Integrated Lower Rio Grande Model

Linking RiverWare with two MODFLOW Models

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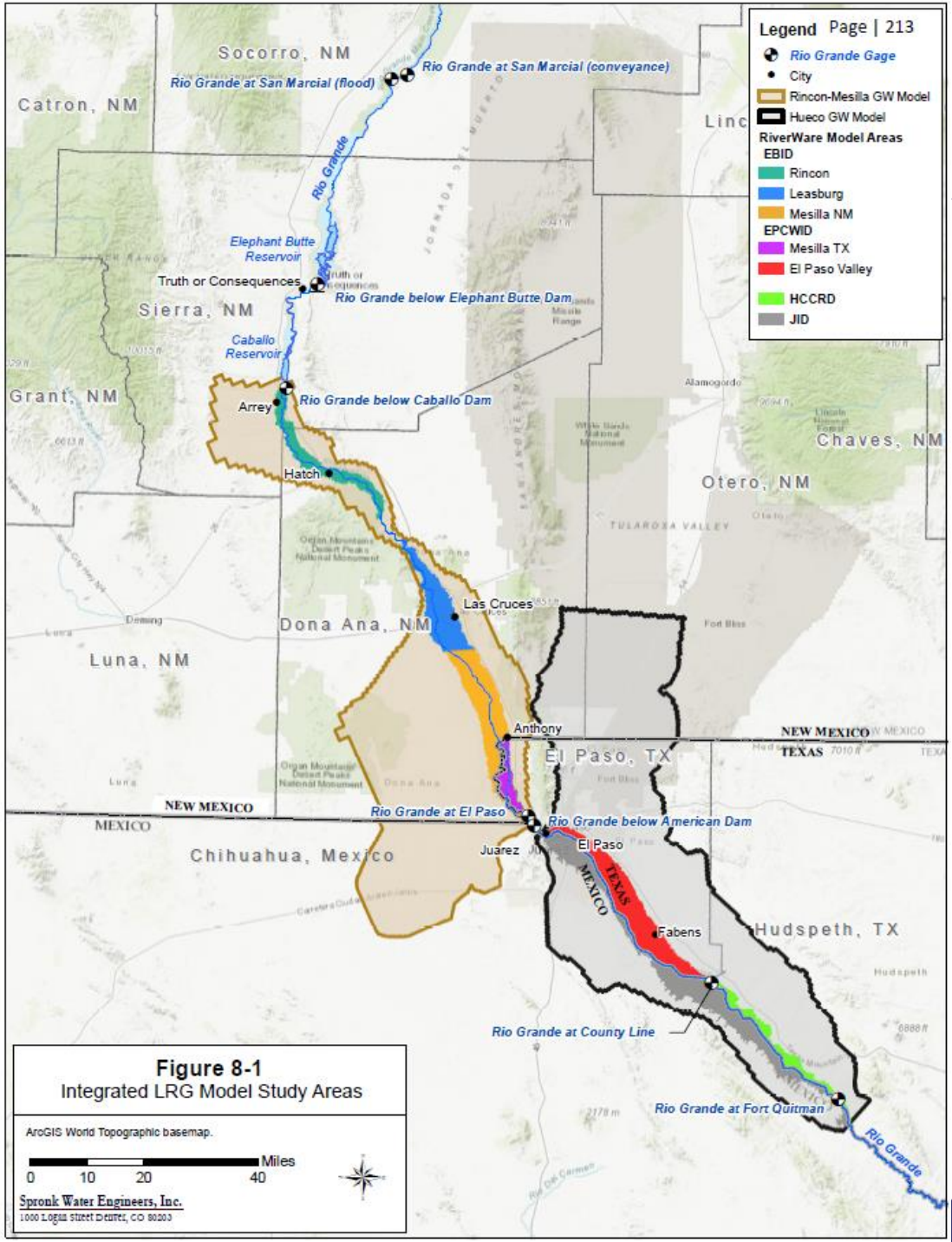
Overview

- Hydros developed a RiverWare model of the Rio Grande Project (Project) and the Rio Grande basin from Elephant Butte Reservoir to Fort Quitman, TX
  - Storage and delivery of Project water to Elephant Butte Irrigation District (EBID) and El Paso County Water Improvement District No. 1 (EPCWID)
- Coupled with two ground water models (MODFLOW)
  - Rincon-Mesilla basin model developed by S.S. Papadopulos and Associates, Inc.
  - Hueco-Bolson basin model developed by McDonald Morrissey Associates
- When the three models are “linked” referred to as Integrated Lower Rio Grande Model

Overview

- RiverWare model includes operating rules to simulate Project operations and Project accounting associated with Reclamation's current and past operating policies
- Integrated LRG Model was used to evaluate a number of different “what if” scenarios related to groundwater pumping, surface water deliveries, Project operating rules, Project accounting, etc.


Legend Page | 213
Rio Grande Gage
City
Rincon-Mesilla GW Model
Hueco GW Model
RiverWare Model Areas
EBID
Rincon
Leasburg
Mesilla NM
EPCWID
Mesilla TX
El Paso Valley
HCCRD
JID
Socorro, NM
Rio Grande at San Marcial (flood)
Rio Grande at San Marcial (conveyance)
Catron, NM
Rio Grande
Elephant Butte Reservoir
Truth or Consequences
Rio Grande below Elephant Butte Dam
Sierra, NM
Caballo Reservoir
Grant, NM
Arrey
Rio Grande below Caballo Dam
Hatch
Chaves, NM
Otero, NM
Las Cruces
Dona Ana, NM
Luna, NM
Anthony
NEW MEXICO
TEXAS
El Paso, TX
Rio Grande at El Paso
Rio Grande below American Dam
NEW MEXICO
MEXICO
Chihuahua, Mexico
Juarez
El Paso
TEXAS
MEXICO
Fabens
Hudspeth, TX
Rio Grande at County Line
Rio Grande at Fort Quitman
Rio Grande
Figure 8-1
Integrated LRG Model Study Areas
ArcGIS World Topographic basemap.
Miles
0 10 20 40
Spronk Water Engineers, Inc.
1000 Logan Street Denver, CO 80203

Why is this necessary?

- Developed for litigation purposes (*Texas v New Mexico*)
  - Robust, comprehensive, and defensible model
  - MODFLOW has been challenged and accepted in previous Supreme Court cases
- To accurately capture and reflect how changes in system efficiency and water deliveries impact Project water supply, need a surface water model that can simulate:
  - Project allocations
  - District deliveries and accounting
  - Reservoir releases
  - Project storage carryover from one year to the next

Why is this necessary?

- Changes in groundwater pumping impact returns to the river which impact Project operations, reservoir releases, carry over water, etc.
- Example: reduced pumping and river depletions

Solution…

- Three models simulate interactively and iteratively with each other to incorporate information from each model that may not be included in another model

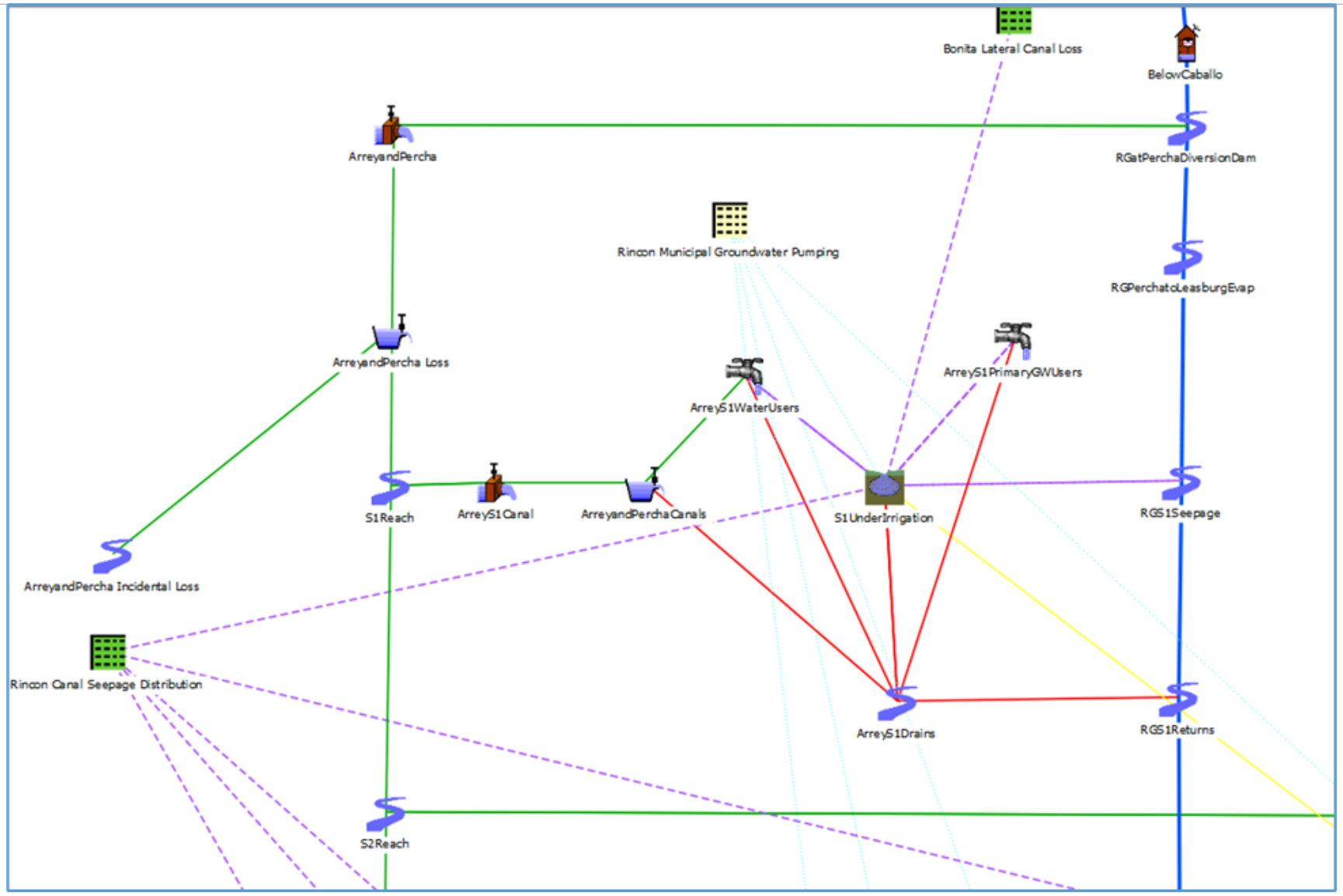
- RiverWare Model simulates Project operations: reservoir releases, district allocations, and river headgate orders to meet demands, while the groundwater models do not

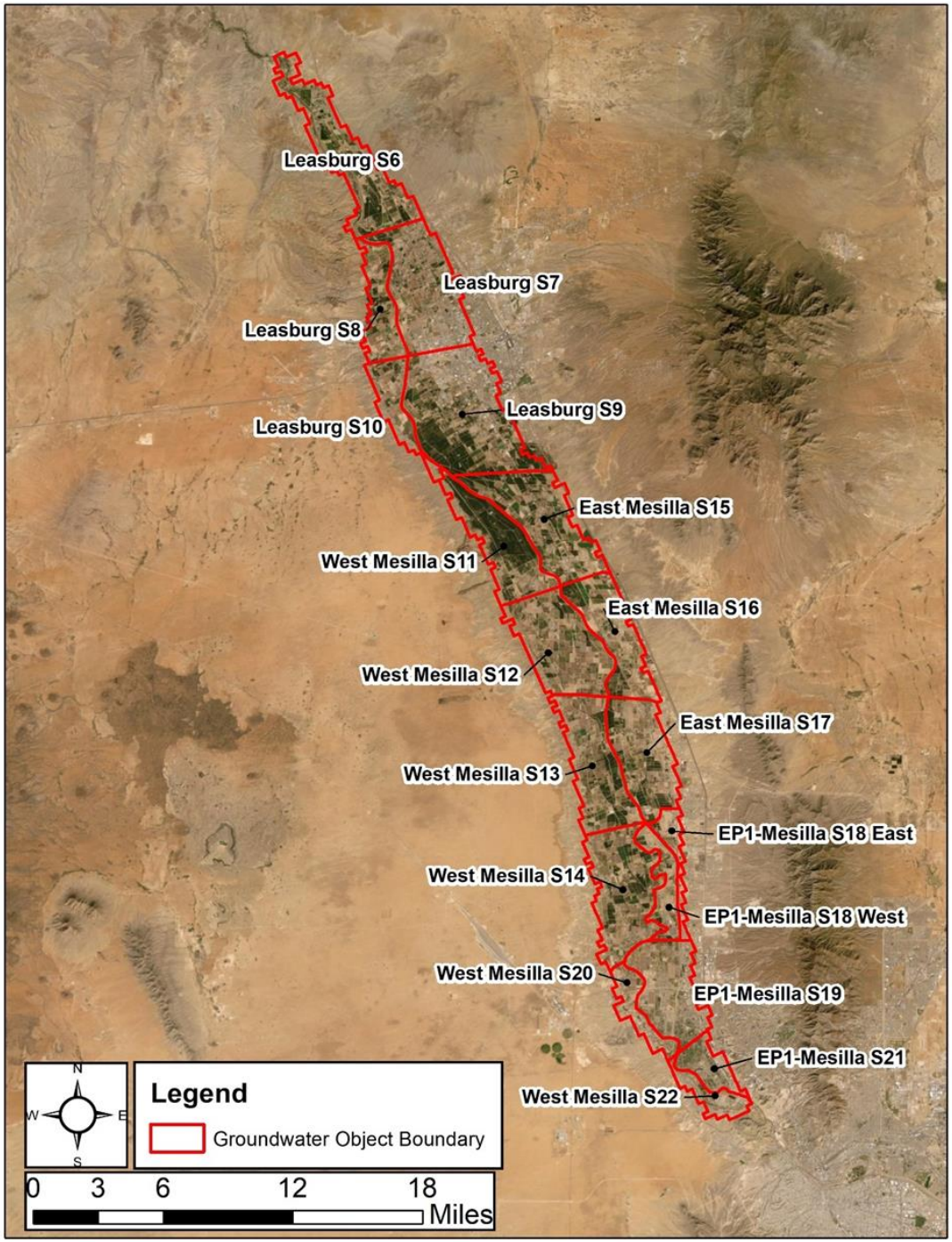
- Conversely, the groundwater models simulate a much larger domain with respect to the aquifer system, and with greater detail - both deep aquifer layers and a larger spatial extent with respect to the surface area covered

RiverWare Model Simulates …

- Elephant Butte and Caballo Reservoirs including Project operations, Project accounting, etc.
- On-farm processes including farm headgate deliveries, crop irrigation requirement, field efficiency, soil moisture consumption and replenishment, surface return flows, and GW recharge
- Supplemental pumping when surface water deliveries do not meet crop demand
- Shallow groundwater system
- Surface water – groundwater interaction between river, the irrigation drains, delivery canals, and the alluvial aquifer system

Example “sub area”




Leasburg S6
Leasburg S7
Leasburg S8
Leasburg S9
Leasburg S10
East Mesilla S15
West Mesilla S11
East Mesilla S16
West Mesilla S12
East Mesilla S17
West Mesilla S13
EP1-Mesilla S18 East
West Mesilla S14
EP1-Mesilla S18 West
West Mesilla S20
EP1-Mesilla S19
EP1-Mesilla S21
West Mesilla S22
N
W
E
S
Legend
Groundwater Object Boundary
0 3 6 12 18
Miles

Data Passed between Models

Table TM 2.1: Data Transferred from RiverWare Model to Rincon-Mesilla and Hueco Models

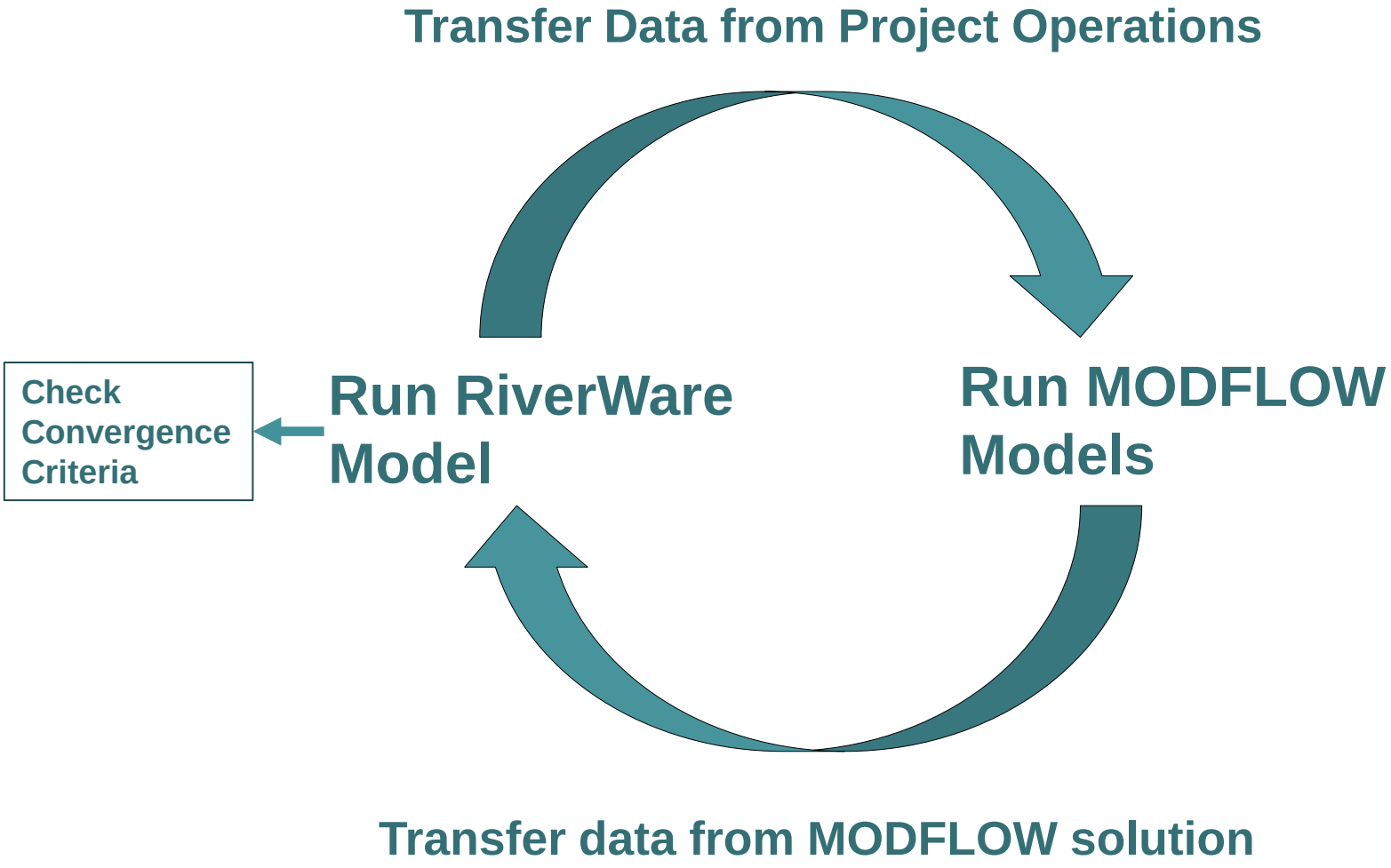
From RiverWare to Rincon-Mesilla and Hueco Models
Caballo Reservoir releases*
Farm headgate deliveries
Wasteway returns
Recharge (deep percolation) from surface water and groundwater applied to fields
Surface water returns from surface water and groundwater applied to fields
Supplemental pumping
River headgate diversions*
Water treatment plant diversions (Hueco Model only)
Waste water treatment plant returns (Hueco Model only)
HCCRD reservoir operations (Hueco Model only)

* When running the Historical Calibration Simulation observed/historical data is used.

Table TM 2.2: Data Transferred from the Rincon-Mesilla and Hueco Models to RiverWare Model

From Rincon-Mesilla and Hueco Models to RiverWare Model
Canal seepage
Riparian ET
Municipal pumping from alluvial aquifer system
Lateral aquifer flows from areas outside RiverWare model domain
Flows between shallow/alluvial aquifer system and deep aquifer system
Urban infiltration
Alluvial aquifer heads (used to populate the initial timestep)

Integrated Model Iteration



Outcome

- Three models converge:
  - Convergence is considered achieved when the total farm headgate deliveries differ by 0.1% or less between the last two iterations
- Where the models overlap in representing physical processes, they are consistent with each other
- How long does it take?

Outcome

- We were asked by New Mexico's counsel to use the RiverWare Model (as part of the Integrated LRG Model) to simulate a number of different modeling scenarios
- Scenarios which evaluate alternative pumping strategies, Project operations, and Project accounting
- Example: several scenarios evaluate the effects of eliminating groundwater pumping in one or more regions of the model domain.

Acknowledgements

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- Hydros Staff (John Craven)
- New Mexico Interstate Stream Commission

Questions?