accounts exclusively for the sewerage system operation earmarking the annual revenues derived from sewerage service charges and capital and operational expenditures as well as financial plan to seek budgetary allocations and funding resources.

The existing Administration Department is required to administer the internal personnel policies and procedures and control the staff performance to consider incentive payment and promotion, including manpower planning, recruitment, and staff training program.

The existing Department of Legal Affair is required to perform the functions to administer the legal aspects, such as prosecution for illegal disposal of wastewater to drains.

(2) The existing Sewerage Units which are responsible mainly for the operation and maintenance of the sewerage facilities in every Marakaz are required to be expanded in accordance with long term development plan of sewerage facilities such as new extension of public sewers, new construction of the pumping station and treatment plant.

The following Marakaz are required to provide the new units in addition to expansion of existing units to meet the planned systems expansion.

Marakaz of Kafr Saqr, Abu Kebir, Abu Hammad, Ibrahimiya, Hihya Bilbeis and Minyet El Qamh are required to provide a new unit to administer the operation and maintenance of treatment plant.

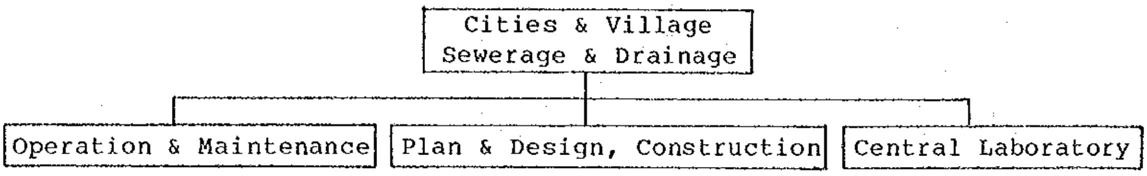
Marakaz of Diarb Nigm, Mashtul El Soak and Qenayat City are required to provide the new units for treatment plant and pump station. The Markaz of Huseiniya is required to provide the new units for sewerage and treatment plant.

The Markaz of Zagazig is required to expand the existing units by increasing staff levels.

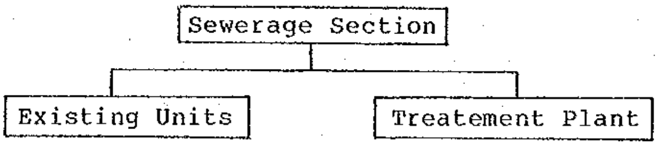
The existing departments of Administration, Finance and Legal Affairs in all Marakaz are required to extend their functions to administer the sewerage system operation and maintenance under the control of the respective departments in the Governorate head office.

In addition to above, it should be emphasized that the present Revenue Departments in all Marakaz are required to collect the sewerage charge together with water supply charge in close coordination with the sewerage engineering units and the accounting reports should be provided in these departments to define the sewerage service income separately from the water supply and other public service incomes. The newly proposed units to be provided in the existing sewerage organization are indicated by Figure 4.2.

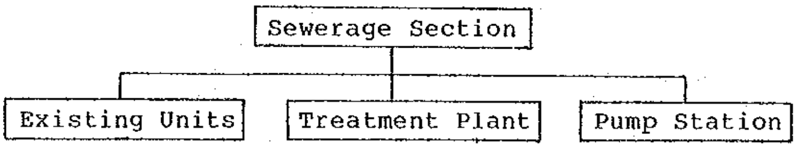
a) Sharqiya Governorate



b) Marakaz of Kafr Saqr, Faqus, Abu Kebir, Abu Hammad, Ibrahimya, Bilbeis, Minyet El Qamh and Hihya



c) Marakaz of Diarb Nigm and Mashtul El Soak and Qenayat City



d) Markaz of Huseiniya

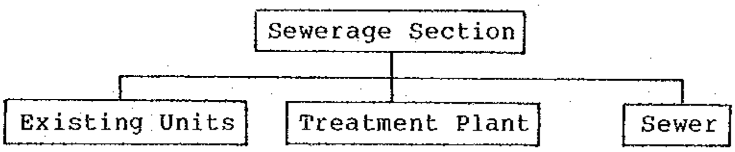


Figure 4.2 New Units Proposed to be Provided in Existing Organization

4.5 Staff Requirements and Training

The estimation of staff required for the proposed sewerage development plan up to the year 2005 has roughly been made as shown in Table 4.6, providing that more detailed staffing schedule would be made in the subsequent study of the phase 1 program (up to 1995).

Adequate staffing for the routine operation and preventive maintenance should be emphasized, as there is, presently, an acute shortage of professional staff especially skilled laborers, including mechanics and electricians. Vigorous efforts will be required to recruit newly required staff in sufficient numbers because there is an attendant difficulty to find suitable qualified personnel and the intensified training activities will be required to meet primarily the immediate needs for the improvement of the existing level of operation and maintenance and secondly the future manpower requirements in the development of the sewerage systems.

The existing training activities, which are considered one of the necessary measures to remedy the shortage of the qualified staff, have been found to be in sufficient. Some staff members of the sewerage units in every Markaz are being sent to NOPWASD for technical training on a few occasions.

Concerted efforts should be made to develop a long term training program with an initial short term strategy to meet the immediate needs for the training of the existing staff to improve the existing level of operation and maintenance and to meet the future manpower requirements of the proposed project.

NOPWASD is considered a key central agency for training and training courses are provided for the various public sector works including sewerage and sanitary drainage. The budget for such training is, however, not sufficient and the participants are limited. The need for training should be communicated to the higher levels of the government and more budget should be allocated to intensify and to expand the training program. Special strategy for operational and maintenance training should be designed using high degree of visual, practical on-the-job training.

Table 4.6 Estimated Staffing of All Sewerage Works Units in 2005

Job Title / Section	Engineer	Technician	Operator	Foreman	Laborer	Driver	Total
Sharqiya Governorate Cities & Village Sewerage Drainage							
Plans & Design	2	4					6
Constructions	2	4					6
Operation & Maintenance	2	4					6
Central Laboratory	1(chemical)	3			5		9
Zagazig							
Sewer	1	50		4	90	4	149
Pumping Station	1	39	26	6	130		202
Treatment Plant	1	15	10	2	30		58
Huseiniya							
Sewer	1	10		4	90		105
Treatment Plant	1	5	3	1	15		25
Transh System		1			10	5	16
Kafr Saqr							
Sewer	1	10		3	70		84
Pumping Station	1	15	10	2	50		78
Treatment Plant	1	5	3	1	15		25
Transh System		1			4	2	7
Faqus							
Sewer	1	10		5	110		126
Pumping Station	1	18	12	3	60		94
Treatment Plant	1	5	3	1	15		25
Transh System		1			10	5	16
Abu Kebir							
Sewer	1	12		7	150		170
Pumping Station	1	12	8	2	40		63
Treatment Plant	1	5	3	1	15		25
Transh System		1			8	4	13
Abu Hammad							
Sewer	1	7		3	70		81
Pumping Station	1	9	6	2	30		48
Treatment Plant	1	5	3	1	15		25
Transh System		1			10	5	16

Table 4.6 Estimated Staffing of All Sewerage Works Units in 2005 (Cont'd)

Job Title Section	Engineer	Technician	Operator	Foreman	Laborer	Driver	Total
Ibrahimiya							
Sewer	1	5		3	60		69
Pumping Station	1	6	4	1	20		32
Treatment Plant	1	5	3	1	15		25
Hihya							
Sewer	1	9		4	90		104
Pumping Station	1	12	8	2	40		63
Treatment Plant	1	5	3	1	15		25
Transh System		1			10	5	16
Diarb Nigm							
Sewer	1	7		3	70		81
Pumping Station	1	9	6	2	30		48
Treatment Plant	1	5	3	1	15		25
Transh System		1			8	4	13
Bilbeis							
Sewer	1	7		3	70		81
Pumping Station	1	15	10	2	50		78
Treatment Plant	1	5	3	1	15		25
Minyet El Qamh							
Sewer	1	10		5	100		116
Pumping Station	1	9	6	2	30		48
Treatment Plant	1	5	3	1	15		25
Transh System		1			10	5	16
Mashtul El Soak							
Sewer	1	10		5	100		116
Pumping Station	1	9	6	2	30		48
Treatment Plant	1	5	3	1	15		25
Transh System		1			6	3	10
Qenayat							
Sewer	1	9		4	90		104
Pumping Station	1	6	4	1	20		32
Treatment Plant	1	5	3	1	15		25
Transh System		1			6	3	10
Total	45	415	152	94	1,987	45	2,738

At the initial stage of the program, the personnel with a range of technical and communication skills should be selected to serve as the training officers, and such training officers are recommended to be sent to NOPWASD where training models, training skills and materials, and standards have been developed.

At the governorate level, the training of existing staff by the training officers using presently available training facilities is desirable, concentrating on practical on-the-job training undertaken as close as possible to operating systems in the field. The training officers should be carefully selected and rewarded sufficiently and supported to sustain the training program.

At the outset of the program, it is also necessary to develop practical training methodology, procedures and training curriculum. Off-shore training can also be employed for the key officers who are capable of delivering advanced knowledge and skills acquired in the training to their local staff. In case of the training executed by expatriate professionals, the contents of the training should be tailor made locally and the text materials should preferably be in Arabic.

4.6 Financial Analysis

4.6.1 Financial Trends of Egypt

(1) Government Revenue

The public finance consists of (1) general account, (2) investment account, and (3) capital transfer account. The general budget account is further broken down into (a) tax revenue and (b) non-tax revenue. The tax revenue, in the recent years, has accounted for more than 70% of the total general account revenue which comprises mainly of income tax, consumption tax, import duty, etc. The non-tax revenue are Suez Canal receipts, oil revenue and surplus from public corporations. Among them, Suez Canal receipts and oil revenues, in particular, have been falling over the years due to international recession and decline in oil prices. For the investment and capital transfer accounts, self-financing capacity has been considerably limited and therefore, complementary finance resource making up for budget deficit has been sought from domestic banking as well as foreign loan and credit facilities.

The budget deficit, as it has been growing, is getting to be a more serious matter for Egypt in connection with its accumulated debt. For 1986/87 fiscal year, the deficit reached one-forth of the total annual budget.

(2) Government Expenditure

The public expenditure is also divided into (1) general account, (2) investment account, and (3) capital transfer account. In the general account, major expenditure items are salary and wages, subsidy and defence which account for 30.4%, 13.7% and 14.7% respectively in 1986/87. The Government has been trying to curb the current outlays, yet the results do not appear to lend optimism. The investment account expenditure consists of development project financing for the central government and local government projects (26.4%), public corporation projects (34.3%), and state-owned corporation projects (25.8%). The economic activity is, in fact, dominated by the public sector in Egypt. Under the capital transfer account, main items are debt service payment for internal and external borrowings which amounted to more than half of the total in 1986/87. For details, financial trends are illustrated in the following Table 4.7.

Table 4.7 Summary of Financial Trends 1982/83-1986/87

(In Millions of LE Current Prices)

	1982/83	1983/84	1984/85	1985/86	1986/87
Total Public Revenue	9,800.0	11,219.1	12,877.2	14,926.4	14,451.1
Tax revenue	5,926.6	6,915.7	7,646.6	8,475.6	9,126.3
Non-tax revenue	2,769.4	3,070.2	3,891.7	4,288.5	3,602.0
Investment	1,107.0	1,233.2	1,338.9	1,453.1	1,136.4
Capital Transfer	-	-	-	709.2	586.4
Total Public Expenditure	14,645.2	16,231.5	18,277.2	19,916.4	20,002.2
Current Expenditure	8,754.4	9,902.9	11,354.5	12,178.3	12,535.1
Salaries/Wages	2,444.1	2,935.0	3,296.0	3,650.0	3,865.0
Subsidy	2,040.4	1,686.4	2,058.4	1,996.1	1,746.1
Defence	1,742.0	2,132.9	2,397.0	2,598.3	2,740.3
Others	2,527.9	3,148.6	2,603.1	3,933.9	4,183.7
Investment	3,935.5	4,400.0	4,865.0	5,430.0	5,150.0
Capital transfer	1,955.3	1,928.3	2,057.7	2,308.1	2,317.1
Fiscal deficit	4,845.2	5,012.4	5,400.0	4,990.0	5,551.1

(Source: *Ministry of Finance*)

4.6.2 Financial Status of the Sharqiya Governorate

To review financial status of the Sharqiya Governorate, the data on its annual revenues and expenditures for the last three years (1983/84-1985/86) were thoroughly examined.

(1) Annual Revenue

The revenues for the Sharqiya Governorate are composed of 1) Local Governorate revenue, 2) Current revenue, 3) Investment Resource revenue, 4) Capital Transfer revenue, and 5) Subsidy. Among these revenue categories, the overwhelming portion is the central government's subsidy which has amounted to LE 142.67 mill. or 76.2% of the total revenues in 1985/86. This heavy dependence on subsidy has remained rather constant at 73.8% in 1984/85 and 71.8% in 1983/84. The second largest category is investment resource revenue which is mainly channeled through the National Investment Bank. The recorded revenue from this category appeared to be LE 18.657 mill. which was 10.0% of the total revenue in 1985/86. Thus, apart from the central government support, the locally-generated revenues i.e., local governorate revenue and current revenue have accounted only for LE 24.081 mill. or 12.8% in 1985/86. During these three fiscal years the total Governorate revenue has grown at more than 18% per annum.

(2) Annual Expenditure

On the other hand, the expenditures for the Sharqiya Governorate are allocated by departmental activity. The largest share is to the Department of Education which has accounted for LE 74.924 mill. or 43.4% in 1985/86 while the second largest share of the expenditure is to the department of Markaz/Governorate administration which has amounted to LE 48.568 mill. or 28.1% in 1985/86. It is then followed by the Department of Health (LE 29.922 mill., 17.3%), Agriculture/Livestock (LE 12.374 mill. 7.2%) and Social Service (LE 3.734 mill., 2.2%). The total expenditures have increased at around 15% over the three years (1983/84-1985/86). The detailed break-down of revenues and expenditures for 1983/84-1985/86 is shown in the Tables 4.8 and 4.9 below:

Table 4.8 Annual Revenue for Sharqiya Governorate, 1983/84-1985/86

(Unit: LE)

	1983/84	%	1984/85	%	1985/86	%
Local Gov. Revenue						
Land Tax	3,337,208		3,477,976		3,490,116	
Housing Tax	138,263		196,623		192,148	
Amusement Tax	21,396		25,560		29,659	
Vehicle Fees	1,425,598		1,728,928		1,821,556	
Public Corp Surplus	80,554		241,002		78,409	
Shared Fund Surplus	3,675,496		5,696,335		5,098,125	
Sub-Total	8,678,515	(6.5)	11,366,424	(7.2)	10,710,013	(5.7)
Current Revenue						
Markaz	604,513		1,430,956		845,472	
Local Tax	650,866		888,033		866,557	
Miscellaneous	1,839,009		1,741,251		700,501	
Mining (Aggregates)	82,600		138,787		155,402	
Local Dev./Serv. Loan	7,221,688		6,737,361		8,603,144	
Housing Loan	594,795		-		486,147	
Sub-Total	10,993,471	(8.2)	10,936,388	(6.9)	13,371,103	(7.1)
Investment Resource Revenue						
Nat. Invest. Bank	13,732,347		13,114,213		15,583,399	
Invest. Self-Finance	989,330		2,219,465		2,814,142	
Credit Facilities	1,141,744		273,000		257,178	
Additional Revenue	-		-		2,435	
Sub-Total	15,863,412	(11.8)	15,606,678	(9.9)	18,657,154	(10.0)
Capital Transer						
Storage Sale	-		43,510		23,996	
Housing Accont	220,955		366,750		609,148	
Loan from MOF	-		-		-	
Advance Cap. Transfer	2,101,423		3,023,091		1,281,745	
Sub-Total	2,322,378		3,433,351		1,914,159	
Total Revenue	37,857,785		41,342,841		44,653,159	
Subsidy	96,583,286	(71.8)	116,740,305	(73.8)	142,672,779	(76.2)
Grand Total	134,441,071	(100.0)	158,083,146	(100.0)	187,325,938	(100.0)

Table 4.9 Annual Expenditure for Sharqiya Governorate, 1983/84-1985/86

(Unit: LE)

	1983/84	%	1984/85	%	1985/86	%
Markaz/Governorate	39,635,826	(30.7)	45,286,598	(29.6)	48,567,765	(28.1)
Dept of Education	52,039,417	(40.3)	64,589,512	(42.2)	74,924,013	(43.4)
Dept of Health	18,191,987	(14.1)	19,758,443	(12.9)	20,922,414	(12.1)
Dept of Housing	2,561,147	(2.0)	2,810,051	(1.8)	3,093,745	(1.8)
Dept of Social Serv.	2,901,665	(2.2)	3,529,619	(2.3)	3,734,426	(2.2)
Dept Comm.Trade	1,482,952	(1.2)	1,867,554	(1.2)	2,151,867	(1.2)
Dept of Agri./L'stock	8,939,838	(6.9)	10,990,715	(7.2)	12,374,237	(7.2)
Dept of Man. Training	647,193	(0.5)	753,069	(0.5)	847,246	(0.5)
Dept of Transport	1,823,932	(1.4)	2,046,502	(1.4)	2,006,360	(1.1)
Dept of Youth/Sports	839,650	(0.7)	1,371,633	(0.9)	1,399,113	(0.8)
Dept of Administration	-		-		60,320	(-)
Dept of Tax Office	-		-		2,734,354	(1.6)
Grand Total	129,063,607	(100.0)	153,003,732	(100.0)	172,815,860	(100.0)

Note: ( ) indicate percentage.

(Source: Finance Dept. Sharqiya Governorate)