

OREGON

Malheur
National Forest

Investigation of the Groundwater System of the Harney Basin, Oregon

Stephen B. Gingerich

For the
Greater Harney Valley Groundwater Study
Advisory Committee
October 20, 2016

Burns, OR

Study Objectives

- Develop a quantitative conceptual understanding of the groundwater-flow system of the Harney Basin using field data and fundamental hydrologic principles.
- Develop tools to test the conceptualization of the groundwater-flow system and accurately simulate its response to current conditions and proposed groundwater development.
- Describe the groundwater-flow system through reports and presentations.

Study Information

- 6-yr cooperative study using State and Federal money
- Work elements will be shared by USGS and OWRD
- Stakeholder involvement critical to long-term success of the study for proper aquifer management
- Final reports will be peer-reviewed USGS publications
- USGS modeling reports will not recommend any specific course of action but can describe the impacts of various scenarios that have been designed with stakeholder input

Some questions to be addressed

- How much water enters the Harney Basin (recharge)?
- How much water leaves the Harney Basin (discharge)?
- How might water-level declines progress in the future?
- How can water-level declines be managed?
- How does pumping affect surface-water discharge?
- To what degree are different parts of the basin hydrologically connected?

Study Approach

- Compile, review, and analyze existing hydrologic data
- Develop an understanding of the groundwater-flow system
- Collect additional hydrologic data in areas with gaps
- Develop hydrologic budget to estimate water flow in and out of the system
- Develop a numerical groundwater flow model to test our understanding of the flow system and evaluate management options

Compile existing hydrologic data

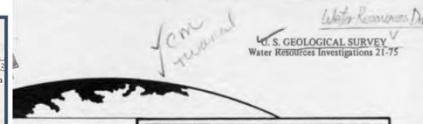
Oregon Water Resources Department
Harney County Observation Wells

Return to Search Page

- State Observation Wells
- HARN 9
- HARN 10
- HARN 75
- HARN 107
- HARN 130
- HARN 147
- HARN 198



Hydrology of Malheur Lake, Harney County, southeastern Oregon



USGS and OWRD databases

UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Jenkins, Secretary
W. A. SHERIDAN, Director

Water-Supply Paper 841

GEOLOGY

Published hydrology reports

HARNEY BASIN, OREGON

BY
A. M. PIPER, T. W. ROBINSON, and
C. F. PARK, Jr.

Driller's reports

USGS
National Water Information System: Mapper

Prepared in cooperation with the
OREGON AGRICULTURAL EXPERIMENT STATION
W. A. SHERIDAN, Director
DEPARTMENT OF SOILS
W. C. FOSTER, Chief

Private data

GROUND-WATER RESOURCES IN
HARNEY VALLEY,
HARNEY COUNTY, OREGON

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1939

BY
A. R. LEONARD
U.S. GEOLOGICAL SURVEY



PREPARED IN COOPERATION WITH
THE UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
AND HARNEY COUNTY COURT
NOVEMBER, 1970



PERMIT CONDITION WATER-LEVEL REPORTING FORM

Well owner: Name, Address, City/State/Zip, Email, Application Permit, Certificate, License, Transfer

Other water rights that list this well: Application number(s), Permit number(s), Certificate number(s)

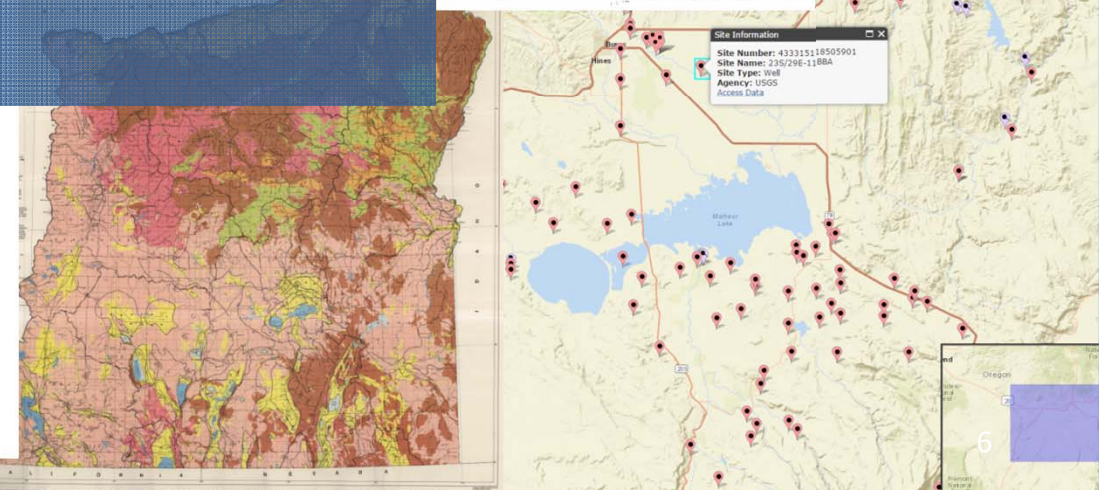
Identification of measured well (Provide as much information as possible): Water Resources Well Log ID, Owner's well name, Well drilled by, Well ID (Well Tag) on Well Log, Start Card # on Well Log, Date drilled, Owner on well log, Casing diameter (inches)

Water-Level Measurement: Date of measurement, Measurements should be made to at least the nearest tenth of a foot (0.2), the nearest inch (1/2) or the nearest percent of a foot, Depth to water below measuring point, Airline length or transducer depth, Measuring point height above/below land surface, Airline pressure, psi x 2.31', Depth to water below land surface, Airline pressure, psi x 2.31', Measurement Station, State, Pumping, Measurement Method, Edge, Airline, Other, Length of time well was idle prior to measurement, Measuring point description, The measuring point is the reference point from which the measurement is made. Examples are: 10' across port in well cap; 1.50' post pipe on N side, pressure gage. Comments

When did water use begin for this well under this permit? Month, Year

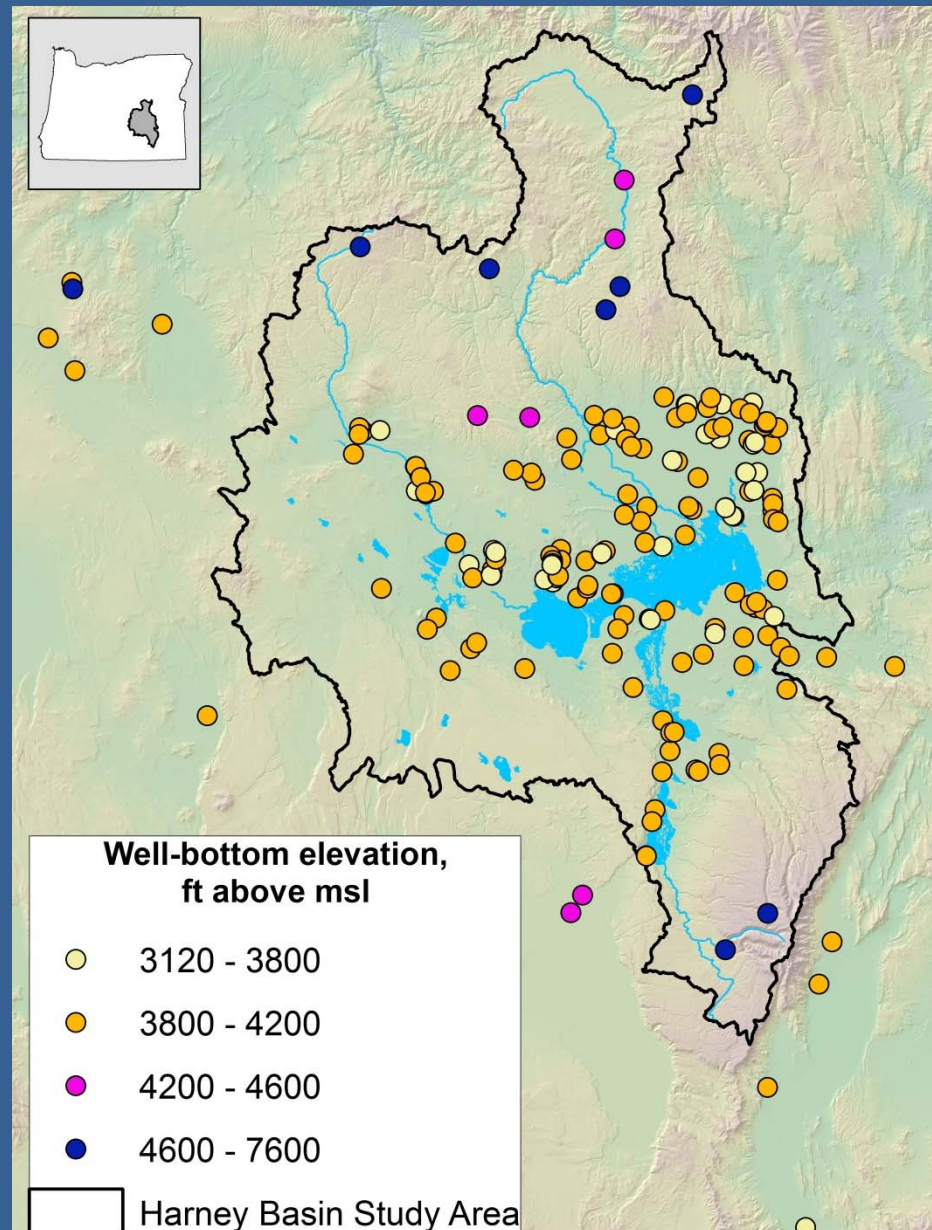
I hereby certify that the information on this report is accurate and represents the static water level in the well at the time of measurement. Person making measurement (print): Signature of measurement, Company, Licensed number (circle license type: CWRE, RG, PL, WWC, Pump Installer), District phone number, Email address

If you have any questions about this notice, please call the Measurement & Reporting Section of the Department at 503-946-0822. Review this Form on the OWRD, Water & Rangeland Section, 725 Summer St., N.W., Salem, OR 97301 or e-mail at waterresources@oregon.gov or visit our website at <http://www.owrd.state.or.us>. Additional forms can be obtained from our web site at <http://www.owrd.state.or.us>



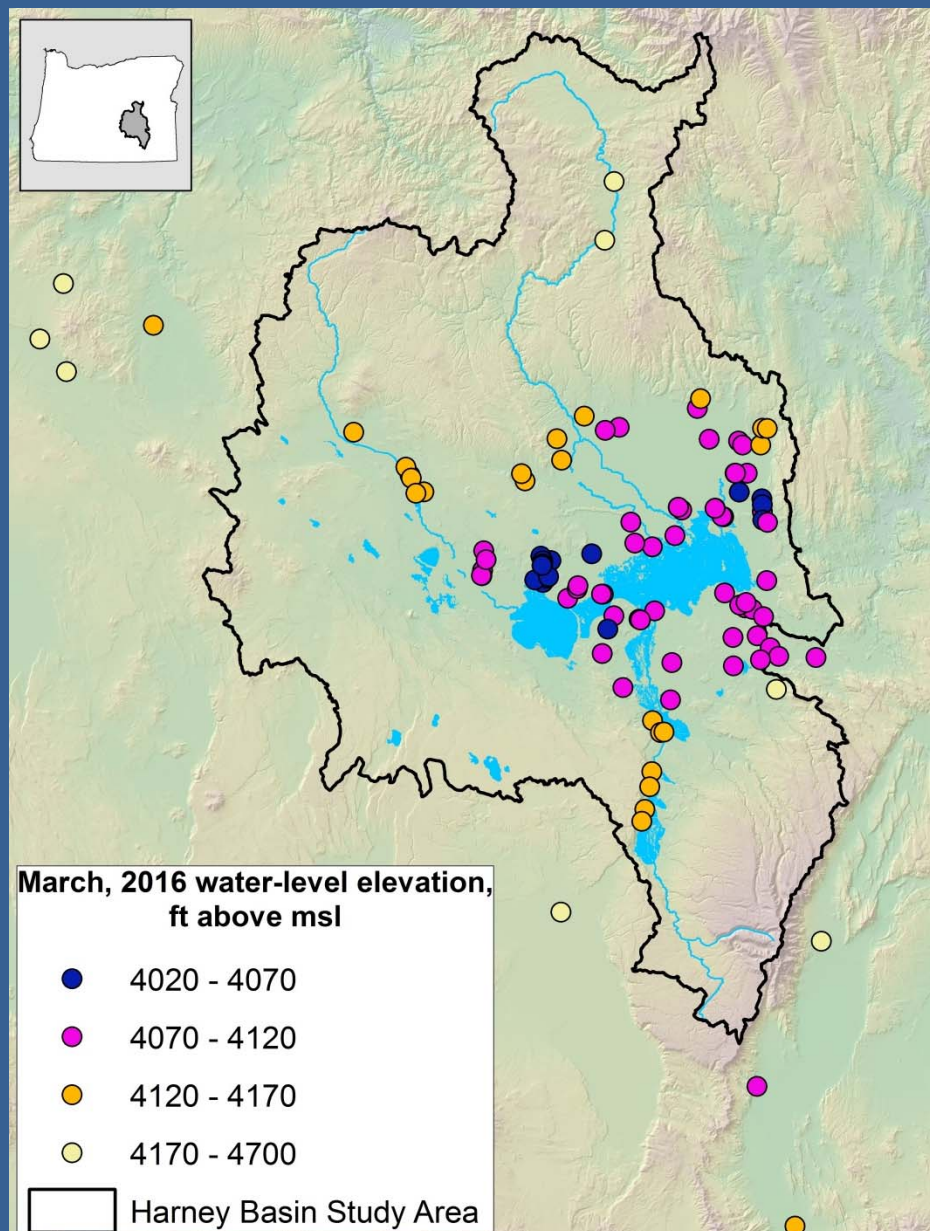
GROUND-WATER LEVEL CONTOURS AND DISTRIBUTION OF IRRIGATION, INDUSTRIAL AND PUBLIC SUPPLY WELLS IN EASTERN OREGON

Monitoring well elevations



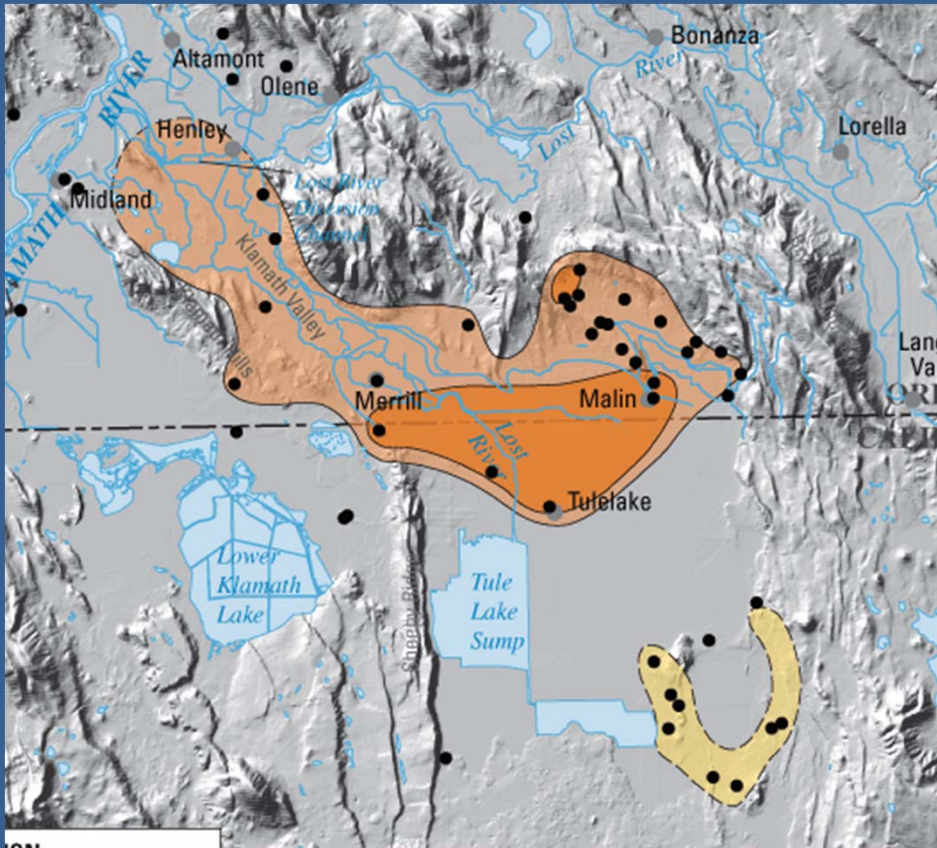
Data from OWRD
well database

March 2016 water levels

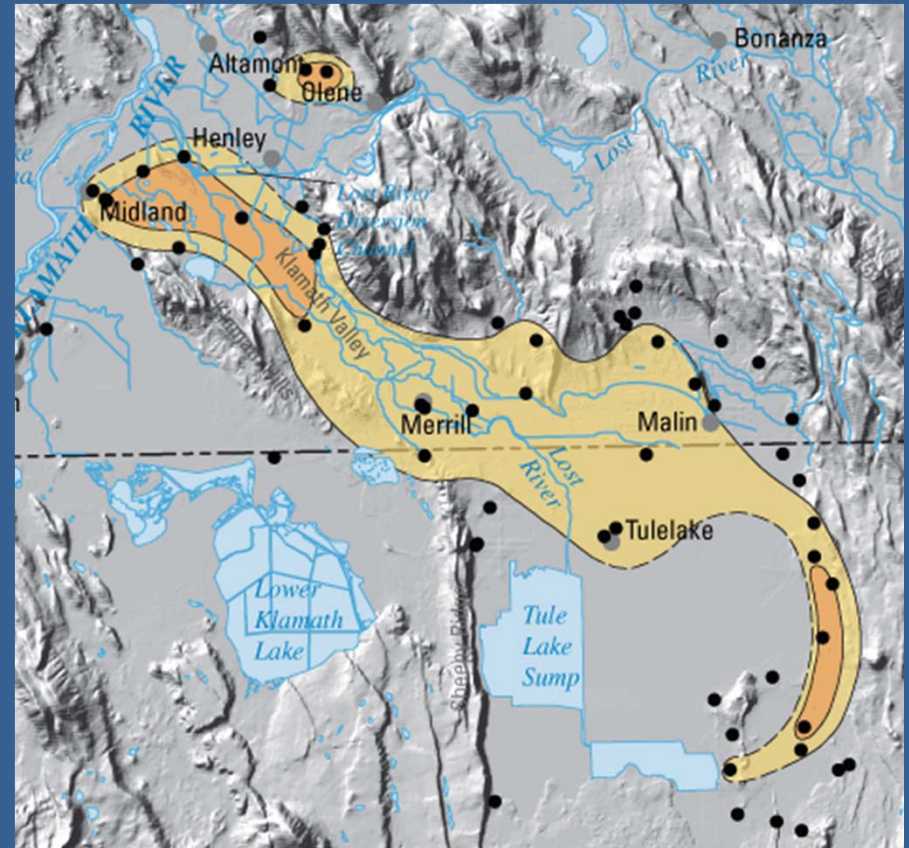


Data from OWRD
well database

Example of water-level decline maps

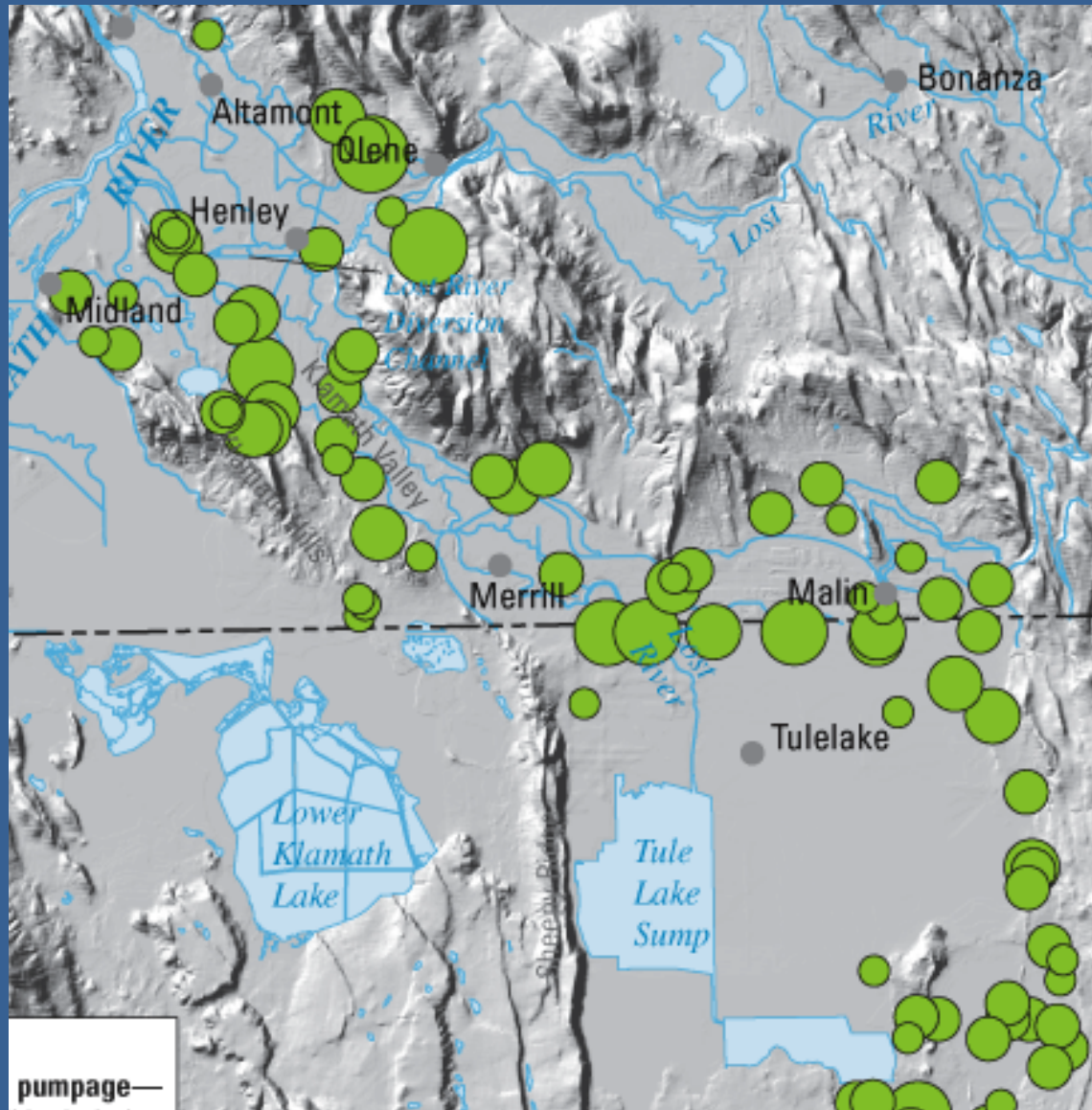


Year-to-year

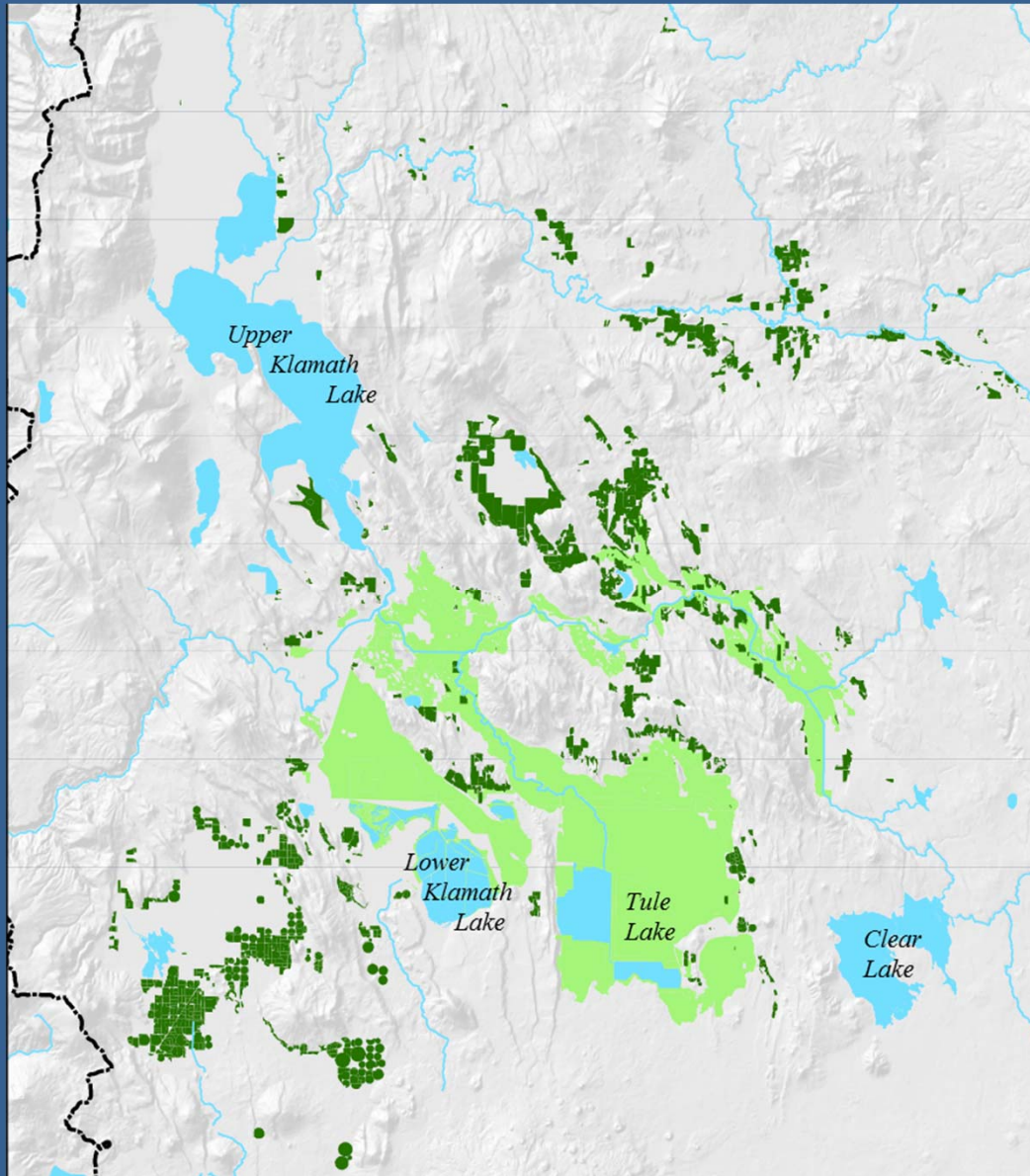


Spring-to-fall

Example of groundwater pumping map



Example of irrigation map



Describe geologic framework

- Determine the thickness, extent, and boundaries of the hydrogeologic units in the Harney basin

Compile geologic information

Published geologic maps and cross sections

Driller's logs

Journal articles

New OWRD monitor wells

DOGAMI (State of Oregon) mapping

Geophysical logs

A DESCRIPTION OF AQUIFER UNITS IN EASTERN OREGON

By Joseph B. ...

From Steens Mountain to the Malheur River Gorge, Oregon

Victor E. Camp
Department of Geological Sciences, San Diego State University, San Diego, California 92182, USA
Martin E. Ross
Department of Geology, Northeastern University, Boston, Massachusetts 02115, USA

Revisions to the Cenozoic Stratigraphy of Harney Basin, Southeastern Oregon

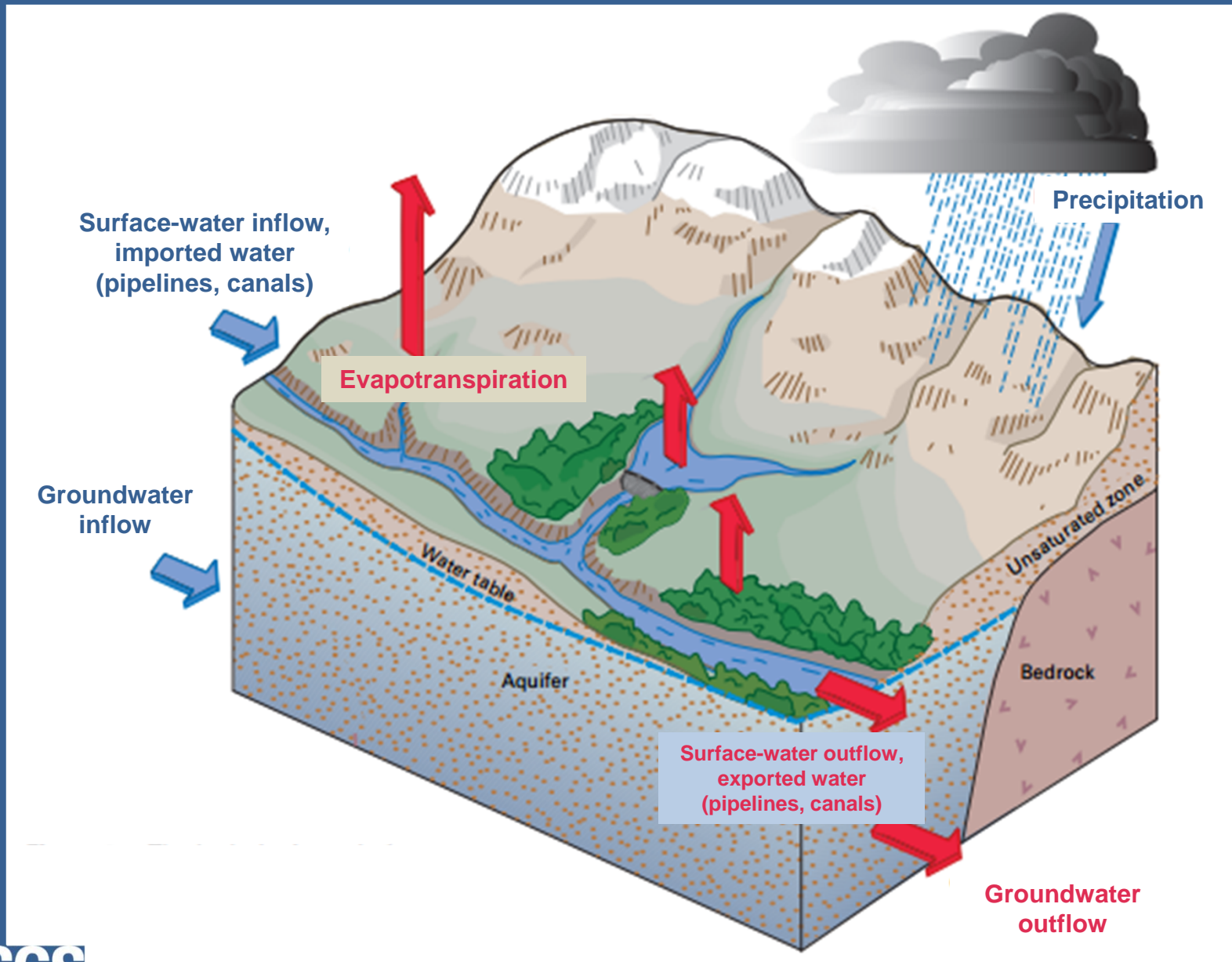
An integrated geophysical imaging of the upper-crustal features in the Harney Basin, southeast Oregon

M. Khatiwada* and G. Randy Keller*
*Central Oklahoma School of Geology and Geophysics, University of Oklahoma, Norman, Oklahoma 73019, USA

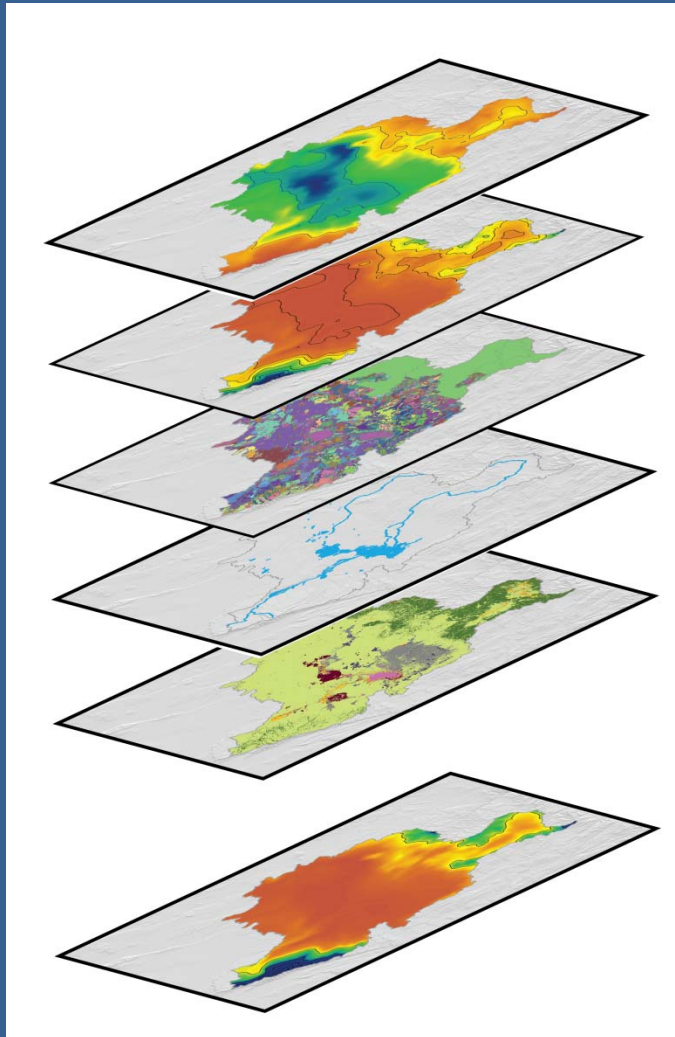
ABSTRACT
The Harney Basin is a relatively flat-lying ... formed due to complex intra-plate volcanism during the Cenozoic (e.g., Carlson and Hart, 1987; Camp et al., 2003; Stock and Grauder, 1979; Russell, 1984). One element of the HLP Project was to target the Harney Basin with 3D seismic coverage as part of the active source

GEOLOGIC CROSS SECTIONS OF AQUIFER UNITS IN EASTERN OREGON
(LOCATIONS ON PLATE 1)

Determine water budgets for groundwater and surface-water systems



Recharge components



Precipitation

Evapotranspiration

Soils

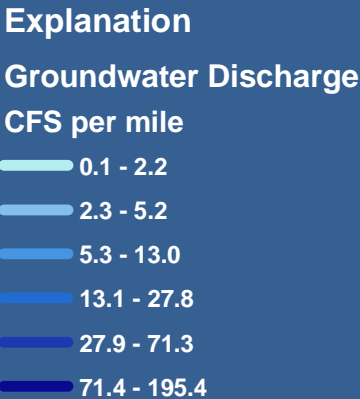
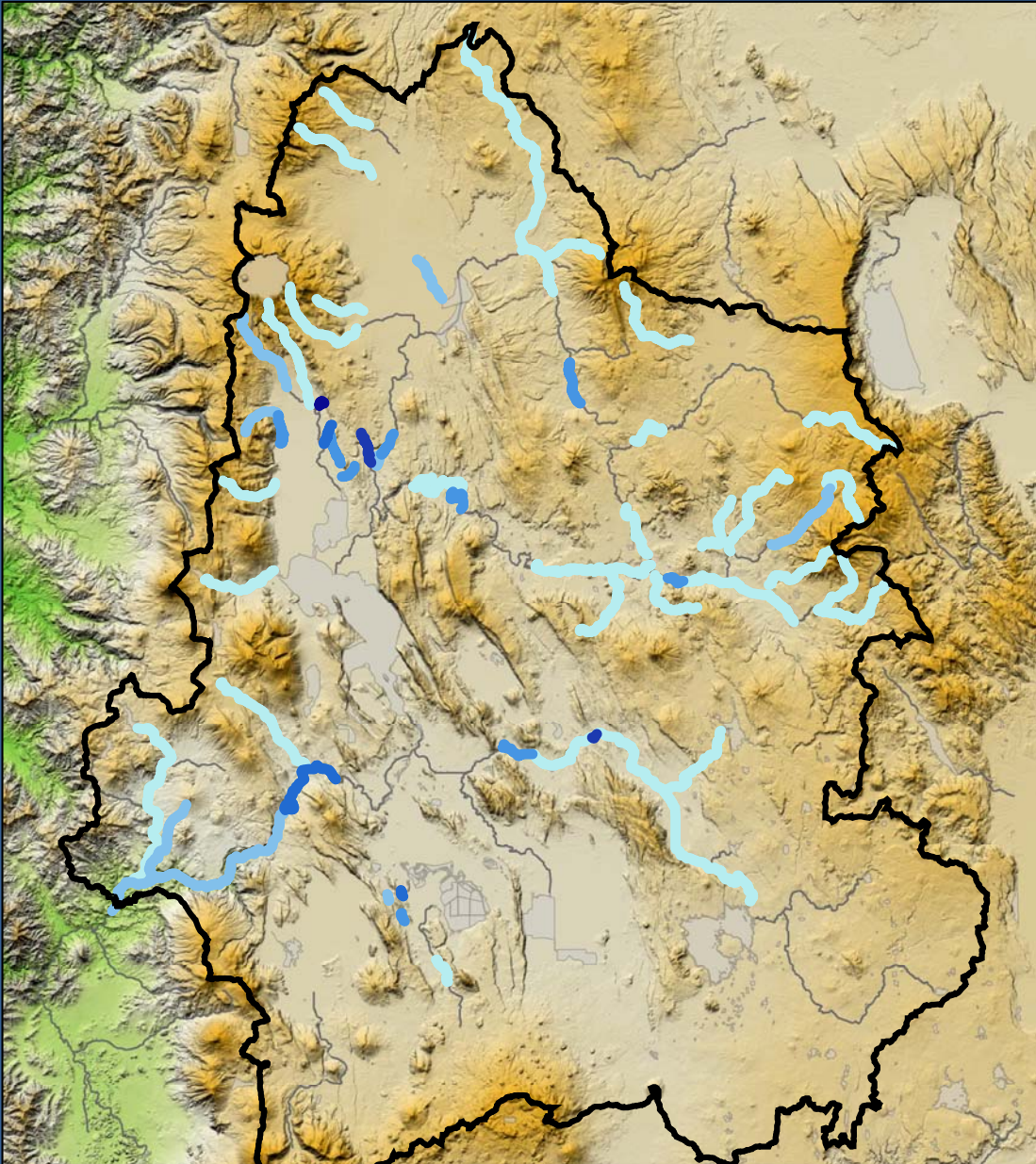
Runoff

Land use



Recharge

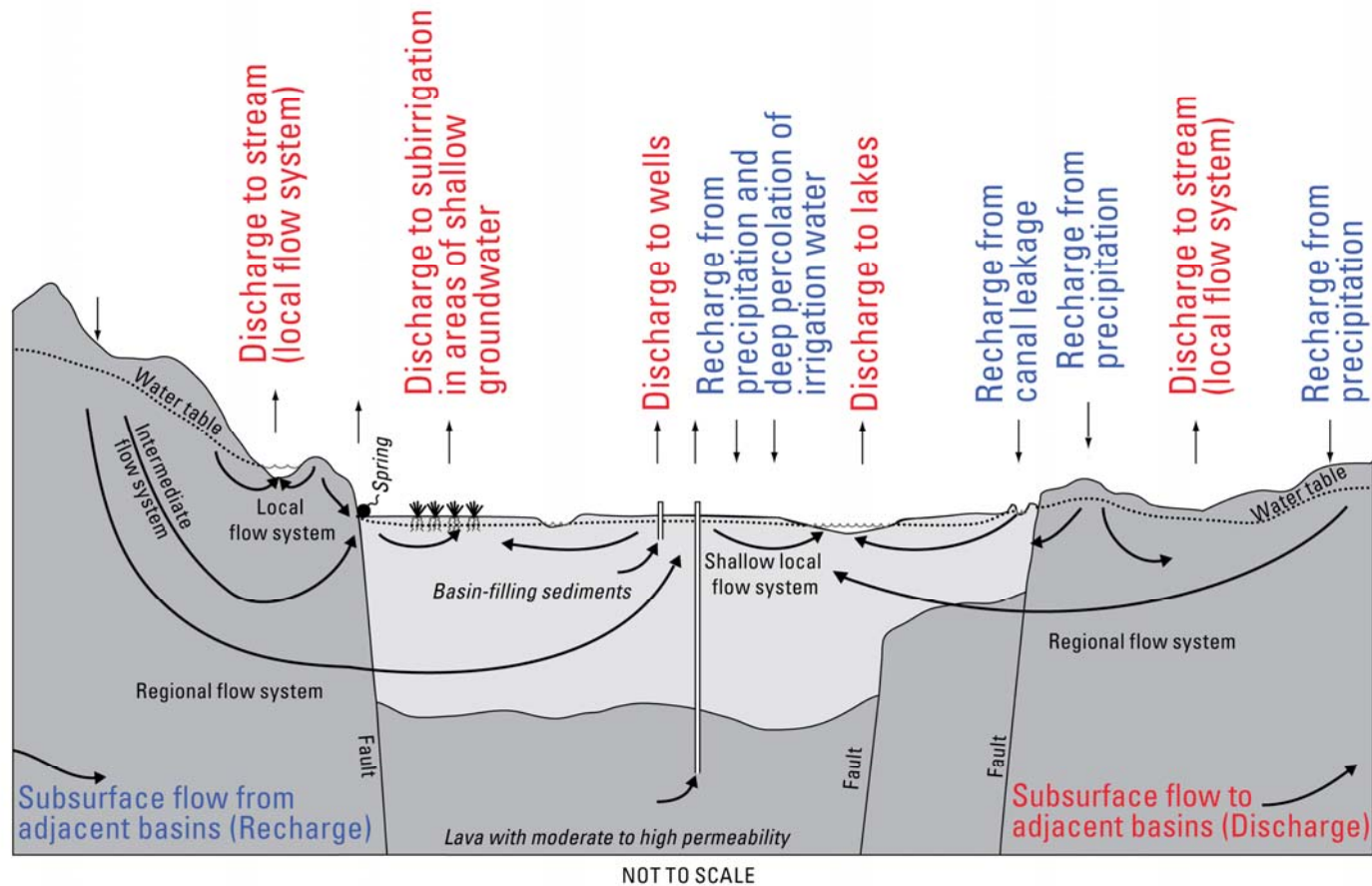
Groundwater Discharge to Streams in the Upper Klamath Basin



Determine aquifer properties

- Hydraulic conductivity (how fast water moves)
- Storage coefficient (how much water can it hold)
- Historical and new aquifer tests
- Specific capacity of existing wells

Describe the flow system (conceptual model)

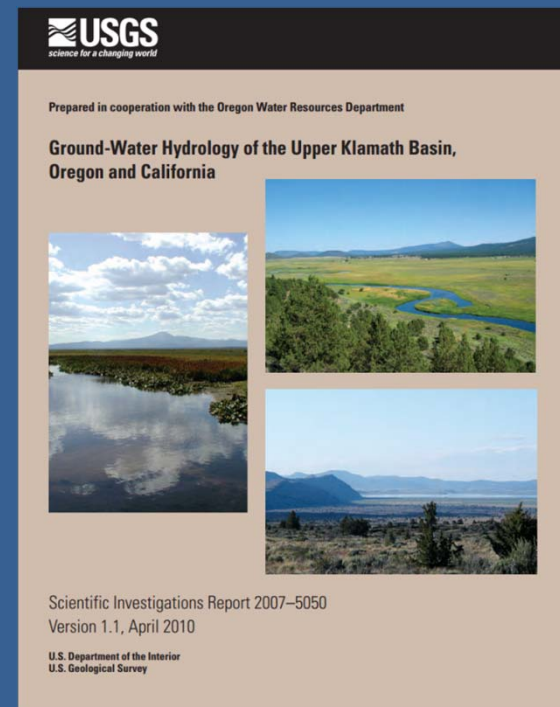


$$\text{RECHARGE} = \text{DISCHARGE} \pm \text{CHANGE IN AQUIFER STORAGE}$$

Schematic representation of sources of groundwater recharge, flow paths, and mechanisms of groundwater discharge in the Harney Basin, Oregon.

At the end of 2019, a USGS report describing the hydrologic flow system will be published

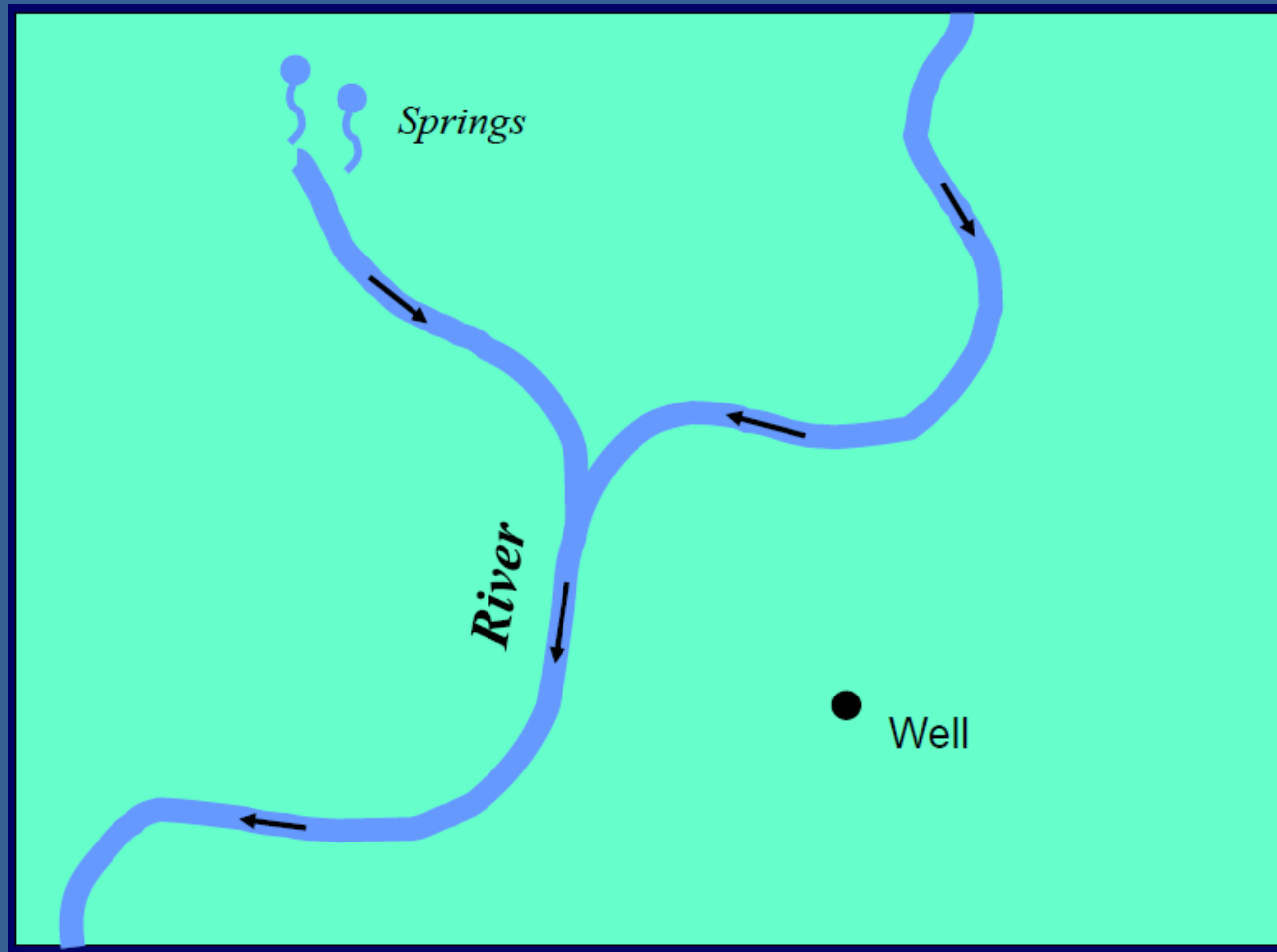
- Report will provide answers to some of the questions shown earlier and allow OWRD to begin making decisions about water allocation in the Harney Basin



Phase 2

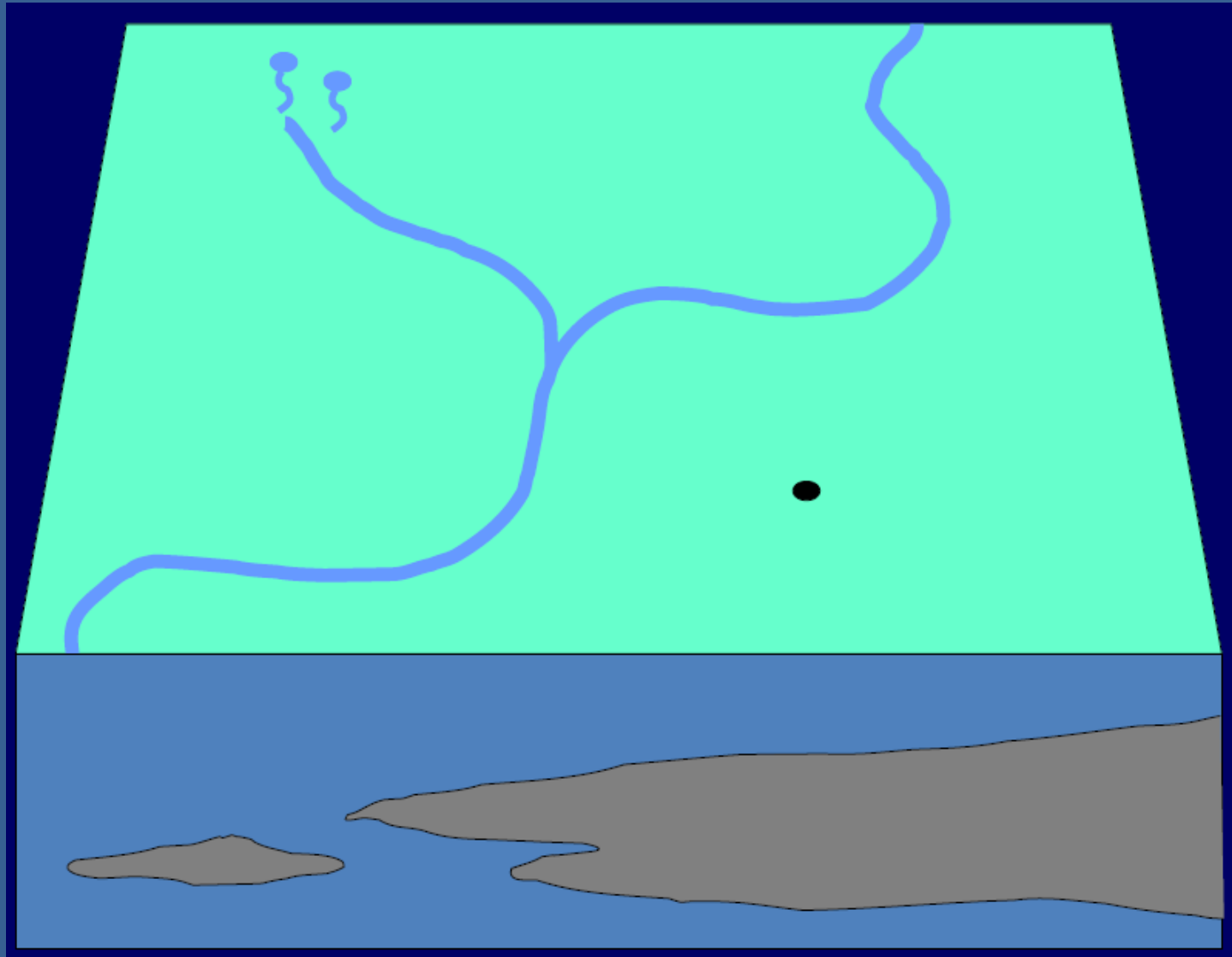
- Synthesize understanding of the flow system into a numerical groundwater-flow model
- Match model to historical water levels and groundwater discharge (calibration)
- Test hydrologic understanding and future pumping scenarios with the model

Numerical Model Basics

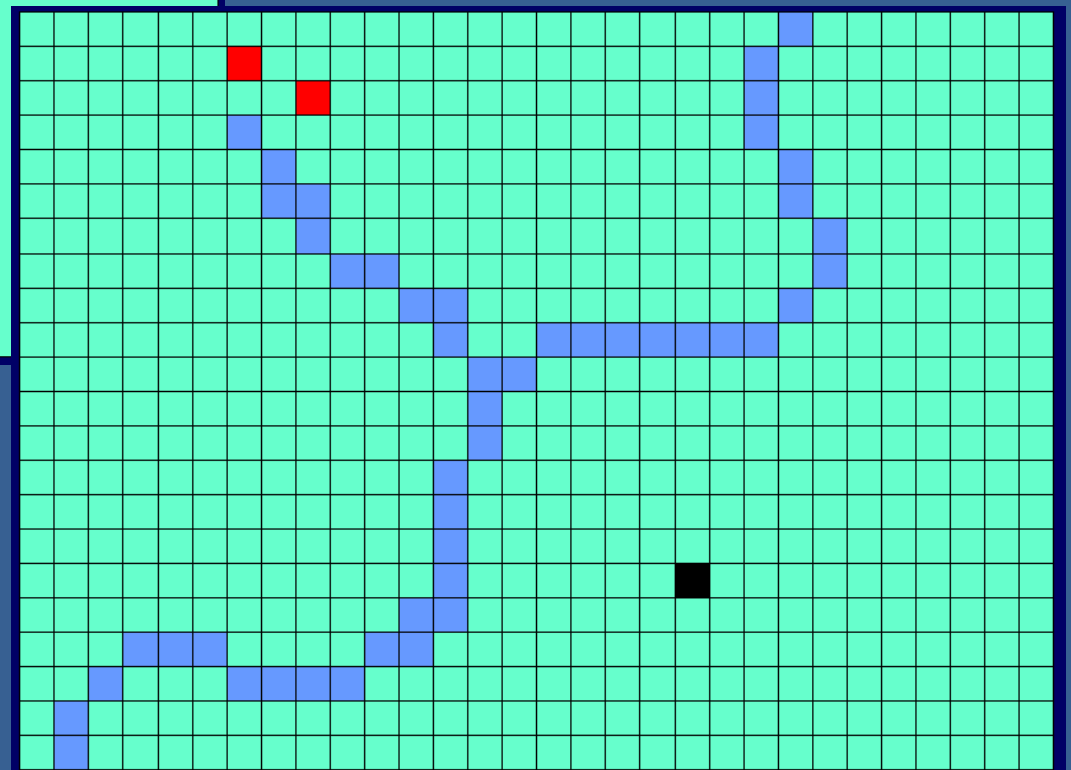
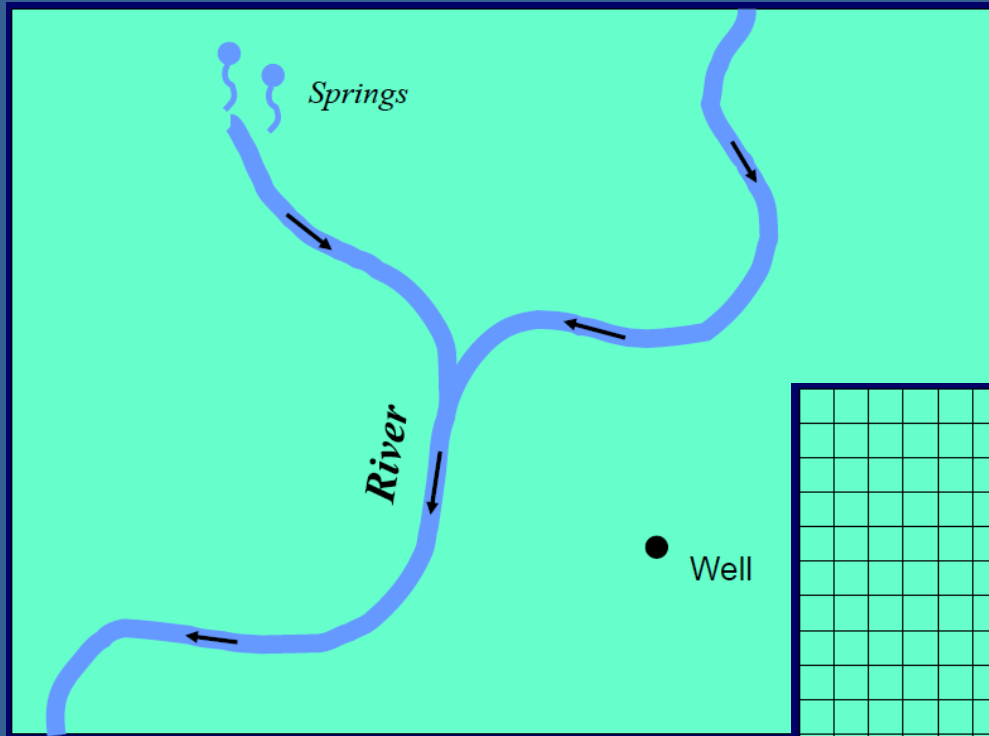


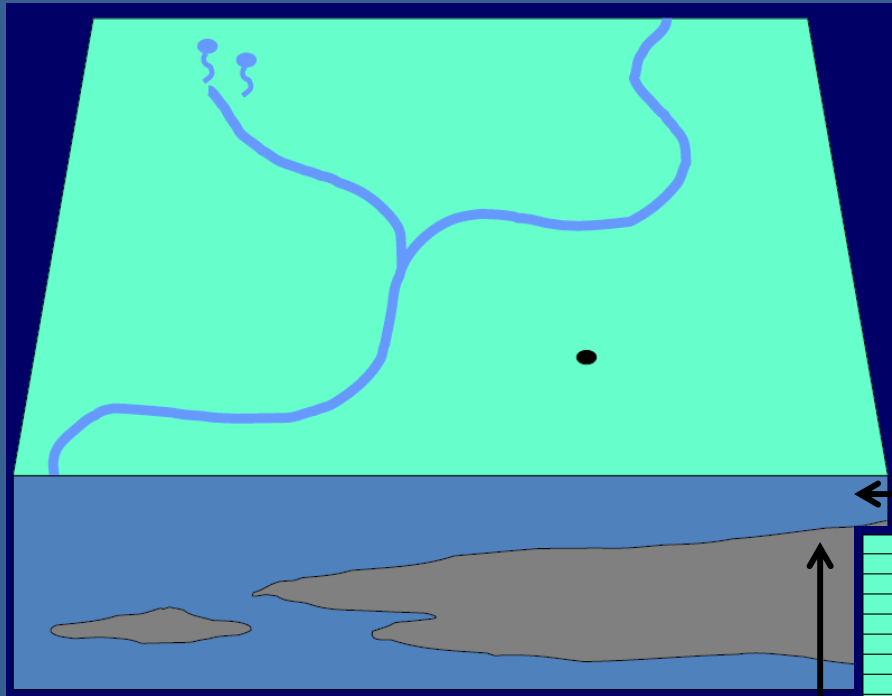
The complexities of natural systems make answering simple quantitative questions about groundwater very difficult.

The geology introduces complexity in the third dimension.



In computer modeling, the system is divided into discrete regions called *cells*. Conditions in each cell are considered homogeneous, so the math becomes simple. Cells can be formulated to act as streams, well, springs, etc.

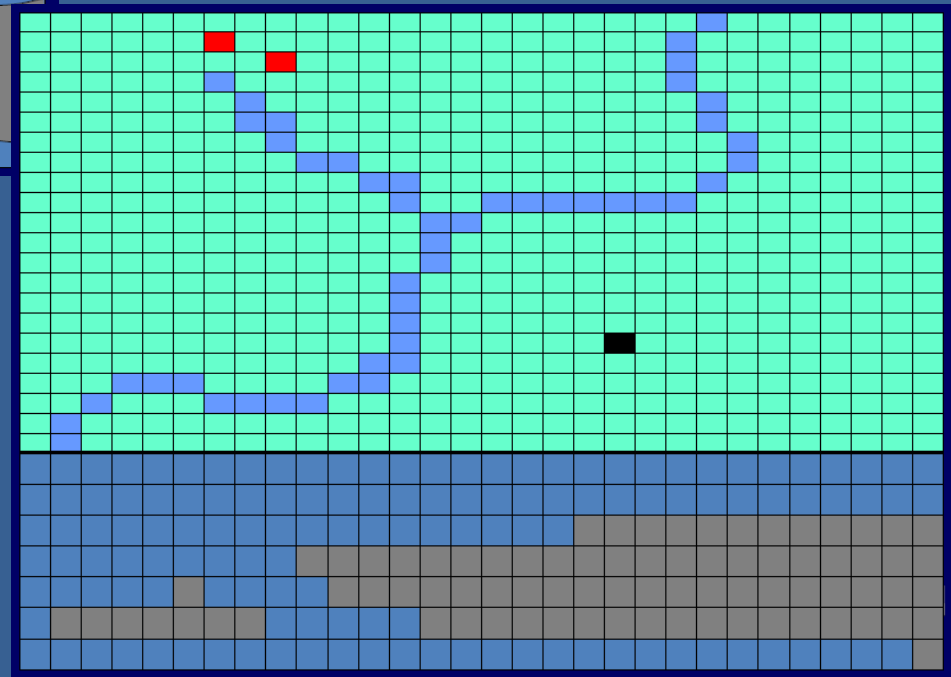




Columns

Rows

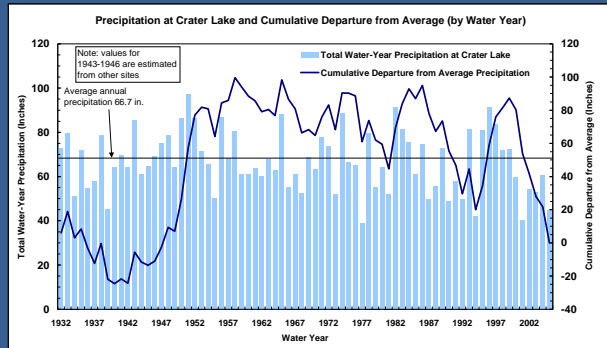
Layers



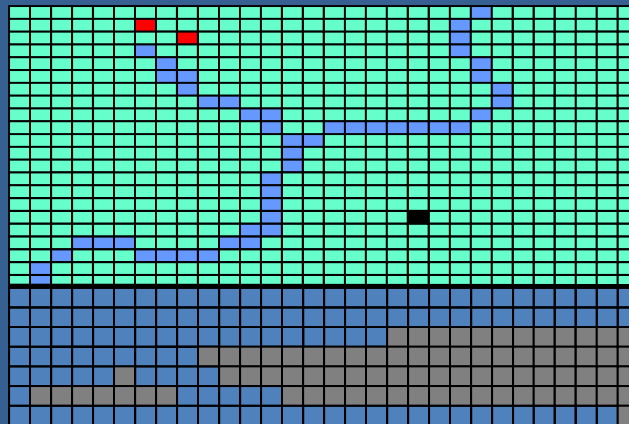
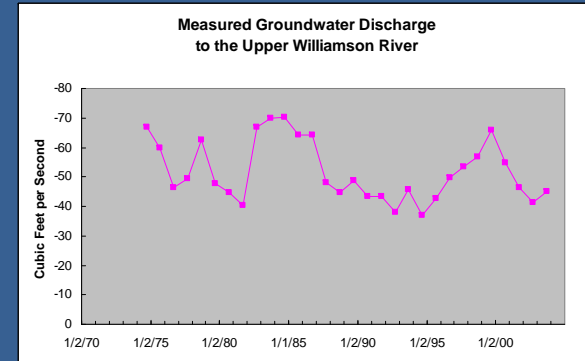
The computer calculates the groundwater flow and head in each cell, as well as the movement of water to boundaries such as streams and springs.

In order to have predictive capability or to provide useful insights, a model should be able to accurately simulate the observed behavior of the groundwater system.

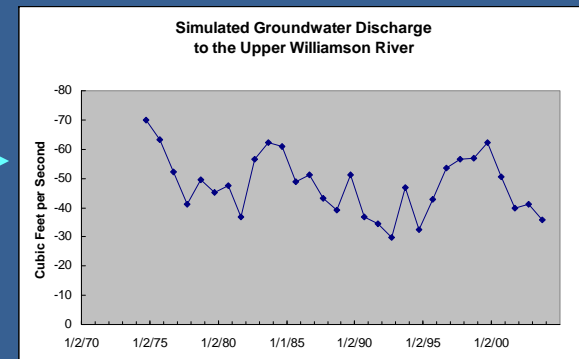
Measured External Stress



Measured Response

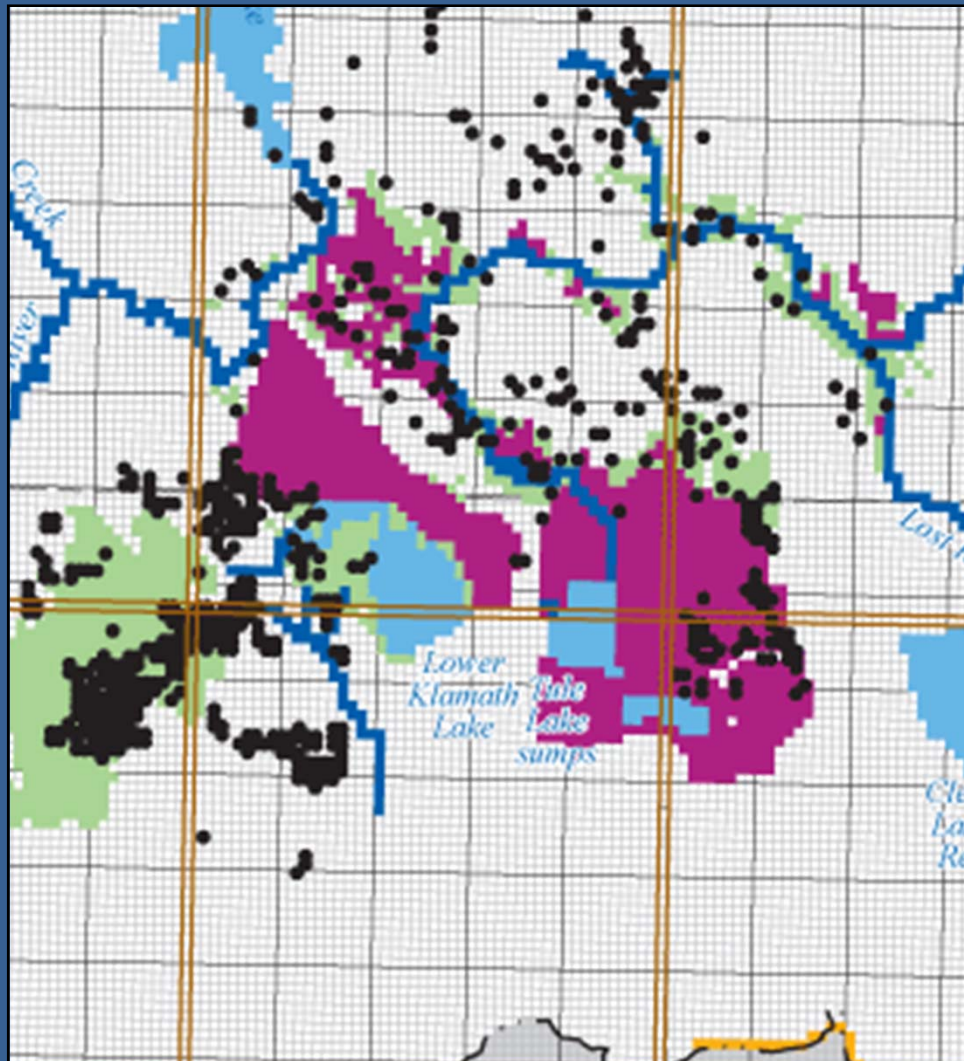


Simulated Response

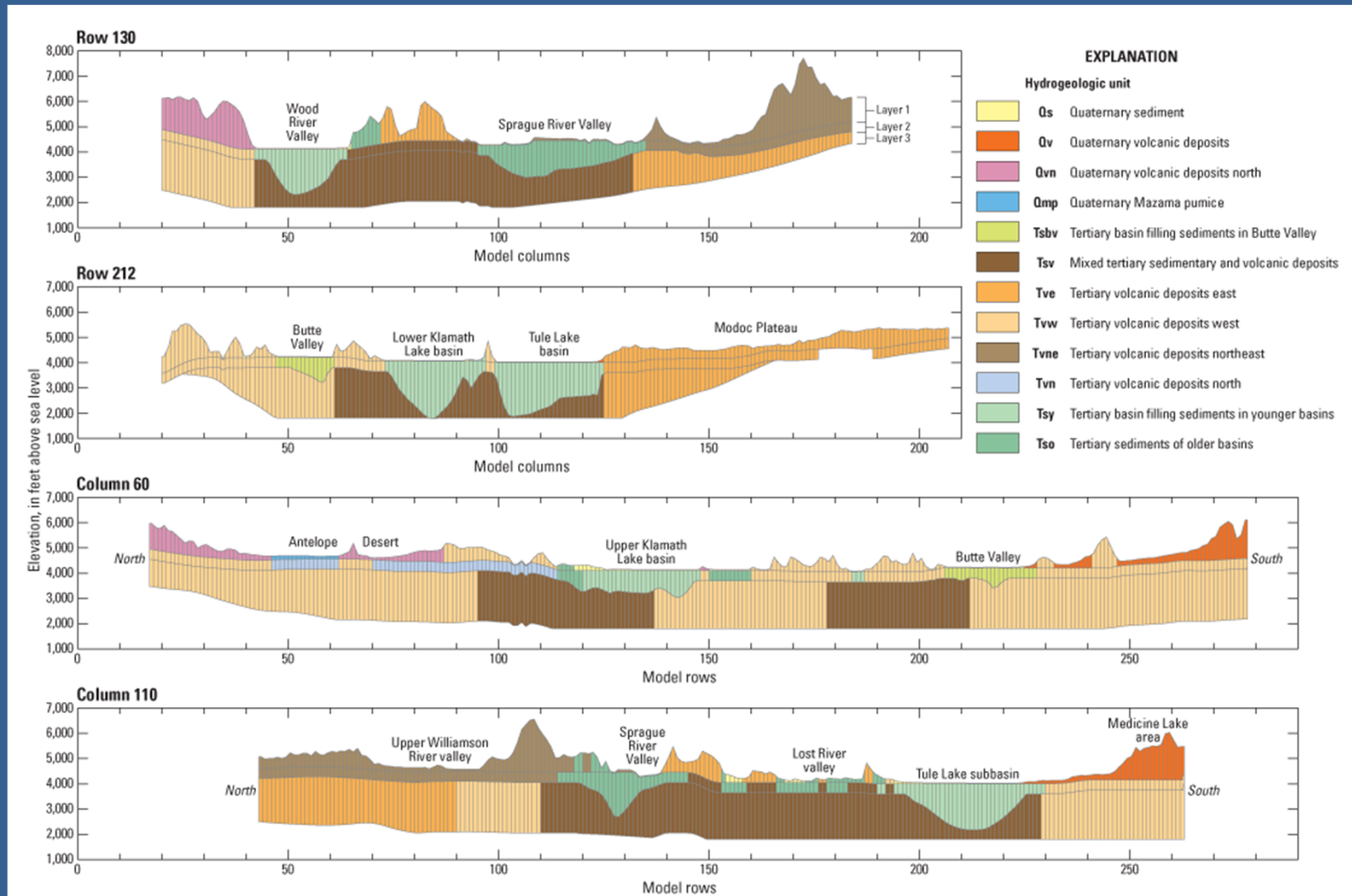


A model that can simulate actual observed conditions is said to be *calibrated*.

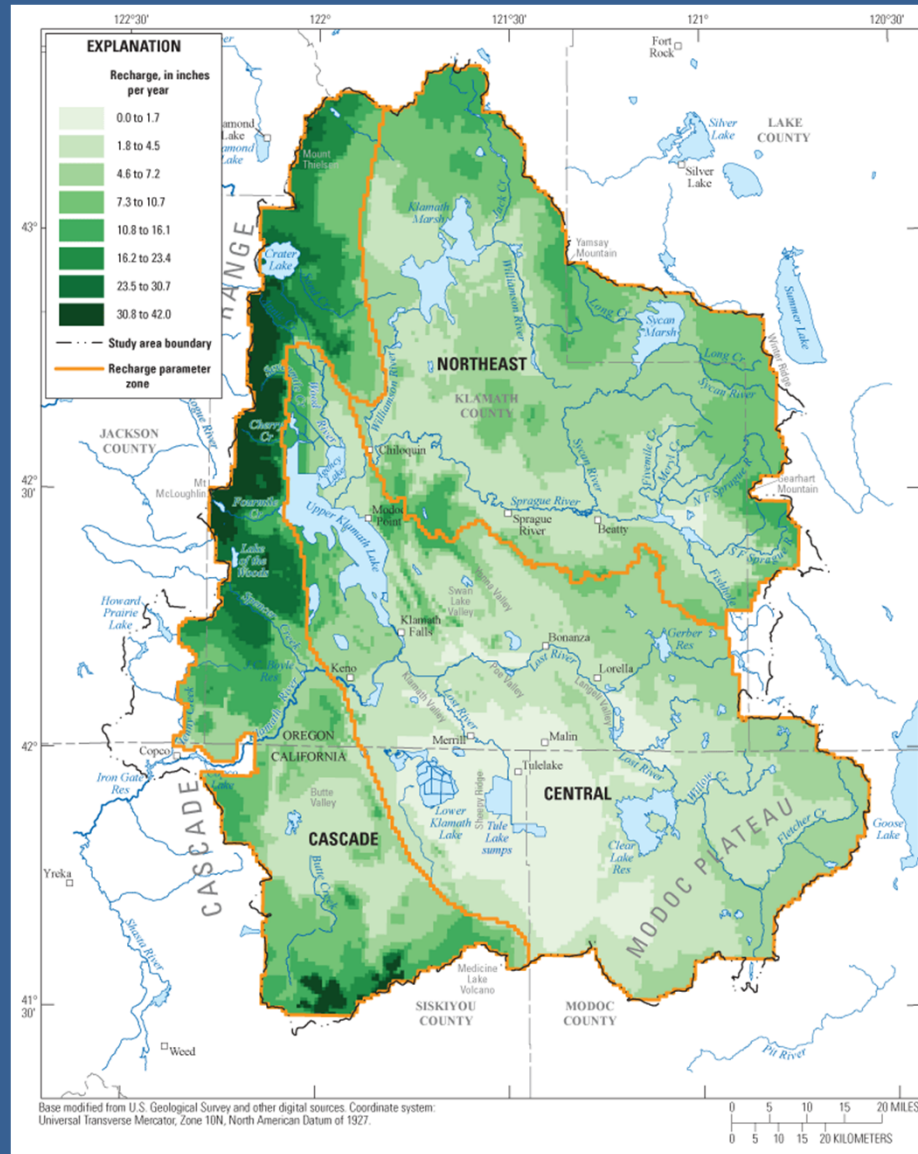
Example groundwater model grid



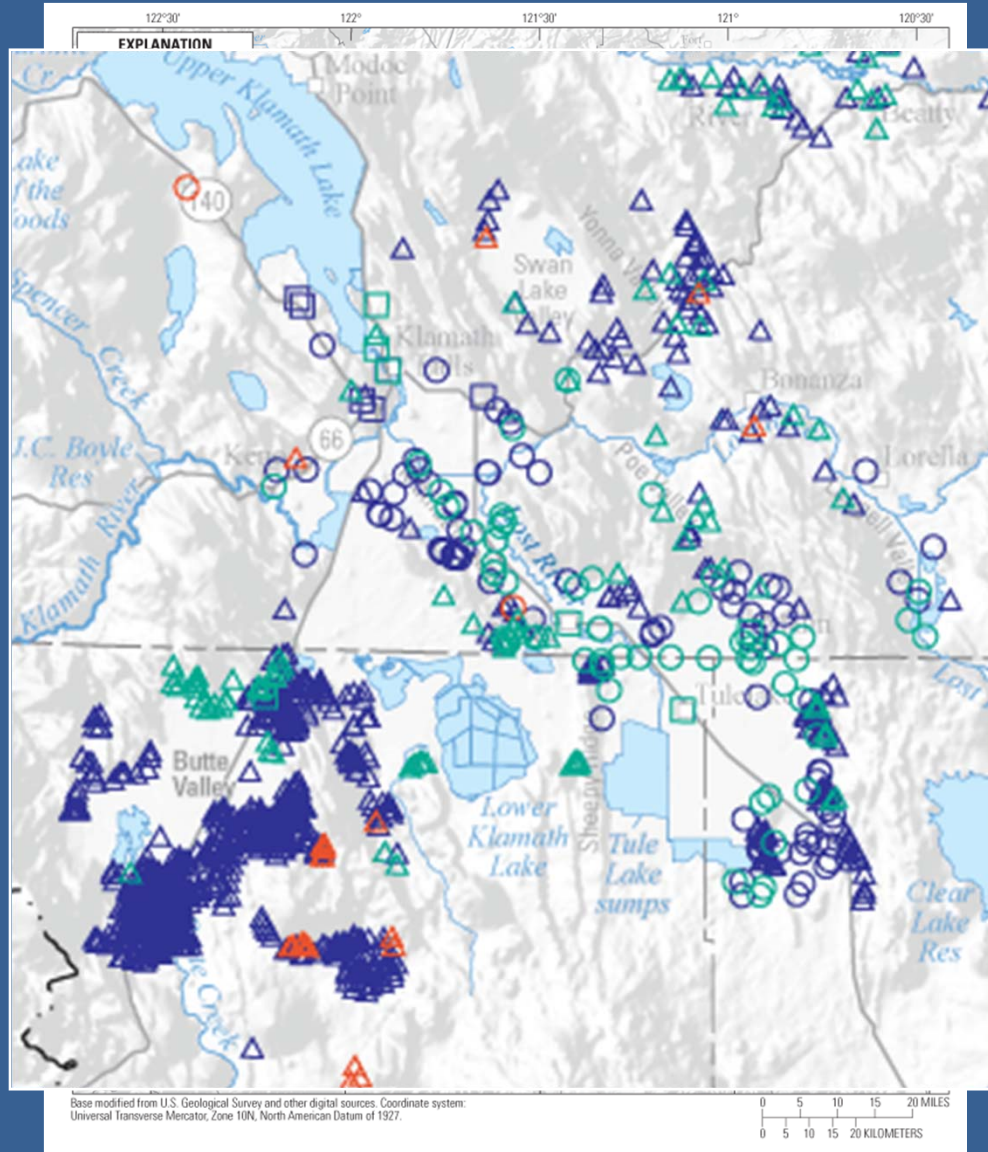
Example groundwater model grid



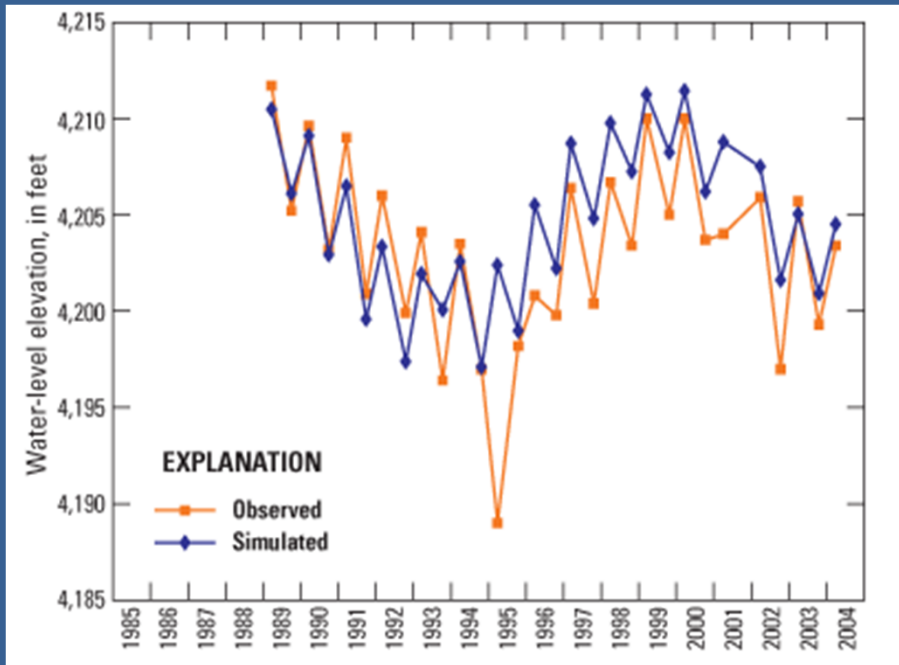
Example recharge distribution



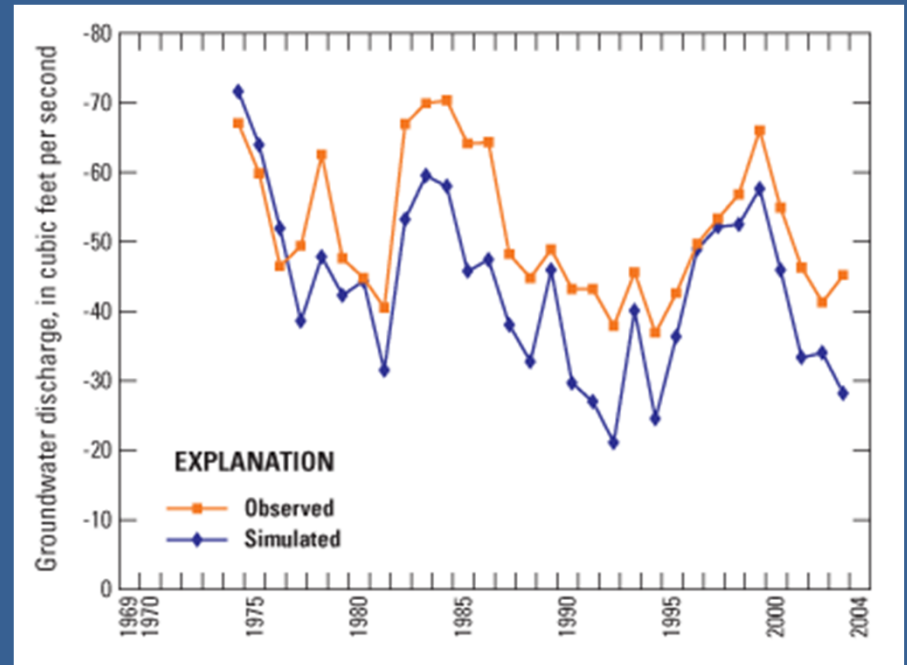
Example pumping distribution



Match model to measured hydrologic data

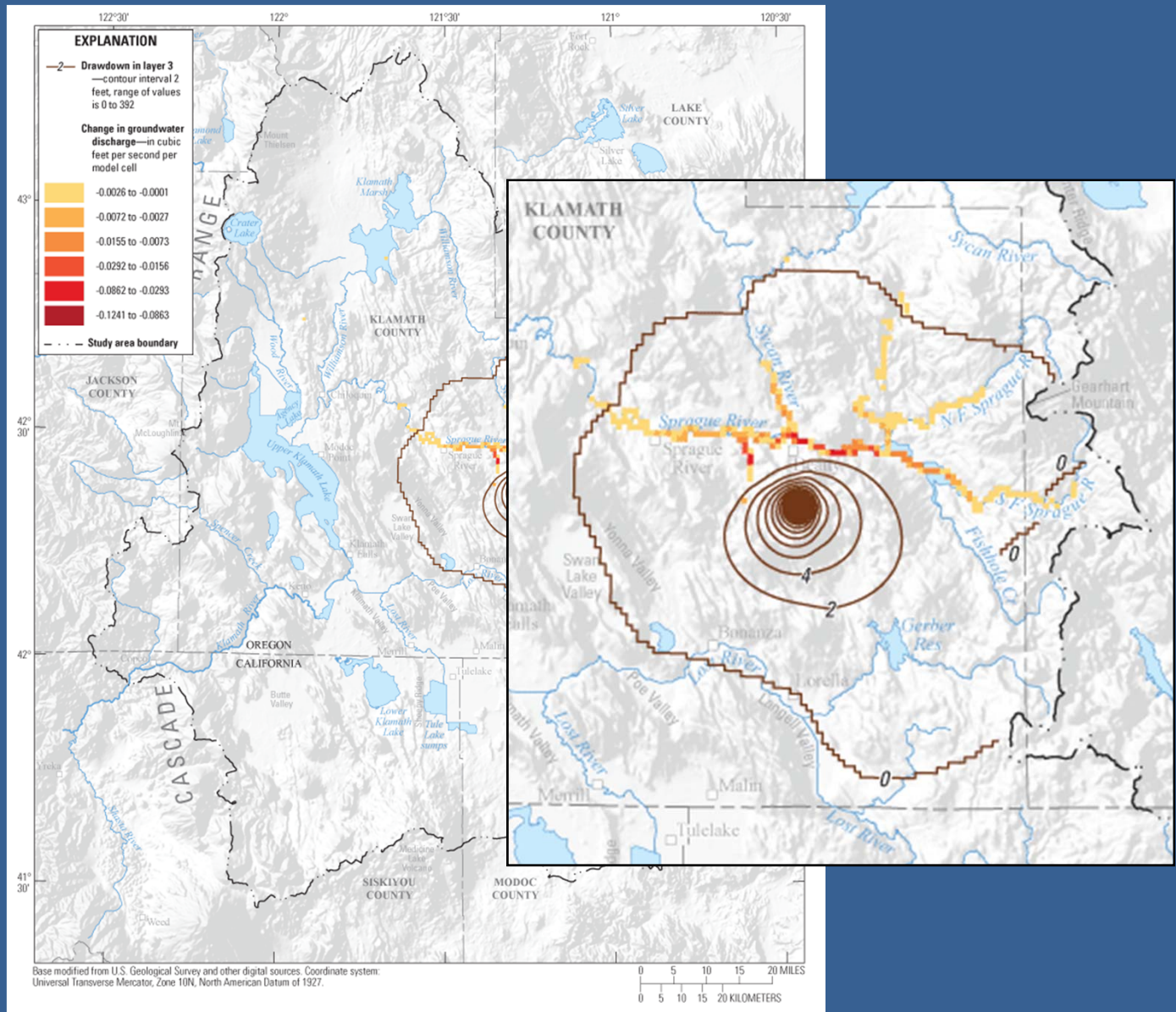


Water levels

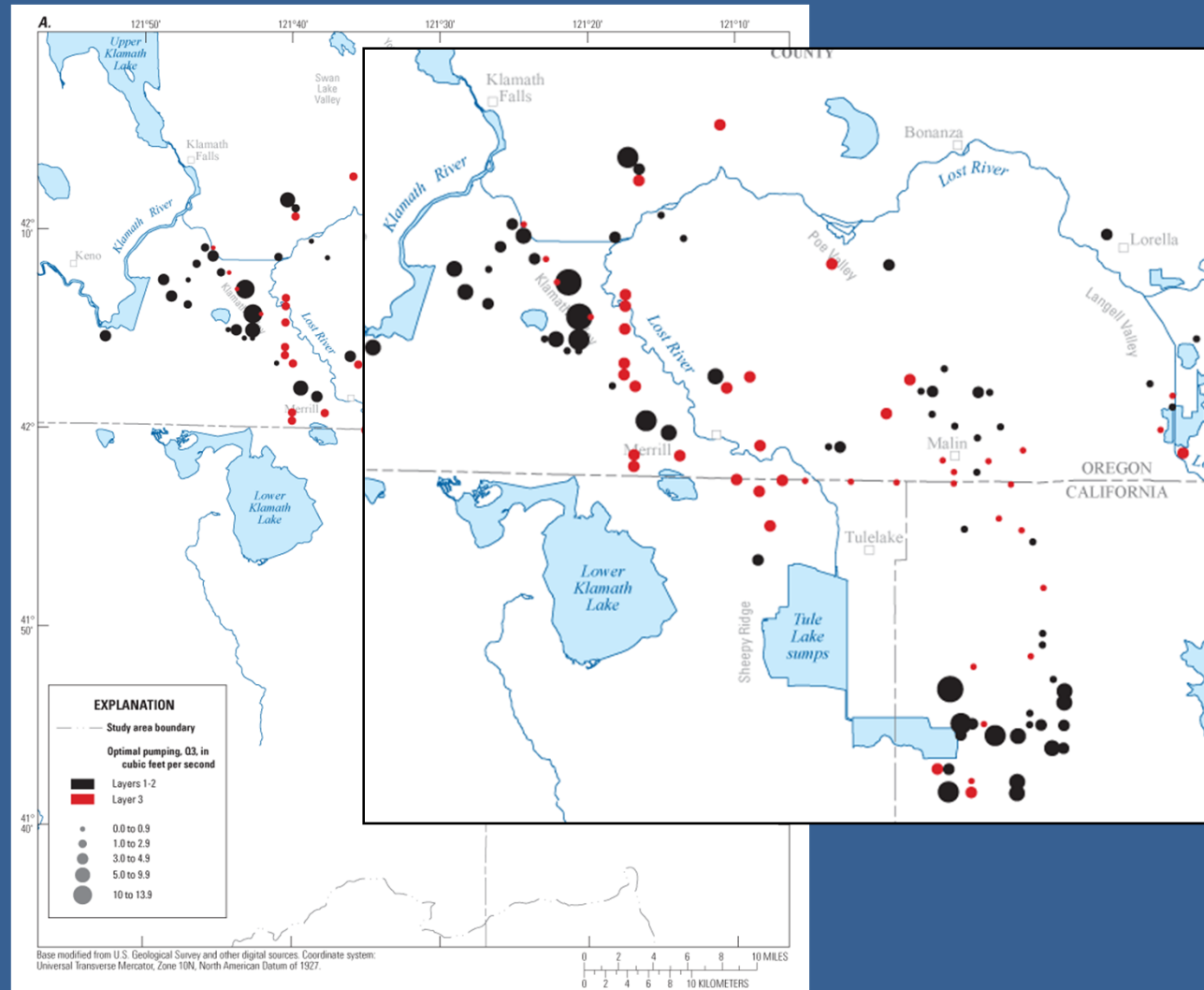


Stream and river discharge

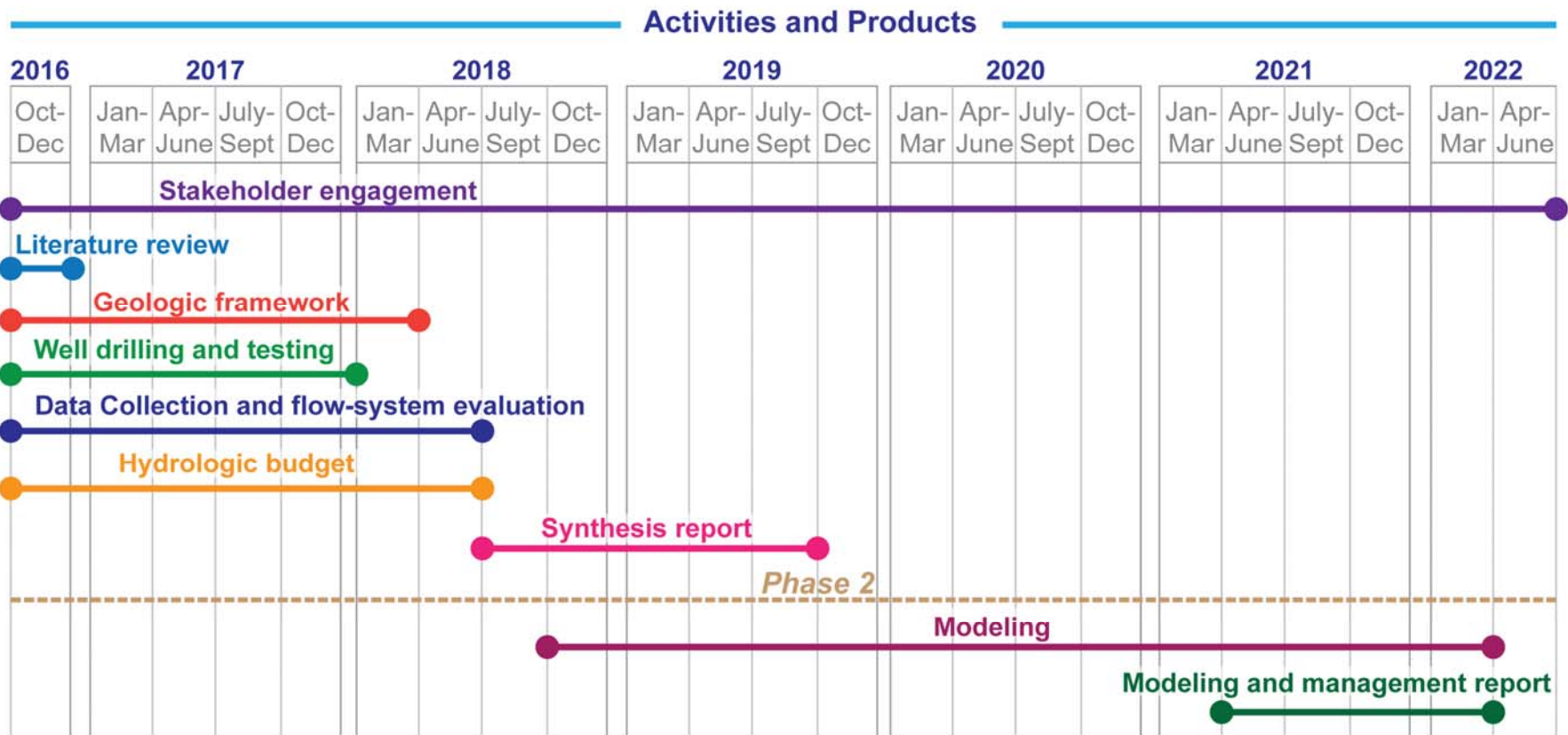
Test pumping scenarios with model



Test pumping scenarios with model



Project timeline



References

- Gannett, M.W., Lite, K.E. Jr., La Marche, J.L., Fisher, B.J., and Polette, D.J., 2007, Ground-water hydrology of the upper Klamath Basin, Oregon and California: U.S. Geological Survey Scientific Investigations Report 2007-5050, 84 p.
- Gannett, M.W., Wagner, B.J., and Lite, K.E., Jr., 2012, Groundwater simulation and management models for the upper Klamath Basin, Oregon and California: U.S. Geological Survey Scientific Investigations Report 2012–5062, 92 p.
- Healy, R.W., Winter, T.C., LaBaugh, J.W., and Franke, O.L., 2007, Water budgets: Foundations for effective water-resources and environmental management: U.S. Geological Survey Circular 1308, 90 p.
- Oregon Water Resources Department Database at http://www.oregon.gov/owrd/pages/gw/well_data.aspx