4.6.3 Financial Position of Sewerage Sector

(1) Changes in National Budget for Sewerage Sector

During the period 1960-80, annual budget allocation for investment in public utilities sector failed to exceed LE 60 mill. per annum. For this reason the first Five-Year Plan gave attention to this sector, providing about 8.2% of the total national investment. During this period LE 2,894 mill. was spent on water supply and sewerage projects. Of this amount, LE 1,520 mill. went into wastewater investment while LE 1,091 mill. was used for potable water projects and remaining LE 283 mill. was spent on other utilities. As a result, annual investment in public utilities significantly jumped from about LE 60 mill. to nearly LE 522 mill. (excluding other utilities) in pursuance of the strategy outlined in the First Plan. In the second Five-Year Plan, to further reinforce public services in this sector, a total budget of LE 3,731 mill. is allocated with share of LE 2,296 mill. for wastewater projects and LE 1,435 mill. for water supply projects. For the year 1987/88, annual investment will amount to LE 385 mill. for wastewater projects and LE 297 mill. for water supply projects. This implies that annual volume of investment in public utilities will increase to LE 682 mill. for 1987/88 and around LE 763 mill. onward. As a result, average growth rate in this sector appears to be 9.4% per annum during 1977-1991. The changes in national budget for water supply and sewerage sector for 1981/82 - 1991/92 is shown in Figure 4.3

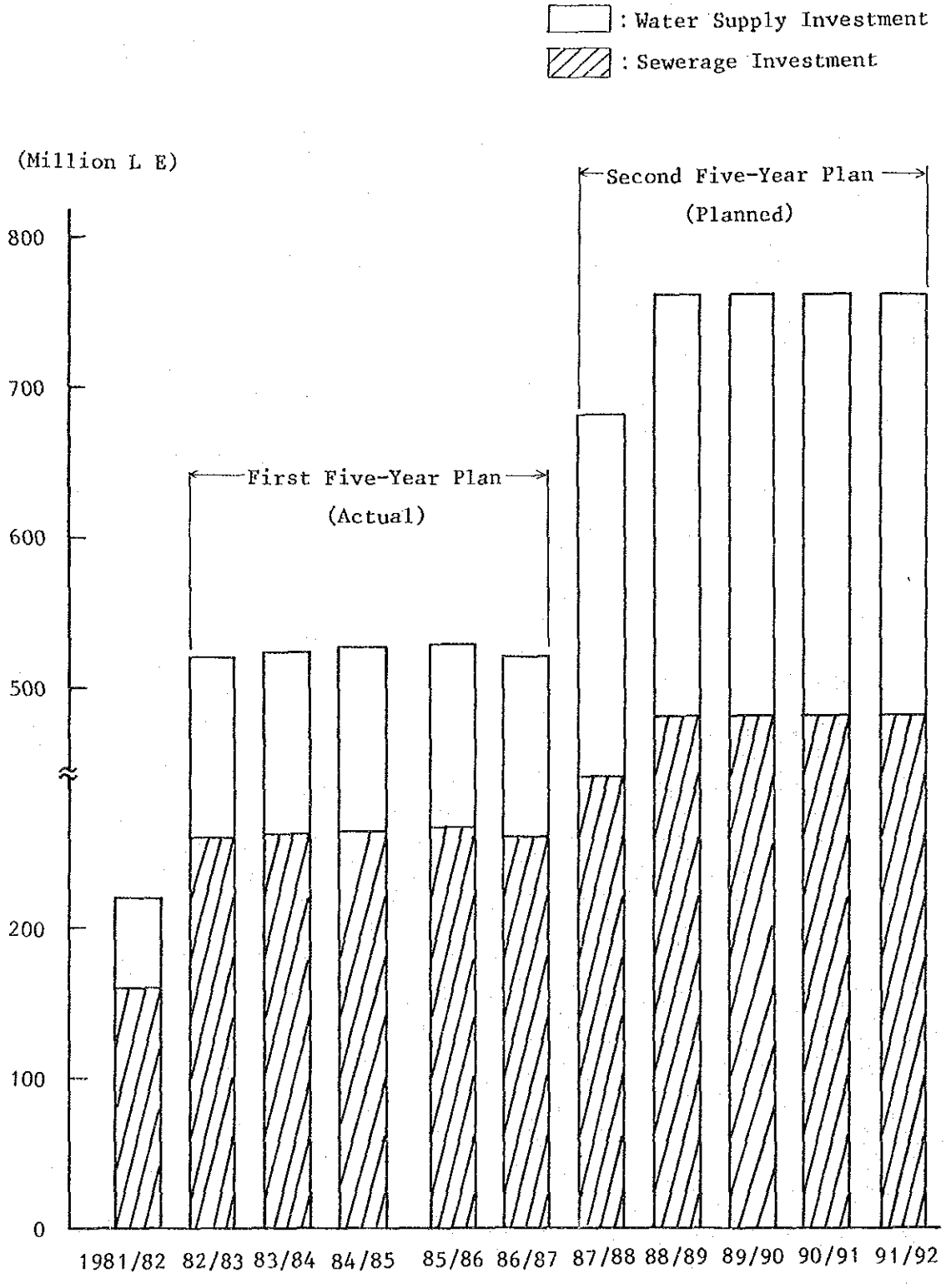


Figure 4.3 Changes in National Budget for Water and Sewerage Sector

(Source; Ministry of Planning)

(2) Budget and Expenditures for Sewerage Sector in Sharqiya

Because of inadequate accounting information available for the sewerage sector in the Governorate, reliable financial statements showing past and present trends are not available. Nevertheless, with the limited information available, the performance of the existing entity is overviewed in terms of expenditures and revenues.

In the last three fiscal years, the Sharqiya governorate allocated a annual budget of LE 700,000 in 1984/85, LE 700,000 in 1985/86 and LE 500,000 1986/87 for the Markaz sewerage system development. It has remained at rather minimum level in the sense of investment volume and was further curtailed in 1986/87 in spite of acute needs of improvement. The central Government, on the other hand, has been implementing through NOPWASD a new treatment plant at Zagazig with the budget of about LE 3.5 million from 1985. In this project the Governorate has no involvement at all and it will be continued to be supervised by NOPWASD till its completion. Under the new five-Year Plan, the amount of LE 8.0 mill. is allocated to this Zagazig treatment plant for its second phase. The detailed breakdown of the Governorate's expenditures by Markaz is shown below:

Table 4.10 Expenditures for Sewerage System by Markaz

(Unit: LE)

	Markaz	1984/85	1985/86	1986/87
1.	Zagazig	150,000	150,000	90,000
2.	Minyet El Qamh	45,000	45,000	35,000
3.	Faqus	45,000	45,000	35,000
4.	Bilbeis	45,000	45,000	35,000
5.	Huseiniya	25,000	25,000	25,000
6.	Abu Hammad	25,000	25,000	25,000
7.	Kafr Saqr	25,000	25,000	25,000
8.	Diarb Nigm	25,000	25,000	25,000
9.	Abu Kebir	45,000	45,000	25,000
10.	Hihya	25,000	25,000	25,000
11.	Mashtul El Soak	20,000	20,000	20,000
12.	Ibrahimiya	20,000	20,000	20,000
13.	Qenayat	5,000	5,000	15,000
	Drainage Maintenance*	200,000	200,000	200,000
	Total	700,000	700,000	500,000

* Expenditure for drainage canal maintenance carried out by Irrigation Department.

Source: Dept. of Finance, Sharqiya Governorate

(3) Revenues for Sewerage Sector in Sharqiya

The revenues of the sector is basically derived from tariff receipts on sewerage service operation. The Government introduced a surcharge system in July 1985, based on potable water consumption as 10% of the water supply charges. The present tariff structure for water supply has been modified recently as follows;

	Previous Rate	Present Rate (1985 onward)
Domestic/Public /Government /Religious Use	2.5pts/m^3	5.0pts/m^3
Industrial Use	5.0pts/m^3	10.0pts/m^3

It indicates, as shown above, that water tariff was substantially raised by 100%. The collection of the sewerage surcharges are currently underway in urban areas alone throughout the Governorate. For the fiscal years 1984/85-1986/87, the revenues of the water supply charges including 10% of sewerage charges is shown in the Table 4.11.

Table 4.11 Revenue of Water Supply and Sewerage Charges, 1983/84-1985/86

(Unit: LE)

	1983/84		1984/85		1985/86	
	Water Supply	Sewerage	Water Supply	Sewerage	Water Supply	Sewerage
Zagazig	288,592	(26,236)	341,112	(31,010)	228,847	(20,804)
Faqus	55,292	(5,027)	77,488	(7,044)	86,582	(7,871)
Bilbeis	61,124	(5,557)	125,861	(11,442)	105,971	(9,634)
Kafr Saqr	16,786	(1,526)	24,010	(2,183)	38,088	(3,463)
Huseiniya	3,793	(345)	6,195	(563)	7,089	(644)
Abu Hammad	16,126	(1,466)	28,238	(2,567)	24,882	(2,262)
Minyet El Qamh	70,690	(6,426)	139,283	(12,662)	160,766	(14,615)
Mashtul El Soak	20,019	(1,820)	35,031	(3,185)	47,342	(4,304)
Abu Kebir	24,103	(2,191)	43,064	(3,915)	52,774	(4,798)
Hihya	12,478	(1,139)	22,548	(2,050)	22,335	(2,030)
Diarb Nigm	39,659	(3,605)	59,955	(5,450)	69,471	(6,316)
Ibrahimiya	5,856	(532)	8,625	(784)	8,586	(781)
Qenayat	n.a.	(n.a.)	n.a.	(n.a.)	n.a.	(n.a.)
Governorate Office	298,271	(27,116)	n.a.	(n.a.)	631,589	(57,417)
Total	912,789	(82,981)	911,410	(82,855)	1,484,325	(134,939)

Note: ( ) is estimated sewerage revenues.
(Source: Dept. of Finance, Sharqiya Governorate)

In addition to the sewerage charges, the Governorate levies connection or installation fees to households to connect to the existing main sewer pipelines. The connection charges, however, vary between Markaz, from LE 5.0 per installation to LE 50.0 per installation. Moreover, for those households which have no access to pipeline connection, a vacuum car collection system is currently practised in Sharqiya. The capacities of vacuum cars/tracks operated by Markaz are $2m^3$, $3m^3$, $5m^3$ and $7m^3$ which are rented periodically upon request from consumers. The rental fees per transfer range between LE 1.0 and LE 3.0. The vacuum car collection system has also been applied to some rural areas outside the urban centers. The revenues of connection charges and vacuum car rental fees are included in the above Governorate revenues. In Table 4.12 below, the present installation charges and vacuum car collection charges are illustrated.

Table 4.12 Vacuum Car Collection System in Sharqiya Governorate

Markaz	No. of Vacuum Cars	Capacities (m3)	Rental Fees (LE/car)	Sewerage Connection Charge (LE/connection)
Bilbeis	5	3, 5, 6, 8	5.00	5.00
Minyet El Qamh	5	5	1.75	5.00
Zagazig	20	3, 4, 5	1.00	5.00
Faqus	23	3, 7	1.00	50.00
Abu Kebir	4	5, 7	1.00	15
Diarb Nigm	2	2, 7	3.00	N.A.
Ibrahimiya	2	4	1.00	15
Hihya	5	2, 5	1.00	17.00
Huseiniya	4	4, 6, 7, 8	1.50	15
Qenayat City	3	N.A.	N.A.	8.00
Mashtul El Saok	3	3	1.00-1.50	6.00
Kafr Saqr	2	5	1.00	25.00
Abu Hammad	5	3, 4, 5	1.70	6.00

(4) Financial Position of Sewerage Sector in Sharqiya

During the period reviewed, income from sewerage operations was LE 135,000 in 1986/87 which is about one fourth of operating expenses (LE 500,000) and it should be noted that this operating outlay does not include manpower costs for the Governorate and Markaz offices' technical personnel. According to the field survey, it is estimated that around LE 692,000 was spent on salaries and wages in 1986/87 for sewerage operation services in Sharqiya. It is, therefore, evident that the existing entity consistently sustained overall deficits and inadequate pricing policy, in turn, indicates inadequate maintenance and replacement of existing facilities resulting in poor operation. In fact, it was cited during field survey that the current budget has been insufficient to cover the costs of operation and maintenance and more seriously, insufficient to cater for capital expenditures for new pipeline networks and rehabilitation of present pumping stations. A need for the Governorate to recover financial viability and a sound financial position will, therefore, necessiate a gradual increase in average tariff level. Nevertheless, one should note that such a measure alone will not suffice if satisfactory services would not be available to most customers and incremental costs to be charged would not be affordable to them.

(5) Pricing Policy for Sewerage Sector

The pricing policy for water supply and sewerage services, as is discussed is of profound importance in securing a sound and viable financial position of the executing institutions in Egypt. Nevertheless, most of the related organizations at present have suffered from inadequate levels of cost recovery. The insufficient internal cash generation has prevented the water and sewerage entities from maintaining, rehabilitating and expanding existing system to meet the demands of Egypt's increasing population. Due to low pricing policy, they faced difficult financial status and heavy burden of operation and maintenance costs such as labor, spare-parts and equipment, and new capital investment.

Therefore, in order to alleviate inadequacy in the financial resources of the sanitation and sewerage sector, the Government established a steering committee comprising representatives from various ministries and agencies concerned and recently, the Ministry of Housing has submitted to the committee, a policy proposal to ascertain the economic balance of water supply and sanitary drainage organizations. The proposal mentioned here is envisaged to carry out the following recommendations:

1) To categorize the governorates by;

   a. large cities such as Cairo, Alexandria

   b. remotely located governorates

   c. governorates depending on groundwater for less than 25% for its water supply source

   d. governorate depending on groundwater for 25-50% for its water source

   e. governorate depending on groundwater for 50-75%

   f. governorate depending on groundwater for more than 75%

2) to gradually raise tariff level by categorized governorates to appropriately meet the necessary cost requirements for operation and maintenance by the year of 1991 and to fully meet requirements for capital costs onward.

3) to apply progressive pricing system

4) i. to review a measurement method for water consumption, measurement equipment used and on-going fee collection system

   ii. to strive to improve the present water supply and sewerage service, and

   iii. to publicize and obtain public understanding on appropriate water use and gradual changes of tariff structure.

4.6.4 Financing Plan of Long-Range Development for Sewerage Sector in Sharqiya

(1) Financial Resource for Long-Range Development

In order to implement the proposed long-range development plans for the sewerage sector in Sharqiya the total project cost, net of duties and taxes, is estimated at LE 446.2 million, including a foreign exchange cost of LE 76.5 million. Base costs reflect 1987 prices.

This investment plan is aimed at providing a new and extensive sewerage network throughout urban areas of the Governorate and enabling the inhabitants to improve their sanitary and environmental conditions in the long-term perspective by the year 2005.

In view of such large sum of investment, the implementation schedule should be desinged to be undertaken in phases, based on available financial resources and projections. The staged development for the sewerage sector should also comply with priority ratings among Marakaz in accordance with the due evaluation of needs and the urgency of their social and environmental situation as shown in the Figure 4.1.

In this context, financial projections are necessary and it is proposed that the total fund requirements would be met from the following sources, assuming necessary arrangements are to be made by the Sharqiya Governorate.

a. local currency portion:

The necessary local currency costs of the project would be provided by the central government in the form of equity, subsidy or public investment in the national budget. As the Egyptian government places a high priority on satisfying the basic needs of its citizens, it will be important, at least, to finance the local portion of the project expenses. From the nature of the project i.e. public utilities, it would be difficult to expect the private sector to be involved in financing.

b. foreign currency portion:

On the other hand, foreign exchange portion of the project would be required to seek long-term loans at concessionary terms or grant for some portion from foreign countries or international organizations. Taking into account the present financial position of the Sharqiya Governorate, the debt service repayment for this foreign borrowing would be made by the central government until local fund will be sufficiently generated.

c. working capital:

The necessary operation and maintenance costs would be expected to be covered by the Sharqiya Governorate in the form of internal cash generation through tariff revenue. It is anticipated, however, that the central government would finance necessary working capital at the initial stage of development until the Governorate's ability to earn the revenues is strengthened by the gradual increase in tariff and sufficient funds are internally generated.

To ensure the proposed financial projections of the project, detailed financial analysis has been made.

(2) National Budgetary Perspective

The national budget for the sewerage sector has been rapidly increasing. This is a due reflection of the government's high priority placed on the development of sewerage sector. During 1977-1981/82, out of LE 18,200 million, the public utilities sector received about LE 1,135 million which was 6.2% of the total budget, and sewerage sector alone received about LE 570 million. During the First Five-Year Plan (1982/83-1986/87), investment allocated to the public utilities amounted to LE 2,894 million, representing 8.0% of the total public investment and LE 1,520 million went into sewerage sector. For this new Five-Year Plan, the total budget for public utilities is estimated at LE 4,017 million which is 8.7% of the total public investment and LE 2,296 million is planned to be used for sewerage sector.

It is indicated, as a result, that an annual average budget for public utilities sector has grown from LE 227 million in the 1970s to LE 803 million in 1991/92 and concurrently, an annual average budget for the sewerage sector alone has increased drastically from LE 90 million to LE 460 million during the same period. This would suggest that public utilities investment has increased at a growth rate of 9.4% per annum while sewerage sector investment has grown at a rate of 12% per annum in the last fifteen years.

Table 4.13 Changes in National Budget for Sewerage Sector

(In million LE at current prices)

	National Budget	Public Utilities Sewerage Sector		Sharqiya Portion
1977-1981/82*	18,200	1,135 (6.2%)	460 (90/year)	N.A.
1982/83-1984/87**	36,400	2,894 (8.0%)	1,520 (300/year)	7.0
1987/88-1991/92*	46,500	4,017 (8.7%)	2,296 (460/year)	21.5

Source: Ministry of Planning

Note : * estimated figures
** actual figures

Therefore, if this trend of growth in public investment in the sewerage sector is sustained, the capital costs of the project, particularly local currency portion (at maximum LE 26 million per annum), would be available from the national budget, presuming that the central government would give a special priority to the Sharqiya Governorate for its budgetary allocation.

(3) Cost Recovery Mechanism

In spite of the long history of a sewerage service in Sharqiya, the present mechanism is not efficiently set up for the recovery of operation and maintenance, and capital costs. Accordingly, there is a need to establish an appropriate mechanism for the recovery of costs, as well as a tariff structure, and billing, collection and control procedures.

Here, a number of alternative taxes and user charges can be considered, each having advantages and disadvantages. The main alternatives which could be dealt with will include the following:

a. A Surcharge on Water Bill;

As an indirect user charge, this would normally be easy to implement, and if tied to a proper tariff structure it would meet economic efficiency and equity criteria. In effect, it would be appropriate if the majority of customers who benefit from the sewerage service, are also customers of the water supply utility. This is the case with Sharqiya, as many customers obtain water from public utility services. It is conceived, therefore, that as the Governorate will extend its area of operations and more uniformly serves through direct connections, the surcharge on water bills, as being currently practiced, would be a viable option for the time being.

b. Property Taxation;

It could be used as a method of revenue-earning to cover increasing operation, maintenance and capital costs. Egypt, however, has no national property tax of this sort specifically for sewerage services revenue source. The local government, even if this is an appropriate method, have little control over the magnitude and incidence of this kind of tax. And one of the disadvantages of this system would be that if it is imposed nationwide, it would have the effect of having the population in unsewered areas subsidize the people in the sewered areas. This is the case with Sharqiya, as the majority of population reside in rural areas where sewerage services is still at initial stage. Therefore, this system would need further considerations on its equity criteria and practicability.

c. A Direct User Charge;

This would also appear an appropriate mechanism for the costs recovery. The tariff could be based on i) the estimated number of users per connection, which would distribute cost in accordance to potential benefits, ii) the type of effluent, e.g., household or industrial, which would put loading on tariff in accordance with the degree of treatment required, and iii) customer categories, which through cross-subsidization would distribute cost in relation to each customer categories' ability to pay, differentiating among residential, commercial and industrial customers. This method,

however, requires substantial number of personnel who need to make separate billings and collection from water services. Accordingly, as the present surcharge system in Sharqiya already includes tariff differentials among customer categories, it would be more appropriate in the meantime to continue to apply this system.

(4) Projection for Sewerage Service Revenue

Sufficient revenue for sewerage services is essential to meet financial requirements of current outlay for operation and maintenance activities. It is expected that significant increases in sewerage tariff would be made to generate sufficient incomes and to sustain a long-term investment program for the Sharqiya Governorate. Yet, it is the responsibility of the central government to revise the tariff level. It is proposed for the central government to raise the tariff rate in order to strengthen financial capability of the Sharqiya and to reduce its increasing financial burden of subsidy in the sewerage sector.

Under the present tariff rate, a financial revenue for sewerage service has been projected at current prices for the period 1991/92-2005/06 as shown below.

Then, the projected difference between the revenues and O&M expenditures for the same period is also computed to show a future financial gap and its cumulative total of deficits by the year 2005.

As the table suggests, the financial gap between the revenues and expenditures will increase over the period and prospective financial deficits will amount to LE 0.7 million in 2005/2006 when the expenditures will become 1.3 times larger than the revenues for the sewerage operation. As a result, a cumulative total of deficits in the fiscal year 2005/06 will reach at as much as LE 0.7 million.

Therefore, unless there is substantial increases in sewerage tariff charges, necessary fund for operation and maintenance costs would not be internally available. The progressive increases in tariff level will be imperative to encourage internal fund raisings so that independent viable operation of sewerage services would be ensured.

4.7 Economic Analysis

In the evolution of successive five-year development plans, the Government of Egypt gave priority to the public utilities sector, leading to the increase in production and distribution of potable water as well as substantial improvement in sanitation and sewerage system. These development priorities should be seen against the unsatisfactory sanitary conditions still prevalent in Egypt, as evidenced by high infant mortality rates and a very high incidence of water-born diseases including cholera, typhoid fever, amoebic dysentery and intestinal diseases.

The proposed Sharqiya Sewerage Master Plan would be the first comprehensive step in the development of sewerage and sanitation system in Sharqiya, and would complement earlier Water Supply Master Plan and on-going sewerage development projects e.g. new Zagazig treatment plant project, in urban and rural regions in the Governorate. The Plan would improve environmental conditions and public health in the project area. It would benefit to varying degrees about 409,000 people in 1986 and 1,200,000 in 2005. The Plan would also contribute to institutional development and formulation of appropriate financial policies and practices to achieve financial viability of the sewerage service.

Table 4.14 Projected Sewerage Service Revenue, 1991/1992-2005/2006

	1991/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Incremental Wastewater Consumption (1,000m^3)	13,870	16,425	18,980	37,595	42,340	45,260	47,815	50,370	52,925	55,845	66,430	72,635	77,380	83,950	106,215
Average Water Tariff (pts/m^3)	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Sewerage Revenue (LE 1,000)	194	230	266	526	593	634	669	705	741	782	930	1,017	1,083	1,175	1,487
Non-Tariff Revenue (LE 1,000)	-	-	-	-	291	312	333	354	372	411	504	552	660	762	828
Total Revenue	194	230	266	526	884	946	1,002	1,059	1,113	1,193	1,434	1,569	1,743	1,937	2,315

Note: 1) Sewerage tariff revenues are calculated as 10% of water tariff revenues.

2) Average water tariff is computed from weighted average of the proportions between industrial and household use tariff. No increase in current tariff is considered.

3) Non-tariff revenues are revenues from the sludge sales.

Table 4.15 Financial Gap between Revenues and Expenditures (1991/92-2005/2006)

	1991/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	Cumulative Total
Revenue (LE 1,000)	194	230	266	526	884	946	1,002	1,059	1,113	1,193	1,434	1,569	1,743	1,937	2,315	16,411
O&M Expenses (LE 1,000)	332	362	390	489	653	762	809	957	1,018	1,136	1,413	1,542	1,941	2,274	3,043	17,121
Financial GAP (LE 1,000)	-138	-132	124	37	231	-184	193	102	95	57	21	27	-198	-337	-728	-710

The economic and social benefits accruing from a sewage collection and disposal system and other sanitary improvements in the proposed project could be summarized as follows:

a. it will considerably increase the urban population served by sewer connections from present number of 409,000 to 535,000 in 1995 and to 1,200,000 in 2005. It will thereby increase the ratio of served population from 57.5% to 58.5% and 100.0% respectively.

b. it will reduce water-born diseases as well as the health hazard caused by inadequate sanitary sewerage services and prevent an increase in number of people suffering from these diseases.

c. it will significantly improve the quality of underground water which is presently tapped from shallow-wells and is highly contaminated by domestic wastewater infiltration. It will therefore greatly increase efficient use of underground water which, otherwise, would have to be stopped due to serious pollution.

d. it will also contribute to improving water quality of canals i.e. irrigation canals and drainage canal which would, directly or indirectly enhance agricultural productivity and its utilization as a potable water source.

e. in addition to the above social and environmental impact of the project, it will contribute to consolidating the financial position of executing entity in terms of its pricing policy, financial management, internal fund generation and above all, viable operation and maintenance practices.

f. from the institutional point of view, it will strengthen organizational structure, staff training and efficient administrative procedures.

The economic evaluation of these socio-economic factors is important to justify the viability of the project. However, adequate quantification of such factors mentioned above is extremely difficult. The reduction in the incidence of water-borne infectious diseases, of infant mortality and of the pollution of waters for agricultural uses, and the improvements in the general aesthetic conditions and in the quality of life, and enhancement of potential economic activities are all difficult to quantify satisfactorily.

In theory, the economic analysis of the project would rest in a comparison of the economic benefits with the costs in terms of their present values applying the appropriate discount rates. The benefits, for instance, would include the medical and hospitalization costs attributable to water-borne infection and inadequate hygiene which would be saved as a result of the project as well as consequential gains in productive man-days thereby secured. Others would be intangible benefits accrued from better sanitary and sewerage conditions.

However, health and disease do not respond to water and sanitation interventions alone. Nutrition, respiratory infections, local customs concerning disease treatment, and local health care are equally important. Many other factors outside the scope of the project also impinge on health improvement, notably domestic hygiene. Unfortunately, statistical data and information to support definition of project scope and calculation in monetary terms are hardly available.

To use the sewerage tariff would be one of alternative methods. Yet, the prices the consumers pay for their sewerage services cannot satisfactorily be employed as a surrogate for the benefits they receive, since the present level of the tariff does not represent the economic cost of the services. In fact, it is tentatively estimated that the current tariff level is lower than the economic cost. Accordingly, if it is used as a level of willingness to pay it would produce a negative rate of return and so merely confirm that it will need to be substantially increased in real terms.

CHAPTER - FIVE

FIRST PHASE PROGRAM (UP TO 1995)

CHAPTER FIVE

FIRST PHASE PROGRAM (UP TO 1995)

5.1 Scope of the First Phase Program

As described in Chapter Four, four cities, namely, Zagazig, Faqus, Bilbeis and Minyet El Qamh were evaluated as priority cities for the implementation of the sewerage project by the year 1995. Of the four cities, with the exception of Bilbeis, all were listed under the New Five Year Plan (1987/88 - 1992/93), and construction of the sewage treatment plants was already given budgetary allocations. A feasibility study for the four cities selected for the first phase program was conducted according to the Scope of Work for the project described in Section 1.3.3 of the current report. Study items include the following.

Ground survey

- Water and wastewater quality survey
- Topographic survey of the site for the proposed facilities

Facility planning

- Design criteria
- Examination of alternatives
- New sewerage facilities
- Rehabilitation of existing facilities
- Preliminary engineering design
- Cost estimation
- Procurement planning of construction materials and estimation of manpower requirements

Institutional and organizational planning

- Appropriate institution form
- Organization of the institutions
- User charge system

Project evaluation

- Financial evaluation (least cost analysis)
- Economic evaluation
- Environmental and social evaluation

Implementation program

- Implementation schedule
- Disbursement schedule

Some of the above mentioned items are studied under the long term program and were described in the previous chapters. The remaining are presented in this Chapter.

5.2 Alternative Study for the Four Cities

5.2.1 Introduction

Alternative studies of the sewerage facilities for the four cities were carried out in order to work out the most appropriate sewerage system from a technical point of view. A few alternative sewerage systems were developed for each of the four cities, and construction and operation and maintenance costs were estimated based on the outline design of the each alternative. The following assumptions were made to develop and evaluate the alternatives.

(1) The entire sewerage systems to cope with 2005 flows were considered.

(2) Construction costs for the branch and lateral sewers were excluded in the cost comparison, since these costs were considered to be almost the same in all cases. Construction cost of treatment plant is also excluded from the cost comparison for the same reason. Therefore, trunk sewers and pumping stations were the focus of the alternative study.

(3) Existing sewerage facilities, such as trunk sewers and pumping stations should be utilized as much as possible so as to minimize the total costs.

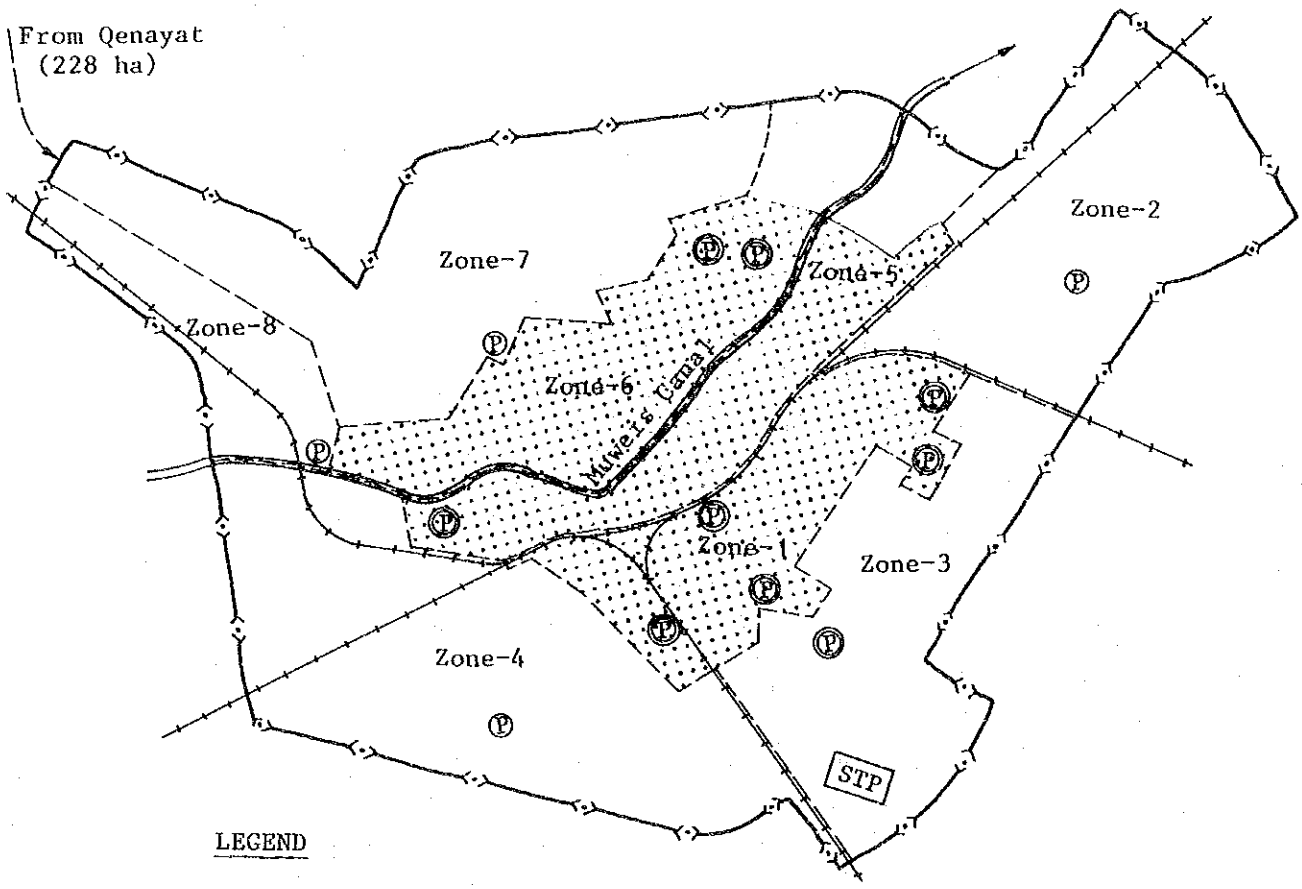
(4) Any facility which is considered to be similar in configuration and capacity in all cases is excluded from the comparison.

5.2.2 Zagazig

Sewerage service area in Zagazig in 2005 is 2,726 ha in total. The whole area is divided into 8 sewerage zones, considering the existing service areas and topographic conditions, as illustrated in Figure 5.1. The areas of each zone are as follows:

Zone No.	Area (ha)	Served or unserved
1	220.0	served
2	388.7	unserved
3	334.8	unserved
4	497.4	unserved
5	325.0	served, partly unserved
6	383.6	served, partly unserved
7	440.8	unserved
8	135.7	unserved
Total	2,726	served area 794 ha unserved area 1,932 ha

As mentioned in Section 2.10 of the report, a new sewage treatment plant is under construction by NOPWASD for Zagazig city. Therefore, no alternative locations are considered for the treatment plant. The present service area is comparatively large, and the existing trunk sewers, force mains and pumping stations in the service area are to be used as they are until and beyond 2005. As illustrated in Figure 5.1, the existing service area is located in the central part of the city, and divides the new service area into two parts, i.e. east and west parts. Therefore, alternative sewerage systems for the new areas are considered separately for the two parts. There are two zones in the east part, Zones 2 and 3, and three zones in the west part, Zones 4, 7 and 8. Thus, for Zagazig, alternatives are developed how to facilitate the trunk main systems to transport the sewages from these five zones. Topographical features in Zagazig, where the Muweis Canal divides the urban area into two parts, are to be taken into account in the west part. Crossing of the Muweis Canal should be avoided as much as possible, since these crossings by siphon or force main would require special construction methods, which will obviously result in higher construction cost. Based on the above mentioned considerations, two alternatives in the east part and three alternatives in the west part are developed for the study. These are illustrated on Figures 5.2 to 5.6, and brief descriptions of each alternative are as follows.



LEGEND

: Boundary of Sewerage Service Area

: Zone Boundary

: Existing Service Area

: Railway

STP : Sewage Treatment Plant

Ⓟ : Pumping Station

Ⓟ : Existing Pumping Station

Figure 5.1 General Plan of Sewerage System in Zagazig

Alternative-1 (East Part)

This alternative provides a new pumping station in Zone 2 in addition to that in Zone 3. From that pumping station, sewage is sent to the treatment plant by force mains. One of the advantages of this alternative compared to the alternative-2 below is that construction of the force main will be less expensive than the construction cost of gravity sewers.

Alternative-2 (East Part)

Instead of the pumping station in Zone 2 and force main from there onwards, gravity trunk sewers from Zone 2 is considered in this alternative. One of the advantages of this alternative is that the existing small pumping stations along the route of the gravity sewers can be eliminated, resulting in ease of maintenance and lesser operation cost. However, there are some disadvantages. One of them is the higher initial construction cost for the gravity sewers which accomodate flows from both Zones 2 and 3.

Alternative-3 (West Part)

This alternative was firstly developed for the long term program. Sewage from Zones 7 and 8 are separately collected by different trunk sewers and pumped to the new pumping station which is to be constructed in Zone 4. Force mains cross the Muweis Canal at two points. One of the advantages of this alternative is that construction of the sewerage facilities in Zones 4, 7 and 8 can be implemented independently.

Alternative-4 (West Part)

Two force mains from Zones 7 and 8 are combined before crossing the Muweis Canal. The advantage of this alternative over alternative-3 is that crossing of the Muweis Canal is minimized to one, and that the gravity trunk sewers which start from Zone 4 are smaller in diameters than those in alternative-3. On the other hand, the diameter of the force main which cross the Muweis Canal is larger than that of alternative-3, and therefore require higher construction costs.

Alternative-5 (West Part)

This alternative was developed to utilize the capacity of the existing main pumping station to the maximum extent. Two gravity trunk sewers from the new pumping stations in Zones 7 and 8 are combined before the Muweis Canal, which then crosses the Canal by siphon. A new siphon is to be constructed near the existing one, because the latter is insufficient to transport sewage from Zones 7 and 8 together with that from Zone 6. The advantage of this alternative, in addition to utilization of the existing pumping station, is that the construction costs of the branch and lateral sewers are somewhat less expensive because some of them can be connected directly to gravity trunk sewers.

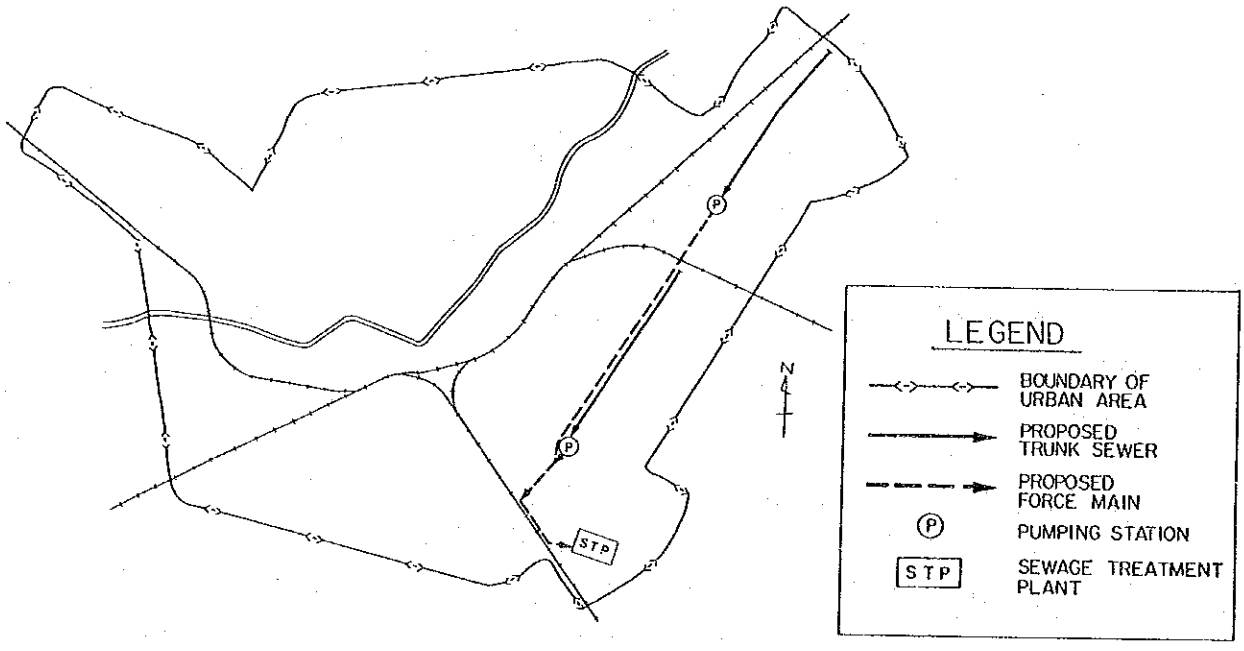


Figure 5.2 Alternative-1 for Zagazig (East Part)

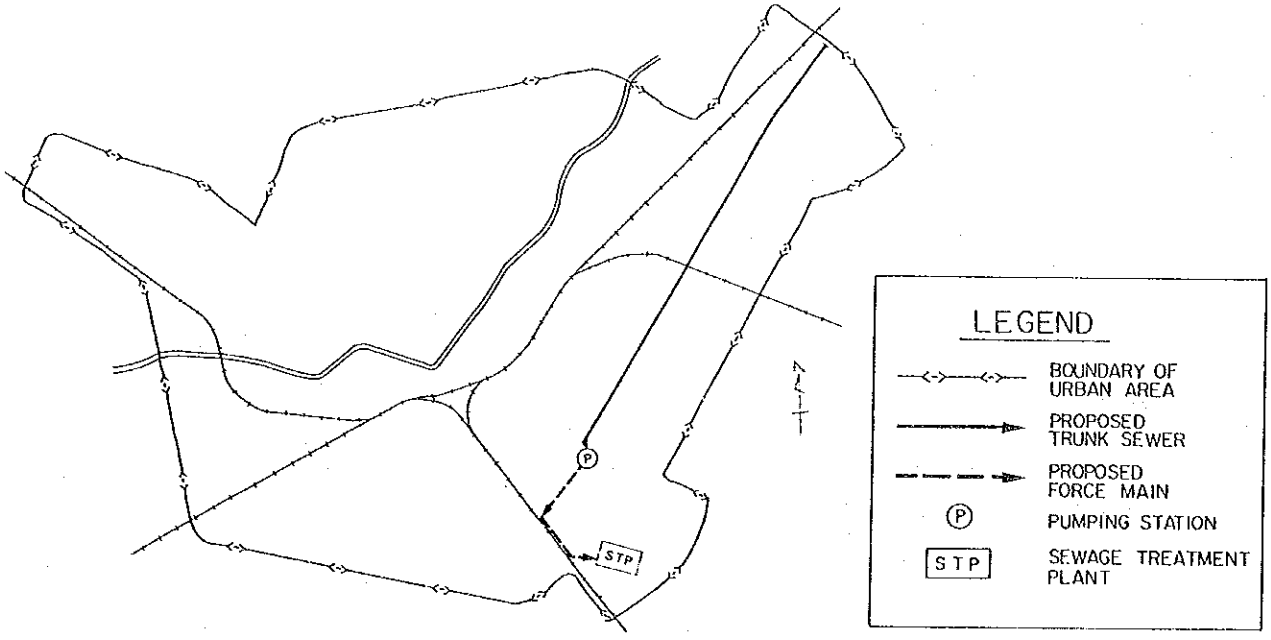


Figure 5.3 Alternative-2 for Zagazig (East Part)

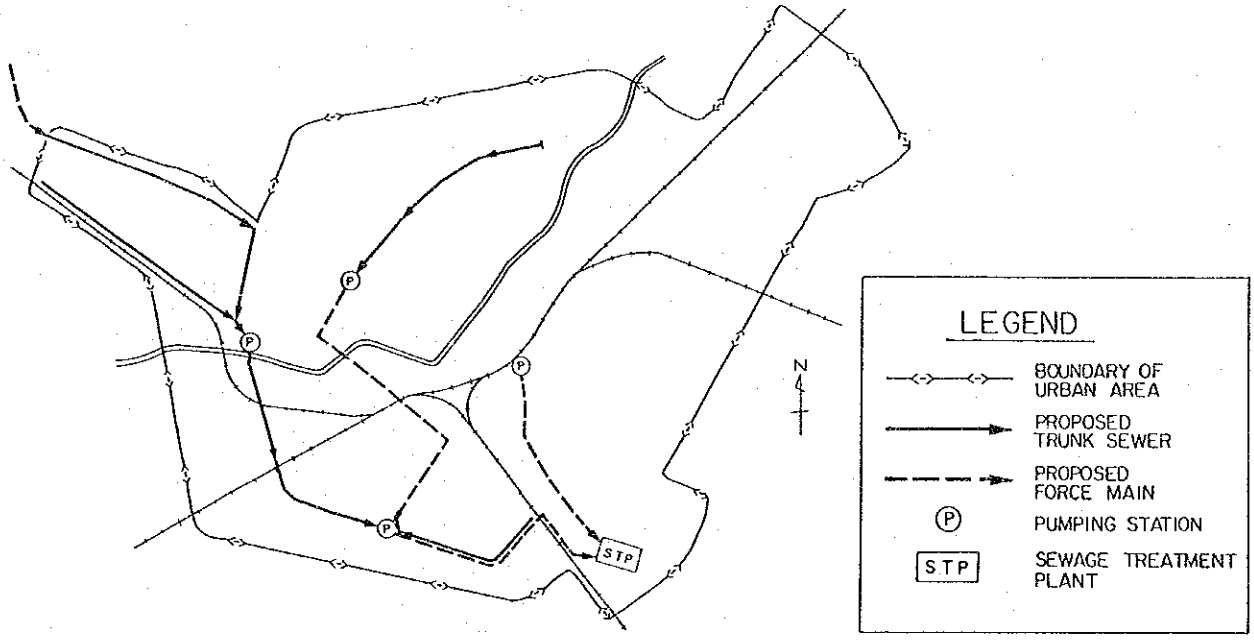


Figure 5.4 Alternative-3 for Zagazig (West Part)

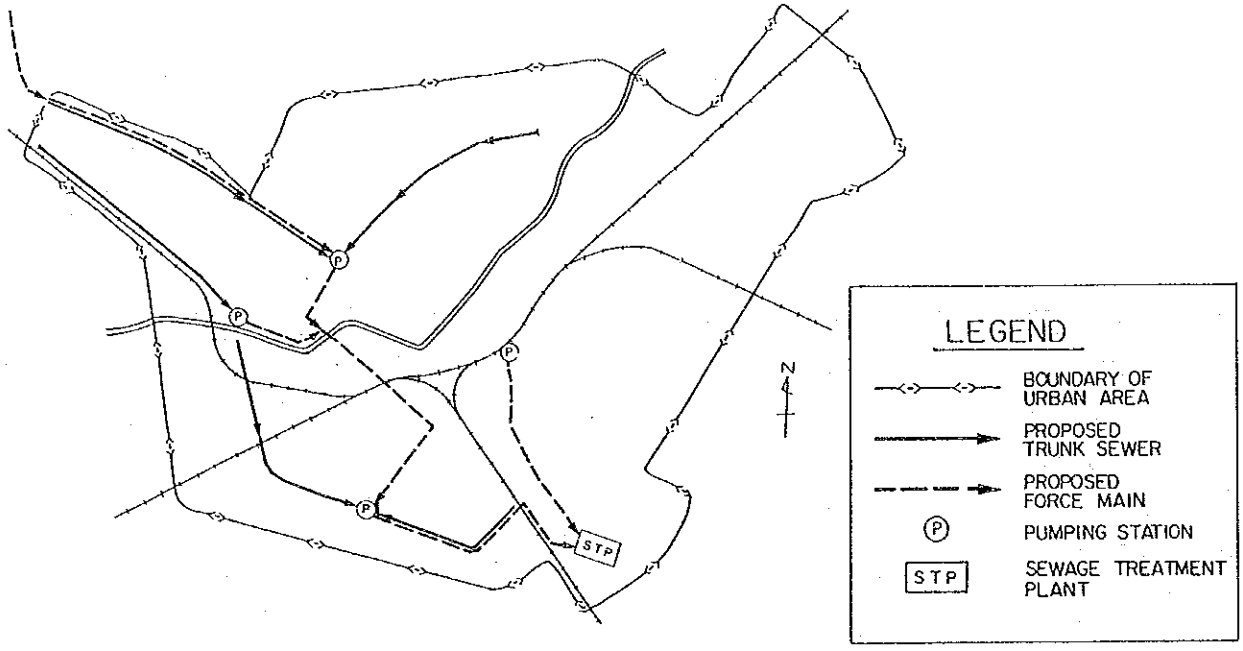


Figure 5.5 Alternative-4 for Zagazig (West Part)

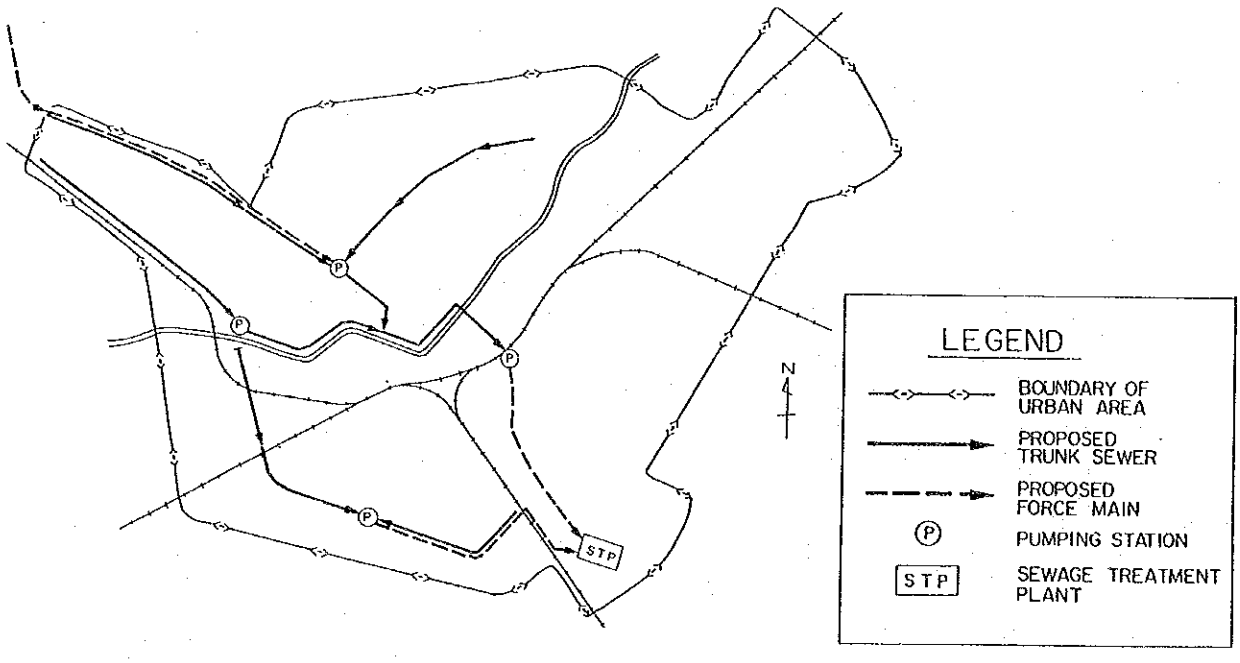


Figure 5.6 Alternative-5 for Zagazig (West Part)

5.2.3 Faqus

Total sewerage service area of Faqus city in 2005 is 515 ha, outline of which is shown on Figure 5.7. The present service area totals 99.5 ha, but branch and lateral sewers in the area shall be completely replaced by the year 2005. This was requested by a Markaz engineer. The need for the replacement is because all the sewer pipes were originally installed for the groundwater lowering system and depths and gradients of these pipes are totally inadequate for the sewerage system. Therefore, all the service areas are considered as new service area. As depicted in the Figure, service area is divided into two parts, northern and southern parts, by the Faqus Canal and railway both running in the east-west direction, parallel to each other. Ground elevation around the Faqus station and surrounding commercial area is higher than the rest of the area by approximately 2 m. There is a depression area near the railway in the northern portion of the area. In addition to these topographical features of the area, there are no drains in the vicinity of the urban area which has sufficient capacity to accommodate wastewater discharge from the city. Treated effluent should be discharged to the Bahr El Bakar Drain, which flows in the north-south direction about 2.5 km distance from the city. Therefore, possible locations of the treatment plant are limited to points where roads from the city cross the Drain. There is an existing pumping station in the area, which should be used as long as possible.

Taking the above mentioned considerations into account, the following three alternative sewerage systems were developed for comparison.

Alternative-1 All sewage from the area is sent to the new pumping station in the northern part, and then sent to the treatment plant by a force main. This system was originally considered for the long term program. Since all trunk sewers inside the area are designed as gravity sewers, it is considered most advantageous for the provision of the branch and laterals, since they can be connected to the gravity trunk sewers easily.

Alternative-2 This alternative deals with the sewage in the two parts of the area separately. The new pumping station in the northern part serves the northern portion only, and sewage produced in southern portion of the area is pumped by a new pumping station and separately sent to the treatment plant. Although total length of force main is longer than in the previous alternative-1, independent implementation of the sewerage system in the two parts of the area is considered to be an advantage of this alternative. Gravity trunk sewers inside the area are the same as for alternative-1.

Alternative-3 Instead of a gravity sewer which starts from near the railway, an additional new pumping station in the depressed area and force main pipes to the new pumping station in the northern part are considered in this alternative. All sewage produced in and around the depressed area is sent to the new pumping station in the north part.

Locations of the sewerage facilities for each of the above three alternative systems are illustrated on Figures 5.8 to 5.10.

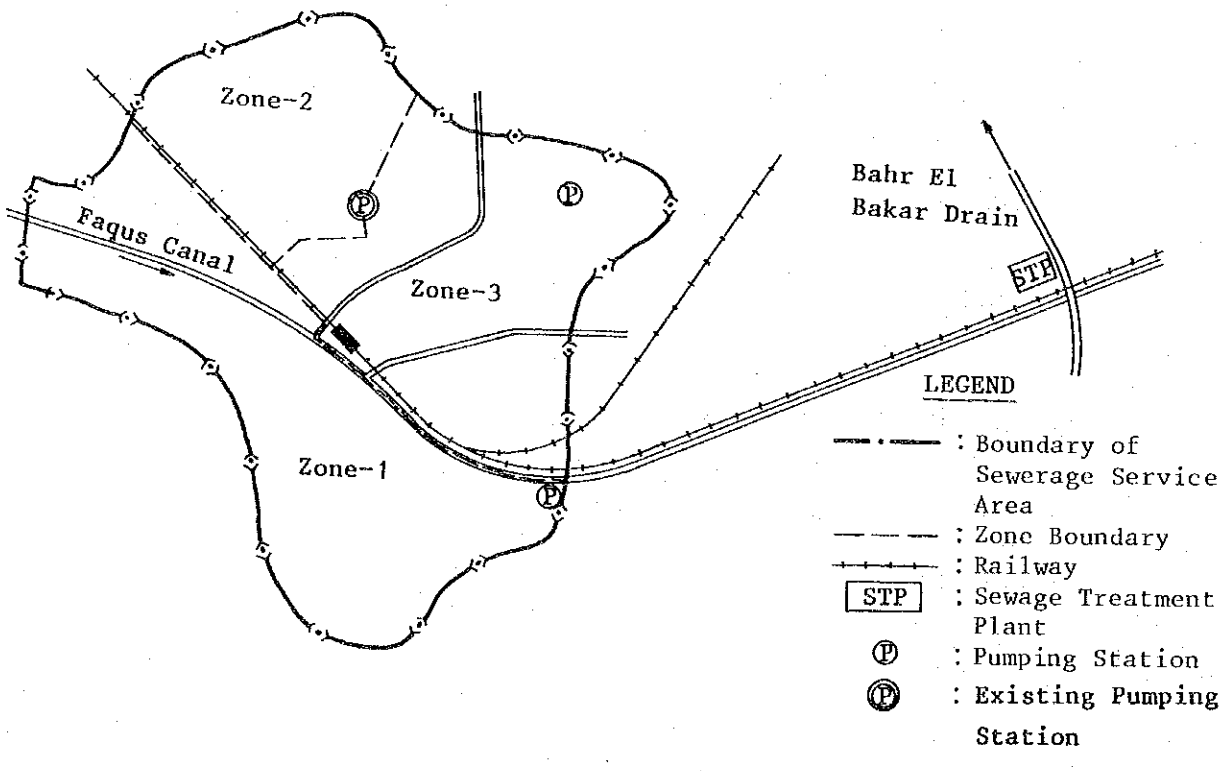


Figure 5.7 General Plan of Sewerage System in Faqus

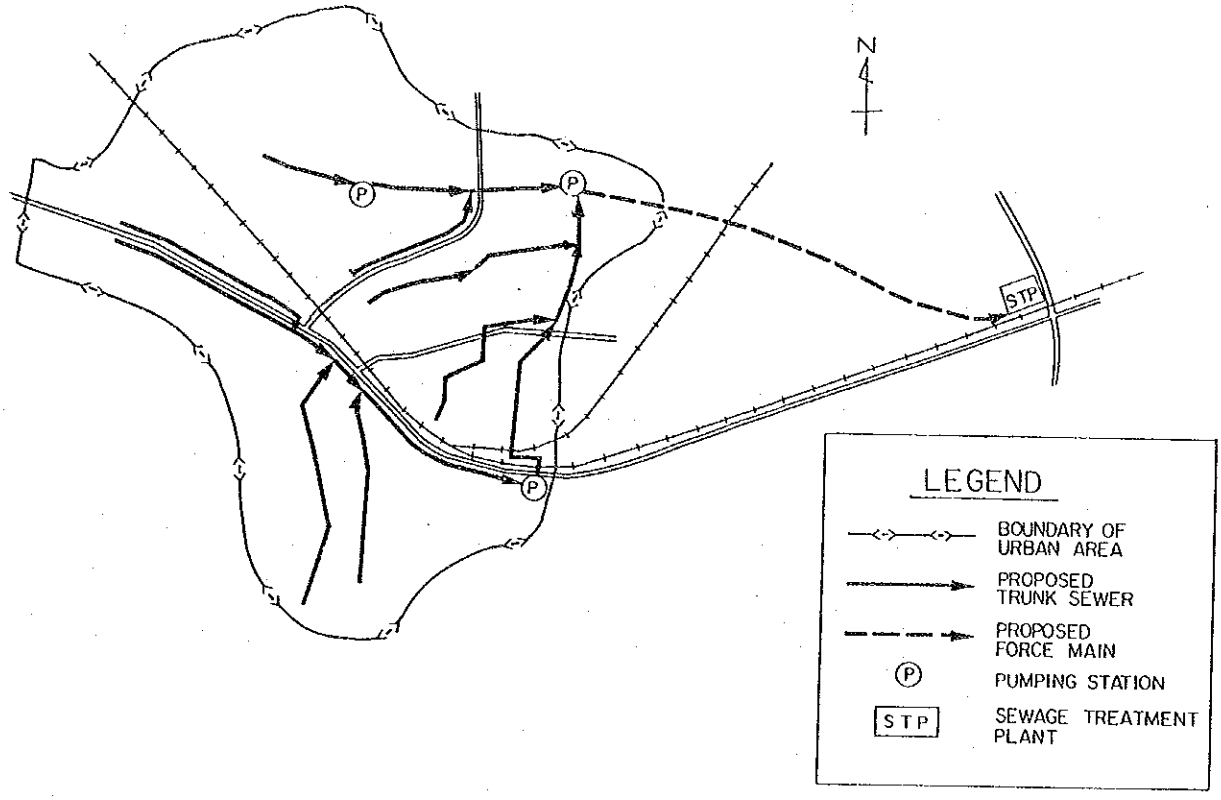


Figure 5.8 Alternative-1 for Faqus

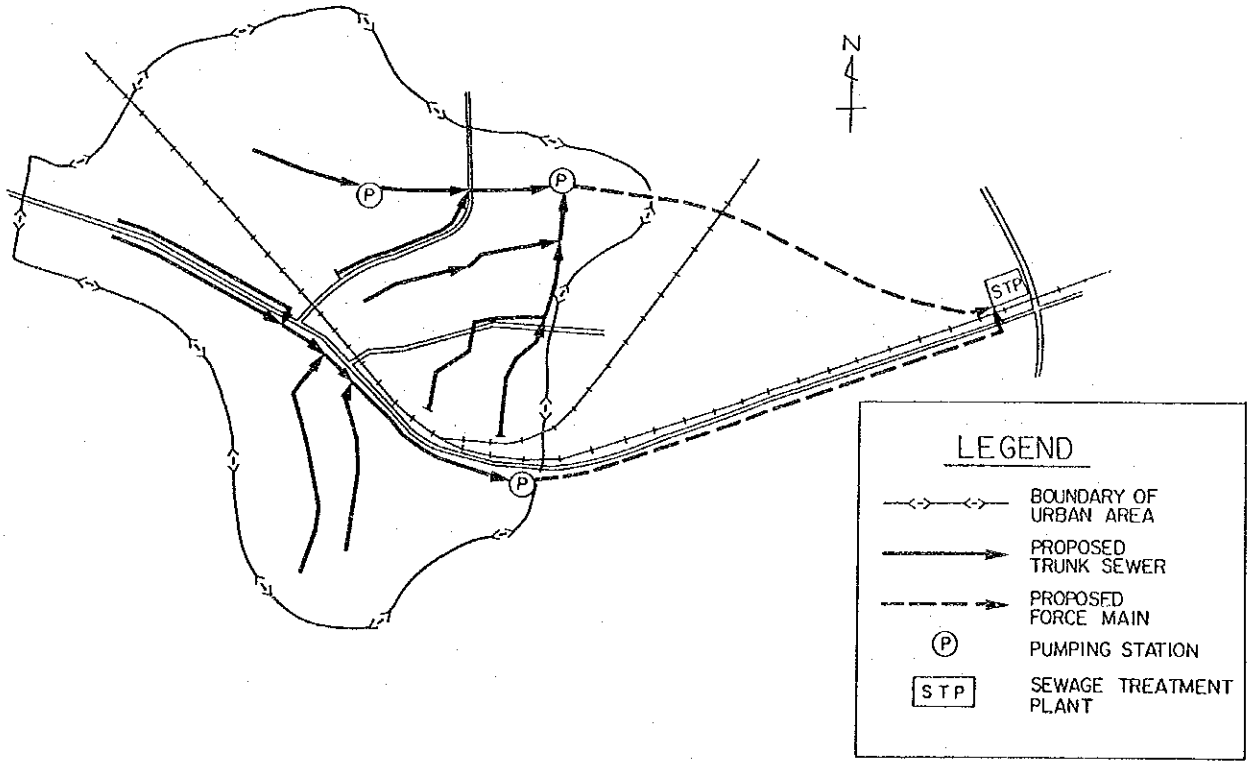


Figure 5.9 Alternative-2 for Faqus

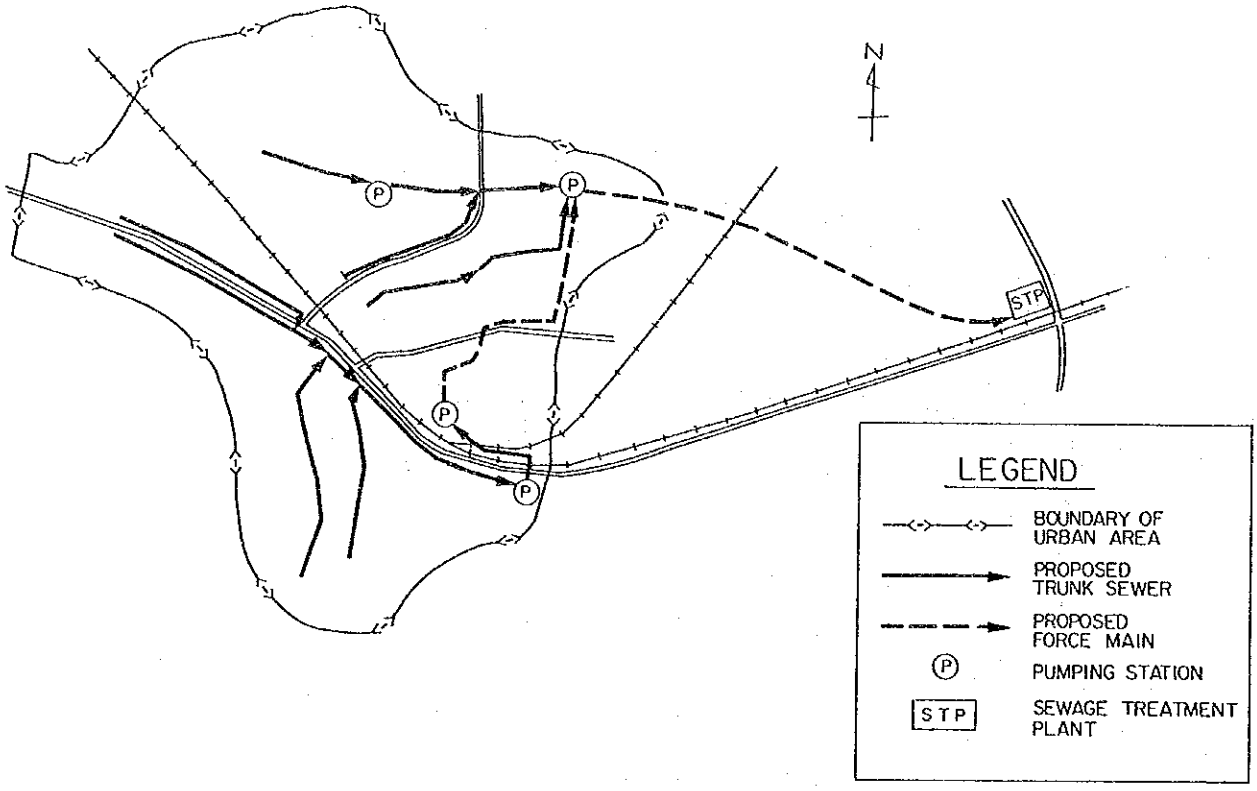


Figure 5.10 Alternative-3 for Pagus

5.2.4 Bilbeis

Sewerage service area for Bilbeis city was agreed on with the Markaz engineer to be 667 ha, main features of which are illustrated on Figure 5.11. Up to the year 2005, the urban area will grow rapidly and extend beyond the present administrative boundaries of the city. The service area is divided into two parts by the Ismailiya Canal which is one of the major canals in the region. There are three pumping stations presently in operation, and one is under construction. Considering the topographic features and service areas of the existing pumping stations, the service area is divided into 9 zones, which are shown on Figure 5.11. The areas of each zone are as follows:

Zone No.	Area (ha)	Served or unserved	
1	210.5	unserved	
2	40.5	unserved	
3	79.1	served	
4	97.0	served, partly unserved	
5	41.6	unserved	
6	28.5	served, partly unserved	
7	55.9	served, partly unserved	
8	48.3	unserved	
9	65.6	unserved	
Total	667	served area	227 ha
		unserved area	440 ha

Sewage flows collected from the present service areas are pumped by one of the existing pumping stations and discharged to the Bilbeis Drain (upstream of Bahr El Bakar Drain) without treatment. A few sewers also discharge the raw sewage directly to the Drain by gravity. Since discharge to canals, even after secondary treatment, is strictly prohibited, a possible receiving water course for the wastewater is the Bahr El Bakar Drain. Therefore, sewage produced in Zone 1 located to the south of Ismailiya Canal should be sent to the northern part for treatment and disposal to the Bahr El Bakar Drain. Most suitable location of the treatment plant is considered near the discharge point of the existing pumping stations to the Drain.

In consideration of the above, the following three alternatives were developed for comparison.

Alternative-1 A new pumping station will pump the sewage from Zone 1, which is located on the right bank of the Ismailiya Canal, to cross the Canal and transport it to the treatment plant. Another new pumping station will be provided in Zone 2, and a force main line starting from there will collect pumped sewage from the existing pumping stations located along the line to the treatment plant. Small pumping stations are necessary for Zones 5, 8, and 9 to pump sewage to the force main line because of the topography.

Alternative-2 A new pumping station in Zone 1 in alternative-1 is shifted downstream along the Ismailiya Canal, and the force main which starts from there connects to the main line. There is only one force main line collecting sewage from all the zones. The rest of the sewarage system is the same as in alternative-1.

Alternative-3 Arrangement of the trunk sewers is the same as in alternative-2, however, the main line is designed as gravity sewers. All pumping stations along the main line are removed. Special construction method such as driving and tunneling methods might be needed for the gravity trunks and a siphon for crossing the Canal. As a result, construction costs of the trunk sewers might be higher than that of force mains, which may or may not make up for the decrease in costs for pumping stations. Small pumping stations in Zones 5 and 8 are necessary for the same reason mentioned above.

Three alternative plans are shown on Figures 5.12 to 5.14.

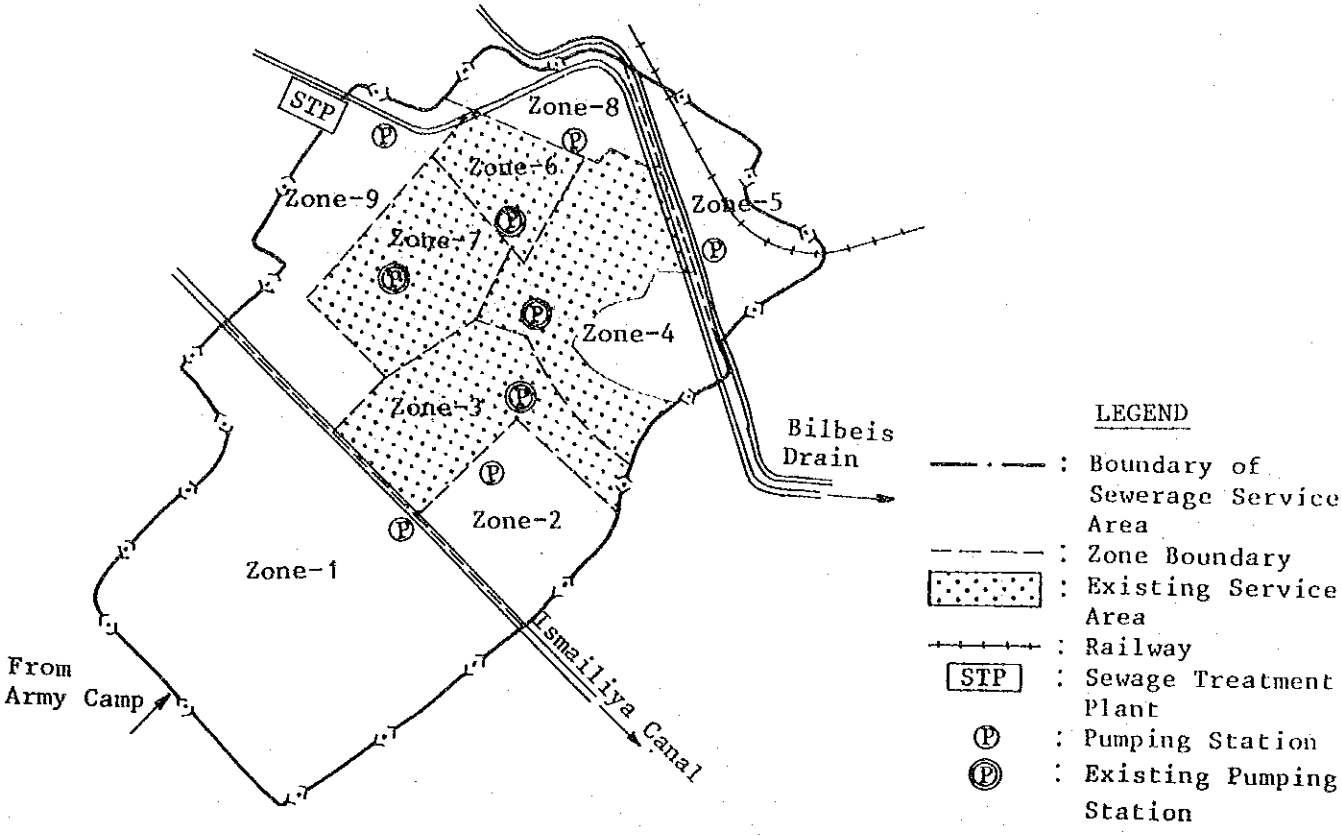


Figure 5.11 General Plan of Sewerage System in Bilbeis

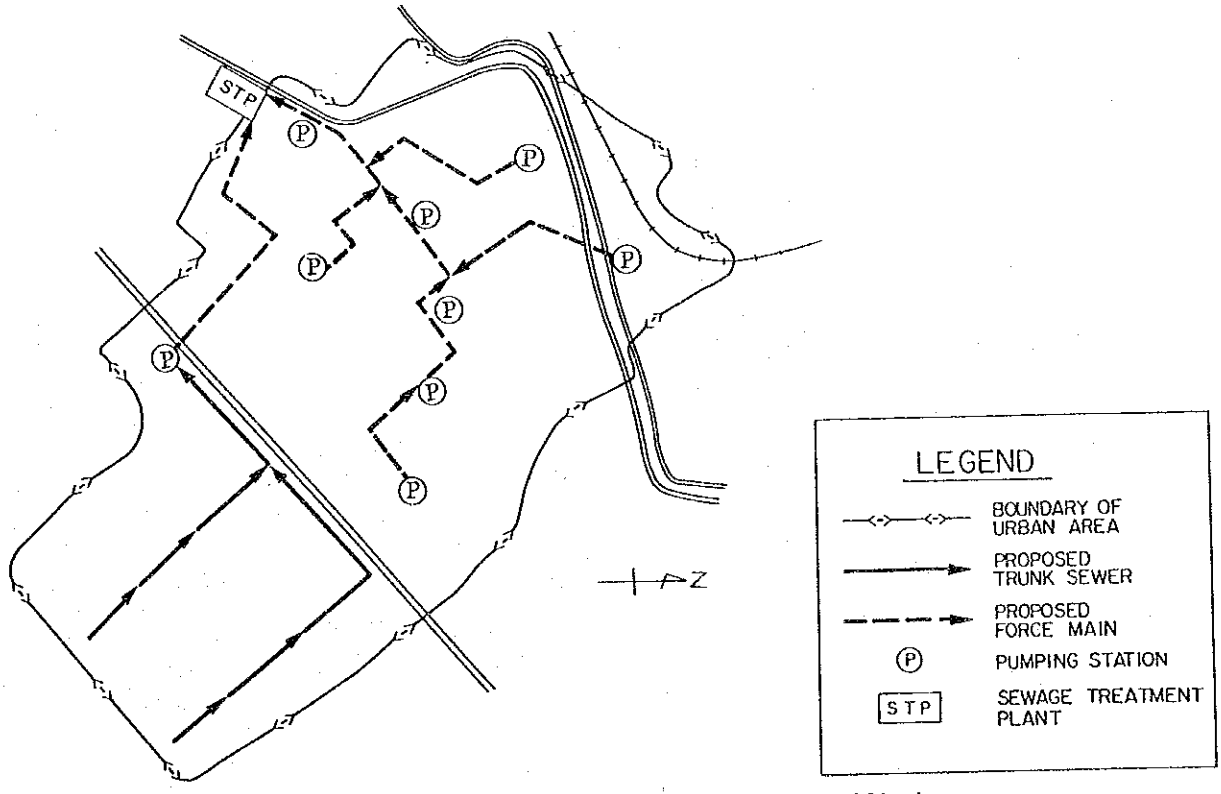


Figure 5.12 Alternative-1 for Bilbeis

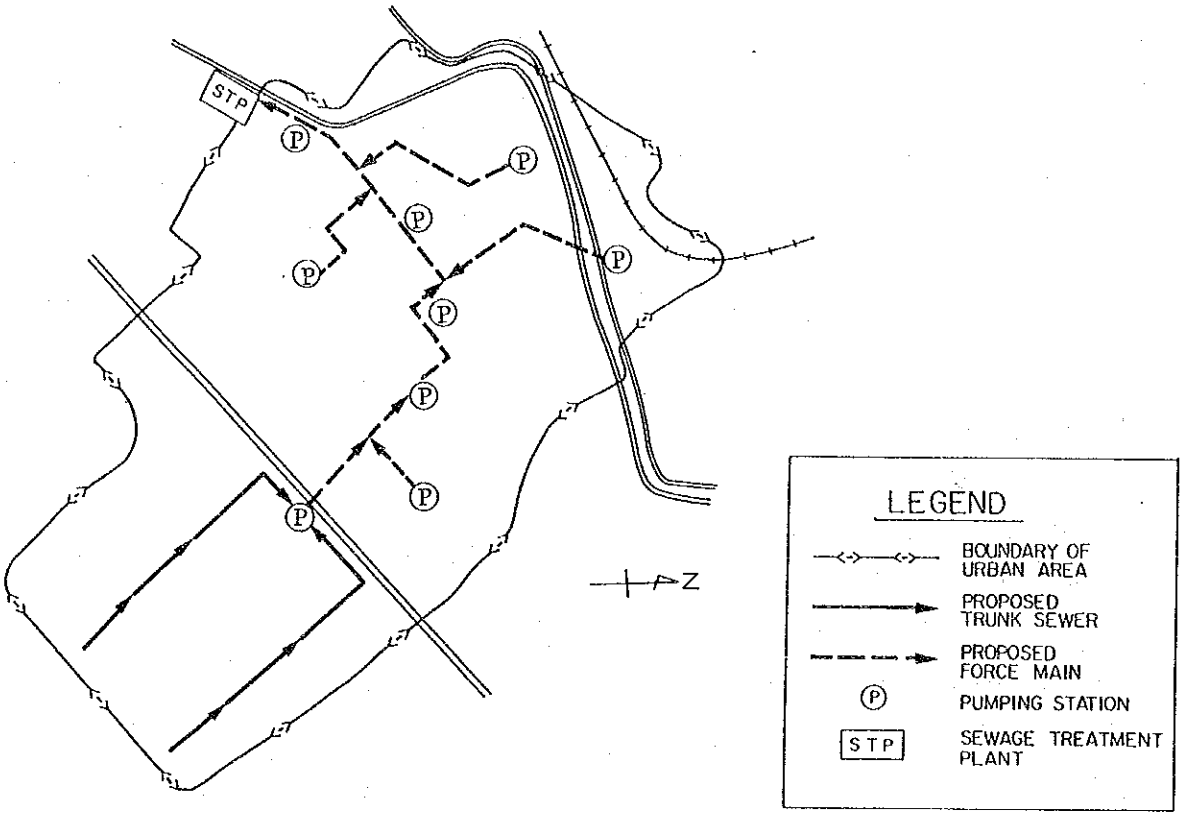


Figure 5.13 Alternative-2 for Bilbeis

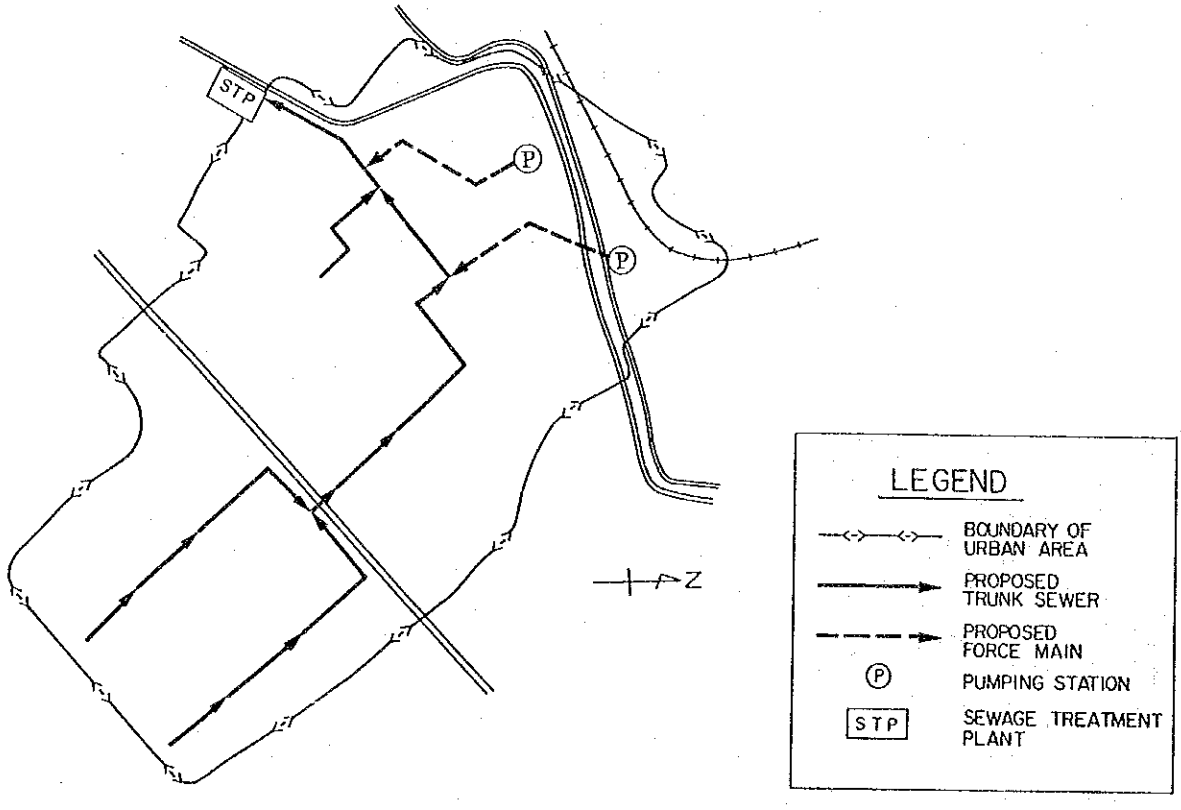


Figure 5.14 Alternative-3 for Bilbeis

5.2.5 Minyet El Qamh

Sewerage service area for Minyet El Qamh in 2005 is 300 ha, which is divided into northern and southern parts by the Muweis Canal. There are three pumping stations in operation at present. A pumping station located in the northern part of the area discharges its effluent to the drain north to the city area. On the other hand, two pumping stations in the southern part discharge collected sewage to the Minyet El Qamh Drain which runs along the southern boundary of the urban area. The area is generally flat and has no undulations. Taking these present conditions of the area into consideration, the service area is divided into 5 zones as depicted on Figure 5.15. Area of the zones are as follows:

Zone No.	Area (ha)	Served or unserved
1	90.1	unserved, partly served
2	30.3	served
3	67.4	served
4	87.3	unserved
5	24.9	served, unserved
Total	300	served area 150 ha unserved area 150 ha

Possible receiving drains for the sewage from Minyet El Qamh city are a drain located at a distance north of the city and Minyet El Qamh Drain. Location of the treatment plant can be chosen at either the northern or southern part of the city along either of the drains. In any case, sewage produced in the opposite side of the treatment plant is to be sent over the Muweis Canal, since this Canal runs through the heart of the city. Considering the fact that sewage in the southern part is larger in quantity at present and in the future as well, than that produced in the northern part, and that distance to the discharge point is longer in the northern part, it is considered appropriate to locate the treatment plant in the southern part. In this case, sewage from Zone 1 should be pumped and sent to the treatment plant by force mains, and no alternative is considered. Therefore, Zone 1 is disregarded in comparison. The following three alternatives are considered for the rest of the zones.

Alternative-1 Sewage from unserved areas in the eastern part of Zone 4 are collected to the existing pumping station in Zone 2. Sewage from the unserved portion in Zone 3 is sent to the existing pumping station and sent to the treatment plant together with that from present service areas. Sewage produced in the west part of Zone 5 flow by gravity into a small pumping station located in the treatment plant.

Alternative-2 Since urbanization in Zone 4 lags behind the other zones, this zone is separated from Zone 2. Gravity trunk sewers collecting sewage from Zone 4 is considered. These sewage are pumped up in the treatment plant together with sewage from Zone 5. Two existing pumping stations will remain to pump sewage from Zones 2 and 3.

Alternative-3 Instead of the existing pumping stations and force mains to the treatment plant, all the trunk sewers in the area are designed as gravity sewers. Two existing pumping stations will be demolished by the year 2005. Sewage from Zones 2, 3, 4, and 5 are lifted by a pumping station located inside the treatment plant.

Three alternatives are shown on figures 5.16 to 5.18.

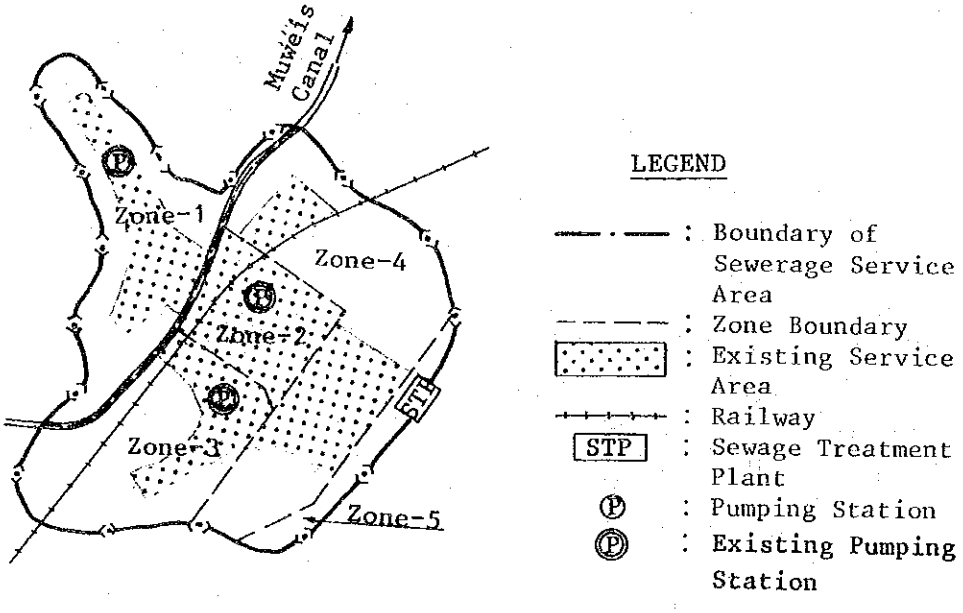


Figure 5.15 General Plan of Sewerage System in Minyet El Qamh

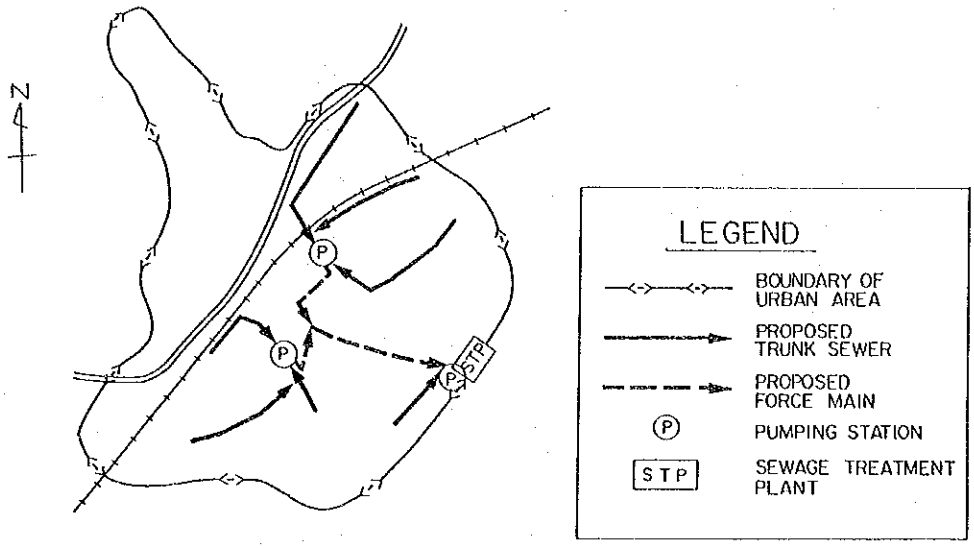


Figure 5.16 Alternative-1 for Minyet El Qamh

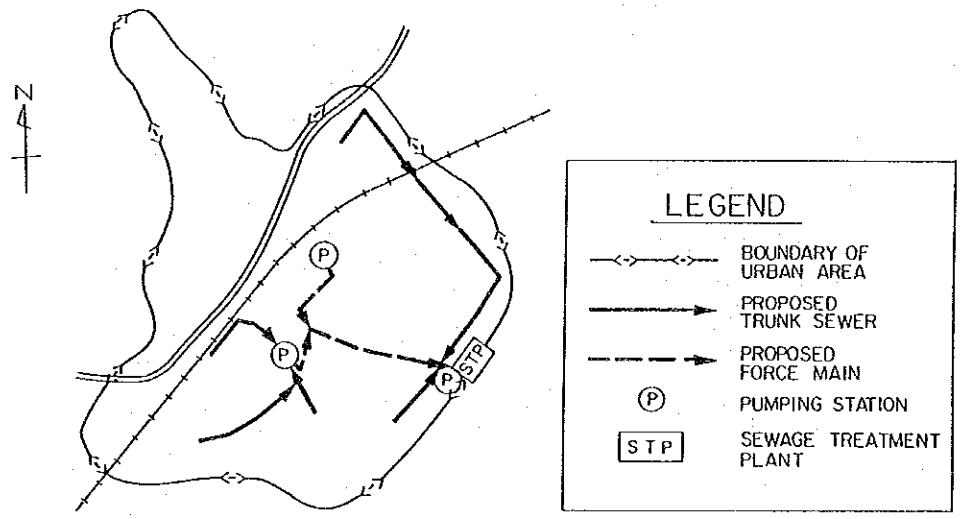


Figure 5.17 Alternative-2 for Minyet El Qamh

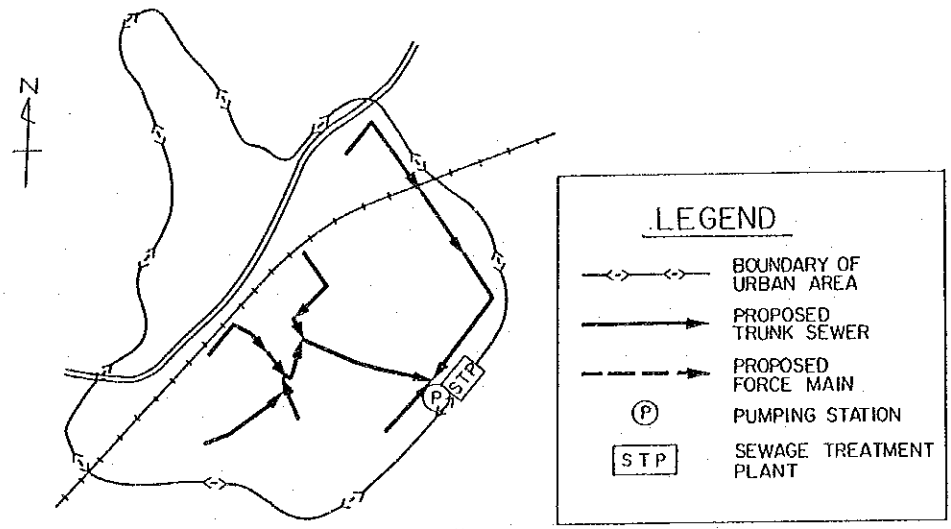


Figure 5.18 Alternative-3 for Minyet El Qamh

5.3 Cost Comparison

Costs are one of the most important factors to be considered for the selection of the most suitable sewerage system for each city. Costs of the alternatives are estimated and compared with each other. Costs are estimated based on the following assumptions.

(1) The target year for the design of the facilities is to be 2005. However, gravity trunk sewers are designed for the flow rates in 2040. For force mains, two lines, one line to accomodate flows in 2005 and another line for the increment flows after 2005 up to 2040 are designed, and construction costs of both lines are added for the comparison purpose. Pumping stations are designed for 2005 flows.

(2) Operation and maintenance costs are summed up for a 30 year period based on the 2005 flow, because the average useful life time of the facilities is assumed to be 30 years.

(3) Operation and maintenance costs for the sewers are estimated based on the average annual costs of 0.52 LE/m for gravity sewers and 0.05 LE/m for force mains (see Appendix VII).

(4) Costs of power and repair are calculated as operation and maintenance costs for pumping stations. Power cost is calculated based on the prevailing tariff rate of 0.10 LE/kWh. Annual repair cost is assumed to be 0.5 percent of the construction cost.

Results of the cost estimation are shown in Table 5.1.

Table 5.1 Costs of Alternatives for the Four Cities

City	Alternative	Construction Cost (LE 1,000)			O & M Cost for 30 years (LE 1,000)			Total and Rank		
		Sewer Pipes	Pumping Stations	Sub-total	Sewer Pipes	Pumping Stations	Sub-total	Total Cost	Rank	Ratio*
Zagazig	1	760	1,437	2,197	27	1,761	1,788	3,985	1	100
	2	2,178	936	3,114	50	1,183	1,233	4,347	2	109
	3	11,532	5,081	16,613	156	8,909	9,065	25,678	3	120
	4	12,074	3,896	15,970	163	5,341	5,504	21,474	1	100
	5	11,956	3,896	15,852	227	7,246	7,473	23,325	2	109
Faqus	1	5,036	2,017	7,053	200	1,486	1,686	8,739	2	106
	2	4,463	2,139	6,602	173	1,504	1,677	8,279	1	100
	3	4,639	2,881	7,520	156	2,075	2,231	9,751	3	118
Bilbeis	1	5,102	4,145	9,247	75	3,526	3,601	12,848	2	103
	2	4,745	4,145	8,890	74	3,526	3,600	12,490	1	100
	3	12,091	3,270	15,361	125	3,264	3,389	18,750	3	150
Minyet El Qamh	1	1,585	890	2,475	76	1,593	1,669	4,144	3	115
	2	1,283	835	2,118	56	1,439	1,495	3,613	1	100
	3	1,671	900	2,571	75	1,318	1,393	3,964	2	110

Note: * Ratios are indicated as the least cost alternative is to be 100.

5.4 Recommended Sewerage Systems

Sewerage systems for the four cities are selected based on the results of the cost estimation and other such important factors as ease of implementation, and magnitude of initial investment and its effect. As a rule, least cost alternatives are selected for adoption, unless there are apparent disadvantages. Recommended alternatives and reasons for adoption are described below.

5.4.1 Zagazig

Alternative-1 is recommended for the eastern part of the service area, as this alternative is less expensive. Moreover, there are some advantages compared with alternative-2. Since urbanization in Zone 2 in the immediate future is not likely to occur, initial investment will be significantly smaller than that for alternative-2, in which construction of gravity trunk sewers to accommodate flows from Zones 2 and 3 is necessary at the early stage of the project implementation. Independence of the sewer system in both zones and flexibility of the implementation program in Zone 2, and the fact that the sewerage systems can be modified at later stage when other infrastructure development plans arise are the other advantages of this alternative.

Alternative-4 is recommended for the western part. This has the least cost among the three alternatives. Reasons for the inexpensiveness, particularly in operation and maintenance cost, are that, in this system, sewage produced in Zone 8 is pumped up only once to the treatment plant instead of twice in alternative-3. In case of alternative-5, sewage from Zones 7 and 8 is also pumped twice to reach the treatment plant. This results in high operation and maintenance cost, although utilization of the existing pumping station relieves the construction cost of pumping stations to some extent. Another advantage of this system is the minimum number of canal crossings. There is no considerable difference between alternatives-3 and -4 regarding case of operation. However, in case of alternative-5, replacement of the existing sewer pipes may be required along the route of the gravity trunk sewers.

For the reasons mentioned above, alternatives-1 and -4 are selected for the eastern and western parts of Zagazig, respectively.

5.4.2 Faqus

Alternative-1 is recommended, although this case is second lowest in cost comparison. The main reason for the rejection of the least cost alternative-2 is the expected higher initial investment. Since the provision of the sewerage system in the present commercial area located in the south of the railway is of urgent necessity, two pumping mains will be required at the outset of the project. In case of alternative-1, the initial cost to send sewage from this part is lower than that of alternative-2 because shorter length of force main is required at the initial stage. Cost of the alternative-3 is higher than that of either alternative 1 or 2. This is due to the higher cost of an additional pumping station and force main against gravity sewers. This is a major disadvantage of alternative-3.

5.4.3 Bilbeis

Alternative-2 is recommended. This is the least cost alternative. Alternative-3 is the most expensive and the difference between this alternative and alternative-1 or -2 is large. This indicates the apparent disadvantages of the deep gravity trunk sewers which require special construction methods compared to a pumping station and force main system. Costs of the alternatives-1 and -2 are almost same, and there is not much difference in initial investment. For the early implementation of the sewerage system in the area south to the Ismailiya Canal, it is better to adopt alternative-2, since at present there is no road along the route of the force main to the treatment plant in alternative-1, and therefore there is the possibility of a delay in the construction of this force main in the immediate future.

5.4.4 Minyet El Qamh

Alternative-2 is recommended. This is the least cost alternative. In view of the project implementation, this system is considered to be most appropriate, since urbanization in Zones 4 and 5 is not progressing so rapidly as in the other Zones, and therefore priority of the sewerage project in these Zones is considered to be lower. Gravity trunk sewer system as considered in alternative-3 is more expensive compared to a pumping station and force main system. This alternative is rejected for its higher costs.

5.5 Preliminary Engineering Design

Preliminary engineering design was carried out for the four cities based on the selected alternatives described in the previous section. For the design of the main trunk sewers, leveling survey was conducted by a local contractor employed by the study team. Routes of the leveling survey in each city are shown in Appendix XIX. During the survey, official bench marks in the cities were confirmed by the study team, and temporary bench marks to be used for the sewerage project were established by the contractor under the supervision of the study team. Locations and elevation of the official and temporary bench marks are illustrated in Appendix XIX. Results of the leveling survey were plotted on the drawings as longitudinal sections with scales 1:5,000 horizontal, and 1:100 vertical. These drawings are included in Volume Four of the report.

Major sewerage facilities, such as trunk sewers, pumping stations and treatment plants are designed on the basis of the design criteria developed in Chapter Three of the current report. Drawings of these facilities are included in Volume Four. Hydraulic calculations of the trunk sewers are tabulated in Appendix XX. Longitudinal sections of the trunk sewers are included in Volume Four.

The treatment plant which is under construction at present in Zagazig by NOPWASD is not included in the preliminary design, since the design capacity of the current construction is revealed to be sufficient to cope with the wastewater flow from Zagazig and Qenayat and no new facility is required up to the year 2005. Sewage treatment plants for the other three cities, namely Faqus, Bilbeis and Minyet El Qamh are designed using the conventional activated sludge process. Goals of the treatment are set at 30/30 mg/l for BOD and SS, which are well below the legal requirements of 60/50 mg/l. Sludges are treated by sludge drying beds which follow the thickener. Final disposal of sludges is assumed to be used for agricultural purpose. Design details are presented in Appendix XX and drawings of all treatment plants are included in Volume Four.

5.6 Cost Estimation

Project costs necessary for the implementation of the sewerage system are estimated. Construction costs for facilities are estimated up to the year 1995 to develop an implementation schedule and to work out the financial analysis. Operation and maintenance costs are estimated according to the implementation schedule described in the following section.

Cost estimation was carried out in the same manner mentioned in Chapter Four of the report. Firstly, the project cost is divided into direct and indirect portions. Direct portion includes construction costs of such sewerage facilities as branch and lateral sewers, trunk sewers, pumping stations and treatment plants. Construction costs for house connections are excluded from the project cost, since these costs have been and will be borne by inhabitants and not by the governments. Costs required for the rehabilitation of the existing facilities are included in this category. Land acquisition costs are also a part of direct costs. Indirect portion of the project cost includes engineering and contingency costs. Indirect costs are estimated as a ratio of direct costs. Engineering and contingency costs are estimated to be 10 and 20 percent, respectively, of the total construction and rehabilitation costs.

Secondly, all costs are divided into local currency and foreign currency components accoridng to the nature of goods and services. The foreign currency component, is deemed to be the cost for imported goods, mostly mechanical equipment for pumping stations and treatment plants. The study team was advised by NOPWASD of its present policy to limit imported materials. This was reflected in calculating the foreign currency portion of the costs presented here. Examination of the latest report provided by NOPWASD revealed that mechanical equipment have become more readly available locally in recent times. Consequently 50 percent of the cost of mechanical equipment for treatment plants is assumed to be foreign currency portion.

In order to estimate the construction cost required up to the year 1995, necessary sewerage facilities are identified. Outline of facilities is shown in Table 5.2. Sewerage facilities in the area where urbanization is not likely to occur are excluded from the implementation program to be completed by 1995. The areas to be provided with the sewerage system in the four cities are illustrated on Figures 5.19 to 5.22.

Total project costs to cover the implementation program up to 1995 are shown in Table 5.3. A total of approximately LE 144 million is required for the four cities. Of the total project cost, LE 120 million or 83 percent is the local currency component and LE 24 million or 17 percent is the foreign currency component. Project costs for each city are LE 48.5 millin for Zagazig, LE 39.2 million for Faqus, LE 33.9 million for Bilbeis and LE 22.5 million for Minyet El Qamh. Construction cost for the Zagazig treatment plant which is now under construction by NOPWASD is not included in the estimation.

The implementation schedule up to the year 1995 for each city is shown in Table 5.4, together with breakdown of the costs by work items. The implementation schedule was developed on the following assumptions:

- The project will start in fiscal 89/90 and will be completed by 94/95, within a six year period. Treatment plants in the three cities except for Zagazig will start operation by the end of fiscal 94/95.

- Necessary land for pumping stations and treatment plants will be purchased in the first year.

- Engineering costs including detailed design, preparation of the tender documents and construction supervision of the facilities will occur in the first four years.

- Istallation of sewer pipes will be carried out after the completion of detailed design and other necessary preparatory work. Thus, construction cost will be distributed evenly from fiscal 91/92 to 94/95.

- Four years will be required for the construction of treatment plants in the three cities, with the first two years mainly for civil works and the last two years mainly for mechanical and electrical works.

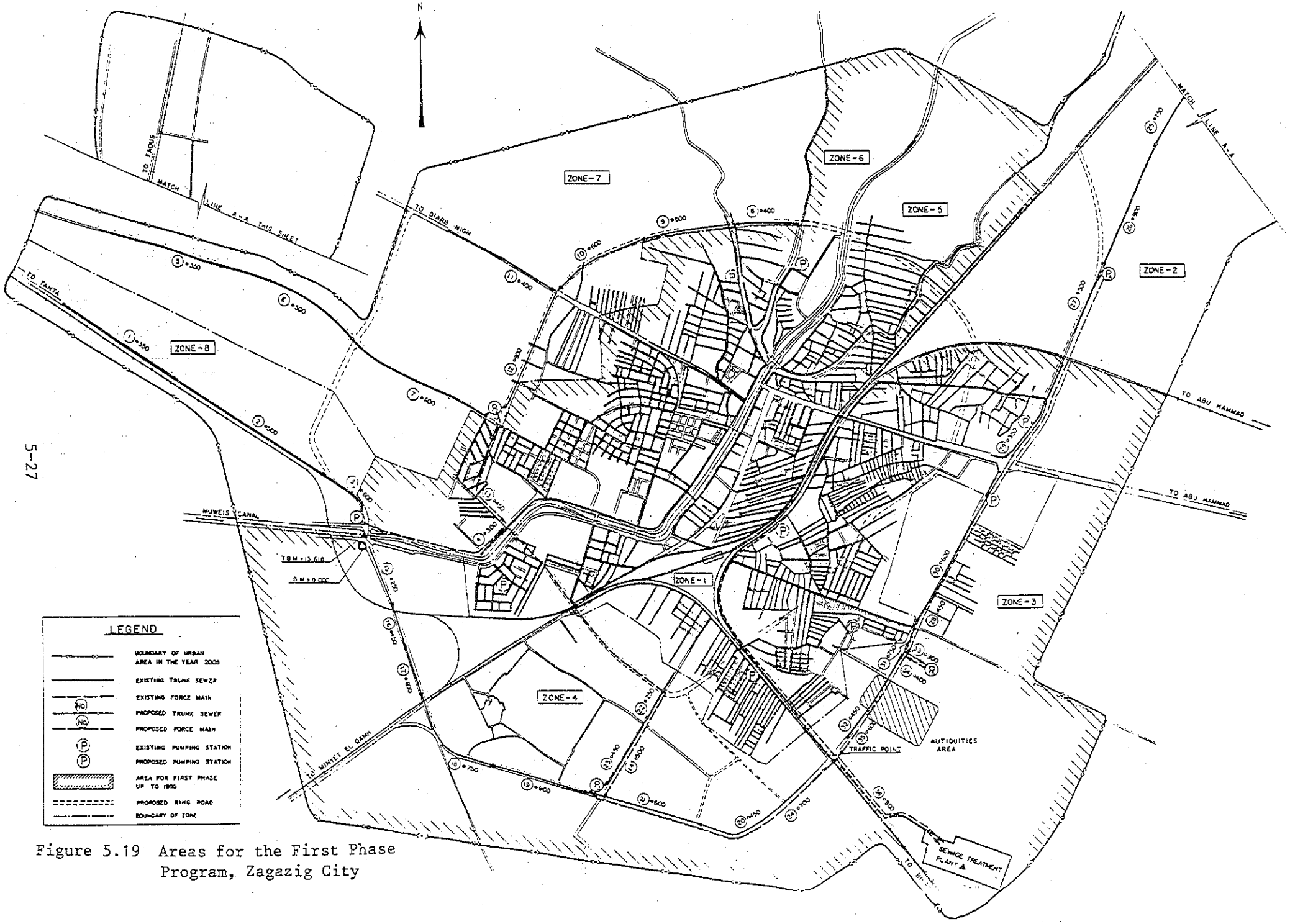


Figure 5.19 Areas for the First Phase Program, Zagazig City

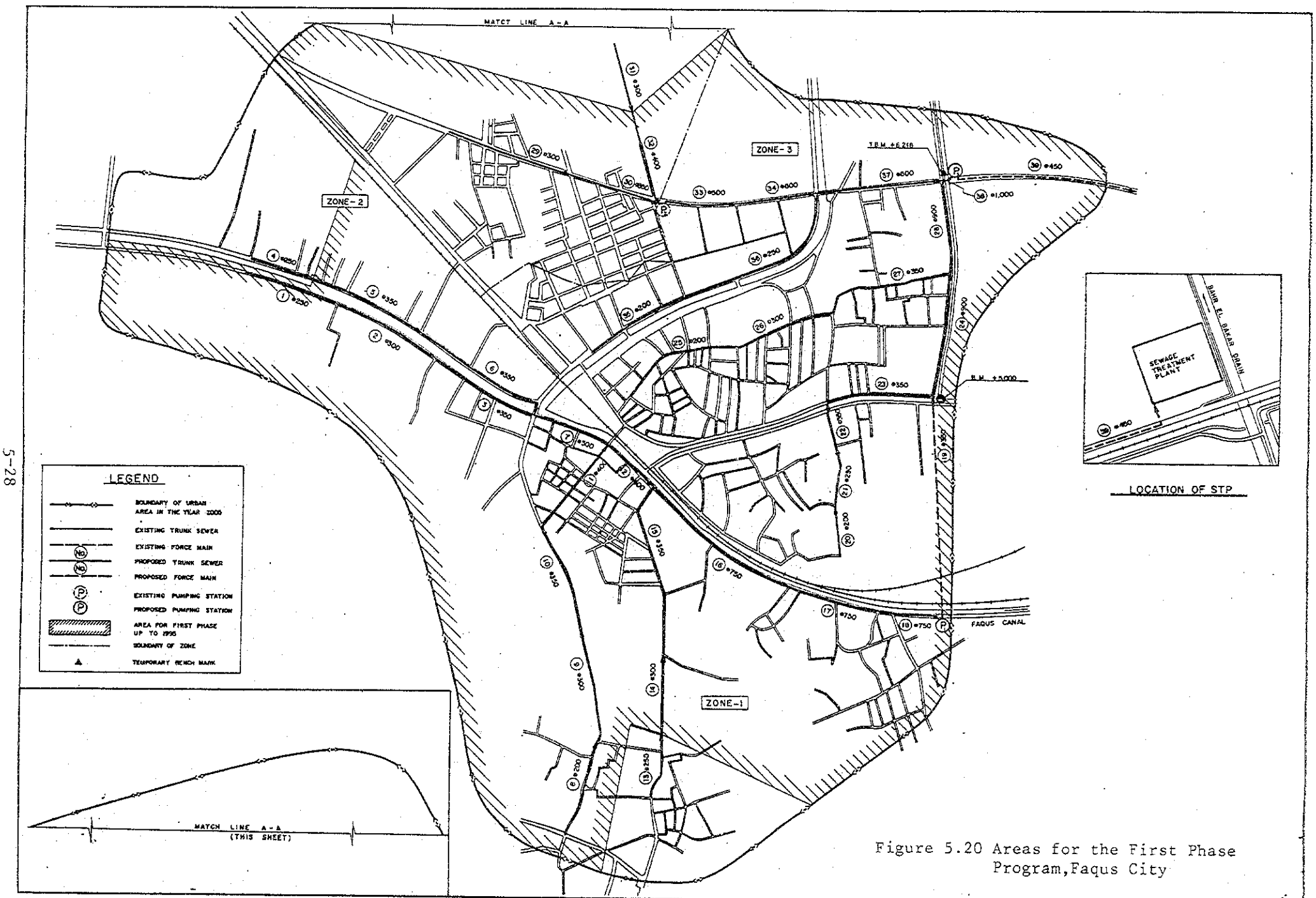


Figure 5.20 Areas for the First Phase Program, Faqus City

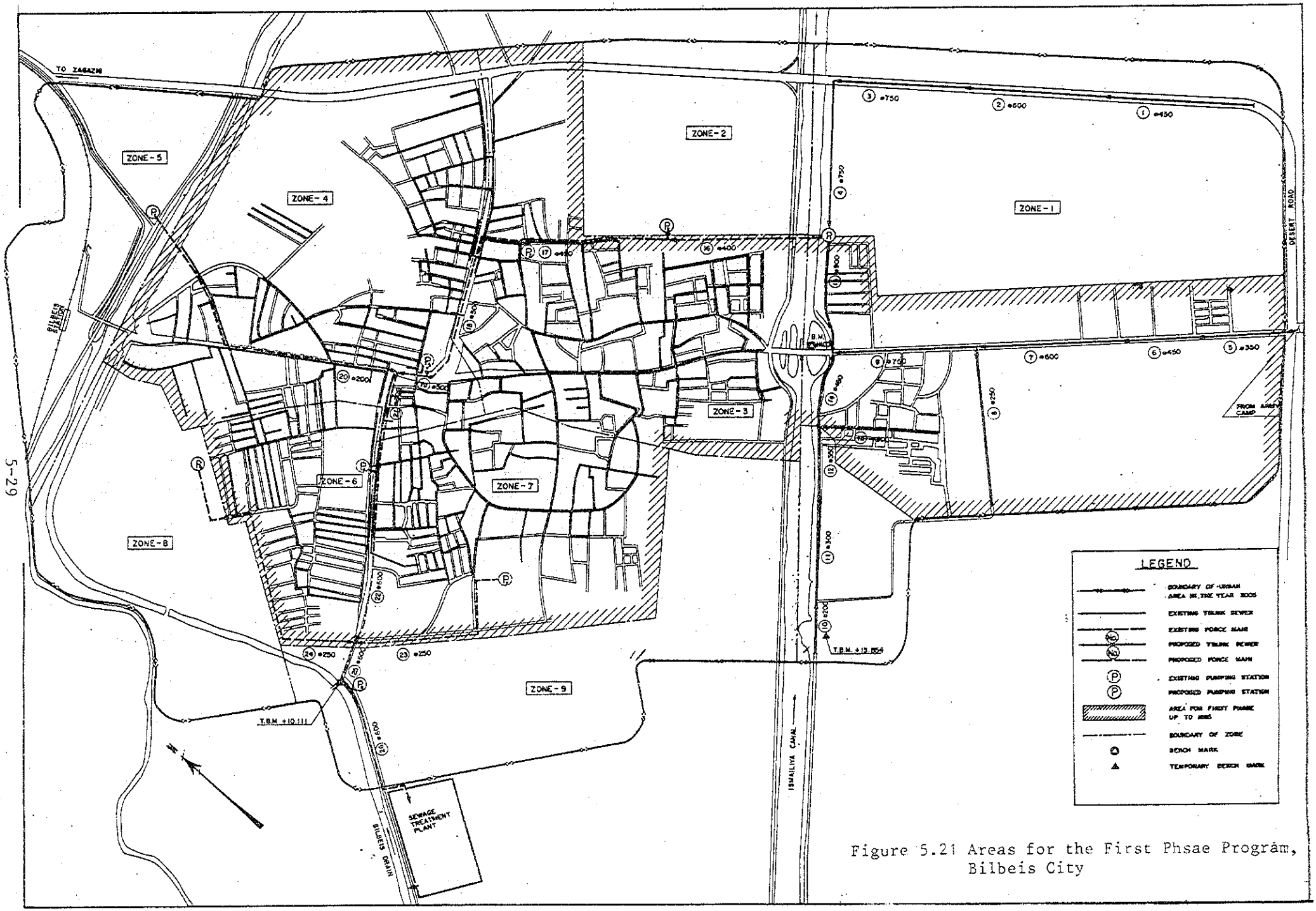


Figure 5.21 Areas for the First Phsae Progrâm, Bilbeis City

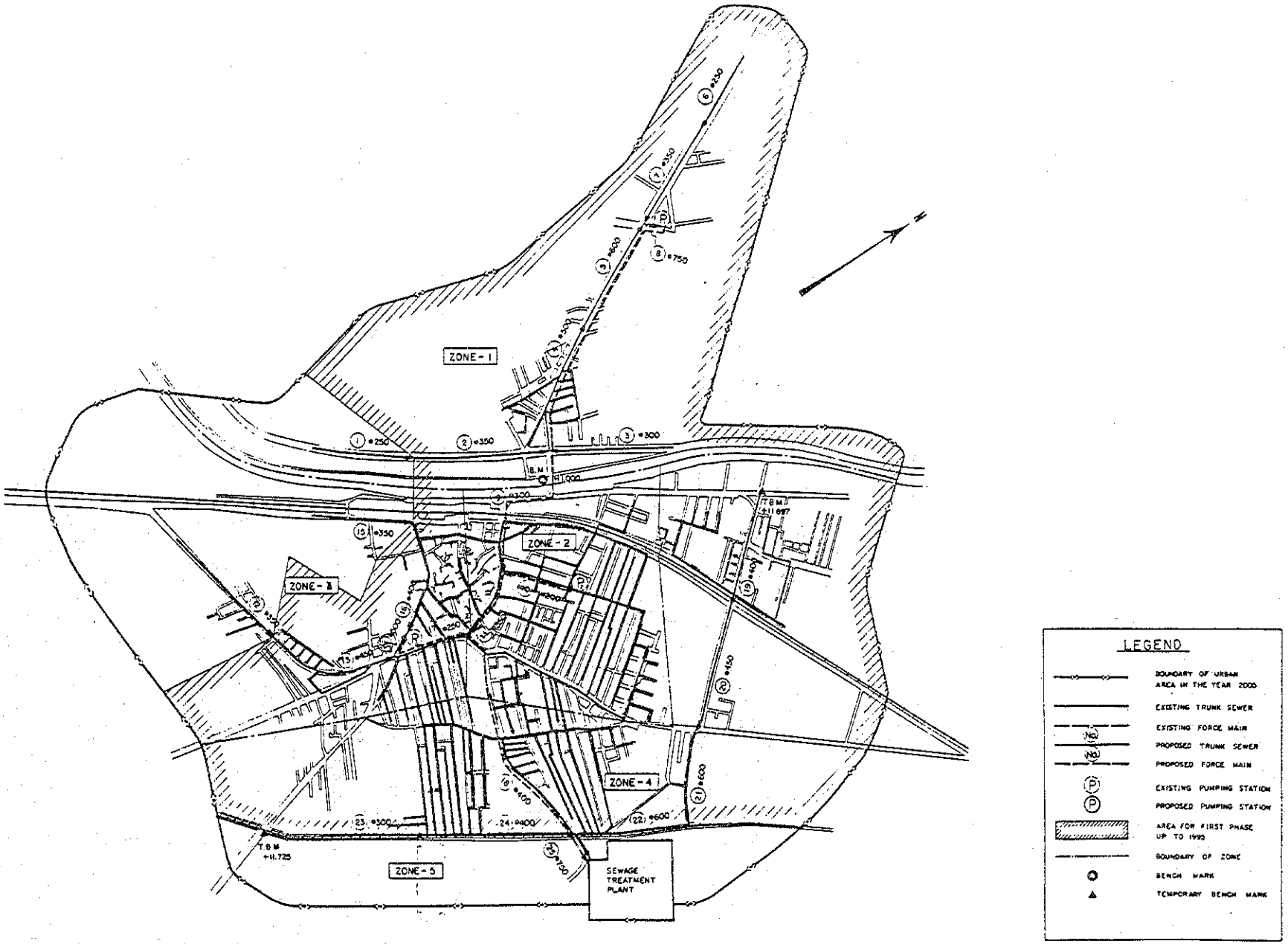


Figure 5.22 Areas for the First Phase Program, Minyet El Qamh City

- Completion of the pumping stations will keep pace with sewer pipe installation and treatment plant construction and the cost is distributed evenly for the four year period, from 91/92 to 94/95.

5.7 Rehabilitation of the Existing Facilities

As mentioned in Section 4.2.6, rehabilitation of the existing facilities will be needed at various levels as condition requires. Since no detail information to determine the degree and extent of rehabilitation of each facility is available, an assumption was made to estimate the rehabilitation costs as follows.

- For branch and lateral sewers in the existing service area, 15 percent of construction costs for new sewers are considered to be required for improvements and repair work of the existing sewers.

- For pumping stations, heavy duty mechanical equipment, such as pumps and motors will be replaced and structures and other equipment are usable until 2005. Therefore costs for replacement of pumps and motors are included in rehabilitation costs.

Rehabilitation costs are included in total project cost described in the preceding Section 5.6, and are distributed for the first four years for Zagazig and for two years for the other three cities, taking into consideration the magnitude of financial burden and the priority of work.

Table 5.2 Outline of Sewerage Facilities up to 1995

City	Service Area (ha) Exis.	New	Total	Population	New Facilities: Branch and Lateral Sewer (km) Exis.	New	Total	Trunk Sewer & Force Main Dia.(mm)	Force Main Length (m)	Pumping Station Dia.xNos.		Treatment Plant: Wastewater Flow Rate	Treatment Capacity*
Zagazig	794	832	1,626	297,000	318	333	651	250-900	10,760	No.3 No.5	250x4 200x4	---	---
Faqus	-	424	424	61,000	-	170	170	200-1000	13,830	No.1 No.2 No.3	200x3 150x3 300x3	12,213**	10,241 (1/2)
Bilbeis	227	129	356	133,000	91	52	143	200-900	6,140	No.1	250x3	20,983**	22,303 (1/2)
Minyet El Qamh	150	100	250	61,000	60	40	100	200-750	7,270	-		9,800**	9,559 (1/2)

Note: * Parentheses under treatment capacity indicate a portion of major treatment units to be completed by 1995.

** Daily average flow

Table 5.3 Total Project Costs (1995)

(LE 1,000)

City		B/L Sewer	Trunk Sewer	P/S	STP	Sub-total	Land Purchasing Cost	Rehabilitation Cost	Contingency	Engineering Cost	Total Cost
Zagazig	T	24,960	4,274	2,121	-	31,355	150	5,841	7,439	3,720	48,505
	L/C	24,960	3,633	1,082	-	29,675	150	2,561	6,447	3,224	42,057
	F/C	-	641	1,039	-	1,680	-	3,280	992	496	6,448
Faqus	T	12,720	4,102	1,936	7,230	25,988	4,665	592	5,316	2,658	39,219
	L/C	12,720	3,487	1,136	5,148	22,491	4,665	420	4,582	2,291	34,449
	F/C	-	615	800	2,082	3,497	-	172	734	367	4,770
Bilbeis	T	2,040	1,821	1,711	13,370	18,942	8,075	942	3,977	1,989	33,925
	L/C	2,040	1,548	616	9,334	13,538	8,075	426	2,793	1,397	26,229
	F/C	-	273	1,095	4,036	5,404	-	516	1,184	592	7,696
Minyet El Qamh	T	3,000	1,530	700	7,650	12,880	4,500	930	2,762	1,381	22,453
	L/C	3,000	1,301	140	5,497	9,938	4,500	244	2,036	1,018	17,736
	F/C	-	229	560	2,153	2,942	-	686	726	363	4,717
TOTAL	T	42,720	11,727	6,468	28,250	89,165	17,390	8,305	19,494	9,748	144,102
	L/C	42,720	9,969	2,974	19,979	75,642	17,390	3,651	15,858	7,930	120,471
	F/C	-	1,758	3,494	8,271	13,523	-	4,654	3,636	1,818	23,631

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 5.4 Implementation Schedule

(LE 1,000)

City	Work Item	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	Sub-total
Zagazig	1. Sewer Pipes	-	-	7,309	7,309	7,309	7,307	29,234
	2. Pumping Station	-	-	530	530	530	531	2,121
	3. Treatment Plant	-	-	-	-	-	-	-
	4. Rehabilitation	1,460	1,460	1,460	1,461	-	-	5,841
	5. Land Acquisition	150	-	-	-	-	-	150
	6. Engineering	930	930	930	930	-	-	3,720
	7. Contingency	1,860	1,860	1,860	1,859	-	-	7,439
	Sub-total	4,400	4,250	12,089	12,089	7,839	7,838	48,505
Faqus	1. Sewer Pipes	-	-	4,206	4,206	4,206	4,204	16,822
	2. Pumping Station	-	-	484	484	484	484	1,936
	3. Treatment Plant	-	-	1,808	1,808	1,808	1,806	7,230
	4. Rehabilitation	296	296	-	-	-	-	592
	5. Land Acquisition	2,333	2,332	-	-	-	-	4,665
	6. Engineering	665	665	665	663	-	-	2,658
	7. Contingency	1,329	1,329	1,329	1,329	-	-	5,316
	Sub-total	4,623	4,622	8,492	8,490	6,498	6,494	39,219
Bilbeis	1. Sewer Pipes	-	-	965	965	965	966	3,861
	2. Pumping Station	-	-	428	428	428	427	1,711
	3. Treatment Plant	-	-	3,343	3,343	3,343	3,341	13,370
	4. Rehabilitation	471	471	-	-	-	-	942
	5. Land Acquisition	4,038	4,037	-	-	-	-	8,075
	6. Engineering	497	497	497	498	-	-	1,989
	7. Contingency	994	994	994	995	-	-	3,977
	Sub-total	6,000	5,999	6,227	6,229	4,736	4,734	33,925
Minyet El Qamh	1. Sewer Pipes	-	-	1,133	1,133	1,133	1,131	4,530
	2. Pumping Station	-	-	175	175	175	175	700
	3. Treatment Plant	-	-	1,913	1,913	1,913	1,911	7,650
	4. Rehabilitation	465	465	-	-	-	-	930
	5. Land Acquisition	2,250	2,250	-	-	-	-	4,500
	6. Engineering	345	345	345	346	-	-	1,381
	7. Contingency	691	691	691	689	-	-	2,762
	Sub-total	3,751	3,751	4,257	4,256	3,221	3,217	22,453
Total	1. Sewer Pipes	-	-	13,613	13,613	13,613	13,608	54,447
	2. Pumping Station	-	-	1,617	1,617	1,617	1,617	6,468
	3. Treatment Plant	-	-	7,064	7,064	7,064	7,058	28,250
	4. Rehabilitation	2,692	2,692	1,460	1,461	-	-	8,305
	5. Land Acquisition	8,771	8,619	-	-	-	-	17,390
	6. Engineering	2,437	2,437	2,437	2,437	-	-	9,748
	7. Contingency	4,874	4,874	4,874	4,872	-	-	19,494
	Total	18,774	18,622	31,065	31,064	22,294	22,283	144,102

5.8 Procurement of Equipment and Materials

Most of the costruction materials for the sewerage facilities are readily available locally in the Governorate. Local contractors are, in general, capable of carrying out the construction work under supervision of experienced engineers presumably provided by NOPWASD. However, some mechanical and electrical equipment, such as various kinds of pumps, motors, monitoring and control devices, are not locally available and shall be imported from foreign countries. Although foreign currency components required for these equipment are relatively small in total construction costs, foreign currencies are to be prepared. Under the present circumstances in Egypt, and considering the nature of the projects, it is deemed most appropriate for NOPWASD to procure these equipment and to supply to contractors. This is the best method in respect of smoothest implementation of the project, since it takes a considerable time for private contractors to obtain import licences, allocation of foreign currency and other necessary approvals. In this case, NOPWASD shall take necessary actions as soon as detailed design of facilities and preparation of specifications are completed. International bidding can be applied for procurement.

Procurement of imported equipment can be included in construction contracts, and contractors are responsible for supply and erection of equipment. However, even in this case, NOPWASD shall obtain approvals and licences from ministries and government agencies concerned.

5.9 Institutional Arrangement

In pursuance of the long-term program of the sewerage development program up to the year 2005, the first phase program up to the year 1995 has been identified.

In this first-phase program, four cities of Zagazig, Bilbeis, Faqus and Minyet El Qamh have been selected and major construction of the sewerage systems and facilities such as treatment plants, trunk sewers and pumping stations, small size branch and lateral sewers, rehabilitation works and installment of house connections have been proposed in these selected cities.

The necessary institutional arrangement at the national and local levels have been studied in this section to cope with and support the first-phase program.

5.9.1 NOPWASD

For the execution of the first-phase program of the proposed project, the central agency of NOPWASD is proposed to perform the leading role from the initiation of the program to the completion of the system construction, undertaking the responsibility to construct the major sewerage facilities as sewage treatment plants, pumping stations and trunk sewers. At the preparatory stage of the program, NOPWASD is required to keep in close contact with other key central agencies such as the Ministry of Housing and Public Utilities, and the Ministry of Planning to obtain the necessary support in funding and administrative arrangements.

If the funding of foreign capital is involved in the project investment, the Ministry of International Cooperation is required to be involved in the proposed organizational framework for the funding arrangement and coordination among foreign agencies and national agencies concerned.

If it is decided to implement proposed project, NOPWASD is required to provide the key personnel who would be responsible for supporting the project implementation.

The following are the key personnel required and their respective functions.

(1) Project Manager/Assistant Project Manager

The following functions are mainly performed by the project manager and the role of the assistant manager is to assist the project manager or act as a representative of the project manager in case he is absent.

a. Responsible for the preparation of the detailed designs of the project by mobilizing in-house design engineers or employing local or foreign engineering consultants.

b. Review detailed designs, working drawings and specifications prepared by design engineers or engineering consultants.

c. Ensure that basic data required for the detailed designs are furnished to design engineers or engineering consultants.

d. When the detailed design is completed and NOPWASD has elected to supervise the construction, the project manager would have to prepare the overall construction schedule in order to ensure the completion of the project within the time schedule at minimum cost.

e. Responsible for coordination of activities of the various contractors to ensure that (1) construction is in accordance with plan and detailed design specifications, (2) materials are available in the field when needed, (3) request for payment of contractors are in order. He is also responsible for coordination of project activities with other government agencies.

f. In case, NOPWASD decides to avail of the services of outside engineering consultants (local or foreign) for supervision of construction, the function of the project manager is conformed to coordination, ensuring that materials are available when needed and approving request for payments from contractors after the same have been reviewed and certified by engineering consultants. He prepares necessary reports for submission to appropriate government and lending agencies on the status of the project.

(2) Project Design Engineer

a. Assist the project manager in reviewing the detailed engineering design, drawing, bill of quantities and specifications.

b. Prepare tender documents and, in cooperation with the cost engineer, evaluate tenders and make recommendation.

c. Prepare engineering design and working drawing for change of orders or revisions which may become necessary in the course of construction.

d. Monitor progress of construction and recommend measures for avoiding or minimizing delays.

(3) Project Cost Engineer

a. Review engineering designs with respect to its appropriateness to the Egyptian situation from a cost standpoint.

b. Evaluate tenders with the design engineer.

c. Monitor and evaluate construction expenditures against physical accomplishments and estimate possible cost overrun/underrun.

d. Review requests for payment of contractor and, on the basis of reports of the construction inspectors, recommend appropriate payments.

(4) Project Construction Inspector

a. Ensure that construction plans and specifications are complied by the various contractors.

b. Prepare regular reports on the accomplishments of contractors.

c. Supervise testing of completed facilities.

(5) Project Accountant

a. Ensure proper recording of all disbursements (foreign and local components) for the project. This involves ensuring that the proper accounts are kept of all expenditure.

b. Prepare regular financial reports to the Ministry of Housing and Public Utilities, Ministry of Finance and the governorate.

c. Program release of any local funds to meet the requirements of the project.

(6) Project Treasurer

a. Act as the custodian of the local funds of the project.

b. Ensure that all the required documentation are in order before any local disbursements are made.

(7) Counterpart (Engineer Trainee)

a. Act as understudy to the regular design engineer, cost engineer, and construction inspectors. As such, assist the same in the regular performance of their respective job.

(8) Expediter and Clerk-Typist

a. Provide adminsitrative support to the engineers, accountant and treasurer.

5.9.2 Sharqiya Governorate

While NOPWASD would be responsible for the construction of major sewerage facilities, Sharqiya Governorate would be responsible for the works of small size branch and lateral sewers, minor rehabilitation and installment of the house connections under the technical assistance and cooperation of NOPWASD.

After the completion of the sewerage system construction in all four cities by NOPWASD, the completed systems are to be transferred to the governorate, so that the governorate would undertake full responsibility for the operation and maintenance of the transferred systems.

In this context, the governorate should strengthen the organization and staffing mainly related to the operation and maintenance of the sewerage systems in accordance with the project implementation, providing the new unit and/or expanding the existing unit as follows.

(1) The sub-sections of Operation and Maintenance and Central Laboratory should newly be provided for in the existing section of Cities & Village Sewerage and Drainage and the functions of these units are as follows.

(a) Operation & Maintenance

- Supervise, coordinate and centrally control day-to-day operation and maintenance activities in all Marakaz, especially in four Marakaz of Zagazig, Bilbeis, Faqus and Minyet El Qamh selected for first-phase sewerage development program.

- Resolve operation and maintenance problems and assist each sewerage unit in Marakaz.

(b) Central Laboratory

- Perform monitoring and analysis of the quality of domestic and industrial wastewater, sewage discharged directly to drains and effluents from 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.

(2) The existing sewerage units which are responsible for the operation and maintenance of the sewerage facilities in Marakaz of Zagazig, Bilbeis, Faqus, and Minyet El Qamh are required to be expanded or new units are to be provided in accordance with the first-phase program to be completed in 1995 as follows.

(a) Zagazig

The existing units for operation and maintenance of pumping stations, treatment plant and sewer are required to be expanded to cope with two newly constructed pumping stations, about 11 km of trunk sewers, about 330 km of lateral sewers and a treatment plant with a capacity of about 70,000 m3/day.

(b) Bilbeis

The existing operation and maintenance units for pumping station and sewers are required to be expanded to cope with one newly constructed pumping station, about 6 km of trunk sewers and about 52 km of lateral sewers. The new unit is required for the operation and maintenance of a treatment plant with a capacity of about 22,000 m3/day, to be completed in 1995.

(c) Faqus

The existing operation and maintenance units for the pump station and sewer are required to be expanded to cope with three newly constructed pumping stations, about 14 km of trunk sewers, about 170 km of lateral sewers. The new unit is required for the operation and maintenance of a new treatment plant with a capacity of about 10,000 m3/day, to be completed in 1995.

(d) Minyet El Qamh

The existing operation and maintenance units for the pumping stations and sewers are required to be expanded to cope with about 7 km of trunk sewers, about 40 km of lateral sewers. The new unit is required for the operation and maintenance of a new treatment plant with a capacity of about 10,000 m3/day, to be completed in 1995.

The common functions of all operation and maintenance unit to be expanded or newly provided in the four above mentioned Marakaz are as follows.

(a) Treatment Plant Unit

- Undertake sewage treatment operation to achieve desired effluent quality.

- Operate and maintain the sewage treatment plant in the most efficient and economical manner.

- Undertake proper disposal of the sewage treatment plant effluent.

- Perform laboratory tests essential to the successful operation of the treatment plant.

- Undertake maintenance and repair of the treatment plant works and equipment to keep it in good working condition.

- Maintain adequate tools, materials and supplies necessary for undertaking maintenance and repair work.

- Undertake housekeeping activities to keep the plant premises neat.

- Prepare and maintain records and reports, as maybe required by the management.

(b) Pumping Station Unit

- Undertake the operation of the pumping stations efficiently to ensure uninterrupted conveyance of sewage.

- Undertake the overall maintenance of the pumps and its accessories.

- Undertake the routine maintenance of pumping station buildings and grounds.

- Prepare reports and maintain records as maybe required by the management.

(c) Sewer Unit

- Provide adequate and reliable sewage and wastewater collection and conveyance to treatment plant.

- Undertake proper maintenance of the public sewers and its appurtenances to ensure uninterrupted service in the most efficient and economical manner.

- Undertake minor construction, and repair of damaged sewers and its appurtenances promptly and economically.

- Undertake continuous inspection for physical damage and obstructions of the public sewers and determination of causes.

- Prepare reports of violations of the law (Law No. 48/1982) including inadmissible discharges into natural outlets detected in the course of inspection, to initiate filing of court suits against violators.

- Assist the Treatment Plant Unit in obtaining samples of sewage and industrial wastewater for laboratory analysis.

- Control the discharge of transh systems into sewers.

- Prepare reports and maintain records required by management.

(3) The following existing functions of head offices of the Governorate and four Marakaz of Zagazig, Bilbeis, Faqus and Minyet El Qamh are required to be reinforced to support the proposed first phase sewerage development program in close coordination with the corresponding departments.

(a) Administration Department

This department is required to administer the internal personnel policies and procedures, and control the staff performances, to consider incentive payment and promotion, including manpower planning, recruitment, and staff training program.

(b) Finance Department

This department is required to prepare annual financial accounts exclusively for the sewerage system operation, earmarking the annual revenues derived from sewerage service charge.

(c) Legal Department

This department is required to perform the functions of administering the legal aspects such as prosecution for violations of laws such as illegal disposal of wastewater to drain.

In addition to above, the existing Revenue Departments in charge of bill collection provided in all Marakaz are required to collect sewerage charges together with water supply charges and reports should be prepared by these departments to define the sewerage service income separately from other public service income.

The proposed organization charts for the first-phase program are indicated by Figures 5.23, 5.24, and 5.25.

Figure 5.23 Proposed Organization Chart related to First Phase Sewerage Development Project

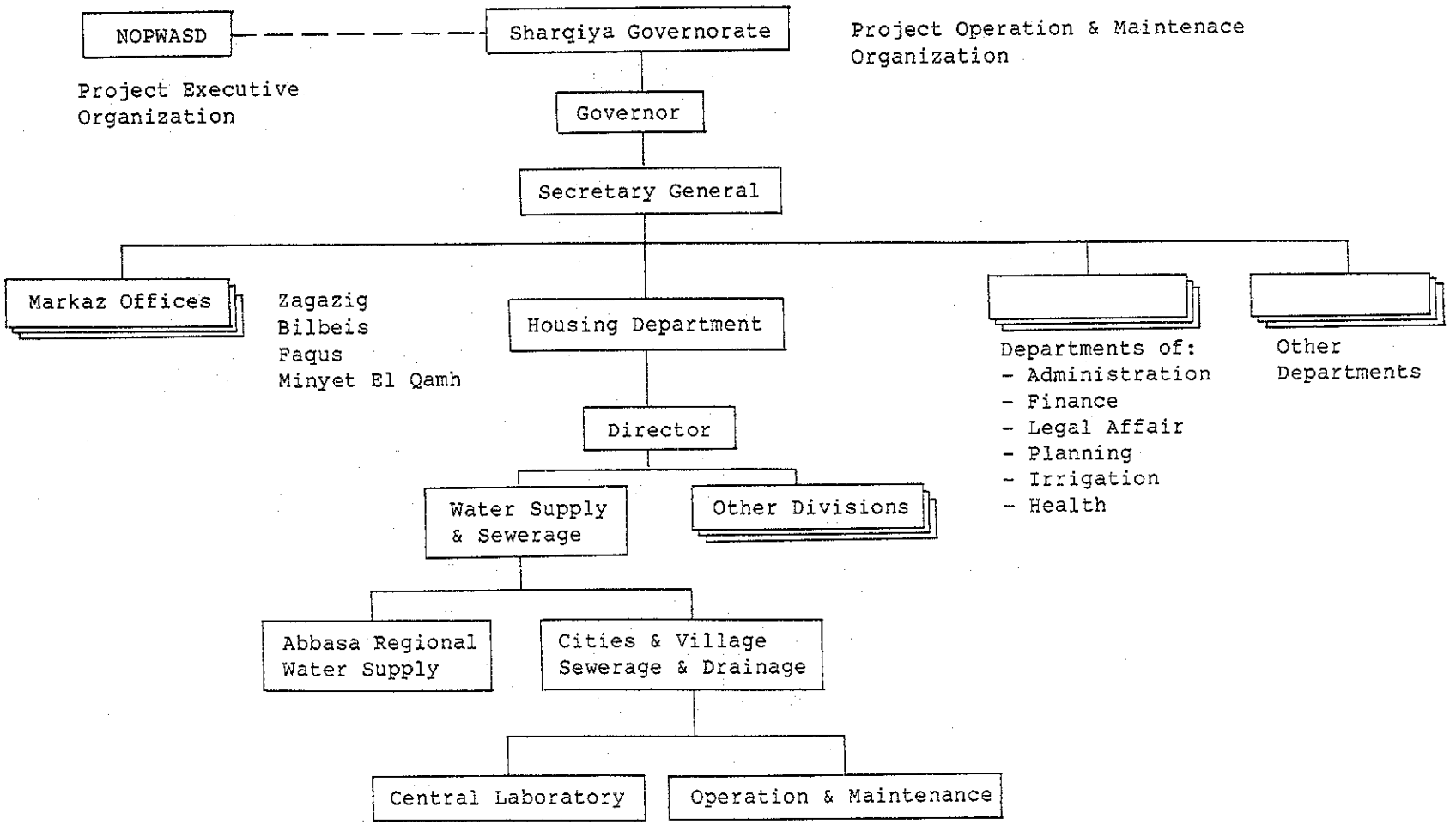
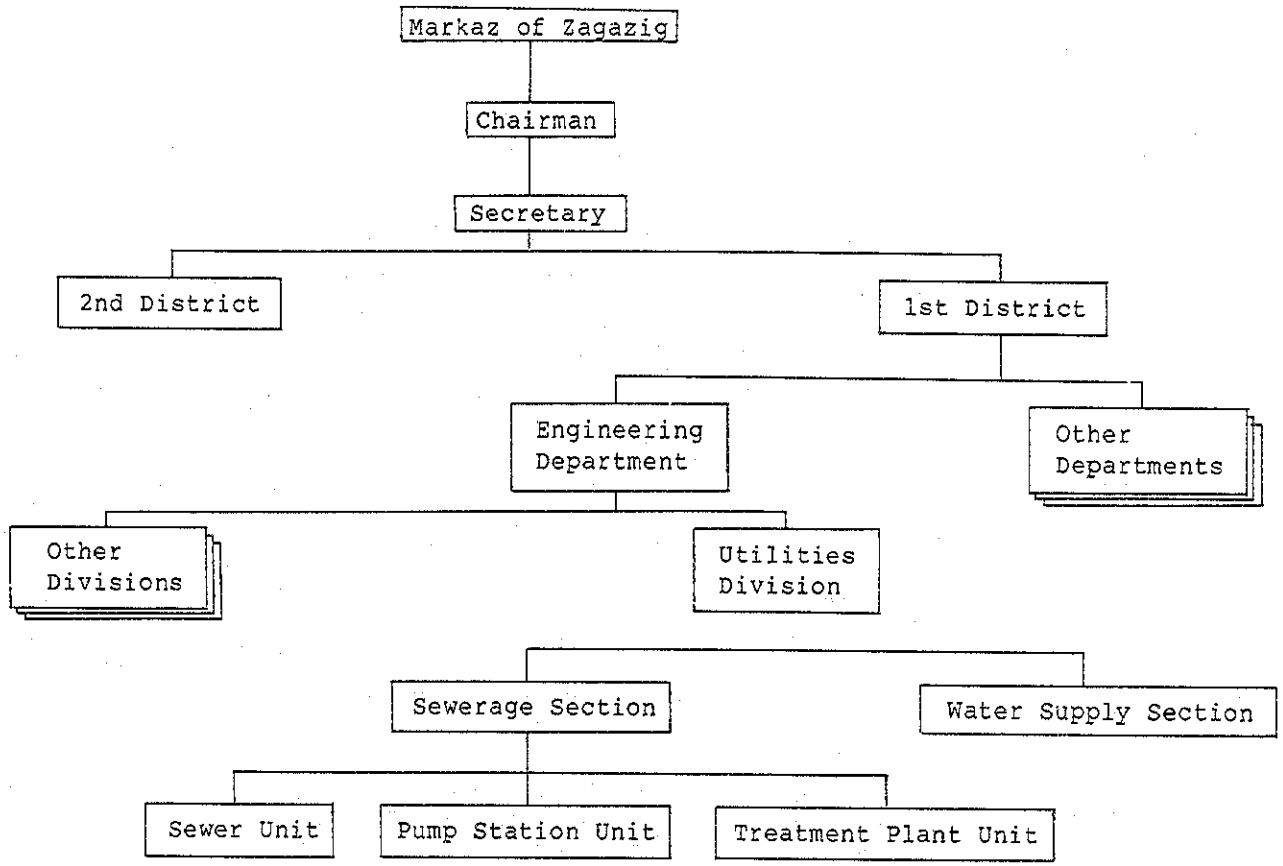
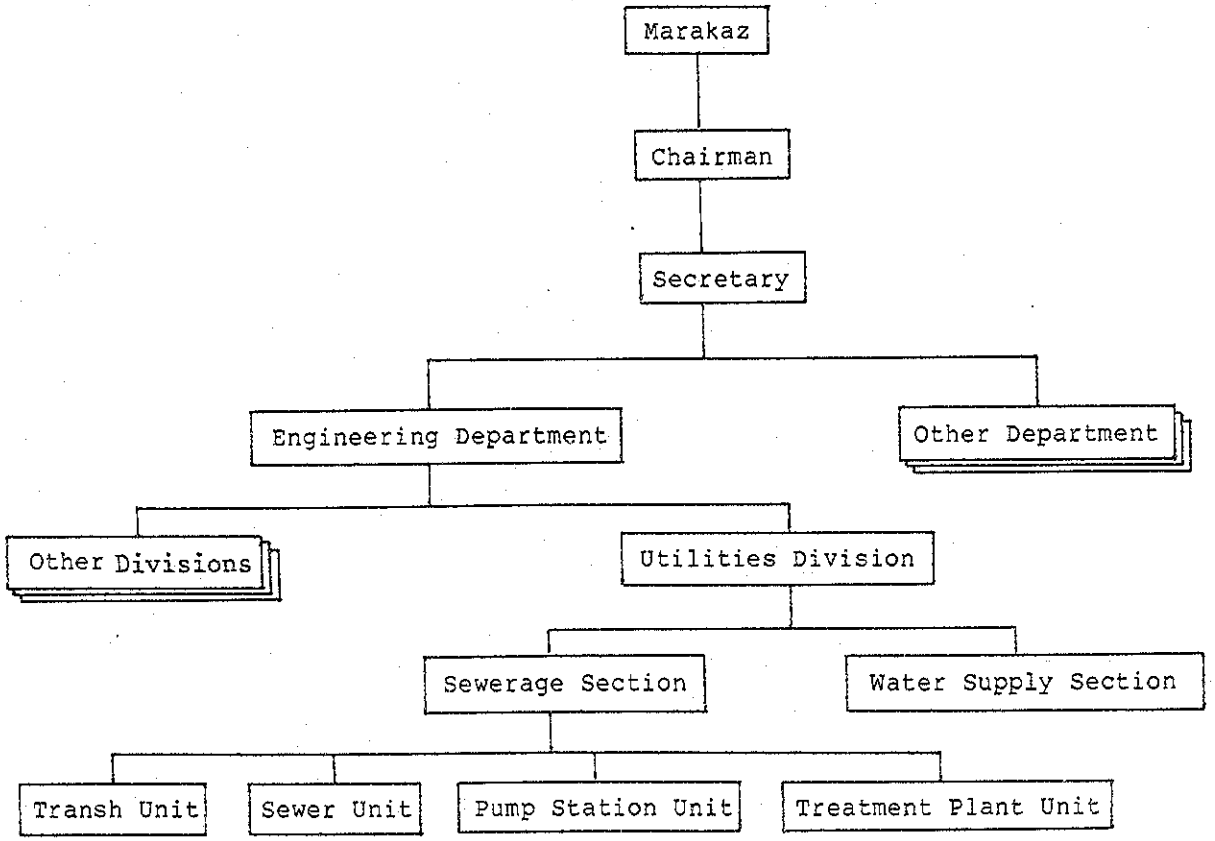


Figure 5.24 Proposed Organization Chart in Markaz of Zagazig



Note: The functional framework under 2nd District is similar to that under the 1st District excluding the Treatment Plant Unit.

Figure 5.25 Proposed Organization Chart in Marakaz of Bilbeis, Faqus, and Minyet El Qamh



(4) Staffing Schedule

The schedule of requirement of estimated number of additional staff required for the implementation of the first-phase Sharqiya sewerage system project has been made covering the period 1990/91 to 1999/2000, as shown in Table 5.5.

This schedule is based on the projected number of personnel needed at the end of each fiscal year assuming that the start of construction of the project will be in 1991/92, the completion of the construction in 1995/96, while the operation of some facilities will start even before 1995/96, after the completion of the treatment facilities.

Vigorous efforts will be required to recruit the required numbers of qualified staff scheduled. Competitive remuneration to attract and retain qualified individuals will be required. In case competitive salaries cannot be provided, there might be difficulty in retaining the required number of qualified staff.

In addition to the recruitment of the qualified staff, the intensified training of the existing staff is desirable to meet the immediate needs for the first phase program and future staffing requirement as detailed in the previous Chapter Four, Long Term Plan, 4.5 Staff Requirement and Training.

As mentioned in the initial part of the section 5.9.2, the full cooperation with the executive agency of NOPWASD during the course of first phase program, would provide a vital opportunity for on-the-job training of the staff.

Table 5.5 Schedule of Estimated Staff Requirements for the First Phase Program

	1990/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000
Governorate Office:										
Cities & Village										
Sewerage & Drainage										
Operation & Maintenance										
Section Chief	1	1	1	1	1	1	1	1	1	1
Assistant Engineers	1	1	1	1	1	1	1	1	1	1
Technicians	-	1	1	1	1	1	2	2	2	2
Clerk Typists	-	1	1	1	1	1	2	2	2	2
Central Laboratory										
Laboratory Chief	-	1	1	1	1	1	1	1	1	1
Chemists	-	-	1	1	1	1	2	2	2	2
Laboratory Assistant	-	-	1	1	1	1	1	1	1	1
Markaz of Zagazig:										
Treatment Plant Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	3	3	3	3	3	3	3	3	3
Mechanics	-	3	3	3	3	3	3	3	3	3
Electrician	-	2	2	2	2	2	2	2	2	2
Foremen	-	1	1	1	1	1	1	1	1	1
Laborers	-	10	10	10	10	10	10	10	10	10
Pumping Station Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	-	-	-	6	6	6	6	6	6
Technicians	-	-	-	-	9	9	9	9	9	9
Laborers	-	-	-	-	30	30	30	30	30	30
Sewer Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Maintenance Crew	-	-	-	-	22	22	44	44	44	44
Laborers (Maintenance)	-	-	-	-	-	72	72	72	72	72
Laborers (Construction)	-	50	50	50	50	-	-	-	-	-

Table 5.5 Schedule of Estimated Staff Requirements for the First Phase Program (Cont'd)

	1990/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000
Markaz of Bilbeis:										
Treatment Plant Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	-	-	-	-	3	3	3	3	3
Mechanics	-	-	-	-	-	3	3	3	3	3
Electrician	-	-	-	-	-	2	2	2	2	2
Foremen	-	-	-	-	-	1	1	1	1	1
Laborers	-	-	-	-	-	10	10	10	10	10
Pumping Station Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	-	-	-	-	8	8	8	8	8
Technicians	-	-	-	-	-	12	12	12	12	12
Laborers	-	-	-	-	-	40	40	40	40	40
Sewer Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Maintenance Crew	-	-	-	-	-	12	12	12	12	12
Laborers (Maintenance)	-	-	-	-	-	8	8	8	8	8
Laborers (Construction)	-	5	5	5	5	-	-	-	-	-
Markaz of Faqus:										
Treatment Plant Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	-	-	-	-	3	3	3	3	3
Mechanics	-	-	-	-	-	3	3	3	3	3
Electricians	-	-	-	-	-	2	2	2	2	2
Foremen	-	-	-	-	-	1	1	1	1	1
Laborers	-	-	-	-	-	10	10	10	10	10
Pumping Station Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	-	-	-	-	6	6	6	6	6
Technicians	-	-	-	-	-	9	9	9	9	9
Laborers	-	-	-	-	-	30	30	30	30	30
Sewer Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Maintenance Crews	-	-	-	-	-	22	22	22	22	22
Laborers (Maintenance)	-	-	-	-	-	37	37	37	37	37
Laborers (Construction)	-	25	25	25	25	-	-	-	-	-

Table 5.5 Schedule of Estimated Staff Requirements for the First Phase Program (Cont'd)

	1990/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000
Markaz of Minyet El Qamh:										
Treatment Plant Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	-	-	-	-	3	3	3	3	3
Mechanics	-	-	-	-	-	3	3	3	3	3
Electricians	-	-	-	-	-	2	2	2	2	2
Foremen	-	-	-	-	-	1	1	1	1	1
Laborers	-	-	-	-	-	10	10	10	10	10
Pumping Station Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Shift Operators	-	-	-	-	-	6	6	6	6	6
Technicians	-	-	-	-	-	9	9	9	9	9
Laborers	-	-	-	-	-	30	30	30	30	30
Sewer Unit										
Chief Engineer	1	1	1	1	1	1	1	1	1	1
Maintenance Crews	-	-	-	-	-	10	10	10	10	10
Laborers (Maintenance)	-	-	-	-	-	10	10	10	10	10
Laborers (Construction)	-	6	6	6	6	-	-	-	-	-
Total	14	122	124	124	191	483	508	508	508	508

5.10 Financial Analysis

5.10.1 Sewerage Revenue Survey

The revenues of the sewerage sector was reviewed during the second field survey. According to the finance departments of the priority Marakaz and Abu Kebir, it was revealed that the revenue sources comprise, of 1) water tariff surcharge, 2) vacuum car revenue and 3) sewerage connection charge. The billing and collection practices were also examined. The following are the summary of its findings:

(a) The tariff rates used are unitary throughout the project area. All Marakaz apply the same tariff which was revised in January 1988 by the Ministry of Housing. Nevertheless, Abu Kebir city levies additional charge (LE 2.0 per annum at flat rate) on all consumers who have sewerage pipe connection. The reason that this city alone is granted to have extra source of the revenue is not clear.

(b) The billings and collection systems are more or less the same in Sharqiya. The interval of bill collection period is either on monthly basis or three months basis. Yet, the penalty on delay payment differs from Markaz. Again the reason for this differentiation is not known.

(c) The meter quality and checkings are found to be problematic throughout the project area. A major cause for faulty meters is sedimentation in the supplied water. The spareparts are not easily obtainable as they are imported meters. It was reported that there were many cases that default meters remained unrepaired more than one year.

(d) The individual pipe connection to the households is financially the responsibility of the consumers. All the household users bear the costs of pipe installation. It ranges between LE 10.0 and LE 200.0 depending on adjacency to main pipeline and soil conditions. It was noticed during the field survey that there were cases where wealthy families contributed to the low-income families a substantial portion of the necessary installation expenses.

(e) The use of vacuum cars to dispose sewage is still prevalent in Sharqiya. Both cesspit/vaut (tank type) and transh (bottomless tank type) are observed. The cesspit located in the high groundwater level

area requires frequent transfer of sewage. The private sewage collectors are seen at every Markaz. They are called to houses of which vaults can not be reached by the Markaz vacuum car due to their location. Generally, the private cleaning service is far expensive than the public vacuum car service.

(f) The finanical revenue data were collected from the relevant Markaz offices. Based on these information, the total revenues for the sewerage sector are estimated for the years 1985/86 and 1986/87 as follows;

	1985/86	1986/87
Bilbeis	LE 18,431	LE 17,817
Abu Kebir	7,191	6,503
Faqus	12,558	14,378
Zagazig	49,134	52,588
Minyet El Qamh	8,361	6,519

For the details, please refer to the Appendix XVII, "Sewerage Revenue Survey".

5.10.2 Household Income Survey

The level of the sewerage tariff is a serious concern not only for the consumers but for the sewerage entity (the Governorate) which runs wastewater collection and management. In order to assess the appropriateness and affordability of the present sewerage pricing policy for the consumer in particular, an family interview study was intensively undertaken by visiting the four priority cities i.e. Zagazig, Faqus, Mineyt El Qamh and Bilbeis, and Abu Kebir. About one hundred sixty (160) households in these Marakaz were randomly selected as a mother sample with due consideration to even distribution among high-income, middle-income and low-income groups. The location of households sampled during the survey are shown on Figures in Appendix XVI. The results of the survey are given in the following, and summarized in Table 5.6.

(a) The average family size is 5.7 persons in the project area. The smallest family size is Zagazig (5.1 persons) while the largest is Abu Kebir (6.2 persons).

(b) The mean income of the household per month ranges between LE 233.6 in Zagazig and LE 180.1 in Abu Kebir. The aggregate average monthly income is LE 210.9 in the project area.

(c) The monthly payment for water supply is LE 1.2 on average. LE 1.6 is for Minyet El Qamh whereas LE 0.6 is for Bilbeis. If the 10% surcharge of this water bill is taken, the average monthly payment for sewerage service would be LE 0.12.

(d) The average monthly payment for vacuum car rental varies among Marakaz. It is between LE 0.2 and LE 10.0. The private sewage collectors are also at work in the project area. It is observed that some of families pay even LE 20.0 to a private effluent collector every month.

Table 5.6 Results of Income Survey

	Zagazig	M.E.Q.	Bilbeis	Abu Kebir	Faqus	All
Average Family Size	5.1	5.7	6.1	6.2	5.5	5.7
Average Monthly Income (LE)	233.6	208.1	200.4	180.1	232.3	210.9
Average Monthly Water Bill (LE)	1.5	1.6	0.6	1.5	1.1	1.2
Average Monthly Sewerage Expenditure (LE)	0.15	0.16	0.06	0.15	0.11	0.12
Average Vacuum Car Rental Cost (LE)	n.a.	1.6-4.0	3.5-5.0	0.2-0.6	1.4-20.0	0.2-20.0

From these results of the family income survey, the average monthly water and sewerage charges by level of income group was analyzed. The low-income group which is estimated below LE 100 per month spends LE 1.1 for water supply charge. As the mean income of this group is LE 74.0, the proportion of the water charge including sewerage charge indicates 1.5% of the monthly income. The average income gruop pays LE 1.2 for water, then their percentage against the average monthly income which is LE 211 would be merely 0.6%. This analysis does not, however, take into account vacuum car rental costs. If this costs are taken, the affordability of the consumers expressed by the "willingness to pay" would be significantly higher than the current tariff level.

Table 5.7 Average Monthly Water and Sewerage Charges per Household

	Average Income (LE)	No. of Households	Ave. Family Number	Monthly Water Charge (LE)	Monthly Sewerage Charge (LE)	Percent of Average Income (%)
Low-Income Group						
Less LE 100	74	56	5.3	1.1	0.11	1.5
Medium-Income Group						
101 - 200	166	67	5.9	1.2	0.12	0.7
201 - 300	279	21	6.0	1.1	0.11	0.4
301 - 400	400	5	4.2	1.1	0.11	0.3
High-Income Group						
401 - 500	500	8	5.6	2.0	0.20	0.4
Over 500	1,063	7	7.4	1.9	0.19	0.2
Average/Total	210.9	164	5.7	1.2	0.12	0.6

Note: The monthly sewerage charges are inclusive in the monthly water charges in this table.

5.10.3 Affordability and Proposed Tariff

The tariff rates, generally, must be set at a level sufficient to cover the operation and maintenance costs of the sewerage system. The recent Government's revision of the tariff was its expricit commitment to this cost recovery policy. To examine the difference between the new tariff and old one, the revised tariff table and annual incremental percentage announced against the previous tariff rates until 1991/92 are shown in Table 5.8 below:

Table 5.8 Revised Tariff Rates

	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
Residential (pts/m3)						
(1) below 30 m^3	3.0	4.5 (50%)	6.0 (100%)	6.5 (117%)	7.5 (150%)	8.5 (183%)
(2) over 30 m^3	5.0	6.0 (20%)	7.0 (40%)	8.0 (60%)	9.0 (80%)	10.0 (100%)
Construction and Building Sector (pts/m3)	10.0	13.0 (30%)	16.0 (60%)	19.0 (90%)	22.0 (120%)	25.0 (150%)
Industry (pts/m3)	10.0	13.0 (30%)	16.0 (60%)	19.0 (90%)	22.0 (120%)	25.0 (150%)

Note: Parenthesis is incremental percentages.

Normarlly, the affordable limit of combined water and sewerage rates is estimated at 3 to 5 percent of the total household income. Assuming that the present average monthly income is LE 211, as seen above, and that it increases by 7.0% per annum hereafter, the average monthly income would amount to LE 362.0 in 1995/96, LE 508.0 in 2000/01, and LE 713.0 in 2005/06. Assuming also that affordability rate is 3.0% of the monthly income as a conservative limit, then appropriate water tariff level would become pts 39/m^3, pts 53/m^3 and pts 71/m^3 in 1995/96, 2000/01 and 2005/06 respectively. The sewerage charges which is surcharged on water bill as 10.0% of water charges would remain unchanged.

Table 5.9 Appropriate Water Tariff

	1987/88	1990/91	1995/96	2000/01	2005/06
Monthly Income (LE)	(211)	258	362	508	713
Afforability Rate (%)	(0.6)	3	3	3	3
Afforable Water Payment (LE)	(1.2)	7.74	10.86	15.24	21.39
Average Water Consumption Per Capita (lcd)	(157)	160	165	172	178
Average Household Water Consumption Per Month (m3)	(27)	27	28	29	30
Appropriate Water Tariff (pts/m^3)	(4)	29	39	53	71

Note: 1. Assuming the monthly income would increase by 7% per annum.

2. Assuming the average water consumption per capita would grow by 0.7% per annum.

3. Parenthesis is currently estimated data obtained from the "Household Income Survey"

Based on these analysis, it is proposed that the present water tariff should be further raised over the years to 28 pts/m^3 (100% increase of average tariff rate of 14 pts/m^3 in 1991/92) in 1992/93, to 42 pts/m^3 (200% increase) in 1997/98 and to 56 pts/m^3 in 20002/03. Moreover, because of this extension of sewerage pipeline network and growth in wastewater production, surcharge ratio must be re-assessed and be raised to 20% in 2002/03. With these changes, the combined water and sewerage charges would be 2.3% of the monthly income in 1992/93, 2.6% in 1997/98 and 3.5% in 2002/03 which falls within the affordability and willingness to pay limit of the urban consumers.

5.10.4 Financing Plan

The proposed project requires the total investment costs of LE 144,102,000 of which foreign exchange portion is LE 23,631,000 (16.4%) and local currency portion is LE 120,471,000 (83.6%). This includes engineering service cost as well as price and physical contingency. The detials are shown in Table 5.10.

Table 5.10 Summary of Project Cost

(LE 1,000)

Item	Foreign Exchange	Local Currency	Total Cost
Sewer Pipes	1,758	52,689	54,447
Branch and Lateral Sewer	-	(42,720)	(42,720)
Trank Sewer	(1,758)	(9,969)	(11,727)
Pumping Station	3,494	2,974	6,468
Sewerage Treatement Plant	8,271	19,979	28,250
Rehabilitation	4,654	3,651	8,305
Land Acquisition	-	17,390	17,390
Engineering	1,818	7,930	9,748
Sub-Total	19,995	104,613	124,608
Contingency	3,636	15,858	19,494
Total Project Cost	23,631	120,471	144,102
(%)	16.4	83.6	100.0

For the financing plan of this project, the various sources of funding must be sought out in order to reduce the current heavy burden of the financial conditions of the Egyptian Government and Sharqiya Governorate. For the foreign portion and a part of local currency portion of the project costs, the grant assistance scheme would be most appropriate in view of social sector project which normally shows low financial rate of return. For the local portion, the subsidy and equity contribution from the central government would be essential as the Governorate financial status is presently extremely tight.

In case of foreign loan, though not recommendable, it is assumed that the concessionary loan would be made available to the Government to be repaid over 30 years after 10-year grace period, at 3.5 percent interest rate. The Appendix XIV shows the debt service cash flow including interests and amortization of principal.

5.10.5 Financial Projection

The projections of sewerage operation revenues have been made according to the pricing policy discussed before. Until 1991/92 after the project implementation period, the revenues are expected to grow slightly and from 1992/93 due to proposed tariff increase, sewerage revenues are expected to increase substantially. The sludge sale will start from this year and amount to around 20% of the total revenues at the initial stage. The forecast of the sludge sales is made as shown in Table 5.11.

From 2002/03 and onward, further tariff changes as well as proposed increase in surcharge rate on water bill are expected to contribute to sustained growth of the operating revenues. Between 1991/92 and 2005/06, the revenues are expected to grow at about 22% per annum. During the same period, the oeprating expenses will increase at about 13% annually. Major items for the expenses are wages and salary, electricity, cleaning costs for pipeline and necessary spare-parts for pumping station. The financial projection shows that the operation and maintenance costs can be covered. However, it must be noted that if the loan arrangement is made for this project, the debt service repayment would be extremely difficult, if not impossible.

5.10.6 Internal Rate of Return

The internal rate of return (IRR) is, in theory, the discount rate at which the present value of cash inflows is equal to the present value of cash outflows. And it is the rate at which the present value of the project incremental benefits is equal to the present value of the project incremental costs and net present value is zero. The calculation is made using the formula $\sum \frac{B}{(1+r)^t} = \sum \frac{C}{(1+r)^t}$ where t is year, B is benefit, C is cost and r is internal rate of return. Before computation of FIRR, the long-term marginal cost for sewerage service has been estimated through the long-run average incremental cost (AIC) approach. All calculations refer to constant 1987/88 prices. The results show that the AIC per m^3 at market price ranges between 74 pts/m^3 at discount rate of 13% and 94 pts/m^3 at discount rate of 17%.

Table 5.11 Sludge Sales Forecast

	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Faqus	50	52	54	56	58	60	62	64	66	68	70
Bilbeis	100	105	110	115	120	120	125	130	135	140	141
Minyet El Qamh	45	47	49	51	53	55	57	59	61	62	63
Daily Production (m^3)	195	204	213	222	231	235	244	253	262	270	274
Annual Production (1,000 m^3)	71	74	78	81	84	86	89	92	96	99	100
Sales Revenue (LE 1,000)	213	222	234	243	252	258	267	276	288	297	300

Note: The sludge is sold at LE 3.0 per m^3.

Table 5.12 Financial Projection (Base Case) for Proposed Sewerage Project

	1991/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06-2034/35
Incremental Water Volume (m3)	24,199	26,402	28,024	29,687	31,350	31,593	31,877	32,201	32,486	32,769	33,012	33,256	33,580	33,823	34,067
Average Tariff (pts/m^3)	14	28	28	28	28	28	42	42	42	42	42	56	56	56	56
Surcharge Ratio (%)	10	10	10	10	10	10	10	10	10	10	10	20	20	20	20
Sewerage Revenue (LE 1,000)	345.8	739.3	784.7	831.2	877.8	884.6	1,338.8	1,352.4	1,364.4	1,376.3	1,386.5	3,724.7	3,761.0	3,788.2	3,815.5
Non-Tariff Revenue (LE 1,000)	-	-	-	-	213.0	222.0	234.0	243.0	252.0	258.0	267.0	276.0	288.0	297.0	300.0
Total Revenue (LE 1,000)	345.8	739.3	784.7	831.2	1,090.8	1,106.6	1,572.8	1,595.4	1,616.4	1,634.3	1,653.5	4,000.7	4,049.0	4,085.2	4,115.5
Direct Operating Expenses (LE 1,000)	332.0	362.0	390.0	489.0	653.0	762.0	809.0	957.0	1,018.0	1,126.0	1,258.0	1,315.0	1,529.0	1,658.0	1,848.0
Net Income (deficit) (LE 1,000)	13.8	377.3	394.7	342.2	437.8	344.6	763.8	638.4	598.4	508.3	395.5	2,685.7	2,520.0	2,427.2	2,267.5

Discount Rate	AIC at Market Price	Estimated Average Charge (1991/92)
13%	74 pts/m3	1.4 pts/m3
15%	84 pts/m3	1.4 pts/m3
17%	94 pts/m3	1.4 pts/m3

It indicates that the AIC is considerably higher (approximately 60 times) than the present average monthly charge. Therefore, to meet increasing operation and maintenance costs, appropriate sewerage tariff increase must be introduced.

Hence, as discussed above, it is proposed that the existing water rates should be reviewed and raised to 28 pts/m^3 in 1992/93, 42 pts/m^3 in 1997/98 and to 56 pts/m^3 in 2002/03 with 20% surcharge ratio. In 1992/93 an average household is expected to pay about 2.3%, in 1997/98 to pay about 2.6% and in 2002/03 3.5% of its income for combined water and sewerage charges. These expenses are within levels considered to be affordable by the consumers in the project area. Furthermore, quantification of the environmental and health benefits of the project was not possible. Incremental sewerage revenues and sludge sale revenues are, therefore, taken as a minimum indication of the benefits of the project.

On the basis of this assumption and a gradual tariff increase, the financial internal rate of return is, however, negative (-2.2%). A sensitivity analysis was carried out to test the FIRR under the more favorable conditions.

Case-1: if an average water tariff rate increases to 35 pts/m3 in 1992/93, 49 pts/m3 in 1997/98 and 63 pts/m3 in 2002/03 together with surcharge rate increase (20%) in 1997/98, the FIRR is, yet, -1.2%.

Case-2: if a surcharge rate, in addition to Case-1, increases to 30% of water bill in 1992/93, the FIRR is still +1.4%.

Case-3: if the foreign portion of the project costs is financed on grant basis from foreign country, tariff increases are made as Base Case and surcharge rate increase as Base Case, then the FIRR is -1.6%.

Case-4: if the foreign portion is excluded and tariff increases as well as surcharge rate increrase are made as Case-1, the FIRR is -0.5%.

Case-5: if the foreign portion is deducted from the project costs and both tariff level and surcharge rate increase as Case-2, the FIRR is +2.4%.

The results of the sensitivity analysis said above are summarized as follows:

Table 5.13 The Results of Sensitivity Analysis

	Base Case	Case-1	Case-2	Case-3	Case-4	Case-5
Investment Costs	Both F/C and L/C are borne by Egyptian Government	Both F/C and L/C are borne by Egyptian Government	Both F/C and L/C are borne by Egyptian Government	F/C is on foreign grant basis, while L/C is borne by Egyptian Government.	F/C is on foregin grant basis, while L/C is borne by Egyptian Government.	F/C is on foreign grant basis, while L/C is borne by Egyptain Government.
Proposed Average Tariff to be Increased (pts/m3)	1992/93: 28 1997/98: 42 2002/03: 56	1992/93: 35 1997/98: 49 2002/03: 63	Same as Case-1	Same as Base Case	Same as Case-1	Same as Case-1
Proposed Surcharge Ratio (%)	2002/03: 20 (and onward)	1997/98: 20 (and onward)	1992/93: 30 (and onward)	Same as Base Case	Same as Case-1	Same as Case-2
Percentage of Average Income (%)	1992/93: 2.3 1997/98: 2.6 2992/03: 3.5	1992/93: 3.6 1997/98: 4.1 2002/03: 3.9	1992/93: 4.3 1997/98: 4.5 2002/03: 4.2	Same as Base Case	Same as Case-1	Same as Case-2
AIC at Discount Rates (pts/m3)	13% 74 15% 84 17% 94	13% 74 15% 84 17% 94	13% 74 15% 84 17% 94	13% 63 15% 71 17% 79	13% 63 15% 71 17% 79	13% 63 15% 71 17% 79
Net Present Worth at 15%	-86,248	-83,742	-76,770	-71,598	-69,092	-62,051
B/C at 15%	0.08	0.11	0.18	0.09	0.12	0.21
FIRR (%)	-2.2	-1.2	+1.4	-1.6	-0.5	+2.4

In view of this sensitivity test results, it is suggested that the proposed project would not be suitable for implementation under the conventional financing scheme such as foreign loan and credit facilities unless drastic tariff increases are introduced to ensure the loan repayment capability of the entities. Instead, it is strongly recommended that for this social sector project, foreign grant assistance program should be properly incorporated into project financing in order to minimize the financial obligation of the project investment costs.

5.11 Economic Analysis

5.11.1 General

Ideally, all the costs and benefits related to the project should be computed and evaluated through the economic analysis. However, as is true of many public service projects, it is impossible to quantify most of the benefits such as those of improved health conditions, user convenience, and environmental betterment. In general, there is no completely satisfactory way to get around this difficulty.

In the case of sanitation project it is extremely important to value properly the cost of the additional water that will be required rather than to value the intangible benefits. For this purpose, the economic cost of this additional water should be computed as its average incremental production cost and it is not the cost charged to the consumers or its current average production cost. All the investment cost are incurred at the beginning of its lifetime whereas the benefits of the services are realized gradually over time. Just as costs incurred in the future have a lower present value than those incurred today, benefits received in the future are less valuable than those received immediately. In the derivation of per household costs, this means that serving a person five years hence is not worth as much as serving the same person now.

5.11.2 Long-run Incremental Average Cost (AIC)

One of the best methods adopted in doing this analysis throughout the world is the average incremental cost (AIC) approach. The per capita (or household) AIC of a sewerage system is calculated by dividing the sum of the present value of the investment costs and incremental operating and maintenance costs by the sum of the present value of incremental persons (households) served or the total incremental wastewater flow. The AIC is calculated by the following equation:

$$AIC = \frac{\sum_{t=1}^{t=T} (C_t+O_t)/(1+r)^{t-1}}{\sum_{t=1}^{t=T} N_t/(1+r)^{t-1}}$$

where t = time in years

T = design lifetime in years

C_t = investment costs incurred in year t

O_t = incremental operation and maintenance costs incurred in year t

N_t = additional people (households) or incremental wastewater flow in year t

r = opportunity cost of capital

Besides, for the economic evaluation, the project costs estimated at market prices must be adjusted to the economic costs using shadow pricing and standard conversion factors method. In this analysis, the conversion factor for the country is assumed 0.7 in reference to the world bank's estimation and the AIC computation is made accordingly. The results are as follows:

Discount Rates	AIC
13%	52 pts/m^3
15%	59 pts/m^3
17%	66 pts/m^3

The analysis indicates that appropriate tariff levels are between 52 pts/m^3 amd 66 pts/m^3 at discount rates of 13%-17%. Then, as is done before, these must be compared with household income levels to check their affordability to pay. Our proposed tariff rates in 2002/03 are 56 pts/m^3 for Base Case and 63 pts/^{3} for Case-2 and -3 which amount to 3.5% and 4.2% respectively of the projected average monthly incomes. It is assumed, therefore, that the proposed tariff levels would be reasonable within the limit of the internationally acceptable affordability of the consumers.

5.11.3 Economic Benefits

(1) Overall Benefits

The need for improving urban sewerage service to medium-sized cities throughout the country is evident from the existing widespread and severe environment problems. The expansion of piped potable water of the dwellings, coupled with high density population, inadequate sanitation, and inadequate sewerage treatment facilities appear to be the leading cause of infectious diseases in the urban areas. Cholera, typhoid, paratyphoid, dysentery and infectious hepatitis are endemic.

The proposed project would help to increase wastewater consumption to the levels required to reduce the current sewerage service deficit in the project area with the objective of meeting needs of the year 2005 and onward, based on the Governorate's goal. The quality of the drain and canal water would also be greatly improved due to the combined effects of improved water treatment and protection of the raw water sources by the treatment of sewerage prior to its discharge to drains.

The project would benefit some 480,000 people in 2000 and 520,000 people in 2005 living in the project area. The extension of sewerage networks in the four priority cities would help sanitary service needed in the rapidly expanding urban areas. The proposed works would also provide access to sewerage service for industry where industrial wastewater has been discharged direcly to the drain due to inadequacy of basic services.

(2) Externality

There are numerous health, environmental, employement and other indirect economic benefits that the project would generate, such as:

a. reduced expenses for health care

Because of the project, it is expected that sanitary environment would be significantly improved and outbreaks of epidemic diseases would be substantially decreased. This would contribute to reduction of households' expenditures for health care in the project area.

b. higher productivity of children in school

When the sanitary conditions are improved, greater impact would be seen on mortarity rate enhancement and the risks that chidlren die at pre-schooling age and schooling age would be alleviated. The school productivity ratio of the children would be enhanced.

c. improved welfare of the population

The provision of appropriate sewerage network is essential for better dailylife of the population. The streets, housing zone, office environment and even sports and recreation areas would be largely benefitted. In view of increasing population in the urban area accelerated by the migration from the rural areas, a cleaner and better environment providing modern utilities and infrastructure would be urgent task for the Government to undertake.

d. higher land value due to installation of sewerage connection

The residential land as well commercial and industrial land need access to the sewerage pipe network. These land, if equiped with sewerage connection, would obviously enhance the value of the land. The increase in land value in monetary term would be indirect benefit accrued from the installation of the sewerage connection. Due to the proposed project, the land value of the urban areas of the priority cities would be increased.

e. increased employment opportunities

The implementation of the project requires a large number of manpower such as laborers, workers, engineers in varied economic sectors. It may involve construction, transportation, manufacturing, trade and commerce and other service industries. For these economic sectors, the project is expected to create substantial number of job opportunities and sources of their income in the project areas.

f. transfer of technology

One of significant indirect benefits of the project would be the demonstration effect of the technologies upon local contractors and Governorate engineers. Because of recent financial constraints faced by the Egyptian Government, large-sized public works projects have been suspended in Sharqiya. For the utilities sector in particular, only small-sized projects except on-going treatment plant at Zagazig have been executed. Hence there are potential needs and requirements to further improve local engineering know-how and technologies. This is, in fact, quite important needs for their future operation and maintenance works envisaged. Therefore, through construction of the proposed project, it is expected that the international consultants and contractors would contribute to transfer of modern and up-dated technologies to the local engineers and technical personnel of the Governorate.

5.12 Environmental and Social Evaluation

5.12.1 General

Future environmental pollution control should respond to changes in economic and social structure, the diversification of forms of pollution and changes in environmental attitudes of the country. In the meaning, it is desirable, first of all, to boost anti-pollution measures with the aims of attaining and maintaining environmental standards. Second, with respect to the national environment, the pollution control policy should be adopted in accordance with the local natural features and their patterns of utilization. Attention should be paid to conserve the natural environment within the sphere of daily life. Third, in order to forestall environmental pollution from accruing, efforts should be made to rationalize land utilization and promote evaluation of the environmental impact.

5.12.2 Environmental Evaluation

Until recently, evaluation prior to the commencement of development projects was mainly conducted on the basis of social, economic and environment. In the course of rapid urbanization, water pollution due to the accumulation of organic and inorganic substances has increased, and they affect badly both the health and living environment of the public.

As a result, many pollution control related laws and decrees have enacted also in Egypt, and the importance of carrying out environmental evaluation prior to the commencement of implementation has been widely reconginzed. No law covering environmental evaluation method has been actually applied for various development projects, but already accumulated various experiences have been widely utilized for the evaluation.

In the meantime, it is said that environmental evaluation is a technical analysis to be provided to inform decision makers and project designers of the potential environmental impacts in the proposed project area and to evaluate technical alternatives and to identify possible mitigation activities based on the above evaluation.

In conducting the actual environmental evaluation for the Sharqiya Governorate Sewerage System Project, the following three alternatives have been especially taken up.

a. Phasing alternatives for facilities construction
b. Technical alternatives for wastewater treatment
c. Technical alternatives for effluent disposal

5.12.3 Problems Derivable from Proposed Sewage Treatment and Discharge

Sewage treatment is generally effected by two main steps. The first or primary treatment is a physical liquid-solid separation process consisting of screening, grit removal and sedimentation. The secondary treatment step is generally a biological process in which the primary effluent is contacted with microorganisms.

As known already, most secondary treatment systems are not particularly effective at reducing the large number of pathogenic organisms in the raw sewage. Even though the reduction of pathogens is remarkably large, a number of pathogens per litre are said to remain. It is needless to say that these levels are unsatisfactory for the public health. The greater reduction can be achieved by chemical disinfection. Chlorine is an effective and widely accepted agent for the disinfection.

A great amount of solid waste will be produced in the proposed sewerage systems. Disease spread throgh the intermediate solid waste is not so serious compared to those spread by water/wastewater. Practically, accumulation of solid waste is more a nuisance than a health hazard. It produces noxious odours and provides breeding grounds for rats, cockroaches, mosquitos and flies. And actual incidence and prevalence of related diseases are less both in severity and frequency and tend to be localized problems or potential epidemics.

When the water and wastewater systems are improved and properly maintained, water-related disease would be reduced. However, if sewers are not properly maintained, uncollected solid waste in neighbourhood remains as a very important health hazard because it provides the frequent occasion for contamination of food, water, hands, etc., and produces odours as mentioned above.

Clearly, most wastewater imposes a greater risk to the public. It is very important to reduce the potential health hazards to acceptable levels. In general, the health concern is in proportion to the degree of human contact with the water, especially quality of the effluent.

The contaminants may be largely divided into two, namely biological and chemical. These agents pose the greatest health risks. Control of contaminants is necessary for the Sharqiya Sewerage System Project area where the public is more directly exposed.

The number of pathogens in sewage has markedly declined over the decades as a result of disease control with antibiotics and improved sanitary conditions and practices even in Egypt. The principal infectious agents that may be present in raw sewage may be classified into three broad groups, namely bacteria, parasites and viruses.

From the public health standpoint, the major chemical contaminants of concern are the toxic heavy metals, pesticides and other organic compounds that may cause adverse long-term health effects.

5.12.4 Environmental and Social Outlook

According to the study, the result of the environmental and social evaluation on the proposed sewerage development system is as follows.

The most obvious impact of the project will be the improvements expected in the public health of the residents in the Sharqiya Governorate through the provision of the new sewerage system. The wastewater being mostly infiltrated into the ground and discharged to nearly drains without proper treatment will be shut off and collected by the sewers, and finally treated at the treatment plants to the level acceptable to the environ and discharged to drains such as Bahr El Bakar.

Consequently, the danger of the groundwater contamination that has already become a deplorable level will be greatly reduced. All the sewage treatment plant effluent will be planned to discharge into drains. On account of this, it is expected that the overall environmental and social impact of the sewerage system will be positive.

Since the sewage treatment plant construction site is selected at an isolated area apart from the residential and commercial districts, the impact to environ by the treatment facilities will be not significant. Construction activities of the treatment plant may not effect to the nearby residents. Noise and vibration to be caused by the excavation, pilings, etc., may not be untolerable level in view of the isolated location of construction.

In planning and design of the treatment plant facilities, particular care must be taken to prevent and control unwanted and annoying odours, sound and vibration which might be originated in the treatment plant facilities.

In abating odours from the facilities, consideration was given to the configuration of the plant facilities, locating such units as grit chambers and other odour creating facilities as far as practicable away from the residences or the facilities with due consideration on wind direction. Odour levels expected at the treatment plant site boundary have been found to be within acceptable levels.

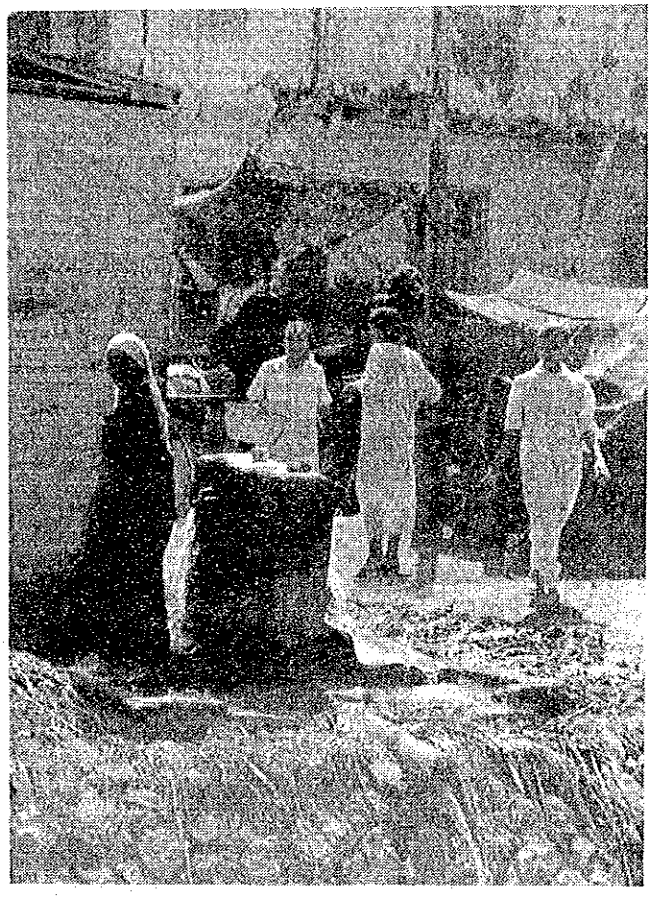
In reducing the noise at the sources, consideration was given in planning and design of the facilities. Shielding and improving the muffling of combustion engines and compressors, restricting the operation of noise-producing equipment to certain hours of the day, and improving vibration characteristics of equipment are the major counter measures to reduce the noise level from the plant. In addition, the treatment plant site will be provided with solid barriers, planting of belts of trees and other vegetation receiving the effluent, and the use of sound-proof materials and shape of building exteriors, which are measures that reduce the propagation of sound.

Excavation for sewers and pumping stations throughout the project area will cause traffic interruption for several years, however, this problem can be avoided as much as possible by the well scheduled construction programs. The excavations may also cause soil erosion, but such erosion will be limited by minimizing excavation on steeply sloping the land and by requiring reasonable soil conservation measures by the contractors.

In view of the above conditions, the overall environmental and social impacts of the sewerage system is expected to be positive.

CHAPTER - SIX

CONCLUSION AND RECOMMENDATIONS



CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Justification

In such a region as Sharqiya Covernorate where rainfall is very scarce throughout a year and terrain is generally flat and low lying with high groundwater table, provision of sewerage system is indispensable to collect, treat and dispose of wastewater from domestic and non-domestic uses, since wastewater, when discharged in quantities, can hardly find natural water courses to flow into. Construction of a sewerage system in parallel with or even in advance of provision of a water supply system is most desirable from technical view points. A master plan and feasibility study on water supply system for the Governorate has already been established, and population served by the potable water supply system has been growing steadly, and water consumption, particularly in urban areas, will increase in the future. On the other hand, implementation of the sewerage project in the Governorate has lagged behind the population growth and implementation of water supply project. Under these circumstances, accelaration of the sewerge project is of urgent necessity.

The central government significantly increased the budget allocation for the public utilities sector, sewerage sector in particular under the current New Five-Year Plan. Commitment of the central government which is shown by high priority given to the sewerage projects is also an indication of the urgent necessity of the project not only for the Sharqiya Governorate but also for the whole country. As one of the stratigically important development area in the Nile Delta region, urbanization is expected to progress rapidly in the Governorate. In order to collect and treat the wastewater in the urban areas, conventional sewerage system is justified to be the most suitable solution from technical and economical points of view.

Benefits derived from the sewerage project, although most of them are difficult to evaluate in a quantitative manner, are significant from enivornmental and public health points of view. Furthermore, as mentioned in environmental and social evaluation, other social benefits accrued from the implementation of the sewerage projects are also significant. Therefore, implementation of the sewerage projects is justified in all aspects. This study confirmed feasibility and viability of the sewerage projects.

6.2 Recommendations

For successful and efficient implementation of the sewerage projects in the Governorate, specifically in the four priority cities, recommendations are made and are mentioned in Chapters Three, Four and Five of the current report in all aspects, such as technical, institutional and financial. These are summarized as follows, together with those derived from findings obtained during the course of the study.

Technical

- Preparation of topographic maps

  There are no pertinent topographic maps on which sewerage plans are based. The Sharqiya Governorate shall obtain topographical maps with relevant scales (1/1,000 to 1/10,000) from the Survey Department or other agencies and supply them to Markaz. These maps are useful not only for the sewerage planning but also for the other physical plannings.

- Sound engineering design

  There are no detailed engineering designs for construction of sewer pipes and other minor structures, which were carried out by Markaz under the supervision of Governorate engineers. Drawings and specifications shall be prepared even for minor construction work, such as installation of small diameter branch sewers, to assure comformity with total system. The Sharqiya Governorate shall prepare standard specifications for such kind of work, and provide Markaz with them. Local consultants might be employed for detailed engineering design.

- Acquisition of land

  The Sharqiya Governorate shall aquire land spaces necessary for pumping stations and treatment plants. New treatment plants in the three cicties, Faqus, Bilbeis and Minyet El Qamh, are located in agricultural farm lands. Since sizable spaces are required for construction of treatment plants, immediate action to obtain approvals and to purchase lands shall be taken.

- Utilization of local contractor and materials

Construction work shall be undertaken by local contractors, and strict supervision shall be provided by NOPWASD together with coordination with the Governorate and Markaz engineers. Construction materials and mechanical equipment, which are locally available, shall be used as much as possible. NOPWASD shall procure equipment to be imported well in advance of initiation of construction work, and shall supply them to contractors.

- Provision of secondary treatment

In order to meet the legal requirements for treated effluent, secondary treatment shall be provided for all sewerage systems in the Governorate. For five medium size cities conventional activated sludge process is recommended and oxidation ditch process is recommended for the other small size cities.

- Measurement and record of sewage flow

Sewage flow shall be measured at certain key points of sewerage system, such as pumping station and sewage treatment plant. These data are essential not only for proper operation of the facilities, but also for strict financial management. Sewerage Section of Markaz shall maintain the duty and prepare records to report to the Governorate.

- Monitoring of sewage quality

Monitoring of water quality of both raw sewage and treated effluent is important for proper operation of the treatment plant, as well as for development of the design criteria. Establishment of Central Laboratory in the Sharqiya Governorate is recommended to carry out this task in coopertion with Sewerag Section of Markaz.

- Records of as-built drawings

Sewerage Section of Markaz shall keep as-built drawings of all facilities under its control. NOPWASD shall transfer all construction and as-built drawings to Markaz through the Governorate after completion and commissioning of the facilties.

- Reuse of dried sludge for agricultural purpose

As for the final disposal of sludge produced in the treatment plants, reuse for agricultural purpose is recommended. However, there are no information about application of sludge to farm lands. There is also a concern about hazadous materials in sludge. Therefore, further study including experimental study in pilot farm, are recommended.

- Reuse of treated effluent for agricultural purpose

Reuse of treated effluent from treatment plant for agricultural purpose is considered to be most appropriate means of final disposal of sewage. Study on practical reuse of effluent is recommended. The Sharqiya Governorate shall conduct the study in close cooperation with agencies concerned with land reclamation and irrigation. Faqus, as one of the four priority cities for the first phase program, and where people are suffering from pollution of their water sources for both potable and agricultural supply, is considered to be appropriate site for the study.

Institutional

- Role of NOPWASD

NOPWASD shall execute the sewerage projects in the four cities selected for the first phase program. For this purpose, NOPWASD shall, through the Minsitry of Housing and Public Utilties, obtain approvals from the ministries concerned of ARE. NOPWASD shall also arrange budgetary provisions for both the local and foreign components of the project costs. Foreign aids shall be sought to furnish foreign component.

- Role of the Governorate

The Sharqiya Govenorate shall be a sole executing entity of sewerge development projects ultimately. In this regard, the existing organization shall be modified and expanded significantly to cope with increasing resposibilities by the year 2005. For the first phase program up to 1995, main role of the Governorate is provision of coordination to NOPWASD.

- Role of Markaz

Sewerage Section of Markaz shall be directly involved in operation and maintenance of the entire sewerage system when construction is completed. The exisiting Sewerage Section shall be expanded and new units shall be added to assume the responsibility. Vigorus efforts shall be excerted to recruit sufficient number of qualified staff.

- Training of personnel

Considering the present serious shortage of qualified personnel at all levels necessary for proper management of sewerge system in the Govenrorate, efficinet and practical training program shall be established and fulfilled. NOPWASD shall play a key role in this aspect.

Financial

- Raise of sewerage tariff to assure positive FIRR

The current tariff levels are extremely low in comparison with the long-run average incremental costs as well as affordability of the consumers. The substantial tariff increase, hence, are suggested. Based on this assumption, financial projection is made. The results shows that the estimated operation and maitenance costs can be covered. However, if the loan component is involved, the debt service repayment would be extremely difficult. The internal rate of return (FIRR) is computed on six cases. The highest FIRR (+1.77%) is given in case of foreign portion of the project costs to be excluded together with rapid rises in tariff and surcharge ratio. The lowest return (-2.6%) is in case of all the costs financed locally and moderate tariff rises.

- Need for foreign grant aid

In view of results of sensitivity analysis, it is suggested that the proposed project should not be implemented under the conventional financial scheme such as foreign loan arrangement. Instead, it is strongly recommended that the foreign grant assistance program should be incorporated in order to separate the foreign portion of the project investment costs.

The need for improving urban sewerge service to medium size cities throughout Egypt is evident from the existing widespread and severe environment problems. Due to the expansion of piped potable water of the dwellings, coupled with high population density, inadequate sanitation system apears to be the leading cause of infectious diseases in the urban areas. The proposed project would help to enhance wastewater treatement with the objective of meeting needs of the year 2005 and onward. The first phase project would also benefit some 480,000 people in 2000 and 520,000 people in 2005 living in the project area. The AIC analysis indicates that the current tariff could be further raised within the limit of the affordability of the consumers (below 5% of the monthly income). In light of numerous health, environmental and employment benefits to be generated, it is recommended that the proposed project should be implemented as soon as possible to realize afore-mentioned economic benefits in Sharqiya.

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