

# RECLAMATION

*Managing Water in the West*

## Hood River Basin Study

Groundwater Modeling

20May2013



U.S. Department of the Interior  
Bureau of Reclamation

# Outline

- Purpose and objectives
- Modeling details
- Steady state (SS) model calibration
- Proposed scenario definitions

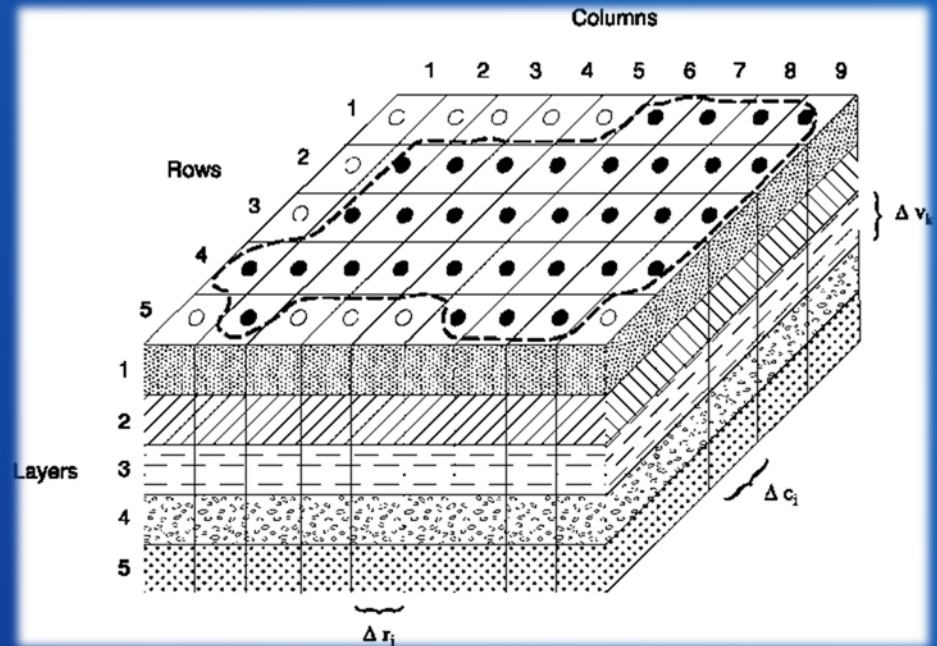
# Purpose & Objectives

- Understand the sources and rates of groundwater recharge and the geologic controls on its movement and discharge as it relates to the overall hydrology of the basin and groundwater contributions to streams and aquatic ecosystems.
  
- The study addresses the following questions:
  1. How will hydrologic changes due to climate change impact groundwater conditions?
  2. How will new development impact groundwater conditions in the basin including discharge to streams?
  3. Is managed recharge a viable option for improving stream flow?
  4. Can the basin aquifer be used for aquifer storage and recovery?

# Methods

## ➤ Groundwater modeling

- MODFLOW
- Steady state
- Transient



[http://upload.wikimedia.org/wikipedia/commons/thumb/8/80/MODFLOW\\_3D\\_grid.png/640px-MODFLOW\\_3D\\_grid.png](http://upload.wikimedia.org/wikipedia/commons/thumb/8/80/MODFLOW_3D_grid.png/640px-MODFLOW_3D_grid.png)

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# Modeling Approach



- Single layer MODFLOW model calibrated to limited observation data
- Adopt assumptions made in studies for neighboring basins for missing datasets

# Recharge



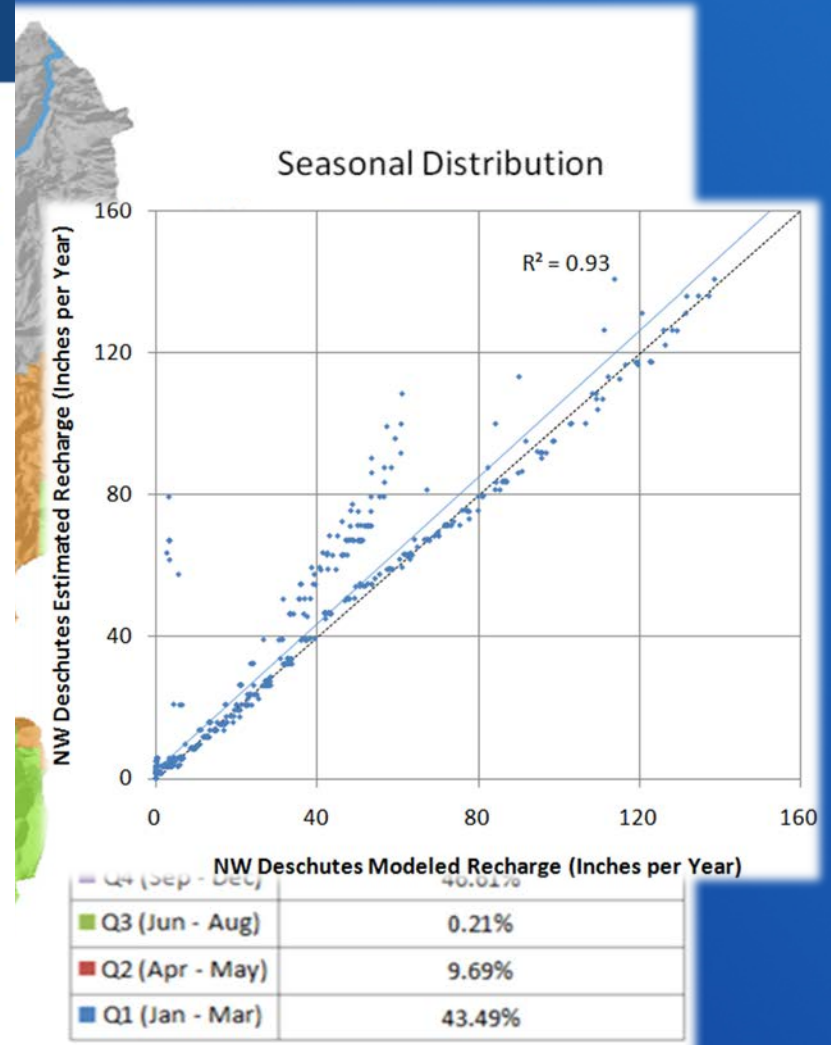
Groundwater Resources Program

## Hydrogeologic Framework and Hydrologic Budget Components of the Columbia Plateau Regional Aquifer System, Washington, Oregon, and Idaho



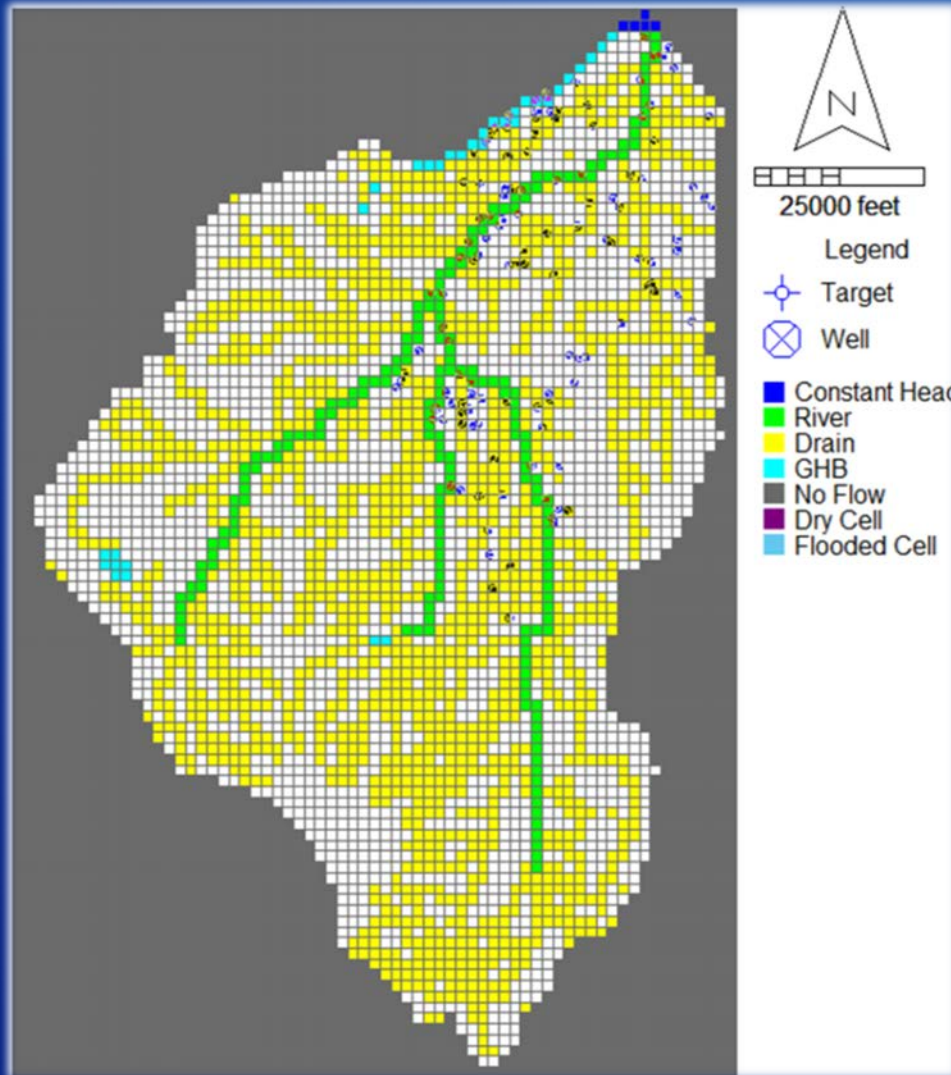
Scientific Investigations Report 2011-5124

U.S. Department of the Interior  
U.S. Geological Survey



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# Model Details



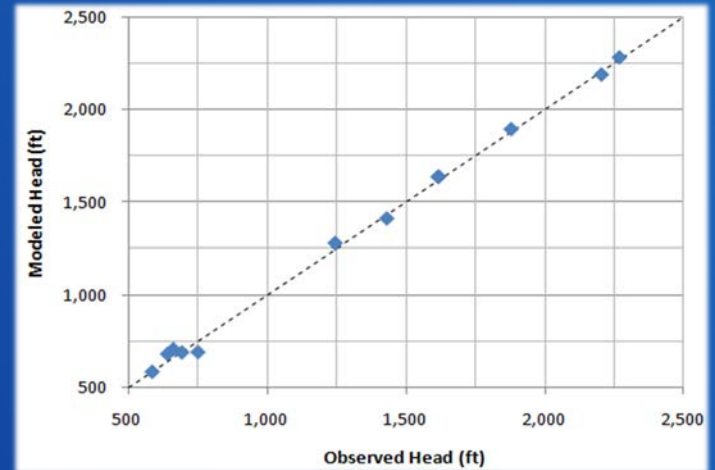
➤ The following are represented in the model:

- Columbia River
- Hood River
- Creeks and streams
- Mapped springs
- Lakes
- Wells

# SS Model Calibration

➤ Model calibrated to match well heads and approximated river baseflows

- Observed vs. Modeled average well heads



- Tucker gage baseflow estimate:

Observed natural flow minimum = 400cfs

Observed average natural flow = 750cfs

Modeled river and spring gains above the Tucker gage = 610cfs

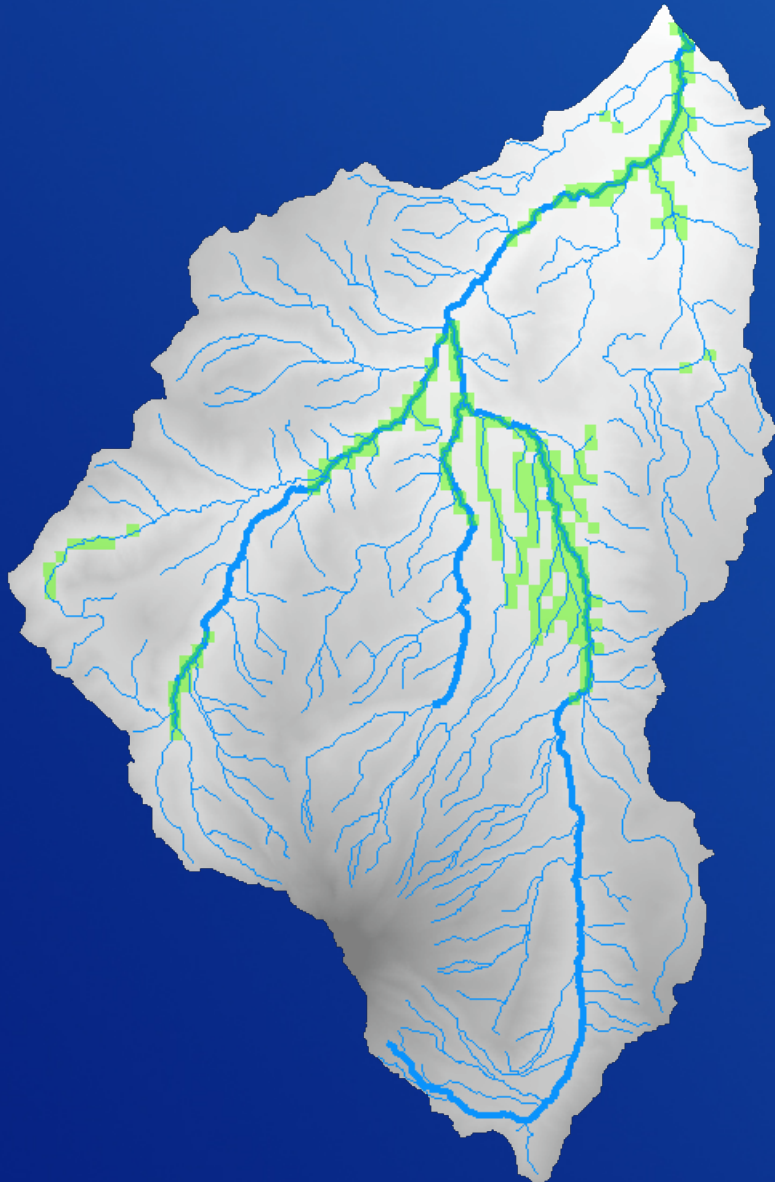


# SS Modeled Heads



- Steady state well heads shown
- Assumes Middle Mountain wells tap a perched aquifer
- Lack of Upper Valley observed data prevent accurate calibration of heads in this area

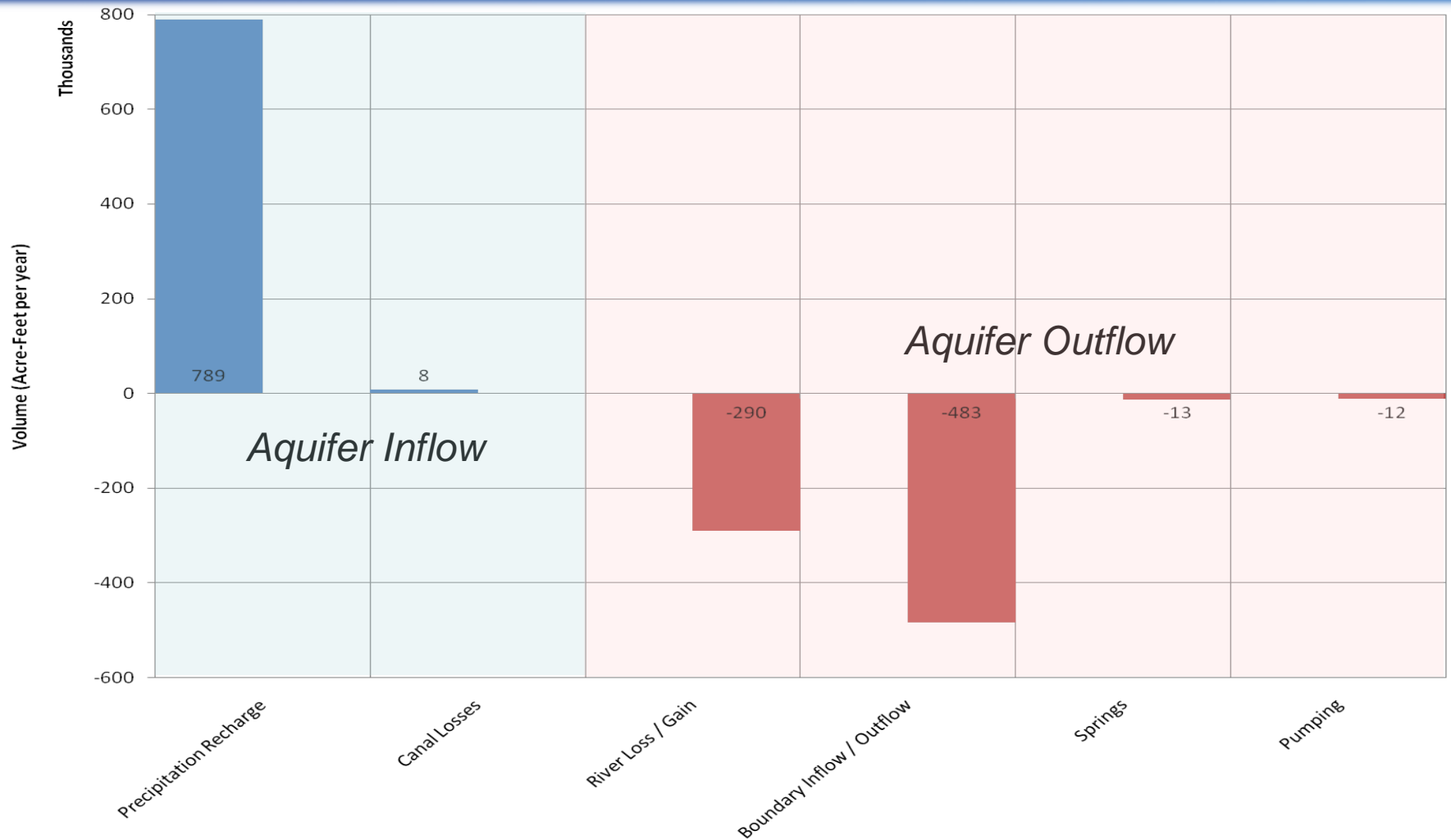
# SS Modeled River Gains



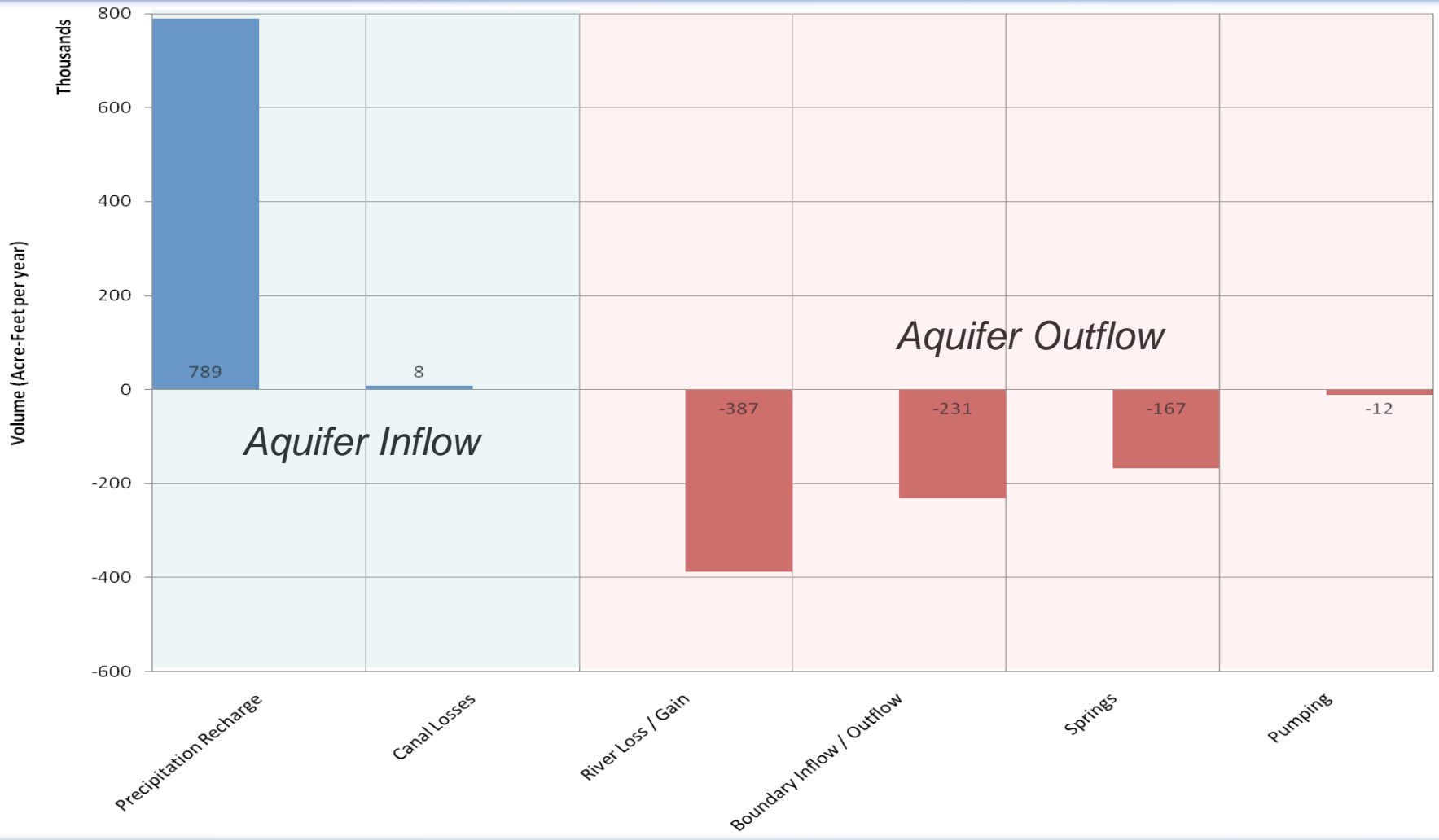
➤ Gaining reaches and streams shown

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# Preliminary Water Budget



# SS Modeled Water Budget

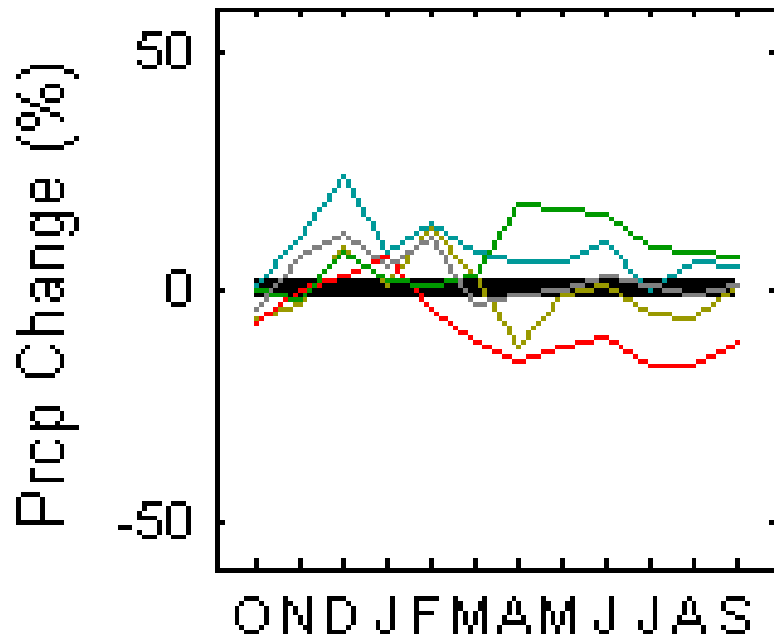


# Scenario Definition

- Scenarios will be catered to answer the following questions:
  1. How will hydrologic changes due to climate change impact groundwater conditions?
  2. How will new development impact groundwater conditions in the basin including discharge to streams?
  3. Is managed recharge a viable option for improving stream flow?
  4. Can the basin aquifer be used for aquifer storage and recovery?

# Climate Change

- How will hydrologic changes due to climate change impact groundwater conditions?
  - Adjust GW recharge based on projected climate change scenarios (CMIP3) relating to temperature and precipitation
  - Can be addressed by the SS model



colors = climate change, 1950-1999 to 2030-2059 (gold, red, blue, green, gray = drier-less warming, drier-more warming, wetter-more warming, wetter-less warming, middle)

[http://gdo-dcp.ucllnl.org/downscaled\\_cmip\\_projections/techmemo/downscaled\\_climate.pdf](http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/techmemo/downscaled_climate.pdf)

- Projected 10, 50, and 90 percentile values for climate change informed precipitation and temperature
- Recalculate precipitation and recharge based on projected change factors

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# Scenario: New Development

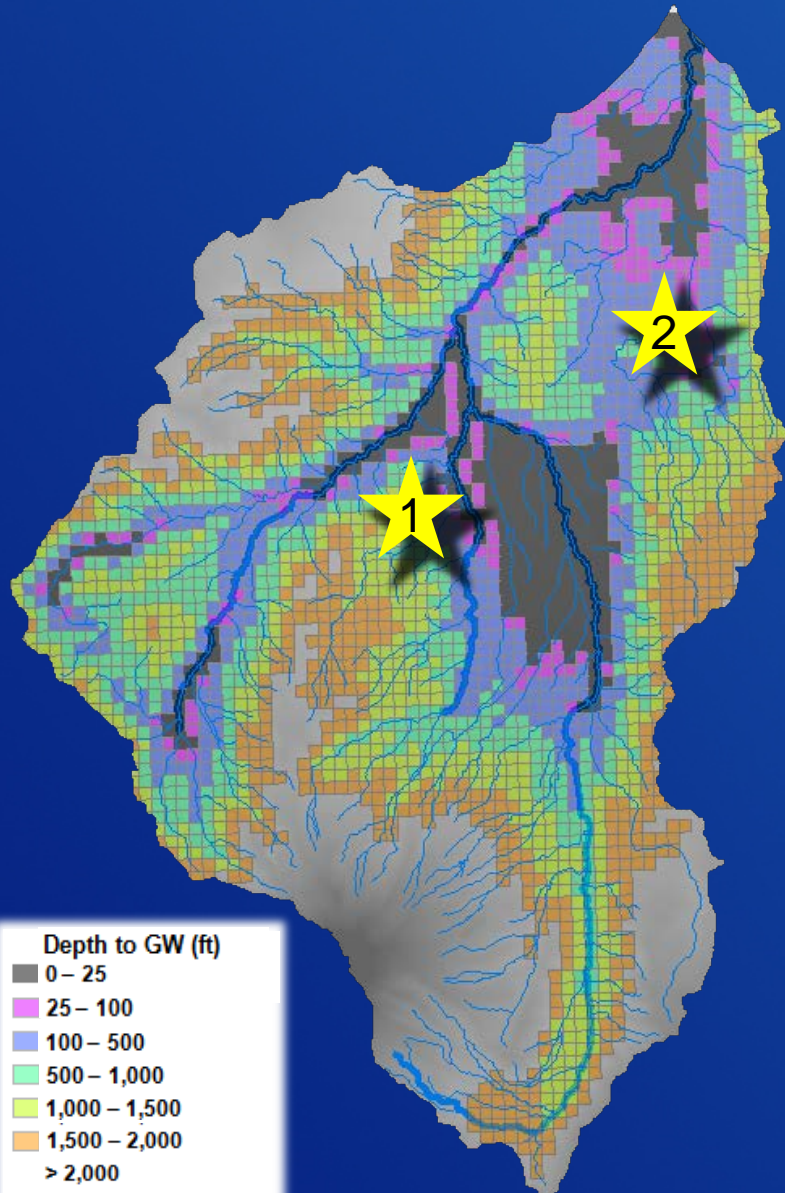
➤ How will new development impact groundwater conditions in the basin including discharge to streams?

- Increase pumping out of existing pumps and replicate the GW demand growth that was seen in the neighboring Mosier basin
- Can be addressed by the SS model

Decade	Total	M&D	M&D %Increase	Irrig	Irrig %Increase
1960s	250	75	-	175	-
1980s	725	125	167	600	343
2000s	950	175	233	775	443

> Pumping use in AF/year

# Scenario: Aquifer Recharge



- Can the basin aquifer be used for aquifer storage and recovery, and is managed recharge a viable option for improving streamflow?
  - Inject water at locations where there is available space and analyze behavior

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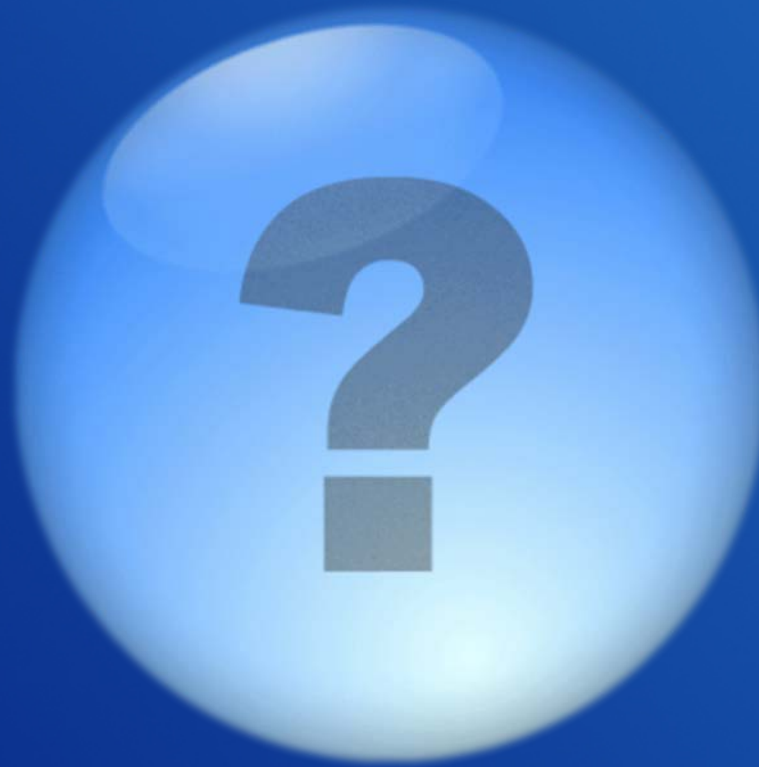
# Ongoing Efforts

- Model development and calibration
  - USGS collaboration
  - Transient model calibration
- Scenario definition and modeling
- Documentation

# Projected Schedule

Task	Mar-13	Apr-13	May-13	Jun-13
Model Development	■			
Model Calibration & Validation		■		
Scenario Modeling			■	

# Questions



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