CADSWES

The Center for Advanced Decision Support for Water and Environmental Systems

WELCOME

to the

TENTH Annual

RiverWare

User Group Meeting

Tenth Annual User Group Meeting

- Introductions
- Meeting Information
- Overview of Licensing Agreements
- Current users
- Overview of current applications

Tenth Annual User Group Meeting

Meeting Logistics

Gwen Colby

RiverWare License MOU

- Original R&D funded by TVA, Reclamation (since 1992)
- RiverWare is made available to others in order to:
  - Contribute to more effective water management
  - Allow stakeholders to participate in operations/planning
  - Share the cost of software maintenance
- MOU between CU, Reclamation and TVA agreeing on terms of licensing RiverWare to others
- RiverWare is licensed by CU Office of Technology Transfer. License fees contribute to software maintenance (requires about $250K per year). TVA and Reclamation get cost-free licenses and contribute to maintaining the software.
- Viewer license is cost-free

New in MOU

U.S. Army Corps of Engineers have No-cost licenses until June 30 2011

(COE must contribute to software maintenance costs; the 3-year timeframe allows us to work out a permanent way for COE to contribute. For now, offices with existing licenses will contribute for all.)

RiverWare Users

Bureau of Reclamation

- Lower Colorado
- Upper Colorado
- Lahontan AO
- Albuquerque AO
- Yuma
- Yakima
- Columbia Basin
- Grand Junction
- Durango
- Provo
- Billings
- Boise

Tennessee Valley Authority

- Tennessee Basin

U.S. Army Corps of Engineers

- Albuquerque
- Tulsa
- Ft. Worth
- Little Rock
- Kansas City
- Omaha
- Sacramento*

RiverWare Users

Other Federal Agencies

USGS – Albuquerque, Ft. Collins
U.S. Fish and Wildlife Service
BIA (Farmington, Albuquerque)
National Park Service (Gunnison)
National Renewable Energy Lab
Reno Federal Water Master
International Boundary & Water Commission
Southwest Power Administration

Tribes

Jicarilla Apache Nation
Pueblo of Jemez

States and Local Govt

Arizona DNR
Colorado Water Conservation Board
Colorado River Board of California
Colorado River Commission of Nevada
New Mexico Interstate Stream Commission
Kansas Water Office
Montana Dept of Natural Resources
New Jersey Dept Environ Protection
City of Lompoc

RiverWare Users

Water Districts, Authorities, Utilities

- Central Arizona Project
- Central Utah Water Conservation District
- Coachella Valley Water District
- Colorado River Water Conservation District
- Lower Colorado River Authority
- Lower Neches Valley Authority
- Metropolitan Water District of Southern California
- El Dorado Irrigation District
- New Jersey Water Supply Authority
- Southern Nevada Water Authority
- Truckee Meadows Water Authority
- Tarrant Regional Water District
- East Bay Municipal Utility District
- Pacificorp
- AvistaCorp

RiverWare Users - Consultants

- AMEC (formerly Hydrosphere Resource Consultants)
- B H&H Engineering
- Brown and Caldwell
- Camp Dresser & McKee
- Freese and Nichols
- HDR
- Keller - Bliesner Engineering
- Natural Resources Consulting Engineers
- Northwest Hydraulic Consultants
- Riverside Technology, inc.
- Stetson Engineers
- Stockton Engineering
- Tetra Tech, SWC
- TRC/ Brandes
- Wave Engineering
- West Consultants, Inc

RiverWare Users
Universities and Research Institutes

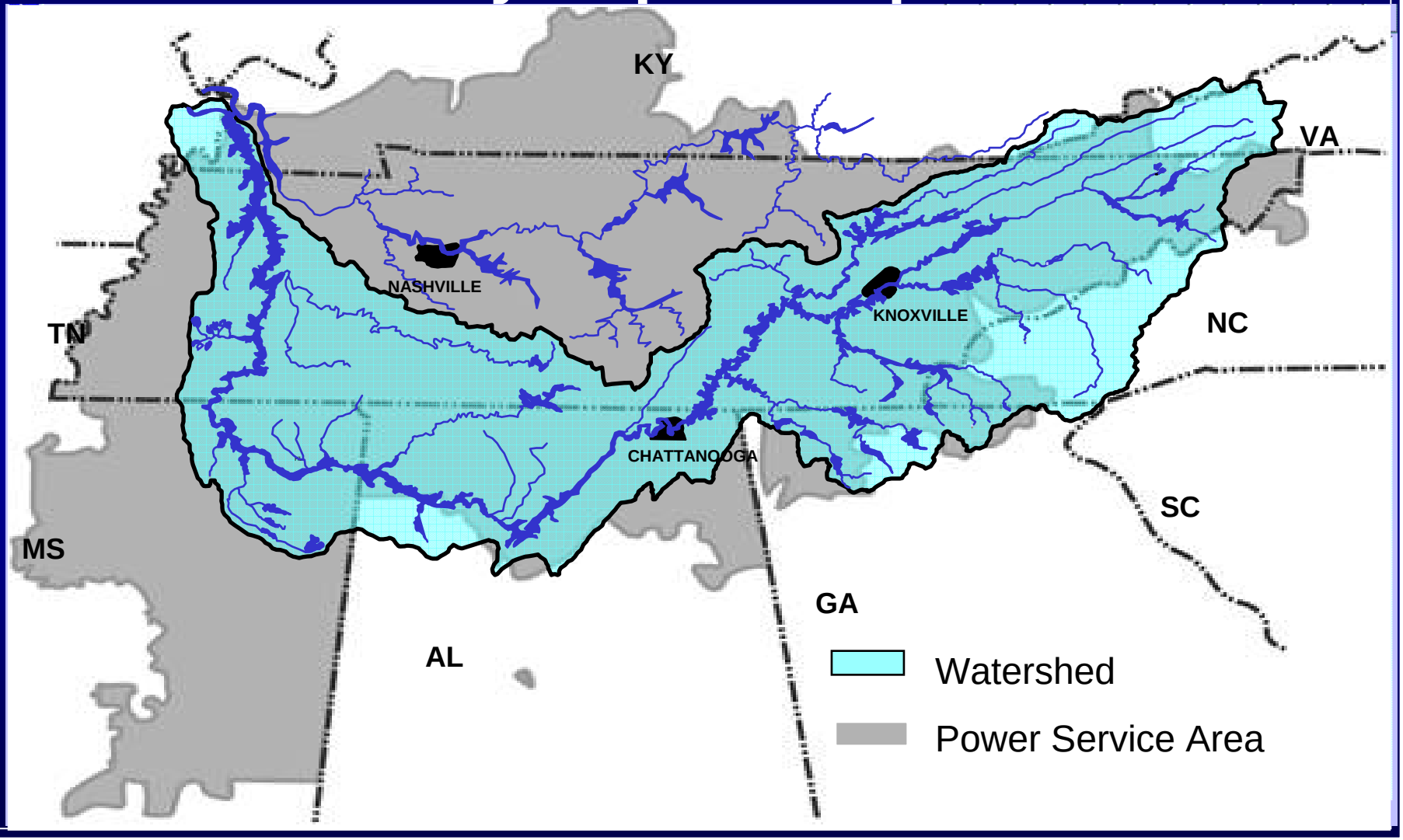
- University of Arizona - SAHRA
- New Mexico State University
- Texas A&M University, El Paso
- University of Nevada – Desert Research Institute
- Humboldt State University (California)
- Pacific Northwest National Laboratory
- Oak Ridge National Laboratory
- Living Rivers

RiverWare Users
Foreign Users

- Comision National del Agua (Mexico)
- University of Zacatecas (Mexico)
- Instituto Mexicano de Technologia del Agua (Mexico)
- China Institute of Water and Hydropower Research
- Public Works Research Institute, Japan
- University of Ljubljana, Slovenia
- Indian Institute of Technology, Madras
- MWH (Peru)
- Lithuanian Energy Institute

RiverWare Applications

TVA's reservoir system is modeled as a whole for hydropower optimization



RiverWare Applications

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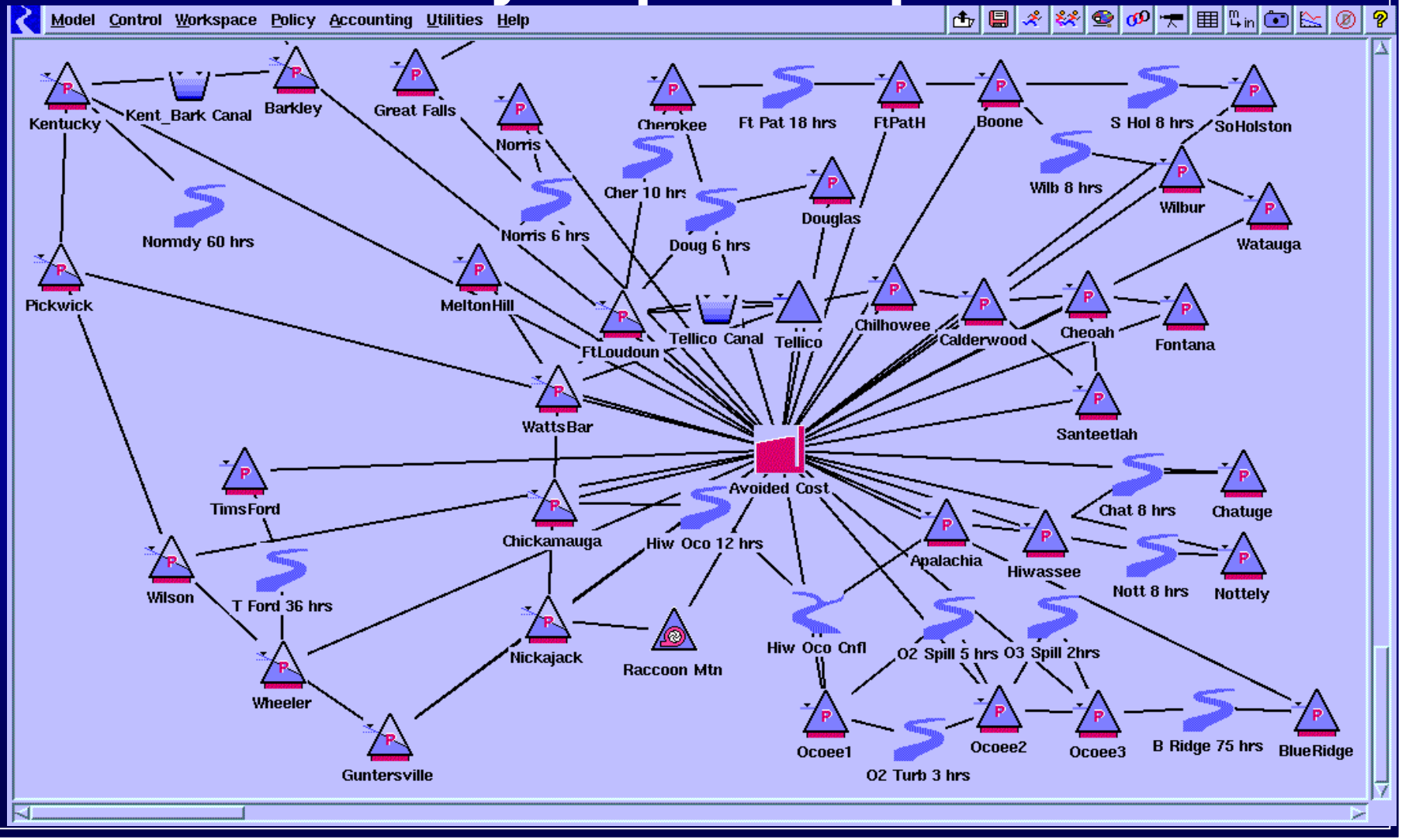
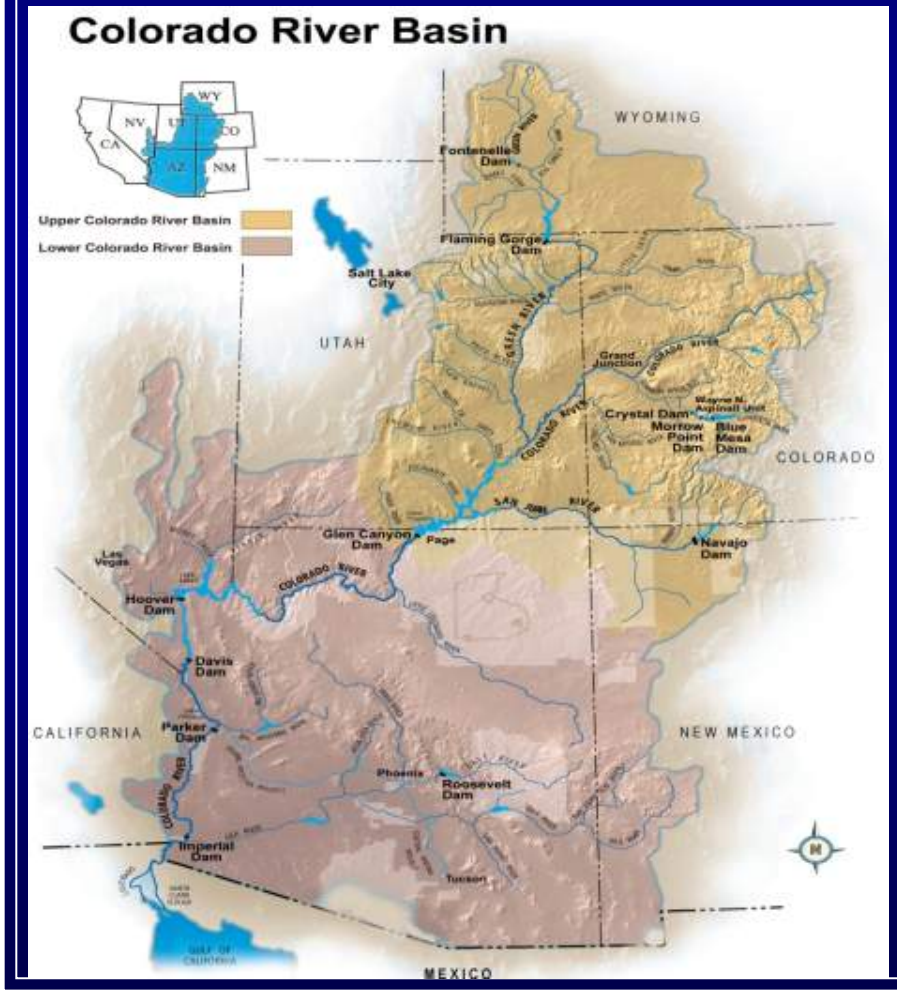


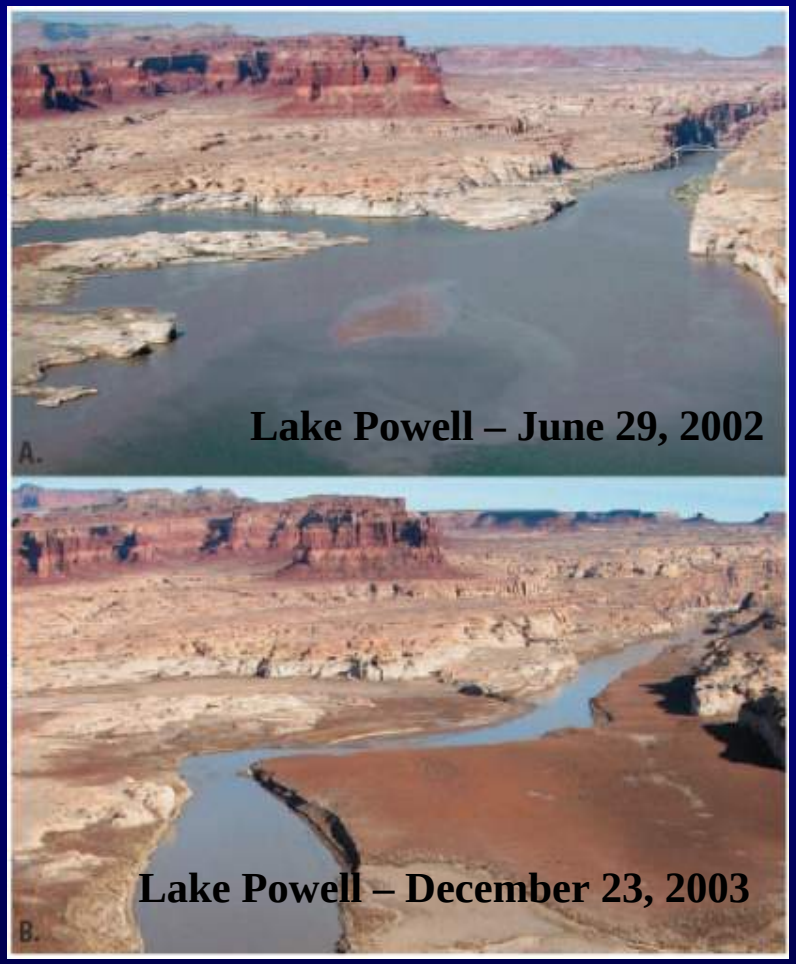
RiverWare Applications: Reclamation

Colorado River



- Lower Colorado Regional Office (Boulder City, NV)
- Upper Colorado Regional Office (Salt Lake City, UT)
- Area and Project Offices for Local Issues and Sub-basin Models
- **CRSS – Colorado River Simulation System is primary modeling tool for planning operations and evaluating policy**

RiverWare Applications: Reclamation – Colorado Basin
Shortage EIS



Final EIS on Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead – Nov 2007

Used CRSS and CRSS-Lite, a screening model used to develop 5 proposed operational alternatives for the EIS

ALSO: CRSS used in the EIS to evaluate the potential effects of potential alternatives hydrologic scenarios to the Index Sequential Method that uses the 99-year natural flow record

RiverWare Applications: Reclamation – Colorado Basin

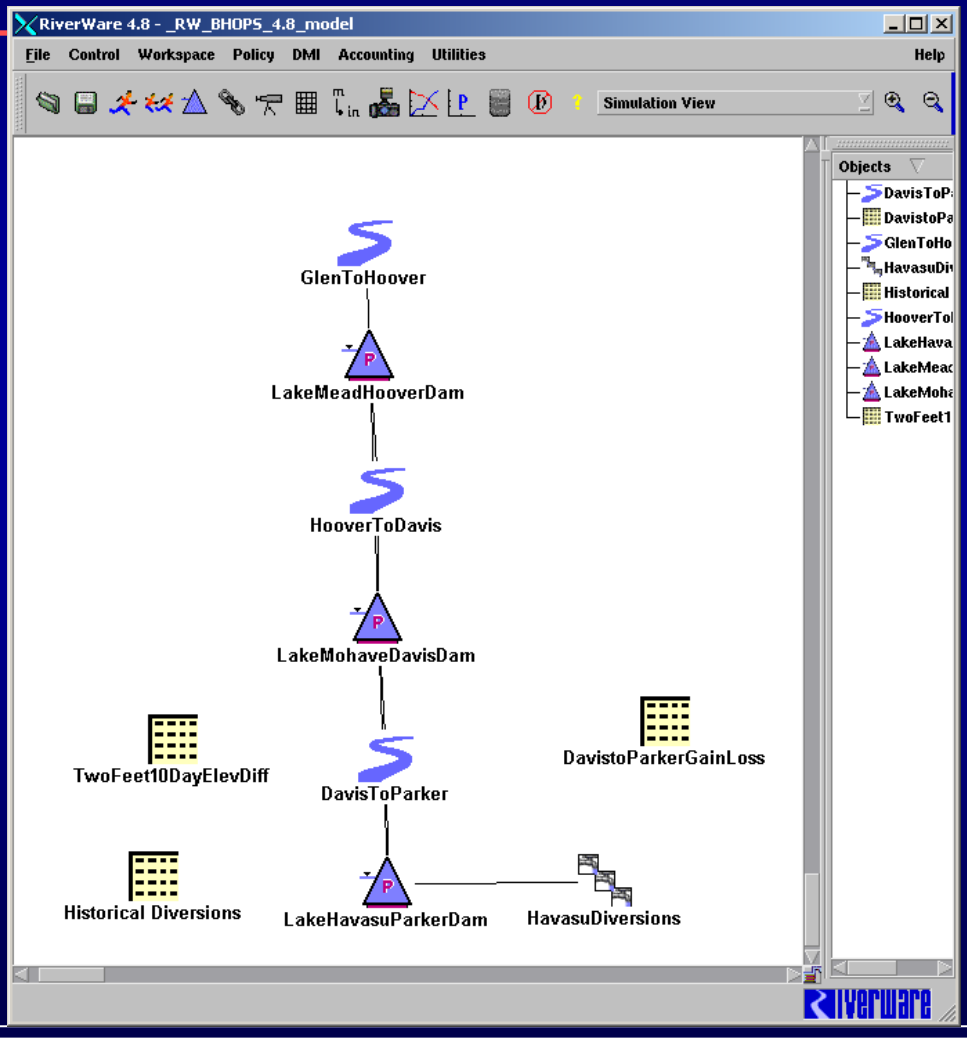
Stakeholders who use RiverWare CRSS

- Arizona Dept of Water Resources
- Central Arizona Project
- Colorado River Commission of Nevada
- Colorado River Commission of California
- State of Colorado Water Conservation Board
- Metropolitan Water District of S. California
- Southern Nevada Water Authority
- Mexico Comision Nacional del Agua

RiverWare Applications: Reclamation – Colorado Basin

Lower Colorado River Daily Operations Model

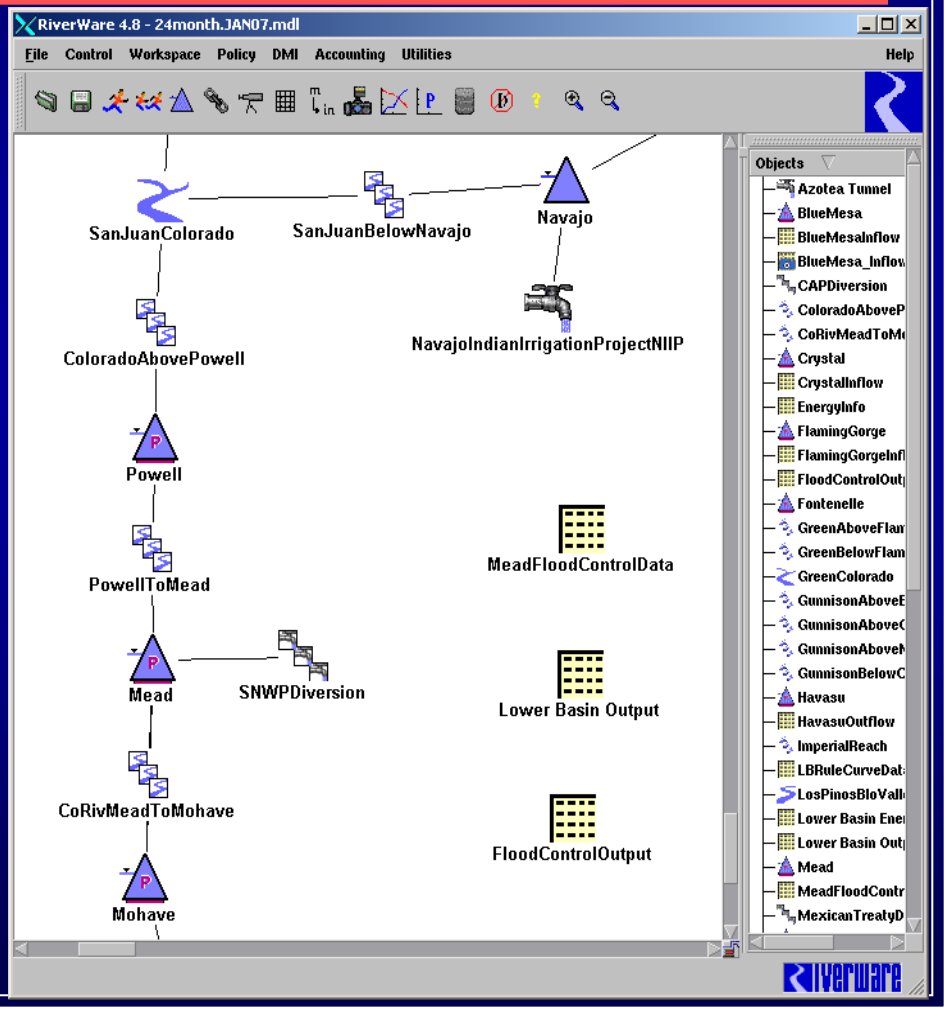
- Operation of Lake Mead
  - Meet downstream demand
  - Flood Control
- Operation of Lakes Mohave and Havasu
  - Water for downstream use
  - Environmental constraints
  - Recreational constraints
  - Flood Control



RiverWare Applications: Reclamation – Colorado Basin

Colorado River 24-Month Study

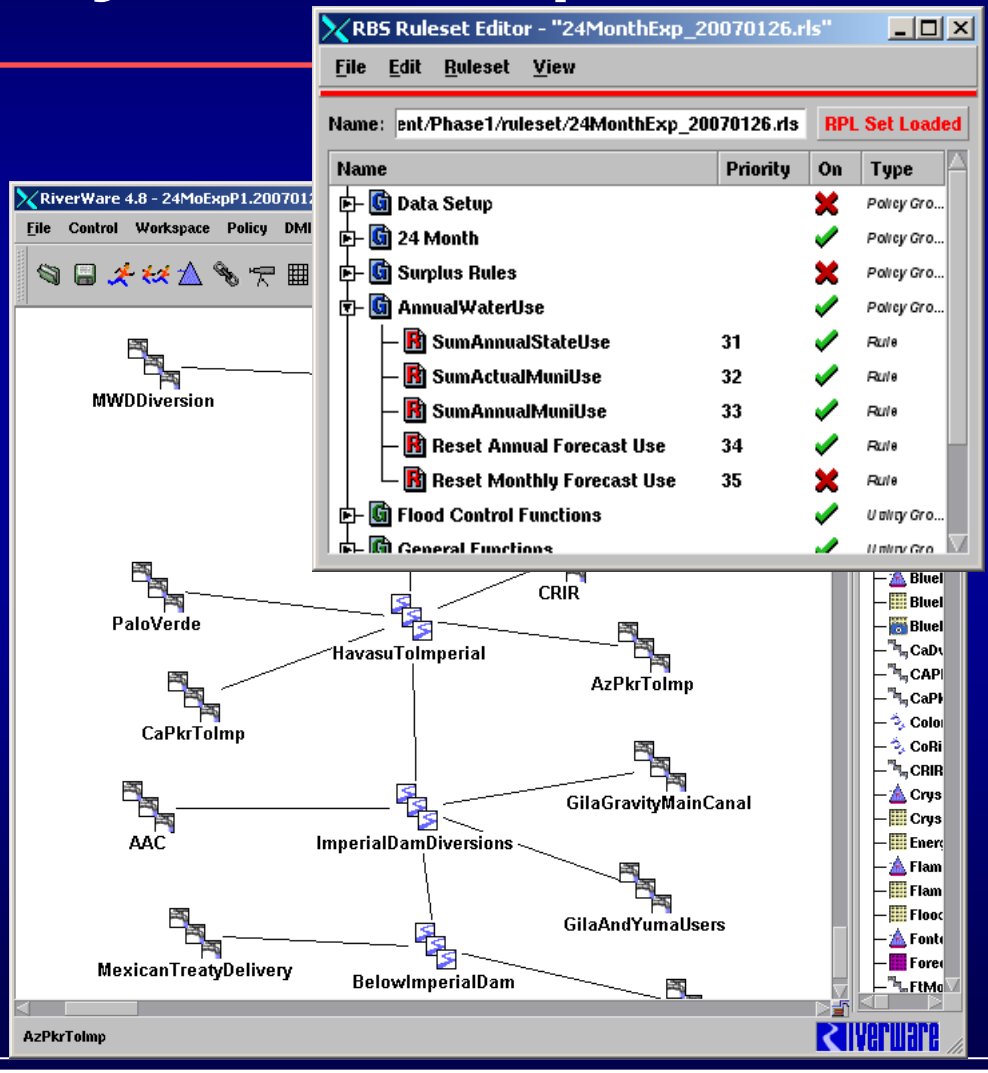
- Mid-Term Operations
- Basin-Wide Model (LC and UC collaborate)
- Used to develop the Annual Operating Plan
  - Normal, Surplus, Flood Control Conditions
- Updated monthly
  - Reflects changes in hydrology
  - Updated water demand



RiverWare Applications: Reclamation – Colorado Basin

24-Month Study Development

- Expand model to include more detail in Lower Basin
  - Diversions, tributary inflow
- Expand rule-based capabilities
  - Water allocation policies
  - Surplus water assignments



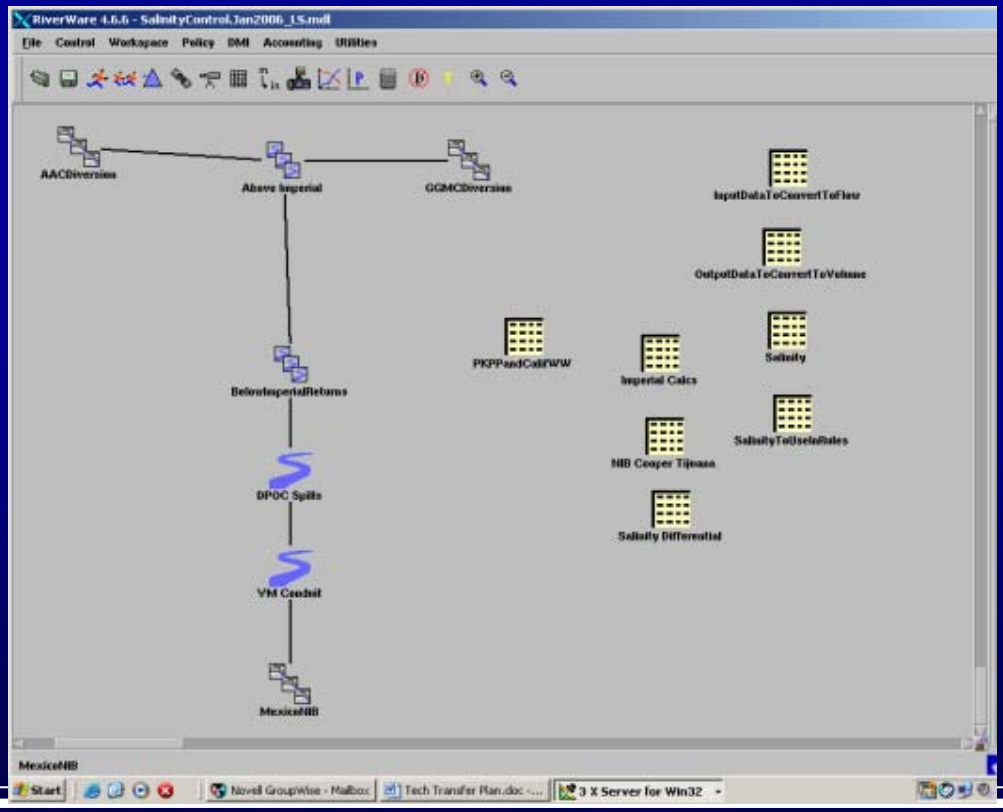
RiverWare Applications: Reclamation – Colorado Basin

Yuma Area Office Salinity Operations Models

Minute 242 of the U.S.- Mexico International Boundary and Water Commission of 1973 required U.S. to take actions to reduce the salinity of water being delivered to Mexico at Morelos Dam

Operational Constraints:

- Agricultural drainage water salinity
- Manage ground water levels
- Meet delivery requirements to Mexico (quantitative and qualitative)



RiverWare Applications: Reclamation – Colorado Basin

Flaming Gorge EIS

Operations of Flaming Gorge Dam to protect and assist in recovery of endangered fish and critical habitats on Green and Colorado River Basins

EIS 2000 to 2006 (ROD signed in February 2006)
RiverWare model used to develop alternatives

Current Model: to evaluate the effects of operations under the ROD for the next 70 years. Uses MRM with natural flows 1922-2004.

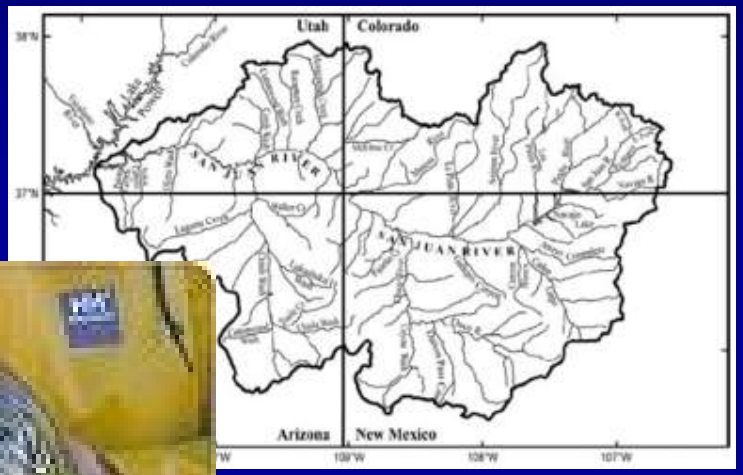
RiverWare Applications: Reclamation – Colorado Basin

Aspinall Operations EIS

The Upper Colorado River Basin Recovery Program has prepared flow recommendations for the Gunnison River to assist in the recovery of endangered fish. The EIS will evaluate alternative operations that assist in meeting the flow recommendations while maintaining the congressionally authorized purposes of the Aspinall Unit. In addition to Reclamation, the National Park Service uses RiverWare to explore alternatives

San Juan Recovery Implementation Program

To help recover endangered fish while allowing water development to continue in the San Juan Basin



Razorback Sucker

Reclamation, BIA, FWS, Tribes, BLM, Colorado, NM

Keller-Bleisner, Tribes and Reclamation use RW Model

Evaluate alternative operations of Navajo Dam

RiverWare Applications: Reclamation – Rio Grande

Upper Rio Grande Water Operations Model (URGWOM)

URGWOM

A collaborative effort

Reclamation	NMISC
USACE	Albuquerque
USGS	Santa Fe
FWS	MRGCD
BIA	Colorado
IBWC	Tribes

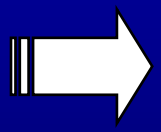
Upper Rio Grande Basin

RiverWare Applications: Reclamation – Rio Grande

Upper Rio Grande Water Operations Model (URGWOM)

4 Models Developed and Used by Reclamation, Corps of Engineers, USGS and New Mexico Instate Stream Commission

- **Water Accounting model**
- **Daily Operations model**
- **Forecast model**
- **Planning/EIS model**

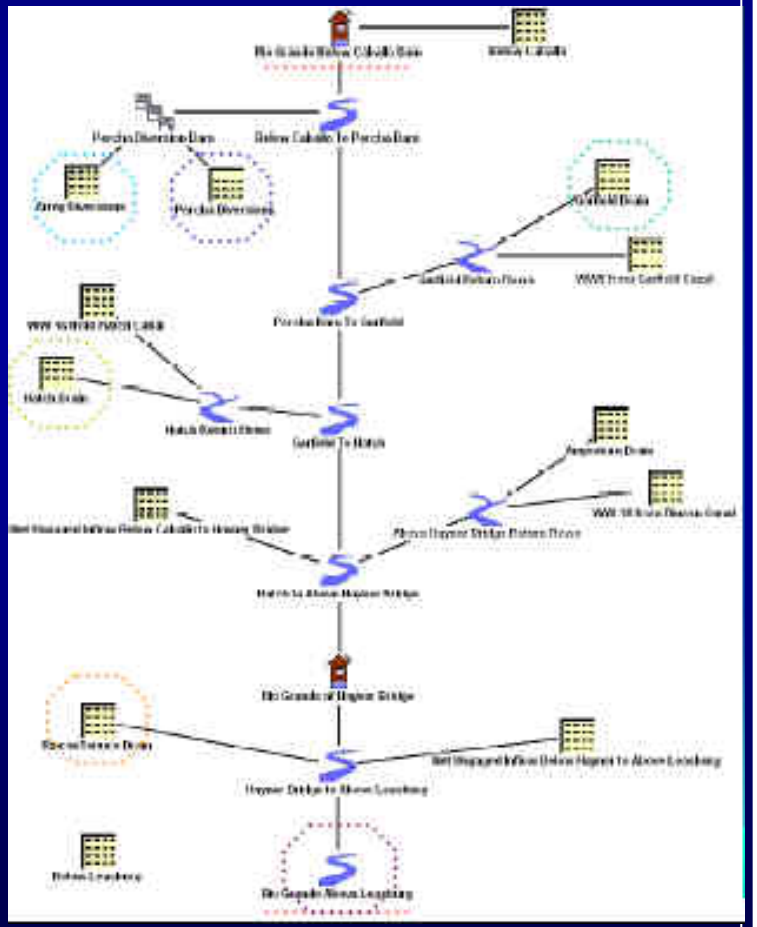


Stakeholders Developing Alternatives and Approving Model

RiverWare Applications: Reclamation – Rio Grande

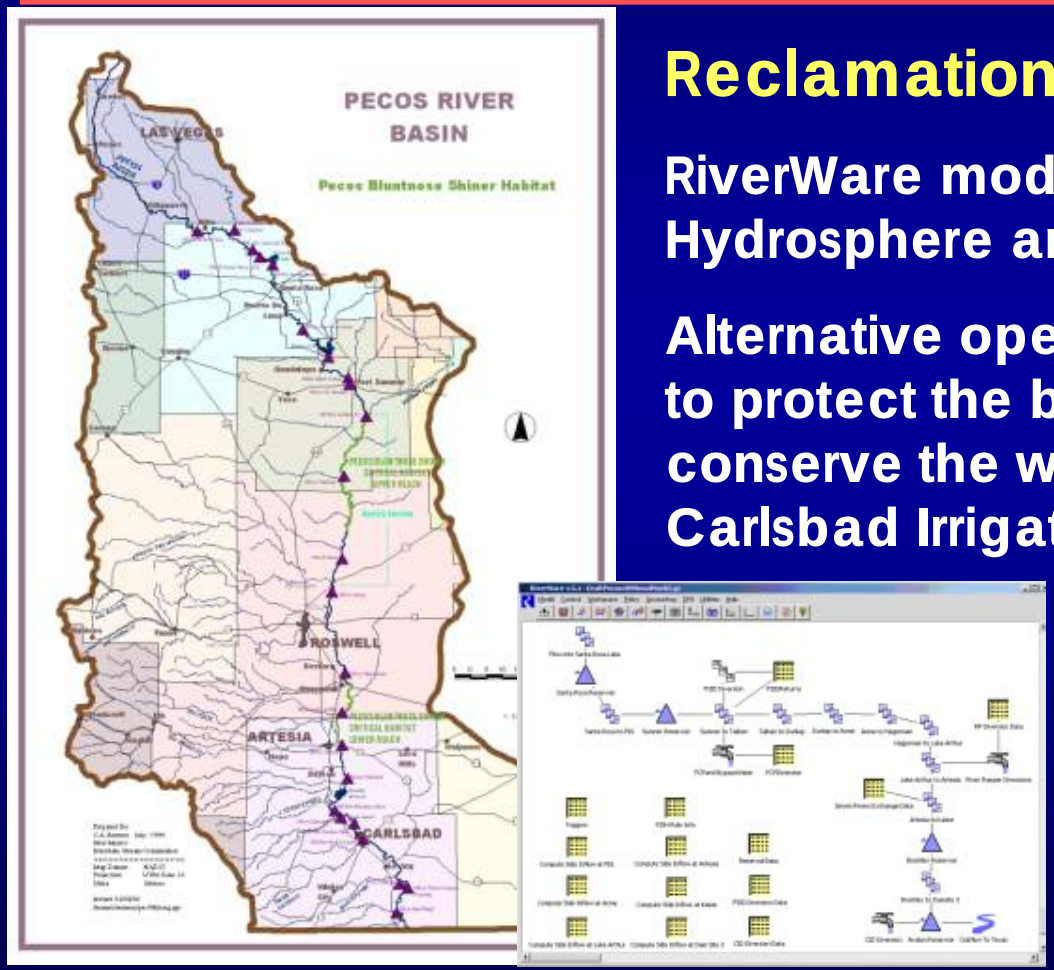
Lower Rio Grande (Rincon Reach) Flood Control Planning

- By New Mexico State University (Phil King and Sue Tillery), and Texas A&M at El Paso (Zhuping Sheng)
- Model uses transfer functions to characterize the interaction between groundwater and surface water in the Mesilla Basin and Rincon Valley
- Monthly timestep



RiverWare Applications: Pecos River Basin

Carlsbad Project Water Operations and Water Supply Conservation EIS



Reclamation and NMISC

RiverWare model developed by Hydrosphere and Tetra Tech

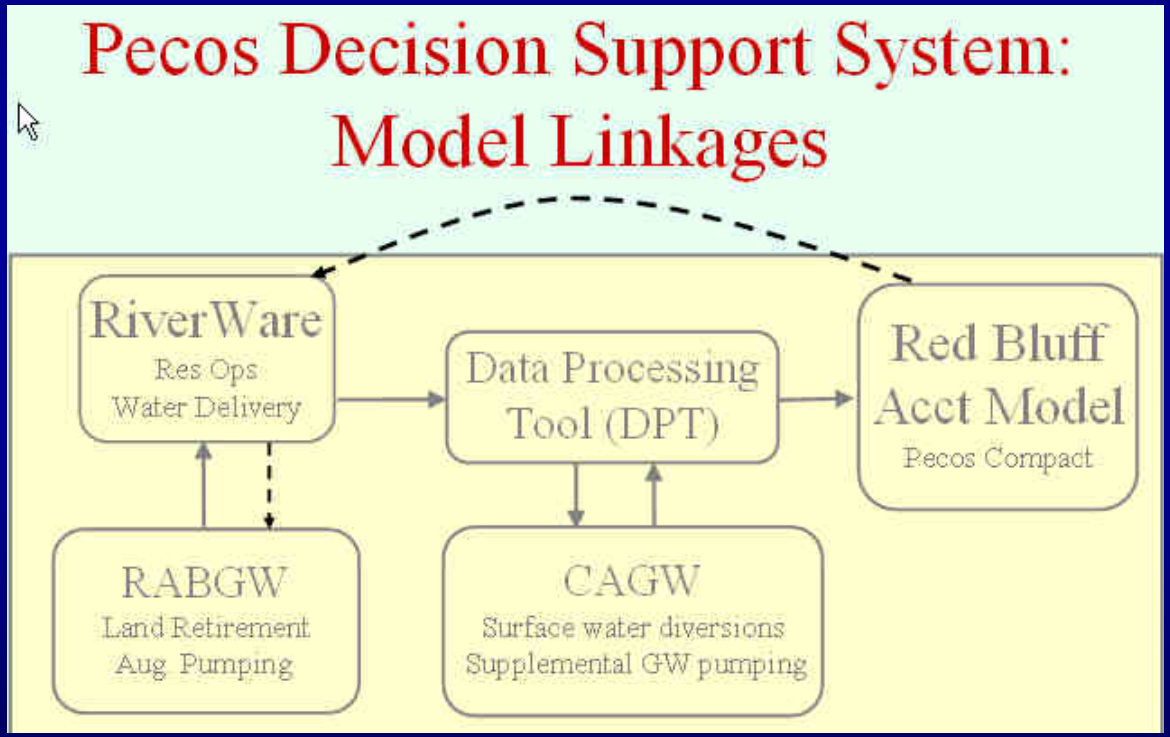
Alternative operations of Sumner Dam to protect the bluntnose shiner and conserve the water supply of the Carlsbad Irrigation Project

ROD: June 2006

RiverWare Applications: Pecos River Basin

Pecos Adjudication Settlement EIS and Pecos River DSS

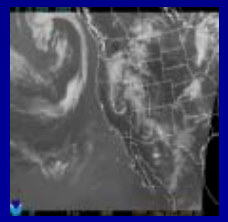
DSS links a RiverWare model of Pecos River with 2 MODFLOW models, an accounting model and various I/O tools (see presentation Carron UGM '03)



RiverWare Applications: Reclamation

Truckee-Carson Basin

Hydrologic Data



RiverWare Accounting Model

RiverWare Forecasting Model

RiverWare Operations Model

Hydrologic Data

Forecasted Hydrology

Forecasted Flows, Storages, etc.

Accounting Data

TROF Spreadsheet

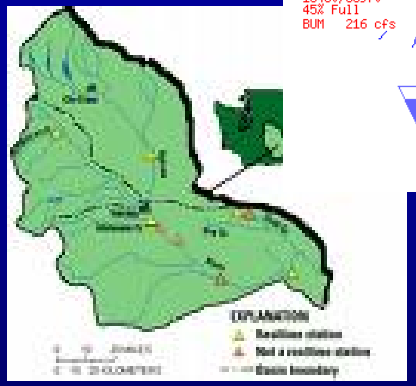
Reno

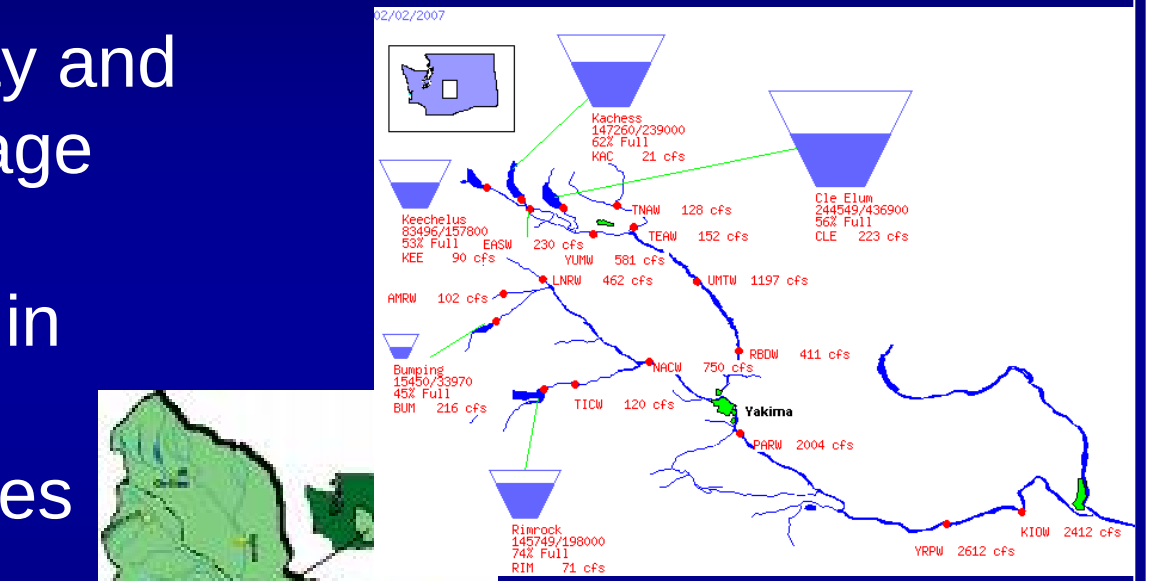
Carson City

RiverWare Applications: Reclamation – Upper Columbia Area Office

Yakima River Basin Water Storage Feasibility Study

To examine feasibility and acceptability of storage augmentation in the Yakima River Basin in order to improve conditions for fisheries and water supply.





RiverWare was used to evaluate alternative plans; report issued Nov 2006; EIS will follow

RiverWare Applications: Reclamation – Upper Columbia Area Office

Columbia Basins Project: Odessa Subarea Special Study

Investigate possibility of extending development of the Columbia Basins Project to deliver project water to lands currently using groundwater

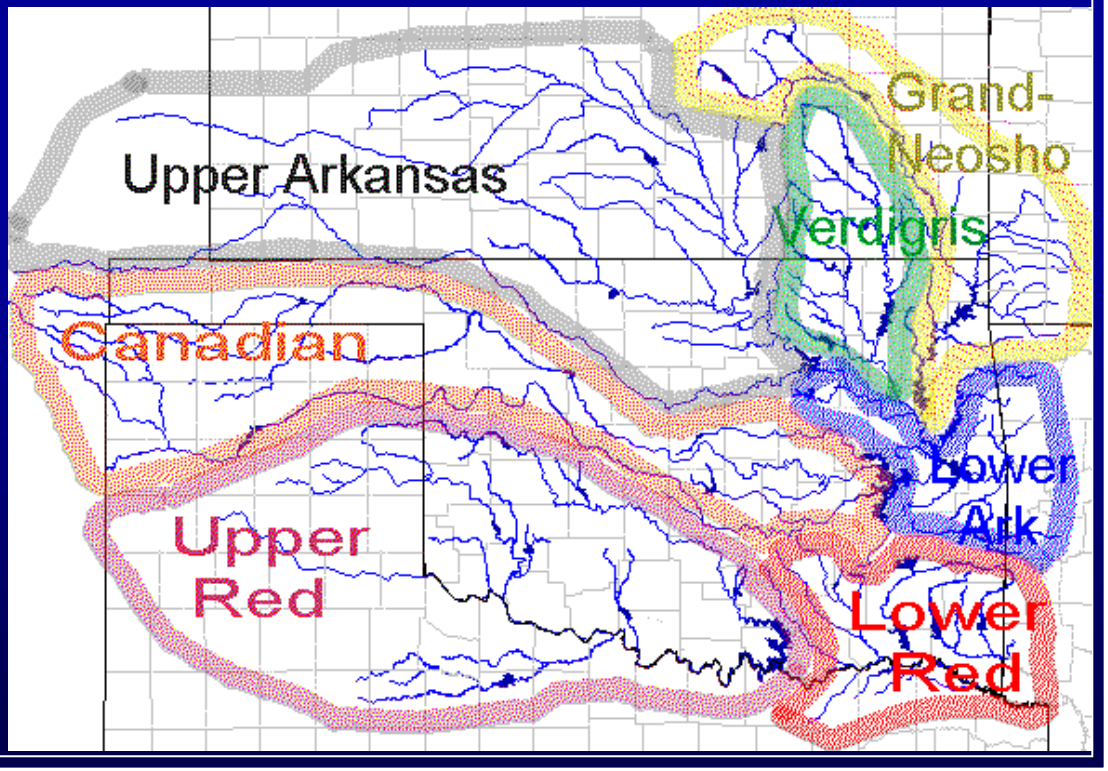
Reclamation's Columbia Basin Irrigation Project RiverWare Model (CBIP-RW) was used to assess the impacts and ability of the CBP infrastructure to deliver water to the Odessa Subarea (Report Nov06)

RiverWare Applications: US Army Corps of Engineers

Tulsa District

Period of Record simulations for:

- North Canadian River
- Red River
- Arkansas River
- Wichita River



US Army Corps of Engineers ®

RiverWare Applications: US Army Corps of Engineers

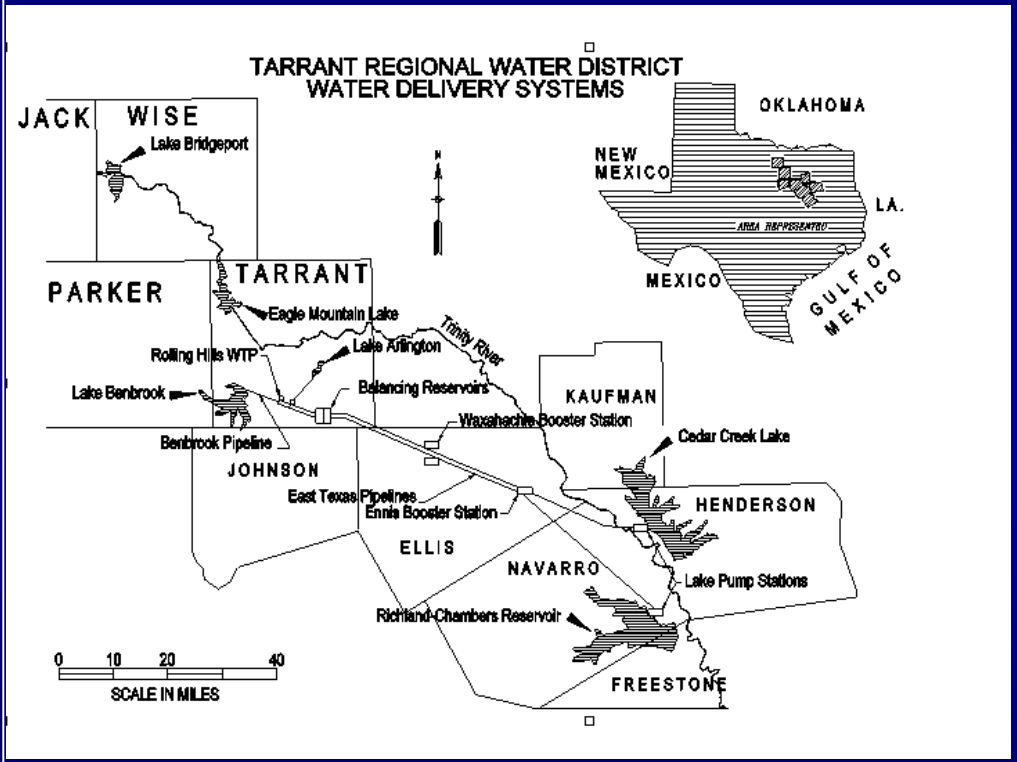
Ft Worth District

- Yield Studies for 9 projects on the Brazos River
- Revised Rule curves for the Neches River Project (Sam Rayburn Dam)

US Army Corps of Engineers

RiverWare Applications:

Tarrent County Regional Water District

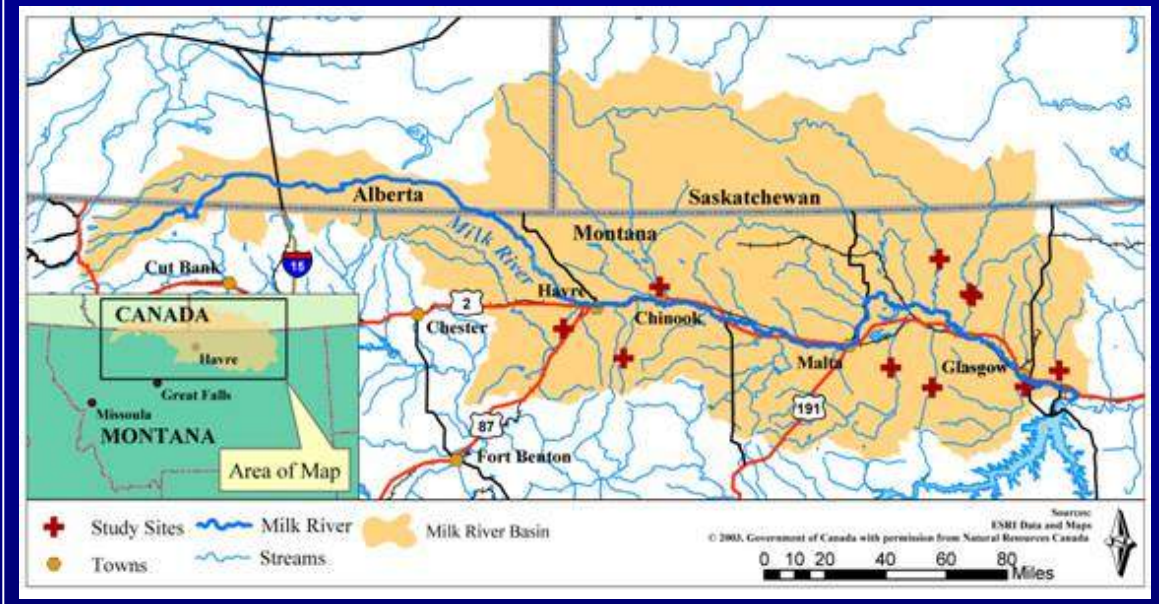


- Long Range Planning Model
- Water Supply Reliability and Drought Response Planning Studies

(TCRWD, Wave Engineering and Hydrosphere Resource Consultants)

RiverWare Applications: State of Montana

Milk River Basin, Montana



Planning model runs rulebased simulations at a daily timestep for 1959-2003 hydrologic record; hope to use for operations eventually

Model could be used for future NEPA process for rehab of St Mary's canal

RiverWare Applications: Santa Ynez River, CA

Daily Operations Model (Stetson)

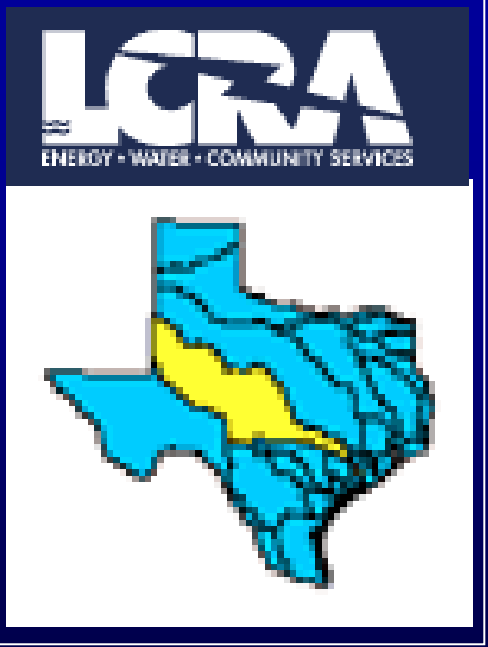
- Santa Ynez River is major source of water supply for Santa Barbara County, California
- Current watershed model is in DOS-Basic and experiencing memory limitations –new model being developed in RiverWare
- Rules will incorporate existing agreements and legal requirements
- Interesting hydrologic features: reservoir operations for endangered Southern steelhead, tunnel infiltration, cloudseeding operations, interactive surface and groundwater involving recharge program

RiverWare Applications:

Lower Colorado River Authority

- **Monthly timestep planning model that simulates priority administration of water rights, including run-of-river irrigation rights, M&I rights, and storage rights.**
- **Daily model development upcoming**
- **Comparisons with WAM and other LCRA modeling tools**

(LCRA with Wave Engineering and Hydrosphere)



RiverWare Applications:

LCRA River Operations Center

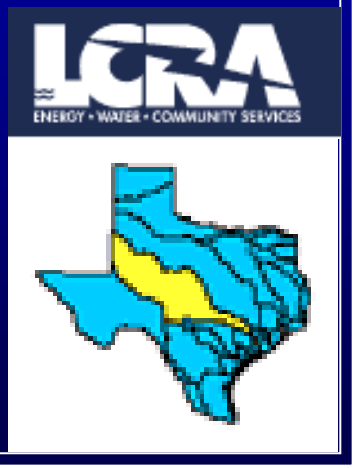
Daily River Operations Model

Daily reservoir scheduling (RiverWare)
Demands, water rights, environmental flows, *flood control

Routing for hourly hydro generation (RiverWare)
Hourly hydro schedule developed from daily volumes

Allocation / accounting model (RiverWare)
Water rights accounting, customer billing, regulatory compliance

Databases, data acquisitions tools, *HEC tools, analyses, and reporting



RiverWare Applications:

Lower Neches Valley Authority

LNVA's new salt water barrier

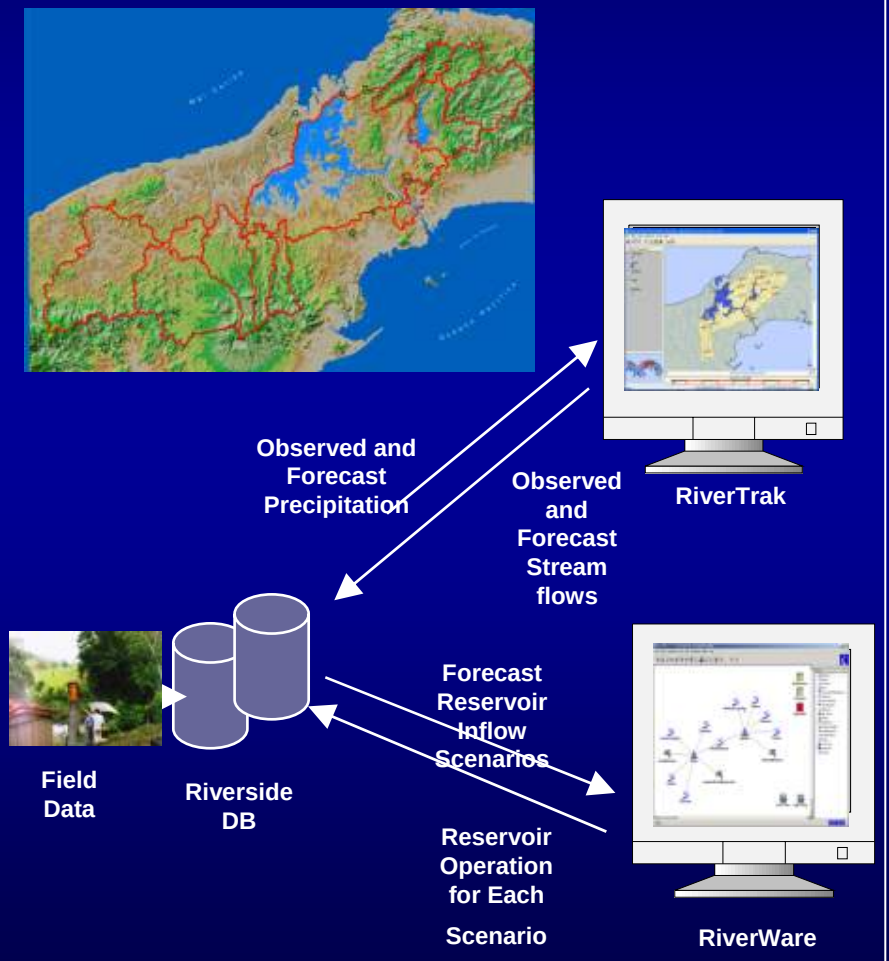
RiverWare: Development of a Water Rights model to explore allocation of water that was previously used to control salt water intrusion.

(Wave Engr, CADSWES and LVNA)

RiverWare Applications: Riverside Technology, inc.

Panama Canal Study

- Coupled RiverWare with RTi's realtime DB and RiverTrak to forecast streamflows
- Rules predict operations in flood conditions



RiverWare Applications
Other Applications

- Raw Water Operations Modeling for North Texas Municpal Water District
- Clark Fork Hourly Operations
- Kansas River model (Corps of Engineers)
- El Dorado Irrigation District – Development of Daily Operations Model (Hydrosphere; ongoing)
- Kansas City Operations and Flood Control
  RiverWare model used for planning and operations
- Emery County: Cottonwood Creek water rights and real time operations (water rights) Dave King and Provo AO
- Raritan River Basin, New Jersey
  Yield study and analysis for new storage New Jersey Water Authority (completed 2006)
- Yasu River Basin, Japan
  Study for low flow operations (PWRI 2004)
- Methow River Basin (Reclamation 2003)- evaluation of storage alternatives (Roger Sonnichsen CBAO)