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CITY OF SACRAMENTO

DEPARTMENT OF PUBLIC WORKS

OFFICE OF THE DIRECTOR

Melvin H. Johnson
Director
Leslie M. Frink
Deputy Director
Reginald Young
Deputy Director

April 19, 1988

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

Honorable Members in Session:

SUBJECT: CURRENT AND PROPOSED STORM DRAINAGE SYSTEM 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 of these reports, discussing the water system, was reviewed by the joint committees in February.

The second report, an overview of the storm drainage system, is now presented for committee information. (See attached exhibit). The adequacy and condition of storm drainage facilities varies greatly from one area of the City to another, and the report discusses each area separately. Addressing deficiencies in the existing system alone will require debt financing. Enlarging and expanding the system to meet the needs of future development will be very costly, and may also involve debt financing for the City's portion in some areas.

The report does not address the Central City combined sewer/storm drainage system, which will be presented as a separate report. Major flood control projects involving the Sacramento and American rivers and their tributaries will be discussed in a third report.

RECOMMENDATION

This report is submitted for Committee information.

Respectfully submitted,

for Reginald Young
Melvin H. Johnson
Director of Public Works

Approved for Committee Information:

Solon Wisham Jr.
Assistant City Manager

April 19, 1988
ALL DISTRICTS

CITY OF SACRAMENTO

OVERVIEW OF CURRENT AND PROJECTED STORM DRAINAGE SYSTEM REQUIREMENTS

PREPARED BY

DEPARTMENT OF PUBLIC WORKS

FLOOD CONTROL & SEWER DIVISION

MARCH 1988

SUMMARY

The storm drainage system in the City of Sacramento is a composite of ditches, canals, creeks, pipes, pump stations and surface flows. Depending on location, various improvements have occurred in the past that generally alleviated particular problems as they became known. Over time, various systems were tied together in an attempt to dispose of storm water into the rivers as inexpensively as practical. Major systems have developed from this linkage, some of which are quite old. As development continued, the capacity of some of these systems was exceeded, causing some localized area flooding every two years on the average. Future development, in some instances, could increase this problem. Enlargement of these systems will be very costly, requiring debt financing for certain improvements.

This report does not address the central City combined sewer/storm drainage system, which will be presented as a separate report, as will major flood control projects involving the American and Sacramento Rivers and their tributaries within the City.

INTRODUCTION

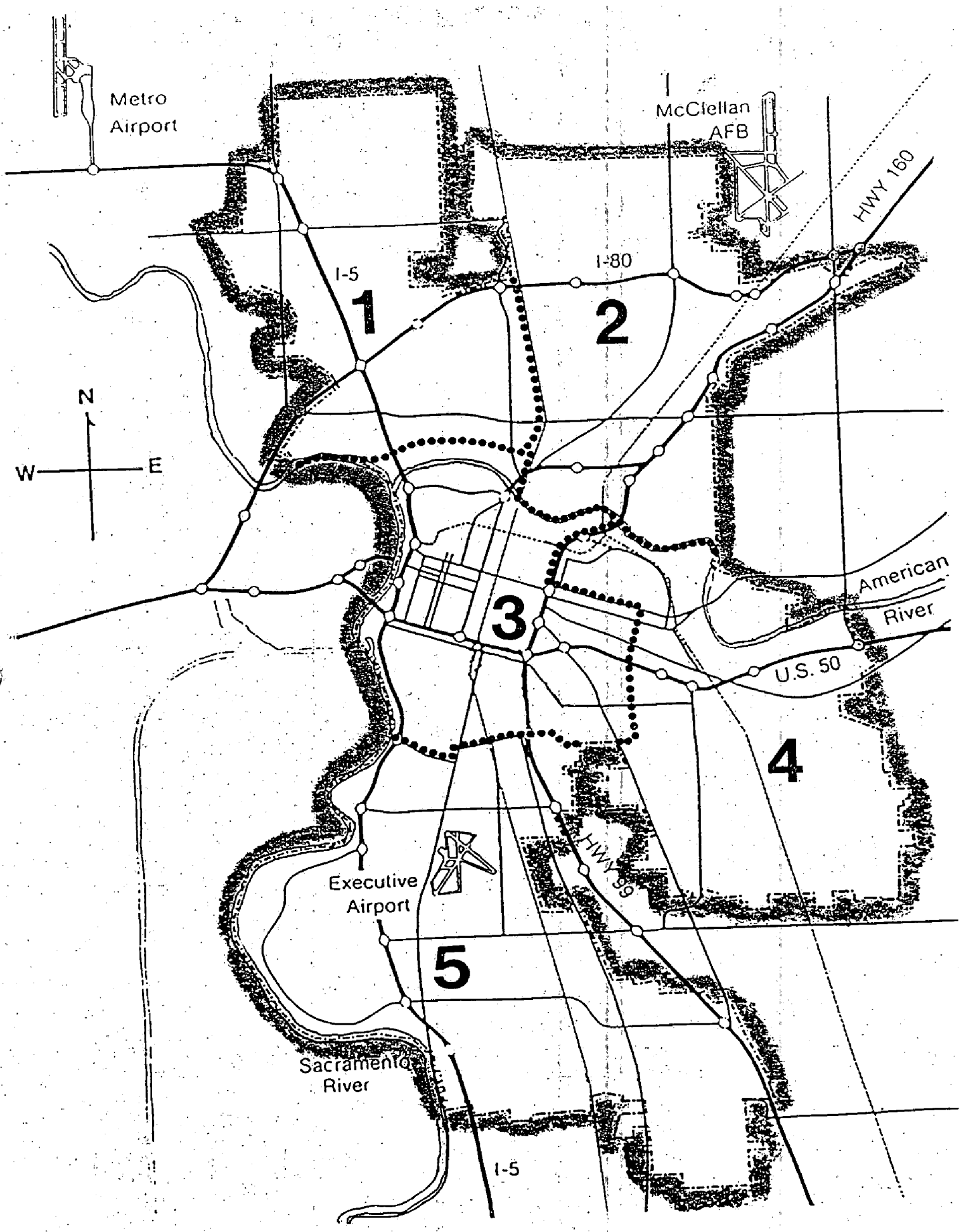
The City of Sacramento is located on the confluence of two rivers, and since its very founding drainage conditions have affected development.

Early developments were simply infilled with native soils whenever flooding occurred and lower levels of structures raised or added on above the new infill. Levees along both the American and Sacramento River started developing in the late 1800's and were fairly well established by the early 1900's. Interior storm drainage necessitated flood gates at river outlets and sometimes included temporary storage. Over a period of time pump stations were added to directly discharge storm water into the river.

The climate in the City of Sacramento is typical of the Sacramento (Central) Valley with hot dry summers and cool winters with moderate amounts of rainfall, occurring primarily between December and March. The mean seasonal precipitation in the Sacramento area is between 17 and 18 inches. The maximum rainfall over a 24-hour period from a storm with a 100-year return frequency can be estimated at 4 to 5 inches.

The existing City covers approximately 98 square miles, but handles storm drainage from the north and east covering approximately 400 square miles. This does not include any watersheds draining into the American River. The present drainage system consists of 87 storm drainage pump stations, 566 miles of storm drainage conduit ranging from 96 inches in diameter down to 6" diameter, and over 61 miles of canals, channels and levees, all draining towards the pump stations. (Exhibit III provides greater detail on the miles of various sizes of storm drain pipe).

Each geographical area of the City of Sacramento is discussed separately in this report to facilitate a clear understanding of the storm drainage system requirements. Figure 1 delineates the areas discussed below. Exhibit II illustrates the locations of areas and sumps.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Sacramento
River
I-5

FIGURE I

For ease of identification in this report, the City has been broken into five (5) areas, which are as follows:

Area	Geographical Area	Common Name
1.	North/West Sacramento	Natomas Area
2.	North/East Sacramento	North Sacramento Robla
3.	Central Sacramento	Original Sacramento
4.	South of American River, generally east of U.S. 99	East/Central Sacramento
5.	South of Sutterville Road, west of U.S. 99	South Sacramento Pocket Area

GENERAL DISCUSSION BY AREAS

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.

Sufficient storm drainage improvements are planned in the City limits area to accommodate all future development. The East Drainage Canal and West Drainage canal presently handle flows in a north to south pattern. Two major east-to-west flowing canals are planned, one near San Juan and the second from Elkhorn Road southerly to I-5 and westerly to the Sacramento River. Both canals will drain west from the Natomas East Main Drain and have major pipelines and channels flow into each canal. These two pump stations will be very large. Because development in this area is relatively new, there appear to be minimal storm drainage concerns in Natomas from localized rainfall.

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 most of the storm drainage system installed prior to city annexation. Many areas presently have undersized pipes and ditches, and there are a number of other factors which complicate drainage maintenance in this area.

Many roadside ditches and ditches that run through private property allow little or no access for maintenance. In areas of North Sacramento where street and drainage improvements have not been installed, it is necessary to provide maintenance to backyard drainage ditches. These areas were initially constructed below the street level and therefore depend on ditches for final drainage outlets.

Another problem in this area is the infill process. Some new homes are presently being constructed below the street elevation and will continue to depend on drainage through adjoining private property. In these cases, the contractors seem to show little regard for drainage on these infill projects, which creates instant problems for drainage maintenance.

A third unique problem that exists in North Sacramento is the presence of separate drainage agencies, such as the City of Sacramento, State Department of Water Resources, and the American River Flood Control District. When the residents of this area have a drainage problem they automatically refer it to the City and assume the problem is a City maintenance problem. At times, this creates confusion due to the fact that each agency provides a different level of maintenance to their specific areas and each responds differently to citizen complaints. This problem is best illustrated by the nine pump stations acquired from the American River Flood Control District. (See the Section on pump stations for more discussion.)

Two tributaries that cause storm drainage problems under extreme conditions in this area are Dry Creek and Arcade Creek which caused some flooding in the 1986 flood. Both flow southwesterly from the foothills and enter the Natomas East Main Drain. Each has a significant watershed area that is presently being developed upstream. Significant water flows can concentrate quickly in the North Sacramento area if the major rivers are also near capacity. Magpie Creek and the Magpie Creek Diversion in Robla caused localized drainage problems and must also be improved in the future to handle planned flows and to conform with F.E.M.A. standards for capacity and freeboard.

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.

All of this area is part of the combined sanitary sewer/storm drainage system. Robert E. Young Engineers are conducting a study of alternatives to determine the projects with the best potential to aid in lowering localized flooding in this area.

A separate report on the combined system will be presented later this year.

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.

Many of the storm drain systems were constructed in backyards, making maintenance difficult and more costly. Some storm drainage curb inlets have been replaced starting in the late 1970's. This has decreased the localized flooding somewhat. However, capacity is a problem and larger storms in excess of 2-5 year frequency will continue to cause localized flooded areas. Another problem that contributes to localized flooding throughout the City is leaves and trash placed in the street gutters. This material washes into the storm drains, blocks the main, and causes first, second and oftentimes third rainstorm localized flood problems. Replacement of existing grate-only inlets with curb opening inlets combined with increasing the size of some of the drainage pipe will help mitigate this problem.

Large trees in the streets and backyards also cause problems. Tree roots intrude into the mains and drain inlet pipes, damaging the pipes. Several storm drain lift stations in this area lack sufficient capacity or are severely deteriorated and require future replacement.

Area 5 (South Sacramento/Pocket Area)

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

The Storm Drainage System in South Sacramento was constructed within the past 40 years. Some of this was constructed to adequate standards while other portions are deficient in capacity. One of the problems in this area is on the major thoroughfares where storm drain inlet boxes were not constructed to allow for maximum drainage, and often plug with debris.

The newest developed area is the so-called "Pocket Area" which is designed to a higher level storm capacity than the older areas. Therefore, in general, this drainage system is currently the best in the entire City.

GENERAL DISCUSSION: 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 storm flows or wastewater will be required as new development occurs and as the capacity of some of the pumping stations becomes unacceptable. Eighty nine (89) of the facilities are storm pumping stations with individual pumps ranging from 5 H.P. to 1,000 H.P. each. The largest station is Sump 132 in the Pocket Area with a total of 6600 H.P. These pump stations are shown on a map in Exhibit I.

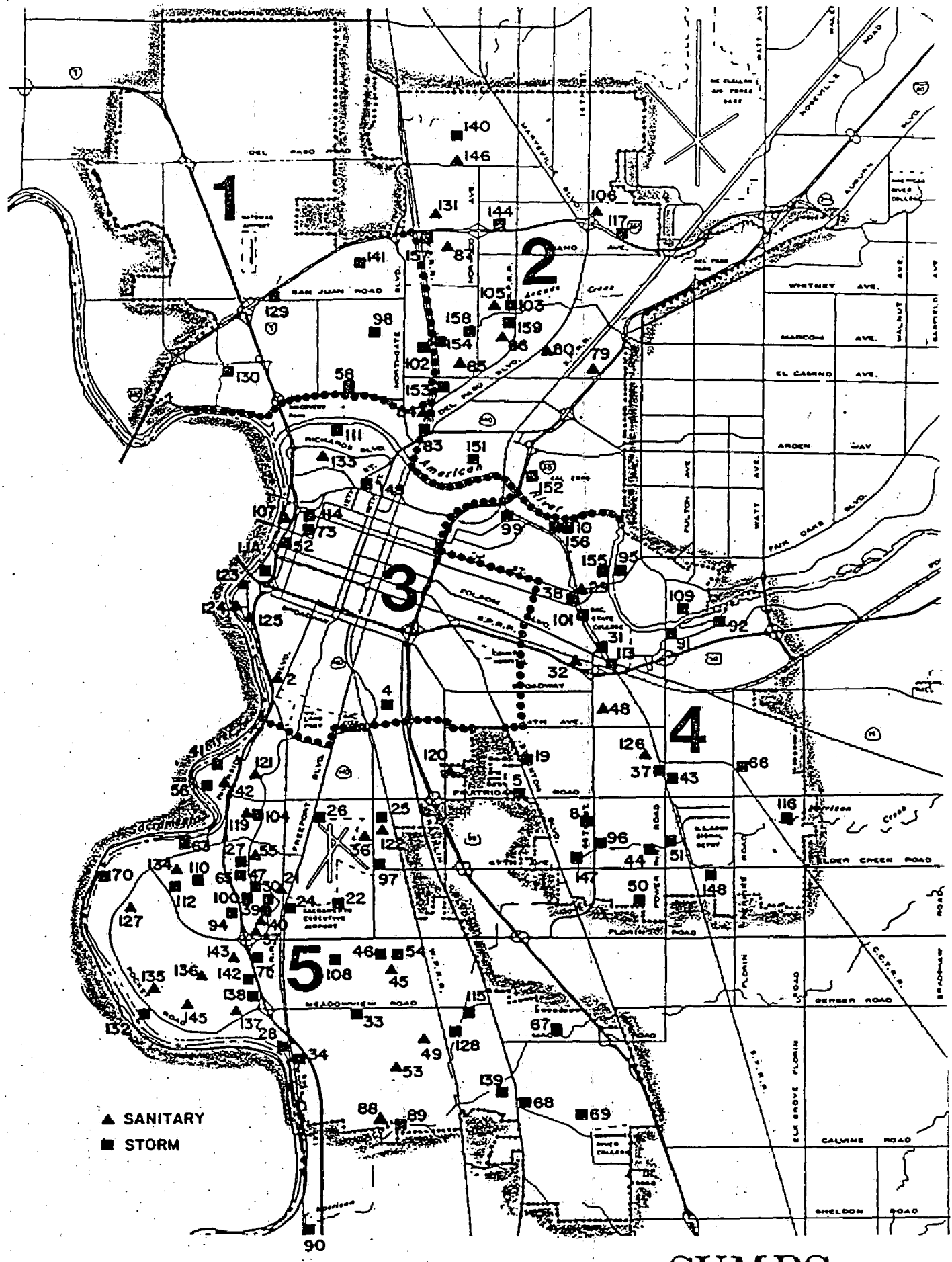
The number of storm drainage pump stations by area are as follows:

Area 1	6 stations
Area 2	12 stations
Area 3	7 stations
Area 4	26 stations
Area 5	38 stations
	89 stations

(Two very large stations are presently in the design stage for the Natomas area are not included above.)

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 1916 in operation. 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.

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.



SUMPS

EXHIBIT I

AMERICAN RIVER PUMP STATIONS

As stated previously, the American River Flood Control District has transferred nine pump stations to the City of Sacramento. These pump stations were found to provide a much lower degree of reliability than the pump stations already maintained by City staff. An estimated $7 million in repairs is necessary at this time to correct the deficiencies, provide the needed capacity, and make the necessary improvements for providing a level of reliability similar to present City maintained pumping plants.

Four key factors should be kept in mind when discussing the transfer of these pump stations to the City of Sacramento:

1. The American River Flood Control District did not maintain their nine pumping plants to present City standards of reliability. Due to the small number of plants under their control, it was difficult to provide the maintenance personnel and the facilities necessary to maintain them with a high degree of dependability.

2. The City has previously funded major improvements to the American River Flood Control District pumping plants on a voluntary basis.

3. The American River Flood Control District pumping plants serve a significant portion of the City area with a degree of flood protection lower than that provided by most City facilities.

4. The District chose to minimize annual assessments. Major fee increases are necessary for the American River Flood Control District to provide the same degree of flood protection provided by City facilities, and to provide for major unfunded repair and replacement of current facilities.

PUMP STATIONS: STORM DRAINAGE DISCHARGE PERMITS

One of the major issues facing the City of Sacramento in the next several years is the imposition of more stringent standards for the quality of storm drainage water discharged to a receiving body of water such as the rivers. The current limits proposed on discharges to area rivers by the Central Valley Regional Water Quality Board (CVRWQCB) are designed to protect the beneficial uses of the American and Sacramento Rivers. The beneficial uses are:

* Municipal Water Supply
* Agriculture Water Supply
* Industrial Water Supply
* Water Recreation
* Wildlife
* Fish Migration
* Navigation

National Pollution Discharge Elimination System (NPDES) permits now in effect for wastewater discharges, and EPA proposals to regulate future storm water discharges are examples of major attempts to insure water quality. The City of Sacramento is required to comply with the various provisions of the NPDES wastewater permit which in its present form has seventeen (17) general provisions and specifies exact reporting and monitoring data to be collected for wastewater discharge.

The Water Quality Act of 1987 directed the EPA to develop regulations relating to storm water discharges. These regulations will require that permits for these discharges be obtained by the City. The permit may be issued on a system or area wide basis. The permits will require differing disposal techniques and methods as applicable to specific sites throughout the country. This will require obtaining information to determine the effects of storm water discharges to Sacramento area receiving waters. A program to sample and monitor storm discharges will be very costly and will require that clear objectives be defined. The standard EPA Test Scanning Method would most likely be used. A number of affected jurisdictions have requested a delay in implementing the regulations due to the requirement for more detailed data than originally envisioned. It is expected that issuance of both general and individual discharge permits, as determined on a case by case basis, will be the eventual EPA strategy.

GENERAL DISCUSSION ON LEVEES, STREAM CHANNELS AND CANALS

The American and Sacramento River levees are not addressed in the following discussion, as they will be included in a separate report dealing with major flooding issues.

Not all levees within the Sacramento City limits are under City control. Agencies such as RD1000, the American River Flood Control District, Sacramento County, and the State of California, all have some jurisdictional responsibility to maintain portions of levees. The miles of levees within each of the areas discussed previously are shown below:

Area 1 (Natomas)	15.0 miles
Area 2 (N. Sac/Robla)	10.4 miles
Area 3 (Orig. Sacto)	4.5 miles
Area 4 (E. Central Sacto)	11.1 miles
Area 5 (S. Sacto/Pocket)	19.6 miles
	60.6 miles

A problem discovered during the February 1986 heavy storm was that some railroads and roadways crossing channels and canals were actually lower in elevation than the tops of the levees. Flood waters breached these levees at several of these penetrations and consequently some actual flooding occurred. Subsequently, gates of various types have been designed and constructed at these railroad and roadway crossings. These portable gate closure systems will be used when surface water elevations reach certain stages. Additionally, numerous breaches in levees, such as culverts, have been discovered by staff. Each of these now have a closure system available to install when conditions warrant.

One major problem with most of the levees in the Sacramento system is that they were constructed when no specific "stability" requirements existed. Present federal conditions require stability analysis on levees to assure that they will function properly at design capacity. This "stability" requirement consists of mass considerations (height, width, and material), permeability coefficients, and other special features such as gates, pipes, etc., that extend through a levee. The Corps of Engineers usually sets the requirements for these standards. For small height levees (6' or less in height) this is not a major factor since the width of those levees controls stability analysis. As levees are heightened, the seepage calculations become quite extensive and require considerable test data for accurate analysis.

Maintenance of all the canals, channels, and levees is a full time job for crews assigned this task. A smooth channel or canal will allow more water to pass through it in a given period of time, thereby increasing its capacity. This benefit is unnoticed until water surfaces start rising significantly. The more debris, trees, obstructions, etc. in a canal or channel, the higher the water must rise to pass through the area. This Division's goal is to fully clear all channels and canals twice between summer and late fall, and ideally, once again in mid-winter and mid-spring.

Storm drainage in any area is also affected by controlling run-off from streets and highways. Where concrete curbs and gutters exist, it is much easier to control rain and pass it on to the river through the storm drainage system. Areas without curbs and gutters usually have ditches of varying depths and widths and almost always lead to flooding conditions during minor rain storms. This occurs even under a good maintenance program. This element is the responsibility of the Transportation Division and will be discussed more thoroughly in their report.

FUTURE OF STORM DRAINAGE

Internal drainage systems will need constant modifications as infill development occurs. Due to the age of most of the City's system, replacement for both capacity and structural failures will also be required.

Natomas will become the newest system and should offer the best overall performance in the next twenty years. South Sacramento/Pocket Area should also handle most storms quite well for the next twenty years.

The remaining Areas (North Sacramento/Robla, Old Sacramento and East Sacramento) will require considerable investment in maintenance and capital improvement projects if they are to perform to acceptable standards of capacity and level of ongoing maintenance.

North Sacramento/Robla is approximately sixty percent completed in terms of storm drainage. Major systems should be installed in most of the northern portion of this area but a number of existing systems are inadequate. To properly install the pipes necessary for drainage in this area will cost $10 million for the primary storm drainage and secondary (minor collectors into individual streets, cul-de-sacs and tie-in areas) collection areas. This equates to assessments of approximately $13,000 per net developed acre. Pump stations would add a minimum of $2,500 per net developed acre. Funding for the improvement of Magpie Creek and the Magpie Creek Diversion will also be required, at an estimated cost of five to six million dollars.

East Sacramento needs only modifications to existing systems to meet future needs. Costs for these improvements would appear in future capital improvement program budgets over the next 20 years.

PROJECTED FUTURE EXPENDITURES (BOND ISSUE)

The next five years of capital projects are broken down into two categories: pump stations and pipes, levees, creeks and culverts. These projects and costs are shown on Exhibit II. They indicate a capital improvement program of $2,990,000 for fiscal year 1988-1989.

The Flood Control & Sewer Division has identified a number of drainage deficiencies which are not contained in the 5-year Capitol Improvement Program, due to a lack of available funding. A list of these projects is attached. On-going studies will undoubtedly identify numerous other deficiencies in the City's drainage system not identified or quantified in this list. This list is attached as Exhibit III.

In addition, this listing does <u>not</u> include any projects for improving the capacity of the City's Combined Sewer-Drainage System to accommodate storm frequencies greater than once in two years. Preliminary estimates from the City's consultant studying the Combined Sewer System indicates that in excess of $100 million dollars in construction will be required to provide meaningful improvements to the capacity of the combined system. Similarly, there is no provision for the City's share of major flood control projects being studied by the Corps of Engineers on the Sacramento and American Rivers and their tributaries.

The deficiencies in the City's storm drainage systems can be divided into three basic categories as follows:

1. Deficiencies in pumping plant capacity.

2. Deficiencies in pipe sizes to carry drainage.

3. Absence of drainage facilities.

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

In areas where drainage facilities are non-existent, it is appropriate that the initial installation be financed by the property owners who benefit. Since most of these deficient areas are also served by unimproved streets, it appears possible that an arrangement can be considered wherein the property owners finance basic street improvements, such as curbs, sidewalks, paving, street lights, etc., by assessment district, with the City participating by funding the needed drainage improvements. This partnership would result in a visual, as well as functional improvement to many areas of the city.

Bond issue financing would provide for drainage improvements as needed in these deficient areas since the bonds could be sold in increments as the projects are designed and as the public agrees to finance the accompanying street improvements through formation of assessment districts.

The estimated construction cost of the drainage projects on the attached list, for which funding is presently available, is $29.5 million. Engineering, inspection, overhead and contingency costs are not included in this cost. If this construction were to be financed by a bond issue at an assumed interest rate of 8%, the City's estimated yearly cost to retire the bonds would be $3.97 million for 20 year bonds or $3.46 million for 30 year bonds.

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. The next section covers a desirable time period to complete this goal.

MAINTENANCE AND REVENUE REQUIREMENTS

The storm drainage system of Sacramento is predicated on a good maintenance program. Additionally, facilities must be constantly improved and replaced as necessary through a capital improvement program. These requirements are well established with the present and all past City Councils, as evidenced by past approved budgets.

What constitutes a good maintenance program and the appropriate Capital Improvement budget are two questions every political body decides each year. Ultimately, the appearance and satisfactory functioning of the infrastructure shows how accurate those annual decisions have been.

Prior to making a final decision on these drainage issues, it is helpful to consider 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 is needed to assure continued capacity, not necessarily improvements in the pipe materials themselves.

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.

D. Earthwork is considered a long term benefit and as such should be properly handled, placed, compacted and graded initially to meet this requirement.

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.
- 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 per year.
- Underground utilities maintenance should be funded at a level of 1.5 to 2 percent of the present worth per year.
- Earthwork should be maintained for each separate system design, i.e., canals and channels for flood frequencies, levees for only long term considerations, etc.

Exhibit IV shows an approximate present worth value of Sacramento's storm drainage infrastructure. Using these estimated costs, the yearly maintenance, operations and capital improvement program budget equates as follows:

Item			Yearly Maintenance Costs
Storm drainage mains	($96,054,000)(1.5%)	=	$1,441,000
Secondary Mains	($597,067,000)(1.5%)	=	8,956,000
Storm drainage pump stations	($58,470,000)(4%)	=	2,339,000
Storm drainage canals & channels	($155,891,000)(2%)	=	3,118,000
Storm drainage levees	($27,730,000)(1%)	=	277,000
TOTAL YEARLY REQUIREMENTS		=	$16,131,000

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.

The storm drainage fund is currently operating with a total annual revenue of approximately $9.7 million for fiscal year 1987–1988. This will allow for some debt financing of needed improvements. However, the amount would not provide adequate funding for the list of improvements previously discussed. Approximately $15 million of improvements could be bonded under the present revenues. The present revenue would be fully utilized, either with a bond issue or yearly capital improvements, as well as continued maintenance and operation. Not included in the overall analysis are the combined storm drain/sewer system requirements which will be presented in a later report. That report will demonstrate the costs associated with altering existing systems.

The shortfall between the revenue now earned and that required to meet the infrastructure evaluation cost is shown as follows:

- Present Revenue Stream:

  Equivalent 6 and 7 room homes = 170,000 (for calculation purposes only)

  Cost per month per equivalent home = $\frac{9,700,000}{170,000 \times 12}$ = $4.75 per month

- Required Revenue Stream:

  Cost per month per equivalent home = $\frac{\$16,131,000}{170,000 \times 12}$ = $7.90 per month

This would be a 66% increase in revenue if implemented all at one time. 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. To meet this increase the following chart is offered as a guideline:

Number of Years	Yearly Percent Increase (Includes 6% Inflation per Year)
1	66%
2	37%
3	26%
4	20%
5	17%
6	15%
7	14%
8	13%
9	12%
10	12%

Public Works would not recommend extending major rate increases longer than a five year period, since the infrastructure needs will change if it takes a long period of time to fund a major program. The goal would be to have the necessary funding in place by 1994 as well as start the first major storm drainage bond issue.

CONCLUSION

The City has been fortunate in recent years that few of its deficient drainage systems have been severely tested. The storms of 1986, however, revealed a number of problems that must be solved if the City is to have a reliable and well-maintained drainage system. The adequacy and condition of storm drainage facilities varies greatly from one area of the City to another. 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 in some areas. Changing federal requirements and the imposition of more stringent stormwater discharge standards will also affect planning for drainage system improvements.

LONG TERM FINANCING PROJECTS
EXHIBIT III

MARCH, 1988

DRAINAGE CIP'S NOT SHOWN
ON CITY'S 5-YEAR PROGRAM

PROJECT NO.	LOCATION	DRAINAGE PLANNING AREA	PROPOSED WORK	$(1,000'S) ESTIMATED COST
1	Various	Various	Various capacity and functional imp. A.R.F.C. pump plants	$6,075
2	Various	Various	Reconstruct gutter drains (3000 @ $1,000)	3,000
3	Various	Various	Concrete lining of existing channels to increase capacity & minimize erosion	5,000
4	Vicinity Renee Ave.	2	Concrete line exist ditch	265
4	Vicinity of Knoll	2	Const. various drainage improvements	165
5	Oakmont, Calvados, Arden - Oxford and S. to Hwy. 160	2	Construct closed conduit	480
6	Lexington, Dixieanne, Clay & El Camino Ave.	2	Construct closed conduit and open channel	250
7	Arcade Blvd. W. of Norwood	2	Replace inadequate drainage system	360
8	Arcade Creek, various locations E of Marysville Blvd.	2	Construct paved bottom, access ramps erosion protection	600
9	Edgewater to Norwood vic. of Lampassas	2	Various open channel & closed conduit improvements	500
10	Ice House Ditch bet. Grove & 160 FWY	2	Concrete line and expand existing ditch	240
11	Globe Ave to N. Sump 3	2	Place closed circuit to replace existing ditch	300
12	Eleanor Ave. vicinity Norwood	2	Replace inadequate drainage system	650

13	Fairfield Street N of Las Palmas	2	Replace inadequate drainage system	20
14	Colfax St. vicinity Lampassas	2	Construct closed conduit drainage	225
15	Sonoma bet. Clay & Callecita	2	Replace inadequate drainage system	225
16	Juliesse Avenue Hagginwood to Academy Way	2	Replace inadequate drainage system	200
17	Empress & Dixieanne	2	Construct closed conduit	75
18	Dixieanne & Beaumont	2	Construct closed conduit	100
19	Globe Avenue	2	Construct closed conduit	75
20	Winterhaven E of Northgate Blvd.	2	Construct closed conduit	100
21	Carlson, Shepard & Camelia	2	Reconstruct existing system	200
22	East Del Paso Heights	2	Misc. closed conduit drainage construction	300
23	Magpie Creek Diversion	2	Improve existing drainage channel to greater capacity	4,000
24	Combined Sewer Repl. R St. bet 10th/13th Streets	3	Replace deteriorated combined sewer	200
25	Combined Sewer Repl. 9th St. bet T & U Streets	3	Replace deteriorated combined sewer	50
26	Combined Sewer Repl. 4th Street	3	Replace deteriorated combined sewer	400
27	Area bounded by 14th Ave., Power Inn Rd. & East Railroad Ave.	4	Construct closed conduit	1,600
28	Ramona Avenue	4	Construct closed conduit	360
29	Ditch bet. Kiefer and Folsom	4	Concrete line existing ditch	75
30	Sump 31 & vicinity	4	Construct pump plant and related facilities	3,000

31	S. Sac Drainage Canal N. of 43rd Ave.	5	Replace existing open channel with closed conduit	250

Total est. construction		$29,520,000
10% engineering		2,952,000
5% inspection & testing		1,476,000
5% overhead		1,476,000
	Subt.	$35,424,000
10% contingencies		3,542,000
	TOTAL	$38,966,000
		$39,000,000

PROJECT FUTURE EXPENDITURES

The next five years of capital projects as presently proposed by Flood Control and Sewers Divisions are broken down as follows:

A. PUMP STATIONS

Project Description	Drainage Planning Area	Location	Cost by Year 88-89	89-90	90-91	91-92	92-93
Sump 33D Expansion	5	Meadowview Rd., nr. 22nd St.	650				
Sump 41D Reconstruction	5	Piedemont Drive	600				
Sump 25D Reconstruction	5	Fernandez Dr., nr. 24th St.			400		
Sump 28D Catenary Trash Rack	5	Freeport Blvd., South of Meadowview	330				
Sump 2 Switchgear	5	11th Ave, nr. Riverside	50	50			
Sump 83D Reconstruction	2	Del Paso, nr. Railroad Dr.		250			
Plant 158D Expansion	2	Olmstead Dr., nr. Norwood			650		
Sump 9 Reconstruction	2	Arcade Blvd., nr. Norwood				2,150	
Sump 22D, Outfall Repair	5	Golfview Dr., nr. 53rd Ave.					1,200
American River Flood Control Reconstruction		Various	400	600	600	800	800
Stormwater Pumping Miscellaneous Impr.		Various	65	65	65	65	65
Stormwater Discharge Monitoring Program		Various	75	75	100	200	200
Sub total			2,170	1,040	1,815	3,215	2,265

EXHIBIT II

Proposed 5 Year Capital Improvement Program

B. PIPES, LEVEES, CREEKS and CULVERTS

Project, Description	Drainage Planning Area	Cost by Year 88-89	89-90	90-91	91-92	92-93
Hagginwood Creek; Kathleen to S.P.R.R.	2	50	900			
Highway 160 South Drainage Improvement	2	450				
27" Combine Sewer/Stormdrain near Sacramento State College Reconstruction	4	50				
Oxford-Oakmont Drainage Improvement	2		450			
Drainage Improvement near Johnston Park	2		400			
El Monte Avenue; Del Paso to Arden Way	2			250		
Drainage Improvements near Lexington	2			420		
Riza Avenue Ditch west of Stockton Blvd.	4			300		
C.W.W.T.P. Exfiltration Study	5	20				
Misc. Drainage Ditch Improvements	Various					700
Radio Telemetry for Monitoring Pump Stations	Various					200
Ditch Invert Paving; Ramp Construction	Various	100	150	150	150	150
Misc. Drainage Improvements	Various	150	150	150	150	150
Sub total		820	2,050	1,270	300	1,200
TOTAL (A + B)		2,990	3,090	3,085	3,515	3,465

EXHIBIT TT

CITY OF SACRAMENTO
STORM DRAINAGE
INFRASTRUCTURE EVALUATION

A. Assumptions for general analysis.

1. Presently the City has 566 miles of storm drainage mains.

2. Inflation factor is established by using the ENR (Engineering New Record) construction index.

3. 50% of the storm drainage system was in place by 1940, and 80% was in place by 1970.

4. Useable life span for concrete pipe is 75 years. All pipe is assumed to be concrete for ease of calculations.

5. Pump station costs are estimated using an empirical formula developed by the Boyle Engineering Corporation:

$$\text{Cost (Feb. 1988 \$)} = \frac{(\text{ENR, Feb. 1988} = 4459.5)}{(\text{ENR, Dec. 1982} = 3950\ )}\ (\text{BEC})$$

and,

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

6. All secondary costs (those pipes smaller than 36 inches in diameter, and associated appurtenances to serve individual areas connecting to the storm drainage main) are based on average costs of $18,000 per acre.

7. Costs for canals and channels is based on $0.15/cfs/lineal foot; this does not include pump station costs, right-of-ways, engineering and other contingencies.

8. All levee costs are calculated at today's in-place value of $6.00 per cubic yard. No depreciation is associated with this earthwork.

B. Cost analysis for present worth:

$$\text{Average Depreciation Factor} = \frac{75 - [(1988-1940)(.5) + (1988-1970)(.5)]}{75}$$

$$= \frac{75-33}{75} = 0.56 \text{ for concrete pipe}$$

(1) PIPE COSTS:

DIAMETER	L.F.	1988 $/L.F	1988 VALUE	AVERAGE DEPR. FACTOR	1988 PRESENT WORTH
24" FM	1,850	$150	$ 277,500	0.56	$ 155,400
18" FM	1,400	$113	$ 158,200	0.56	$ 88,592
8" FM	900	$ 50	$ 45,000	0.56	$ 25,200
12'x 10'box	1,200	$690	$ 828,000	0.56	$ 463,680
10'x 8'box	3,100	$470	$ 1,457,000	0.56	$ 815,920
96" FM	13,712	$962	$ 13,190,944	0.56	$ 7,386,929
90" FM	90	$860	$ 77,400	0.56	$ 43,344
84" FM	6,430	$831	$ 5,343,330	0.56	$ 2,992,265
78" FM	10,588	$741	$ 7,845,708	0.56	$ 4,393,597
72" FM	18,520	$650	$ 12,038,000	0.56	$ 6,741,280
66" FM	17,974	$543	$ 9,759,882	0.56	$ 5,465,534
63" FM	1,540	$507	$ 780,780	0.56	$ 437,237
60" FM	35,908	$470	$ 16,876,760	0.56	$ 9,450,986
54" FM	53,824	$416	$ 22,390,784	0.56	$ 12,538,839
51" FM	250	$380	$ 95,000	0.56	$ 53,200
48" FM	78,821	$344	$ 27,114,424	0.56	$ 15,184,077
42" FM	101,569	$302	$ 30,673,838	0.56	$ 17,177,349
39" FM	7,773	$264	$ 2,052,072	0.56	$ 1,149,160
37" FM	158	$238	$ 37,604	0.56	$ 21,058
36" FM	91,035	$225	$ 20,482,875		$ 11,470,410
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TOTAL VALUES			$171,525,100		$ 96,054,057

(2) SECONDARY STORM DRAINAGE COSTS:

AREA	DEVELOPED ACREAGE	1988 VALUE	AVERAGE DEPR. FACTOR	1988 PRESENT WORTH
1	3,593	$ 64,674,000	0.87	$ 56,267,000
2	8,093	$145,674,000	0.56	$ 81,578,000
3	9,428	$169,700,000	0.56	$ 95,034,000
4	12,459	$224,262,000	0.67	$150,256,000
5	16,281	$293,058,000	0.73	$213,932,000
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		$897,368,000		$597,067,000

(3) STORM DRAINAGE PUMP STATION COSTS:

SUMP #	LOCATION	VALUE AT TIME OF CONSTRUCTION	1988 VALUE	1988 PRESENT WORTH
			(estimate)	
1	Front & U Streets (power)	$ 180,000	1,800,000	900,000
1-A	2nd & U Streets (power)	$ 140,000	1,400,000	700,000
2	n. west cnr. of 11th Ave. & Riverside Blvd.	$ 2,407,200	24,072,000	12,036,000
			(estimate)	
4	9th Ave. & West Curtis (Curtis Park)	$ 40,000	400,000	200,000
5	4913 Fruitridge Road	$ 61,274	535,785	276,000
8	5975 64th Street	$ 100,395	824,517	430,000
10	5105 Sandburg Drive	$ 153,618	1,141,767	610,000
19	4500 52nd Street	$ 83,549	593,288	321,000
22	6800 Golfview Drive	$ 139,957	993,851	537,000
24	s. of entrance Bing Maloney Golf Course on Freeport Bl.	$ 131,767	890,324	488,000
25	2423 Fernandez Drive	$ 63,491	450,857	244,000
26	5711 Freeport Bl.(n.west cnr, Airport and Freeport)	$ 163,988	1,108,108	607,000
27	6420 S.Land Park Drive	$ 76,281	491,585	273,000
28	7788 Freeport Bl. (s. of Meadowview TP)	$ 341,497	1,955,561	1,132,000
30	6698 S. Land Park Drive	$ 81,890	481,143	274,000
31	6429 Elvas Avenue	$ 178,894	1,051,082	599,000
33	2196 Meadowview Road	$ 188,814	1,109,364	633,000
34	Freeport Bl. south of Meadowview Road	$ 267,554	1,571,994	896,000

(3) STORM DRAINAGE PUMP STATION COSTS: (continued)

SUMP #	LOCATION	VALUE AT TIME OF CONSTRUCTION	1988 VALUE	1988 PRESENT WORTH
37	Colonial Village Unit #13 Power Inn Road	$ 143,746	844,580	482,000
38	N/S J Street underpass	$ 69,956	391,429	237,000
39	6792 S. Land Park Drive	$ 94,344	554,315	316,000
41	989 Piedmont Drive	$ 51,266	342,803	198,000
43	Power Inn s. of 21st Ave.	$ 182,951	1,023,677	592,000
44	6200 Sun River Drive	$ 136,246	762,344	441,000
46	7260 24th Street	$ 125,012	699,486	405,000
47	6610 13th Street	$ 99,565	557,102	322,000
50	6709 75th Street	$ 112,870	610,855	357,000
51	e. side of Power Inn Road and n. of Morrison Creek	$ 117,389	635,312	372,000
52	217 P Street	$ 211,157	1,142,785	668,000
54	7201 24th St. bypass	$ 156,367	823,283	486,000
56	980 Seamas Avenue	$ 53,213	259,632	157,000
58	Garden Hwy. & Azusa off Thelma	$ 166,053	851,555	507,000
63	725 Clipper Wy & Greenhaven	$ 202,360	1,034,893	616,000
65	1133 Silver Lake Drive	$ 175,185	895,912	534,000
66	Florin Perkins Rd & 24th Av	$ 283,564	1,432,109	856,000
67	7756 Center Parkway	$ 283,245	1,378,964	835,000
68	Franklin Blvd. Pump Station bet. Ehrhardt & Valley Hi	$ 181,270	882,505	534,000

(3) STORM DRAINAGE PUMP STATION COSTS: (continued)

SUMP #	LOCATION	VALUE AT TIME OF CONSTRUCTION	1988 VALUE	1988 PRESENT WORTH
69	8242 Center Parkway	$ 291,141	1,420,505	859,000
70	6494 Surfside Way	$ 174,475	847,570	514,000
71	7338 Willow Lake Way	$ 151,333	735,152	445,000
73	5th St. underpass, w. side	$ 68,287	331,726	201,000
74	El Camino Subway	$ 95,334	457,140	278,000
83	Del Paso Blvd. Subway Railroad Dr. n. Northgate	$ 55,645	261,764	160,000
89	s. end of 24th St. bypass	$ 365,077	1,651,179	1,026,000
90	8651 River Road Freeport & Meadowview s.	$ 266,147	1,201,290	747,000
91	La Riviera Drive and Howe Avenue bridge	$ 221,066	1,029,068	633,000
92	La Riviera Dr. & Grand Rio under powerlines @ levee	$ 294,775	1,372,184	844,000
94	7015 Reichmuth	$ 119,886	519,564	328,000
95	190 Cadillac Drive	$ 366,837	1,585,185	1,001,000
96	e. side of 65th Street @ Morrison Creek	$ 434,412	1,875,374	1,185,000
97	24th Street @ 47th Avenue	$ 284,444	1,229,145	776,000
98	Potamac & Northstead s.w. corner of schoolyard	$ 324,599	1,399,949	885,000
99	C Street & Elvas Avenue	$ 383,470	1,597,789	1,023,000
100	1144 Silver Lake Drive (across from S-65)	$ 71,005	289,971	187,000
101	Elvas Ave. 500 ft. south J Street subway	$ 413,705	1,549,054	1,033,000

(3) STORM DRAINAGE PUMP STATION COSTS: (continued)

SUMP #	LOCATION	VALUE AT TIME OF CONSTRUCTION	1988 VALUE	1988 PRESENT WORTH
102	e.end Bowman Ave & levee Rd Gardenland Park @ W-159	$ 346,171	1,296,180	865,000
103	Carol & Altos Avenue s. of Ford Road	$ 219,429	878,405	571,000
104	5698 South Land Park Drive	$ 626,190	2,522,578	1,635,000
108	21st Street & 63rd Avenue	$ 284,581	545,375	394,000
109	117 Breckenwood Way	$ 167,667	671,193	436,000
110	Sail Court & Havenside Way between #2 & #10 Sail Ct.	N/A	no pump	N/A
111	5th St. n. of Richards Blvd	$ 354,462	1,349,892	894,000
112	Country Place off Florin Rd near Lake Greenhaven	$ 152,055	516,049	358,000
113	6800 Folsom Blvd.	N/A	no pump	N/A
114	4th and J Streets	$ 32,995	100,300	73,000
115	4100 Meadowview Road @ Morrison Creek	$ 295,550	829,456	627,000
116	88th St & Morrison Creek	$ 256,298	719,295	544,000
117	n.of Chenault & e.Nimitz St Village Green Mobile Home Park off Bell Avenue	$ 315,081	525,273	525,000
128	Mack Road across from 3951 Brook Meadow	$ 595,590	1,268,402	1,268,000
129	San Juan Rd e. of I-5 Fwy.	$ 1,116,442	2,159,988	2,160,000
130	West El Camino Avenue west of I-5 Freeway	$ 705,117	1,364,194	1,364,000
132	7550 Pocket Road 1/4 mile of Garcia Bend	$ 1,009,223	1,682,479	1,682,000

(3) STORM DRAINAGE PUMP STATION COSTS: (continued)

SUMP #	LOCATION	VALUE AT TIME OF CONSTRUCTION	1988 VALUE	1988 PRESENT WORTH
138	8201 Pocket Rd intersection of Alder Tree & Maple Tree	$ 467,977	726,652	727,000
139	Valley Hi Drive, left on Torrente, end of street	$ 553,055	803,110	803,000
140	Pinedale Ave & Sulley St	$ 630,694	915,852	916,000
141	between 765 & 753 Turnstone off Northgate	$ 405,950	441,545	442,000
142	Greenhaven Drive @ S.Land Park Dr, w. of I-5		under construction	N/A
144	near Jessie & Main Street n. side of 880 Freeway		under construction	N/A
	TOTALS	$20,572,000	$ 94,665,000	$ 58,470,000

(4) CANAL AND CHANNEL COSTS:

CREEK NAME	CITY LIMIT/cfs	MID POINT	CONFLUENCE/cfs	TOTAL LENGTH /cfs	CAPITAL COSTS (.15c/cfs/LF)
Dry Creek				7000'/9980	$10,479,000
Magpie north (div.)				11000'/1150	$ 1,898,000
Magpie south				12000'/1880	$ 3,384,000
Arcade				32200'5000	$24,150,000
Natomas EMD				37400'/11200	$62,832,000
Natomas MD				7000'/950	$ 998,000
Natomas EDC				25200'/690	$ 2,608,000
Natomas WDC				18000'/270	$ 729,000
Morrison north	12,260/2,855	1,555	13,800/3,395	26000'/3395	City mid / Mid con / total 4,054,995/5,123,250/13,241,000
Morrison south	8,000/3,395		9,600/5,315	17600'/7410	4,074,000/7,653,600/19,562,000
Elder				11400'/2240	$ 3,830,000
Florin				4400'/1005	$ 663,000
Union House	4,800/675	1,125	13,200/1,560	18000'/1560	648,000/2,658,150/4,212,000
Strawberry				2400'/655	$ 236,000
Robla				9200'/2900	$ 4,002,000
Laguna				7200'/2840	$ 3,067,000
		1988 VALUE			$155,891,000

(5) Secondary Levee Costs:

These levees are of various sizes and lengths with no canals or channels associated with them.

- Approximately one-third of the levees have a 2,000 square foot cross section:

$$(2{,}000 \text{ sq. ft.})\left(\frac{48{,}000 \text{ l.f.}}{}\right)\left(\frac{1}{27}\right) \$6.00/\text{c.y.} = \$21{,}330{,}000$$

- Approximately one-third of the levees have a 400 squar foot cross section:

$$(400 \text{ sq. ft.})\ (48{,}000 \text{ l.f.})\left(\frac{1}{27}\right) \$6.00/\text{c.y.} = \$\ 4{,}267{,}000$$

- Approximately one-third of the levees have a 200 square foot cross section:

$$(200 \text{ sq. ft.})\ (48{,}000)\left(\frac{1}{27}\right) \$6.00/\text{c.y.} = \$\ 2{,}133{,}000$$

TOTAL VALUE = $27,730,000

C. Summation of Storm Drainage Infrastructure Value:

B. (1) Storm Drianage Mains	$ 96,054,000
B. (2) Storm Drainage Secondary Mains	$597,067,000
B. (3) Storm Drainage Pump Stations	$ 58,470,000
B. (4) Storm Drainage Canals and Channels	$155,891,000
B. (5) Storm Drainage Levees	$ 27,730,000
Total (Approximate 1988 Valuation)	$935,212,000