

# Evolution of RiverWare models for water operations planning in the Paso del Norte region

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**RiverWare User Group Meeting  
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# Funding Agencies

- U.S. Army Corps of Engineer
- U.S. Bureau of Reclamation (Water 2025)
- U.S. Department of Agriculture (Rio Grande Basin Initiative)
- El Paso Water Utilities



# Project Team

- TAMU – Z. Sheng, A. Michelsen, B. Mohanty
- NMSU – J.P. King, C. Brown, B. Creel
- UACJ – A. Granados
- TAMU & NMSU: Postdoctoral Associates
- TAMU, NMSU and UACJ: Graduate Students
- URGWOM Tech Team

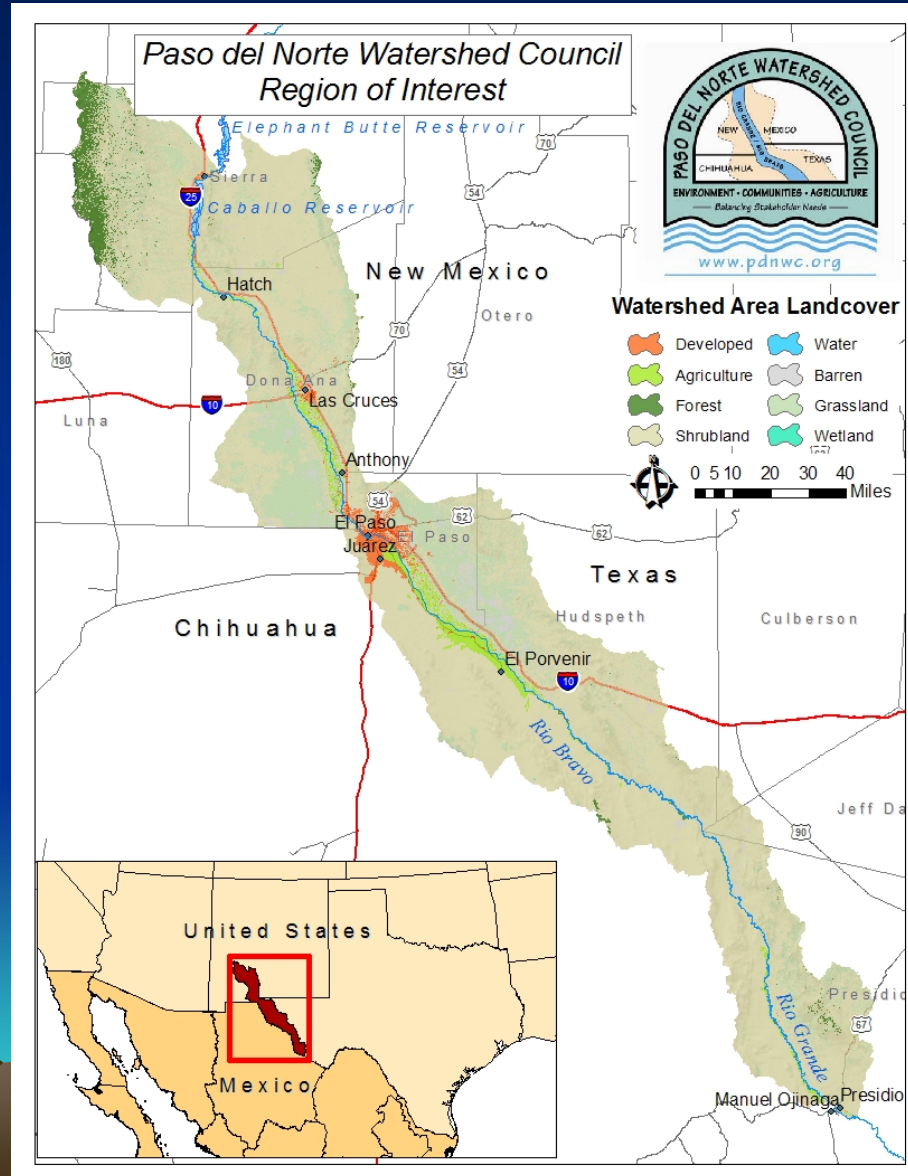


# Objectives

- Database & GIS: Facilitate greater sharing of data among both data providers and end users
- Strengthen capacity of numerical simulation with real-time data
- Enhance water resource management via regional approach in the Paso del Norte watershed



# Paso del Norte Watershed



# DB & GIS (Website)

- An Operational Website: <http://www.pdnwc.org>

**Paso del Norte  
WATERSHED COUNCIL**

**Welcome**

The Paso del Norte Watershed Council works to address issues related to the establishment and maintenance of a viable watershed, including approximately 430 river miles between Elephant Butte Reservoir in southern New Mexico to the confluence of the Rio Conchas in Presidio County, Texas. These include promoting projects to improve water quality and quantity, ecosystem integrity, the quality of life, and economic sustainability in the Paso del Norte watershed. The Paso del Norte Watershed Council also provides a forum for exchanging information about any and all activities on the Rio Grande.

Among its **members** are representatives of non-governmental organizations, federal and state agencies, water utilities, municipal governments, and universities, as well as private citizens. Membership on the Council is free and open to anyone who is dedicated to providing an integrated vision for watershed management. As a result, Council members represent diverse regional interests and provide interdisciplinary expertise in many aspects of watershed and natural resource management.

**Interactive GIS Project**

Chiles, the Chile Pepper Institute at New Mexico State University

Home - Our Watershed - Our History - Meetings - 319(h) Watershed Restoration Grant - **Interactive GIS Project** - Stakeholders - Watershed 101 - Issues - Contact Us - En Español

This website and PdNWC activities are made possible through funding from the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Environmental Protection Agency, El Paso Water Utilities, Texas A&M AgriLife Research Center at El Paso, New Mexico State University, New Mexico Department of Agriculture, University of Texas at El Paso, Universidad Autonoma de Ciudad Juarez, River Network and World Wildlife Fund. Design by GKG.NET, INC.

# Evolution of RiverWare Models

- Monthly model for flood control planning with transfer function to estimate drain flows (Rincon & Mesilla)
- Monthly model for water operations planning using GWO in Rincon Valley
- Daily model for water operations planning (GWOs for Rincon & Mesilla and lower El Paso valley)



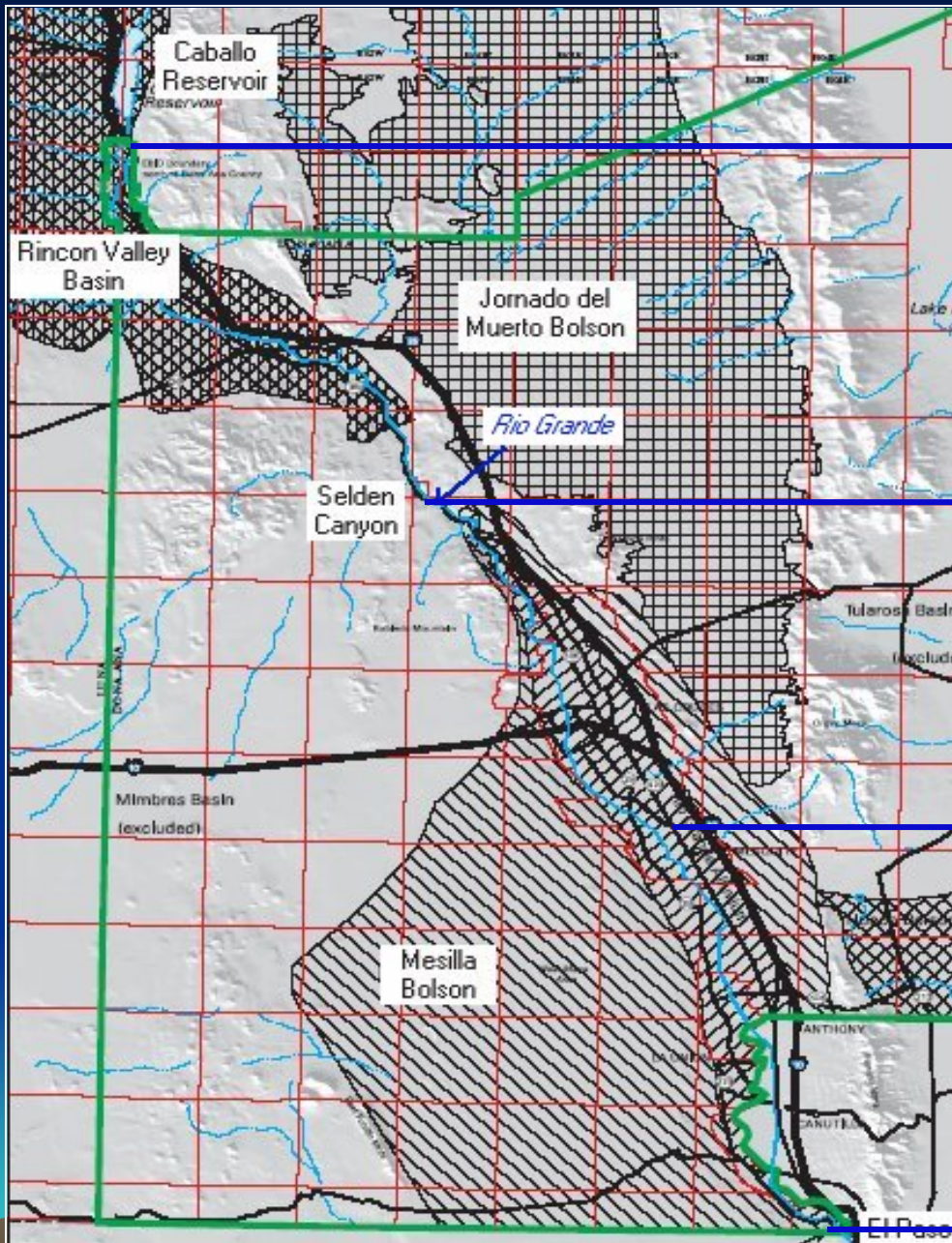
# RiverWare Monthly Model for Mainstem

- Develop conceptual model for surface/ground water interaction
- Develop RiverWare model for (Lower) Rio Grande (LRG)
- Use RiverWare DMI to link data to the model





# Rio Grande Reaches



Rincon Reach

Leasburg Reach

Mesilla Reach

Figure 1. Lower Rio Grande Basins (Terracon et al., 2004)

# Surface/Groundwater Interactions

## Conceptual Model

- The main variables of interest for forecasting flows
  - ❖ Diversions
  - ❖ Conveyance infiltration
  - ❖ Deep percolation from irrigation
  - ❖ Groundwater withdrawal
  - ❖ Precipitation
- The variable with largest effect on interactions = **DIVERSION**



# Surface/Groundwater Interactions

## Conceptual Model (cont.)

- Use diversions as input time-series to an **AutoRegressive Integrated Moving Average (ARIMA) Transfer Function** model to predict return flow
- Even though ground-water withdrawals can be significant
  - ❖ Ground-water pumping is strongly correlated to diversions
  - ❖ So using diversion data indirectly accounts for ground-water pumping



# Transfer Functions Implemented

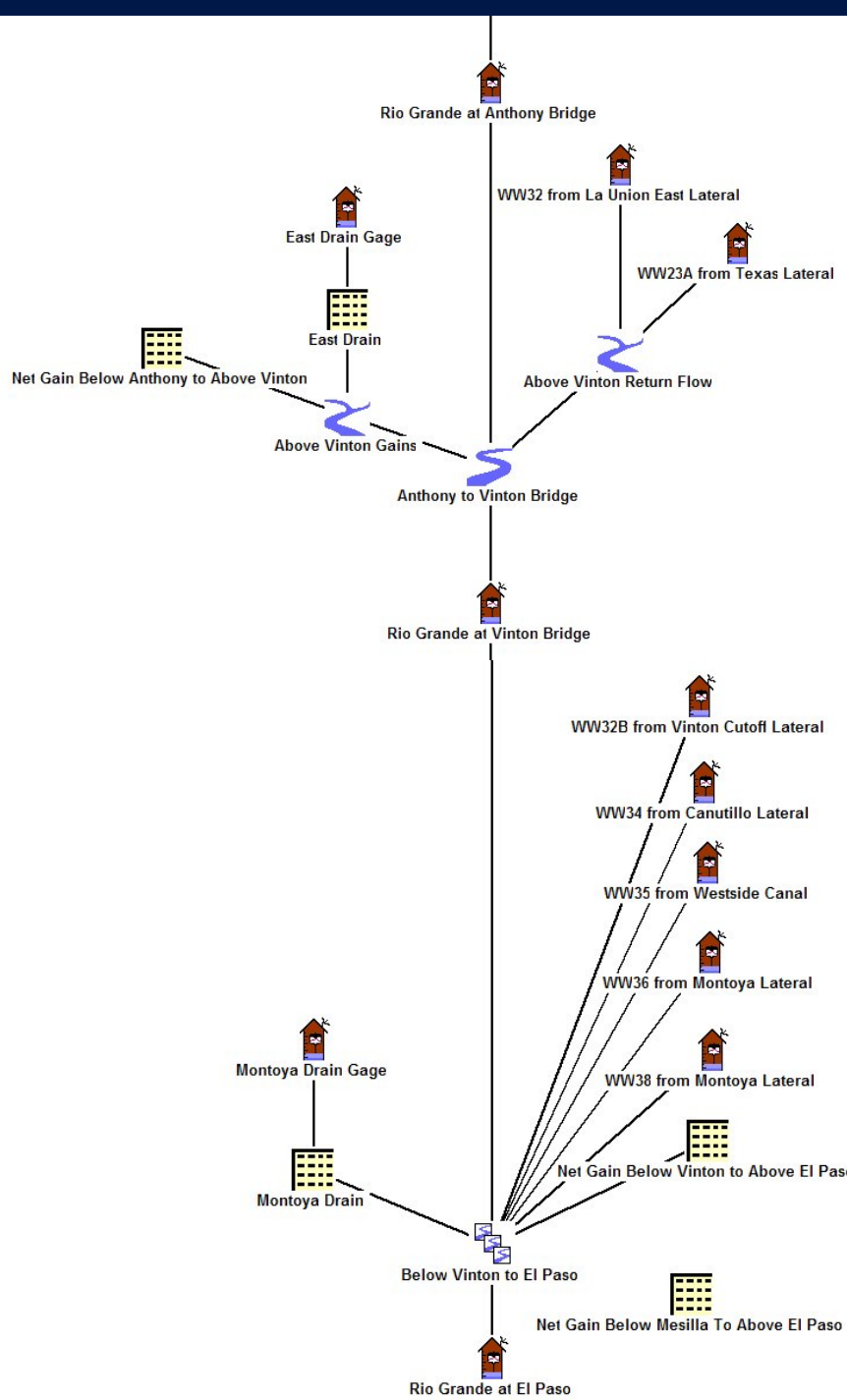
## Rincon Reach

- Garfield Drain from Arrey Canal Diversion
- Hatch Drain from Arrey Canal Diversion
- Rincon Drain from Arrey Canal Diversion

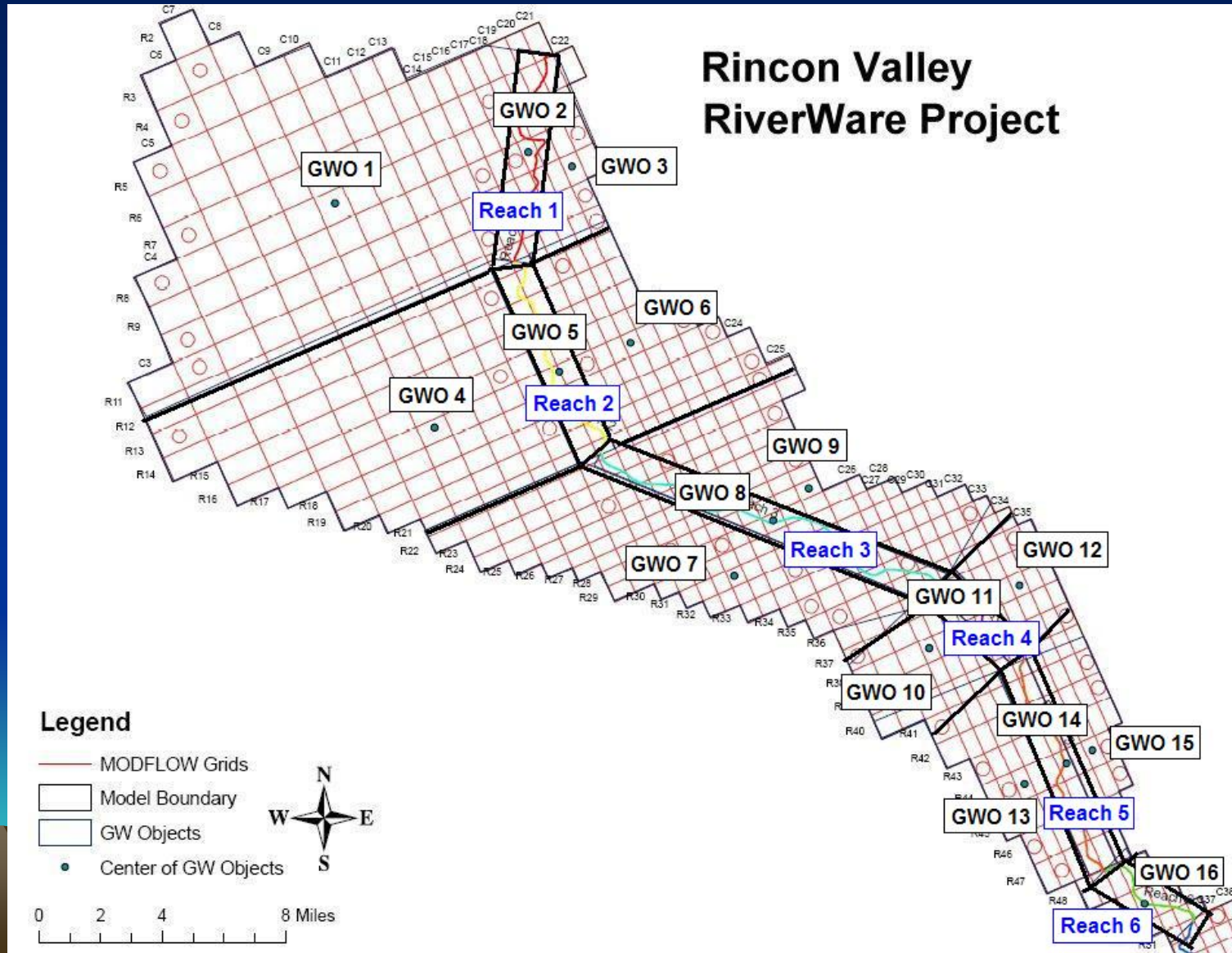
## Mesilla Reach

- Del Rio Drain from Eastside Canal Diversion
- La Mesa Drain from Westside Canal Diversion
- East Drain from Eastside Canal Diversion
- Montoya Drain from Westside Canal Diversion



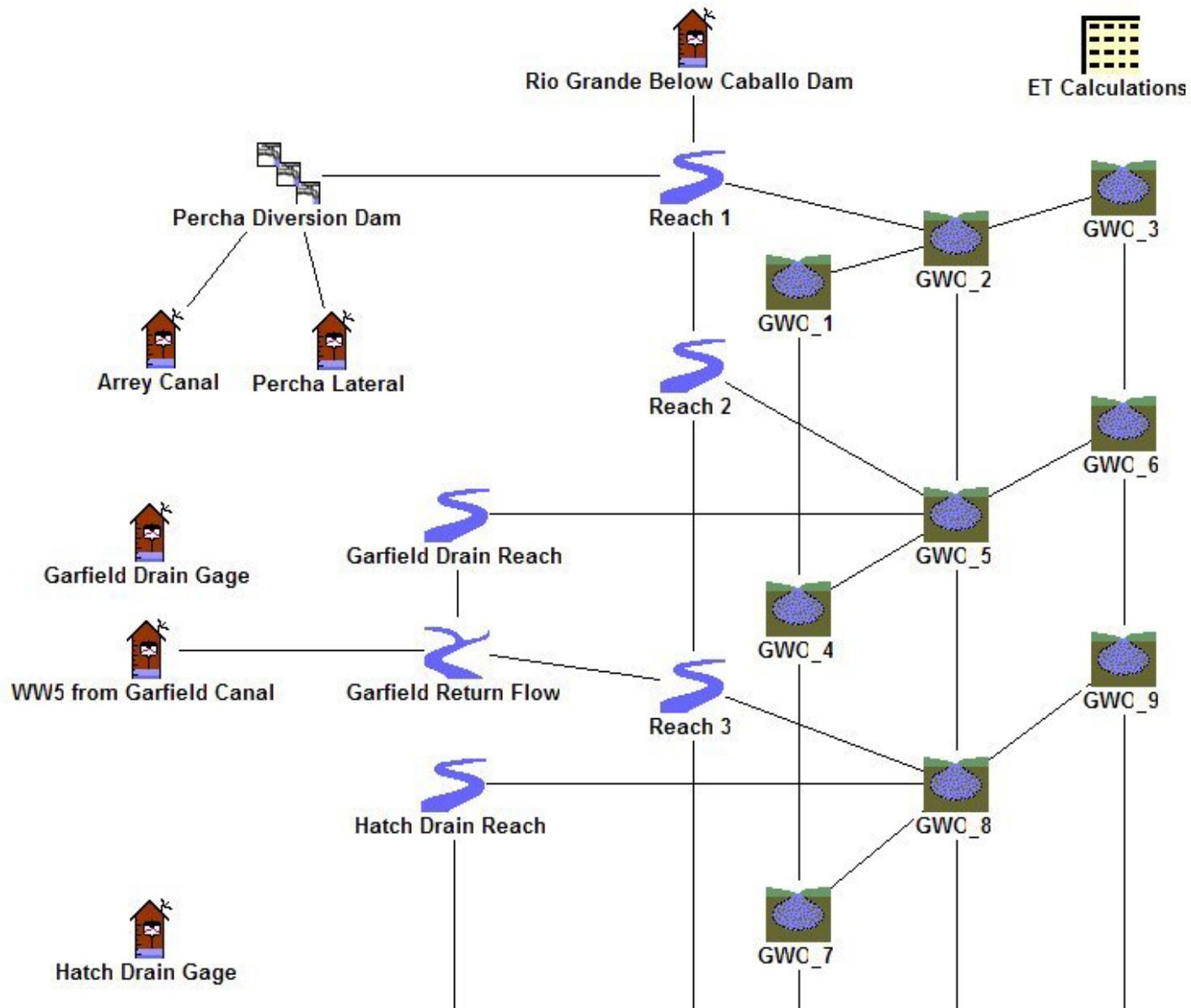


# RiverWare Monthly Model with GWOs



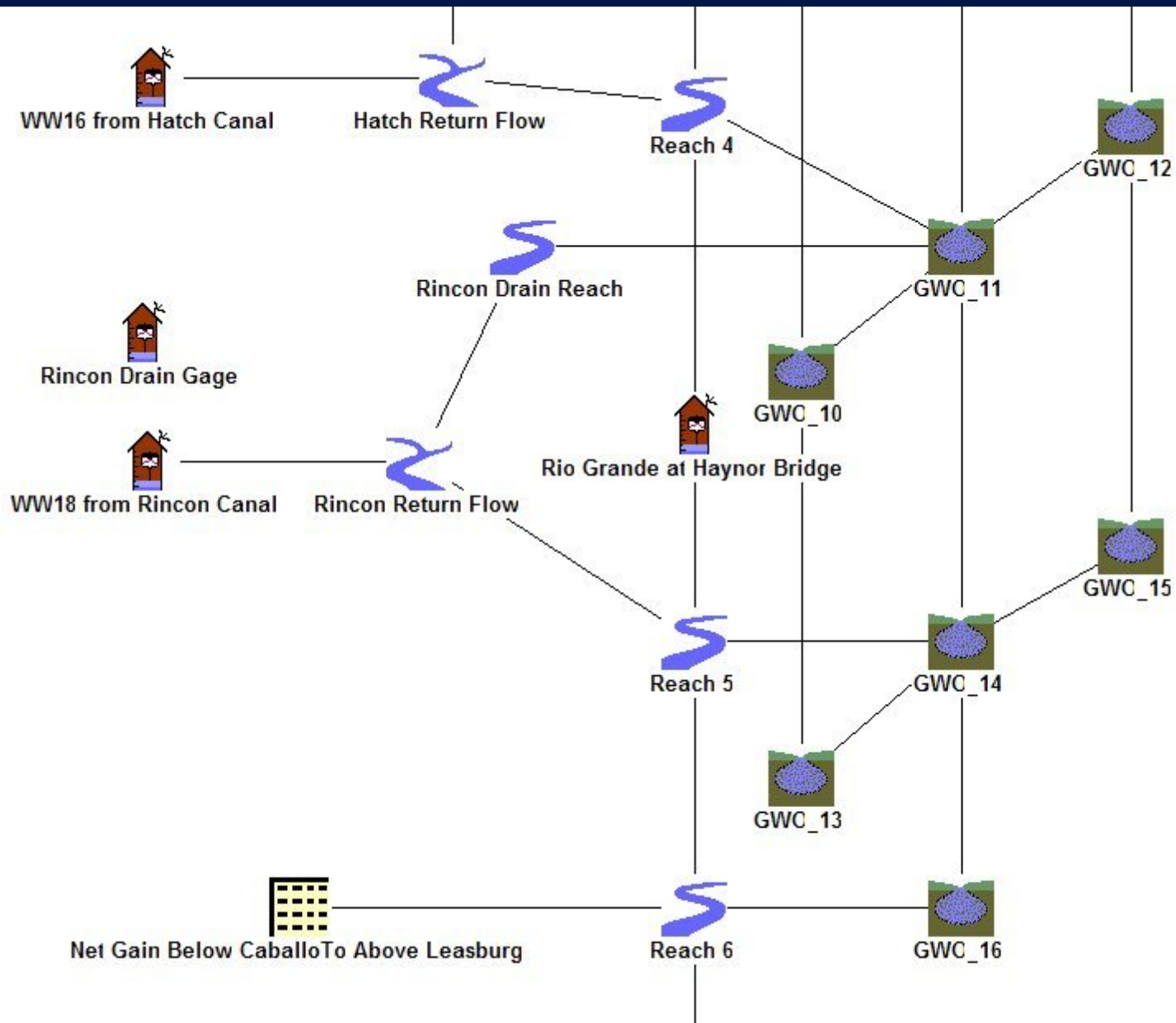
# Groundwater Storage Objects

- 16 GWOs were added to model to:
  - simulate heads in alluvial aquifer
  - simulate interactions with deep groundwater layers
  - simulate losses to riparian vegetation
  - simulate flow in the drains
- Three GWOs assigned to River Reaches 1-5
  - Left, middle and right of reach
- One GWO assigned to River Reach 6
  - Middle of reach
- One of middle GWOs assigned to each Drain Reach



Top of RiverWare Model Layout





Bottom of RiverWare Model Layout

# RiverWare Daily Model – River & Irrigation Network

- Daily time step
- Include river reaches, canals, and drains
- Rincon and Mesilla Basin – Groundwater-Surface Interactions using groundwater objects link MODFLOW and RiverWare
- Expand the model into El Paso-Juarez valley



# Rincon Valley

## Irrigation System in the Rincon Valley

Caballo Reservoir



Sierra County

GARFIELD DRAIN

HATCH DRAIN

RINCON DRAIN

- CANAL
- DRAIN
- LATERAL
- DAM
- WASTEWAY
- Rio Grande

Aerial Photos: RGIS - NMU



## Land Use in the Rincon Valley



Caballo Reservoir

Sierra County

- Rio Grande
- Agricultural Land
- Barren Land
- Forest Land
- Rangeland
- Urban or Built-Up Land
- Water
- Wetland







# Rincon Valley

## MODFLOW Grid



Caballo Reservoir

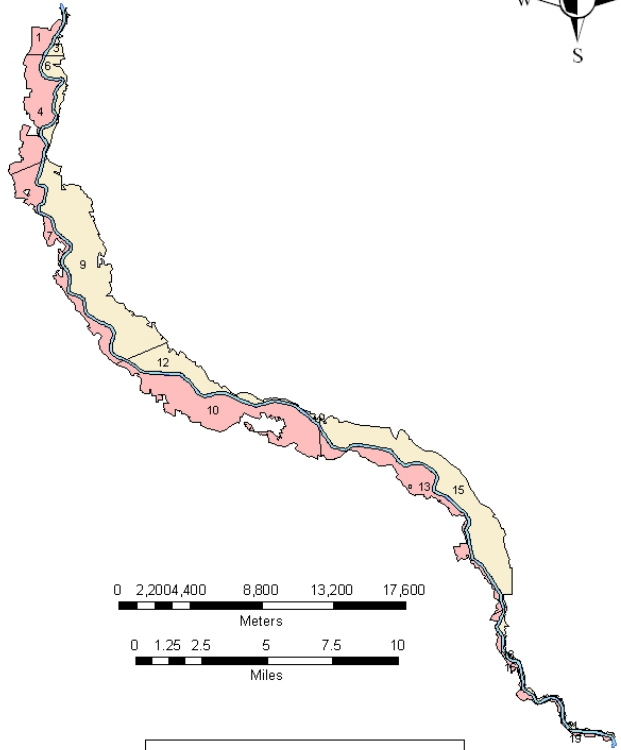
Sierra County

-  MODFLOW Grid
-  Active Grid Cells
-  Groundwater Objects
-  Rio Grande




0 2.5 5 10 15 20 Kilometers

Aerial Photos, RGIS - NMIU

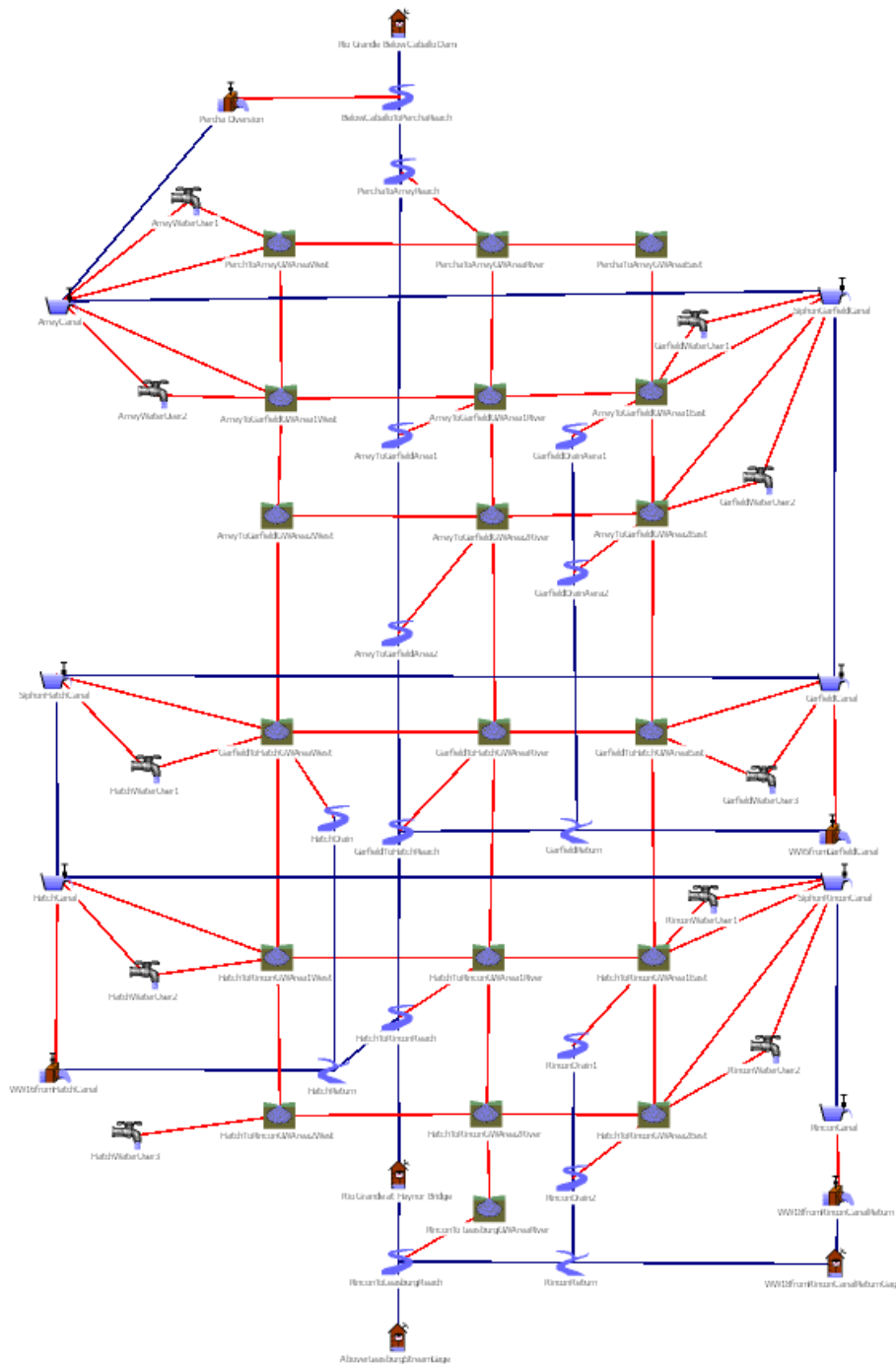
## Groundwater Objects in the Rincon Valley

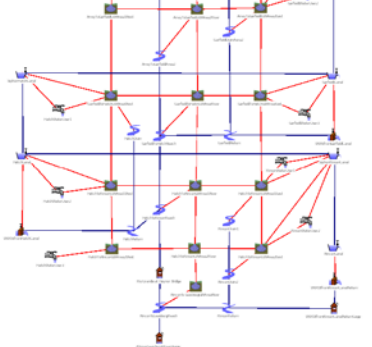
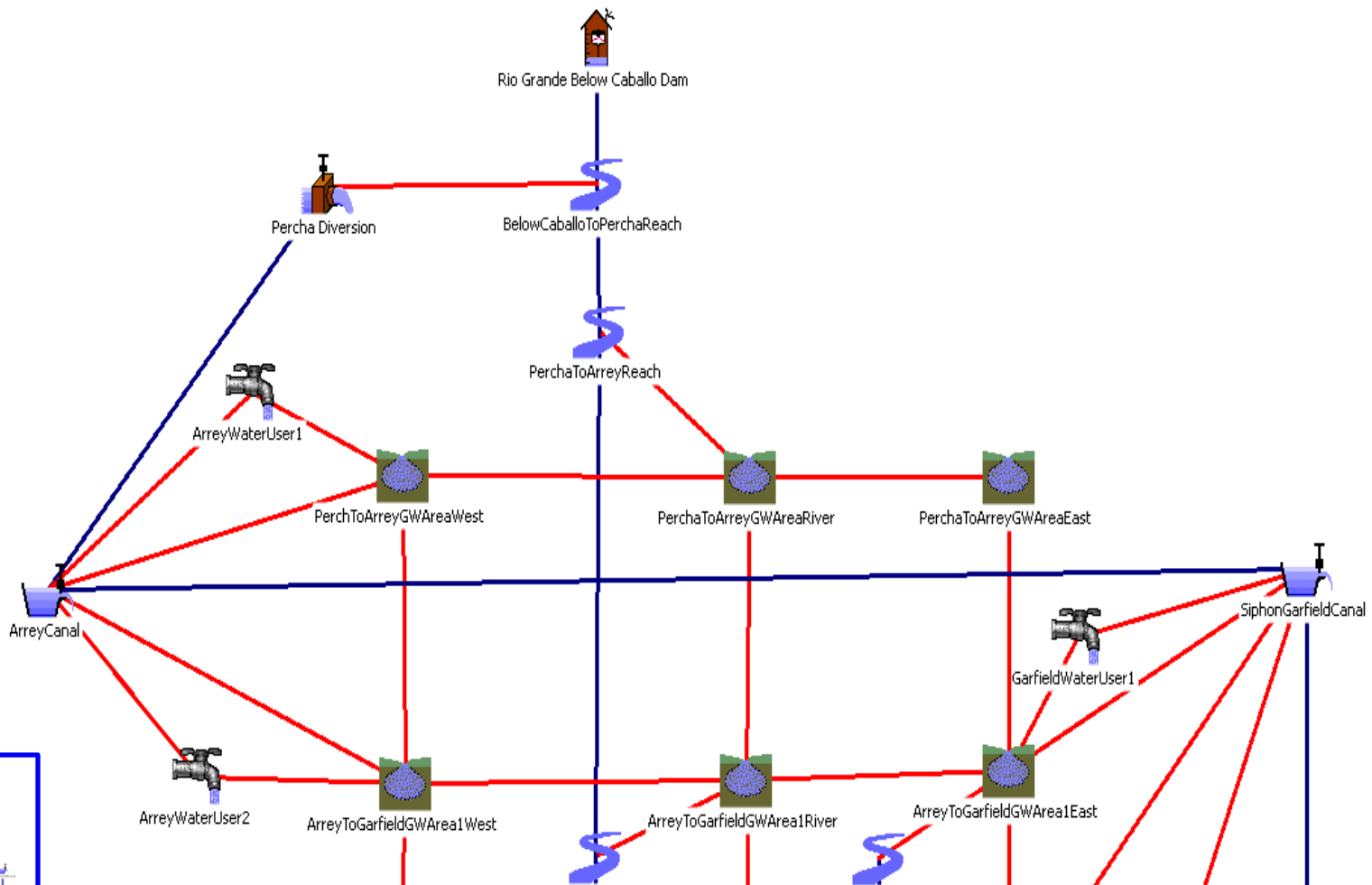


0 2,200 4,400 8,800 13,200 17,600  
Meters  
0 1.25 2.5 5 7.5 10  
Miles

- Legend**
-  Groundwater Objects - West
  -  Groundwater Objects - East
  -  Groundwater Objects - Rio Grande

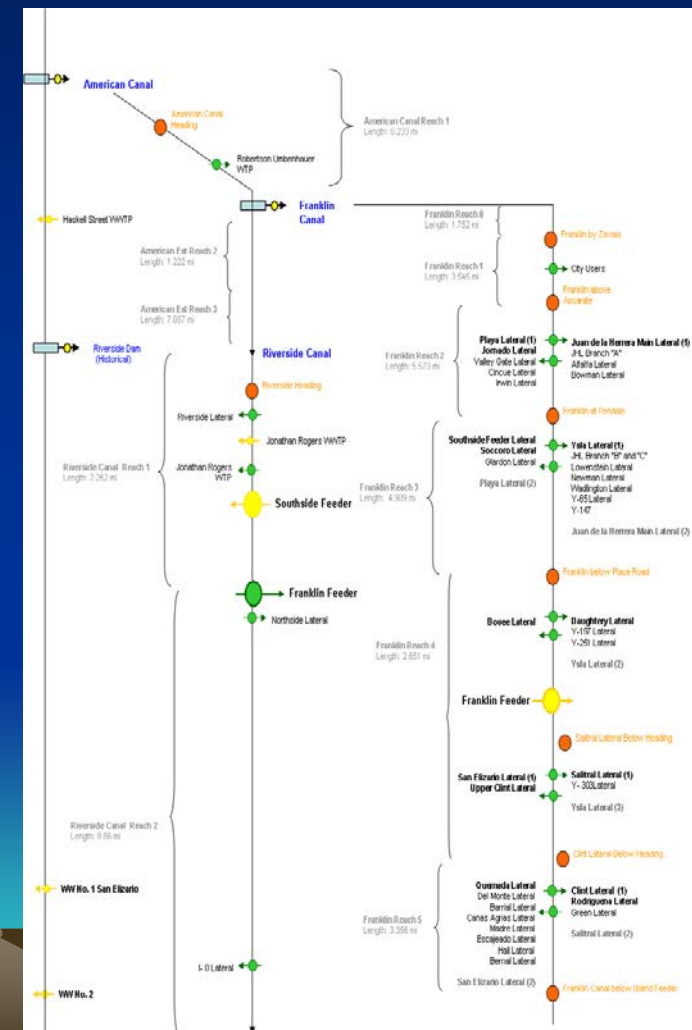
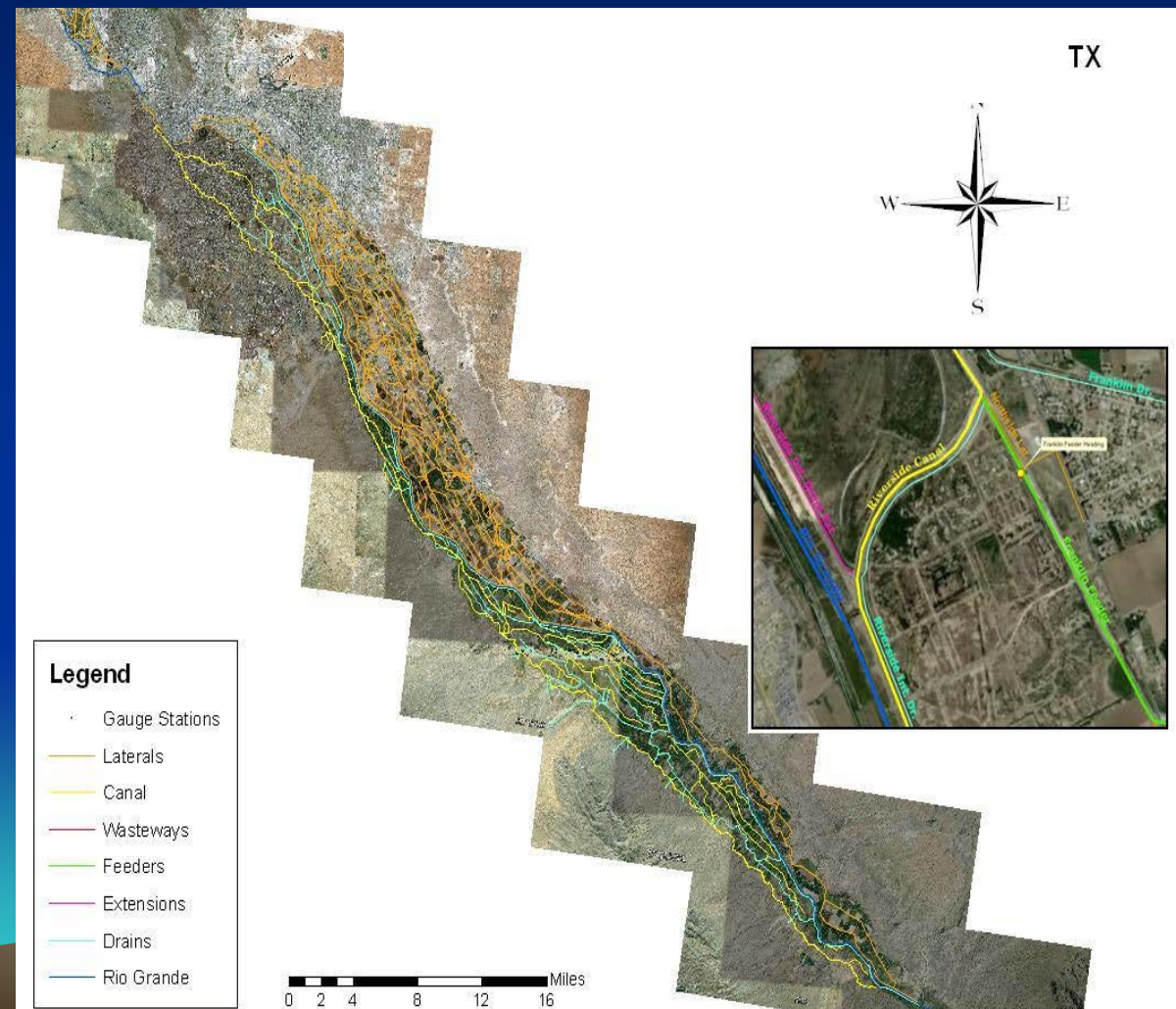
# Rincon Valley

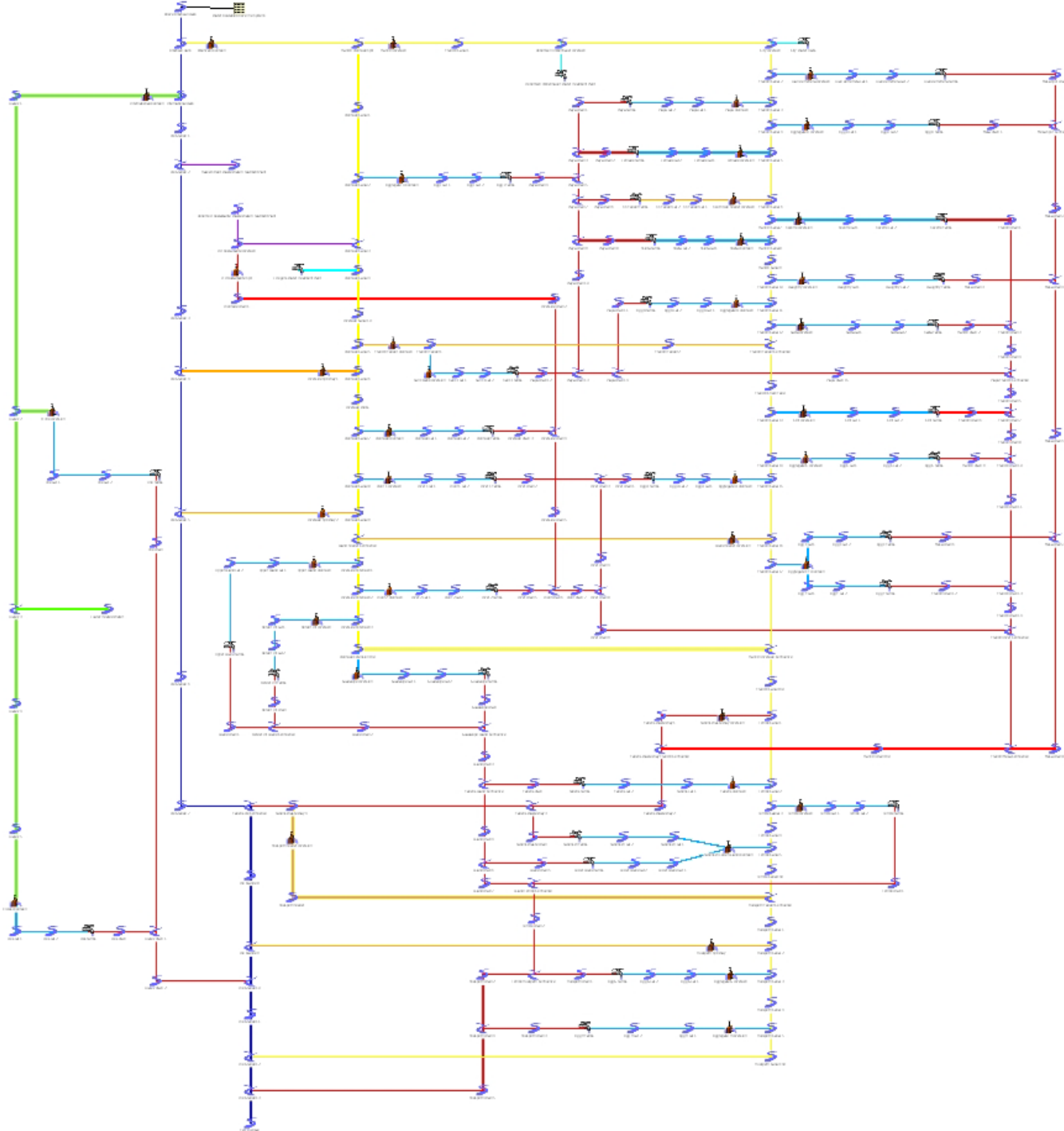




# Rincon Valley

# El Paso – Juarez Valley Conceptual Model

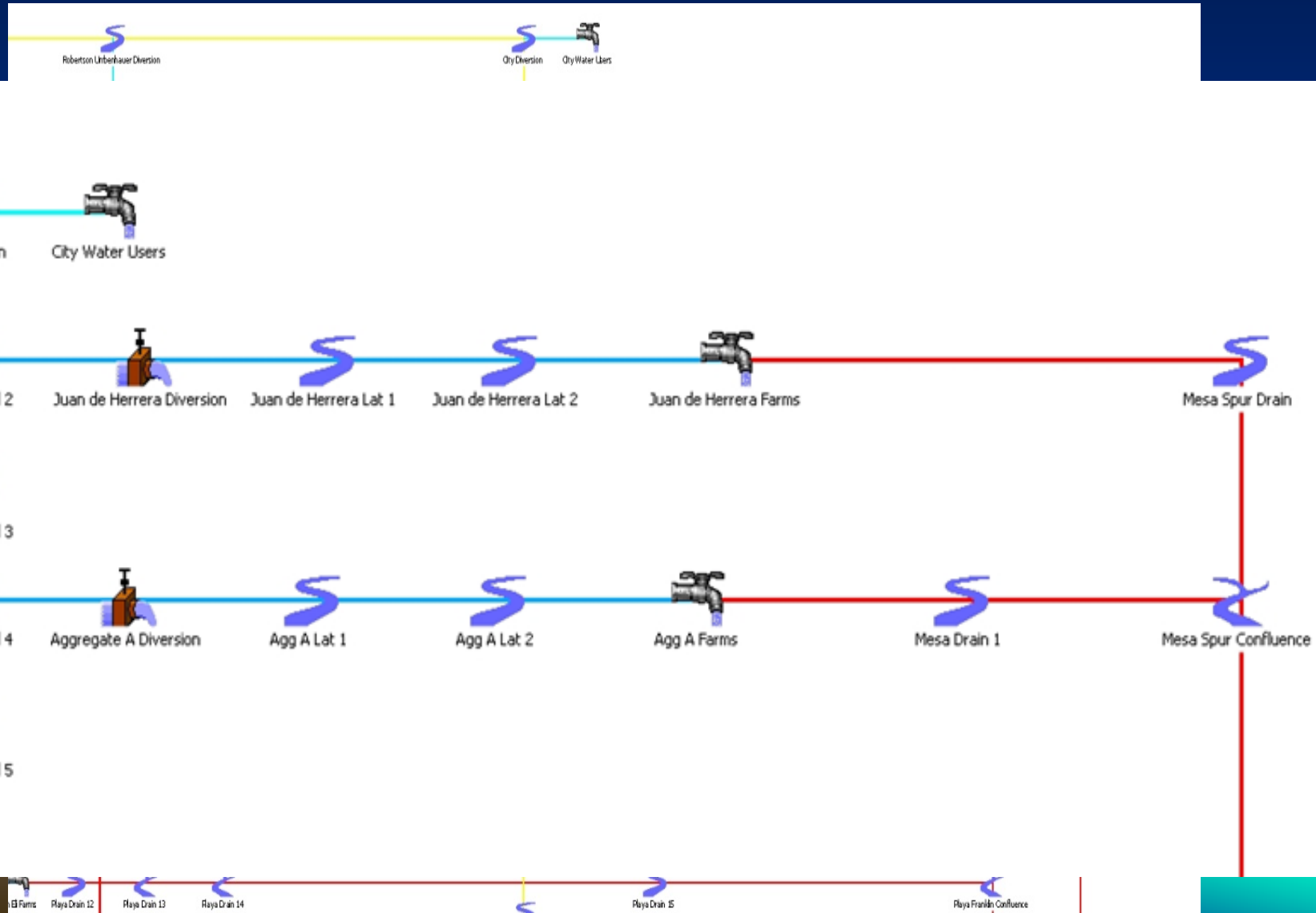




# El Paso – Juarez Valley RiverWare Layout




# El Paso – Juarez Valley RiverWare Objects



# El Paso – Juarez Valley

## RiverWare: Rule sets

- To govern the split of water that flows into the Riverside Canal and Franklin Canal
  - To specify diversion of water into the Hudspeth Feeder
  - To generate supplemental groundwater during droughts.
  - To generate system consumption values at each timestep and system supply deficit data for each time step.
- 

# Summary

- Data & GIS – Foundation for model configuration
- Model evolves from simple to complex framework to serve different purposes
- Complex model – time consuming and resources
- Well designed models – tools for decision making



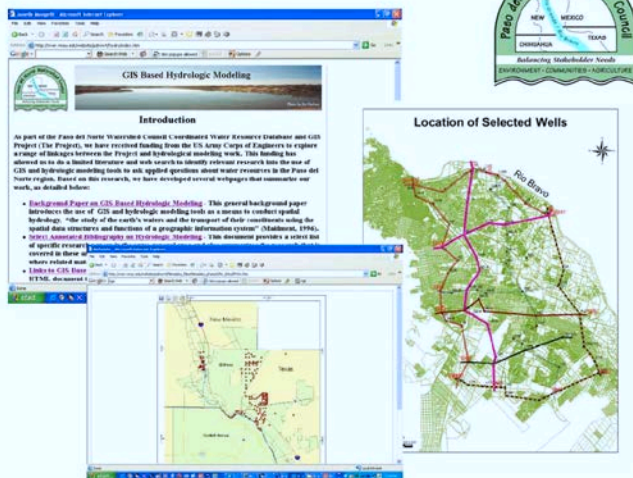
# Findings & Outcomes

December 2006

Report No. 337

## The Development of a Coordinated Database for Water Resources and Flow Model in the Paso Del Norte Watershed

Technical Completion Report No. 337  
New Mexico Water Resources Research Institute  
Texas Water Resources Institute



Department of  
Geography  
and  
Department of  
Civil Engineering  
New Mexico State  
University



New Mexico  
Water Resources  
Research Institute



Texas A&M  
University  
Texas Agriculture  
Experiment  
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Universidad  
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Centro de  
Información  
Geográfica



Texas Water  
Resources Institute



COLLEGE OF AGRICULTURE  
AND LIFE SCIENCES

TR-359, Part I  
2009

## The Development of a Coordinated Database for Water Resources and Flow Model in the Paso Del Norte Watershed (Phase III)

### Part I Lower Rio Grande Flood Control Model [LRGFCM] RiverWare Model Development

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Texas Water Resources Institute Technical Report No. 359, Part I  
Texas A&M University System  
College Station, Texas 77843-2118

New Mexico Water Resources Research Institute  
Technical Completion Report No. 348, Part I

November 2009



# Collaboration of Multiple Agencies

- ❖ City of Las Cruces
  - ❖ Comision Nacional del Agua
  - ❖ Elephant Butte Irrigation District
  - ❖ El Paso County Water Improvement District #1
  - ❖ El Paso Water Utilities
  - ❖ Junta Municipal de Agua y Saneamiento de Juarez
  - ❖ Universidad Autonoma de Ciudad Juarez
  - ❖ NMSU-WRRI
  - ❖ TAMU-TAES
  - ❖ PdNMaPA
  - ❖ Project del Rio
  - ❖ Comision Nacional del Agua
  - ❖ International Boundary and Water Commission
  - ❖ US Army Corp of Engineers
  - ❖ US Bureau of Reclamation
  - ❖ US Geological Survey
- 

Thank You!

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<http://www.pdnwc.org>