

Flood Risk and Comprehensive Flood Management Plan



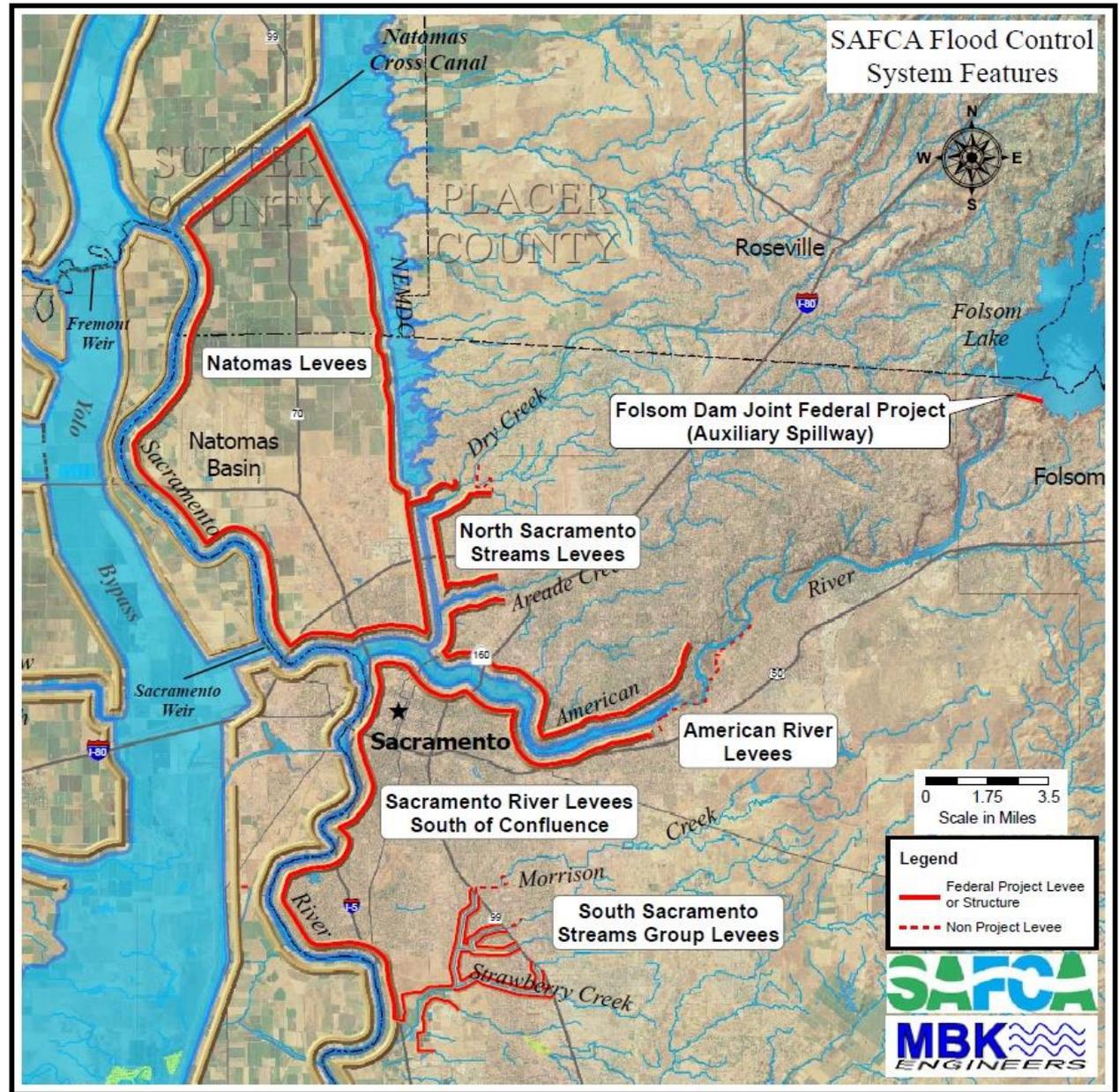
Presented by:
Tony Bertrand
Supervising Engineer

May 7, 2018
Planning Academy

Presentation Overview

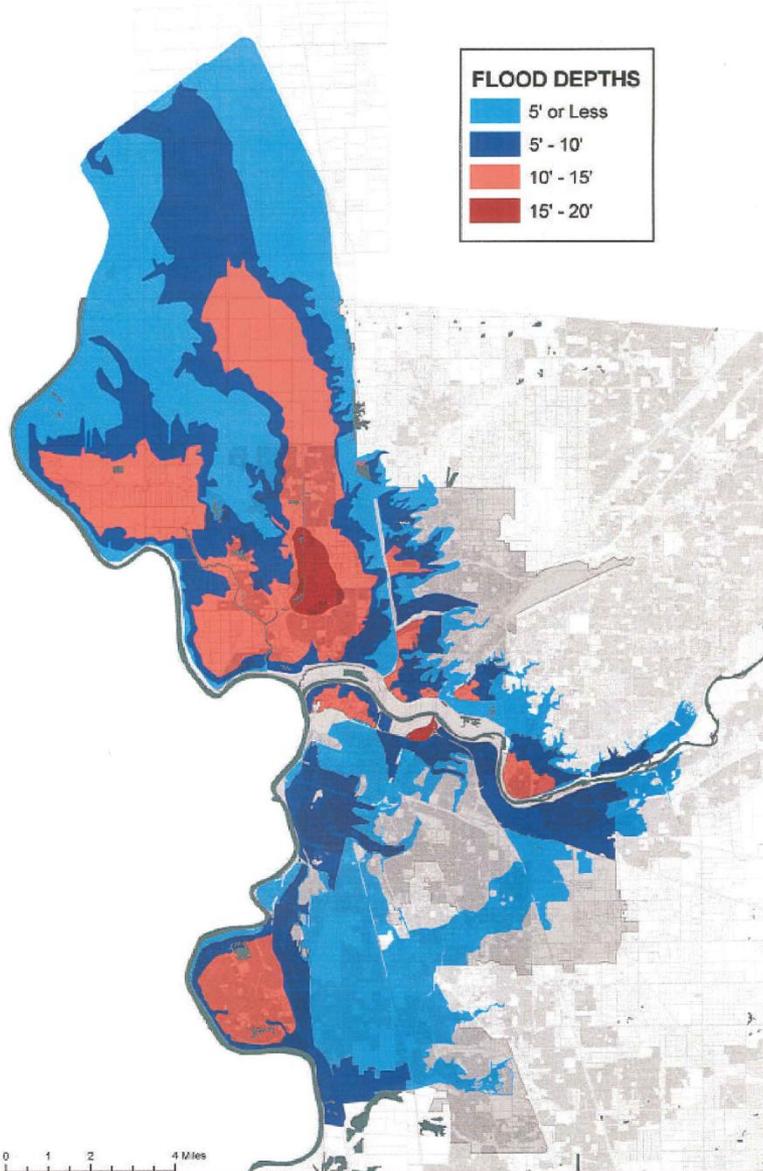
- ▶ City of Sacramento's Flood History
 - ▶ Overview of Floodplain Management
 - ▶ Comprehensive Flood Management Plan
 - ▶ Next Steps
- 

Sacramento River Flood Control System



ULTIMATE FLOOD DEPTHS

ASSUMES NO LEVEES



Historical Perspective

- ▶ Sacramento has experienced great floods events in 1860, 1911, 1913, 1950, 1955, 1962, 1964, 1986, 1995, 1997, & 2006



K. STREET, FROM THE LEVEE.

**INUNDATION OF THE STATE CAPITOL,
City of Sacramento, 1862.**

Published by AROSENFELD, San Francisco



▶ 8/21 Dec. 30, 2005-Jesse Rubalcaba paddles his way down Pomegranante Ave. In Sacramento, CA

Sacramento Flood History

- ▶ **1956 Record Flood:** When Folsom Dam was nearly completed, this second record storm filled the dam in a week and Sacramento was saved from flooding.
- ▶ **1964 Record Flood:** The 3rd record flood in less than 15 years. Engineers concluded that Folsom Dam was only designed to handle is a 120-yr storm, not a 500-yr storm.
- ▶ **1986 Record Flood:** 10 in. of rain in 11 days. Folsom Dam downgraded to about a 60-year storm. Corps determines that a majority of the city does not have 100-year protection. SAFCA was formed.
- ▶ **1995 Record Flood:** The storm dumped nearly 1-1/2 inches of rain on Sacramento in an hour. (That's the most in a single hour during the last 100 years. Major local flooding.

January 7-10, 2017 Storm



January 7-10, 2017 Storm



January 7-10, 2017 Storm

Oroville Dam



National Flood Insurance Program

- ▶ City participates in National Flood Insurance Program (NFIP) administered by FEMA
- ▶ NFIP provides federally backed flood insurance to communities that participate and enforces floodplain development standards
- ▶ Receive federal emergency funding



FEMA

Flood Insurance Rate Maps (FIRMs)

- ▶ Issued by Federal Emergency Management Agency (FEMA)
- ▶ Controls flood insurance rates and development restriction based on flood zone
- ▶ msc.fema.gov

PANEL 0045H

FIRM
FLOOD INSURANCE RATE MAP

SACRAMENTO COUNTY,
CALIFORNIA
AND INCORPORATED AREAS

PANEL 45 OF 705
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

<u>COMMUNITY</u>	<u>NUMBER</u>	<u>PANEL</u>	<u>SUFFIX</u>
SACRAMENTO, CITY OF	060266	0045	H
SACRAMENTO COUNTY	060262	0045	H

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

 MAP NUMBER
06067C0045H

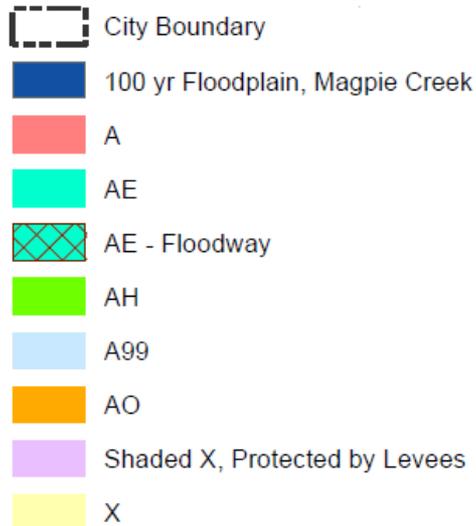
EFFECTIVE DATE
AUGUST 16, 2012

Federal Emergency Management Agency

Definitions

- ▶ **100-year flood** – 1% annual chance of a flood in any given year
 - aka Base Flood Elevation (BFE)
 - 26% chance of flooding over 30 years
- ▶ **Special Flood Hazard Areas** – areas that are subject to a 100-year flood (A flood zones)
- ▶ **200-year flood** – 0.5% annual chance of a flood in any given year

Current Flood Insurance Rate Map



Flood Zone Definitions

Zone A: No base flood elevations determined.

Zone AE: Base flood elevations determined.

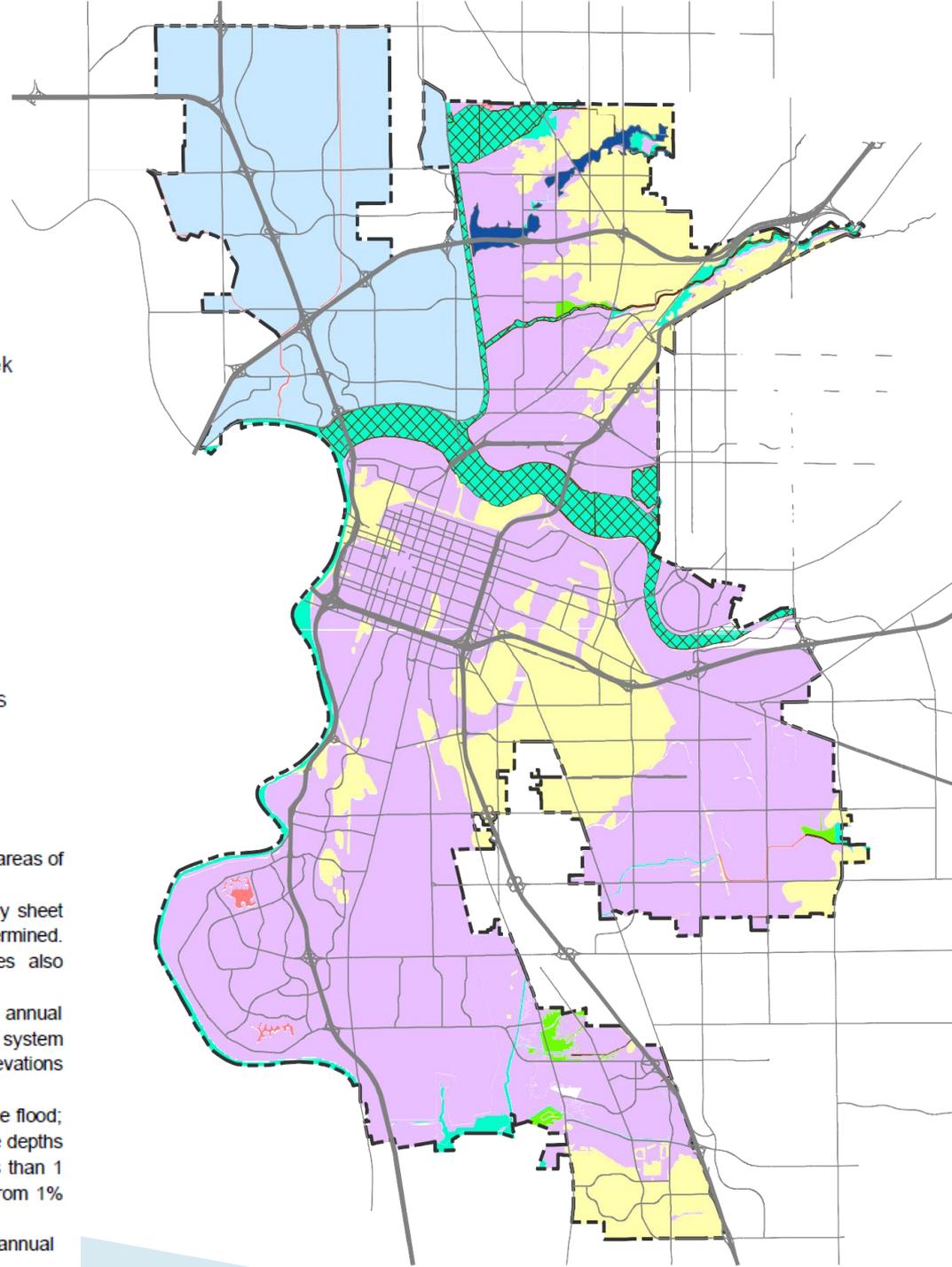
Zone AH: Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

Zone AO: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.

Zone A99: Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no base flood elevations determined.

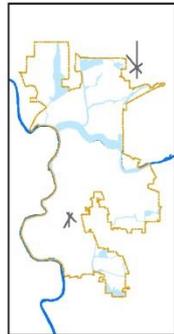
Shaded Zone X: Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with rainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

Zone X: Areas determined to be outside 0.2% annual



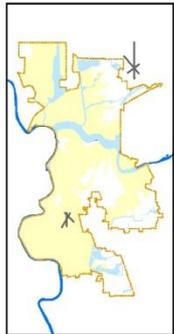
Historical FIRMs

CITY OF SACRAMENTO FLOODPLAIN HISTORY



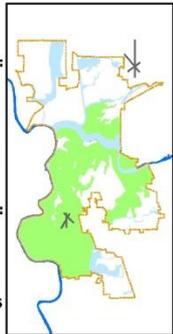
PRE-1986
Zone X

- 1986 - 1989**
- 1986 STORMS
 - ARMY CORPS DETERMINES SACRAMENTO FLOOD CONTROL SYSTEM DOES NOT PROVIDE 100-YEAR PROTECTION
 - CONGRESS AUTHORIZES A99 ZONE FOR CITY (1989)
 - SACRAMENTO AREA FLOOD CONTROL AGENCY (SAFCA) FORMED (1989)



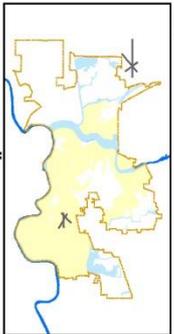
1989
Zone A99

- 1990 - 1998**
- CONGRESS AUTHORIZES (1992):
 - NATOMAS LEVEE FEATURES PROJECT (NLFP) AND REIMBURSEMENT
 - FOLSOM DAM REOPERATION
 - CORPS REPORTS ON AMERICAN RIVER WATERSHED STUDIES (1992 & 1996)
 - CONGRESS AUTHORIZES (1996):
 - \$56.9M FOR AMERICAN RIVER COMMON FEATURES PROJECT
 - SAFCA COMPLETES NLFP (1998)
 - FEMA REMAPS NORTH NATOMAS AND NORTH SACRAMENTO TO SHADED X ZONE (1998)
 - FEMA REMAPS SACRAMENTO TO AR ZONE (1998)



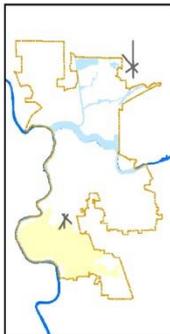
1998
Zone AR

- 1999 - 2000**
- CORPS INITIATES COMMON FEATURES PROJECT (1998)
 - CORPS COMPLETES SO. SAC. CO. STREAM GROUP (SSSG) STUDY (1998)
 - CONGRESS AUTHORIZES (1999):
 - INCREASE TO \$91.9M FOR COMMON FEATURES PROJECT
 - \$65.5M FOR SSSG
 - \$150M FOR FOLSOM DAM MODIFICATIONS
 - CITY COMPLETES NATOMAS COMPREHENSIVE DRAINAGE PLAN; FEMA REMAPS NATOMAS INTERNAL DRAINAGE AREA TO ZONE X (1999)
 - FEMA DETERMINES ADEQUATE PROGRESS ON SACRAMENTO FLOOD CONTROL SYSTEM; REMAPS MOST OF SACRAMENTO TO A99 ZONE (2000)



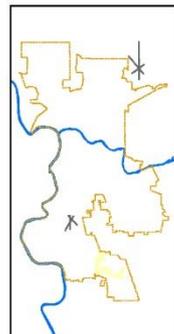
2000
Zone A99

- 2001 - 2005**
- CONGRESS AUTHORIZES (2003):
 - INCREASE TO \$205M FOR COMMON FEATURES PROJECT
 - \$257.3M FOR FOLSOM DAM MINI RAISE
 - CORPS CERTIFIES AMERICAN RIVER LEVEES (2004)
 - FEMA REMAPS REMAINDER OF AMERICAN RIVER FLOODPLAIN TO SHADED X ZONE
 - SSSG CONSTRUCTION STARTS (2005)



2004/2005
Zone X

- 2006 - 2007**
- WORK COMPLETED ON:
 - COMMON FEATURES PROJECT (2004)
 - SACRAMENTO RIVER
 - MORRISON CREEK
 - NORTH BEACH LAKE LEVEE PROJECT (SSSG)
 - FOLSOM DAM MODIFICATION
 - REMAP PARTS OF SSSG AND POCKET AREA FLOODPLAIN TO ZONE X (2007)



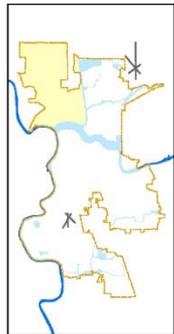
2007
Zone A99

- 2007 - 2008**
- CORPS DETERMINES NATOMAS LEVEES PROVIDE <33-YEAR PROTECTION
 - FEMA REMAPS NATOMAS TO AN AE ZONE (2008)



2009
Zone AE

- 2009 - 2015**
- FEMA REMAPS SSSG 'WEST SIDE OF MORRISON CREEK' (2010)
 - FEMA REMOVES MAJORITY OF SSSG FROM A99 ZONE; REMAINING AH ZONE AROUND FLORIN CREEK (2014)
 - ARMY CORPS EXPIRES LEVEE CERTIFICATION (2012 & 2013)
 - WRRDA BILL AUTHORIZED BY CONGRESS TO IMPROVE NATOMAS LEVEES (2014)
 - NATOMAS REMAPPED TO A99 ZONE (2015)



2016
Zone A99

- 2016 - CURRENT**
- WORK TO CONTINUE:
 - FLORIN CREEK WIDENING AND DETENTION BASINS
 - FOLSOM DAM RAISE AND JOINT FEDERAL PROJECT
 - COMMON FEATURES PROJECT
 - SAFCA LEVEE ACCREDITATION
 - MODERNIZATION PROGRAM
 - STATE OF CALIFORNIA 200-YR FLOOD PROTECTION REQUIREMENT EFFECTIVE (JULY 2016)

Legend

- ◻ OUTSIDE SPECIAL FLOOD HAZARD ZONE
- A, AE, AH, AO ZONES
- A99 ZONE
- AR ZONE

Climate Change – News Headlines

← Entitlement “Death Spiral” Begins in California

End Of Days – Only 3 Weeks To Go! →

California Extreme Super Flood

Posted on 29 November 2012

Can It Happen Again?

And what **was** it anyway?

I figured I’d get a jump on the inevitable stories to come about how this is extreme weather and therefor caused by Global Warming!!!

(We really need a sound effect whenever AGW is mentioned, like [in Young Frankenstein when the horses would always sound off at Frau Blucher](#) being mentioned. Perhaps thunder or a ‘dun duun Dun DUUNNN’ on the piano...)

At any rate, we’re going to get rain. LOTS of rain. I’m on the lower edge of it, so hopefully will just get modest rain. Crosspatch in T8 deserves a h/t for the pointer.

The screenshot shows the NOAA website interface. At the top is a navigation bar with links: NOAA HOME, WEATHER, OCEANS, FISHERIES, CHARTING, SATELLITES, CLIMATE, RESEARCH, COASTS, CAREERS. Below this is the NOAA logo and the text 'NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION UNITED STATES DEPARTMENT OF COMMERCE'. A secondary navigation bar contains links: » About NOAA, » Contacts, » Staff Directory, » Help, and a search box with a » SEARCH button. The main article title is 'Sacramento: The Nation's Next Urban Flood Disaster?'. The text discusses West Coast winter storms and their impact on Sacramento. A photo shows a snow-covered roof with a caption: 'By 2/5/2008, nearly eight feet of snow had fallen on this U.S. Forest Service's summer visitor center in Tahoe National Forest northeast of Sacramento. High resolution (Credit: NOAA)'. Another photo shows a dam with a caption: 'A system of levees protects the city from inundation by the rain-swelled rivers. One or more levees giving way could drown parts of Sacramento under 20-plus feet of water. One big miss on a major storm forecast may be all it takes to catch water managers off guard and turn a background risk into nightmarish reality. To prevent such a disaster, NOAA's Earth System Research Laboratory (ESRL) is funneling years of West Coast storm...'. On the right side, there is a sidebar titled 'Protecting Lives & Property' with several links: 'The Wildest Weather', 'Confused About Seafood?', 'Spies of the Sky', 'Tornadoes 101', and 'The Destructive Power of Water'. At the bottom of the sidebar is an 'Archive' link.

Climate Change...It's Getting Real!



Climate Change

- ▶ City's Climate Actions Plan:
 - Extreme weather is expected to become more common in the Sacramento region causing larger storm events
 - Shifts in seasonal timing of raining and snowpack runoff
 - Causing increase water runoff to streams and rivers during the winter months
- ▶ Impacting the City's system of pipelines, pump stations, levees/floodwalls and dams that may be strained by climate change

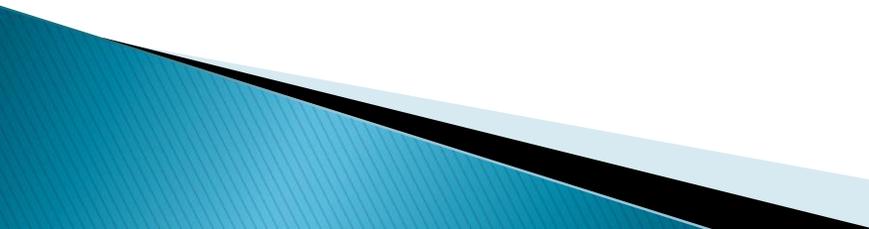
So What's Our Plan?

- ▶ Proposed Change to State and Local Hazard Mitigation Plans to Address Future Climate Variability Issues (2014 & 2016)
- ▶ Central Valley Flood Protection Plan– Senate Bill 5 (2016)
 - New Development standards – 200–year flood event
 - Sea Level Rise – Design water surface elevation for flood control structures
- ▶ Being prepared!

Sacramento Comprehensive Flood Management Plan (CFMP)

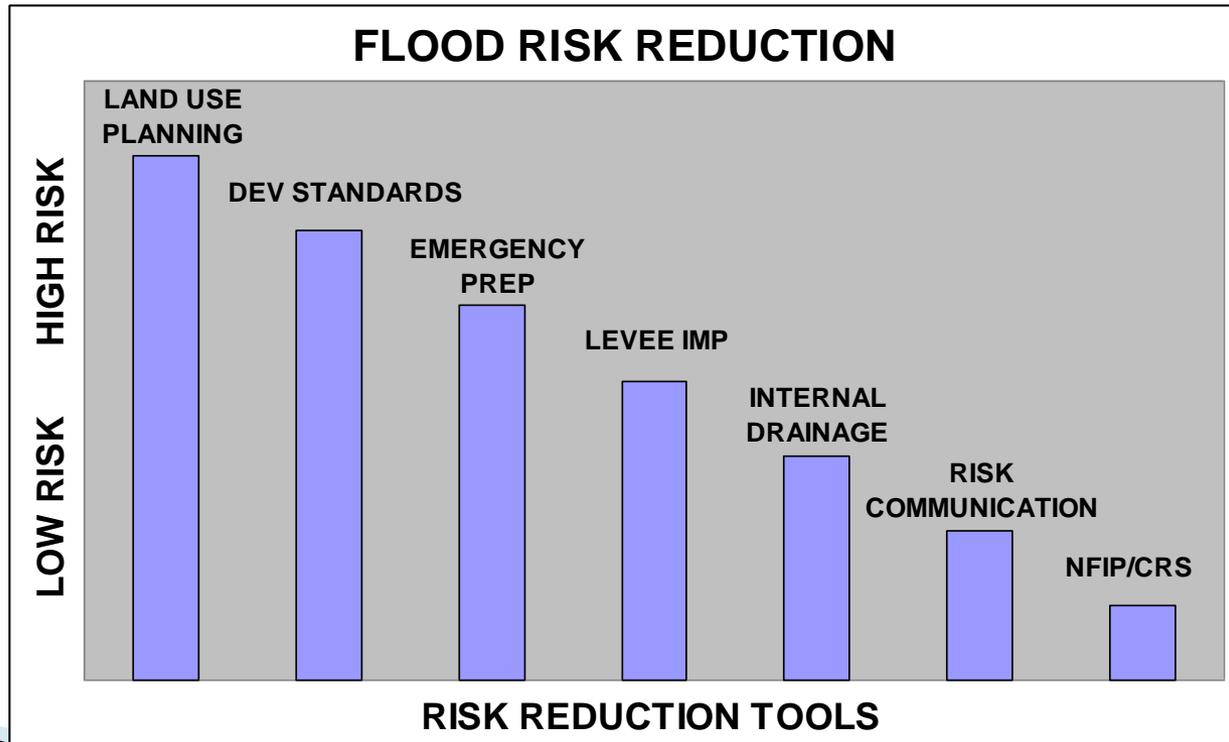
- ▶ City's strategic plan to reduce flood risk over the next 5 years.
 - ▶ A comprehensive management document that will guide the City's flood risk reduction and mitigation efforts.
- 

Need for a Comprehensive Flood Management Plan

- ▶ City's strategic plan to reduce flood risk over the next 5 years with implementation goals
 - ▶ A comprehensive management document that will guide the City's flood risk reduction and mitigation efforts.
 - ▶ Help increase the City's Community Rating System (CRS) Class
 - ▶ Sacramento Countywide Local Hazard Mitigation Plan
- 

Risk Reduction Tools

Flood risk reduction is best achieved by employing a suite of risk reduction tools.



Land Use & Development Guidelines

- ▶ Elevate lowest floors of structures at least one foot above the 100-yr floodplain
 - Add freeboard of one foot or more to reduce insurance premiums in an A Zone
 - ▶ Floodproof non-residential structures a minimum of 1-foot above the 100-yr floodplain
- 

Elevating a Structure

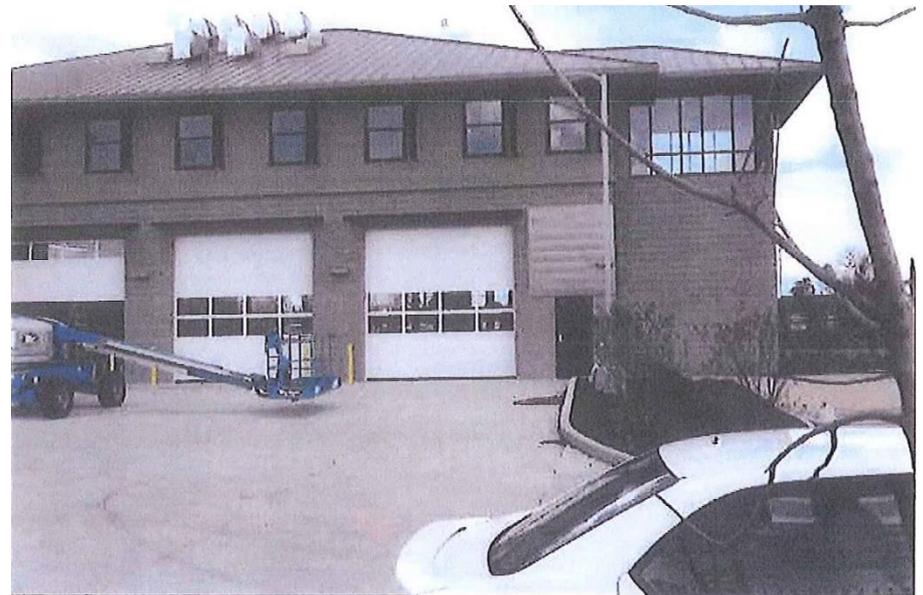
Lowest Floor = Top of Slab



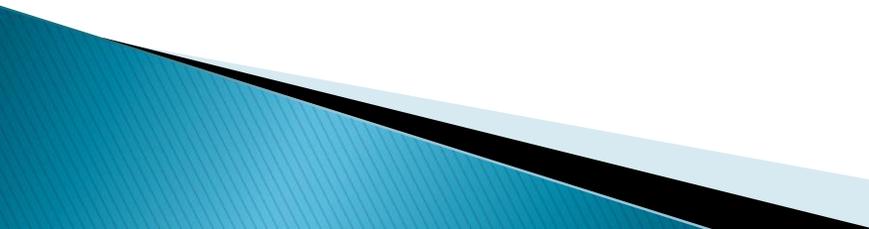
Floodproofing a Structure



Floodproofing a Structure



Central Valley Flood Protection Plan

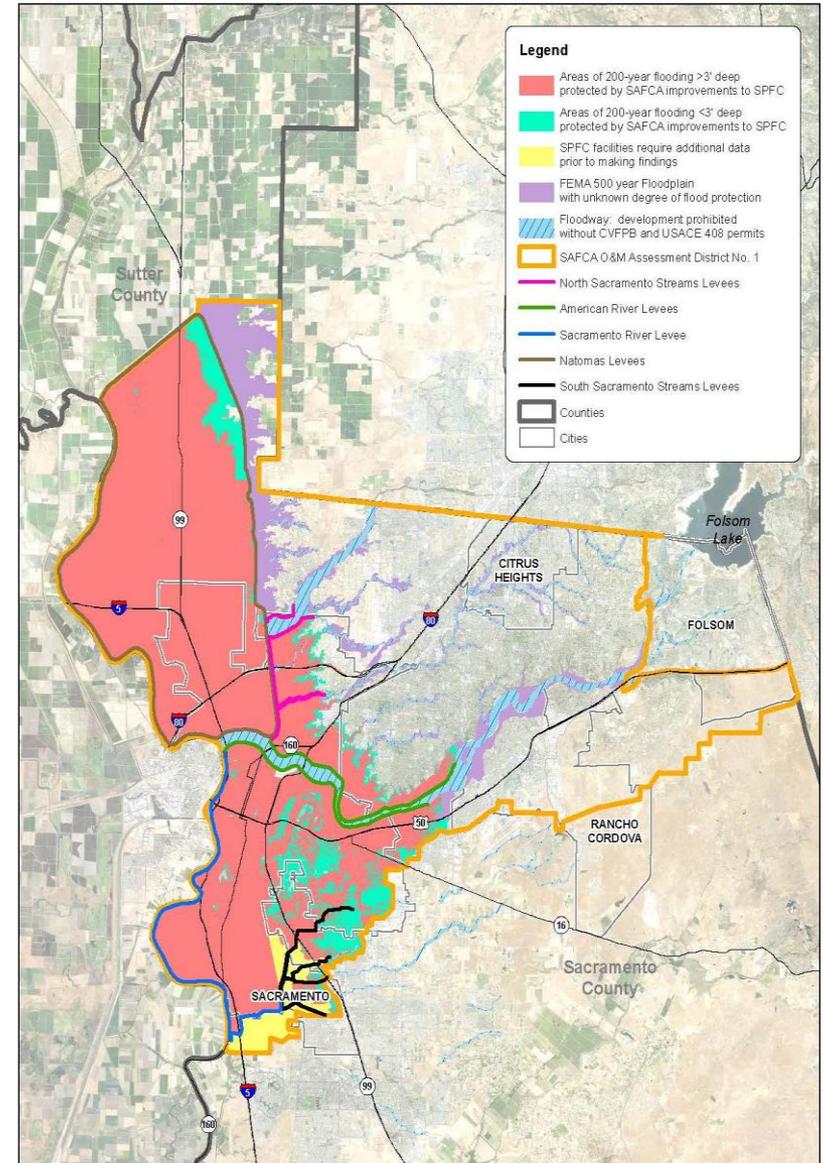
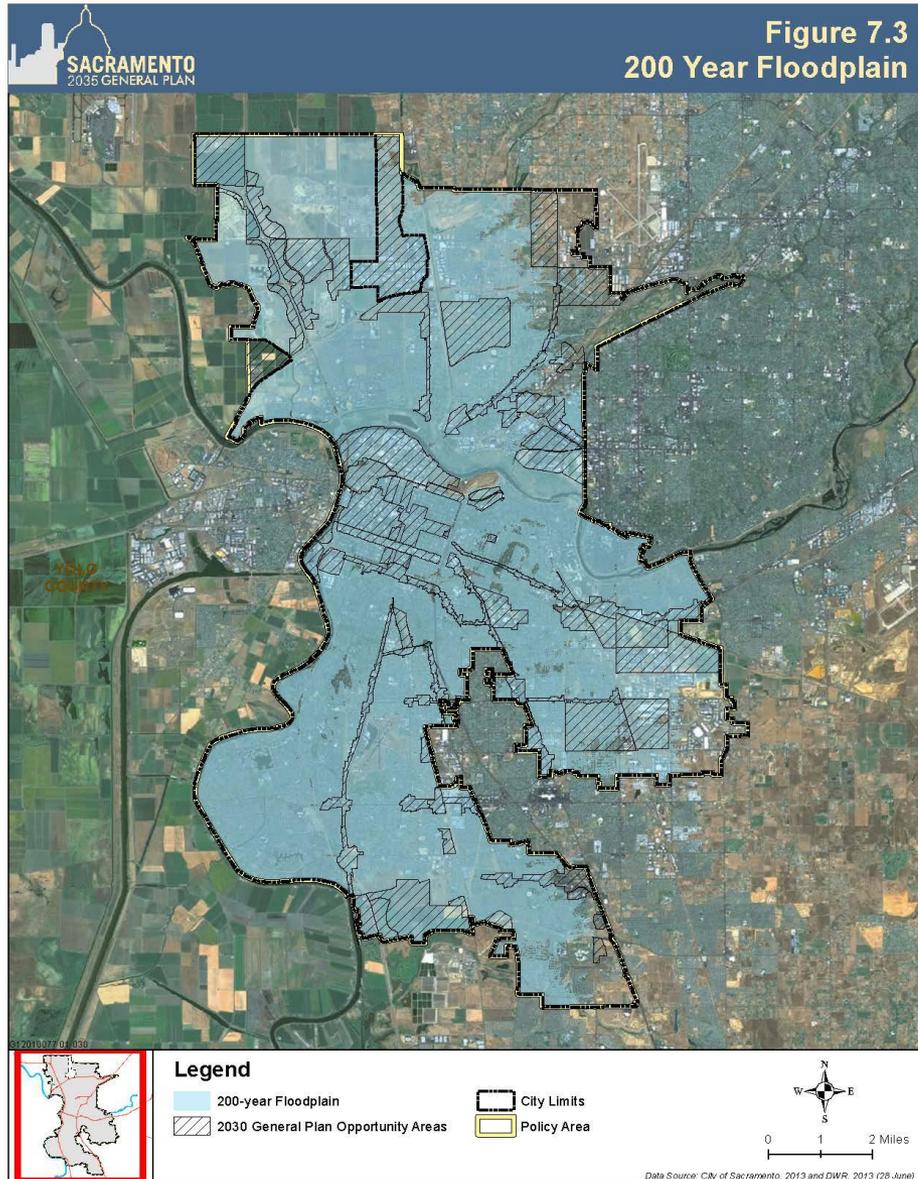
- ▶ SB5 / AB162
 - ▶ 200-yr level flood protection by 2025
 - ▶ Regional Flood Control Plans
 - ▶ Levee clearance, encroachments, and maintenance requirements
 - ▶ New state building code standards for evacuation
- 

Development Projects Findings

There is substantial evidence that the project has met one of the following conditions:

- ▶ Currently have 200–year flood protection
- ▶ Imposed conditions (floodproofing or elevating structures)
- ▶ Making adequate progress (the urban level of flood protection shall be achieved by 2025);
or
- ▶ Within an undetermined risk area.

City's 200-Year Floodplain Map



City's 200-Year Floodplain Localized Flooding Map

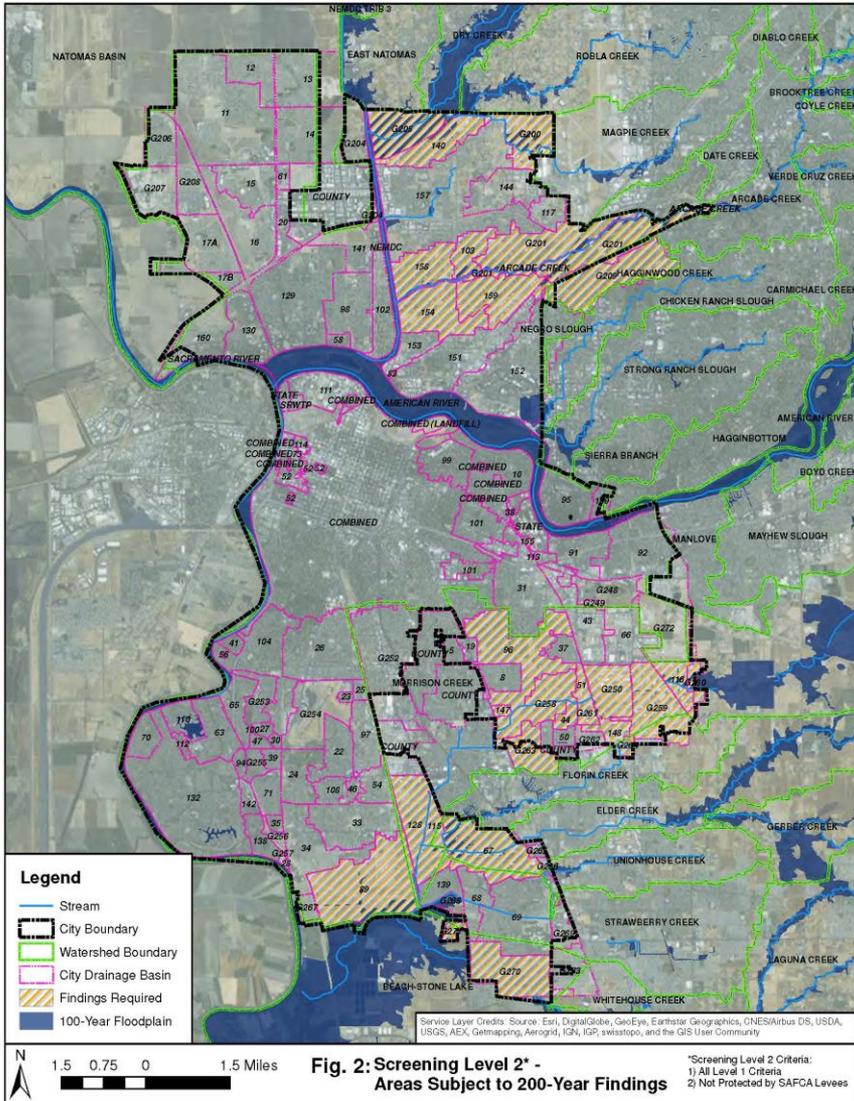
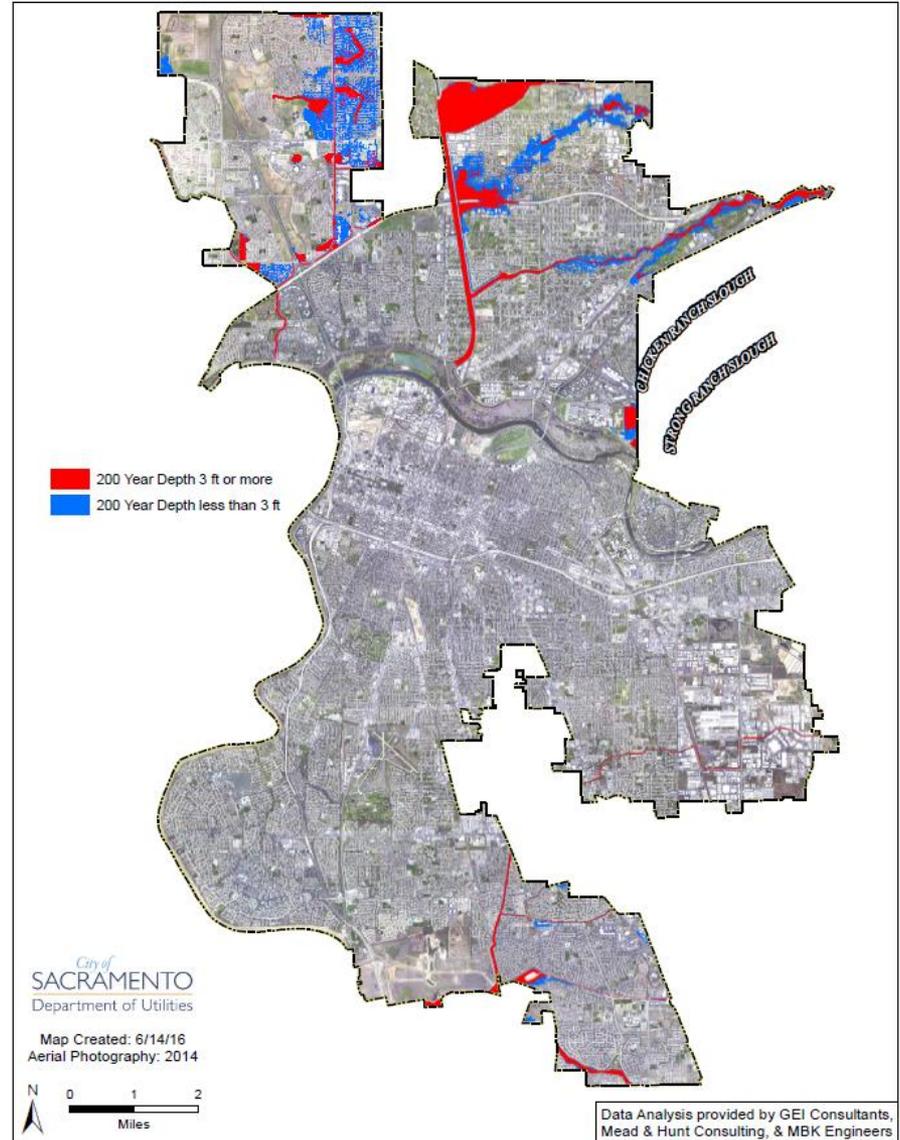
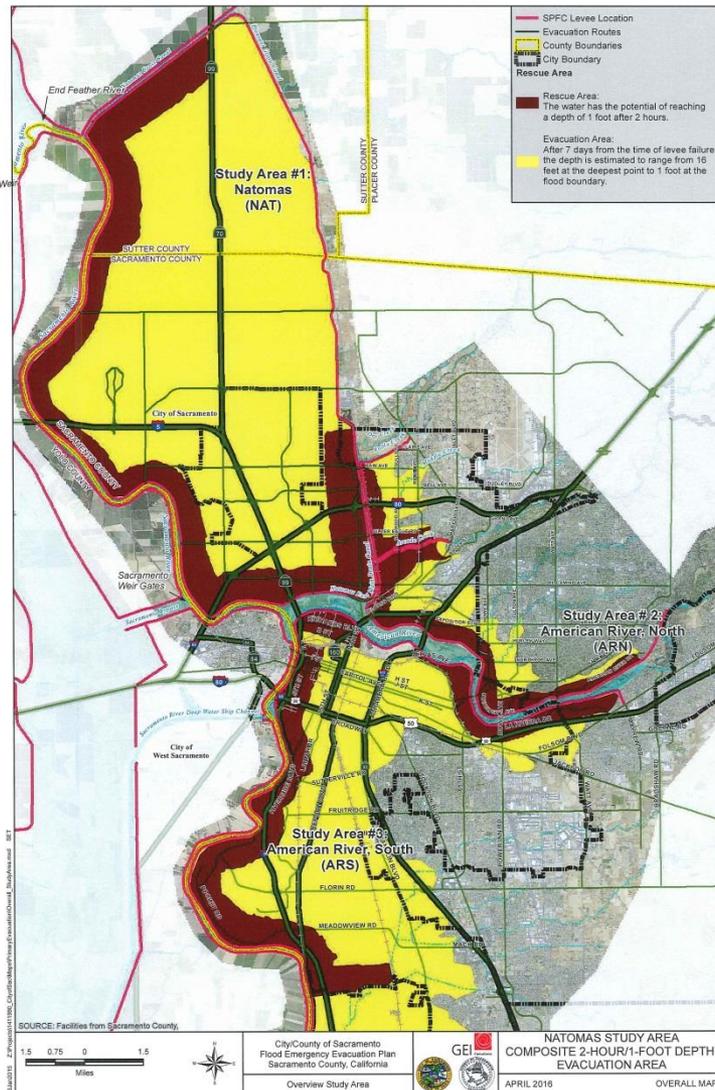


Fig. 2: Screening Level 2* - Areas Subject to 200-Year Findings



Rescue and Evacuation Maps



Rescue Zone: An area of the City that would flood to a depth of 1 foot in 2 hours.

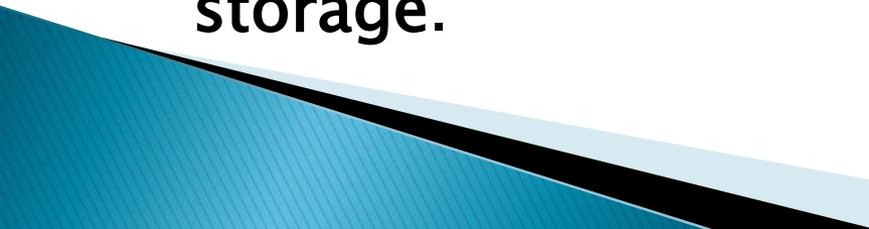
Evacuation Zone: An area protected by levees that would flood slowly, allowing for adequate time to evacuate.

Land Use & Development Guidelines

Rescue Zones

- ▶ Evacuation Plans for **special needs facilities** (schools, hospitals etc.);
- ▶ Identification of **refuge and evacuation locations** for special needs facilities, new residential developments, large commercial and public buildings

Rescue and Evacuation Zones

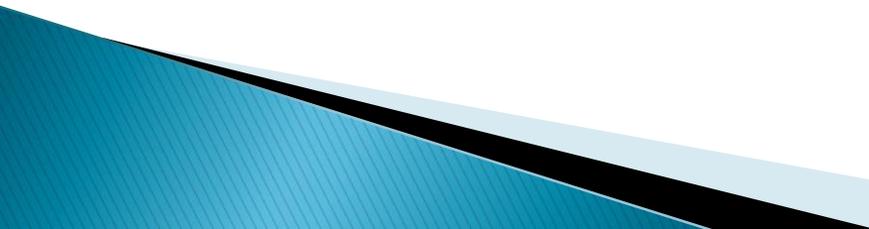
- ▶ Identification of **emergency vehicle access** to subdivisions
 - ▶ Provision of infrastructure to **protect on-site fuel storage.**
- 

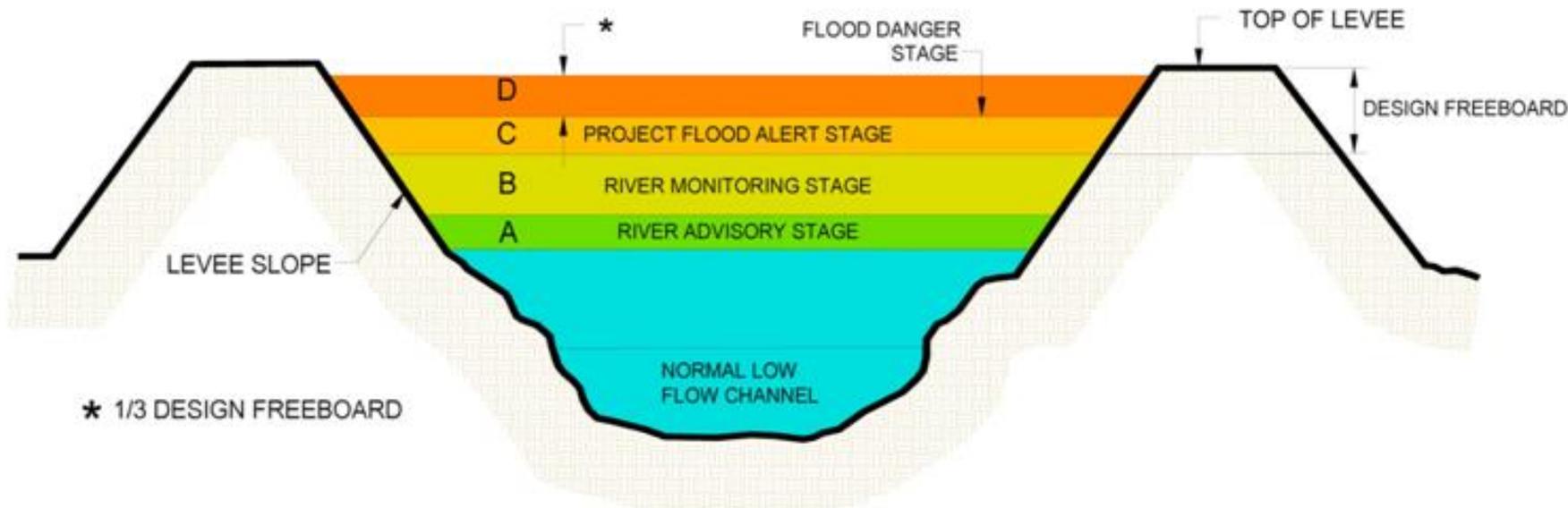
Emergency Preparation

- ▶ Reviewing and summarizing all emergency response documents
- ▶ List of flood maps available
- ▶ City's Exercises & Training Schedule
- ▶ Recording High Water Marks
- ▶ Recovery Plan
 - Damage Assessment
 - Recovery Ordinance
 - Sample Emergency Broadcasts / Press Releases



Emergency Response

- ▶ Dept. of Utilities Operation Center
 - Single base of operation
 - Communicate with field crews, other City Departments, non-City agencies, and other resources
 - Rain Patrols / Levee Patrols
 - ▶ City Emergency Operation Center
 - ▶ County Emergency Operation Center
- 



* 1/3 DESIGN FREEBOARD

		WS ELEVATIONS		STAGE DEFINITION/ACTIONS	PUBLIC INFORMATION ACTIONS
		MINIMUM	MAXIMUM		
A	RIVER ADVISORY STAGE	39.0	40.0	THE STAGE AT WHICH THE RIVER IS RISING AND ELEVATION OF RIVER IS ONE FOOT BELOW RIVER WARNING STAGE.	HIGH WATER PRECAUTIONARY ADVISORY. CHECK EMERGENCY SUPPLIES LISTEN TO NEWS WEATHER REPORTS.
B	RIVER MONITORING STAGE	40.0	42.8	THE STAGE AT WHICH PATROL OF FLOOD CONTROL PROJECT LEVEES BECOMES MANDATORY, OR THE STAGE AT WHICH FLOW OCCURS INTO BYPASS AREAS FROM PROJECT OVERFLOW WEIRS.	EVACUATION PREPAREDNESS ADVISORY. WHERE TO GO / WHAT TO WATCH OUT FOR.
C	PROJECT FLOOD ALERT STAGE	42.8	43.8	THE STAGE AT WHICH THE FLOW IN A FLOOD CONTROL PROJECT IS AT MAXIMUM DESIGN CAPACITY. AT THIS LEVEL THERE IS A MINIMUM FREEBOARD BELOW THE TOP OF LEVEES.	ADVISE EVACUATIONS FOR PERSONS AT RISK. MOVE LARGE ANIMALS, RV's etc. RECOMMEND SCHOOL AND BUSINESS CLOSURES. CANCELLATION OF PUBLIC GATHERINGS IN AFFECTED AREA.
D	FLOOD DANGER STAGE	43.8		THE STAGE AT WHICH THE FLOW IN THE FLOOD CONTROL PROJECT IS GREATER THAN MAXIMUM DESIGN CAPACITY AND WHERE FLOW HAS ENCRoaCHED INTO 1/3rd OF THE DESIGN FREEBOARD.	A SIGNIFICANT HAZARD TO LIFE AND PROPERTY EXIST IN THE EVENT OF LEVEE FAILURE. CITY EOC SHOULD CONSIDER MANDATORY EVACUATION OF AFFECTED AREAS.

NOTES:

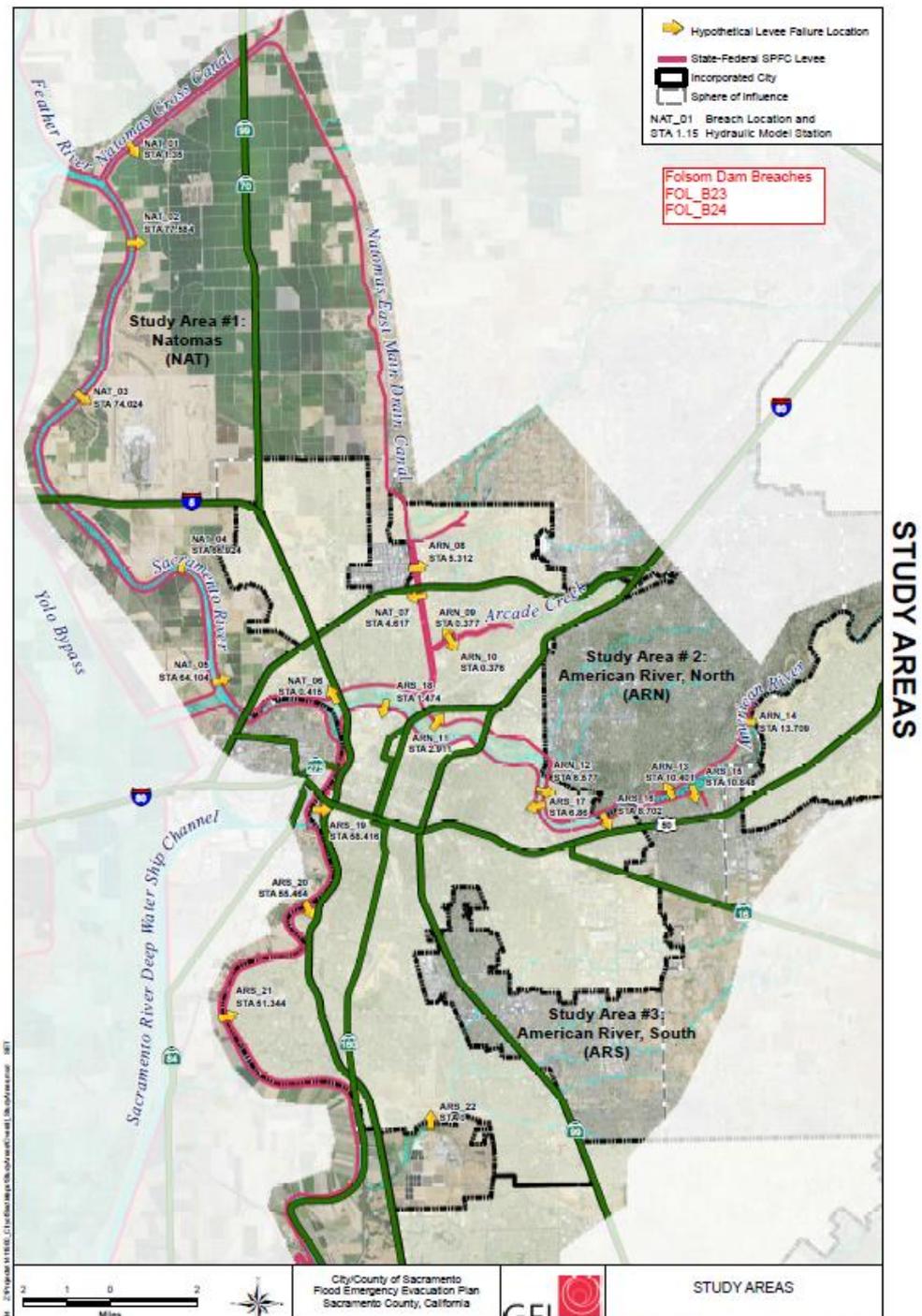
1. SEVERE AND/OR UNEXPECTED CONDITIONS MAY NECESSITATE MOVING FROM RIVER ADVISORY OR RIVER WARNING STAGE TO FLOOD DANGER STAGE.

AMERICAN RIVER
at "H" ST. BRIDGE

AMRVRB.DWG KRJ 01/09/04

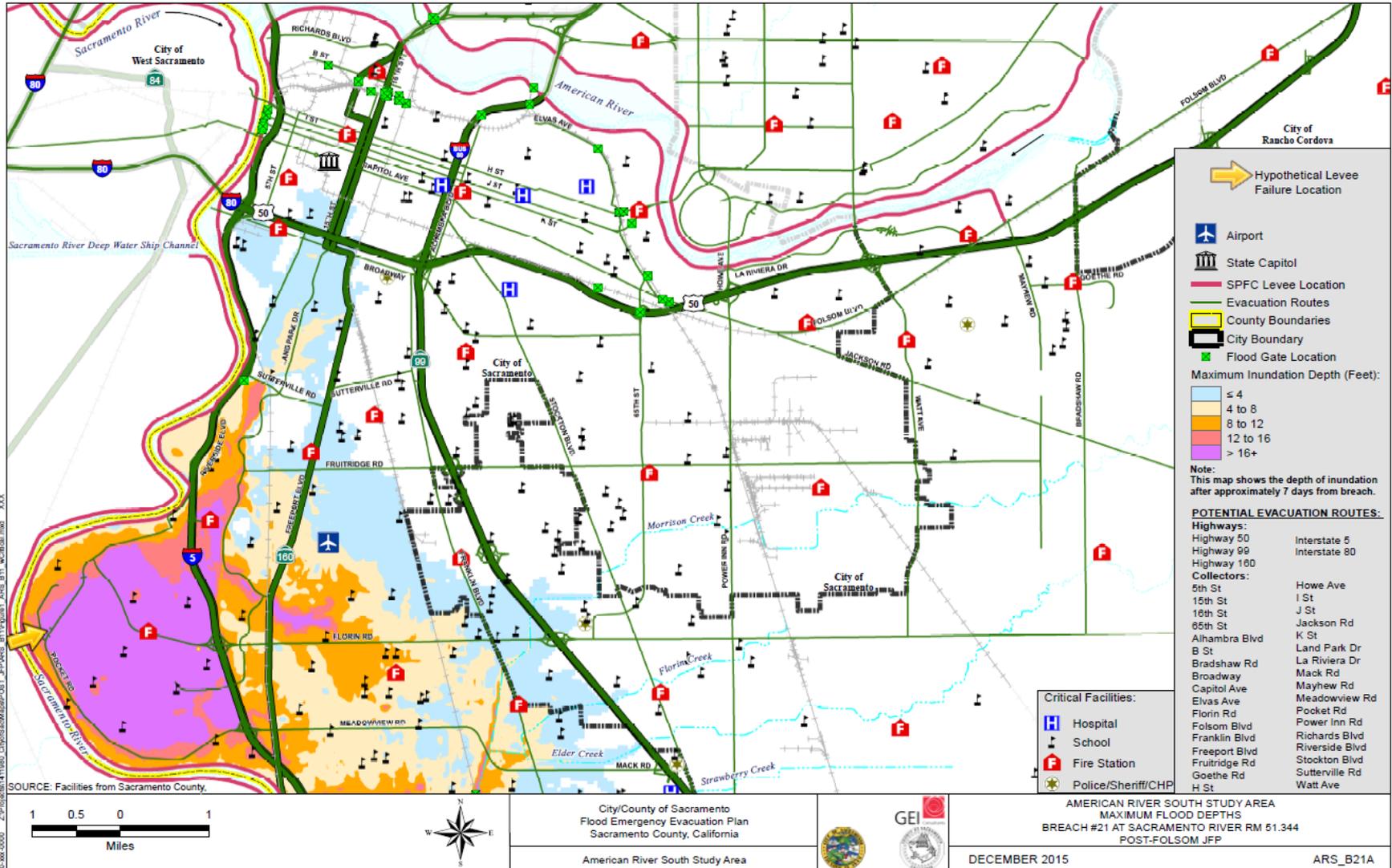
2016 Rescue & Evacuation Maps

- ▶ 22 Levee Break Scenarios
- ▶ Based on 200-year flood State requirement
- ▶ Animated levee break scenarios (State website)



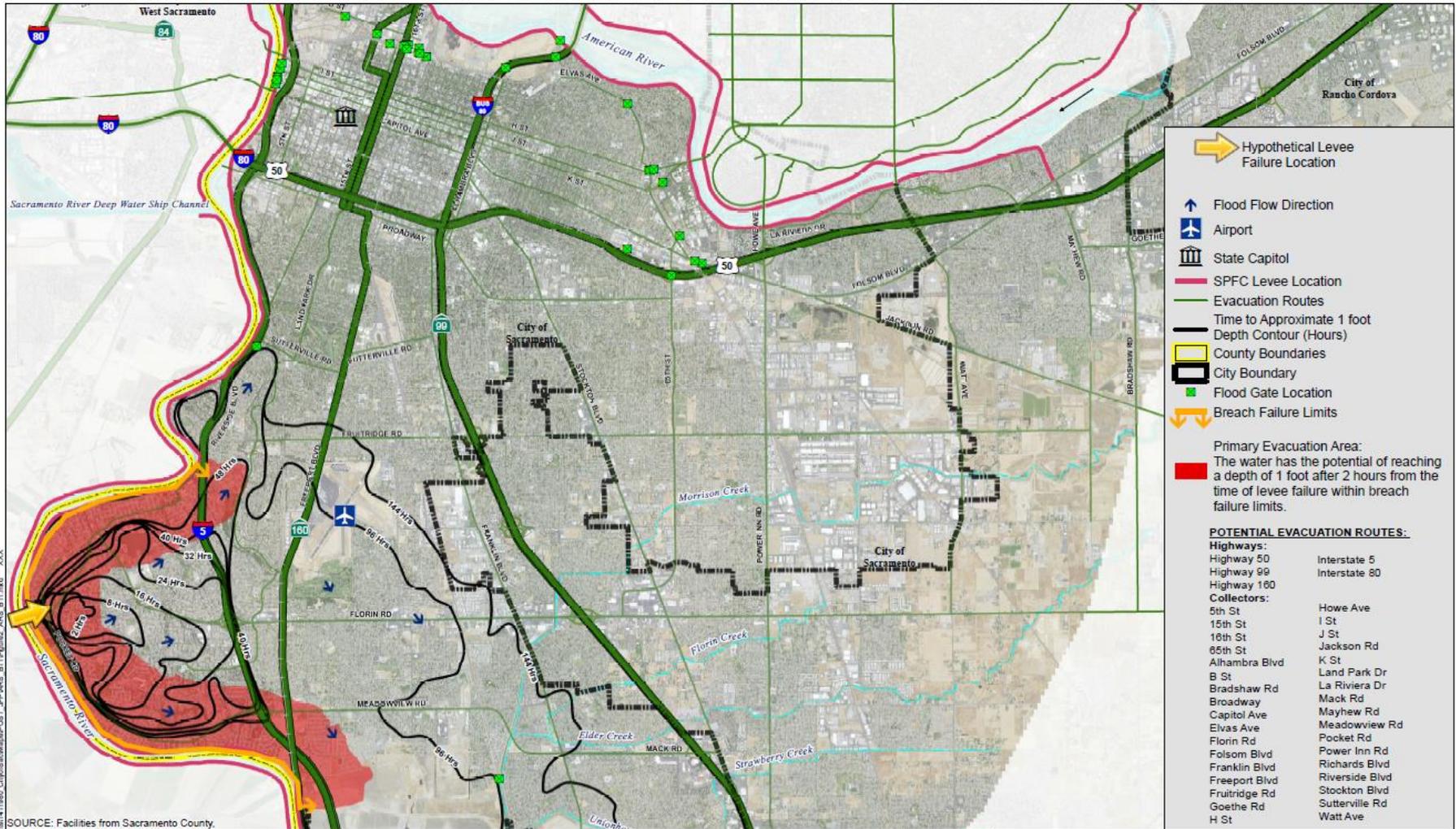
Rescue & Evacuation Maps

MAXIMUM FLOOD DEPTH MAP



Rescue & Evacuation Maps

TIME CONTOURS IN HOURS TO APPROXIMATE DEPTH OF ONE FOOT



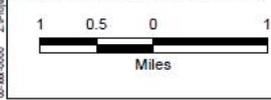
Legend:

- Hypothetical Levee Failure Location
- Flood Flow Direction
- Airport
- State Capitol
- SPFC Levee Location
- Evacuation Routes
- Time to Approximate 1 foot Depth Contour (Hours)
- County Boundaries
- City Boundary
- Flood Gate Location
- Breach Failure Limits

Primary Evacuation Area:
 The water has the potential of reaching a depth of 1 foot after 2 hours from the time of levee failure within breach failure limits.

POTENTIAL EVACUATION ROUTES:

Highways:	Interstate 5
Highway 50	Interstate 80
Highway 99	
Highway 100	
Collectors:	
5th St	Howe Ave
15th St	I St
18th St	J St
65th St	Jackson Rd
Alhambra Blvd	K St
B St	Land Park Dr
Bradshaw Rd	La Riviera Dr
Broadway	Mack Rd
Capitol Ave	Mayhew Rd
Elvas Ave	Meadowview Rd
Florin Rd	Pocket Rd
Folsom Blvd	Power Inn Rd
Franklin Blvd	Richards Blvd
Freeport Blvd	Riverside Blvd
Fruitridge Rd	Stockton Blvd
Goethe Rd	Sutterville Rd
H St	Watt Ave



City/County of Sacramento
 Flood Emergency Evacuation Plan
 Sacramento County, California

American River South Study Area

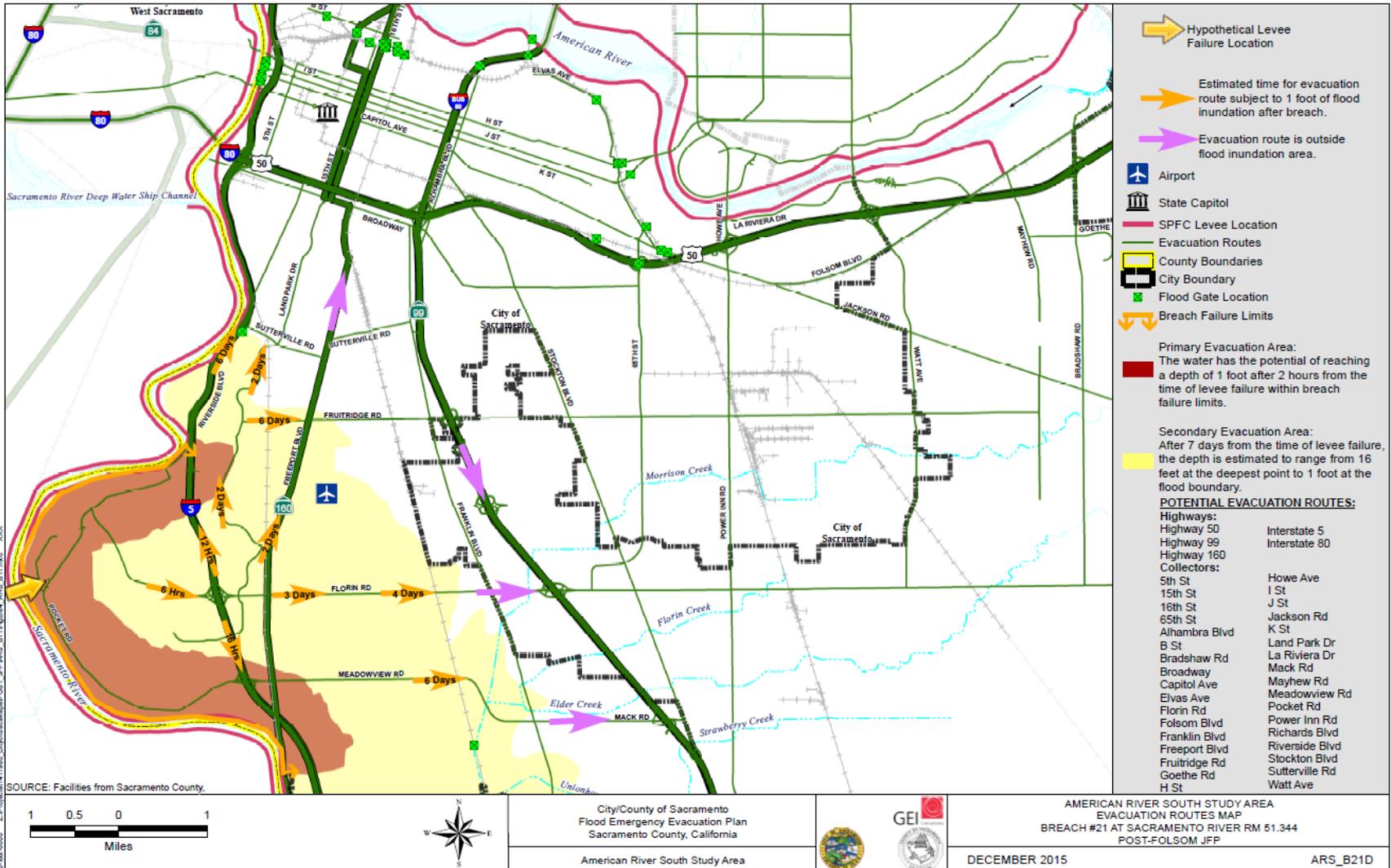
AMERICAN RIVER SOUTH STUDY AREA
 TIME CONTOURS TO APPROXIMATE DEPTH OF 1 FT
 BREACH #21 AT SACRAMENTO RIVER RM 51.344
 POST-FOLSOM JFP

DECEMBER 2015

ARS_B21B

Rescue & Evacuation Maps

RECOMMENDED EVACUATION ROUTES



Preparing for a Flooding Disaster

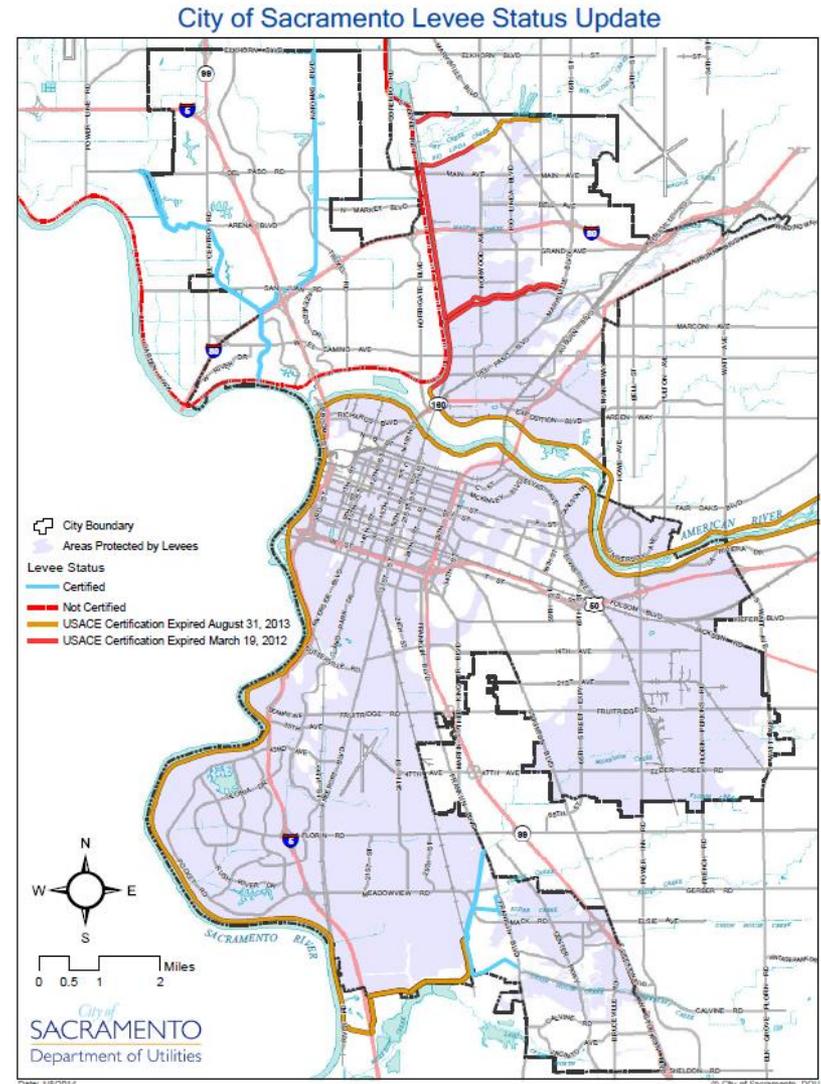
- ▶ Protect your assets– buy and keep flood insurance!
 - Preferred Risk Policies (PRP) are available for most Sacramento residents
- ▶ Sign up for Everbridge (Reverse 911)
 - www.sacramentoready.org
- ▶ Be aware during winter rain events
 - Listen to radio and television reports
 - Follow creek and river level status online
 - www.sacflood.org or www.cdec.ca.gov
 - Call 311 for any major flooding or levee issues

Preparing for a Flooding Disaster

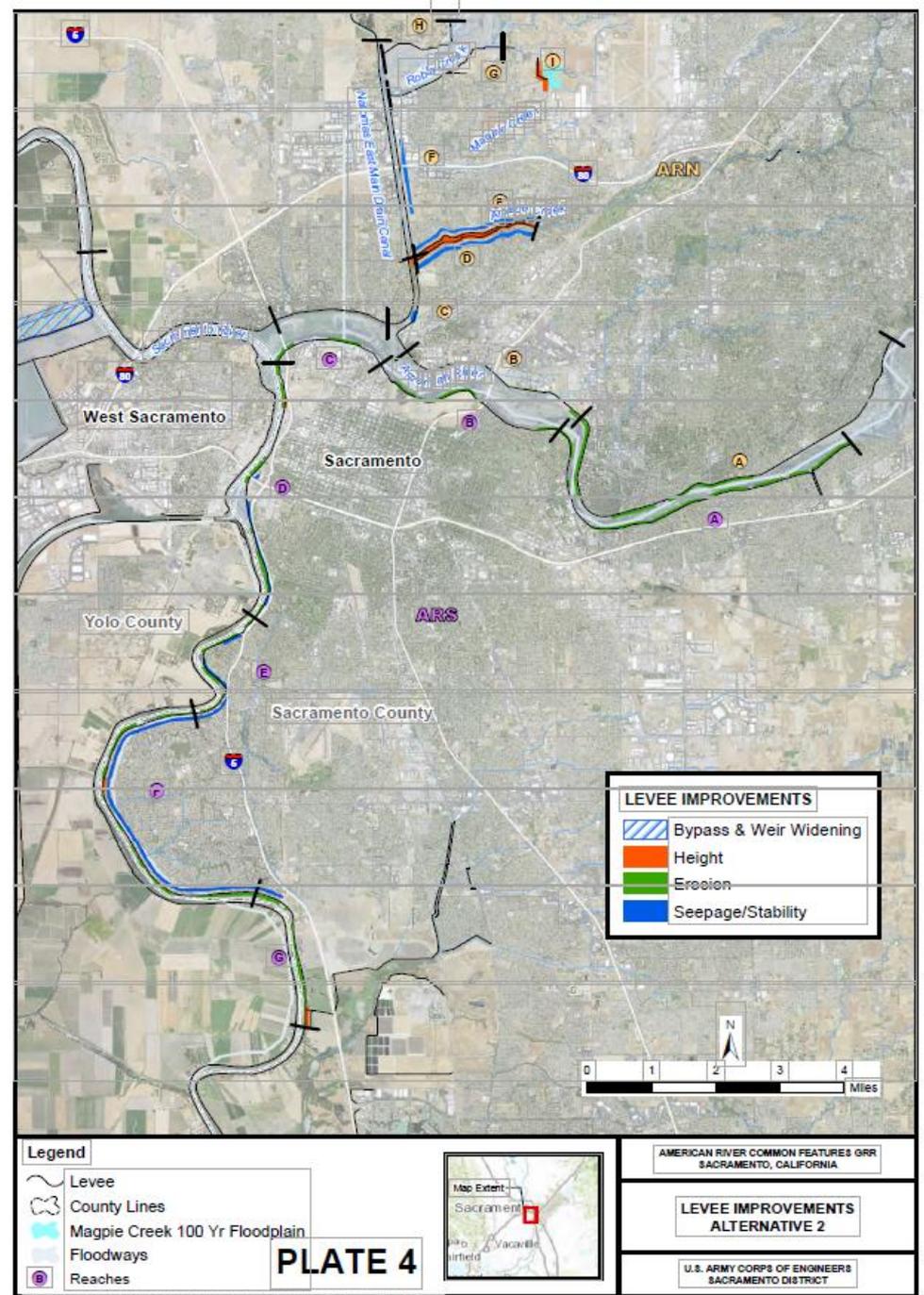
- ▶ **Emergency Kit**
 - Flashlight, batteries, water, food, important documents, etc.
- ▶ **Communication Plan**
 - Make plans now so you will know how to contact each other in any situation
- ▶ **Keep Pets Safe**
 - Identification
 - Locate a shelter for you and your pet

Sacramento Area Flood Control Agency Levee and Other Structural Improvements

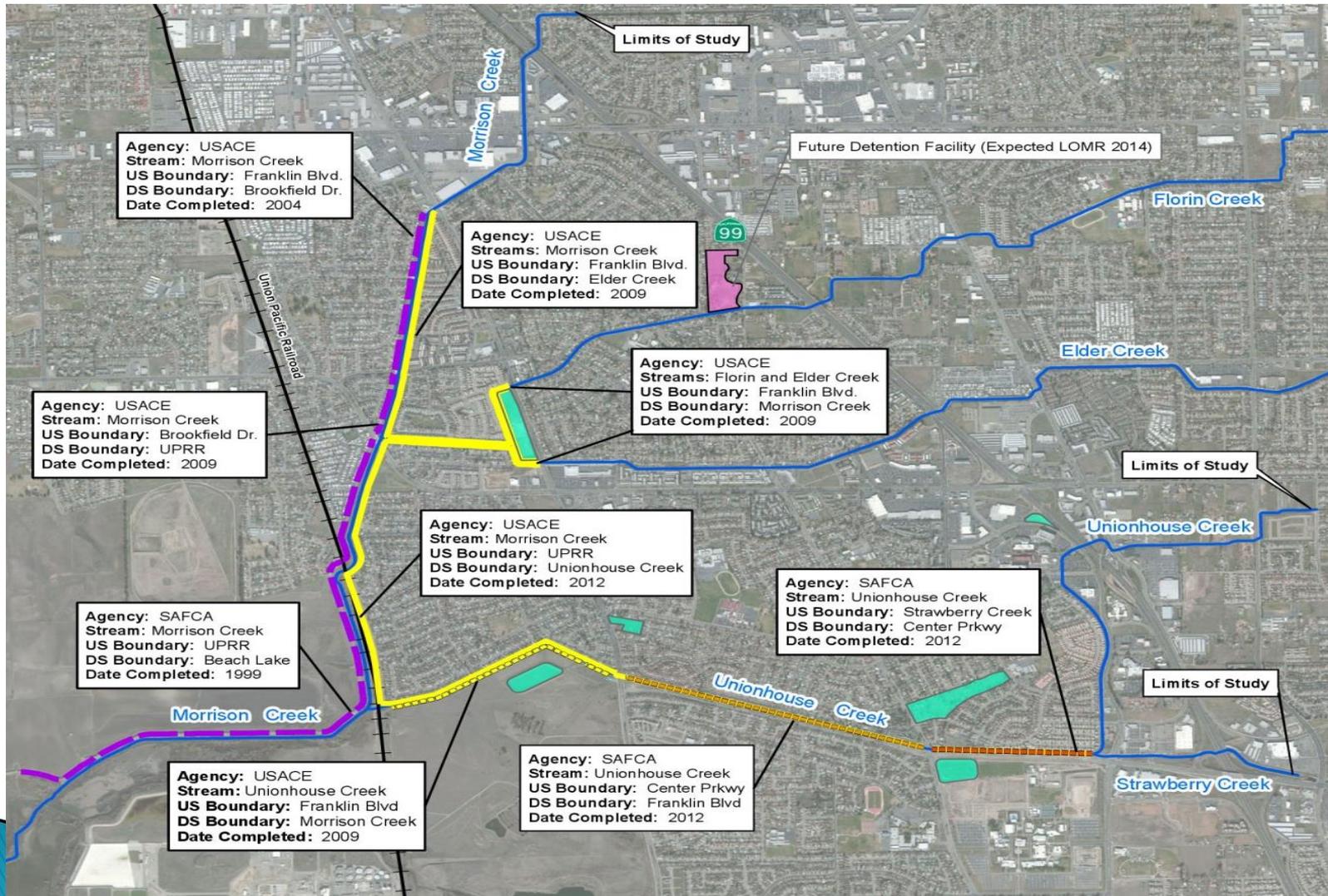
- ▶ Levee Accreditation Plan
 - 100-year plan
 - USACE expired the City's levee certifications
- ▶ Levee Modernization Plan
 - 200-year plan



Levee and Other Structural Improvements



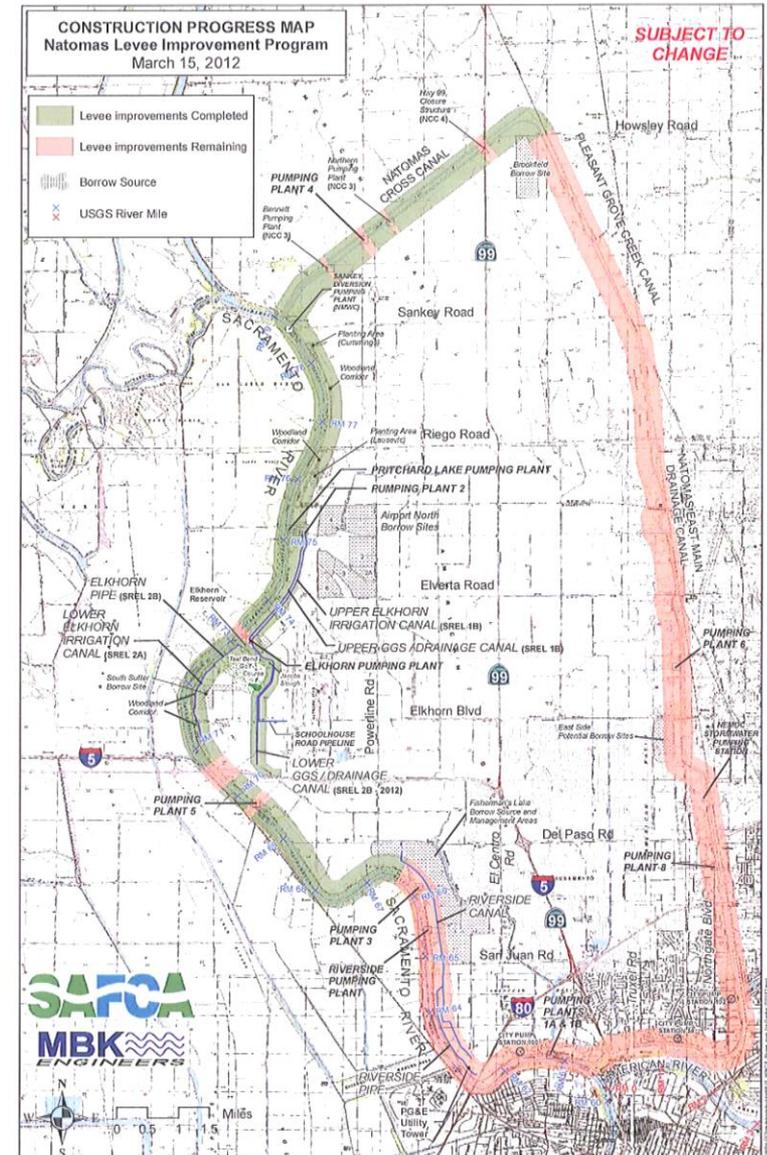
South Sacramento Streams Group



Natomas Levee Improvement Project



42 miles total
18 miles completed
24 miles to finish

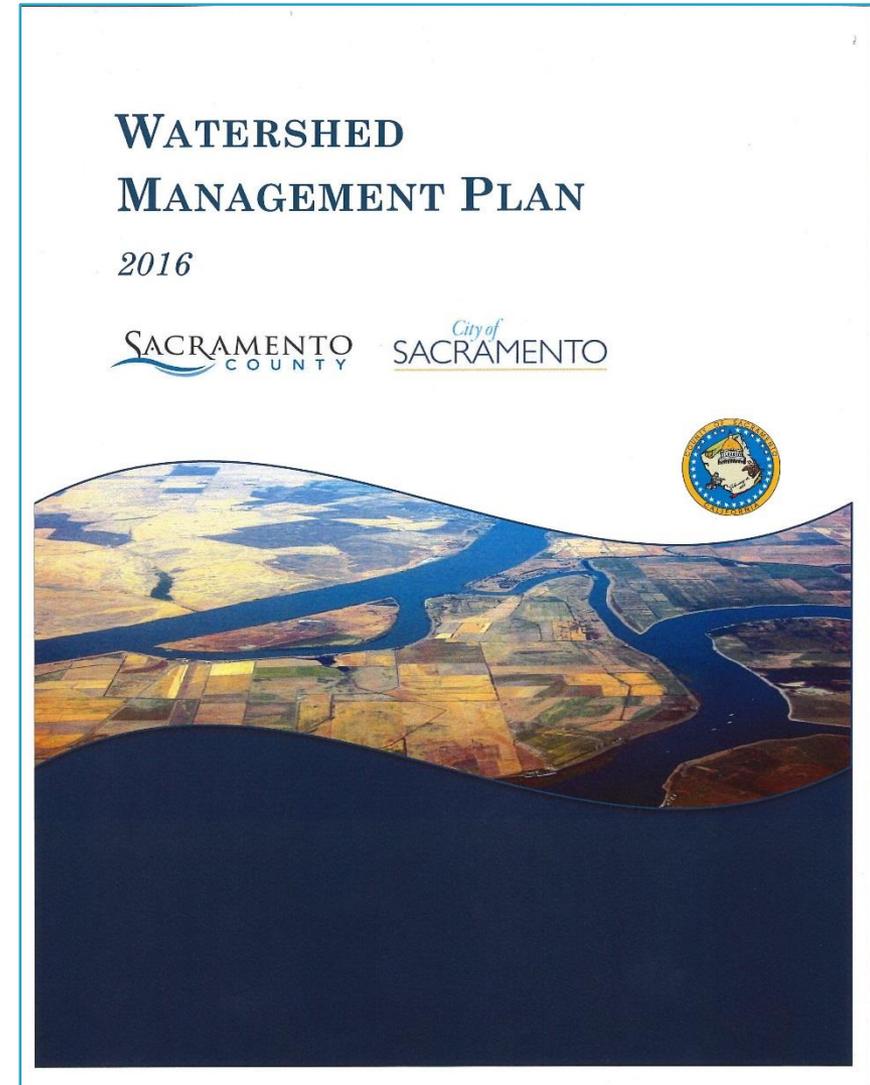


Folsom Dam Modifications/Joint Federal Project



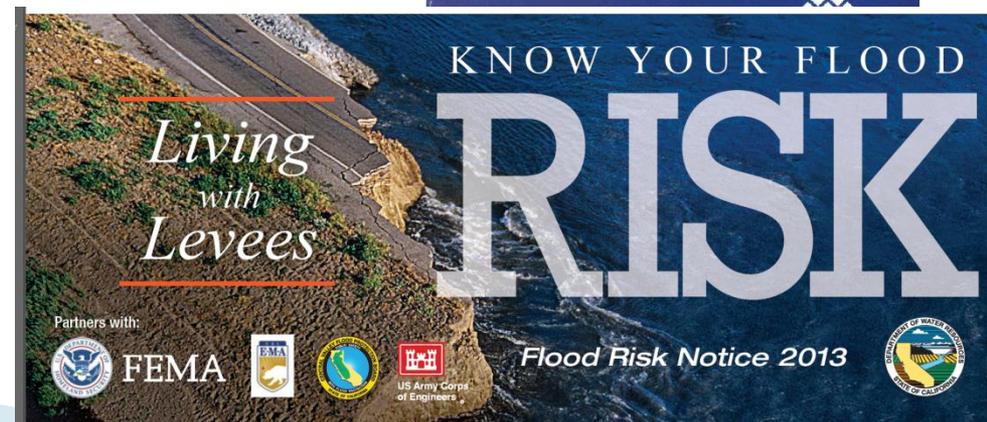
Interior Drainage

- ▶ City/County Watershed Management Plan (WMP)
- ▶ Reducing the increased flooding from upstream Development on watershed-wide basis
- ▶ Updated every 5 years



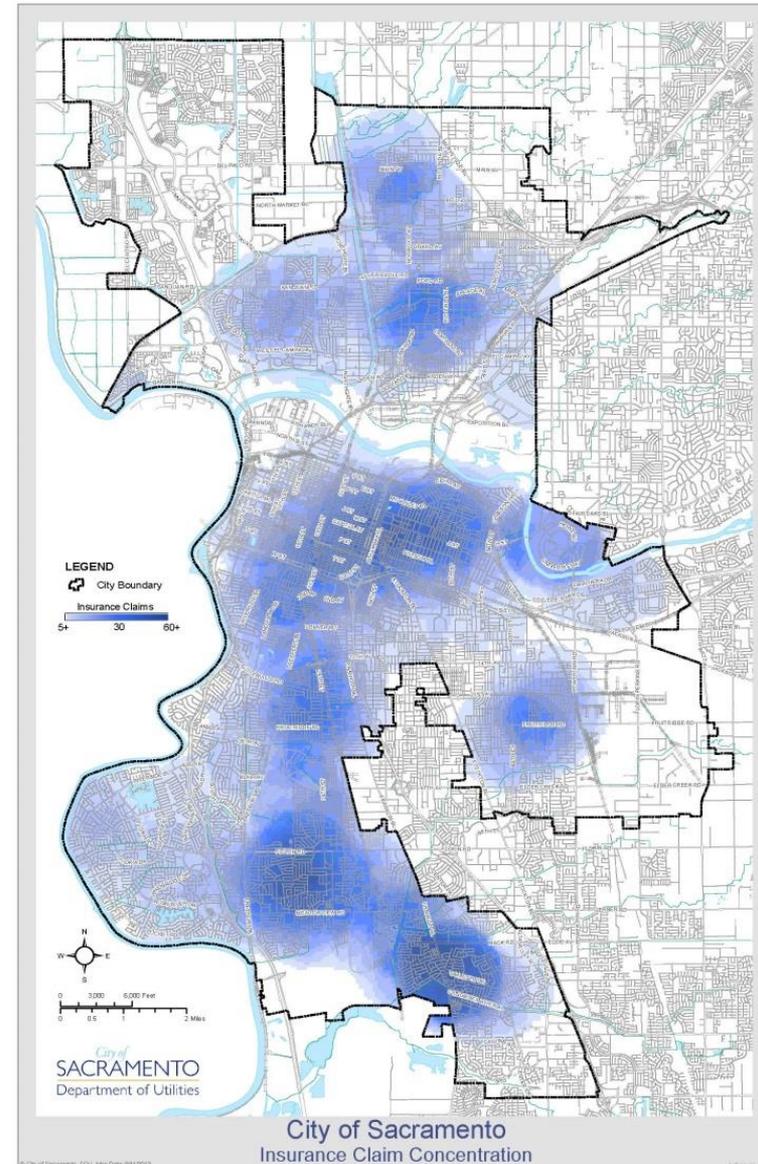
Risk Communication

- ▶ Brochure in City's Utility Bill annually
- ▶ Mailing to Repetitive Loss properties
- ▶ State of CA's Flood Risk Notice to 200-yr floodplain properties
- ▶ Billboards, advertisements on buses, community meetings and events
- ▶ High Water Mark Signs



NFIP/CRS

- ▶ Flood insurance
 - 40,000 policies
- ▶ Community Rating System (CRS) program – encourage communities to exceed the minimum standards of the NFIP by the use of flood insurance premium reductions
- ▶ CRS Rating of 2
 - Equals a 10–40% reduction in flood insurance rates
 - Equals a savings of \$1.3 million/yr. to community



Next Steps

- ▶ CFMP: Future updates every 5 years
 - ▶ CFMP: Annual review of implementation goals for each risk reduction tool
 - ▶ SAFCA Annual Reports showing progress toward 200-year flood protection
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Questions?

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