The San Antonio River Improvements

Design Management

Past, Present and Future

San Antonio River Authority

San Antonio River – Past, Present and Future

- SARA was created by the State of Texas in 1937.
- In 1961, the State expanded our responsibilities to preserve, protect and manage the resources and ecosystems of the San Antonio River Basin.
- SARA has a role in:
  - Protecting our communities from flooding
  - Ensuring the future of our water resources
  - Nurturing our parks and natural resources
  - Preserving the quality and quantity of our water

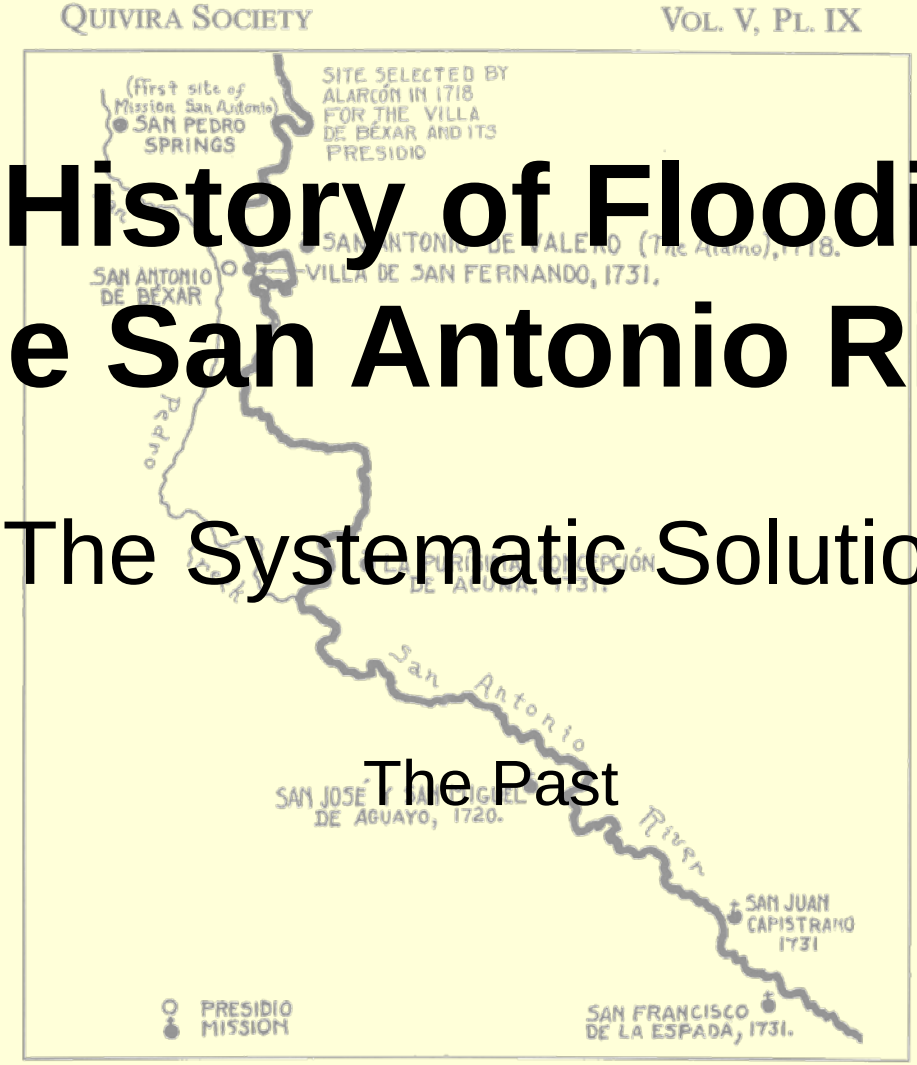
Presentation Outline

- The history of the San Antonio River, Olmos Dam, downtown flood gates, and the San Antonio River Tunnel as a ‘designed system’.
- Taking a multi-faceted approach to future project planning and design.
- The case of the future San Antonio River Improvements Project.
- Flood Warning and Flood Forecasting

The History of Flooding on the San Antonio River

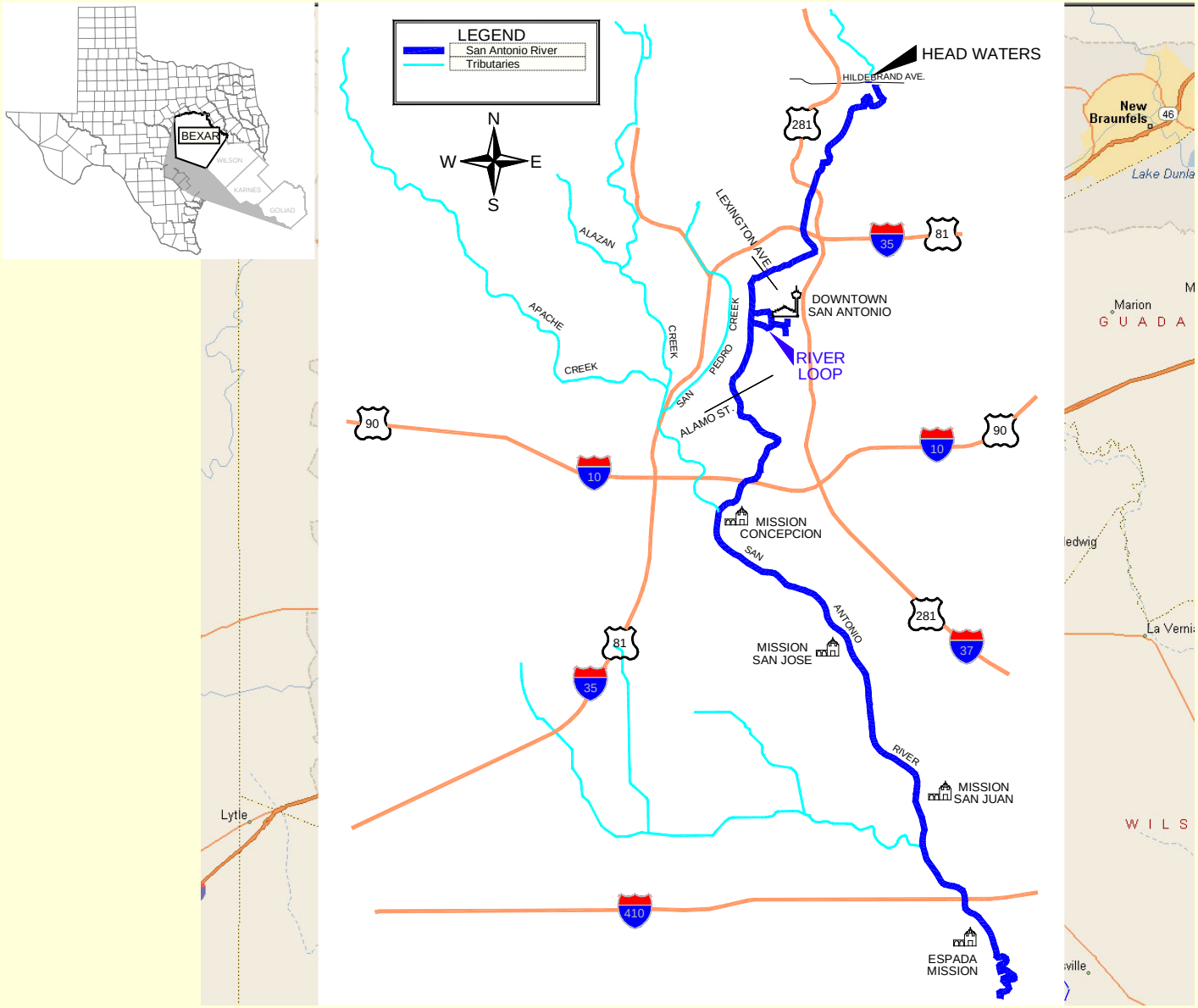
The Systematic Solution

The Past

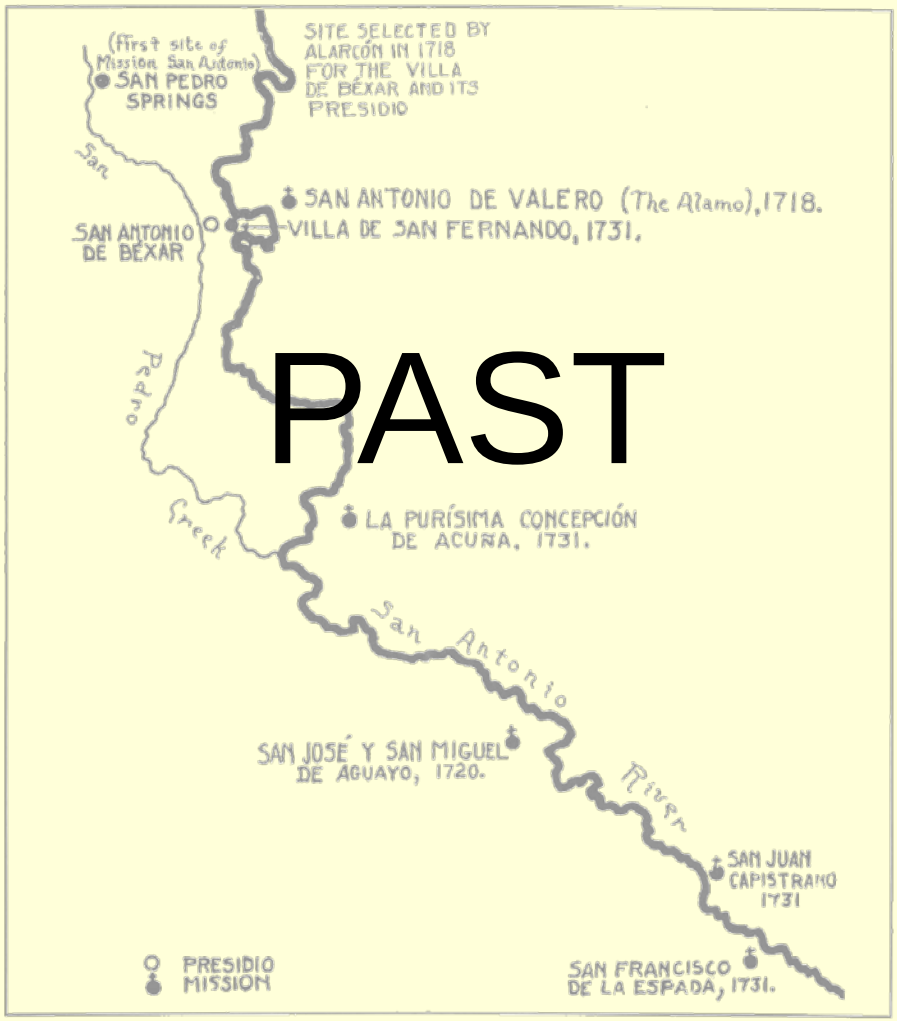


Location Map

San Antonio River – Past, Present and Future



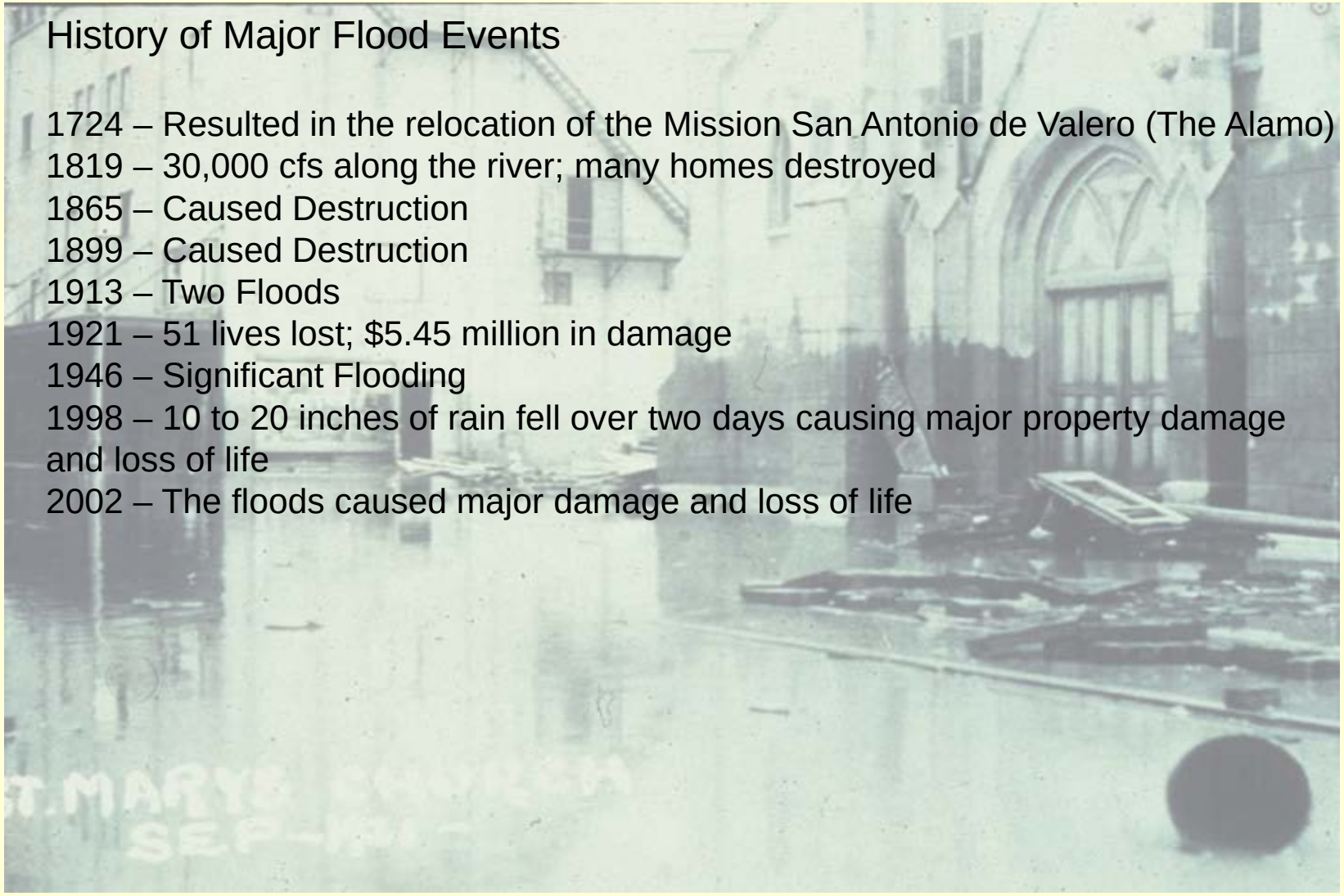
San Antonio River – Past, Present and Future



Past

- Waters of the San Antonio River have sustained human occupation along it's banks for thousands of years.
- Throughout the 1700's development of what is now known as the City of San Antonio, occurred when Spanish Colonial missions were established near the river.
- As San Antonio continued to grow, the river periodically flooded which brought destruction and loss of life.

Past



History of Major Flood Events

1724 – Resulted in the relocation of the Mission San Antonio de Valero (The Alamo)
1819 – 30,000 cfs along the river; many homes destroyed
1865 – Caused Destruction
1899 – Caused Destruction
1913 – Two Floods
1921 – 51 lives lost; $5.45 million in damage
1946 – Significant Flooding
1998 – 10 to 20 inches of rain fell over two days causing major property damage and loss of life
2002 – The floods caused major damage and loss of life

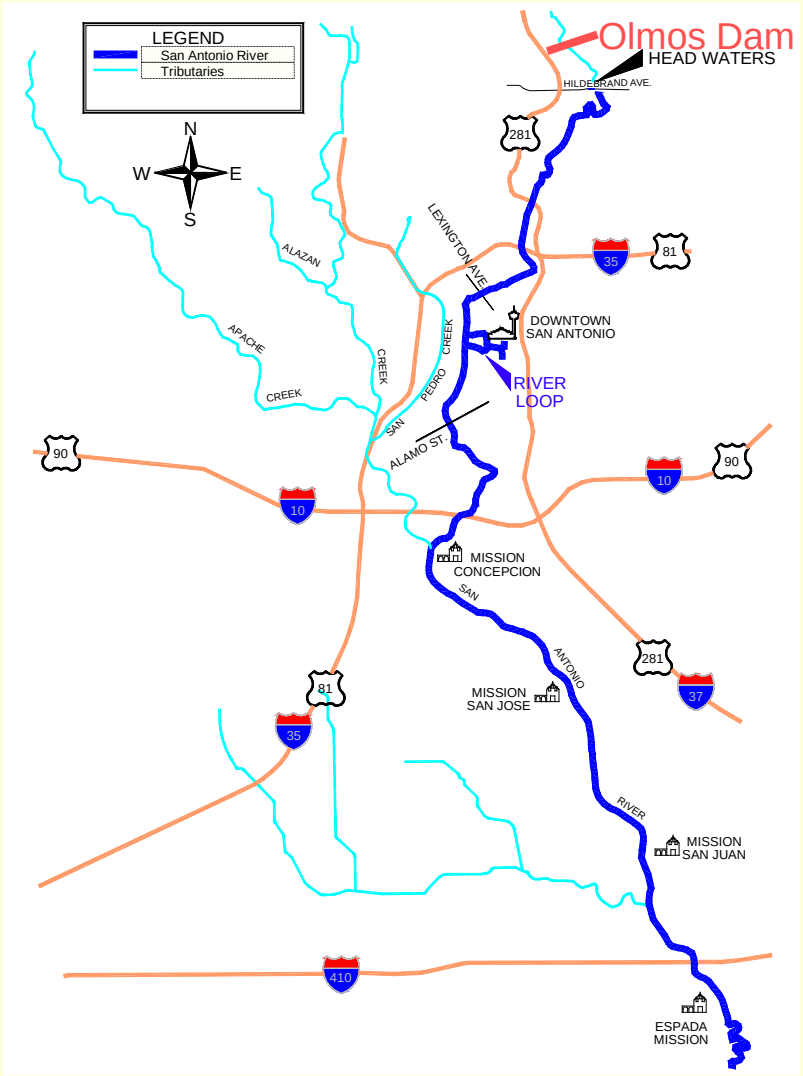
Past

Destruction Due to Flooding

- Flood of 1921

Past

Olmos Dam



Past

- San Antonio has invested in a number of significant projects to manage flooding.
- Olmos Dam Completed in 1927 and Retrofitted in 1982.

Olmos Dam Under Construction

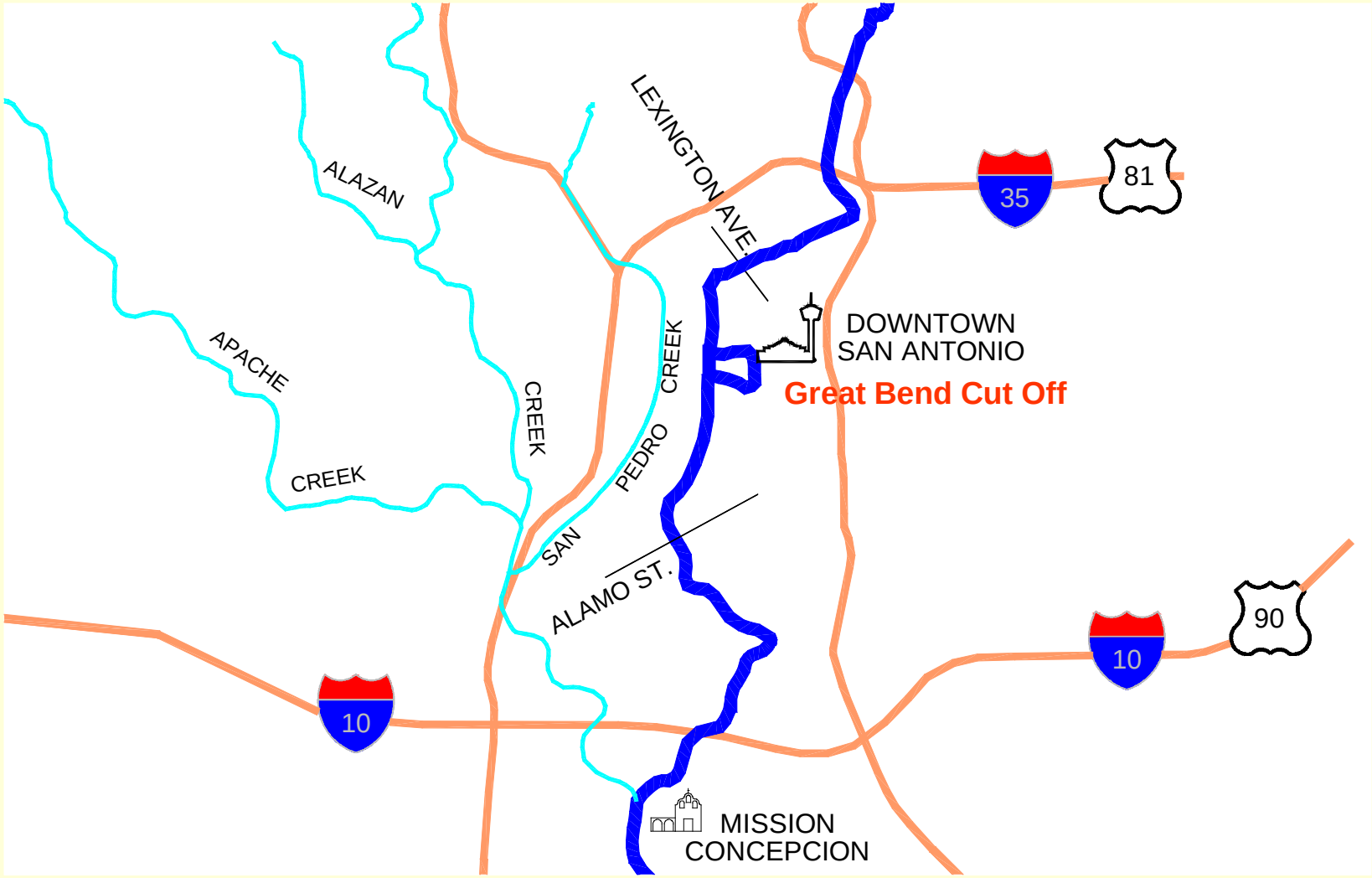
Past

Olmos Dam After Retrofitting

Past

San Antonio River – Past, Present and Future

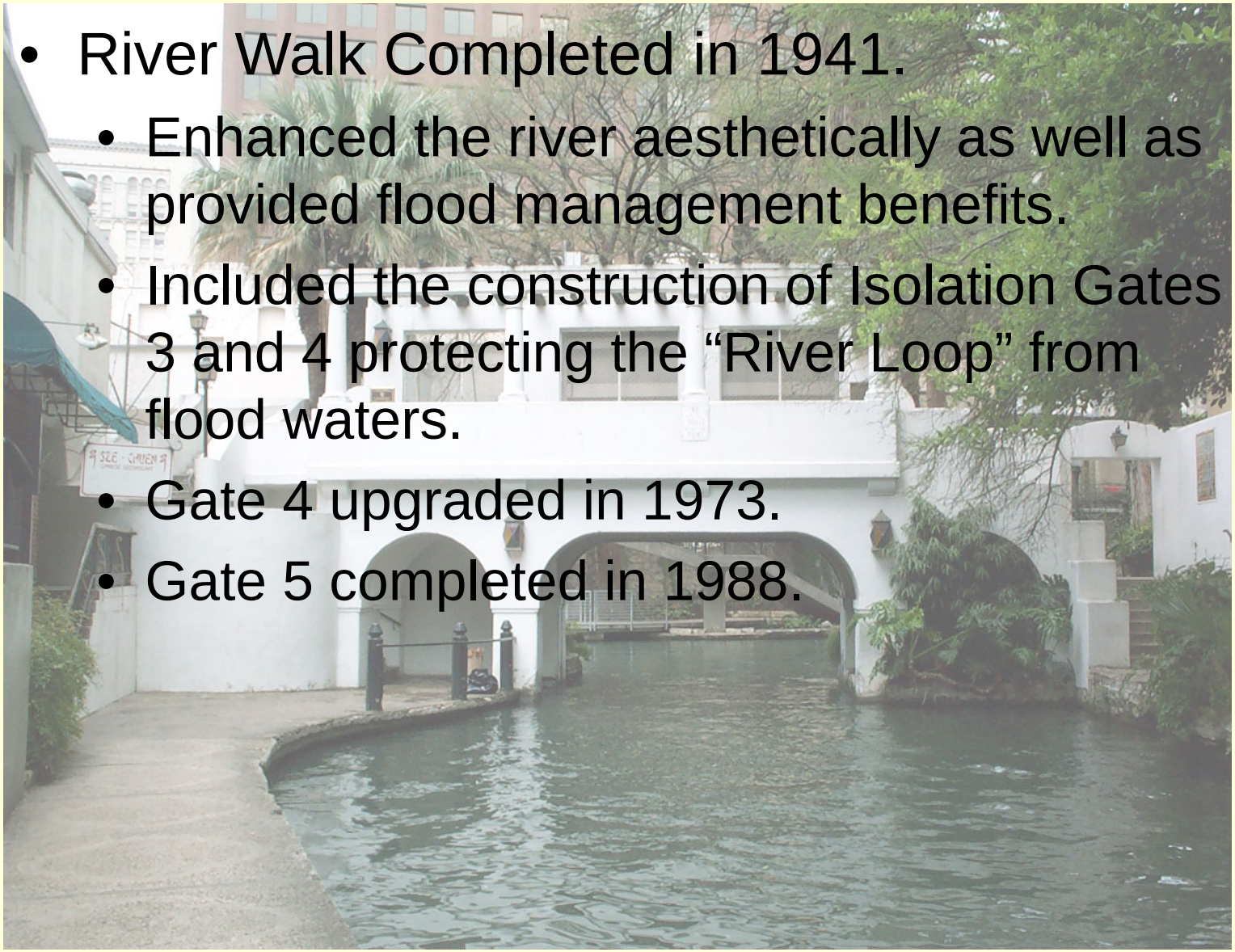
- "Great Bend Cut Off" Completed in 1929.



Past

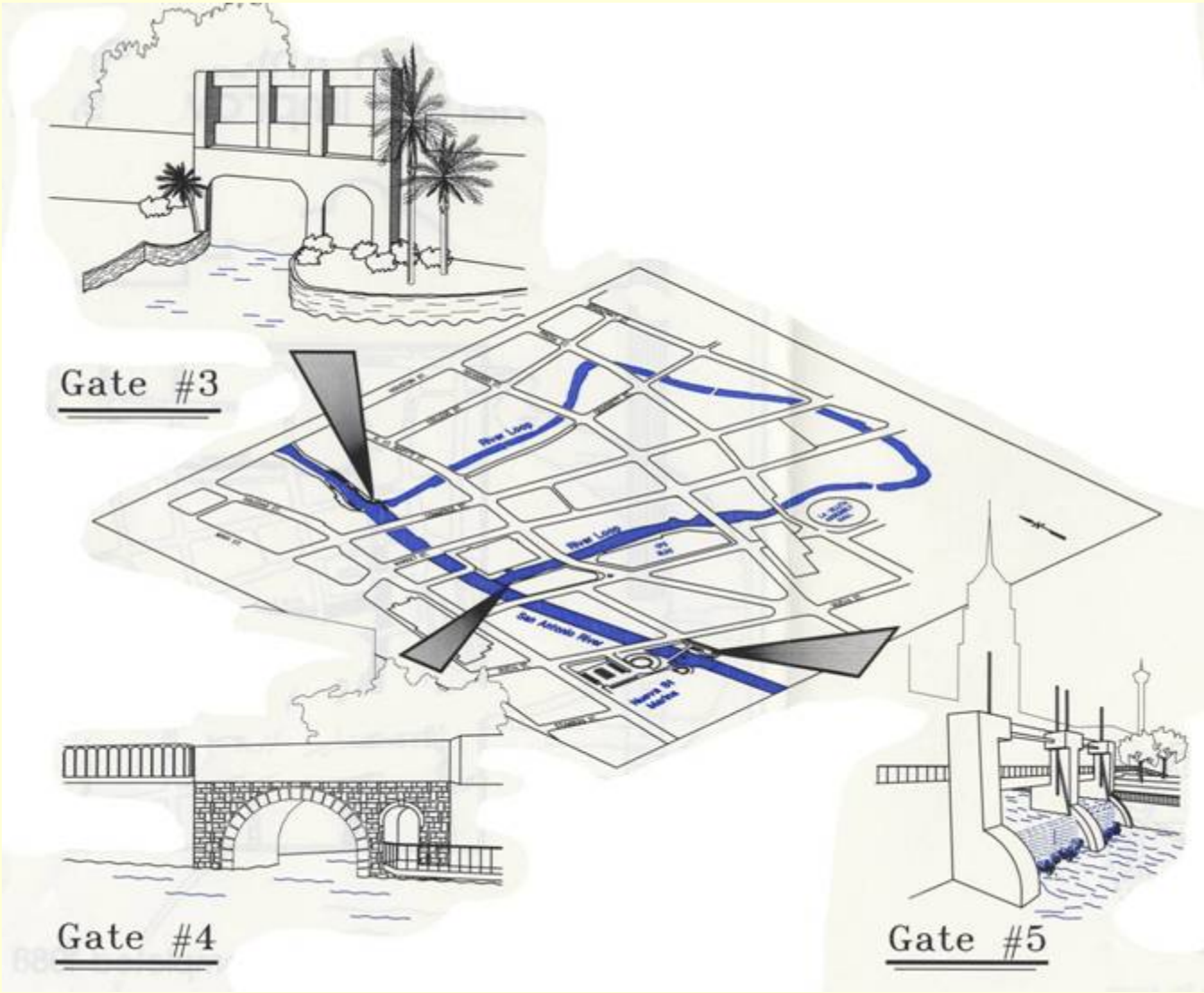
“Great Bend Cut Off” Under Construction

Past



- River Walk Completed in 1941.
  - Enhanced the river aesthetically as well as provided flood management benefits.
  - Included the construction of Isolation Gates 3 and 4 protecting the “River Loop” from flood waters.
  - Gate 4 upgraded in 1973.
  - Gate 5 completed in 1988.

Past



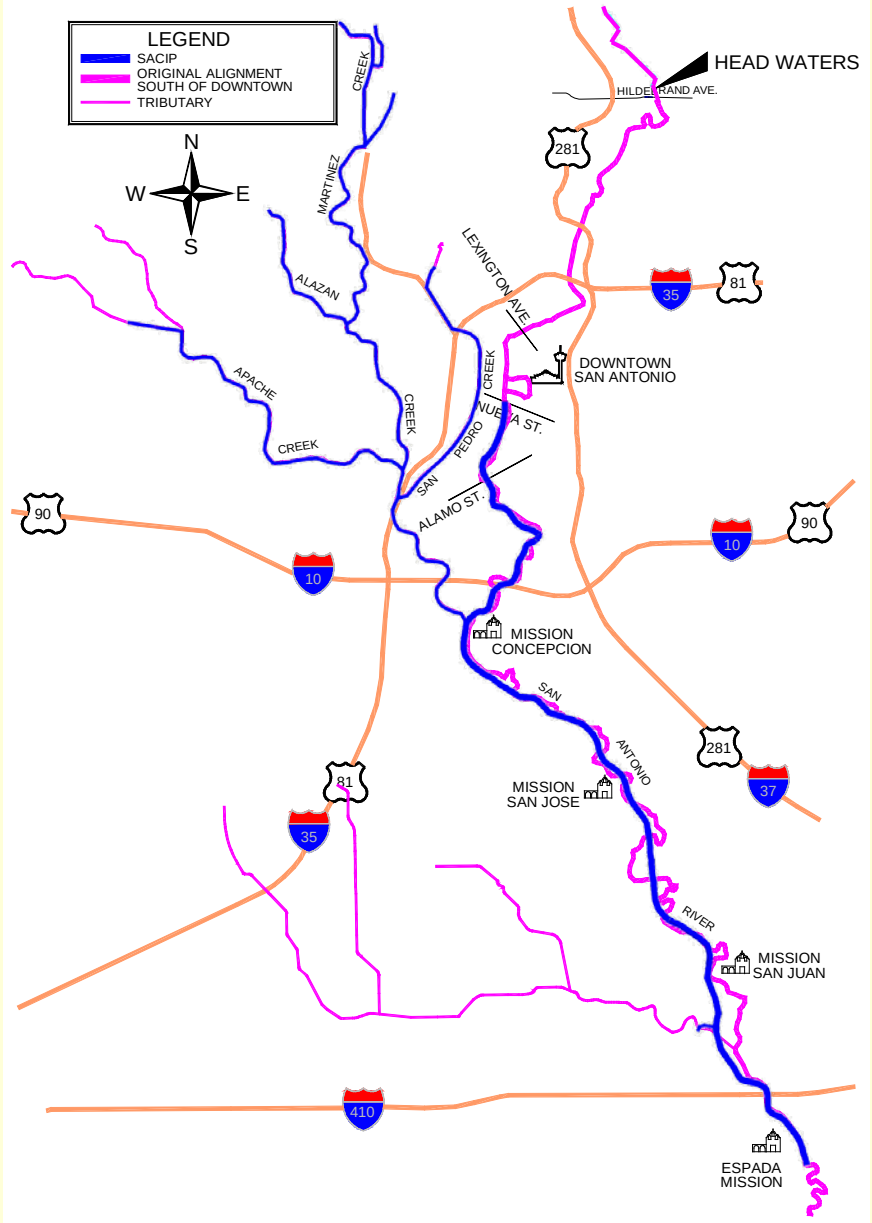
River Walk Gates after completion of Gate 5 in 1988.

Past

- San Antonio Channel Improvements Project (SACIP) was authorized in 1954 by the United States Congress.
  - USACE was the project's federal sponsor and SARA was the local sponsor.
  - SACIP Consisted of:
    - Channelization and Improvements of approximately 31 miles of the San Antonio River and it's tributaries.
      - South of downtown phases were completed in the early 1970's.
      - As channelization approached downtown, enhancements were added to beautify the river and provided an extension to the River Walk.

Past

San Antonio River – Past, Present and Future



Past

SACIP near King William neighborhood

Past

SACIP at Roosevelt Bridge

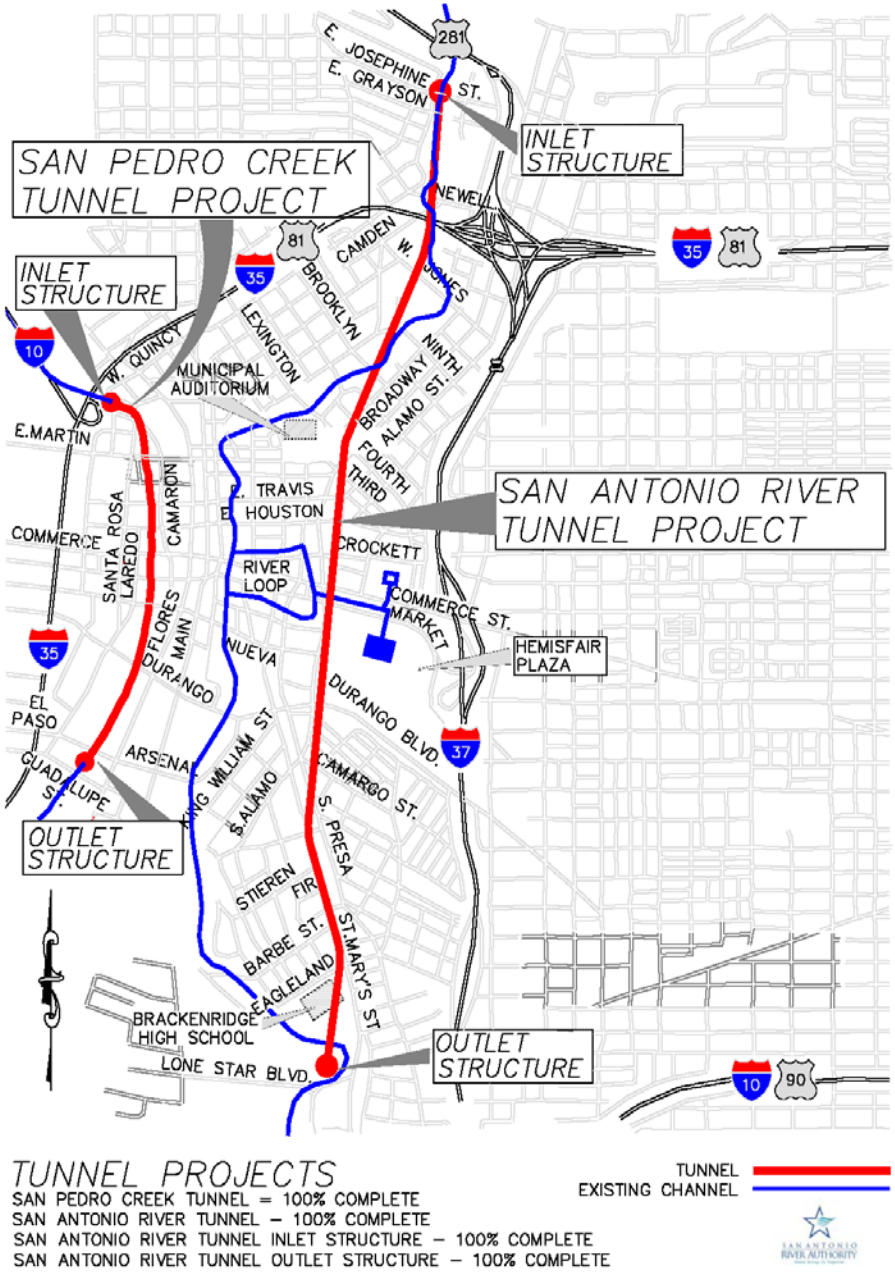
Past

SACIP at Loop 410 Bridge

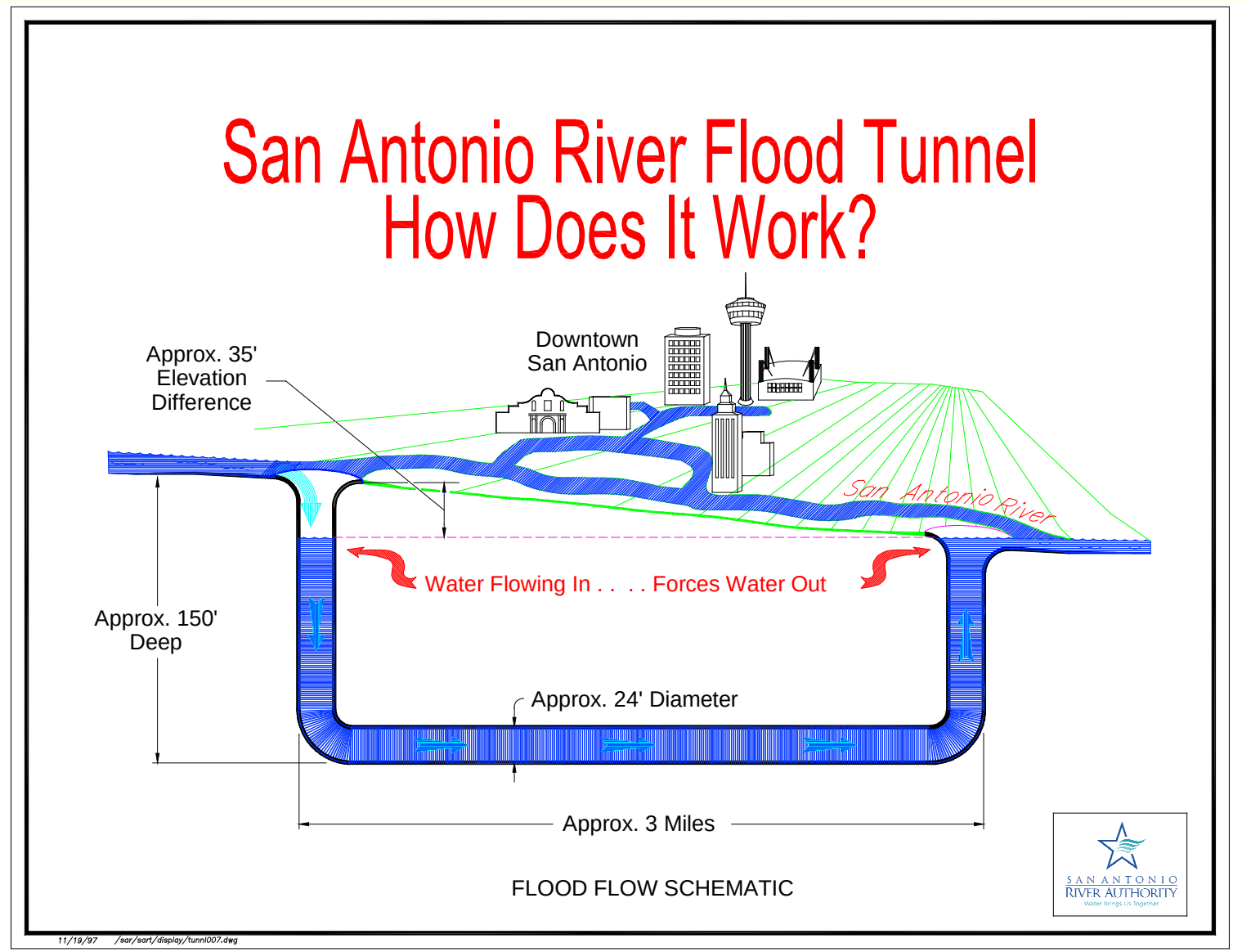
Past

- SACIP Consisted of (continued):
  - 4 miles of Tunnels.
    - San Antonio River Tunnel was completed in 1998, is 24 feet in diameter and 3 miles long.
    - San Pedro Creek Tunnel was also completed in 1998, is 24 feet in diameter and 1 mile long.
    - The San Antonio River Tunnel bypasses approximately 80% of the 100 year storm frequency flood flows underneath downtown.

San Antonio River – Past, Present and Future



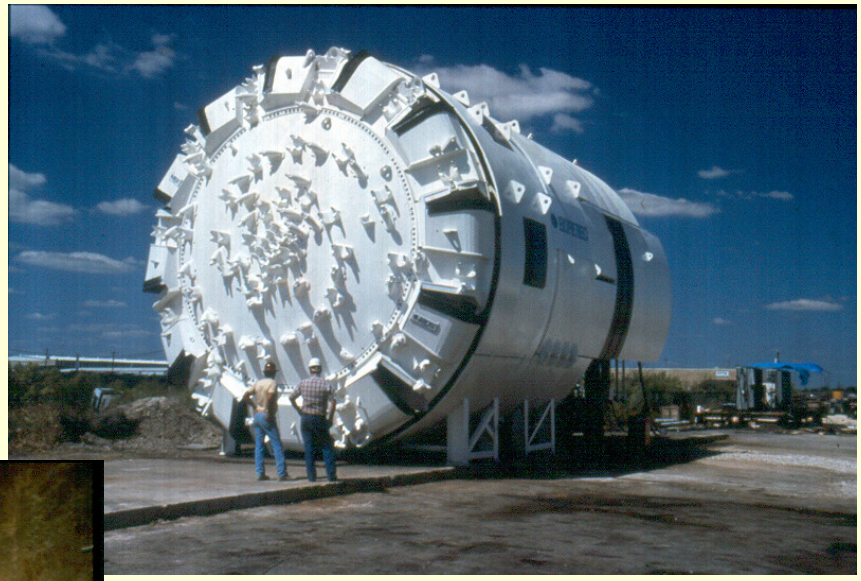
Past


San Antonio River Flood Tunnel
How Does It Work?
Approx. 35' Elevation Difference
Downtown San Antonio
San Antonio River
Water Flowing In . . . Forces Water Out
Approx. 150' Deep
Approx. 24' Diameter
Approx. 3 Miles
FLOOD FLOW SCHEMATIC
SAN ANTONIO RIVER AUTHORITY
Water Brings Us Together
11/19/97 /sar/sart/display/tunnl007.dwg

Past

San Antonio River Tunnel Construction

Past



San Antonio River Tunnel Construction

Past

San Antonio River Tunnel Inlet

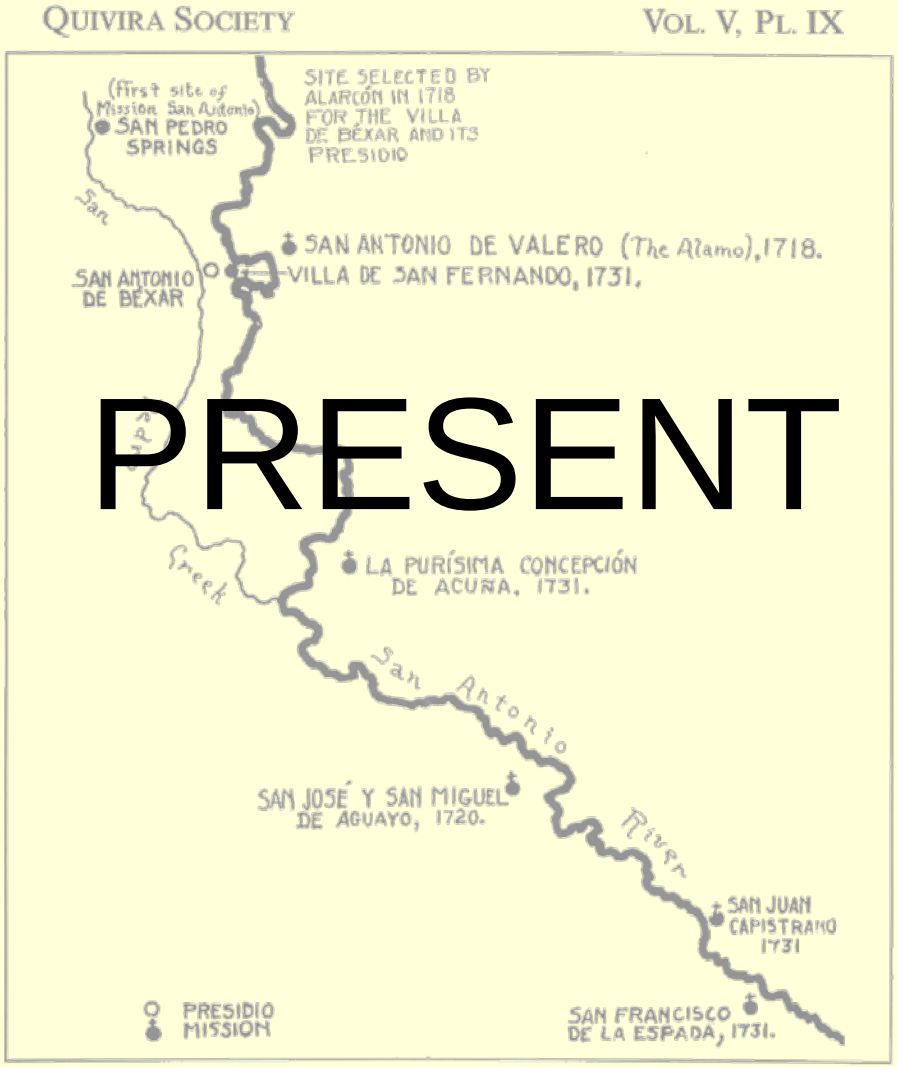
Past

San Antonio River Tunnel Outlet

Past

- The Channel Improvements and Enhancements near downtown and the Tunnel Inlet and Outlet designs were developed in conjunction with public education and input.

San Antonio River – Past, Present and Future



SAN ANTONIO, 1718-1731

Present

- San Antonio has a multicomponent system to manage flooding through and south of the downtown area.

Olmos Dam

River Walk

Tunnel Outlet

Present

San Antonio River – Past, Present and Future

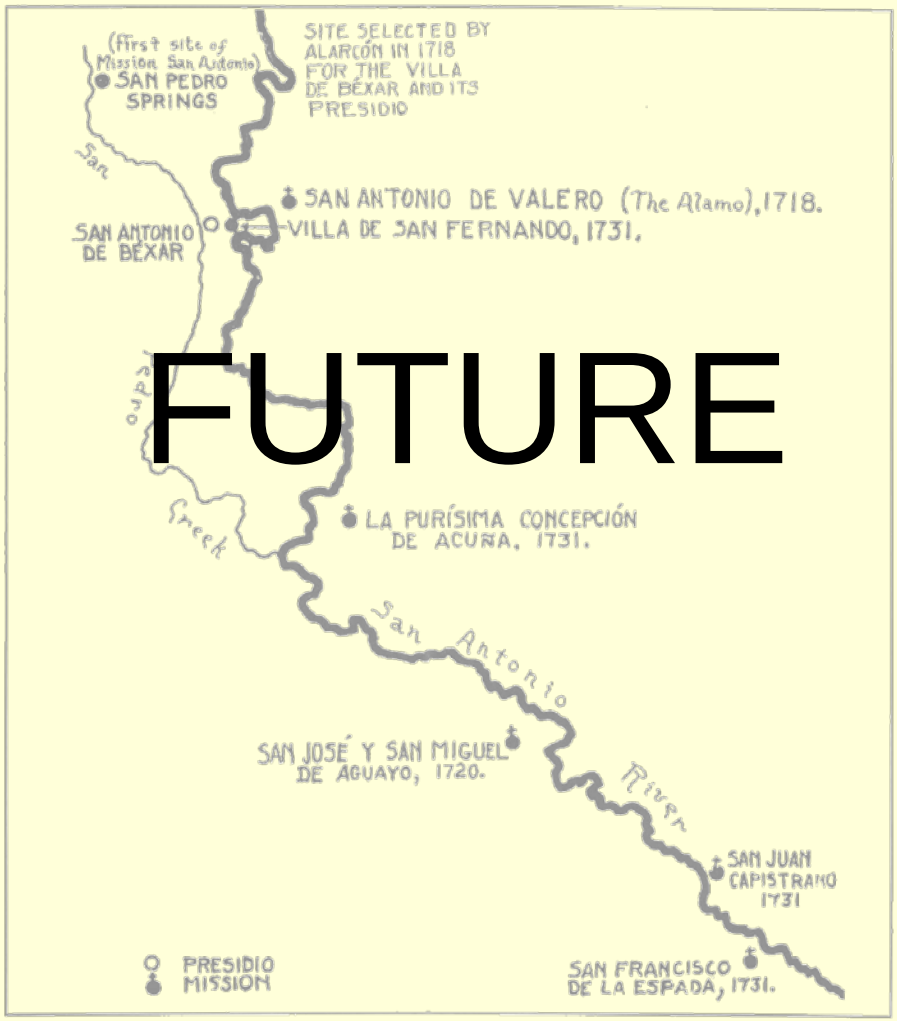
•River Walk provides flood management benefits and preserves the historic tradition and natural beauty of the San Antonio River.

Present

San Antonio River – Past, Present and Future

•Public involvement which influenced the design of the river in the past will continue to guide future improvements.

San Antonio River – Past, Present and Future



SAN ANTONIO, 1718-1731

Future Project Planning and Development

- Limited resources, increased regulations, and an increase in public accountability have mandated a smarter way to design and prioritize public projects.
- Taking a multi-faceted, multi-benefits, multi-partner approach to design.
- The case of the San Antonio River Improvements Project.

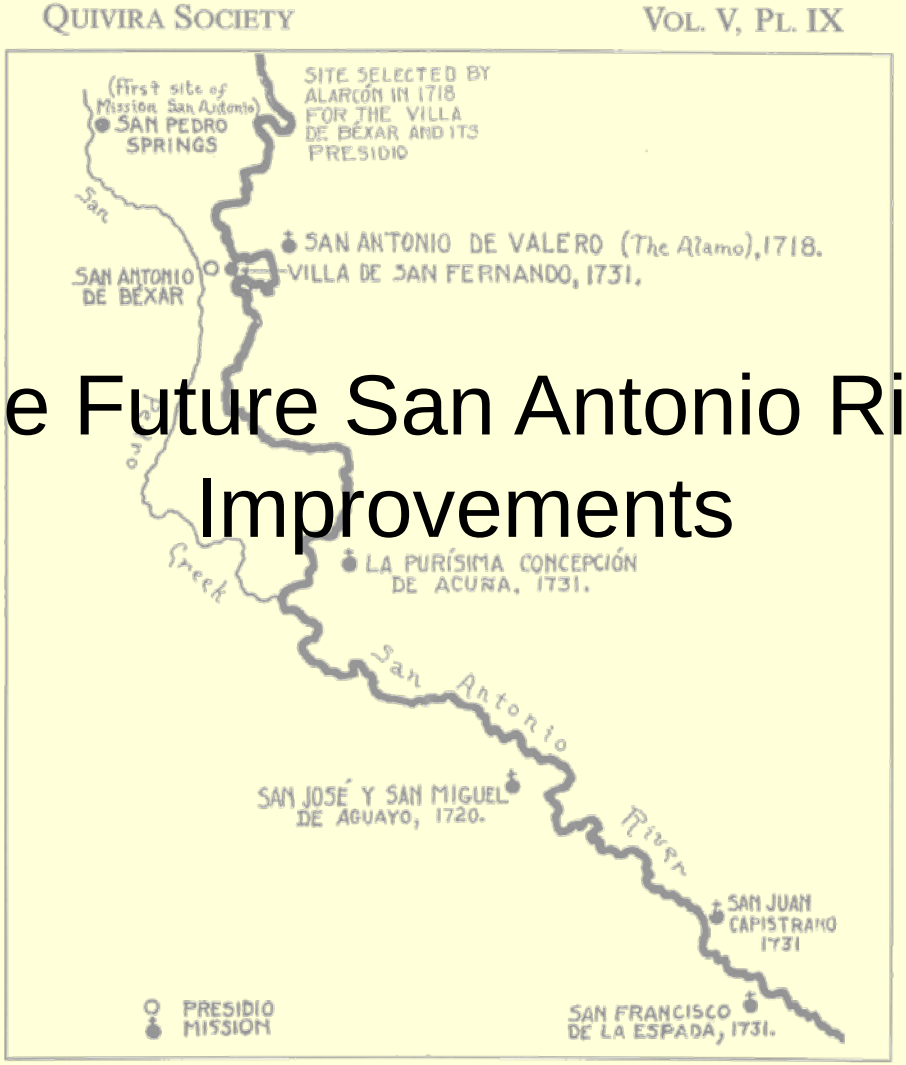
Capital Watershed Project Ranking Factors

- Public Safety
- Element of a comprehensive Watershed Plan
- Mobility or effects on transportation system
- Sustainability or low operations & maintenance cost
- Funding sources (leverage of participants available funds)
- Promote orderly development or improve economic development/redevelopment potential
- Beneficial neighborhood impacts
- Water Quality enhancement
- Environmental or Habitat enhancement
- Potential for recreation/open space/connectivity for linear parks

Capital Project Ranking Factors

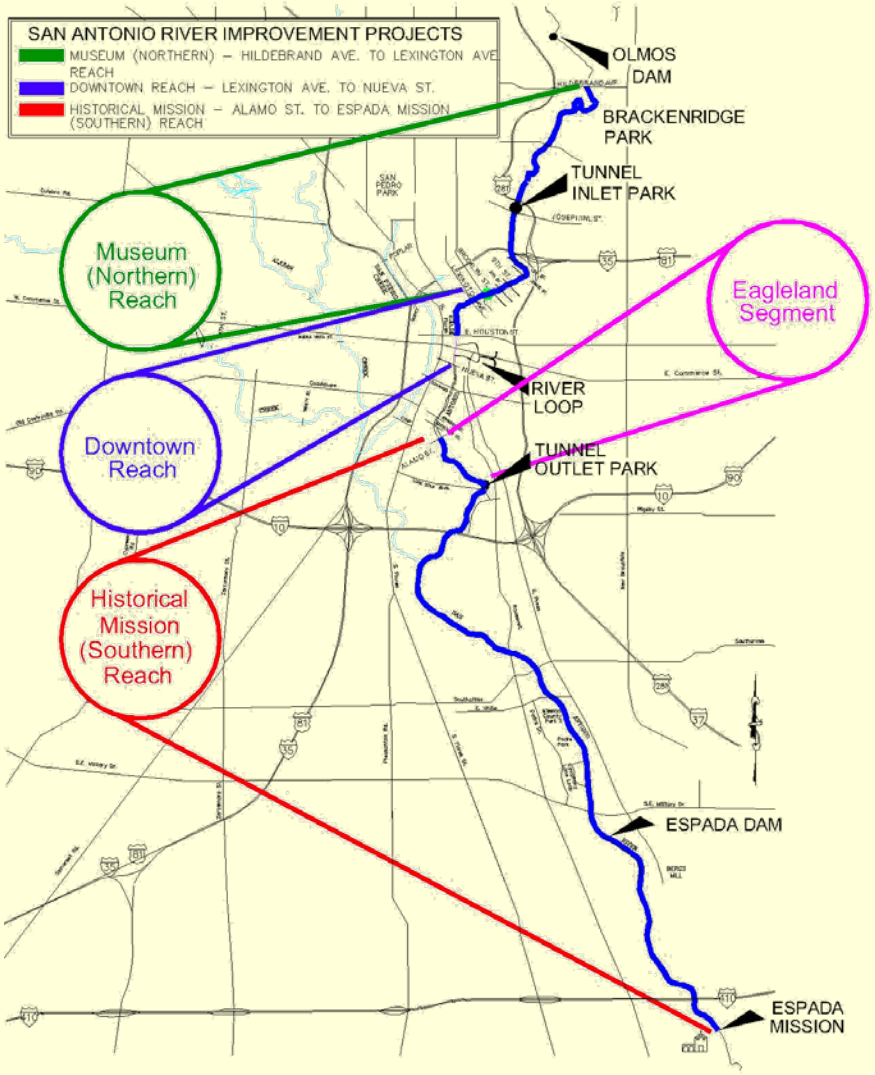
Prioritization Ranking Factors	Ranking Factor Weight	A Road Drainage Ditch Project Specific Score	A Road Drainage Ditch Project Specific Weighted Score	Wet Creek Buyouts Project Specific Score	Wet Creek Buyouts Project Specific Weighted Score	Maximum Possible Score Project Specific Score	Maximum Possible Score Project Specific Weighted Score
Hydraulic/hydrologic significance or impact	4	3	12	3	12	3	12
Public safety	4	1	4	2	8	3	12
Benefit/cost ratio	4	2	8	3	12	3	12
Element of a comprehensive watershed plan	4	1	4	3	12	3	12
Dependency on other projects	2	3	6	3	6	3	6
Mobility or effects on transportation system	2	3	6	0	0	3	6
Sustainability or low operations & maintenance cost	2	1	2	3	6	3	6
Level of protection provided (i.e. 25 year, 50 year or 100 year flood)	2	3	6	3	6	3	6
Funding sources (leverage of participants available funds)	2	0	0	1	2	3	6
Promote orderly development or improve economic dev./redev. potential	2	3	6	3	6	3	6
Beneficial neighborhood impacts	1	3	3	2	2	3	3
Water quality enhancement	1	1	1	1	1	3	3
Time to implement or construct	1	2	2	1	1	3	3
Permitting resistance or difficulty	1	1	1	3	3	3	3
Environmental or habitat enhancement	1	0	0	1	1	3	3
Potential for Recreation/Open Space/Connectivity for linear parks	1	0	0	3	3	3	3
Total Project Score			61		81		102
Check Items That Apply:							
Recharge Enhancement							X
No specific or pending litigation			X		X		X
Agency has administration and/or staff capable of o&m			X		X		X

The Future San Antonio River Improvements



Project Limits

Project Area



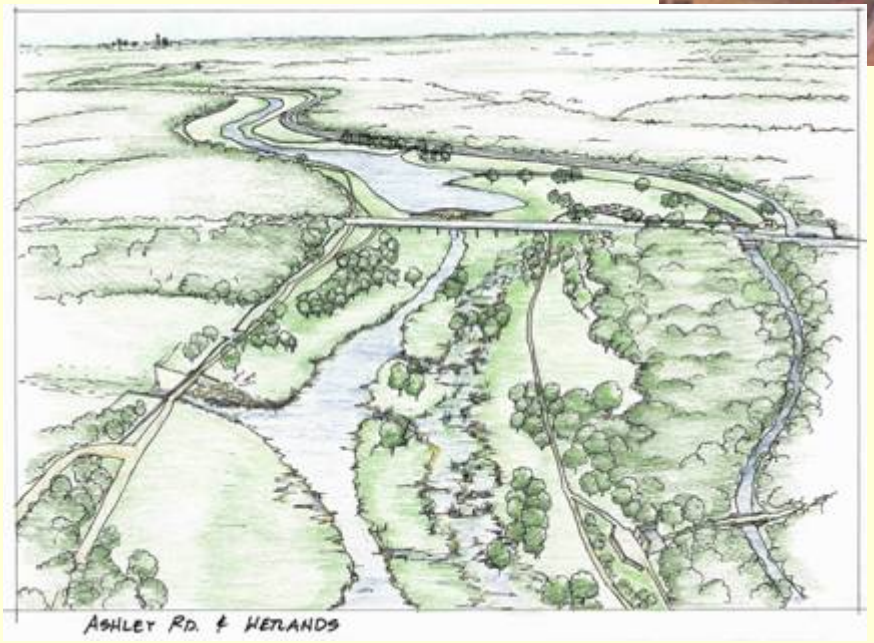
FUTURE

Project Vision

- Historical Mission (Southern) Reach at Ashley Road

Existing

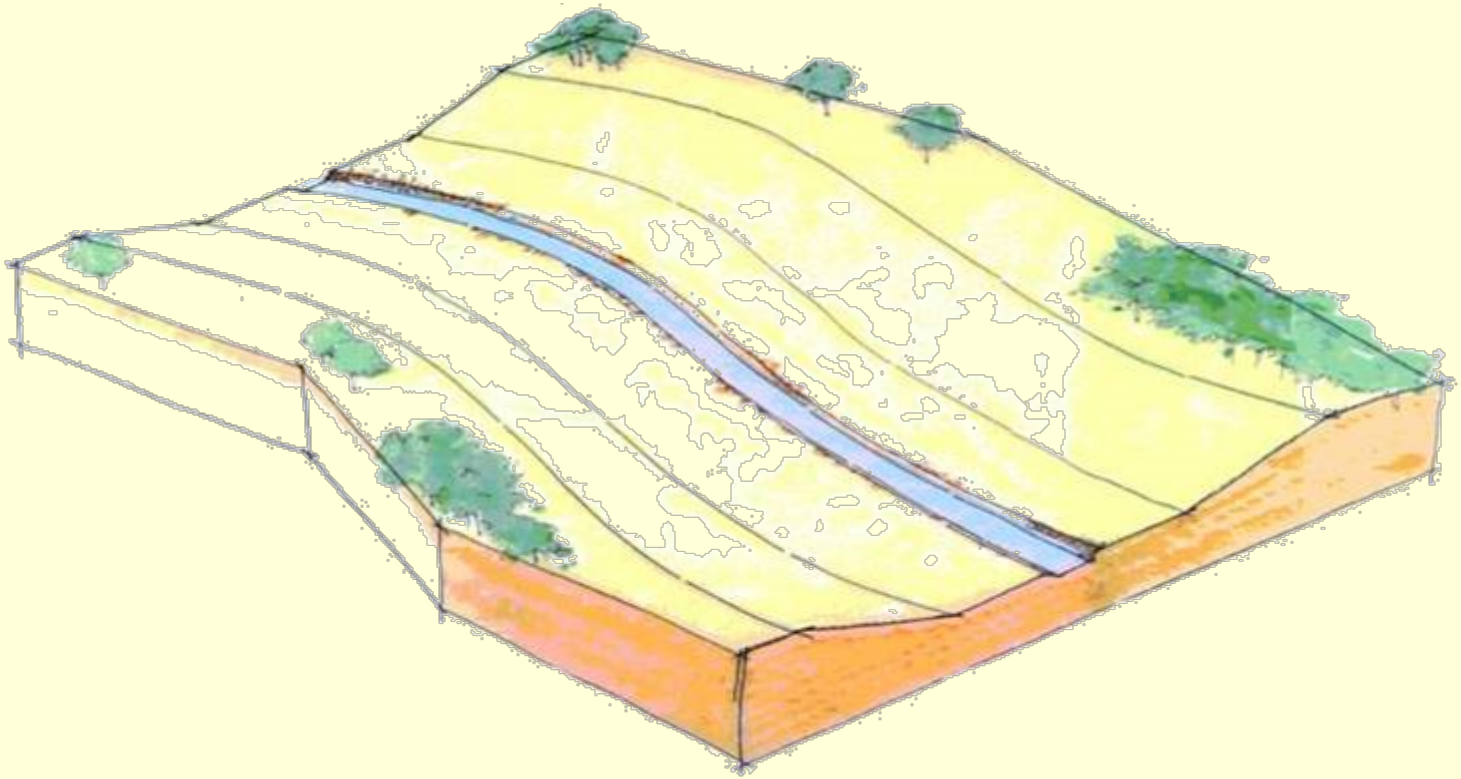
Proposed



FUTURE

River Channel Restoration

Existing River Channel



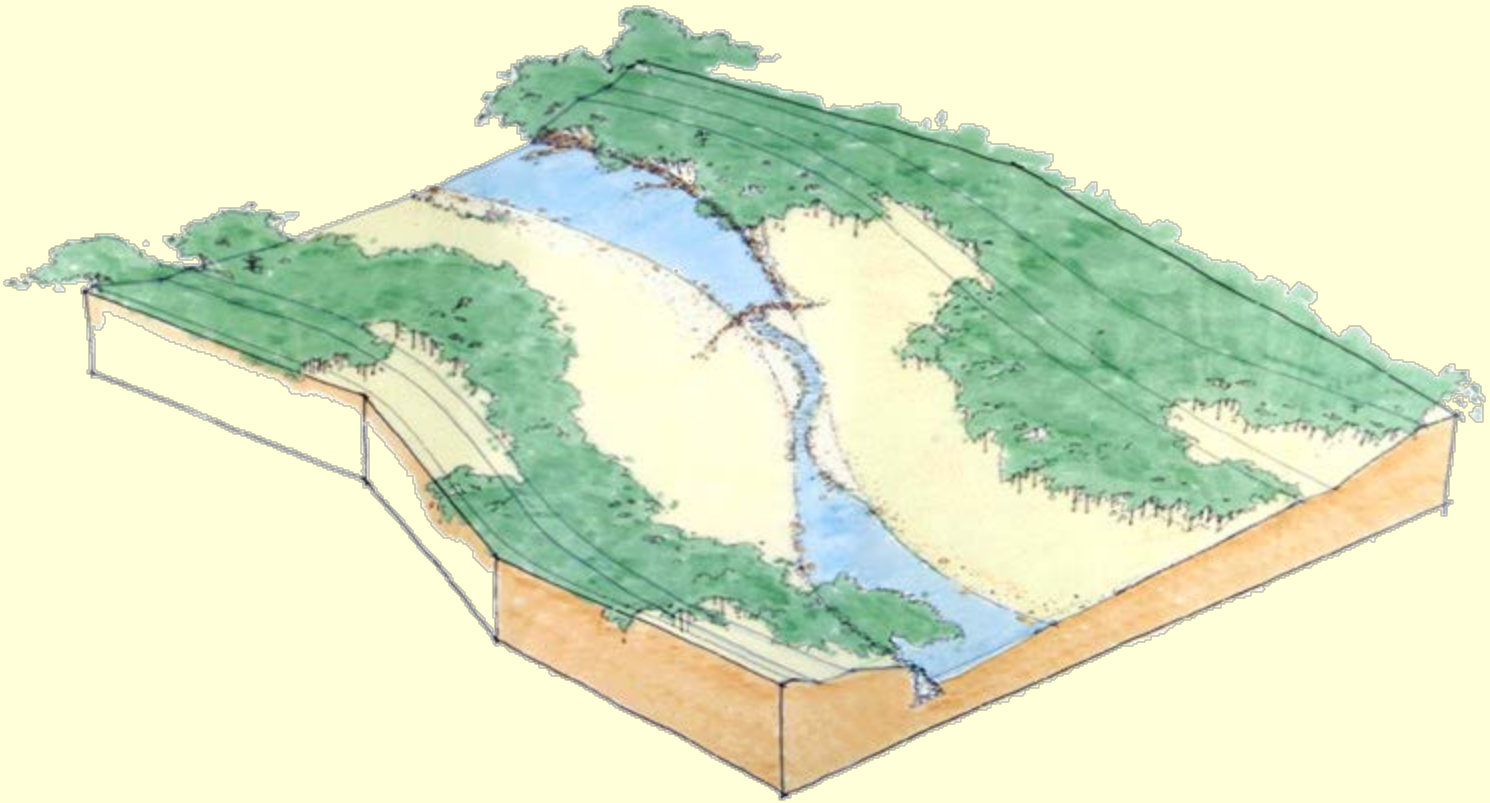
FUTURE

River Channel Restoration

Proposed River Channel

- Through geomorphic and sediment transport analysis a more stable and natural river channel will be produced.

- Addition of vegetation will provide habitat for terrestrial and aquatic species.



FUTURE

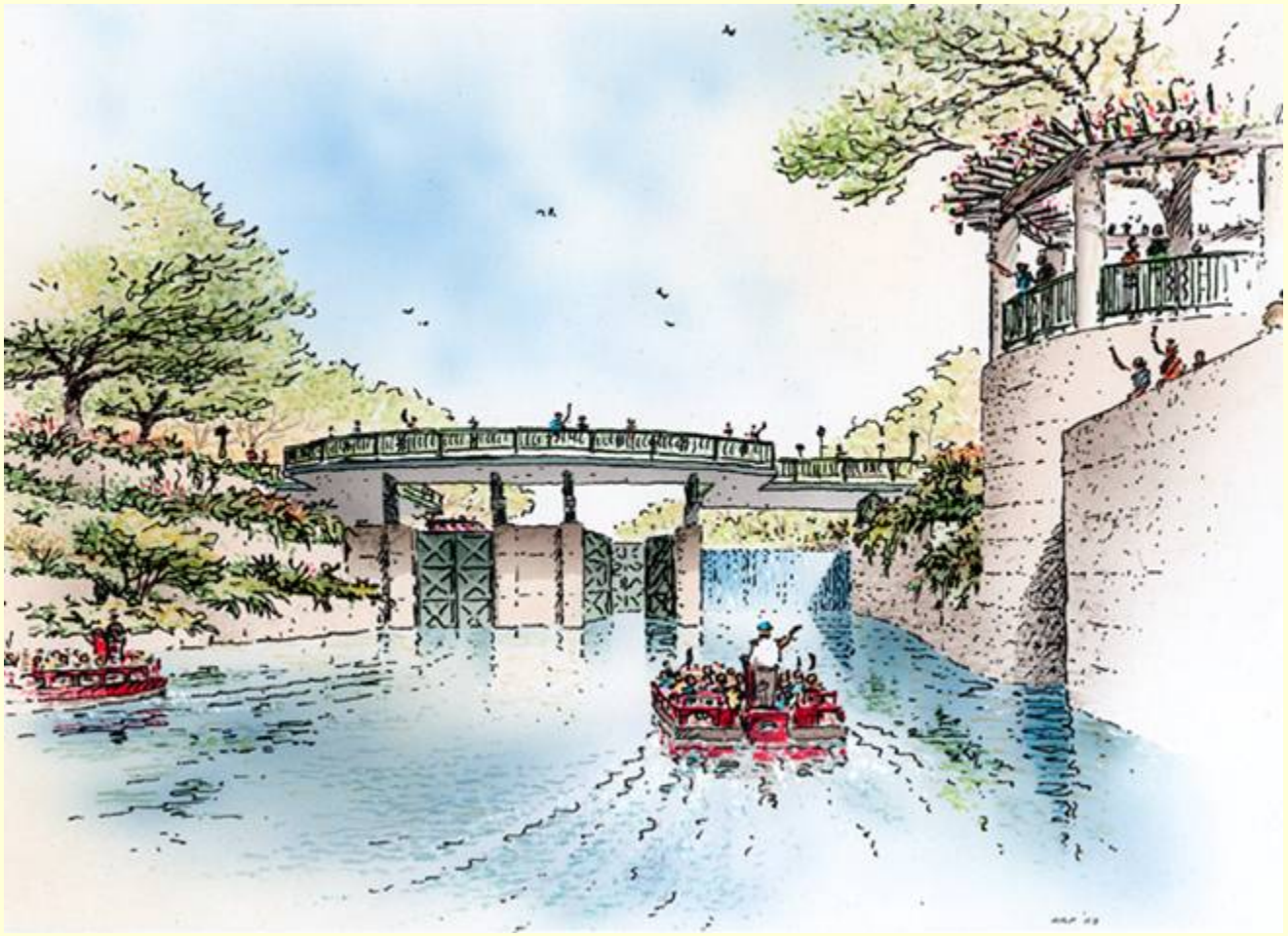
Project Vision-Urban Segment

- Museum (Northern) Reach at Brooklyn Ave.

Existing

Proposed

Brooklyn Dam



FUTURE
Project Benefits

- **Economic Development** – *The project should increase land values and promote business development along and adjacent to the river. Improvements will also enhance tourism.*
- **Flood Protection** – *The project will have no increase to the 100 year flooding water surface profile, in fact most areas the project will reduce the threat due to flooding.*
- **Quality of Life** – *Add to San Antonio's unique charm and make the city more attractive to residents, visitors, and businesses.*
- **Environmental Restoration** – *The changes proposed will increase water quality and the quantity and diversity of plant and animal species.*
- **Linking People & Neighborhoods** – *This project will increase community use of the river and may act as a catalyst to some neighborhood revitalization.*
- **Connecting Cultural Resources** – *Serve as a thirteen mile link between San Antonio's Museums, Missions, and downtown attractions.*

FUTURE

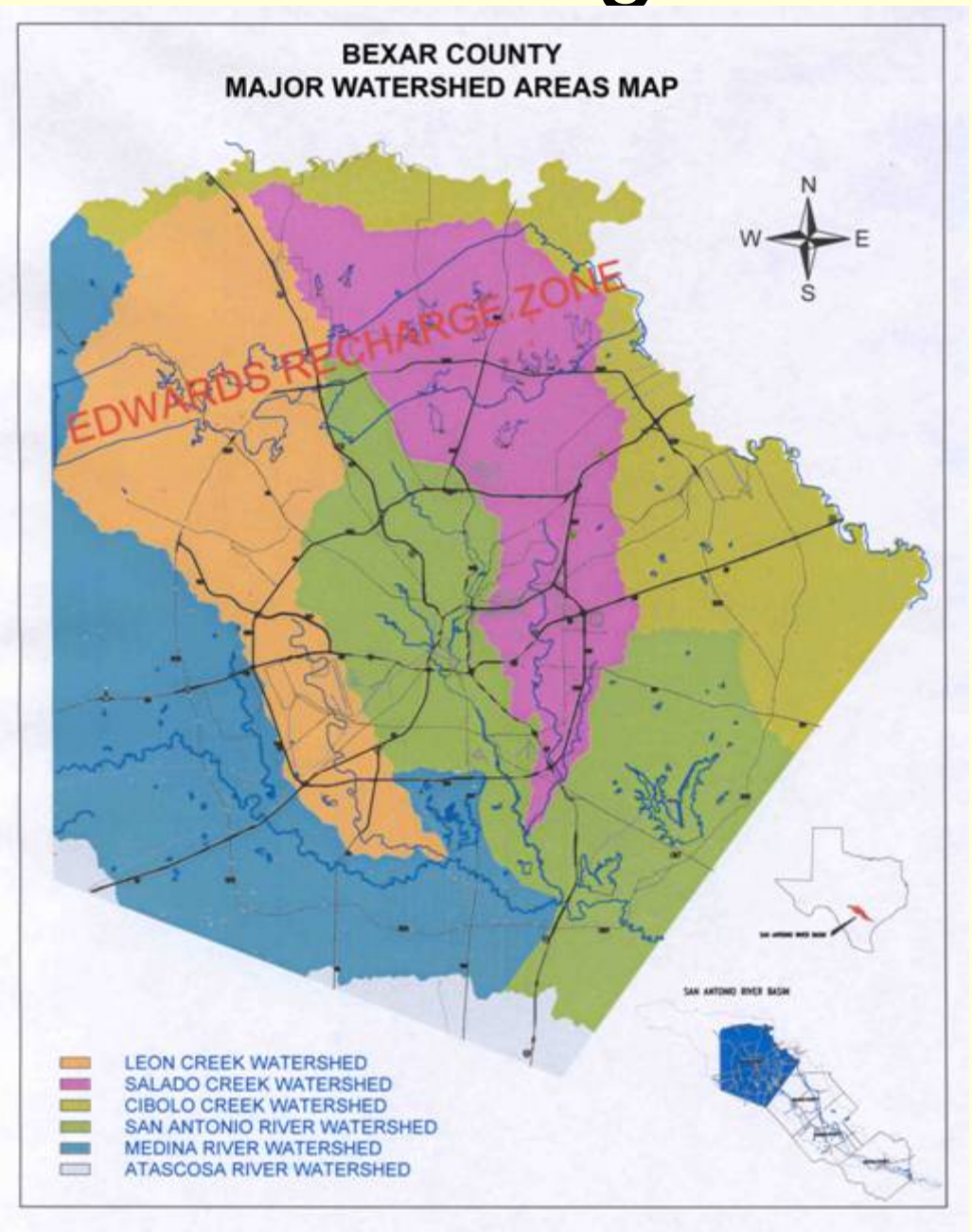
Participation

- **City of San Antonio**
  – Provide project funding for project amenities (i.e.. Sidewalks, Landscaping, Lighting, etc.)
- **Bexar County**
  – Provides project funding for flood control elements of the project
- **San Antonio River Authority (SARA)**
  – Provide project administration and management
- **Corps of Engineers**
  – Provides project funds for river restoration and some recreational funding
- **Potential Private Sector Participation**
  – Provide funds to enhance or upgrade the city's base amenities to something "First Class"
- **San Antonio River Oversight Committee**
  – A 22 person, citizens committee appointed by the City, County and SARA representing the various neighborhood and business stakeholders along the river.

Bexar Regional Watershed Management

Inter-local Agreement

ILA Coverage Area



Watershed	Area Sq. Mi.	Population
Cibolo Creek	204	97,000
Leon Creek	235	278,000
Medina River	290	83,000
Salado Creek	222	349,000
San Antonio River	270	582,000

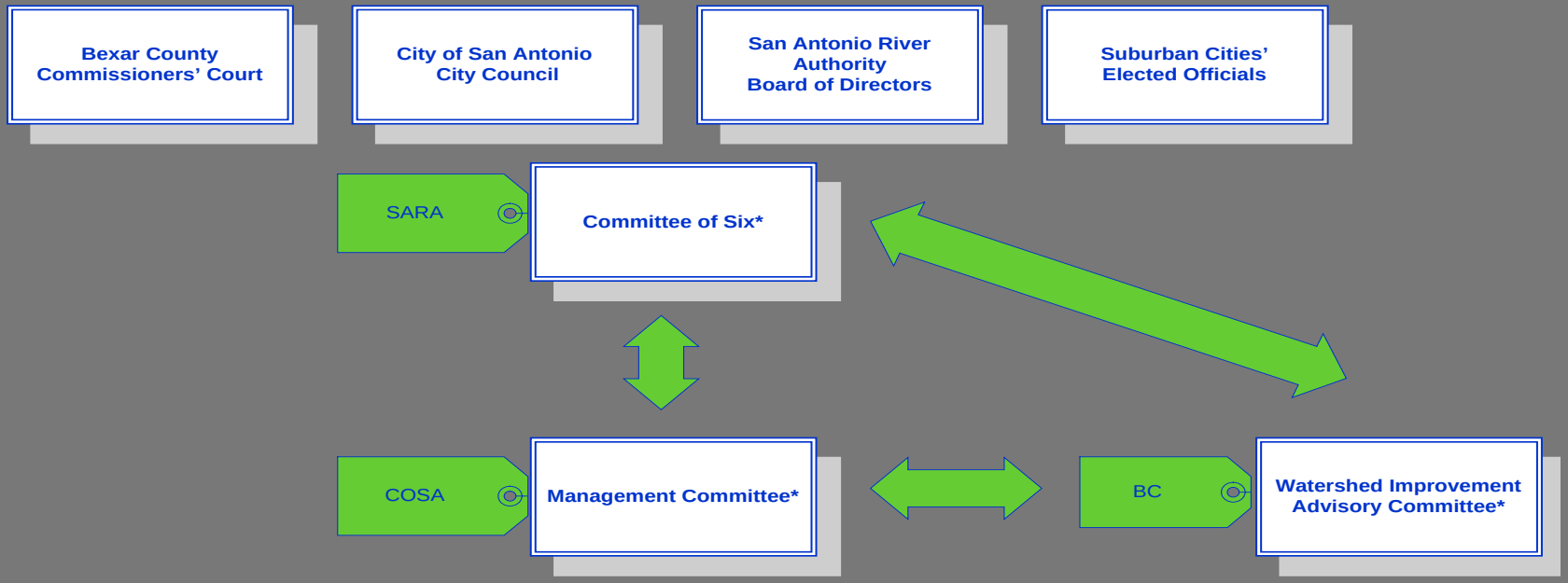
Program Partners

- Inter-local Agreement (ILA) establishes a partnership between:
  - Bexar County (County)
  - City of San Antonio (COSA)
  - San Antonio River Authority (SARA)
- Future agreements are planned with:
  - Other municipalities
  - Federal installations
  - Local, regional, state, and federal agencies

Goals

- Improve the management of flood control and storm water issues in Bexar County
- Promote more effective use of public resources
- Reduce the threat of loss of life and property due to flooding and heavy rain

Regional Management Program Oversight and Implementation



Executive Director of Infrastructure Services, BC

General Manager, SARA

Director of Public Works, COSA

Suburban Cities Representative

Watershed Financial Committee*

Bexar County Staff
COSA Staff
SARA Staff
Others

CH2MHILL Team

Impervious Area Study

Impact Fee Study

Watershed Technical Committee*

Bexar County Staff
COSA Staff
SARA Staff
Others

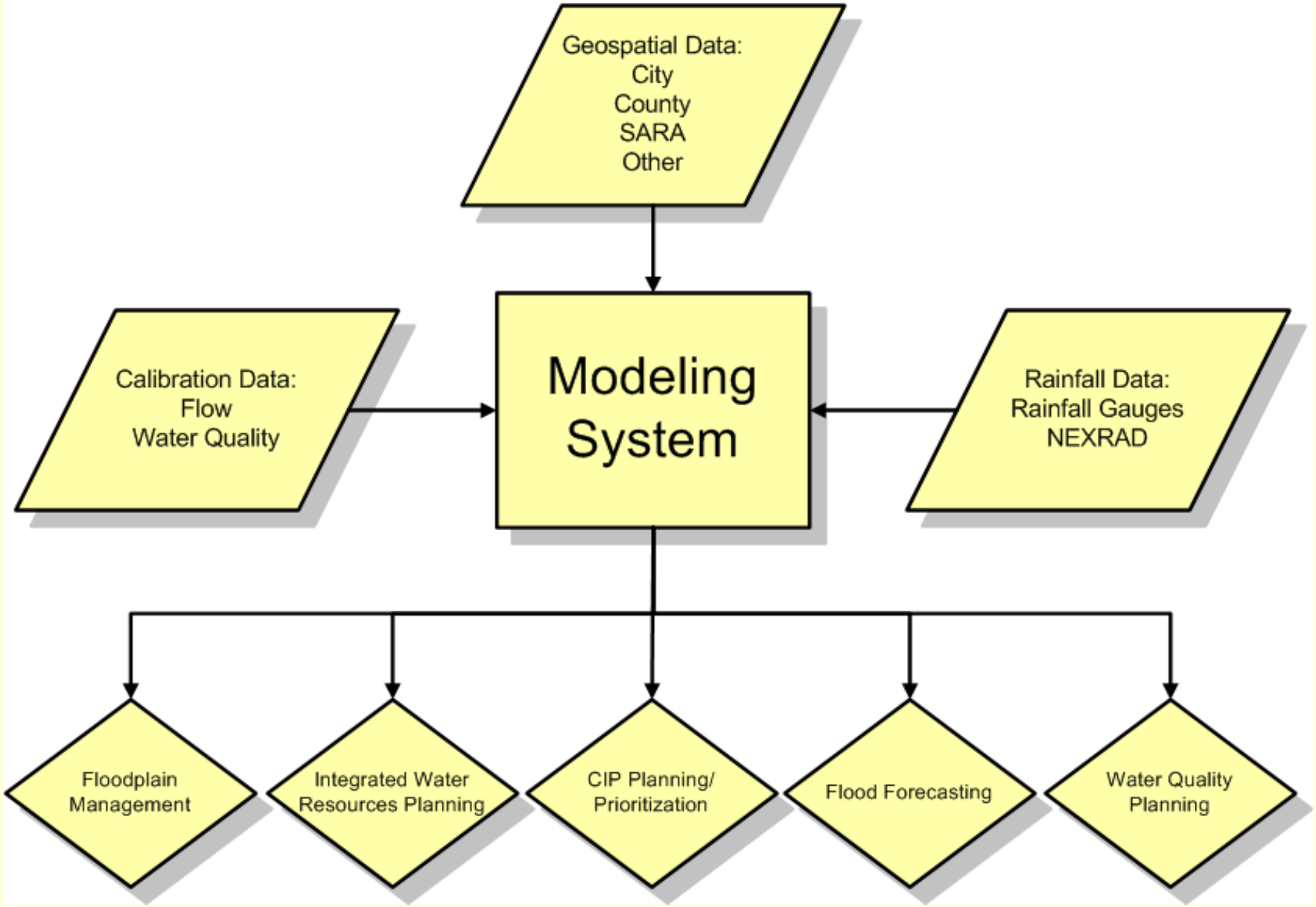
PBS&J Team

Recharge Study

H&H Focus Group
Water Quality Focus Group
GIS Focus Group

*** Potential suburban city representation**

Overall Process



Digital Flood Insurance Rate Maps (DFIRM)

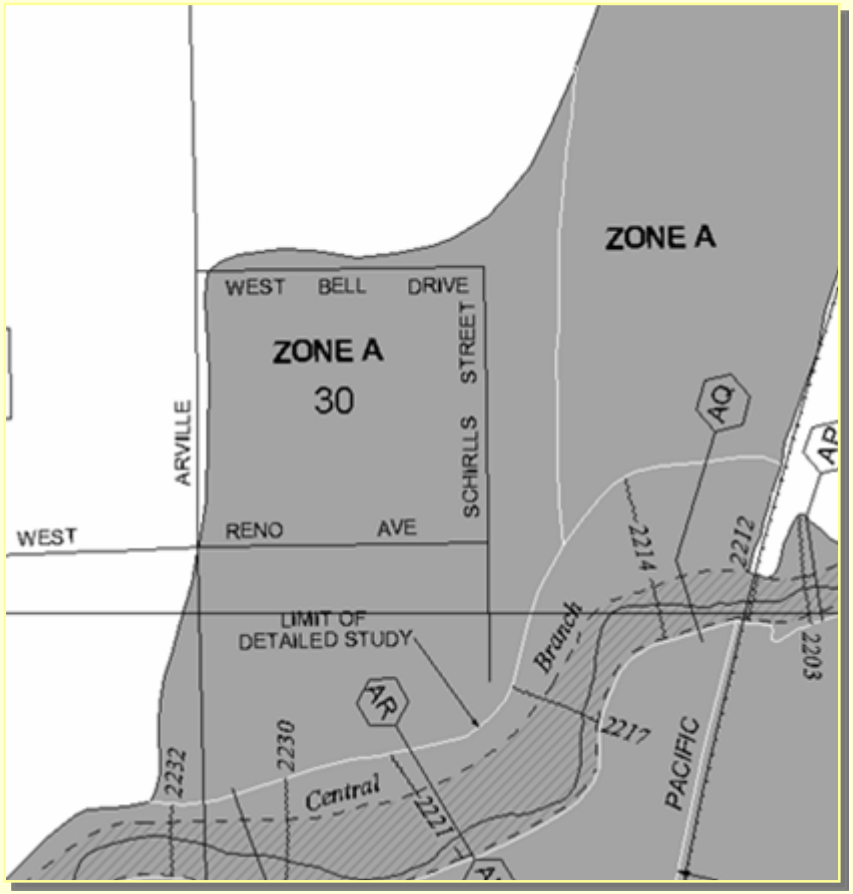
Update of all FEMA Flood Maps

Digital Flood Insurance Rate Maps (DFIRM) Scope

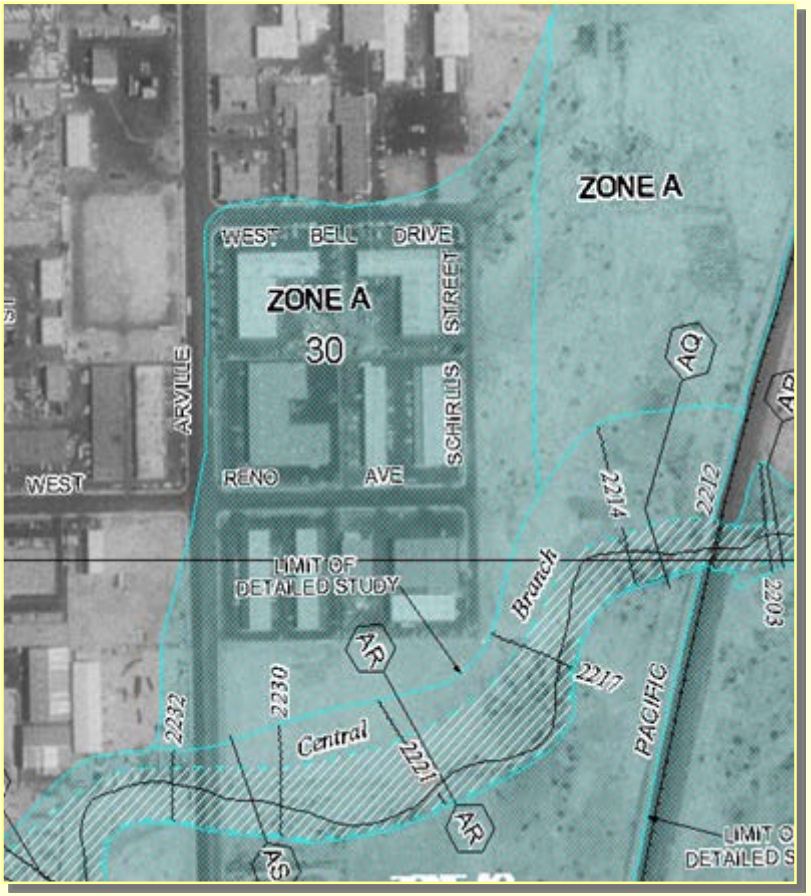
- **Due to the success of the collaborative and regional approach towards flood control in Bexar County, FEMA has launched an ambitious Map Modernization program to develop updated flood maps in Bexar County. The partnering support from FEMA through their CTP program, has reduced our project schedule from end dates of FY 09 to FY 07 for flood control task items such as H&H model creation and Flood Map generation.**

- **FEMA is anticipated to provide $1.4M over the two fiscal years. SARA will expend approximately $9 M over the same period.**

Facilitate DFIRM Production

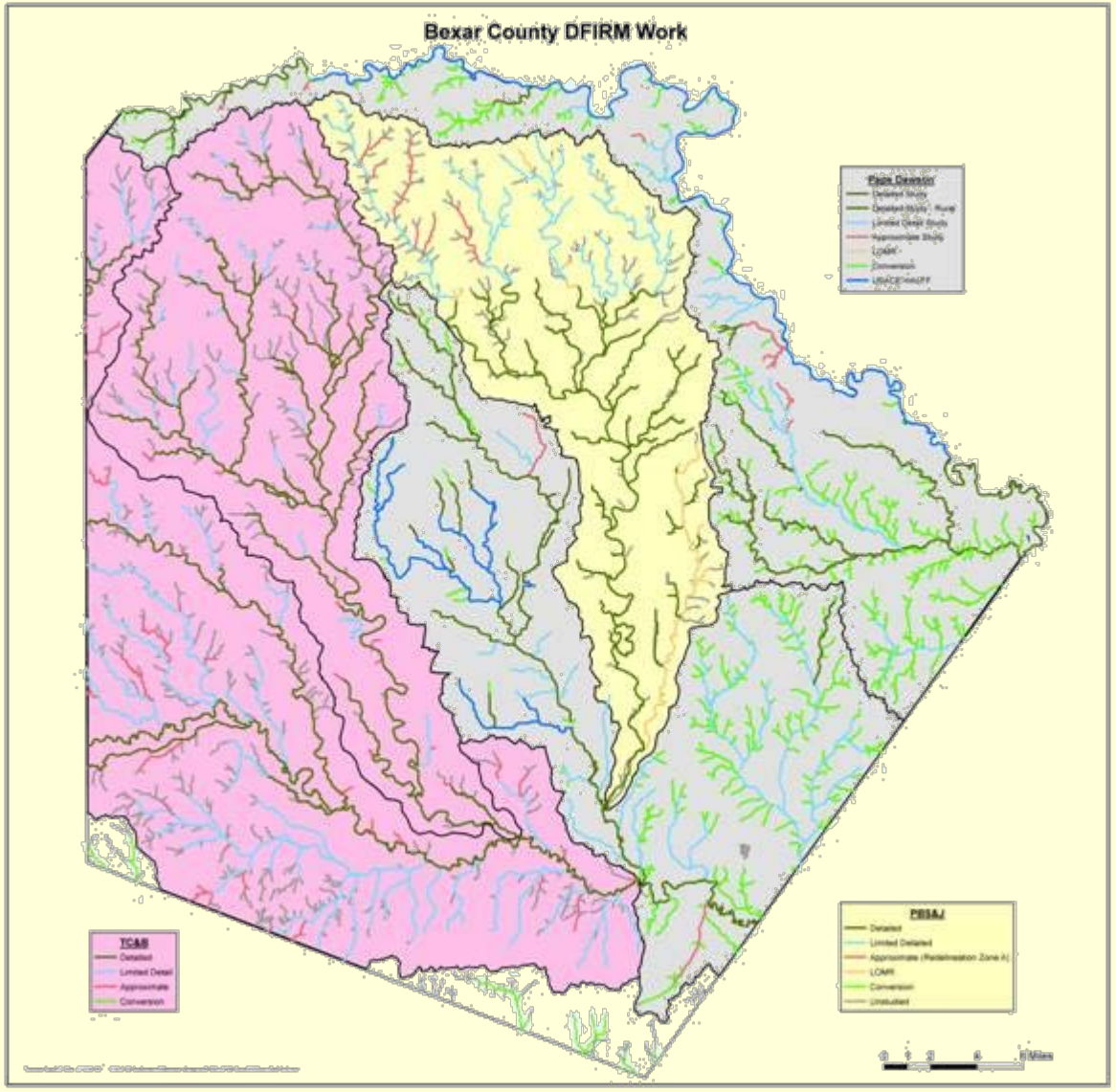


Vector Base Map

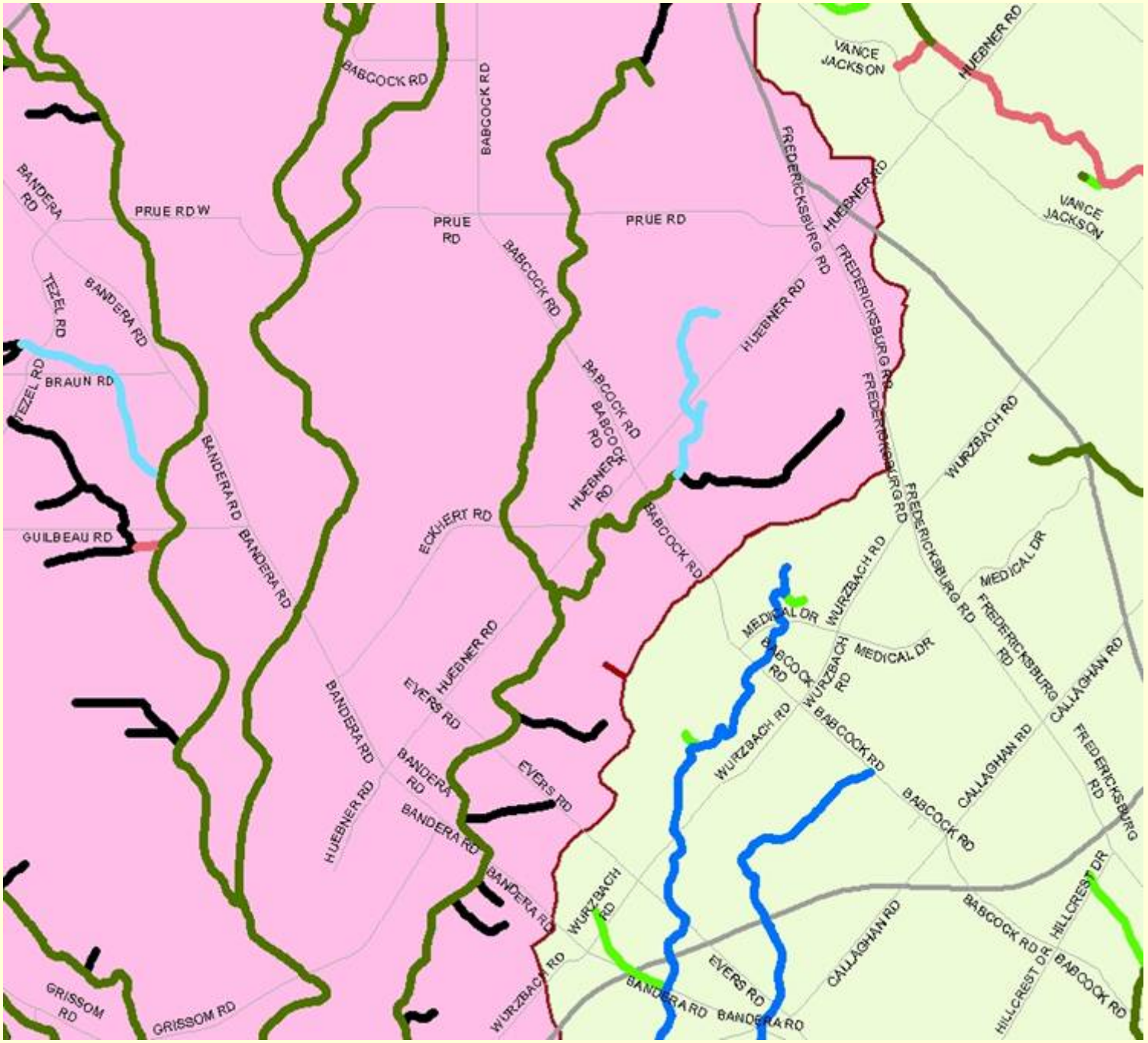


DOQ/Raster Base Map

Streams and rivers to be modeled and re-mapped



Over 1100 stream miles in Bexar County


BABCOCK RD
BABCOCK RD
VANCE JACKSON
HUEBNER RD
BANDERA RD
PRUE RD W
PRUE RD
PRUE RD
FREDERICKSBURG RD
HUEBNER RD
VANCE JACKSON
TEZEL RD
BANDERA RD
BABCOCK RD
HUEBNER RD
TEZEL RD
BRAUN RD
BABCOCK RD
BABCOCK RD
HUEBNER RD
FREDERICKSBURG RD
WURZBACH RD
BANDERA RD
GUILBEAU RD
ECKHERT RD
BANDERA RD
BABCOCK RD
FREDERICKSBURG RD
MEDICAL DR
MEDICAL DR
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BABCOCK RD
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MEDICAL DR
CALLAGHAN RD
HUEBNER RD
EVERS RD
BANDERA RD
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BABCOCK RD
FREDERICKSBURG RD
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CALLAGHAN RD
HUEBNER RD
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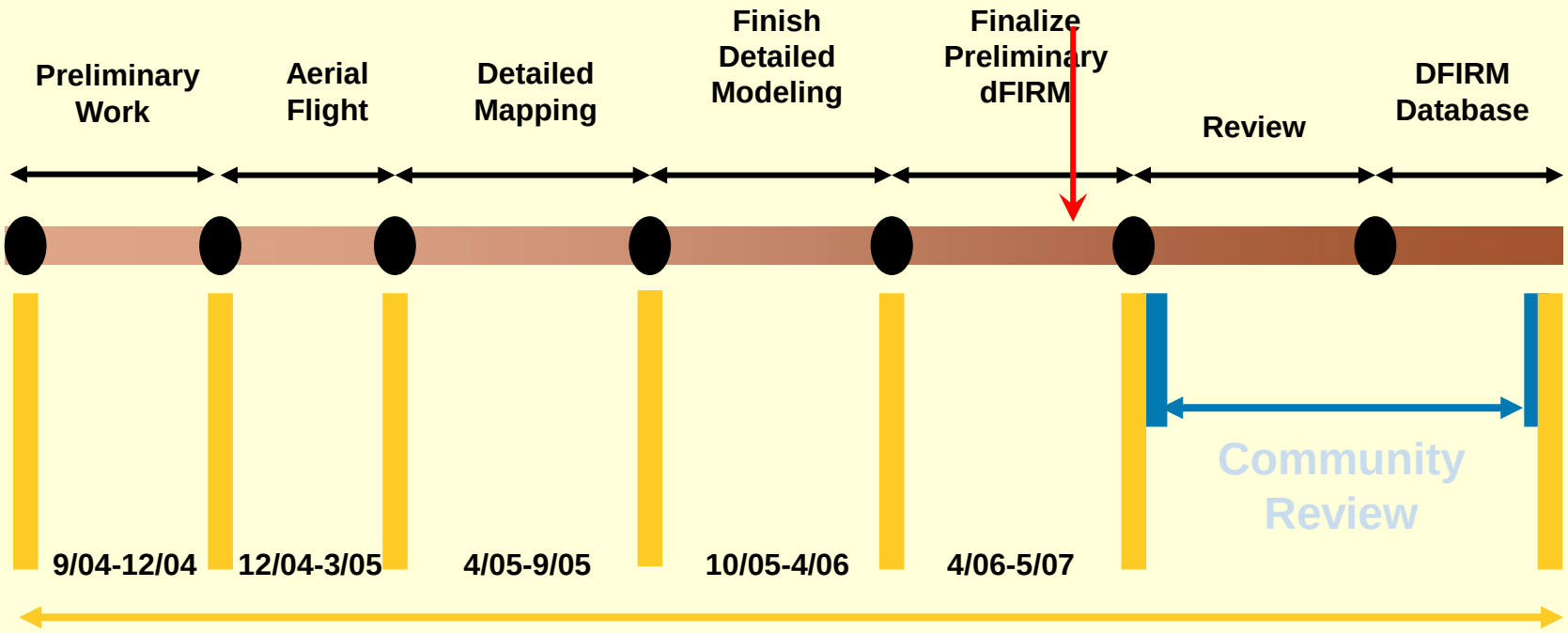
HILLCREST DR
GRISSOM RD
GRISSOM RD
WURZBACH RD
EVERS RD
CALLAGHAN RD
BABCOCK RD
BANDERA RD
BANDERA RD
HILLCREST DR
BABCOCK RD

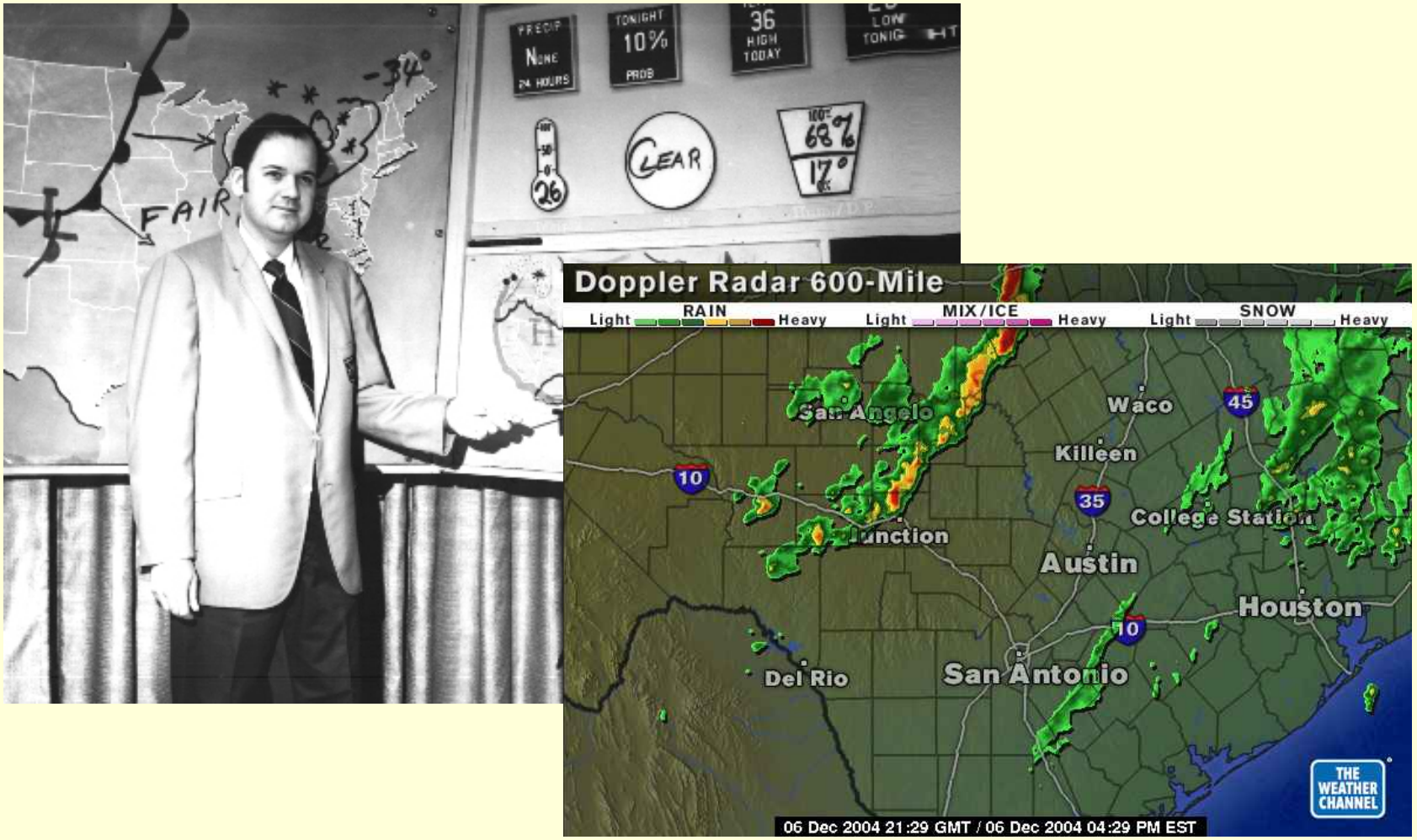
dFIRM Schedule



San Antonio River Basin Flood Warning and Response System

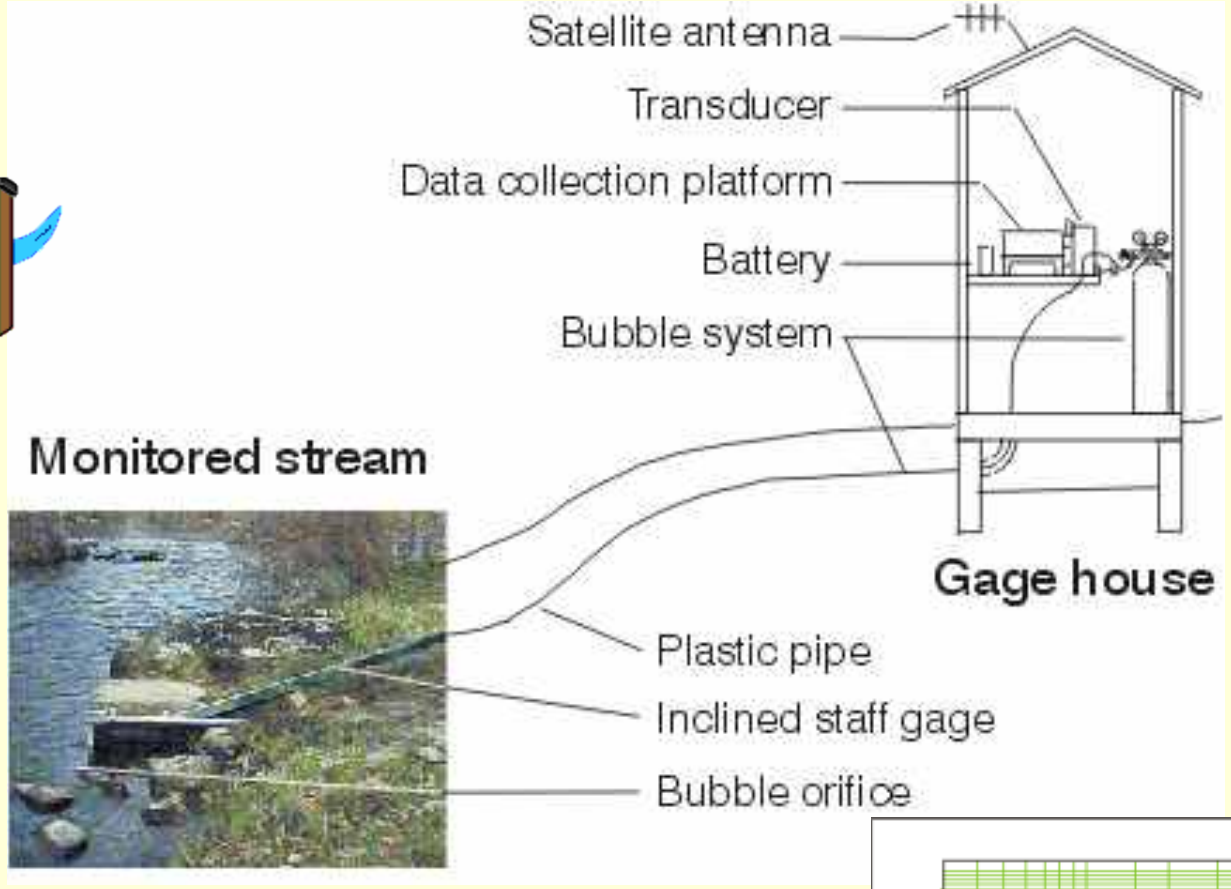
San Antonio River Basin Flood Warning and Response System

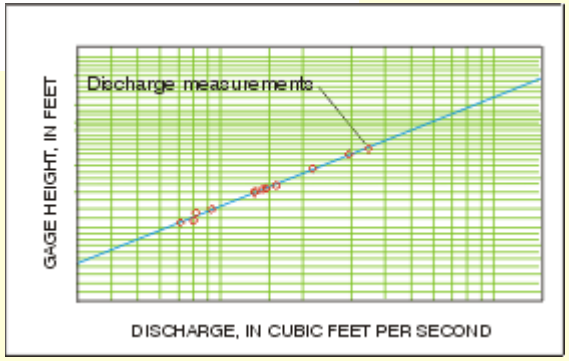
- Critical to flood response is the communication of accurate and timely data
  - Flood warnings are communicated by:
    - Radio
    - Telephone
    - TV
    - Internet
  - All these are based on the National Weather Service (NWS) predictions
    - These NWS predictions are at predetermined sites
      - These predetermined sites are the USGS Stream Gages

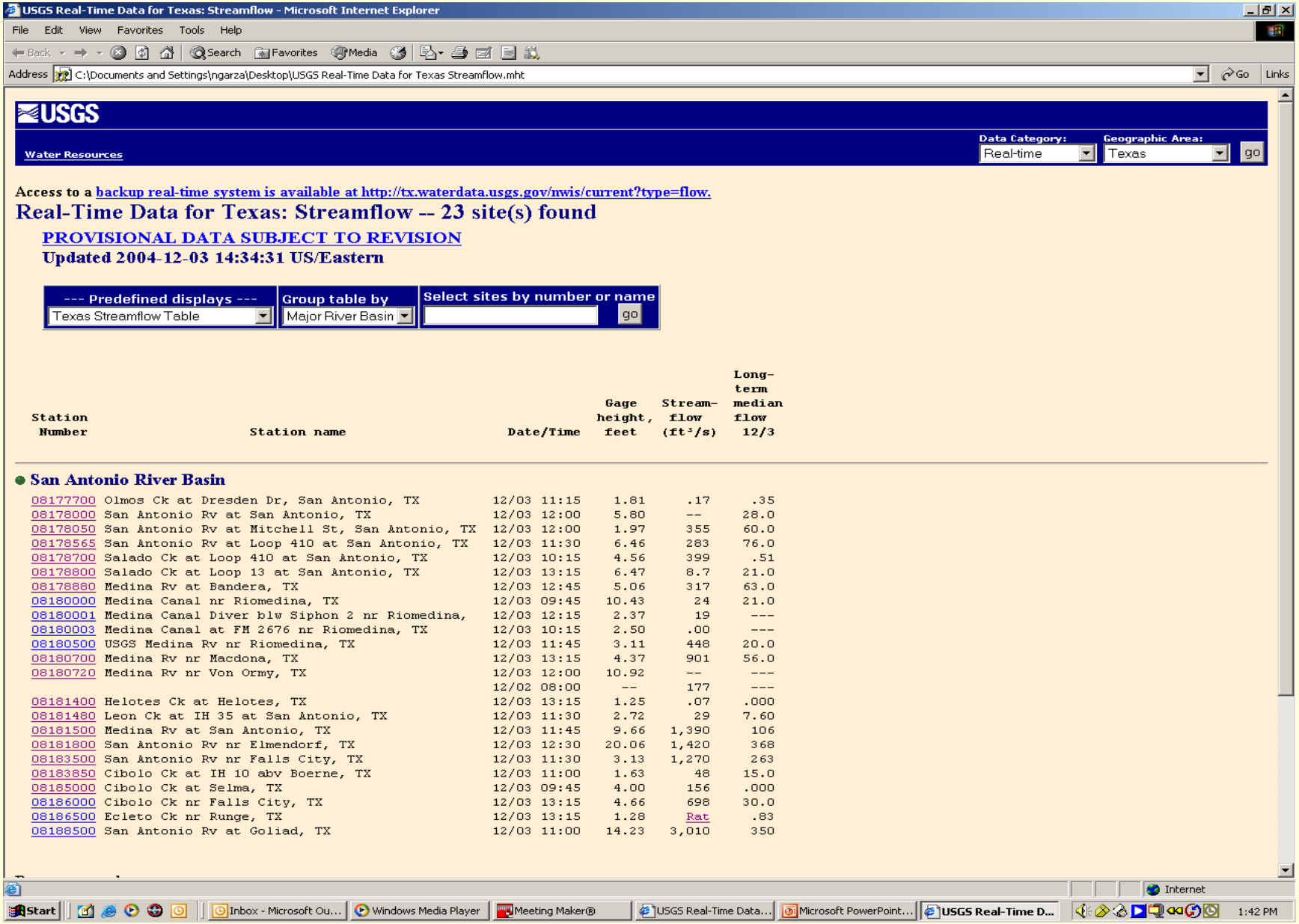

FAIR
-34°
PRECIP
NONE
24 HOURS
TONIGHT
10%
PROB
36
HIGH
TODAY
CLEAR
68%
17°
Doppler Radar 600-Mile
RAIN
Light
Heavy
MIX/ICE
Light
Heavy
SNOW
Light
Heavy
San Angelo
Waco
45
Killeen
10
35
College Station
Austin
Houston
10
San Antonio
Del Rio
THE WEATHER CHANNEL
06 Dec 2004 21:29 GMT / 06 Dec 2004 04:29 PM EST


BDAT2
Bandera
Selma
SELT2
San Antonio
SACT2
LACT2
La Coste
SMMT2
SAAT2
ELMT2
Elmendorf
Falls City
FCTT2
FACT2
GLIT2
Goliad


USGS


Satellite antenna
Transducer
Data collection platform
Battery
Bubble system
Monitored stream
Gage house
Plastic pipe
Inclined staff gage
Bubble orifice


Discharge measurements
GAGE HEIGHT, IN FEET
DISCHARGE, IN CUBIC FEET PER SECOND



Station Number	Station name	Date/Time	Gage height, feet	Stream-flow (ft³/s)	Long-term median flow 12/3
San Antonio River Basin					
08177700	Olmos Ck at Dresden Dr, San Antonio, TX	12/03 11:15	1.81	.17	.35
08178000	San Antonio Rv at San Antonio, TX	12/03 12:00	5.80	--	28.0
08178050	San Antonio Rv at Mitchell St, San Antonio, TX	12/03 12:00	1.97	355	60.0
08178565	San Antonio Rv at Loop 410 at San Antonio, TX	12/03 11:30	6.46	283	76.0
08178700	Salado Ck at Loop 410 at San Antonio, TX	12/03 10:15	4.56	399	.51
08178800	Salado Ck at Loop 13 at San Antonio, TX	12/03 13:15	6.47	8.7	21.0
08178880	Medina Rv at Bandera, TX	12/03 12:45	5.06	317	63.0
08180000	Medina Canal nr Riomedina, TX	12/03 09:45	10.43	24	21.0
08180001	Medina Canal Diver blw Siphon 2 nr Riomedina,	12/03 12:15	2.37	19	---
08180003	Medina Canal at FM 2676 nr Riomedina, TX	12/03 10:15	2.50	.00	---
08180500	USGS Medina Rv nr Riomedina, TX	12/03 11:45	3.11	448	20.0
08180700	Medina Rv nr Macdona, TX	12/03 13:15	4.37	901	56.0
08180720	Medina Rv nr Von Ormy, TX	12/03 12:00	10.92	--	---
		12/02 08:00	--	177	---
08181400	Helotes Ck at Helotes, TX	12/03 13:15	1.25	.07	.000
08181480	Leon Ck at IH 35 at San Antonio, TX	12/03 11:30	2.72	29	7.60
08181500	Medina Rv at San Antonio, TX	12/03 11:45	9.66	1,390	106
08181800	San Antonio Rv nr Elmendorf, TX	12/03 12:30	20.06	1,420	368
08183500	San Antonio Rv nr Falls City, TX	12/03 11:30	3.13	1,270	263
08183850	Cibolo Ck at IH 10 abv Boerne, TX	12/03 11:00	1.63	48	15.0
08185000	Cibolo Ck at Selma, TX	12/03 09:45	4.00	156	.000
08186000	Cibolo Ck nr Falls City, TX	12/03 13:15	4.66	698	30.0
08186500	Ecleto Ck nr Runge, TX	12/03 13:15	1.28	Rat	.83
08188500	San Antonio Rv at Goliad, TX	12/03 11:00	14.23	3,010	350

Real-time data for USGS 08185000 Cibolo Ck at Selma, TX - Microsoft Internet Explorer

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Address Q:\Watershed_Management\Nov22Storm11am\Real-time data for USGS 08185000 Cibolo Ck at Selma, TX.htm

USGS

Water Resources

Data Category: Real-time Geographic Area: Texas go

USGS 08185000 Cibolo Ck at Selma, TX

PROVISIONAL DATA SUBJECT TO REVISION

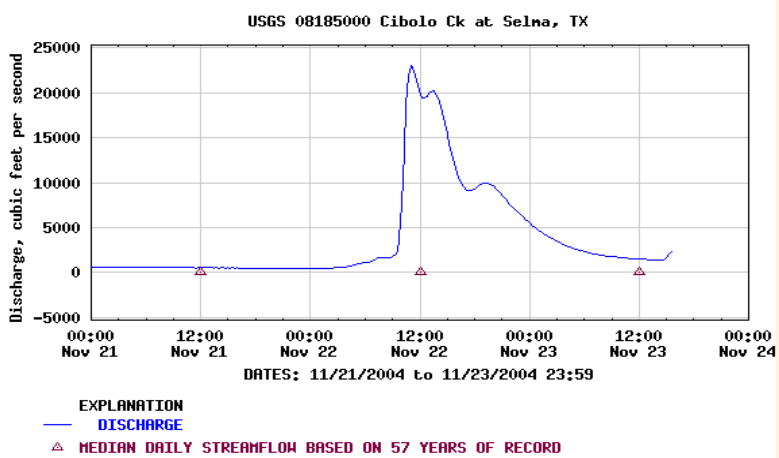
Available data for this site Real-time GO

This station maintained in cooperation with the Edwards Aquifer Authority.
This station managed by the San Antonio Field Unit.

Available Parameters	Output format	Days	
All 2 parameters available at this site 00060 Discharge (DD 01) 00065 Gage height (DD 06)	Graph	2 (1-31)	get data

Discharge, cubic feet per second

Most recent value: 2,310 11-23-2004 15:30



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△ MEDIAN DAILY STREAMFLOW BASED ON 41 YEARS OF RECORD

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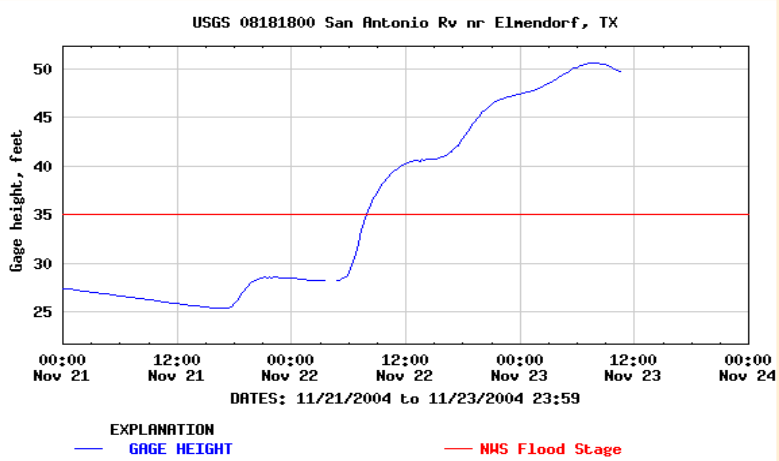
Daily mean flow statistics for 11/23 based on 41 years of record in ft^3/sec

Current Flow	Minimum	Mean	Maximum	80 percent exceedance	50 percent exceedance	20 percent exceedance
19,200	128	400	1,110	202	322	578

Percent exceedance means that 80, 50, or 20 percent of all daily mean flows for 11/23 have been greater than the value shown.

Gage height, feet

Most recent value: 49.74 11-23-2004 10:30



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Real-time Data for Texas
http://waterdata.usgs.gov/tx/nwis/uv?

Texas NWISWeb Data Inquiries
Texas NWISWeb Maintainer

Top
Explanation of terms

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Department of the Interior, U.S. Geological Survey
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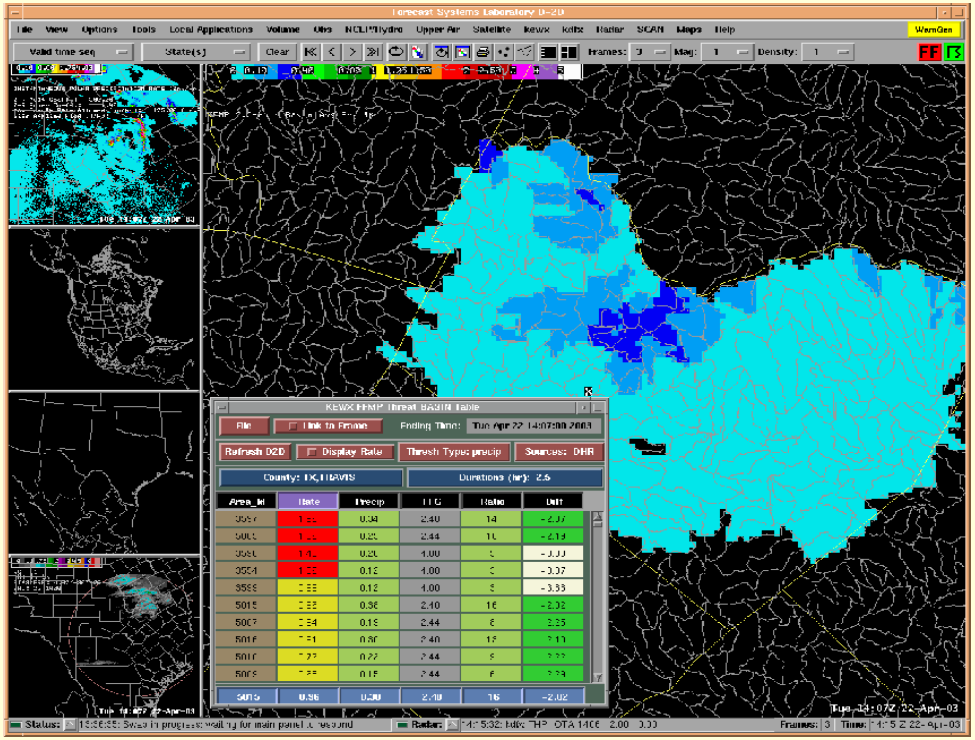
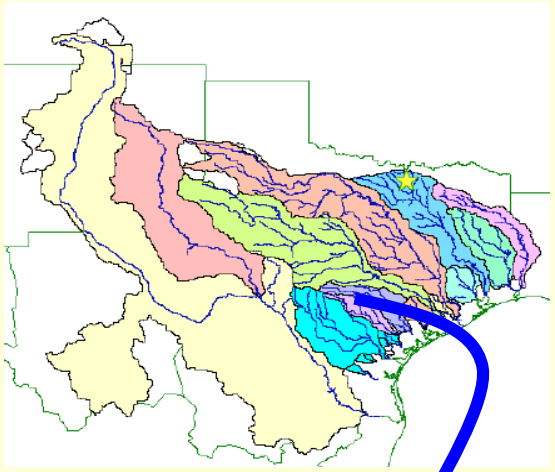
2.78 1.52 va

Flood Forecasting
Role of NWS

- RFC Area of Responsibility
- NWS River Forecasting for Basin





- Flash Flood Monitoring Program

National Weather Service Advanced Hydrologic Prediction Service - Microsoft Internet Explorer

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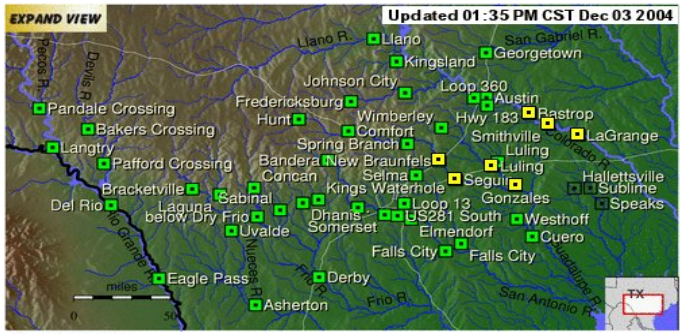
Weather Forecast Office Austin/San Antonio TX



Click on a point or river on the map **or** select from the menus below.

- – San Gabriel River (and Tribu
- – Colorado River (and Tributa
- – Llano River (and Tributaries
- – Pedernales River –
- – Guadalupe River (and Tribu
- – Comal River –
- – Blanco River –
- – San Marcos River (and Trib
- – San Antonio River (and Trib
- – Medina River –
- – Cibolo Creek –
- – Frio River (and Tributaries) -
- – Nueces River –
- – Pecos River –
- – Devils River –
- – Rio Grande –

Map Legend

- or **at or above Flood Stage**
- or **high water, below Flood Stage**
- or **below Flood Stage**
- or **observation more than 12 hours old**
- or **neighboring area point**

A square indicates that hydrograph information is available

A circle indicates that both probability and hydrograph information are available

Current Flood Status (tabular listing)

Hydrologic Resources
- Text Products
- Past Precipitation
- Forecast Precipitation
- River Forecast Centers
- About AHPS
- AHPS Feedback
- Rainfall Frequency Atlas Maps
- Hydrometeorological Prediction Center

Additional Resources
- National Significant River Flood Outlook
- West Gulf River Forecast Center
- Lower Colorado River Authority
- Guadalupe Blanco River Authority
- San Antonio River Authority
- Edwards Aquifer Authority
- Nueces River Authority
- International Boundary and Water Commission

The National Weather Service prepares its forecasts and other services in collaboration with agencies like the US Geological Survey, US Bureau of Reclamation, US Army Corps of Engineers, Natural Resource Conservation Service, National Park Service, ALERT Users Group, Bureau of Indian Affairs, and many state and local emergency managers across the country. For details, please click here.

Return to Main NWS Austin/San Antonio Home Page

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Corpus Christi, TX

West Gulf
River Forecast Center

Nueces River 11s Tilden

Observations courtesy of the US Geological Survey.

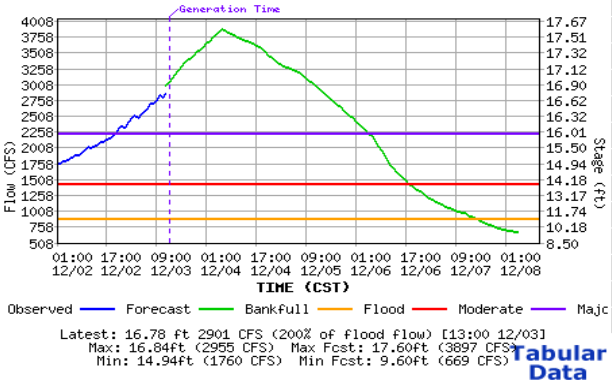
Flood Stage: 14 Feet

Latest Stage: 16.78 Feet at 13:00 CST 12/03

[Graph Description] [Feedback] [Text Products] [Precip.]
[Impacts] [Map] [Historical Crests] [Low Water Events]

Flood Warning

Click Here for Nueces River at a Glance



Latest: 16.78 ft 2901 CFS (200% of flood flow) [13:00 12/03]
Max: 16.84ft (2955 CFS) Max Fcst: 17.60ft (3897 CFS)
Min: 14.94ft (1760 CFS) Min Fcst: 9.60ft (669 CFS)

Tabular Data

- San Antonio River -
- Guadalupe River (and Tribu
- Mission River -
- Aransas River -
- Atascosa River -
- Frio River -
- Nueces River (and Tributari
- Copano Creek -
- Oso Creek -
- Garcitas Creek -
- Medio Creek -
- San Fernando Creek -
- San Casimiro Creek -
- Rio Grande -

NOTE: Forecasts for Nueces River 11s Tilden are issued as needed during times of high water, but are not routinely available.

About this graph
Printable Forecast

Upstream | Return to River Map | Downstream

A *hydrograph* shows how the river level changes over time at a specific location. Forecast hydrographs are

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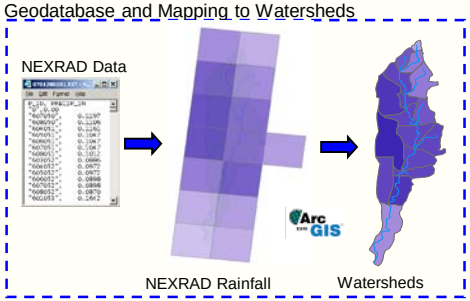
Flood Warning and Response System

Map2Map

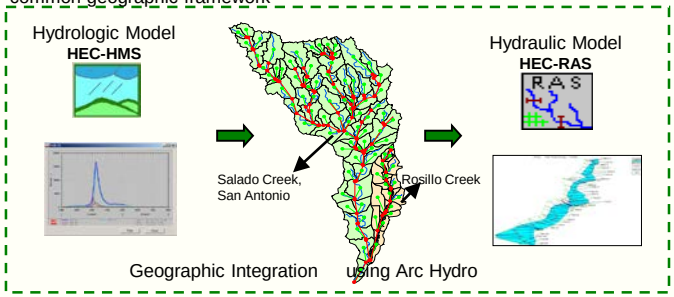
From a NEXRAD Map to a Floodplain Map

Center for Research in Water Resources

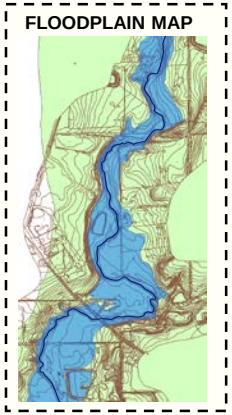
Component 1: Importing NEXRAD data into Geodatabase and Mapping to Watersheds



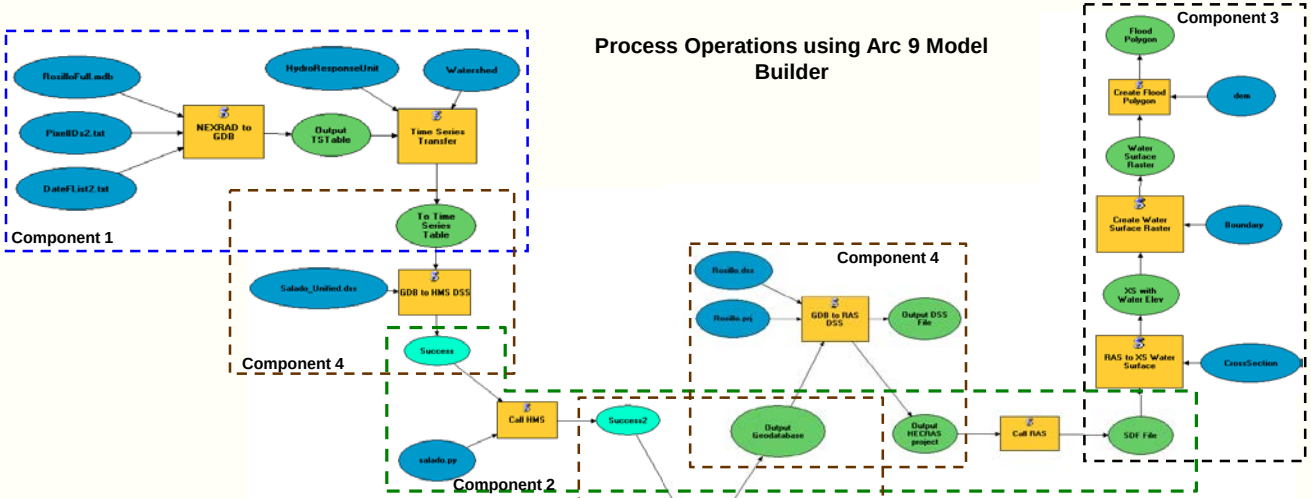
Component 2: Hydrologic & Hydraulic Integration based on common geographic framework



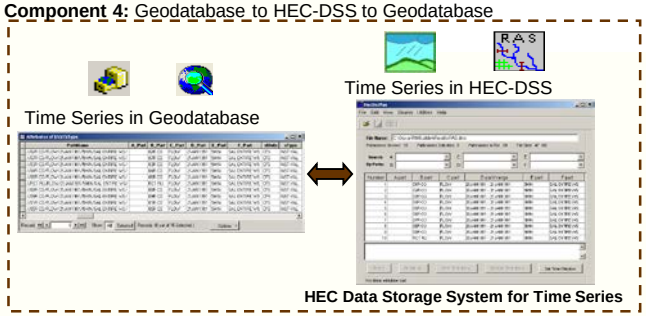
Component 3: Creating a Flood Inundation Map



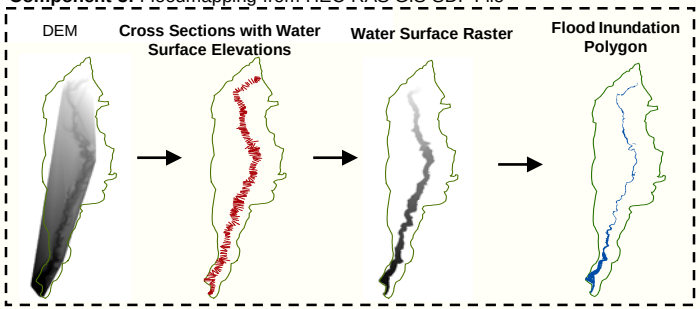
Process Operations using Arc 9 Model Builder



Component 4: Geodatabase to HEC-DSS to Geodatabase

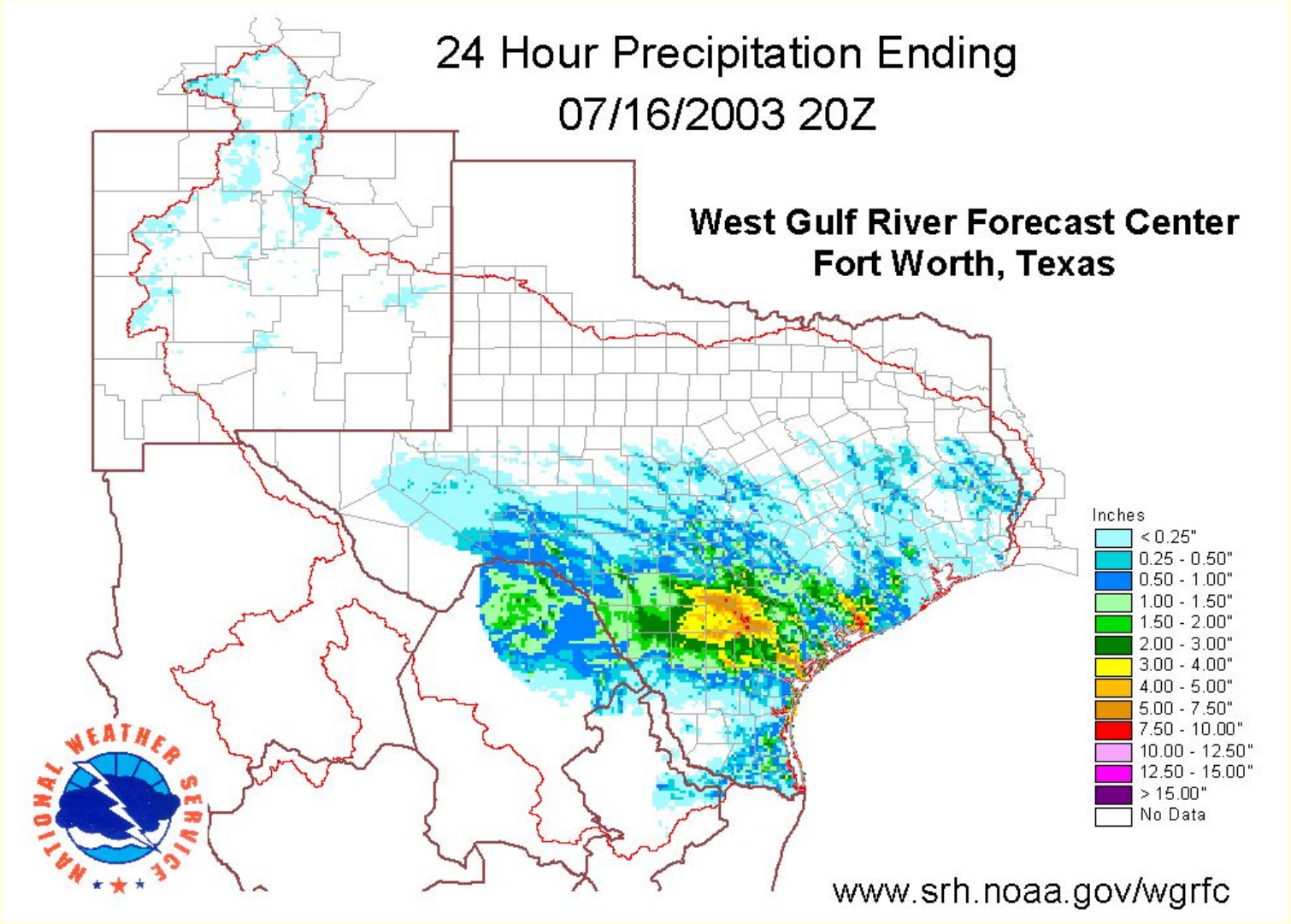


Component 3: Floodmapping from HEC-RAS GIS SDF File

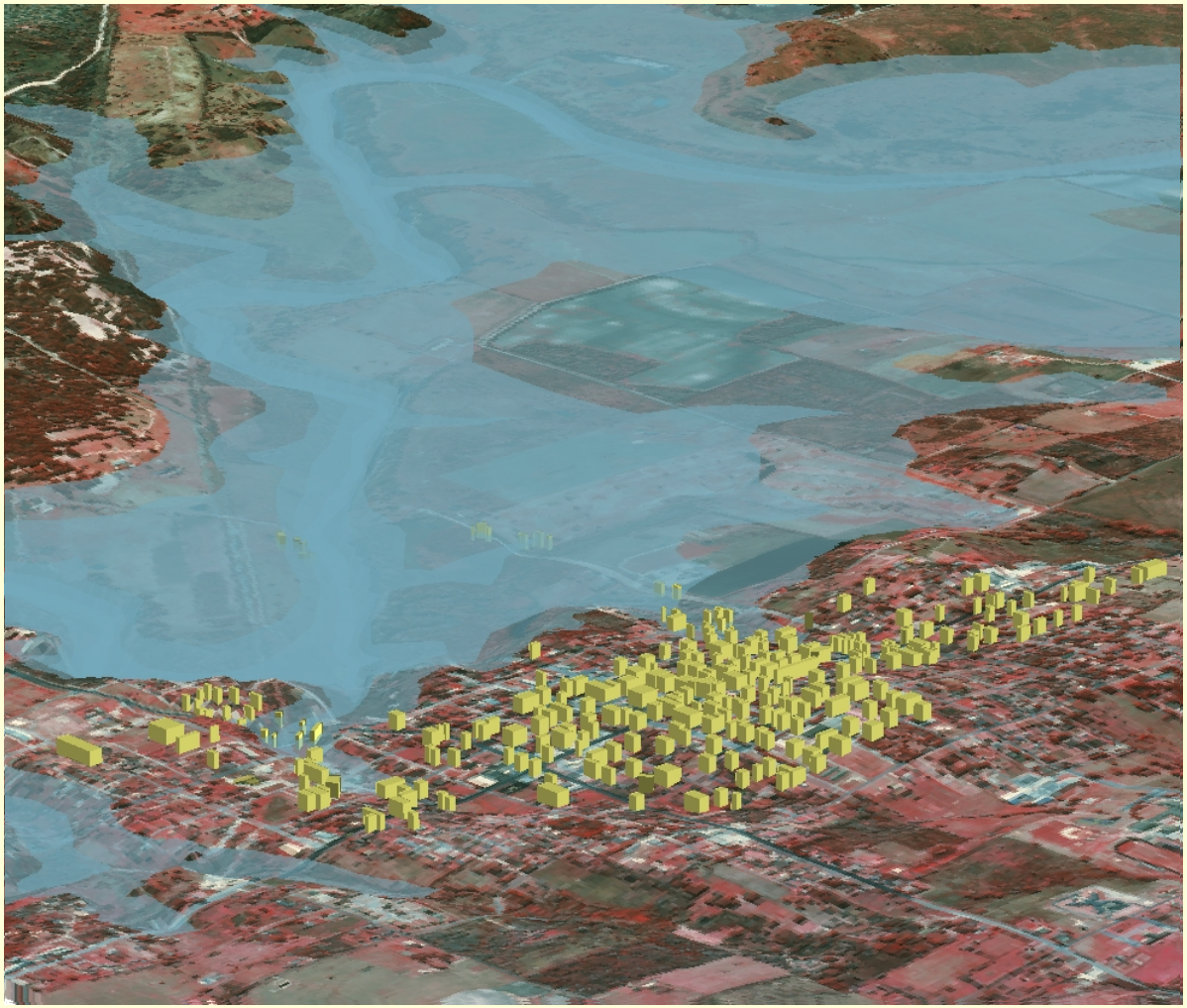


Research funded by The San Antonio River Authority

NWS gage-adjusted radar-rainfall mosaic during the passage of Tropical Storm Claudette



City of Goliad Flood Model



Conclusion

- Through the ILA in Bexar we have been able to look at and address serious drainage and flood control issues – we are on our way
- Many of the tools developed for this effort will be of much benefit to other disciplines
- All the information and tools will be made available to the public
- In a time of limited resources collaboration and communication is critical to success in any and all environmental issues

The San Antonio River Improvements

Design Management

www.sara-tx.org

Past, Present and Future