Executive Summary

FEASIBILITY REPORT
AND PRELIMINARY
ENGINEERING STUDIES

IRBID MUNICIPAL WATER DISTRIBUTION, SEWERAGE, STORM DRAINAGE AND SOLID WASTE DISPOSAL PROJECT

SUBMITTED THRU

MINISTRY OF MUNICIPAL, RURAL AND ENVIRONMENTAL AFFAIRS - EXECUTING AGENCY

TO THE

NATIONAL PLANNING COUNCIL - THE HASHEMITE KINGDOM OF JORDAN

August 1980

By
WESTON INTERNATIONAL, INC.

in association with
STANLEY CONSULTANTS, INC.
SIGMA-CONSULTING ENGINEERS
MRM-CONSULTING ENGINEERS
CO., LTD.

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Engineering Studies

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IRBID - EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

INTRODUCTION AND SCOPE

In May 1979, the National Planning Council (NPC) of Jordan, through its executing agency, the Ministry of Municipal, Rural and Environmental Affairs (MMREA), gave authority to proceed with the feasibility and preliminary engineering phase of this project. The consultant group selected by NPC to provide services was Weston International, Inc., with its subcontractors; Stanley Consultants, Inc.; SIGMA-Consulting Engineers and MRM Consulting Engineers Co., Ltd.

The objective of this feasibility study was to investigate the technical and economic feasibility of constructing four types of municipal services for the Irbid Town Plan area, as follows:

1. Water distribution system.
2. Sewage collection, treatment, and disposal system.
3. Stormwater drainage system.
4. Solid waste collection and disposal system.

As of 1979, Irbid had a very limited water supply system, no effective sewerage system, a limited solid waste system, and a very limited storm drainage system. The inadequate existing municipal services permitted unhealthy conditions to exist in many areas of the Municipality.

FEASIBILITY STUDIES

The consultant performed a series of interrelated studies to determine the best type of service in each category for use in Irbid. These studies included:

1. Socioeconomic studies.
2. Development of technical criteria.
3. Water distribution studies.
4. Sewerage system studies.
5. Solid waste studies.
6. Stormwater drainage system studies.
7. Environmental studies.
8. Financial and economic studies.
9. Institutional and implementation studies.

The consultant reviewed all available data, information, reports, policies, guidelines, and goals as part of these studies to formulate technical alternatives for each type of service

needed. These alternatives were analyzed using technical, socioeconomic, economic, and environmental factors. The recommended systems designed in this way are efficient, cost-effective municipal services especially suited to provide the services necessary for the Municipality of Irbid.

RECOMMENDED FACILITIES

The consultant has prepared the feasibility studies and preliminary engineering designs for all four types of municipal services to serve a future population of about 265,000 people in the year 2000 and beyond, based on the results of the 1979 census and independent studies conducted by the consultant.

Water Distribution System

The existing water distribution system in Irbid is efficiently operated, but is poorly designed and badly undersized. A new water distribution system is proposed that will incorporate the useable parts of the existing system, and will include nearly 75 km of new water mains, ranging in size from 10 cm (4 in.) to 80 cm (32 in.). Operation, maintenance, and training programs were formulated especially for the proposed system. The proposed system is designed to deliver sufficient water to meet an average daily demand of 55,600 cu m per day by the year 2000.

The new system is designed to take water from both the existing Water Supply Corporation (WSC) facilities and the Jordan Valley Authority's (JVA) proposed North Jordan water supply project facilities.

Sewerage Facilities

Until this year, Irbid has been dependent on septic tanks and cesspools for sewerage service. Because of the lack of suitable soil characteristics and the large growth of the City, this type of service has become unsuitable and unhealthy.

The consultant has prepared a staged-development plan to construct 10.5 km of large interceptor sewers and over 340 km of smaller trunk and lateral sewers, as well as six pumping stations. Of that amount, about 190 km of interceptors and three of the pump stations are recommended for Phase 1 construction.

After thorough analysis of various low-and medium-technology alternatives, the consultant recommends the construction of a modular, staged sewage treatment plant which uses the "extended aeration" treatment process to remove impurities and renovate

the water for future downstream water users in the Wadi Arab. This system was recommended for several reasons, including its ability to meet recommended discharge standards, cost effectiveness, and other technical, socioeconomic, environmental, reliability, and safety considerations.

Stormwater Drainage Facilities

After identifying the areas in Irbid that experience drainage problems, and performing meteorological and hydrological studies, the consultant prepared a drainage plan for the City. The recommended system derived from this optimizing process includes limited use of existing facilities and construction of new facilities to relieve flooding problem areas.

In Wadi el Hamam, a new major collector network will be routed along the natural drainage course. An extension of this line, running southwest along Heckma Street, will relieve a flood problem area to the east of the refugee camp.

In Wadi Tariq Saum, a new storm drain line is also recommended to intercept the runoff from the large southern area of the basin. It also will relieve the overloaded existing drain which will continue in service, but with a much smaller contributing area.

Solid Waste Disposal System

The Municipality of Irbid presently provides solid waste collection and disposal service to its residents. Currently, waste material is placed in plastic or burlap bags, and stored in vacant lots until it is picked up by a collection truck. Pick-up schedules are irregular.

Several solid waste disposal alternatives were studied, including energy recovery, landfilling, and composting. Landfilling was selected mostly on the basis of economic cost-effectiveness. The recommended plan calls for the construction of a sanitary landfill on a 22-hectare (54.6 acres) site with simultaneous construction of a 10-ton per day pilot composting facility. The latter facility is recommended to provide data and demonstrate to area residents the use of composted wastes for agricultural purposes.

Improvements to the collection system have also been recommended in terms of scheduled collection and improved containers.

ECONOMIC AND FINANCIAL FEASIBILITY ANALYSIS

The total estimated capital costs for the entire project are 30,052,000 JD (in constant 1979 JD). The cost per phase for the entire project is 17,891,000 JD for Phase 1 (1980 to 1985), and 12,161,000 JD for Phase 2. These costs are tabulated by major system element in Table 1.

The Phase 1 capital costs are to be expended during the entire 10-year period as indicated in the construction funding schedule presented in Table 2. An annual capital cost inflation rate of 10 percent has been assumed for the project.

Table 3 presents the inflated capital costs estimated for the Phase 1 period. The total inflated costs for the project, financed in accordance with the schedule presented in Tables 2 and 3, is 26,688,000 JD.

A computerized cash flow analysis model was developed and used to project annual revenues, project costs for proposed facilities, integrate costs with existing system expenses, and compare projected costs and revenues for each element of the project. User charges and connection fees were manipulated in the model to produce positive accumulated surpluses on the income and expenditure statement as close to zero as possible.

Output from the model was used to produce cash flow statements, balance sheets, and income/expenditure statements which were checked for viability. Where outputs from these statements were unsatisfactory, user charges and connection fees were adjusted to produce new income/expenditure statements.

The cash flow model was then used to evaluate the sensitivity of the proposed facility to various factors, including inflation, water use rates, user charges, capital costs, and user population. The user charges were further analyzed, together with socioeconomic data, to determine the ability of low-income residents in the City of Irbid to pay for the proposed municipal utility services.

An internal rate of return evaluation was conducted to measure the viability of the proposed project.

These analyses indicate the project is affordable to the people of Irbid, and should be financed based on the benefits that will accrue to the people of Irbid.

Due to timing problems with the lending institutions, insufficient funds are available to initially finance all of Phase 1. For this reason, the consultant, NPC staff, and USAID staff cooperated to identify the portions of the project that can be

Table 1

Capital Cost Summary

(Costs - JD x 1,000)

Major Work Element	Phase 1 Local	Phase 1 Foreign	Phase 1 Total	Phase 2 Local	Phase 2 Foreign	Phase 2 Total	Total Project Local	Total Project Foreign	Total Project Total
Water Supply System									
Probable construction cost[1]	2,279	2,264	4,543	1,978	1,799	3,777	4,257	4,063	8,320
Contingencies	341	342	683	295	272	567	636	614	1,250
Engineering and administration[2]	228	455	683	189	378	567	417	833	1,250
Subtotal	2,848	3,061	5,909	2,462	2,449	4,911	5,310	5,510	10,820
Wastewater System									
Probable construction cost[1]	4,170	1,910	6,080	3,025	1,367	4,392	7,195	3,277	10,472
Contingencies	625	345	970	454	205	659	1,079	550	1,629
Engineering and administration[2]	625	345	970	454	205	659	1,079	550	1,629
Subtotal	5,420	2,600	8,020	3,933	1,777	5,710	9,353	4,377	13,730
Storm Drainage System									
Probable construction cost[1]	2,289	123	2,412	928	14	942	3,217	137	3,354
Contingencies	272	18	290	139	2	141	411	20	431
Engineering and administration[2]	91	181	272	47	94	141	138	275	413
Subtotal	2,652	322	2,974	1,114	110	1,224	3,766	432	4,198
Solid Waste System									
Probable construction cost[1]	449	438	937	--	316	316	449	754	1,253
Contingencies	26	--	26	--	--	--	26	--	26
Engineering and administration[2]	13	12	25	--	--	--	13	12	25
Subtotal	538	450	988	--	316	316	538	766	1,304
Total Project Costs	11,458	6,433	17,891	7,509	4,652	12,161	18,967	11,085	30,052
Equivalent U.S. $ Cost (U.S. $ = 0.300 JD)		59,637,000			40,537,000			100,174,000	

[1] Including right-of-way.

[2] Engineering and administration is a fee equal to 15% of the probable construction cost. This represents a commonly used fee which is suitable for the budgetary accuracy required here. A more accurate estimate will be made at the end of the design period.

Table 2

Phase 1 Construction Funding Schedule

(Costs - JD x 1,000)

Description	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Total Phase 1 Cost
Water Supply System											
Water supply system costs	0	924	925	930	930	440	440	440	440	440	5,909
Wastewater System											
Wastewater treatment	-	423	829	324	323	323	323	-	-	-	2,545
Sewer construction	-	887	1,883	845	753	410	697	-	-	-	5,475
Subtotal -- Wastewater System Costs	0	1,310	2,712	1,169	1,076	733	1,020	-	-	-	8,020
Storm Drainage System											
Storm drainage system costs	991	1,983	-	-	-	-	-	-	-	-	2,974
Solid Waste System											
Landfill development	440	110	-	-	-	-	-	-	-	-	550
Equipment procurement	162	-	25	-	22	100	30	69	-	30	438
Subtotal -- Solid Waste System	602	110	25	-	22	100	30	69	-	30	988
Total Project Costs	1,593	4,327	3,662	2,099	2,028	1,273	1,490	509	440	470	17,891
Equivalent U.S. Dollar Cost (1.00 U.S. Dollar = 0.300 JD)	5,310,000	14,423,000	12,207,000	6,997,000	6,760,000	4,123,000	4,967,000	1,697,000	1,467,000	1,567,000	59,518,000

Note: All costs in this table are constant 1979 costs.

Table 3

Phase 1 Construction Funding Schedule
Escalated Costs

(Costs - JD x 1,000)

Description	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Total Phase 1 Cost
Water Supply System											
Water supply system costs	0	1,118	1,230	1,358	1,497	779	857	943	1,037	1,141	9,142
Wastewater System											
Wastewater treatment		512	1,102	473	520	572	630	-	-	-	3,809
Sewer construction	-	1,073	2,504	1,234	1,212	726	1,359	-	-	-	8,108
Subtotal -- Wastewater System Costs	0	1,585	3,606	1,707	1,732	1,308	1,989	-	-	-	11,917
Storm Drainage System											
Storm drainage system costs	1,090	2,399	-	-	-	-	-	-	-	-	3,489
Solid Waste System											
Landfill development	484	133	-	-	-	-	-	-	-	-	617
Equipment procurement	178	-	33	-	35	177	58	147	-	77	705
Subtotal -- Solid Waste System	662	133	33	-	35	177	58	147	-	77	1,322
Total Project Costs	1,752	5,253	4,869	3,065	3,264	2,264	2,904	1,090	1,037	1,218	26,688
Equivalent U.S. Dollar Cost (1.00 U.S. Dollar = 0.300 JD)	5,840	17,450	16,230	10,217	10,879	7,546	9,680	3,633	3,456	4,059	88,960

Note: All costs in this table are escalated from 1979 costs, using 10% inflation.

Source: Tables 9-9, 9-12, and 9-15

constructed with money available from USAID. It was decided to fund the first module of the sewage treatment plant, and several of the water distribution and sewage collection system construction packages. Other elements of the project will be initiated as financing becomes available.

USAID is prepared to fund this initial project with a loan in the amount of $21 million (U.S) and a grant of $2.5 million (U.S).

The rates related to the full project are shown in Table 4, which shows annual user charges in 1980 of 25.2 JD, rising to 61.7 JD per year by 1989.

INSTITUTIONAL RECOMMENDATION

The consultant formulated an organization plan for an operating authority independent of the Municipality of Irbid. This authority would have responsibility for the administration and operation of all recommended facilities. It is our understanding that this authority will operate under the Water Supply Corporation.

IMPLEMENTATION SCHEDULE

A proposed list of construction contracts and an initial construction schedule that meets the requirement to construct the initial project facilities by the end of 1981 is developed and presented in Figure 1 and Table 5. This schedule takes into account the mandate to serve the low income, public health problem areas first.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations have been developed during this study:

1. The project is affordable by the people of Irbid, and should be financed based on the benefits that will accrue.

2. Recommended project elements should be financed and work initiated as soon as possible since projected inflation factors have significant effects on overall project costs.

Table 4

Summary of Household Average Annual
User Charges and Fees for Proposed Municipal Services
(1980-1989)

(in JD)

	Water Supply[1]		Wastewater		Solid Waste	Stormwater	
Year	Administrative Connection Fee	Annual User Charge	Administrative Connection Fee	Annual User Charge	Annual User Charge	Annual User Charge	Total Annual User Charge
1980	14	7.2	0	0	18.00	0	25.2
1981	19	7.2	32	0	18.00	11.30	36.5
1982	19	7.2	32	0	18.00	10.70	35.9
1983	19	7.2	32	4.8	18.00	10.30	40.3
1984	19	9.6	32	4.8	27.60	9.70	51.7
1985	19	9.6	32	4.8	27.60	9.30	51.3
1986	19	9.6	32	15.6	27.60	8.90	62.0
1987	19	10.8	32	15.6	27.60	8.50	69.3
1988	19	10.8	32	15.6	27.60	8.00	62.0
1989	19	10.8	32	15.6	27.60	7.70	61.7

[1] Charges do not include wholesale water costs.

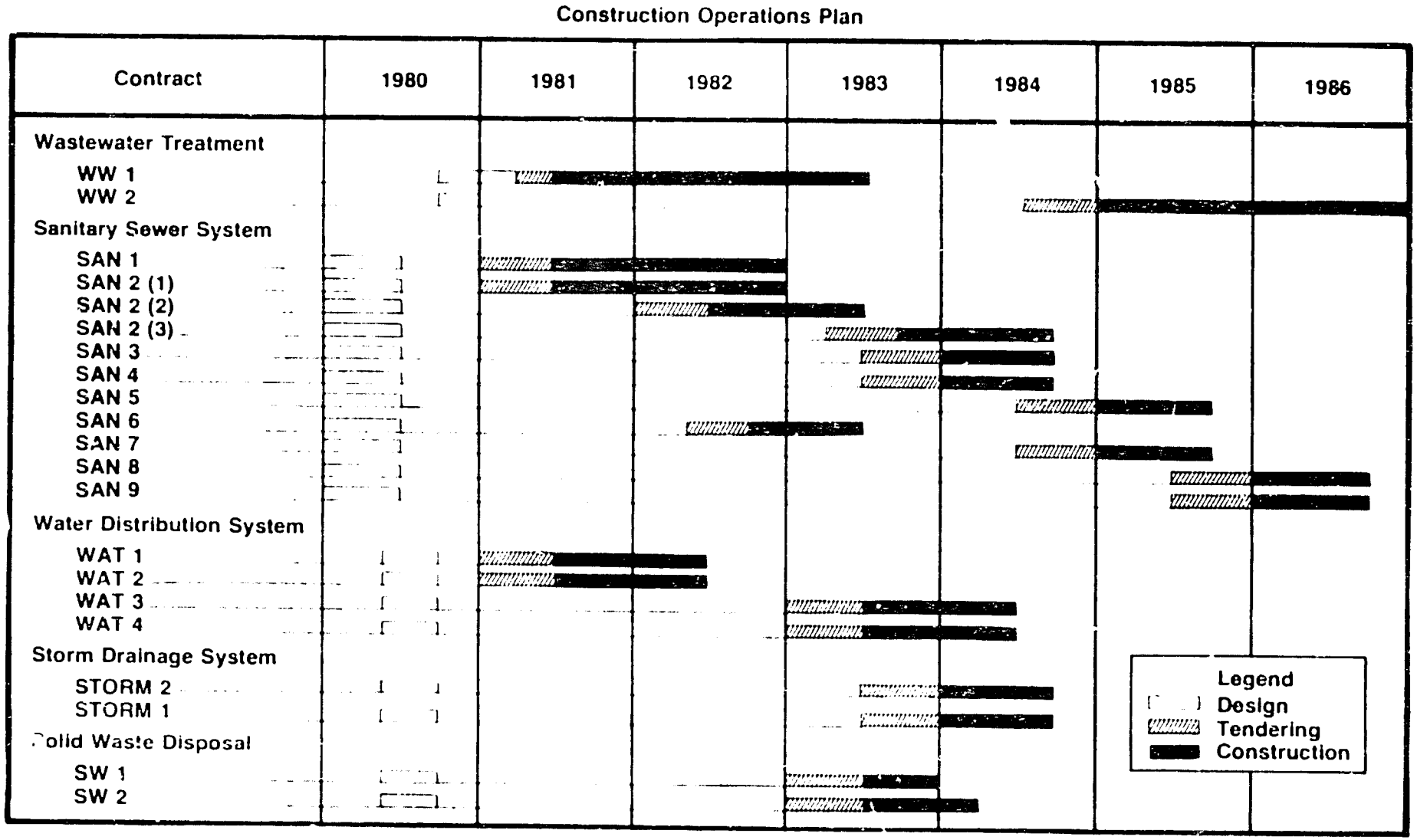

FIGURE 1 INCREMENTAL IMPLEMENTATION PLAN

Table 5

Phase 1 -- Sanitary Sewer Construction Contracts
Contract Description and Estimate Costs

Contract Designation and Description	Pipe Diameter (mm) millimeters: 250 Length (meters)	250 No. of Manholes	250 Cost ($)	600 Length (meters)	600 No. of Manholes	600 Cost ($)	500 Length (meters)	500 No. of Manholes	500 Cost ($)	400 Length (meters)	400 No. of Manholes	400 Cost ($)	250 Length (meters)	250 No. of Manholes	250 Cost ($)	200 Length (meters)	200 No. of Manholes	200 Cost ($)	Pump Station Cost ($)	Force Main Length (meters)	Force Main Cost ($)	Sub-Total ($)	Contingencies -- 15% ($)	Engineering and Admin. -- 15% ($)	Total Cost ($)
SAN 1 -- Includes Interceptor A; A-4 and A-7 trunks; A-4, A-7A, A-7B, and A-7C laterals; A-5, A-6, A-6A, A-8, A-10, A-11, A-18, and A-19 trunks and laterals; pump station no. 2, and force main.	2,260	27	287,581	-	-	-	1,025	22	179,597	1,650	18	57,846	1,375	15	29,711	42,245	461	823,465	27,000	500	7,500	1,333,000	200,000	200,000	1,733,000
SAN 2 (1) -- Includes Interceptor B to B-1 connection; B-1, B-1A, and B-1B trunks; and B-1A and B-1B laterals.	1,040	10	48,508	400	2	20,706	1,775	15	66,157	-	-	-	-	-	-	13,776	146	258,629	-	-	-	396,000	59,500	59,500	515,000
SAN 2 (2) -- Includes B-1C and B-1D trunks and laterals.	-	-	-	-	-	-	-	-	-	1,200	17	41,882	-	-	-	23,130	236	432,718	-	-	-	474,600	71,200	71,200	617,000
SAN 2 (3) -- Includes remainder of interceptor B (Phase 1), B-2A, B-2B, B-4, B-6, and B-9 trunks and laterals; industrial park laterals; pump station no. 1; and force main.	-	-	-	-	-	-	1,019	10	39,901	-	-	-	1,000	8	20,147	21,603	216	430,612	20,000	1,250	21,860	532,400	79,800	79,800	692,000
SAN 2 -- Total	1,040	10	48,508	400	2	20,706	2,794	25	106,138	1,200	17	41,882	1,000	8	20,147	60,503	598	1,121,759	20,000	1,250	21,860	1,403,000	210,500	210,500	1,824,000
SAN 3 -- Includes A-3 trunk and laterals.	-	-	-	-	-	-	-	-	-	-	-	-	820	9	17,813	7,740	68	142,963	-	-	-	160,800	24,100	24,100	209,000
SAN 4 -- Includes A-7C1 and A-9 trunk and laterals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14,480	127	267,700	-	-	-	267,700	40,150	40,150	348,000
SAN 5 -- Includes A-14 trunk and laterals; pump station no. 3; and force main.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,170	28	58,856	27,000	1,300	18,000	103,850	15,575	15,575	135,000
SAN 6 -- Includes A-15 and A-16 trunks; and A-15A and A-16A laterals.	-	-	-	-	-	-	-	-	-	3,180	38	110,032	-	-	-	10,815	62	192,968	-	-	-	303,000	45,000	45,000	393,000
SAN 7 -- Includes B-2 and B-5 trunks and laterals.	-	-	-	-	-	-	-	-	-	-	-	-	1,200	22	36,331	6,460	52	129,669	-	-	-	160,000	24,000	24,000	208,000
SAN 8 -- Includes A-12 and A-13 trunks and laterals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,210	125	279,200	-	-	-	279,200	41,900	41,900	363,000
SAN 9 -- Includes A-15B, A-15C, and A-16B laterals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,140	75	201,600	-	-	-	201,600	30,200	30,200	262,000
Total Phase 1 Costs	3,300	37	256,389	400	3	20,706	5,865	97	287,335	6,030	73	289,766	4,395	54	98,082	171,763	1,596	3,218,196	74,000	2,950	47,360	4,212,156	631,425	631,425	5,475,000

Note: All costs in this table are 1979 costs.

3. Guidelines and procedures should be adopted to create the new implementing agency by the end of 1980. Accounting and cost control should be in accordance with the methods and procedures of the Financial Accounting Standards Board, Stamford, Connecticut, USA. The new agency should be audited annually.

4. For purposes of maintaining institutional stability, user charges and rate schedules should be established and the frequency of rate changes minimized to provide a positive image to the public.

5. Decisions regarding the new water system should be made concerning reconnection of residents who are currently part of the existing water supply system. It is recommended that the 19 JD administrative/connection fee for the 1980 population of 15,500 residential users be covered by a governmental subsidy. This subsidy would be equal to 294,500 JD in 1980 to be used as revenues in the water distribution system.

6. Grants should be made available to low-income families who cannot afford the costs of connection (estimated at 200 JD per connection) to the wastewater collection system. A short-term loan program should also be developed to reduce the burden of wastewater connections for other residents. The schedule of subsidies for assisting low-income families is as follows:

Low Income Subsidies
(JD)

1981	251,000
1982	251,000
1983	165,600
1984	165,600
1985	372,700
1986	231,900
1987	338,800
1988	231,900
1989	90,300

Figures are based on a constant 251 JD administrative/connection fee (not escalated) for a combined water and wastewater system.