Treasure Valley Groundwater Flow Model Development Project

Presented by Sean Vincent
June 7, 2017

Talking Points

- Background
- Developments during 2016
- Project overview
  - Scope of work
  - Timeline
  - Budget

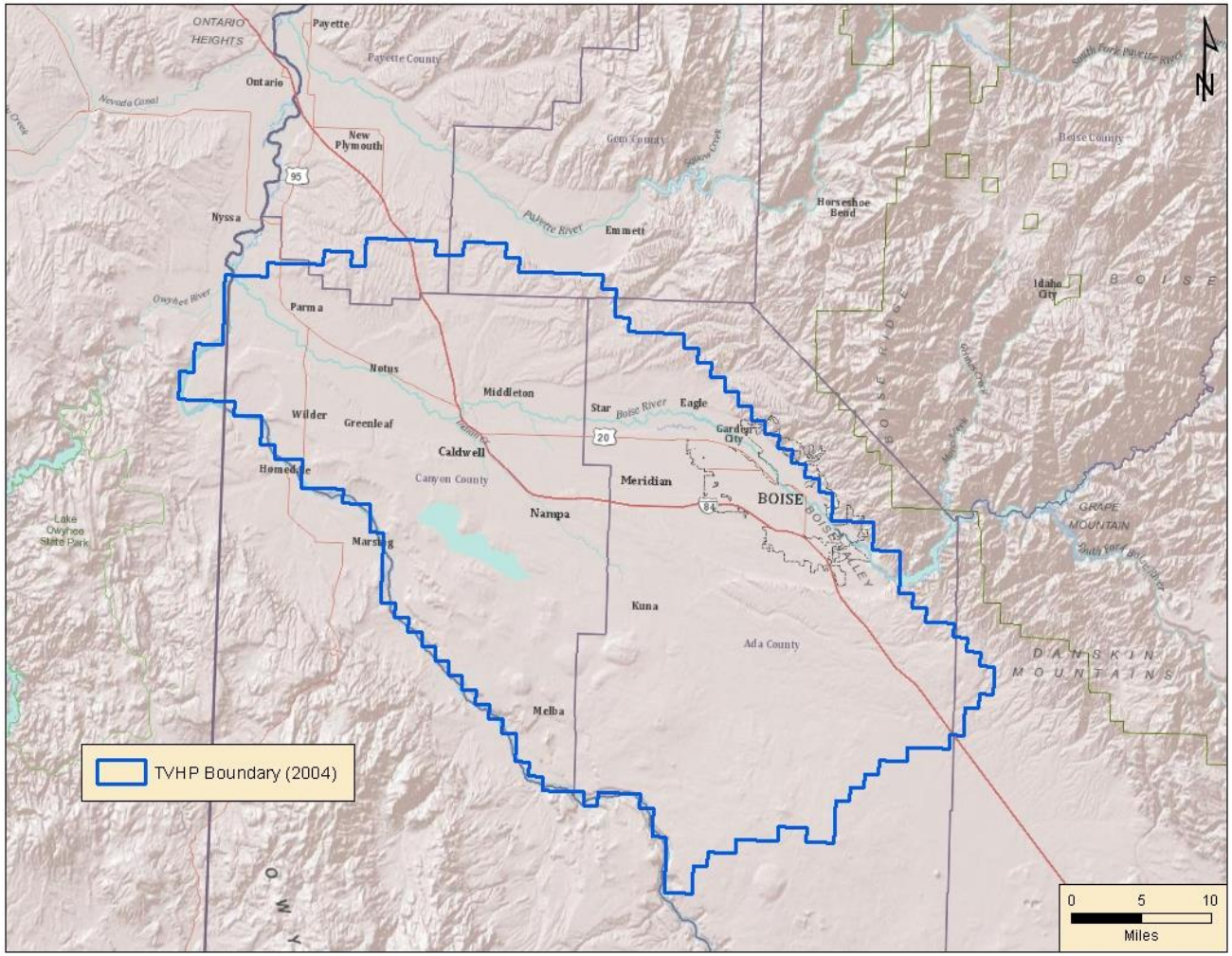
Background

- Cosgrove review of 7 models for the TV CAMP Program (2010)
  - Recommended using steady-state TVHP model (Petrich, 2004) and making modifications
    - Fill data gaps
    - Attempt transient calibration
    - Extend model boundaries to include areas of proposed development
- USBR initiated project to develop pseudo-transient, hydro-economic model
- Decided to use USBR model as starting point
- USBR agreed to work w/ IDWR staff on model expansion

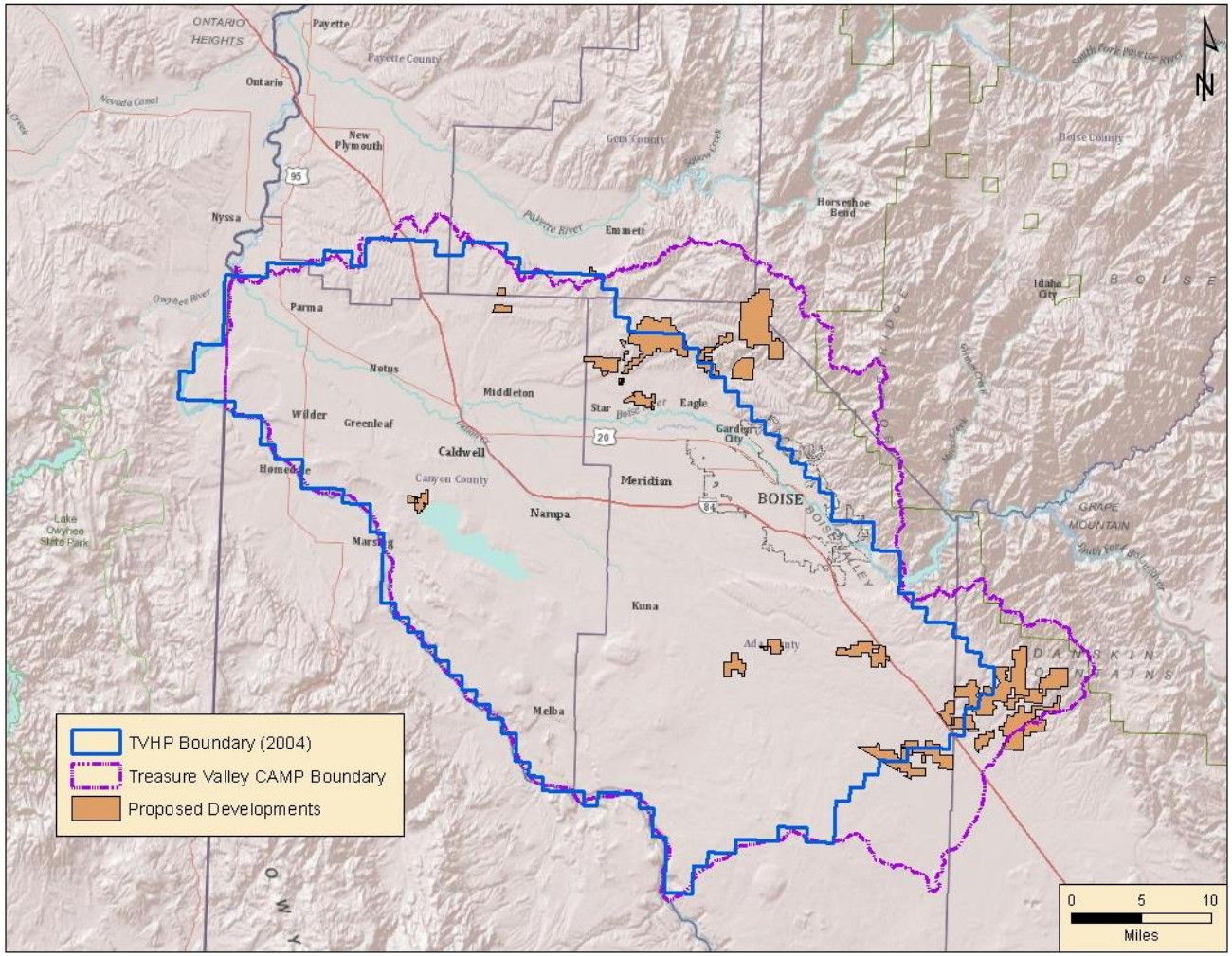
Background (cont'd)

- TV MTAC meeting held November 2012
- TV CAMP submittal put on indefinite hold in November 2012
- Staff assigned to work on IDWR/USGS model of WRV aquifer system
- USBR published final report for updated TVHP model in July 2013

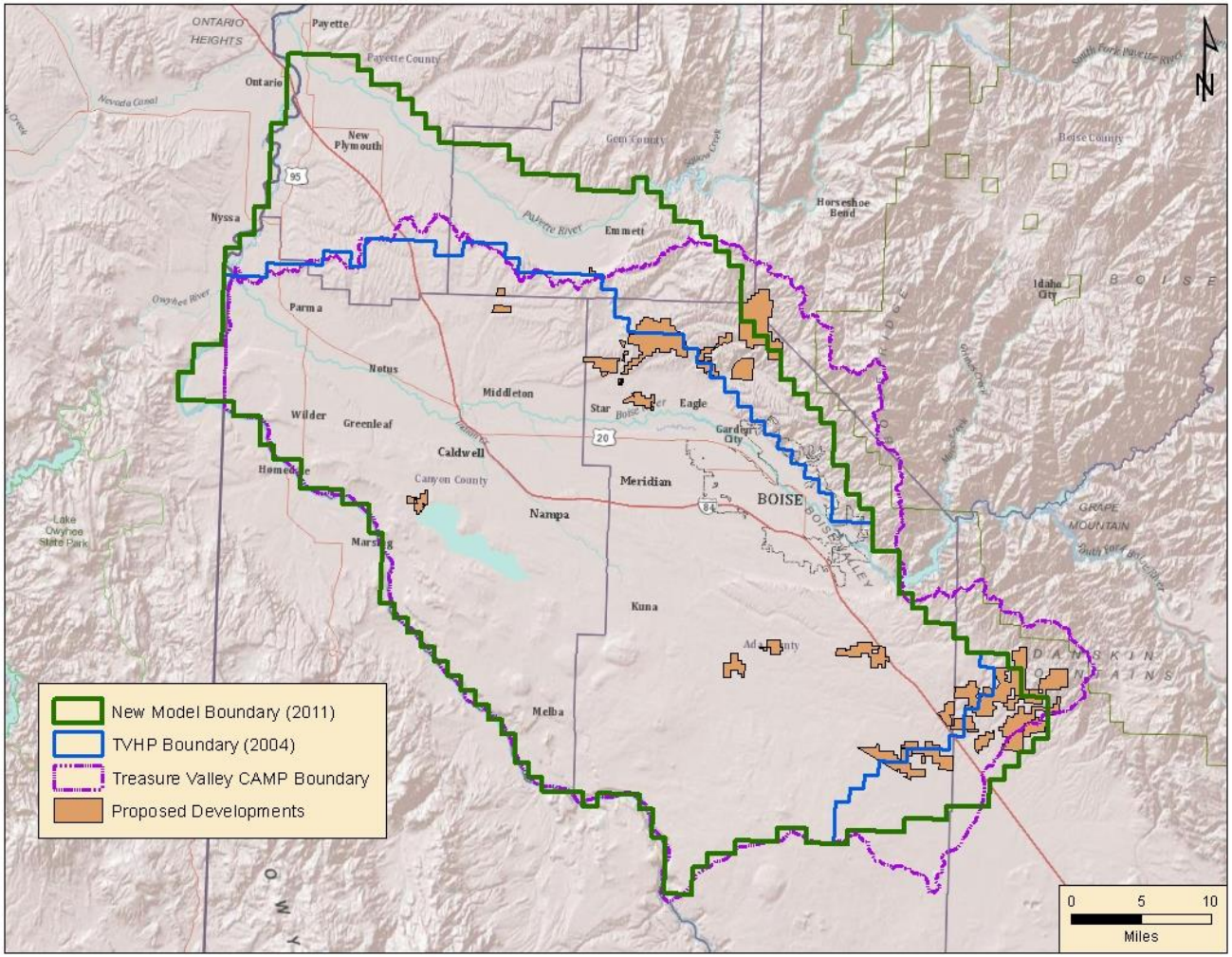
TVHP Model Boundary



TV CAMP Boundary



USBR Model Boundary



Developments during 2016

- Concurrent Resolution 137 adopted by Senate on 2/16
  - Included directive for model development
- Presentation at IWRB Work Session on 3/17
- IDWR review of USBR model on 5/12
- IWRB approved project and funding on 5/20
- Developed scope of work, timeline, and budget & JFA between IWRB and USGS signed 9/21

Senate Concurrent Resolution 137

"A CONCURRENT RESOLUTION STATING FINDINGS OF THE LEGISLATURE AND REQUESTING THAT THE IDAHO WATER RESOURCE BOARD ADDRESS STATEWIDE AQUIFER STABILIZATION AND SUSTAINABILITY STUDIES…"

"BE IT FURTHER RESOLVED that the Idaho Water Resource Board conduct aquifer recharge studies and develop a ground water model, with all necessary measurement networks, for the Treasure Valley Aquifer." (emphasis added)

Background (cont'd)

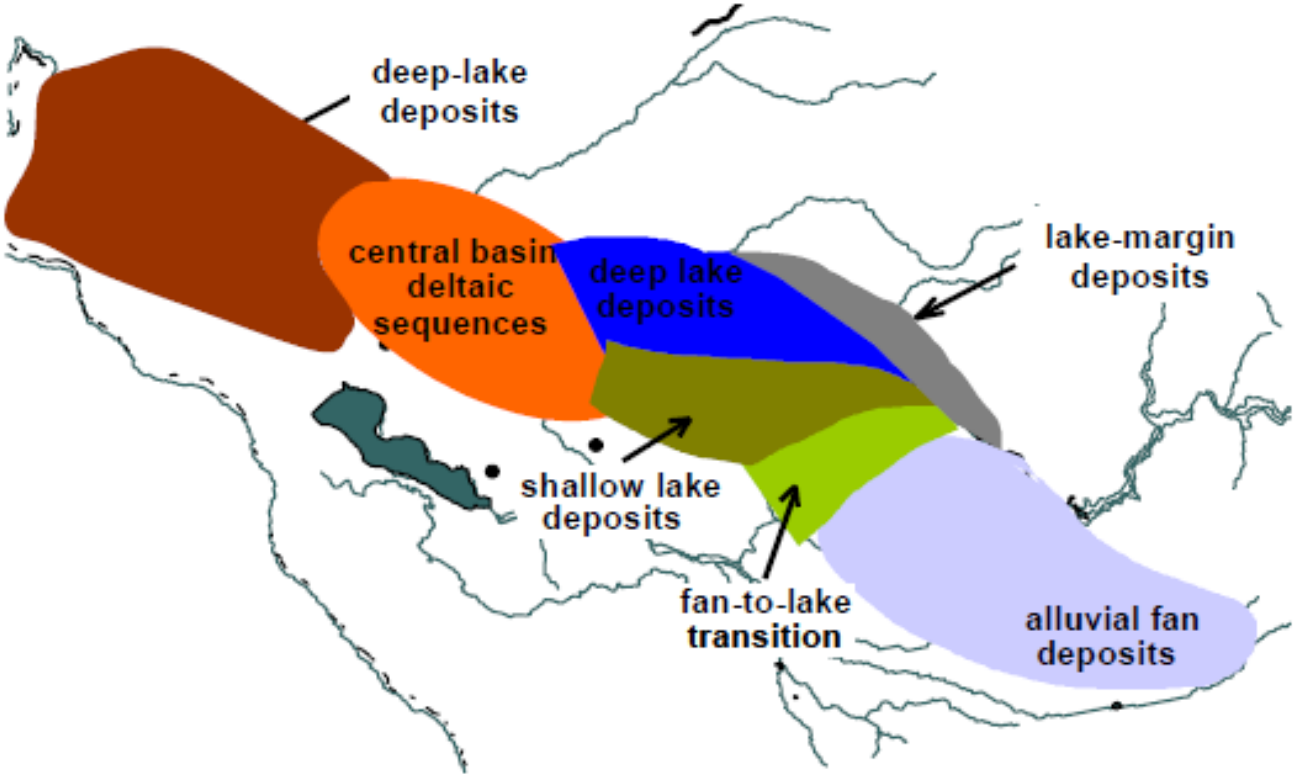
- Expectation setting at IWRB Work Session
  - Technical factors may impede progress
    - Data gaps
    - Geologic complexity
  - Non-technical factors also
    - Incomplete list of modeling objectives
    - Need to involve stakeholders in model development

Complexity

"The Treasure Valley region of southwestern Idaho has a complex history of lacustrine and alluvial deposition that influences regional ground water movement. In general, basin sedimentary deposits grade from coarser, more permeable sediments near the Boise Front to finer, less permeable sediments at the distal end of the basin…These regional trends are interrupted by a complex arrangement of highly permeable deposits associated with paleo-river channels, river deltas, alluvial fans, and other features characteristic of a dynamic lacustrine history. Productive units are often surrounded by lower permeability deep-lake deposits, which, in some cases, limit interaction between productive units. The complexity of the ground water environment is well documented…

…Basin downwarping and an associated downslope trend in sediment deposition contribute to steeply dipping sedimentary deposits along the northern basin margin, which may cause deeper aquifer units to pinch out at depth (Wood, 1997). An erosional unconformity associated with changing lake levels in Pliocene Lake Idaho truncates down-dipping units along the basin margin near Boise (Wood, 1997; Squires et al., 1992). The relationship between ground water above the unconformity and ground water in the underlying delta deposits, while unclear, is thought to be significant … In addition to complexity inherent in deposition and erosion, a series of major faults bisect the stratigraphic section along the northern basin margin. The hydrologic impact of these faults is poorly understood, but they are likely to be an important influence on ground water flow in Boise-area aquifers." (emphasis added, Hutchings and Petrich, 2002)

Depositional Environments



From Hutchings and Petrich, 2002 (after Squires et al., 1992 and Wood, 1994)

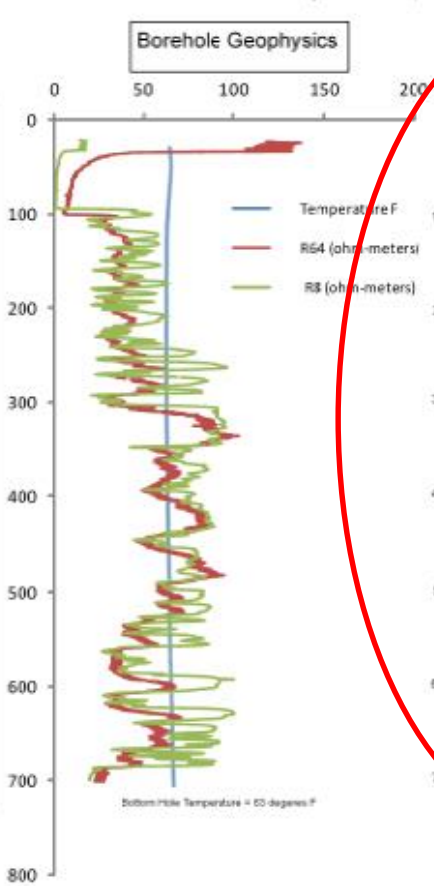
Lithologic Log

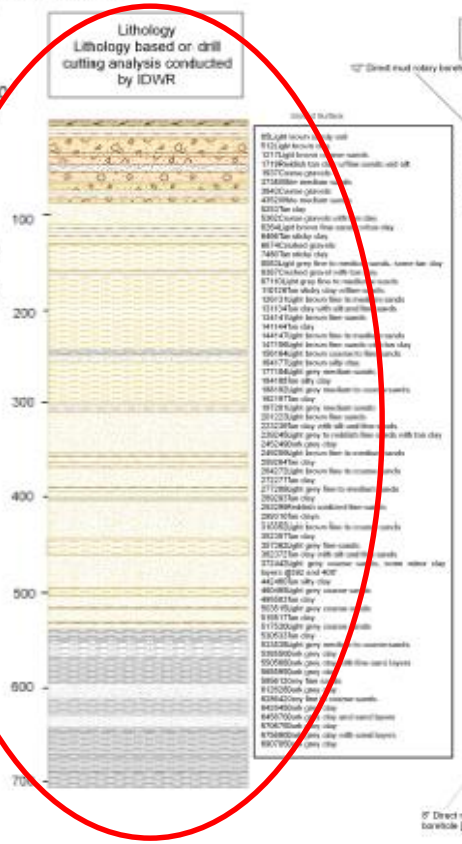
North Ada County Monitoring Well #6
T. 1 N., R. 1W.. Section 1

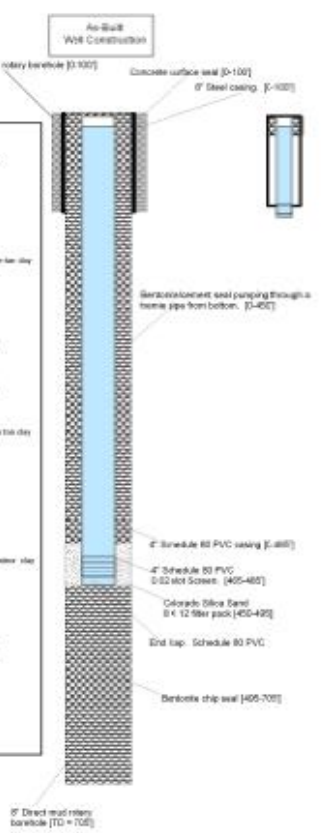
April 2011

Water Chemistry

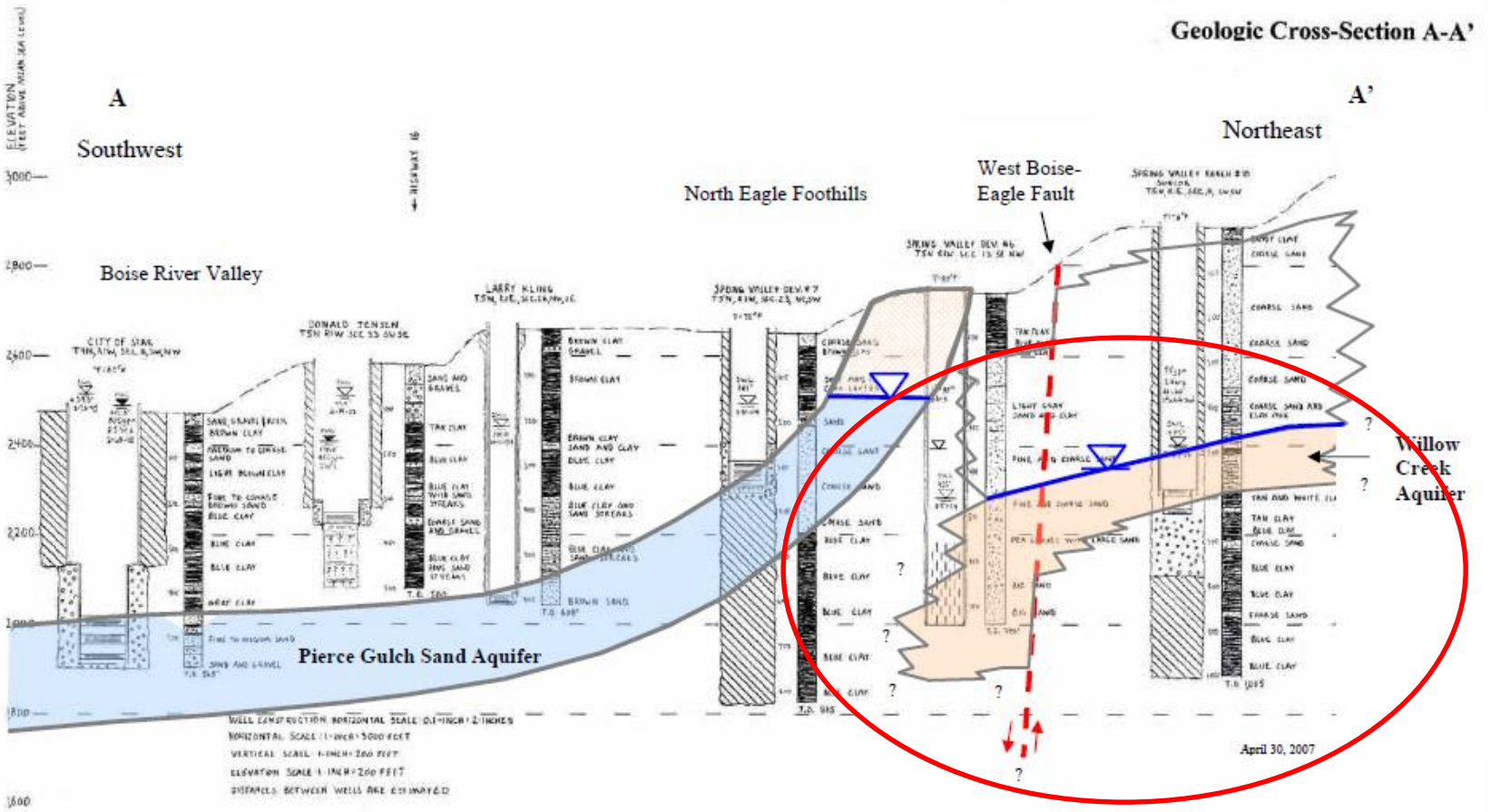
Analyte (mg/L unless otherwise noted)	Shallow	Deep
Alkalinity as CaCO3	260	137
Ammonia	<0.010	<0.010
Arsenic	0.011	0.006
Calcium as CaCO3	61	38
Chloride	4.07	4.85
Conductivity (uS/cm)	418	282
Fluoride	0.487	0.49
Hardness	200	120
Iron	<0.01	0.018
Iron (dissolved/filtered)	<0.010	<0.010
Magnesium	12	6.9
Manganese (dissolved)	<0.002	0.01
Nitrate as N	2.19	0.702
Nitrite as N	<0.18	<0.18
Orthophosphate as P	0.153	0.22
pH (SU)	7.31	7.18
Potassium	2.9	2
Silica	45	35
Sodium	38	20
Sulfate	9.02	22.1
Sulfide	<0.10	<0.10
Total Dissolved Solids	320	200
Total Kjeldahl Nitrogen	0.18	0.2
Total Organic Carbon	0.69	0.19
Field Temperature (C)	14.6	17.1
Field Conductivity (uS/cm)	482	312
Field pH (SU)	7.45	7.27







Geologic Cross-Section



From Squires et al., 2007

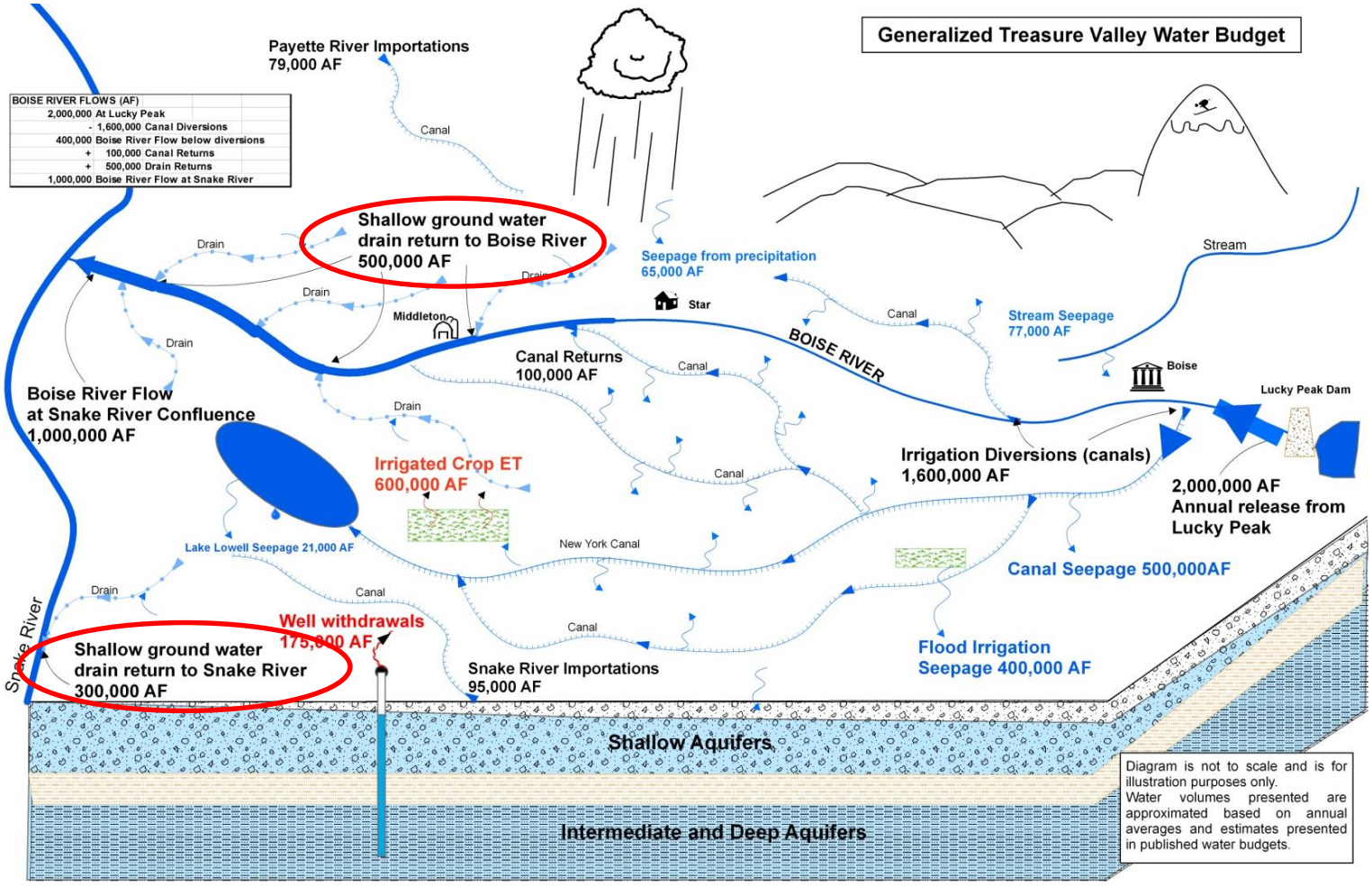
Staff Review – Key Findings

- TVHP/USBR model layering (4 layers w/ uniform thicknesses) should be revisited and possibly revised based upon review of geology and water level data

- Calibration of pseudo-transient model likely not rigorous enough for planning & water management purposes
  - Different modeling objectives → calibration focused on the upper model layer

- Inadequate measurement data available to define spatial and temporal distributions of aquifer discharge

Water Budget



Drains

E. Hartley

S. Middleton

Scope of Work - General

- Four, overlapping work phases to accommodate synchronous data collection and conceptual/numerical model development

- Available data support a 30-year transient calibration period (1986-2015)

- Model development primarily by USGS w/ task-specific support from U of I Kimberly and IWRRI
  - Independent, unbiased 3rd parties w/ histories of successful, collaborative model development projects w/ IDWR

USGS/IDWR Final Reports

SVRP

USGS
science for a changing world

Prepared in cooperation with the
IDAHO DEPARTMENT OF WATER RESOURCES
WASHINGTON STATE DEPARTMENT OF ECOLOGY
UNIVERSITY OF IDAHO
WASHINGTON STATE UNIVERSITY

Ground-Water Flow Model for the Spokane Valley-Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho

Scientific Investigations Report 2007–5044

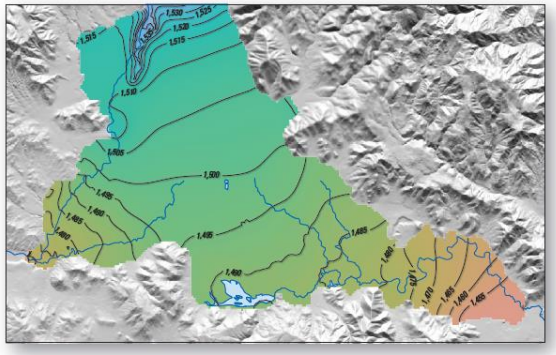
U.S. Department of the Interior
U.S. Geological Survey

WRV

USGS
science for a changing world

Prepared in cooperation with the Idaho Department of Water Resources

Groundwater-Flow Model for the Wood River Valley Aquifer System, South-Central Idaho



Scientific Investigations Report 2016–5080

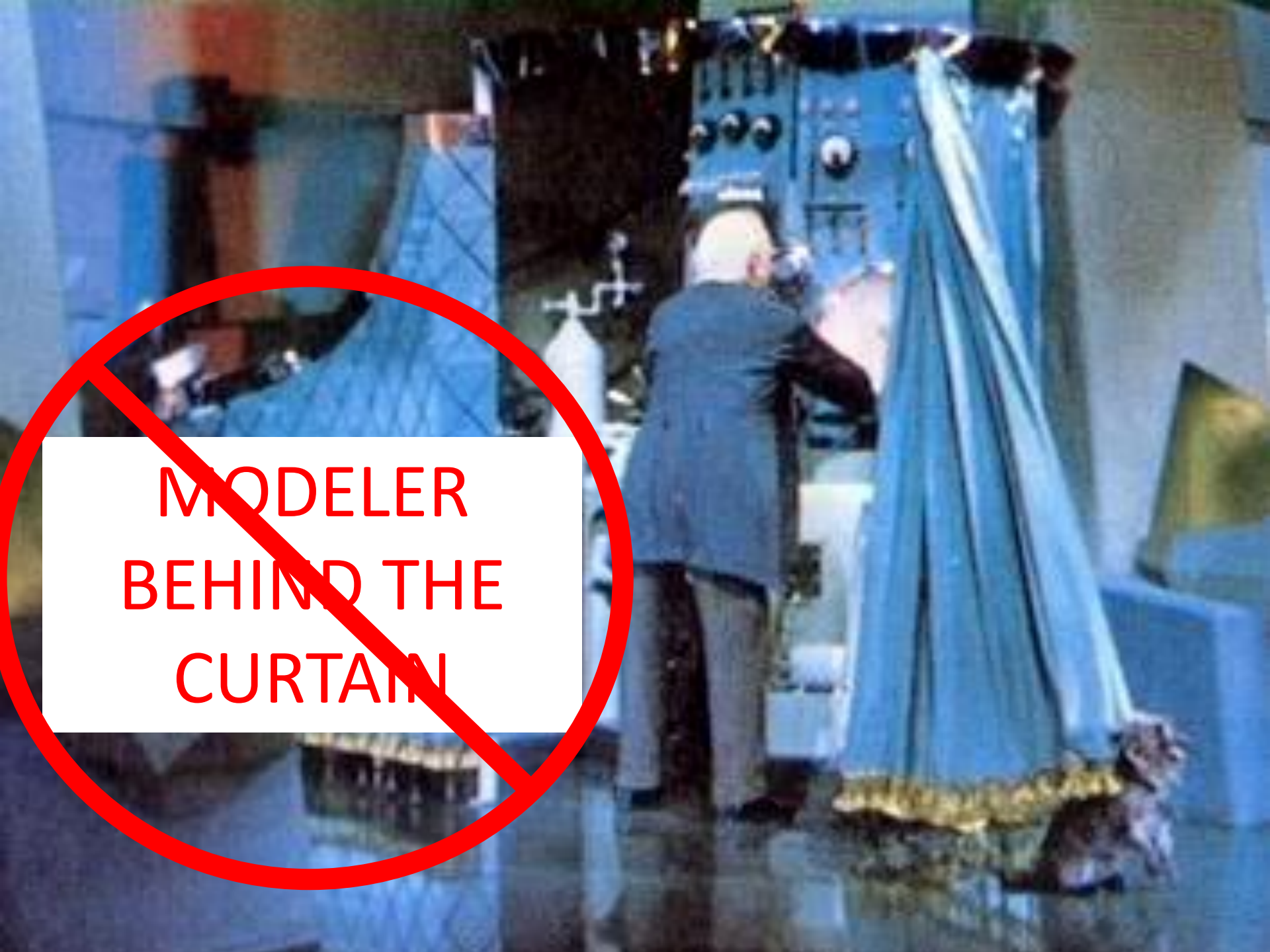
U.S. Department of the Interior
U.S. Geological Survey

Scope of Work - Phase 1

- Project Initiation
  - Scope of work + contracting
  - Publish USGS Fact Sheet describing the project
  - Establish Modeling Technical Advisory Committee (MTAC)
    - Serves as vehicle for stakeholder input & provides for transparency

Transparency

- MTAC meetings
- Public domain model and software (MODFLOW)
- Documentation
  - Fact sheet, design documents, USGS scientific report, etc.
- IDWR website to disseminate data, documents, model files, etc. (http://www.idwr.idaho.gov/water-data/projects/treasure-valley/)

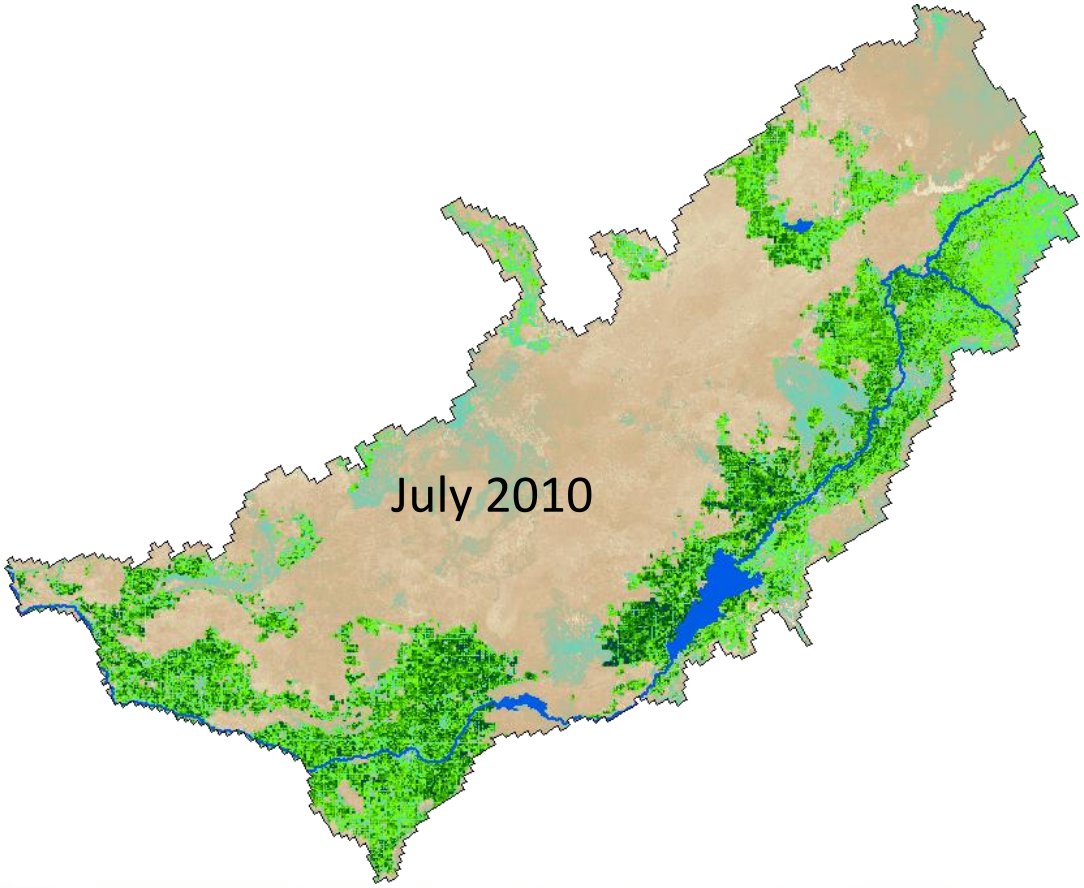

MODELER
BEHIND THE
CURTAIN

Scope of Work - Phase 2

- Data gathering/processing
  - Establish year-round drain gaging stations in lower valley
    - Survey drain, wellhead, and ground surface elevations
    - Correlate well water levels with drain discharge
  - Compile and review geology and water level data
    - Contact municipal water providers for data from deep aquifers
    - Develop layer-specific well log and water level databases
    - Determine data gaps
  - Quantify evapotranspiration (ET) using METRIC for 8 years and interpolate for intervening years using ET Idaho

METRIC ET

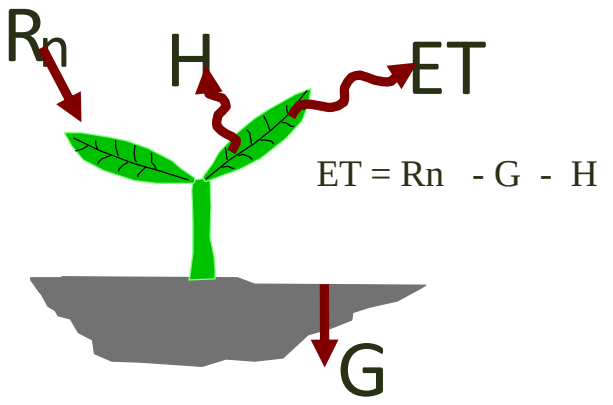
Mapping Evapotranspiration at High Resolution w/ Internalized Calibration



METRIC ET is derived from remote sensing (satellite) data.

ET is calculated as a "residual" of the energy balance

The energy balance includes all major sources (R_n) and consumers (ET, G, H) of energy



Landsat 8

Scope of Work (cont'd)

- Phase 3 – Develop hydrogeologic framework, conceptual water budget, and conceptual model
  - Analyze drillers' logs and geophysical data
  - Construct potentiometric surface maps
  - Evaluate aquifer boundary conditions
  - Develop conceptual water budget
- Phase 4 - Groundwater flow model
  - Evaluate/revise model boundaries and layering
  - Reevaluate uniform 2-month lag time for recharge
  - Develop monthly water budget for 30-yr calibration period
  - Construct transient model in MODFLOW and calibrate w/ PEST
  - Run scenarios

Project Timeline

- ~5 years to complete project
  - Phase 1 project initiation (years 0 – 0.5)
  - Phase 2 data collection = (years 0 – 5)
  - Phase 3 hydrogeologic framework (years 0 - 2.5)
  - Phase 4 model development (years 1 – 5)

Budget

- $500K budgeted for FY 2017
- Total cost to State of Idaho for 5-year project ~ $2.5 million
- >60% of total cost = data collection/processing


END