

# **Use of RiverWare for a Coordinated Groundwater-Surface Water Project**

*RiverWare User Group Meeting  
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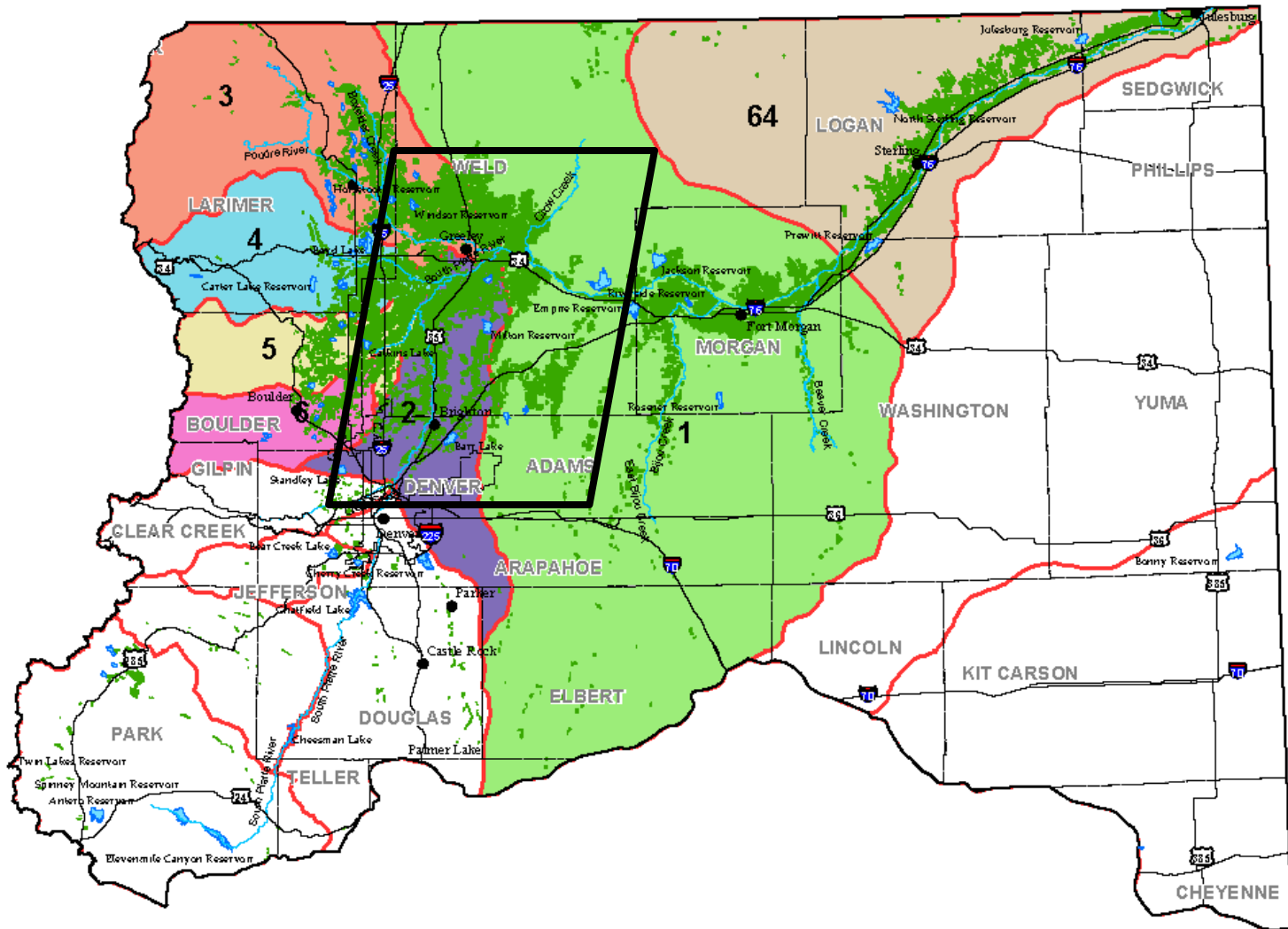
# Model Disclaimers

- Model is under development
- Final water court decrees will result in changes in inputs and operations
- No findings have been reviewed or approved by the clients

# General Project Location South Platte Basin Colorado



# South Platte Basin Colorado





# Project Background

- Storage reservoirs difficult to permit
- Scarcity of high quality supplies
- Last in-basin storage projects with high quality supplies under development
- Need for reliable yield
- Available senior water rights in agricultural use
- Colorado Water Conservation Board studies project continued transfer of agricultural rights to M&I use
- Proposed project involves minimal surface storage, lower quality supplies, groundwater recharge and advanced water treatment



# Project Components

- Three water user accounts
- Senior agricultural surface water rights
  - Shares in 20 irrigation companies
  - Direct flow, storage and recharge rights
  - Net stream depletions
- Surface reservoirs
- 3 alluvial well fields with lagged depletions
- Recharge ponds with lagged accretions
- Exchanges in 8 river accounting reaches



# Modeling Goals

- Model potential operations of decreed augmentation plans, change cases and exchanges
  - Develop annual operating plan
  - Simulate over historical period of record
- Ability to incorporate terms of future water rights decrees
  - Flow rate and volumetric limitations
  - Net stream depletion calculations for transferred water rights
  - Lagged depletions from groundwater pumping
  - Lagged recharge accretions
- Size and develop infrastructure to reliably meet demands
- Does not duplicate water court decreed accounting

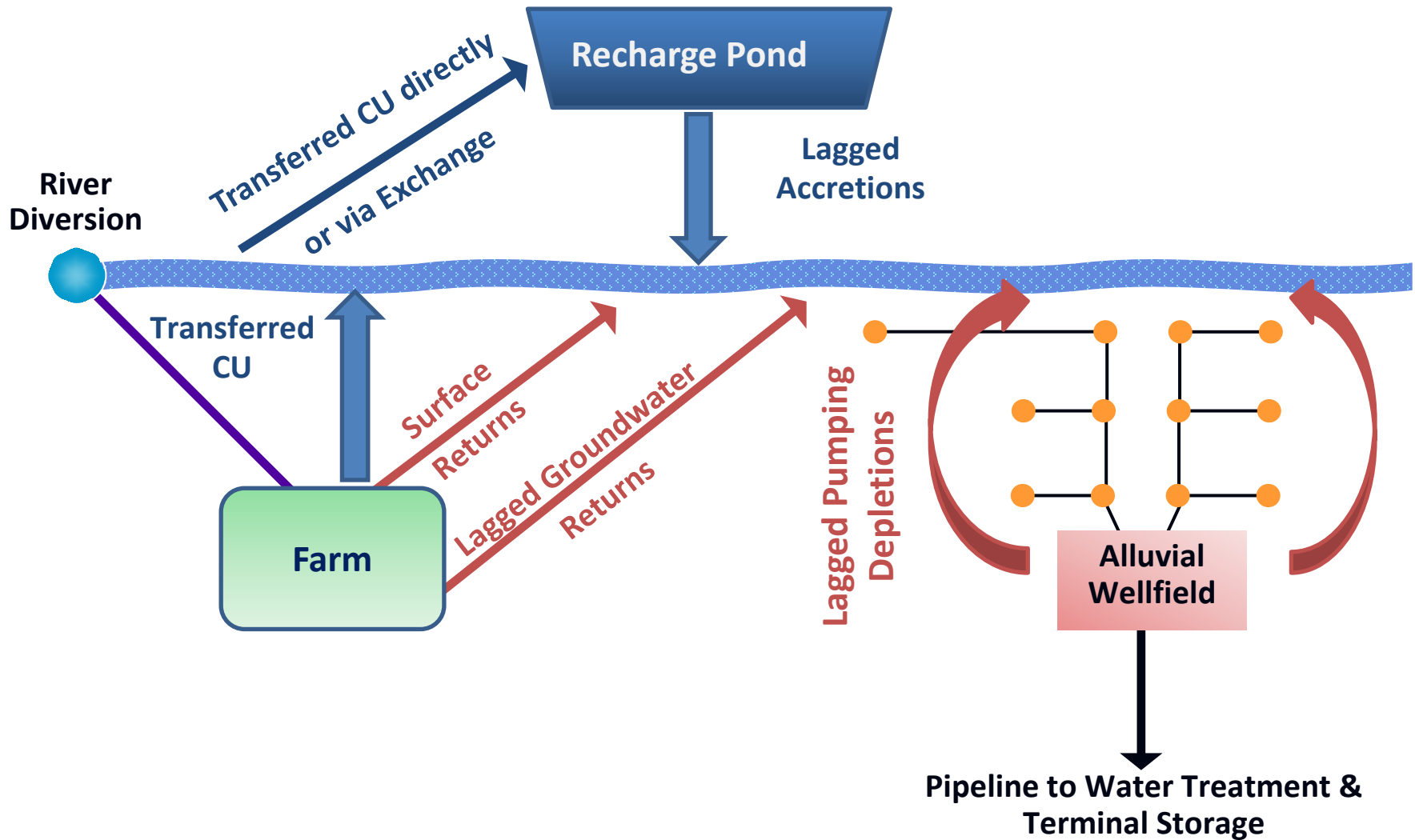


# Model Objectives

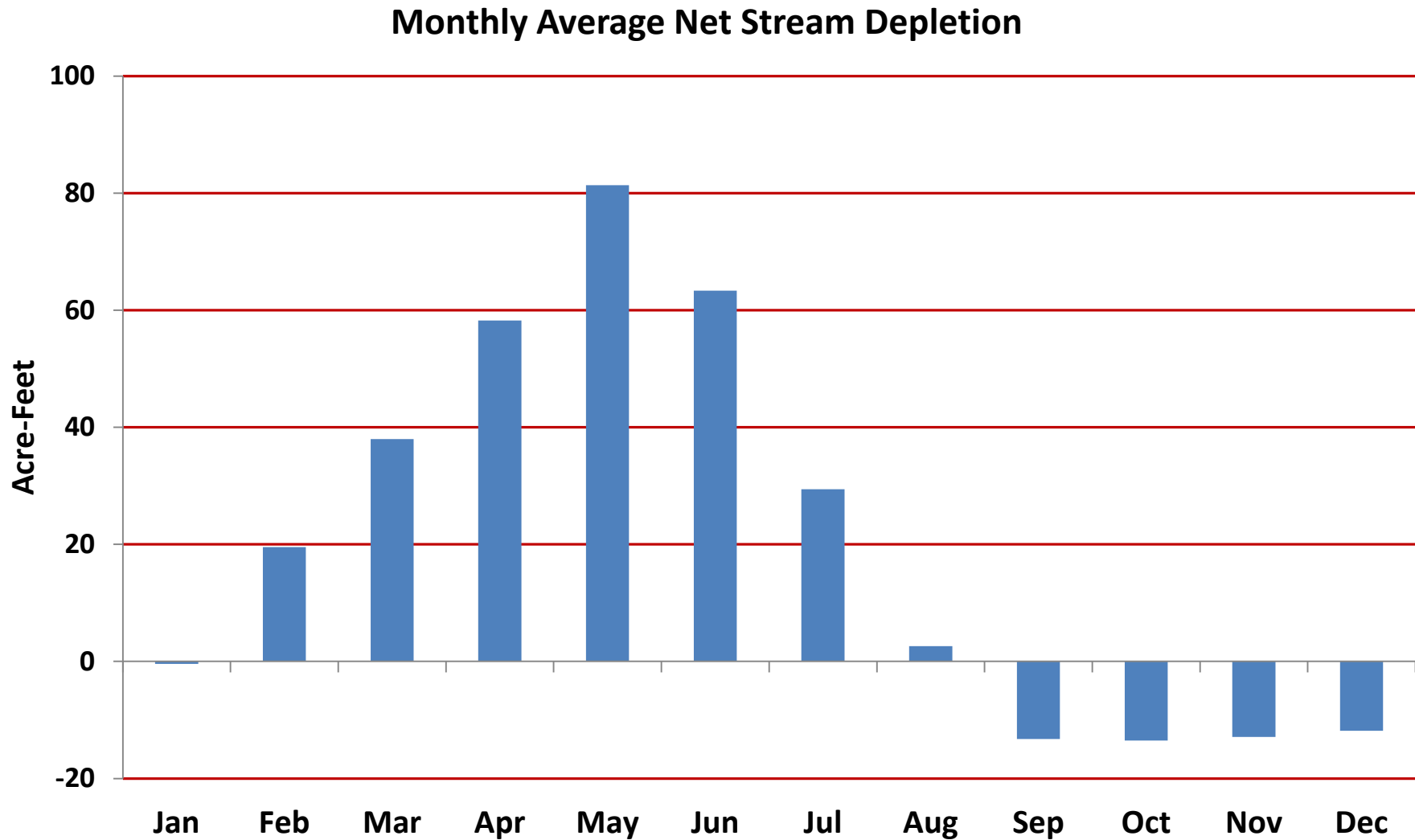
- Replace (augment):
  - Lagged alluvial well pumping depletions (20+ wells)
  - Historical return flow obligations from transferred water rights
- Replacement sources:
  - Lagged accretions from groundwater recharge
  - Direct flow and storage releases and exchanges of transferred consumptive use



# Project Features



# Example Monthly Net Stream Depletion



# Recharge Ponds

## Options:

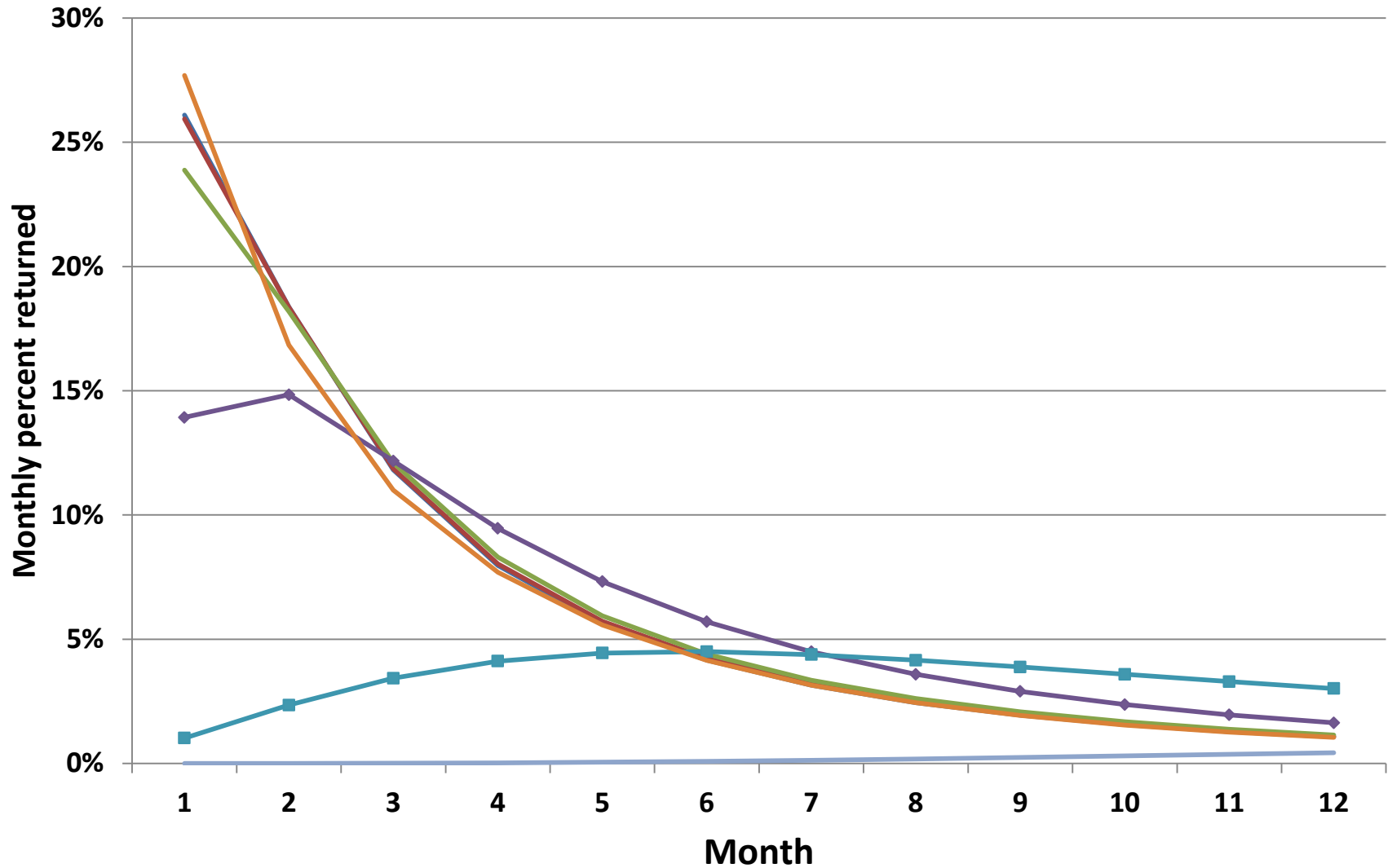
- Upper recharge ponds to meet physical supply
- Lower recharge ponds for augmentation



## Modeled:

- Water sent to upper recharge ponds when pumping exceeds groundwater replacement rates
  - Distribution based on volume and timing (URFs)
- Excess water in storage reservoir sent to lower ponds
  - Distribution based on volume and timing (URFs)
- Lagged accretions from all ponds used as augmentation sources
- Individual pond accretions may accrue to up to 3 basins

# Lower Recharge Ponds Unit Response Functions

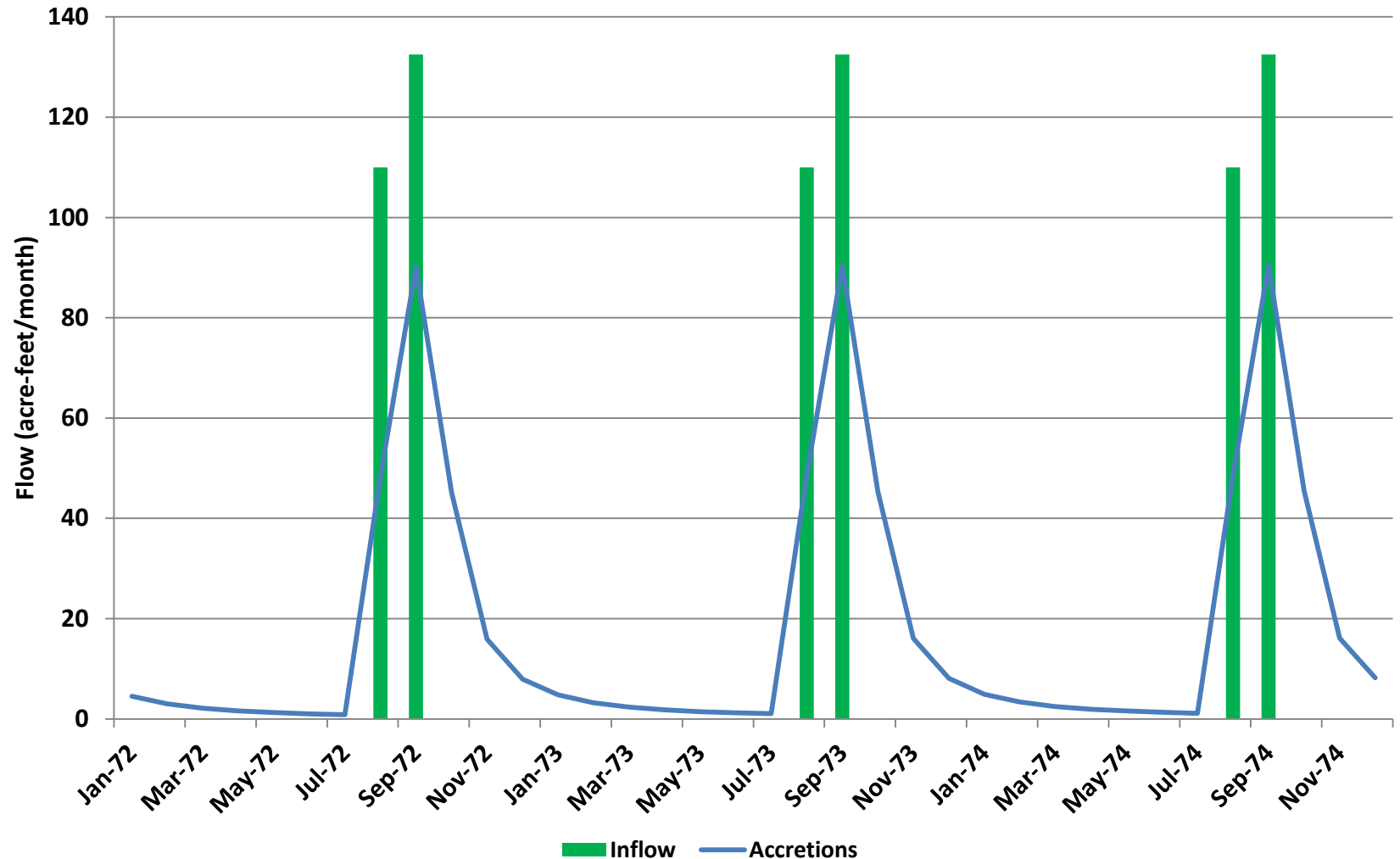


# Recharge Pond

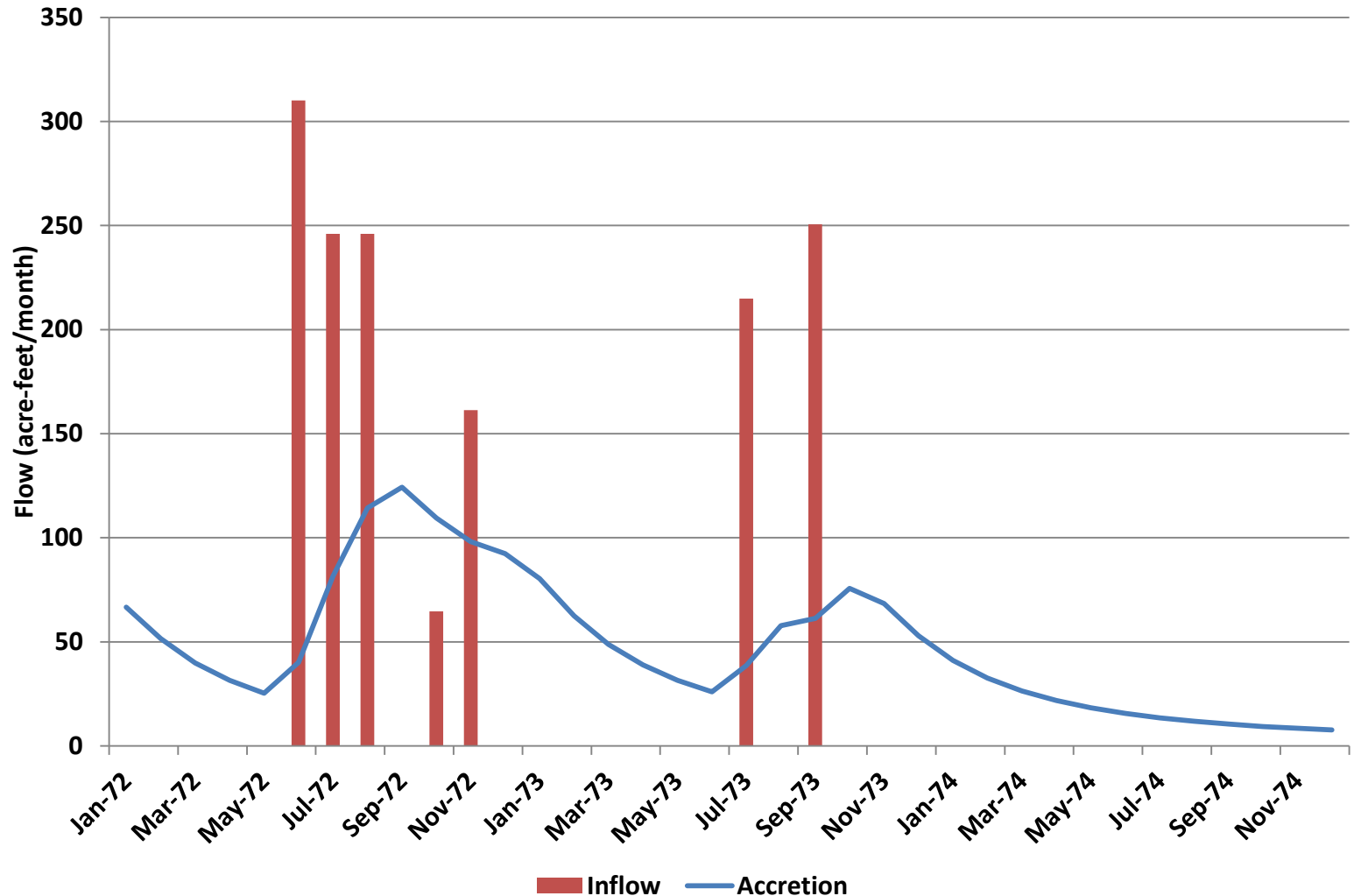
Recharge Ponds modeled as reservoirs  
Infiltration rates vary by pond, by month  
Infiltration calculated using seepage slot  
Seepage\*URF= accretion credit  
Evaporation accounting per decrees  
Area-elevation-volume tables required modification based on flat bottoms



# Recharge Pond 1 Inflow and Accretions

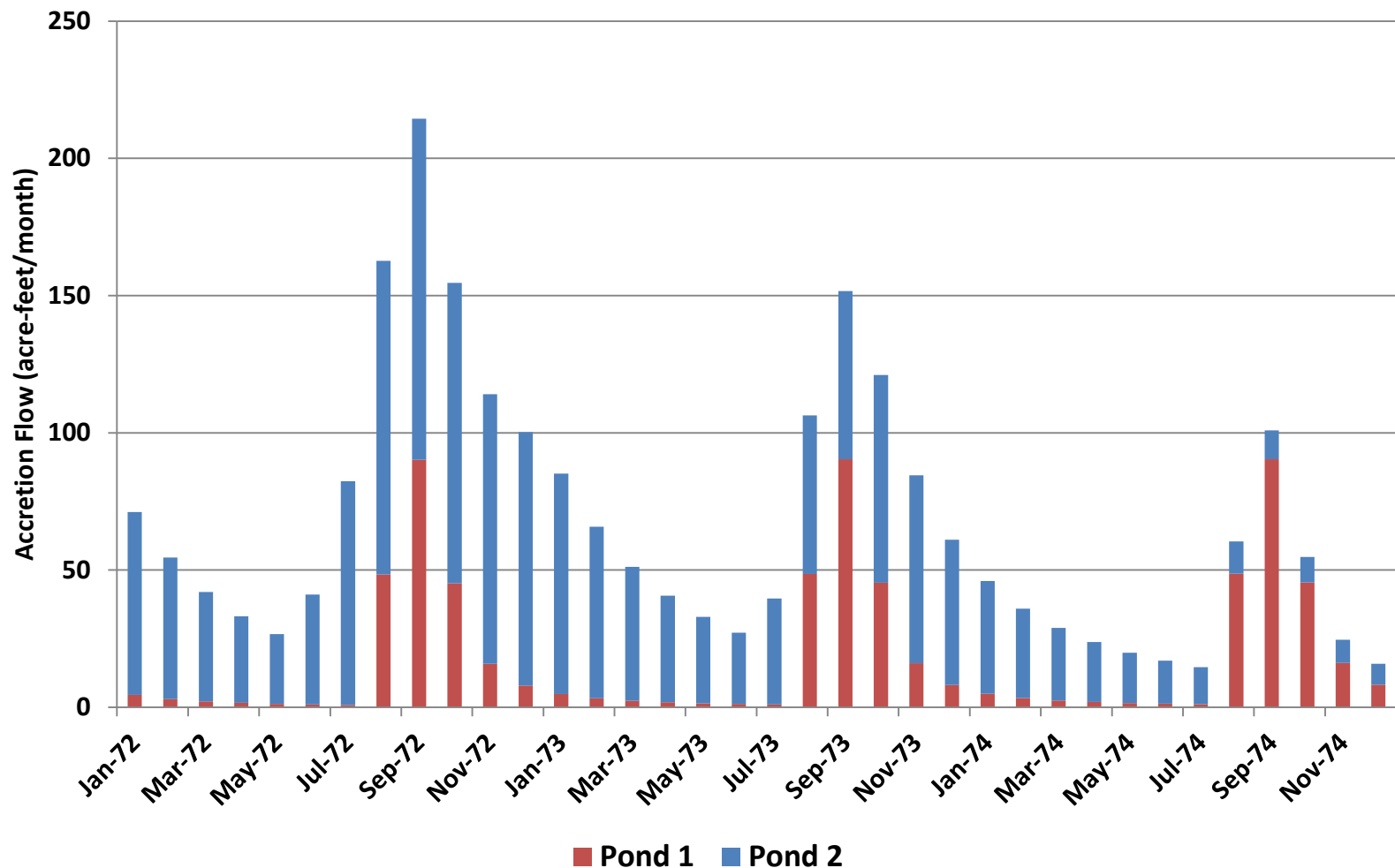


# Recharge Pond 2 Inflow and Accretions





# Recharge Pond 2 Inflow and Accretions



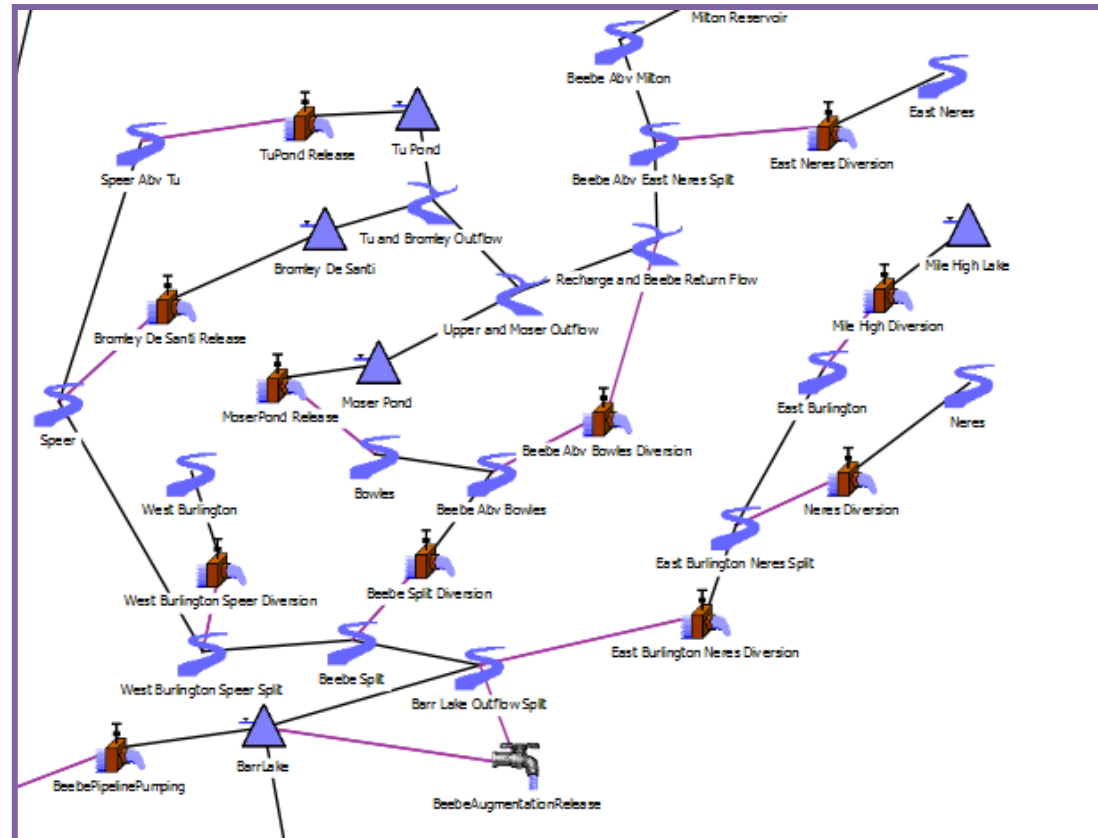
# Exchanges

- Designated accounting reaches of the South Platte River
- Decreed exchanges rules
  - Priority
  - Live flow in all reaches
  - Flow rate and volumetric limits
- Infrastructure capacities
  - Diversion
  - Storage
  - Recharge



# RiverWare Model Features

- Groundwater depletions and accretions derived from MODFLOW and input at URFs
- Recharge Ponds modeled as reservoirs
- Canals modeled as river reaches
- Exchange potential computed externally
- South Platte River and tributaries are not explicitly modeled
  - Input as data tables to provide exchange potential and reach-by-reach credit and obligation information



# Next Steps

- Incorporate exchanges and decreed accounting reaches
- Multiple infrastructure and operations scenarios
  - Timing and location of recharge
  - Meet return flow obligations from various sources
  - Augment pumping depletions
  - Firming water rights via surface water storage or lagged groundwater accretions
  - Minimize surface storage
- Develop operational scenarios to minimize permanent dry-up of historically irrigated lands
  - Use of surplus supplies or new junior recharge rights
  - Regulate supplies via groundwater recharge
  - Provide for interruptible supplies for irrigation

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