Fort Worth District Water Management: Forecast Informed Reservoir Operations (FIRO)

Date: 13 September 2019

Audience: Workshop on Forecast Informed Reservoir Operations (UTA)

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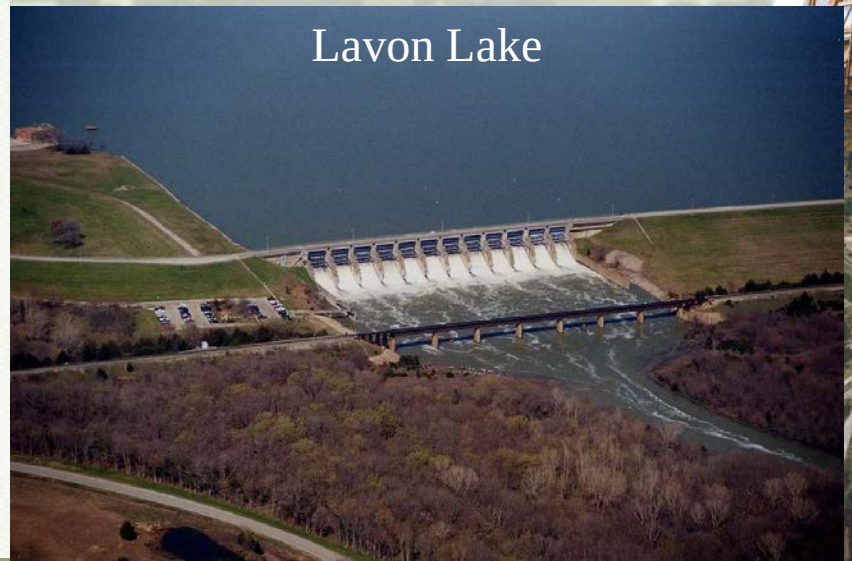
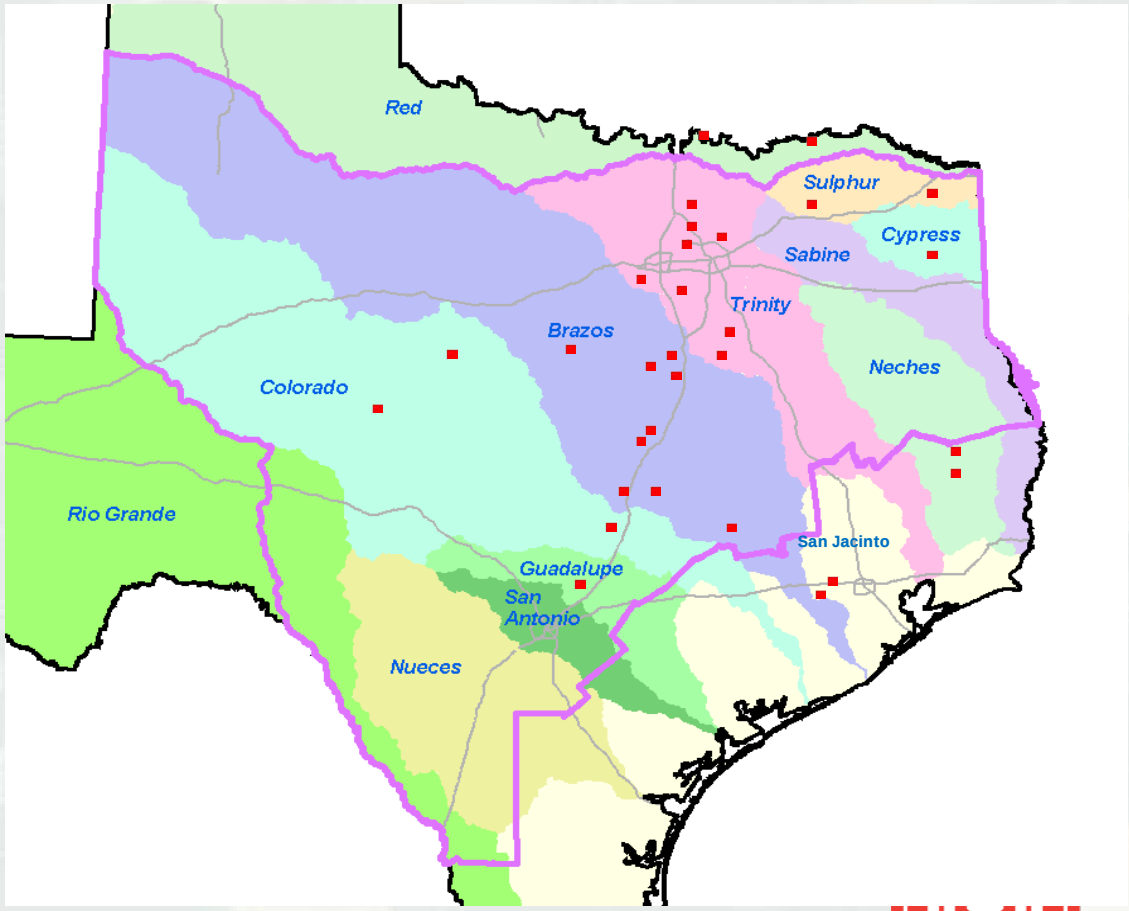


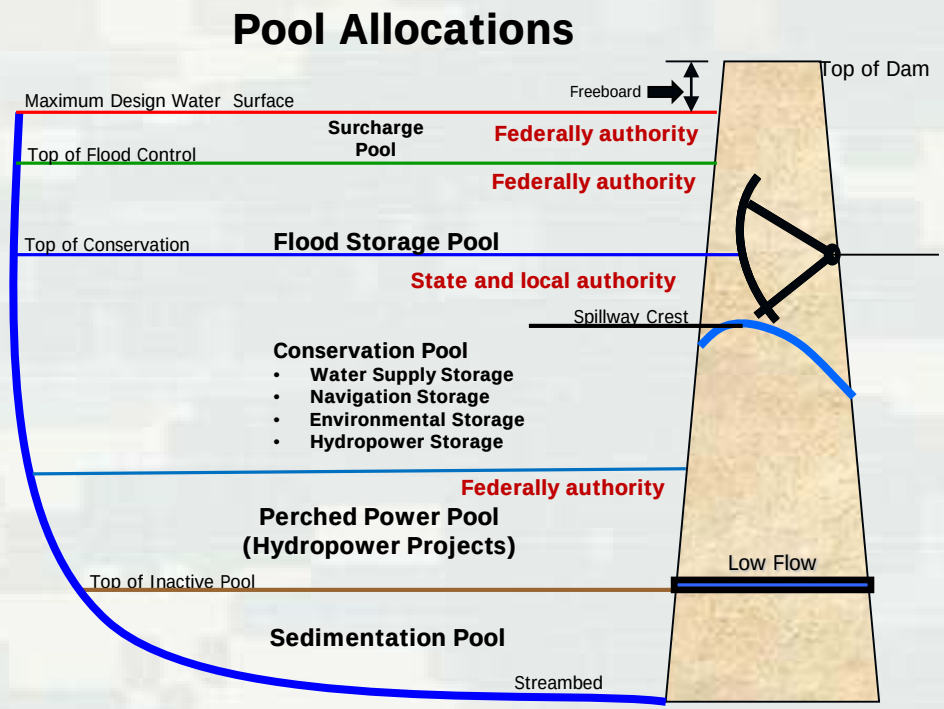
Statewide Reservoir Development Background

- Multi-purpose
  - FDR, WS, hydro, env, rec, ~~navigation~~
- Critical to the early development of Texas
- Significant federal economic contribution
- Planned/constructed dams 111/32
  - 1st - Marshall Ford Dam (Lake Travis) 1942
  - Last – Cooper (Jim Chapman Reservoir) 1991
- 9 M ac-ft conservation storage
  - 20% - 25% surface water storage
  - State and local authority
- 16 M ac-ft flood storage in 31 federal dams
  - USACE authority
- Costs (2013)
  - Construction - $8.2 billion
  - Benefits - ~~$76~~ $100+ billion (flood only)
  - B/C ratio – 9+:1
- Annual recreation visits – 22 M



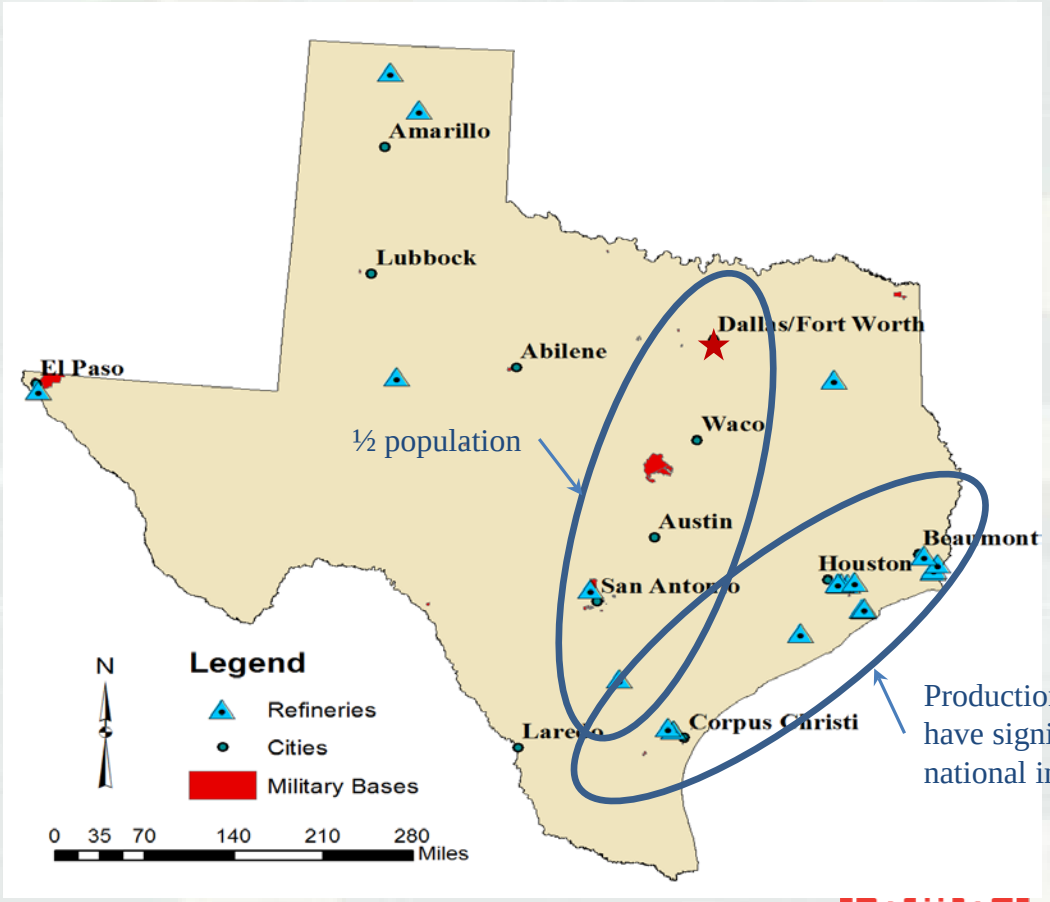
Water Management Operational Objectives

- USACE Operational goals
  - Follow published plans of operation – target maximum DS flows
  - Operate as a system
  - Retain flood inducing runoff until safe to release into DS areas
  - Fill conservation pools
  - Make water supply releases from conservation pools
  - Empty flood pools quickly
  - Minimize usage of surcharge pools
  - Utilize forecasts for forecast informed reservoir operations
- USACE Tools
  - USGS managed Cooperative Streamgage Program observation network
  - NWS precipitation, weather and climate forecasts
  - Forecasting tools, analysis and data
- Coordinate and communicate with partners and stakeholders
  - Collaborate with NWS for operations and public flood warnings!



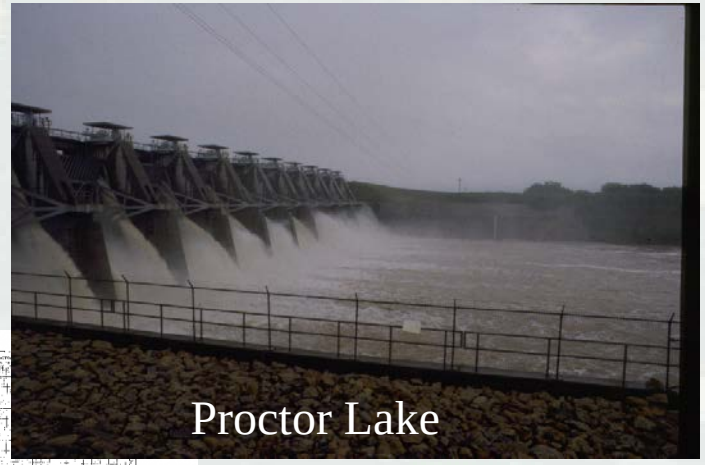
Why Consider FIRO?

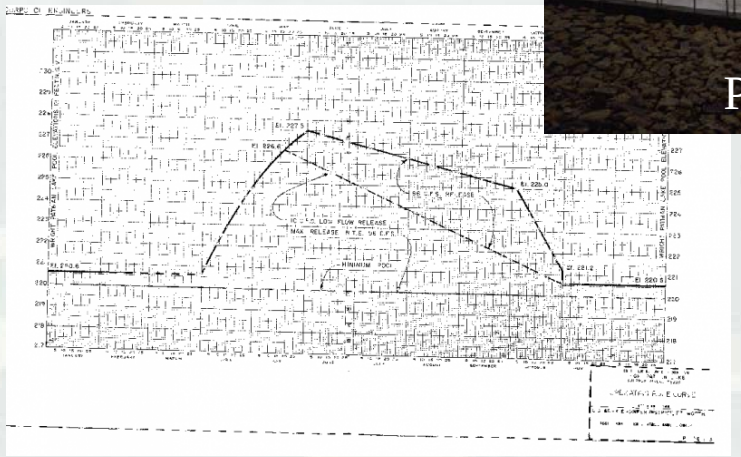
- Population growth (water supply and flood risk)
- Significant water needs along the coast for petroleum and related manufacturing
- Extreme climate variability and possible climate change
  - Extreme flooding
  - Extreme drought
- Responsibility to maximize the benefits of the reservoirs for citizens of Texas



Current FIRO Opportunities

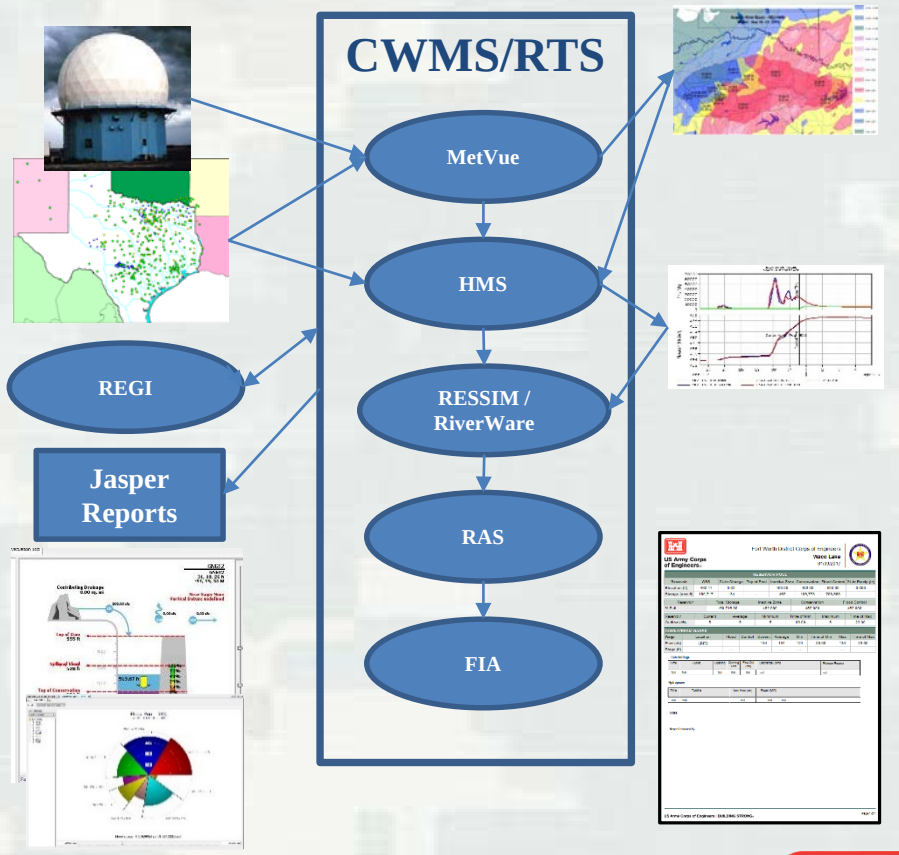
- Current FIRO
  - ► Tainter gate projects, release less earlier for longer periods with reliable forecasts
  - ► Seasonal pools
  - ► Monitor and react to drought conditions and drought forecasts
    - Retain 5% or 1’ of flood storage (seasonal and stipulations)
    - Drought contingency plans and related drought activities


Proctor Lake



USACE Tools and Technologies

- Real-time forecasting with CWMS/RTS
- Planning with WAT
- System of tools
- Data use and management



RiverWare as a Watershed Management Tools

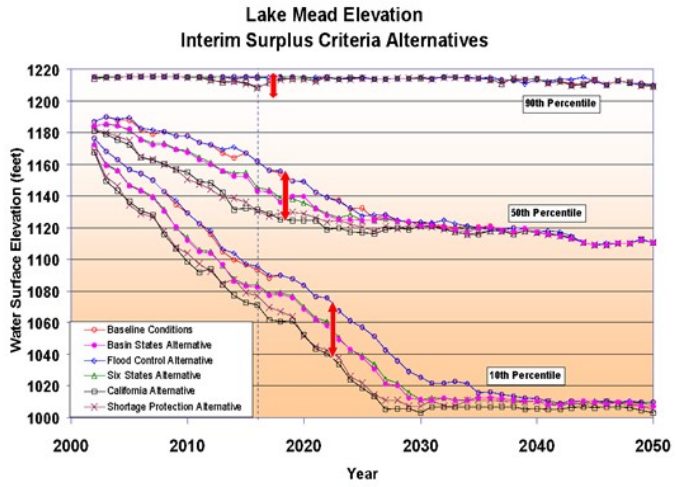
- $50 million investment
- $27 million USBR, TVA, USACE
- Capable of modeling all water in and out of each system, monthly, daily and hourly
- Wide array of simulation capabilities
- Multi-objective analysis
- Probabilistic results
- Internal methods and data accessible

Meet all DSS System Management Needs –
Planning, Operating, Analysis, Negotiations

Risk Analysis for Ensembles

- Stochastic Input
- Stochastic Output
- Evaluate using GPAT (Graphical Policy Analysis Tool)
- Distribute runs to multiple cores on a machine

Graphical Policy Analysis Tool (GPAT)
Excel-based Tool for statistical analysis of ensemble output

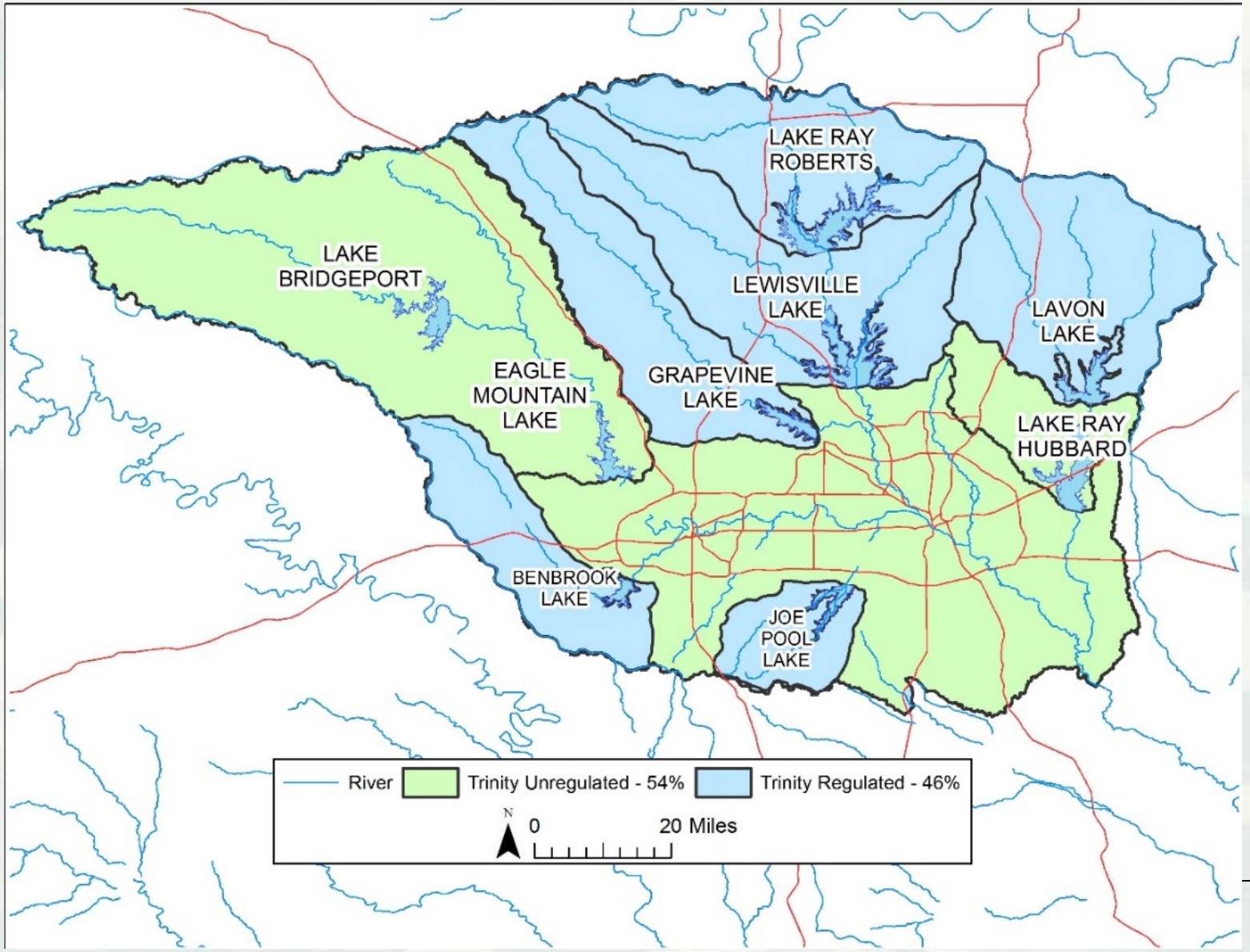


RiverWare

Challenges

- Decisions can have significant consequences
- Water rights and ownership of pools (consistency and risk/funding)
- Cumulative impacts of drought and flooding over time
- Uncertainty associated with precipitation, weather and climate forecasts
- Inter and intra basin transfers (water pipelines)
- Non-stationarity in Brazos and Colorado Basins
- Involves probabilities and risk
- Lack of understanding of climate change
- Lack of research in our region (tools, analysis and data)
- Impacts of water operations National Environmental Policy Act (NEPA)

Dallas-Fort Worth - Flood Risk and Water Supply System



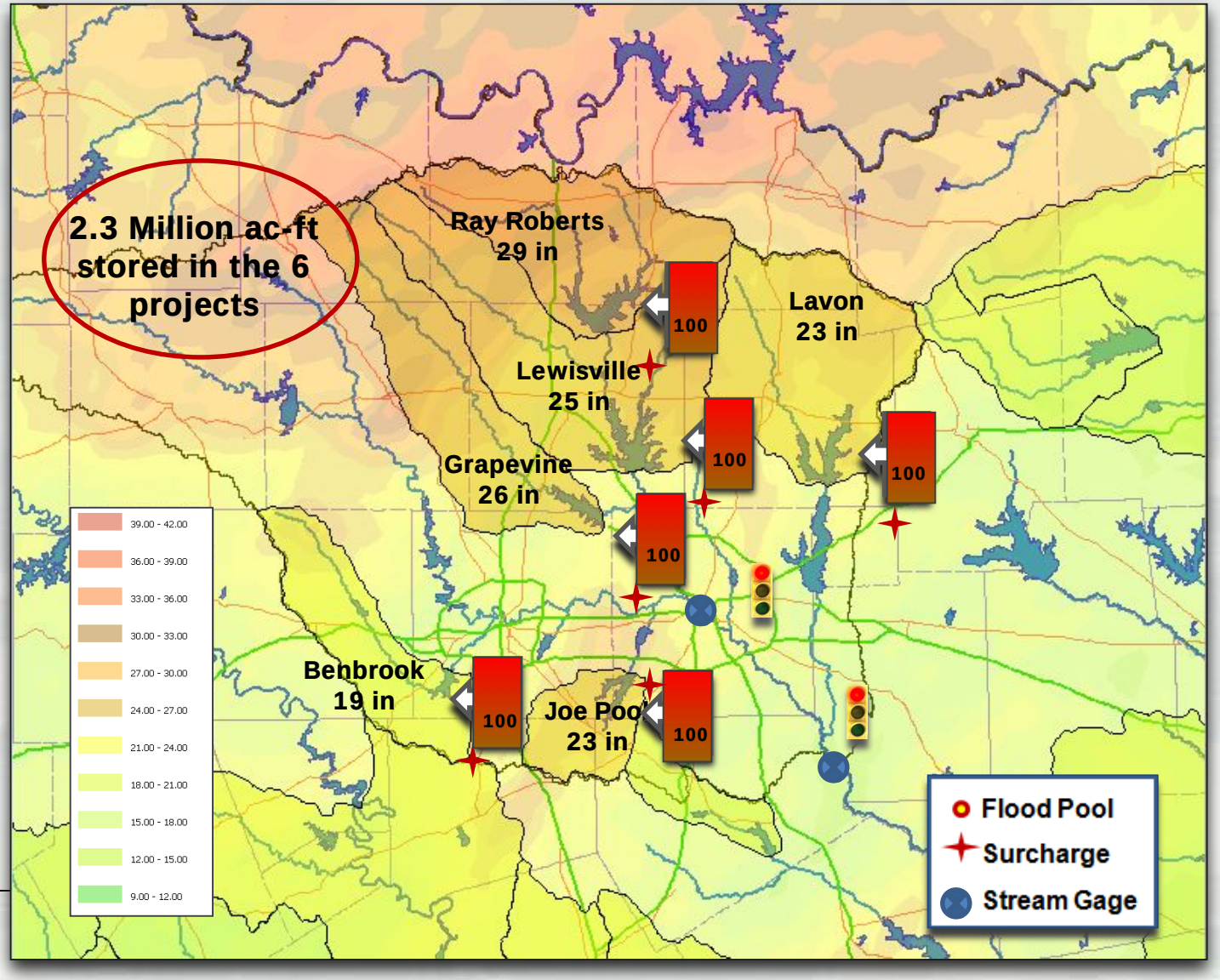
- 6 multi-purpose reservoirs (1952-1987)
- 2 federal levee systems
- $100+ billion in damages prevented
- Water supply for 7.4 million

BUILDING STRONG®

Dallas-Fort Worth Flood Control System Operations

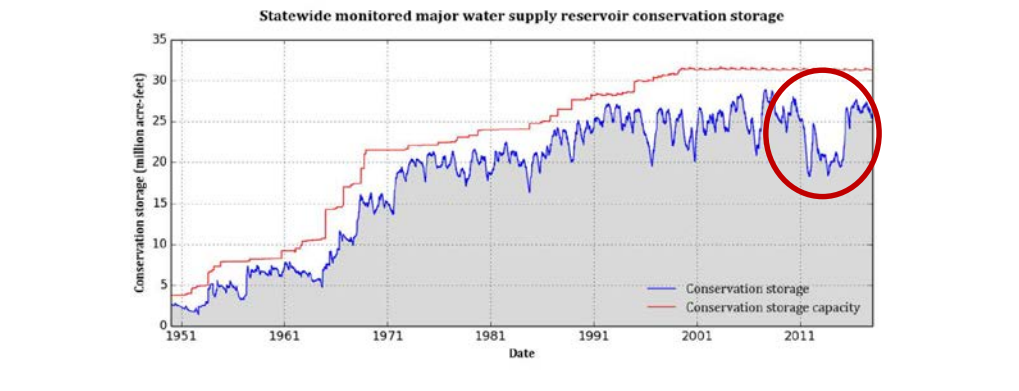
May-June 2015

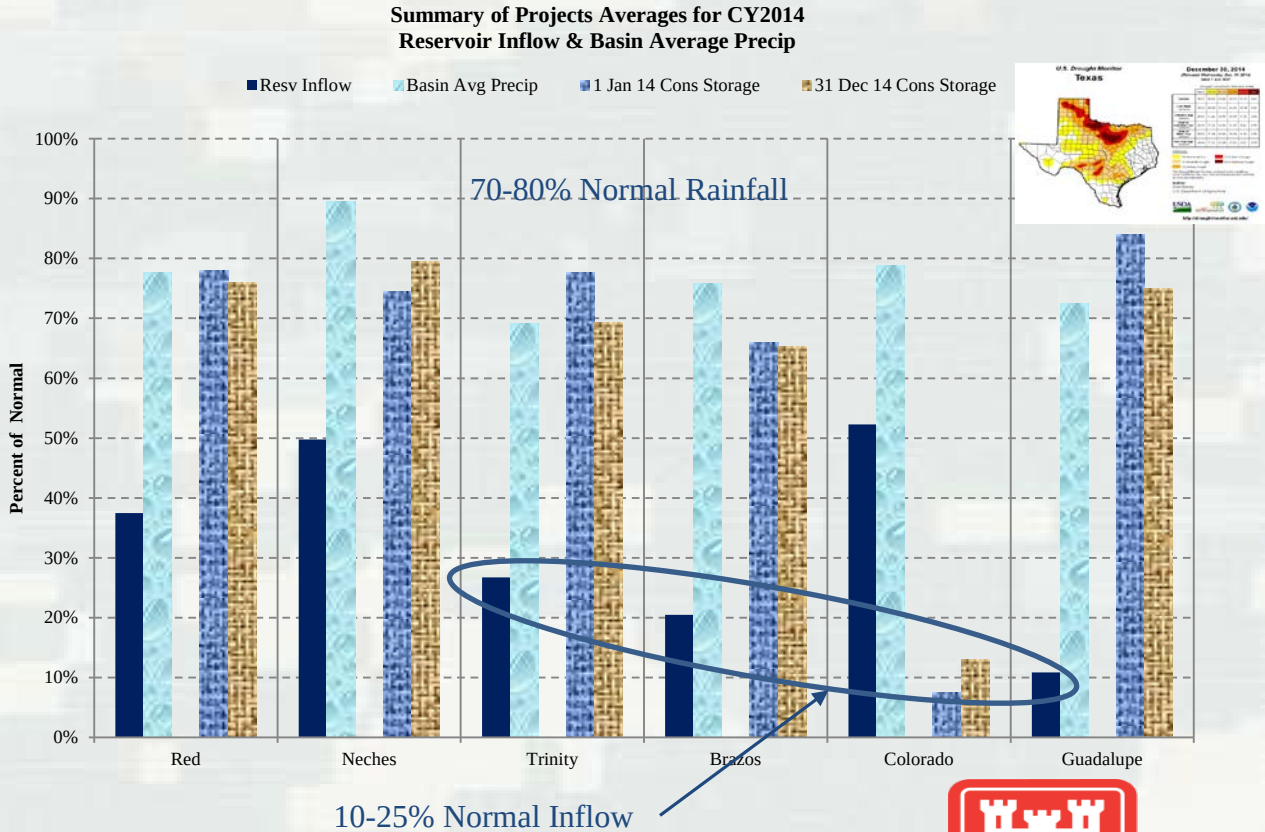
- Rainfall totals approaching 39”
- Basin average rainfall of 20” – 30” (entire upper Trinity River)
- Completely filled all flood storage within reservoirs
- System taxed to limit
- Surcharge operations all 6 reservoirs
- Unprecedented event



Impacts of Drought on Water Availability

- Inflow changes rapidly with small changes in precipitation
- Sequential drought years are greatest threat





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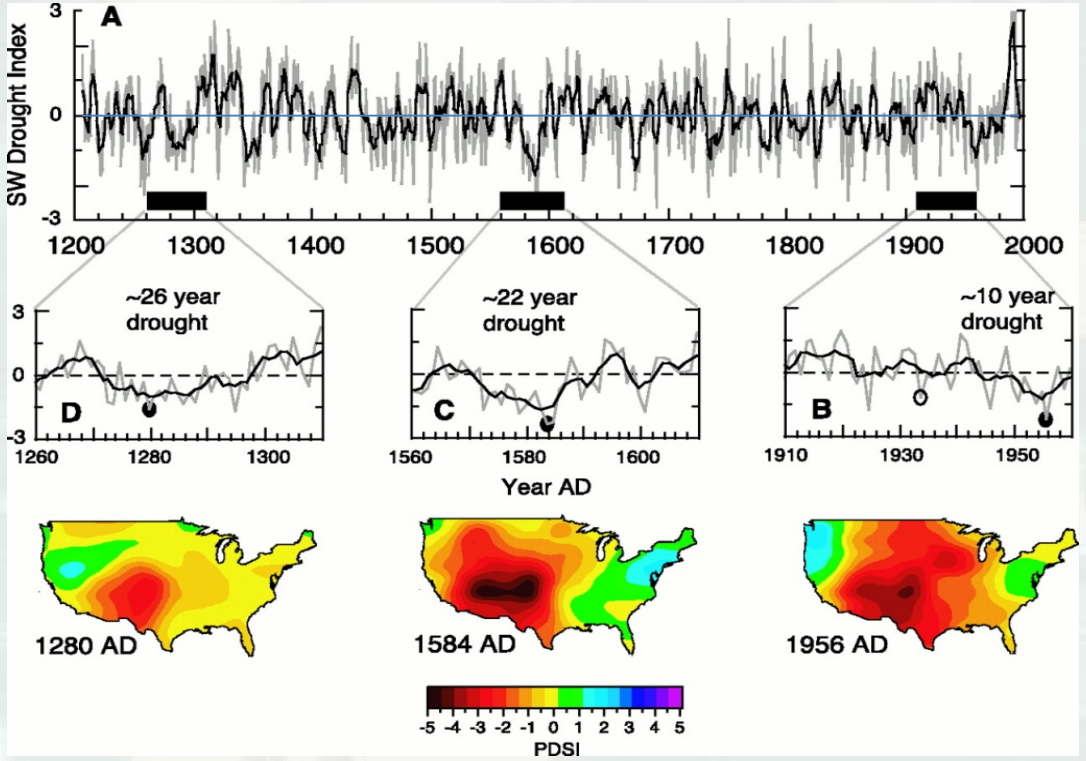
Climate Variability - Historical Perspective

- Significant Historical Droughts
  - 1271-1297 (26 years)
  - 1570-1592 (22 years)
  - 1947-1957 (10 years)
- WS yields determined based on the 1947-1957 drought period
- Greater risk on WS

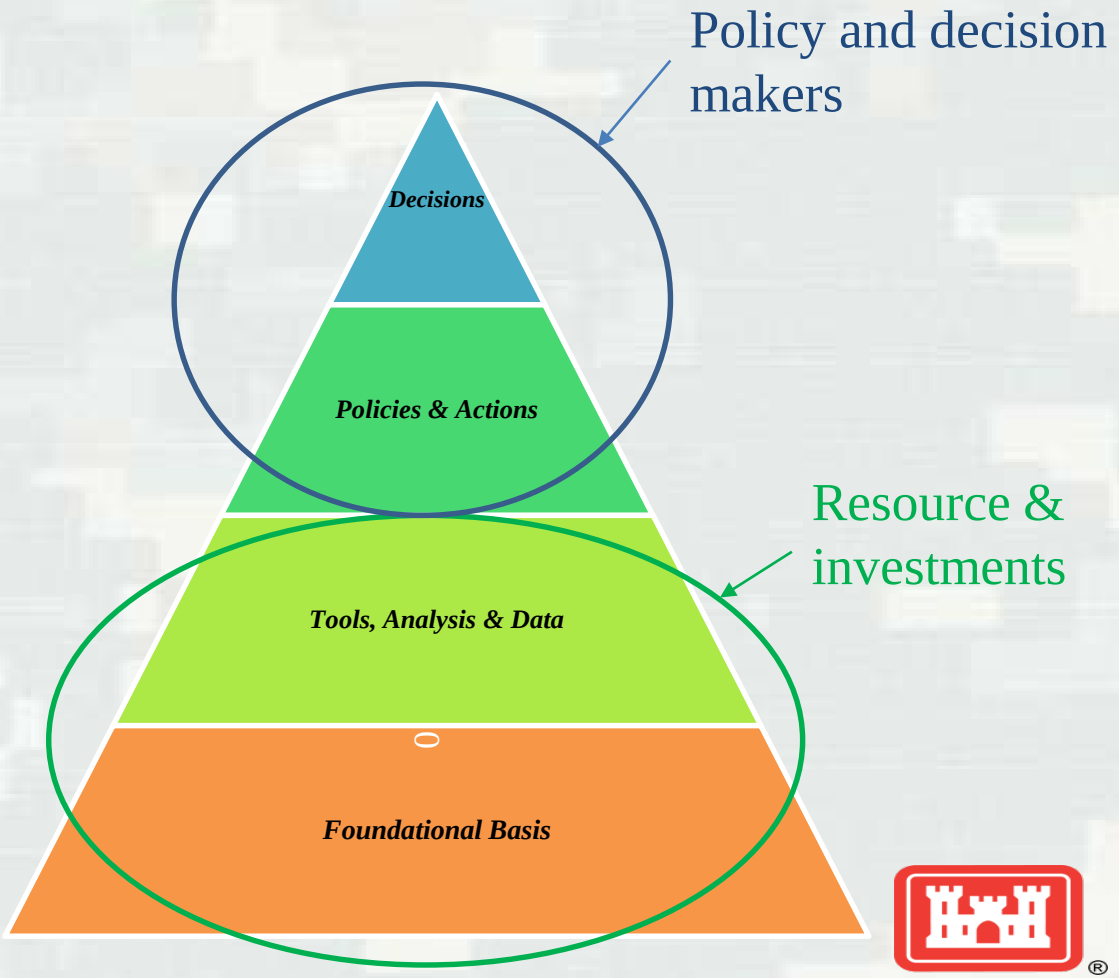


What major civilization shift occurred as a result of the 1271-1297 drought?

The Anasazi civilization fled their homeland south and east toward the Rio Grande and Colorado River to find better water sources.

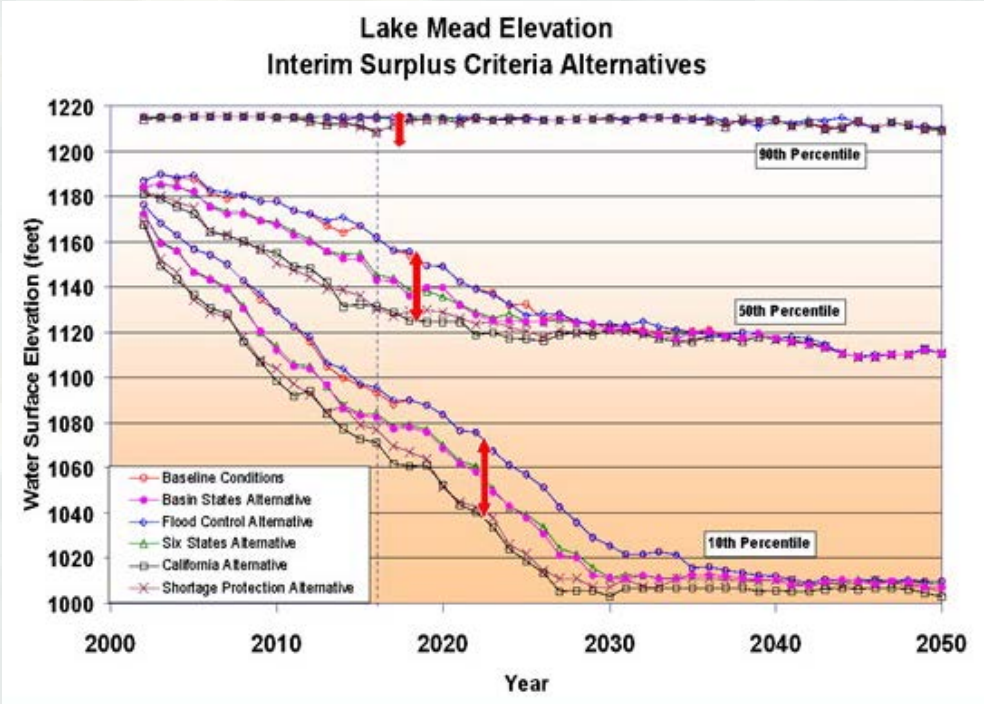
Roadmap to Increasing the Use of FIRO

- Funding & resources
- Research that produces methods, analysis and data that can be implemented operationally
- Implement the research in operational tools
- Pilot reservoirs/watersheds
- Testing and evaluation of tools and data
- Policy decisions related to use of the new tools, analysis and data



Future FIRO Opportunities

- Future FIRO opportunities
  - ► Water Supply –
    - Utilize historical observations of inflow and storage
    - Utilize probabilistic forecasts of runoff and climate/weather forecasts (WS stakeholder decision)
  - ► Flood Risk –
    - Utilize historical flood observations
    - Utilize probabilistic forecasts and seasonality of flooding with climate/weather forecast (USACE with local input)
      - ▷ Must consider dam safety and dam safety status



Suggested Research

- Climate and climate trend study for Texas
  - Significant climate variability in central Texas
  - ½ Population at risk along I35 corridor
  - Refinery and other coastal industry
  - Agricultural industry
- Improved climate and weather predictions (regionally)
  - Near real-time water models for entire watersheds
  - Probabilistic forecast data
  - Verification studies
  - Policy and Actions

UCAR
UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Acknowledgements and Questions?

- You!
- UTA
- Federal partners
  - ►Federal Emergency Management Agency (FEMA)
  - ►United States Geological Survey (USGS)
  - ►National Weather Service (NWS)

US Army Corps of Engineers

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