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DEPARTMENT OF
PUBLIC WORKS

OFFICE OF THE DIRECTOR

CITY OF SACRAMENTO
CALIFORNIA

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August 23, 1988

Budget and Finance/Transportation
and Community Development Committee
Sacramento, California

Honorable Members in Session:

SUBJECT: **OVERVIEW OF CURRENT AND PROJECTED SEWER FACILITY REQUIREMENTS**

SUMMARY

In the fall of 1987, the City Council directed staff to report on the condition of the City's infrastructure, identify deficiencies and outline plans to meet future growth. The first two of these reports, discussing the water system and the drainage system, were reviewed by the Joint Committees earlier this year. The third report, an overview of the sewer system, is now presented for the Committees' information (see attached exhibit under separate cover).

Some of the City's sewer facilities, although seeming to work satisfactorily today, are nearing the end of their useful life. As a result, maintenance and capital improvement costs will be on the rise. Of particular note is the need to repair and/or replace old brick sewers in the central City. The attached report also discusses street flooding problems associated with the combined sewer system. Correction of these street flooding problems would be very expensive and probably require debt financing.

RECOMMENDATION

This report is submitted for Committee review.

Respectfully submitted,

MELVIN H. JOHNSON
Director of Public Works

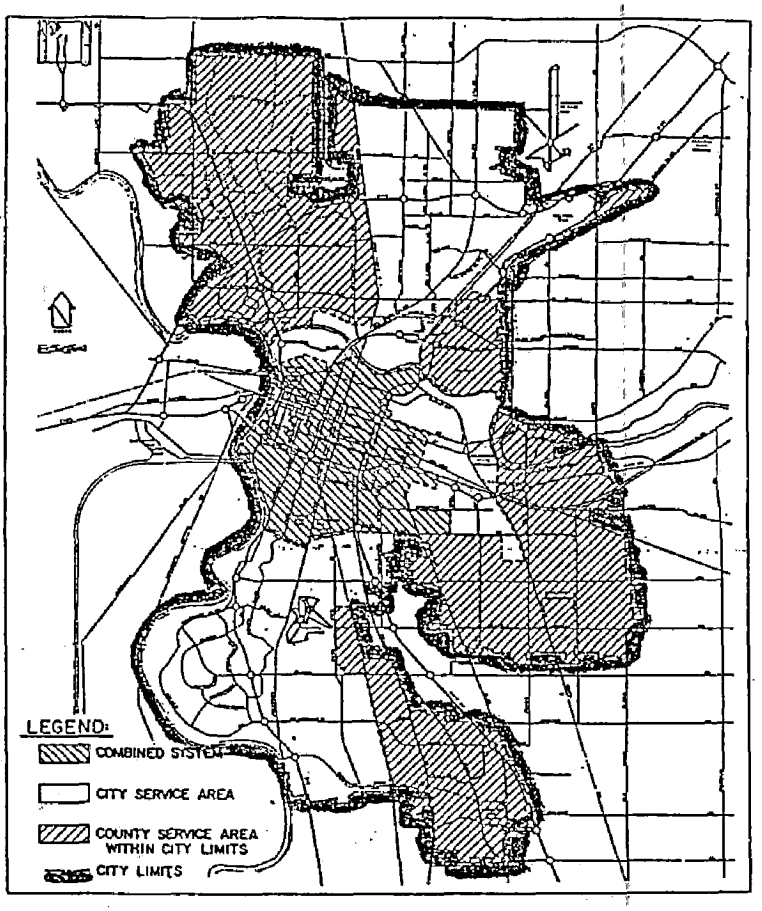
Approved for Committee Information:

Soton Wisham, Jr.
Assistant City Manager

August 23, 1988
All Districts

CITY OF SACRAMENTO

OVERVIEW OF CURRENT AND PROJECTED SEWER FACILITY REQUIREMENTS



PREPARED BY

DEPARTMENT OF PUBLIC WORKS

FLOOD CONTROL AND SEWER DIVISION

AUGUST 1988

CITY OF SACRAMENTO

OVERVIEW OF CURRENT AND PROJECTED SEWER FACILITY REQUIREMENTS

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FLOOD CONTROL AND SEWER DIVISION

AUGUST 1988

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SUMMARY

This report is an overview of the City's sewer facilities. Included in this report is a description of the sewer and combined sewer facilities, a discussion of facility problems, a summary of current and future capital improvement projects, an estimate of projected expenditures, and a description of current maintenance programs.

The City's sewer facilities consist of 310 miles of combined sewer/drainage pipelines, 510 miles of separate sewer pipelines and 42 wastewater pumping plants. The combined and separate sewer pipelines are anywhere from new to 130 years old and, due to deterioration, root intrusion and settlement, the older pipelines need to be repaired or replaced. Additionally, the combined sewer system needs to be upgraded since it does not have sufficient capacity to handle even a minor storm without local flooding occurring at various locations throughout the Central City. The wastewater pumping plants, which are more than 30 years old, are nearing the end of their useful life and need to be rehabilitated and/or replaced.

Depending on location, various improvements and maintenance work have been performed in the past that generally alleviated particular problems as they became known. Due to the age of the system, however, problems are on the increase. The latest estimate of the cost of needed capital improvements is $89.4 million. Included in this estimate is $80 million for partial separation of the combined system and $9.4 million for the existing and future capital improvements.

Approximately $6.7 million in revenues is expected to be generated in fiscal year 1988–89. This revenue will be needed to pay the operation and maintenance cost ($5.4 million) and to fund the yearly capital improvements ($1.3 million). Consequently if the $89.4 million in capital improvements are to be completed in a timely manner, an additional revenue source will be necessary. If the goal is to complete the separation of the combined system in 20 years and the other capital improvements in five years, approximately $12 million in total annual revenue would be required.

INTRODUCTION

Description of Sewer Facilities

The City's sewer facilities consist of a large combined sewer/storm drain system, herein after referred to as the combined system, serving the downtown and surrounding areas and a separated sewer system serving the other areas. Figure 1 shows the areas of the City served by the combined and separate systems.

A significant portion of the City's sewer facilities is maintained by the County Sanitation District No. 1 (CSD1). Figure 2 shows the district's service areas inside the City limits. These areas comprise approximately 40% of the total area within the City limits.

The first combined pipelines were constructed in the late 1800's and consisted of brick laid pipelines that conveyed, by gravity, municipal and residential wastewater and stormwater runoff to the Sacramento River. However, as levee improvements were constructed along the Sacramento River to protect the City from intermediate flooding, the need arose to add pump stations at the ends of these gravity pipelines. The first pump station, Sump 1, was constructed in 1908 followed by Sump 2 in 1916. Both these sumps originally pumped untreated sewer and storm drain water over the levees and into the Sacramento River. Today there are 42 pumping plants included in the City's sewer system. The combined system has seven (7) and the separate sewer has 35 pumping plants. Figure 3, page 5 shows the location of the pumping plants.

The expansion of the City's combined system continued until 1946. At that time, the City discontinued the practice of using combined pipelines and initiated an improvement program wherein new separated storm drains were constructed in selected areas. The service area of the combined system is now limited to approximately 7000 acres located in the central portion of the City of Sacramento.

In 1952 the City, in an effort to satisfy State Health Department regulations, completed the construction of a primary treatment facility at 35th Avenue. Upon completion of this facility, untreated wastewater from the combined system was, for the most part, no longer discharged into the Sacramento River. Only during extreme storm events would wastewater directly discharge into the river. The original treatment facilities consisted of primary settling basins with chlorination. In 1973 the facilities were expanded to include two trickling filters, an additional clarifier and a contact chlorination chamber. This expanded treatment facility remained in service until 1982.

In 1982, the Sacramento Regional Wastewater Treatment Plant (SRWTP) was completed and began treating the wastewater from both the City's combined system and separate sewer system. This new plant and interceptors were constructed to consolidate the County's numerous wastewater treatment facilities and to help resolve an odor problem that historically plagued the City's treatment plant. The Sacramento Regional Wastewater Treatment Plant is operated and maintained by the County.

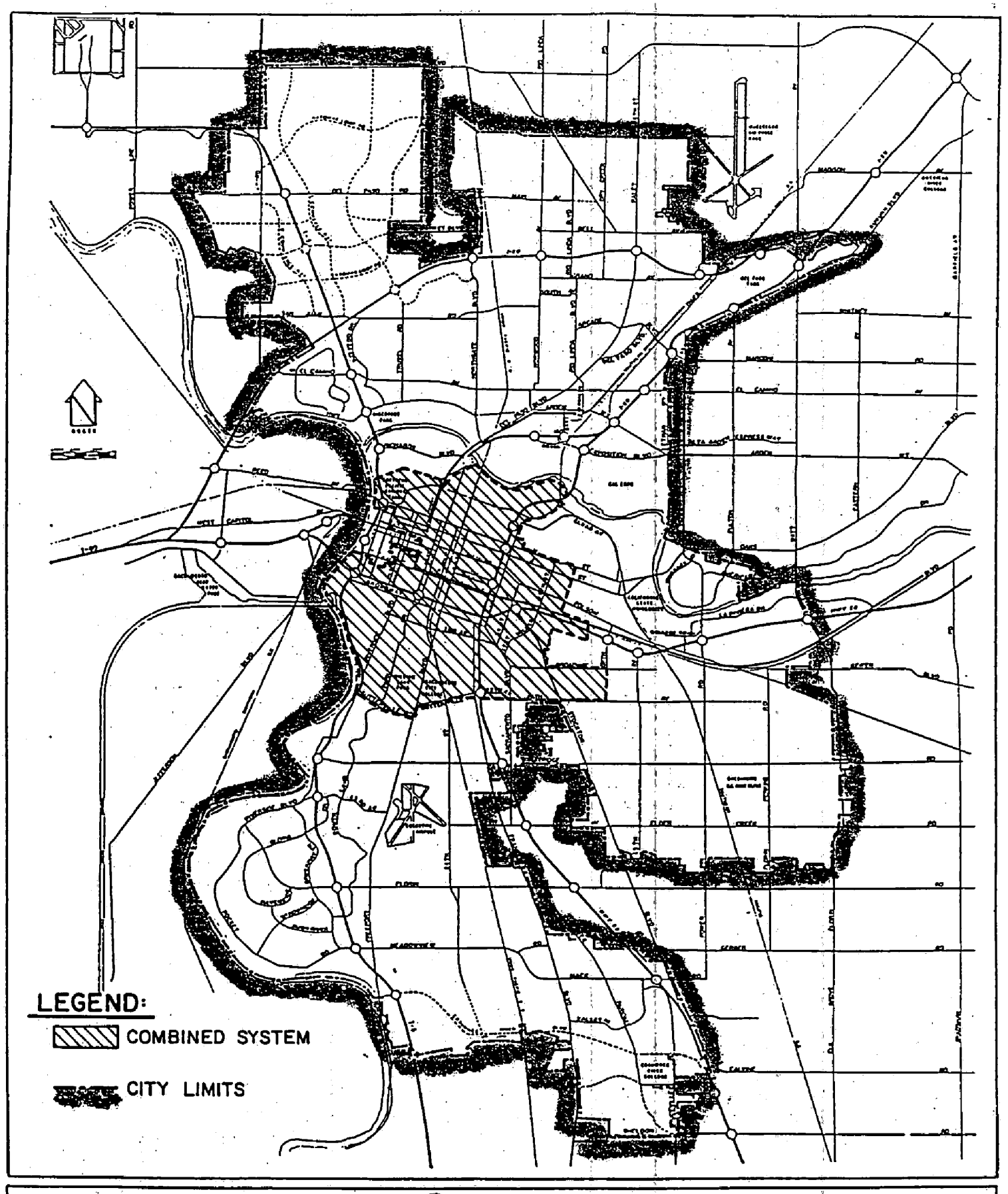

FIGURE 1

AREA OF COMBINED SEWERS

L.R.K. 6/88

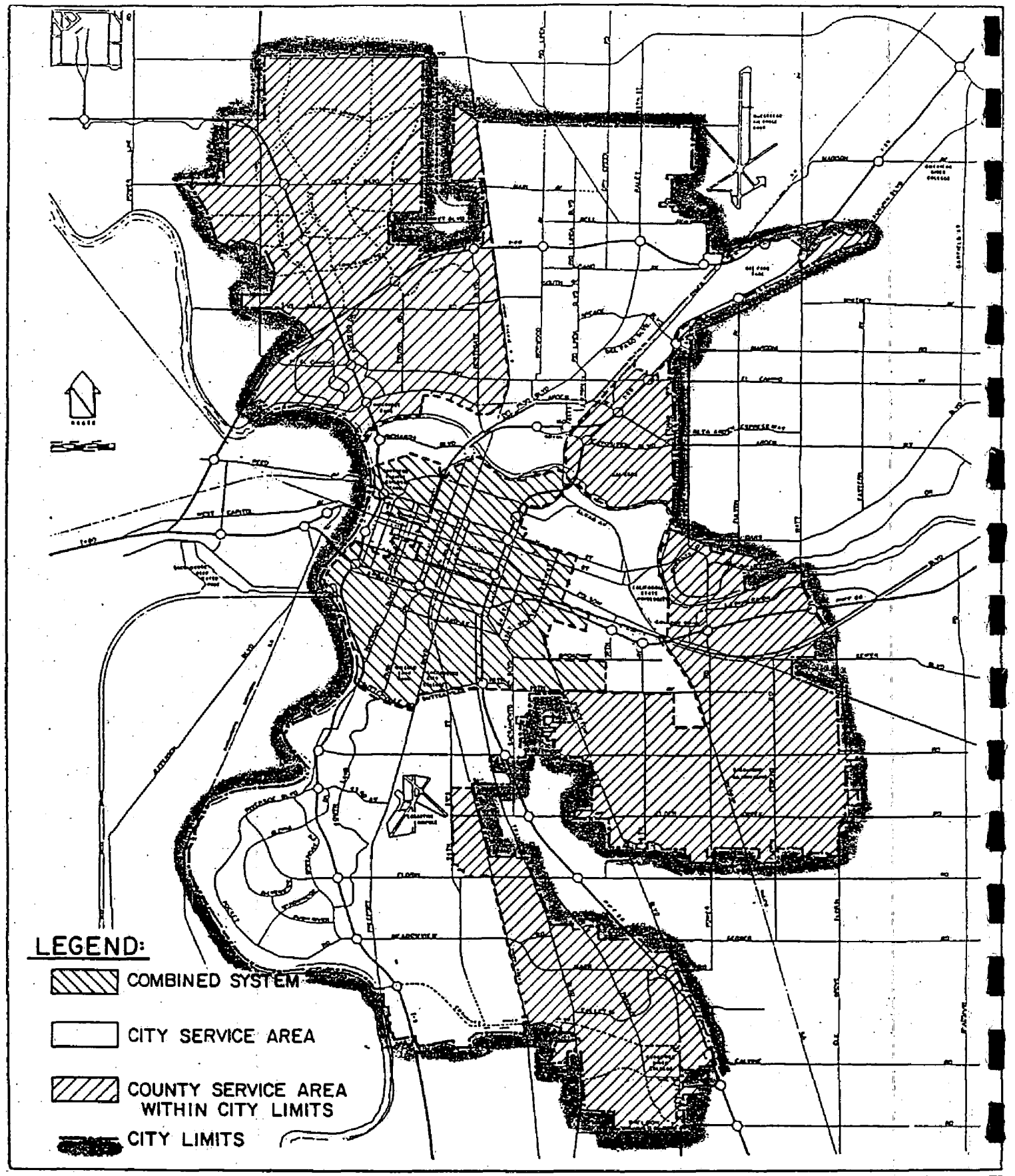

FIGURE 2

SEWER SERVICE AREAS

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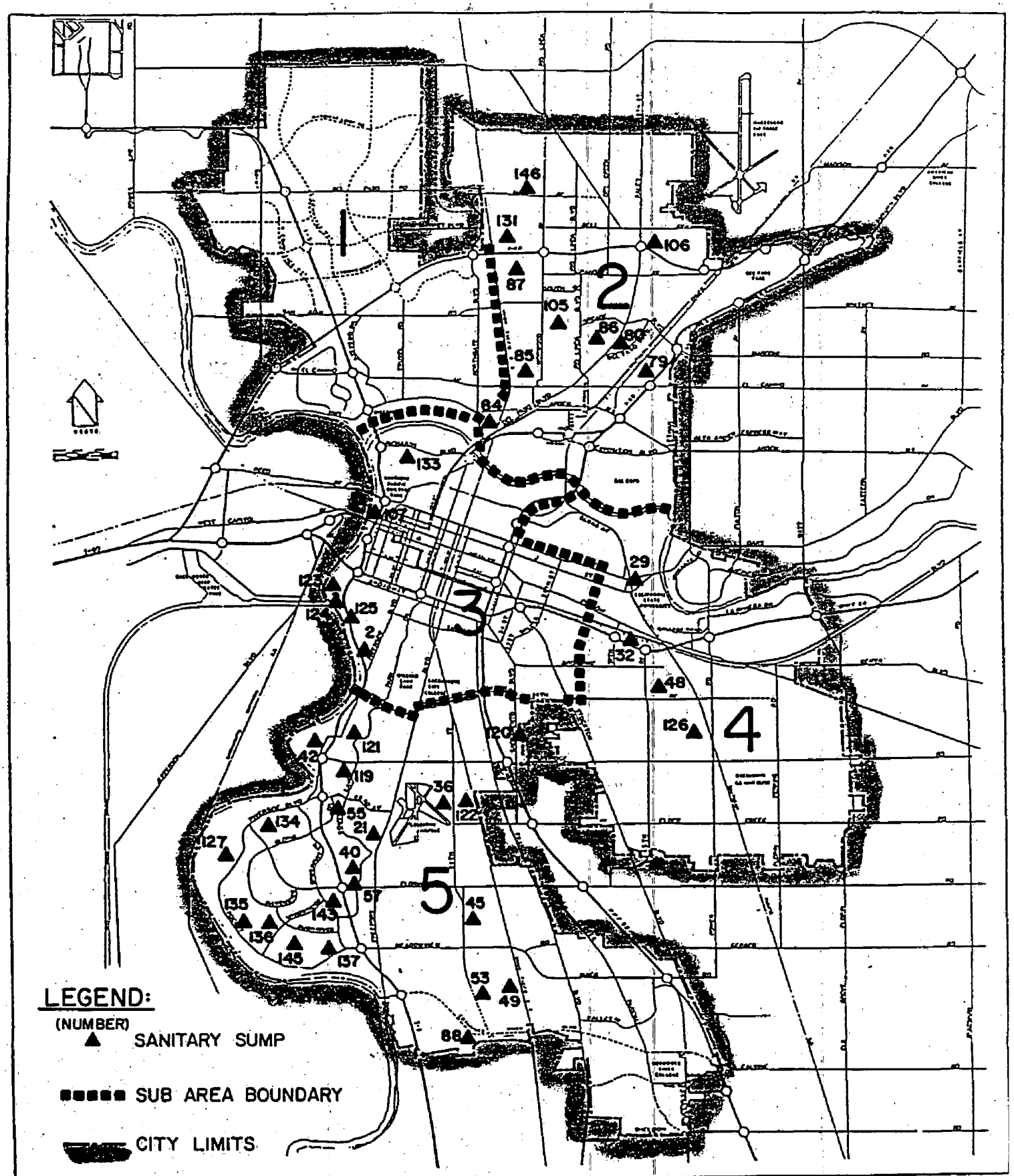

FIGURE 3
SANITARY SUMPS

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Description of Sewer Facilities (continued)

The City's Combined Wastewater Treatment Plant (CWTP) although unused for the most part, is an integral part of the Sacramento Regional Wastewater Treatment Plant (SRWTP) and is operated by City staff. Wastewater from the City's combined system and separate sewer system is conveyed to Sump 2 where it is pumped to the SRWTP facilities. When the combined wet weather inflow to Sump 2 exceeds the City's allocated portion of the SRWTP's capacity, the excess inflow is pumped from Sump 2 to the CWTP for treatment. When the combined capacity of these two treatment sources is exceeded by the inflow to Sump 2, the excess is diverted through the Pioneer Interceptor to the Pioneer Reservoir for storage. The stored wastewater is then diverted back to the CWTP for treatment as the inflow to Sump 2 subsides. During extreme storm weather, combined wastewaters are discharged into the Sacramento River from Sump 1, Sump 2 and the Pioneer Reservoir, as conditions require and in accordance with the City's wastewater discharge permit. A schematic presentation of these facilities is presented in Figure 4.

Inventory of Sewer Facilities

The existing City area is approximately 98 square miles, but the City provides sewer service to only 53 square miles. The remaining 45 square miles are serviced by the County Sanitation District No. 1 (CSD1). Figure 2, page 4 of this report, shows the area served by the City's sewer facilities and the CSD1 facilities.

The City's sewer facilities consist of 304 miles of combined pipelines, 510 miles of separate sewer pipelines and 42 pumping plants. Table I provides greater detail on the lengths of various sizes of pipe for the combined and separate sewer systems. Figure 3, on page 5 of this report, shows the locations of the pumping plants. There are 7 pumping plants in the combined and 35 in the separate sewer system.

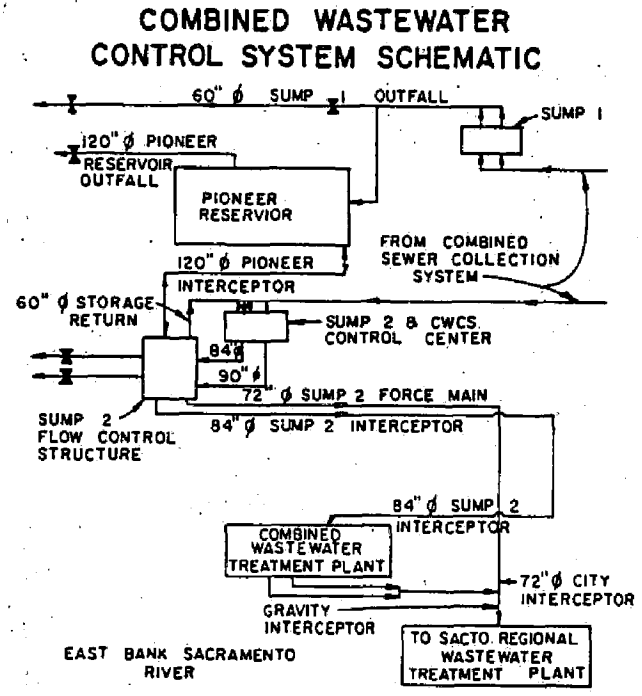

FIGURE 4

TABLE I

COMBINED

SIZE	ADDITIONS IN FEET	FEET TO DATE	SIZE	ADDITIONS IN FEET	FEET TO DATE
4"		2,480	51"		2,560
6"		233,230	52"		2,000
8"	5,998	771,207	54"		6,302
10"	75	121,152	56"		1,220
12"	1,414	93,844	57"		2,920
14"		18,470	58"		2,920
15"	1,283	33,744	60"		18,858
16"		26,960	63"		4,250
18"	1,045	40 ,041	65"		440
20"		12,490	66"		3,030
21"	10	6,980	69"		560
22"		11,400	72"		7,940
24"	1,509	41,949	78"		1,990
27"		9,125	84"		8,360
28"		450	90"		3,340
30"	1,330	11,480	102"		2,580
33"		9,530	108"		11,470
36"		8,254	114"		11,080
39"	1,225	7,325	22" x 30"		240
42"		12,180	30" x 45"		820
44"		2,470	36" x 42"		2,150
45"	446	11,626	4.9' x 3.1'		950
48"		11,440	1.5' x 1.0"		370
			30" FM		3,650
			TOTAL		1,602,817
					(304) Miles

SANITARY SEWERS

SIZE	ADDITIONS IN FEET	FEET TO DATE	SIZE	ADDITIONS IN FEET	FEET TO DATE
4"	500	38,902	36"		5,096
6"	30,954	1,408,946	39"		3,410
8"	14,298	635,542	42"		15,310
10"	1,527	148,802	45"		1,730
12"	594	126,964	54"	669	919
14"		7,030	72"		1,840
15"	690	61,282	36" x 48" brick		1,090
16"		5,720	6" FM		13,459
18"		40,770	8" FM		2,405
20"		5,440	10" FM		1,300
21"		33,792	12" FM		9,750
22:		2,530	16" FM		10,100
24"		42,670	18" FM		4,200
26"		5,550	21" FM		4,800
27"		10,214	24" FM		1,600
30"		13,044	30" FM		800
33"		8,980	36" FM		1,414
			78" FM		5,000
			TOTAL	49,232	2,680,401
					(510) Miles

DISCUSSION

Sewer Facility Problems

To facilitate a clear understanding of the sewer facility problems, the City has been divided into five sub-areas for discussion purposes. These sub-areas are shown on Figure 5 and are identified as follows:

SUBAREA	GEOGRAPHICAL AREA	COMMON NAME
1	North/West Sacramento	Natomas
2	North/East Sacramento	N. Sacramento/Robla
3	Central Sacramento	Original Sacramento
4	South of American River, generally east of U.S.99	E. Central Sacramento
5	South of Sutterville Road, west of U.S.99	S. Sacramento/Pocket

Area 1 - Natomas Area

This area is basically "Natomas" bounded by the City limits on the northwest, the American River on the south; and the Natomas East Main Drain on the east. The southern portion of this area is well developed. The remaining area is agricultural with anticipated development proceeding northerly.

The entire Natomas area is in the County Sanitation District No. 1 (CSD1). Consequently the City has no responsibility for the sewer service to this area.

The developed southern portion of the area (So. Natomas) has interceptors which convey the sewage to the Sacramento Regional treatment facilities located south of the City. The sewer facilities for undeveloped northern portions of this area (No. Natomas) have been master planned by the County and will be implemented by the CSD1.

Area 2 - North Sacramento/Robla

This area is bounded by the Natomas East Main Drain on the west, the City limits on the north, McClellan Air Force Base on the east and the City limits down to the American River on the south. This area, sometimes referred to as North Sacramento, had its sewer service provided by the Hagginwood Sanitation District prior to City annexation. The ages of the sewers vary from 10-60 years and they are generally in average to poor condition. Additionally, some of the sewers have capacity problems due to changes in land use intensities.

Of the total 12,000 acres within this area, 2200 acres lie within the CSD1 service area and 9800 acres are located within the City service area. Approximately 1,550 acres within the City service area are unsewered. This area is commonly referred to as the Robla area and is shaded as shown on Figure 5 on page 9 of this report.

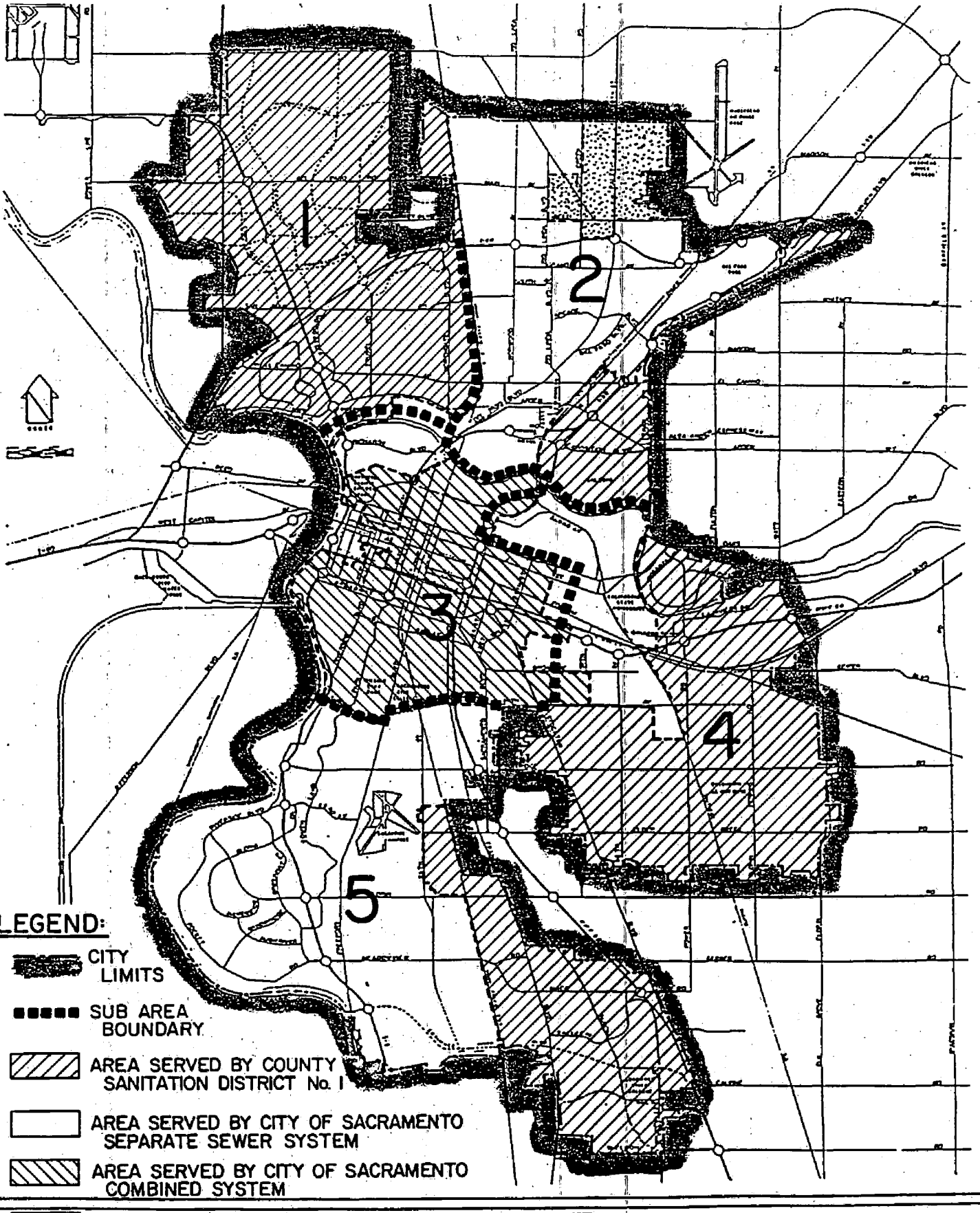

FIGURE 5

SEWER FACILITIES SUB AREAS

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DISCUSSION

Sewer Facility Problems

Area 2 – North Sacramento/Robla (continued)

The majority of this 1,500 acres which extends north of Bell Avenue is vacant land with sparsely scattered residences. The remainder of the area including Bell Avenue and the area South of Bell Avenue is residential development. The North Sacramento Community Adopted Land Use Plan has designated the majority of the area for industrial use with that portion south of Bell Avenue designated for residential use.

Although unsewered, the Robla area has existing sewer mains located at its eastern and southern boundaries. If extended and/or enlarged these existing sewer mains could provide sewer service to the area. An August 1987 study by Spink Engineers entitled, "West of McClellan Air Force Base, Detail Infrastructure Study" analyzed the capacities of the existing sewer mains and designed new mains which would connect to these existing mains and serve this area. The cost to extend and/or enlarge these existing sewer mains is approximately $5.74 million using August 1987 dollars. A summary of pipe sizes and lengths can be found on Exhibit "A" in the appendix of this report.

These sewer line extensions have not been included in the City's five year capital improvement program since they will be financed by assessment districts as development occurs. To assure this, the Public Works Department will require that, as a condition of development, the necessary sewer lines be constructed to serve the area.

Most of the pipelines in the residential area are vitrified clay pipe with concrete and tar joints. As is typical with such a joint, excessive concrete protruding into the flow path of the sewer line causes grease buildup which results in continued maintenance problems. The area is also served by 10 sewer pump stations. (Sanitary Sumps, see Figure 3, page 5)

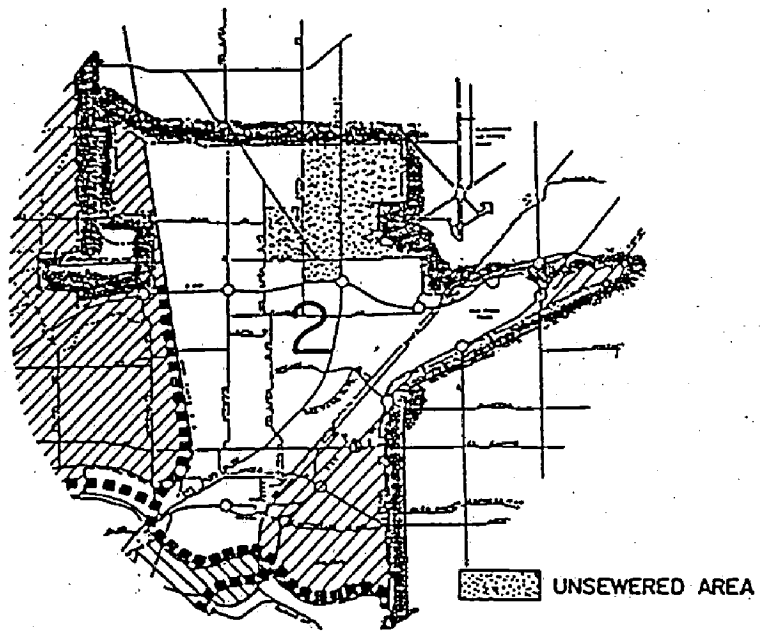


FIGURE 6

UNSEWERED PORTION AREA 2
NORTH SACRAMENTO/ROBLA

DISCUSSION

Sewer Facility Problems

Area 3 - Original Sacramento

This area is bounded by the American River on the north, Freeways 99/80 on the east, Sutterville Road to the south, and the Sacramento River to the west. However, because of the combined sewer system extending easterly of Freeways 99/80, the eastern boundary actually is uneven. This eastern boundary follows Freeways 99/80 down to "H" Street, easterly to 46th Street, and south to 14th Avenue, which aligns with Sutterville Road west of Freeway 99. (See Figure 5, page 9)

This area is served by the City's combined system. This system is 80-130 years old and, for the most part, needs to be rehabilitated and/or replaced. Included in the combined system are 7 pump stations, (Sanitary Sumps, see Figure 3, page 5).

The first combined system pipelines were installed in the late 1800's and were extended as areas were annexed to the City. By the 1940's the system had been extended to the point that it could not contain even a mild rain storm without some City streets being flooded.

Recognizing the need for a comprehensive solution to the capacity problem, the City engaged the services of Robert E. Young Engineers to analyze the City's combined system, evaluate future changes in Federal or State policies on storm drainage discharges, and to investigate alternatives for the complete separation of storm drainage and sewerage flows as well as alternate plans to complete separation. This study should be completed in the next few weeks. Preliminary conclusions as of this writing are as follows:

1. Street flooding occurs throughout the study area for the 5-year storm event.

2. The general conveyance capacity of the existing system is limited to conveying runoff from the 1-year storm without significant street flooding.

3. The primary factor contributing to street flooding within the study area is inadequate pipeline conveyance capacities.

4. In order to handle a five year storm a portion of the combined system would need to be separated.

5. The cost estimate to separate the total combined system is $317,000,000.

When the study has been completed, staff will prepare a report to council with recommendations on a future course of action. A copy of the summary of the draft report by Robert E. Young Engineers is included as Exhibit "B" in the appendix of this report.

DISCUSSION

Sewer Facility Problems

Area 3 - Original Sacramento (continued)

In addition to capacity problems, the combined sewer mains have deteriorated due to age to the point that they need to be rehabilitated or replaced. The City has had an ongoing program of rehabilitating these sewer mains and currently has identified an estimated $6.2 million of work needed over the next few years. Table II is a list of pipelines needing work. The estimates reflect the cost of installing new sewer mains and therefore would be lower if the existing sewer lines could be rehabilitated by slip lining them. A few of these projects are currently scheduled in the sewer's five year Capital Improvement Program and represent only a fraction of the problems throughout the combined system.

TABLE II
COMBINED SEWER STORM DRAIN
STRUCTURAL FATIGUE WORK

SEWER/REACH	EXISTING SEWER SIZE, INCHES	APPROXIMATE LENGTH, FEET	TOTAL ESTIMATED COST 1,000's
7th Street			
D/E to F/G	14	900	250
F/G to G/H	16	450	150
Bulkhead to K/L	varies from 36 x 47 to 48 x 60	1,100	500
P/Q to R	24	550	200
13th Street			
F to G/H	20	650	250
G/H to H	22	200	200
N Street			
18th to 20th	30	775	400
20th to 22nd	30	775	400
R Street			
10th to 11th	22	400	150
11th to 12th	20	450	175
12th to 13th	20	500	200
S Street			
9th to 11th	54	800	600
11th to 13th	54	850	700
4th Street			
Capitol to P	24	1200	400
25th Street			
F to H	22 x 33	850	300
H to J	30 x 45	850	400
J to L	36 x 55	850	400
L to N	36 x 55	900	600
N to O	42	400	300
O to P/Q	42	650	500
P/Q to Q	45	200	150
Q to S	45	850	500
20th Street			
F to H/I	20	1,050	300
H/I to J	21 x 23	650	200
J to L	22 x 23	850	300
L to N	24 x 26	850	300
G/H alley			
9th to 10th	8	200	50
3rd Street			
O to Q	16	850	300
K/L alley			
8th to 9th	8	250	100
Capitol/N alley			
8th to 9th	8	200	50
R Street			
10th to 13th	20	460	200
X/Broadway alley			
26th to 27th	8	160	50
	TOTAL ESTIMATED COST		$ 6150

DISCUSSION

Sewer Facility Problems (continued)

Area 4 - East/Central Sacramento

This area includes everything east and south of Area 3 described above to the easterly City limits, Freeway 99 on the west; and the American River on the north.

The sewer lines in this area were generally constructed before and up to the 1950-60's and consequently are in good condition.

Of the total 12,500 acres within this area, 10,000 acres lie within the CSD1 service area and 2500 are connected to City maintained sewer mains (See Figure 5 Page 9). The area is also served by 4 sewer pump stations, (Sanitary Sumps, see Figure 3, page 5).

Large trees in the streets and backyards also cause problems in this area. Tree roots intrude into the mains and service lines, damaging the pipes. The main problem of the sewer facilities in this area is the control of root intrusion in the pipelines.

Area 5 - South Sacramento/Pocket Area)

This area is bounded by Sutterville Road on the north, the City limits on the east and south, and the Sacramento River on the west.

The sewer lines in this area were generally constructed in the 1950-60's or after and thereafter and are consequently in good condition.

Of the total 17,500 acres within this area, 5,000 acres lie within the CSD1 service area and 12,500 are connected to City maintained sewer mains (See Figure 5 Page 9). The area is also served by 21 sewer pump stations (Sanitary Sumps, see Figure 3, page 5).

The main problem with the sewer facilities in the area is infiltration and a high water table. Many of the sewer mains have neoprene gaskets that compress when the sewer mains are installed or stainless steel band couplings that deteriorate when they come in contact with the chemicals in the ground water. Both situations result in excessive infiltration that puts an additional pumping burden on the sewer pump stations. The net result is higher overall pumping costs.

Sewer Pump Stations

The City of Sacramento's facilities to pump storm water or sanitary flows, and store or treat wastewater are in some instances relatively trouble free and capable of performing as designed. Areas that are tributary to older facilities usually require additional capacity or replacement. New facilities to pump wastewater will be required as new development occurs and as the capacity of some of the pumping stations becomes unacceptable. The sewer facilities include 42 pumping stations with individual pumps ranging from 1 H.P. to 500 H.P. each. The largest station is Sump 2 in the Original Sacramento area with a total of 4000 H.P. These pump stations are shown on Figure 3, page 5 of this report.

DISCUSSION

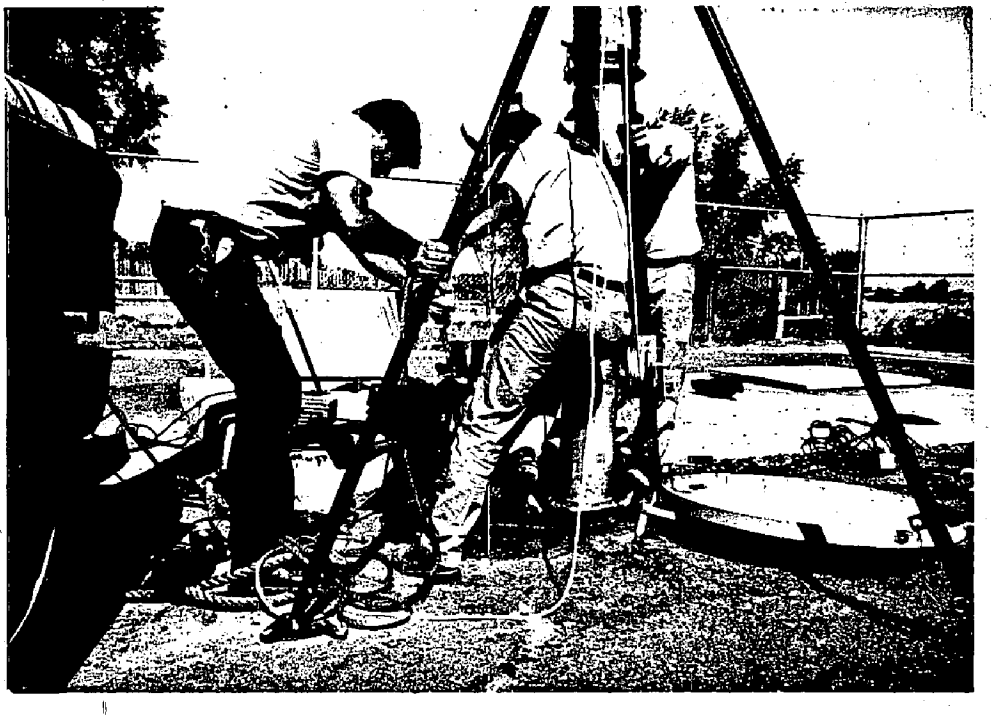
Sewer Pump Stations (continued)

The number of sanitary sewer pump stations by area are as follows:

Area 1	0 stations
Area 2	10 stations
Area 3	7 stations
Area 4	4 stations
Area 5	21 stations
	42 stations

An aggressive Preventive Maintenance and Corrective Maintenance Program, conducted over a period of many years and with constant City Council support, has resulted in the City being able to keep facilities dating from 1908 in operation; however, a number of these facilities are nearing the end of their useful life or have capacity problems and must be upgraded or replaced in the future. Staff anticipates that over the next five years, five of the older pumping facilities will need to be reviewed for replacement. The cost to replace these pumping stations is estimated at $3.0 million.

As the City's pumping system expands with development, the Division will need to promote an on-going program of station improvements and new facilities. Additional qualified personnel will have to be recruited and complete system training provided. The continued use of available technology will require knowledgeable and highly motivated personnel, capable of adapting as system requirements change. This will be necessary in order to protect the expensive equipment being utilized and to insure a high degree of pumping station reliability for public safety and convenience.



City Crews Cleaning Wet Well

CAPITAL IMPROVEMENT PROJECTS (CIP's)

Existing CIP's The recommended Five Year Capital Improvement Program for 1988-93 has identified $6,405,000 in sewer capital improvement projects. The schedule to complete these CIP's is found in Table III, page 16 of this report, and indicates an annual cost for the next five years of approximately $1.3 million dollars. Only a few of the necessary structural improvements to the combined system are included in this 5-year CIP program and for fiscal 88-89 are itemized by project.

Future CIP's As the sewer facilities get older, additional replacement of pipelines and pumping equipment for both capacity and structural problems will be required. Although not conclusive, a study is nearing completion that will identify future projects that are not included in the City's 1988-93 Five Year Capital Improvement Program. These future CIP's are in Area 3 - Original Sacramento Area, and deal with the capacity problems of the combined system. Based on the draft report, it will take approximately $80 million to partially separate and help provide a capacity capable of handling a five year storm event in the combined system. Additionally, within the next 5 years staff estimates that five of the older sewer pumping plants will need to be replaced. The preliminary cost estimate for pumping plant replacement work is $3.0 million.

Summary CIP's A summary of costs for the existing and future CIP's for the sewer facilities are listed on Table IV. This table is laid out as follows; the first line shows the present approved 5-year Capital Improvement Program discussed in the first paragraph of this section. In addition to this, the second line shows necessary additional funding for existing pump station improvements. These improvements are presently delayed because of lack of funds. The third line shows project costs for structural improvements presently necessary in the combined storm drain. These structural improvements include deteriorated brick mains, inadequate storm drainage inlets, and other considerations that need immediate attention as shown in Table II, (page 12).

The fourth line in the table covers yearly costs for improvements as discussed in the combined sewer study. If the study's recommended plan were followed, these corrective costs to improve capacity (flooding) problems in the selected areas would be $7.4 million per year via a bond. A safer approach would be to do each area separately and plan on five year intervals of correction. The initial project (Alhambra Pumping Station and Associated Piping with an estimated construction cost of $33 million) would cost $3.1 million per year via bond financing.

The summary of costs shows that improvement necessary to correct deficiencies is very expensive, but should not be ignored.

PROJECTED EXPENDITURES

The current revenue generated by the City's sewer fee and other sources amounts to approximately $6.7 million annually. This revenue not only finances the necessary capital improvement projects, but is also used for the operation and maintenance cost of the sewer facilities. Consequently, if the City is going to undertake a capital improvement schedule as indicated on Table IV, additional revenues will be necessary.

Where sewer facilities exist, but are deficient, it follows that any upgrading should be accomplished at general City expense, such as funding from the monthly sewer user fee or from the proceeds of a City wide bond issue.

TABLE III
1987-1988 CIP PROGRAM SEWER RECOMMENDED PLAN
x 1000

PROJECT DESRIPTION	88-89	89-90	90-91	91-92	92-93	5 YR.TOTAL
Misc. Imp. Wastewater Pumping Station Improvements	60	60	60	60	60	300
Misc. Sewer Improvements	100	100	100	100	100	500
CWWTP Electrical	60	60				120
4th St. Brick Main Repl. between Capitol and P	260					260
R St. bet. 10th & 13th Main Replacement	170					170
Capitol & N alley between 18th/ 20 Main Replacement	40					40
Santiago-El Camino alley bet. Fairfield & Rio Linda Main Replacement	40					40
G & H - 9th & 10th alley Main Replacement	30					30
El Camino - Redwood alley between Western & Colfax	25					25
X & Broadway alley between 26th and 27th	20					20
3rd St. from O to Q main replacement	100					100
Main Replacement alley 8th & 9th - K & L	50					50
Reconstruction misc. manholes	100					100
9th St. between T & U	50					50
Misc. Sewer repl. Downtown	200	1000	1000	1000	1100	4,300
Pump Station Radio Telemetry		100	100	100		300
TOTAL EXISTING CIP's	1305	1,320	1,260	1,260	1,260	6,405

TABLE IV
CAPITAL IMPROVEMENT PROJECTS

CAPITAL IMPROVEMENT PROJECTS	FISCAL YEAR CIP ESTIMATED COSTS X 1000 88-89	89-90	90-91	91-92	92-93
Existing CIP's					
1. 5 yr. CIP	1305	1320	1260	1260	1260
Future CIP's					
2. Pumping	600	600	600	600	600
3. Combined structural	1300	1300	1300	1300	1300
4. Combined capacity	3100	3100	3100	3100	3100
TOTAL EXISTING & FUTURE CIP's	6300	6320	6260	6260	6260

PROJECTED EXPENDITURES (continued)

If the City wishes to undertake this construction in a relatively short period of time through bond issue financing, the design phase of the projects should begin well in advance of the sale of a majority of the bonds. The design should probably be accomplished by consultants with an overview by City personnel who would check the work, administer consultant agreements and contracts and inspect the construction. Such a program would require approximately six engineering positions to administer contracts, check plans and inspect the work.

MAINTENANCE PROGRAM

The sewer facilities are maintained by a staff of electricians, machinists, plant operators and service workers who have been very successful in keeping an aging system operating. The cost to maintain the system in fiscal year 1987-88 was $5.4 million.

For the sewer mains, staff mainly perform needed maintenance as problems occur. The work includes cleaning roots and grease and controlling pests inside the sewer mains. For pumping plants, staff routinely inspects the 42 sumps and performs maintenance as necessary. This work includes, but is not limited to, machining new impellers, cleaning bowls and installing worn out parts. Also included in the work is the upkeep of the pump station grounds and structures.

As the sewer facilities near the end of their useful life, additional maintenance problems are anticipated which will reduce the ability of the existing maintenance staff to keep the sewer facilities running satisfactorily. Recognizing this, the Flood Control and Sewer Division staff has purchased a computerized wastewater management system to keep track of maintenance costs and schedule routine work. The overall goal of buying this system is to increase the efficiency of the maintenance staff and thereby reducing operating costs.

The expected increase in the maintenance cost as the sewer facilities get closer to the end of their useful life is dependent on the level of past maintenance and therefore difficult to estimate. However, what constitutes a good maintenance program and its respective cost can be estimated if one considers certain guidelines:

A. All underground materials start to fail the day they are placed. Stated differently, the day the pipeline was installed it is in the best condition it will ever be.

B. Maintenance of all underground utilities, not necessarily improvements in the pipe materials themselves is needed to assure continued capacity.

C. Pump stations represent a considerable investment in equipment that fails routinely within ten to twenty years. Mechanical and electrical items should be reviewed on a limited time span. Maintenance and operations are significant costs for this infrastructure.

Based upon these guidelines, the following methodology can be used to design a maintenance/operation and capital improvement program:

- Equipment and electrical replacement (large items) should be considered to have a maximum life of 20 years.

MAINTENANCE PROGRAM (continued)

- Structures which house equipment should be considered to have a 50 year life.
- Pump station maintenance and operations should ideally be funded at a level of four percent of their present worth value per year.
- Underground utilities maintenance should be funded at a level of four percent of the present worth value per year.

Exhibit C in the appendix shows an approximate present worth value of Sacramento's sewer infrastructure. Using these estimated costs, the yearly maintenance, operations and capital improvement program budget ideally equates as follows:

Item		Yearly Maintenance and Improvement Cost
Sewer Mains	($184,440,000)(4%)	= $7,378,000
Laterals	($52,250,000)(4%)	= $2,090,000
Sewer Pump Stations	($9,030,000)(4%)	= $ 361,000
Sewer Treatment Facilities	($15,000,000)(3%)	= $ 450,000
TOTAL YEARLY REQUIREMENTS		= $10,279,000

This would be a starting point in developing an analysis, divided into approximately 50% capital improvement projects and 50% maintenance and operation. This is a goal to strive toward when considering financing for long term infrastructure improvements.

Approximately $6.7 million in revenues is expected to be generated in fiscal year 1988-89. These revenues will be completely used to pay the operation and maintenance cost ($5.4 million) and to fund the yearly capital improvements ($1.3 million). Consequently there is no revenue available to support any bond debt financing of the additional capital improvements presently needed. Stated differently, if Table IV were used for CIP costs and all of those items were presently funded, no money would be available for yearly operation and maintenance.

The shortfall between the revenue now earned and that required to fund the necessary improvements and maintenance cost is shown as follows:

- Present Revenue Stream:

  Equivalent 6 and 7 room homes = 98,800 (for calculation purposes only)

  Cost per month per equivalent home = $\frac{6,700,000}{98,800 \times 12}$ = $5.65 per month

- Required Revenue Stream:

  Cost per month per equivalent home = $\frac{\$10,279,000}{98,800 \times 12}$ = $8.67 per month

If implemented all at one time, this would mean a 53% increase in revenue. A better method would be to establish rate increases for a series of years until the revenue meets the required level necessary to support all the improvement programs envisioned. Table V is offered as a guideline to meet this revenue increase:

TABLE V

NUMBER YEARS	INCREASE NEEDED PER YEAR (%) without combined capacity system improvement*	INCREASE NEEDED PER YEAR (%) with combined capacity system improvements**	INCREASE NEEDED PER YEAR (%) with combined capacity system improvements***
1	53	75	142
2	30	37	58
3	23	36	39
4	21	35	38
5	20	34	38
6	19	31	37
7	17	27	32
8	16	25	27
9	15	23	24
10	14	21	22

* assumes needed revenues will increase 6% annually

** assumes phases one and two of combined capacity system improvements will be implemented in 10 years.

*** assumes all combined capacity system improvements are implemented at one time ($80,000,000).

MAINTENANCE PROGRAM

Public Works would not recommend extending rate increases longer than five years, since additional sewer system needs will have a tendency to offset the gains made by the extended rate increases. Based on the seriousness of the problems of the sewer system, a prudent goal would be to have the necessary funding sources in place by 1994. To fund the O&M cost and to finance capital improvements including the structural needs of the combined system would require a 20% increase in sewer rates for each of the next five years. An additional 14% annual increase would be required to fund the necessary capacity improvements to the combined system for the next five years.

CONCLUSION

Some of the City's sewer facilities, though seeming to work satisfactorily today, are nearing the end of their useful life. As a result, maintenance and capital improvement costs will be on the rise. A summary of existing and projected funding needs for the next five years are listed in Table VI.

The total annual revenue requirements of Table VI average approximately $2,000,000 more annually than those indicated on page 18 of the report. The reason for this difference is that the general requirement method, if implemented, collects revenues in advance of needed improvements. As a result, needed improvements for the most part are completed sooner and at a lower cost. Another way of saying this is that it is cheaper to build today than to wait until tomorrow. Unfortunately, the City has not collected money in advance of the needed improvements and, today, faces major modification requirements of the combined sewer system.

As is obvious from Table VI, addressing deficiencies in the existing system alone will require debt financing, and periodic improvements and replacements will be required as part of an ongoing maintenance program. Enlarging and expanding the system to meet the needs of future development will be expensive and will also involve debt financing for the City's portion.

TABLE VI
CAPITAL IMPROVEMENT PROJECTS

CAPITAL IMPROVEMENT PROJECTS	FISCAL YEAR CIP ESTIMATED COSTS X 1000				
	88-89	89-90	90-91	91-92	92-93
Existing CIP's 5 yr. CIP	1305	1320	1260	1260	1260
Future CIP's					
Pumping Plants	600	600	600	600	600
Combined structural	1300	1300	1300	1300	1300
Combined capacity	3100	3100	3100	3100	3100
TOTAL CIP's	6305	6320	6260	6260	6260
OPERATION AND MAINTENANCE	5400*	5700*	6100*	6400*	6800*
TOTAL CIP's O & M COST	11705	12020	12360	12660	13060

*Includes a 6% yearly increase

APPENDIX

WEST OF McCLELLAN AIR FORCE BASE INFRASTRUCTURE STUDY
PRELIMINARY CONSTRUCTION COST ESTIMATE FOR
SANITARY SEWER IN REGION NO. 1

ITEM.	DESCRIPTION	QUANTITY	UNIT/	D=	UNIT PRICE	TOTAL
1.	6" ABS OR PVC SEWER	3135.0	LF	6.9	$38.80	$121,638.00
2.	8" VCP SEWER	7665.0	LF	8.3	$46.70	$357,955.50
3.	10" VCP SEWER	6654.0	LF	10.8	$56.20	$373,954.80
4.	12" VCP SEWER	9870.0	LF	12.3	$66.90	$660,303.00
5.	15" VCP SEWER	4070.0	LF	17.5	$83.60	$340,252.00
6.	18" VCP SEWER	1960.0	LF	16.6	$90.90	$178,164.00
7.	21" VCP SEWER	2658.0	LF	17.4	$107.50	$285,735.00
8.	24" VCP SEWER	2635.0	LF	19.6	$120.10	$316,463.50
9.	SEWER DROP CONNECTIONS OR CONNECTIONS TO EXIST SWR	28.0	EA		$2,500.00	$70,000.00
10.	48" MANHOLES	120.0	EA		$1,650.00	$198,000.00
11.	ABANDON AND REMOVE EXISTING PUMP STATION	1.0	JOB	L.S.	$18,000.00	$18,000.00

SUBTOTAL SANITARY SEWER FOR REGION NO. 1. =	$2,920,465.80
PRELIMINARY ESTIMATE CONTINGENCY 15% =	$438,069.87
TOTAL SANITARY SEWER CONSTRUCTION COSTS = FOR REGION NO. 1.	$3,358,535.67
USE TOTAL =	$3,359,000.00

EXHIBIT "A"
SHEET 1 of 2

WEST OF McCLELLAN AIR FORCE BASE INFRASTRUCTURE STUDY
PRELIMINARY CONSTRUCTION COST ESTIMATE FOR
SANITARY SEWER IN REGION NO. 2

ITEM.	DESCRIPTION	QUANTITY	UNIT/	D=	UNIT PRICE	TOTAL
1.	6" ABS OR PVC SEWER	0.0	LF		$0.00	$0.00
2.	8" VCP SEWER	11555.0	LF	9.3	$39.20	$452,956.00
3.	10" VCP SEWER	10335.0	LF	10.7	$47.00	$485,745.00
4.	12" VCP SEWER	12070.0	LF	12.0	$57.00	$687,990.00
5.	15" VCP SEWER	1010.0	LF	13.4	$68.30	$68,983.00
6.	18" VCP SEWER	2745.0	LF	14.9	$79.30	$217,678.50
7.	SEWER DROP CONNECTIONS	15.0	EA		$1,100.00	$16,500.00
8.	48" MANHOLES	89.0	EA		$1,600.00	$142,400.00

SUBTOTAL SANITARY SEWER FOR REGION NO. 1. =	$2,072,252.50
PRELIMINARY ESTIMATE CONTINGENCY 15% =	$310,837.88
TOTAL SANITARY SEWER CONSTRUCTION COSTS = FOR REGION NO. 1.	$2,383,090.38
USE TOTAL =	$2,383,000.00

EXHIBIT "A"
SHEET 2 of 2

SUMMARY

On April 1, 1987, Robert E. Young Engineers (REYE) was commissioned by the City of Sacramento to analyze the City's combined sewer system, evaluate future changes in Federal or State policies on storm drainage discharges, and to investigate alternatives for the complete separation of storm drainage and sewerage flows as well as alternate plans to complete separation. The Boyle Engineering Corporation (Boyle) served as a sub-consultant on the completion of this project.

The City of Sacramento (City) discontinued the practice of using combined sanitary and storm sewer systems in 1946. An improvement program was initiated in the 1950's wherein new separated storm sewers were constructed in selected areas. The service area of the combined sewer system is now limited to about 7,000 acres which is located in the downtown and southern portion of Sacramento.

The combined sewer system is now an integral part of the City's Combined Wastewater Control System (CWCS), which was completed in the early 1980's. The CWCS conveys domestic and industrial wastewater and storm runoff from the combined sewer area to Sump 2 where it is pumped to the Sacramento Regional Water Treatment Plant (SRWTP) for treatment. When the combined wet weather inflow to Sump 2 exceeds the City's allocated portion of the SRWTP's capacity, the excess inflow is pumped from Sump2 to the (CWTP) for treatment. When the combined capacity of these two treatment sources is exceeded by the inflow to Sump 2, the excess is diverted through the Pioneer Interceptor to the Pioneer Reservoir for storage. The stored waste is then diverted back to the CWTP for treatment as

the inflow to Sump 2 subsides. During extreme storm weather, combined wastewaters are discharged into the Sacramento River from Sump 1, Sump 2, and the Pioneer Reservoir, as conditions require.

The water quality and regulatory aspects, of the combined sewer system were evaluated by Boyle. The investigation results were submitted to the City in the report titled "Water Quality and Regulatory Aspects, Study of Combined Sewer System, City of Sacramento", September 1987.

Of considerable interest to this study was the finding that the Federal EPA is in the process of establishing new storm water discharge permit application procedures and regulations. This process is to be completed by February 4, 1989. The City will need to apply for a discharge permit by February 4, 1990. The permit will be issued or denied by EPA by February 4, 1991. The City will have three years after the date of permit issuance (at a maximum) to comply with the discharge permit requirements.

Two programs (or blocks) of the EPA's Storm Water Management Model (SWMM) were used to evaluate the existing combined sewer system. These blocks were the RUNOFF, which simulates runoff hydrographs from subcatchment areas, and the EXTRAN, which routes the hydrographs through the conveyance system.

Boyle completed substantial modifications to the EXTRAN block as part of this study. Boyle's modifications were submitted to the City under separate cover in the report titled "User Manual, A Modified Version of the RUNOFF and EXTRAN Block of the Storm Water Management Model", November 1987.

The hydrologic and hydraulic analysis of the existing system provided information regarding the capabilities and flooding problems of the existing system, This information included the following:

- The flood situation in the vicinity of Sump 1 and Sump 2 may be improved by changing the operating criteria to increase pumping rates during the early stages of the storms.

- Street flooding occurs throughout the study area for the 5-year storm event.

- The general conveyance capacity of the existing system is limited to conveying runof from the 1-year storm without significant street flooding.

- The primary factor contributing to street flooding within the study area, is inadequate pipeline conveyance capacities.

- The H Street, O Street, and P-Q Street relief sewers serve to reduce flooding in the East Sacramento/McKinley Park Area by transporting runoff into the Old City Area.

A reconnaissance level analysis of several alternatives for the complete separation of the storm and sanitary sewers was performed. The results were reviewed with the City and a complete separation plan was selected.

The Selected Plan for Complete Separation was refined through detailed hydrologic and hydraulic analysis utilizing the RUNOFF and EXTRAN blocks. The major drainage facilities and selected model information of the Plan is presented in the following figure.

In brief, the Plan would require construction of separated storm sewer systems to serve the entire study area. These systems would drain to six pumping plants which would pump the runoff into the American and Sacramento Rivers.

Under the Selected Complete Separation Plan the existing conduits of the combined system would primarily be used to convey sanitary flows. However, three new sanitary trunks would parallel the portions of the 18th Street and Donner trunks used for storm drainage. A new sanitary pumping station would also be constructed in the vicinity of Sump 2, because Sump 2 would be used entirely for storm flow.

The construction cost of the Selected Plan for Complete Separation was estimated to be $315,178,000. The construction cost per cubic foot of flood reduction was estimated to be $67.20.

The separation of the storm waters in the combined sewer area may place the City in the position of abandoning a drainage system that has an approved treatment level, and constructing a separate system that has an uncertain future as far as treatment of its effluent. The very high construction cost to separate the combined sewer system, and the uncertain future of treatment requirements for storm water discharges, makes it prudent for the City to evaluate alternatives to complete separation of the combined sewer to provide a higher level of flood protection.

A total of seventeen alternative plans to complete separation were evaluated using the RUNOFF and EXTRAN blocks. These alternatives included nonstructural components, such as modifying the operating criteria of Sump 1 and Sump 2; minor structural components such as removal of interconnection between trunks; and/or substantial capital improvement components such as constructing additional pumping stations and separating the storm and sanitary sewer systems for portions of the study area.

The alternative plans to complete separation were compared in terms of their magnitude of flood reduction, estimated construction costs and environmental aspects. Based upon the comparison, an alternative plan to complete separation was selected.

The major facilities of the Selected Alternative Plan to Complete Separation and selected model information is presented in the following fingure. Under the Plan, approximately 3,450 acres of the study area will continue to be served by the combined sewer system. The remaining area will be served by three new storm sewer systems and associated pumping stations. No additional sanitary sewerage facilities would be required.

The construction cost of the Selected Alternative Plan to Complete Separation was estimated to be $77,982,000. The construction cost per cubic foot of flood reduction was estimate to be $18.59.

Should the City decide that reduction of street flooding is warranted, it is recommended that this be accomplished by implementing the Partial Separation Plan. This recommendation is based upon the following considerations:

- The estimated construction cost of the Alternative Plan to Complete Separation is over $236,000,000 less than would be required for the Complete Separation Plan.

- Implementation of the Alternative Plan to Complete Separation could be phased as available funding permits. The recommended phasing and estimated construction costs are: 1) the Redding Avenue Pumping Station and associated storm drainage system ($23,446,000); 2) The Alhambra Pumping

EXHIBIT 'B' SHEET 5 of 6

Station and associated separated storm drainage system ($32,682,000); and 3) the 26th Street Pumping Station and associated storm drainage system ($22,151,000).

- Construction and operation of the Alternative Plan to Complete Separation would have less severe environmental impacts than would the Complete Separation Plan.

EXHIBIT 'B' SHEET 6 of 6

CITY OF SACRAMENTO
SEWER SYSTEM INVENTORY
AND EVALUATION

A. Assumptions for general analysis

1) Presently the City has 508 miles of sewer mains
2) Inflation factor is established by using the ENR (Engineering News Record) construction index.
3) 55% of the existing sewer mains were in place by 1940, and 89% were in place by 1970
4) Useful life span for concrete sewer pipe is 40–60 years. Useful life span for clay sewer pipe is 60–80 years. All pipe is assumed to be concrete, with a useful life of 60 years for ease of calculations
5) Pump station costs are estimated using an empirical formula developed by the Boyle Engineering Corporation:

$$\text{COST}_{\text{June '88}} = \frac{\text{ENR Index June '88} = 4471}{\text{ENR Index Dec. '82} = 3950} (\text{BEC})$$

and

$$(\text{B.E.C.}) = \$181{,}700\ (\text{MGD})^{0.37} + \$1{,}560\ (\text{H.P.})^{0.78}$$

6) Pipe costs used were based upon 75% of average with mechanical compaction. Example with 8" at 10' depth:

1. Mechanical compaction = $60–$100 L.F.
2. Jetting = $40–$85 L.F.
3. Used 75% high mechanical = $90 L.F.

B. Cost analysis for pipe

Average depreciation factor based on 60 year life:

$$\text{ADF} = \frac{60 - [(1988-1940)(.55) + (1988-1958)(.16) + (1988-1958)(.29)]}{60}$$

$$= \frac{60 - 39.9}{60}$$

$$= 0.335$$

C. Treatment Plant Costs

Present day cost for primary wastewater treatment plants of large capacity (above 20MGD) equates to approximately $200,000 per million gallons treated.

100MGD x $200,000 = $20,000,000

This plant is missing digesters and filters, therefore, reduce 25%.

Present worth = (0.75)($20,000,000) = $15,000,000

D. SEWER MAINS COSTS

DIAMETER	L.F.	1988 $/L.F.*	1988 VAL	AVG.DEP. FACT	1988 PRESENT WORTH
4"	38,902	50.00	1,945,000	0.335	852,000
6"	1,408,946	75.00	105,671,000	0.335	35,400,000
8"	635,542	90.00	57,199,000	0.335	19,162,000
10"	148,802	95.00	14,136,000	0.335	4,736,000
12"	126,964	110.00	13,966,000	0.335	4,679,000
14"-18"	114,802	125.00	14,350,000	0.335	4,807,000
20"-24"	84,432	150.00	12,665,000	0.335	4,243,000
26"-30"	28,808	175.00	5,042,000	0.335	1,689,000
33"-36"	14,076	225.00	3,167,000	0.335	1,061,000
39"-42"	18,720	300.00	5,616,000	0.335	1,881,000
45"	1,730	315.00	555,000	0.335	186,000
54"	919	420.00	386,000	0.335	129,000
72"	1,840	650.00	1,196,000	0.335	401,000
36" x 48" brick**	1,090	325.00	354,200	0.335	119,000
6"FM	13,459	80.00	1,077,000	0.335	361,000
8"FM	2,405	95.00	229,000	0.335	77,000
10"FM	1,300	100.00	130,000	0.335	44,000
12"FM	9,750	115.00	1,121,000	0.335	376,000
16-18"FM	14,300	130.00	1,859,000	0.335	623,000
21-24"FM	6,400	160.00	1,024,000	0.335	343,000
30"FM	800	185.00	148,000	0.335	50,000
32"FM	1,414	235.00	333,000	0.335	112,000
78"FM	5,000	750.00	3,750,000	0.335	1,256,000
TOTALS	2,680,401		$245,919,000		82,387,000

The present worth for maintenance purposes is 75% of the 1988 value.
Maintenance PW = (0.75)($245,919,000) = $184,440,000

* MECH. COMPACTION
**REPLACED W/RCP

E. LATERALS

An average lateral can be installed to the property line from the centerline of the street for approximately $475.

98,800 equivalent residential laterals x$530 = $52,250,000,
Therefore present worth is $52,250,000.

EXHIBIT "C"
SHEET 2 of 4

F. SEWER PUMP STATION COSTS

SUMP #1	LOCATION	VALUE @ TIME OF CONSTRUCTION	1988 REPLACEMENT VALUE	1988 DEPRECIATED VALUE
2	Riverside and 11th Avenue	63,000	3,134,000	1,567,000
21	6693 14th Streets	51,000	350,000	175,000
29	57th and H Streets	3,000	85,000	42,000
32	6201 S Street(w.side)	74,000	257,000	178,000
36	5810 24th Street	16,000	96,000	54,000
40	6802 S.Land Park Drive	29,000	171,000	98,000
42	1039 Seamas & Riverside	36,000	202,000	117,000
45	7439 24th Street	48,000	270,000	156,000
48	6577 San Joaquin	59,000	321,000	186,000
49	7761 Detroit Blvd.	20,000	108,000	63,000
53	S.end 24th St. bypass	40,000	216,000	127,000
55	6203 Gloria Drive	115,000	576,000	349,000
57	S.Land Pk.Dr. & Florin Rd	21,000	106,000	64,000
79	Frienza and Plover	25,000	119,000	72,000
80	2928 Marysville Blvd.	40,000	195,000	118,000
84	3000 Railroad Drive	43,000	199,000	122,000
85	249 Santiago Avenue	110,000	513,000	314,000
86	2980 Fairfield	43,000	202,000	123,000
87	121 Morrison Avenue	69,000	323,000	197,000
88	Freeport & Meadowview Rd	66,000	295,000	183,000
105	Carroll Ave & Taylor St.	48,000	187,000	121,000
106	Calhoun Ct. off Macarthur	67,000	264,000	171,000
107	1230 Firehouse alley - @ Capitol Mall	146,000	504,000 649,000	350,000
119	W.end of Old San I	254,000	649,000	493,000
120	4712 Sacramento Blvd.	106,000	269,000	205,000
121	5002 S.Land Park Drive	67,000	172,000	131,000
122	2624 Fernandez Drive	37,000	94,000	72,000
123	Miller Park - 600's of Broadway	65,000	154,000	120,000
124	Miller Park - across from Snack Bar	67,000	160,000	128,000
125	Miller Pk. near boat ramp	61,000	147,000	117,000
126	Marin Avenue & 78th St.	58,000	136,000	108,000
127	6697 Orleans Way	63,000	137,000	137,000
131	3753 Pell Drive	141,000	265,000	265,000
133	Bannon Street	81,000	139,000	139,000
134	786 Shoreside Circle	79,000	124,000	124,000
135	7550 Pocket Road	99,000	143,000	143,000
136	Windbridge & S.Land Pk.Dr	97,000	143,000	143,000
137	Greenhaven & Heritage	228,000	359,000	359,000
143	S.Land Park Drive - S. of Florin Road	188,000	204,000	204,000
145	7651 Windbridge	28,000	30,000	30,000
146	N.side of Main Ave@Austin	20,000	22,000	22,000
		$ 2,971,000	12,040,000	$ 7,887,000

The present worth for maintenance purposes is 75% of the 1988 replacement value.
Maintenance PW = (0.75)($12,040,000) = $9,030,000

EXHIBIT "C"
SHEET 3 of 4

G. SUMMARY OF SEWER SYSTEM INFRASTRUCTURE COST

Facility	1988 Replacement cost x1000 (1)	Calculated Present Worth x1000 (2)	Maintenance Present worth x1000 (% of (1)) (3)
(C) Treatment Plant	20,000	15,000	15,000(100)
(D) Sewer Mains	245,919	82,387	184,400 (75)
(D) Laterals	52,250	52,250	52,250(100)
(F) Sewer Pump Stations	12,040	7,887	9,030 (75)
TOTALS	330,209	157,524	260,068

EXHIBIT "C"
SHEET 4 of 4