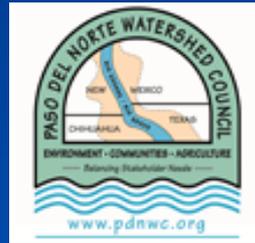


Development of RiverWare models of the Rio Grande flow for flood control and water operations planning

Conrad G. Keyes, Jr., Ph.D., P.E., PdNWC Chair

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The Stormwater Coalition Meeting

EBID, January 10, 2013

Acknowledgement

- U.S. Army Corps of Engineer
- 4 Irrigation Districts
- URGWOM Tech Team
- USBR & IBWC & USDA
- Texas AgriLife Research – TAMU
- WRRI – NMSU
- UACJ



Project Team

- TAMU – Z. Sheng, R. Marmolejo, A. Michelsen, and B. Mohanty
- NMSU – J.P. King, S. Abudu, and C. Brown
- UACJ – A. Granados and Víctor Esquivel-Ceballos
- Conrad G. Keyes, Jr., Consultant



SOW - LRG

RiverWare Model for Rincon Valley and Mesilla Basin (NMSU & TAMU)

- ❖ Surface water diversions linked to cropped area demand
 - ❖ Interactive groundwater objects linked to drain return flows
 - ❖ Expand the RiverWare model to represent the main canal system
 - ❖ Simulate river flow and water operations planning scenarios
 - ❖ Enhance coordinated water resources database
- 

SOW - LRG

RiverWare Model for Lower El Paso Valley (TAMU and UACJ)

- ❖ Compile flow and crop data
- ❖ Develop the RiverWare™ model to simulate the river flow and water operations planning scenarios
- ❖ Incorporate data into the coordinated water resources database
- ❖ Evaluate USGS MODFLOW model for Hueco Bolson for SW/GW interaction



RiverWare Daily Model – River & Irrigation Network

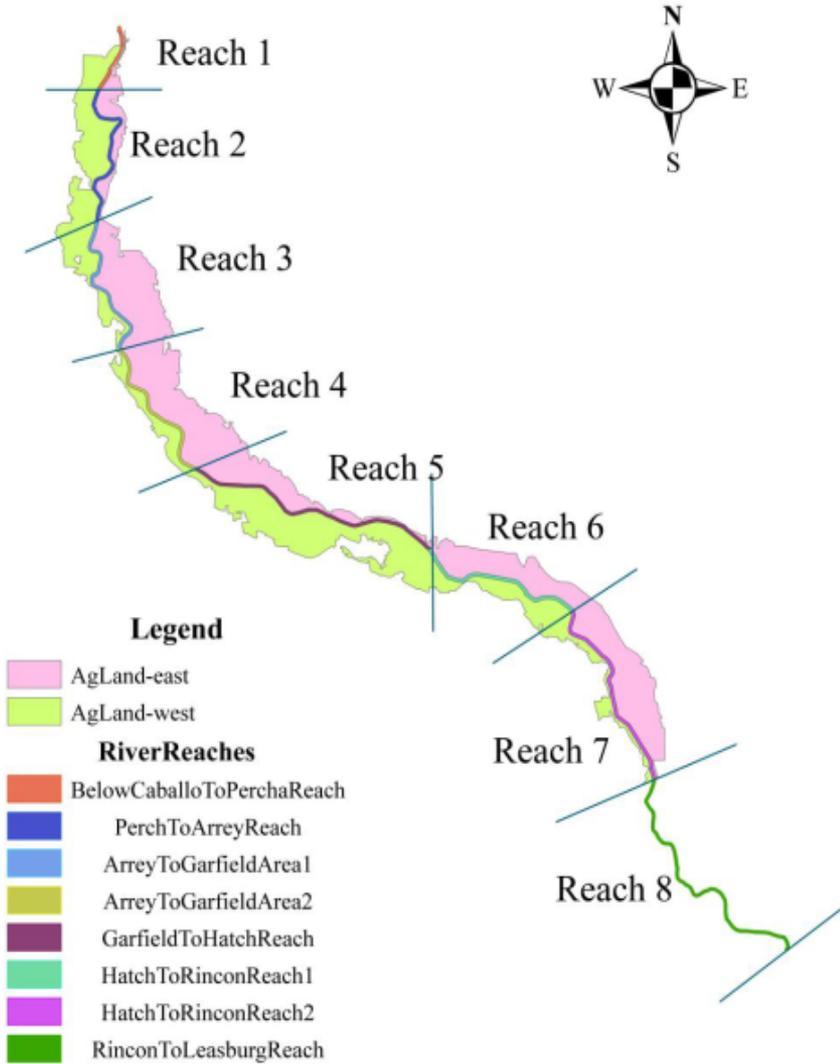
- Daily time step
- Include river reaches, canals, and drains
- Rincon and Mesilla Basin – Groundwater-Surface Interactions using groundwater objects link MODFLOW and RiverWare
- Expand the RiverWare model into El Paso-Juarez valley



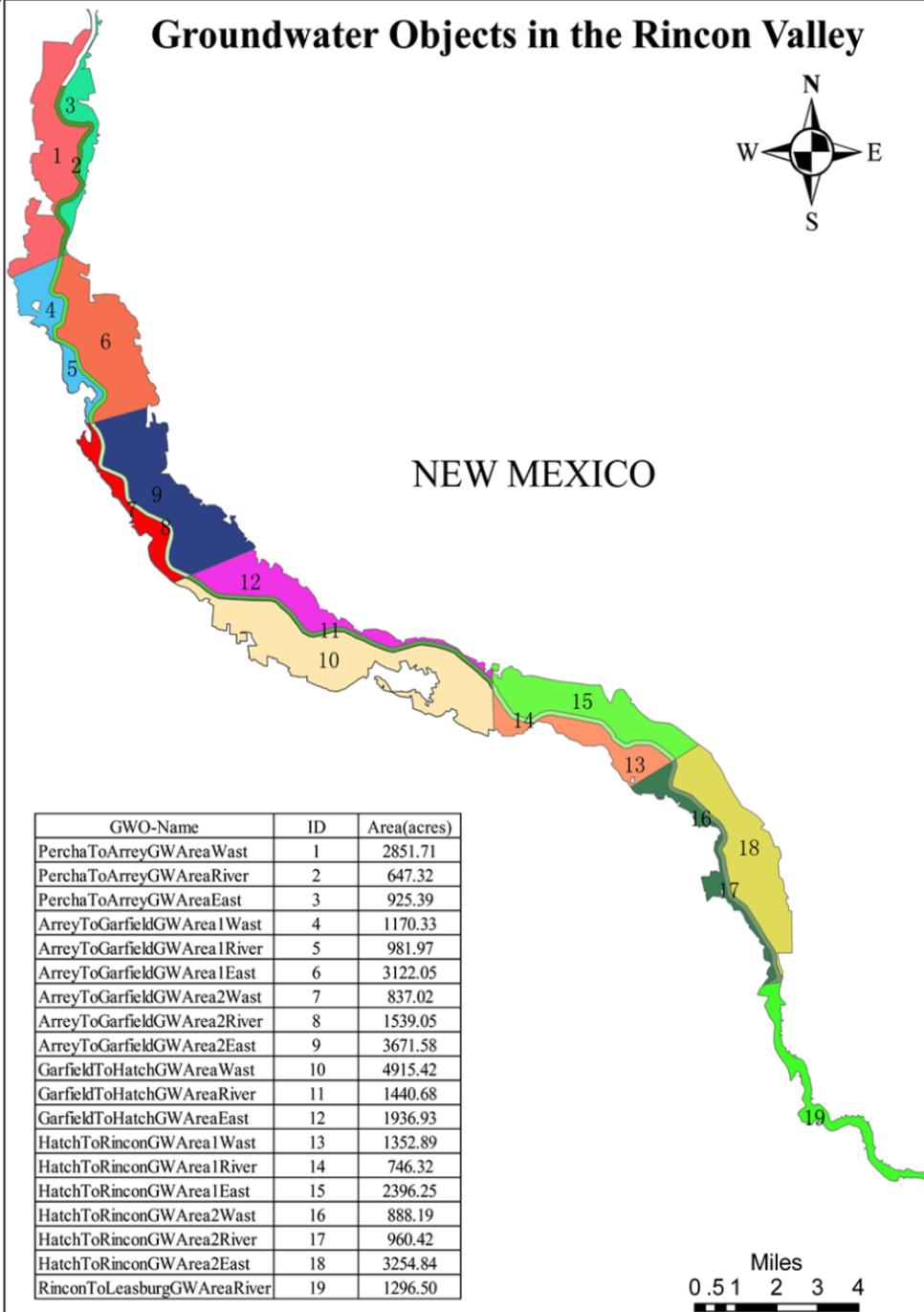
Rincon Valley Model



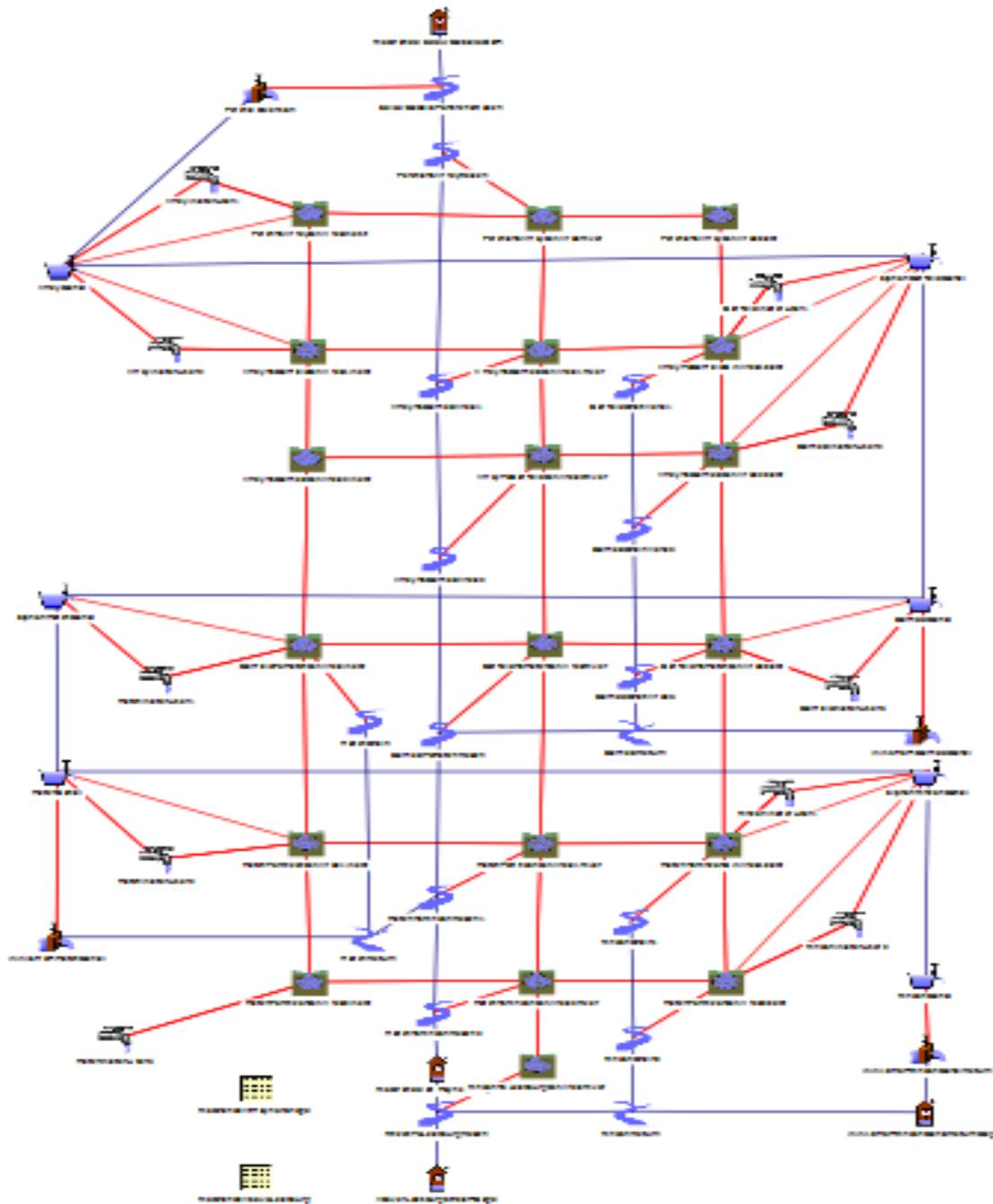
River Reaches in the Rincon Valley



Groundwater Objects in the Rincon Valley

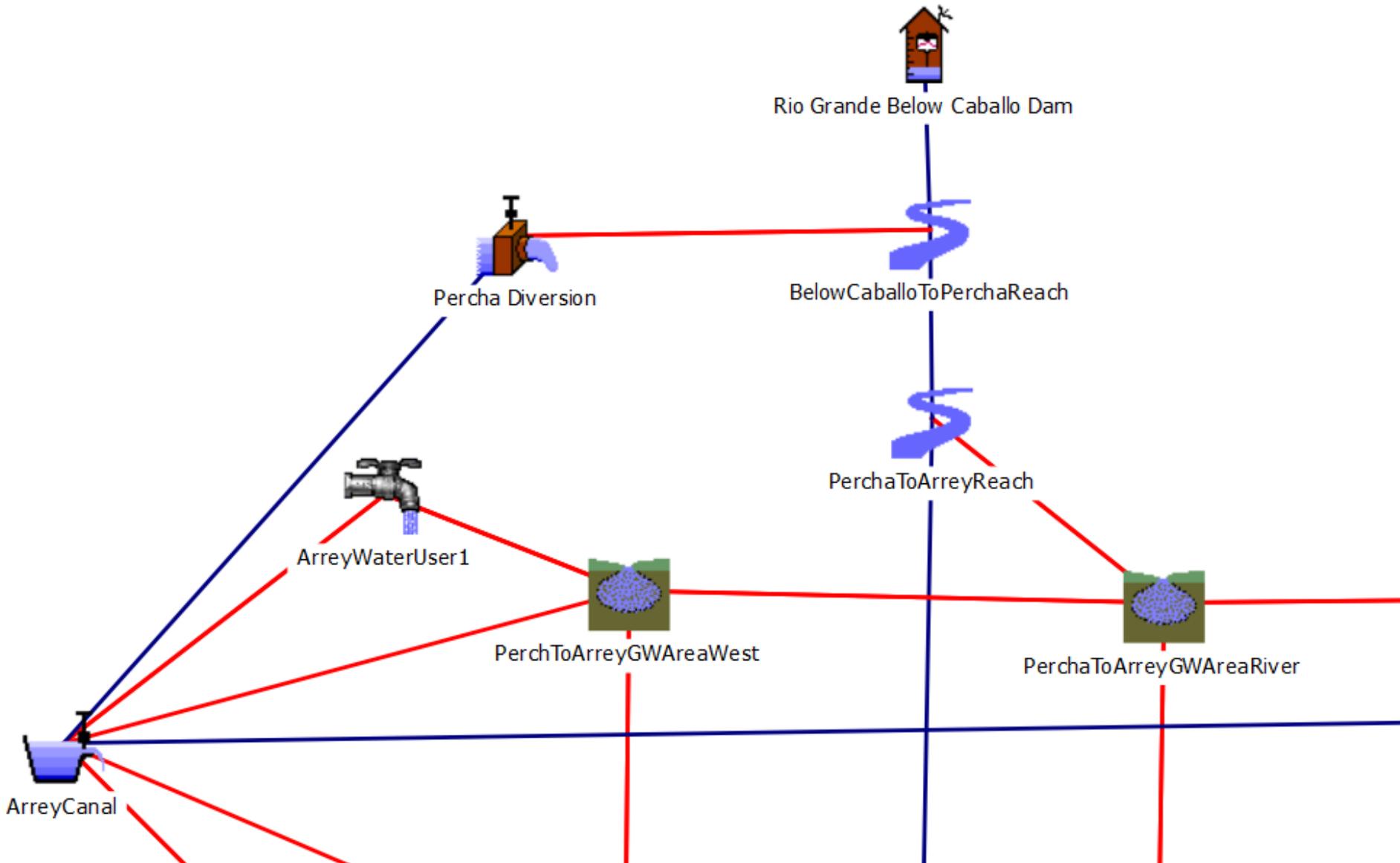


GWO-Name	ID	Area(acres)
PerchaToArreyGWAreaWest	1	2851.71
PerchaToArreyGWAreaRiver	2	647.32
PerchaToArreyGWAreaEast	3	925.39
ArreyToGarfieldGWArea1 West	4	1170.33
ArreyToGarfieldGWArea1 River	5	981.97
ArreyToGarfieldGWArea1 East	6	3122.05
ArreyToGarfieldGWArea2West	7	837.02
ArreyToGarfieldGWArea2River	8	1539.05
ArreyToGarfieldGWArea2East	9	3671.58
GarfieldToHatchGWArea West	10	4915.42
GarfieldToHatchGWAreaRiver	11	1440.68
GarfieldToHatchGWAreaEast	12	1936.93
HatchToRinconGWArea1 West	13	1352.89
HatchToRinconGWArea1 River	14	746.32
HatchToRinconGWArea1 East	15	2396.25
HatchToRinconGWArea2West	16	888.19
HatchToRinconGWArea2River	17	960.42
HatchToRinconGWArea2East	18	3254.84
RinconToLeasburgGWAreaRiver	19	1296.50

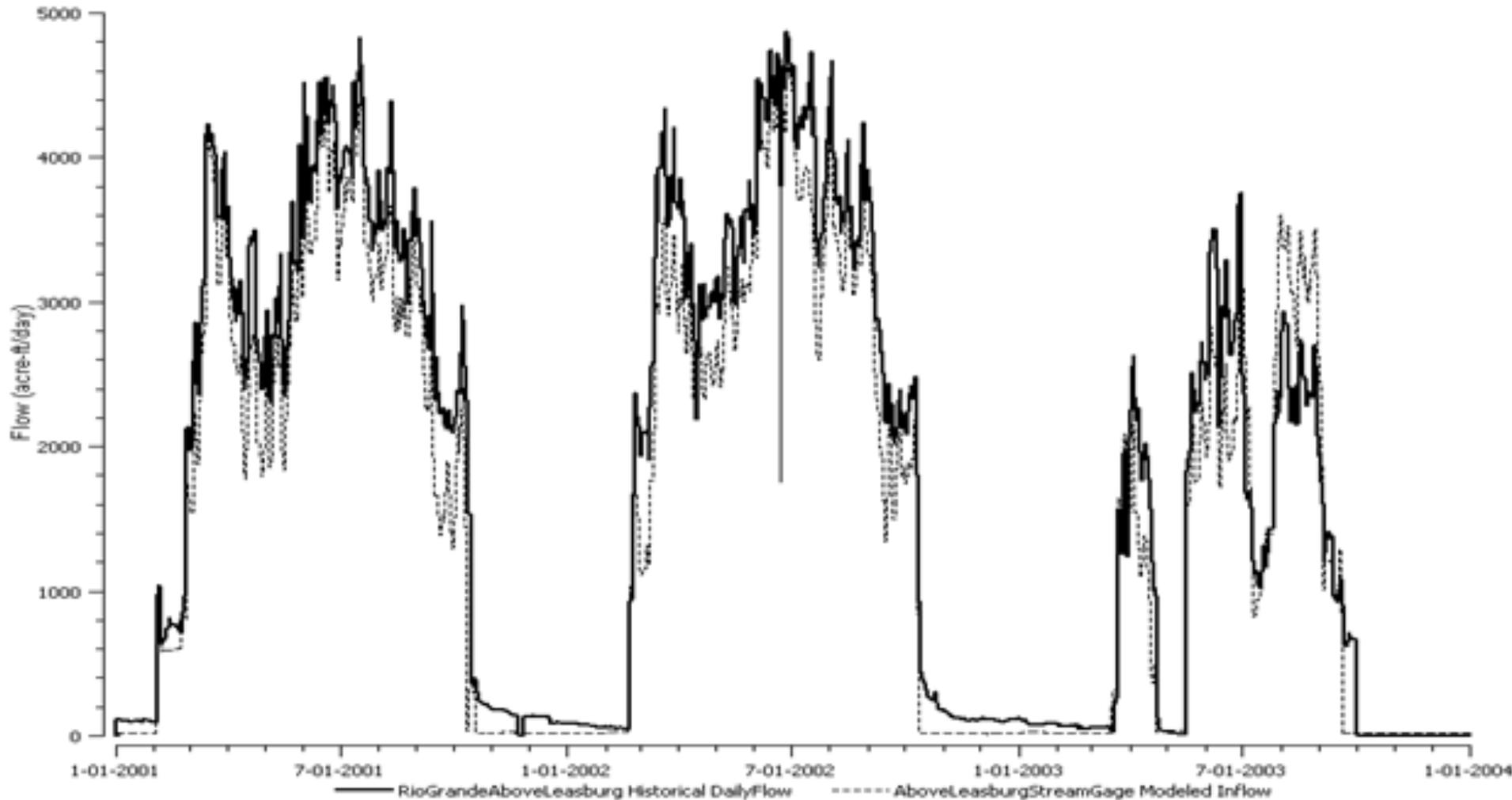


Rincon Valley RiverWare Layout

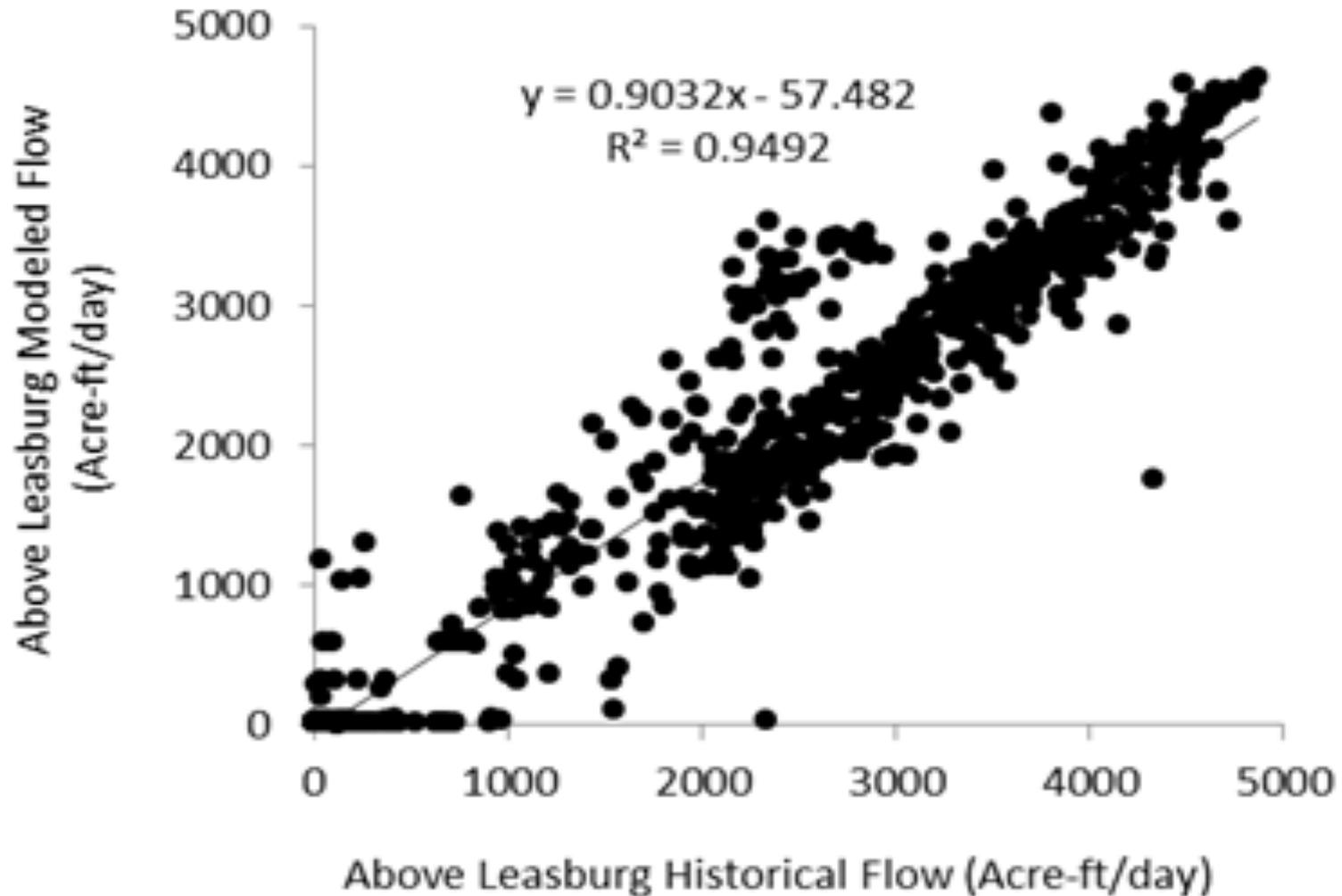
Rincon Valley RiverWare Layout



Rio Grande above Leasburg



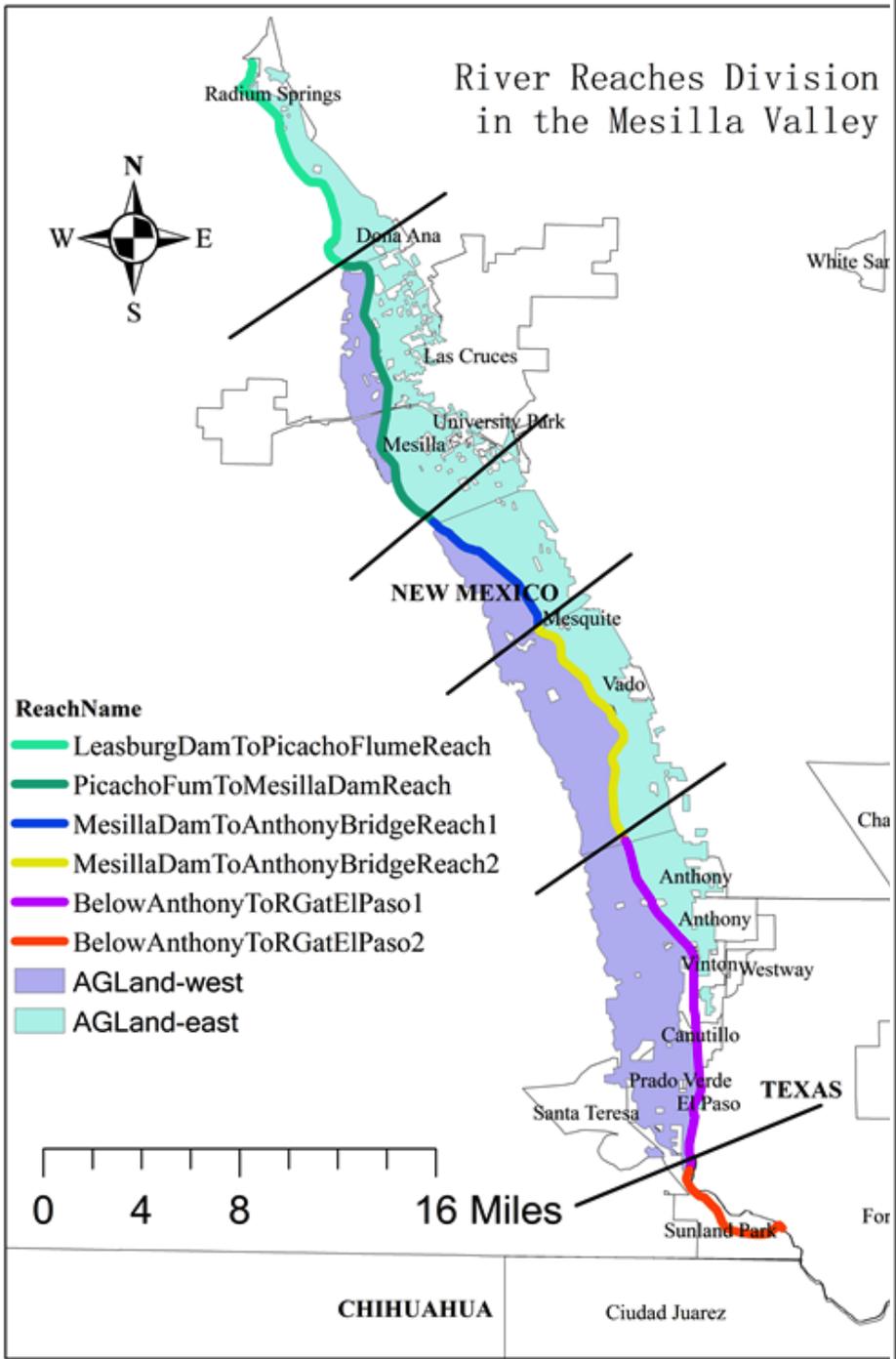
Rio Grande above Leasburg



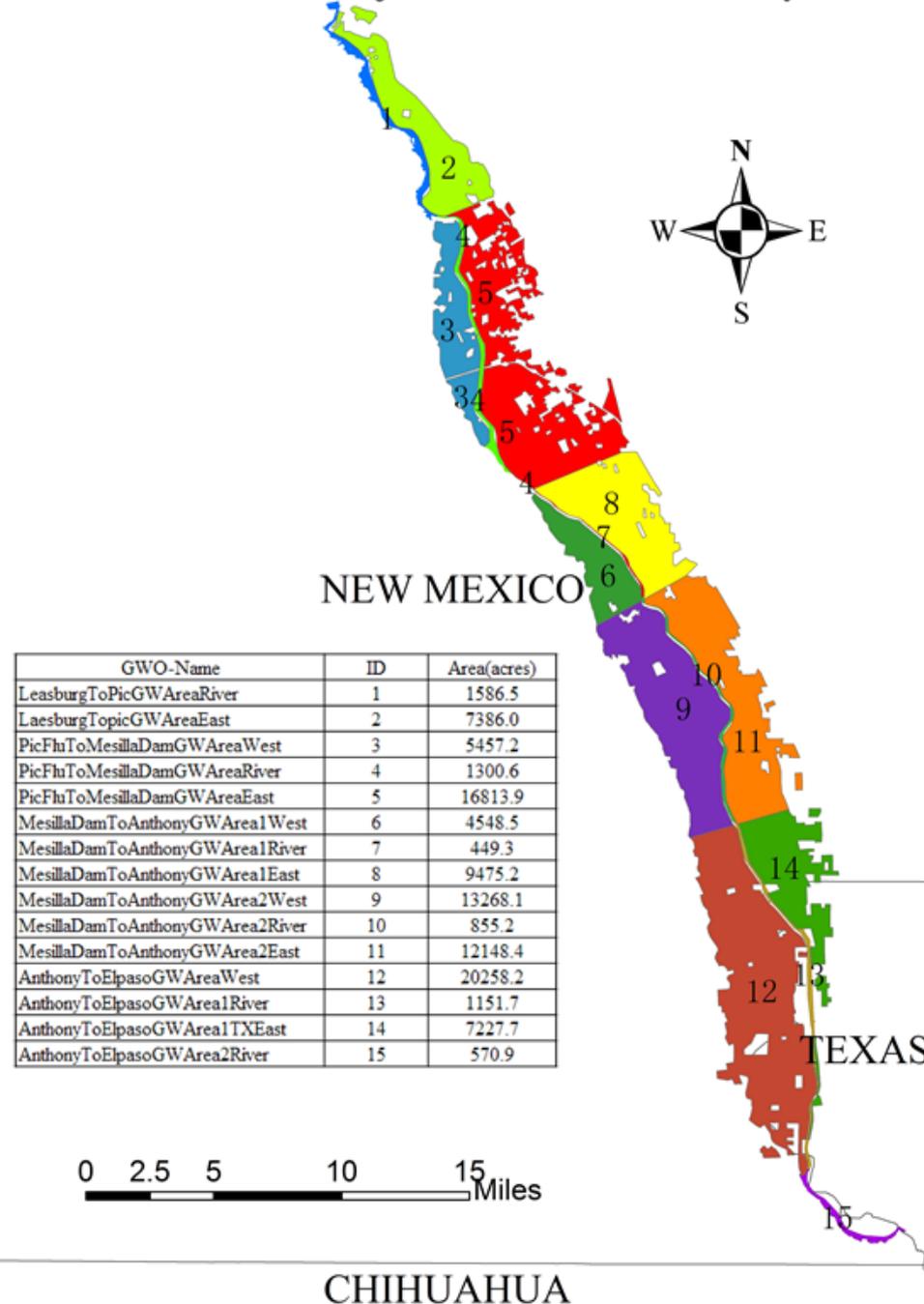
Mesilla Basin Model

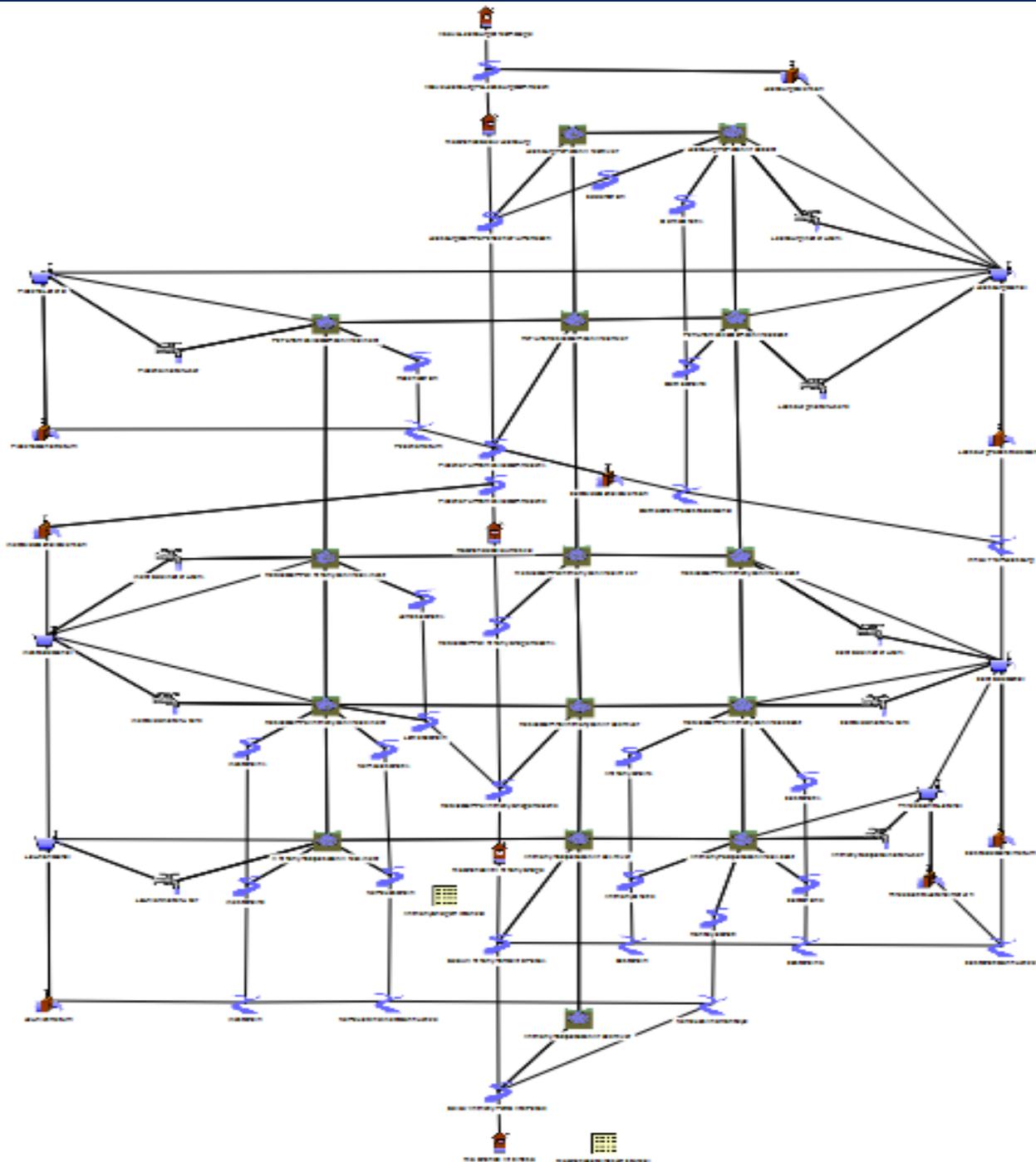


River Reaches Division in the Mesilla Valley

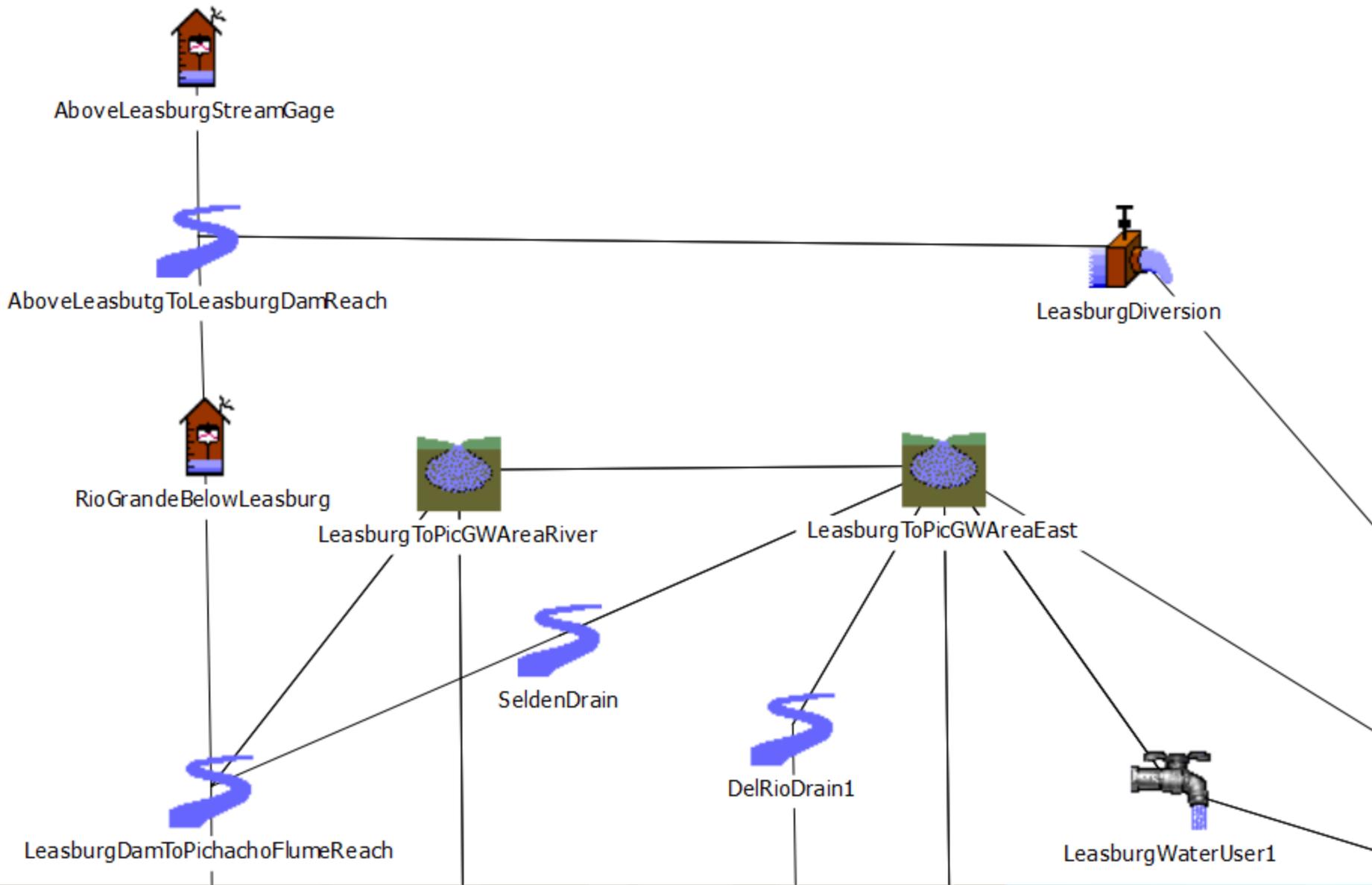


Groundwater Objects in the Mesilla Valley

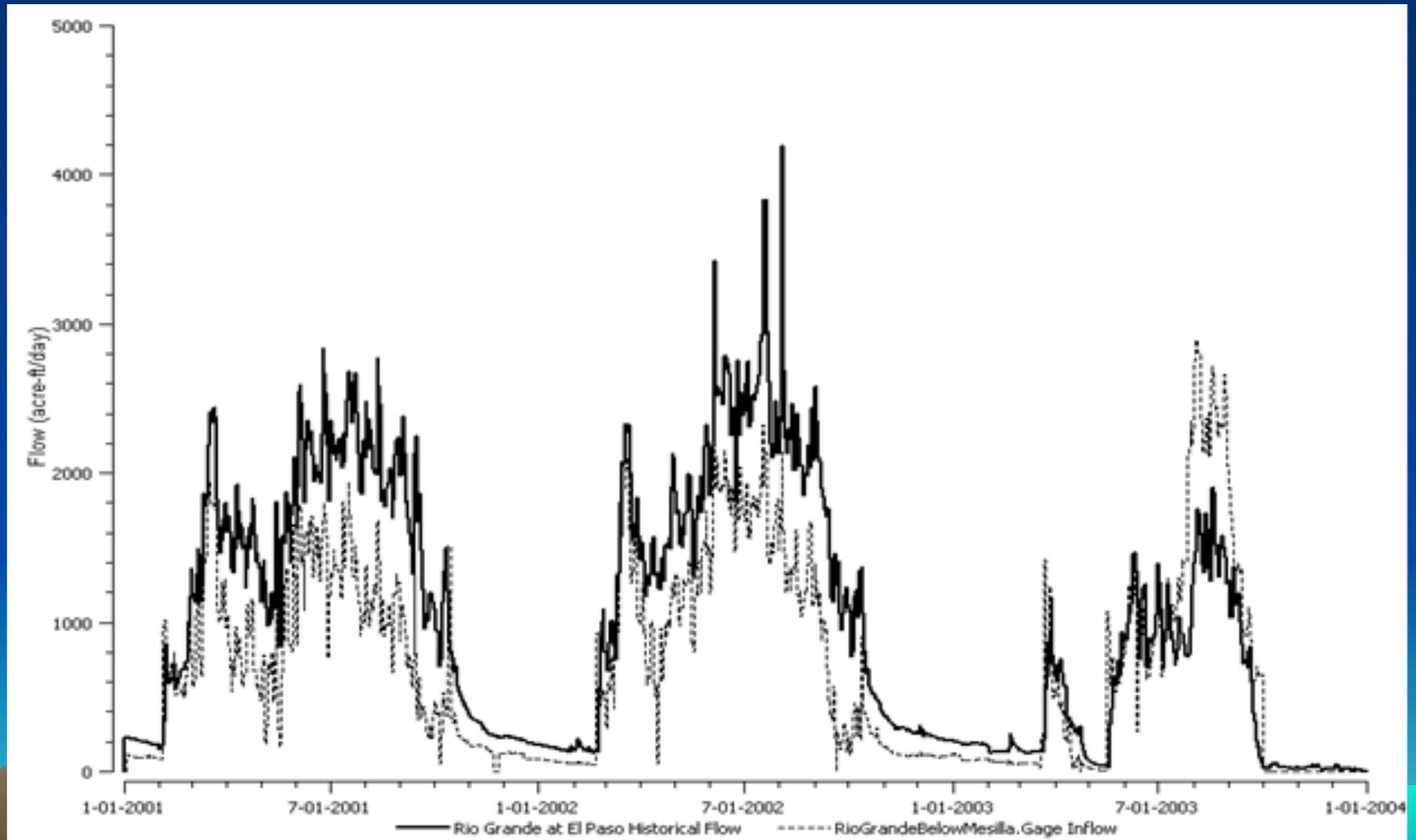




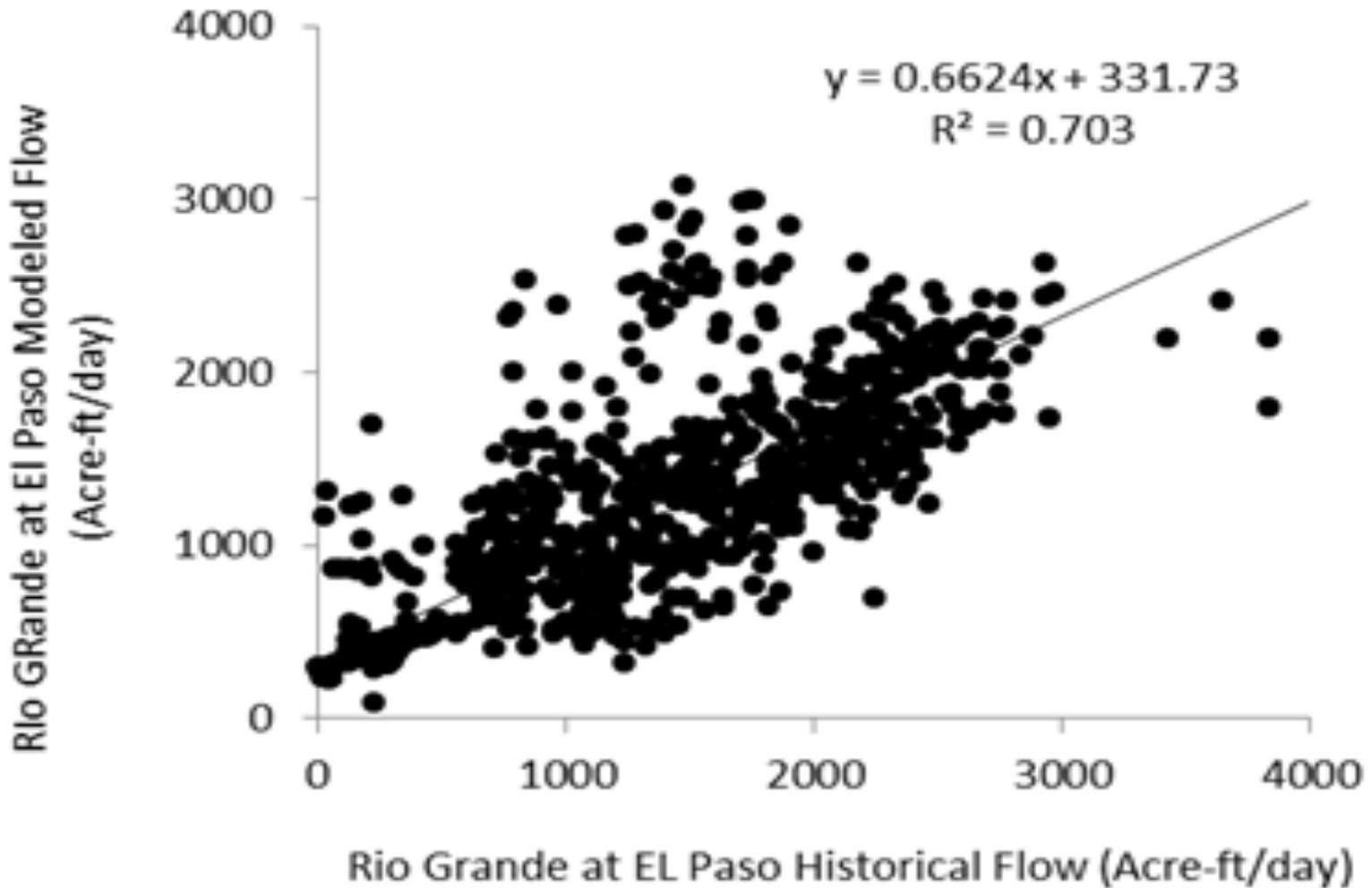
Mesilla Basin RiverWare Layout



Flow of Rio Grande at El Paso



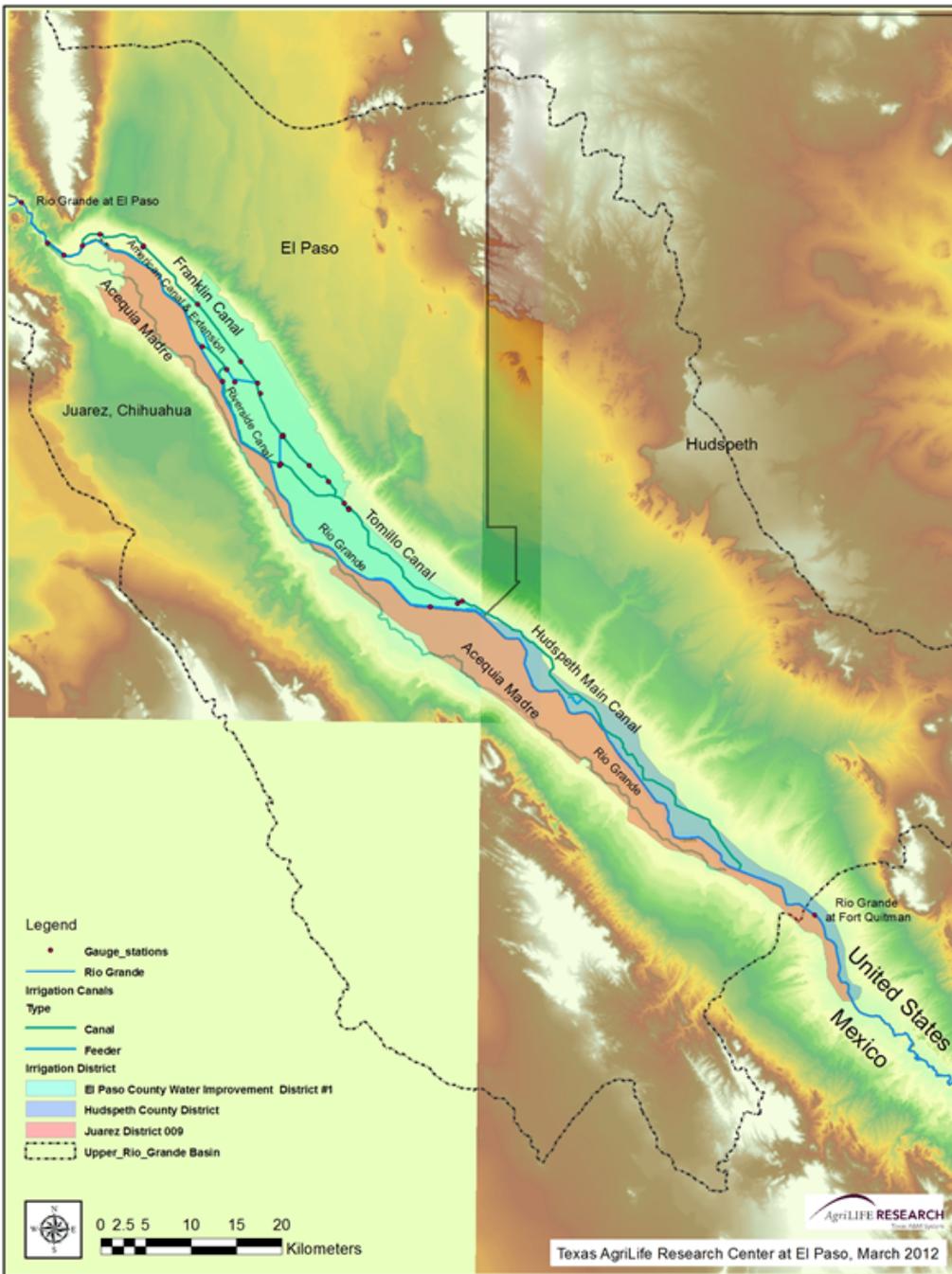
Rio Grande at El Paso



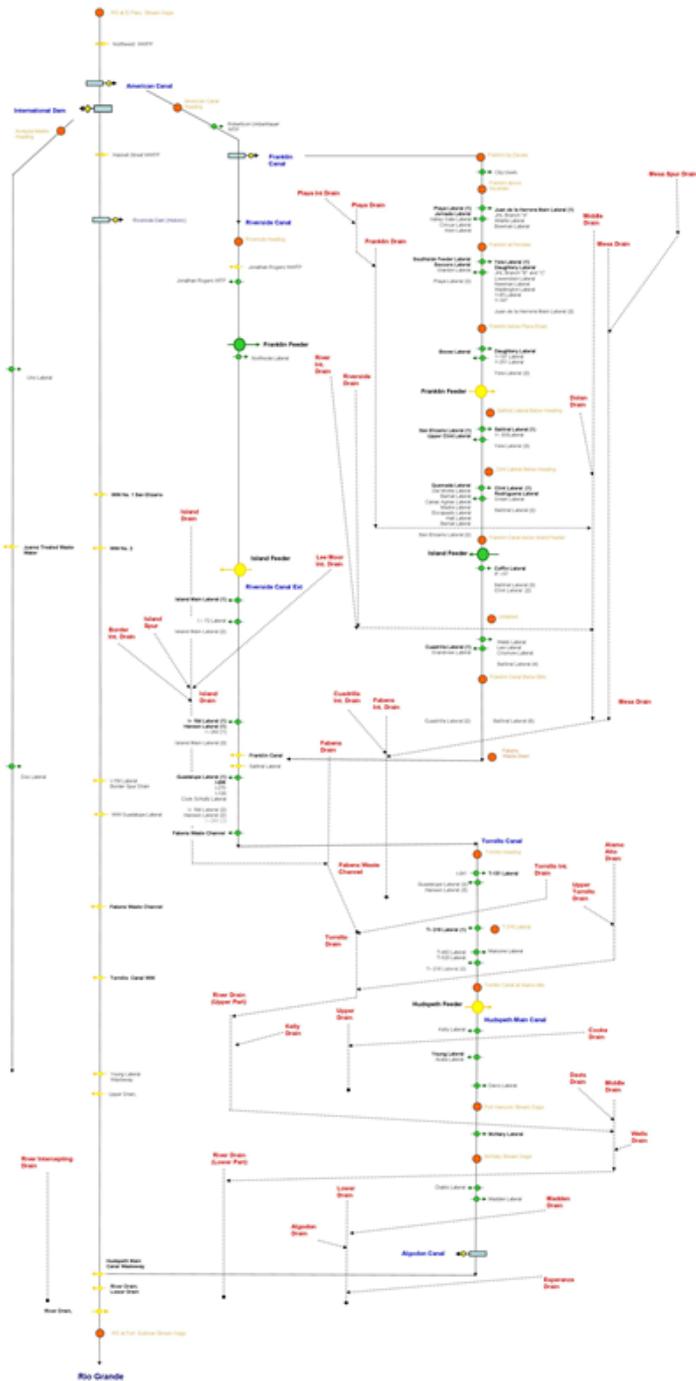
El Paso – Juarez Valley Model



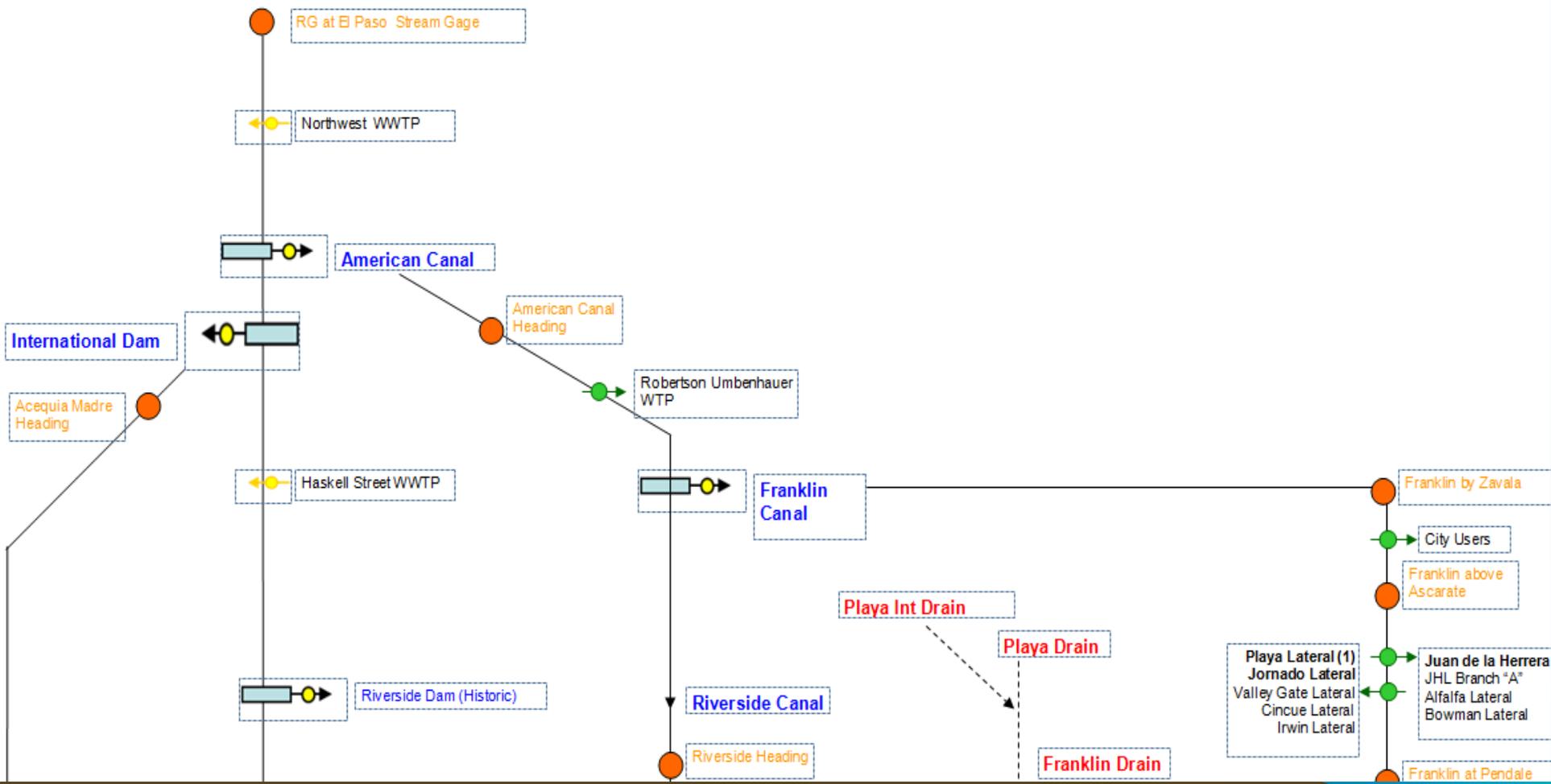
El Paso – Juarez Valley

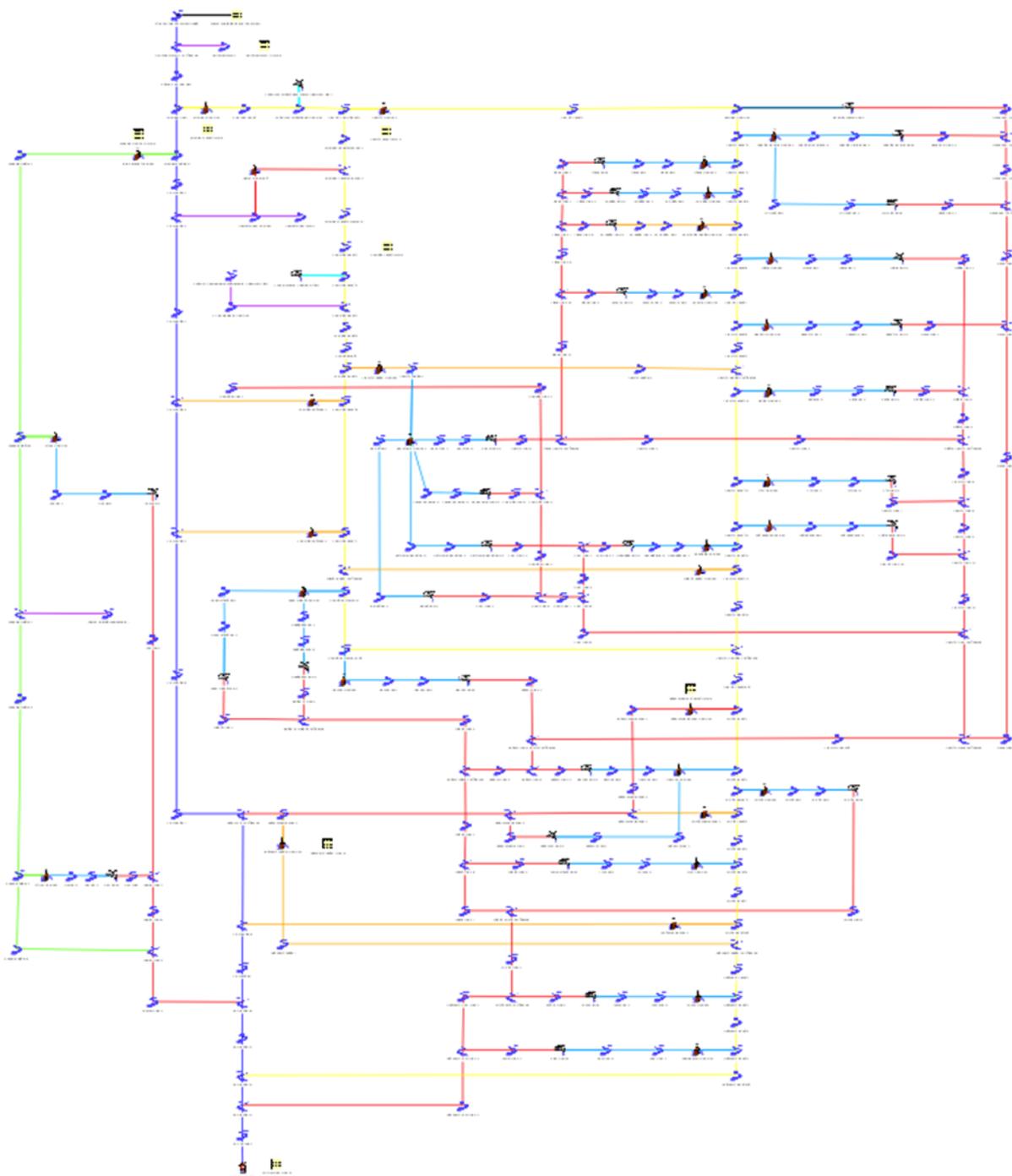


El Paso – Juarez Valley Conceptual Model



El Paso – Juarez Valley Conceptual Model





El Paso – Juarez Valley RiverWare Layout

El Paso – Juarez Valley RiverWare Objects

The screenshot displays the RiverWare 6.1.3 software interface for the 'EIPaso-Juarez-Model-V1.mdl' project. The main simulation view shows a network of water system objects:

- El Paso Irrigation System Head** (blue wavy line) connected to **Water Available Above The System** (grid icon).
- Northwest WWTP Confluence** (blue wavy line) and **Northwest WWTP** (blue wavy line) connected to **Northwest WWTP Historic** (grid icon).
- Above American Dam** (blue wavy line) connected to **American Dam** (dam icon).
- American Dam** connected to **American Diversion** (dam icon) and **American Canal** (blue wavy line).
- American Canal** connected to **Robertson Umbenhauer Water Treatment Plant** (tap icon) and **Robertson Umbenhauer Diversion** (dam icon).
- Robertson Umbenhauer Diversion** connected to **Franklin Riverside Split** (blue wavy line) and **Franklin Diversion** (dam icon).
- Franklin Riverside Split** connected to **American Canal Extension 1** (blue wavy line).
- American Canal Extension 1** connected to **American Canal Extension 2** (blue wavy line).
- American Canal Extension 2** connected to **Haskel Street Spill** (dam icon).
- Acequia Diversion Historic** (grid icon) connected to **International Diversion** (dam icon).
- International Diversion** connected to **International Dam** (dam icon).

The **Simulation Object List** on the right side of the interface shows a list of objects sorted by name, including:

- American Canal Extensic
- American Canal Extensic
- American Canal Extensic
- American Canal Historic
- American Dam
- American Diversion
- Bernal Farms
- Bernal Lat 1
- Bernal Lat 2
- Border Int Drain
- Border Int Island Conflu
- Bowman Diversion
- Bowman Water Users
- Canas Agrias Farms
- Canas Agrias Lat 1
- Canas Agrias Lat 2
- Clint Diversion
- Clint Farms
- Clint Lat 1
- Clint Lat 2
- Daughtry Diversion
- Daughtry Farms
- Daughtry Lat 1
- Daughtry Lat 2
- Del Monte Barrial Farms
- Del Monte Barrial Lat 1
- Del Monte Barrial Lat 2
- Dos Drain
- Dos Farms
- Dos Lat 1
- Dos Lat 2

The software interface includes a menu bar (File, Control, Workspace, Policy, DMI, Accounting, Utilities, Help) and a toolbar with various simulation and navigation tools. The RiverWare logo is visible in the bottom right corner.

Rule set

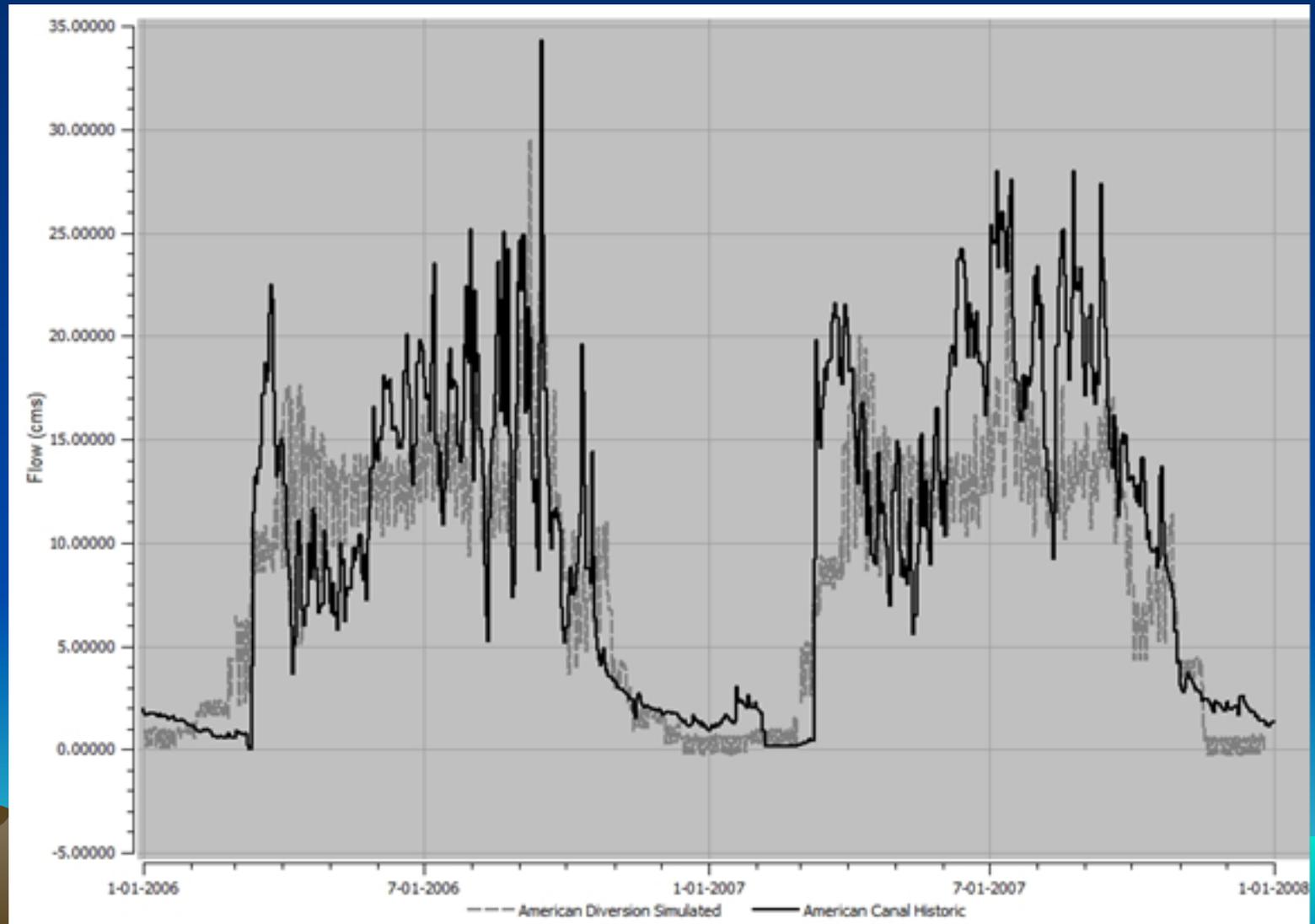
Rule Editor - "ElPaso-Juarez-Model-RulesetV1.rls : Policy Group : Hudspeth Feeder Rule"

File Edit Rule View

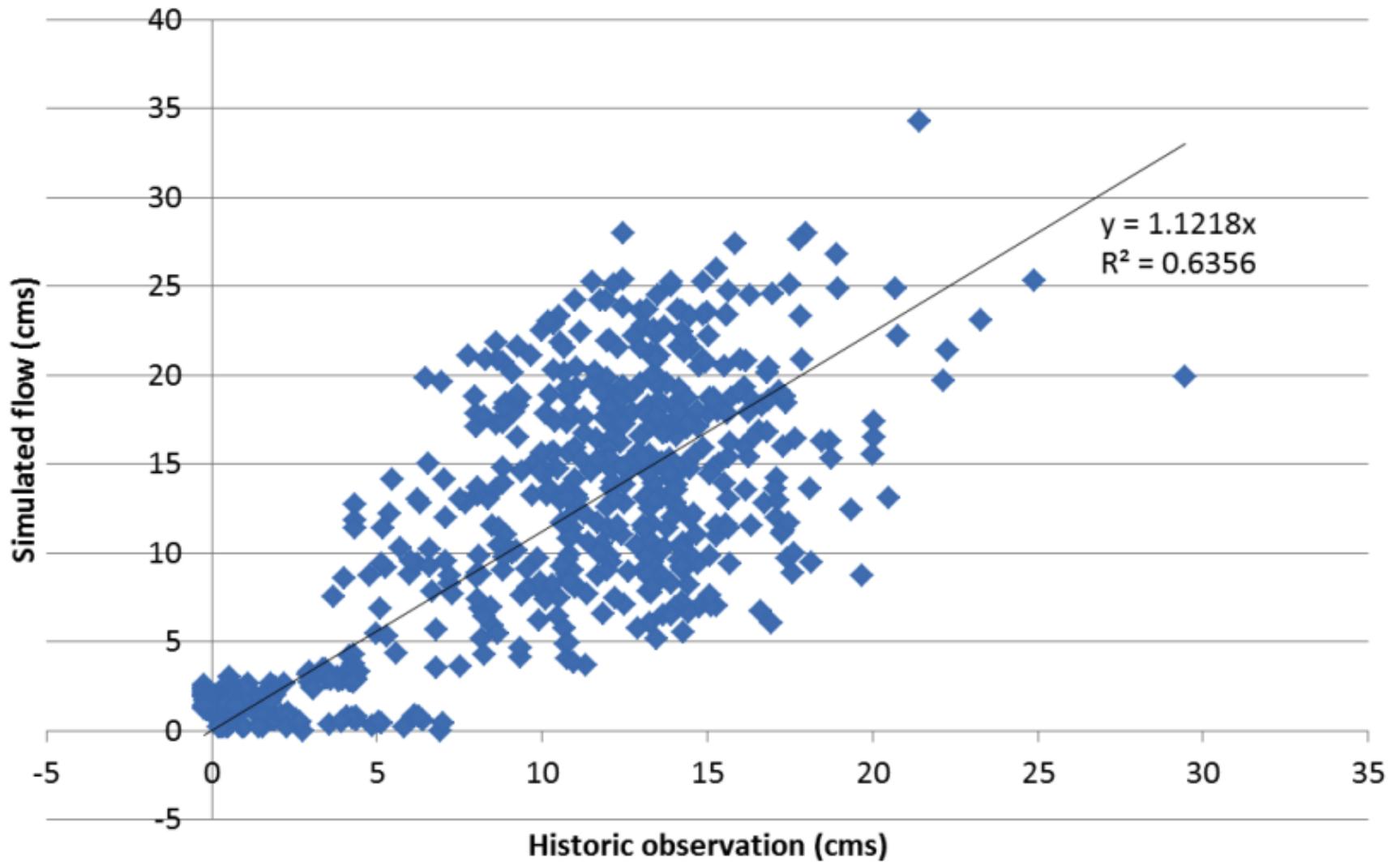
  Hudspeth Feeder Rule

```
IF ( Hudspeth Diversion Sent ( ) ) THEN
  IF ( All Fabens Drain Water Sent ( ) ) THEN
    Hudspeth Feeder.Outflow [ @"t + 4" ] = Fabens Waste Way 5.Inflow [ @"t + 4" ]
  ELSE
    Hudspeth Feeder.Outflow [ @"t + 4" ] = Hudspeth Feeder Confluence.Outflow [ @"t + 4" ]
  ENDIF
ELSE
  Hudspeth Feeder.Outflow [ @"t + 4" ] = 0.00000000 "cms"
ENDIF
```

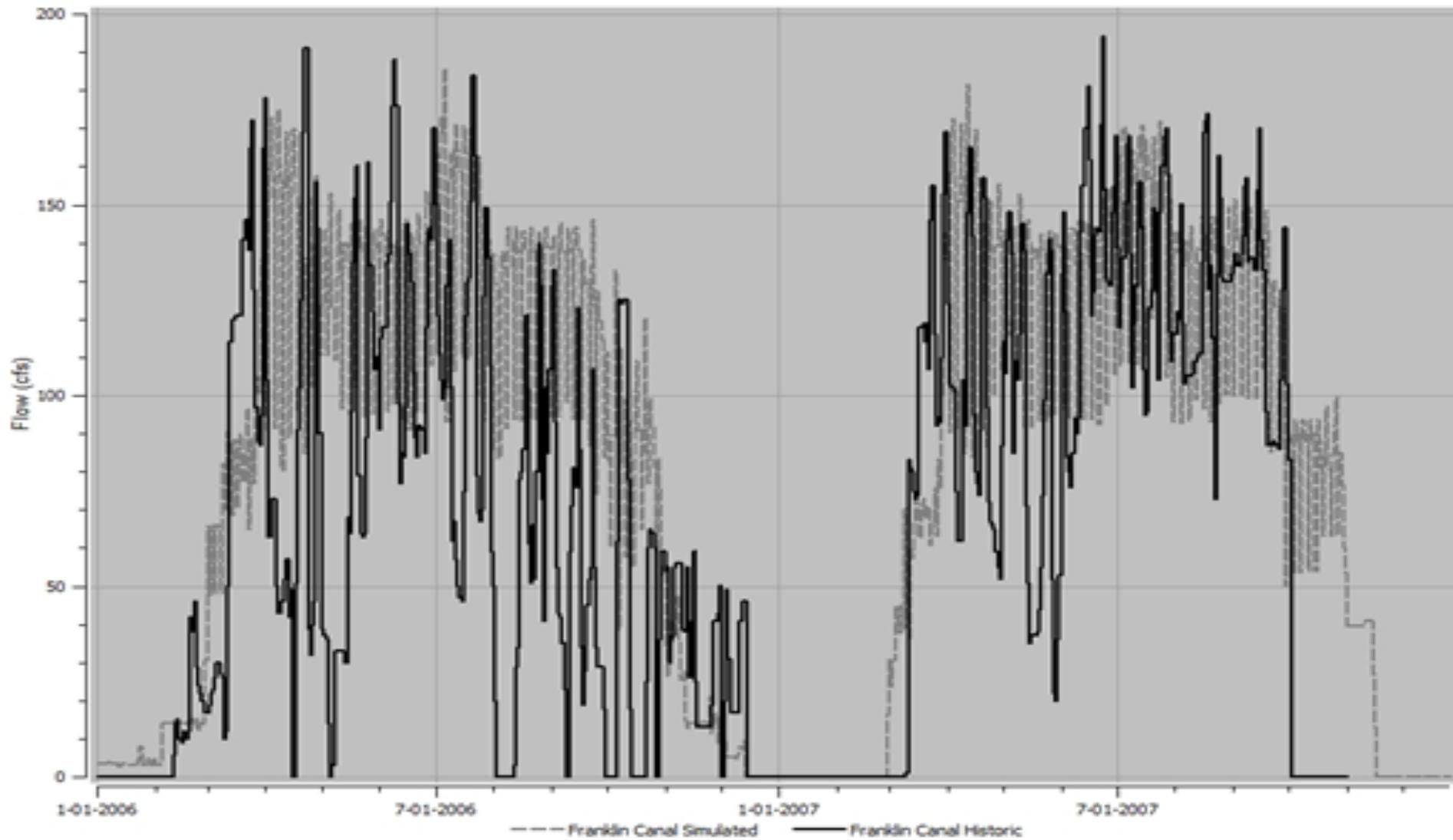
American Canal



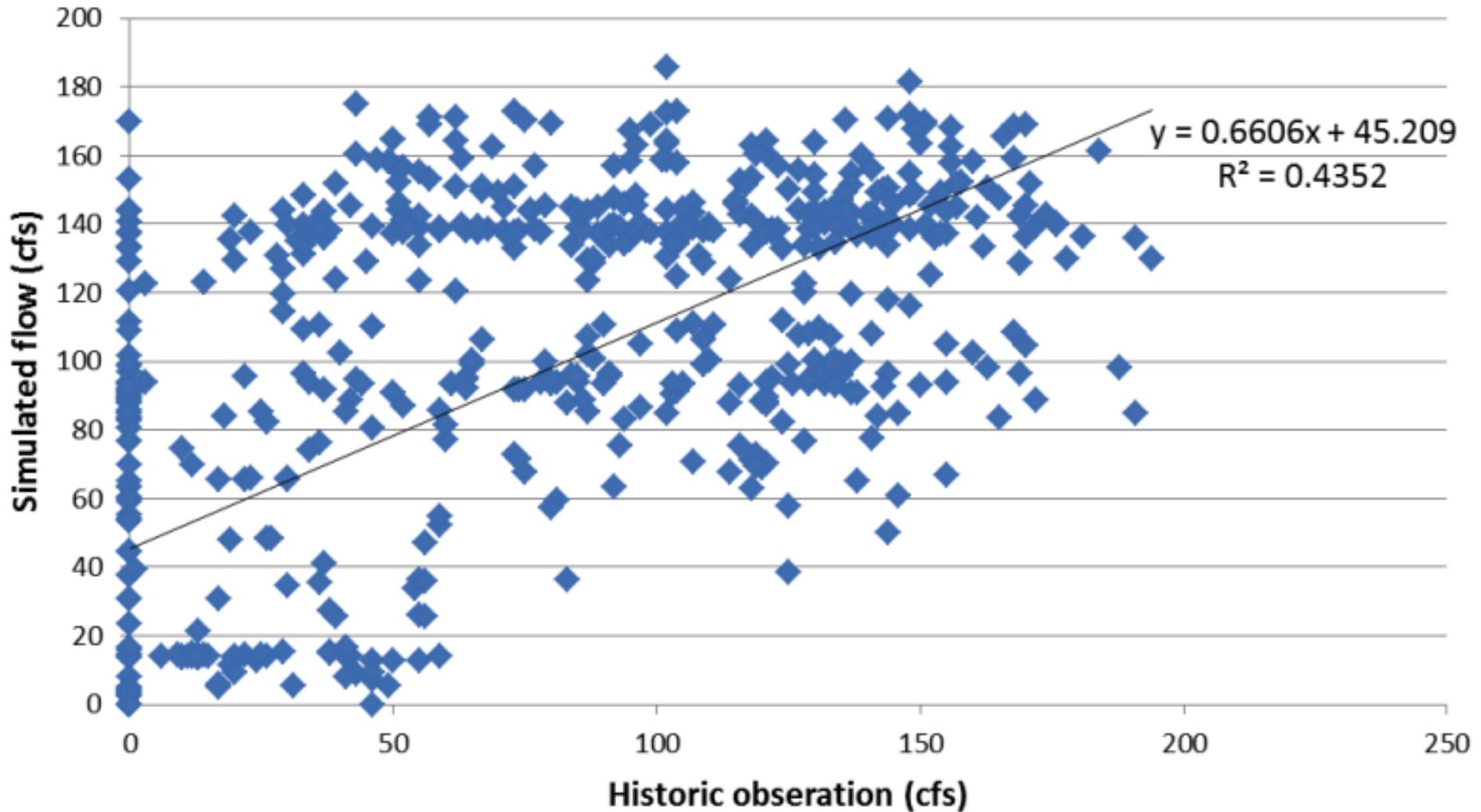
American Canal



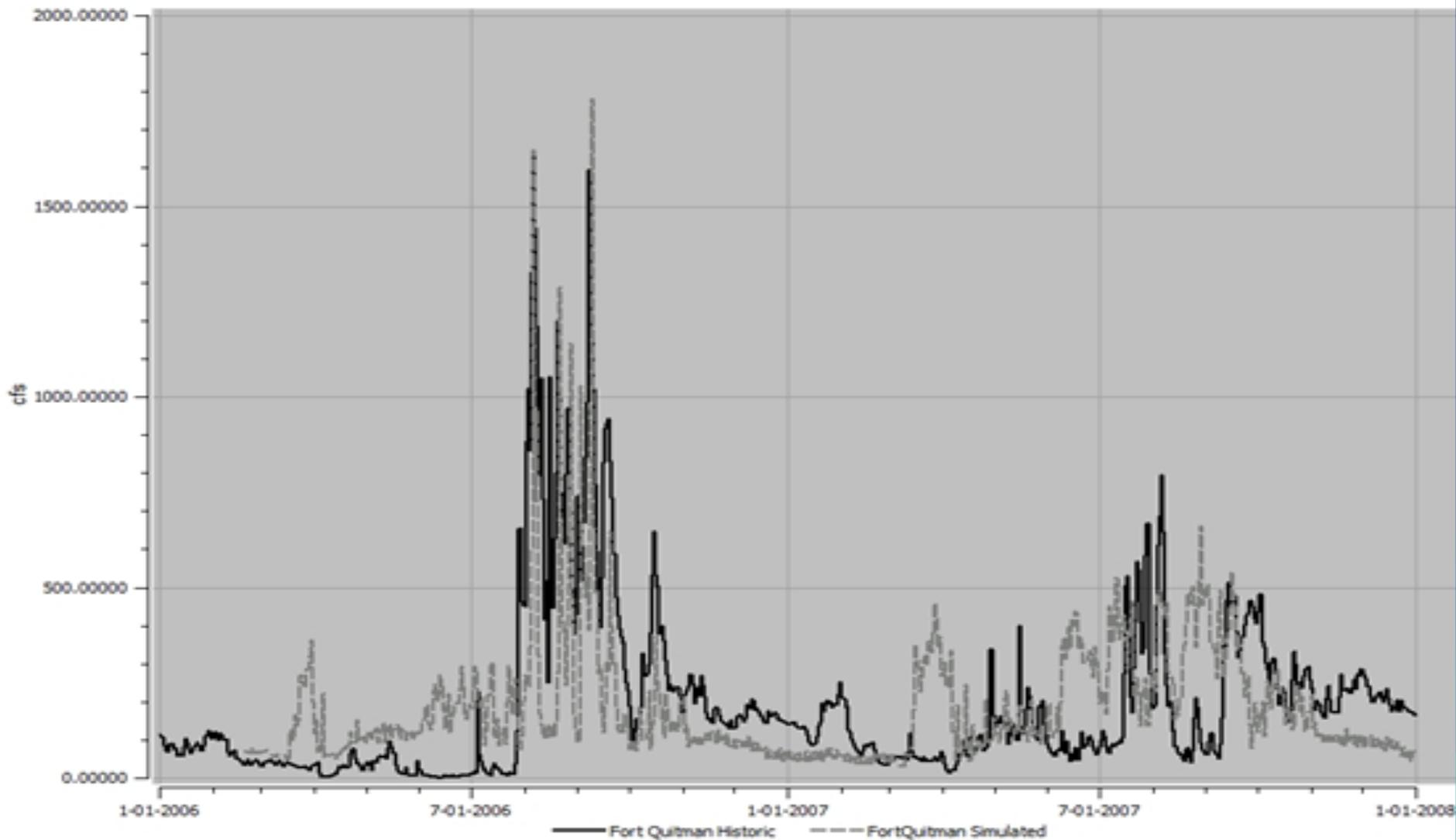
Franklin Canal



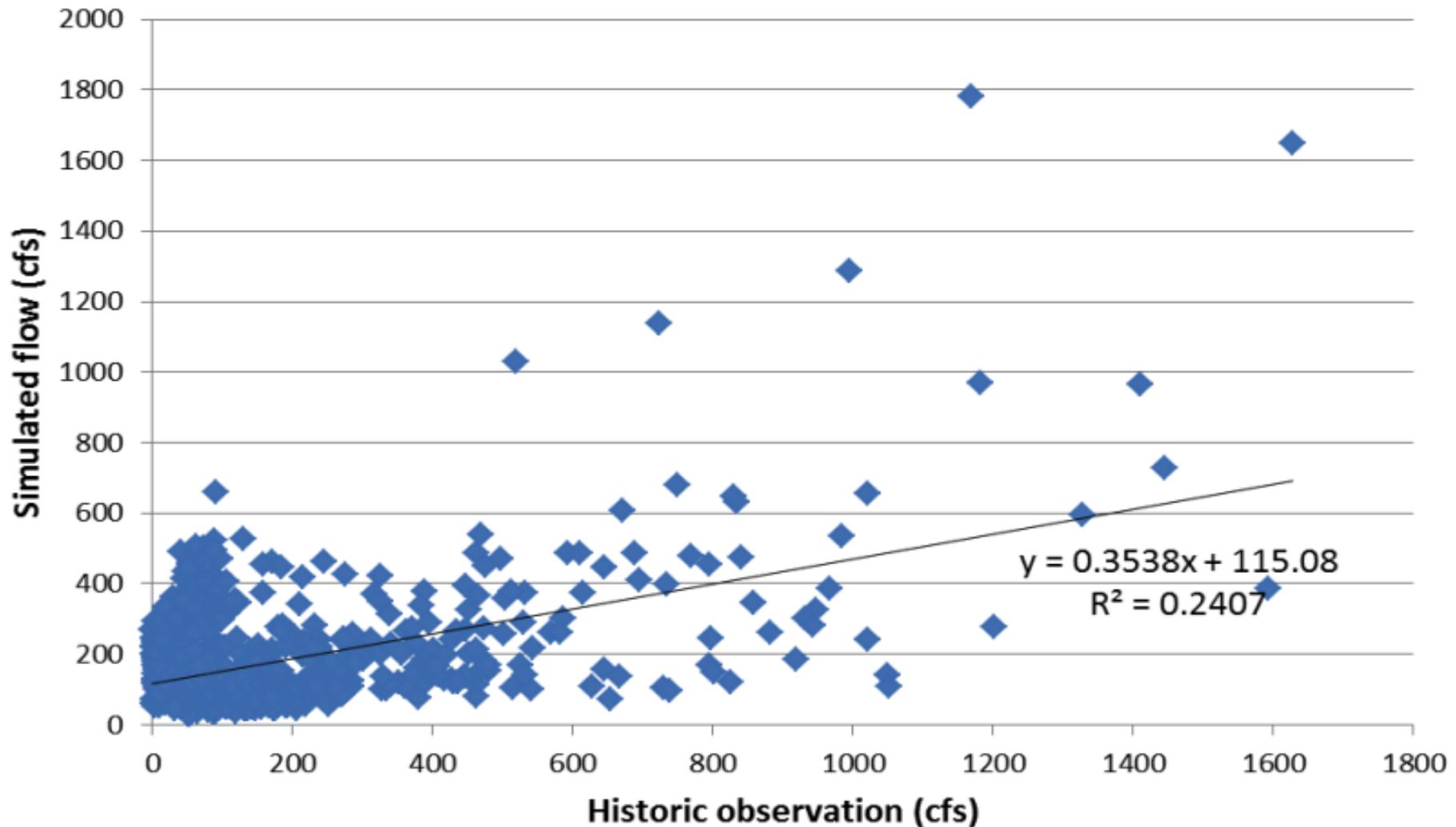
Franklin Canal



Rio Grande at Fort Quitman



Rio Grande at Fort Quitman



Recommendation for Future Work

- Enhancement of DB & GIS
- Enhancement of the RiverWare models
- Integration of models for the Rio Grande Project area
- Incorporate operations rules into the model
- Evaluation of different operations planning scenarios



Thank You!

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<http://www.pdnwc.org>