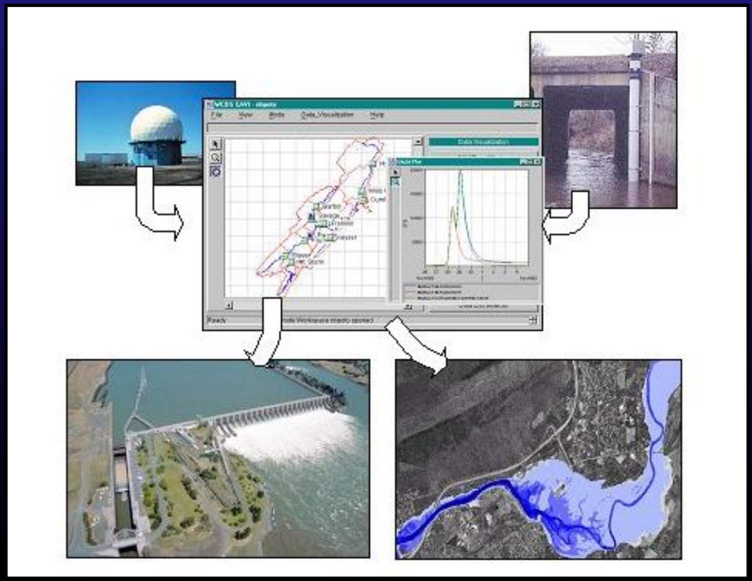
U.S. Army Corps of Engineers' Corps Water Management System : CWMS



FLOODS HAPPEN

ARIZONA FLOODPLAIN MANAGEMENT ASSOCIATION

Chuck Davis, CFM – WEST Consultants, Inc.

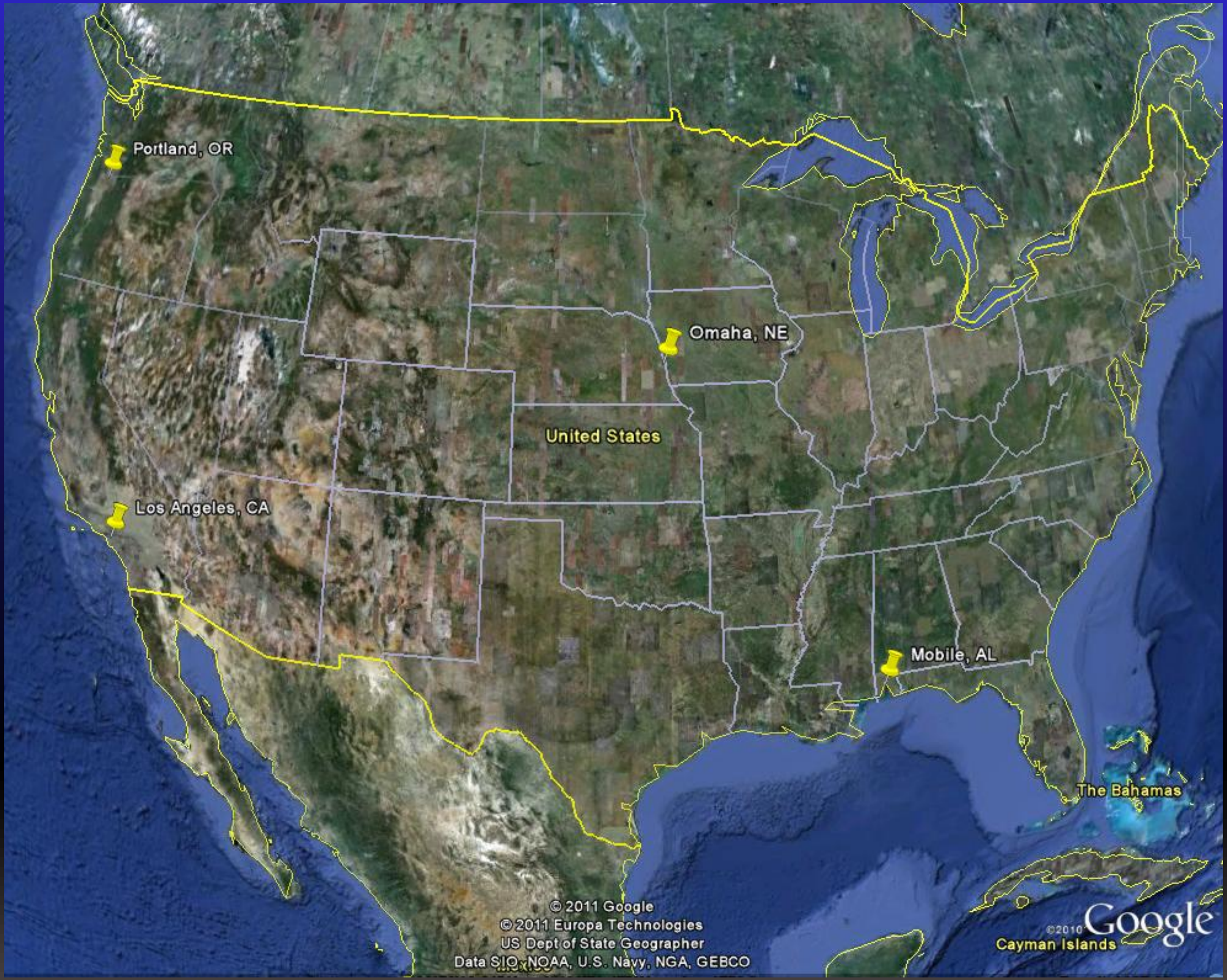
Darren Bertrand – WEST Consultants, Inc.

Presentation Overview

- Brief overview of CWMS
- Synopsis of the Modules and Components
- Overview of the Santa Ana River CWMS

CWMS – Overview

CWMS is an integrated system of hardware, software, and communication resources supporting the U.S. Army Corps of Engineers' real-time water control mission.


Portland, OR
Omaha, NE
United States
Los Angeles, CA
Mobile, AL
The Bahamas
Cayman Islands
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US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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CWMS – Overview

Automated data collection via satellites

CWMS suite of hydrologic, operations, and impact analysis models available.

WEST develops and deploys CWMS.

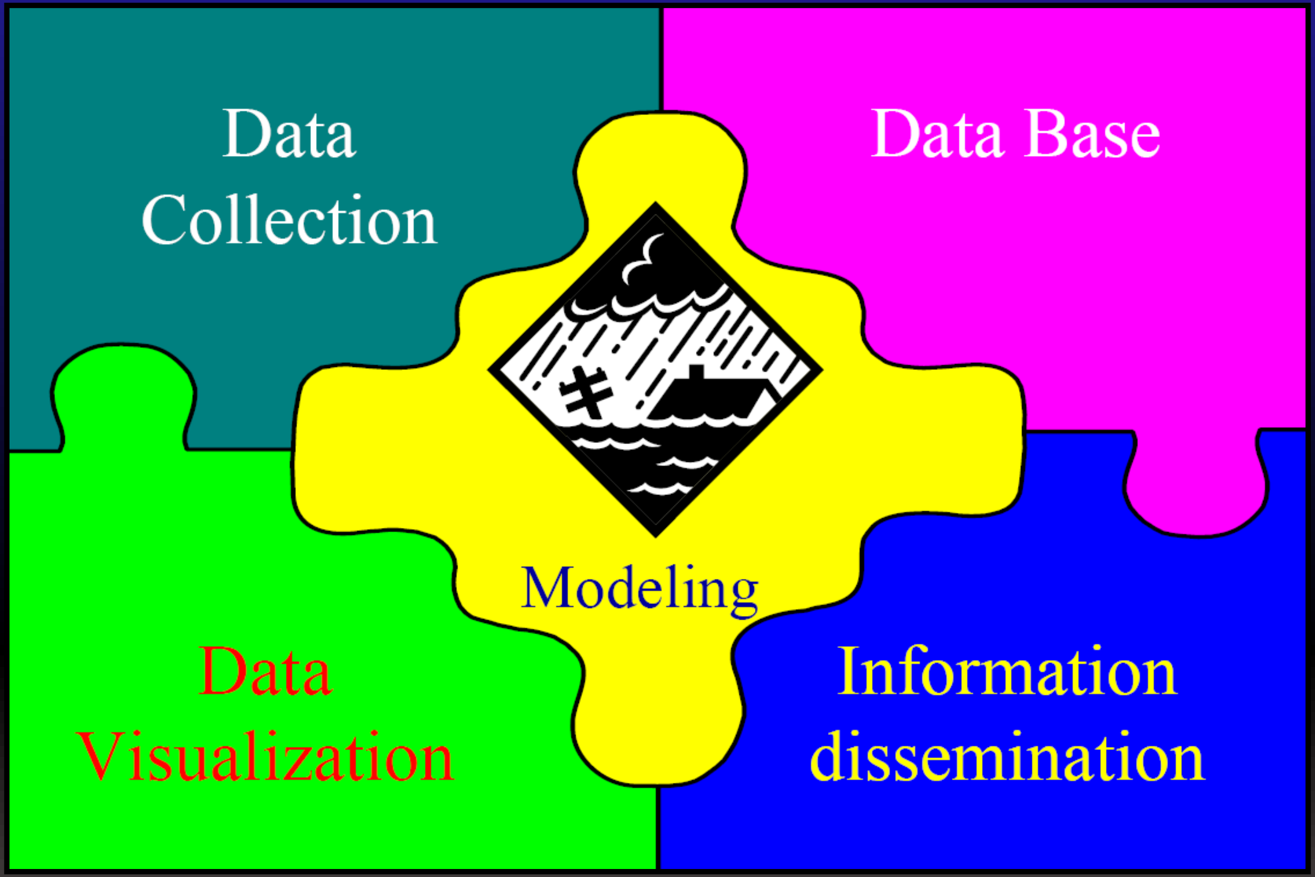
1975 1985 1995 2005 2015

Manual data collection & storage

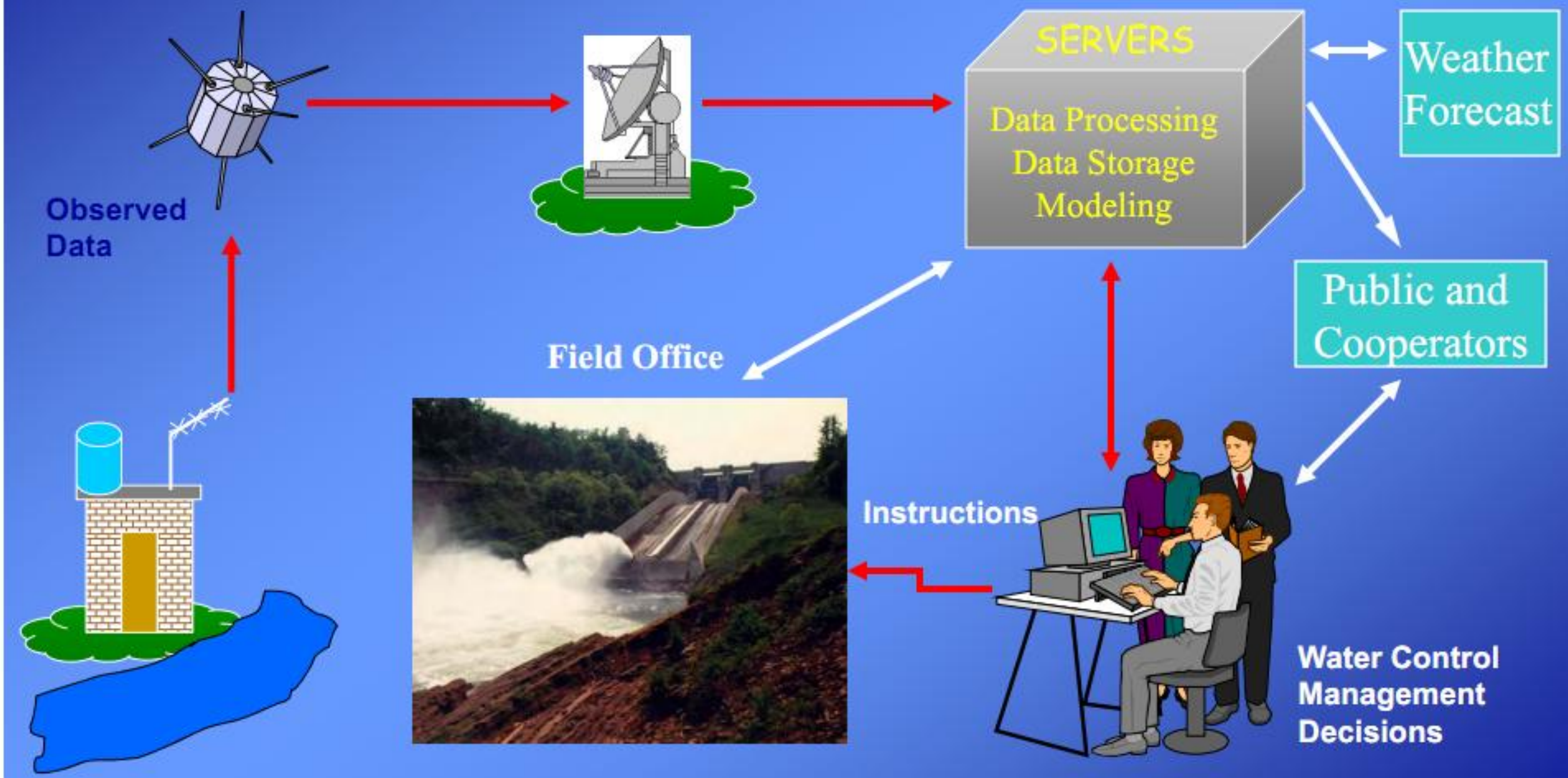
Real-time data handling, WCDS modernization

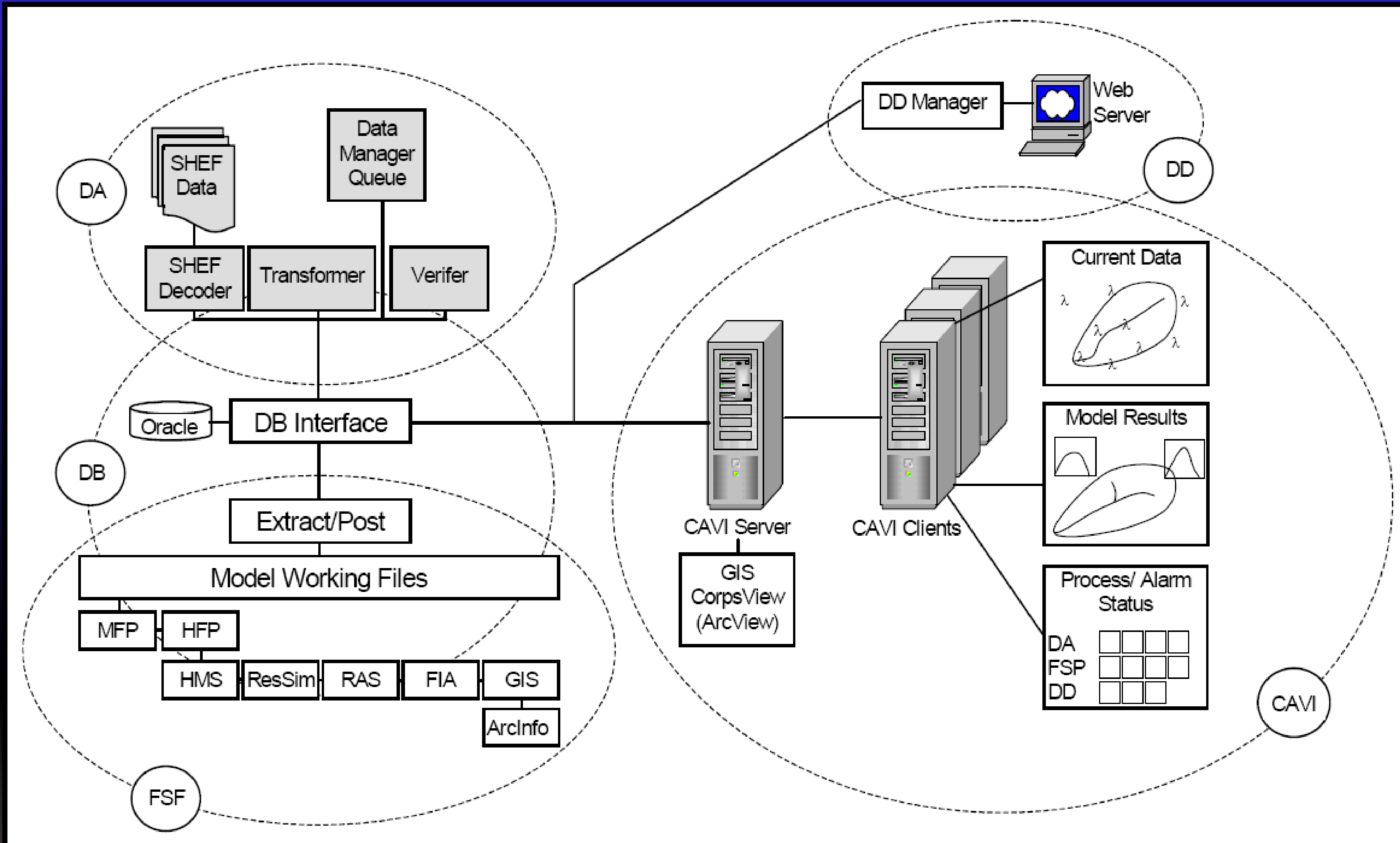
CWMS deployed Corps-wide for all major watersheds.

CWMS – Overview



CWMS Software Integrates the Processing from Data to Water Management Decisions




DA
SHEF Data
Data Manager Queue
SHEF Decoder
Transformer
Verifer
DD Manager
Web Server
DD
Current Data
Oracle
DB Interface
CAVI Server
CAVI Clients
Model Results
DB
Extract/Post
Model Working Files
GIS CorpsView (ArcView)
Process/ Alarm Status
DA
FSP
DD
MFP
HFP
HMS
ResSim
RAS
FIA
GIS
ArcInfo
CAVI
FSF

Modeling Components

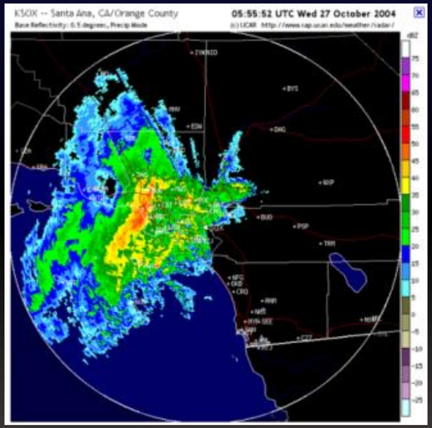
CWMS provides support for decision making using any combination of the following models:

- Meteorology
- Hydrology
- Reservoir operations
- River hydraulics
- Flood impact/economic analysis

Modeling – Meteorology (MFP)

The Meteorological Forecast Processor (MFP) combines observed precipitation with future precipitation scenarios

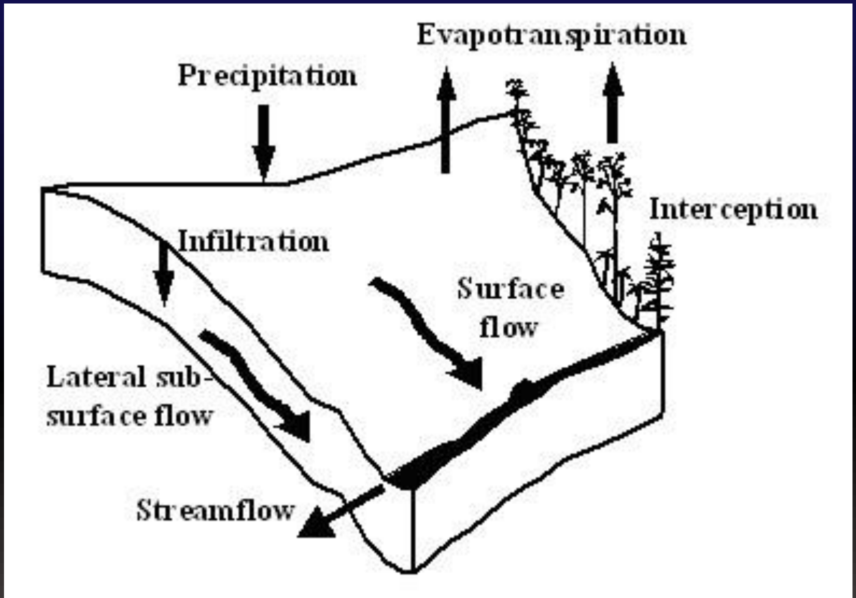
- Observed Precipitation
    - Rain gages (ALERT)
    - Radar based rainfall (NEXRAD)
- Future Precipitation
    - NWS Quantitative Precipitation Forecasts (QPF's)
    - Manual entry



Modeling – HEC-HMS

Hydrologic Modeling (HEC-HMS)

- HEC-HMS computes hydrologic forecasts based on precipitation data
- Allows for adjustment of loss and baseflow parameters real-time



Modeling – HEC-ResSim & RiverWare

Reservoir Operations modeling using HEC-ResSim or RiverWare

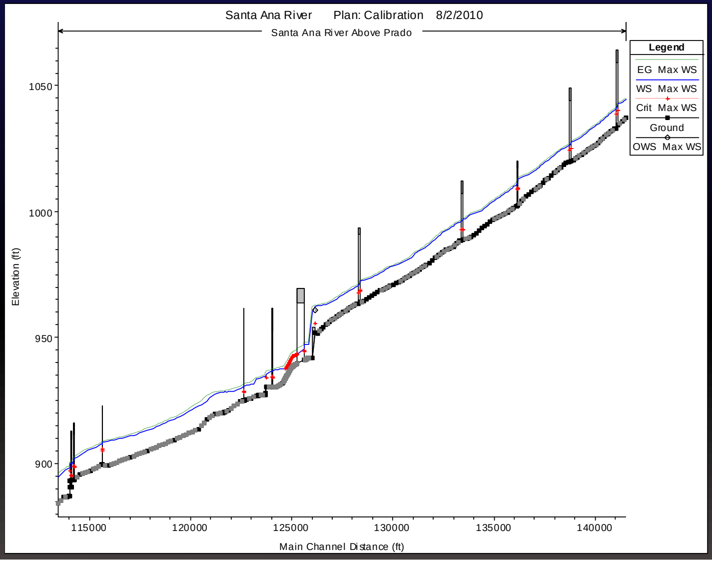
Inflow hydrographs → **HEC-ResSim RiverWare** → **Reservoir stage and outflow hydrographs**

User-developed rules and releases → **HEC-ResSim RiverWare**

Modeling – HEC-RAS

River Hydraulics – HEC-RAS

- Computes water depths and velocities
- Steady and unsteady flow analysis available
- Results sent to GIS for inundation boundaries

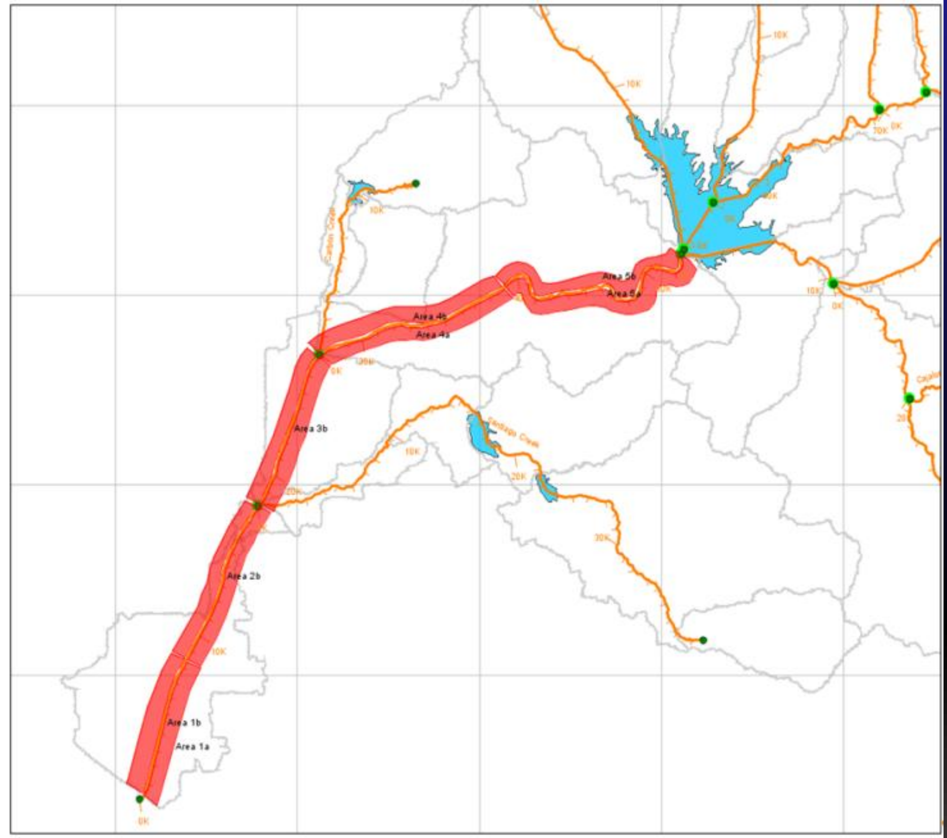


Modeling – HEC-FIA

Economic /Impact Analysis

HEC-FIA

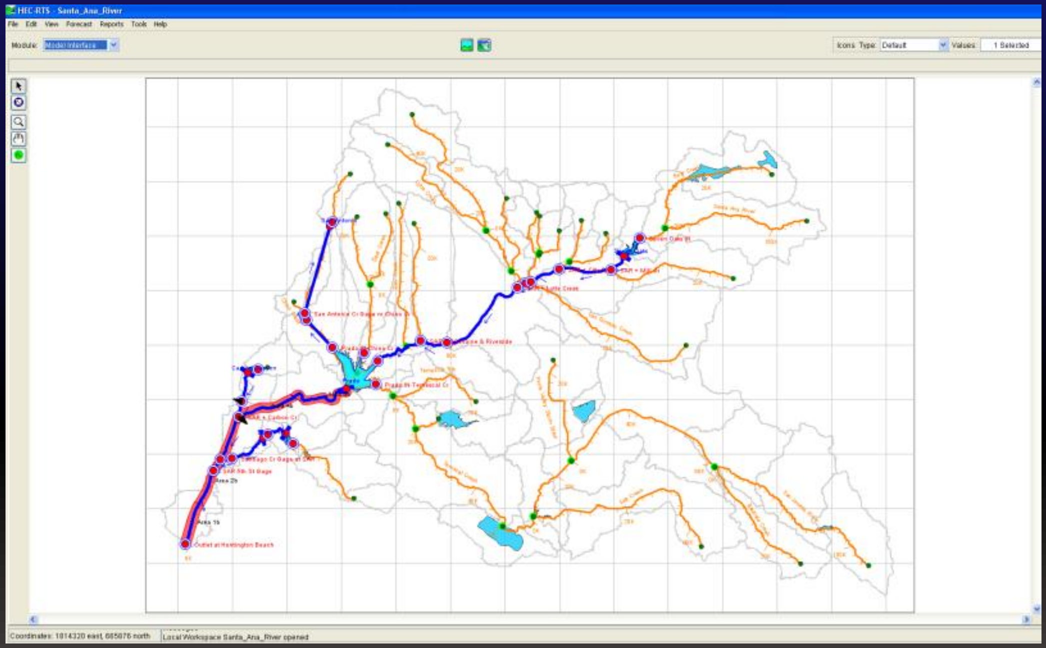
- Impact Areas
- Damages and benefits with and without the project
- Action tables provide instructions for managers during events

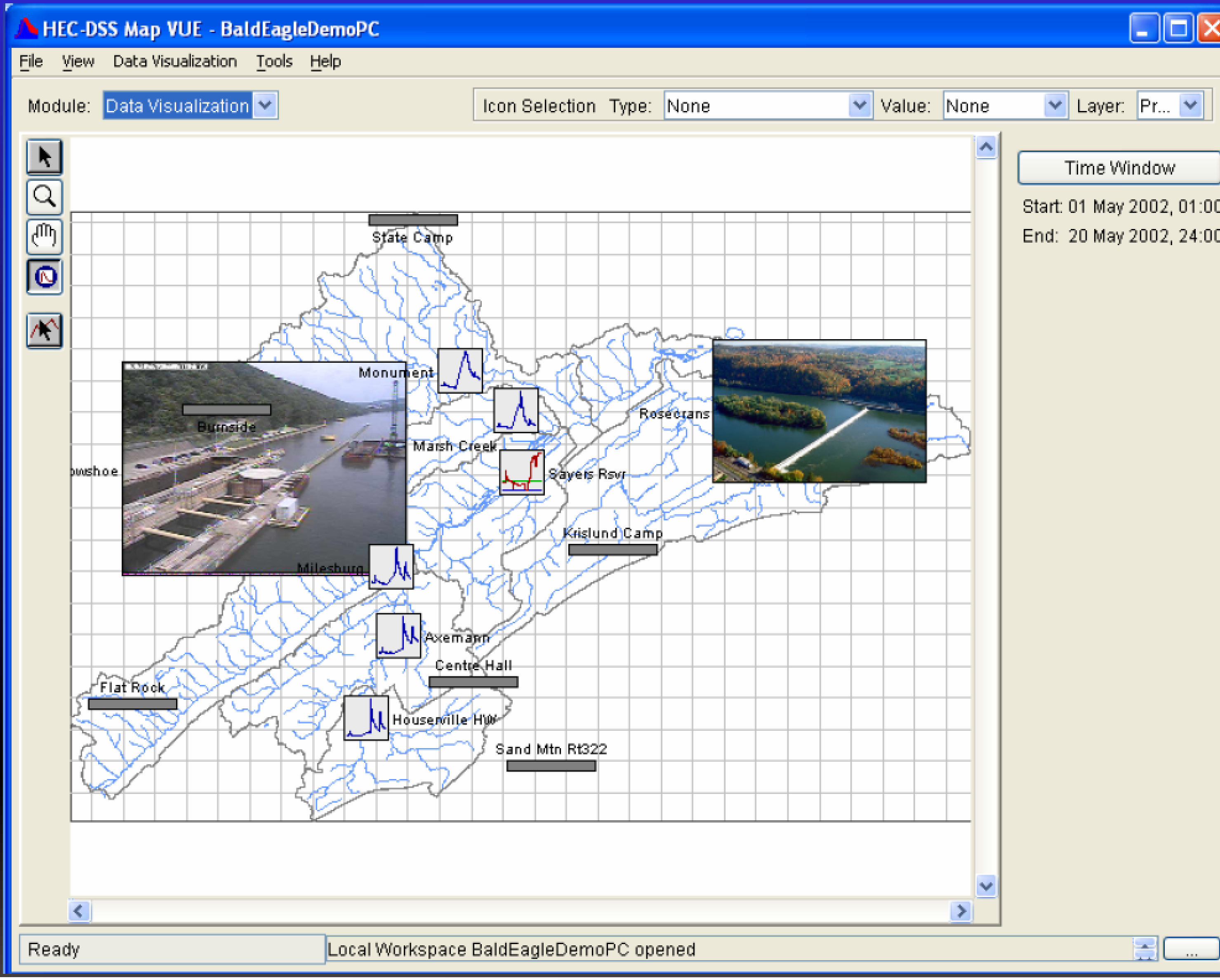


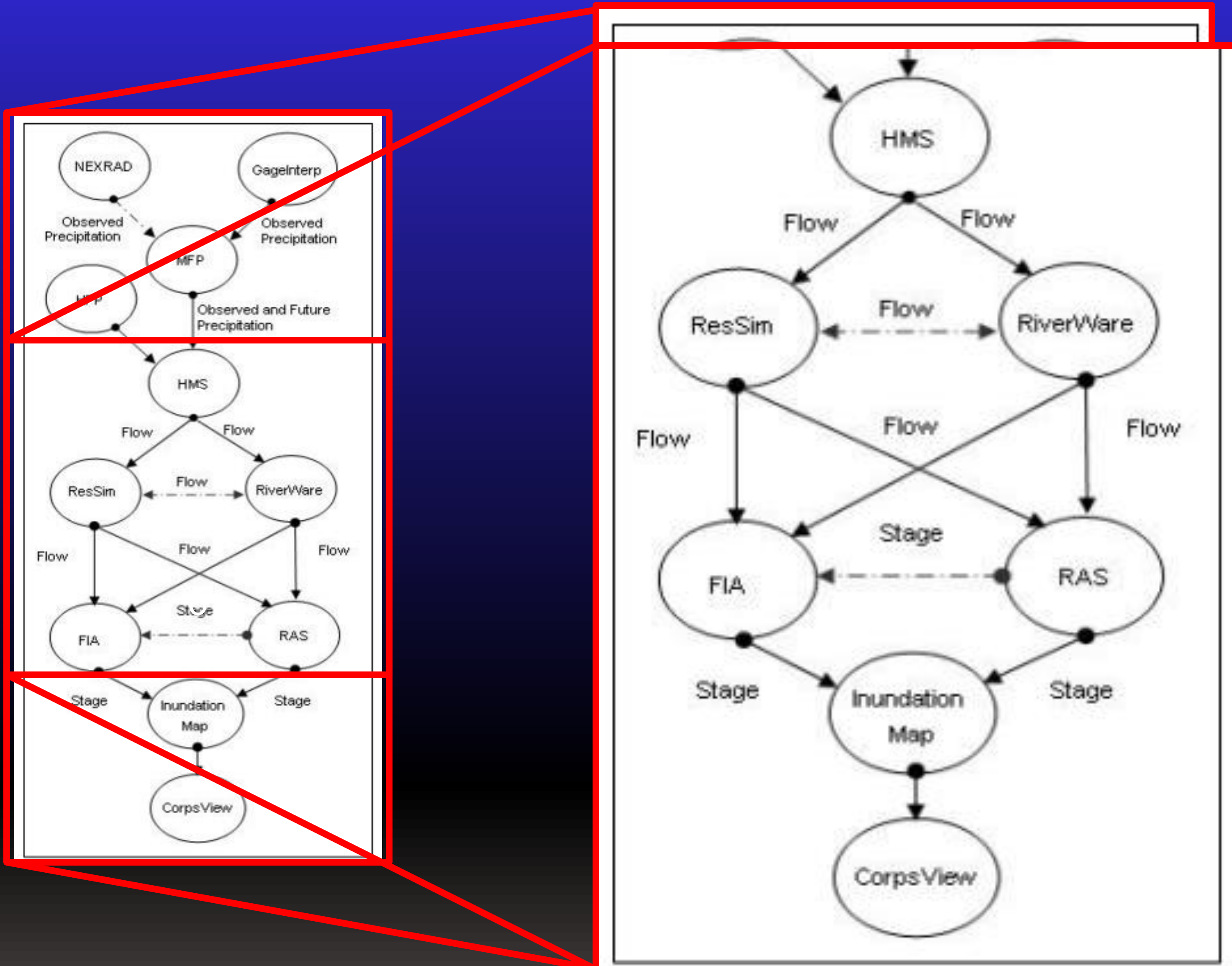
Modules and components

The Control and Visualization Interface (CAVI) is the primary framework of CWMS and controls the other functional modules.

- Data Acquisition Module
- Data Visualization Module
- Model Interface Module
- Watershed Setup Module




HEC-DSS Map VUE - BaldEagleDemoPC
File View Data Visualization Tools Help
Module: Data Visualization
Icon Selection Type: None Value: None Layer: Pr...
Time Window
Start: 01 May 2002, 01:00
End: 20 May 2002, 24:00
State Camp
Monument
Burnside
Marsh Creek
Rosecrans
Sayers Rsvr
Krislund Camp
Milesburg
Axemann
Centre Hall
Flat Rock
Houserville HW
Sand Mtn Rt322
Ready
Local Workspace BaldEagleDemoPC opened


NEXRAD
GageInterp
Observed Precipitation
Observed Precipitation
MFP
Observed and Future Precipitation
HMS
Flow
Flow
ResSim
Flow
RiverWare
Flow
Flow
Flow
FIA
Stage
RAS
Stage
Inundation Map
Stage
CorpsView
HMS
Flow
Flow
ResSim
Flow
RiverWare
Flow
Flow
Flow
Stage
FIA
RAS
Stage
Inundation Map
Stage
CorpsView

Modeling Steps

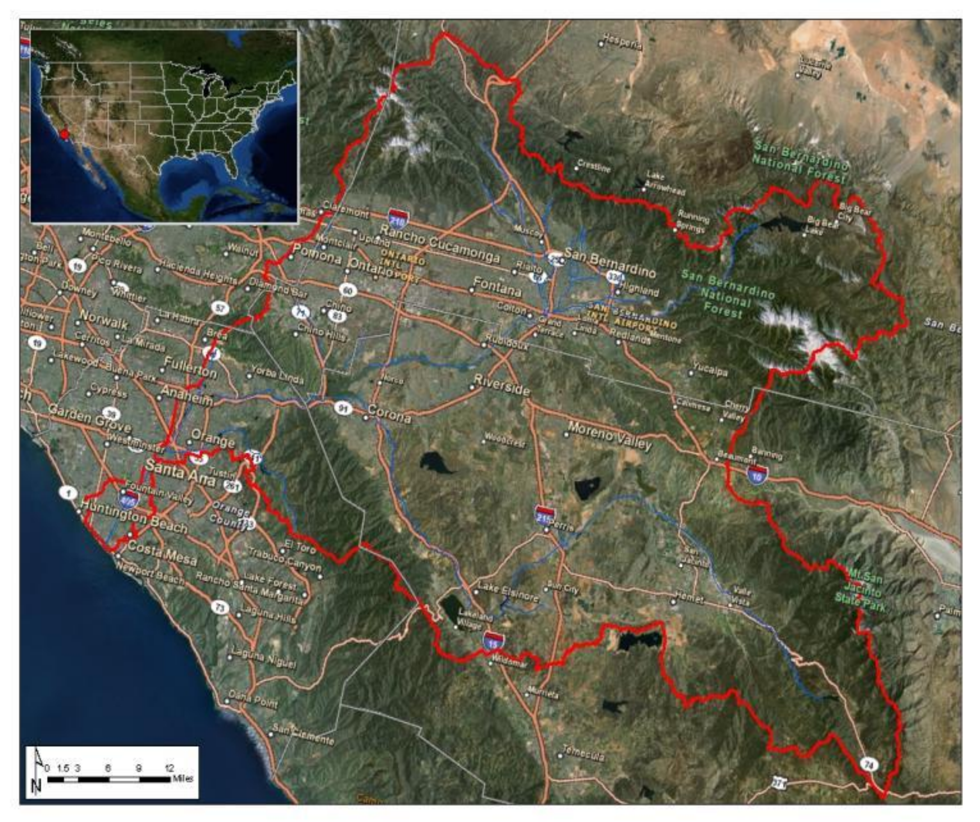
The modeling process for CWMS is as follows

- Check status and currency of real-time data
- Select a forecast time
- Adjust model parameters to reflect current conditions
- Perform model computations
- View results
- Modify model parameters as necessary
- Re-compute the simulation

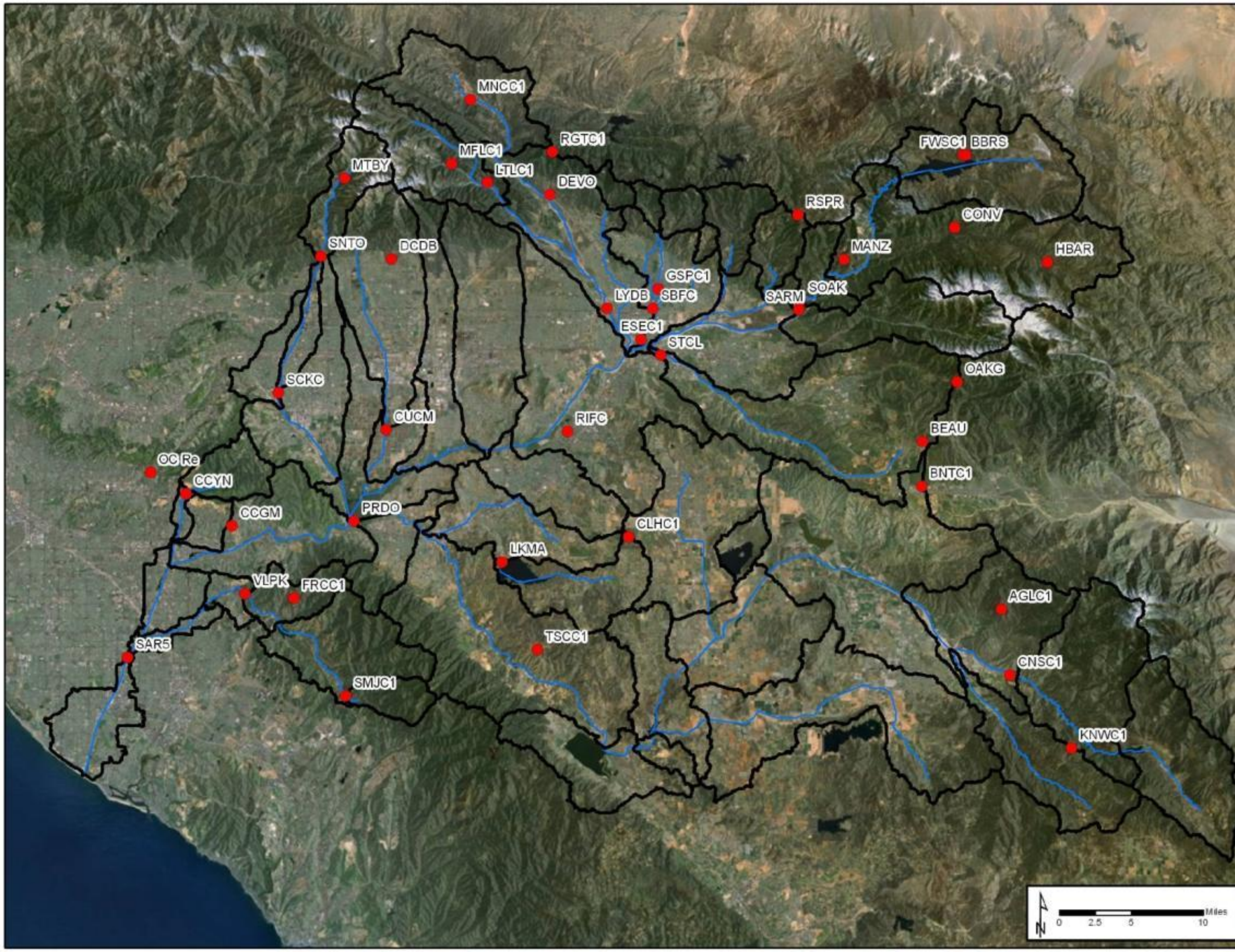
Santa Ana River CWMS

Santa Ana River Watershed

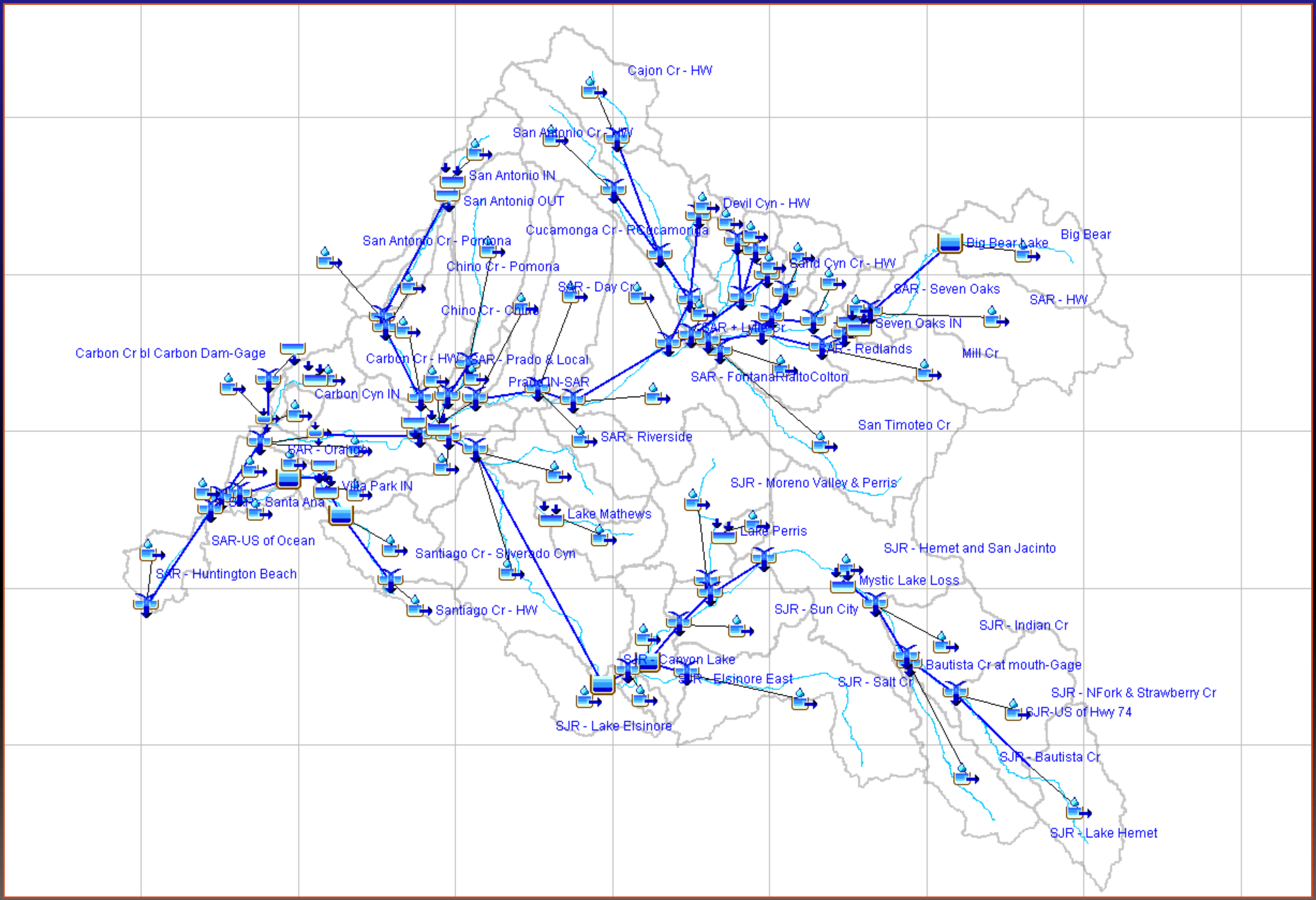
- Drainage Area: 2,500 mi²
- Main Stem: 110 miles long
- Heavily Urban
- Approx. 4.8 million people



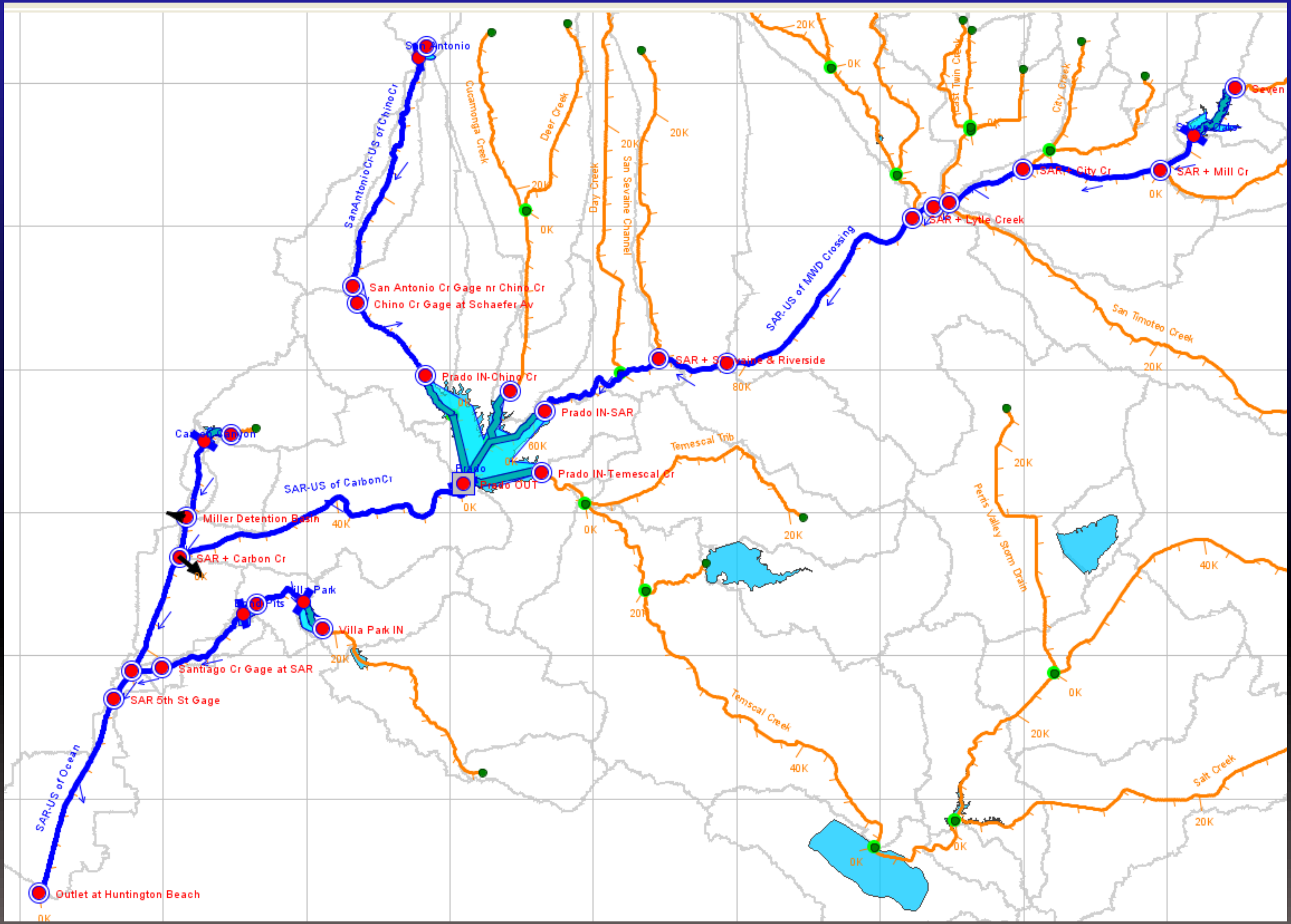
Santa Ana River CWMS – MFP



Santa Ana River CWMS – HEC-HMS



Santa Ana River CWMS – HEC-ResSim



Santa Ana River CWMS – HEC-ResSim

Table 1. MINIMUM AND MAXIMUM GATE OPENING REQUIREMENTS		
GATE TYPE	MINIMUM GATE OPENING (FEET)	MAXIMUM GATE OPENING (FEET)
REGULATION OUTLET (R.O.)	.75	6.8
LOW FLOW (L.F.)	.5	2.8

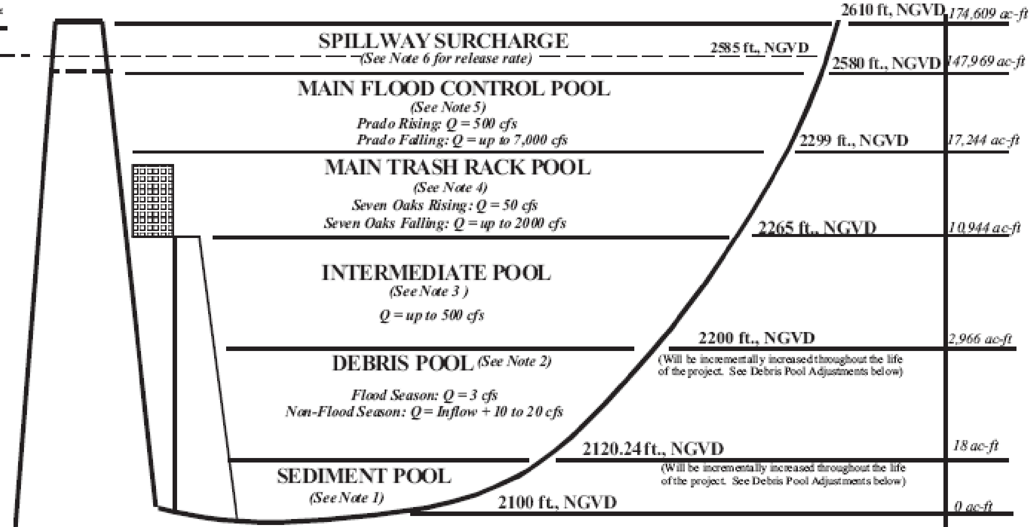
Table 2. RECOMMENDED MAXIMUM RATE OF RELEASE CHANGE		
DISCHARGE	TO INCREASE FLOW	TO DECREASE FLOW
0 - 200	NO RESTRICTION	NO RESTRICTION
UP TO 500	250 CFS/HOUR	250 CFS/HOUR
500 - 4,000	500 CFS/HOUR	500 CFS/HOUR
4,000 -8,000	1000 CFS/HOUR	1000 CFS/HOUR

MDL - Minimum Discharge Line
LF - Low Flow Gate
RO - Regulation Outlet Gates (Main Gates)
MDLE - Minimum Discharge Line Extension *

* During the dry months, the MDLE will usually be used to bypass the plunge pool. The MDLE is controlled by a 30-inch ball valve. This ball valve cannot be used to regulate flows and must be either in a fully open or fully closed position.

Storage values shown were acquired from year 1999 survey data.

DESIRED GATES TO USE	REQUIRED SLUICE GATE POSITION **
MDL, LF, RO	RISING : OPEN * FALLING: OPEN *
PRADO RISING: MDL, LF PRADO FALLING: LF, RO	RISING: OPEN * FALLING: OPEN *
SEVEN OAKS RISING: MDL SEVEN OAKS FALLING: MDL, LF, RO	OPEN
MDL & LF	OPEN
MDL & LF	OPEN Once the water level approaches the top of debris pool elevation, sluice gate should be opened, and should remain open throughout the flood season (Refer to Section 7-05.b. for details).
MDL	CLOSED



* May be closed if necessary. Prior to closure during high flows, however, the LF and RO gates must be temporarily closed to avoid the possibility of damaging the sluice gate.

** Refer to Section 7-06.b. for procedures in operating the sluice gate.

(For detailed drawings of the outlet works features, see Plates 2-06 to 2-24 of this document)

DEBRIS POOL ADJUSTMENTS:

- The maximum allowance for Debris Pool storage is about 3,000 ac-ft. The minimum required Debris Pool storage by the end of project life is about 800 ac-ft.
- As sediments accumulate and additional stop logs are placed within the multilevel withdrawal structure, the top of sediment pool will rise and the debris pool storage will diminish.
- When it is suspected that the debris pool storage is approaching the minimum of 800 ac-ft, the reservoir should be re-surveyed and the top of debris pool elevation raised to re-establish the 3,000 ac-ft of debris pool storage.
- Continue raising the top of debris pool elevation over project life until the top of debris pool reaches the final elevation of 2300 ft, NGVD.

NOTES:

1. SEDIMENT POOL:
- Additional stop logs are installed as necessary prior to each flood season. Sediment pool elevation may vary in any given year. Additional stop logs may be installed during the flood season, if necessary. When reservoir water surface elevation is within this pool, releases are generally made through the MDLE.

2. DEBRIS POOL:
- Prior to using LF and or RO gates sluice gate needs to be opened. See Section 7-06.b. of this document for procedures.

3. INTERMEDIATE POOL:
- Maximum combined capacity of LF and MDL in this elevation range is 500 cfs.
- May delay releases and modify release rates if hydrologic conditions warrant to support mitigation and enhancement plans.

4. MAIN TRASH RACK POOL:
- During Rising Stages: Release 50 cfs through the MDL only.
- During Falling Stages: Release theoretical maximum safe rates. The theoretical maximum Q's at different elevation ranges are:
- @2265 ft, NGVD — Q = 500 cfs
- @2269 ft, NGVD — Q = 1,000 cfs
- @2275 ft, NGVD — Q = 1,500 cfs
- @2299 ft, NGVD — Q = 2,000 cfs
- Note that the rates shown can be adjusted depending upon the amount of trash observed, the proximity of the next storm, the time required to clean the trash racks, and operation of the dam.
- May delay releases and modify release rates if hydrologic conditions warrant to support mitigation and enhancement plans.
- See Table 1 for max & min allowable gate openings.

5. MAIN POOL:
- During Falling Stages: The Q's at different elevation ranges are:
- @2299 ft, NGVD — Q = 2,000 cfs
- @2300 ft, NGVD — Q = 2,030 cfs
- @2400 ft, NGVD — Q = 4,340 cfs
- @2500 ft, NGVD — Q = 6,560 cfs
- @2580 ft, NGVD — Q = 7,000 cfs
- May delay releases and modify release rates if hydrologic conditions warrant to support mitigation and enhancement plans.
- See Table 1 for max & min allowable gate openings.

6. SPILLWAY SURCHARGE:
- During Rising Stages below el 2585 ft, NGVD, maintain a combined release total of 7,000 cfs. Above el. 2585 ft, NGVD, all gates shall be closed.
- During Falling Stages: Gates may be adjusted to maintain the resulting maximum spillway flow for quicker evacuation of the remaining surcharge pool.

7. OPERATIONAL CONSIDERATIONS:
- For all release adjustments, see Tables 1 and 2.
- Scheduled releases will be curtailed, if necessary, in order to assure the safe operation of the dam (i.e., exceedance of downstream channel capacity, or any other emergencies.
- All release ranges shown can be cut or increased, as necessary, in order to allow safety inspection for inspection or for maintenance purposes.
- Instrumentation Testing Program: Collection of data to verify the dam's performance may be done if the opportunity exists.

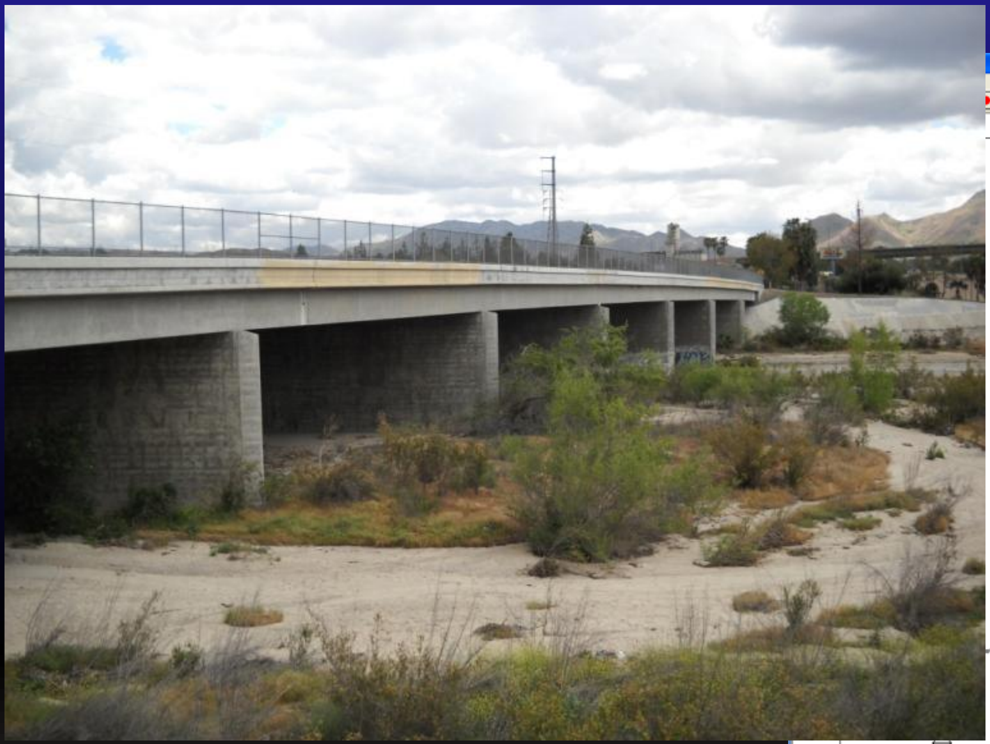
SEVEN OAKS DAM
SANTA ANA RIVER BASIN, CALIFORNIA
WATER CONTROL MANUAL

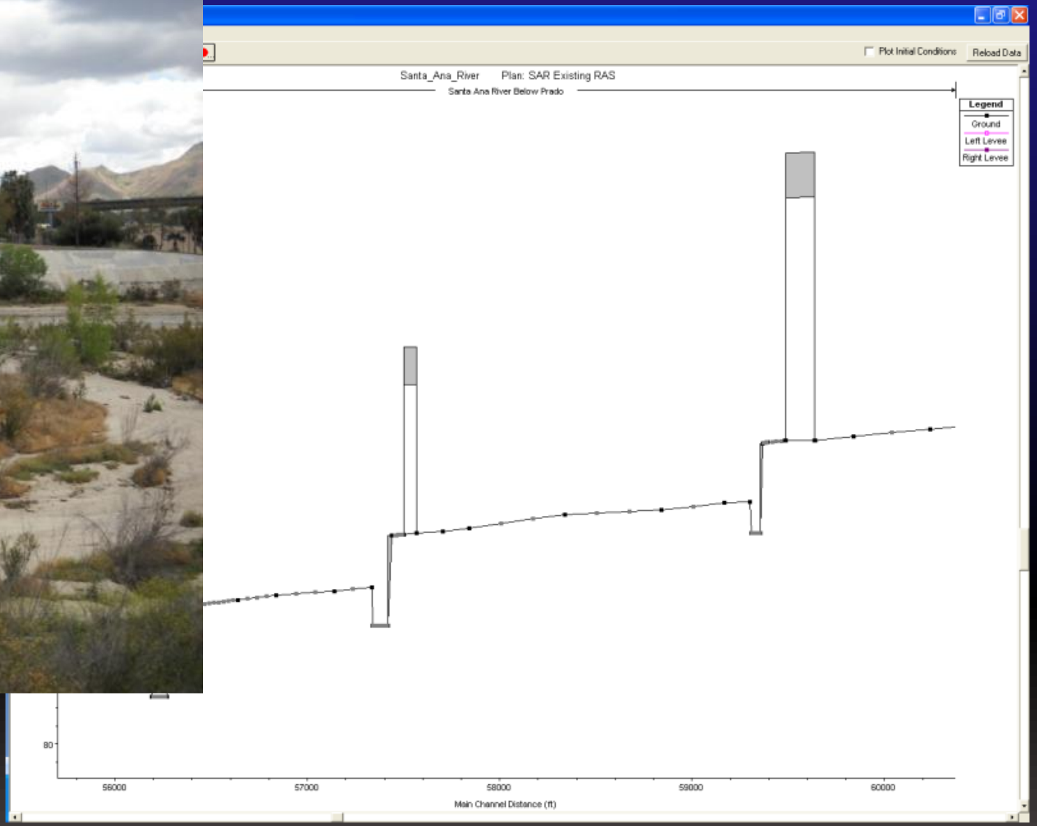
WATER CONTROL PLAN
Revised: October 2002
(Note: Revise Plate every time debris pool elevation is increased)

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

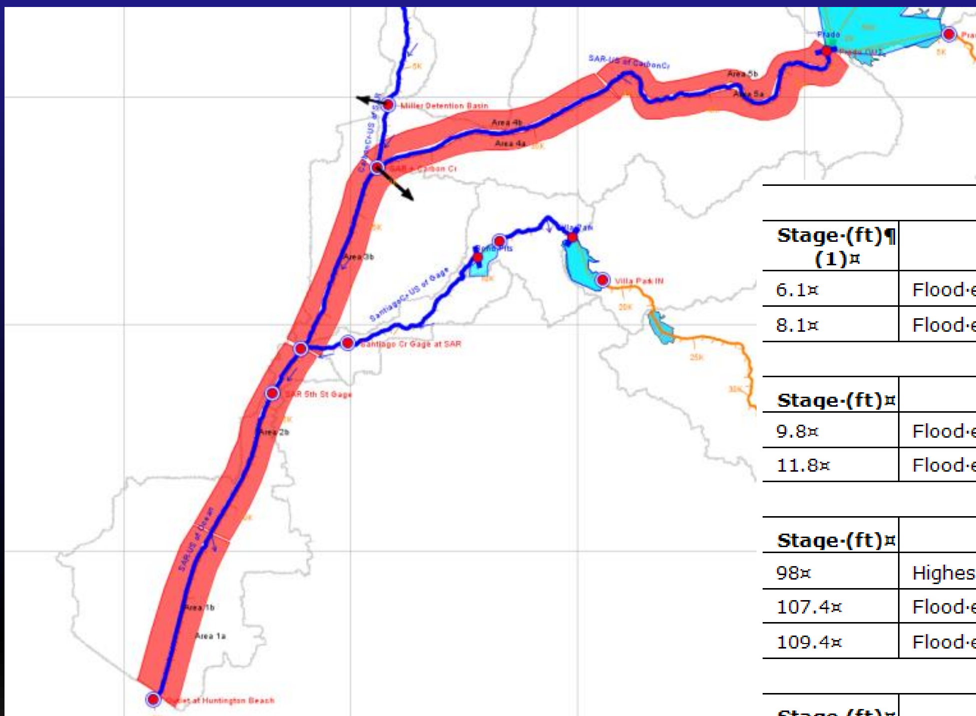
PLATE 7-01

Santa Ana River CWMS – HEC-RAS





Santa Ana River CWMS – HEC-FIA



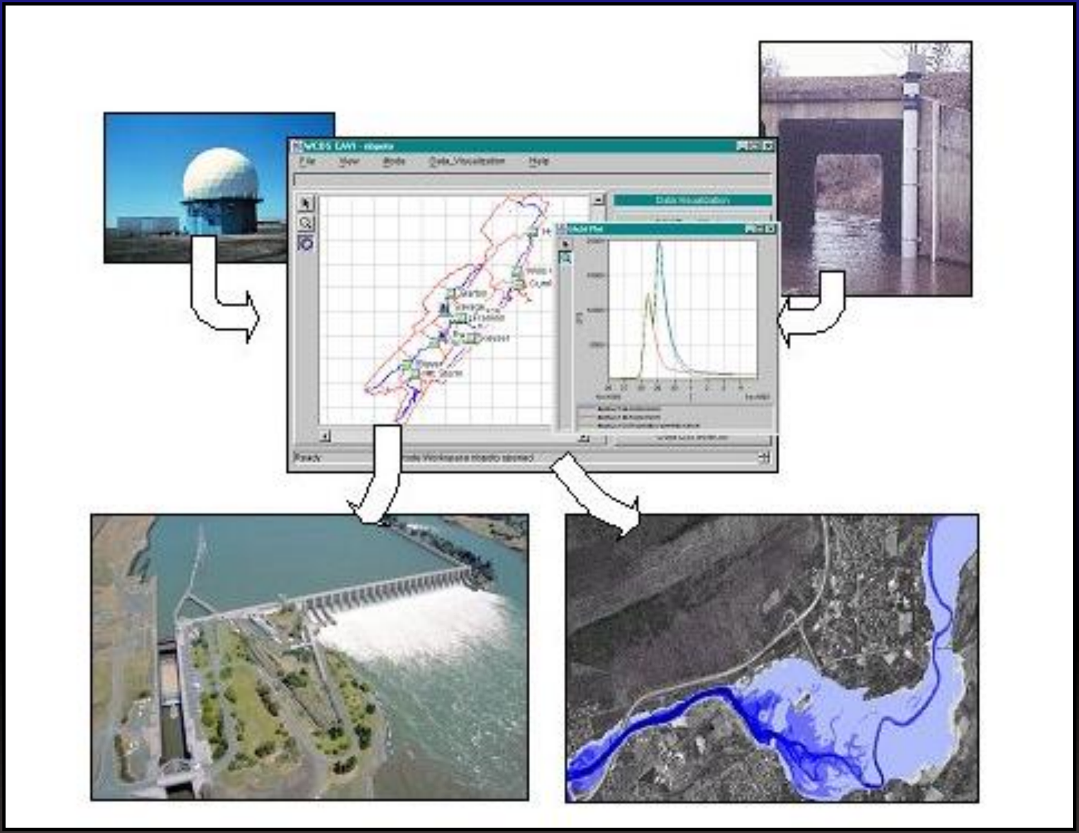
1a		
Stage (ft) (1)	**Flood Impact (2)**	**Action Required (3)**
6.1	Flood elevation within 2-ft of top of levee	Prepare for potential levee overtopping
8.1	Flood elevation reaches top of levee	Perform flood fighting operations

1b		
Stage (ft)	**Flood Impact**	**Action Required**
9.8	Flood elevation within 2-ft of top of levee	Prepare for potential levee overtopping
11.8	Flood elevation reaches top of levee	Perform flood fighting operations

2a		
Stage (ft)	**Flood Impact**	**Action Required**
98	Highest stage on record	None
107.4	Flood elevation within 2-ft of top of levee	Prepare for potential levee overtopping
109.4	Flood elevation reaches top of levee	Perform flood fighting operations

2b		
Stage (ft)	**Flood Impact**	**Action Required**
98	Highest stage on record	None
107.7	Flood elevation within 2-ft of top of levee	Prepare for potential levee overtopping
109.4	Flood elevation reaches top of levee	Perform flood fighting operations

Questions?



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