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APPROVED
BY THE CITY COUNCIL

SEP 6 1994

OFFICE OF THE
CITY CLERK

DEPARTMENT OF
UTILITIES

ENGINEERING SERVICES

CITY OF SACRAMENTO
CALIFORNIA

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August 23, 1994

City Council
Sacramento, California

Honorable Members in Session:

SUBJECT: COMPREHENSIVE FLOOD MANAGEMENT PLAN - PUBLIC WORKSHOPS

LOCATION AND COUNCIL DISTRICT: Citywide (All Districts)

RECOMMENDATION:

Staff recommends that Council approve the attached resolution directing staff to hold a series of public workshops to present and obtain comments on draft elements of the Comprehensive Flood Management Plan.

CONTACT PERSON: Gary A. Reents, Acting Engineering Services Manager, 433-6633

FOR COUNCIL MEETING OF: September 6, 1994

SUMMARY

In response to Council direction, staff is preparing a Comprehensive Flood Management Plan. The main elements of the plan have been drafted and staff proposes to conduct a series of workshops with interested public groups to present the drafts and solicit comments. After incorporating comments from the workshops, staff will return to Council in November for approval of the Plan.

COMMITTEE/COMMISSION ACTION

None.

BACKGROUND INFORMATION

On December 7, 1993, Council adopted Resolution 93-696 requiring staff to prepare a Comprehensive Flood Management Plan for the City of Sacramento (Plan) within twelve months. The stated goal of the Plan is to minimize the loss of life, personal injury, and property damage in the event of a flood.

In response to Council's direction, the Department of Utilities was assigned the lead for coordinating preparation of the Plan, and a Core Group was formed to prepare the Plan. The Core Group consists of individuals from the Sacramento Area Flood Control Agency (SAFCA) and the City's Police, Fire, Planning, and Utilities Departments. The Core Group identified seven elements for inclusion in the Plan to meet the objectives and analyses required by Council. Drafts of each of the elements are included as Exhibit A to this report.

A brief description of each of the elements, along with identification of the responsible Department, is presented below:

1. Primary Flood Control Projects - as the responsible agency, SAFCA has prepared a complete description of both existing and proposed flood control projects. The description of existing projects consists of the background and history of the Sacramento and American River flood control systems, as well as their performance during the 1986 flood. The description of proposed projects includes the Sacramento Urban Area Levee Reconstruction (including the riverwall), the American River Project (including Folsom Reservoir reoperation, the SAFCA Local Project, and the Lower American River levee investigation), and other local projects such as the South Sacramento County Stream Group (Morrison Creek) and Magpie Creek projects.

2. Emergency Preparedness - the Fire Department reviewed and extracted, as appropriate, the sections of the current Multi-Hazard Emergency Plan as it relates directly to flooding. The extracted sections focus on response actions during flood events. Additional material regarding recovery of City services, and public education regarding preparation, warning, and response is also included.

3. Evacuation Plans - the Police Department has updated the existing area evacuation plans to be specific to flooding. Flooding inundation maps prepared by the Utilities Department were overlain on the existing evacuation plans and revisions made accordingly.

4. Protection of Hazardous Material Storage Sites - The Fire Department has catalogued and plotted all known sites which store hazardous materials within the City. Flooding inundation maps prepared by the Utilities Department were used to determine which hazardous material storage sites are subject to flooding. Existing regulations (federal, state, and other local jurisdictions) regarding hazardous materials storage were reviewed, and recommended or required protection measures for local adoption are proposed.

5. Protection and/or Recovery of Key Public Facilities - The Utilities Department, along with other local agencies (Sacramento County, SMUD, PG&E, Pacific Telephone, U.C. Medical Center, etc.), has developed a list of key facilities to the City both during a flood and immediately after for rapid recovery. Possible protection, or recovery, measures were developed and reviewed for feasibility, and planning level cost estimates were developed.

6. Residential and Non-Residential Development Guidelines - The Planning and Development Department has reviewed both building restrictions and requirements for flood prone areas presently used by the City and other jurisdictions. New development guidelines been drafted and their cost effectiveness evaluated.

7. Flood Insurance Participation - SAFCA has researched both existing regulations and proposed legislation regarding flood insurance. Methods to increase participation under the existing, or proposed, laws have been developed. The "residual risk" of economic losses for events greater than the 100-year event was used to develop an proposed insurance program.

Upon Council approval, staff proposes to hold a series of workshops with business, environmental, and neighborhood groups to present and discuss the draft elements of the Plan. Staff will solicit comments at all of the workshops, and revise the draft elements as appropriate. After revisions, the Plan will be finalized and submitted for Council review and approval sometime in November, 1994.

ENVIRONMENTAL CONSIDERATIONS

There are no environmental impacts associated with preparation of the plan. At the time of plan approval in November, environmental concerns and California Environmental Quality Act requirements will be identified.

FINANCIAL CONSIDERATIONS

At this time, the only expected expenditures are for staff time to develop the respective Plan elements. The Plan itself will identify costs for various flood protection measures.

POLICY CONSIDERATIONS

Development of the Comprehensive Flood Management Plan is consistent with Council Resolution 93-696. It is expected that a number of important policy questions will be identified by the Plan. These will be presented by staff for Council consideration and decision at the time of Plan adoption.

MBE/WBE

MBE/WBE requirements are not applicable to this item since no goods or services are being requested.

Respectfully submitted,

Gary A. Reents
Acting Engineering Services Manager

RECOMMENDATION APPROVED:

William H. Edgar
City Manager

APPROVED:

James G. Sequeira
Director of Utilities

APPROVED
BY THE CITY COUNCIL

SEP 6 1994

OFFICE OF THE
CITY CLERK

RESOLUTION NO. 94-549

ADOPTED BY THE SACRAMENTO CITY COUNCIL

ON DATE OF _____

RESOLUTION DIRECTING STAFF TO CONDUCT PUBLIC WORKSHOPS REGARDING THE COMPREHENSIVE FLOOD MANAGEMENT PLAN

BE IT RESOLVED BY THE SACRAMENTO CITY COUNCIL THAT:

Staff is hereby directed to conduct a series of public workshops to present draft elements, and solicit comments regarding the Comprehensive Flood Management Plan.

_____
MAYOR

ATTEST:

_____
CITY CLERK

FOR CITY CLERK USE ONLY

RESOLUTION NO.: _____

DATE ADOPTED: _____

9.4

COMPREHENSIVE FLOODPLAIN MANAGEMENT PLAN
OVERALL SCHEDULE

Plan Coordinator: Gary Reents - Utilities Department

		March	April	May	June	July	August	September	October	Nov	Dec
A.	Develop Scope and Elements of Plan	I----------I(4/15)									
B.	Prepare Plan Elements	I----------I(8/1)									
C.	City and outside Agency Review of Draft Elements						I----------I(9/1)				
D.	Public Review, Meetings and Workshops							I----------I(10/15)			
E.	Council Presentation									*(11/1)	
F.	Plan Revisions (if necessary)									(11/1 ----------12/6)	
G.	Final Council Adoption of Plan										*(12/6)

	March	April	May	June	July	August	September	October	November
D. Public Review, Meetings and Workshops							(9/15)I----------I----------I(10/15)		
				Workshop with Environmental Organizations----------I					
				Workshop with Business and Development Committee----------I					
				Workshops with Neighborhood Associations----------I-----I-----I					
				Final Workshop with all concerned parties----------I					

FEMA AR ZONE STRATEGY

COUNCIL POLICY COMPARISON

	Staff Proposal	Council Policy	Applicability
1.	Maintain restriction on residential construction, but allow non-residential development in Natomas	Restrict residential development in Natomas, permit non-residential with design requirements and waiver agreement	Consistent
2.	Allow flexibility in requiring elevation of structures	No elevation requirements outside of Natomas, will be addressed as part of Comprehensive Flood Management Plan, Development Guidelines Element	Consistent
3.	Allow eligibility of locally funded projects	SAFCA (of which City is a member) is funding Natomas Local Project	Consistent
4.	Allow 10 year time limit	None	None
5.	Allow multiple use of AR designation	None	None
6.	Allow AR designation at reconnaissance report stage	None	None

ENVIRONMENTAL GROUPS AND DEVELOPMENT COMMUNITY POSITIONS REGARDING PROPOSED AR ZONE STRATEGY

AR Regulations	Staff Proposal	Environmental Groups Position	Development Community Position	Natomas Neighborhood Assn. & SCAN Position
Allow construction in developed areas, but effectively precludes all construction in undeveloped areas.	Maintain prohibition of residential development, but allow non-residential development consistent with Council Policy in Natomas Basin.	Prohibit both residential and non-residential development throughout Natomas Basin.	Can accept prohibition on residential construction; strongly support allowing non-residential construction in undeveloped areas.	Generally agree with City.
Require structures within developed areas be elevated three feet.	Allow locals flexibility to require elevation of structures only where it will significantly reduce property damage or loss of lives.	Agree some flexibility may be warranted, need further definition.	Agree with City.	Agree with City.
Limit AR Zone term to five years.	Allow 10 year limits, with allowances for extension due to factors beyond the City's control.	Allow 10 years without extensions.	Agree with City.	Agree with City.
Limit AR Zone eligibility to federally funded projects only.	Allow use of AR Zone for local projects which are approved by federal agencies.	Agree with City.	Agree with City.	Agree with City.
Limits use of AR Zone to only one time for a community.	Allow use of AR Zone anytime a flood control system is decertified by federal agency due to circumstances beyond the control of the local community.	Agree with City.	Agree with City.	Agree with City.
Requires completion of a feasibility report for AR Zone eligibility.	Allow use of AR Zone after completion of a reconnaissance report.	Agree with City.	Agree with City.	Agree with City.

REVISED 8/30/94

CITY OF SACRAMENTO
FEMA FLOOD ZONE STRATEGY
TIME SCHEDULE

		COMMENTS
May 3, 1994	Oral Presentation to City Council	Presentation made
May 6, 1994	Letter to FEMA requesting extension of time for responses	Letter sent
May 16, 1994	City comments to FEMA AR Regulations	Sent 5/13/94
May 16 - June 14, 1994	Weekly staff meetings to discuss City's approach to FEMA flood zones	In progress
May 16 - 27, 1994	Interview Washington, D.C. consultant to assist City with FEMA	Completed 5/16/94
June 7, 1994	Meeting w/ John Freshman and SAFCA briefing	Completed
June 21, 1994	Meet with FEMA staff from San Francisco office	Completed
June 27, 1994	Meet with Sacramento County, Sutter County, Airport and SAFCA to report on respective Board actions	Completed
July 15, 1994	Brief business organizations on FEMA strategy; request letters of support to both FEMA and congressional representatives • BIA • CC • Property owners in Natomas area	
July 19, 1994	Brief Neighborhood Interest groups - request letter of support to FEMA and congressional representatives	
July 21, 1994	Brief Environmental Community - ECOS, Sierra Club on FEMA strategy - request letter of support to FEMA and congressional representatives	
July 1 - 22, 1994	Brief Ad Hoc Committee - Serna, Fargo, Yee, and Panell	Bob Thomas to schedule
July 1 - 22, 1994	Brief local congressional staff regarding City FEMA strategy that: • Congressman Matsui • Congressman Fazio • Senator Feinstein • Senator Boxer	Met with matsui, Fazio, and respective staff

		COMMENTS
September 6, 1994	Staff report to City Council (also reports to County Board of Supervisor, and SAFCA Board on same day) • Presents City position regarding FEMA zones • Authorizes staff to retain lobbyist consultant • Directs staff to meet with congressional representatives • Directs staff to meet and negotiate with FEMA - Washington, D.C.	
September 9, 1994	Send briefing package to FEMA - Washington, D.C.	
**********	SAFCA trip to Washington • Discuss flood control projects (not FEMA issues)	• Representatives from City; also John Freshman Postponed until *******
September 6 - 9, 1994	Meet with Sacramento County, Sutter County, Airport and SAFCA to report on respective Board actions	12:30 p.m. at 5770 Freeport Boulevard, Suite 100
September 12 - 16, 1994	Meeting w/ FEMA - Washington, D.C. to present proposal. Meet with Matsui, Fazio, Boxer and Feinstein staff	
September, October, 1994	Negotiations with FEMA regarding proposed AR Zone Rule	
October, November, 1994	Final AR zone regulations published in Federal Register	
October, November, 1994	Report to City Council and Board of Supervisors on result of negotiations with FEMA	
April, 1995	City must be in compliance with FEMA AR Zone regulations	

CITY OF SACRAMENTO

COMPREHENSIVE FLOOD MANAGEMENT PLAN

DRAFT ELEMENTS

SACRAMENTO FLOOD CONTROL

I. Background and History

The City of Sacramento sits at the confluence of two great rivers the Sacramento and American. The water sheds of the two rivers drain most of Northern California and part of southern Oregon from the coastal mountain ranges on the west to the Sierra Nevada mountains on the east for a total of _____ square miles.

The topography of this region is dominated by its flat lands which gently rise to the foothills on both the east and the west before rising dramatically into the mountains themselves. This area is part of the region of California known as the Great Central Valley which extends from Redding on the north to Bakersfield on the south enclosed on the east and west by the mountain ranges described above.

Small creeks and streams start high in the mountains fed by underground springs, storm run-off and melting snow. As these streams transcend from the upper watershed carrying water in channels they have carved for centuries through the granite, they combine forces until reaching the valley floor forming large rivers such as the Sacramento, American, Feather, Yuba, San Joaquin, Mokuleme and Consumes. These channels were characterized by small river beds to carry the normal flow from the mountain streams; and wide overbank flood plains which carried the flood flows caused by intense rainfall in the mountains which fall as winter storms rolling in from the Pacific attempting to rise above the Sierra mountain peaks to the east. These intense storms typically occur in the months of Dec, Jan, Feb and in the past turned much of the Central Valley floor into an "inland sea".

From an historical perspective, this area got its start as settlers began to move west, across the Great Plains, from the crowded cities in the eastern United States. The Central Valley became a stopping point on the trails to Los Angeles, San Francisco and the Northwest. Because of its fertile soil from the almost annual flood inundations, some people began to settle and farm the land. However, the boom to development and growth in this area came about with the discovery of gold in 1849 at Sutters Mill which lies just east of Sacramento in the Sierra Foothills. The gold mining era reached its pinnacle in the mid to late 1800s and finally came to a close in the late 1800s when hydraulic mining was outlawed by the Sawyers Decision . However, by this time the dredge tailings, consisting of sands and gravels produced by the hydraulic mining activity, had so clogged the valley's river system that the frequent flooding of this inland sea was further exacerbated.

In addition, people who had come to rely on the fertile valley to grow crops both for themselves and for export around the country and the world were taking stock of their situation and contemplating ways to control the rivers from coming out of their banks and flooding their houses and farms. In an independent fashion, they began to build a piecemealed flood control system consisting of levees, embankments and channels together to protect themselves from the frequent inundation of the rivers. This early patchwork of predominately levee improvements provided little protection for the larger flood events that occurred in the 1800's.

These failures urged some to look beyond their own fences and try to develop a comprehensive plan to control the raging rivers. A coordinated effort, however, did not occur until the State of California through the Reclamation Board and the Federal Government through the U.S. Army Corp of Engineers got involved. Their joint efforts, through the early 1900's, culminated with authorization of the Sacramento River Flood Control Project by Congress in 1917. The original authorized project envisioned a systematic construction of levees along the river channels parallelled by large leveed over flow channels connected to the rivers through a series of weirs and by-pass channels thereby safely conveying flows in excess of the channel's capacity to the Delta. This original authorization in 1917 was followed by subsequent authorizations in 1928, 1937, 1941, 1944, and 1950, which increased the Federal Governments involvement and expanded the Flood Control System.

Today, the Sacramento River Flood Control System is essentially complete (See Figure 1) as originally envisioned.

Acompanion to the Sacramento Flood Control Project is the Central Valley Project originally authorized to provide water supply and generate hydro-electric power for urban, and agricultural uses throughout the Central Valley. Recently, this project has also been providing water for environmental purposes. The Project's primary components are a series of multi-purpose dams and reservoirs in the foothills to collect winter rain and spring snow melt for use in summer and fall. These multi-purpose reservoirs are also connected to the existing flood control system. In addition to providing water supply, recreation and power, they are also used during the flood control season to provide valuable storage space for run-off generated by large flood events. The most prominent feature of the Central Valley Project in Sacramento is Folsom Dam and Reservoir located immediately upstream of the City of Sacramento on the American River near the City of Folsom.

II. EXISTING FLOOD CONTROL PROJECTS

The Sacramento area is affected--directly or indirectly--by numerous flood control and related water resource projects as outlined above. The American River is a major east-side tributary to the Sacramento River, which drains the Sacramento Valley, the Northern Portion of the Great Central Valley of California. In the Sacramento area, the Sacramento River Flood Control System includes reservoirs, narrow leveed river channels, numerous relief weirs, and leveed tributaries. The system is paralleled by large, broad, leveed bypass channels. This system conveys all the floodwater of the Sacramento River and its principal tributaries to the tidewater in Suisun Bay, in the Sacramento-San Joaquin Delta.

(1) American River System

Major flood control features in the American River basin include Folsom Dam and Reservoir on the American River and a complex system of downstream levees and channel improvements (See Figure 2). Downstream from Folsom Dam, the river flows into the historical flood plain, where it is contained on both banks by predominantly project levees, with a few private ones extending upstream. Project levees are those built as part of a federal flood control project or later upgraded to minimum standards and accepted into a federal project. while private levees are those typically built by developers or other individuals specific to a piece of property and are not part of the federal flood control project.

A. **Folsom Dam and Reservoir** Folsom Dam is a multi-purpose facility constructed by the Corp of Engineers, operated by the U.S. Bureau of Reclamation as part of the Central Valley Project (CVP). The dam regulates run-off on about 1860 square miles of drainage area through three separate forks, the north, middle and south of the American River. Folsom Lake has a normal full pool storage capacity (Elevation 466) of 975,000 acre feet with a seasonally designated flood control storage space of 400,000 acre feet (See Figures 3&4).

During normal operations of Folsom Reservoir, waters are released through penstocks into a power house in order to generate hydro-electric power. During the winter times when flows are high enough to require flood control releases from the reservoir they are initiated through a series of low level outlet gates through the face of the dam. These eight outlet gates are located on two-tiers of four outlets each with a total capacity to release _____ cfs.

During larger flood events when the inflow causes the reservoir to rise above the spillway elevation and higher out flows are required to be released these are made over the main spillway through five primary outlet gates, located along the top of the dam, which control the rate of release. The

operation of the reservoir is such that downstream releases are made to match the inflow (with some constraints) up to the maximum design capacity of the downstream levee system which is currently 115,000 cfs. When inflows exceed this threshold, the outlet is held and the remaining storage capacity of the reservoir is filled. When the reservoir reaches the point that there is no longer flood control storage, the downstream releases must be increased to match the inflow to avoid overtopping and losing the dam. This is accomplished by increasing flows over the main spillway gates and if necessary opening the three additional emergency spillway gates located adjacent to the five main gates.

B. **Nimbus Dam.** Nimbus Dam and its reservoir, Lake Natoma, are located about 6 miles downstream from Folsom Dam. Nimbus Dam, a power after bay to Folsom, is a diversion dam constructed and operated by the USBR as part of the CVP. The reservoir has a capacity of 8,760 acre-feet. Because of its small capacity, Nimbus has essentially no regulatory effect on flood flows in the American River.

C. **American River Levees**

The American River flows through the City of Sacramento from the outlet of Folsom Dam down to its terminus at the confluence with the Sacramento River near Discovery Park. The City is protected from flooding along the American River by a system of levees on both the north and south banks from the mouth until they tie into higher ground upstream beyond the City limits (See Figure 2). The south levee consists of 10.8 miles of levee improvements from the confluence at the Sacramento River upstream to Mayhew Drain at Mayhew Road. At this point the levee turns to the south and extends for a short reach along the existing Mayhew drain channel to its terminus.

The north levee along the American River starts at the confluence with the Sacramento River. The first approximately 2.5 miles contains the combined flood plain of the American River and the Natomas East Main Drain Canal (NEMDC). Discovery Park and other pieces of property are located on the land mass between the low flow channels which is dry during normal flows. From the NEMDC the northern American River levees continue for approximately 12 miles past Cal Expo and eventually terminating at the Carmichael Bluffs across the River from Goethe Park.

This levee system has been designed to safely contain flows out of Folsom Dam of up to 115,000 cfs. However, in 1986 flows of approximately 134,000 cfs were experienced and safely passed down this corridor for about a 24 hour period, because of the additional levee height or freeboard added to the

levees when they were originally built.

D. **NATOMAS EAST MAIN DRAINAGE CANAL (NEMDC)**

The NEMDC is a north-south channel which collects flows from creeks and strams in eastern placer and western Sacramento county. In addition, large releases from Folsom, American River under will flow up the NEMDC and threaten adjacent properties. Portions of both North Sacramento and the South Natomas area of the City are protected from flooding along the NEMDC by levees along its east and west banks (See Figure 2). The west levee of the NEMDC extends from the American River upstream about 13 miles to high ground near Sankey Road in Sutter County.

Sankey Road is the watershed boundary with run-off south being conveyed to the NEMDC and out the American River while run-off to the north uses the Pleasant Grove Creek Canal to the Cross Canal and out to the Sacramento River.

The east NEMDC levee extends from the American River upstream about 4 miles, crossing Arcade Creek, before it ends at the confluence with the Dry/Robla Creek levee. The existing Union Pacific Railroad line parallels the levee on the east for most of the reach.

E. **ARCADE CREEK**

Arcade Creek begins in eastern Sacramento County and runs easterly until it joins the NEMDC in North Sacramento. The Arcade Creek system provides flood protection to areas of North Sacramento easterly of the NEMDC. Arcade Creek includes levees along both the north and south side from the NEMDC to high ground approximately 2 miles upstream near Hagginwood Park (See Figure 2).

F. **DRY/ROBLA CREEK**

Dry Creek is the largest watershed which brings inflow to the Lower American River below Folsom's. It starts in Placer County and collects drainage in both Placer and Sacramento before joining the NEMDC near Ascot Avenue in Rio Linda. The Dry Creek watershed includes the major tributaries of Robla Creek and Magpie Creek Division. Portions of Sacramento lying south of the Dry Creek flood plain are afforded flood protection by a single levee system which is adjacent to the Robla Creek (See Figure 2). During high flood flows the Robla and Dry Creeks flows overlap creating one large floodplain commonly referred to as the Dry Creek floodplain. The existing Robla Creek levee extends from the NEMDC approximately 1.3 miles to the east terminating at the end of Claire Avenue westerly of Marysville Blvd.

2. **SACRAMENTO RIVER**

The City of Sacramento is protected from flood flows in the Sacramento River by a system of levees and flood walls along the west bank of the river (See Figure 2). The Sacramento River Flood Control System protecting the City can be divided into two independent elements divided by the American River confluence. The northern area includes that portion of the Natomas Basin within the City limits; the southern portion includes Downtown, Old Town, South Sacramento and the Pocket Area.

A. Natomas Area. That portion of the City of Sacramento within the Natomas Basin is protected from flows on the Sacramento by a series of levees along 1) the west side of the Sacramento River; 2) south side of the Natomas Cross Canal; and 3) easterly side of the Natomas basin which hold back flows from the NEMDC in Sacramento County and the Pleasant Grove Creek Canal in Sutter County. A break in any one of these levee systems can eventually bring flood waters into the City of Sacramento within the Natomas Basin.

B. In the area south of the American River; Downtown, Old Town and Pocket areas are provided flood protection from the Sacramento River by an existing river wall and levee which extends south from the American River confluence beyond the city limits.

3. **SOUTH SACRAMENTO STREAMS**

A. **MORRISON CREEK**

Morrison Creek drain s much of southern Sacramento County from its beginning east of Mather Air Force Base to its end at the beach - Stone Lake wetland area east of the Sacramento River south of Freeport. The Creek runs through heavily urbanized areas of Sacramento near its down stream locations. Flooding from Morrison Creek is contained by existing levees on the north and south. The north levee begins near the town of Freeport where it ties into the existing Sacramento River levee system. At this point the levee sets far back from the existing Morrison Creek low flow channel. The levee proceeds easterly, cross Interstate 5, then merges with the Morrison Creek low flow channel where together they proceed northeasterly to the levee's terminus near Franklin Blvd for approximately _____ miles of levee. On the southwesterly side of the channel the levee begins at the confluence of Morrison Creek with Union House Creek and proceeds upstream to its terminus also at Franklin Blvd, for a total reach of approximately _____ miles of levee (See Figure 5).

B. **UNION HOUSE CREEK**

The existing Union House Creek is a westerly running tributary to Morrison Creek. It runs through a heavily urbanized area in the City of Sacramento with flooding prevented contained with levees on both the north and south side from its confluence with Morrison Creek to approximately Franklin Blvd. for a total of _____ miles (See Figure 5).

C. **ELDER CREEK**

Elder Creek is a westerly running stream through portions of south Sacramento which also joins Morrison Creek. The Creek is contained by levees on both its north and south sides from the confluence with Morrison Creek up to approximately Franklin Blvd. for a total of _____ miles (See Figure 5).

CITY OF SACRAMENTO FLOOD GATES

The City of Sacramento has incorporated into their flood control system a series of permanent and portable flood gates. These gates are located at railroad streets, bike trails, pedestrian trails and other crossings of the levee which create low points which would allow flood flows to get out of the system. Location of theses flood gates is shown on figure 2. Under an emergency plan the City would have discretion to erect or close these flood gates as appropriate.

III. OPERATIONS AND MAINTENANCE

The above described flood control system which protects the City of Sacramento is operated and maintained in part by one of four local agencies. They are:

1) City of Sacramento;
2) State of California Department of Water Resources;
3) American River Flood Control District; and
4) Reclamation District 1000.

The following is a brief outline of each agency and its responsibilities for operating and maintaining the existing flood control system.

A. **The City of Sacramento** - The City of Sacramento is responsible for operating and maintaining the pumping plants and interior storm drainage system which carries the local run-off and drainage which falls on the streets and properties in the City out to the main tributaries flood control channels. In addition to local drainage the City also has responsibility for portions of the regional flood control levee system. The City is currently responsible for operating and maintaining the existing levee and flood wall system on the east bank of the Sacramento River, from its confluence with the American River down to Sutterville Road. Also, the City is responsible for maintenance on the majority of the Morrison Creek north levee from the City limits up to its terminus at Franklin Blvd. as well as the entire south levee of Morrison Creek as well as the levees along both sides of Elder and Union House Creeks.

B. **The State of California** - The State through its Department of Water Resources has established Maintenance District No. 9 to maintain that portion of the east levee of the Sacramento River from Sutterville Road south beyond the City limits.

C. **American River Flood Control District (ARFCD)** - ARFCD is responsible for the operations and maintenance of the existing American River Levees including the entire south levee of the American River from its confluence with the Sacramento River up to its terminus at Mayhew drain; as well as that portion of the north levee of the American River from the NEMDC up through its terminus at the Carmichael Bluffs. In addition, the ARFCD is responsible for all of the east levee of the NEMDC from the American River up to Robla Creek. They are also responsible for maintaining both sides of the Arcade Creek Levees, as well, as the existing South Robla Creek Levee.

D. **Reclamation District 1000** - is responsible for operation and maintenance of the levees surrounding and protecting the Natomas Basin. These include the north levee of the American River from its confluence with the Sacramento River up to the NEMDC. The entire east levee of the Sacramento River from the American River up to the mouth of the Natomas Cross Canal, the south levee of the Natomas Cross Canal, the Pleasant Grove Creek Canal levee as well as the west levee of the NEMDC.

Flood Emergency Response

During a flood event, each local agency is responsible for patrolling and addressing problems which arise on their respective facilities. These patrols are established based on pre-determined river stages. The frequency of patrols increases as the river stage rises or problems with the system develop. If problems develop with the system, the local agency provides the materials, equipment and man power to address the situation.

Its a way of coordinating the activities of the local agencies, the State of California acts as a clearinghouse of information through the Storm Operation Center. Agency report on river stages and conditions of the levee system from their patrols. The National Weather Service, US Bureau of Reclamation and Corps of Engineers provides information on rainfall projections, reservoir levels and reservoir releases. In this way local agencies such as the City can gain information on condition throughout the flood control system.

The Bureau of Reclamation (federal) is responsible for the operation and maintenance of Folsom Dam. They operate the outlet gates releasing flows to the Lower American River through Sacramento. Releases are based on a complex set of information including weather forecast, reservoir level, Sacramento River stage, releases from other reservoirs and downstream levee conditions. The Corps of Engineers has also been given responsibility to assist the Bureau in flood control operations at the dam.

In addition to reservoir operations, the Corp of Engineers is also available to assist local agencies in flood fighting and emergency response by providing engineering advise as well as potentially equipment and materials. The Corps can fully mobilize its efforts and direct a flood emergency response if the local agencies are unable to provide the resources needed to effectively fight the flood event.

IV. EXISTING FLOOD PROTECTION

At the time Folsom Dam was constructed, it was thought to provide Sacramento protection against a 250-year flood. However, in December 1955, just months before the newly constructed reservoir was scheduled to formally commence operations, a major storm blanketed Northern California. Heavy rains caused uncontrolled flooding in the Feather River Basin north of Sacramento, triggering catastrophic property damage and loss of life in the Yuba City/Marysville area. In the American River Basin, the storm generated enough runoff to fill the empty reservoir at Folsom in just four days, a feat the designers had thought would take several months to accomplish. Two similarly large storms followed in 1963 and 1964, leading the Corps to reevaluate the hydrologic assumptions underlying earlier estimates of Folsom's protective capacity. Adding these recent events to the record of precipitation in the American River watershed, the Corps concluded that Folsom was capable of controlling no more than 1/120-year event. Folsom was thus deemed incapable of providing Sacramento with the level of flood protection intended in the original 1949 authorization. During the decade that followed, a concerted effort was made to augment Folsom by creating new storage capacity at the confluence of the North and Middle Forks of the American River near Auburn for water, power, recreation, and flood control.

To date this project has not been completed though it was authorized in 1965, with construction having commenced soon thereafter by the Bureau of Reclamation. However, growing environmental opposition, changing federal water resource development priorities, and a significant earthquake near Oroville Dam resulted in a halt of construction activities to review the seismic safety of the dam. Although a blue ribbon panel of dam engineering experts ultimately determined that a multipurpose facility could be safely constructed at the site, financial support for the dam waned and construction did not recommence.

The community's exposure to uncontrolled flooding was powerfully demonstrated in February of 1986, when major storms in Northern California caused record flood flows in the Sacramento River Flood Control System. Although the Sacramento metropolitan area was largely spared, serious localized flooding occurred to the north in the town of Rio Linda and in the pleasant Grove area of South Sutter County. In addition, flood waters forced hundreds of residents in the Rio Linda/Elverta area of Sacramento County and Strawberry Manor area of the City to flee their homes. Only a determined flood fight prevented a collapse of the east levee of the Sacramento River (which protects more than 35,000 residents of the Natomas area), located five miles north of downtown Sacramento. In the American River Basin, releases from Folsom exceeded the design capacity of the lower American River

levee system for over two days, causing extensive erosion along the toe of the north and south levees of the American River near California State University, Sacramento. Had the rains continued much longer, even higher releases from Folsom would have been required, and a major levee failure might have occurred in one of the heavily urbanized portions of Sacramento, resulting in potentially catastrophic property damages and loss of life.

After the 1986 flood, the Corps initiated a comprehensive evaluation of the entire Sacramento River Flood Control system. The first phase of this evaluation focused on the east levee of the Sacramento River which protects Natomas, downtown Sacramento, and the urbanized areas to the south. These levees were constructed in the early 1900's using material dredged from the river channel. Due to the sandy quality of this material, much of which was deposited in the river bed during hydraulic mining era in Northern California, and poor compaction methods, the Corps determined that the levees along the 33-mile stretch of the Sacramento River between Freeport and the mouth of the cross channel were structurally deficient (**Figure 8**). Without remedial work, the Corps concluded, high flows in the Sacramento River could produce enough seepage through the levees to trigger a breach. The east levee protecting Natomas between the mouth of the American River and Verona, where severe seepage and a near breach occurred in 1986, was found to be particularly vulnerable, with the east levee south of the American River to Freeport being in slightly better condition.

In addition, the Corps reevaluated the frequency of flooding in the American River Basin. As previously discussed, prior to 1986, Folsom and the lower American River levee system were thought to provide approximately a 120-year level of flood protection to the residents and businesses occupying the American River flood plain. After the flood, using data gathered from the storm itself and hydrologic information compiled since the construction of Folsom, the Corps downgraded the system's flood control capacity to a 63-year level. The Corps also concluded that the levees along the Natomas East Main Drainage Canal (NEMDC) which protect Natomas and the Dry Creek area to the east, were too low to safely contain the flows produced by the coincidence of peak discharges in Dry and Arcade Creeks and maximum flood releases from Folsom.

As a result of the Corps' findings, the Federal Emergency Management Agency (FEMA) reassessed the 100-year flood plain in the Sacramento area and issued new Flood Insurance Rate Maps (FIRMs). These maps, which became effective in November 1989, mandated the purchase of flood insurance by all residents and businesses within the 100-year flood plain and caused the City to impose severe restrictions on all new residential development in the Natomas area.

The overlapping American and Sacramento River flood plains encompass a land mass of more than 100,000 acres (**Figures 9&10**). About half of this land lies within the Natomas Basin (Natomas), an agricultural reclamation district which has experienced significant development pressure during the past two decades, and which now contains over two billion dollars worth of damageable residential, commercial and industrial property, including Sacramento Metropolitan Airport. Outside Natomas and the Dry Creek area immediately east of the basin, the flood plain straddles the American River. To the north, it covers about 6,000 acres, including the state fairgrounds at Cal Expo, the Campus Commons subdivision, and a portion of North Sacramento near McClellan Air Force Base. South of the American River, the flood plain covers about 45,000 acres, and encompasses much of downtown Sacramento, the State Capitol, California State University at Sacramento, the City's water treatment facility, the River Park neighborhood (adjacent to the river northeast of the downtown core), and a number of large residential areas to the south.

Although, the Corps estimates that the flood plain area outside Natomas and Dry Creek contains over 300,000 residents and $30 billion worth of damageable property. grade elevations in most of these areas are significantly lower than water surface elevations in the river channels during major floods, thereby creating the potential for extensive deep flooding in the event the levees are overtopped, or if they otherwise fail due to prolonged high flows. As a result, the Corps estimates that a levee failure along the American River could cause as much as $9 billion worth of damage, slightly more than the losses attributable to the 1989 Loma Prieta earthquake in the San Francisco Bay Area.

V. RECENT FLOOD CONTROL PROJECTS (PROPOSED/COMPLETED/UNDER CONSTRUCTION)

In order to address the deficiencies of the existing flood control system, the Corps recommended bifurcation of the Sacramento and American River problems. The Sacramento is predominately a rehabilitation project of the existing system while the American requires a significant increase in the system's flood control capacity. The State of California, through the Department of Water Resources (DWR) and the State Reclamation Board (State), joined these efforts as the non-federal sponsor.

Local agencies responsible for operating and maintaining the levee system around the Sacramento metropolitan area and for managing land use in the flood plain, reacted to these developments by creating the Sacramento Area Flood Control Agency (SAFCA), a regional joint exercise of powers agency consisting of the City of Sacramento, Sacramento County, Sutter County, Reclamation District 1000, and the American River Flood Control District. SAFCA's long term goal is to provide the urbanized portions of Sacramento with as much flood protection as possible in order to reduce the risk of catastrophic damages and loss of life in the event of an uncontrolled flood.

A number of studies have begun to determine the best projects to address the flood problem. These projects are in various stages of implementation; some still in planning, others are under construction and some have been completed. Following is a brief description of each project including its purpose, protection it provides and anticipated schedule for implementation.

A. SACRAMENTO RIVER

1. Sacramento Urban Area Levee Reconstruction Project (SUALRP)

During the 1986 flood, seepage occurred along much of the Sacramento River levees both in Natomas and the Pocket areas. This was evidenced by serious landside erosion of the levee in Natomas and "seepage boils" along the landside toe in the Pocket. This deficiency in the system, caused by porous levee materials and poor compaction, was corrected by installing a slurry wall (lean concrete mix) or by adding a landside stabilizing berm along most of the levee from Verona on the north to Freeport on the south (See Figure 8). This project, under the direction of the Corps of Engineers, was completed in the Spring of 1993. The project restored the level of protection provided by the Sacramento River system but did not add any additional protection. The approximate $37 million project costs were shared by the federal government through the Corps, the State Reclamation Board and SAFCA.

2. **Sacramento Riverwall**

The Sacramento Riverwall is a concrete floodwall adjacent to Old Sacramento and a feature of the Sacramento River Flood Control system. It is located on the east side slope of the Sacramento River between the I Street Bridge and Broadway (See Figure 11). Constructed in 1917 by the Southern Pacific Railroad, the Riverwall has been determined to be unstable because of serious erosion on the waterside toe and design deficiencies found with the original construction. Failure of this section of the Sacramento River Flood Control System at flood stage on the Sacramento River would cause flooding to the adjacent Old Sacramento, Downtown, and portions of Interstate 5.

Reconstruction of the Riverwall is being addressed by the Corps of Engineers as an additional element of the SUALRP described above. The Corps is currently designing a project to stabilize the wall and anticipates construction to begin in 1995 with a fairly short construction duration. The State and SAFCA will cost share with the Corps in the project. As with the SUALRP, stabilizing the existing wall will restore the level of protection anticipated when the original project was constructed and is not intended to increase the level of protection.

Besides fixing the wall itself, additional work may be needed on the riverbank where erosion has seriously undercut the wall's foundation. This work is being evaluated by the Corps, State, City and SAFCA. Any remedial work necessary to insure the wall's stability would probably not begin until 1996.

B. **AMERICAN RIVER**

SAFCA along with the State of california have been working with the Corps to identify a project on the American River to address the serious under capacity of the existing system. As part of this effort, in 1992, SAFCA joined the Corps and the State in offering federal legislation to authorize: 1) construction of an expandable flood control dam along the north fork of the American River near Auburn; 2) improvement of the existing levee system around Natomas; and 3) reoperation of Folsom to create additional space for flood storage on an interim basis, pending completion of the flood control dam. The proposed dam would have increased the capacity of the existing flood control system to permit safe containment of floods up to a 200-year frequency in the American River watershed.

However, in view of environmental and cost concerns about the dam, Congress deferred any action on the flood control dam and reoperation of Folsom, but authorized the Corps either to proceed with construction of the Natomas levee improvements, or to credit or reimburse SAFCA for undertaking these improvements as a local project.

SAFCA anticipates a renewed federal/state/local effort to secure Congressional authorization of a long term American River action as part of the 1996 Water Resources Development Act. In the interim, the agency's goal is to achieve the maximum practicable improvement in flood protection which can be financed locally and implemented without prejudicing any of the measures that may be considered for inclusion in the long term action. Accordingly, pending congressional authorization of a long term action, SAFCA is pursuing the following projects along the American River System:

1. **Natomas Area Flood Control Improvements (Local Project)**

The 1986 flood also demonstrated the inadequacy of the levee system protecting the Natomas basin and the lower Dry and Arcade Creek watersheds from high flows in the American River and the tributary streams east of the basin. To address this problem, the Corps has proposed a series of levee and other flood control improvements designed to work in tandem with increased storage on the American River to provide the affected areas with increased flood protection. SAFCA has been positioning itself to undertake these improvements on a local basis. Language attached to the 1992 Defense Appropriation Act (DOD legislation) which authorized the Local Project improvements permits the Corps to reimburse SAFCA for the cost of the project in an amount equal to the Federal share.

In taking on the task of actually designing and constructing the federally authorized improvements as a local project, SAFCA has incrementally added to the project to increase the level of protection it provides. As designed, the project will provide a minimum 100-year level of protection to Natomas, and the lower Dry and Arcade Creek watersheds including portions of Rio Linda and North Sacramento without any other improvements to the American River system (See Figure 12). They will also be consistent with other long term alternatives being considered on the American River which would likely increase the level of protection beyond 100-year.

Construction began on this project in 1993 and will continue over the subsequent three years with completion anticipated by late 1996. Replacement of the Main Avenue Bridge may be delayed until 1997, but will not affect the level of flood protection provided by the project.

2. **Folsom Reoperation**

During the flood season, Folsom Reservoir is operated in accordance with criteria promulgated by the Secretary of the Army. As previously described, under these criteria, the design release from the reservoir during a flood event is 115,000 cubic feet per second (cfs) and 400,000 acre-feet of storage space

(about 40% of the total reservoir) is dedicated to flood control. When these criteria were developed in the early 1950's, it was believed that Folsom would provide Sacramento with a 250-year level of flood protection. Over the years, however, this estimate has been steadily downgraded as more and better data has been gathered on flows in the american River. As previously described, in the aftermath of the 1986 flood, the Corps determined that eh reservoir provides little more than a 63-year level of protection to the people and property occupying the American River floodplain.

SAFCA and U.S. Bureau of Reclamation (Reclamation) are considering options for modifying the current operation of Folsom Dam and Reservoir (Folsom) to provide the people and property currently occupying the American River flood plain with as much immediate flood protection as possible pending federal authorization and implementation of a long term project to improve the existing American River flood control system. This goal would be achieved through an agreement between SAFCA and Reclamation under which Folsom's existing flood control diagram governing reservoir storage space allocations and outflows during flood control operations would be revised to permit safe containment of a 100-year or larger flood event in the watershed. In exchange for the additional flood protection, SAFCA would be obligated to reimburse the Bureau for any costs due to lost water or power that results from the reoperation. In addition SAFCA would likely do some mitigation for potential impact to vegetation, fisheries and water resources.

The alternatives being considered by SAFCA and Reclamation would increase the space available for flood control at Folsom by requiring a variable reduction in the reservoir pool when a designated amount of empty space is no longer available for flood storage in the three largest hydropower reservoirs (French Meadows, Hell Hole, and Union Valley) in the watershed upstream of Folsom. Because Folsom is not designed for efficient flood releases with a low reservoir pool, substantial increases in empty space in the reservoir yield only marginal increases in flood protection thereby limiting the additional protection which can be achieved through a reoperation plan to approximately the 100-year level.

SAFCA is intending to bring a formal agreement to its Board of Directors near the end of 1994. If signed, the reoperation plan would become effective for the 94-95 flood season. As long as the agreement remains in effect, areas south of the American River and those areas north not affected by Arcade Creek would have 100-year flood protection. The intent is for reoperation to continue until it either becomes part of the long term plan for flood control improvements or is replaced by an alternative means of protection.

3. Lower American River

SAFCA initiated the Lower American River (LAR) Task Force in February 1994, following a number of discussions with the Corps and the state Department of Water Resources/Reclamation Board exploring ways to address the need for bank protection and improved floodway management in the Lower American River, and to make the flood control planning process more responsive to environmental interests. Meeting on a monthly basis , the Task Force has served as an effective forum for achieving agreement on a wide variety of issues among organizations and agencies

that have had difficulty finding common ground in other flood control settings.

They will lead to detailed recommendations in Phase Two which could be incorporated into the locally preferred flood control plan for the American river, should the SAFCA Board embrace an alternative involving an increase in the design release from Folsom Reservoir.

Most notably, the Task Force has agreed on a series of principles and guidelines for carrying out and maintaining flood control and associated improvements in the American River Parkway. These principles and guidelines create the planning framework within which the following improvements to the Parkway will be pursued:

(1) Develop recommendations on levee design, infrastructure modification, Parkway improvements, and downstream hydraulic mitigation to be presented to the SAFCA Board in December 1994 for a decision on whether or not to include these recommendations in the locally preferred flood control plan for the American River;

(2) Develop a consensus project description for a Lower American River bank protection project to be presented to the SAFCA Board in February 1995 for a decision on whether and how to proceed with environmental review and project implementation under the Sacramento River Bank Protection project (federal project); and

(3) Agree on the elements of a floodway management plan for the Lower American River to be presented to the SAFCA Board in February 1995 for a decision on whether and how to proceed with the drafting and review of a formal plan.

4. **American River Project**

As indicated above, SAFCA together with the Corps and State are anticipating a long term project to address the flood risk along the American River for inclusion in the 1996 Water Resources Development Act to be approved by Congress. As directed by Congress when the 1992 recommended plan was not authorized, the Corps is re-evaluating the various alternatives previously rejected during the first planning process.

The alternatives for flood protection basically fall in three categories 1) increased storage; 2) modifications at Folsom Reservoir; or 3) downstream improvements to provide additional capacity. Each alternative has a number of options or flood control measures associated with it. These various measures will be combined into a number of flood control projects providing varying levels of flood protection and varying costs.

An alternatives report will be presented by the Corps to SAFCA and the State in approximately October 1994. It is anticipated the SAFCA Board and State Reclamation Board will select a locally preferred plan which the Corps will use to develop an environmental document and detailed cost estimate. This information will become the basis for Congress to take action in 1996.

If authorized as anticipated, construction would likely commence in the late 1990's with completion sometime in the next century. The level of flood protection to be provided by the project and costs to the local taxpayer are dependent on the plan selected by SAFCA and the State. It is anticipated the local community's share of the project would be paid out of a benefit assessment district created by SAFCA.

C. SOUTH SACRAMENTO

1. South Sacramento Stream Group

The existing levee system along Morrison Creek and its major tributaries has been found not to have sufficient capacity to carry a major (100-year) flood event. The revised projection for decreased flood protection provided by the system is based on 1) increased water surface elevations projected in the Delta and 2) higher flows coming through the system from the upper reaches of the watershed. The problem could be further exacerbated as new development occurs upstream unless the additional runoff is either detained upstream or the downstream channel capacity is increased.

The Corps of Engineers (with participation by SAFCA, the City and County) are beginning a study to propose alternatives including both upstream detention and modifications to the downstream levee system. Preliminary results have shown work will likely be done to the existing Morrison Creek levees as well as the Unionhouse and Elder Creek levees (See Figure 13&14) The County is also collecting fees from upstream developers which will be used to build large detention basins to detain the additional runoff generated as new development is built.

The current schedule is to complete the study and environmental documentation by 1997 with Congressional authorization in 1998. If approved, construction would begin around the year 2000. A portion of the project would have to be financed by the local community benefitting from the project through an assessment district.

2. **Beach Lake Levee**

The reach of the Morrison Creek north levee from its terminus at the Sacramento River near Freeport upstream to approximately Mack Road has been referred to as the Beach Lake Levee because of its proximity to Beach Lake in south Sacramento (See Figure 21). This reach of levee is included in the above South Sacramento Stream Group study being initiated by the Corps. However, because this reach is the most susceptible to failure, causes the widest and deepest floodplain, and has the most damage potential; SAFCA proposes to raise or otherwise rehabilitate the existing levee to prevent its failure prior to the Corps project.

SAFCA anticipates commencing and completing construction of these modifications in 1996. These improvements will protect large areas of the Pocket and South Sacramento from being inundated during a 100-year flood.

D. **OTHER PROJECTS**

In the aftermath of 1986, the potential for larger storm events than previously anticipated in the Sacramento have increased significantly. This potential has lead to a reanalysis of existing flood control and levee systems which previously were thought to adequately protect the lives and properties sitting behind them. These new analyses have shown the existing systems to be inadequate. This is not only true for the American River and Morrison Creek systems described above but also smaller creeks and streams. The City, County, SAFCA and Corps have begun to reanalyze these smaller systems for deficiencies. Following are new studies which may evolve into future projects. It is anticipated more studies and projects are likely to begin as additional watersheds are investigated.

1. **Magpie Creek**

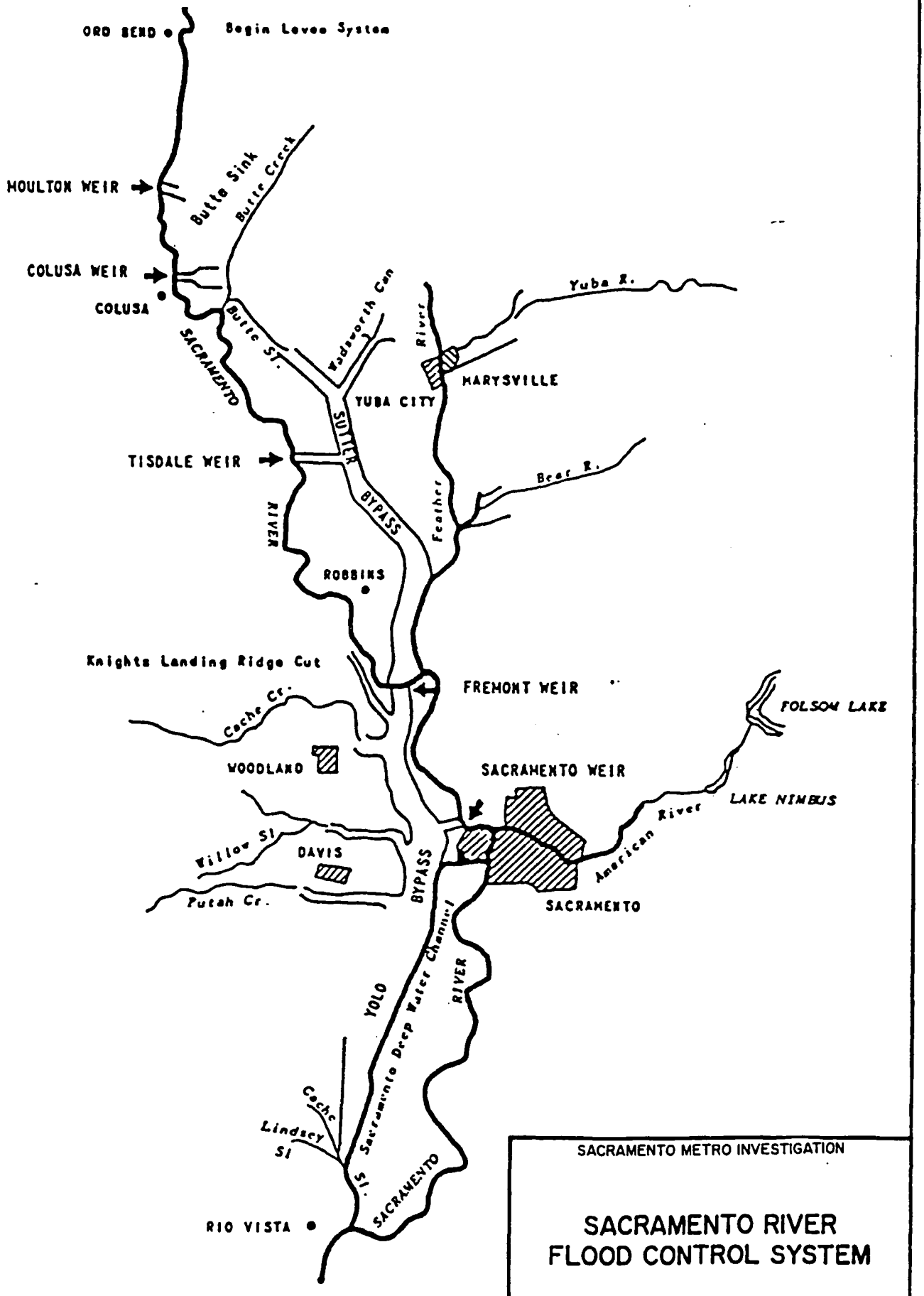
Work done by the Corps of Engineers has shown the Magpie Creek channel below McClellan Air Force Base is not adequate to contain the new 100-year flood event. The Corps with participation from the City have studied alternatives which include both detention of flows on the Base, downstream channel improvements, or a combination thereof.

The Corps is nearing completion of the alternatives and the City/SAFCA will be in a position to select a locally preferred plan to begin a more detailed cost analysis with anticipation that Congress would authorize this project in 1996. If approved construction would begin in approximately 1998 and completed several years thereafter. As with the South Sacramento Stream Group described above, a portion of the project costs would have to spread among the beneficiaries of the project through an

assessment district.

2. **Upper Arcade Creek**

The proposed improvements by SAFCA under their Local Project previously described under the American River would modify the existing Arcade Creek levees up to approximately Marysville Blvd. Based on preliminary information on water surfaces upstream of Marysville, there may be locations on Arcade Creek within the City limits where flows could escape the channel and outflank the levee system or jump into other watersheds such as Haggin Creek. The City together with SAFCA are quantifying the problem and analyzing potential solutions. At this there is no definitive proposal or schedule for implementation of any improvements, if necessary.



SACRAMENTO METRO INVESTIGATION

SACRAMENTO RIVER FLOOD CONTROL SYSTEM

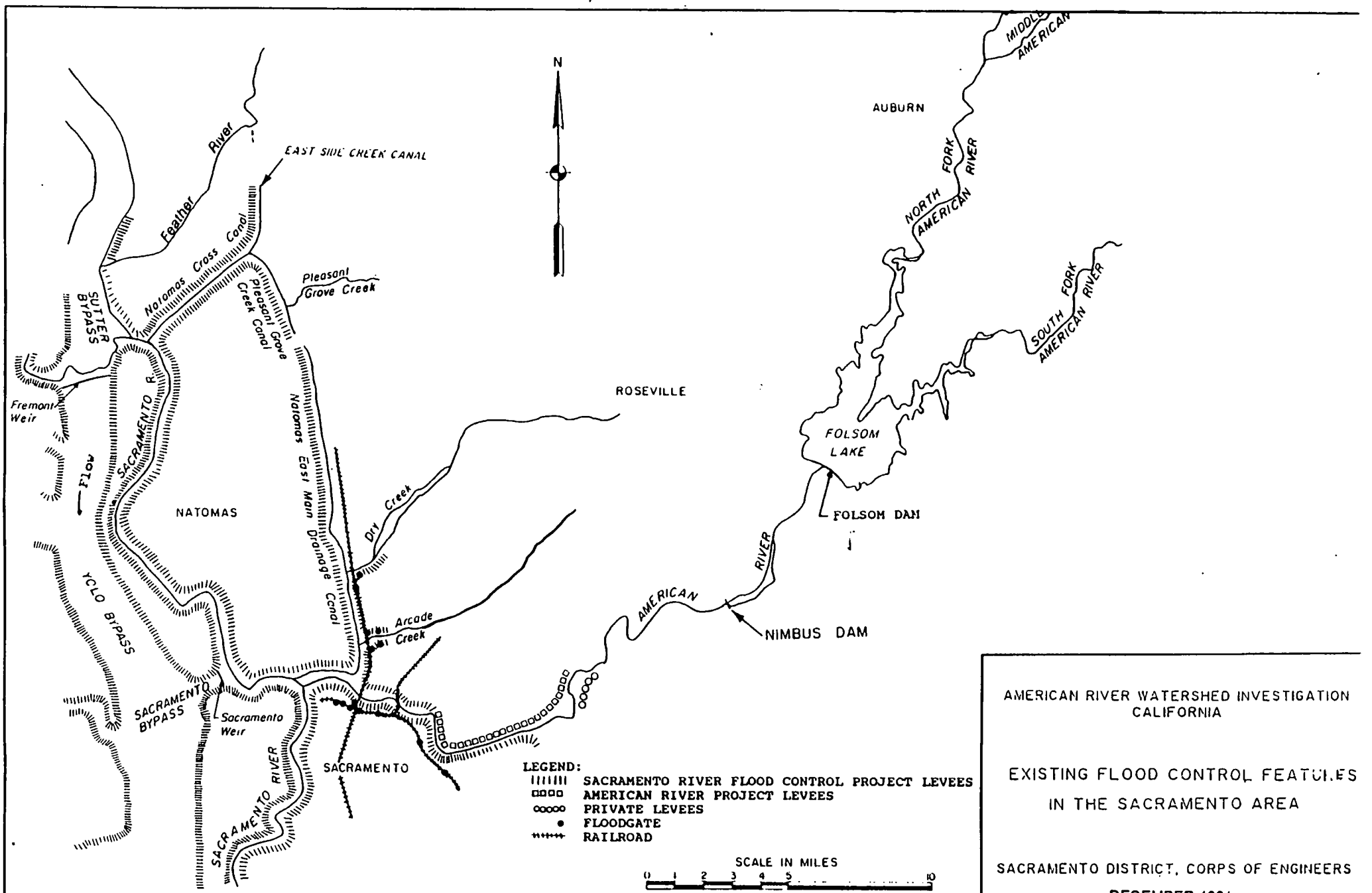
CORPS OF ENGINEERS. SACRAMENTO. CALIFORNIA

Prepared: J.H. Date: JUNE 1990

Drawn: J.H.

CHART 5

F. 9. 2



AMERICAN RIVER WATERSHED INVESTIGATION
CALIFORNIA

EXISTING FLOOD CONTROL FEATURES
IN THE SACRAMENTO AREA

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
DECEMBER 1971

PLATE 2

Main Spillway

Auxiliary Spillway

Tainter Gates

Spillway Crest

Power Penstocks

Flip Bucket

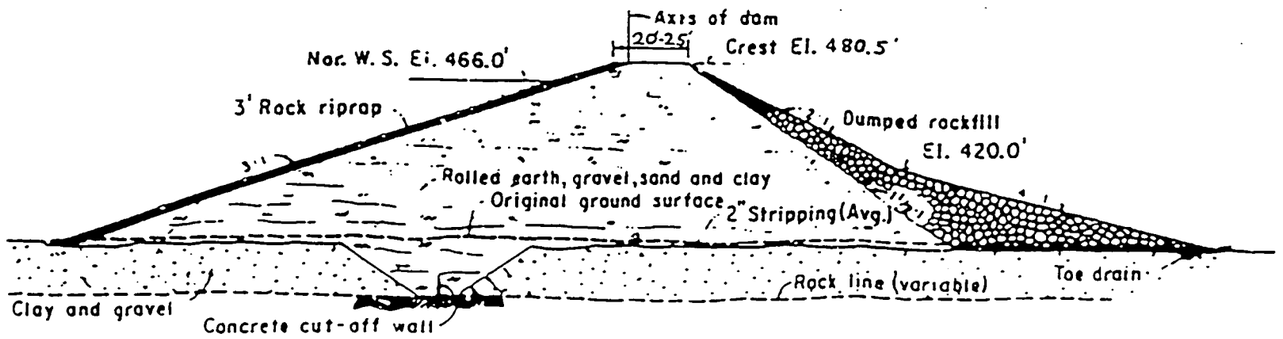
River Outlets

Stilling Basin

SECTION THRU PENSTOCK NO. 2

SECTION THRU FLIP BUCKET

SECTION THRU STILLING BASIN



TYPICAL SECTION OF DIKE

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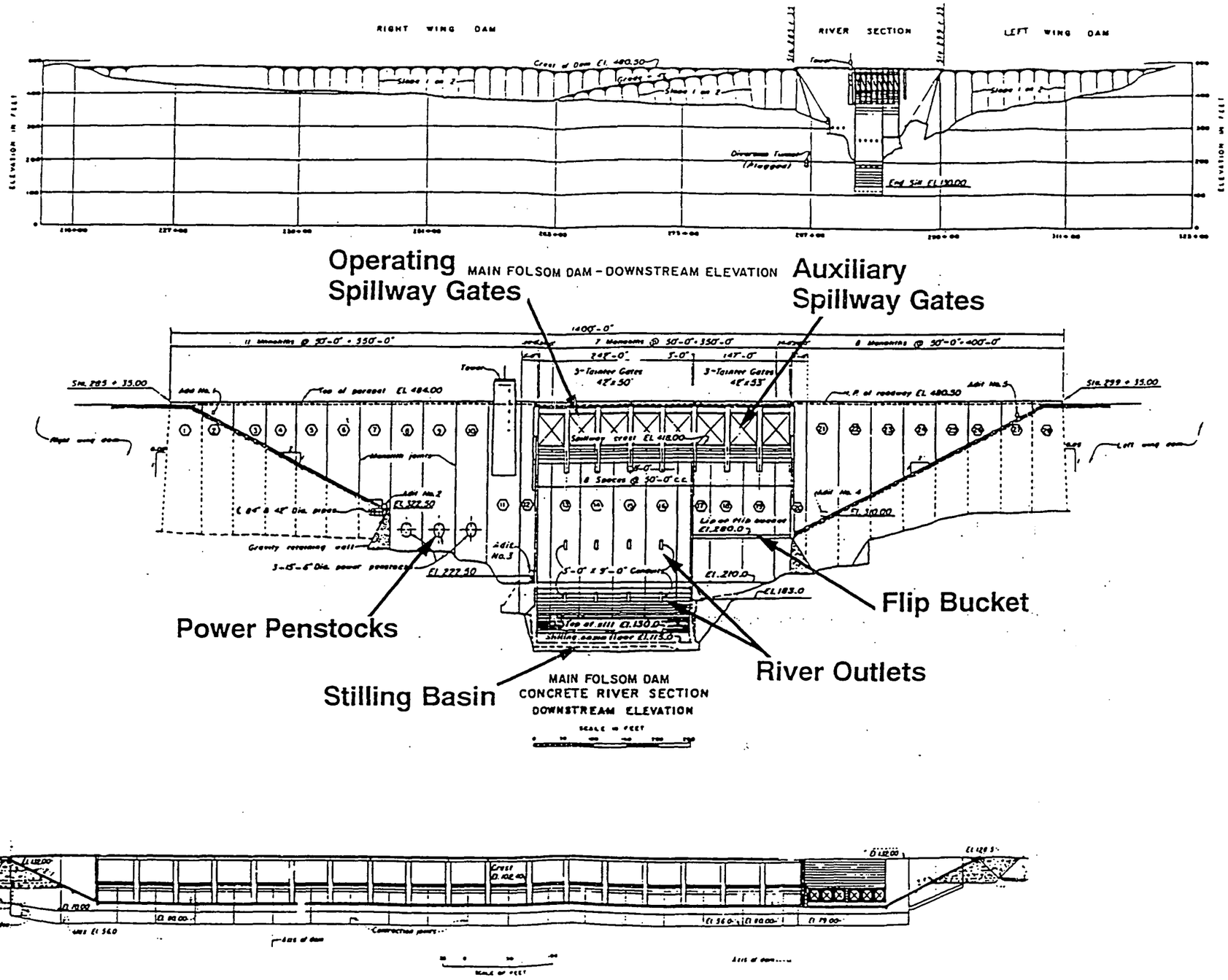
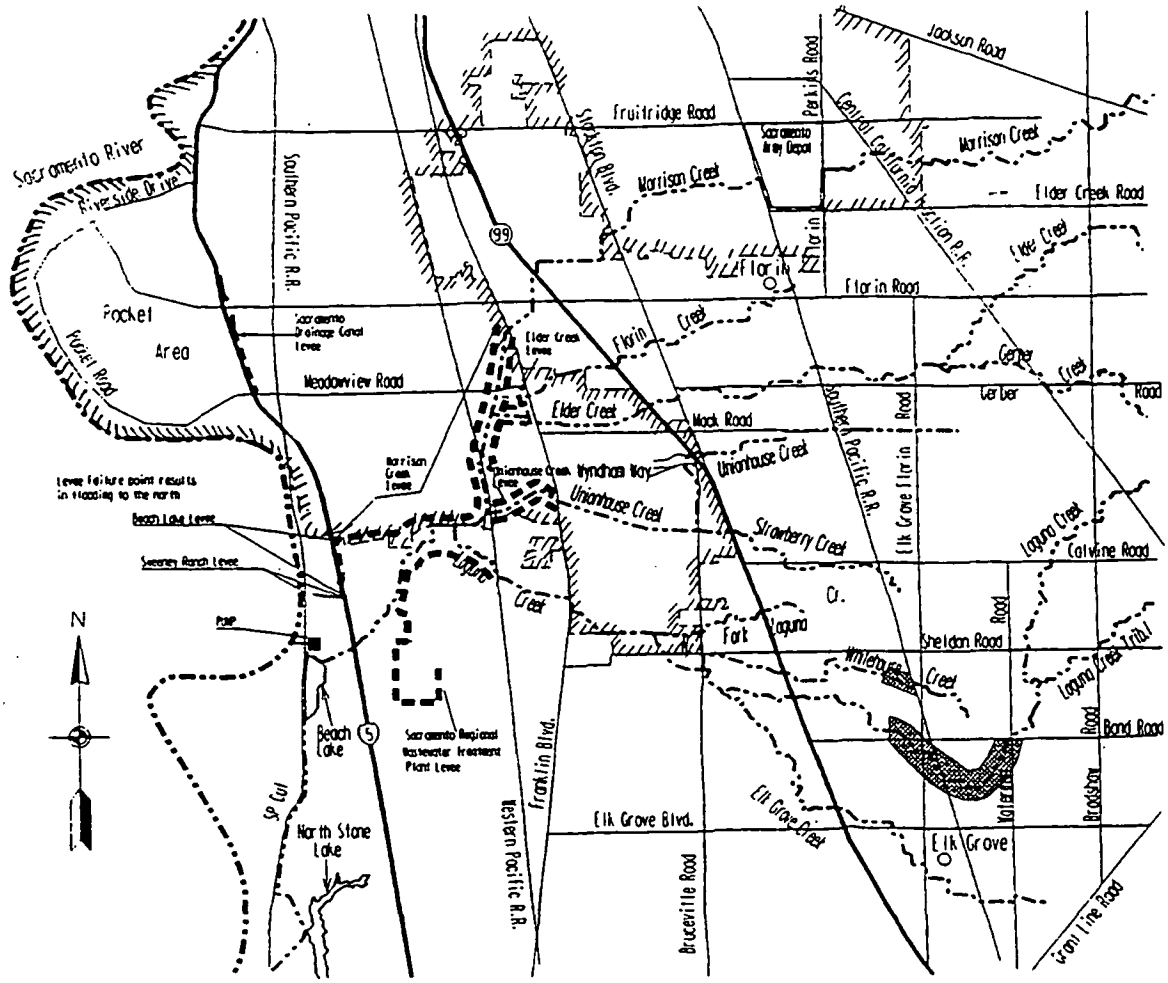


FIGURE 2-6. FOLSOM DAM SPILLWAY & OUTLET ELEVATIONS



NOTE: Lambert Road Levee to South of Beach-Stone Lakes is along Lambert Road between Sacramento River Levee and Western Pacific Railroad

LEGEND

- RECENT CHANNEL IMPROVEMENTS
- DIVERSION CHANNEL & FLOOD CORRIDOR
- LEVEES
- CREEKS
- BASIN BOUNDARY
- CITY OF SACRAMENTO LIMITS
- HIGHWAYS
- PUMPING STATION

Scale in Miles: 0 1 2 (0.5)

San Joaquin River Basin
South Sacramento County Streams, California
Reconnaissance Report

EXISTING FLOOD CONTROL IMPROVEMENTS

Sacramento District, Corps of Engineers
Sacramento, California
March 1994

PLATE 6

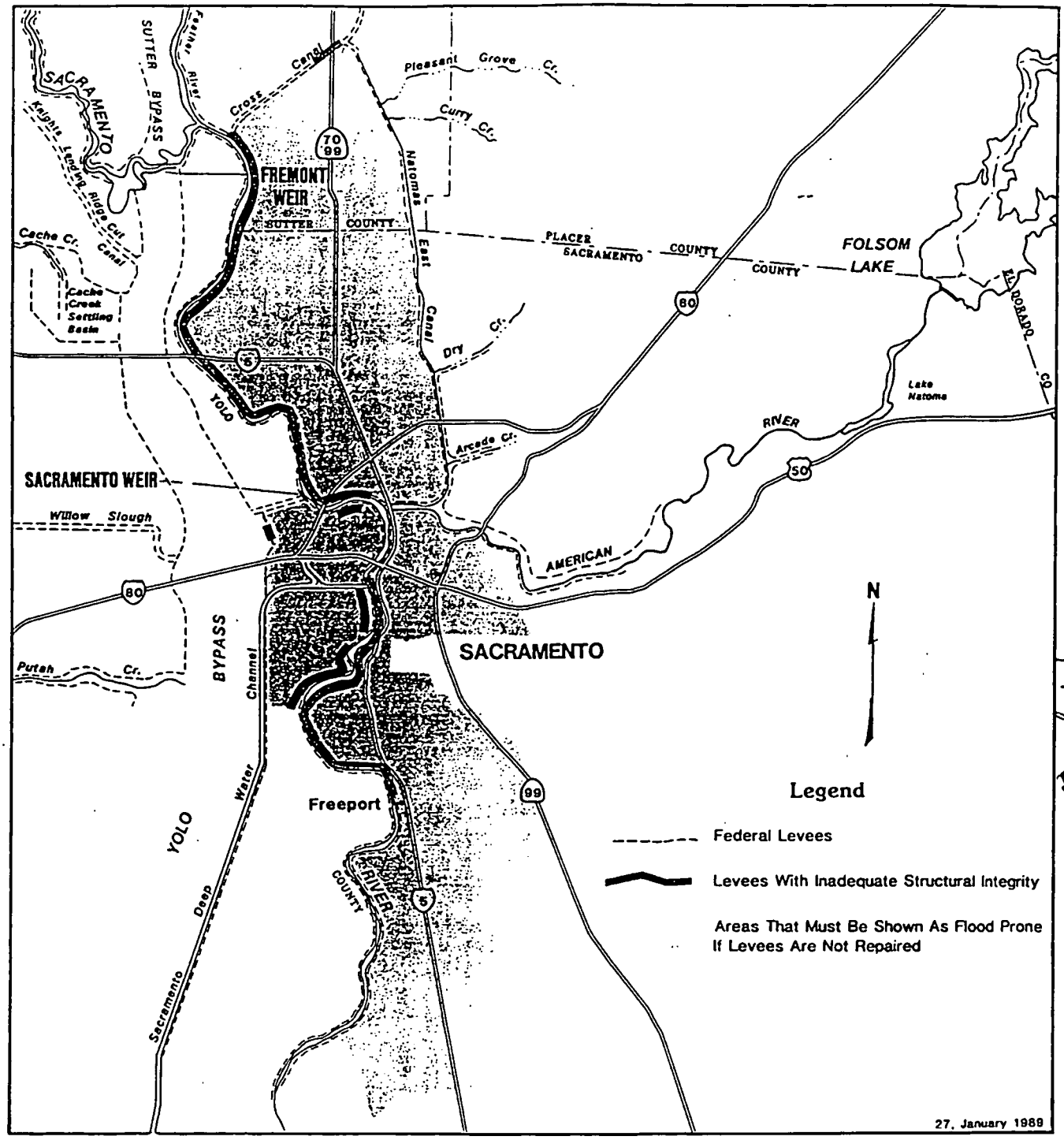


Figure 1-3. Structurally Deficient Levees

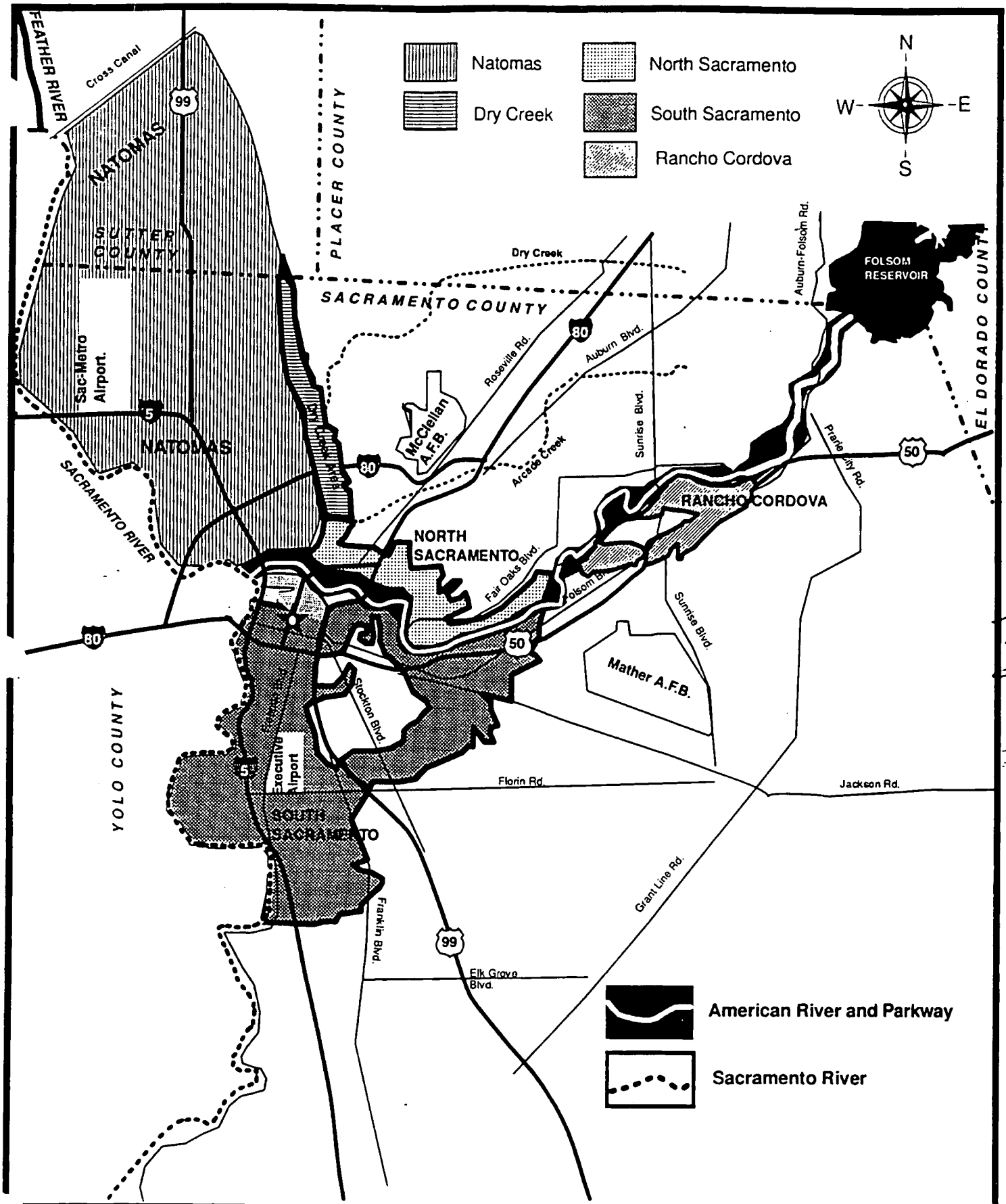


Figure 1-2. American River Floodplain and Delineated Subareas.

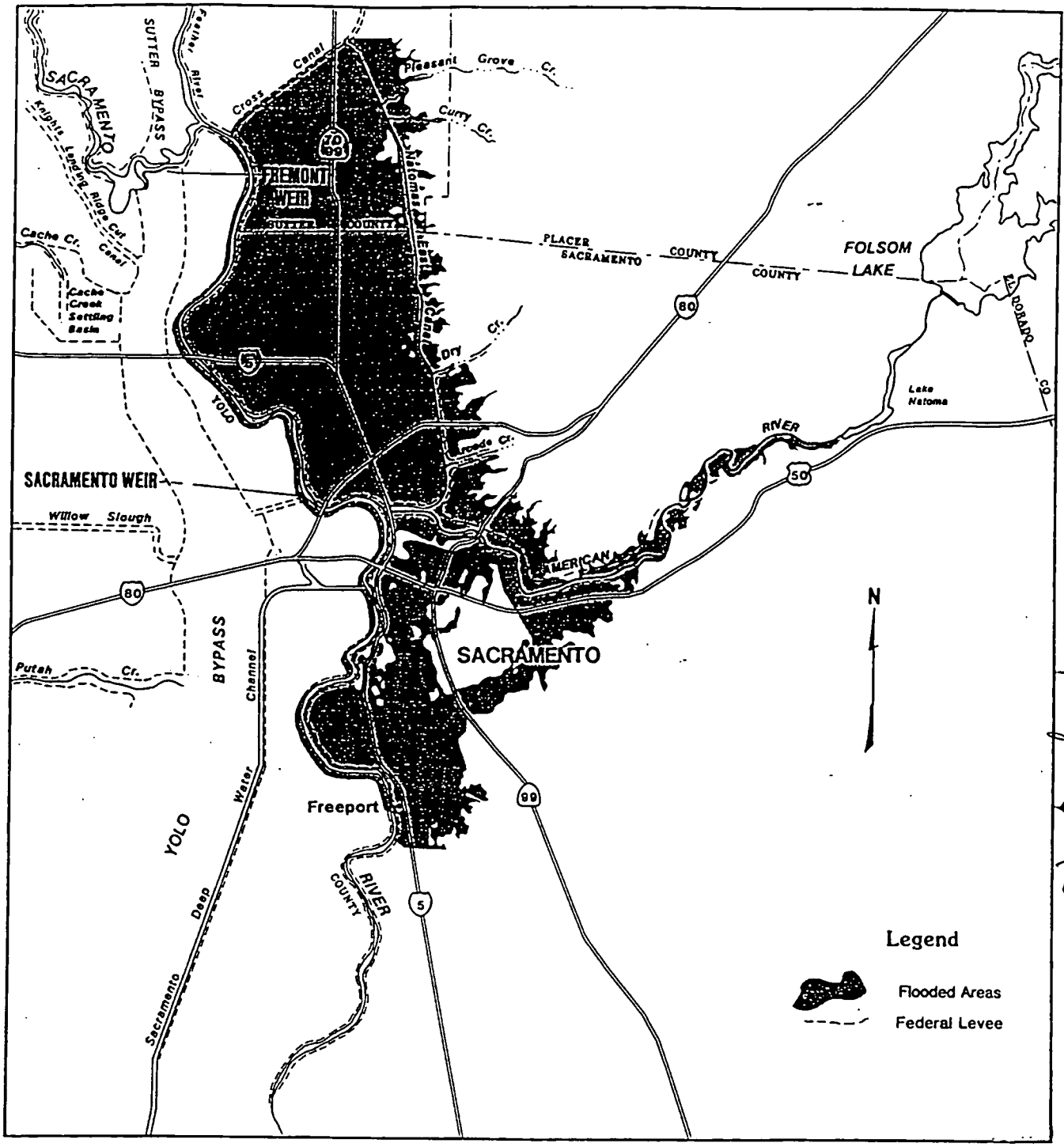
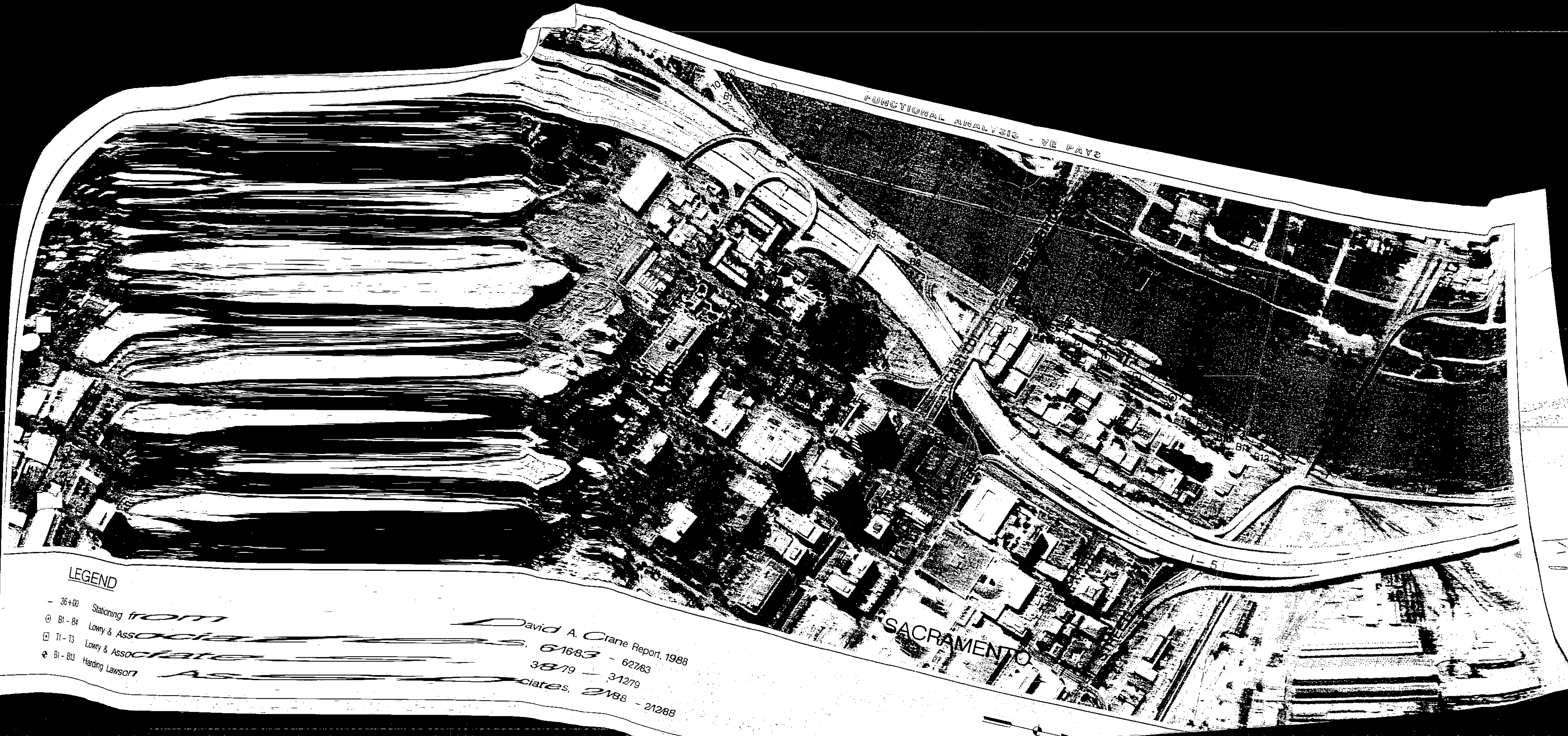
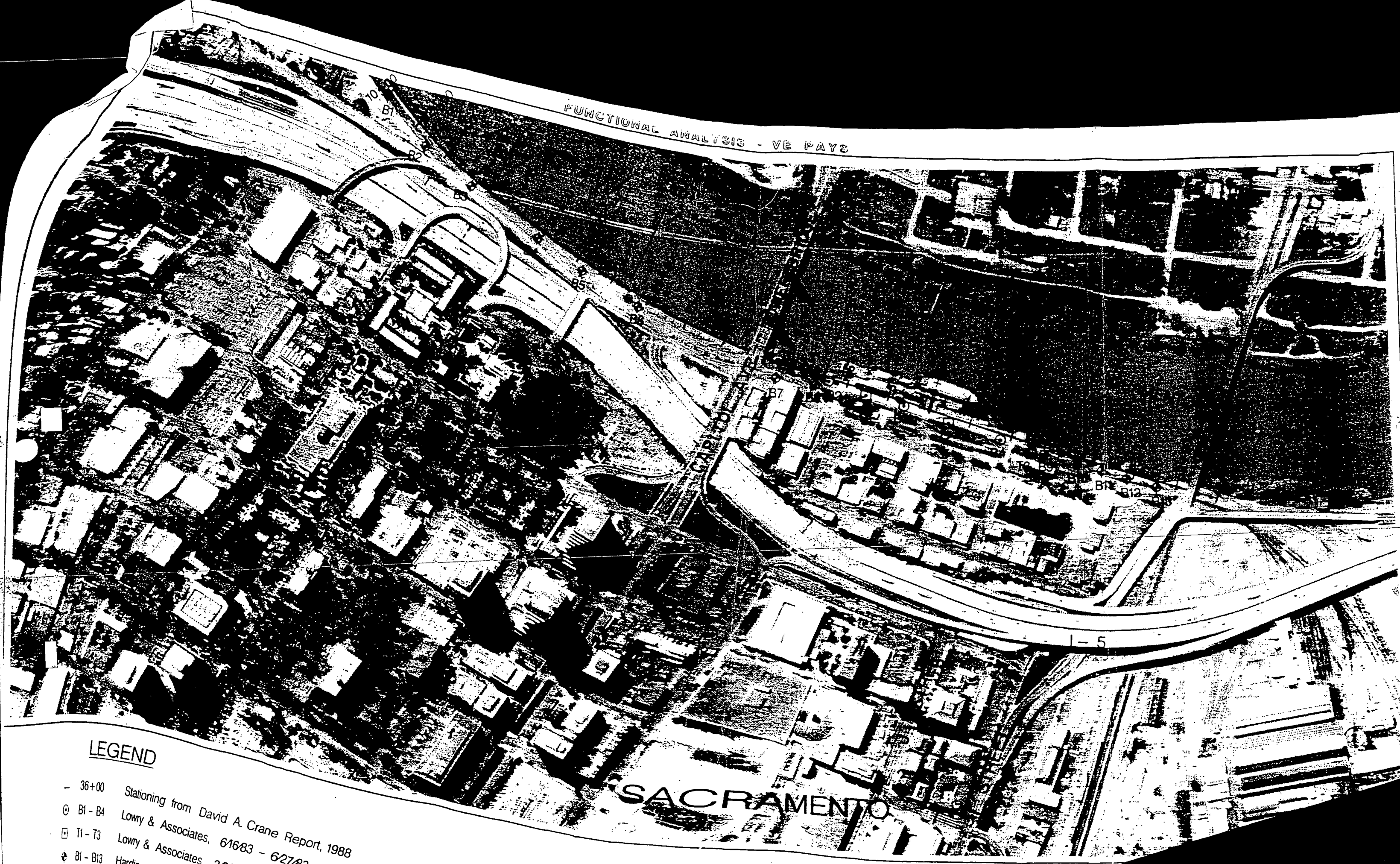


Figure 1-4 100-Year FEMA Flood Plain - Sacramento/American Rivers


FUNCTIONAL ANALYSIS - VE PAYS
B1
B2
B5
B7
B12
I - 5
SACRAMENTO
LEGEND
36+00 Stationing from David A. Crane Report, 1988
B1 - B4 Lowry & Associates, 6/1683 - 6/27/83
T1 - T3 Lowry & Associates, 3/879 - 3/12/79
B1 - B13 Harding Lawson Associates, 2/1988 - 2/12/88

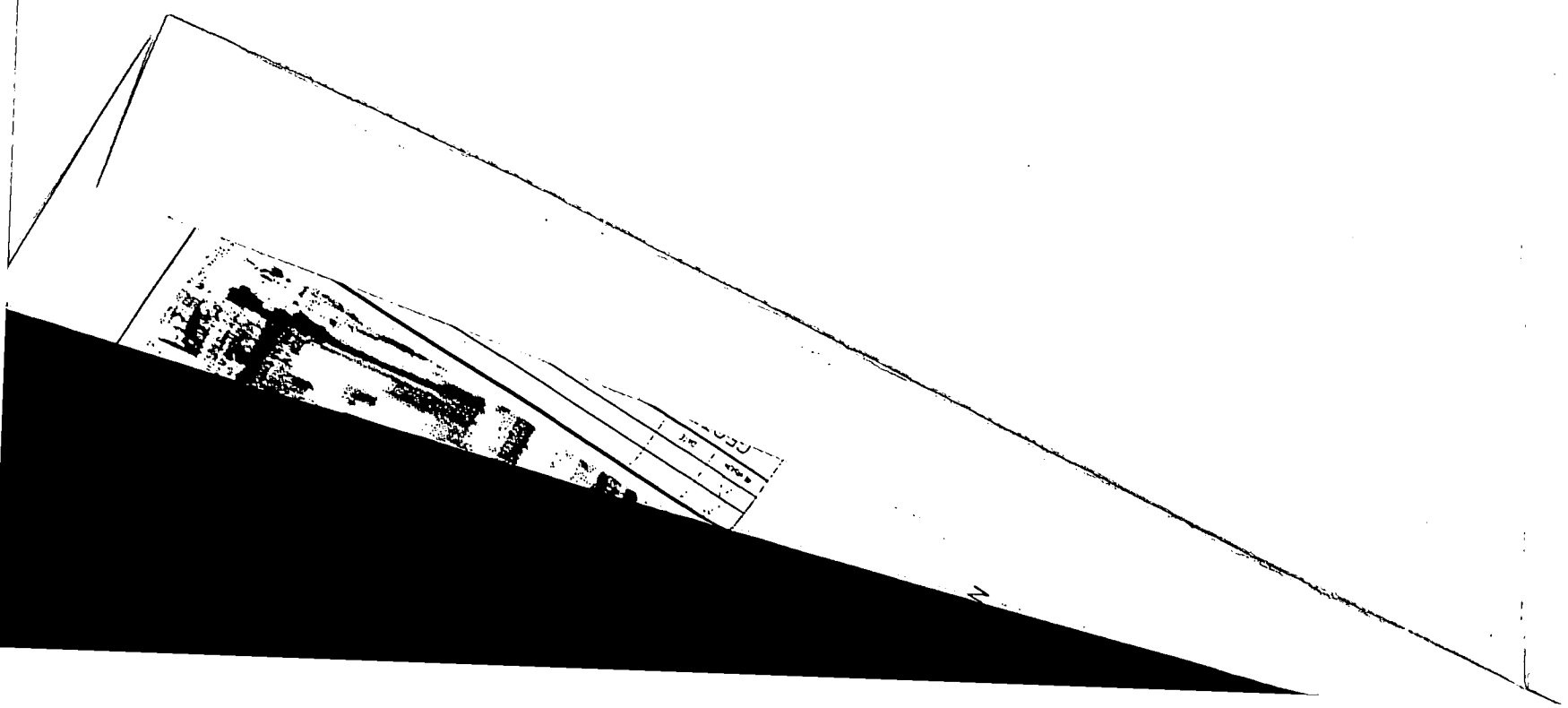

400' 300 200 100 0 400
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
K. MAI
D. RICKETTS
SACRAMENTO RIVER
STRUCTURAL & GEOTECHNICAL
EVALUATION OF SACRAMENTO RIVERWALL
EXPLORATIONS & LOCATION MAP
AS SHOWN
BORING, DATA



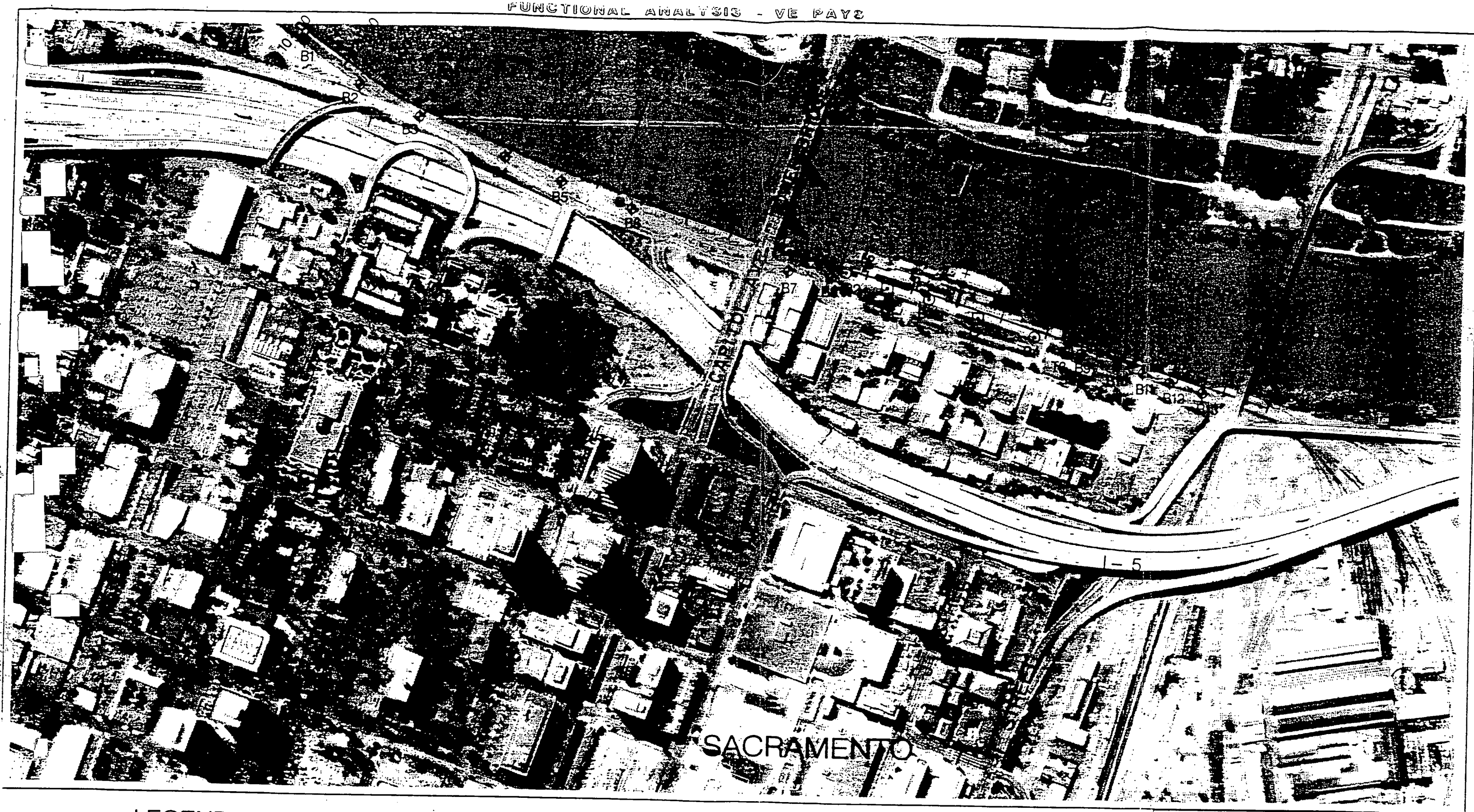
LEGEND

- 36+00 Stationing from David A. Crane Report, 1988
- B1 - B4 Lowry & Associates, 6/16/83 - 6/27/83
- T1 - T3 Lowry & Associates, 3/8/79 - 3/12/79
- B1 - B13 Harding Lawson Associates, 2/1/88 - 2/12/88

FIG. B-11



FUNCTIONAL ANALYSIS - VE PAYS



LEGEND

—	36+00	Stationing from David A. Crane Report, 1988
⊙	B1 – B4	Lowry & Associates, 6/16/83 – 6/27/83
⊡	T1 – T3	Lowry & Associates. 3/8/79 – 3/12/79
⌖	B1 – B13	Harding Lawson Associates, 2/1/88 – 2/12/88

N

SCALE

1" = 400' 400 300 200 100 0 400

GEOTECHNICAL BRANCH
SOIL DESIGN SECTION

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

K. MAI

K. MAI

D. RICKETTS

SACRAMENTO RIVER
STRUCTURAL & GEOTECHNICAL
EVALUATION OF SACRAMENTO RIVERWALL

EXPLORATIONS & LOCATION MAP

SCALE AS SHOWN

BORING.DGN

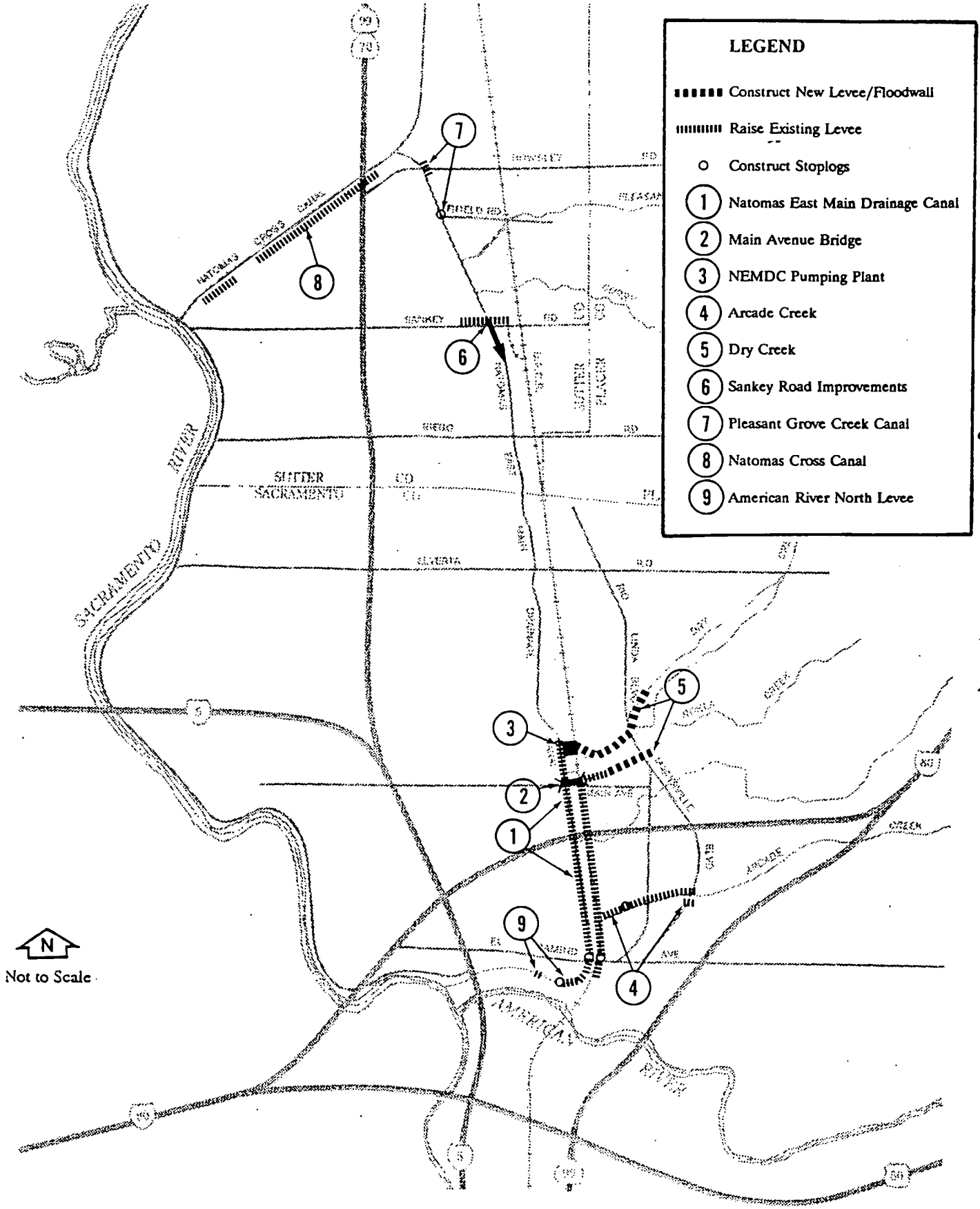
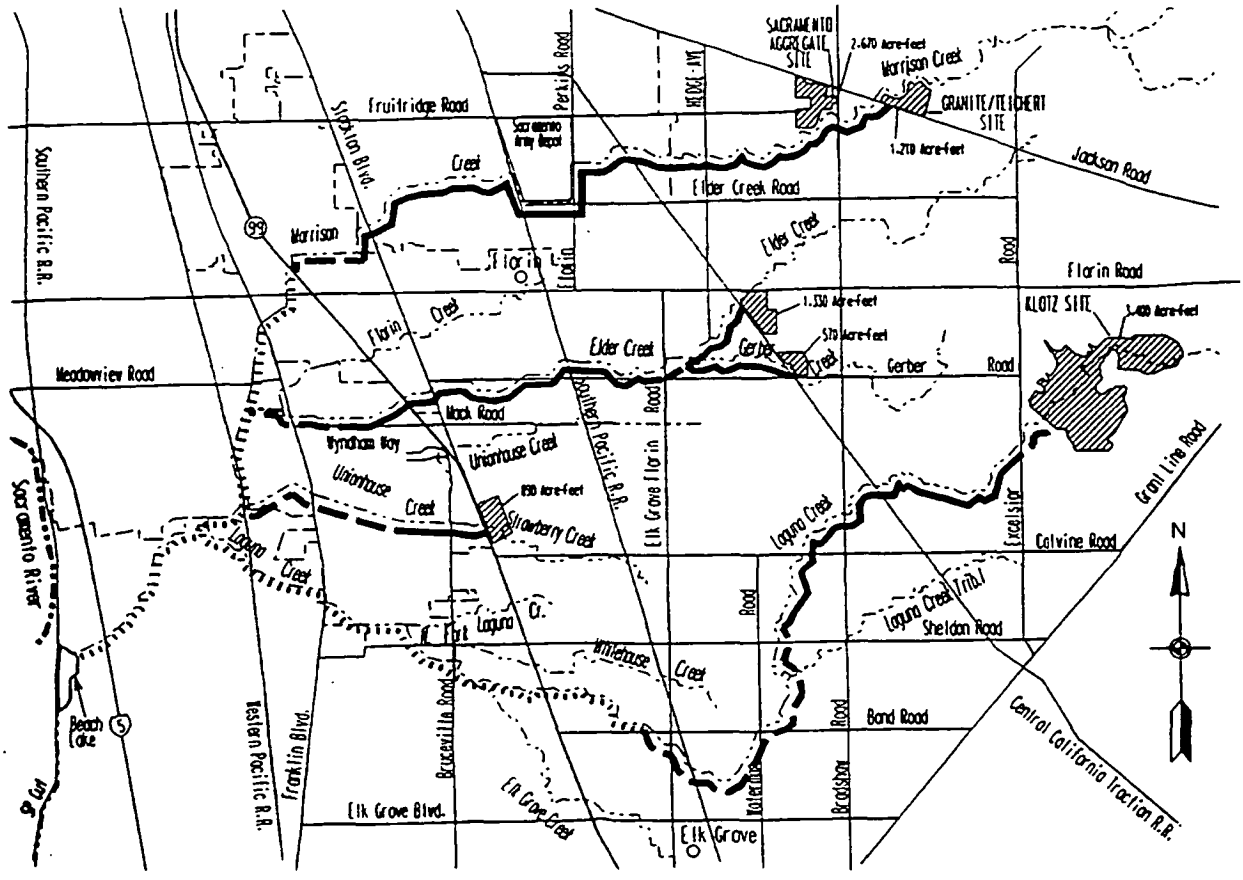


Fig 2.1-2

FLOOD CONTROL IMPROVEMENTS
REGIONAL LOCATION MAP



LEGEND

- CREEKS
- CITY OF SACRAMENTO LIMITS
- HIGHWAYS
- DETENTION BASIN

WITH-PROJECT LEVEL OF PROTECTION
(LINES OFFSET FROM STREAM)

- 100-YR
- LESS THAN 100-YR; WITHOUT-PROJECT FUTURE CONDITION 100-YR OVERBANK FLOWS REDUCED 50% OR MORE
- MUCH LESS THAN 100-YR; WITHOUT-PROJECT FUTURE CONDITION 100-YR OVERBANK FLOWS REDUCED LESS THAN 50%

Scale In Miles: 1 0 1 2
0.5

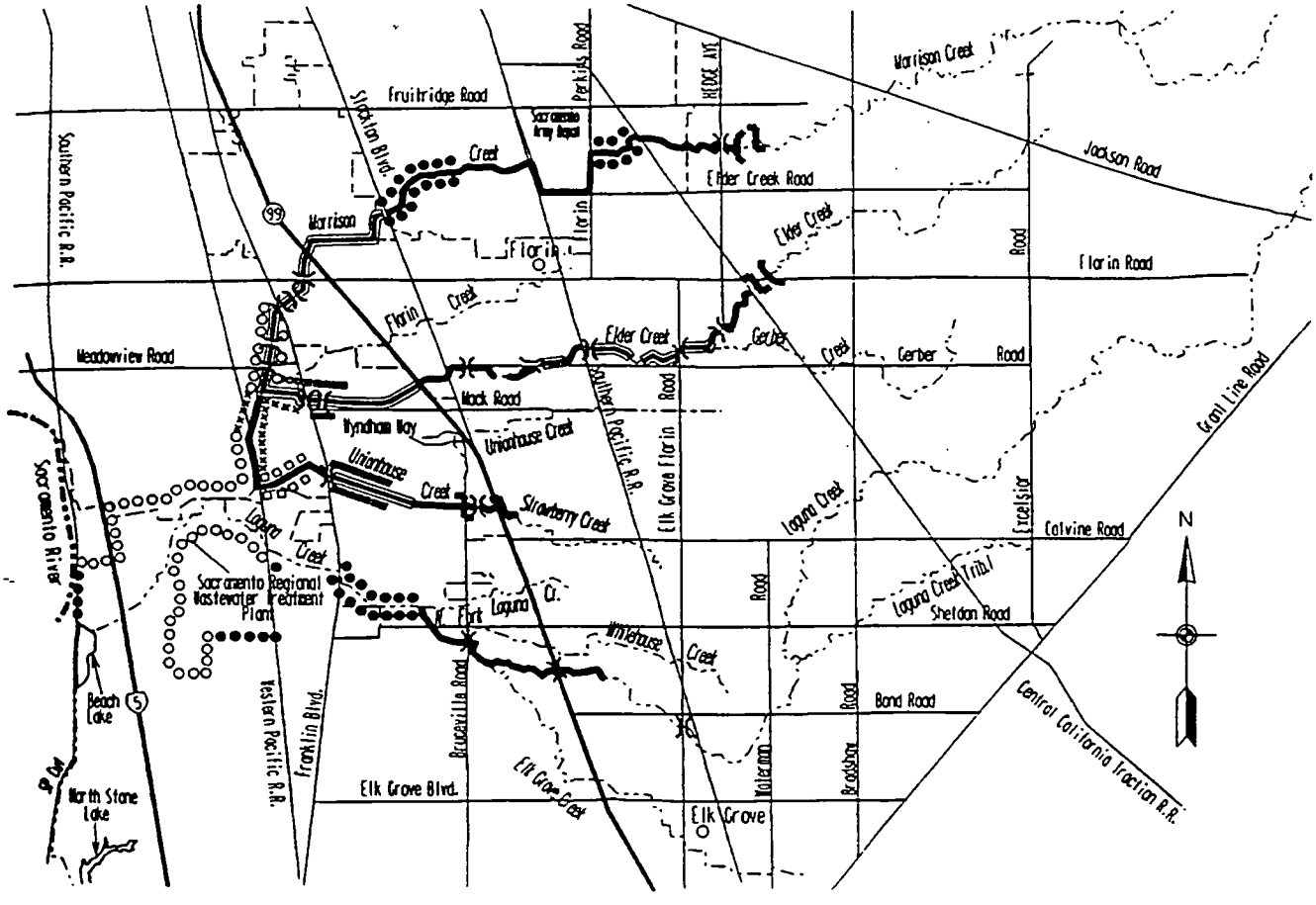
San Joaquin River Basin
South Sacramento County Streams, California
Reconnaissance Report

DETENTION BASIN MEASURES

Sacramento District, Corps of Engineers
Sacramento, California
March 1994

Fig. 13

PLATE 15



LEGEND

- CREEKS
- CITY OF SACRAMENTO LIMITS
- HIGHWAYS
- EXCAVATED EARTH CHANNEL
- CONCRETE LINE DL CHANNEL
- FLOODWALL ON FORMERLY ENTRENCHED CHANNEL
- FLOODWALL TO REPL. EXISTING LEVEE
- WING LEVEE
- DROP STRUCTURE
- NEW LEVEE
- RAISE EXISTING LEVEE
- RECONSTRUCT EXISTING LEVEE
- REPLACE BRIDGE

Scale in Miles: 1 0 1 2 (0.5)

San Joaquin River Basin
South Sacramento County Streams, California
Reconnaissance Report

LEVEE AND CHANNEL IMPROVEMENT MEASURES

Sacramento District, Corps of Engineers
Sacramento, California
March 1994

PLATE 14.

COMPREHENSIVE FLOODPLAIN MANAGEMENT PLAN
Evacuation Plans
Lt. John Kane, Sacramento Police Department

INTRODUCTION

The purpose of this section will be to explain the evacuation plans currently in place within the City of Sacramento in the event of a major flood emergency.

In the way of an introduction, it's important for the reader to understand that there is a distinct difference in a flood emergency between the concept of an EVACUATION and a RESCUE.

The orderly EVACUATION of a mass population from a given area within the City presupposes the fact that there is sufficient warning regarding the emergency. This advanced warning time will enable the City of Sacramento to put into effect plans that will safely evacuate the population from the given danger zone where we believe the emergency is likely to occur. An example would be a slow rising flood, monitored over a period of days and weeks, that enables us to plan for the evacuation of the area we feel will be most threatened.

A RESCUE is an entirely different matter. A RESCUE presupposes that the emergency event has already occurred and that a given number of people are affected by this disaster and must be rescued out of the area for their own safety. An example of this concept would be a catastrophic levee failure.

In a RESCUE effort, priorities rest with the immediate saving of lives. The people most at-risk are identified, their RESCUE is prioritized, and they are taken out of the danger zone as rapidly as possible. All of the effort of the rescuers would be spent in this endeavor.

The main functions of RESCUE fall to the Fire Department with assistance from the Police Department, and the main function of an orderly EVACUATION falls to the Police Department with the Fire Department acting as the assisting agency.

Once the EVACUATION/RESCUE effort is accomplished, and a given area of the City is vacated, the procedures that follow are the same for both types of occurrences. A perimeter to contain the EVACUATION/RESCUE area is established along with access control by the Police Department; and whatever shelter and mass care facilities are necessary are put into effect by the local American Red Cross in cooperation with the Neighborhood Services Division.

The security of this area is established for two reasons. First, to regulate entry for people with legitimate reasons to go into the danger zone; and second, to control potential looters and other criminal activity.

As the reader can readily determine, the needs of an EVACUATION/RESCUE operation focus on advanced warning and planning. The more early warning the city government has relative to the kind of problem and its scope, the better we'll be able to handle the management of the problem.

DISCUSSION

The importance of planning, early warning and decision making can't be overstated. The more advance warning that is given to the agencies within the city such as police and fire, the more prepared we'll be when the actual crisis occurs. As an example, there are currently in place extremely sophisticated mutual aid systems in which both the Police Department and the Fire Department can call on outside agencies for assistance throughout the Sacramento region and throughout the State of California. These systems take many hours and even days to put into effect, so the earlier the warning and decision making process, the better able we'll be to handle the problem.

Warning of an EVACUATION would occur through the City Emergency Operations Center. The designated Public Information Officer would use a combination of regular press briefings, emergency briefings, and if necessary, the city siren system and the Emergency Broadcast System to get the information out to our citizens.

The City Police Department bears the main responsibility for the EVACUATION of mass populations. In our planning to facilitate an EVACUATION, the Police Department has divided up the City of Sacramento into twenty EVACUATION zones.

Each one of these zones consists of a designated geographical area and is displayed in the attached Product section. These zones were selected by a police planning committee using factors such as major boundaries, landmarks, geographical areas, access to highways and freeways and obstacles in the path of an EVACUATION group.

These twenty EVACUATION zones are strictly for planning purposes and are not designed to be hard and fast rules that we have to adhere to. They are guidelines to help us in evacuation, traffic control, the direction and routing of the population to be evacuated. Each map contains traffic control points, some major facilities such as hospitals for each area, and an approximation of the population.

PRODUCT

Evacuation Maps

INDEX by ALPHA

INDEX by PAGE

EVACUATION AREA 1 NORTH NATOMAS

A. POPULATION: 600

B. BOUNDARIES:
NORTH - CITY LIMITS, EAST, EAST-DRAINAGE CANAL, SOUTH-I80, WEST, WEST-DRAINAGE CANAL.

C. ACCESS CONTROL POINTS:
SAN JUAN ROAD/I-80, El CENTRO/SAN JUAN ROAD, DEL PASO ROAD/POWER LINE, BAYOU/POWER LINE, ELKHORN/US99, ELKHORN/EAST DRAINAGE CANAL, MARKET BLVD/SIERRA POINT, DEL PASO ROAD/I-5.

D. EVACUATION ROUTES:
DEL PASO ROAD (WEST) TO I-5/ NORTHGATE BL (SOUTH) TO I-80/ SAN JUAN ROAD (EAST)/DEL PASO RD (EAST) TO NORTHGATE BL

E. CRITICAL FACILITIES:
ARCO ARENA, NATOMAS AIRPORT

F. SHELTERS:
GRANT HIGH SCHOOL - 1400 GRAND AVENUE, MARTIN LUTHER KING JUNIOR HIGH - 3051 FAIRFIELD, RIO LINDA HIGH SCHOOL - 6304 DRY CREEK ROAD.

G. NOTIFICATION:
EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 2 ROBLA

A. POPULATION: 11,869

B. BOUNDARIES:
NORTH - CITY LIMITS, EAST - CITY LIMITS, SOUTH - I-80, WEST - EAST DRAINAGE CANAL.

C. ACCESS CONTROL POINTS:
RIO LINDA/CITY LIMIT, WINTERS STREET/I-80, PINELL STREET/NORTH AVENUE, RALEY BLVD./I-80, NORWOOD/I-80, MAIN AVENUE/EAST DRAINAGE CANAL, DRY CREEK/I-80, RIO LINDA/I-80, NORTH/I-80, GRAND AVENUE/I-80.

D. EVACUATION ROUTES:
RALEY BLVD. (SOUTH) TO I-80 RIO LINDA BLVD. (NORTH), MAIN AVENUE (WEST), TO DEL PASO RD AND I-5.

E. CRITICAL FACILITIES: MCCLELLAN AFB TO THE EAST

F. SHELTERS:
GRANT HIGH SCHOOL - 1400 GRAND AVENUE, MARTIN LUTHER KING JUNIOR HIGH - 3051 FAIRFIELD, RIO LINDA HIGH SCHOOL - 6304 DRY CREEK ROAD.

G. NOTIFICATION:
SIREN 11, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 3 GARDEN HIGHWAY

A. POPULATION: 2,789

B. BOUNDARIES:
NORTH - I-80, EAST - I-5, SOUTH - SACRAMENTO RIVER, WEST - CITY LIMIT.

C. ACCESS CONTROL POINTS:
I-80/WEST EL CAMINO, I-5/WEST EL CAMINO, GARDEN HIGHWAY/I-5, GARDEN HIGHWAY/MILLER ROAD.

D. EVACUATION ROUTES:
WEST EL CAMINO (WEST OR EAST), GATEWAY OAKS (NORTH/SOUTH) TO EL CAMINO, GARDEN HIGHWAY (EAST/WEST).

E. CRITICAL FACILITIES: GATEWAY OAKS APTS AND OFFICES

F. SHELTERS:
MARTIN LUTHER KING JUNIOR HIGH - 3051 FAIRFIELD, CAL-EXPO - 1600 EXPOSITION BLVD.

G. NOTIFICATION:
EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 4 SOUTH NATOMAS

A. POPULATION: 32,043

B. BOUNDARIES:
NORTH - I-80, EAST - EAST DRAINAGE CANAL, SOUTH - AMERICAN RIVER, WEST - I-5.

C. ACCESS CONTROL POINTS:
SAN JUAN ROAD/I-80, NORTHGATE/I-80, SILVER EAGLE/EAST DRAINAGE CANAL, EL CAMINO/EAST DRAINAGE CANAL, NORTHGATE/GARDEN HIGHWAY, GARDEN HIGHWAY/I-5, JIBBOOM/RICHARDS BLVD.

D. EVACUATION ROUTES:
NORTHGATE BLVD. (NORTH OR SOUTH), WEST EL CAMINO (EAST OR WEST), TRUXEL (SOUTH) TO EL CAMINO, (NORTH) TO SAN JUAN RD, SAN JUAN ROAD (EAST) TO NORTHGATE (NORTH), AZEVEDO (NORTH/SOUTH)

E. CRITICAL FACILITIES: NORTHGATE AND EL CAMINO STORES

F. SHELTERS:
GRANT HIGH SCHOOL - 1400 GRAND, MARTIN LUTHER KING JUNIOR HIGH - 3051 FAIRFIELD, CAL-EXPO - 1600 EXPOSITION BLVD.

G. NOTIFICATION:
SIREN 36, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 5 DEL PASO HEIGHTS

A. POPULATION: 14,980

B. BOUNDARIES:
NORTH - I-80, EAST - SP TRACKS, SOUTH - ARCADE CREEK, WEST - EAST DRAINAGE CANAL.

C. ACCESS CONTROL POINTS:
I-80/NORWOOD, I-80/RIO LINDA, I-80/DRY CREEK, I-80/RALEY, I-80/WINTERS STREET, I-80/GRAND, NORTH/PINELL, DEL PASO BLVD./ARCADE CREEK, ARCADE CREEK/NORWOOD, SILVER EAGLE/EAST DRAINAGE CANAL.

D. EVACUATION ROUTES:
MARYSVILLE (NORTH OR SOUTH), RIO LINDA (NORTH OR SOUTH) NORWOOD (NORTH OR SOUTH)

E. CRITICAL FACILITIES:
GRANT HIGH SCHOOL, ROBINSON COMMUNITY CENTER

F. SHELTERS:
CAL-EXPO - 1600 EXPOSITION BLVD., RIO LINDA HIGH SCHOOL - 6309 DRY CREEK ROAD, MARTIN LUTHER KING JUNIOR HIGH - 3051 FAIRFIELD.

G. NOTIFICATION:
SIREN 11 AND 10, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 6 NORTH SACRAMENTO

A. POPULATION: 18,067

B. BOUNDARIES:
NORTH - ARCADE CREEK, WEST - SP TRACKS, SOUTH - AMERICAN RIVER, WEST - EAST DRAINAGE CANAL.

C. ACCESS CONTROL POINTS:
ARCADE CREEK/NORWOOD, A-C/RIO LINDA, A-C/MARYSVILLE, A-C/DEL PASO, SP TRACKS/MARCONI, SP TRACKS/EL CAMINO, SP TRACKS/ARDEN, NORTH 16TH STREET/AMERICAN RIVER, NORTHGATE/DE; PASO, WEST EL CAMINO/MAIN DRAINAGE CANAL.

D. EVACUATION ROUTES:
MARYSVILLE BLVD. (NORTH/SOUTH), DEL PASO BLVD. (NORTH/SOUTH), ARCADE-MARCONI (EAST, TO I-80) EL CAMINO (EAST OR WEST), ARDEN (EAST).

E. CRITICAL FACILITIES:
MARTIN LUTHER KING JUNIOR HIGH

F. SHELTERS:
GRANT HIGH SCHOOL - 1400 GRAND AVENUE, CAL-EXPO - 1600 EXPOSITION BLVD., SACRAMENTO HIGH SCHOOL - 2315 34TH STREET.

G. NOTIFICATION:
SIREN 10, 26, 36, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 7 ARDEN WAY

A. POPULATION: 6,557

B. BOUNDARIES:
NORTH WEST - SP TRACKS, EAST - CITY LIMIT, SOUTH - AMERICAN RIVER.

C. ACCESS CONTROL POINTS:
CONNIE/MARCONI, ETHAN/EL CAMINO, ETHAN/ALTA ARDEN, ETHAN/ARDEN, AMERICAN RIVER/I-BR 80, SP TRACKS/ARDEN, SP TRACKS/EL CAMINO, SP TRACKS/MARCONI, ETHAN/COTTAGE, ETHAN /WYDA, ETHAN/BLUEBIRD.

D. EVACUATION ROUTES:
ARDEN (EAST OR WEST), EL CAMINO (EAST OR WEST), I-BR 80 (NORTH OR SOUTH).

E. CRITICAL FACILITIES:
CALIFORNIA EXPOSITION, ARDEN FAIR MALL

F. SHELTERS:
GRANT HIGH - 1400 GRAND, MARTIN LUTHER KING JUNIOR HIGH - 3051 FAIRFIELD, SACRAMENTO HIGH - 2315 34TH STREET.

G. NOTIFICATION:
SIREN 22, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 8 RICHARDS BLVD.

A. POPULATION: 1,646

B. BOUNDARIES:
NORTH - AMERICAN RIVER, SOUTHEAST - SP TRACKS, WEST - SACRAMENTO RIVER.

C. ACCESS CONTROL POINTS:
RICHARDS/I-5, RICHARDS/NORTH 12TH STREET, NORTH 12TH STREET/SP TRACKS, NORTH 16TH STREET/SP TRACKS.

D. EVACUATION ROUTES:
RICHARDS (WEST) TO I-5, RICHARDS (EAST) TO NORTH 12TH STREET, BANNON (EAST) TO NORTH 12TH STREET.

E. CRITICAL FACILITIES:
COMMUNICATIONS CENTER, AREA MOTELS, DOS RIOS SCHOOL, BLUE DIAMOND FACTORY

F. SHELTERS:
CAL-EXPO - 1600 EXPOSITION BLVD., C.K. MCCLATCHY - 3066 FREEPORT BLVD., SACRAMENTO HIGH - 2315 34TH STREET

G. NOTIFICATION:
SIREN 16, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 9 DOWNTOWN

A. POPULATION: 31,648

B. BOUNDARIES:
NORTH - SP TRACKS, EAST & SOUTH - I-BR 80, WEST - SACRAMENTO RIVER.

C. ACCESS CONTROL POINTS:
I-5/J STREET, NORTH 12TH STREET/SP TRACKS, I-BR 80/AMERICAN RIVER, 29TH STREET/NUMEROUS THROUGH STREETS, X STREET/NUMEROUS THROUGH STREETS, I-BR 80/5TH STREET, TOWER BRIDGE/I STREET BRIDGE, I-5/Q STREET.

D. EVACUATION ROUTES:
16TH STREET (NORTH), 15TH STREET (SOUTH), I STREET (WEST), P STREET (WEST), H STREET (WEST), Q STREET (EAST), CAPITOL (EAST), CAPITOL MALL (WEST), J ST (WEST).

E. CRITICAL FACILITIES:
CITY HALL, POLICE DEPARTMENT, COUNTY JAIL, FIRE DEPARTMENT (EOC), SUTTER GENERAL HOSPITAL, STATE CAPITOL AND VARIOUS STATE BLDGS, HYATT HOTEL.

F. SHELTERS:
CAL-EXPO - 1600 EXPOSITION BLVD., C.K. MCCLATCHY - 3066 FREEPORT BLVD., SACRAMENTO HIGH - 2315 34TH STREET

G. NOTIFICATION:
SIREN 25, 13, 14, 15, 30 AND 31, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 10 EAST SACRAMENTO

A. POPULATION: 16,472

B. BOUNDARIES:
NORTH & EAST - SP TRACKS, SOUTH - US 50, WEST - I-BR 80.

C. ACCESS CONTROL POINTS:
30TH STREET/VARIOUS THROUGH STREETS, J STREET/SP TRACKS, FOLSOM/SP TRACKS, US-50/65TH STREET, US-50/59TH STREET, US-50/51ST STREET, US-50/48TH STREET, US-50/39TH STREET, US-50/STOCKTON BLVD., H STREET/SP TRACKS.

D. EVACUATION ROUTES:
ELVAS (EAST OR WEST), H STREET (EAST OR WEST), J STREET (EAST OR WEST), FOLSOM (EAST OR WEST).

E. CRITICAL FACILITIES:
MERCY HOSPITAL, SUTTER HOSPITAL, NATIONAL GUARD ARMORY, OFFICE COMPLEX 39&C STS.

F. SHELTERS:
CAL-EXPO - 1600 EXPOSITION BLVD., C.K. MCCLATCHY - 3066 FREEPORT BLVD., SACRAMENTO HIGH - 2315 34TH STREET

G. NOTIFICATION:
SIREN 6, 24, 34, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 11 RIVER PARK, COLLEGE GREEN, GLENBROOK

A. POPULATION: 15,798

B. BOUNDARIES:
NORTH - AMERICAN RIVER, EAST - WATT AVENUE, SOUTH - LIGHT RAIL TRACKS, WEST - SP TRACKS.

C. ACCESS CONTROL POINTS:
FAIR OAKS/AMERICAN RIVER, HOWE/AMERICAN RIVER, WATT/AMERICAN RIVER, WATT/US-50, WATT/FOLSOM, FOLSOM/JACKSON, FOLSOM/KIEFER, FOLSOM/POWER INN, FOLSOM/SP TRACKS, J STREET/SP TRACKS, H STREET/SP TRACKS.

D. EVACUATION ROUTES:
MODDISON (EAST TO J STREET (EAST), HOWE (NORTH OR SOUTH), WATT (NORTH OR SOUTH), FOLSOM (EAST OR WEST), LA RIVIERA (EAST OR WEST)

E. CRITICAL FACILITIES:
CALIFORNIA STATE UNIVERSITY **AVG DAILY POPULATION 18,000**

F. SHELTERS:
CAL-EXPO - 1600 EXPOSITION BLVD, HIRAM JOHNSON - 6879 14TH AVENUE, KIT CARSON MIDDLE SCHOOL - 5301 N STREET.

G. NOTIFICATION:
SIREN 7, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 12 LAND PARK

A. POPULATION: 33,368

B. BOUNDARIES:
NORTH - I-BR 80, EAST - US99, SOUTH - 35TH AVE,
WEST - SACRAMENTO RIVER

C. ACCESS CONTROL POINTS:
I-BR 80/VARIOUS CROSS STREETS, BROADWAY/US99, 5TH AVENUE/US99, 12TH AVENUE/US99, FRUITRIDGE/US99, FRUITRIDGE/VARIOUS CROSS STREETS, SEMAS/I-5, SUTTERVILLE/I-5.

D. EVACUATION ROUTES:
BROADWAY (EAST OR WEST), SUTTERVILLE (EAST OR WEST), FRUITRIDGE (EAST OR WEST), FREEPORT (SOUTH), 24TH STREET (SOUTH) FRANKLIN (SOUTH), RIVERSIDE (NORTH).

E. CRITICAL FACILITIES:
SACRAMENTO CITY COLLEGE, C.K. MCCLATCHY HIGH, SAM BRANNAN MIDDLE SCHOOL, ELEMENTARY SCHLS-IRVIN AND HARTE AREA.

F. SHELTERS:
SACRAMENTO HIGH - 2315 34TH STREET, CHRISTIAN BROTHERS HIGH - 4315 MARTIN LUTHER KING BLVD., KENNEDY HIGH - 6715 GLORIA DRIVE

G. NOTIFICATION:
SIREN 31, 5, 25, 23, 33, 37, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 13 OAK PARK, TAHOE PARK

A. POPULATION: 43,454

B. BOUNDARIES:
NORTH - US50, EAST - SP TRACKS, SOUTH - FRUITRIDGE, WEST - US99.

C. ACCESS CONTROL POINTS:
US50/39TH, US50/STOCKTON BLVD, US50/48TH STREET, US50/51ST STREET, US50/59TH STREET, US50/65TH STREET, SP TRACKS/14TH AVENUE, POWER INN/FRUITRIDGE, FRUITRIDGE/VARIOUS CROSS STREETS, US99/FRUITRIDGE, US99/12TH AVENUE.

D. EVACUATION ROUTES:
STOCKTON (NORTH OR SOUTH), 65TH STREET (NORTH OR SOUTH), BROADWAY (EAST OR WEST), 14TH AVENUE (EAST OR WEST), FRUITRIDGE (EAST OR WEST), HWY 99(NORTH/SOUTH), HWY 50 (EAST/WEST) .

E. CRITICAL FACILITIES: UCDMC, SAC HS, HIRAM JOHNSON HS, CHRISTIAN BROS. HS, MCGEORGE LAW SCHL, OAK PARK COMM CNTR,
DOJ 49TH AND BROADWAY.

F. SHELTERS:
SACRAMENTO CITY COLLEGE - 3835 FREEPORT, CSUS - 6000 J STREET, FERN BACON MIDDLE SCHOOL - 4140 CUNY AVENUE

G. NOTIFICATION:
SIREN 3, 4, 20, 21, 27, 34, 35, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 14 POCKET, GREENHAVEN

A. POPULATION: 43,194

B. BOUNDARIES:
EAST - I-5, SOUTH, WEST & NORTH - SACRAMENTO RIVER.

C. ACCESS CONTROL POINTS:
I-5/43RD AVENUE, I-5/GLORIA, I-5/FLORIN, I-5/SOUTHLAND PARK, I-5/POCKET, RIVERSIDE/43RD AVENUE

D. EVACUATION ROUTES:
RIVERSIDE (NORTH), POCKET (SOUTH), FLORIN (EAST), I-5 (NORTH OR SOUTH).

E. CRITICAL FACILITIES:
KENNEDY HIGH SCHOOL, ELDERLY APT COMPLEXES- RUSH RIVER EAST OF GREENHAVEN

F. SHELTERS:
LUTHER BURBANK - 3500 FLORIN ROAD, GOETHE MIDDLE SCHOOL - 2250 68TH AVENUE, SAM BRANNAN MIDDLE SCHOOL - 5301 ELMER WAY

G. NOTIFICATION:
SIREN 17, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 15 SOUTHLAND PARK, FRUITRIDGE, NORTHERN MEADOWVIEW

A. POPULATION: 25,570

B. BOUNDARIES:
NORTH - FRUITRIDGE, EAST - US99, SP TRACKS, SOUTH MEADOWVIEW, WEST - I-5.

C. ACCESS CONTROL POINTS:
FRUITRIDGE/SEAMAS, FRUITRIDGE/VARIOUS CROSS STREETS, FRUITRIDGE/US99, CITY LIMIT/47TH AVENUE, CITY LIMIT/51ST AVENUE, FLORIN/SP TRACKS, MEADOWVIEW/SP TRACKS, MEADOWVIEW/I-5, I-5/FLORIN, I-5/GLORIA.

D. EVACUATION ROUTES:
FREEPORT (NORTH OR SOUTH), SOUTHLAND PARK (NORTH), 24TH STREET (NORTH OR SOUTH), 47TH AVENUE (EAST), FLORIN (EAST OR WEST), MEADOWVIEW (EAST OR WEST).

E. CRITICAL FACILITIES:
EXECUTIVE AIRPORT, LUTHER BURBANK HIGH SCHOOL, CITY CORP YARD, FLORIN RD SHOPPING CENTERS.

F. SHELTERS:
SAM BRANNAN MIDDLE SCHOOL - 5301 ELMER WAY, KENNEDY HIGH SCHOOL - 6715 GLORIA DRIVE, VALLEY HIGH SCHOOL - 6300 EHRHART

G. NOTIFICATION:
SIREN 1, 32, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 16 ELDER CREEK

A. POPULATION: 11,385

B. BOUNDARIES:
NORTH - FRUITRIDGE, EAST - SP TRACKS, SOUTH & WEST - CITY LIMITS.

C. ACCESS CONTROL POINTS:
FRUITRIDGE/STOCKTON, FRUITRIDGE/VARIOUS CROSS STREETS, FRUITRIDGE/SP TRACKS, POWER INN/53RD AVENUE, 65TH STREET/CITY LIMIT, 47TH AVENUE/54TH STREET.

D. EVACUATION ROUTES:
STOCKTON (NORTH OR SOUTH), 65TH STREET (NORTH OR SOUTH), POWER INN (NORTH OR SOUTH), ELDER CREEK (EAST OR WEST), FRUITRIDGE (EAST OR WEST)

E. CRITICAL FACILITIES:
WILL C. WOOD JUNIOR HIGH, SIM PARK COMM CENTER, STOCKTON BLVD SHOPPING CENTERS.

F. SHELTERS:
LUTHER BURBANK - 3500 FLORIN, SACRAMENTO HIGH - 2315 34TH STREET, SACRAMENTO CITY COLLEGE - 3835 FREEPORT BLVD.

G. NOTIFICATION:
SIREN 3, EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 17 FLORIN - PERKINS

A. POPULATION: 188

B. BOUNDARIES:
NORTH - LIGHT RAIL TRACKS, EAST & SOUTH - CITY LIMITS, WEST - SP TRACKS.

C. ACCESS CONTROL POINTS:
FOLSOM/POWER INN, FOLSOM/JACKSON, KIEFER/REITH, JACKSON/ELK GROVE-FLORIN, ELK GROVE-FLORIN/ELDER CREEK, ELK GROVE-FLORIN/FRUITRIDGE, FLORIN-PERKINS/WEYLAND, SP TRACKS/FRUITRIDGE, SP TRACKS/POWER INN, SP TRACKS/14TH AVENUE.

D. EVACUATION ROUTES:
FRUITRIDGE (WEST), FLORIN PERKINS (NORTH OR SOUTH), ELK GROVE-FLORIN (NORTH OR SOUTH), POWER INN (NORTH OR SOUTH).

E. CRITICAL FACILITIES:
SACRAMENTO ARMY DEPOT, PROCTOR & GAMBLE, **POWER INN RD LT INDUSTRY - HEAVY DAILY POPULATION**

F. SHELTERS:
HIRAM JOHNSON HIGH SCHOOL - 6879 14TH AVENUE, CSUS - 6000 J STREET, WILL C. WOOD MIDDLE SCHOOL - 6201 LEMON HILL.

G. NOTIFICATION:
EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 18 MEADOWVIEW

A. POPULATION: 12,309

B. BOUNDARIES:
NORTH - MEADOWVIEW, EAST - MORRISON CREEK, SOUTH - CITY LIMIT, WEST I-5.

C. ACCESS CONTROL POINTS:
MEADOWVIEW/I-5, MEADOWVIEW/FREEPORT, MEADOWVIEW/24TH STREET, MEADOWVIEW/29TH STREET, MEADOWVIEW/SP TRACKS.

D. EVACUATION ROUTES:
FREEPORT (NORTH), 24TH STREET (NORTH), MEADOWVIEW (EAST OR WEST).

E. CRITICAL FACILITIES: JOHN STILL AND FREEPORT SCHLS, CALIFORNIA STATE OES, FEDERAL JOB CORPS SITE.

F. SHELTERS:
LUTHER BURBANK - 3500 FLORIN ROAD, KENNEDY HIGH SCHOOL - 6715 GLORIA DRIVE, VALLEY HIGH SCHOOL - 6300 EHRHART.

G. NOTIFICATION:
EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 19 VALLEY HI

A. POPULATION: 17,348

B. BOUNDARIES:
NORTH - MACK, EAST US99, SOUTH - CITY LIMIT, WEST - CITY LIMIT AND MORRISON CREEK.

C. ACCESS CONTROL POINTS:
MACK/FRANKLIN, MACK/TANGERINE, MACK/CENTER PARKWAY, MACK/US99, STOCKTON BLVD./US99, STOCKTON BLVD./DULUTH, MACK/LA MANCHA, STOCKTON BLVD./SHASTA, STOCKTON BLVD./JACINTO, STOCKTON BLVD./SHELDON, SHELDON/FRANKLIN.

D. EVACUATION ROUTES:
FRANKLIN (NORTH OR SOUTH), CENTER PARKWAY (NORTH OR SOUTH), STOCKTON BLVD. (NORTH OR SOUTH), MACK (EAST OR WEST).

E. CRITICAL FACILITIES:
VALLEY HIGH SCHOOL, COSUMNES RIVER COLLEGE, METHODIST HOSPITAL, KAISER HOSPITAL, MACK RD SHOPS.

F. SHELTERS:
LUTHER BURBANK HIGH SCHOOL - 3500 FLORIN ROAD, KENNEDY HIGH SCHOOL - 5715 GLORIA, FERN BACON MIDDLE SCHOOL - 4140 CUNY.

G. NOTIFICATION:
EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

EVACUATION AREA 20 VALLEY HI

A. POPULATION: 11,914

B. BOUNDARIES:
NORTH - FLORIN ROAD, EAST - US99, SOUTH - MACK ROAD, WEST - SP TRACKS.

C. ACCESS CONTROL POINTS:
FRANKLIN/52ND AVENUE, FRANKLIN/FLORIN, FLORIN/EAST PARKWAY, MACK/US99, MACK/FRANKLIN, MACK/BROOKFIELD.

D. EVACUATION ROUTES:
FRANKLIN (NORTH OR SOUTH), MACK (EAST OR WEST.

E. CRITICAL FACILITIES:
LUTHER BURBANK HIGH SCHOOL

F. SHELTERS:
VALLEY HIGH SCHOOL - 6300 EHRHART, KENNEDY HIGH SCHOOL - 6715 GLORIA DRIVE, GOETHE MIDDLE SCHOOL - 2250 68TH AVENUE.

G. NOTIFICATION:
EMERGENCY BROADCAST SYSTEM, ROVING PATROL, LOUD SPEAKERS.

RECOMMENDATIONS

Our primary recommendations consist of education and potential drills. The City of Sacramento has never had a major EVAGUATION except for the RESCUE/EVACUATION of the Strawberry Manor area during the flooding of February 1986. Other than this one limited occasion, a major EVACUATION has not occurred in recent memory.

Public educational forums would be a critical resource in order to properly prepare the public and lessen panic during an event. A series of community meetings could be held explaining the dangers within the city, and the concepts of a potential evacuation, similar to the recent one organized by the River Park Homeowners Association and Councilman Pane.

Additionally, part of the educational seminars could include home preparation information. One of the keys to surviving a major disaster such as a flood or an earthquake is having individual citizens assume responsibility for their own survival and not depend completely on their city or county government to save them in the event of a crisis. This kind of home preparation was critical during the Northridge and Loma Prieta earthquakes, and were instrumental in saving whole neighborhoods.

An actual practice evacuation and conduct of a drill would be another recommendation. While we realize the cost problems of such an organized drill, the benefits received would be immeasurable.

A drill/disaster exercise of having a large population actually evacuated from their neighborhood, say for example the residents of River Park, would heighten public awareness in the minds of all citizens and would benefit us for years with the experience we would gain in conducting this kind of an operation.

Our secondary recommendations are to maintain and update as necessary the city wide siren system, to investigate the use of an emergency phone dialing system, and to post signs along major evacuation routes.

The key to an evacuation during any kind of calamity is immediate public awareness and the dissemination of clear instructions to the population affected. The old Civil Defense siren system that's throughout Sacramento is one of the excellent points of this city. It's immediate use, along with the Emergency Broadcast System for TV and Radio, would save lives. This siren system needs to be fully updated and available, and its growth must keep pace with the population of the city.

A second recommendation would be for an auto phone dialer system. Currently there exists the technology for an auto phone dialing system capable of dialing five thousand phone numbers simultaneously and repeating a given taped message. The phone numbers would be pre-programmed by the three digit prefix code for whatever residential area that we wanted to evacuate. The actual taped message would be provided by us. It would be a recommendation to further explore the concepts of this system and see if it is fiscally feasible for us to participate in this program.

Our final recommendation concerns the placement of evacuation route signs. We in Sacramento live behind levees that hold back the force of rivers. To constantly remind the population of this fact, and the need to keep key streets clear in an emergency evacuation, signs saying "Flood Emergency Evacuation Route" would be placed on our major surface streets.

If you drive anywhere on the coast of Florida, you will see signs saying: "Hurricane Evacuation Route" on all of the major roadways. These signs serve many key purposes. They alert the citizens that these roads must never be blocked, that this road will get them out of harms way, and it serves as a constant reminder of the danger they face in living in this area. The increased public awareness, and subsequent personal preparation, is extremely valuable.

While we realize the possible objections to sign placement, we feel the benefits far out-weigh any of the negative aspects.

<u>Recommendations Summary:</u>

Primary: Educational Forums
Full Scale Evacuation Exercise

Secondary: Maintain and Expand Siren System
Obtain Auto-Dialing Phone System
Place Signs on Major Roadways

I. Purpose

The purpose of the review of the Emergency Preparedness element of flood planning is to identify current plans and identify areas which may require additional focus.

The concept of emergency preparedness is in concert with the City's overall goal of protecting life and property during an emergency. The City recognizes that city staff must know their role in an emergency,and developed several layers of planning documents. The City conducts annual exercises/training which are conducted to assure city staff are practiced in their emergency functions.

The City also recognizes the advantage of having public education for its citizens. Coping with a disaster is much more difficult and dangerous if you are not prepared. Disasters can happen any time, anywhere. The better prepared citizensa are the less fear, inconvenience and losses surround a disaster thereby allowing responders to concentrate on protection of life and termination of the emergency. If a disaster threatens the community, local government and disaster organizations will be overwhelmed. With adequate planning families can be educated to evacuate their homes, make stays in public shelters more comfortable and know how to take care of their basic medical needs. They can even save each other's lives.

II. Background/Methodology

The City has an excellent and progressive planning process in place. The process includes plans for city employees dealing with the protection of life and property during an emergency. These include: Departmental Operational Plans (SOP's), and the Multi-Hazard Plan. The City also plans for continuing city operations in order to continue to serve the City's customers (the public). These plans include: Building Action Plans, and Business Recovery Plans.

III. Product

Departmental Operational Plans

The role of the City in a disaster is the protection of life and property. In order to accomplish this task, departments having field response roles have developed Operational Plans which are implemented on a daily basis. During an emergency these departments will activate their Operations Centers and manage their field resources from the Operations Center facility. The departments having Operation Centers include: Fire, Police, Public Works, Utilities, and Neighborhood Services.

Multi-Hazard Plan

The Multi-Hazard Plan supports activity in the City's Emergency Operations Center. The Department Heads (decision-makers in the Emergency Operations Center) will utilize the Multi-Hazard Plan. This plan has been designed as a policy level document. The Multi-Hazard Plan is just that and covers the following disasters:

- Major Earthquake
- Hazardous Material Incident
- Flooding/Dam Failure (See Attachment 1)
- Urban Wildfire
- Transportation Incident
- National Security
- Severe Weather

Response issues contained in the Multi-Hazard Plan include:

- Emergency Public Information and Warning
- Situation Survey & Analysis
- Allocation and Mobilization of Response Resources
- Evacuation and Rescue
- Care and Treatment of Causalities
- Collecting, Identifying and Disposing Of Deceased
- Mass Care For Displaced Persons and Families
- Enforcing Police Powers, Access Control & Movement
- Implementing Health and Safety Measures
- Controlling and Allocating Vital Resources, Supplies
- Protecting and Restoring Facilities and Systems

Building Action Plans

The building action plans are indented to provide contacts and evacuation mechanisms for facilities housing City Employees. Procedures include:

- Site specific procedures and hazard analysis
- Appointment of Building Managers-having the authority to order a building evacuation. Appointment of Floor Managers and Area Managers.
- Safety Issues
- Evacuation Plans
- Resources and supplies
- Identification of back-up power sources

The implementation of these plans is an ongoing project.

Business Recovery Plans

Both the public and the City have interest in the City continuing business as usual. The City recognizes that particularly in these fiscal times we cannot afford to be "closed" any longer than absolutely necessary. The development of Business Recovery Plans is a pioneering effort for City government.
The Departmental Safety Representatives have been the contact in the development of these documents. Planners were asked to presume that business could not be conducted from primary facilities due to a disaster. Departmental Business Recovery Plans deal with the City's ability to continue business as usual following a disruption. This process includes addressing the following issues:

- Functional Description: Day to day activities, critical/mandated activities, what must continue? What produces revenue? What tolerates disruption?

- Location and Identification of Critical Personnel: Which staff is needed to continue your critical/mandated activities?

- Key Supporting Organizations & Responsibilities: Who do you rely on with in the City? Who do you rely on outside of the City?

- Checklists: Used to assess a department's ability to function

- Resource listing: What is needed for the critical personnel identified to continue working? (Computer, Phone, Fax). A phone listing of the critical personnel/resources needed to continue functioning.

The City, in conjunction with the Red Cross, has in an ongoing effort of joint public education have developed the "Ten Steps to Disaster Preparedness" (See Attachment 2). The "Ten Steps" cover preparedness techniques necessary in any disaster, in addition to steps unique to certain disaster scenarios. We also have many Red Cross scenario specific disaster preparedness pamphlets, booklets, and video information, available in English, Spanish, Cantonese, Mandarin, Tagalog, Vietnamese, Korean and Braille.

This year (at the request of the River Park Neighborhood Association) the City assembled a panel on flood related issues. This very effective method of providing public information included: Emergency Planning, Utilities-Flood Control, Police, Sacramento Area Flood Control Agency, and American River Flood Control District. This multi-disciplinary approach is the most functional method of presenting sometimes very technical information.

IV. Recommendations

The City must continue their aggressive approach to creating internal plans and exercising those plans regularly. These plans are all living documents and require periodic updating. The continuation of this process is critical.

In the upcoming fiscal year the plan is to formulate recovery documents to include in the Multi-Hazard Plan. These documents will deal with the long task of restoring the community following a disaster.

Emergency Planning is currently working with all City departments to develop an Energy Contingency plan which will deal with energy disruption resulting from a disaster or a market disruption. This plan will be used in a flood as well as many other scenarios which could affect the power supply.

Emergency Planning continues to work with appointed building managers to include all facilities housing City employees in our Building Action planning effort.

Public Education must increase. Emergency Planning's current Public Education Program is provided on an "as requested" basis. This is the only reasonable method given current staffing (1.0 Emergency Services Officer, .5 Typist Clerk III).

There are existing community planning models in other citys which use already established neighborhood groups to educate neighborhoods to be self supportive following a disaster. A program of this sort is the cadillac of emergency preparedness. The City of San Francisco has such a program called Neighborhood Emergency Response Teams (NERT), the City of Novato also has such a program called Homeowners Emergency Action Response Team (HEART). These programs include modules addressing the following: EMS principles & skills; Cardio Pulmonary Resuscitation; Wildland Urban Interface; Earthquake Preparedness; Urban Search & Rescue Basics; Hazardous Materials & Floods; Fire and Burn Prevention; Injury Prevention and Loss Control.

The use of the multi-disciplinary team to deliver scenario specific information in a lecture format, is an excellent plan. This group could work through the Neighborhood Services Department to connect with neighborhood groups to offer education on flood related issues. Even if we do not actively pursue these groups, we could offer an awareness of our abilities and resources.

I. Purpose

In 1993 flooding in the mid west, as well as in the 1994 flooding episode in Georgia, we saw examples of hazardous material incidents with potential and actual releases. It is critical that emergency planning and response address the potential effects of flooding on hazardous material facilities.

II. Background/Methodology

The Hazardous Materials Division of the Fire Department contacted St. Louis Fire Chief Neil Sventanics, to discuss findings as a result of the 1993 flooding of the Mississippi. Chief Sventanics described a propane tank farm which stored 51 propane tanks. The tank farm, owned by Phillips Pipeline Company, had taken some preventative measures to protect the farm. Based on experiences in a 1973 flooding episode, where the river crested at 47 feet, the company toped off the tanks to 85% of capacity and personnel engineered strapping for the tanks to withstand flooding of up to 47 feet. As the water rose above 47 feet the tanks began to break the straps. Eventually all 51 tanks were floating, as the water crested at 49.3 feet. Five of the floating tanks began leaking near the flanges. It is estimated that 25,000 to 40,000 gallons leaked out. Officials feared that the vapors would ignite, causing a massive explosion. An evacuation was ordered within a 1/2 mile radius of the propane tanks involving 12,000 residents. In other unrelated locations numerous fires were attributed to hazardous material releases.

The Hazardous Materials Division of the Fire Department also contacted Captain Marty Kasman, Los Angeles County Hazardous Materials Division. Capt. Kasman indicated that following the Northridge Earthquake many potentially hazardous materials were moved, combined and mixed with water. A situation not unlike that which would occur during a flood episode. Los Angeles County Hazardous Material Division had to do a door-to-door examination of businesses and residences storing hazardous materials. This "clean-up" effort was very labor intensive and time consuming.

The City then began the identification of hazardous materials use & storage sites, in and adjoining the City of Sacramento, which could be dangerous in the event of a flood. In conjunction with the County of Sacramento, Environmental Management Department, Hazardous Materials Division, and the County Emergency Operations Division, the City Hazardous Material Division and Emergency Planning Division examined the potential for a hazardous material incident. The working group divided the hazard into three phases:

A. The Educational Phase

Aggressive education of business, industry, and citizens storing hazardous materials could help to minimize the potential effects of a flood. Training on storage precautions, including limiting or eliminating inventory during episodes of potential or eminent flooding, would significantly minimize the time required for City/County staff to evaluate impacts and reclaim containers of materials. Pre-planning would speed the authorization of re-entry time for business, creating a situation which would minimize the time the business remained closed.

B. The Emergency Phase

Historically in the emergency phase the greatest threat was demonstrated to be the unseating of storage tanks and the compromise of fixed storage facilities, and the subsequent threat of fire or toxic release.

C. The Recovery Phase

In the recovery or "clean-up" phase facilities storing even minimal amounts of toxic substances would have to be evaluated prior to resumption of business (example a discount store which retails swimming pool chemicals, fertilizer, charcoal briquettes, lighter fluid). A team consisting of city and county staff would need to evaluate each site prior to authorizing re-entry.

III. Products

Attached is a listing of known (provided by County Hazardous Materials) fixed and portable storage tanks, in and adjoining the City. These sites were mapped by City staff. Based on the anticipated inundation pattern the City can identify affected facilities.

IV. Recommendations

Incorporate into our report all facilities in the County area. The City of Sacramento provides emergency response to hazardous material incidents in the City and County. Water flows could move from City to County or County to City. What begins as a storage tank in the County may become a City problem when the flood waters carry it into City limits. The County has indicated a willingness to participate in making this program comprehensive. Verification of tank size, current existence etc. would be necessary to give this product a higher degree of reliability.

The following are potential tracts for mitigating the effects of flooding on a hazardous material site.

A. Provide education to business, industry and the citizens, regarding precautions that can be taken prior to a flood.

B. Purge tank early in flood episode (would take days or weeks) or remove products from fixed facilities.

C. Research the feasibility of requiring that tanks be strapped to their foundations and or that fixed facilities be prepared to restrict product to the site (through use of diking, sandbags or booms could be used). This would require incorporation into current city code.

DRAFT

Date 9/6/94

COMPREHENSIVE FLOOD MANAGEMENT PLAN: RESIDENTIAL AND NON-RESIDENTIAL DEVELOPMENT GUIDELINES

I. PURPOSE

The purpose of residential and non-residential development guidelines within the floodplain is to provide additional protection for commercial, industrial and residential development should a flood occur. The guidelines address: building design (wet and dry flood proofing), building elevations and siting criteria. Although federal legislation will allow development to occur within the proposed AR (restoration) flood zone, the exposure to and potential for a 100 year storm event still exists. Even after 100 year flood protection is achieved, there are still flood risks associated with larger storm events (i.e., 200 year storm). Structures and buildings should be designed so that potential loss of life and property damage impacts are reduced.

II. BACKGROUND

Loss of Flood Protection Certification

Based on new hydrologic data gathered from storm and flood events in 1986, the Federal Emergency Management Administration (FEMA) prepared new flood maps that indicated that approximately 2/3 of the City of Sacramento was located within a 100 year floodplain (see Attachment A). In response, an interim flood designation was provided in 1989 that classified the entire 100 year floodplain within the City as A-99. This designation allowed unrestricted development within the flood plain, with the understanding that adequate progress would be made to provide 100 year flood protection. In 1990, the City Council approved a citywide flood policy that place restrictions on both residential and non-residential development in North and South Natomas. Because of the extreme flood depths (projected to be 5 to 25 feet) in the Natomas Basin, a de facto moratorium on residential development resulted and is still in place.

Basic Flood Areas/Types

There are two basic flood areas in Sacramento. First, the Natomas Flood Basin, which is subject to flood depths of up to 25 feet. The second area is the City and County south of the American River.

Proposed AR Zone

The A-99 flood plain designation was an interim designation that expired in 1992. The A-99 zone still exists, however, but is expected to be replaced in the fall of 1994 by a proposed new designation of AR. This zone allows for restricted development within the 100 year flood plain. It is intended for communities, such as Sacramento, where a certified 100-year or greater flood protection system has been de-certified due to updated hydrologic or other data. This zone will allow development to continue, with some restrictions, while progress is made towards achieving 100 year flood protection. Like the A-99 zone, this zone is also temporary, and will expire 5 years from the date of classification or when certification of 100 year flood protection is obtained.

III. FLOOD PROTECTION STATUS

Natomas

The AR flood zone regulations, as proposed by FEMA, will prohibit both residential and non-residential development in North Natomas. Some infill development may be allowed in South Natomas. A definition for infill has yet to be determined by FEMA. A local flood control project, which focuses primarily on the Natomas East Main Drain Canal (NEMDC), and the tributary creeks that flow into it, is currently in progress and is expected to be completed in 1996 or early 1997. Once this project is completed, it is anticipated that North and South Natomas will have a 100 year level of flood protection. Once the 100 year level of flood protection is achieved, the FEMA flood insurance rate maps will be revised and the City will likely allow residential development to occur.

Remainder of the City

The remainder of the City currently has approximately 70 year flood protection. Recently, however, the Sacramento Area Flood Control Agency (SAFCA), developed a preliminary plan for the re-operation of Folsom Dam to provide additional storage capacity and flood protection. The re-operation, anticipated to take place by late 1994, would provide the remainder of the City with 100 year flood protection. Once certified 100 year flood protection is provided, development may be allowed to occur without strict development standard requirements.

IV. IMPLEMENTATION

In a report to City Council on December 7, 1993, the City Council approved a resolution to allow development to occur with a minimum of 100 year flood protection and to pursue as a long range goal for the City a 200 year level of flood protection. The 100 year level of flood protection satisfies the FEMA requirements for flood insurance, but does not necessarily eliminate flood risk. Consequently, Council also directed staff to prepare guidelines for both residential and non-residential development within the 100 year flood plain that would help reduce potential impacts to lives and property, particularly in areas of deep flooding.

The following guidelines and measures address both residential and non-residential development. The guidelines also address two levels of flooding: 1 to 5 feet and greater than 5 feet. The guidelines suggest options for more stringent standards for deep floodplain development. The purpose of the guidelines is to ensure that structures, both residential and non-residential, are constructed so that potential flood impacts are reduced to the greatest extent possible. Attached are draft guidelines for development within the floodplain.

RESIDENTIAL AND NON-RESIDENTIAL DEVELOPMENT GUIDELINES

I. INTRODUCTION

The development guidelines address two basic categories of development: Residential and Non-Residential. Within each of those two categories there are two levels of flooding identified: 1 to 5 feet and 5 feet and greater. The following text outlines each of the proposed measures and highlights the advantages and disadvantages of each.

II. RESIDENTIAL DEVELOPMENT

The A-99 flood plain designation was an interim designation that expired in 1992. The A-99 zone still exists, however, but is expected to be replaced in the fall of 1994 by a proposed new designation of AR. This zone allows for restricted development within the 100 year flood plain. It is intended for communities, such as Sacramento, where a certified 100-year or greater flood protection system has been de-certified due to updated hydrologic or other data. This zone will allow development to continue, while progress is made towards achieving certified 100 year flood protection. Like the A-99 zone, this zone is also temporary, and will expire 5 years from the date of classification or when certification of 100 year flood protection is obtained.

There are three basic categories of options for development guidelines for new residential development, as well as substantial improvements to existing residential development, to be implemented at least until 100 year flood protection is provided. The first category, FEMA AR zone requirements, are mandated by FEMA. The FEMA standard flood zone requirements are **recommended** as options for development guidelines and not required by FEMA at this time. The supporting measures are also drawn from standard FEMA requirements and are also recommended as supporting options at this time. The third category is other development guidelines options which are design criteria options recommended based on depth of flooding.

Development in North Natomas may be severely restricted by the AR regulations which are currently being drafted. Consequently, development there will be severely restricted due to the deep flooding that is anticipated to occur there. However, once certified 100 year flood protection is in place and Flood Insurance Rate Maps (FIRMs) are revised, development can occur pursuant to development guidelines for the remainder of the City.

A. FEMA Development Guidelines: AR Zone Requirements

The **AR flood zone regulations**, as currently proposed, would require that new residential development, and substantial improvements to residential development within developed areas (outside North Natomas), be **required** to be built 3 feet above the adjacent grade. This requirement does not address potential impacts from a flood even greater than a 100 year event, nor does it recognize that potential flood depths may, in some areas of the City, exceed 3 feet.

The City will be required to designate and adopt either an official community map of those areas within the AR restoration zone. This information will be made available to inform permit applicants of the implications of the AR Zone designation and whether the applicant's proposed structure(s) would be elevated or protected to or above the AR base flood elevation. In those areas where there is a pre-existing 100 year flood zone under the AR zone, then a "dual zone" will result (e.g., AR-A or AR-AE), and the underlying flood zoning designation supersedes the AR flood zone regulations.

Advantages:

- Provides protection up to 3 feet of flood depth
- Satisfies AR zone requirements to allow development to occur
- Relatively easy to implement
- Can be used in conjunction with other "standard" FEMA measures

Disadvantages:

- May not be effective in areas subject to deep flooding
- May not be compatible with design of adjacent development, particularly in infill areas

Analysis:

The AR regulations will allow development to occur (outside North Natomas) while the City is pursuing long term 100 year flood protection. However, the 100 year level of protection that the Sacramento Area Flood Control Agency hopes to achieve with the re-operation of Folsom Dam may not be recognized by FEMA. Consequently, until permanent/long term 100 year protection recognized by FEMA is provided, all development will continue to be subject to the requirement to build 3 feet above adjacent grade.

Although the requirement is fairly easy to implement, and will allow development to receive low cost flood insurance, it may result in design conflicts or inconsistencies with adjacent development, especially in case of infill development. The requirement may also prove ineffective in areas of deep flooding. Staff therefore recommends that additional measures be used to supplement the AR requirement where necessary to raise the lowest floor above the 100 year base flood elevation (BFE).

B. FEMA Development Guidelines: Standard Flood Zone Requirements

In a typical 100 year flood zone FEMA has specific measures that are required prior to the issuance of building permits. The primary focus of these measures is to raise the lowest floor of a dwelling above the BFE. Exceptions and/or variances are rarely granted in standard flood zones when required by FEMA. The most common measures are listed below.

Elevate structure above base flood elevation (BFE)

Raise or locate the structure so that floodwaters cannot reach damageable (non-flood resistant) portions of it. Methods of raising include construction on piles or columns with no lower area enclosures except access, garage and storage.
Advantages:

- Works well to raise the lowest floor elevation above the BFE to flood depths of up to 10 feet

Disadvantages:

- May be incompatible with surrounding design, especially in infill areas
- Would likely result in additional construction costs
- Loses effectiveness in depths greater than 10 feet

Analysis:

Elevated structures may be most effective in those areas of the City located in an area with flood depths of 5 to 10 feet. The design, however may not be consistent with existing development, especially in infill areas. Elevating structures will also result in some additional construction costs. Consequently, this measure might be best utilized in areas of deep flooding if no other viable options exist.

Wet flood proofing in building design

Design or modify a structure to allow flood waters below the lowest floor level, while ensuring that there is minimal damage to the building and contents. This method typically involves a raised foundation (versus a cement slab) to elevate the lowest floor elevation above the BFE. Openings are provided in the foundation to let water in. Appliances, including water heaters, furnaces and heating and air conditioning units should be raised or mounted above the BFE.

Advantages:

- Effective in those areas with flood depths of up to 5 feet
- Relatively easy to implement
- Allows for compatible design with some types of Sacramento development

Disadvantages:

- Loses effectiveness with flood depths 5 feet and greater
- May be incompatible with surrounding design, especially in infill areas.
- May increase construction costs.

Analysis:

This measure would probably work best in the Central City where many of the existing homes have elevated first floors. It would also work in new subdivisions where this type of development could be established as a model for development and would allow for consistency of design. Like the other FEMA measures, it may result in conflicts with existing adjacent designs in areas of infill.

Raising appliances 5 feet or higher may result in " awkward" aesthetics and in some cases may be technically infeasible or not practical. In addition, the measure becomes less stable, and therefore less feasible above 5 feet in height. Therefore, this measure should be used in areas of lesser flood depth or, in deeper flood areas, in conjunction with other measures such as raised building pads and second story construction.

Raise building pad above base flood elevation

Building pads should be elevated so that the lowest floor elevation of a structure is above the BFE. This method is used where elevated structures are not feasible.

Advantages:

- Effective in areas with flood depths of 5 feet or less
- Satisfies standard flood zone requirements to allow development to occur
- Relatively easy to implement
- Can be used in conjunction with other "standard" FEMA measures

Disadvantages:

- May not be effective in areas subject to deep flooding
- May not be compatible with design of adjacent development, particularly in infill areas

Analysis:

Although the requirement is fairly easy to implement, and will allow development to receive low cost flood insurance, it may result in design conflicts or inconsistencies with adjacent development, especially in case of infill development. The requirement may also prove ineffective in areas of deep flooding. This measure would be best utilized in areas of shallow flooding, particularly for new subdivisions. The AR zone requirements are similar to this measure in that it requires pads to be elevated 3 feet above adjacent grade. Consequently, this measure will probably be the most commonly utilized, especially in new subdivision developments.

Supporting Measures/Guidelines

Each of the measures described in the development guidelines shall comply with FEMA, City Building Code and Uniform Building Code standards and regulations. All structural and non-structural building materials at or below the BFE must be flood resistant consistent with FEMA guidelines. In addition, all mechanical equipment (furnaces, hot water heaters, air-conditioners, water softeners etc.), utilities and drains should be located above expected flood waters.

Advantages:

- Protects structures and equipment from potential damage caused by direct contact with water
- Relatively easy to implement when flood depths are 5 feet or less
- Reduces potential for structure and equipment damage should flood depths exceed anticipated elevations

Disadvantages:

- May result in increased construction costs
- May not be feasible in areas of deep flooding

Analysis:

Although the supporting measures may result in some increased costs, they are necessary to make other measures effective. In addition, although these measures may not be 100% effective in areas of deep flooding, their implementation would help to lessen potential flood damage impacts than if these measures were not taken at all. Supporting measures should be used in conjunction with FEMA AR zone requirements and standard flood zone requirements.

C. Other Development Guidelines Options

In addition to the above measures, residential units in areas with estimated flood depths of 5 to 10 feet should incorporate a flat top porch "landing" or exterior roof access in the design of the building. Residential development in areas with estimated flood depths of 10 to 15 feet should be required to be of two story construction with exterior roof access or be on the second floor over a retail, office, or other non-residential use. Residential development in an area with over 15 feet of flood depth should not be allowed.

Advantages:

- Protects structures and equipment from potential damage caused by direct contact with water
- Provides an added measure of safety in areas with a potential for deeper flooding
- Reduces potential for structure and equipment damage should flood depths exceed anticipated elevations

Disadvantages:

- May result in increased construction costs
- May result in designs inconsistent with adjacent development

Analysis:

The other measures should be recommended to homebuilders in areas of deep flooding (i.e., greater than 5 feet). These measures provide a method of evacuation should deep flooding occur. This measure alone does not provide for protection of a structure or other property if no other measures are implemented. These measures, therefore, should only be used in combination with other measures that provide some level of flood protection.

III. NON-RESIDENTIAL DEVELOPMENT

Non-residential development in the AR flood zone is **required** by FEMA to be constructed with the foundation built a minimum of 3 feet above the adjacent grade. No non-residential development will be allowed in North Natomas, according to the AR zone regulations, until 100 year flood protection is achieved. The following recommended options for design guidelines until 100 year flood protection is provided.

A. FEMA Development Guidelines: AR Zone Requirements

The **AR zone flood regulations**, as currently proposed by FEMA, would **require** that new non-residential development, and substantial improvements to non-residential development within developed areas (outside North Natomas), be required to be built 3 feet above the adjacent grade. This requirement does not address potential impacts from a flood even greater than a 100 year event, nor does it recognize that potential flood depths may, in some areas of the City, exceed 3 feet.

Advantages:

- Provides protection up to 3 feet of flood depth
- Satisfies AR zone requirements to allow development to occur
- Relatively easy to implement
- Can be used in conjunction with other "standard" FEMA measures

Disadvantages:

- May not be effective in areas subject to deep flooding
- May not be compatible with design of adjacent development, particularly in infill areas
- May result in increased construction costs

Analysis:

The AR regulations will allow development to occur (outside North Natomas) while the City is pursuing long term 100 year flood protection. The 100 year level of protection that the Sacramento Area Flood Control Agency hopes to achieve with the re-operation of Folsom Dam, however, may not be recognized by FEMA. Consequently, until permanent/long term 100 year protection recognized by FEMA is provided, all development will continue to be subject to the requirement to build 3 feet above adjacent grade in order to receive affordable flood insurance rates.

Although the requirement is fairly easy to implement, and will allow development to receive low cost flood insurance, it may result in design conflicts or inconsistencies with adjacent development, especially in case of infill development. The requirement may also prove ineffective in areas of deep flooding. This measure should be utilized as a stand alone measure whenever possible and in conjunction with other measures where needed.

B. FEMA Development Guidelines: Standard Flood Zone Requirements

elevate structure above base flood elevation (BFE)

Raise or locate the structure so that floodwaters cannot reach damageable portions of it. Methods of raising include raising on piles or columns with no lower area enclosures except access, parking and storage.

Advantages:

- Works well to raise the lowest floor elevation above the BFE to flood depths of up to 10 feet.
- Allows for parking areas to be located on the ground level

Disadvantages:

- May be incompatible with surrounding building design, especially in infill areas
- Would likely result in additional construction costs
- Loses effectiveness in depths greater than 10 feet

Analysis:

Elevated structures may be most effective in those areas of the City located in an area with flood depths of up to 10 feet. The design, however may not be consistent with the design of existing development, especially in infill areas. Elevating structures might also result in increased construction cost. Consequently, this measure might be best utilized in areas of deep flooding where wet or dry flood proofing is not a feasible option.

raise building pad above base flood elevation

Building pads should be such that the lowest floor elevation of a structure is above the BFE. This method should be used where elevated structures are not feasible.

Advantages:

- Satisfies standard flood zone requirements to allow development to occur
- Relatively easy to implement
- Can be used in conjunction with other "standard" FEMA measures

Disadvantages:

- May not be effective in areas subject to deep flooding
- May not be compatible with design of adjacent development, particularly in infill areas

Analysis:

Although the requirement is fairly easy to implement, it may result in design conflicts or inconsistencies with adjacent development, especially in case of infill development. The requirement may also prove ineffective in areas of deep flooding. It may also require a large amount of fill, depending on the ground floor area (footprint). This measure would be best utilized in areas of shallow flooding, particularly for new subdivisions. The AR zone requirements are similar to this measure in that it requires pads to be elevated 3 feet above adjacent grade. Consequently, this measure will probably be the most commonly utilized, especially in new business or industrial parks.

wet flood proofing in building design

Design or modify a structure to allow flood waters inside, while ensuring that there is minimal damage to the building and contents. This method typically involves a raised foundation (versus a cement slab) to elevate the lowest floor elevation above the BFE. Openings are provided (e.g., through windows or doors designed for failure during a flood event), to let water in the ground floor area. The floor area subject to flooding shall be used solely for parking of vehicles, building access or storage in an area other than a basement.

New structures should be designed and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads. Construction materials should be resistant to flood damage. Equipment and Appliances, including water heaters, furnaces and heating and air conditioning units should be raised or mounted above the BFE. Equipment and other service facilities should be designed to prevent water from entering the components during conditions of flooding.

Advantages:

- Works well to raise the lowest floor elevation above the BFE to flood depths of up to 5 feet
- Relatively easy to implement
- Allows for design with some types of warehouse and office developments

Disadvantages:

- Loses effectiveness with flood depths 5 feet and greater
- May be incompatible with surrounding design, especially in infill areas
- May increase construction costs
- May allow for minor water damage to occur

Analysis:

This measure would probably work best for warehouse and distribution centers as well as some office development that includes ground floor parking in the design.

Raising appliances 10 feet or higher may result in " awkward" aesthetics and may in some cases be technically infeasible or not practical. In addition, the measure becomes less stable, and therefore less feasible above 10 feet in height. Therefore, this measure should be used in areas of lesser flood depth or, in deeper flood areas, in conjunction with other measures such as raised building pads.

dry flood proofing in building design

Buildings should, together with attendant utility and sanitary facilities, be designed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water and with structural components having the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy.

Advantages:

- Works well to raise the lowest floor elevation above the BFE to flood depths of up to 5 feet.
- Relatively easy to implement.
- Allows for compatible design with some types of Sacramento development.

Disadvantages:

- Extremely expensive to construct
- Difficult to design

Analysis:

This measure work best for industrial and warehouse uses with equipment or goods stored on the ground level.

Supporting Measures/Guidelines

Each of the measures described in the development guidelines shall comply with FEMA, City Building Code and Uniform Building Code standards and regulations. All structural and non-structural building materials at or below the BFE must be flood resistant consistent with FEMA guidelines. In addition, all mechanical equipment (furnaces, hot water heaters, air-conditioners, water softeners etc.), utilities and drains should be located above expected flood waters.

Advantages:

- Protects structures and equipment from potential damage caused by direct contact with water
- Relatively easy to implement when flood depths are 5 feet or less and in conjunction with dry flood proofing measures
- Reduces potential for structure and equipment damage should flood depths exceed anticipated elevations

Disadvantages:

- May result in increased construction costs
- May not be feasible in areas of deep flooding

Analysis:

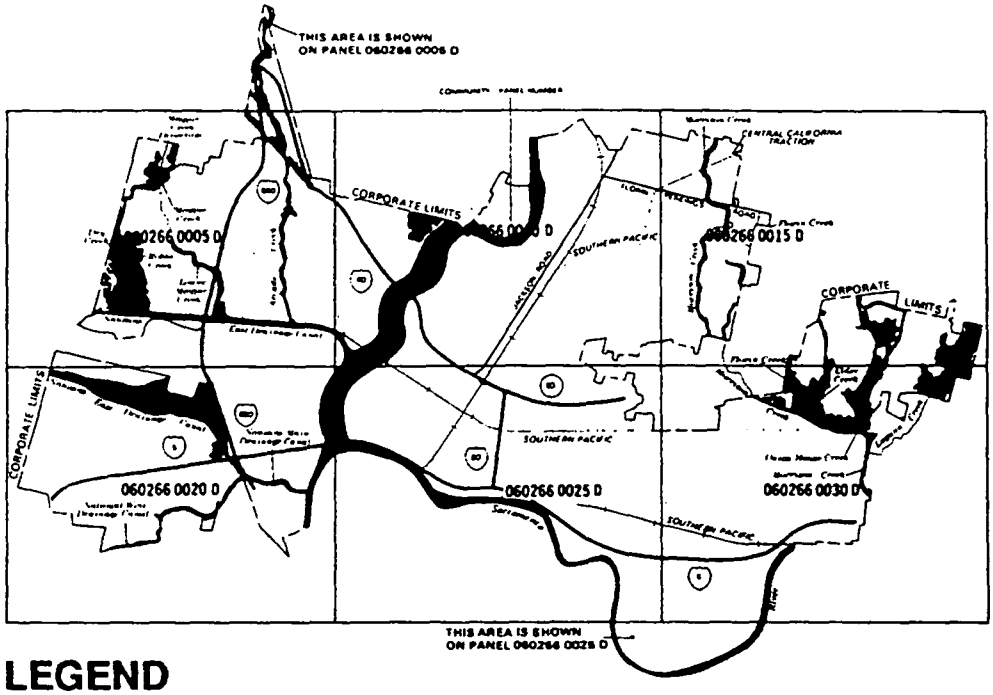
Although the supporting measures may result in some increased costs, they are necessary to make other measures effective. In addition, although these measures may not be 100% effective in areas of deep flooding, their implementation would help to lessen potential flood damage impacts than if these measures were not taken at all. Supporting measures should be used in conjunction with FEMA AR zone requirements and standard flood zone requirements.

JM/jm:M94-023F.POL 9/6/94

OFFICIAL FEDERAL FLOOD MAPS
CITY OF SACRAMENTO, CALIFORNIA

The extent of the flood insurance problem is dramatically demonstrated by the November 15, 1989 revision of the Official Federal Flood Map for the City of Sacramento

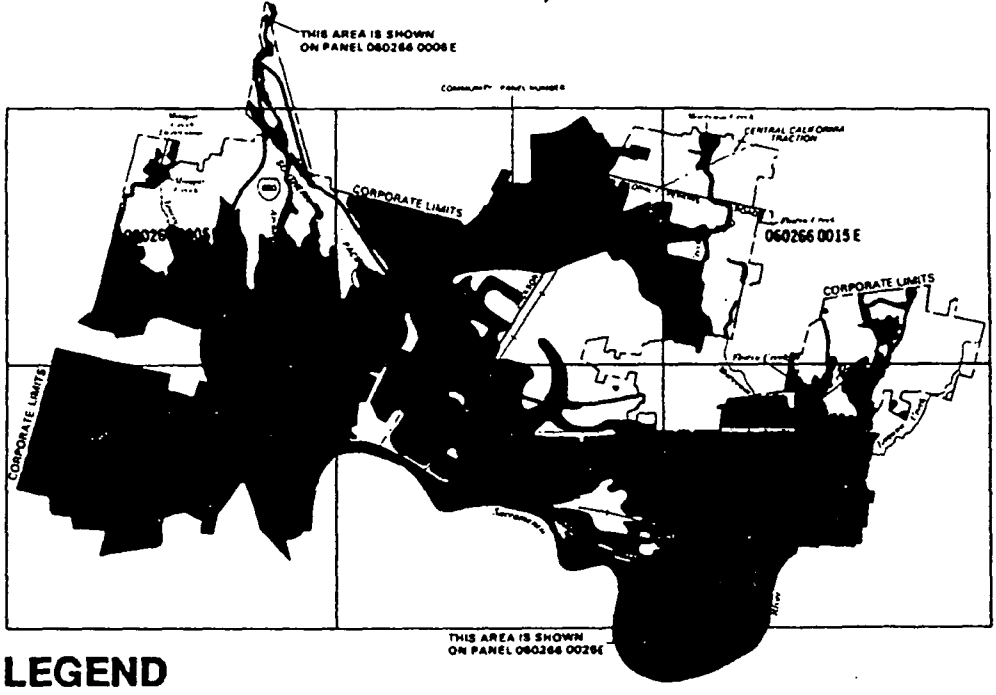
FEBRUARY 4, 1988



LEGEND

FLOOD—PRONE AREAS;
FOR ORIENTATION PURPOSES ONLY

NOVEMBER 15, 1989



LEGEND

FLOOD—PRONE AREAS;
FOR ORIENTATION PURPOSES ONLY

FINAL REPORT

COMPREHENSIVE FLOOD MANAGEMENT PLAN

PROTECTION OF KEY FACILITIES

CITY OF SACRAMENTO

DEPARTMENT OF UTILITIES

Prepared by

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August 15, 1994

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This study identifies key/critical public facilities whose ability to function during extreme flood events may be affected. Critical/key public facilities are defined by the City of Sacramento as:

A critical/key public facility is a facility that is essential in providing:

- utility or direction during the response to a flood emergency, or
- utility or direction during the recovery operation.

The significance of the facilities are identified by means of a classification system to aid the City in prioritizing improvements that may be needed to protect these facilities. Key public facilities are divided into two categories, viz. facilities required for emergency response and those required for recovery. The two sets of critical/key public facilities thus identified are shown in the following two tables.

Summary of all Class 1 Response Facilities in the Flood Zone

Facility Key	Agency	Facility Name	Min. Lead Time* (hours)	Max. Depth (ft)	Critical Elev. (ft)**
4	SMUD	Bulk Substation - Hurley #1-#3	8	5	35
5	SMUD	Bulk Substation - Mid City #1-#4	N/A	5	20
6	SMUD	Bulk Substation - North City #1-#4	36	5	20
7	SMUD	Bulk Substation - Pocket #1-#2	N/A	5	15
9	SMUD	Bulk Substation - Station B #1-#3	8	10	15
10	SMUD	Bulk Substation - Station D #1	1	10	15
97	Department of Utilities	Sump 2 (N29)	8	6	19.0
118	State of California	OES Headquarters	N/A	5	14
161	City of Sacramento	IBM Main Frame Data Center	30	5	20
162	City of Sacramento	City Emergency Operations Center	30	5	20
163	Police/Fire Department	Police / Fire Communications center	4	8	25
238	Fire Department	Fire Dept. Administrative Services	30	5	20
282	Department of Water Resources	DWR Emergency Operations Center	1	5	20

*N/A indicates that this facility is located outside the regions included in the flood inundation maps. However, the facility is still in the 100-yr flood zone.

**Critical elevations are defined as elevations at which critical equipment will fail when flooded. Some of these elevations were provided by City staff. Ground elevations from USGS maps where used in locations where this information was not readily available.

Summary of all Class 1 Recovery Only Facilities in the Flood Zone

Facility Key	Agency	Facility Name	Min. Lead Time* (hours)	Max. Depth (ft)	Critical Elev. (ft)**
96	Department of Utilities	Sump 119 (N28)	N/A	5	11.0
116	S.R.C. Sanitation District	Sac Regional WWTP	N/A	5	15.8
133	Department of Utilities	Sacramento River WTP	4	8	20
134	Department of Utilities	E.A. Fairbairn WTP	2	10	30
135	Department of Utilities	35th Ave. Plant Maintenance	N/A	5	22
168	Department of Utilities	Building 19	N/A	5	20
170	Department of Utilities	C.W.T.P.	N/A	5	22.1
171	Department of Utilities	Building 7	N/A	5	20.0
208	Department of Utilities	City College Reservoir	40	1	24.5
209	Department of Utilities	Sump No. 157	1	15	28.0
211	Department of Utilities	Sump No. 132	N/A	5	11.0
212	Department of Utilities	Alhambra Reservoir	4	25	21.2
213	Department of Utilities	Freeport Reservoir	N/A	5	14.7
215	Department of Utilities	Sump No. 21	1	15	14.3
216	Department of Utilities	Sump No. 137	N/A	5	5.8
217	Department of Utilities	Capital Gateway Reservoir	N/A	20	12.6
218	Department of Utilities	Sump No. 1	8	10	14.0
219	Department of Utilities	Sump No. 1-A	8	10	14.0

*N/A indicates that this facility is located outside the regions included in the flood inundation maps. However, the facility is still in the 100-yr flood zone.

**Critical elevations are defined as elevations at which critical equipment will fail when flooded. Some of these elevations were provided by City staff. Ground elevations from USGS maps where used in locations where this information was not readily available.

Careful consideration of the availability of the importance of facilities and the availability of substitute facilities guided the team in making the following recommendation:

It is recommended that the following facilities be considered for relocation:

- The EOC's of the City, Department of Utilities and the Department of Water Resources,
- the State of California Office of Emergency Services, and
- the Police and Fire Departments Communications Center.

The following key/critical public facilities are recommended for permanent flood proofing:

- Sump pumps for pumping flood water construct earthen levees around stations,
- bulk substations (flood proof by building concrete retaining walls around these facilities),
- the Sacramento River Water Treatment Plant (flood proof by constructing a levee around the plant), and
- Capitol Gateway Reservoir should be assessed for "wet" flood proofing. This would mean shutting it down and allowing it to flood due to excessive inundation (15 ft.) at that location.

It is also recommended that the following follow-on work be completed:

- Obtain a better resolution of the topography of the City of Sacramento and of the critical elevations of key/critical public facilities. Such information will provide an improved assessment of the depth of inundation, the impacts of flooding, and the actions and expenditures that are required to protect public safety and property. The current resolution of five feet is very coarse and can result in erroneous assessments of the true impacts of a flood event.

- Use improved data on the resolution of topography to conduct DAMBREAK analysis on the same assumed levee failure locations. This will provide better information pertaining to lead time and depth of inundation. The improved information will provide better data for cost estimates and decision-making purposes.

- Investigate the susceptibility of transportation corridors to damage by significant flood events. Preliminary investigations that were previously conducted for the City on the American River indicated that degradation of the river due to the presence of Folsom Dam presents a real danger to the integrity of bridges, levees and other structures in close proximity to the rivers surrounding the City of Sacramento. Degradation is a lowering of the river bed which can expose support structures such as bridge piers to the dangers of scour during flood events, and possible failure. Disruption of transportation corridors resulting from such failure can hinder both the response and recovery phases of a flood management operation, and disrupt the economy for a considerable period of time after the flood event.

- Investigate the routes of water and sewer mains, especially in areas where the rivers are crossed. The crossing of one of the water mains over the American River is located on an abandoned railway bridge that is susceptible to both river degradation and excessive scour during flood events. These river processes can lead to the failure of the bridge during excessive floods, and the associated rupturing of the water main. Other water mains may be located in the river bed and could be susceptible to damage by scour during flood events.

The estimated cost of relocation and permanent flood proofing are shown in the following table.

Summary of Flood Proofing / Relocation Costs

Facility Key	Agency	Facility Name	Cost to Flood Proof	Cost to Relocate
4	SMUD	Bulk Substation - Hurley #1-#3	$84,000	
5	SMUD	Bulk Substation - Mid City #1-#4	$84,000	
6	SMUD	Bulk Substation - North City #1-#4	$84,000	
7	SMUD	Bulk Substation - Pocket #1-#2	$84,000	
9	SMUD	Bulk Substation - Station B #1-#3	$161,000	
10	SMUD	Bulk Substation - Station D #1	$161,000	
95	Department of Utilities	Sump No. 55	$124,000	
96	Department of Utilities	Sump 119 (N28)	$124,000	
97	Department of Utilities	Sump 2 (N29)	$2,622,000	
116	S.R.C Sanitation District	Sac. Regional WWTP	$2,458,000	
118	State of California	OES Headquarters		$27,000,000
133	Department of Utilities	Sacramento River WTP	$1,639,000	
134	Department of Utilities	E.A. Fairbairn WTP	$2,183,000	
135	Department of Utilities	35th Avenue Plant Maintenance		$1,800,000
161	City of Sacramento	IBM Main Frame Data Center		$1,000,000
162	City of Sacramento	City Emergency Operations Center		$5,000
163	Police/Fire Department	Police/Fire Communications Center		Planned
168	Department of Utilities	Building 19		$1,000,000
170	Department of Utilities	C.W.T.P.	$841,000	
171	Department of Utilities	Building 7		$1,000,000
208	Department of Utilities	City College Reservoir	$124,000	
209	Department of Utilities	Sump No. 157	$987,000	
211	Department of Utilities	Sump No. 132	$124,000	
212	Department of Utilities	Alhambra Reservoir	$124,000	
213	Department of Utilities	Freeport Reservoir	$124,000	
215	Department of Utilities	Sump No. 21	$987,000	
216	Department of Utilities	Sump No. 137	$124,000	
217	Department of Utilities	Capital Gateway Reservoir	"Wet" Flood Proof	
218	Department of Utilities	Sump No. 1	$2,622,000	
219	Department of Utilities	Sump No. 1-A	Same as Sump No. 1	
238	Fire Department	Fire Dept. Administrative Services	Same as City EOC	
282	Dept. of Water Resources	DWR Emergency Operations Center		Planned

COMPREHENSIVE FLOOD MANAGEMENT PLAN

PROTECTION OF KEY PUBLIC FACILITIES

COMPREHENSIVE FLOOD MANAGEMENT PLAN

PROTECTION OF KEY PUBLIC FACILITIES

INTRODUCTION

The City of Sacramento's Department of Utilities is responsible for coordinating flood fighting activities in the event of a local flood emergency. Their efforts, along with the City Emergency Operation Center and the Department of Water Resources EOC will provide the necessary response to minimize the floods impact. The Department of Utilities and DWR have identified key facilities that would be utilized to conduct emergency operations. However, some of these facilities are located in flood prone areas of the City, which could render them inoperable in an actual flood emergency.

This study identifies key/critical public facilities whose ability to function could be affected by flooding. In addition this study provides a method for classifying the significance of these facilities to assist the City in prioritizing the improvements that may be needed to protect these facilities. The maximum depth of inundation and the shortest lead time to flooding were determined for the highest rank facilities. The accessibility and operability of these facilities were also evaluated. This allowed the study team to determine the impact on public safety, emergency response and recovery operations, and to assess the relocatibility and flood proofing potential of each facility. A rough estimate of the cost of relocation and/or flood proofing is provided for the higher ranking facilities.

HDR Engineering, Inc. acknowledges the assistance provided by the staff of the City of Sacramento's Department of Utilities, State Office of Emergency Services, Sacramento Fire Department, Department of Water Resources, Red Cross and SMUD. It would not have been possible to accomplish this task in the short time that was available without the assistance of the dedicated staff of these public agencies.

SCOPE OF WORK

The tasks that were required to execute the project are listed below. This report deals with tasks 1 to 3. Tasks 4 to 7 will be conducted later.

Task 1 - Compile map of critical key public facilities.

This is achieved by using information collected from different agencies to compile a map showing where the critical key public facilities are located.

Task 2 - Compare City inundation maps and COE's 100-year flood map to the map compiled in Task 1 to determine time and depth of flooding at critical facilities.

A. The original requirement to determine the depth of inundation of the key public facilities for 12, 24, 36 and 72 hours durations was changed during subsequent discussions with City engineers because adequate data is not readily available. It was decided to rather determine the minimum lead time and depth of ultimate flooding for key\critical public facilities where this information was readily available.

B. Determine if each key public facility would be accessible by road if flooding were to occur.

C. Determine if each key public facility would be operational if flooding were to occur.

D. If a key public facility is non-operational during a flood, determine its impact on public safety, emergency operations, or recovery operations.

E. Determine if each key public facility could be relocated in the event of an emergency.

F. Determine if each key public facility could be flood-proofed.

G. Determine the approximate cost comparisons for the most important key facilities identified in E and F as agreed with City staff.

H. Make recommendations

Task 3 - Prepare maps illustrating the following for each agency's key public facilities.

A. Illustrate the key public facilities that would flood versus those facilities which would not flood.

B. Illustrate the key public facilities that could be flood proofed versus those which would not be able to be flood proofed. (Include the total cost incurred by each agency to flood proof their facilities).

C. Illustrate the key public facilities that could be relocated versus those which could not be relocated. (Include the total cost incurred by each agency to relocate their facilities).

Task 4 - Meet with agencies (1 meeting per agency) to discuss flood proofing/relocating their key public facilities.

A. Meet with agency representative to discuss the maps compiled in Task 3.

B. Meet with agency representative to discuss recommendations on flood proofing and\or relocation. Determine who would plan and fund the flood proofing and\or relocation.

Task 5 - Attend public meetings regarding flood protection.

Meet with neighborhood groups and the public. Be prepared to discuss the study outcome. (Up to 3 meetings).

Task 6 - Attend City Council meetings regarding flood proofing of key public facilities.

Brief City Council on the study results and recommendations.

Task 7 - Attend SAFCA Board of Directors meeting regarding flood proofing of key public facilities.

Brief SAFCA Board of Directors on the study results and recommendations.

METHODOLOGY

The study proceeded according to the following steps:

- Data and information pertaining to public facilities were collected from the Department of Utilities, the City and the Department of Water Resources. Additional data on hospitals, radio and television stations, etc. were collected by making use of the Yellow Pages telephone directory.

- Addresses and other key information, such as critical elevations and ownership, of each of the public facilities were determined by contacting individuals at the respective agencies.

- The data was entered into a dBase IV database. Appendix B contains a complete listing of all the facilities in the database along with selected information fields.

- AutoCAD maps were obtained from the City and loaded into our computer system. The 100 year flood inundation map developed by the Corps of Engineers was digitized and overlayed onto these maps. The maps were linked to the database and the location of the public facilities were displayed on the AutoCAD maps.

- A significance ranking system was developed to prioritize the key/critical public facilities. The system classes ranged from Class 1 - greatest impact to Class 5 - no impact.

- The key/critical public facilities that were identified in the previous step were then highlighted on the AutoCAD map and the digitized flood inundation map to distinguish the facilities that are susceptible to flooding and those that are not.

- The study furthermore distinguished between key/critical public facilities that are required for response and those that are required for recovery. It was concluded that all of the facilities that are required for response are a subset of the facilities that are required for recovery, because all response facilities continue to operate during much of the recovery phase. Therefore, all Class 1 response facilities are also designated as Class 1 recovery facilities.

- The City provided flood inundation maps developed by Boyle Engineering that show the extent of inundation that would result from 13 potential levee failure scenarios. These are used to estimate the minimum lead time for response at most of the key/critical public facilities. These inundation maps have been digitized and reprinted in Appendix F of this report. The maximum depth of inundation for each flooded facility is determined by using the Corps of Engineers 100 year inundation map.

- Functionality is determined by accessibility, operability and the impacts on public safety, emergency response and recovery operations. Evaluation of the functionality of the key public facilities was used to identify candidate facilities for relocation and/or flood proofing.

- Key public facilities that were identified as candidates for relocation and/or flood proofing are determined by estimating costs and considering the relative importance of these facilities to both flood response and recovery operations.

- Recommendations pertaining to relocation and flood proofing are made, followed by recommendations related to activities that would improve the quality of the information developed during the course of this investigation for purposes of decision-making.

IDENTIFICATION OF KEY/CRITICAL PUBLIC FACILITIES

Definition of key/critical public facilities

The City of Sacramento defines a key/critical public facility as follows:

A critical/key public facility is a facility that is essential in providing:

- *utility or direction during the response to a flood emergency, or*
- *utility or direction during the recovery operation.*

Response Facilities

Facilities required for response differ from facilities required for recovery. Response facilities are defined as facilities that direct or support collection and interpretation of realtime flood related data, and direct and support the execution of flood response activities. Flood related data include information pertaining to the integrity of levees, prediction of near term rainfall, modeling of flood stage. Other, response activities include emergency levee maintenance during the course of a flood event, evacuation and rescue of residents, and relocation and temporary flood proofing of some facilities.

Recovery Facilities

Facilities used during recovery operations are defined as those required for the following:

- providing shelter, food and medical attention to flood victims,
- removing flood water after the flood event,
- providing essential resources such as clean water, and
- restoring and fixing damaged public facilities such as electric substations, etc.

Significance Classification

284 candidate key/critical public facilities were identified during the investigation (see Appendix B). In order to list the most important key/critical public facilities, as per the City definition, it is necessary to develop a significance ranking system that distinguishes the facilities relative importance in flood response and recovery operations. The classification system uses two criteria. The first identifies whether the facility is considered "essential" or not. "Essential" facilities are recognized as those facilities that are listed in the Department of Utilities Emergency Manual, the California Department of Water Resources Flood Emergency Operations Manual, or in the group of key facilities identified by the City's Department of Utilities. Facilities with available alternates (e.g. there are 23 fire stations in the city limits, many of which are not in the flood zone and can serve as alternates for those that are inundated) are given lower priority than those that have no alternates . The significance classification system that was used is shown in Table 1. Appendix B provides a complete list of the rankings that were given to each of the facilities.

Table 1. Significance Classification System

Class	Essential Facility	Comparable Alternates Available
1	yes	no
2	yes	yes
3	no	no
4	no	yes
5	Facility does not contribute to this phase of the flood emergency.	

Class 1 and 2 facilities correspond to the City's definition of key/critical public facilities and will be referred to as such. Each key public facilities serves in either a response or recovery role. Response facilities are a subset of recovery facilities, as all response facilities would continue to operate during the recovery phase.

LOCATION OF KEY/CRITICAL PUBLIC FACILITIES

The locations of all identified public facilities, as listed in Appendix B, are located on the map in Appendix C, with their corresponding facility numbers. The outline of the flood zone on this map makes it possible to distinguish between facilities that are inside and outside of the flood zone. The key/critical public facilities, that are of particular interest to the City, is a subset of the facilities shown on the map in Appendix C. These facilities, with their corresponding facility numbers, are shown on the map in Appendix D. It is possible to distinguish between the key public facilities that are inside and outside of the flood plain on this map. Figures 1 and 2 provides the same overview of key/critical public facilities that are inside and outside of the flood plain, but do not contain facility numbers.

Source: City of Sacramento GIS

AGENCY	COLOR
SMUD	
DEPARTMENT OF UTILITIES	
FIRE DEPARTMENT	
SACRAMENTO CITY	
POLICE DEPARTMENT	
S.R.C. SANITATION DISTRICT	
OTHER	

CLASS 1	XXX
CLASS 2	XXX

DENOTES FACILITY NUMBER

DENOTES FACILITY CLASIFICATION

CITY OF SACRAMENTO (NORTH AREA)
FACILITY LOCATIONS
CLASS 1 AND 2

HDR

Figure 1

Source: City of Sacramento GIS

N

SACRAMENTO RIVER

FRONTAGE RD

AGENCY	COLOR
SMUD	
DEPARTMENT OF UTILITIES	
FIRE DEPARTMENT	LAKE
SACRAMENTO CITY	
POLICE DEPARTMENT	
S.R.C. SANITATION DISTRICT	
OTHER	

CLASS 1	
CLASS 2	

DENOTES FACILITY NUMBER

DENOTES FACILITY CLASIFICATION

CITY OF SACRAMENTO (SOUTH AREA)
FACILITY LOCATIONS
CLASS 1 AND 2

HDR

Figure 2

TIME AND DEPTH OF FLOODING

Maximum Depth of Inundation

The maximum depths of inundation for the key public facilities within the City limits were determined by interpolating the depth information shown on the Corps of Engineer's 100 year flood map. The maximum depth of inundation for response and recovery facilities are shown in Tables 2 and 3. These depths are accurate to within 5 feet as this is the resolution of the Corps of Engineers' 100-year flood map. It is not possible to increase the accuracy beyond 5 feet because the Corps of Engineers map is derived from 7.5 minute USGS maps which also have a 5-foot contour resolution.

Minimum Lead Time

The minimum lead time that is available for response during a flood emergency is defined as the shortest time for flood water to reach a facility. These durations were determined from the study of 13 assumed levee failure scenarios that was conducted by Boyle Engineering (Appendix F) and are reported in Tables 2 and 3. Some facilities are located outside the regions included in the inundation maps, so it is not possible to determine an accurate time to inundation. These facilities have an "N/A" value for "Min. Lead Time" in Tables 2 and 3.

FUNCTIONALITY OF FACILITIES DURING FLOOD EVENTS

Accessibility During Flood Events

Criteria that can be used to determine accessibility for individuals into flooded areas is a function of flow velocity and depth of inundation. Knee-high flow depth (approximately 18 inches) combined with velocities in excess of 2 fps is usually considered dangerous. Water in excess of three feet is considered to be unsafe for access by regular vehicles. The information that is used in this study for determining accessibility during events is contained in the inundation maps that were generated by Boyle Engineering and the inundation maps showing the 100 year flood line that was developed by the Corps of Engineers. The resolution on these maps is 5 foot contour intervals, which is not fine enough to distinguish areas that are marginally accessible and those that are not. For purposes of this study it is therefore concluded that all key public facilities that are shown to be subject to flooding in Table 2 and Table 3 are also inaccessible. In addition to these, there are also other facilities that are considered to be inaccessible, although they may not be inundated. These facilities are located on islands within the flooded area, including Police Headquarters (813 6th Street), and SMUD Bulk Substation A #1-#4 (6th and H Street).

Operability and Impact on Public Safety, Emergency Response and Recovery Operations

The operability of all the key/critical public facilities that are listed in Tables 2 and 3 will be affected during extreme flood conditions, should they remain unprotected in their current locations. The relative impact on key/critical public facilities by the 13 assumed levee breaks that were analyzed in the Boyle report are shown in Figure 3, with the locations of the assumed levee breaks shown in Figure 4. Figure 3 contains a histogram that shows the number of affected facilities in each of the five classes that are defined in Table 1. It also contains a pie chart showing the distribution of all facilities that are affected by the Corps' 100 year flood inundation map by class. The histogram shows that the impact varies with the location of the assumed failure. Levee failures at locations 1, 2, 5, 6 and 8 individually impact the greatest number of key public facilities. The pie chart shows that approximately half of all facilities

in the City that will be affected by an extreme flood are classified as key public facilities (Classes 1 and 2).

The emergency response facilities that are listed in Table 2 essentially consist of emergency response command centers (OES Headquarters, City EOC, Police/Fire Communications Center and DWR EOC) and utilities to support the emergency response (SMUD bulk substations and sump 2 (N29)). Recovery facilities (Table 3) consists mainly of sump pumping stations, water treatment plants, wastewater treatment plants, water reservoirs and the maintenance facilities of the Department of Utilities. None of the facilities in Tables 2 and 3 are considered operable when inundated by 5 or more feet of water, including the command centers in high rise buildings. Although the current location of the DWR EOC is on the sixteenth floor of the Water Resources Building the five feet of inundation on the ground floor will hamper access, operability and general logistics of flood response.

The conclusion is that extreme flood conditions will hamper the operability of all the key/critical public facilities that are listed in Tables 2 and 3, with the associated impacts on public safety, and response and recovery operations.

The City's IBM mainframe computer is not directly linked to emergency response, but its importance in flood recovery requires that the City consider relocating it outside the flood zone.

Table 2. Summary of all Class 1 Response Facilities in the Flood Zone

Facility Key	Agency	Facility Name	Min. Lead Time* (hours)	Max. Depth (ft)	Critical Elev. (ft)**
4	SMUD	Bulk Substation - Hurley #1-#3	8	5	35
5	SMUD	Bulk Substation - Mid City #1-#4	N/A	5	20
6	SMUD	Bulk Substation - North City #1-#4	36	5	20
7	SMUD	Bulk Substation - Pocket #1-#2	N/A	5	15
9	SMUD	Bulk Substation - Station B #1-#3	8	10	15
10	SMUD	Bulk Substation - Station D #1	1	10	15
97	Department of Utilities	Sump 2 (N29)	8	6	19.0
118	State of California	OES Headquarters	N/A	5	14
161	City of Sacramento	IBM Main Frame Data Center	30	5	20
162	City of Sacramento	City Emergency Operations Center	30	5	20
163	Police/Fire Department	Police / Fire Communications center	4	8	25
238	Fire Department	Fire Dept. Administrative Services	30	5	20
282	Department of Water Resources	DWR Emergency Operations Center	1	5	20

*N/A indicates that this facility is located outside the regions included in the flood inundation maps. However, the facility is still in the 100-yr flood zone.

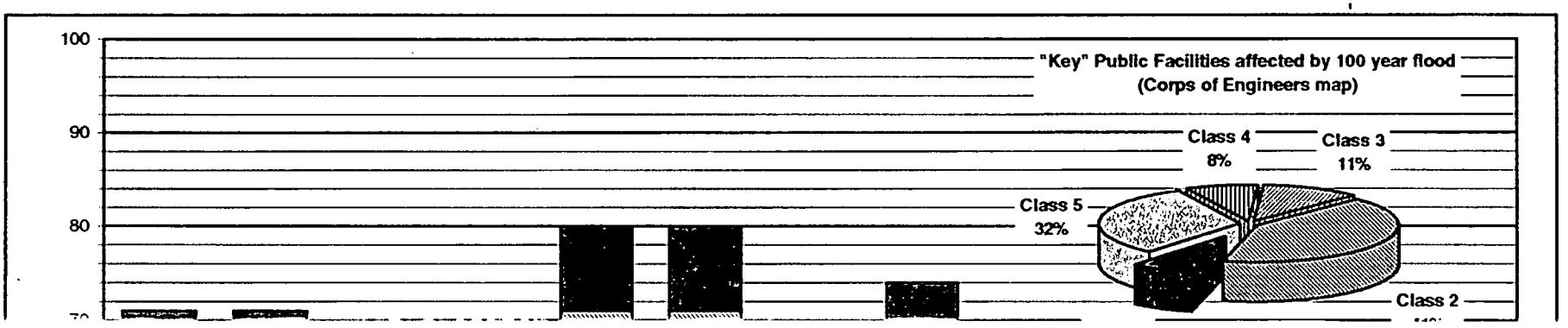
**Critical elevations are defined as elevations at which critical equipment will fail when flooded. Some of these elevations were provided by City staff. Ground elevations from USGS maps where used in locations where this information was not readily available.

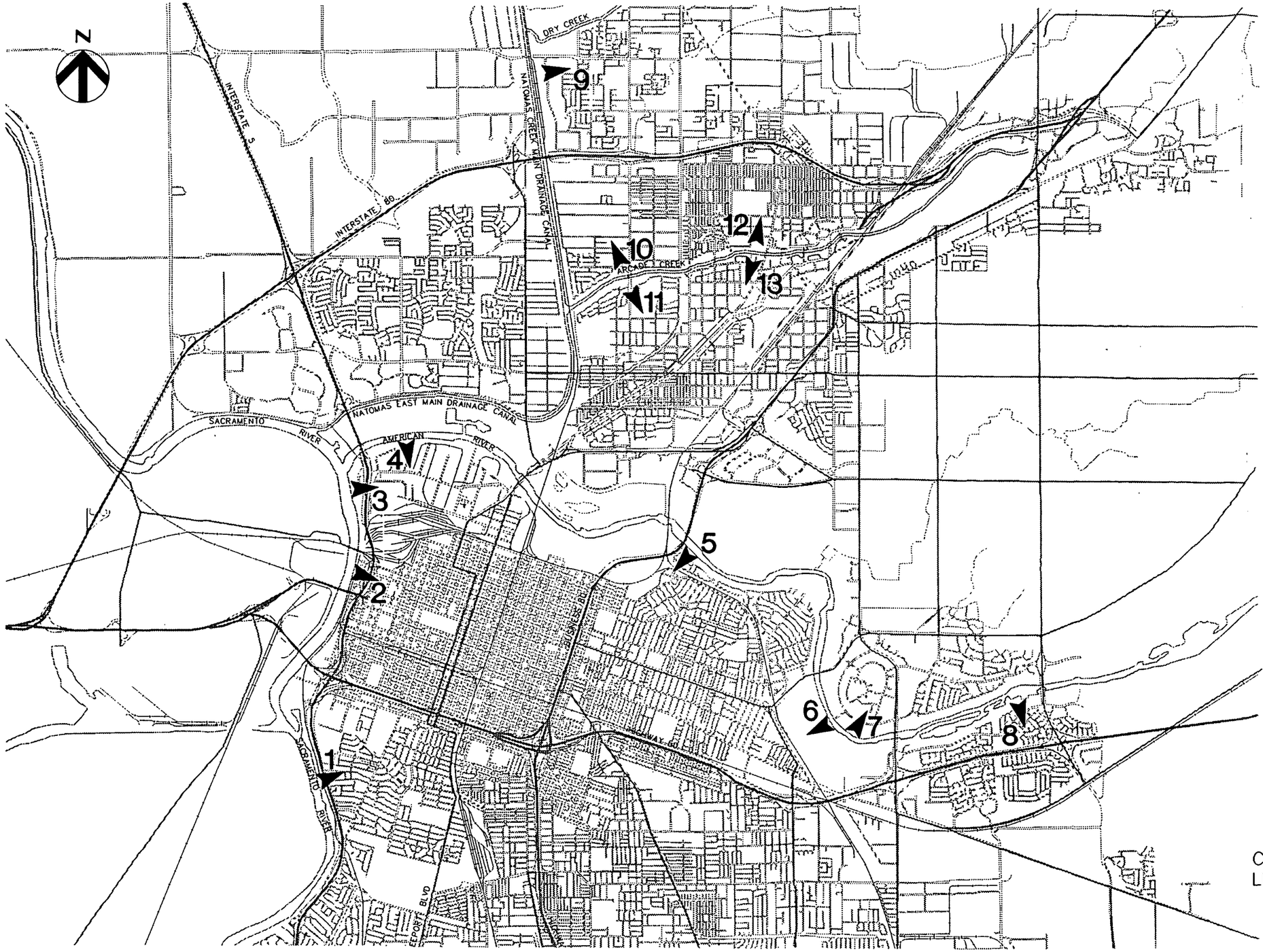
Table 3. Summary of all Class 1 Recovery Only Facilities in the Flood Zone

Facility Key	Agency	Facility Name	Min. Lead Time* (hours)	Max. Depth (ft)	Critical Elev. (ft)**
96	Department of Utilities	Sump 119 (N28)	N/A	5	11.0
116	S.R.C. Sanitation District	Sac Regional WWTP	N/A	5	15.8
133	Department of Utilities	Sacramento River WTP	4	8	20
134	Department of Utilities	E.A. Fairbairn WTP	2	10	30
135	Department of Utilities	35th Ave. Plant Maintenance	N/A	5	22
168	Department of Utilities	Building 19	N/A	5	20
170	Department of Utilities	C.W.T.P.	N/A	5	22.1
171	Department of Utilities	Building 7	N/A	5	20.0
208	Department of Utilities	City College Reservoir	40	1	24.5
209	Department of Utilities	Sump No. 157	1	15	28.0
211	Department of Utilities	Sump. No. 132	N/A	5	11.0
212	Department of Utilities	Alhambra Reservoir	4	25	21.2
213	Department of Utilities	Freeport Reservoir	N/A	5	14.7
215	Department of Utilities	Sump No. 21	1	15	14.3
216	Department of Utilities	Sump No. 137	N/A	5	5.8
217	Department of Utilities	Capital Gateway Reservoir	N/A	20	12.6
218	Department of Utilities	Sump No. 1	8	10	14.0
219	Department of Utilities	Sump No. 1-A	8	10	14.0

*N/A indicates that this facility is located outside the regions included in the flood inundation maps. However, the facility is still in the 100-yr flood zone.

**Critical elevations are defined as elevations at which critical equipment will fail when flooded. Some of these elevations were provided by City staff. Ground elevations from USGS maps where used in locations where this information was not readily available.


100
90
80
"Key" Public Facilities affected by 100 year flood
(Corps of Engineers map)
Class 4
8%
Class 3
11%
Class 5
32%
Class 2



LEGEND

1 STUDY AREA

▲ LEVEE BREAK LOCATION AND DIRECTION

CITY OF SACRAMENTO
LEVEE BREAK INDEX MAP

HDR

07440
07140.
8/16/9-
11-02
0-XX.DWG

Figure 4

SAFEGUARDING

Relocatibility of Facilities Per Agency

Relocating a facility to an area outside of the flood plain is the only absolute method for protecting it against flood. Given sufficient advance warning, some facilities may be able to relocate when there's an imminent flooding danger. However, temporary relocation in an emergency requires that all necessary equipment, information, and staff be readily transportable and that acceptable alternate locations be readily available. If any of these requirements cannot be met, then the facility may need to be relocated permanently outside the flood zone. Permanent relocation is often initially more costly but it means that the facility can be fully functional in an emergency, regardless of whether advanced warning is available or not.

The permanent relocatibility of facilities is a function of relative importance, availability of alternate facilities outside of the flood zone and cost of relocation. The recommendations in this report (Table 4) are based on perceptions of relative importance and availability of alternate facilities. Estimated costs of relocation are provided to aid decision-making by the City.

Key/critical public facilities that have no alternates but are critical to flood response include:

- Emergency Operating Centers (EOC's) of the City, Department of Utilities and the Department of Water Resources,
- Office of Emergency Services (State of California), and
- The Police and Fire Departments' Communications Center.

The importance of these facilities for directing the response to a flood emergency require them to be accessible and outside of the flood zone. It is therefore recommended that these facilities be permanently relocated to higher ground.

The Fire Department Communications Center is already slated for relocation to a dry area near Mather Air Force Base, and should be moved by next year. The Police Department communications will not be moved for another 5 to 6 years under current plans. The City EOC is easily relocatable, requiring only that communications be readily available. This could be ensured anywhere with a large bank of cellular phones.

It is further recommended that the City consider relocating the IBM mainframe that is currently on the ground floor. Although this facility is not directly responsible for flood response, its importance in facilitating recovery should not be underestimated. Loss of the mainframe use for an extended period affect revenue with associated implications to fund recovery.

Flood Proofing of Facilities Per Agency

Flood proofing can be employed either on a permanent basis or in time of emergency only. Temporary flood proofing measures generally consist of constructing levees around facilities using sandbags or other material. The effectiveness of temporary flood proofing measures is dependent on sufficient warning time and availability of material, labor, and equipment necessary to construct a secure levee. Permanent flood proofing would eliminate the amount of effort and warning time necessary at the time of the emergency, however it is usually a costlier alternative and can be unaesthetic. Permanent flood proofing methods include raising structures above predicted flood levels, constructing permanent earthen levees, constructing flood walls, or sealing exterior surfaces of buildings below predicted flood levels ("dry flood proofing"). Permanent levees or flood walls require storm drains or sump pumps located within the protected area to remove normal storm water buildup. Also, if openings are left in flood walls or levees for normal building access, those openings need to be sealed in an emergency. This again requires sufficient flood warning time, however, the amount of time is reduced because of the smaller area to be filled. A final alternative is to allow a facility to be inundated, however, taking measures to minimize damage by flood water ("wet flood proofing"). This method would only be employed if a facility was deemed non-essential and could not be dry flood proofed due to excessive water depth.

Flood proofing measures are only effective as long as flood water levels do not overtop the levees, flood walls, etc. If this should occur, then it is possible that measures designed to reduce flood damage could actually increase damage by not allowing flood waters within the building to recede after the flood. Also, flood proofing measures are not recommended for facilities that require staffing during a flood event. Flood proofing in such cases hamper logistics and reduces efficiency. However, sites that provide basic utilities to emergency facilities, such as electric substations, are good candidates for flood proofing alternatives.

The candidate key/critical public facilities that should be considered for flood proofing are summarized from Table 2 and Table 3 under the following categories:

- sump pump stations
- bulk substations
- unit substations
- water treatment plants
- wastewater treatment plants
- reservoirs

These facilities by their nature cannot be relocated because their locations within their respective systems is critical. They must, therefore, be flood proofed. Table 4 shows the facilities that need flood proofing per agency.

Sump pumps are required during the recovery operation to remove water from flooded areas and can be flood proofed by building levees around them. Department of Utilities has considered alternatives involving raising equipment above flood levels and found these options to be cost prohibitive. The sumps that are recommended for flood proofing are those subject to flooding that are listed in Tables 2 or 3.

Although it is usually possible to bypass unit substations, the same is not true of bulk substations. Bulk substations should therefore be flood proofed, preferably by permanent means. The proposed protection measures entail construction of flood walls around the

facilities or raising the facilities. SMUD has indicated that access to these facilities is needed at all times. The bulk substations that are shown to be subjected to flooding in Table 2 are the stations that are proposed for flood proofing.

The immediate needs for clean water by the City after the flood event can be supplied by one water treatment plant, and it is recommended that the Sacramento River Water Treatment Plant be selected for this purpose. This treatment plant is subject to less inundation than the Fairbairn treatment plant and it is therefore more feasible to economically flood protect this facility. It is proposed that the facility be protected by constructing a levee around the plant.

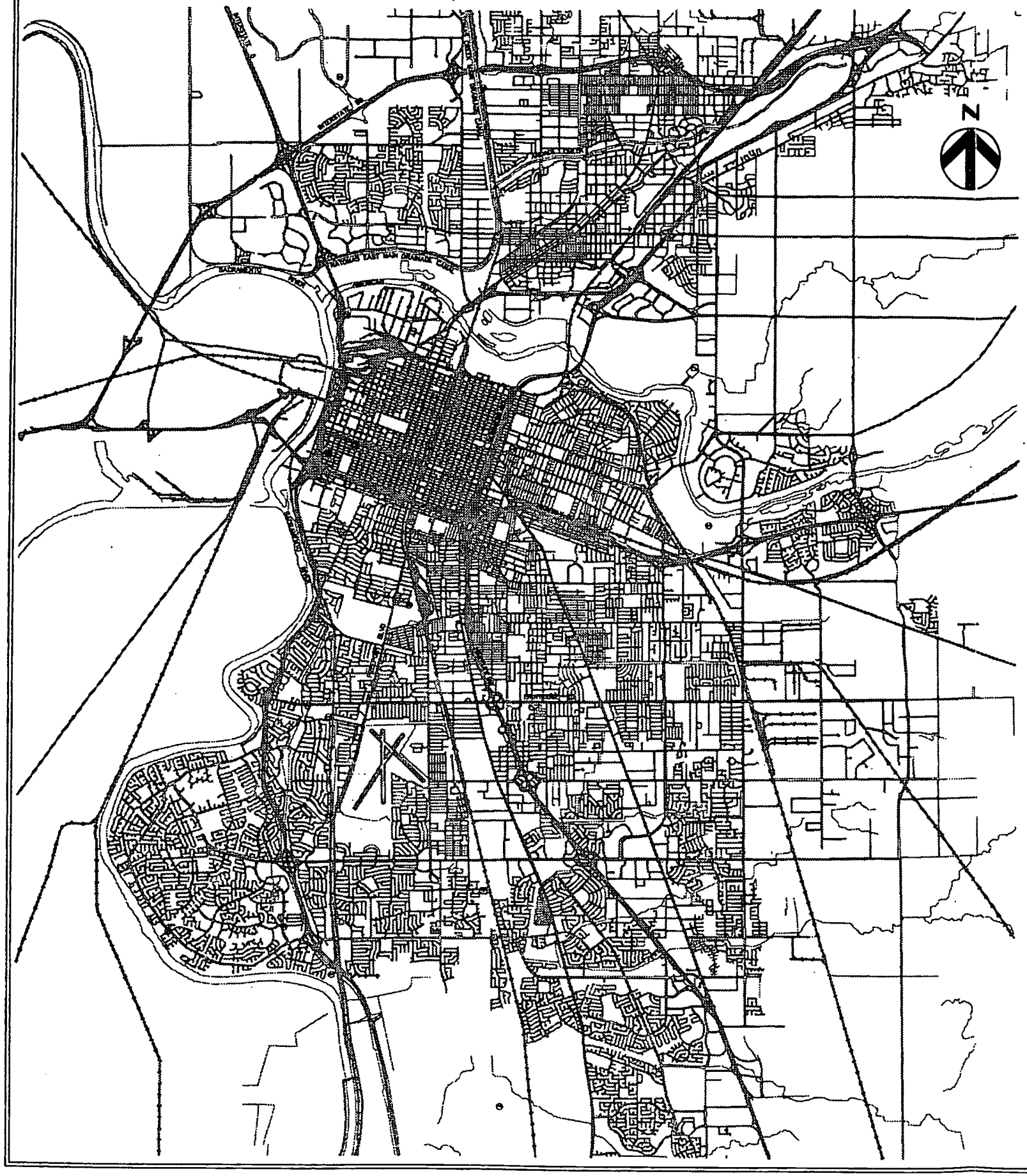
Cost of Flood Proofing and/or Relocation

Table 4 provides a summary of costs associated with flood proofing or relocation of affected facilities. These costs are a preliminary estimate based on fundamental flood proofing methods. The amount of detail included in the estimates is dictated by the information that is readily available without making in-depth studies on a site-by-site basis. Such detailed analysis is very time consuming and beyond the scope of this study. More accurate estimates should be prepared for purposes of construction. Relocations costs are based on information supplied by each agency. These facilities are also indicated on the maps in Figure 5 and Figure 6. For a more detailed breakdown of these costs, refer to Appendix E.

Table 4. Summary of Flood Proofing / Relocation Costs

Facility Key	Agency	Facility Name	Cost to Flood Proof	Cost to Relocate
4	SMUD	Bulk Substation - Hurley #1-#3	$84,000	
5	SMUD	Bulk Substation - Mid City #1-#4	$84,000	
6	SMUD	Bulk Substation - North City #1-#4	$84,000	
7	SMUD	Bulk Substation - Pocket #1-#2	$84,000	
9	SMUD	Bulk Substation - Station B #1-#3	$161,000	
10	SMUD	Bulk Substation - Station D #1	$161,000	
95	Department of Utilities	Sump No. 55	$124,000	
96	Department of Utilities	Sump 119 (N28)	$124,000	
97	Department of Utilities	Sump 2 (N29)	$2,622,000	
116	S.R.C Sanitation District	Sac. Regional WWTP	$2,458,000	
118	State of California	OES Headquarters		$27,000,000
133	Department of Utilities	Sacramento River WTP	$1,639,000	
134	Department of Utilities	E.A. Fairbairn WTP	$2,183,000	
135	Department of Utilities	35th Avenue Plant Maintenance		$1,800,000
161	City of Sacramento	IBM Main Frame Data Center		$1,000,000
162	City of Sacramento	City Emergency Operations Center		$5,000
163	Police/Fire Department	Police/Fire Communications Center		Planned
168	Department of Utilities	Building 19		$1,000,000
170	Department of Utilities	C.W.T.P.	$841,000	
171	Department of Utilities	Building 7		$1,000,000
208	Department of Utilities	City College Reservoir	$124,000	
209	Department of Utilities	Sump No. 157	$987,000	
211	Department of Utilities	Sump No. 132	$124,000	
212	Department of Utilities	Alhambra Reservoir	$124,000	
213	Department of Utilities	Freeport Reservoir	$124,000	
215	Department of Utilities	Sump No. 21	$987,000	
216	Department of Utilities	Sump No. 137	$124,000	
217	Department of Utilities	Capital Gateway Reservoir	"Wet" Flood Proof	
218	Department of Utilities	Sump No. 1	$2,622,000	
219	Department of Utilities	Sump No. 1-A	Same as Sump No. 1	
238	Fire Department	Fire Dept. Administrative Services	Same as City EOC	
282	Dept. of Water Resources	DWR Emergency Operations Center		Planned

Source: City of Sacramento GIS



AGENCY	COLOR
SMUD	
DEPARTMENT OF UTILITIES	
FIRE DEPARTMENT	
SACRAMENTO CITY	
POLICE DEPARTMENT	
S.R.C. SANITATION DISTRICT	
OTHER	

CLASS 1	
CLASS 2	

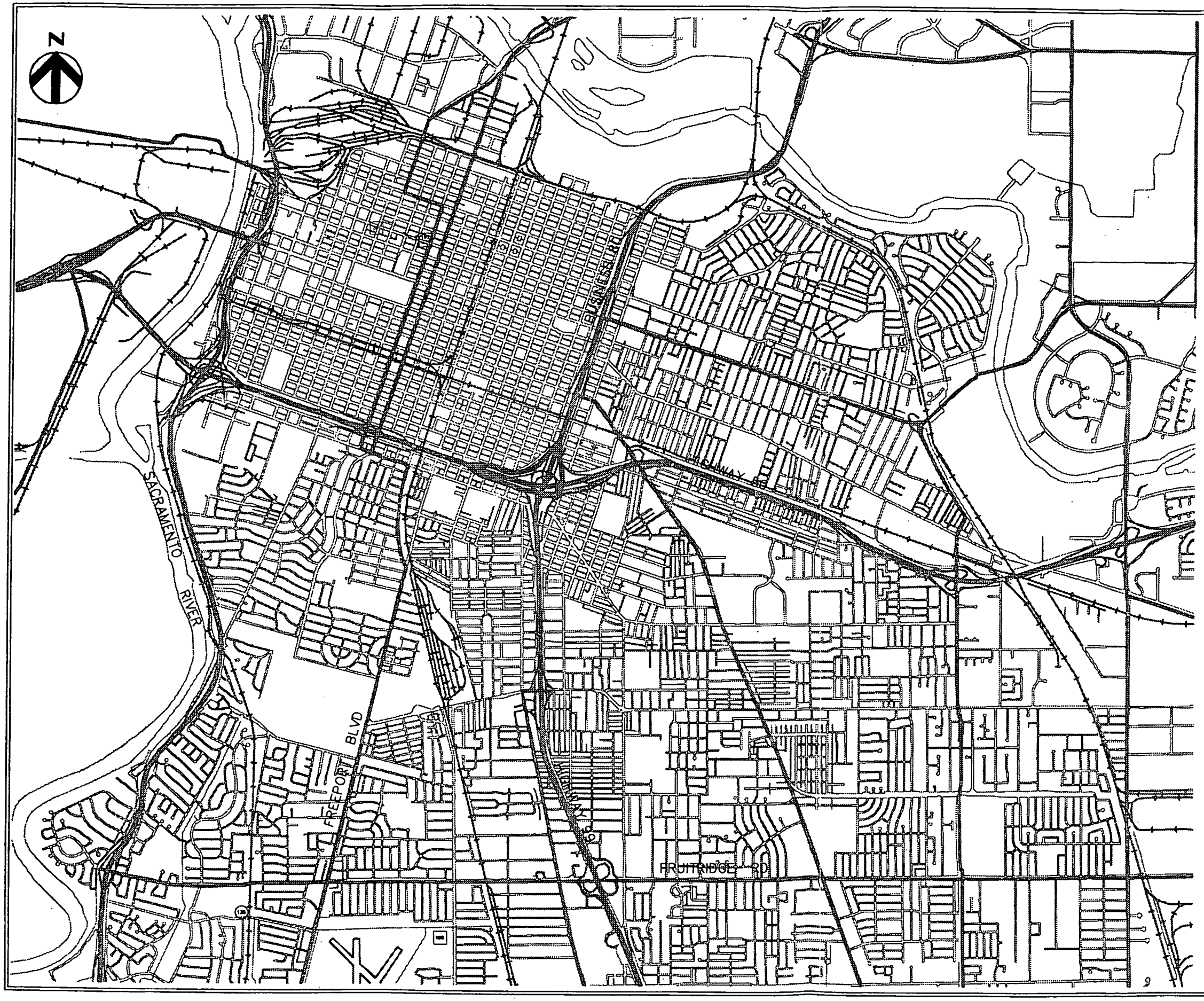
DENOTES FACILITY NUMBER

DENOTES FACILITY CLASIFICATION

CITY OF SACRAMENTO
"KEY" FACILITIES RECOMMENDED
FOR FLOOD PROOFING MEASURES

HDR

Figure 5



Source City of Sacramento GIS

AGENCY	COLOR
SMUD	
DEPARTMENT OF UTILITIES	
FIRE DEPARTMENT	
SACRAMENTO CITY	
POLICE DEPARTMENT	
S.R.C. SANITATION DISTRICT	
OTHER	

CLASS 1	
CLASS 2	

DENOTES FACILITY NUMBER

DENOTES FACILITY CLASIFICATION

CITY OF SACRAMENTO
"KEY" FACILITIES RECOMMENDED
FOR RELOCATION

HDR

Figure 6

RECOMMENDATION

It is recommended that the following facilities be considered for relocation:

- The EOC's of the City, Department of Utilities and the Department of Water Resources,
- the State of California Office of Emergency Services, and
- the Police and Fire Departments Communications Center.

The following key/critical public facilities are recommended for permanent flood proofing:

- Sump pumps for pumping flood water construct earthen levees around stations,
- bulk substations (flood proof by building concrete retaining walls around these facilities),
- the Sacramento River Water Treatment Plant (flood proof by constructing a levee around the plant), and
- Capitol Gateway Reservoir should be assessed for "wet" flood proofing. This would mean shutting it down and allowing it to flood due to excessive inundation (15 ft.) at that location.

It is also recommended that the following follow-on work be completed:

- Obtain a better resolution of the topography of the City of Sacramento and of the critical elevations of key/critical public facilities. Such information will provide an improved assessment of the depth of inundation, the impacts of flooding, and the actions and expenditures that are required to protect public safety and property. The current resolution of five feet is very coarse and can result in erroneous assessments of the true impacts of a flood event.

- Use improved data on the resolution of topography to conduct DAMBREAK analysis on the same assumed levee failure locations. This will provide better information pertaining to lead time and depth of inundation. The improved information will provide better data for cost estimates and decision-making purposes.

- Investigate the susceptibility of transportation corridors to damage by significant flood events. Preliminary investigations that were previously conducted for the City on the American River indicated that degradation of the river due to the presence of Folsom Dam presents a real danger to the integrity of bridges, levees and other structures in close proximity to the rivers surrounding the City of Sacramento. Degradation is a lowering of the river bed which can expose support structures such as bridge piers to the dangers of scour during flood events, and possible failure. Disruption of transportation corridors resulting from such failure can hinder both the response and recovery phases of a flood management operation, and disrupt the economy for a considerable period of time after the flood event.

- Investigate the routes of water and sewer mains, especially in areas where the rivers are crossed. The crossing of one of the water mains over the American River is located on an abandoned railway bridge that is susceptible to both river degradation and excessive scour during flood events. These river processes can lead to the failure of the bridge during excessive floods, and the associated rupturing of the water main. Other water mains may be located in the river bed and could be susceptible to damage by scour during flood events.

APPENDIX A - REFERENCES

APPENDIX A

REFERENCES

1. City of Sacramento, Levee Failure and Inundation Investigation, Boyle Engineering Corporation, Jan. '90

2. Emergency Manual (draft), City of Sacramento, Department of Utilities, '94

3. Flood Emergency Operations Manual, California Department of Water Resources, Dec. '89

4. Flood Proofing - How to Evaluate Your Options, US Army Corps of Engineers, Jul. '93

APPENDIX B - PUBLIC FACILITIES LISTING

APPENDIX B

PUBLIC FACILITIES TABLE

The public facilities table is a complete listing of all the facilities included in the study database. The following are some of the database information sources:

A. Sacramento Energy Emergency Plan Critical Facilities List

B. Time - Inundation Study Pocket Area, Critical Facilities, Boyle Engineering, March 1989

C. Sacramento Pacific Bell Yellow Pages

D. Direct telephone contacts

Also included in the database, is all of the information compiled by the Department of Utilities from their "facility flood emergency information survey. The survey included data from many of the more significant agency involved, including SMUD, PG&E, Sacramento County, U.C. Davis Medical Center, and Sacramento Regional County Sanitation District.

Field Descriptions:

Facility Key	Database number used to uniquely identifiy each facility
Agency Key	Number used to associate each facility with its governing agency
Facility Name	Unique for each facility
Initial Disaster Sign	Significance Classification Number (1 = highest, 5 = lowest) for facility's response during the initial flood disaster phase
Recovery Response Sign	Significance Classification Number (1 = highest, 5 = lowest) for facility's response during the initial flood disaster phase
Address	Facility address or location description
Elev.	Ground elevation at facility locations in the flood zone, interpolated from USGS 7.5 minute topographical maps
In 100 Yr. Zone	Value (1) indicates that facility is in the 100 yr. flood zone, (blank) indicates that it is outside the flood zone.

Agency Key numbers indicated in this appendix correspond to the following table of agencies included in the database:

Table B-1. Agency Key

Agency Key	Agency Name
1	SMUD
2	PG&E
3	Sacramento County
4	U.C. Davis Medical Center
5	S.R.C. Sanitation District
6	Department of Water Resources
7	Pacific Bell
8	State OES
9	Caltrans
10	City of Sacramento Public Works
11	SAFCA
12	Corps of Engineers
13	Sacramento Police Department
14	Highway Patrol
15	Department of Utilities
16	Hospitals
17	Radio Stations
18	Television Stations
19	Sacramento City Fire Department
20	School Districts
21	City of Sacramento
22	Other
23	Red Cross

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
1	1	SMUD Energy Management Center	1	1	6001 "S" St.		
2	1	Bulk Substation - East City #1 - #2	1	1	6190 Folsom Blvd.	30	
3	1	Bulk Substation - Hedge #1 #4	1	1	S. side of Elder Creek Road, 1/2 mi. E. of Hedge Ave.		
4	1	Bulk Substation - Hurley #1 #3	1	1	Enter S. side of Hurley Way, 1320 ft, W. of Howe Ave.	35	1
5	1	Bulk Substation - Mid City #1-#4	1	1	N.W. corner 35th and R St.		1
6	1	Bulk Substation - North City #1-#4	1	1	N. on 20th St. off C St., cross last tracks, turn left & follow tracks	20	1
7	1	Bulk Substation - Pocket #1 #2	1	1	E. end of Gardendale Ave., W. of Western Pacific railroad tracks		1
8	1	Bulk Substation - Station A #1-#4	1	1	Northeast corner of 6th and H St.	25	1
9	1	Bulk Substation - Station B #1-#3	1	1	East side of 19th St. between N and O St.	15	1
10	1	Bulk Substation - Station D #1	1	1	Southwest corner of 8th and R St.	15	1
11	1	Substation - 2nd Ave.-41st St. #1	2	2	211 ft. N. of 2nd Ave.; E. side of 1st and 2nd Ave. alley	25	1
12	1	Substation - 6th-Broadway #1	2	2	W. of 6th St. at X St.- Broadway alley	15	1
13	1	Substation - 14th Ave.-52nd St. #1-#2	2	2	Southeast corner of 14th Ave. & 52nd St.		
14	1	Substation - 20th Ave.- Freeport #1	2	2	S. Side of 20th Ave.; 155 ft. E. of Freeport Blvd.	20	1
15	1	Substation - 24th-Gardendale #1	2	2	E. side of 24th St.' 192 ft. N. of Gardendale Ave.		1
16	1	Substation - 37th-R #1-#2	2	2	N. of Southern Pacific tracks; S.E. end off 37th		
17	1	Substation - 38th-J St. #1-#2	2	2	E. side of 38th St.; 150 ft. N. of J St.		
18	1	Substation - 39th-8th Ave. #1	2	2	E. side of 39th St.; between 8th and 9th Ave.		1
19	1	Substation - 43rd Ave.- So Land Park #1	2	2	130 ft. N. of 43rd Ave.; Entrance 320 ft. W. of South Land Park Dr.		1
20	1	Substation - 49th-Folsom #1 #2	2	2	Alley between 49th & 51st St.; 400 ft. S. of Folsom Blvd.		
21	1	Substation - 59th-Folsom #1	2	2	N.E. corner of SMUD Pole Yard, 59th St. and R St.		
22	1	Substation - 88th-Fruitridge #1	2	2	Entrance .5 mile S of Fruitridge; 675 ft. S.W. 88th St.		
23	1	Substation - Alamos #1	2	2	Alley E. of Clay St.; 190 ft. S. of Alamos Ave.		1
24	1	Substation - Amador-Power Inn #1	2	2	S. Side of Amador Rd.; 75 ft. West of Power Inn Road		1
25	1	Substation - Arden-Point West #1	2	2	S. side Arden Way, E. I-80, Red Lion Lot. Enter off Response Rd		1
26	1	Substation - Azusa-Thelma #1	2	2	End of Azusa St.; N. of Garden Hwy; 2288 ft. W. of Thelma Ave.		1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
27	1	Substation - Bell-Winters #1-#3	2	2	S.W. corner of Bell Ave. and Winters St.		
28	1	Substation - C St.-40th St. #1	2	2	N. side of C St.; at the end of 40th St.	25	1
29	1	Substation - CSUS #1-#3	2	2	Between Jordan Way and SPRR tracks. Enter S. of Jordan	35	1
30	1	Substation - Campus Commons #1-#2	2	2	280 ft. N. of Scripps Dr.; 1100 ft. E. of University Ave.	35	1
31	1	Substation - Cargo-Northgate #1-#2	2	2	End of Cargo Court, E. of Northgate Blvd., N. of I-880		1
32	1	Substation - Sac. #1-#2, E.A. Fairbairn W.T.P.	2	2	N. side of College Town Dr., 850 ft. E. of Jed Smith Dr.	35	1
33	1	Substation - Dixieanne-Evergreen #1	2	2	S. side of Dixieanne Ave., 117 ft. W. of Evergreen St.	40	1
34	1	Substation - Donner-32nd #1-#2	2	2	S. side of Donner Way, btwn. 32nd & 33rd St.		
35	1	Substation - E-F & 21st #1	2	2	S. side of E-F Alley, 160 ft. W. of 21st St.	20	1
36	1	Substation - E-F & 30th #1	2	2	S. side of E-F Alley, 200 ft. E. of 30th St.	20	1
37	1	Substation - El Monte #1-#2	2	2	El Monte / Del Paso Blvd., 175 ft. NE of Gibson St.	33	1
38	1	Substation - Evergreen-Royal Oaks #1	2	2	N. side of Evergreen St. 430 ft. E. of Royal Oaks Dr.	25	1
39	1	Substation - Franklin-Ehrhardt #1	2	2	W. side of Franklin Blvd., 500 ft. S. of Laguna Blvd.		
40	1	Substation - Freehaven-Lake Park #1-#2	2	2	E. side / end of Freehaven Dr., S. of Lake Park Dr.		1
41	1	Substation - Frienza-Albatross #1-#2	2	2	S. side of Frienza Ave., 229 ft. E. of Albatross Way		
42	1	Substation - Front-T St. #1-#3	2	2	NE corner of Front St. and "T" St.	15	1
43	1	Substation - Fruitridge-28th St.	2	2	S. side of Fruitridge Rd., 149 ft. E. of 28th St.		1
44	1	Substation - Fruitridge-64th #1	2	2	N. side of Fruitridge Rd., 173 ft. E. of 64th St.		1
45	1	Substation - Fruitridge So Land Park #1	2	2	350 ft. S. of Seamas Ave., 300 ft. W. of South Land Park Dr.		1
46	1	Substation - Gloria-Florin #1	2	2	S. side of Gloria Dr., 400 ft. W of Florin Rd.		
47	1	Substation - Grand Pinell #1	2	2	S. side of Grand Ave., 100 ft. E of Pinell St.		
48	1	Substation - Greenhaven-South Land Park	2	2	SW corner of I-5 / South Land Park Dr. overpass		
49	1	Substation - H-I & 53rd #1-#2	2	2	S. side of Hidden Lane, 334 ft. W. of 53rd St.		1
50	1	Substation - Havenside-Canal #1-#2	2	2	N. side of Havenside Dr., one block W. of Santa Teresa Way		1
51	1	Substation - Hot & Cold Plant #1	2	2	N. side of "Q" St.. 90 ft. E. of 6th St.	15	1
52	1	Substation - I-J-20th #1-#2	2	2	N. side of I & J Alley, 100 ft. E. of 20th St.	22	1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
53	1	Substation - J-K-30th #1-#2	2	2	W. side of 30th St., J-K alley @ 30th St.	23	1
54	1	Substation - Jamestown-Middleberry #1	2	2	S. side Jamestown Dr., 196 ft. W. of Middleberry Rd.		1
55	1	Substation - Kathleen-Academy #1	2	2	N. side of Kathleen Ave., 130 ft. E. of Academy Way	48	1
56	1	Substation - Lake Forrest-Bennington #1	2	2	S. side of Lake Forest Dr., 100 ft. E. of Bennington Way	40	1
57	1	Substation - Los Robles-Marysville #1	2	2	N. side of Los Robles Blvd., 167 ft. W. of Marysville Blvd.	42	1
58	1	Substation - Mack-Tangerine #1	2	2	N. side of Mack Rd., 1050 ft. E. of Tangerine Ave.		
59	1	Substation - Meadowview-Freeport #1-#2	2	2	N. side Meadowview Rd., 185 ft. W. of Freeport Blvd.		1
60	1	Substation - Meadowview-Mack #1	2	2	E. side of WPRR Tracks, 300 ft. N. of Meadowview Rd.		
61	1	Substation - North B-16th #1-#2	2	2	N. side of North B St., 200 ft. E. of North 16th St.	26	1
62	1	Substation - North Market-Sports #1	2	2	625 ft. N of Stadium Blvd./Arco Park Drive.		1
63	1	Substation - PG&E Gasholder #1	2	2	Edgewater Rd. and Lampasas Ave. Transformer on N.W. corner	23	1
64	1	Substation - P-Q-30th St. #1	2	2	W. side of 30th St., P-Q alley @ 30th St.	25	1
65	1	Substation - Parkway #1	2	2	N. side of A parkway, E. of Center Parkway		
66	1	Substation - Pinedale-Rio LInda #1	2	2	S. side of Pinedale Ave., 700 feet W. of Rio Linda Blvd.	40	1
67	1	Substation - Power Inn-Elder Creek #1	2	2	W. side Power Inn Road, 577 ft. S. Elder Creek Rd.		
68	1	Substation - Proctor-Gamble Plant #1	2	2	N.E. corner of Proctor and Gamble property. Enter thru gate "C"		1
69	1	Substation - Q-19th #1	2	2	S.W. corner of Q and 19th St.	18	1
70	1	Substation - Royale-Yorkshire #1	2	2	E. side Royale Rd., 100 ft. S. of Yorkshire Rd.		1
71	1	Substation - Sacto City College #1-#2	2	2	Next to concrete H20 tank. N.W. corner of Hughes stadium	23	1
72	1	Substation - Sacramento Sump Pumps #1	2	2	W. side of Riverside Blvd., S. of 11th Ave.	13	1
73	1	Substation - Safeway (Transco) #1	2	2	W. side of Florin Perkins Rd., 600 ft. S. of Belvedere Ave.		
74	1	Substation - Southland Park 35th #1	2	2	located on S.W. corner of So Land Park Dr.&35th		1
75	1	Substation - Stockton-Sheldon #1	2	2	W. side of Hiway 99, 850 ft. N. of Sheldon Rd.		
76	1	Substation - Stockton-Wyndham #1	2	2	W. side of Hiway 99, 450 ft. N. of Wyndham Way		
77	1	Substation - Tenya-Northgate #1	2	2	N. side of Tenya Ave., 240 ft. E. of Northgate Blvd.		1
78	1	Substation - Truxel #1-#2	2	2	W. side of Truxel Rd., 1/2 mile South of Jan Juan Rd.		1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr. Zone
79	1	Substation - West El Camino & I-5 #1	2	2	S. side W. El Camino Ave., 60 ft. W. of Grasslands Dr.,		1
80	1	Substation - X-16th #1	2	2	N.W. corner of X St. & 16th St.	15	1
81	1	Substation - X-24th #1-#2	2	2	N.W. corner of X St. and 24th St.	18	1
82	2	Substation - Brighton	2	2	8180 Folsom Blvd.	40	1
83	2	Sacramento Gas Load Center	3	3	2000 Front St.	25	1
84	2	Sacramento Service Center	3	3	5555 Florin - Perkins Rd.		
85	2	N. Sac. Underground Gas Holder	3	3	Edgewater / Lampass	18	1
86	2	Gas Regulator Station	3	3	21st Ave. / Martin Luther King Blvd.		
87	3	Main Jail	5	3	651 "I" St.	25	1
88	3	County Administration Bldg.	5	3	700 "H" St.	25	1
89	3	Sheriffs Bldg.	3	3	711 "G" St.	25	1
90	3	Coroner's Bldg.	5	5	4400 "V" St.		
91	3	County Mental Health	5	5	2150 Stockton Blvd.		
92	3	County Courthouse	5	3	8th and "H" St.	25	1
93	3	Public Works Building	3	3	827 7th St.	25	1
94	4	UCD Medical Center	4	4	2315 Stockton Blvd., Sacramento, Ca, 95817		
95	15	Sump 55 (N27)	2	1	E/side of Gloria Dr. btwn 43rd and Fenwood Ct. (317-A5)	8.4	1
96	15	Sump 119 (N28)	2	1	S.W. corner of S. Land Park Dr. & Semas Ave. Near CWTP (217-B4)	11	1
97	15	Sump 2 (N29)	1	1	Blk bounded by 10th, 11th Ave, I-5, & Riverside Blvd (317-B1)	19	1
98	15	C.W.T.P. (N30)	3	3	S.E. corner of S. Land Park Dr. and Fruitridge Rd. (317-B4)	22.1	1
99	15	Pioneer Reservoir (N31)	3	3	N. of I-80 @ Sac. Ri. near intx of V. St. & Front St. (297-A5)	25	1
100	5	Sump 76 (N35)	3	3	N/side of Eleanor Ave. @ Beaumont St. [805 Eleanor]	33	1
101	5	Sump 82 (N36)	3	3	N. of W Pac RR tracks W/side on Commerce Circle (297-F1)	25	1
102	5	A.R. Drive Sewage Pumping Station (S06)	3	3	A.R. Dr. & Munroe Drwy next to [2583 Am. Ri.] (298-D5)	35	1
103	5	Parkway Chlorine Station (S10)	5	5	~125'W. of Franklin Blvd. on the S/side of Doss Way. (337-G2)		1
104	5	San No, 2 Sewage Pumping Station (S23)	3	3	E/side of Elvas Frwy @ N. levee of A.R. Dr. (297-J1)		1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
105	5	Center Parkway Sewage Pumping Station (S25)	3	3	E/side of Cntr Parkway, 3/4 mi E/side of Ehrhardt Rd. (338-A6)		
106	5	Northgate No. 5 Sewage Pumping Sation (S26)	3	3	[2747 Dorine Wy] (277-D6)		1
107	5	River Gardens Sewage Pumping Station (S28)	3	3	In Drwy next to [940 El Camino] (277-E6)		1
108	5	Natomas Sewage Pumping Station (S30)	3	3	NE cor. of intx of San Juan Rd. & Airport Rd. (277-A4)		1
109	5	Woodgate #1 Sewage Pumping Station (S46)	3	3	Intx of Camarillo & Sotano btwn [775 & 765 Sotano] (277-E5)		1
110	5	Del Rio Sewage Pumping Station (S49)	3	3	NE cor of Florin & Woodbine 200' N of Florin on Wood (337-E1)		1
111	5	College Town Sewage Pumping Station (S79)	3	3	S of Frwy W of Hornet Rd. Access through park. lot (318-C1)	40	1
112	5	Rivergate Sewage Pumping Station (S84)	3	3	W/side of Nedel Wy in NE corner of Northgate Pk. (277-D5)		1
113	5	36th Ave and Power Inn Rd. Chlorination Sta. (S86)	5	5	On 36th Ave. off Power Inn Rd., N/side of cul-de-sac (318-D5)		
114	5	Fruitridge Indstrl Sewage Pump Station (S98)	3	3	EW portion of 88th St. S of Fruitridge Rd. (318-G5)		
115	5	Elder Creek Sewage Pumping Station (S99)	3	3	On Elder Ck. Rd. apprx. 200' E of Florin-Perkins Rd. (318-F6)		
116	5	Sac. Regional WWTP	2	1	8521 Laguna Station Rd., Elk Grove, Ca, 95758		1
117	8	OES Disaster Assistance Branches	3	3	7100 Bowling Dr.		1
118	8	OES Headquarters	1	1	2800 Meadowview Rd.		1
119	21	Department of Finance / OMWSB	5	3	5730 - 24th Street, BLDG 4A	40	1
120	21	Corporate Center South, Building 4	5	3	5730 - 24th Street, BLDG 4		1
121	21	City Hall - Finance / Accounting	5	3	915 "I" Street, RM 12, 14	25	1
122	21	City Hall - Finance Administration	5	3	915 "I" Street, RM 100	25	1
123	21	Traffic Signals & Street Lighting	5	3	Corporation Center South		1
124	21	Fleet Management Division	3	3	5730 - 24th St., Bldg. 3		1
125	13	Kinney Police Facility	1	1	3550 Marysville Blvd.	40	
126	13	Rooney Police Facility	1	1	5303 Franklin Blvd.		
127	13	Rooney Police Maintenance Facility	2	1	Rooney Police Substation		
128	13	Police Headquarters	1	1	813 6th Street	25	
129	13	Police Property Room	5	5	555 Sequoia Pacific Blvd.	20	1
130	14	Calif. Highway Patrol (North Area)	3	3	5109 Tyler		

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
131	14	Calif. Highway Patrol (South Area)	3	3	6 Massie Court		
132	14	Calif. Highway Patrol (Headquarters)	3	3	2555 & 1st Ave.	21	1
133	15	Sacramento River WTP	2	1	101 Bercut Drive	25	1
134	15	E.A. Fairbain WTP	2	1	7501 College Town Drive		1
135	15	35th Avenue Plant Mainenance	2	1	1391 - 35th Avenue		1
136	16	Greater Sacramento Surgery Center	5	4	2288 Auburn Bl		
137	16	Mercy General Hospital	4	4	4001 J. St.	25	1
138	16	Methodist Hospital of Sacramento	4	4		26	1
139	16	Sutter General Hospital	4	4	2801 L St.	22	1
140	4	U. C. Davis Medical Center	4	4	2315 Stockton Blvd.		
141	16	Woodland Memorial Hospital	4	4	1325 Cottonwood, Woodland		
142	17	KCTC - AM 1320	4	4	2225 19th St.	20	1
143	17	KEBR	4	4	3108 Fulton Ave.		
144	17	KFBK - AM 1530	4	4	1440 Ethan Way		1
145	17	KGBY	4	4	1440 Ethan Way		1
146	17	KHYL - FM 101	4	4	2435 Marconi Ave.		
147	17	KJAY	4	4	1430 South River Rd.		
148	17	KSEG - FM 96.9	4	4	620 Bercut Dr.	25	1
149	17	KSMJ - AM 1380	4	4	1750 Howe Ave.	45	1
150	17	KWOD - FM 106.5	4	4	1425 River Park Dr.		1
151	17	KXPR - FM 90.9	4	4	3416 American River Dr.	36	1
152	17	KYMX - FM 96	4	4	2225 19th St.	20	1
153	18	KCMY TV 29	4	4	1029 K St.	25	1
154	18	KCRA TV Channel 3	4	4	3 Television Circle	22	1
155	18	KCSO TV Channel 19, Spanish Network Channel	4	4	1420 River Park Dr.		1
156	18	KOVR TV Channel 13	4	4	2713 KOVR Dr. WS		

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
157	18	KRBK TV 31	4	4	500 Media Place		1
158	18	KTXL FOX 40	4	4	4655 Fruitridge Rd.		
159	18	KVIE-TV Channel 6	4	4	Not available		1
160	18	KXTV 10	4	4	400 Broadway	17	1
161	21	IBM Main Frame Data Center	1	1	904 11th St.	20	1
162	21	Planning & Development Dept.	1	1	1231 "I" St.		1
163	19	Police / Fire Communications center	1	1	111 Bercut Drive	25	1
164	21	28th St. Corporation Yard	2	2	28th & "A" St.		
165	21	28th St. Corporation Yard, 40'	2	2	28th & "A" St.		
166	21	28th St. Corporation Fuel Island	2	2	28th Street		
167	21	28th St. Corporation Maintenance	2	2	28th & "A" St.		
168	15	Building 19	1	1	5730 - 24th St. Corp. Yard	20	1
169	15	Robla North Area Operations Center	1	1	Rio LInda & Bell, N.W.C.	30	
170	15	C.W.T.P.	2	1	1391 - 35th Avenue	22.1	1
171	15	Building 7	1	1	5730- 24th Street, Corp Yard	20	1
172	21	Information / Communication	3	3	819 10th Street (Parking Lot B)		1
173	19	Fire Shop Fleet Maintenance	5	3	5730 - 24th St., Bldg. 6		
174	21	Kinney Garage	5	5	3550 Marysville Blvd.		
175	21	Fleet Maintenance Main Shop	5	3	Corporation Yard South		1
176	21	Street Division	5	3	5730 - 24th St., Bldg. 9		1
177	21	Building 1 Corporate Center South	5	3	5730 - 24th St.		1
178	21	Building 11 Corporate Center South	5	3	5730 - 24th St.		1
179	21	Building 13 Corporate Center South	5	3	5730 - 24th St.		1
180	21	Building 17 Corporate Center South	5	3	5730 - 24th St.		1
181	19	City Fire Station #1	2	2	624 "Q" St.	20	1
182	19	City Fire Station #2	2	2	1229 "I" St.	22	1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
183	19	City Fire Station #3	2	2	7208 W. Elkhorn Blvd.		
184	19	City Fire Station #4	2	2	3145 Granada Way	23.5	1
185	19	City Fire Station #5	2	2	8th St. and Broadway	15	1
186	19	City Fire Station #6	2	2	3301 Martin Luther King Blvd.		1
187	19	City Fire Station #7	2	2	6500 Windham Way	20	1
188	19	City Fire Station #8	2	2	5990 "H" St.	35	1
189	19	City Fire Station #9	2	2	5801 Florin Perkins Rd.		
190	19	City Fire Station #10	2	2	5642 - 66th St.		1
191	19	City Fire Station #11	2	2	785 Florin Rd.		1
192	19	City Fire Station #12	2	2	4500 - 24th St.	22	1
193	19	City Fire Station #13	2	2	1100 - 43rd Ave.		1
194	19	City Fire Station #14	2	2	1341 North "C" St.	25.5	1
195	19	City Fire Station #15	2	2	1591 Newborough Rd.		1
196	19	City Fire Station #16	2	2	7363 - 24th St.		1
197	19	City Fire Station #17	2	2	1311 Bell Ave.	40	1
198	19	City Fire Station #18	2	2	746 No. Market St.		1
199	19	City Fire Station #19	2	2	1700 Challenge Way		1
200	19	City Fire Station #20	2	2	300 Arden Way	25	1
201	19	City Fire Station #21	2	2	3301 Julliard Drive		1
202	19	City Fire Station #22	2	2	3720 - 47th Ave.		1
203	19	City Fire Station #23	2	2	7927 East Parkway		
204	21	City Hall Finance / Revenue	5	3	915 "I" St., Room 105	25	1
205	21	Management / Administration	5	3	915 "I" St., Room 105	25	1
206	21	Utility Billing System (UCIS)	5	3	915 "I" St., Room 105	25	1
207	21	Cashiering System / Revenue Division	5	3	915 "I" St., Room 104	25	1
208	15	City College Reservoir	2	1	11th Ave. & 23rd St.	24.5	1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
209	15	Sump No. 157	2	1	North End of Western Ave.	28	1
210	15	Med Center Reservoir	2	1	45th St. at "V" St.	32	
211	15	Sump. No. 132	2	1	7552 Pocket Rd.	11	1
212	15	Alhambra Reservoir	2	1	3230 "J" St.	21.2	1
213	15	Freeport Reservoir	2	1	7788 Freeport Blvd.	14.7	1
214	15	Florin Reservoir	2	1	6880 Power Inn Rd.	36.8	
215	15	Sump No. 21	2	1	6693 - 14th St.	14.3	1
216	15	Sump No. 137	2	1	Greenhaven Dr. & Alder Tree	5.8	1
217	15	Capital Gateway Reservoir	2	1	4600 Arco Arena Blvd.	12.6	1
218	15	Sump No. 1	2	1	2nd & "U" ST.	14	1
219	15	Sump No. 1-A	2	1	2nd & "U" ST.	14	1
220	21	Plaza Building	5	3	921 - 10th St., Suite 700	25	1
221	21	Management Offices	5	3	915 "I" St., Rm 100	25	1
222	21	Plaza Building - Solid Waste Division	5	3	921 - 10th St., Suite 500	25	1
223	21	Solid Waste Division / Annex Safety	5	3	28th St. & "A" St.		
224	21	Construction Section	3	3	640 Bercut Drive	25	1
225	21	Transportation Division	3	3	1023 "J" St. - Second Floor	25	1
226	21	28th St. Waste Removal	3	3	28th & "A" St.		
227	19	Fire Reserves Headqrtrs., Station 25	2	2	1910 Arica Way	20	1
228	21	City Attorney's Office	5	3	921 10th St., Suite 700	25	1
229	21	Sacramento Convention Center	5	5	1100 - 14th St.	20	1
230	21	City Clerk's Office	5	3	915 "I" St., #304	25	1
231	21	City of Sac. Landfill & Bailer Facility	5	5	20 - 28th St.	25	1
232	21	Parking Garages	5	5	City Wide (See Map)		1
233	21	Animal Care and Control Center	5	5	2127 Front St.		
234	21	Engineering Building	3	3	927 - 10th St.	20	1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
235	21	Division of Training	5	5	3230 "J" St.	24	1
236	21	Parking Ticket System	5	5	915 "I" St., Rooms 104 & 105	25	1
237	21	Department of Neighborhood Services	5	5	1231 "I" St., Suite 400	20	1
238	19	Fire Dept. Administrative Services	1	1	1231 "I" St.	20	1
239	21	Office of Human Services	5	3	6005 Folsom Blvd.	25	1
240	21	Coloma Community College	5	4	4623 "J" St.		
241	21	North Market Office	5	5	601 North Market Blvd., Suite 350		1
242	21	Bell Cooledge Community College	5	4	5699 South Land Park Drive		1
243	21	Central Library	5	4	828 "J" St.		
244	20	Rio Terra Junior High School	5	4	3201 Northstead Drive		1
245	20	Strauch Elementary School	5	4	3141 Norhtstead Drive		1
246	20	Aletha B. Smythe School	5	4	2781 Northgate Blvd.		1
247	20	Natomas Middle School	5	4	3700 Del Paso Road		1
248	20	American Lakes Elementary School	5	4	2800 Stonecreek Drive		1
249	20	Jefferson School	5	4	2635 Chestnut Hill Drive	37	1
250	20	Garden Valley Elementary School	5	4	3601 Northgate Blvd.		1
251	22	Children's World	5	5	2500 Natomas Park Drive		1
252	22	Merryhill Country School	5	5	1593 Waterwheel Drive		1
253	22	Merryhill Country School	5	5	2401 Northview Drive		1
254	22	Discovery Place	5	5	501 San Juan Road		1
255	22	Peace Lutheran Preshool	5	5	925 San Juan Road		1
256	22	Kids On Campus	5	5	2800 Stonecreek Drive		1
257	22	Kids On Campus	5	5	2001 Pebblewood		
258	22	Natomas Guest Home	5	5	421 San Juan Road		1
259	22	Mary's Family Home	5	5	1217 Garaventa Way		1
260	22	Friendship Home	5	5	794 Turnstone Dr.		1

Facility Key	Agency Key	Facility Name	Response Class	Recovery Class	Address	Elev.	In 100Yr Zone
261	22	Northgate Residential Care Home	5	5	735 Pelican Way		1
262	22	Stanford Settlement	5	5	450 W. El Camino Ave.		1
263	20	California Junior High School	5	4		14	1
264	20	McClatchy High School	5	4		15	1
265	20	William Land School	5	4		15	1
266	20	Cathredral School	5	4		15	1
267	20	Lincoln School	5	4		16.5	1
268	20	Holy Angels School	5	4		15	1
269	20	Washington School	5	4		17	1
270	20	Fremont School	5	4		21	1
271	20	Trinity School	5	4		21	1
272	20	Sutter Jr. High School	5	4		23	1
273	20	Sacred Heart School	5	4			
274	20	Judah School	5	4		22	1
275	20	Sacramento State College	5	4		25	1
276	20	Jefferson School	5	4			
277	20	Bancroft School	5	4		40	1
278	20	Kit Carson Jr. High School	5	4			1
279	20	Sierra Oaks School	5	4		42	1
280	20	Greenwood School	5	4		30	1
281	22	YMCA	5	4		20	1
282	6	Department of Water Resources	1	1	1416 9th St.	20	1
283	11	SAFCA	3	3			1
284	23	Red Cross	4	2	8928 Volunteer Lane		1

APPENDIX C - LOCATIONS OF PUBLIC FACILITIES

APPENDIX D - LOCATION OF KEY/CRITICAL PUBLIC FACILITIES

APPENDIX E - FLOOD PROOFING COST ESTIMATE DETAILS

APPENDIX E

FLOODPROOFING COST ESTIMATE DETAILS

The following cost estimates provide preliminary construction costs for flood proofing various key facilities in the flood zone. Estimates were compiled using earthen levees and concrete floodwalls only. There are numerous methods for floodproofing structures, however for purposes of this study, the two methods used correspond with the level of detail readily available. Lengths of levees and floodwalls were estimated from maps of the area.

Date Prepared: 8/15/94

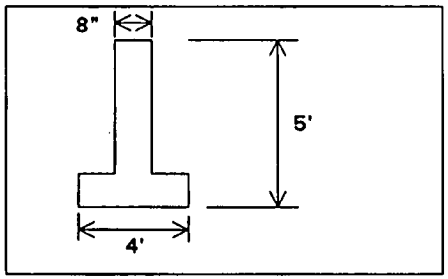
FACILITY No. / NAME
4 SMUD Bulk Substation
5 SMUD Bulk Substation
6 SMUD Bulk Substation
7 SMUD Bulk Substation

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
5' x 30' x 30' Flood Wall (8" Concrete)

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Wall	600 SF	$5.50	$3,300.00	0.300	180.00	$23.70	$4,266.00			$7,566.00
Excavation & Backfill	8 HR	$129.50	$1,036.00	1.000	8.00	$70.66	$565.28			$1,601.28
Drainage & Pumps			$5,000.00				$5,000.00			$10,000.00
Access			$10,000.00				$10,000.00			$20,000.00
Utility Relocations			$5,000.00				$5,000.00			$10,000.00
SUBTOTAL, Direct Costs			$24,336.00				$24,831.28		$0.00	
Burden						35%	$8,690.95	35%	$0.00	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$0.00	
Material Sales Tax		7%	$1,703.52							
SUBTOTAL, (Sub-Contractor + Material)			$26,039.52				$33,522.23		$0.00	$59,561.75
General Contractor OH&P		15%	$3,905.93			15%	$5,028.33	5%	$0.00	
Contingency		25%	$6,509.88			25%	$8,380.56			
TOTAL			$36,455.33				$46,931.12		$0.00	$84,000.00



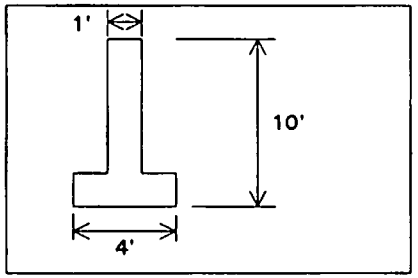
Date Prepared: 8/15/94

FACILITY No. / NAME
9 SMUD Bulk Substation
10 SMUD Bulk Substation

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
10' x 30' x 30' Flood Wall (8" Concrete)

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Wall	1200 SF	$5.55	$6,660.00	0.300	360.00	$23.70	$8,532.00			$15,192.00
Excavation & Backfill	16 HR	$129.50	$2,072.00	1.000	16.00	$70.66	$1,130.56			$3,202.56
Drainage & Pumps			$9,000.00				$10,000.00			$19,000.00
Access			$18,000.00				$20,000.00			$38,000.00
Utility Relocations			$9,000.00				$10,000.00			$19,000.00
										
SUBTOTAL, Direct Costs			$44,732.00				$49,662.56		$0.00	
Burden						35%	$17,381.90	35%	$0.00	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$0.00	
Material Sales Tax		7%	$3,131.24							
SUBTOTAL, (Sub-Contractor + Material)			$47,863.24				$67,044.46		$0.00	$114,907.70
General Contractor OH&P		15%	$7,179.49			15%	$10,056.67	5%	$0.00	
Contingency		25%	$11,965.81			25%	$16,761.11			
TOTAL			$67,008.54				$93,862.24		$0.00	$161,000.00

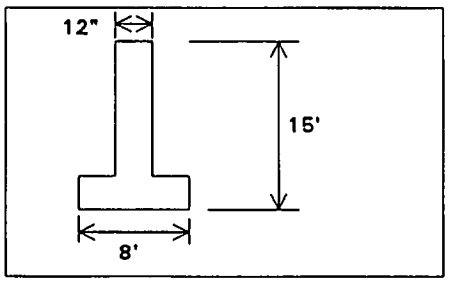
Date Prepared: 8/15/94

FACILITY No. / NAME
209 Sump No. 157
215 Sump No. 21

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
15' x125' x 125' Flood Wall (12" Concrete)

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Wall	7500 SF	$5.55	$41,625.00	0.300	2250.00	$23.70	$53,325.00			$94,950.00
Excavation & Backfill	100 HR	$129.50	$12,950.00	1.000	100.00	$70.66	$7,066.00			$20,016.00
Drainage & Pumps			$55,000.00				$61,000.00			$116,000.00
Access			$110,000.00				$122,000.00			$232,000.00
Utility Relocations			$55,000.00				$61,000.00			$116,000.00
										
SUBTOTAL, Direct Costs			$274,575.00				$304,391.00		$0.00	
Burden						35%	$106,536.85	35%	$0.00	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$0.00	
Material Sales Tax		7%	$19,220.25							
SUBTOTAL, (Sub-Contractor + Material)			$293,795.25				$410,927.85		$0.00	$704,723.10
General Contractor OH&P		15%	$44,069.29			15%	$61,639.18	5%	$0.00	
Contingency		25%	$73,448.81			25%	$102,731.96			
TOTAL			$411,313.35				$575,298.99		$0.00	$987,000.00

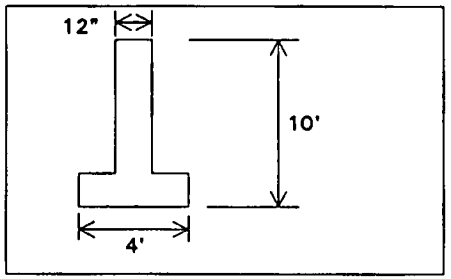
Date Prepared: 8/15/94

FACILITY No. / NAME
97 Sump 2
218 Sump 1
219 Sump 1A

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
10' x500' x 500' Flood Wall (12" Concrete)

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Wall	20000 SF	$5.55	$111,000.00	0.300	6000.00	$23.70	$142,200.00			$253,200.00
Excavation & Backfill	267 HR	$129.50	$34,533.33	1.000	266.67	$70.66	$18,842.67			$53,376.00
Drainage & Pumps			$146,000.00				$162,000.00			$308,000.00
Access			$292,000.00				$324,000.00			$616,000.00
Utility Relocations			$146,000.00				$162,000.00			$308,000.00
										
SUBTOTAL, Direct Costs			$729,533.33				$809,042.67		$0.00	
Burden						35%	$283,164.93	35%	$0.00	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$0.00	
Material Sales Tax		7%	$51,067.33							
SUBTOTAL, (Sub-Contractor + Material)			$780,600.67				$1,092,207.60		$0.00	$1,872,808.27
General Contractor OH&P		15%	$117,090.10			15%	$163,831.14	5%	$0.00	
Contingency		25%	$195,150.17			25%	$273,051.90			
TOTAL			$1,092,840.93				$1,529,090.64		$0.00	$2,622,000.00

Date Prepared: 8/15/94

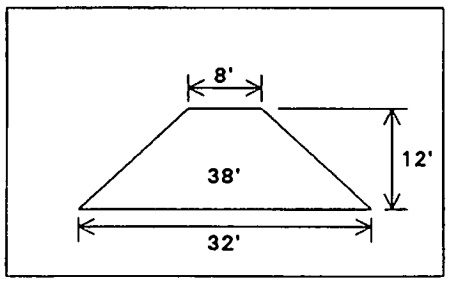
FACILITY No. / NAME
134 E. A. Fairbairn WTP

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
4000' Flood Levee
1:1 Slope Side Walls,32' Base, 8' Top, 12' Height

35600.00

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Levee	35600 CY	$1.25	$44,500.00	0.067	2385.20	$65.79	$156,922.31			$201,422.31
Paving	1446 TON	$30.00	$43,387.50	0.470	679.74			$35.91	$24,409.37	$67,796.87
Drainage & Pumps			$88,000.00				$157,000.00			$245,000.00
Access			$176,000.00				$314,000.00			$490,000.00
Utility Relocations			$88,000.00				$157,000.00			$245,000.00
										
SUBTOTAL, Direct Costs			$439,887.50				$784,922.31		$24,409.37	
Burden						35%	$274,722.81	35%	$8,543.28	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$4,942.90	
Material Sales Tax		7%	$30,792.13							
SUBTOTAL, (Sub-Contractor + Material)			$470,679.63				$1,059,645.12		$37,895.55	$1,568,220.29
General Contractor OH&P		15%	$70,601.94			15%	$158,946.77	5%	$1,894.78	
Contingency		25%	$117,669.91			25%	$264,911.28			
TOTAL			$658,951.48				$1,483,503.16		$39,790.33	$2,183,000.00

Date Prepared: 8/15/94

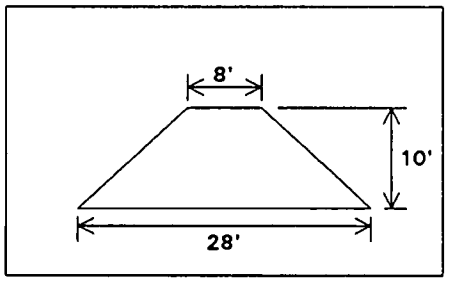
FACILITY No. / NAME
116 SRCWWTP

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
6000' Flood Levee
1:1 Slope Side Walls, 28' Base, 8' Top, 10' Height

40000.00

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Levee	40000 CY	$1.25	$50,000.00	0.067	2680.00	$65.79	$176,317.20			$226,317.20
Paving	1625 TON	$30.00	$48,750.00	0.470	763.75			$35.91	$27,426.26	$76,176.26
Drainage & Pumps			$99,000.00				$177,000.00			$276,000.00
Access			$198,000.00				$354,000.00			$552,000.00
Utility Relocations			$99,000.00				$177,000.00			$276,000.00
										
SUBTOTAL, Direct Costs			$494,750.00				$884,317.20		$27,426.26	
Burden						35%	$309,511.02	35%	$9,599.19	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$5,553.82	
Material Sales Tax		7%	$34,632.50							
SUBTOTAL, (Sub-Contractor + Material)			$529,382.50				$1,193,828.22		$42,579.27	$1,765,789.99
General Contractor OH&P		15%	$79,407.38			15%	$179,074.23	5%	$2,128.96	
Contingency		25%	$132,345.63			25%	$298,457.06			
TOTAL			$741,135.50				$1,671,359.51		$44,708.24	$2,458,000.00

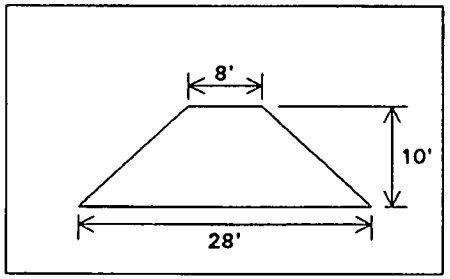
Date Prepared: 8/15/94

FACILITY No. / NAME
133 Sacramento River WTP

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
4000' Flood Levee
1:1 Slope Side Walls, 28' Base, 8' Top, 10' Height

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Levee	26666 CY	$1.25	$33,332.50	0.067	1786.62	$65.79	$117,541.86			$150,874.36
Paving	1083 TON	$30.00	$32,499.19	0.470	509.15			$35.91	$18,283.72	$50,782.91
Drainage & Pumps			$66,000.00				$118,000.00			$184,000.00
Access			$132,000.00				$236,000.00			$368,000.00
Utility Relocations			$66,000.00				$118,000.00			$184,000.00
										
SUBTOTAL, Direct Costs			$329,831.69				$589,541.86		$18,283.72	
Burden						35%	$206,339.65	35%	$6,399.30	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$3,702.45	
Material Sales Tax		7%	$23,088.22							
SUBTOTAL, (Sub-Contractor + Material)			$352,919.91				$795,881.51		$28,385.47	$1,177,186.89
General Contractor OH&P		15%	$52,937.99			15%	$119,382.23	5%	$1,419.27	
Contingency		25%	$88,229.98			25%	$198,970.38			
TOTAL			$494,087.87				$1,114,234.12		$29,804.75	$1,639,000.00

Date Prepared: 8/15/94

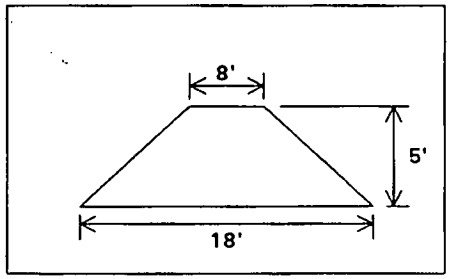
FACILITY No. / NAME
95 Sump No. 55
96 Sump 119
208 City College Reservoir
211 Sump 132
212 Alhambra Reservoir
213 Freeport Reservoir
216 Sump 137

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
800' Flood Levee
1:1 Slope Side Walls, 18' Base, 8' Top, 5' Height

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Levee	1950 CY	$1.25	$2,437.50	0.067	130.65	$65.79	$8,595.46			$11,032.96
Paving	79 TON	$30.00	$2,376.56	0.470	37.23			$35.91	$1,337.03	$3,713.59
Drainage & Pumps			$5,000.00				$9,000.00			$14,000.00
Access			$10,000.00				$18,000.00			$28,000.00
Utility Relocations			$5,000.00				$9,000.00			$14,000.00
SUBTOTAL, Direct Costs			$24,814.06				$44,595.46		$1,337.03	
Burden						35%	$15,608.41	35%	$467.96	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$270.75	
Material Sales Tax		7%	$1,736.98							
SUBTOTAL, (Sub-Contractor + Material)			$26,551.05				$60,203.88		$2,075.74	$88,830.66
General Contractor OH&P		15%	$3,982.66			15%	$9,030.58	5%	$103.79	
Contingency		25%	$6,637.76			25%	$15,050.97			
TOTAL			$37,171.47				$84,285.43		$2,179.53	$124,000.00



Date Prepared: 8/15/94

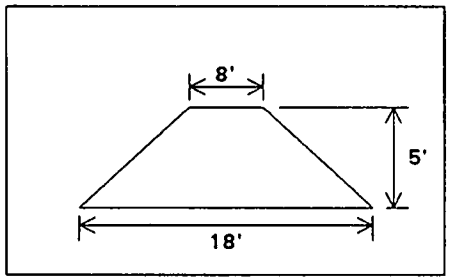
FACILITY No. / NAME
170 CWTP

PROJECT:
Protection of Key
Public Facilities

DESCRIPTION:
4000' Flood Levee
1:1 Slope Side Walls, 18' Base, 8' Top, 5' Height

HDR Engineering, Inc.

Spec. Section / Description	Qnty.	Materials		Labor/Equip.		General Contract		Sub-Contract		Total
		Unit Price	Amount	Unit M.H.	Total M.H.	Rate	Amount	Rate	Amount	
Flood Levee	9750 CY	$1.25	$12,187.50	0.067	653.25	$65.79	$42,977.32			$55,164.82
Paving	396 TON	$30.00	$11,882.81	0.470	186.16			$35.91	$6,685.15	$18,567.96
Drainage & Pumps			$25,000.00				$43,000.00			$68,000.00
Access			$50,000.00				$86,000.00			$136,000.00
Utility Relocations			$75,000.00				$129,000.00			$204,000.00
SUBTOTAL, Direct Costs			$174,070.31				$300,977.32		$6,685.15	
Burden						35%	$105,342.06	35%	$2,339.80	
Sub-Contractor OH&P (Direct Cost + Burden)								15%	$1,353.74	
Material Sales Tax		7%	$12,184.92							
SUBTOTAL, (Sub-Contractor + Material)			$186,255.23				$406,319.38		$10,378.70	$602,953.31
General Contractor OH&P		15%	$27,938.29			15%	$60,947.91	5%	$518.93	
Contingency		25%	$46,563.81			25%	$101,579.84			
TOTAL			$260,757.33				$568,847.13		$10,897.63	$841,000.00



APPENDIX F - CITY OF SACRAMENTO, LEVEE FAILURE AND INUNDATION INVESTIGATION MAPS

APPENDIX F

CITY OF SACRAMENTO, LEVEE FAILURE AND INUNDATION INVESTIGATION MAPS

The following inundation maps were created by Boyle Engineering Corporation as part a study titled, "City of Sacramento, Levee Failure and Inundation Investigation" (Jan. '90). The maps have been digitized by HDR Engineering and included with this report by request of Sacramento Department of Utilities. For a complete background on the development of the inundation maps refer to the Boyle Engineering report.