Components of the Big Lost River Valley groundwater flow model

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USGS
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General Conceptual Model

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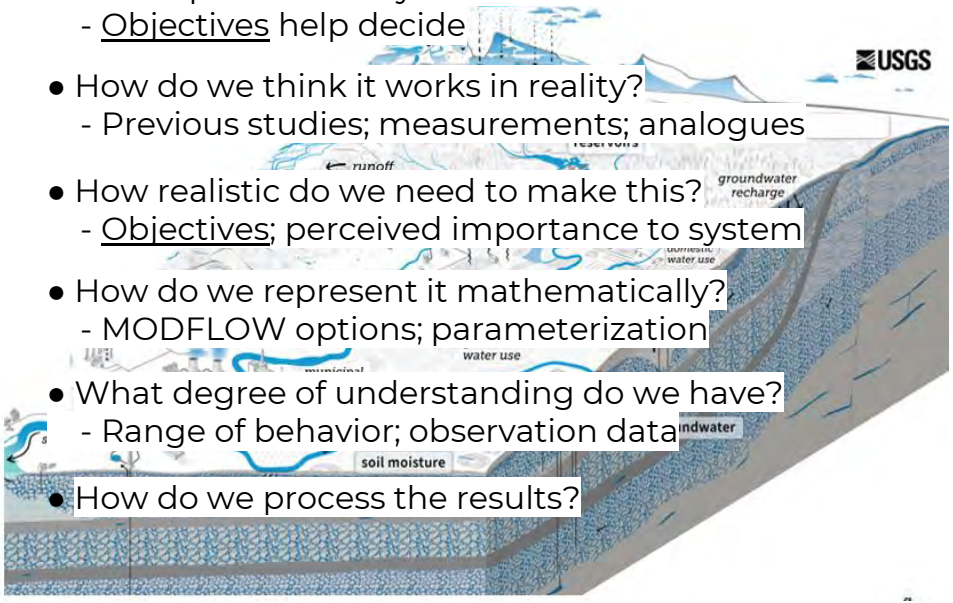
Project Roadmap

Decisions to Make

- Which parts of the system matter?
  - Objectives help decide
- How do we think it works in reality?
  - Previous studies; measurements; analogues
- How realistic do we need to make this?
  - Objectives; perceived importance to system
- How do we represent it mathematically?
  - MODFLOW options; parameterization
- What degree of understanding do we have?
  - Range of behavior; observation data
- How do we process the results?

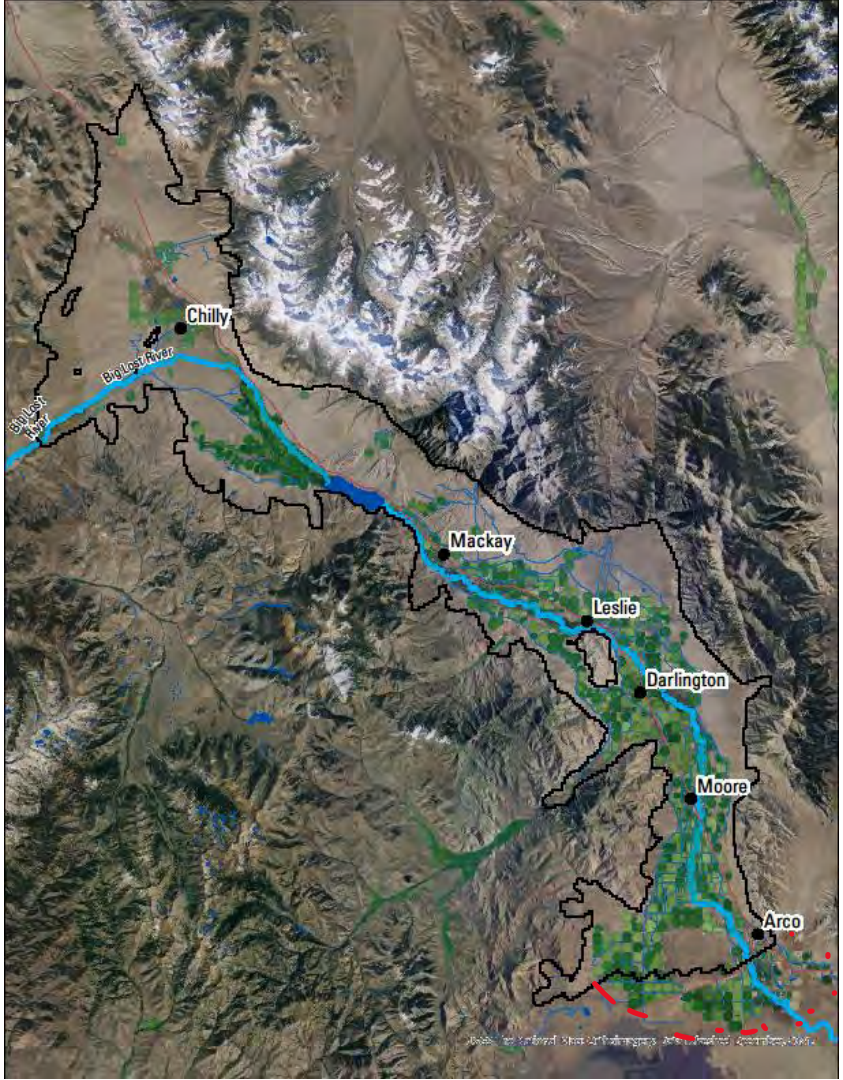


Parts (probably incomplete)

- Historic time period
- Discretization
- Study area
- Hydrogeology
- Subsurface Inflow (tributaries)
- Subsurface outflow (ESPA)
- Pumping
- River
  - Inflow, outflow, flow within, seepage
- Riparian zone
  - Flood plain, phreatophytes, drainage
- Irrigation system
  - Demands, supplies, diversions, drains, etc..
- Consumptive use / ET
- Consumptive use / ET
- Farm recharge
- Precipitation recharge
- Municipal, industrial, domestic use and recharge
- Mackay reservoir
- Soil moisture
- Unsaturated flow
- Weather variability (droughts, floods)
- Other management logic (reservoir, rule 50...)

Model area

- Valley and alluvial fans
  - Include fans?
- Howell Ranch gage upper end
- Will extend further south of Arco (will include Arco gage)
  - Challenging geology
  - Considering our approach



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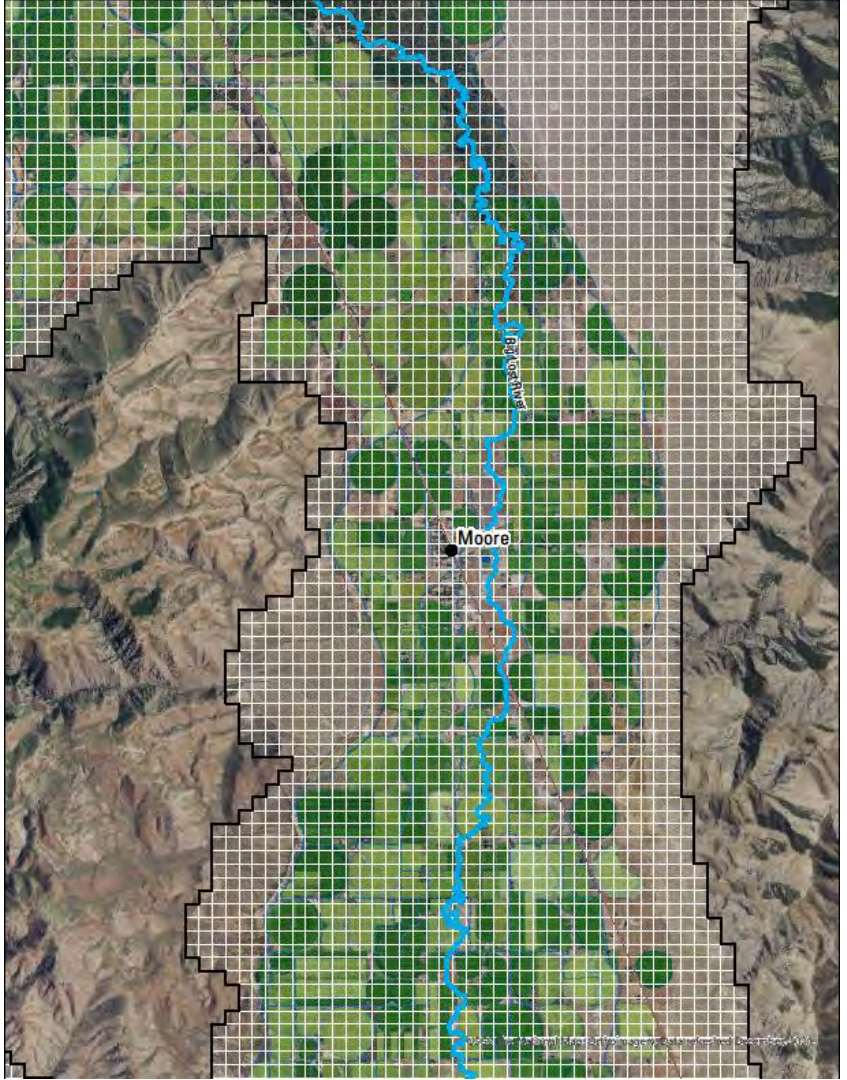
Model grid

- Square 200 m grid cells (currently)
  - Jake's code is versatile – can change this if we need
- Finer grid -> better for SW/GW interaction
- Finer grid -> slower model



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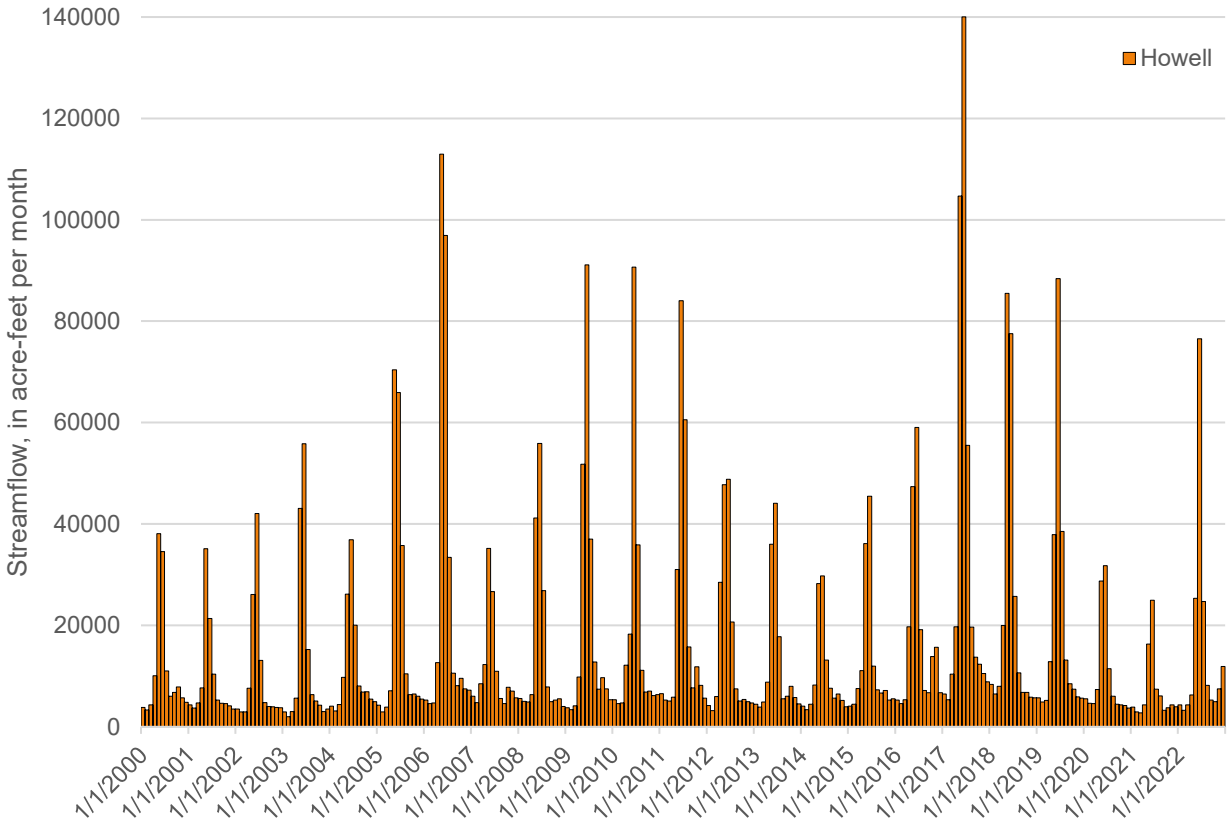
Time

- A historic period will be created covering the past ~20 years
- The time period will be broken into monthly stress periods
- Summarize all volumes and average all water levels over month
  - Total monthly pumping; total monthly river flow…



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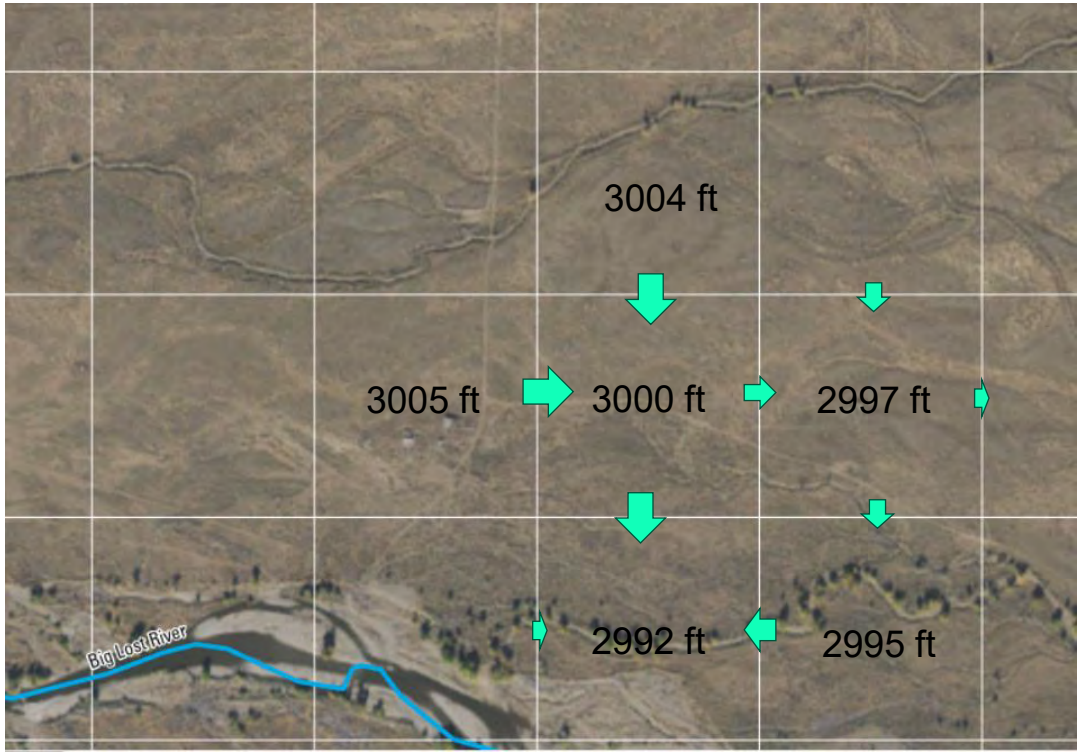
Flow in aquifer

- Simulate groundwater head (water level) in every cell in the model
- Flow between cells; driven by gradients
- Driven by, but distinct from ‘boundary conditions’



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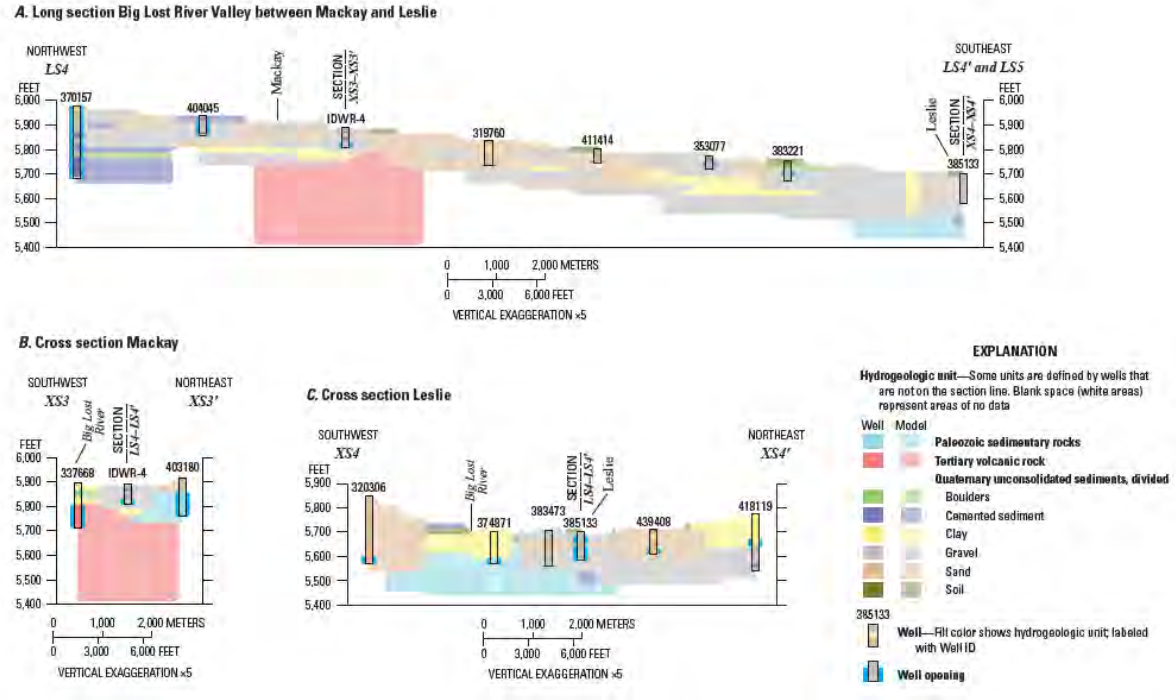
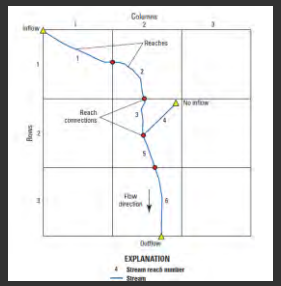
Aquifer properties

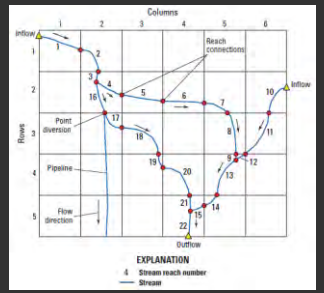
- Aquifer hydraulic properties (hydraulic conductivity, vertical anisotropy, specific yield/storage) influence water levels and flow rates
- Hydrogeologic framework will inform the ranges of values that model cells can take on

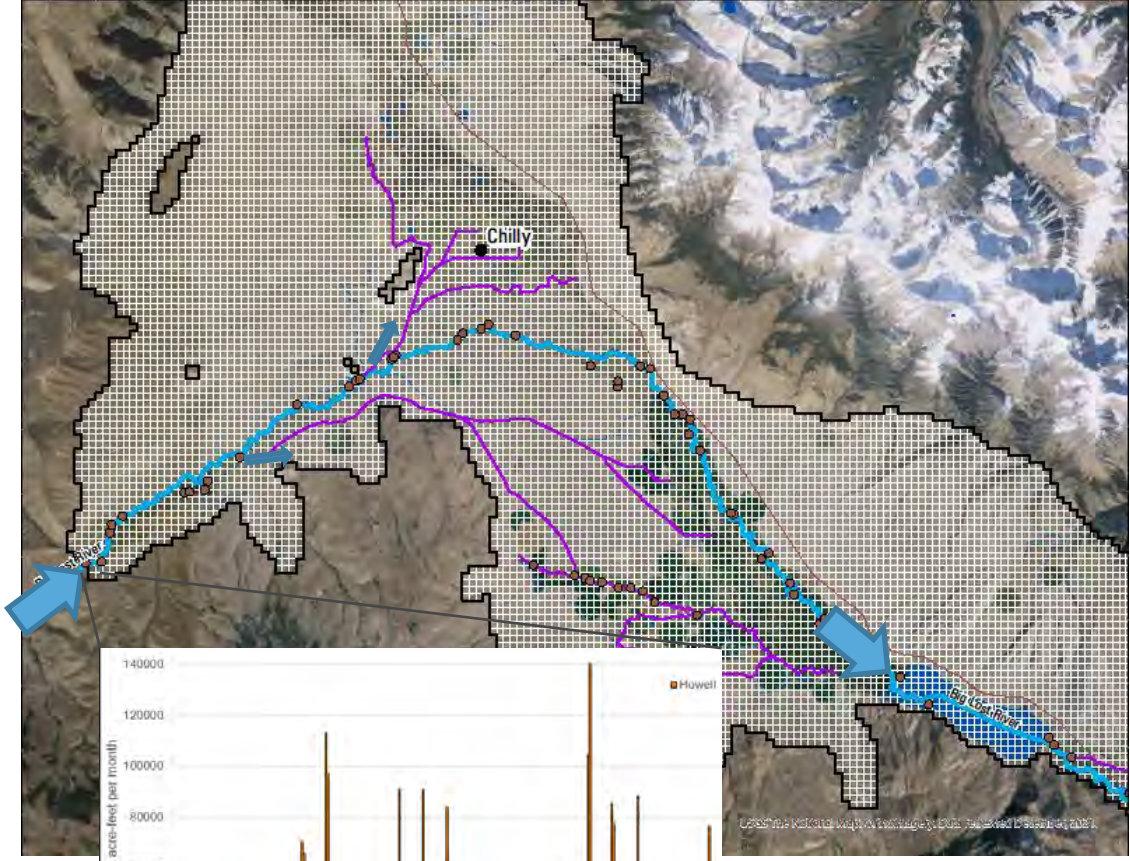


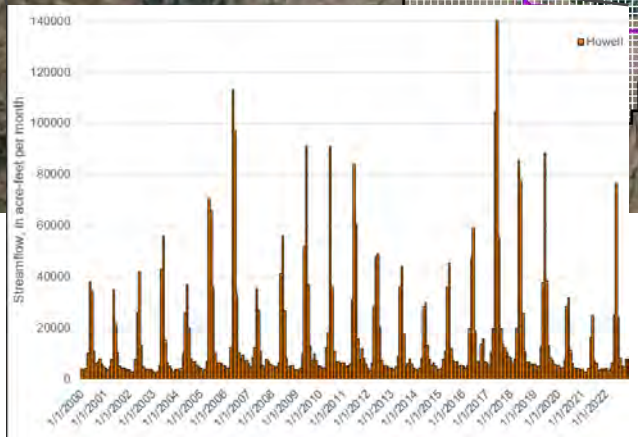
River flow

- Tracking flow rate in river
  - Using SFR package in MODFLOW
- Tell model the upstream inflows, diversions, and returns
- Model calculates seepage from river stage, groundwater level, and riverbed conductance
- Can simulate flow at any point along the river









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River seepage

- The model will calculate seepage from river stage, groundwater levels, and river conductance

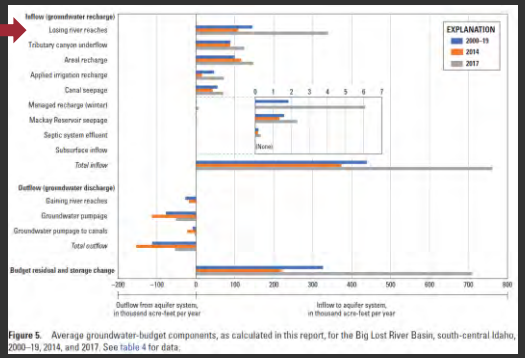
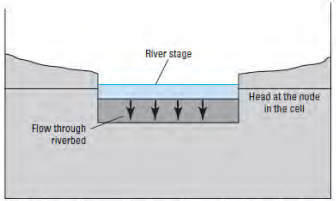
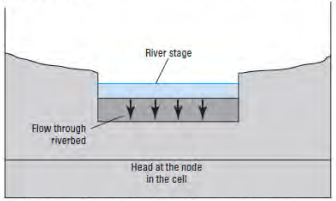


Figure 5. Average groundwater-budget components, as calculated in this report, for the Big Lost River Basin, south-central Idaho, 2000–19, 2014, and 2017. See table 4 for data.



A. Head at the bottom of the riverbed is equal to the head at the node in the cell.



B. Head at the bottom of the riverbed is equal to elevation of bottom of riverbed.

NOT TO SCALE

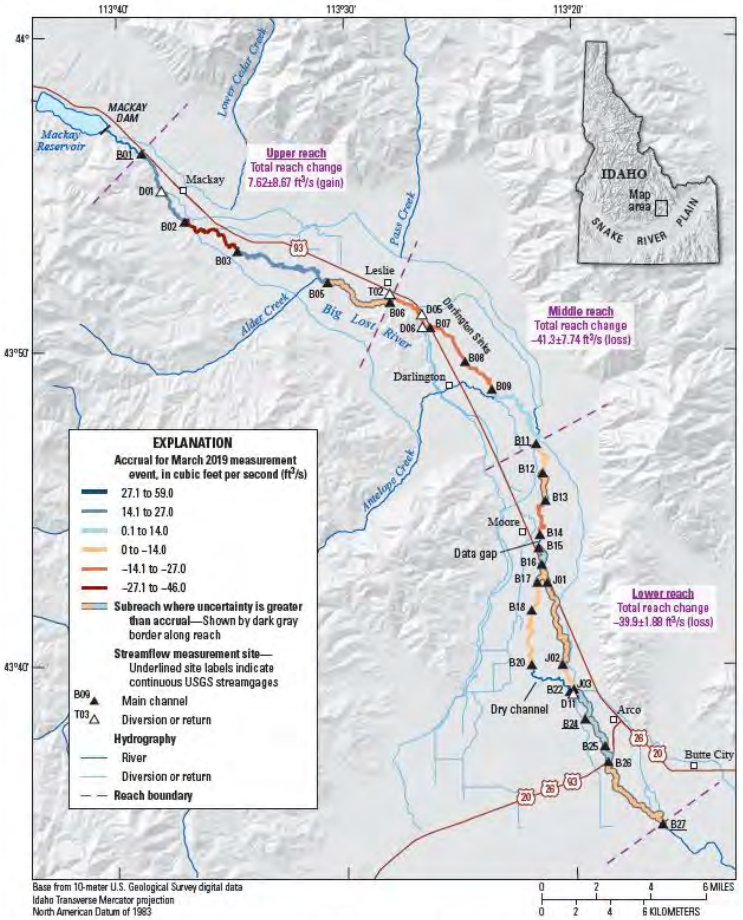


Figure 2. Gaining and losing reaches and subreaches on the Big Lost River, south-central Idaho, March 2019. USGS, U.S. Geological Survey; ±, plus or minus.

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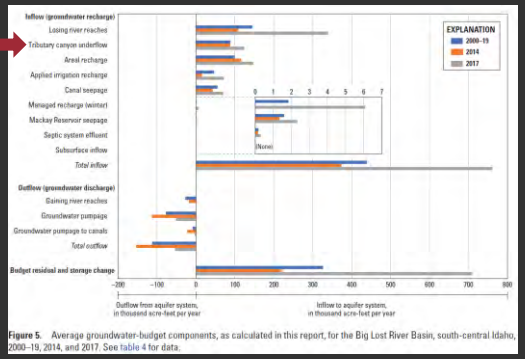
Tributary underflow

- Including mountain front, alluvial fan stream recharge
- Specified flux at outlet of canyon
- Used Clark (2022), vary years for wet and dry years



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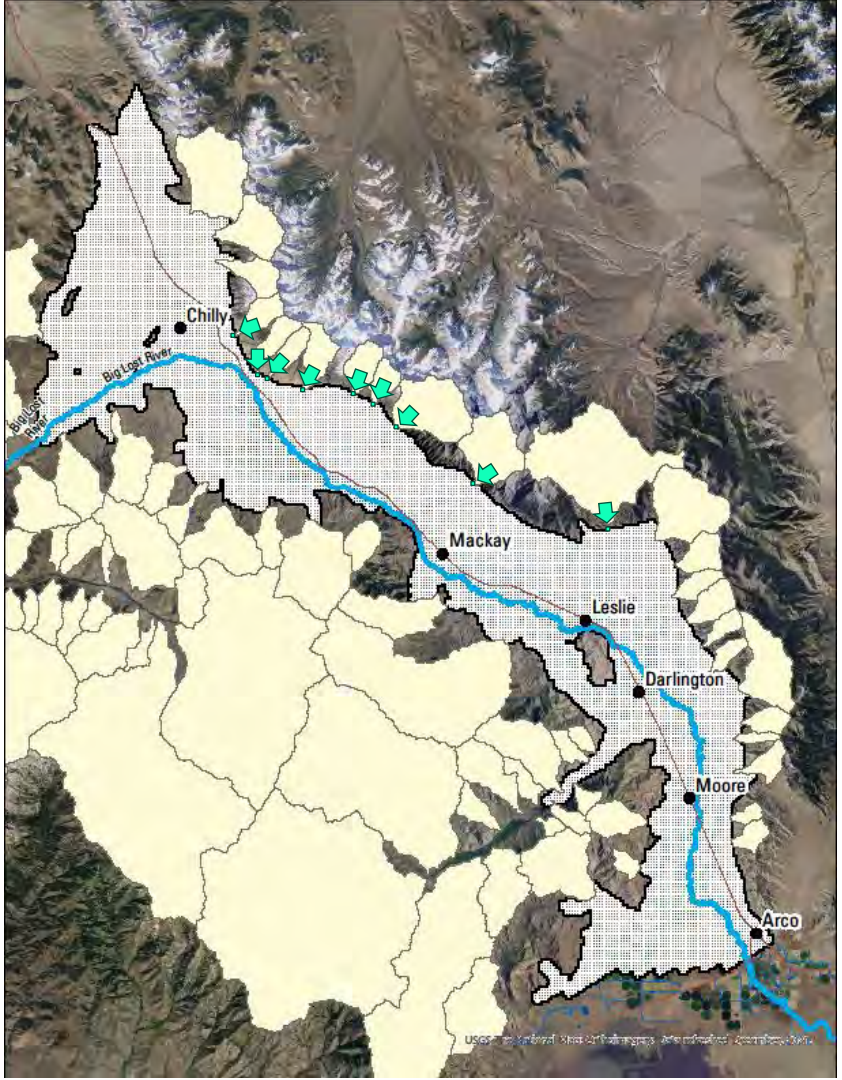

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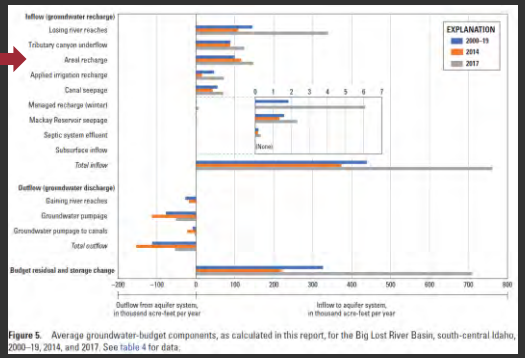
Aerial Recharge

- Precipitation (rain & snow) falling in valley
- Some % becomes recharge
- Not sure yet…
  - PRISM?
  - Reitz & Ward?



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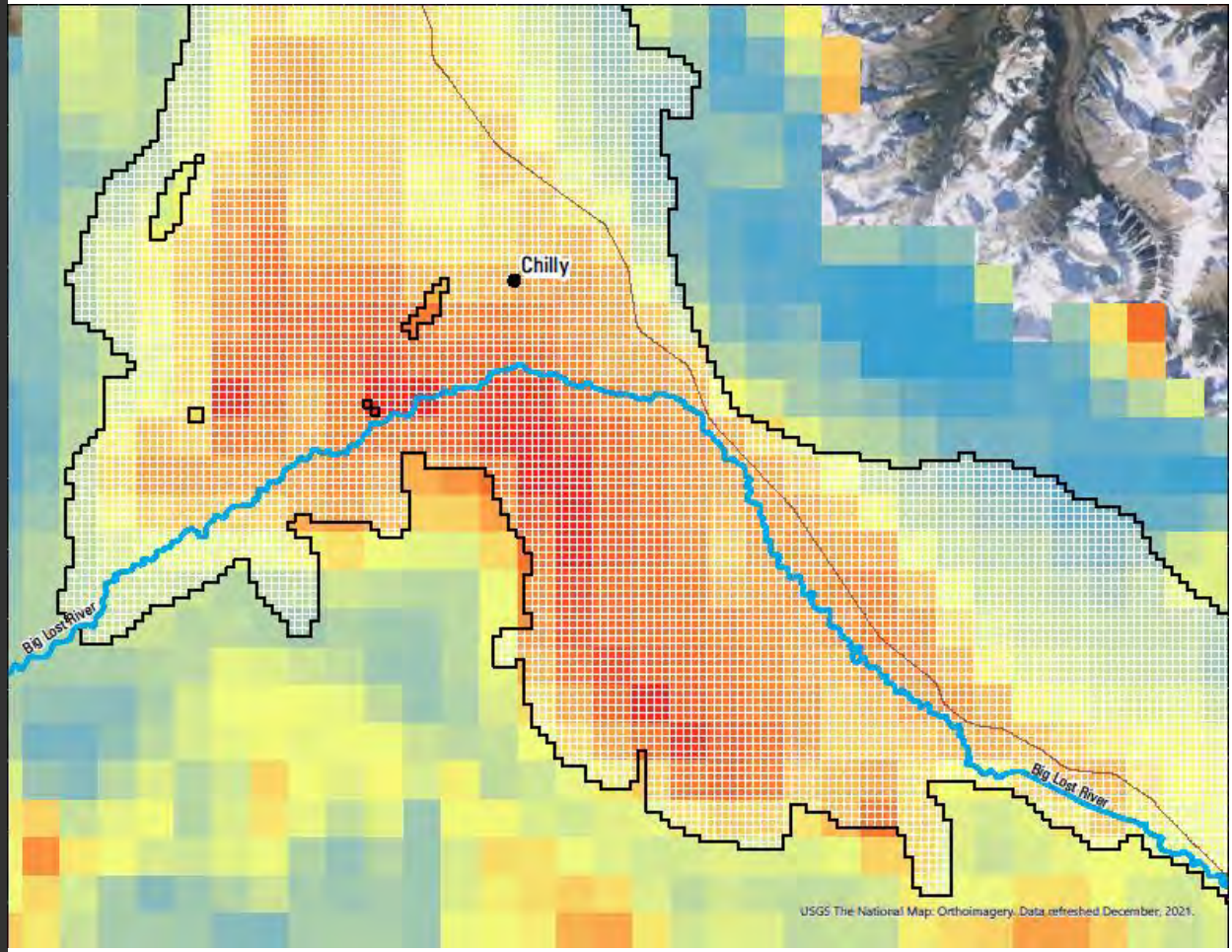

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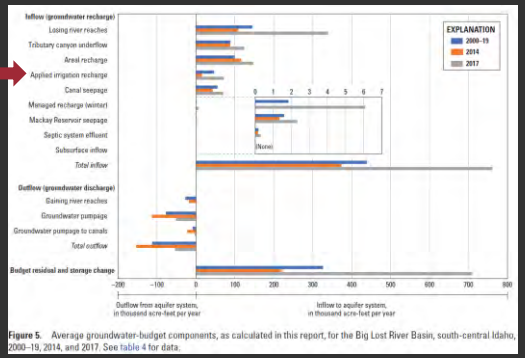
Incidental recharge

- Irrigation water that percolates past plant roots
- We have: diversions, irrigated land maps, diversion POU, total, ET, GW pumping (past few years)



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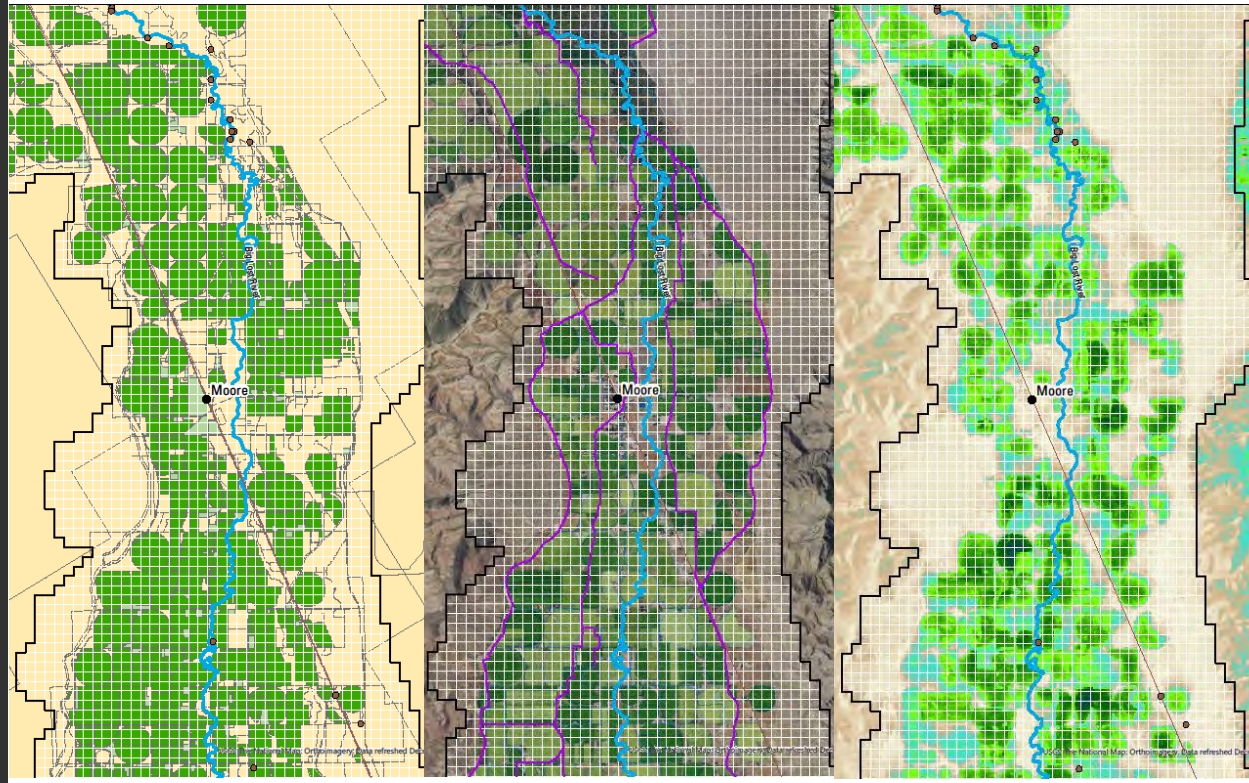

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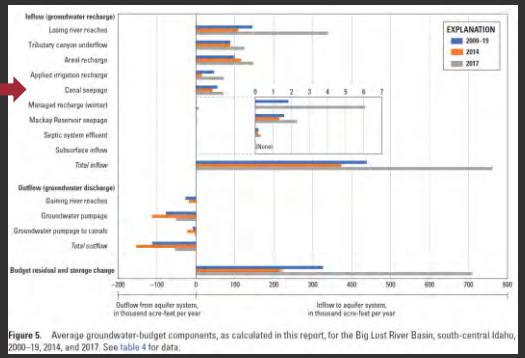
Canal seepage

- We have: diversions, canal locations, and rough estimates of leakage percent
- Will probably spread evenly along canal length; specify flux (not depending on canal level or ground water level)
- Would like more information:
  - Canal leakage volumes or percent losses
  - Which canals are lined and when



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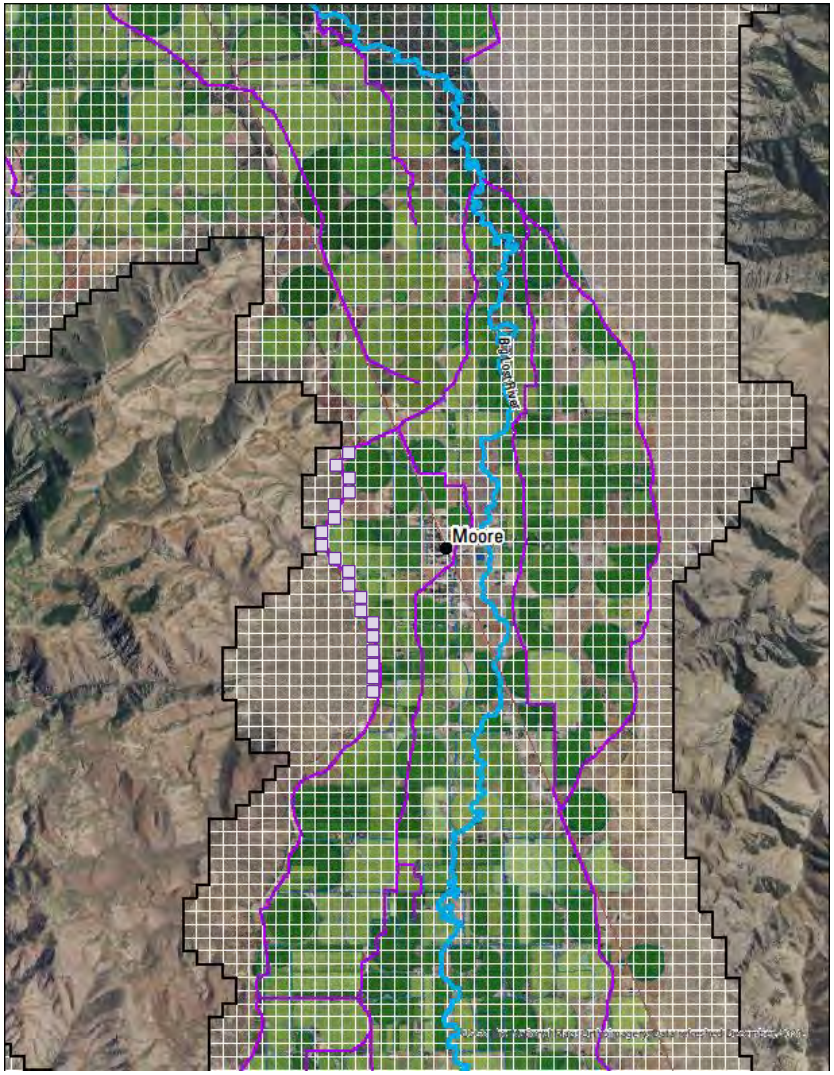

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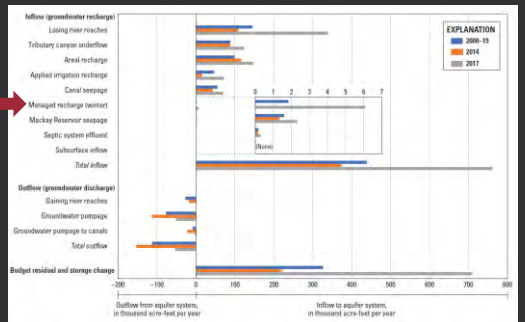
Managed recharge

- We know it is occurring, but…
- We need volumes & locations



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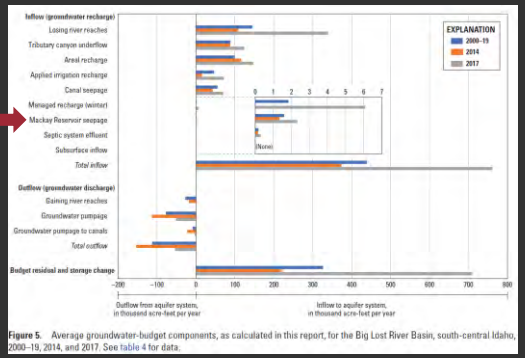
Mackay Reservoir seepage

- Water seeping from reservoir to groundwater
- We haven't yet decided how to represent the reservoir



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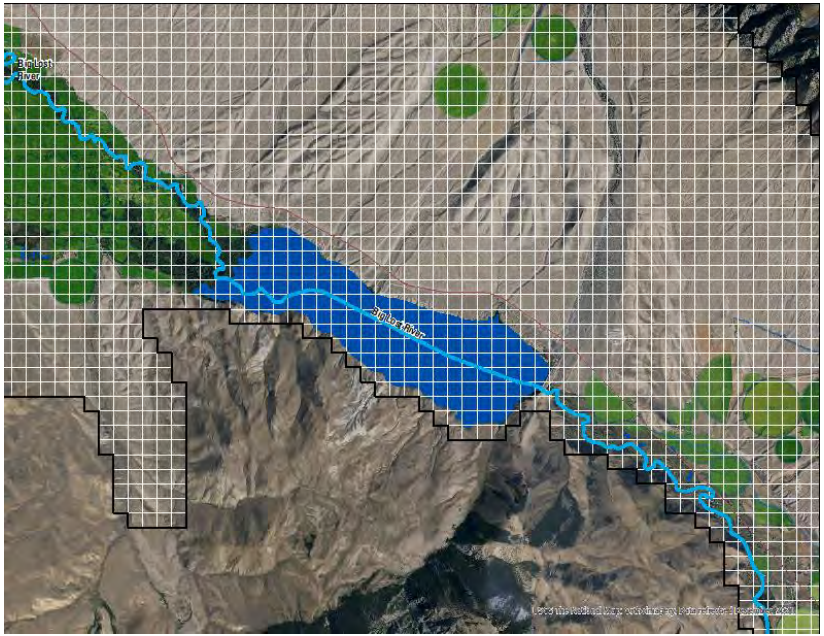

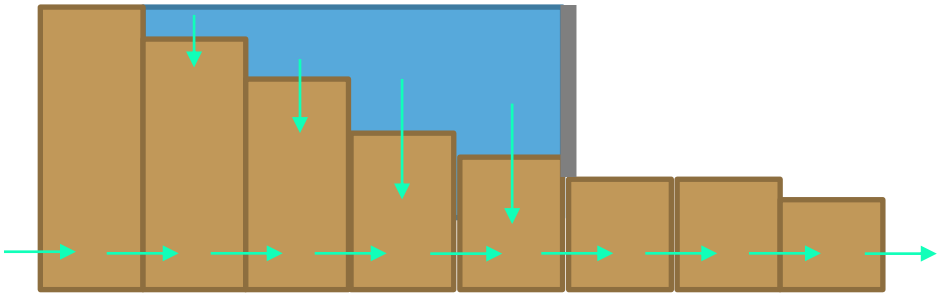

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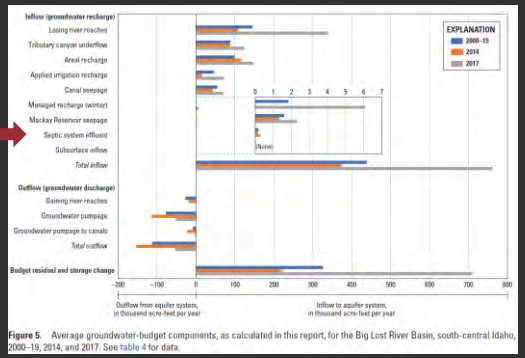
Septic

- Very small; not our priority right now
- Not sure if and how we'll estimate



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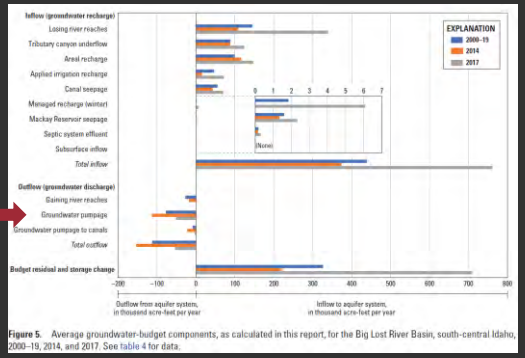
Groundwater pumpage

- We'll put pumping wells in the model in the cell in which they fall
- We have annual records for recent years for (some? all?) wells
  - We'll need to estimate monthly and other years based upon ET, irrigated lands, diversions



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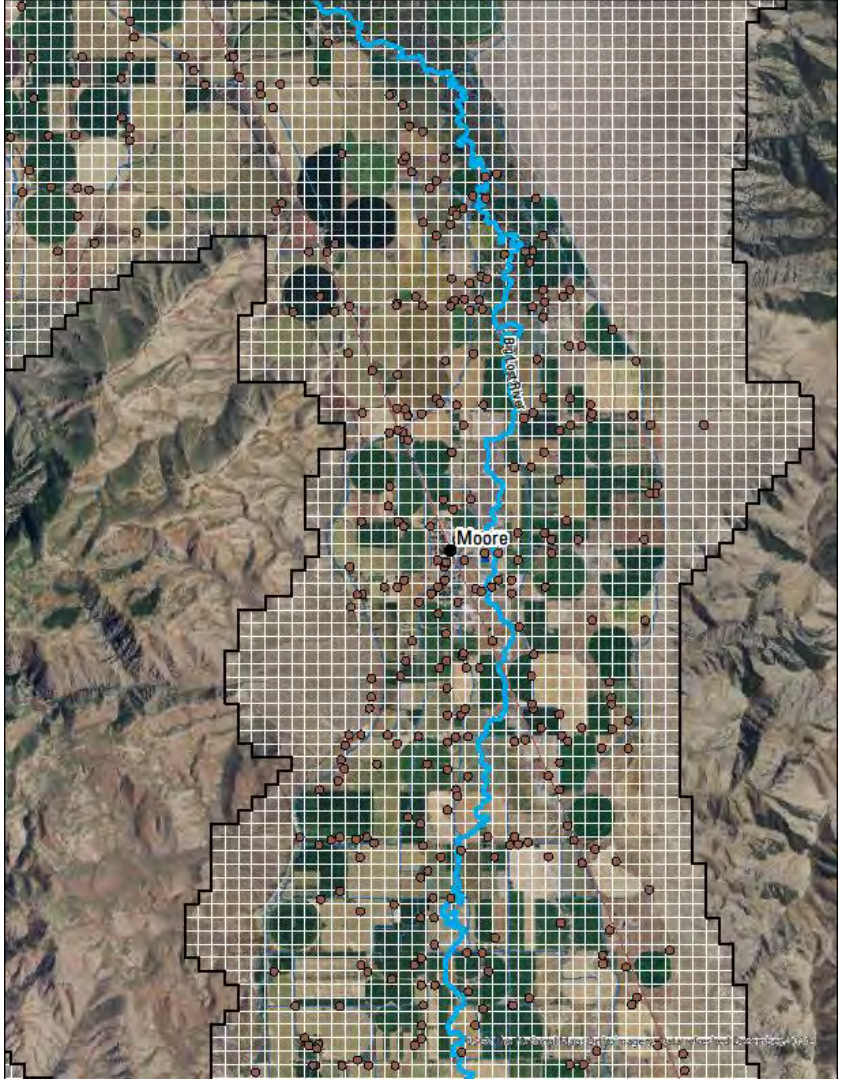

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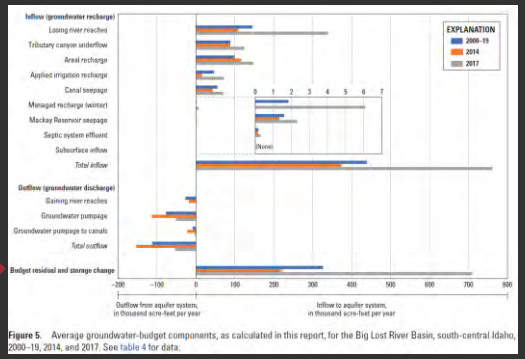
Groundwater outflow to ESPA

- We'll have a boundary on the southern end of the model that allows water to leave
- (Hydro)Geologic complexity in this area. We haven't chosen an approach for yet



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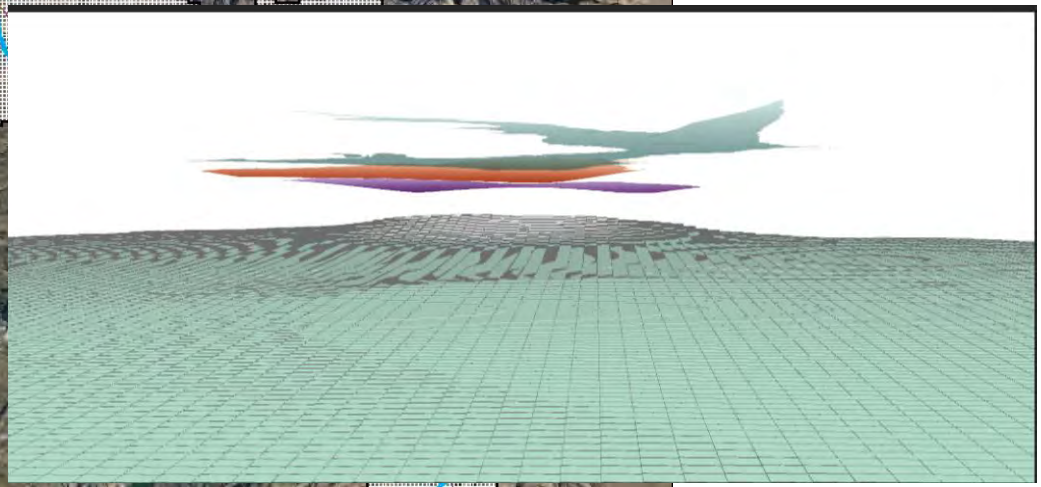

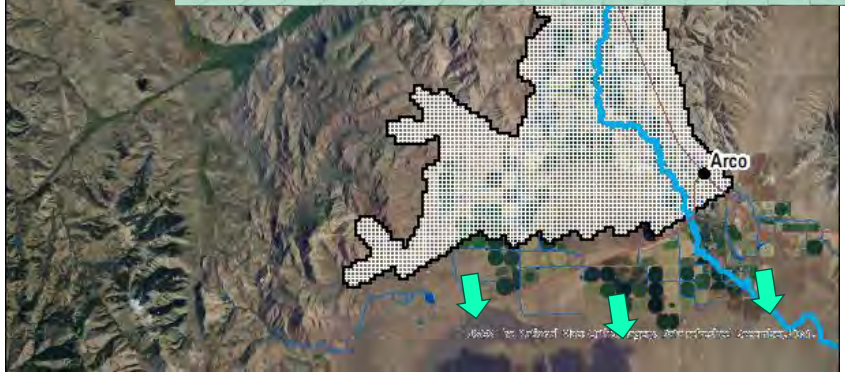

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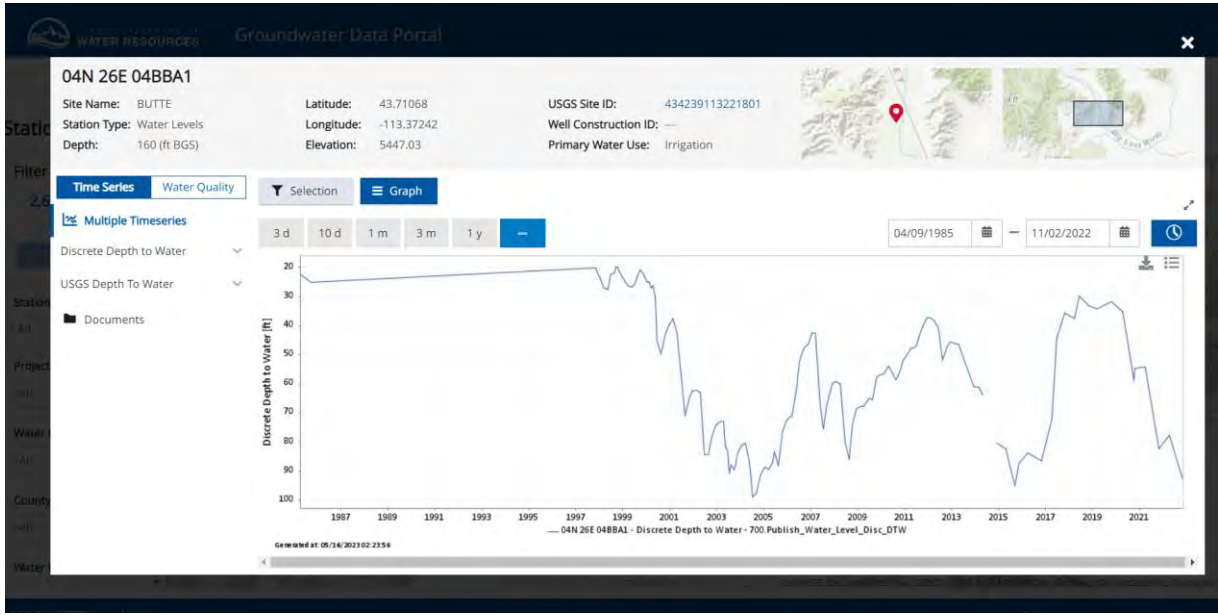
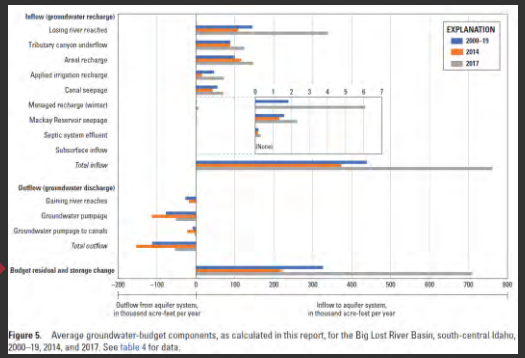
Change in groundwater storage

- Model will calculate monthly water level changes in all model cells
- & volumetric change in storage





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