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# SYRIA

# APPRAISAL OF THE DAMASCUS WATER SUPPLY PROJECT

May 8, 1973

Europe, Middle East and North Africa Region

## CURRENCY EQUIVALENT

| | | |
|---|---|---|
| Currency Unit | = | Syrian Pound (LS) |
| US$1 | = | LS4.0 |
| US$1 million | = | LS4,000,000 |
| LS1 | = | US$0.25 |
| LS1 million | = | US$250,000 |

## ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| mm | = | millimeter (1 millimeter = 0.039 inches) |
| cm | = | centimeter (1 cm = 0.39 inches) |
| m | = | meter (1 meter = 3.28 feet) |
| km | = | kilometer (1 kilometer = 0.62 miles) |
| $km^2$ | = | square kilometer (1 $km^2$ = 247.1 acres) |
| $m^2$ | = | square meter (1 $m^2$ = 10.76 sq ft) |
| $m^3$ | = | cubic meter (1 $m^3$ = 264.2 US gallons) |
| $m^3$/sec | = | cubic meters per second (1 $m^3$/sec = 22.8 million US gallons per day) |
| $m^3$/year | = | cubic meters per year (1 million $m^3$/year = 723,753 US gallons per day) |
| lcd | = | liters per capita per day (1 lcd = 0.26 US gallons per capita per day) |
| ha | = | hectare (1 ha = 2.471 acres) |
| EPEF | = | Damascus Water Supply Agency (Etablissement Public des Eaux de Figeh) |
| SOGREAH | = | Consulting Engineers (French) (Société Grenobloise d'Etudes et d'Applications Hydrauliques) |
| SEURECA | = | Consulting Engineers (French) (Société d'Etudes Pour l'Urbanisme l'Equipement et les Canalisations) |

## FISCAL YEAR

EPEF: January 1 to December 31

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This report is based on the findings of Messrs. Williams, Grover and Al-Khafaji, who visited Syria in November/December, 1972.

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## APPRAISAL OF THE DAMASCUS WATER SUPPLY PROJECT

## SUMMARY AND CONCLUSIONS

i. This report covers the appraisal of the Damascus water supply project, for which an IDA credit of US$15.0 million is proposed. This would be the Bank Group's first investment in this sector in Syria. Damascus, the country's capital and one of the oldest continuously inhabited cities in the world, is experiencing a population growth of 5% a year and now contains one million people -- about a sixth of the total population. Although for many years Damascus has had an abundant supply of cheap and high-quality water from the Figeh spring in the neighboring hills high above the city, peak demand has now overtaken the maximum production capacity, so that the consumers suffer growing shortages and restrictions in the dry season.

ii. The project aims to augment the Damascus water supply by improving the yield of the Figeh spring; increasing the transmission capacity by construction of a 15-km tunnel from the spring to the city; and expanding the storage and distribution system. As interim measures to increase the water supply until completion of these works, leak detection and metering would be improved and the oldest part of the distribution network progressively replaced where the corrosive soils of the old city have adversely affected the pipes.

iii. The project also includes preliminary studies to combat water pollution, not only in the Barada valley at Damascus but also in the Orontes basin farther north where two important cities, Homs and Hama, are located. Sewage treatment facilities are almost non-existent, and the river waters have become dangerously polluted as a result of growing urbanization and industrial expansion.

iv. The pollution control studies component of the project would be undertaken by the Government, and the water supply component would be administered by the Damascus Water Authority -- Etablissement Public des Eaux de Figeh (EPEF). EPEF is an efficiently managed authority, although hampered by staffing difficulties. Measures to eliminate these and other constraints would be conditions of the proposed credit.

v. The total project cost is estimated at US$32.6 million equivalent, including US$1.0 million equivalent for the pollution control studies. Of the US$17.8 million equivalent foreign exchange cost, US$2.8 million equivalent represents pipes purchased by EPEF prior to appraisal and ineligible for financing under the proposed credit. The remaining US$15.0 million equivalent foreign exchange cost would be financed by the proposed credit; US$14.2 million equivalent of this would be relent by the Government to EPEF and US$0.8 million equivalent used for the pollution studies. The balance of the project cost would be financed from internally generated funds of EPEF and by a contribution from the Government. The Government's contribution for

the water supply component would be forthcoming from its central investment pool, embodying the accumulated cash surpluses of state agencies, toward which in past years EPEF has already contributed a substantial part of the amount now needed. Retroactive financing from the IDA credit would amount to not more than US$200,000 equivalent, in respect of feasibility studies for the water supply component.

vi. Construction and supply contracts to be financed by the proposed credit would be subject to international competitive bidding. No local preference has been requested for bid comparisons.

vii. The main item in EPEF's present tariff is a metered-supply rate of LS0.20/$m^3$ (US$0.19/1000 US gallons) which is very low and has not been changed since it was reduced from LS0.25/$m^3$ in 1949. The large investments called for in the project, bringing a greatly increased charge for depreciation in their train, and yet having a low initial load factor, may require this rate to be increased in two installments to reach LS0.30/$m^3$ by 1982, (or the tariff to be otherwise modified to produce similar increases in revenues). These tariffs would produce acceptable financial rates of return and are not expected to influence the volume of water sales.

viii. The proposed program of works represents the first major expansion of the city's water production and transmission facilities in more than 40 years, and is unavoidable if Damascus is to avert serious water shortages and consequential health hazards. The major elements of the program represent the least-cost solution, chosen from among several alternatives. Projected incremental revenues from water sales provide an inadequate measure of the importance to Syria of this project; however, using a price of LS0.30/$m^3$, the economic rate of return would be about 12%.

ix. On the basis of the agreements reached, the project is suitable for an IDA credit of US$15.0 million equivalent.

# SYRIA

## APPRAISAL OF THE DAMASCUS WATER SUPPLY PROJECT

## I. INTRODUCTION

1.01 The Government of Syria has asked IDA to help finance a major expansion of the water supply of Damascus. IDA assistance is also requested for pollution control and sewerage studies in the Damascus area and for pollution control studies in the Orontes River basin. An IDA credit of US$15.0 million is proposed, of which US$14.2 million would be for the Damascus water supply. This would be the first Bank Group lending to Syria for either purpose.

1.02 The water supply project has been prepared following feasibility studies. Those for the expansion of the source facilities were prepared by SOGREAH 1/ (France) and those for the distribution system by SEURECA 2/ (France). Following a sector reconnaissance mission in August, 1971, pre-appraisal missions visited Damascus in March, 1972 and September, 1972. An appraisal mission visited Syria in November-December, 1972 (Messrs. Williams, Grover and Al-Khafaji) at which time representatives of both consultants were in Damascus. This appraisal report is based on the consultants' feasibility reports, on information obtained from EPEF 3/ and on the findings of the missions.

## II. THE SECTOR

### Background

2.01 Syria is bounded on the north by Turkey, on the east and south by Iraq and Jordan, and on the west mainly by Lebanon and the Mediterranean Sea (Map 1). It is about one-third the size of France, with a total land area of 185,000 $km^2$ (71,000 square miles) of which four-fifths is mountainous, desert or semi-arid.

2.02 The population of Syria exceeds six million, of whom roughly a third live in the four largest cities of Damascus, Aleppo, Homs and Hama. Apart from oilfields in the northeast, most of Syria's industrial development is in and around these cities. From imperfect statistics, population growth during 1960-70 has been estimated at 3.2% annually, but urban populations appear to have increased at annual rates of 4% to 6% during this period.

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1/ Societe Grenobloise d'Etudes et d'Applications Hydrauliques.

2/ Societe d'Etudes pour l'Urbanisme, l'Equipement et les Canalisations.

3/ Etablissement Public des Eaux de Figeh, the Damascus Water Authority.

2.03 The climate varies from a Mediterranean type along the coast to an extreme desert type in the southeast. Rainfall occurs mostly in the winter months, being heaviest in the mountainous coastal region. The country's water resources are well-known and increasingly used. The main river is the Euphrates which along with its tributaries is the principal source of irrigation in the northeast and east. Syria's other rivers are small, the most important being the Orontes (El-Assi), flowing through the cities of Homs and Hama, and the Barada at Damascus. There are a number of important aquifers, mainly in the limestone of the Lebanon and Anti-Lebanon ranges along Syria's western borders.

The Water Supply and Sewerage Sector in Syria

2.04 Three Ministries exercise jurisdiction over development and allocation of hydraulic resources. The Ministry of the Euphrates is responsible for construction of the big Tabqa hydroelectric dam and future Euphrates irrigation schemes; the Ministry of Public Works and Water Resources for other irrigation schemes and hydroelectric plants and for water resources generally; and the Ministry of Municipal and Rural Affairs for supervision of municipalities' activities including water supply and sewerage. Except in the larger cities, the latter Ministry designs water and sewerage systems, the provincial governments construct them and the municipalities operate them. Pollution control, however, is the responsibility of the Public Works Ministry, which recently set up a special department for this purpose.

2.05 The four major cities and the main port, Latakia, have publicly owned semi-autonomous water authorities responsible for all aspects of water supply. Elsewhere, all but the smallest urban centers are said to have water distribution systems. Aleppo, Homs and Hama have already embarked on expansion schemes to meet forecast water demand, but Damascus requires major investment for which Bank group aid is requested as a priority in the sector (para 2.08).

2.06 Urbanization and industrial activity have created serious pollution problems in the larger cities. Fairly comprehensive combined sewer networks exist in the major cities of Aleppo, Homs and Hama, but the centuries-old system in Damascus is inadequate. None of these cities nor any large industries have sewage treatment plants. The discharge of untreated sewage into the relatively small rivers, whose dry weather flow is minimal, causes them to be grossly polluted. The water supplied from the rivers for downstream irrigation, industries and towns is deteriorating, at the expense of these users. Although both Homs and Hama lie on the Orontes River, their traditional source of water, the water authority of Homs is currently building a 30 km pipeline to bring groundwater to the city and the Hama authority is considering a similar project. The Pollution Control Department (para 2.04) has prepared draft legislation for regulating discharge of industrial waste and is considering measures to control general sewage discharge; however, progress is hampered by the shortage of resources and diffusion of scarce engineering skills among the various authorities. Aleppo has a study under way for the construction of waste water treatment facilities, but only preliminary research has been commenced into pollution of the Barada River (Damascus) and the Orontes (Homs and Hama).

Water Supply in the Damascus Area

2.07 Damascus is one of the oldest continuously occupied cities in the world. The Barada River 1/ gave rise to the Al-Ghutta oasis in which Damascus is located and there are remains of a Roman aqueduct which brought water to the city from a source of the Barada, a large natural spring at Ain Figeh 15 km distant (Map 2). In subsequent ages, however, the water supply, both for agriculture and human consumption, appears to have again depended on the river flow and on wells until the early 20th century, when the Turkish authorities once more brought water to Damascus directly from Ain Figeh by pipeline. The Ain Figeh waterworks were expanded over the years and in 1932 an aqueduct was completed; distribution was organized by a communal syndicate, which in 1958 was transformed into a state enterprise, EPEF. Annex 1 describes the existing water facilities. The Barada River now mainly provides irrigation of the market gardens around the city. There is an elaborate system, dating back centuries, for allocating agricultural water rights in the Damascus plain, supervised by a hierarchy of committees.

2.08 As the capital and focus of government, as well as a large industrial center, Greater Damascus has in recent years experienced population growth of about 5% annually, and the present potable water system now serves something over a million people (including many refugees from Palestine and the southern war zone). The number of individual water connections is high (about 130,000 - see Annex 2) and there are only 325 public taps, supplying about one-fifth of the population. The capacity of the transmission system, however, is limited to about 3 $m^3$/sec, which is now barely enough to meet peak demand (including losses); dry-season shortages and restrictions were experienced in 1971 and 1972 and are growing. 2/ They will become more serious unless the production and transmission facilities are expanded; as a short-term remedy, increased attention must be paid to reducing unaccounted-for water.

2.09 Because the Damascus water supply flows freely to the city by gravity, requiring neither long-distance pumping nor treatment, EPEF has not in the past felt called upon to pay much attention to husbanding the incoming supply of water; flow measurement and recording have been perfunctory, numerous leaking mains are suspected -- especially in the old city, where centuries of continuous habitation have caused a build-up of organic and unstable soil -- and meters have been allowed to fall into disrepair. The number of consumers with defective meters is believed to be considerable, but since these consumers are merely charged on past consumption EPEF has not so far tackled this problem. Meters are not routinely called in and EPEF has only the most rudimentary testing and repair facilities. Faced now

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1/ Believed to be the Abana River of the Bible (II Kings 5, 12).

2/ These shortages were caused by the limited capacity of the aqueduct. However, in drought conditions in earlier years, the Figeh spring yield had sometimes fallen as low as 2.4 $m^3$/sec.

with a shrinking margin of supply over consumption, EPEF accepts that its performance in these respects requires drastic improvement. The project would include measures to remedy these deficiencies (para 3.25).

## III. THE PROJECT

### Background

3.01 EPEF realized within the past decade that the demand for water resulting from Damascus' growing population was approaching the reliable yield of the Figeh spring and its transmission system. Accordingly consultants (SOGREAH from France) were engaged to study the situation. They provided a report on the hydrology of the spring in 1965 and made preliminary recommendations for the improved utilization of the source. In 1969 the same consultants were commissioned to carry out further studies on increasing the spring yield and to complete a feasibility study on additional transmission facilities between Figeh and Damascus. In 1972 SOGREAH were instructed to prepare final designs and bidding documents for the priority elements in the EPEF expansion program: source development, transmission facilities and terminal reservoirs.

3.02 EPEF has also been concerned with the need to expand the distribution system to serve the growing population. In 1966 additional French consultants (SEURECA, in collaboration with a retired engineer named Fontaine, who had prepared previous reports on the system in 1953 and 1963) were engaged to prepare a master plan for the distribution network for the year 1984. This master plan, which was based on an urban plan prepared by consultants for Damascus Municipality for the period 1964-1984, included recommendations for staged extensions to the system. With its limited resources EPEF has been extending the distribution on the basis of this 1968 master plan. SEURECA updated their previous report in 1972 by outlining a revised program of work to be undertaken in the period 1973-1977, at an estimated cost totalling LS 102 million (US$25.5 million).

3.03 While EPEF and its consultants were developing plans to improve the water supply in Damascus, other authorities were focusing on the increasing problems of water pollution in the area. Damascus Municipality has the prime responsibility for its wastewater system but technical assistance is provided by the Ministry of Municipal and Rural Affairs. In 1971 the Ministry invited bids from engineering consultants in a two stage procedure. In the first stage, a competition for which four prizes totalling LS95,000 were offered, consulting firms were invited to assess the present situation and outline the concepts to be incorporated in a future master plan. Twelve consultants participated in this competition. The intention was that a contract for the second stage, the preparation of a master plan, would be negotiated with one of the prize winners in the competition. This approach was abandoned when the Government subsequently requested that IDA consider financing the necessary studies concerning wastewater in Damascus in conjunction with the water supply project.

3.04 Syria also requested IDA to assist in pollution control studies for the Orontes River basin in conjunction with the Damascus water supply project. Approximately 1.0 million people or 15% of Syria's population live in this valley, location of the third and fourth largest cities in the country (Homs and Hama - see Map 1). Industrialization and irrigation are increasing rapidly in the valley and the water quality in the Orontes River, the principal water resource in the region, has deteriorated to such an extent that major problems have arisen. The Ministry of Public Works and Water Resources has been studying the situation during the past two years and has instigated limited improvements by encouraging major industries to increase their wastewater treatment.

3.05 The project therefore consists of two parts. The first, to be undertaken by EPEF, is the Damascus water supply project. The other, to be undertaken by the Government, comprises the water pollution control studies for the Barada and Orontes Rivers and sewerage studies for Damascus.

Project Description - Water Supply Component

3.06 The project is intended to augment the water supply of Damascus by improving the groundwater source, increasing the transmission capacity to the city and improving and extending the distribution system. It consists of:

(i) An underground cutoff wall to increase the available flow and structures to prevent pollution from surface water at Figeh spring;

(ii) Test pumping at Figeh to determine the storage characteristics of the aquifer and the maximum reliable yield which can be developed by pumping from the aquifer;

(iii) A 15 km tunnel from Figeh to the western edge of Damascus;

(iv) Reservoirs at the terminus of the tunnel and throughout the distribution system with a total capacity of about 75,000 $m^3$;

(v) Construction of a new pumping station and renovations to the existing stations, including equipment to control pumping on the basis of reservoir levels;

(vi) Installation of new mains (about 370 km) and replacement of existing mains (about 160 km) in the distribution system;

(vii) Equipment to assist in the operation and maintenance of the distribution system;

(viii) Assistance of engineering and management consultants; and

(ix) Training for EPEF staff in management and engineering.

A full description is given in Annex 3 and the main elements are outlined on Map 2.

Project Description - Water Pollution Control and Sewerage Studies

3.07 The principal sources of pollution along the Orontes River are the relatively small number of sewer outfalls from industrial plants and town sewer networks. The studies would analyze the present pollution loads and their effect on water quality and existing patterns of use. Projections will be made of future patterns of water use and associated pollution loads. A master plan will be prepared for the optimum location, degree and staging of wastewater treatment facilities in accordance with the projected utilization of river water and relevant water quality standards. The sewerage of the towns will not be studied in detail since these systems are reasonably complete already. After the master plan and its recommended first stage are reviewed by the Government, the consultants would proceed to complete engineering designs to permit tendering for any treatment facilities required for the towns in the immediate future.

3.08 Similar studies will be made of water use and pollution loads along the Barada River. Since the sewer network of Damascus is inadequate and the river is in fact the main sewer, considerable attention will be paid to the sewerage of the urban area. The present system will be analyzed and a master plan prepared for the staged development of sewer networks and appropriate treatment facilities. A feasibility study and preliminary engineering will be completed for works required to be constructed in Damascus in the first stage.

3.09 The studies will deal with the institutional and financial aspects of the pollution problems so that implementation of the first stage can proceed when the master plans are prepared. Draft terms of reference for the consultants, who are expected to be engaged in the second half of 1973, call for the studies for Damascus sewerage and the Barada River to be completed in 18 months, and those for the Orontes River six months earlier. The project also includes training for Syrian technical staff and the purchase of special equipment for monitoring water quality.

Cost Estimates

3.10 The estimated costs of the project are summarized below. Detailed cost estimates are shown in Annex 4.

| | Local | Foreign | Total | Local | Foreign | Total | % of Component Total |
|---|---|---|---|---|---|---|---|
| | LS (000) | | | US$ (000) | | | |
| Part A - Damascus Water Supply | | | | | | | |
| Source Development | 2,480 | 4,200 | 6,680 | 620 | 1,050 | 1,670 | 5 |
| Tunnel | 7,490 | 11,500 | 18,990 | 1,872 | 2,875 | 4,747 | 15 |
| Reservoirs | 5,400 | 5,600 | 11,000 | 1,350 | 1,400 | 2,750 | 9 |
| Pumping Stations | 350 | 440 | 790 | 88 | 110 | 198 | 1 |
| Telecommunications | 110 | 650 | 760 | 27 | 163 | 190 | 1 |
| Pipelines | 15,100 | 26,100 | 41,200 | 3,775 | 6,525 | 10,300 | 33 |
| Equipment | 120 | 800 | 920 | 30 | 200 | 230 | 1 |
| Consultants | 1,900 | 3,700 | 5,600 | 475 | 925 | 1,400 | 4 |
| Land | 8,760 | - | 8,760 | 2,190 | - | 2,190 | 7 |
| Training | 200 | 300 | 500 | 50 | 75 | 125 | - |
| Sub-Total | 41,910 | 53,290 | 95,200 | 10,477 | 13,323 | 23,800 | 76 |
| Physical Contingencies | 7,500 | 6,800 | 14,300 | 1,875 | 1,700 | 3,575 | 11 |
| Price Increases | 8,790 | 8,010 | 16,800 | 2,198 | 2,002 | 4,200 | 13 |
| Total (Part A) | 58,200 | 68,100 | 126,300 | 14,550 | 17,025 | 31,575 | 100 |
| Part B - Pollution Control Studies | | | | | | | |
| Equipment | 80 | 80 | 160 | 20 | 20 | 40 | 4 |
| Consultants | 640 | 2,960 | 3,600 | 160 | 740 | 900 | 90 |
| Training | 80 | 160 | 240 | 20 | 40 | 60 | 6 |
| Total (Part B) | 800 | 3,200 | 4,000 | 200 | 800 | 1,000 | 100 |
| TOTAL PROJECT COSTS | 59,000 | 71,300 | 130,300 | 14,750 | 17,825 | 32,575 | |

3.11 The consultants (SOGREAH) responsible for the source development and tunnel have carried out a thorough sub-surface reconnaissance in completing the preliminary designs on which the cost estimates are based. In the vicinity of the Figeh spring six rotary boreholes were drilled and analyzed and some twenty observation wells have been sunk (including several in the mountains overlying the aquifer). The main spring, which emerges from the limestone like an underground river, has been explored by specially trained divers to supplement data obtained by the drilling program. Nine test

boreholes were drilled along the tunnel axis and a geophysical reconnaissance was carried out along the tunnel route utilizing a total of 21 electrical resistivity tests. 1/ Conventional tunnelling techniques will be used and no major problems are anticipated. The estimates of unit prices prepared by the consultants for the tunnel are comparable to actual costs of Electricite de France for similar work.

3.12 Cost estimates for the reservoirs and telecommunications were prepared by consultants on the basis of preliminary designs. Costs of the project's largest component, the distribution system pipes, were developed by EPEF and its consultants (SEURECA) and updated during appraisal; all pipes to be laid in Damascus in the 4-1/2 year period from 1973 to mid-1977, a total of about 530 km, were included. Preliminary designs exist for the lines to be laid in 1973 and for the main lines required to reinforce the system, which together account for about 35% of the pipelines in the project, but such designs are not available for the remainder. Estimates for pipe replacements are approximate, pending a thorough analysis of the system (para 3.23) and those for extensions to new areas are based on the development plans of the Municipality. In all cases the costs are for ductile iron pipes 2/ and are based on recent costs for similar pipes and their installation. EPEF currently has 190 km of those pipes in stock or on order for use in the project so that firm prices are available for a considerable part of this work. Prior to completing specifications, consultants will assess whether use of this type of pipe is necessary for all parts of the distribution system extensions.

3.13 Allowances for physical contingencies have been made as follows: 30% for underground work at Figeh and the tunnel, 15% for structures above ground, 15% for equipment and consultants and 11% overall for pipe installation. The estimates are based on price levels at the start of 1973 with an allowance for the escalation of all costs at the rate of 6% per annum. With these allowances for physical contingencies and price increases totalling 33% of the basic costs, the estimated cost for the project is reasonable.

3.14 The cost estimates for the pollution control and sewerage studies include contingencies and were prepared by the appraisal mission, based on the cost of similar studies elsewhere.

3.15 In estimating the foreign exchange component it has been assumed that all equipment for the project would be supplied from outside Syria, including the pipes already procured by EPEF (para 3.12). However, these imported pipes, with an estimated foreign exchange cost of LS11.3 million (US$2.8 million), were ordered prior to appraisal; and since they were not purchased in accordance with Bank Group guidelines, they would not be financed from the proposed credit. All large civil works contracts, including those for the Figeh spring works, tunnel, terminal reservoirs and installation of most distribution pipes are assumed to be won by foreign contractors

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1/ Seismic tests will also be carried out prior to final design.

2/ Ductile iron pipes, besides having other physical advantages, provide good resistance to corrosion in the conditions prevalent in Damascus.

in view of the limited capacity of the Syrian construction industry. Local contractors will be used for pipelaying in 1973 and part of 1974 (prior to the preparation of larger contracts by the consultants) and can be expected to participate as subcontractors in the future. Since Syria is a net importer of cement, steel and petroleum, the cost of these materials is included in the estimated foreign exchange component of civil works contracts.

Project Financing

3.16 A credit totalling US$15.0 million equivalent is proposed, representing that part of the estimated foreign exchange component of the project which is eligible for disbursement. US$14.2 million equivalent would be onlent by the Government to EPEF for the water supply component, and the remainder, US$0.8 million equivalent, utilized by the Government for the pollution control studies. The terms agreed during negotiations for the re-lending are a period of 25 years, including five years' grace - the conventional repayment period adopted for similar projects financed by Bank loans - and interest at 6%, in line with the rate at which EPEF could borrow from the Government-controlled banking system. This comparatively low rate is acceptable, since any apparent undercharge to EPEF which it implies must be offset against the considerable loss of interest which EPEF incurs through relinquishing all its spare funds to the state. The proposed project financing would thus be:

| | Water Supply Component | | Pollution Control Studies | | Total | |
|---|---|---|---|---|---|---|
| | US$ million | % | US$ million | % | US$ million | % |
| Proposed IDA Credit | 14.2 | 45 | 0.8 | 80 | 15.0 | 46 |
| Government/Local Resources | 17.4 | 55 | 0.2 | 20 | 17.6 | 54 |
| | 31.6 | 100 | 1.0 | 100 | 32.6 | 100 |

Procurement

3.17 Equipment (subject to minor exceptions 1/) and civil works contracts to be financed from the proposed credit would be awarded on the basis of international competitive bidding in accordance with Bank group guidelines. However, EPEF staff will undertake a limited amount of pipelaying and local contractors are being engaged for this work in 1973/4 on the basis of local competitive bidding. These expenditures, which are not expected to exceed LS2.0 million and which would have a negligible foreign exchange component, would not be financed under the credit.

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1/ Tools and equipment costing less than US$5,000 individually and US$50,000 in total will be exempted from international competitive bidding.

3.18 There is the possibility that plastic or asbestos cement pipes which are manufactured in Syria will be appropriate for some distribution mains in the project (para 3.12). EPEF is exempt from customs duties and no margin of preference has been requested by the Government for locally-produced equipment.

Disbursement

3.19 Disbursements would be made against:

(i) The CIF cost of imported equipment and the ex-factory cost (excluding taxes) of locally-produced equipment;

(ii) The foreign exchange costs of consultants and training; and

(iii) A percentage (55%) of all civil works contracts and equipment exempted from international competitive bidding. This percentage would be subject to revision by IDA in order to disburse in total against the water supply component of the project US$14.2 million, the estimated foreign exchange cost of that component eligible for disbursements.

3.20 The estimated schedule of disbursements shown in Annex 5 indicates that the credit is expected to be disbursed over a period of 4-1/2 years. Retroactive financing is proposed for expenditures for foreign consultants incurred after July, 1972. The amount involved is not expected to exceed US$200,000 for the water supply component, and no such expenditures are expected for the pollution control studies prior to the signing of the proposed credit. On completion of the project any undisbursed amounts should be cancelled.

Project Administration - Water Supply Component

3.21 Construction is scheduled from 1973 through mid-1977 (Annex 6). EPEF intends to create a project unit for the construction program, either under the Technical Manager or responsible directly to the General Manager (Annex 7). Senior engineers will be recruited, probably from Egypt, for this unit (para 5.05). During negotiations assurances were obtained that the unit will be created and staffed within six months of signature of the proposed credit.

3.22 EPEF has engaged consultants (SOGREAH) to prepare final designs and contract documents for the source development, tunnel, terminal reservoirs and telecommunications. During negotiations assurances were obtained that EPEF will also engage consultants on terms and conditions acceptable to IDA to assist in contract administration and construction supervision for these elements of the project, before the relevant construction contracts are signed.

3.23 To extend the distribution system, EPEF intends to use consultants to finalize designs, prepare contract documents and supervise construction. This consulting assistance is also needed urgently to enable EPEF to take remedial measures to reduce system losses by relaying badly-leaking pipes. EPEF has recently entered into a contract to engage SEURECA up to the point of evaluating tenders. Assurances were obtained that EPEF will engage consultants acceptable to IDA to assist in construction supervision for the distribution system, before the signing of the relevant construction contracts.

3.24 EPEF also intends to employ consultants, probably Syrian, to prepare designs and contract documents and to supervise construction of storage reservoirs in the distribution system. During negotiations, assurances were obtained that consultants acceptable to IDA will be engaged for this work before entering into the relevant construction contracts.

3.25 EPEF has already engaged a Syrian hydraulic expert (Dr. Mazen Azem) to make recommendations for a systematic analysis of losses. During negotiations assurances were obtained that EPEF will submit within six months and subsequently carry out a program acceptable to IDA to reduce unaccounted-for water, including checking and if necessary replacing all consumers' meters. (Defective meters 1/ are one cause of unaccounted-for water). Meter testing equipment as well as flow and pressure metering apparatus for system analysis are included in the operational equipment to be purchased under the project (para 3.06).

Project Administration - Pollution Control Studies

3.26 Syria has limited expertise in river pollution control and sewerage and its experts are spread thinly. The Water Pollution Control Department created in 1972 by the Ministry of Public Works has a very small staff. However, this nucleus has prepared preliminary studies of the pollution problems in the Orontes River and has actively participated in encouraging industries there to commence waste treatment programs. Sanitary engineers in the Ministry of Municipal and Rural Affairs have assisted the municipalities (including Damascus, Homs and Hama) in designing sewerage networks, the construction of which was supervised by municipal engineers. The pollution control studies in the project deal with the two most populated river basins in Syria, and in view of the importance of these studies it is essential to have the active participation of all available experts. Accordingly it is proposed that the Government should create a special unit staffed by experts from both Ministries concerned, which would work closely with the consultants and act as their counterparts in the analysis of the problems and the recommendation of solutions. This unit, which should maintain liaison on

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1/ Although nearly all consumers are metered, EPEF reckons about 40% of these meters are unserviceable or under-recording through wear.

behalf of the Government with municipalities and industries in the basins, could eventually be responsible for implementing the appropriate solutions. During negotiations assurances were obtained from the Government that a special unit satisfactory to IDA will be established under the Ministry of Municipal and Rural Affairs prior to any disbursement of the pollution control portion of the proposed credit and that consultants acceptable to IDA will be engaged for these studies.

Land Acquisition and Water Rights

3.27 EPEF needs to purchase land near the Figeh spring and at reservoir sites in Damascus. Fair market prices are paid for such land and expropriation procedures are used if required. The process of acquisition has begun and no problems are anticipated. Assurances were nevertheless obtained from the Government during negotiations that land and access rights necessary for the project will be substantially acquired in time to prevent delays in project construction.

3.28 The principle that EPEF can utilize the water from the Figeh spring to supply Damascus has been established by several Government decrees 1/. However, EPEF is obliged to provide 100 liters/second (or about 3% of the flow presently used for Damascus) for irrigation in Figeh village. This is normally provided from spring flows in excess of requirements for Damascus, but in drought periods EPEF can pump this limited amount of water to the village from the nearby Barada River and thus utilize 100% of the Figeh source for Damascus.

Ecological Aspects

3.29 Since most of the construction is underground the water supply project will have a very limited impact on the ecology of Damascus. Some of the tunnel spoil is expected to be used to improve the landscape by backfilling quarries at the cement factory near Doumar in the Barada valley, and some will be deposited at landfill sites designated by Damascus Municipality.

3.30 The provision of increased supplies of water will in itself improve city and home cleanliness and the standard of living. At the same time it will create increased quantities of wastewater. The pollution control studies included in the project will produce master plans and preliminary designs for sewerage in Damascus and for treatment plants along the Orontes River, necessary first steps to cleaning up two of Syria's most important rivers.

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1/ Decree No. 475 by the Minister of Municipal and Rural Affairs; Presidential Decrees Nos. 124 and 266 of 1958.

## IV. JUSTIFICATION

### Water Supply Component

4.01 Damascus has already begun to experience water shortages in the peak summer months. The immediate constraint is the restricted capacity of the 41-year-old aqueduct from the Figeh spring. The project will eliminate this constraint through the construction of a new tunnel. It also includes development of the spring source and improvements and extensions in the distribution system in accordance with the urban master plan (para 3.02). As an interim measure the project includes the reduction of losses in the distribution system to ensure more efficient use of the available water.

4.02 Consumption of Damascus and adjoining localities in EPEF's supply area averages about 110,000 $m^3$/day (1972) for a population of just over one million. The average consumption of 110 liters per capita per day (lcd) is not high. Population is forecast to increase at approximately 4% annually (compared with about 5% in recent years) and per capita demand of metered consumers at 2% a year, giving a total demand increase of about 6% a year until 1985. Thereafter total demand is projected to increase at 5% annually. Average daily demand is expected to reach about 123 lcd by 1977; since the proposed expansion of production facilities cannot be completed before that year, the growing demand in this interim period can only be alleviated by reducing unaccounted-for water. Nevertheless shortages are expected to persist, particularly in periods of peak demand, until the tunnel is completed in 1977. The measures envisaged in EPEF's program are expected to reduce system losses from over 50% of production in 1972 to 42% in 1977 and further improvements in operating efficiency are conservatively estimated to effect a continuing reduction to below 30% in the late 1980's. This loss reduction is illustrated in Annex 2 and graphically in Annex 8. It is of course possible that EPEF can reduce losses to a greater extent than forecast, but it would be unsafe to rely on this as permitting the project to be deferred, or as producing a corresponding increase in revenues.

4.03 Project components have been selected after extensive planning by EPEF and its consultants. A dam on the Barada River, upstream of Damascus, or increased utilization of the Figeh source with a new tunnel or pipeline to Damascus are the only practicable alternatives for increasing the supply of water to Damascus. As indicated in Annex 9, further development of the Figeh spring and transmission of the water to Damascus by a new tunnel is clearly the least cost solution. The program for expanding the distribution network follows acceptable design criteria, is based on realistic assumptions concerning growth in Damascus and will be modified as appropriate during final design to take account of any changes in the development pattern.

4.04 Syria has no option but to proceed with this large investment if it wishes to avoid serious water shortages and consequential health hazards. Incremental revenues from water sales provide a minimum measure of the benefits generated by the project and by other related investments necessary to permit

full utilization of the project works. Using a retail price of LS0.30/$m^3$ (US$0.28/1000 gals), the rate of return would be almost 12% (Annex 9); this price, though higher than the existing extremely low rate, is still very moderate and would not be likely to affect significantly the volume of water sold. Even at the price which was in force as long ago as 1949 (LS0.25/$m^3$), the rate of return would be 10.1%. A price of LS0.30/$m^3$ would therefore tend to yield a rate of return on the project broadly equivalent to the probable opportunity cost of capital -- i.e., a rough approximation to marginal cost pricing is envisaged.

Pollution Control Studies

4.05 An increased flow of water portends an increased flow of sewage; the benefits of the former bring in their train the problems of the latter. Sewage discharge in Damascus and upstream villages already pollutes the Barada River, whose branches in fact take the place of master sewers for the city and spread the pollution through the surrounding farmland. Though health statistics are deficient, a recent study 1/ of Syria remarks that "in the countryside, gastrointestinal diseases related to polluted water resources are the most prevalent causes of debility and morbidity". The studies proposed to be financed in the project are a necessary prerequisite to the abatement of this health hazard and related environmental nuisances both at Damascus and in the Orontes valley. Although it is not possible to quantify the benefits of improved health and a reduction in morbidity rates, insofar as they affect the working population, they are manifestly real and probably a substantial factor in the economic growth of Syria.

## V. THE BORROWER AND THE BENEFICIARY

5.01 The recipient of the proposed credit would be the Government of Syria, which would relend the water supply portion to EPEF. The portion allocated to the pollution control studies would be utilized by the Government itself, through the Ministry of Municipal and Rural Affairs (para 3.26).

EPEF - Organization and Management

5.02 EPEF was created by the Government, under a 1958 decree, to replace the previous communal syndicate by an "Etablissement public" (state enterprise). Although not a government department, EPEF is subject to the "tutelle" (operational supervision) of the Ministry of Municipal and Rural Affairs; and this and other Ministries exercise wide powers of control in such matters as tariffs, personnel, budgets, accounts, and major contracts. Moreover, EPEF in common with other state agencies is obliged to hand over its surplus cash annually for the Government's national development program (para 6.01). Recently, however, the Government has begun a move towards decentralized administration, so that some powers now exercised by Ministries in relation to EPEF may pass to the Damascus Municipal Council. This is not expected to

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1/ Handbook for Syria, Foreign Area Studies, American University (1971).

produce much change in practice, since the municipality is already influential in EPEF's management (see below).

5.03 EPEF is managed by a Board of seven Directors, headed by the Mayor of Damascus and comprising the technical director of the Municipality, representatives of three Ministries (Finance, Public Works, Municipal and Rural Affairs), a workers' representative, and the General Manager of EPEF. The Board is active, meeting twice a month.

5.04 Annex 7 shows EPEF's present organization; while this reflects the advice of various consultants in the past, EPEF recognizes that it contains anomalies and is constantly reviewing it. The top management is efficient and hard-working but bogged down by routine paperwork. (For example, every expenditure voucher has to be signed by the General Manager, the Technical Manager and the Financial Manager. Besides being time-consuming, this suggests a degree of control which could be quite illusory.) Assurances were therefore obtained that EPEF will commission a study of its organization and operating procedures, submit the findings to IDA, and thereafter promptly implement such recommendations as shall have been mutually agreed.

5.05 The authorized number of employees has not been increased since 1961, hence EPEF's staff has not grown proportionately to its tasks. The present staff numbers about 600 (all Syrian except one) and the management estimates that it needs about 100 more. The shortage of subordinate staff further contributes to the administrative workload of the senior officers, leaving insufficient time for their true function of management. Salaries are low, but employees can increase their incomes by a second job after normal hours; this practice is tolerated because it reduces the possibility of corruption. Low salaries hinder recruitment, though turnover is low (about 5%) and there are limited possibilities for recruiting technical staff on a special contract basis. EPEF is hoping to recruit some Egyptian engineers in this manner (para 3.21) and has also submitted a request for its authorized workforce to be substantially increased. During negotiations assurances were obtained that the Government will permit EPEF to be adequately staffed at all times with experienced and qualified personnel. EPEF is anxious to improve staff training and has submitted an outline training program to IDA. During negotiations, this was reviewed and assurances obtained that a detailed program would be submitted before December 31, 1973, and initiated within six months thereafter.

Accounting and Audit

5.06 EPEF's accounting staff is competent and the accounting system adequate, though in need of tidying up and modernizing. Detailed financial statements, in Arabic, are published annually. Though budgetary control is effective, the accounting system could provide management with more information than it now does. Assurances were obtained that the management assistance referred to in paragraph 5.04 will cover improvements to the accounting system to enable it to function better as a management tool. EPEF was considering renting a computer but the Government is installing one in the adjacent Post Office and EPEF is wisely waiting to see whether time-sharing arrangements will be feasible.

5.07 Billing and collection are slow but effective, and bad debts are few. Bills are prepared by machine and distributed by door-to-door collectors who receive piecework bonuses. Non-payers have their supply cut off and arrears of absconding consumers are recovered from the next occupant. EPEF was considering the separation of billing and collection from the Finance Department; it is recommended that this should not be done and that instead the Financial Manager should have a deputy to handle revenue collection and customer relations. During negotiations, assurances were obtained to this effect.

5.08 Insurance cover exists only for vehicles and workmen's compensation; assurances were therefore obtained during negotiations that EPEF will examine its insurance needs and make recommendations to IDA for review within twelve months of signature of the proposed credit.

5.09 EPEF has no internal audit, except for special investigations occasionally carried out by its statistics section or by ad hoc committees. During negotiations assurances were obtained that a Control and Audit Section will be established for internal audit and efficiency checks.

5.10 External audit is performed by the Ministry of Finance, in addition to general investigative powers exercised by a bureau of the Prime Minister's Office. Though EPEF's auditors perform detailed checks, government audit is generally oriented towards compliance with procedural regulations rather than sound financial management and any reports produced tend to be limited in scope. During negotiations, assurances were obtained that EPEF will have its accounts certified by an independent auditor satisfactory to IDA. Syria has competent commercial audit firms, one of which audited EPEF's accounts up to 1969.

## VI. FINANCES AND TARIFFS

### EPEF Finances - Present Position

6.01 EPEF's financial performance has been sound and unexceptionable, assisted by minimal production costs and a comprehensive tariff structure. Annexes 10 to 12 show EPEF's Income and Cash Flow Statements 1969-71 and balance sheets 1968-71. The income statements show that revenues exceeded expenses by a margin of between 20% and 30% in each of the three years. In addition, EPEF collects substantial capital receipts from its customers, through sale of water rights (para 6.06) and otherwise. It is exempt from income and turnover taxes, but is required - like all public enterprises under Syria's socialist economy - to hand over annually to the Government, for the national development budget, the greater part of its "cash inflow" (profit and consumer contributions plus depreciation) insofar as they are not required for approved investment. To date, these contributions (which EPEF

regards as an interest-free loan to the state) total some LS25 million (US$6.2 million) 1/. Although an integral part of Syria's economy, this system has certain disadvantages, in that it may encourage stockpiling to conserve surpluses, or deprive individual enterprises of necessary resources; and assurances which were obtained to ensure that EPEF's essential financial needs are met at all times are referred to in paragraph 6.16.

6.02 The balance sheets indicate that EPEF's fixed assets have been financed entirely out of earnings or from sale of water rights and other consumer contributions; there is no loan debt and no investment by the central Government. Fixed assets are recorded at historical values. Since about a quarter of the existing value has been added in the last four years and since the older assets are of uncertain age and have been depreciated at high rates (3-3.5% average) it is not felt necessary to require revaluation; this would have little impact compared with the very large expenditures of the coming five years.

6.03 EPEF has excessive inventories, equivalent to about two years' operating expenses. While this stockpiling appears to have been partly dictated by the fear of import rationing, much of the accumulation is large-diameter pipe purchased in advance for the project. The present financing plan assumes a substantial stock rundown (para 6.15).

6.04 Receivables for water charges represent about seven months' revenues, due to billing time lags rather than delinquency (bad debts are almost non-existent). Government departments pay regularly. Creditors' accounts are mostly consumers' deposits; trade liabilities are small.

6.05 The transfers to Government mentioned above are calculated to leave EPEF with only limited cash balances, which in fact fell nearly to zero in 1969. Since then, however, its cash position has improved and is adequate for day-to-day needs.

Tariffs

6.06 Water tariffs in Syria (Annex 13) are regulated by a national law enacted in 1966, which appears to have been based on the tariff structure long practised in Damascus. One component of the tariff is unusual, in that applicants for a supply to premises larger than 100 $m^2$ have to purchase in advance the right to a fixed allowance of water in perpetuity. The allowance to be purchased depends on the size of the premises; the average is 1/2 $m^3$/day which at present costs LS1,000 (US$250). Consumption in excess of the purchased allowance is charged at the normal metered rate. This system of water rights -- generating over LS2 million a year in advance investment finance for EPEF -- evolved from the communal syndicate whose members subscribed for shares in a limited supply of water, but is thought to have its roots in the age-old system of water rights for irrigation-fed agriculture.

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1/ EPEF has also made a similar transfer of about LS1 million to Damascus Municipality.

6.07 Any system requiring purchase of a specific quantity of water, whether by the Syrian system of water rights or by the more common minimum-charge arrangement, might be criticized as discouraging water conservation. In this case, however, the average water right is for only 15 $m^3$ per month, and since each connection serves on average 5-6 persons, the allowance would thus represent about 80 liters (25 gals) per head daily -- little more than normal sanitary and cooking needs.

6.08 Besides the cost of the water right, new consumers have to pay a capital contribution to the cost of the mains. In addition, all owners of water rights pay an annual fee representing the amount by which the value of the "free" water, at current metered rate, exceeds the annual value of the water right (calculated by applying 3% notional interest to the purchase price).

6.09 The rate for metered consumption (or, in the case of water right holders, excess consumption) is LS0.20/$m^3$ (US$0.19/1,000 gals) for all consumers. This rate is very low because Damascus's high-quality water requires no treatment and little pumping; the rate has been unchanged since 1949, when it was reduced. Only religious buildings and the 325 public standpipes receive completely free supplies; EPEF tries, by limiting the flow, to prevent misuse and waste of these supplies.

6.10 EPEF's current rate of return on net fixed assets is small (4% in 1971), but if allowance is made for the sales of water rights, which are operating revenues collected in advance, the current return would be more than doubled.

6.11 The large investments called for in the next few years will considerably increase EPEF's operating expenses, notably in annual depreciation; this will triple in ten years, and rise from just over a quarter of the current expenses in 1972 to about 40% by 1977. The effect is that, if tariffs remain unchanged, operating expenses would overtake annual revenues by 1976. A rate increase from LS0.20/$m^3$ to LS0.30/$m^3$ by two installments (with consequential increases in the annual fee for water rights holders -- see para 6.08) would reverse this trend and produce positive but low financial rates of return of about 2%-3%, rising slowly to about 5.1/2% in 1982 (excluding revenue from sale of water rights).

6.12 Low rates of return would not be surprising with indivisible "lumpy" investments like the tunnel, which will not be fully utilized until nearly the end of the century. Nevertheless, EPEF's cash position would be satisfactory, with a cash flow available for investment of at least LS6 million annually, rising to LS12 million by 1982. The satisfactory cash generation is attributable partly to the large element of depreciation in expenses, but also to the substantial receipts expected from sale of water rights (para 6.06) over and above ordinary annual revenues.

6.13 Since these water right sales (though technically capital receipts) are in effect advance collections of operating revenues, it would be misleading to ignore them completely in expressing EPEF's financial rate of return. There are different ways in which they could be taken into account; one way would be to assume a notional rate of interest earned by the accumulated sale proceeds (or of interest saved, by not having to borrow the capital they provide). This would be conceptually satisfactory, but presents difficulties in practice if the rate of return is to be used for monitoring financial performance and, above all, cash generation. The best alternative is to include each year's actual cash receipts as if they were operating revenues, which would have the effect of adding about 2% to EPEF's financial rate of return after project completion. Such a method produces approximately the same result as allowing 6% notional interest on the recorded accumulation of water right sales, but has the added advantage that it links rate of return to actual cash generation, and also gives EPEF greater flexibility in adjusting tariffs to produce a given rate of return.

6.14 Accordingly, for the reason indicated in para 6.11, assurances were obtained during negotiations that EPEF will modify its tariffs as necessary, in order to:

(i) Ensure that ordinary annual revenues (i.e. excluding sales of water rights) cover operating expenses (including depreciation and interest) at all times;

(ii) Produce a rate of return gradually rising during the years after project completion to reach 7-1/2% in 1982 and thereafter; for purposes of this calculation water right sales would count as revenues, as indicated in paragraph 6.13.

The forecast assumes that a rate increase from LSO.20/$m^3$ to LSO 27/$m^3$ will be introduced in 1975, and a further increase to LSO.30/$m^3$ in 1982. The first increase would produce a rate of return of at least 4% up to 1979, about 5% in 1980 and 5-1/2% in 1981; the second increase would take the rate of return to 7-1/2% and over. The increased charges represent the average tariff needed; in practice, EPEF is likely to restructure the tariff to provide a pattern of different rates, charging more per $m^3$ as consumption increases. The price of water rights is assumed in projections to remain unchanged, though in practice EPEF could amend this also as part of the tariff revision.

EPEF Financing Plan and Future Finances

6.15 Projections of income statements, cash flow and balance sheets up to 1982 appear in Annexes 10 to 12. Annex 14 lists the detailed assumptions used in the projections. Besides the tariff assumptions mentioned above, these include the following:

(a) A 7% annual growth in the number of staff is forecast until 1976, to meet staffing shortages.

(b) Existing stocks of materials are expected to be used for the project to the value of LS8 million, plus a further LS4 million worth of goods which were on order at December 31, 1972.

(c) Inflation of about 3% a year is assumed for operating expenses.

6.16 These projections indicate that EPEF's finances will continue to be sound, with an operating ratio (i.e., operating costs, including depreciation, as a proportion of revenues) falling from 88% in 1974 to 63% in 1982. Internal cash generation plus water right sales and other consumer contributions, presently running at LS5-6 million annually, would gradually rise to LS17 million in 1982. From 1978 onwards about a third of this is forecast to be available for contribution to the Government's central investment pool (see para 6.01). Assurances were obtained during negotiations that EPEF will at all times be allowed to retain funds needed for essential maintenance and investment and for working capital.

6.17 Thus, EPEF would resume, in the late 1970s, its present practice of transferring cash surpluses to Government. In the intervening period, during construction of the project, a flow in the reverse direction would be necessary. During the first four years 1973-76, LS39.7 million would be needed from the Government for project financing; but in the final construction year, as capital expenditures taper off, LS7.8 million would be refunded by EPEF, making a net Government contribution of LS31.9 million during the project construction period. Toward this sum, EPEF has already provided nearly LS25 million, interest free, by its accumulated contributions to the central pool. On these assumptions, EPEF's financing plan would be as follows:

EPEF

FINANCING PLAN 1973-77

| | | LS million | US$ million | % |
|---|---|---|---|---|
| **Capital Requirements** | | | | |
| Project | | 126.3 | 31.6 | 91 |
| Other Capital Works | | 12.6 | 3.1 | 9 |
| Total Requirements | | 138.9 | 34.7 | 100 |
| **Capital Sources** | | | | |
| Internal Sources: | | | | |
| Net Cash Generation | 28.3 | | | |
| Less: Debt Service | 5.4 | | | |
| | 22.9 | | | |
| Water Right Sales | 12.0 | | | |
| Consumer Contributions | 2.7 | 37.6 | 9.4 | 27 |
| Proposed Credit | | 56.8 | 14.2 | 41 |
| Transfers from Government | | 31.9 | 8.0 | 23 |
| Reduction in working capital: | | | | |
| Inventory | 8.1 | | | |
| Cash | 1.5 | | | |
| Other | 3.0 | 12.6 | 3.1 | 9 |
| Total Sources | | 138.9 | 34.7 | 100 |

6.18 Total requirements are thus expected to be financed 41% from borrowing, 23% from the Government, and the balance from EPEF's own revenues and resources. Assurances were obtained during negotiations that the Government will make available any funds needed to complete the EPEF project (including any cost over-runs), on the same interest-free basis on which EPEF funds have hitherto been made available to the Government.

6.19 The Government's contribution to EPEF (LS31.9 million) would be partly offset by about LS5 million received from EPEF during project construction as interest on the re-lending of the proppsed credit, so that the net cash requirement would be little more than the amount EPEF has already transferred to the central development pool (para 6.17). In addition, the resumed transfers by EPEF after project completion would, within six years or so, exceed the Government's investment in the project.

6.20 EPEF should not need to incur any further long-term debt, and its debt/equity ratio is projected to remain small, not exceeding 35:65 during the years covered by the forecast. Nevertheless, assurances were obtained during negotiations that no debt would be incurred without IDA's agreement unless net revenues at the time of incurrence, before depreciation and interest, are at least 1.5 times the annual debt service on the proposed loan and existing debt.

Pollution Control Studies

6.21 Assurances were also obtained during negotiations that the Government will provide any funds, in addition to the proposed IDA financing (para 3.16), necessary to complete the pollution control studies.

## VIII. RECOMMENDATIONS AND AGREEMENTS REACHED

7.01 The establishment of a special unit for direction of the water pollution control and sewerage studies will be a condition for disbursement of any of that portion of the proposed credit related to these studies (3.26).

7.02 Appropriate assurances having been obtained on the other matters referred to in Chapters III, V and VI, the project constitutes a suitable basis for an IDA credit of US$15 million.

# SYRIA

## DAMASCUS WATER SUPPLY PROJECT

## Existing Water Supply Facilities of EPEF

### Background

1. For many centuries Damascus has obtained its water supply from the Barada River. The Figeh spring is the principal source of this river, which creates the Al-Ghutta oasis on which Damascus was founded at the eastern edge of the Anti-Lebanon Mountains. The Figeh spring is about 13 km northwest of Damascus, or slightly further via the valley of the Barada River (Map 2).

2. Early civilizations probably used the river in its natural condition and shallow wells as sources of water for the city. During the Roman period a formal bath and temple were constructed at Figeh and water was conducted to Damascus by an aqueduct.

3. In 1908 a cast-iron pipeline (diameter 250 mm) was laid from Figeh along the Barada valley and terminated at the old city in central Damascus. By that time the river was becoming increasingly polluted as were the shallow wells in the growing city. More clean water was required, so in 1922 a group of citizens organized a committee to arrange for construction of a new aqueduct from Figeh to Damascus. Construction started in late 1925 and by 1932 the new aqueduct was completed. This aqueduct terminates at hillside reservoirs on the west side of Damascus, from which the modern water distribution system originates. The cast-iron pipeline of 1908 is now used to serve villages in the Barada valley.

4. The basic elements of the EPEF system are shown on Map 2 and discussed below.

### Source

5. The Figeh spring is a remarkable resource. Within a few meters of the Barada River valley the spring pours out large quantities of excellent water. The principal emergence of the spring, which has been enclosed in a structure since Roman times, resembles an underground river several meters across which flows up and out of the limestone formation of the mountain. In addition to this main channel, water leaves the aquifer at several nearby locations. A portion of this water from the minor springs is collected and pumped from two locations to the aqueduct. Excess water flows directly to the Barada River.

6. Records of the spring flows since 1941 have been analyzed by the consultants (SOGREAH). The total flow has averaged 8.63 $m^3$/second (745,000 $m^3$/day) but the flow was below 3.0 $m^3$/second for a total of some 360 days in the drought years 1959-61. The lowest recorded daily flow was 2.4 $m^3$/second.

7. The water quality is very good. Its temperature and pH are relatively constant (near 14°C and 7.9 respectively), its taste and color are excellent, and bacteriological contamination at the source is practically non-existent.

8. Little is known about the recharge of the aquifer, which lies in the mountains and Zebedani Plain to the west. The consultants estimate the recharge area to cover from 700 to 800 $km^2$.

9. Although almost all of Damascus is supplied by the Figeh source, EPEF temporarily operates two wells in the Jobar region north-east of Damascus. When the EPEF distribution system in the area is reinforced these wells, in a system which was formerly independent from EPEF, will be abandoned because the water is of relatively poor quality.

Figeh - Damascus Aqueduct

10. The 16.2-km-long aqueduct commences at an elevation of 821 m at Figeh and terminates at the Wali Reservoir where the free water level is 20 m lower. The basic section of the tunnel, which is not pressurized, is horseshoe-shaped with a maximum height of 1.9 m and a width of 1.3 m, When flowing at the normal maximum depth of 1.4 m, the cross sectional area is 1.8 $m^2$. West of the reservoirs the aqueduct crosses a valley in a syphon section.

11. As a result of repairs made to the tunnel since 1969, the capacity has been increased to 3.0 $m^3$/second (260,000 $m^3$/day). However, more repair work remains to be done to eliminate leakage and reduce roughness inside the tunnel which retards flow. These repairs have to be done with the tunnel empty, but until a second tunnel is built the existing one cannot be taken out of service for long enough to complete the necessary repairs.

Distribution System

12. The distribution system of EPEF is relatively simple. Consumers in the villages along the Barada Valley (Figeh, Bassime, Achrafie, Jediede, Edsaya, El Hame and Doumar) are supplied from the original cast iron pipe-line from Figeh to Damascus or from connections to the Figeh - Damascus aqueduct. The Damascus distribution system originates at the Wali reservoirs, terminus of the aqueduct. Some 80% of the consumers are supplied by gravity but residents on the western edge of the urban area, from Berze in the north to Mezze in the south, are in high-level zones, which require pumping. A ring main, 600 mm in diameter, is the principal

feature in the low level distribution system. This line is connected to the Wali reservoir (7,000 $m^3$ at 800 m elevation) and the largest system reservoir at Charki (28,000 $m^3$ at 749 m elevation). It supplies five elevated storage tanks on the eastern edge of Damascus which balance system pressures in peak periods.

13. Most consumers have individual connections but public taps are installed throughout the city. Statistics relating to the distribution system at the end of 1971 are as follows:

Connections

| | | |
|---|---|---|
| Private (metered) | - | 121,600 |
| Public (metered) | - | 1,700 |
| Mosques (unmetered) | - | 325 |
| Public Taps (unmetered) | - | 325 |

Distribution Pipes

| Diameter (mm) | Length of Pipes (km) Damascus | Villages along Barada River | Total |
|---|---|---|---|
| 600 | 22.0 | - | 22.0 |
| 500 | 16.5 | - | 16.5 |
| 400 | 11.7 | - | 11.7 |
| 300 | 1.0 | - | 1.0 |
| 250 | 80.4 | 4.2 | 84.6 |
| 200 | 40.0 | 0.1 | 40.1 |
| 150 | 38.5 | 3.8 | 42.3 |
| 125 | 7.8 | - | 7.8 |
| 100 | 103.4 | 3.2 | 106.6 |
| 80 | 72.2 | 3.9 | 76.1 |
| 50 and smaller | 370.6 | 8.0 | 378.6 |
| Total | 764.1 | 23.2 | 787.3 |

The majority of pipes 100 mm and larger are made of cast iron. Smaller pipes are generally of galvanized steel.

Reservoirs

| Location | Type | Number | Effective Capacity (Cubic Meters) |
|---|---|---|---|
| Barada Valley | Ground Level | 2 | 750 |
| Damascus | Ground Level | 8 | 40,690 |
| Damascus | Elevated | 5 | 2,000 |
| Total | | 15 | 43,440 |

Pumping Stations

| Location | Number | Total Installed Horsepower | Type of Power |
|---|---|---|---|
| Barada Valley | 2 | 457 | Diesel and electric |
| Damascus 1/ | 9 | 1,675 | Diesel and electric |

1/ Including temporary pumping station at Jobar where 20 Hp is installed to utilize groundwater source.

SYRIA

DAMASCUS WATER SUPPLY PROJECT

POPULATION & WATER RESOURCES UTILIZATION

| | EST. POPULATION SERVED | | | NO. OF CONNECTIONS | | | | WATER USE AVERAGE DAY | | | | | | Losses % of Production | EST. WATER USE, PEAK DAY | | | PRODUCTION | | | TOTAL ANNUAL 5/ CONSUMPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | Greater Damascus 1/ | En Route 2/ | Total | Paying | Mosques, Standpipes | Total | No. with Water Rights | | Paying 3/ Customers | Mosques, Standpipes | Total Consumption | Losses | Production | | Total Consumption | Losses | Production | Av. Day | Peak Day | Peak Day ÷ 4/ Av. Day | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16) | (17) | (18) | (19) | (20) | (21) | (22) |
| | Thousand | | | Thousand | | | | Thousand $m^3$/day | | | | | | | Thousand $m^3$/day | | | $m^3$/sec | | | Million $m^3$ |
| 1960 | 557 | n.a. | n.a. | 30.3 | n.a. | n.a. | 31.4 | | | | | | | % | | | | | | | |
| 1965 | 719 | 11 | 730 | 91.9 | 0.7 | 92.6 | 55.4 | | 60.5 | 12.0 | 72.5 | n.a. | n.a. | n.a. | | | | | | | 22.1 |
| 1966 | 746 | 12 | 758 | 98.2 | 0.7 | 98.9 | 57.0 | | 67.9 | 12.0 | 79.9 | n.a. | n.a. | n.a. | | | | | | | 24.8 |
| 1967 | 764 | 12 | 776 | 103.5 | 0.6 | 104.1 | 58.4 | | 68.7 | 12.0 | 80.7 | 94.3 | 175.0 | 54 | | | | | | | 25.1 |
| 1968 | 805 | 13 | 818 | 108.0 | 0.6 | 108.6 | 59.7 | | 75.3 | 12.0 | 87.3 | 96.7 | 184.0 | 53 | | | | | | | 27.5 |
| 1969 | 857 | 13 | 870 | 111.9 | 0.6 | 112.5 | 61.2 | | 83.3 | 11.8 | 95.1 | 101.9 | 197.0 | 52 | | | | | | | 30.4 |
| 1970 | 900 | 14 | 914 | 116.6 | 0.6 | 117.2 | 63.0 | | 90.7 | 10.9 | 101.6 | 98.2 | 199.8 | 49 | 108 | 104 | 212 | 2.31 | 2.45 | 1.06 | 33.1 |
| 1971 | 954 | 14 | 968 | 123.3 | 0.7 | 124.0 | 65.1 | | 96.1 | 9.0 | 105.1 | 104.6 | 209.7 | 50 | 115 | 115 | 230 | 2.43 | 2.66 | 1.09 | 35.1 |
| 1972 | 992 | 15 | 1,007 | 130.1 | 0.7 | 130.8 | 67.5 | (106) | 103 | 8 | 111 | 115 | 226 | 51 | 122 | 126 | 248 | 2.62 | 2.87 | 1.10 | 37.6 |
| 1973 | 1,031 | 15 | 1,046 | 136.3 | 0.7 | 137.0 | 69.7 | (114) | 109 | 8 | 117 | 113 | 230 | 49 | 133 | 127 | 260 | 2.66 | 3.00 | 1.13 | 39.8 |
| 1974 | 1,073 | 16 | 1,089 | 142.8 | 0.7 | 143.5 | 72.0 | (122) | 117 | 8 | 125 | 110 | 235 | 47 | 138 | 122 | 260 | 2.72 | 3.00 | 1.10 | 42.7 |
| 1975 | 1,116 | 16 | 1,132 | 149.5 | 0.6 | 150.1 | 74.4 | (130) | 124 | 8 | 132 | 108 | 240 | 45 | 143 | 117 | 260 | 2.78 | 3.00 | 1.08 | 45.3 |
| 1976 | 1,160 | 17 | 1,177 | 156.5 | 0.6 | 157.1 | 76.9 | (138) | 132 | 8 | 140 | 105 | 245 | 43 | 148 | 112 | 260 | 2.84 | 3.00 | 1.06 | 48.2 |
| 1977 | 1,207 | 17 | 1,224 | 163.8 | 0.6 | 164.4 | 79.5 | (146) | 142 | 8 | 150 | 110 | 260 | 42 | 165 | 121 | 286 | 3.01 | 3.31 | 1.10 | 51.8 |
| 1978 | 1,255 | 18 | 1,273 | 171.4 | 0.6 | 172.0 | 82.2 | | 155 | 8 | 163 | 113 | 276 | 41 | 187 | 130 | 317 | 3.19 | 3.67 | 1.15 | 56.6 |
| 1979 | 1,305 | 19 | 1,324 | 179.3 | 0.6 | 179.9 | 85.0 | | 164 | 8 | 172 | 110 | 282 | 39 | 206 | 132 | 338 | 3.26 | 3.91 | 1.20 | 59.9 |
| 1980 | 1,357 | 19 | 1,376 | 187.5 | 0.6 | 188.1 | 87.9 | | 174 | 8 | 182 | 107 | 289 | 37 | 219 | 128 | 347 | 3.34 | 4.02 | 1.20 | 63.5 |
| 1981 | 1,412 | 20 | 1,432 | 196.0 | 0.6 | 196.6 | 90.9 | | 185 | 8 | 193 | 106 | 293 | 36 | 234 | 125 | 359 | 3.46 | 4.15 | 1.20 | 67.5 |
| 1982 | 1,468 | 20 | 1,488 | 204.9 | 0.6 | 205.5 | 94.0 | | 196 | 8 | 204 | 105 | 309 | 34 | 245 | 126 | 371 | 3.58 | 4.30 | 1.20 | 71.5 |

1/ Including Yarmouk refugee camp
2/ Population served from transmission line Figeh-Damascus
3/ Figures in brackets 1972-77 represent estimated full demand of paying customers if no shortages existed (Col.9)
4/ Normally "peak demand factor" = 1.20. Years to 1978 with factors below 1.20 reflect peak day shortages - system cannot supply more than the amount shown
5/ Excludes non-paying consumers (mosques, standpipes) = Col.10x 365

ANNEX 2

# SYRIA

## DAMASCUS WATER SUPPLY PROJECT

### Project Description

1. EPEF is embarking on a major construction program to provide additional supplies of water to Damascus. The groundwater source which supplies the city is to be further developed, a new tunnel is to be built to deliver the water to the city and substantial improvements are planned in the distribution system. Each element is discussed separately below.

### Figeh Spring Development

2. The Figeh spring is in the Anti-Lebanon Mountains about 15 km northeast of Damascus (See Map 2). The main spring emerges from limestone as an underground river and this major discharge flows directly to the aqueduct. Minor springs also emerge in the alluvium nearby. Some of the water from these minor springs is collected by two pumping stations near the aqueduct origin but some escapes through the alluvium to the Barada River valley, which is less than 150 m from the main Figeh spring. A cutoff wall will be constructed across the alluvium into the impervious rock beneath, slightly upstream of the Barada valley, thus preventing the loss of Figeh water to the river. This cutoff wall will be approximately 250 m long and a maximum of 25 m deep. It can be constructed by casting or driving piles underground or by grouting: the construction method will be decided on the basis of bids for the three alternatives.

3. To safeguard the quality of the groundwater at Figeh it is necessary to divert all surface water away from the area where the spring water is collected. The collecting area which requires this protection will be increased when the cutoff wall is constructed. Planned surface structures include drains and sewers around the perimeter of the spring site, a spillway to lead a local torrent over the collecting area and a large channel to divert excess spring flows from Figeh to the Barada River. This work will involve relocating maintenance and pumping structures presently built near the source as well as removing several residential and commercial buildings on the right bank of the Figeh overflow channel, upstream of the cutoff wall.

4. The reliable yield of the spring at present is simply the lowest natural flow, which has been as low as 2.4 $m^3$/second (210,000 $m^3$/day) in the past (Annex 1). Since the long-term average flow is more than 350% higher than this low flow, it is probable that the reliable yield can be increased by using the presumed storage capacity in the aquifer. To determine the storage characteristics of the aquifer would normally involve a program of exploratory drilling, but the limestone mountains overlying the critical portion of the aquifer

would cause the necessary drilling program to be prohibitively expensive. The alternative way to determine the aquifer storage potential, and hence determine how much the spring yield can be increased, is to conduct a program of test pumping from the aquifer. By pumping at rates in excess of the natural spring flow it is possible to withdraw water from storage in the aquifer. This would lower the water level below the present level at which the springs emerge. The aquifer storage characteristics can be deduced by estimating the natural spring flows (for example, by correlation with other springs in the area), measuring the pumped flows and monitoring the water level in the aquifer. Such test pumping requires careful planning and assessment so that the water supply necessary for Damascus can be assured throughout the test period.

5. The test pumping must take place at rates larger than the natural spring flows. This requires the installation of large capacity pumps capable of pumping approximately 6.0 $m^3$/second, from the lowest level to which the aquifer can be expected to drop. Test wells for these pumps will be drilled in the vicinity of the springs after the cutoff wall is completed. Diesel engines will be used to drive the pumps during the test period. Depending on prevailing hydrologic conditions, the tests should be conducted at several rates and are tentatively planned to last for three years. During the test pumping, which is expected to continue beyond the project period, the water excess to the needs of Damascus would be released to the Barada River. After the storage characteristics of the aquifer are better understood, the pumps used for testing will be permanently installed, probably with electric motors as their power source.

Tunnel from Figeh to Damascus

6. The route of the tunnel is shown on Map 2. It will commence at the Figeh source just upstream of the cutoff wall and will terminate at reservoirs at the Wali site on the edge of the mountains at the northwest side of Damascus.

7. The alignment is the most direct possible: a straight line between Figeh and Wali is prohibited by local topography. Data concerning the tunnel are as follows:

| | |
|---|---|
| Length: | 15.0 km |
| Capacity: | 5.2 $m^3$/second |
| Section: | Horseshoe, flat base. |
| | Excavated area = 5.7 $m^2$ |
| | Height = 2.40 m, maximum width = 2.50 m |

8. The tunnel section is the minimum practical section which can be driven over this length using conventional techniques. The tunnel will be excavated from five attack faces: one from the Wali end and

two each from access portals at 2.5 km and 9.4 km from the Figeh end. Because of the work on source development under way on the relatively small site at Figeh, the tunnel will not be excavated from that face. The consultants estimate that the tunnel excavation will progress at the rate of 7 meters per day on each attack face and that the total task of tunnel construction will require 32 months. These are reasonable but not excessive rates of progress.

9. Water in the tunnel will not be flowing under pressure. The tunnel bottom will be lined with 25 cm of concrete. In sound rock,, estimated throughout 60% of the tunnel length, a gunite lining averaging 5 cm thickness will be applied. In weaker rock sections a concrete lining averaging 25 cm thickness will be used.

10. Sluicegates will be installed at the upstream and downstream ends of the tunnel. To avoid surcharging the tunnel during closure of the downstream gate, which would require more expensive lining, an overflow arrangement is planned to spill excess flows to the Barada River via special drains.

Reservoirs

11. As the EPEF distribution system grows the principal storage will continue to be located at high level on the western edge of Damascus. The project includes major storage reservoirs near the tunnel terminus which will serve to balance pumping from the Figeh source with system demand and to provide a reasonable reserve in the event of problems at the source or in the tunnel. Smaller reservoirs will be built throughout the distribution system to maintain pressures during periods of peak demand. Features of the reservoirs included in the project are as follows:

| Identification | Location | Capacity ($m^3$) |
|---|---|---|
| Tunnel Terminus | | |
| I | Wali | 30,000 |
| II West | Near Wali | 20,000 |
| Sub Total | | 50,000 |
| Distribution System | | |
| I East | West of Berze | 8,000 |
| K 3 | Kassioun | 500 |
| B 1 | Berze | 5,000 |
| K 4 | Kassioun West | 500 |
| K 5 | Kassioun West | 800 |
| K 6 | Kassioun West | 500 |
| M 1 | Mezze | 8,000 |
| M 2 | Mezze | 1,500 |
| Sub Total | | 24,800 |
| TOTAL | | 74,800 |

12. The design of reservoirs at Wali and II West will allow for future expansion to double the initial capacity. Preliminary designs call for these reservoirs to be built of prestressed concrete but at Wali the possibility of building the reservoir underground near the tunnel exit is being investigated by the consultants.

13. By 1977, when the new reservoirs should be completed, the storage in the EPEF system will total about 122,000 $m^3$, which would represent slightly less than 12 hours' storage of the average daily production projected for that year.

Pumping Stations

14. A new pumping station will be constructed to serve the three pressure zones in the new distribution system of Kassioun West. The three sets of pumps in this station will be supplied directly from the existing aqueduct from Figeh.

15. The eight permanent pumping stations presently in service throughout the system will be renovated. At each station the pumps and motors will be overhauled and replaced if necessary. New switchboards and control panels will be installed at each station to permit the pumps to be controlled remotely by telecommunication signals from the distribution reservoirs.

Telecommunication Systems

16. Portable radio equipment will be purchased to facilitate the leak reduction program to be undertaken by EPEF and to expedite routine maintenance operations. The same equipment can be used by operating staff for valve control operations in the event that water rationing is required before the new tunnel can augment the water supply to Damascus.

17. Telecommunications will be established between the Wali reservoirs and the Figeh source, using the new tunnel route, to permit sensible upstream control of the volume of water directed to Damascus.

18. Information on water levels in the reservoirs throughout the distribution system will be transmitted to the associated pumping stations. This will enable the pumps to be controlled by the reservoirs they supply and will reduce overflows and manpower costs.

Distribution System Mains

19. The project includes all mains which will be installed in the EPEF system in the period from 1973 to mid-1977. The following table indicates the approximate annual program of construction during this period:

| Category | Length of Mains to be Installed (km) 1973 | 1974 | 1975 | 1976 | 1977 | Total |
|---|---|---|---|---|---|---|
| Main Lines | - | 14 | 40 | 30 | - | 84 |
| Extension in New Areas | 60 | 110 | 45 | 50 | 20 | 285 |
| Replacements | 40 | 10 | 40 | 50 | 20 | 160 |
| Total | 100 | 134 | 125 | 130 | 40 | 529 |

20. Preliminary designs for the main lines (diameters 100 mm to 1100 mm) have been prepared by the consultants (SEURECA) on the basis of the master plan. This skeleton will reinforce the existing distribution system and enable it to be extended to new areas.

21. EPEF has prepared designs for its 1973 program of extensions and replacements in areas of obvious priority, based on the 1968 master plan of the consultants. Arrangements are under way for the work to be done by various local contractors and the EPEF labor force. The assistance of consultants (SEURECA) is required to prepare designs and organize construction of the expanded program of mains extensions and replacements.

22. Planning for extensions in new areas is largely influenced by the development plans for the Municipality and the rate at which other elements of infrastructure (roads, power, sewers) can be constructed. The Municipality and EPEF continuously revise their plans and all distribution system extensions are planned according to the priorities established by the Municipality. Pipe lengths in the above estimates are based on the areas expected to be served each year and on past experience relating pipe lengths to the area served.

23. Replacement of sections of the existing distribution system is necessary to reduce leakage and to provide adequate capacity. Leakage is generally due to the small diameter pipes of galvanized steel in the old city of Damascus. As a result of continuous habitation over many centuries the soil in these areas is fairly organic and causes accelerated corrosion of steel pipes. Furthermore, the pipes are very small and cause pressure problems during periods of peak demand. Until the consultants can analyze the existing system to determine which sections can be repaired and which must be replaced, EPEF will continue on an ad hoc basis to replace the sections causing the most obvious leakage.

24. When distribution lines are being replaced, EPEF intends to revise the method by which connections used to be made to supply consumers. At present each consumer (e.g., each separate apartment in a building) has an independent connection to the distribution line. EPEF will modify this arrangement so that each building has only one connection to the main.

25. Design criteria for improvements in the distribution system are straightforward. Maximum and minimum pressures are to be 60 m and 30 m respectively. In future the minimum pipe diameter will be 80 mm. Roughness coefficients (Hazen Williams) of 100 for old pipes and 120 for new ones have been assumed. Ductile iron pipes will be used for main lines and for replacement of existing pipes. Consideration will be given to the possible use of plastic or asbestos cement pipes for extensions in new areas where the traffic loads are light or where ground conditions are less difficult.

26. The length of mains expected to be installed in the 4.1/2 year project period is 529 km, an average of 118 km per year. In previous years the length installed by EPEF was as follows:

| | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | Total |
|---|---|---|---|---|---|---|---|---|
| Length (km) Installed by EPEF | 72 | 30 | 31 | 22 | 68 | 72 | 80 1/ | 375 1/ |

1/ Preliminary figure

Approximately 65% of this total was small-diameter pipes (40 cm to 80 cm). The total installed in the past seven years represents about 43% of the total system at the end of 1972. The proposed project would increase the length of the present system by about the same amount, after allowances for removing the pipe which is to be replaced.

27. At the end of 1972 EPEF had a total of 210 km of pipe on stock and on order, of which some 78% was ductile iron. A small amount of this inventory would be retained for maintenance purposes but most is intended to be used during the project period, as follows:-

| Year | Purpose | Length (km) |
|---|---|---|
| 1973 | Extension and Replacements | 100 |
| 1974 | Extension and Replacements | 60 |
| 1974-76 | Main Lines | 30 |
| Total | | 190 |

Operation and Maintenance Equipment

28. EPEF will purchase equipment to assist in the operation and maintenance of the system. This includes master meters and other material necessary for the leak detection program as well as workshop equipment and maintenance vehicles.

Training

29. EPEF wishes to arrange training for its technical, financial and administrative staff. A total of about ten senior employees would

go abroad for periods of up to two years for theoretical and practical training in their specialities. Most of this training would be for engineers. Training in Syria of administrative staff is also envisaged. EPEF has agreed to formulate a more definite program by December 31, 1973.

DAMASCUS WATER SUPPLY PROJECT

ANNEX 4

COST ESTIMATES

| ITEM | LOCAL | FOREIGN | TOTAL | LOCAL | FOREIGN | TOTAL | % FOREIGN |
|---|---|---|---|---|---|---|---|
| | LS (000) | | | US$ (000) | | | |
| **PART A - DAMASCUS WATER SUPPLY** | | | | | | | |
| FIGEH SPRING DEVELOPMENT | | | | | | | |
| a) Underground Cutoff Wall | 700 | 1,000 | 1,700 | 175 | 250 | 425 | |
| b) Surface Structures | 780 | 1,200 | 1,980 | 195 | 300 | 495 | |
| c) Pumping Tests | 1,000 | 2,000 | 3,000 | 250 | 500 | 750 | |
| Sub-Total | 2,480 | 4,200 | 6,680 | 620 | 1,050 | 1,670 | 63 |
| TUNNEL FROM FIGEH TO DAMASCUS | | | | | | | |
| a) Tunnel Excavation and Lining | 6,900 | 10,700 | 17,600 | 1,725 | 2,675 | 4,400 | |
| b) Access Portals | 140 | 200 | 340 | 35 | 50 | 85 | |
| c) Tunnel Spillway to Barada River | 450 | 600 | 1,050 | 112 | 150 | 262 | |
| Sub-Total | 7,490 | 11,500 | 18,990 | 1,872 | 2,875 | 4,747 | 61 |
| RESERVOIRS | | | | | | | |
| a) Vicinity of Tunnel Terminus | 3,000 | 3,100 | 6,100 | 750 | 775 | 1,525 | |
| b) Minor Reservoirs in Distribution System | 2,400 | 2,500 | 4,900 | 600 | 625 | 1,225 | |
| Sub-Total | 5,400 | 5,600 | 11,000 | 1,350 | 1,400 | 2,750 | 51 |
| PUMPING STATIONS | | | | | | | |
| a) New Construction | 150 | 240 | 390 | 38 | 60 | 98 | |
| b) Renovations | 200 | 200 | 400 | 50 | 50 | 100 | |
| Sub-Total | 350 | 440 | 790 | 88 | 110 | 198 | 56 |
| TELECOMMUNICATION SYSTEMS | | | | | | | |
| a) Figeh Tunnel | 20 | 110 | 130 | 5 | 27 | 32 | |
| b) Pumping Station Operation | 70 | 410 | 480 | 17 | 103 | 120 | |
| c) Portable Sets | 20 | 130 | 150 | 5 | 33 | 38 | |
| Sub-Total | 110 | 650 | 760 | 27 | 163 | 190 | 86 |
| DISTRIBUTION SYSTEM PIPELINES | | | | | | | |
| a) Main Lines | 4,200 | 12,400 | 16,600 | 1,050 | 3,100 | 4,150 | |
| b) Extensions in New Areas | 5,600 | 7,600 | 13,200 | 1,400 | 1,900 | 3,300 | |
| c) Replacements | 5,300 | 6,100 | 11,400 | 1,325 | 1,525 | 2,850 | |
| Sub-Total | 15,100 | 26,100 | 41,200 | 3,775 | 6,525 | 10,300 | 63 |
| OPERATION AND MAINTENANCE EQUIPMENT | 120 | 800 | 920 | 30 | 200 | 230 | 87 |
| CONSULTANTS | 1,900 | 3,700 | 5,600 | 475 | 925 | 1,400 | 66 |
| TRAINING | 200 | 300 | 500 | 50 | 75 | 125 | 60 |
| LAND | 8,760 | - | 8,760 | 2,190 | - | 2,190 | - |
| Sub-Total | 41,910 | 53,290 | 95,200 | 10,477 | 13,323 | 23,800 | 56 |
| PHYSICAL CONTINGENCIES | | | | | | | |
| a) Figeh Spring Development (20%) | 770 | 620 | 1,390 | 193 | 155 | 348 | |
| b) Tunnel from Figeh to Damascus (29%) | 2,960 | 2,560 | 5,520 | 740 | 640 | 1,380 | |
| c) Reservoirs (15%) | 900 | 750 | 1,650 | 225 | 187 | 412 | |
| d) Pumping Stations (15%) | 60 | 60 | 120 | 15 | 15 | 30 | |
| e) Communications Systems (15%) | 10 | 100 | 110 | 2 | 25 | 27 | |
| f) Distribution System Pipelines (11%) | 2,600 | 2,070 | 4,670 | 650 | 518 | 1,168 | |
| g) Consultants (15%) | 200 | 640 | 840 | 50 | 160 | 210 | |
| Sub-Total | 7,500 | 6,800 | 14,300 | 1,875 | 1,700 | 3,575 | 48 |
| PRICE INCREASES | 8,790 | 8,010 | 16,800 | 2,198 | 2,002 | 4,200 | 48 |
| TOTAL (PART A) | 58,200 | 68,100 | 126,300 | 14,550 | 17,025 | 31,575 | 54 |
| **PART B - POLLUTION CONTROL STUDIES** | | | | | | | |
| EQUIPMENT | 80 | 80 | 160 | 20 | 20 | 40 | 50 |
| CONSULTANTS | 640 | 2,960 | 3,600 | 160 | 740 | 900 | 82 |
| TRAINING | 80 | 160 | 240 | 20 | 40 | 60 | 67 |
| TOTAL (PART B) | 800 | 3,200 | 4,000 | 200 | 800 | 1,000 | 80 |
| TOTAL PROJECT COSTS | 59,000 | 71,300 | 130,300 | 14,750 | 17,825 | 32,575 | 55 |

March 23, 1973

ANNEX 5

# DAMASCUS WATER SUPPLY PROJECT

## Estimated Schedule of Disbursements

| IBRD Fiscal Year and Quarter | Cumulative Disbursements at End of Quarter (US$ 000) |
|---|---|
| 1973/74 | |
| September 30, 1973 | - |
| December 31, 1973 | 100 |
| March 31, 1974 | 200 |
| June 30, 1974 | 350 |
| 1974/75 | |
| September 30, 1974 | 1,360 |
| December 31, 1974 | 2,310 |
| March 31, 1975 | 3,280 |
| June 30, 1975 | 4,160 |
| 1975/76 | |
| September 30, 1975 | 5,330 |
| December 31, 1975 | 6,670 |
| March 31, 1976 | 8,820 |
| June 30, 1976 | 8,970 |
| 1976/77 | |
| September 30, 1976 | 10,020 |
| December 31, 1976 | 11,000 |
| March 31, 1977 | 12,100 |
| June 30, 1977 | 13,100 |
| 1977/78 | |
| September 30, 1977 | 14,000 |
| December 31, 1977 | 15,000 |

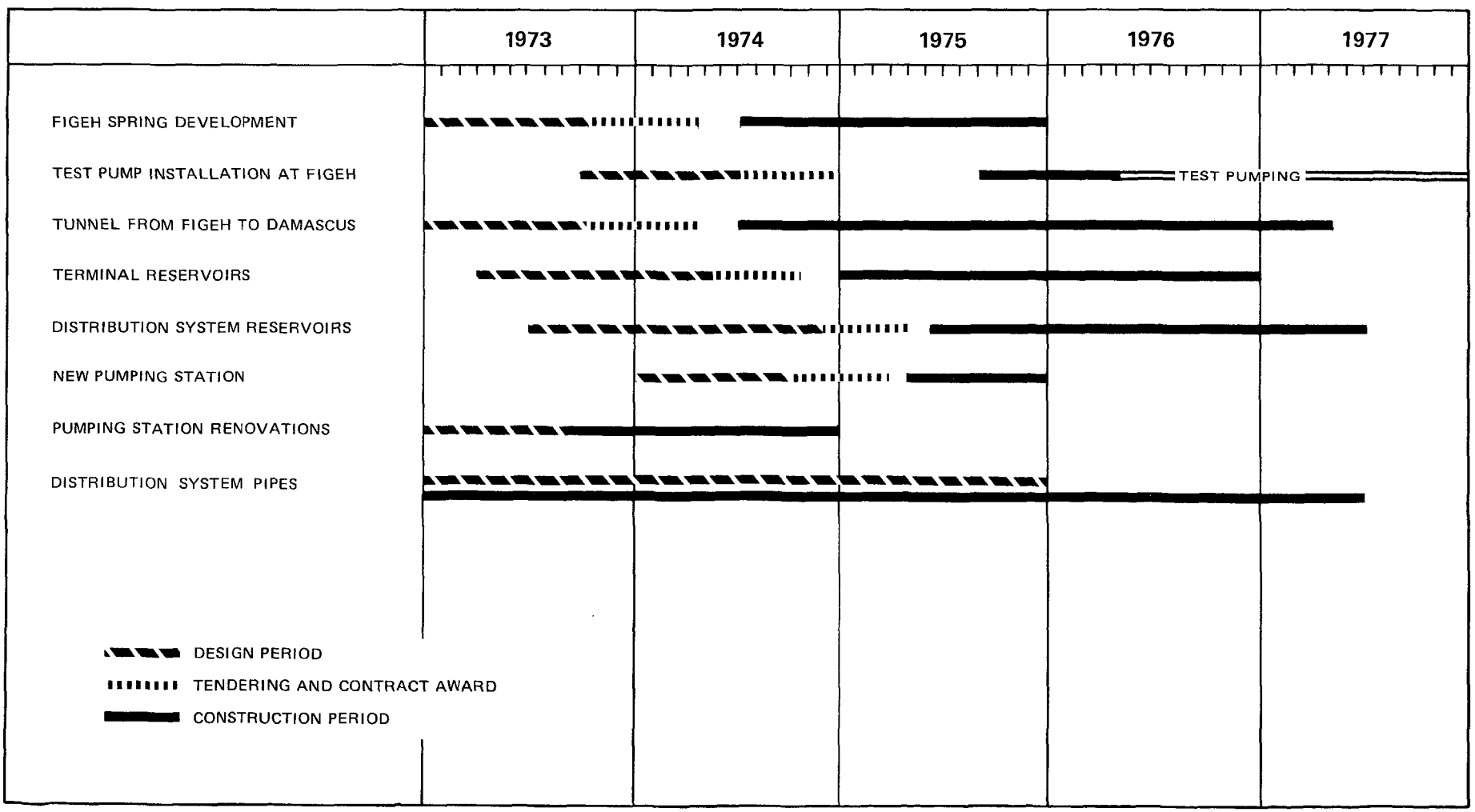
Assumptions

1. IDA Credit for US$15,000,000 of which US$14,200,000 utilized by EPEF for water supply project and balance of US$800,000 by Government for pollution control studies.

2. Credit made effective by September 30, 1973.

March 22, 1973

## DAMASCUS WATER SUPPLY PROJECT
## CONSTRUCTION SCHEDULE

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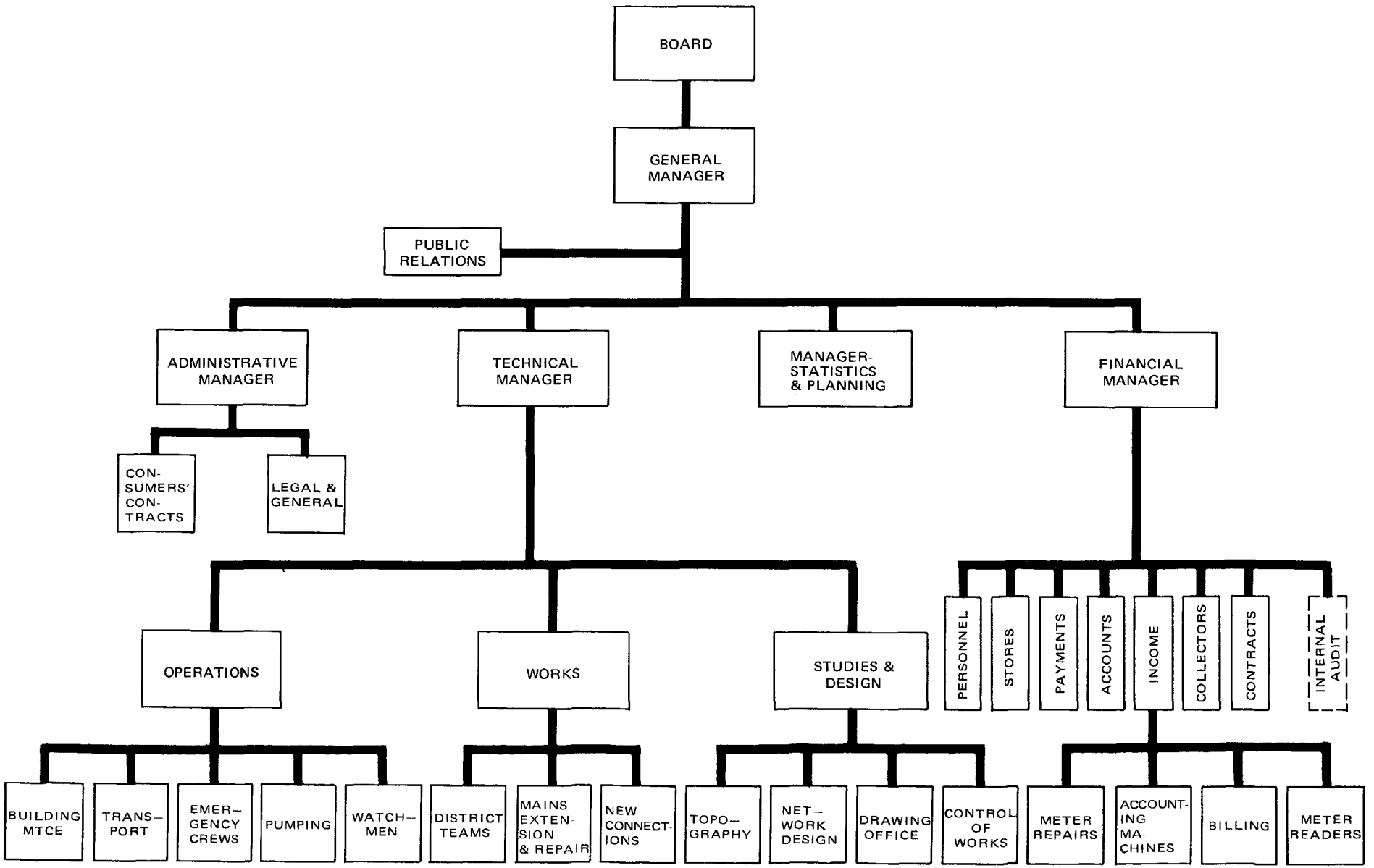
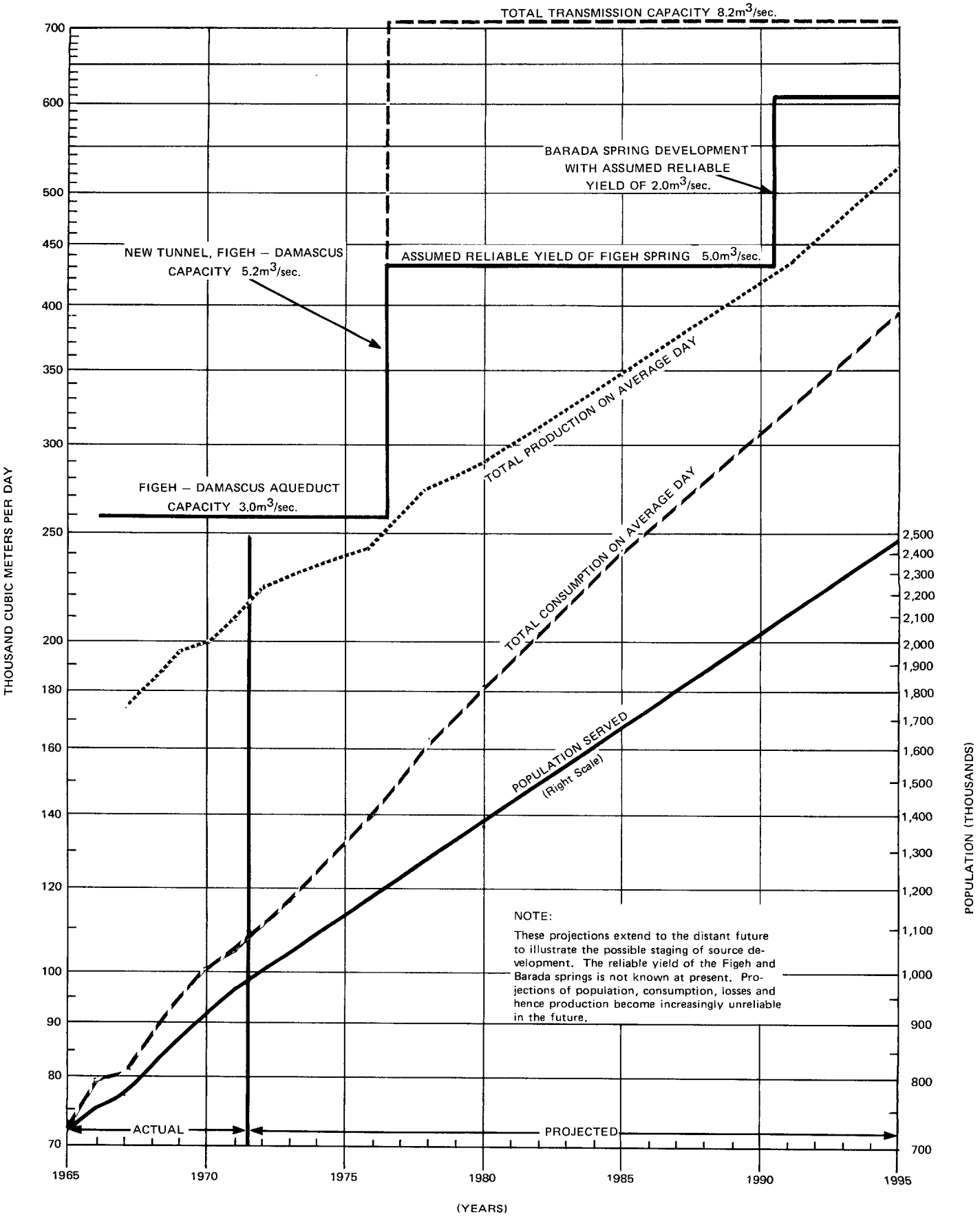
ANNEX 6

SYRIA
DAMASCUS WATER SUPPLY PROJECT
E.P.E.F. – ORGANIZATION 1972




ANNEX 7

# DAMASCUS WATER SUPPLY PROJECT
## PROJECTIONS OF POPULATION, WATER CONSUMPTION AND WATER PRODUCTION




World Bank – 7427

# SYRIA

# DAMASCUS WATER SUPPLY PROJECT

## Economic Analysis

### Least-Cost Solution

1. All major components of the Damascus Water supply system -- source works, transmission lines and distribution system -- require expansion to keep pace with the increasing demand for water. EPEF engaged consultants to plan this expansion on the basis of reasonable projections of future demand (see Annex 2) and after a thorough analysis of alternative development plans which specifically considered staging of the various components.

2. The largest investments (see Annex 4) are in the distribution system. In the 1968 master plan of the consultants (SEURECA) proposals were made to extand the system in two stages to supply the demand expected when Damascus grew according to its 1964-1984 plan for urbanization. In 1972 these plans were updated by SEURECA to take account of modifications in the assumptions and a priority program of work was outlined for the project 1973-1977. Designs for most elements of the distribution system expansions are not yet finalized. They will be reviewed throughout the project and revised as necessary, consistent with the growth of Damascus and its water needs, to ensure the most economic solutions.

3. Four main alternatives were investigated in the planning of the source development and related transmission system. The least-cost solution was clearly the further development of the Figeh spring and construction of a tunnel to deliver water from this source to Damascus. A summary of the alternatives which were considered follows.

4. (i) Figeh spring development and tunnel to Damascus

This groundwater source provides Damascus with excellent water at very low cost since it requires no treatment and flows to most consumers by gravity. However, the flow varies considerably (see Annex 1) with the lowest recorded flow below present requirements, and the transmission capacity of the existing aqueduct (3.0 $m^3$/second) is too small for present and future needs. Fortunately, the average flow of the spring is quite large (8.4 $m^3$/second) and the consultants expect that underground storage in the aquifer which feeds the spring can be utilized to increase its yield at relatively low cost. Accordingly this alternative includes an underground cutoff wall (to avoid wasting spring water) and test pumping to explore the storage possibilities.

In this alternative a tunnel would be constructed to augment the present aqueduct to Damascus. The minimum capacity of the tunnel would have to be about 4.0 $m^3$/second, the estimated system production capacity required in 1977 (when the tunnel would be completed) so that the existing aqueduct could be taken out of service for badly needed repairs. However, the smallest tunnel which would be economical to construct provides a capacity of 5.2 $m^3$/second, more than required. The tunnel would be 15.0 km long and terminate at the Wali reservoir above Damascus. With allowances for physical contingencies the cost of this least-cost alternative totalled LS32.5 million (US$8.1 million).

(ii) Figeh spring development and pipeline to Damascus

As in the previous alternative the existing Figeh source would be further developed.

A pipeline would be constructed to Damascus. The capacity requirement of 4.0 $m^3$/second necessitates a large diameter pipeline (1400 mm asbestos cement) which would be quite expensive to install. The pipeline route, 18.3 km long, is very difficult, along the rocky and narrow Barada valley. Two pipeline bridges would be required over the river and ten crossings under roads, railway and canals. At its terminus at the Wali reservoir the pipeline would be some 50 m lower than the reservoir. Although most of the distribution system could be supplied from the pipeline, it is necessary to consider a pumping station with capacity of about 1.5 $m^3$/second, to pump water to the higher distribution zones that could be supplied by the tunnel alternative.

The estimated costs of this alternative, including land expropriation, access roads and the pumping station and allowances for physical contingencies, total LS42 million (US$10.5 million). This alternative, which also involves annual pumping costs, was rejected because it was more expensive than the first one.

(iii) Dam on the Barada River and pipeline to Damascus

As the Figeh spring is a principal source of the Barada River, the possibility of using the river to transmit the water much of the way to Damascus was investigated. In 1961 consultants from the USSR (Technopromexport)

completed a preliminary analysis of a multipurpose reservoir on the Barada River which could supply water for domestic purposes and irrigation in Damascus as well as control floods. Data from this report was used by SOGREAH to analyze a smaller dam to be built for water supply purposes only, since the hypothetical multipurpose project is unlikely to be built in the immediate future. A water supply project to provide about 4.0 $m^3$/second would require a dam about 60 m high with a reservoir covering some 210 ha. A pumping station and about 10 km of pipeline would be required to deliver the water to Damascus. The preliminary cost estimate for this alternative totals LS75 million (US$18.7 million). This alternative was compared to the first one and was rejected. In addition to being considerably more expensive, it has several disadvantages:

(a) reservoir water would probably require treatment and sewerage schemes would be required to prevent contamination by upstream communities, necessitating additional capital costs;

(b) additional annual costs would be incurred for pumping and treatment;

(c) this alternative project could not be operational for about six years because of the need to prepare engineering designs and relocate buildings, roads and the railway in the reservoir area, and also because of the long construction period for such a project;

(d) a reservoir with associated installations and pipelines is much less secure as a water source than an underground source and a tunnel.

(iv) Groundwater from Damascus Plain

Wells are the common source of water for irrigation in the area around Damascus. The irrigated area totals some 12,000 ha. The Ministry of Public Works and Water Resources estimates that some 8,000 wells rely on this aquifer which is recharged by the Barada River and smaller seasonal streams flowing from the Anti-Lebanon Mountains. EPEF is temporarily using two wells at Jobar but intends to abandon them as soon as possible (see Annex 1). There are many reasons why it is impractical to consider using this groundwater to augment the Damascus water supply.

(a) All the groundwater is bacteriologically contaminated due to gross pollution, mostly from Damascus; until a comprehensive sewerage system is constructed the use of this groundwater is undesirable for health reasons.

(b) A centuries-old system of water rights allocation has evolved in the region including a hierarchy of committees. To meddle with these traditional allocations would be extremely difficult if not impossible.

(c) The yield of individual wells is quite small, generally less than 1,000 $m^3$/day, which would make the development of this source very expensive in view of the large and increasing demand for water in Damascus (see Annex 2). Furthermore, such wells would involve substantial pumping costs, both to bring the water to the surface and (since the ground rises toward the city) to transmit it to higher-lying areas where the urban consumers are located.

Rate of Return

5. Any measurement of the rate of return associated with the proposed project requires an estimation of the future streams of costs and benefits, both of which extend far beyond the period of project construction. The large transmission capacity of the project tunnel will probably not be fully utilized by the Figeh source, whose reliable yield will probably be less than the combined transmission capacity of the present aqueduct and the new tunnel. This is clearly illustrated on the chart in Annex 8.

6. The source to be used to supply water to Damascus after the Figeh spring is fully exploited is not definitely known but it is likely to be the Barada spring, about 14 km NW of Figeh. Water from this source could be piped to Figeh and flow via the tunnel to Damascus. On the basis of current projections, it appears that the combination of these two sources, using the Figeh tunnel, would be sufficient to meet the needs of Damascus until about 1997 (see Annex 8). It is not possible to predict the source to be used subsequently. Alternatives include the A'waj River (20 km south of Damascus) and recycling of treated wastewater. As no subsequent source is expected to use the project tunnel, it is assumed that the benefits of the proposed project do not increase after 1997.

Costs

7. Costs between 1973 and 1997, necessary to obtain the full benefits of the project, are considered. They include:

(i) project expenditures;

(ii) other investment in the physical installations during 1973-1997, including the development of the Barada spring (about 1991);

(iii) operating costs above the 1972 base-year level (including the cost of intensified source pumping as and when required to augment the natural flow).

8. Costs are at constant (1972) prices and exclude taxes (taken at 5% of capital costs); cost increases not attributable to the increased output are likewise excluded (e.g. additional personnel to fill existing staffing gaps). Extensions of the network financed by consumers' capital contributions are similarly excluded, these contributions being taken to reflect a minimum measure of benefits received. Pipes taken from excessive existing stocks however are not excluded; although in a sense "sunk costs", these costs are partly "retrievable" in that, if the pipes were not used for the project, there is an alternative use for them in other parts of the country where large diameter pipes are needed. Accordingly, 75% of their value is included as a cost, the balance representing an approximation of transport costs to the nearest alternative user.

9. No shadow pricing is employed in the calculation; reported unemployment is low, and the exchange rate used for the Syrian pound is a free market rate which has shown remarkable stability. (In a sense this shadow prices the official rate of LS3.83 to the dollar.[1/]) There might be a case for shadow pricing labor costs, which would increase the rate of return, on the grounds that unemployment statistics underemphasize the extent of unpaid family and apprentice labor, but no attempt has been made to calculate this adjustment.

Benefits

10. The benefits from the program of investments come from increased sales of water over 1972 levels, to both new and existing consumers, since neither type of growth would be possible without the investments in question. About 1997 all the project facilities would be fully utilized and a further source development would be needed; accordingly, project benefits from sales of water after that year are taken as static.

11. Ignoring health and social benefits, which are difficult to quantify, a minimum measure of the value of the additional water is the price people are willing to pay for it. This may be the price they are now paying, or even more; yet at a higher price, the same quantities may not be sold.

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1/ The official rate is used mainly for cotton and petroleum exports and pipeline dues; most other transactions take place at the "free" rate of LS4.0 to the dollar, established by the Central Bank on the basis of the Beirut currency market.

12. The present price in Damascus is LS0.20/$m^3$ (US$19/1000 gals), but as long ago as 1949 the price was higher (LS0.25). It might therefore seem reasonable to argue that after more than 20 years of even modest inflation (the exact rate is not known), the present-day equivalent of what consumers were then willing to pay must be at least LS0.35/$m^3$. In 1949, however, the whole pattern of water supply was different; only 15,000 consumers had a supply, compared with about 130,000 now, and it would therefore be unsafe to reason along the lines indicated, especially as we have no knowledge of the level of per capita consumption at that time.

13. At the beginning of the 1960's (from which time price indices are available), the pattern of water supply, with 60,000-70,000 consumers, was taking shape along present-day lines. Since then (when the price of water was the same as now) the retail price index has risen on average by about 3% annually. If water rates had kept pace they would now be about LS0.30/$m^3$ in Damascus; this is comparable with the tariff of LS0.25-0.40/$m^3$ now in force in Aleppo, where per capita consumption is estimated to be about the same as in Damascus. A rate of LS0.30/$m^3$ has therefore been used in the calculation.

14. This rate of LS0.30 would still be low[1/] and it is not thought that such a price would have any noticeable effect on quantities consumed, in a system subject to shortages and where such water uses as car-washing and watering of public gardens are either forbidden or provided from private boreholes.

15. Only that part of the increased supply of water which is charged for at the metered rate is taken into account.[2/] No value is attached to free water supplied through standpipes or to mosques; nor to the free supply to which water right holders are entitled. Instead, however, receipts from sales of <u>new</u> water rights (from 1973 on) are treated as a revenue, since these receipts represent partly a payment for the "free" water, and partly a payment for the right of admission to the network, which would not be possible without the project-related expansion program. They represent the capture of part of the "consumers' surplus" inherent in a flat-rate tariff structure. Incremental revenues from miscellaneous charges are also counted.

---

1/ The rate of LS0.30/$m^3$ is equivalent to US$0.28/1000 gals. For comparison rates charged in other countries in the region are as follows:

Amman, Jordan .....US$0.88/1000 gals.
Istanbul, Turkey.....US$0.47/1000 gals.
Tehran, Iran.....US$0.42/1000 gals.

2/ Some of the additional revenue must be attributable to improved metering and is therefore not strictly an economic benefit; however, the quantity is not ascertainable and, since part of the defective metering is already compensated by "estimation" billing, no adjustment has been made.

Rate of Return Calculation

16. With the rate of LS0.30 used as a minimum measure of benefits, and under the assumption that water right sales will continue to be at present price (LS2000 for one $m^3$/day), the economic rate of return on the investments is 11.9%. An increase of the charge for water rights to, say, LS2500/$m^3$/day would have little effect on the rate of return, since there would be a corresponding reduction in the annual fee payable by the new water-right holders concerned. Attributing a lower price of LS0.25/$m^3$ to metered water would produce a rate of return of about 10.1%. Details of cost and benefit streams are appended to this Annex.

17. A rate of return of 10% would still be attained if:

(i) project costs were underestimated by 21%

or (ii) other investment costs were underestimated by 54%

or (iii) incremental operating costs were underestimated by 42%

or (iv) incremental revenues were overestimated by 21%

18. Three alternative calculations were made to test the effect of different estimates of the Figeh source storage. The assumption on which the main calculation was based is that the source will yield up to 5 $m^3$/sec with pumping, which would require harnessing a second source about 1991. Lower estimates would bring forward and higher rates would defer the need for the additional source, besides altering the probable pattern of pumping costs. The effect of the alternatives on the rate of return was negligible.

19. The calculation takes no account of the social costs resulting from the increased flow of sewage or from the slight loss of agricultural water; but these costs are felt to be counter-balanced by the benefits to health and fire protection.

Rate of Return using Sale Price of LSO.30/$m^3$

| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|
| | | | Million LS | | | |
| Year | Project | Other Invest. | Incremntl. Op. Costs | Incremntl. Revenues | Water Rights | Net Revenues (Net Costs) |
| 1973 | 7.5 | 3.9 | 0.2 | 0.8 | 2.2 | (8.6) |
| 1974 | 29.3 | 2.0 | 0.4 | 1.7 | 2.3 | (27.7) |
| 1975 | 29.4 | 0.7 | 0.7 | 2.5 | 2.4 | (25.9) |
| 1976 | 26.5 | 1.2 | 1.0 | 3.5 | 2.5 | (22.7) |
| 1977 | 9.2 | 0.6 | 1.3 | 4.6 | 2.6 | (3.9) |
| 1978 | - | 2.4 | 1.8 | 6.1 | 2.7 | 4.6 |
| 1979 | - | 1.7 | 2.0 | 7.1 | 2.8 | 6.2 |
| 1980 | - | 1.7 | 2.3 | 8.3 | 2.9 | 7.2 |
| 1981 | - | 1.6 | 2.7 | 9.6 | 3.0 | 8.3 |
| 1982 | - | 1.6 | 2.9 | 10.9 | 3.1 | 9.5 |
| 1983 | - | 1.7 | 3.3 | 12.3 | 3.2 | 10.5 |
| 1984 | - | 1.7 | 3.6 | 13.9 | 3.3 | 11.9 |
| 1985 | - | 1.8 | 3.9 | 15.4 | 3.5 | 13.2 |
| 1986 | - | 1.9 | 4.3 | 16.9 | 3.6 | 14.3 |
| 1987 | - | 1.9 | 4.8 | 18.4 | 3.7 | 15.4 |
| 1988 | - | 2.0 | 5.2 | 20.1 | 3.9 | 16.8 |
| 1989 | - | 2.0 | 5.6 | 21.8 | 4.0 | 18.2 |
| 1990 | - | 2.1 | 6.2 | 23.6 | 4.2 | 19.5 |
| 1991 | - | 7.1 | 6.8 | 25.6 | 4.3 | 16.0 |
| 1992 | - | 2.3 | 6.2 | 27.6 | 4.5 | 23.6 |
| 1993 | - | 2.3 | 6.6 | 29.5 | 4.6 | 25.2 |
| 1994 | - | 2.3 | 7.1 | 31.6 | 4.8 | 27.0 |
| 1995 | - | 2.5 | 7.5 | 33.7 | 5.0 | 28.7 |
| 1996 | - | 2.5 | 8.1 | 36.0 | 5.2 | 30.6 |
| 1997 | - | 2.7 | 8.7 | 38.4 | 5.4 | 32.4 |
| 1998-2012 | - | - | 8.7 | 38.4 | - | 29.7 |

Rate of Return at above values .....11.9%

ROR 10% achieved even if:-

Col. (2) understated by 21%
Col. (3) understated by 54%
Col. (4) understated by 42%
Col. (5) overstated by 21%
Col. (6) overstated by 312%

SYRIA

DAMASCUS WATER SUPPLY PROJECT

EPEF

Income Statements - Actual (1969-71) and Projected (1972-82)

| Fiscal year ending December 31. | | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Population Served | (Thousand) | 870 | 914 | 968 | 1,007 | 1,046 | 1,089 | 1,132 | 1,177 | 1,224 | 1,273 | 1,324 | 1,376 | 1,432 | 1,488 |
| No. of Connections at Year-end 1/ | (Thousand) | 112 | 117 | 123 | 130 | 136 | 143 | 150 | 157 | 164 | 171 | 179 | 187 | 196 | 205 |
| No. of New Connections in Year | | 5,447 | 5,494 | 6,305 | 6,900 | 6,600 | 6,800 | 7,100 | 7,400 | 7,700 | 8,000 | 8,300 | 8,600 | 9,000 | 9,300 |
| No. having Water Rights - Additional | | 1,526 | 1,715 | 2,091 | 2,449 | 2,200 | 2,300 | 2,400 | 2,500 | 2,600 | 2,700 | 2,800 | 2,900 | 3,000 | 3,100 |
| Cumulative | | 61,245 | 62,960 | 65,051 | 67,500 | 69,700 | 72,000 | 74,400 | 76,900 | 79,500 | 82,200 | 85,000 | 87,900 | 90,900 | 94,000 |
| Water Rights as $m^3$/day - Additional | (Thousand $m^3$) | 0.76 | 0.85 | 1.04 | 1.22 | 1.10 | 1.15 | 1.20 | 1.25 | 1.30 | 1.35 | 1.40 | 1.45 | 1.50 | 1.55 |
| Cumulative | (Thousand $m^3$) | 26.74 | 27.59 | 28.63 | 29.85 | 30.95 | 32.10 | 33.30 | 34.55 | 35.85 | 37.20 | 38.60 | 40.05 | 41.55 | 43.10 |
| Water Rights as $m^3$/year - Cumulative | (Million $m^3$) | 9.8 | 10.1 | 10.5 | 10.9 | 11.3 | 11.7 | 12.2 | 12.6 | 13.1 | 13.6 | 14.1 | 14.6 | 15.2 | 15.7 |
| Volume consumed 1/ 2/ | (Million $m^3$) | 30.4 | 33.1 | 35.1 | 37.6 | 39.8 | 42.7 | 45.3 | 48.2 | 51.8 | 56.6 | 59.9 | 63.5 | 67.5 | 71.5 |
| Proportion of Water Rights actually consumed 2/ | (%) | 99 | 98 | 88 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 | 98 |
| Volume attributable to Water Rights 2/ | (Million $m^3$) | 9.7 | 9.9 | 9.2 | 10.7 | 11.1 | 11.5 | 11.9 | 12.4 | 12.8 | 13.3 | 13.8 | 14.3 | 14.9 | 15.4 |
| Excess = Chargeable Consumption | (Million $m^3$) | 20.7 | 23.2 | 25.9 | 26.9 | 28.7 | 31.2 | 33.4 | 35.8 | 39.0 | 43.3 | 46.1 | 49.2 | 52.6 | 56.1 |
| Rate for Chargeable Consumption (average) | (LS/$m^3$) | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.30 |
| Annual Fee for Water Right holders | (LS for 1 $m^3$/day) | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 14.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 40.00 | 50.00 |
| | | Thousand LS | | | | | | | | | | | | | |
| REVENUES | | | | | | | | | | | | | | | |
| Chargeable Consumption | | 4,139 | 4,642 | 5,179 | 5,384 | 5,740 | 6,240 | 9,020 | 9,670 | 10,530 | 11,690 | 12,450 | 13,280 | 14,200 | 16,830 |
| Annual Fees (Water Right holders) | | 366 | 391 | 392 | 410 | 425 | 440 | 1,330 | 1,350 | 1,435 | 1,490 | 1,545 | 1,600 | 1,660 | 2,115 |
| Meter Rent and Maintenance Fees | | 598 | 611 | 628 | 727 | 810 | 865 | 965 | 1,070 | 1,175 | 1,275 | 1,330 | 1,490 | 1,610 | 1,725 |
| Distribution System Maintenance Fees 3/ | | 196 | 190 | 359 | 445 | 480 | 500 | 525 | 555 | 580 | 605 | 630 | 660 | 690 | 720 |
| New Connections and Meter Installation | | 394 | 531 | 463 | 462 | 475 | 470 | 475 | 505 | 475 | 410 | 410 | 435 | 470 | 500 |
| Other Fees and Charges | | 50 | 50 | 49 | 87 | 95 | 95 | 100 | 100 | 100 | 105 | 110 | 115 | 120 | 125 |
| Non-Operating and Previous Year's Revenues | | 93 | 247 | 137 | 490 | 150 | 160 | 170 | 210 | 230 | 250 | 270 | 285 | 300 | 320 |
| | | 5,836 | 6,662 | 7,207 | 8,005 | 8,175 | 8,770 | 12,585 | 13,490 | 14,525 | 15,825 | 16,795 | 17,865 | 19,050 | 22,335 |
| EXPENSES | | | | | | | | | | | | | | | |
| Personnel | | 2,202 | 2,442 | 2,562 | 2,874 | 3,160 | 3,470 | 3,810 | 4,190 | 4,440 | 4,710 | 4,990 | 5,290 | 5,605 | 5,940 |
| Maintenance and Materials | | 62 | 202 | 168 | 175 | 180 | 200 | 250 | 390 | 470 | 625 | 650 | 680 | 700 | 700 |
| Pumping | | 330 | 442 | 626 | 670 | 770 | 865 | 765 | 715 | 750 | 790 | 820 | 935 | 970 | 1,015 |
| Vehicle Expenses, Transport, Travel | | 123 | 90 | 167 | 125 | 140 | 155 | 170 | 190 | 200 | 210 | 225 | 240 | 250 | 270 |
| Heat, Light and Miscellaneous Admin. Expenses | | 158 | 142 | 145 | 162 | 170 | 180 | 180 | 190 | 200 | 210 | 220 | 230 | 240 | 250 |
| New Connections | | 150 | 199 | 224 | 208 | 190 | 190 | 200 | 190 | 180 | 180 | 180 | 200 | 210 | 220 |
| Civil Defence Levy | | 46 | 42 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| Transfers to Bad Debts Provision | | - | 10 | 10 | 10 | 10 | 10 | 20 | 10 | 10 | 10 | 5 | 5 | 10 | 5 |
| Transfers to Retirement Provision | | - | 115 | 2 | 5 | 5 | 4 | 4 | 2 | 2 | - | - | - | - | - |
| Miscellaneous | | 11 | 2 | 4 | 12 | 15 | 15 | 15 | 20 | 20 | 20 | 25 | 25 | 30 | 30 |
| Non-Operating and Previous Years' Expenses | | 175 | 52 | 192 | 100 | 110 | 120 | 135 | 145 | 160 | 170 | 180 | 185 | 195 | 205 |
| Write-offs/Contingencies Provision | | 29 | 22 | - | 100 | 150 | 200 | 280 | 300 | 320 | 345 | 365 | 390 | 410 | 430 |
| Depreciation | | 1,459 | 1,382 | 1,703 | 1,673 | 1,848 | 2,272 | 2,988 | 3,819 | 4,509 | 4,747 | 4,842 | 4,923 | 4,998 | 5,073 |
| | | 4,745 | 5,142 | 5,805 | 6,114 | 6,748 | 7,681 | 8,817 | 10,161 | 11,261 | 12,017 | 12,502 | 13,103 | 13,618 | 14,138 |
| NET OPERATING INCOME | | 1,091 | 1,520 | 1,402 | 1,891 | 1,427 | 1,089 | 3,768 | 3,329 | 3,264 | 3,808 | 4,293 | 4,762 | 5,432 | 8.197 |
| Interest | | - | - | - | - | 4 | 76 | 750 | 1,782 | 2,755 | 3,388 | 3,340 | 3,244 | 3,142 | 3,034 |
| NET INCOME | | 1,091 | 1,520 | 1,402 | 1,891 | 1,423 | 1,013 | 3,018 | 1,547 | 509 | 420 | 953 | 1,518 | 2,290 | 5.163 |
| Operating Ratio (after Depreciation) | | .81 | .77 | .81 | .76 | .83 | .88 | .70 | .75 | .78 | .76 | .74 | .73 | .71 | .63 |
| Average Net Fixed Assets | (Million LS) | 31 | 32 | 32 | 34 | 40 | 56 | 83 | 112 | 143 | 158 | 157 | 155 | 153 | 151 |
| Rate of Return on Average Net Fixed Assets (Net Operating Income plus Water Right Sales). | (%) | 8.4 | 10.1 | 10.9 | 12.7 | 9.1 | 6.1 | 7.4 | 5.2 | 4.1 | 4.1 | 4.5 | 4.9 | 5.5 | 7.5 |

1/ Excluding free supplies (standpipes and religious buildings).
2/ 1969-71 based on samples.
3/ Erroneous under-allocations 1969-70 corrected 1972 (against "Previous Years' Revenues").

ANNEX 10

April 26, 1973

SYRIA

DAMASCUS WATER SUPPLY PROJECT

EPEF

Cash Flow Statements - Actual (1969-71) and Projected (1972-82)

| Fiscal year ending December 31 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | Total 1973-77 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thousand LS | | | | | | | | | | | | | | |
| SOURCES OF FUNDS | | | | | | | | | | | | | | | |
| Net Operating Income | 1,091 | 1,520 | 1,402 | 1,891 | 1,427 | 1,089 | 3,768 | 3,329 | 3,264 | 12,877 | 3,808 | 4,293 | 4,762 | 5,432 | 8,197 |
| Add Depreciation | 1,459 | 1,382 | 1,703 | 1,673 | 1,848 | 2,272 | 2,988 | 3,819 | 4,509 | 15,436 | 4,747 | 4,842 | 4,923 | 4,998 | 5,073 |
| Internal Cash Generation | 2,550 | 2,902 | 3,105 | 3,564 | 3,275 | 3,361 | 6,756 | 7,148 | 7,773 | 28,313 | 8,555 | 9,135 | 9,685 | 10,430 | 13,270 |
| Water Right Sales | 1,516 | 1,706 | 2,075 | 2,440 | 2,200 | 2,300 | 2,400 | 2,500 | 2,600 | 12,000 | 2,700 | 2,800 | 2,900 | 3,000 | 3,100 |
| Consumers' Capital Contributions 1/ | 907 | 730 | 447 | 190 | 495 | 510 | 530 | 555 | 575 | 2,665 | 600 | 625 | 645 | 675 | 695 |
| Transfers from (to) Government | (2,990) | (378) | (1,124) | - | 7,000 | 18,000 | 7,000 | 7,700 | (7,800) | 31,900 | (3,100) | (4,000) | (4,800) | (5,300) | (7,600) |
| Proceeds of IDA Credit | - | - | - | - | 400 | 8,040 | 16,240 | 16,520 | 15,600 | 56,800 | - | - | - | - | - |
| Increase (Decrease) in Accounts Payable, Provisions, etc. | 1,268 | (734) | 750 | 242 | 753 | 1,812 | 1,288 | 1,097 | (1,528) | 3,422 | 747 | 722 | 763 | 805 | 850 |
| TOTAL SOURCES | 3,251 | 4,226 | 5,253 | 6,436 | 14,123 | 34,023 | 34,214 | 35,520 | 17,220 | 135,100 | 9,502 | 9,282 | 9,193 | 9,610 | 10,315 |
| APPLICATION OF FUNDS | | | | | | | | | | | | | | | |
| Capital Expenditure - Project | - | - | - | - | 8,470 | 33,500 | 37,900 | 34,200 | 12,230 | 126,300 | - | - | - | - | - |
| Capital Expenditure - Other Works | 2,577 | 2,113 | 3,763 | 3,650 | 4,700 | 2,700 | 1,400 | 2,200 | 1,600 | 12,600 | 4,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| TOTAL INVESTMENT | 2,577 | 2,113 | 3,763 | 3,650 | 13,170 | 36,200 | 39,300 | 36,400 | 13,830 | 138,900 | 4,000 | 3,000 | 3,000 | 3,000 | 3,000 |
| Interest - IDA Credit | - | - | - | - | 4 | 76 | 750 | 1,782 | 2,755 | 5,367 | 3,388 | 3,340 | 3,244 | 3,142 | 3,034 |
| Repayment - IDA Credit | - | - | - | - | - | - | - | - | - | - | 753 | 1,575 | 1,671 | 1,773 | 1,881 |
| Total Debt Service | - | - | - | - | 4 | 76 | 750 | 1,782 | 2,755 | 5,367 | 4,141 | 4,915 | 4,915 | 4,915 | 4,915 |
| Increase (Decrease) in Stocks | 1,078 | (817) | 399 | 690 | 535 | (1,960) | (7,200) | (220) | 800 | (8,045) | 800 | 800 | 800 | 900 | 900 |
| Increase (Decrease) in Receivables and Short-Term Advances | (110) | 1,456 | 985 | 1,041 | 2,011 | 130 | 1,081 | (2,400) | (400) | 422 | 600 | 500 | 500 | 700 | 1,400 |
| Cash Accrual (Outflow) | (294) | 1,474 | 106 | 1,055 | (1,597) | (423) | 283 | (42) | 235 | (1,544) | (39) | 67 | (22) | 95 | 100 |
| TOTAL APPLICATION | 3,251 | 4,226 | 5,253 | 6,436 | 14,123 | 34,023 | 34,214 | 35,520 | 17,220 | 135,100 | 9,502 | 9,282 | 9,193 | 9,610 | 10,315 |
| Cash at Beginning of year | 315 | 21 | 1,495 | 1,601 | 2,656 | 1,059 | 636 | 919 | 877 | | 1,112 | 1,073 | 1,140 | 1,118 | 1,213 |
| Cash at End of year | 21 | 1,495 | 1,601 | 2,656 | 1,059 | 636 | 919 | 877 | 1,112 | | 1,073 | 1,140 | 1,118 | 1,213 | 1,313 |
| Debt Service Coverage (Times) | n.a. | n.a. | n.a. | n.a. | 818.8 | 44.2 | 9.0 | 4.0 | 2.8 | | 2.1 | 1.9 | 2.0 | 2.1 | 2.7 |

1/ Erroneous over-allocations 1969-70 corrected 1972.

April 26, 1973

ANNEX 11

~~Annex~~

DAMASCUS WATER SUPPLY PROJECT

BEF

Balance Sheet - Actual (1968-71)and Projected (1972-82)

| Fiscal year-end (December 31) | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Thousand LS | | | | | | | | | | | | | | |
| **ASSETS** | | | | | | | | | | | | | | | |
| Fixed Assets | 41,219 | 42,714 | 45,050 | 47,219 | 51,454 | 63,254 | 87,854 | 121,254 | 153,954 | 190,354 | 194,354 | 197,854 | 200,854 | 203,854 | 206,854 |
| Less Depreciation | 10,172 | 11,623 | 13,003 | 14,706 | 16,379 | 18,227 | 20,499 | 23,487 | 27,306 | 31,815 | 36,562 | 41,404 | 46,327 | 51,325 | 56,398 |
| Net Fixed Assets | 31,047 | 31,091 | 32,047 | 32,513 | 35,075 | 45,027 | 67,355 | 97,767 | 126,648 | 158,539 | 157,792 | 156,450 | 154,527 | 152,529 | 150,456 |
| Work in Progress | 132 | 1,214 | 991 | 2,585 | 2,000 | 3,370 | 14,970 | 20,870 | 24,570 | 2,000 | 2,000 | 1,500 | 1,500 | 1,500 | 1,500 |
| Total Fixed Assets | 31,179 | 32,305 | 33,038 | 35,098 | 37,075 | 48,397 | 82,325 | 118,637 | 151,218 | 160,539 | 159,792 | 157,950 | 156,027 | 154,029 | 151,956 |
| Investments and Advances: | | | | | | | | | | | | | | | |
| Government | 20,359 | 23,349 | 23,727 | 24,851 | 24,851 | 17,851 | - | - | - | - | - | 51 | 4,851 | 10,151 | 17,751 |
| Municipality | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 | 1,137 |
| Housing Loans | 221 | 189 | 154 | 116 | 78 | 39 | 19 | - | - | - | - | - | - | - | - |
| Land Options | 300 | 300 | 300 | 300 | 300 | - | - | - | - | - | - | - | - | - | - |
| Total Investments and Advances | 22,017 | 24,975 | 25,318 | 26,404 | 26,366 | 19,027 | 1,156 | 1,137 | 1,137 | 1,137 | 1,137 | 1,188 | 5,988 | 11,288 | 18,888 |
| Stocks | 9,995 | 11,073 | 10,256 | 10,655 | 11,345 | 11,880 | 9,920 | 2,720 | 2,500 | 3,300 | 4,100 | 4,900 | 5,700 | 6,600 | 7,500 |
| Accounts Receivable - Water Consumers | 5,108 | 4,369 | 4,504 | 4,376 | 4,500 | 4,750 | 4,500 | 5,800 | 5,700 | 6,000 | 6,600 | 7,000 | 7,400 | 8,000 | 9,300 |
| - Connections and Water Rights | 389 | 1,326 | 1,734 | 2,322 | 2,400 | 2,200 | 2,300 | 2,400 | 2,500 | 2,600 | 2,700 | 2,800 | 2,900 | 3,000 | 3,100 |
| - Advance Payments and Misc. | 1,388 | 1,112 | 2,060 | 2,623 | 3,500 | 5,800 | 6,100 | 5,800 | 3,400 | 2,600 | 2,500 | 2,500 | 2,500 | 2,500 | 2,500 |
| | 6,885 | 6,807 | 8,298 | 9,321 | 10,400 | 12,750 | 12,900 | 14,000 | 11,600 | 11,200 | 11,800 | 12,300 | 12,800 | 13,500 | 14,900 |
| Less Bad Debts Provision | 10 | 10 | 20 | 30 | 40 | 50 | 60 | 80 | 90 | 100 | 110 | 115 | 120 | 130 | 135 |
| | 6,875 | 6,797 | 8,278 | 9,291 | 10,360 | 12,700 | 12,840 | 13,920 | 11,510 | 11,100 | 11,690 | 12,185 | 12,680 | 13,370 | 14,765 |
| Cash and Bank | 315 | 21 | 1,495 | 1,601 | 2,656 | 1,059 | 636 | 919 | 877 | 1,112 | 1,073 | 1,140 | 1,118 | 1,213 | 1,313 |
| Total Current Assets | 17,185 | 17,891 | 20,029 | 21,547 | 24,361 | 25,639 | 23,396 | 17,559 | 14,887 | 15,512 | 16,863 | 18,225 | 19,498 | 21,183 | 23,578 |
| TOTAL ASSETS | 70,381 | 75,171 | 78,385 | 83,049 | 87,802 | 93,063 | 106,877 | 137,333 | 167,242 | 177,188 | 177,792 | 177,363 | 181,513 | 186,500 | 194,422 |
| **EQUITY AND LIABILITIES** | | | | | | | | | | | | | | | |
| Equity - Prior to 1959 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 | 29,340 |
| - Earned Surplus | 13,877 | 14,968 | 16,488 | 17,890 | 19,781 | 21,204 | 22,217 | 25,235 | 26,782 | 27,291 | 27,711 | 28,664 | 30,182 | 32,472 | 37,635 |
| - Sale of Water Rights | 23,240 | 24,756 | 26,462 | 28,537 | 30,977 | 33,177 | 35,477 | 37,877 | 40,377 | 42,977 | 45,677 | 48,477 | 51,377 | 54,377 | 57,477 |
| - Consumers' Contributions | 1,214 | 2,121 | 2,851 | 3,298 | 3,488 | 3,983 | 4,493 | 5,023 | 5,578 | 6,153 | 6,753 | 7,378 | 8,023 | 8,698 | 9,393 |
| Total Equity | 67,671 | 71,185 | 75,141 | 79,065 | 83,586 | 87,704 | 91,527 | 97,475 | 102,077 | 105,761 | 109,481 | 113,859 | 118,922 | 124,887 | 133,845 |
| Long-Term Debt - IDA Credit proceeds[1] | - | - | - | - | - | 400 | 8,440 | 24,680 | 41,200 | 56,047 | 54,472 | 52,801 | 51,028 | 49,147 | 47,151 |
| Advances from Government | - | - | - | - | - | - | 149 | 7,149 | 14,849 | 7,049 | 3,949 | - | - | - | - |
| Accounts Payable and Other Provisions | | | | | | | | | | | | | | | |
| Consumers' Deposits and Advance Payments | 1,091 | 1,521 | 1,829 | 2,304 | 2,670 | 3,300 | 3,940 | 4,595 | 5,265 | 5,950 | 6,650 | 7,365 | 8,095 | 8,845 | 9,610 |
| Retention Money | 124 | 131 | 101 | 211 | 200 | 340 | 1,500 | 2,100 | 2,460 | 200 | 200 | 200 | 200 | 200 | 200 |
| Suppliers and Miscellaneous | 813 | 1,681 | 549 | 777 | 750 | 820 | 900 | 990 | 1,105 | 1,200 | 1,295 | 1,365 | 1,440 | 1,540 | 1,620 |
| Retirement Provision | 682 | 653 | 765 | 692 | 596 | 499 | 421 | 344 | 286 | 228 | 170 | 102 | 55 | - | - |
| | 2,710 | 3,986 | 3,244 | 3,984 | 4,216 | 4,959 | 6,761 | 8,029 | 9,116 | 7,578 | 8,315 | 9,032 | 9,790 | 10,585 | 11,430 |
| Current Maturities of Long-Term Debt | - | - | - | - | - | - | - | - | - | 753 | 1,575 | 1,671 | 1,773 | 1,881 | 1,996 |
| Total Current Liabilities | 2,710 | 3,986 | 3,244 | 3,984 | 4,216 | 4,959 | 6,761 | 8,029 | 9,116 | 8,331 | 9,890 | 10,703 | 11,563 | 12,466 | 13,426 |
| TOTAL EQUITY AND LIABILITIES | 70,381 | 75,171 | 78,385 | 83,049 | 87,802 | 93,063 | 106,877 | 137,333 | 167,242 | 177,188 | 177,792 | 177,363 | 181,513 | 186,500 | 194,422 |
| Debt/Equity Ratio | 0:100 | 0:100 | 0:100 | 0:100 | 0:100 | 0:100 | 8:92 | 20:80 | 29:71 | 35:65 | 33:67 | 32:68 | 30:70 | 28:72 | 26:74 |

1/ Net of current maturities

April 26, 1973

ANNEX 12

# SYRIA

## DAMASCUS WATER SUPPLY PROJECT

## E.P.E.F. - PRESENT TARIFF

| | Description | Payable by | Amount |
|---|---|---|---|
| **Non-Recurring Charges** | | | |
| (i) | Water Right Purchase | Applicants[1] with premises over 100m$^2$ | LS 2000 per m$^3$/day[2] |
| (ii) | Capital Contribution | All applicants | Min. LS 75 |
| (iii) | Connection Fee | -do- | Cost plus 20% |
| (iv) | Subscription Fee | -do- | LS 5 |
| (v) | Meter Installation Fee | -do- | LS 5 |
| (vi) | Deposit | -do- | Consumption deposit plus value of meter |
| **Recurring Charges** | | | |
| (i) | Metered Supply | Water right holders - excess. Others - all consumption[3] | LS0.20/m$^3$ |
| (ii) | Annual Fee | W.R. holders | LS 14 per m$^3$/day of water right |
| (iii) | Meter Rent and Maintenance | All consumers | Varies (Basic = LS9 per year) |
| (iv) | Subscription to Distribution System Maintenance | -do- | LS 3.60 year |
| (v) | -do- (Temporary Supplies) | As appropriate | LS 50 year |

---

1/ Public, religious and certain other types of premises are exempt.

2/ The allowance to be purchased depends on the size of the premises and can be as little as 1/4 m$^3$/day.

3/ Not for public standpipes or religious buildings.

# SYRIA

## DAMASCUS WATER SUPPLY PROJECT

## Assumptions for Financial Projections

### Income Statements

1. Population served, number of connections and volumes consumed are in accordance with the projections in Annex 2. Total connections grow by slightly less than the number of new connections, because some old connections are abandoned each year. About one-third of new consumers are assumed to purchase a water right; though the overall average to date has been about one-in-two, the trend has shown fluctuations -- after high percentages up to 1966, it dropped to one-in-four in that year, but has since been rising year by year to one-in-three in 1970-71. The average water right purchase is projected to continue to be for about 1/2 $m^3$/day.

2. Of the water supplied, part is not chargeable at the metered rate, being within the allowance purchased by water right holders; this unchargeable portion is assumed to be equal to 98% of the total allowance.

3. Increases in tariffs are, for simplicity, assumed to bear upon the metered rate only (with consequential adjustments in the annual fee which links the price of water rights to the current price of water -- see paragraph 6.08 of main Report); the price of water rights is deemed to remain at LS2000/$m^3$/day. The authorities could however increase this, instead of (or as well as) the metered rate. The tariffs assumed are:

| | To end 1974 | To end 1981 | Thereafter |
|---|---|---|---|
| Price per $m^3$ | LS 0.20 | LS 0.27 | LS 0.30 |
| Annual Fee 1/ | LS14.00 | LS40.00 | LS50.00 |

1/ Calculated in projections on mid-year figures of accumulated water rights.

4. "Meter Rent and Maintenance Fees" are projected at LS9 a year, except for consumers owning their own meter who pay only the maintenance fee of LS5; these are assumed to be phased out by 1982, with EPEF installing its own meters throughout the city. "Distribution System Maintenance Fees" are estimated at the present level of LS3.60 a year per connection, calculated on the mid-year total of connections.

5. "New Connections and Meter Installation" are assumed at LS70 for a decreasing number of new connections, and LS40 for an increasing proportion; the lower fee reflects a new policy of EPEF in providing pavement connection boxes for easier hook-ups. Both are adjusted to reflect 3% annual cost inflation. In addition, it is estimated that 10,000 new meters will be installed yearly for 5 years, at a fee of LS5 each, replacing customers' own meters when defective.

6. "Other Fees and Charges" are based on EPEF's own forecasts to 1976, thereafter increasing slightly to reflect the growing population served. "Non-Operating and Previous Years' Revenues" likewise increase in proportion to sales.

7. Under the heading of expenses, "Personnel" is forecast to increase at 10% annually to 1976 and 6% thereafter. Of these percentages, 3% reflects price inflation and the remainder growth in numbers.

8. "Maintenance and Materials" are calculated each year at about 0.5% of the value of the gross fixed assets at the beginning of the preceding year, excluding land and also the tunnels, for which maintenance is carried out at extended intervals and capitalized. The rate is low because of the large element of mains replacement in the capital program.

9. Of present pumping costs, the portion representing pumping to increase the flow at the source is deemed to double by 1974, then taper off to nil when the underground dam is finished. Later, this pumping recommences and intensifies as peak consumption approaches the new capacity of the spring. The remaining pumping, in the high level distribution network, is assumed to grow at 6% a year, tapering off to 3% as the available high land is built up. Power rate increases of 10% every 4 years are assumed.

10. Vehicle and transport expenses, and heating, lighting and miscellaneous administration expenses increase annually at various rates depending on their nature. Expenses of new connections are projected to maintain the same proportion of the revenues relating to this activity, as at present.

11. "Non-Operating and Previous Years' Expenses" are projected as increasing in proportion to sales. Contributions to the Bad Debts Provision are estimated as building it up to approximately 1% of outstanding consumers' accounts. The Retirement Provision contributions are projected as disappearing after five years since this provision relates only to older employees not covered by social security.

12. A provision for contingencies is added in projections, rising after 3 years to a level equivalent to 5% of expenses other than depreciation.

13. Depreciation charges for existing assets are deemed to continue at present rates, though reducing slightly in total as assets become fully depreciated. For new assets, the following annual rates are assumed:-

| | |
|---|---|
| Tunnel, works at spring | 1.25% |
| Mains and pipes | 2.5 % |
| Reservoirs | 3 % |
| Pumping stations | 6 % |
| Communications system, operational equipment | 10 % |

Cash Flow Statements

14. Capital contributions from new consumers are projected at the minimum present charge of LS75 each. Government contributions are estimated to be as detailed in para 6.17 of the main report.

15. Investment costs outside the project are based on a specific program up to 1977. Thereafter an investment by EPEF of LS3 million a year is assumed plus LS1 million in 1978 to cover the rehabilitation of the existing tunnel.

Balance Sheets

16. Fixed assets are not revalued, in view of the price escalation contained in the cost estimates for upcoming investments which make up the bulk of the rate base.

17. "Investments - Housing Loans" reflect an activity which has ceased, and are projected to disappear by 1975. The contribution to the municipality is assumed to be unchanged.

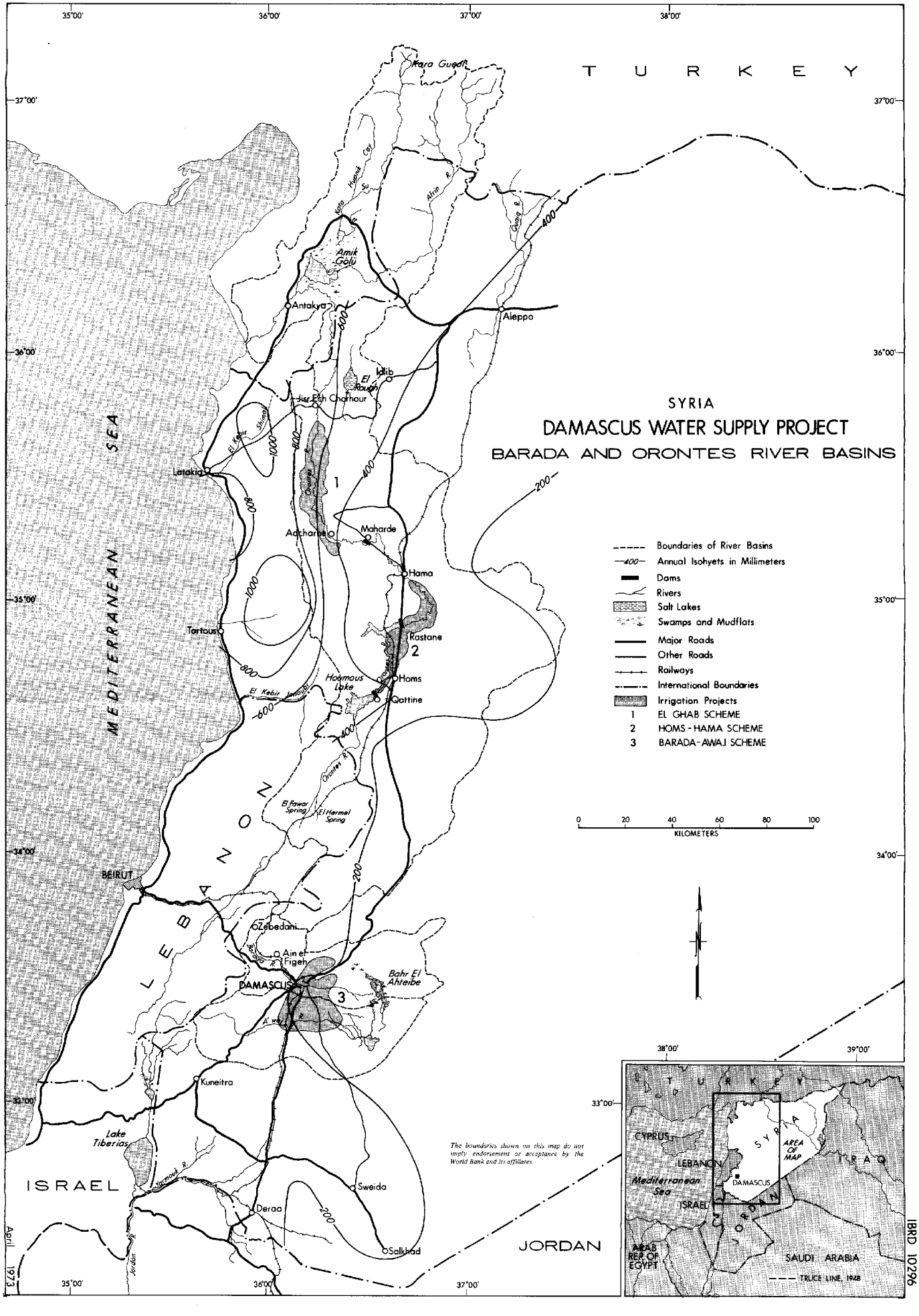
18. Stocks of materials are assumed to run down to LS2.5 million at the end of 1976, thereafter building up again to about LS7.5 million in 1982. As part of the run-down, about LS12 million worth of materials are forecast to be used in the project (including LS4 million on order at December 31, 1972).

19. Receivables due from consumers are forecast to reduce from 7 months' revenues equivalent to 5 months' equivalent over the next 3 years, on the assumption of a speed-up in billing. Outstanding instalments of water right and connection charges are assumed at a level equal to one year's sales of water rights.

20. Advance payments and other receivables are difficult to forecast; they are arbitrarily assumed to fluctuate by about 10% of the rise or fall in the following year's capital expenditure.

21. On the liabilities side of the balance sheet, reserves and provisions have been dealt with in earlier paragraphs. "Consumers' Deposits and Advance Payments" are assumed to increase by LS50 a year

for each new consumer and by LS30 representing deposits received when 10,000 customers' meters are replaced (whether defective or not) by EPEF's own meters, each year for ten years. Amounts due to suppliers and others are projected at the equivalent of two month's operating expenses, other than depreciation; and retention money at 10% of work-in-progress.


SYRIA
DAMASCUS WATER SUPPLY PROJECT
BARADA AND ORONTES RIVER BASINS
Boundaries of River Basins
Annual Isohyets in Millimeters
Dams
Rivers
Salt Lakes
Swamps and Mudflats
Major Roads
Other Roads
Railways
International Boundaries
Irrigation Projects
1 EL GHAB SCHEME
2 HOMS - HAMA SCHEME
3 BARADA - AWAJ SCHEME
KILOMETERS
TURKEY
SYRIA
LEBANON
ISRAEL
JORDAN
MEDITERRANEAN SEA
Lake Tiberias
Hoqmous Lake
Amik Golü
El Fawar Spring
El Hammel Spring
Bahr El Ahteibe
Aleppo
Antakya
Idlib
Latakia
Tartous
Hama
Homs
Rastane
Qattine
Maharde
Acharne
Jisr Esh Chorhour
Zebedani
Ain el Figeh
DAMASCUS
Kuneitra
Deraa
Sweida
Salkhad
BEIRUT
Kara Guedi
CYPRUS
IRAQ
Mediterranean Sea
AREA OF MAP
ARAB REP. OF EGYPT
SAUDI ARABIA
TRUCE LINE, 1948
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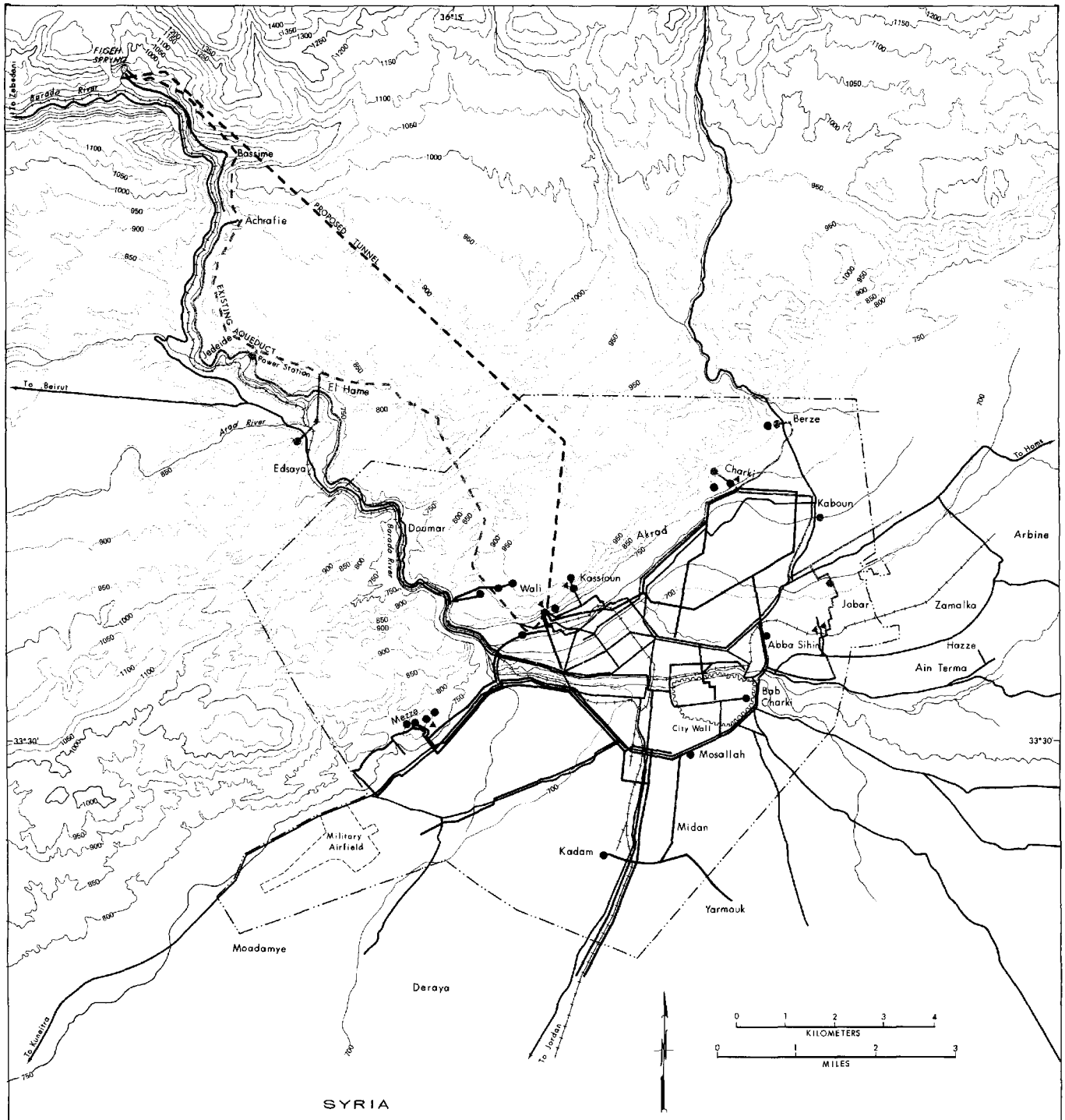
April 1973
IBRD 10296

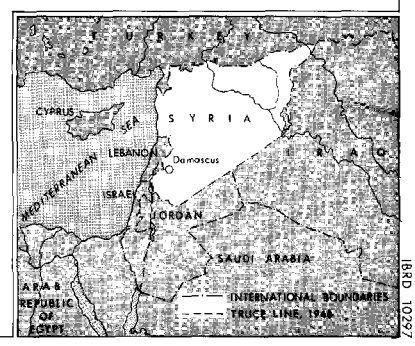



SYRIA

# DAMASCUS WATER SUPPLY PROJECT

## METROPOLITAN AREA OF DAMASCUS

- Proposed Pumping Stations
- Proposed Reservoirs
- Proposed Water Mains
- Existing Pumping Station
- Existing Reservoirs
- Existing Water Mains
- Roads
- Railways
- Boundary of Damascus Municipality
- Contours, 50 Meter Interval

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APRIL 1973

IBRD 10297