Hydrogeologic Framework Lithologies on Model Grid

Stephen Hundt

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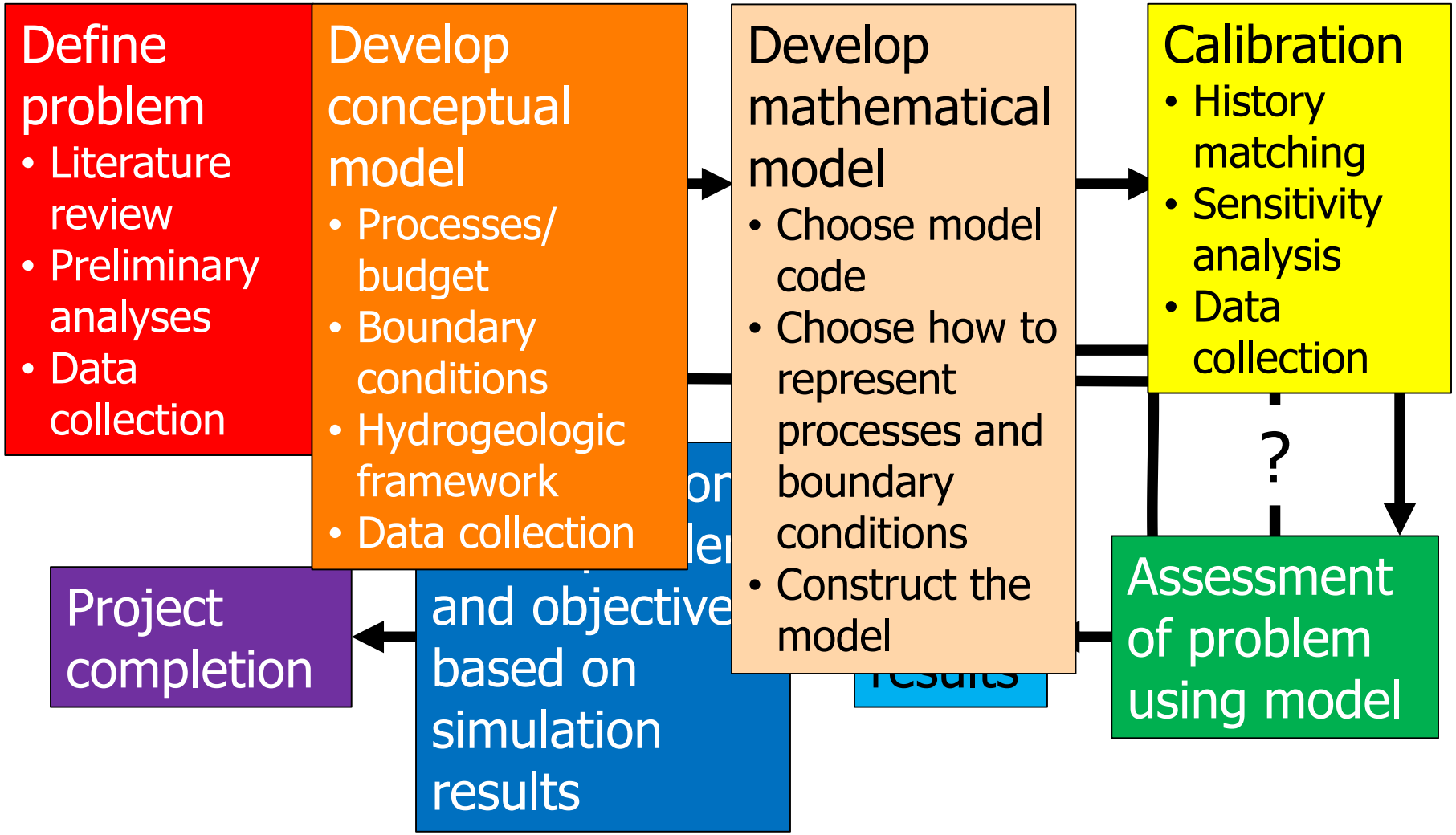
But first,
where are we...

The modeling process

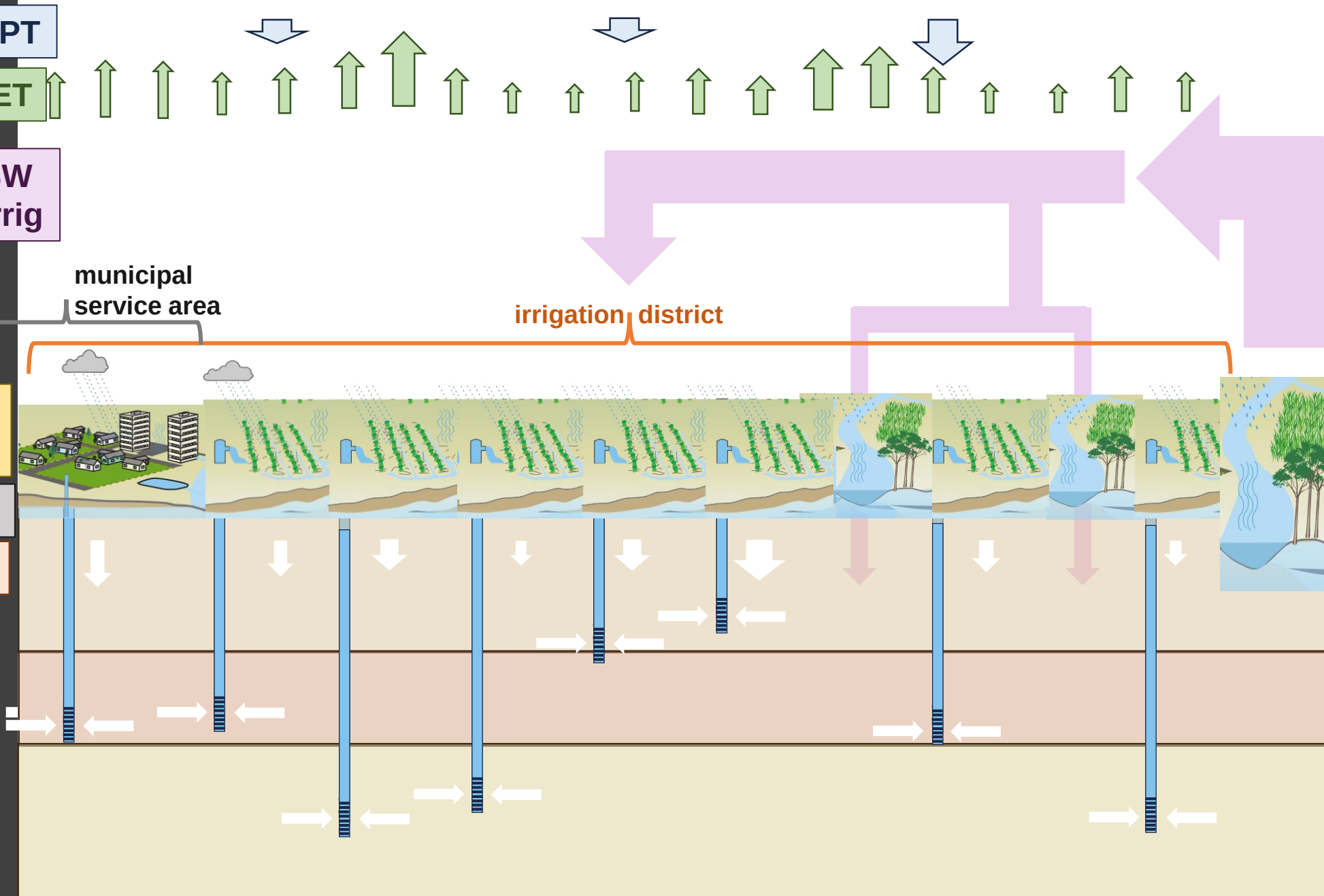


After Reilly (2001) TWRI 3,B8

Soil moisture budget

Needed to figure out:
- Incidental recharge
- PPT recharge
- Canal leakage
- Pumping

Still working on:
- Data
- Cleaning data
- Processing routines



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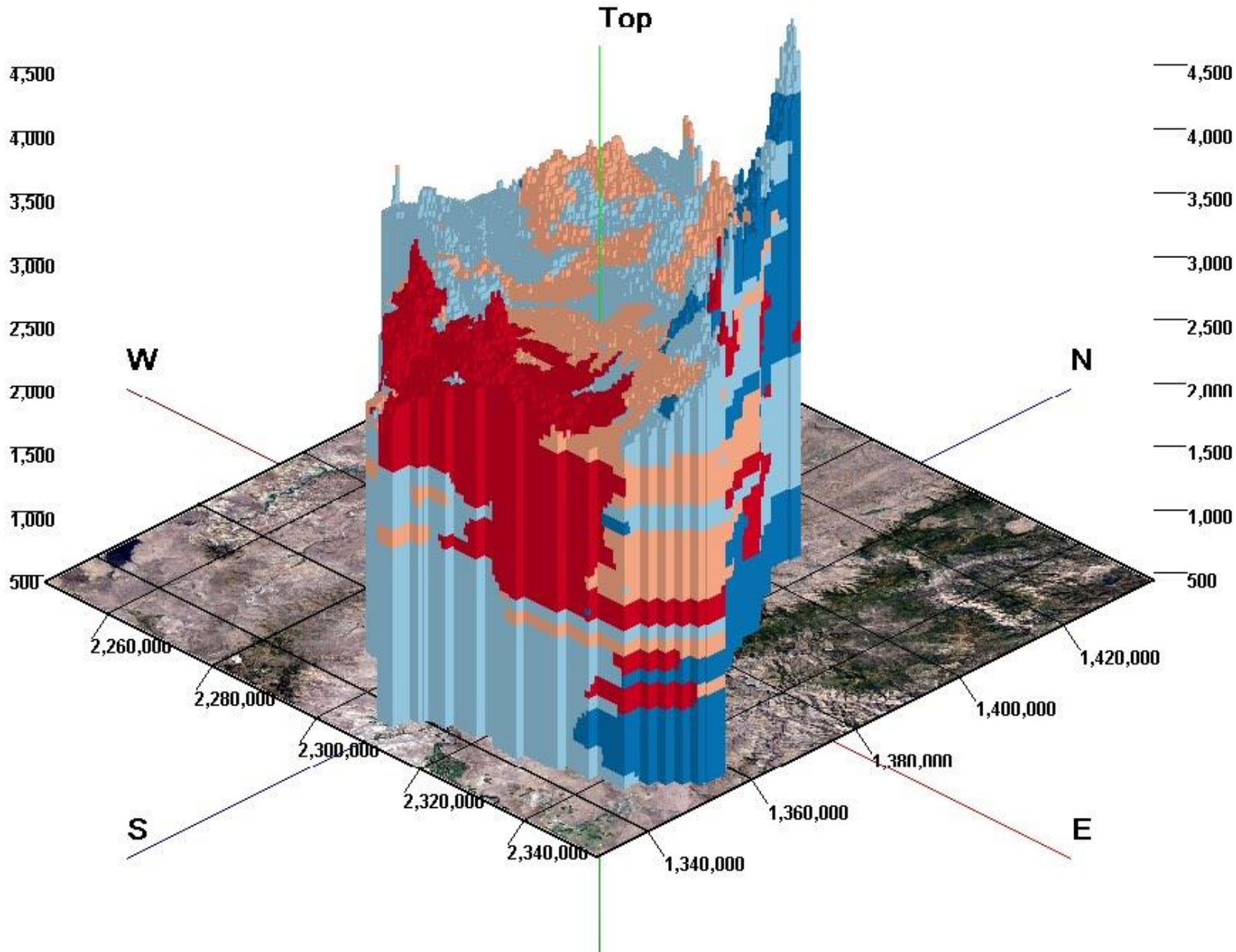
Hydrogeologic Framework of the Treasure Valley and Surrounding Area, Idaho and Oregon

J.R. Bartolino, USGS, Idaho Water Science Center



Hydrogeologic unit

- BAS: Basalt, undifferentiated: includes Pliocene-Pleistocene and Miocene basalts
- CGF: Coarse-grained fluvial and alluvial deposits
- FGL: Fine-grained lacustrine deposits
- GRB: Granitic and rhyolitic bedrock

20X vertical exageration

Vertical scale is feet above datum

Horizontal scale is Idaho UTM meters

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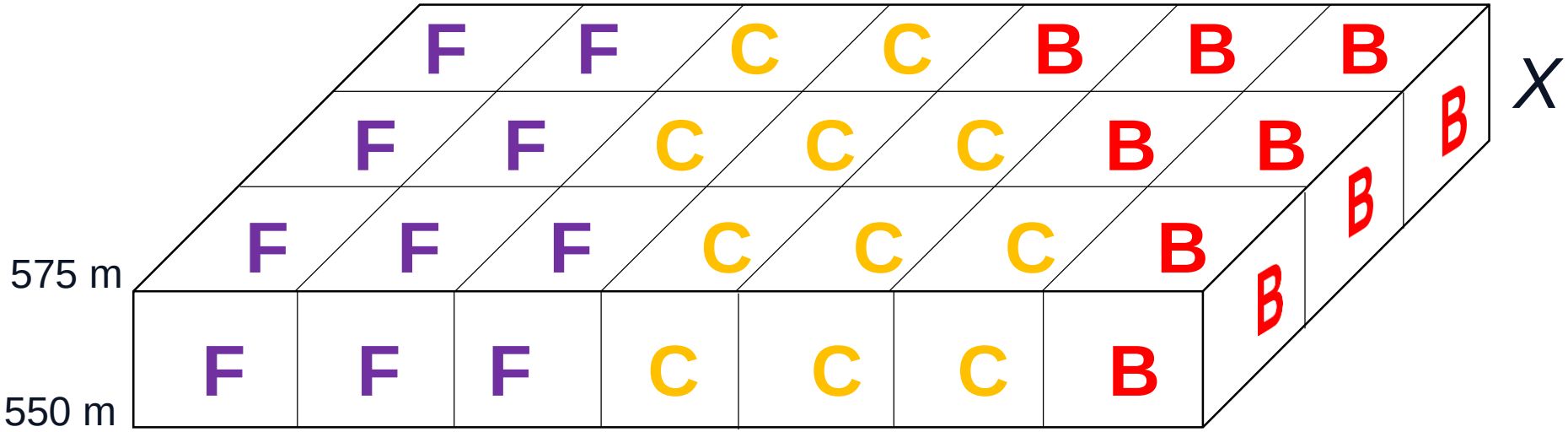
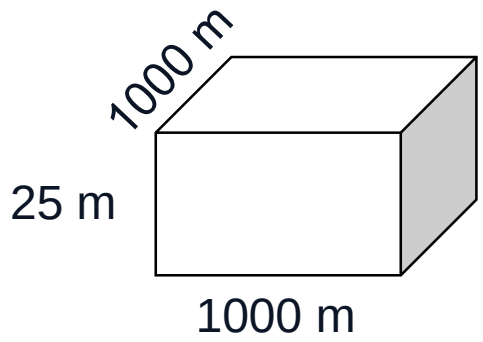
Rockworks hydrogeologic framework model "layer X"





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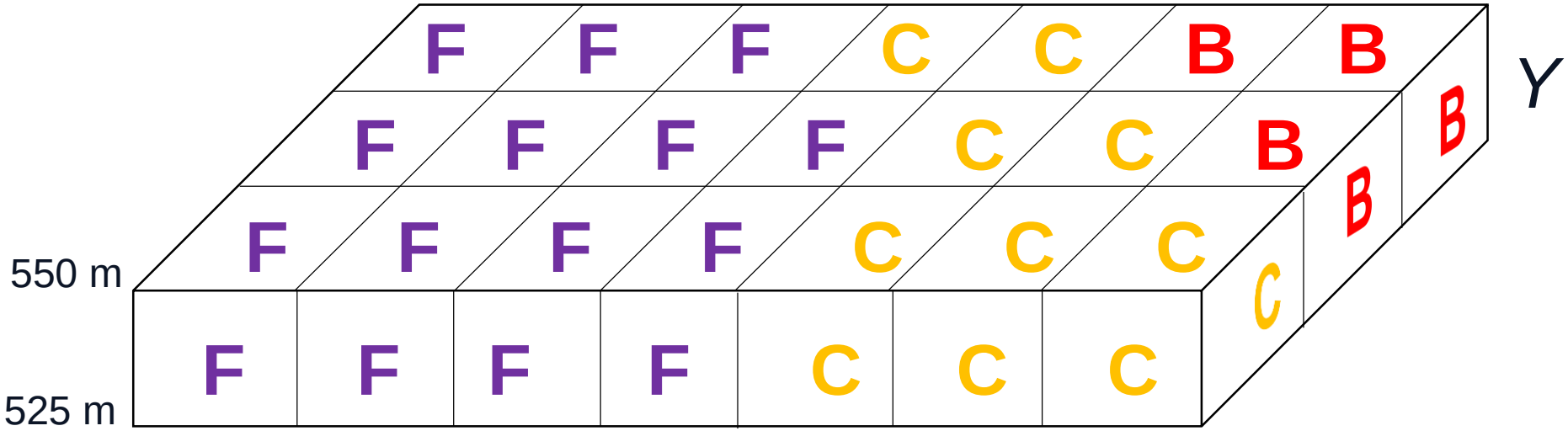
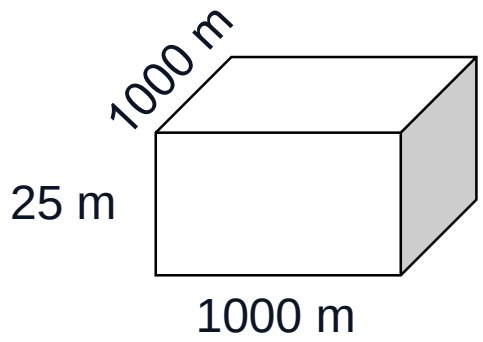
Rockworks hydrogeologic framework model "layer Y"





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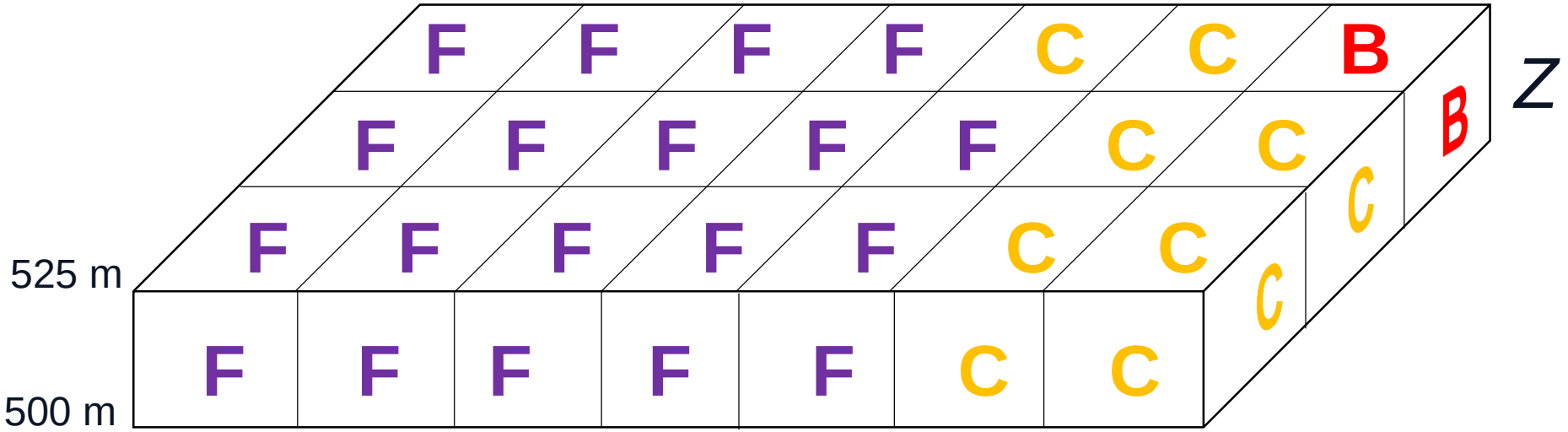
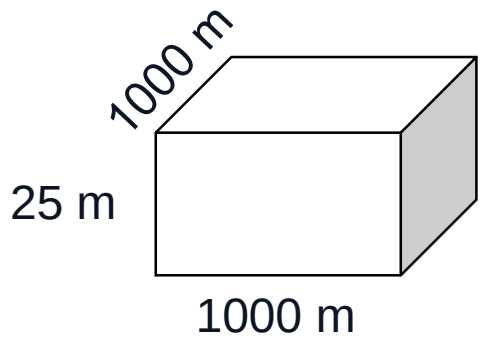
Rockworks hydrogeologic framework model "layer Z"





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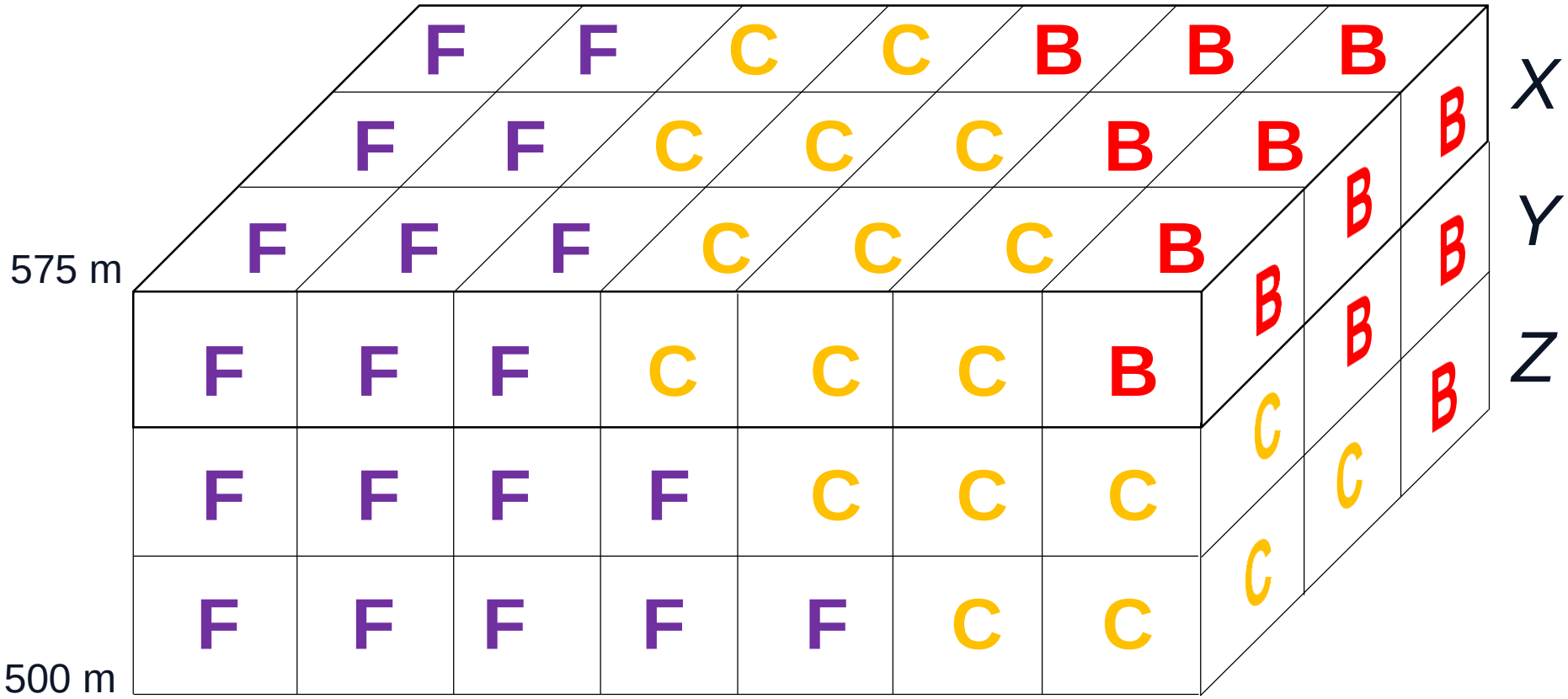
Rockworks hydrogeologic framework model



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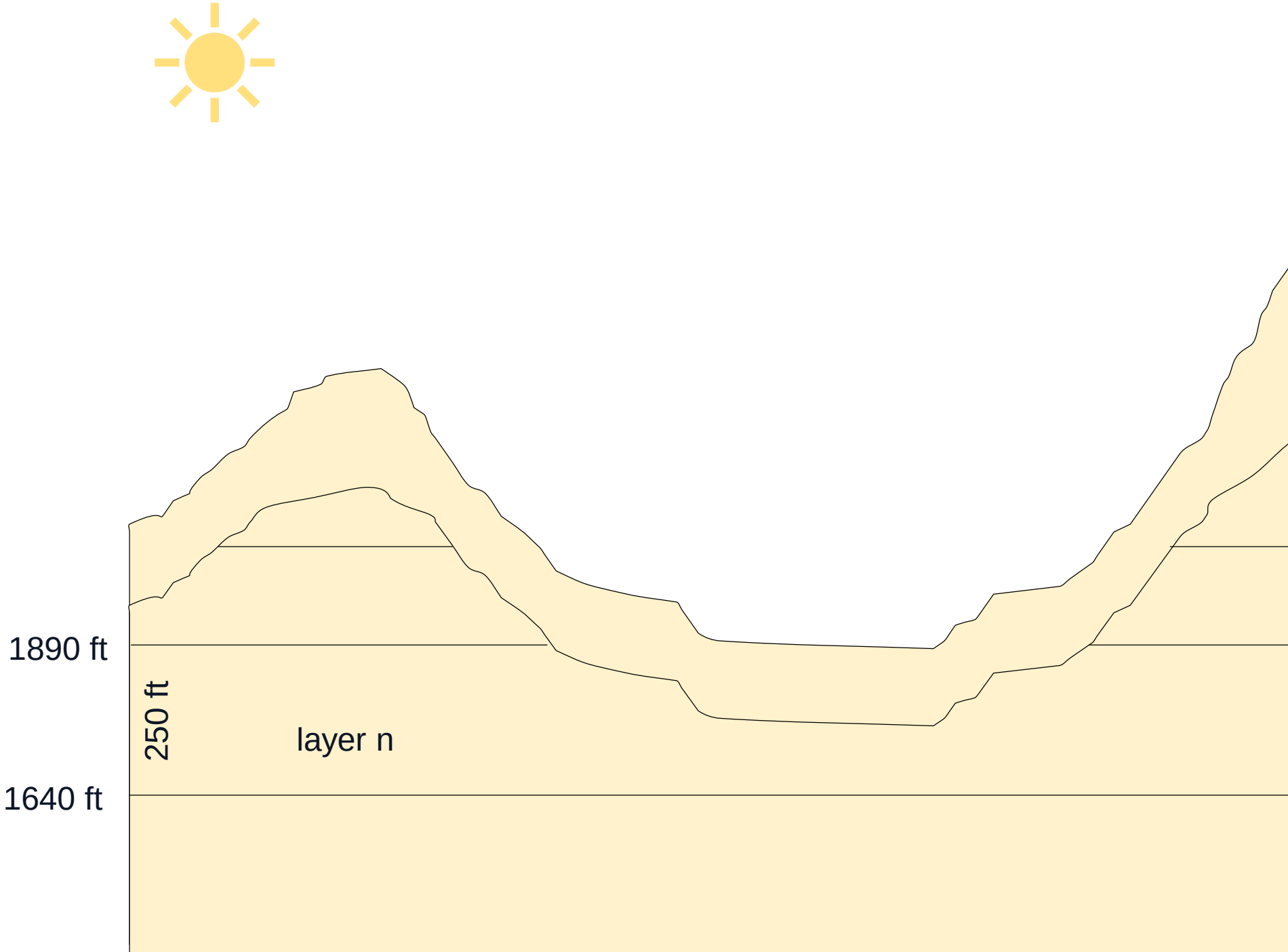
Flow model layer



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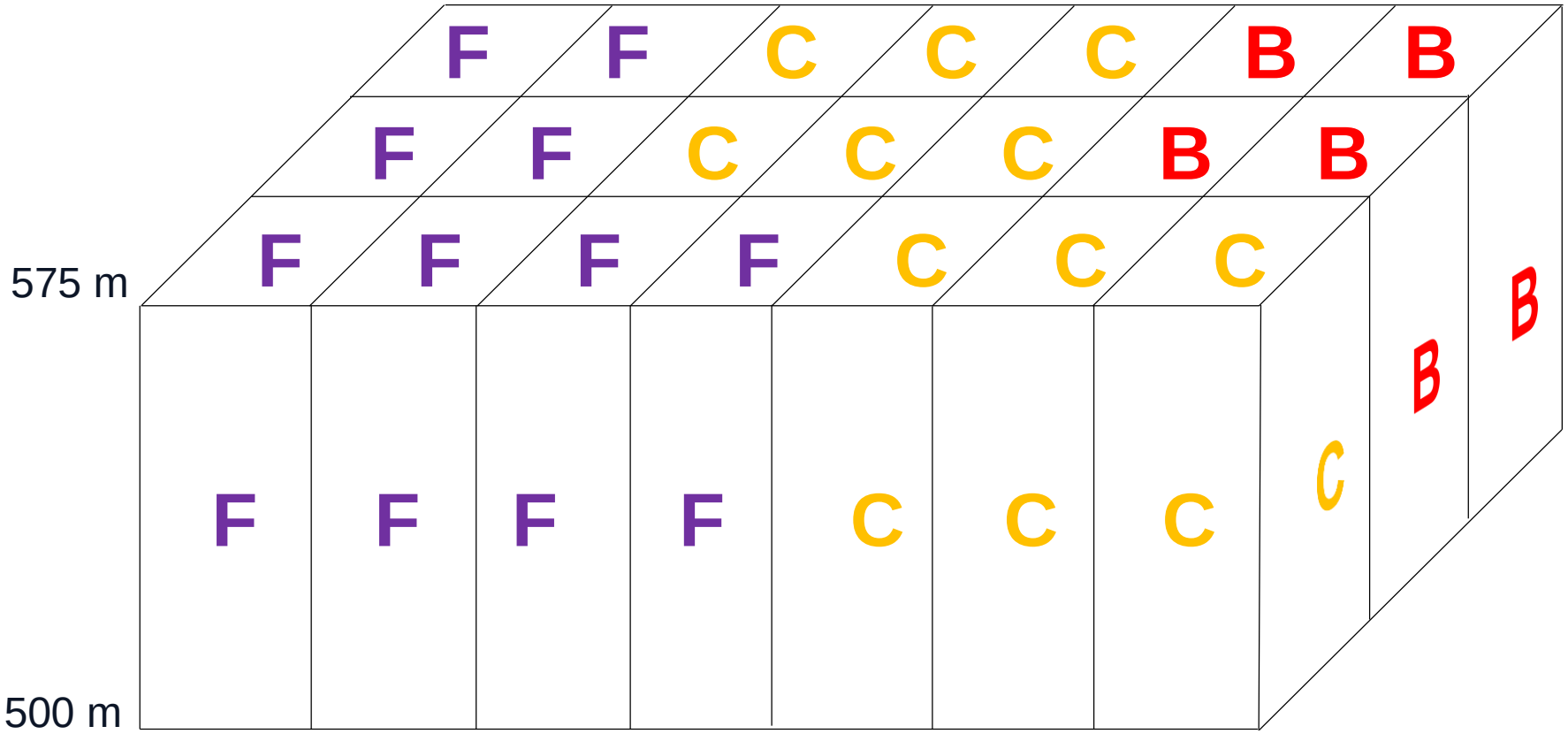
Lithology for the flow model layer



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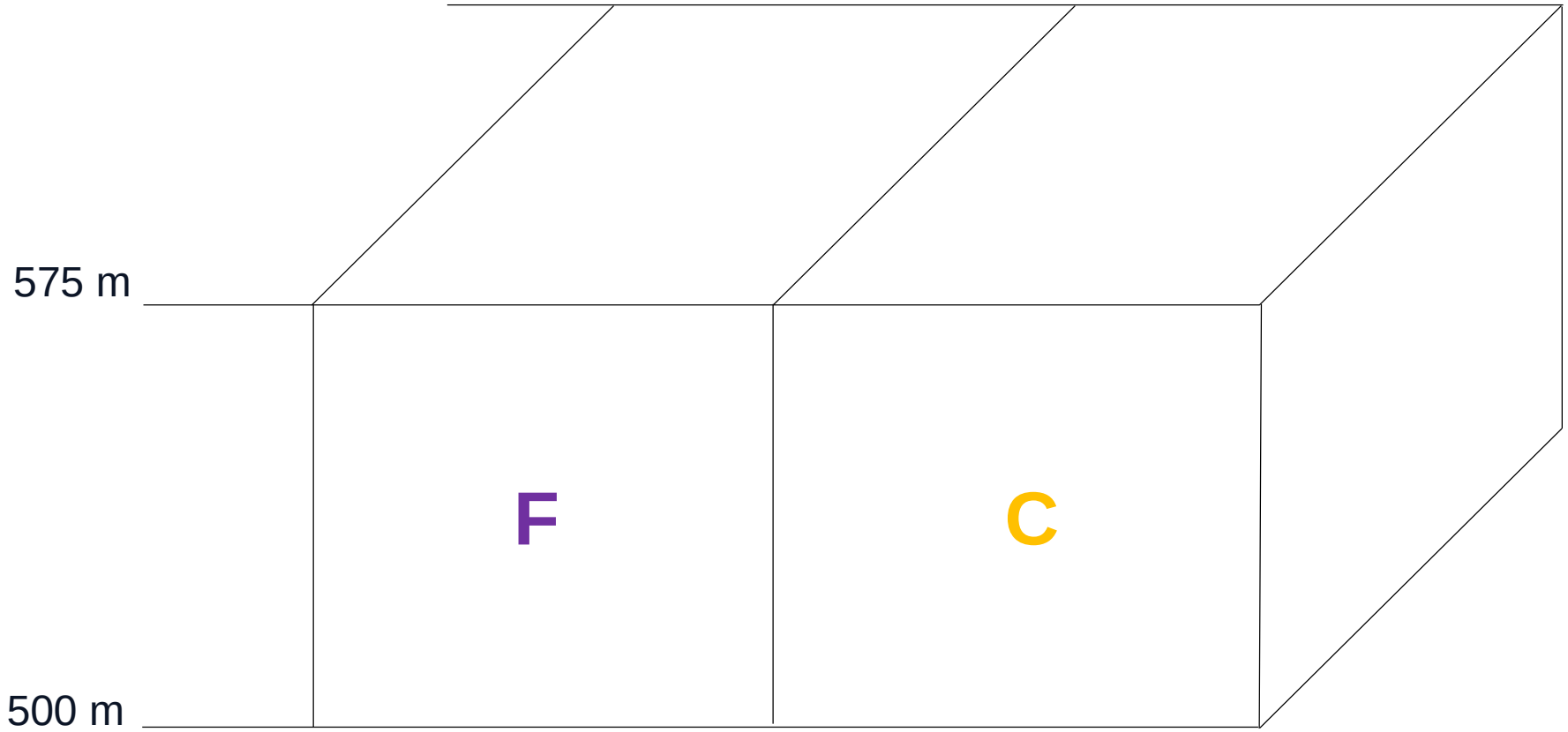
Lithology for the flow model cell



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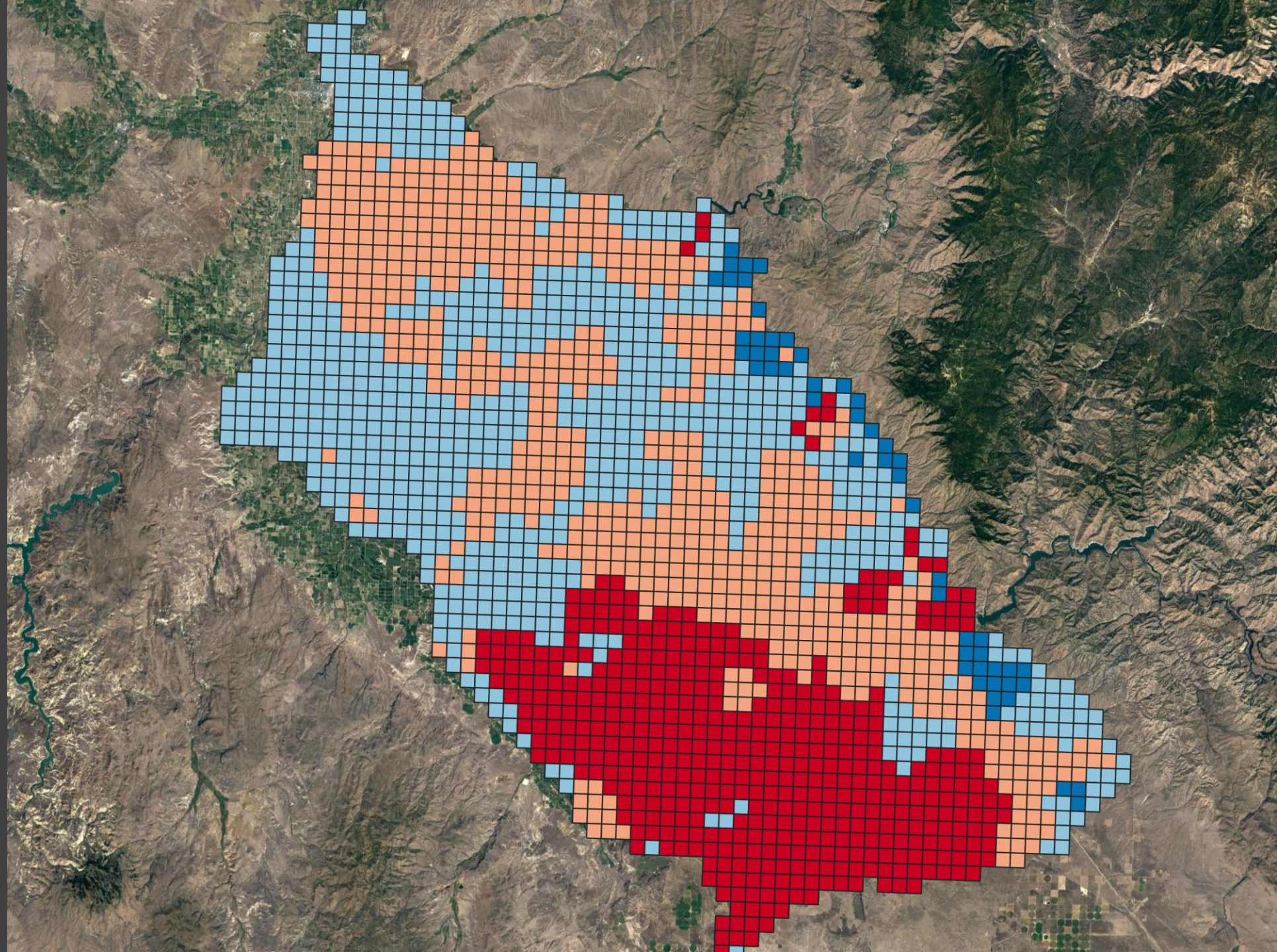
Lithology Mapped to Grid: Layer 1



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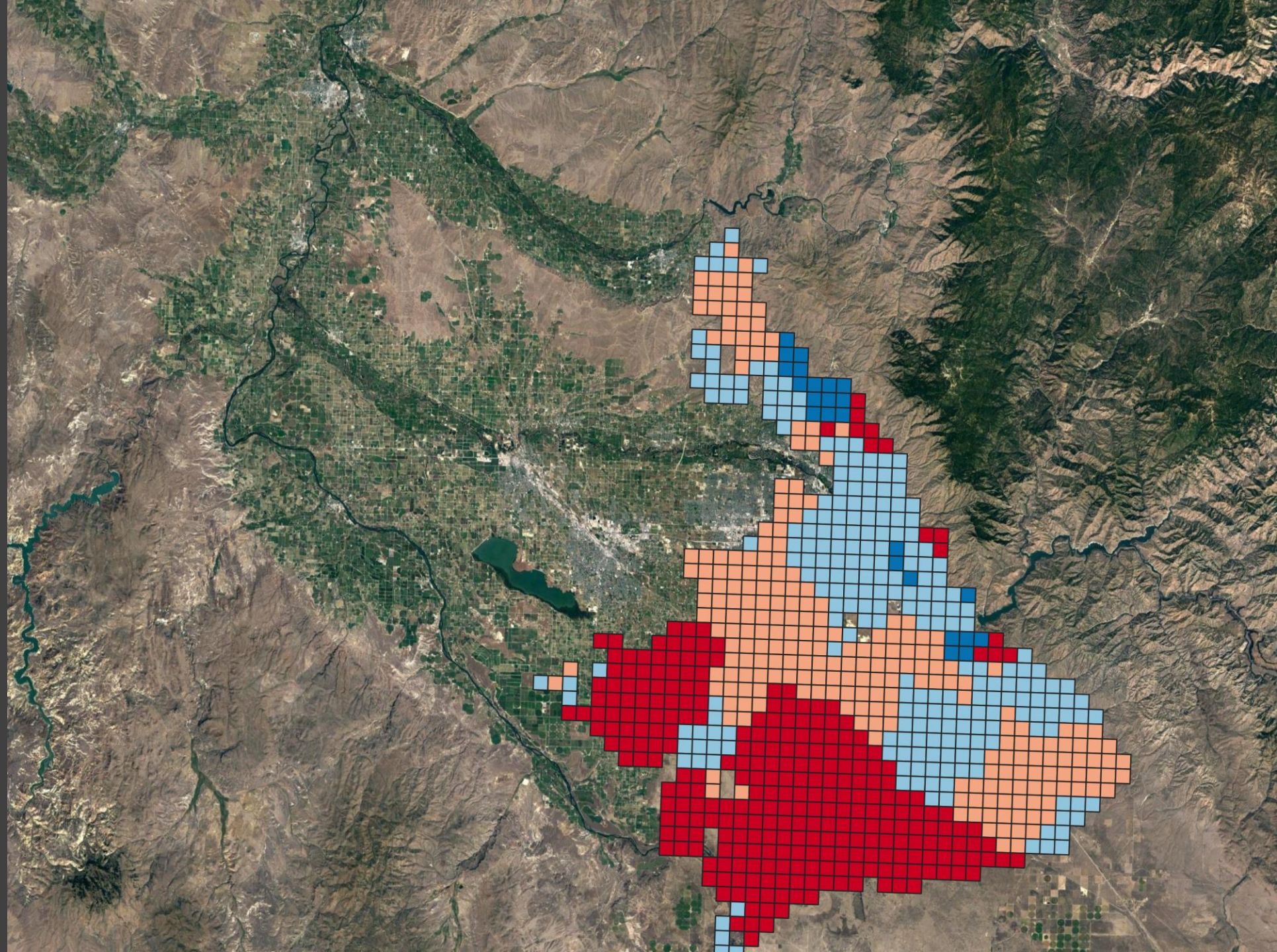
Lithology Mapped to Grid: Layer 2



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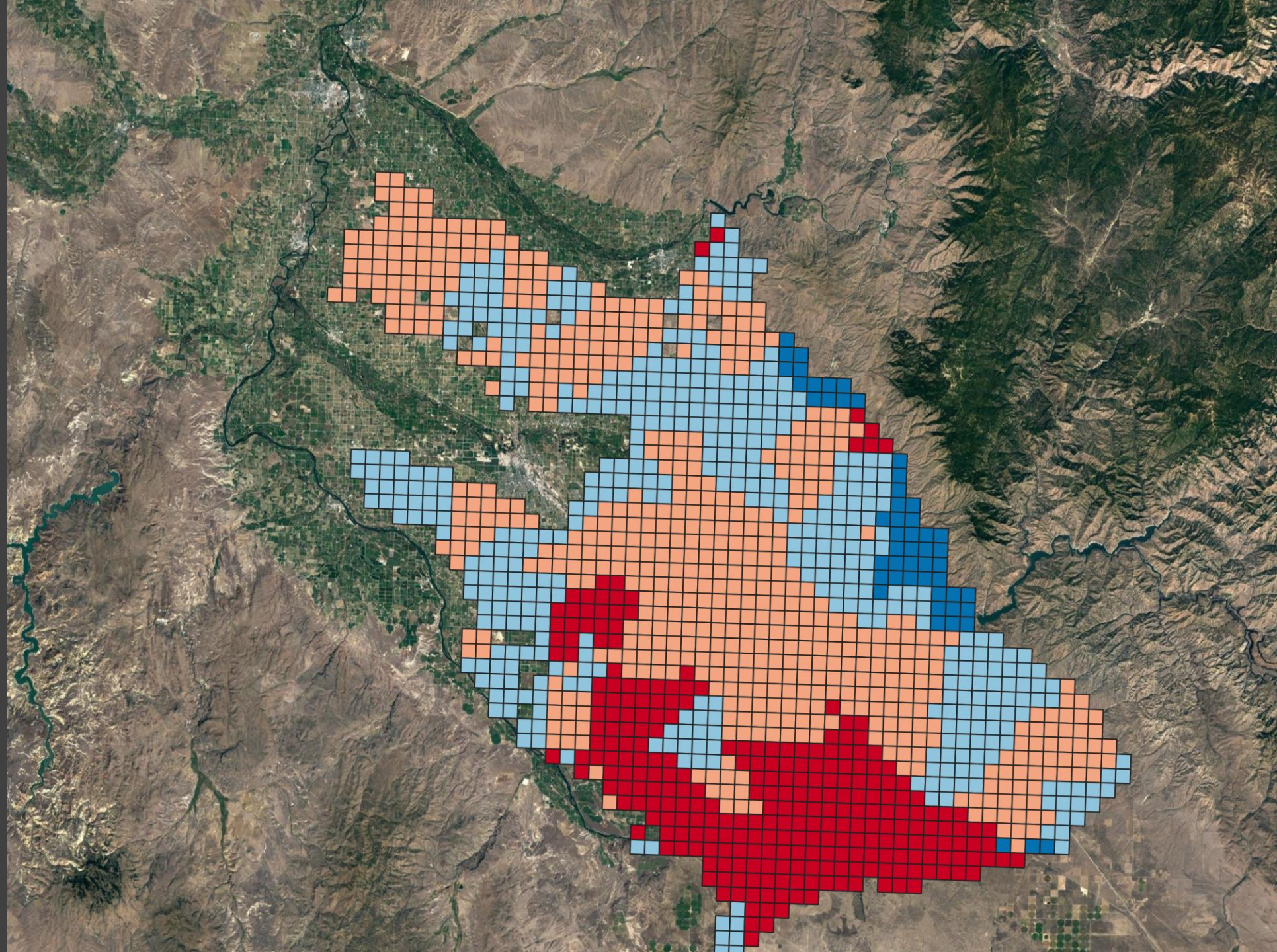
Lithology Mapped to Grid: Layer 3



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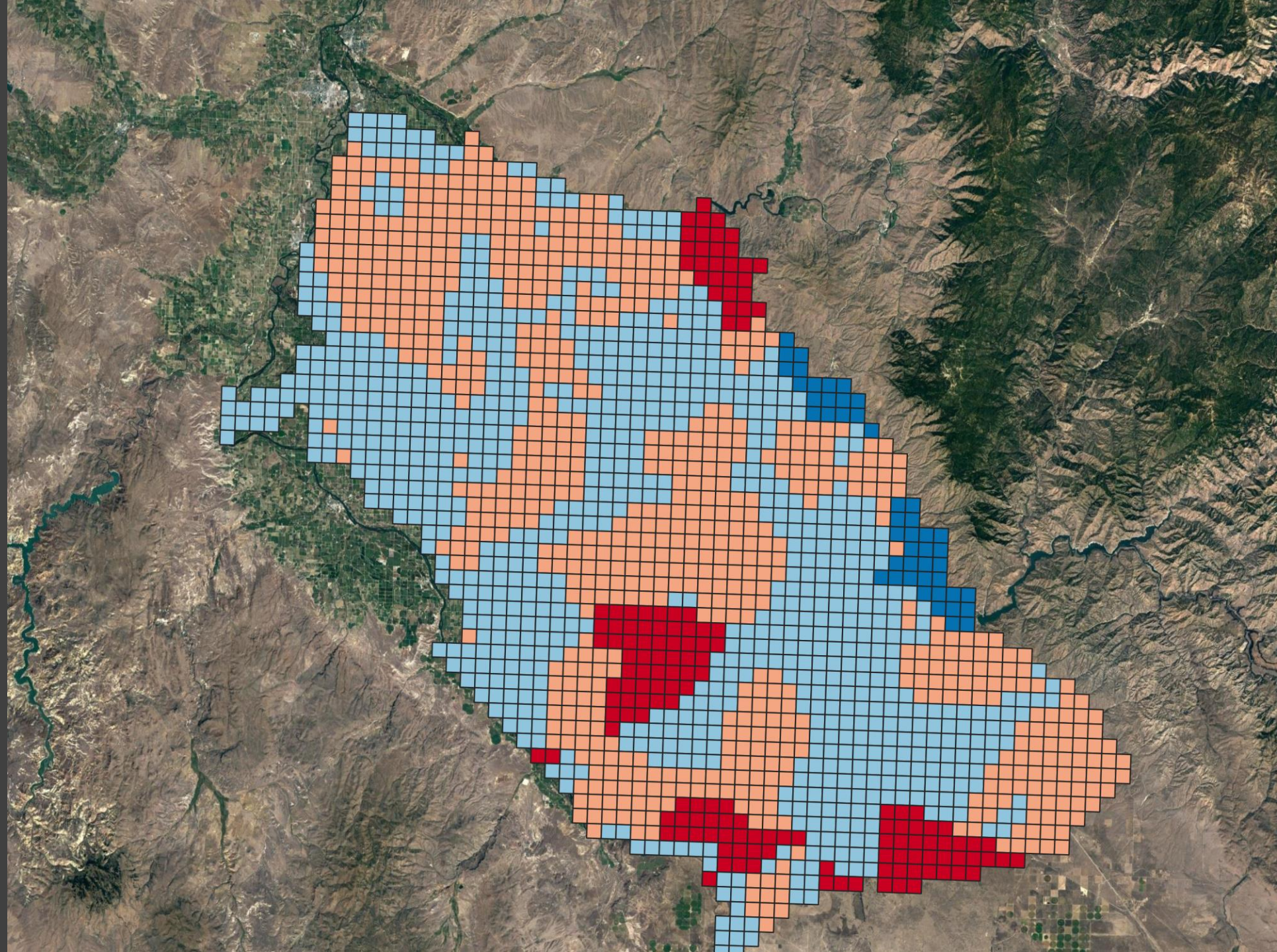
Lithology Mapped to Grid: Layer 4



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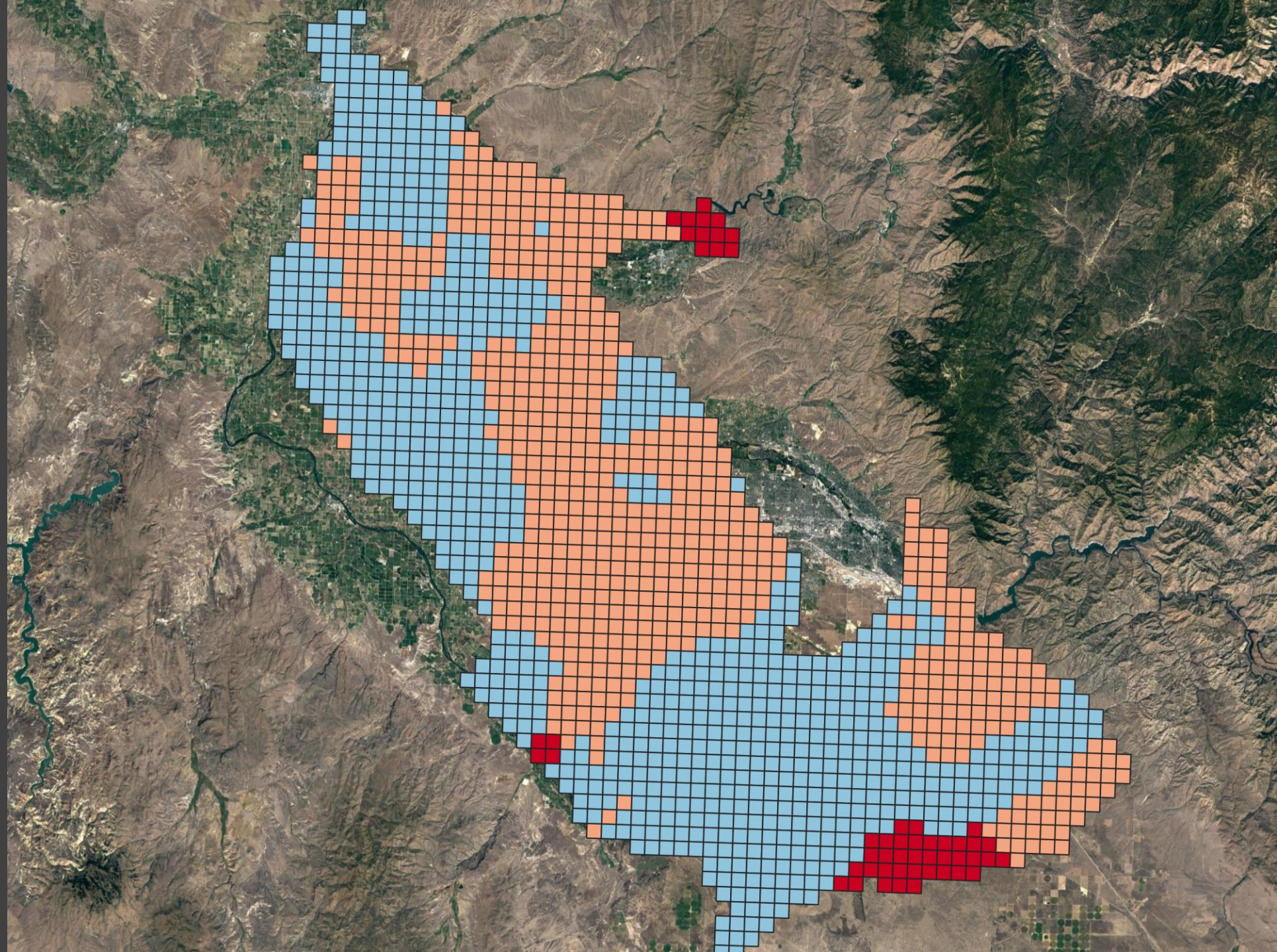
Lithology Mapped to Grid: Layer 5



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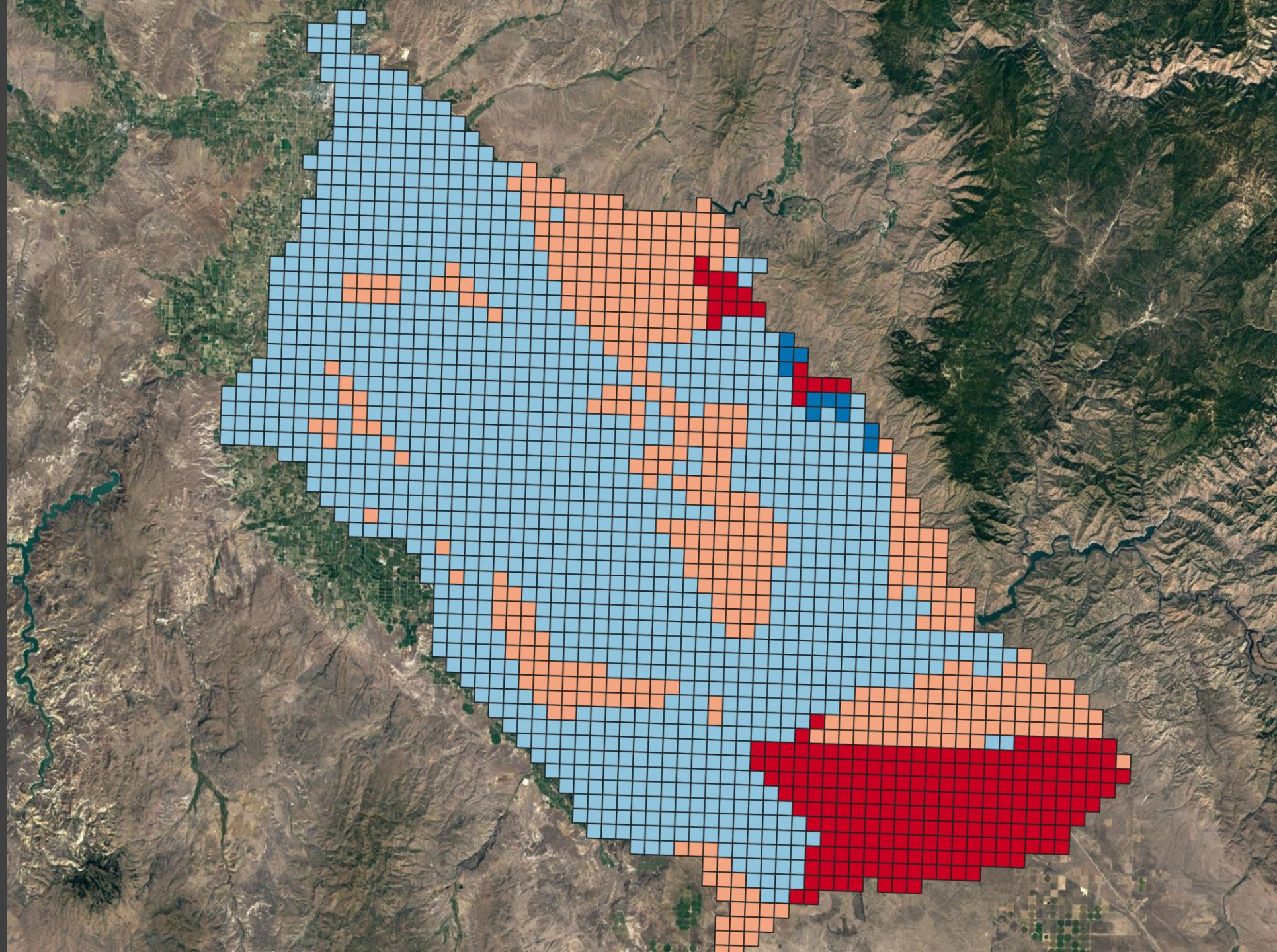
Lithology Mapped to Grid: Layer 6



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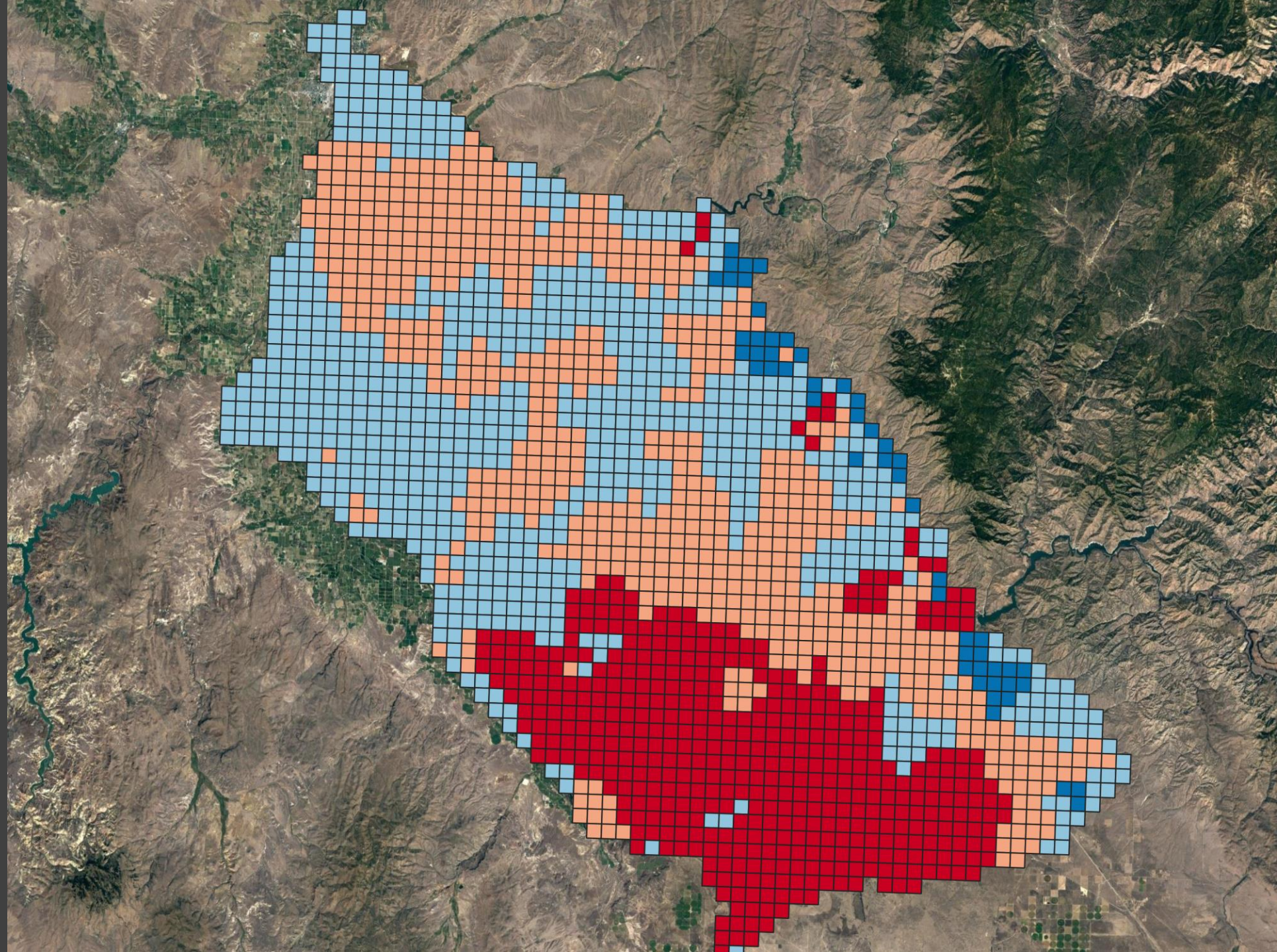
Why?



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Why?

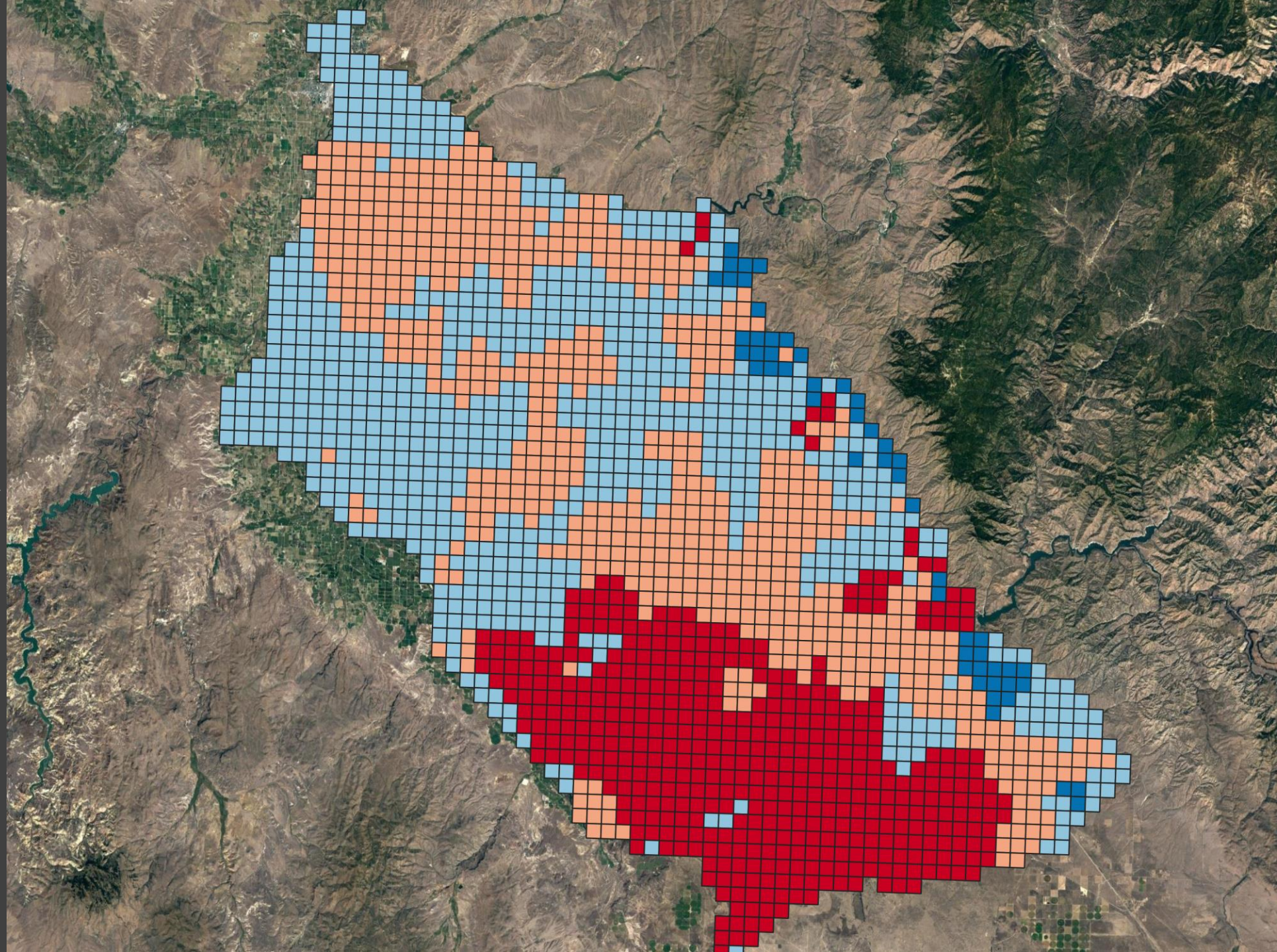
Every cell needs hydraulic parameter values:

- Horizontal hydraulic conductivity (**HK**)
- Vertical hydraulic conductivity (**VK**)
- Storage Coefficient (**S**)

$$\frac{\partial}{\partial x}\left(Hk\frac{\partial h}{\partial x}\right)+\frac{\partial}{\partial y}\left(Hk\frac{\partial h}{\partial y}\right)+\frac{\partial}{\partial z}\left(Vk\frac{\partial h}{\partial z}\right)-W=S\frac{\partial h}{\partial t}$$

Geologic information can inform:

- Values
- Spatial distribution



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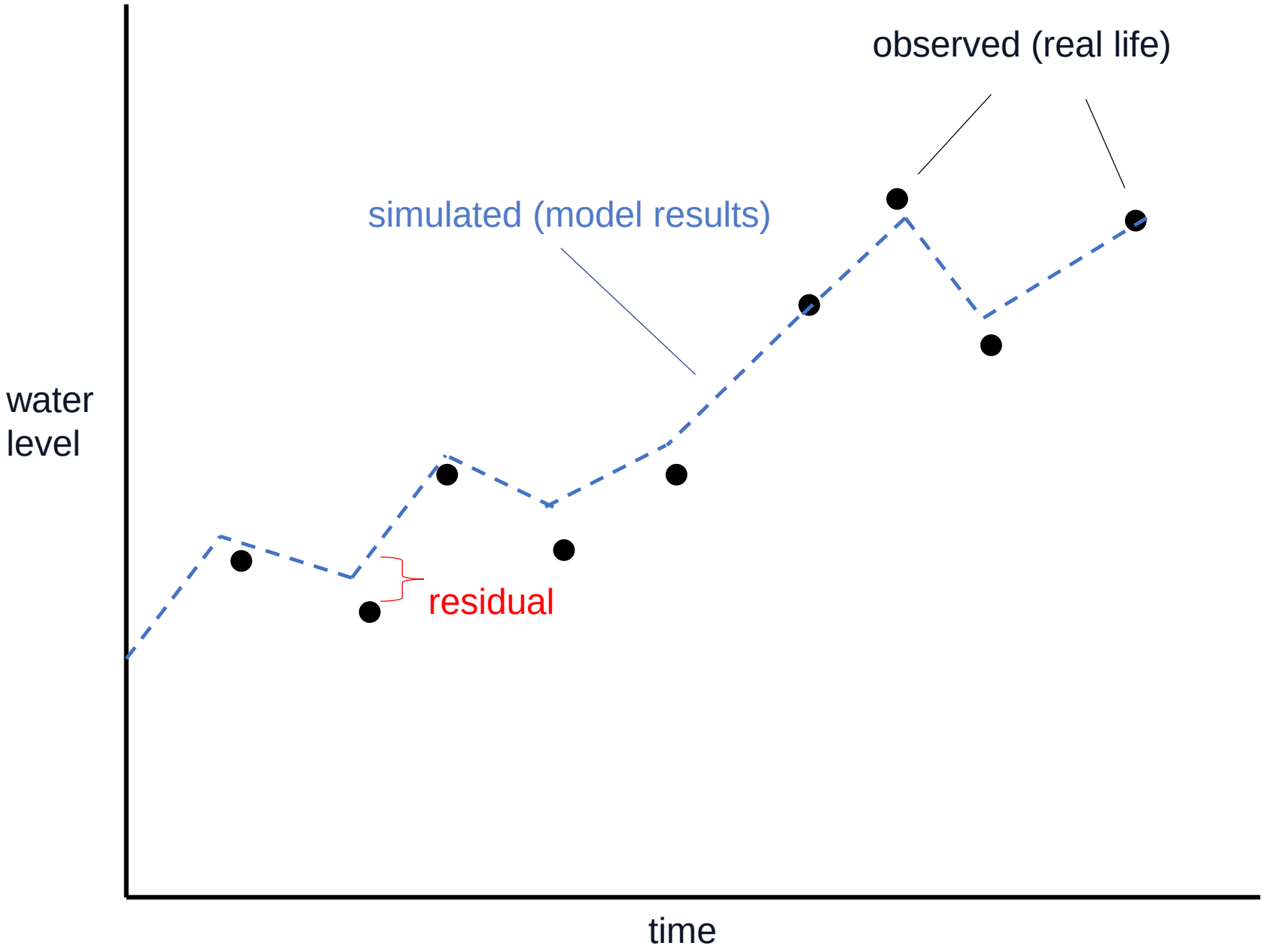
Parameter Estimation

briefly…



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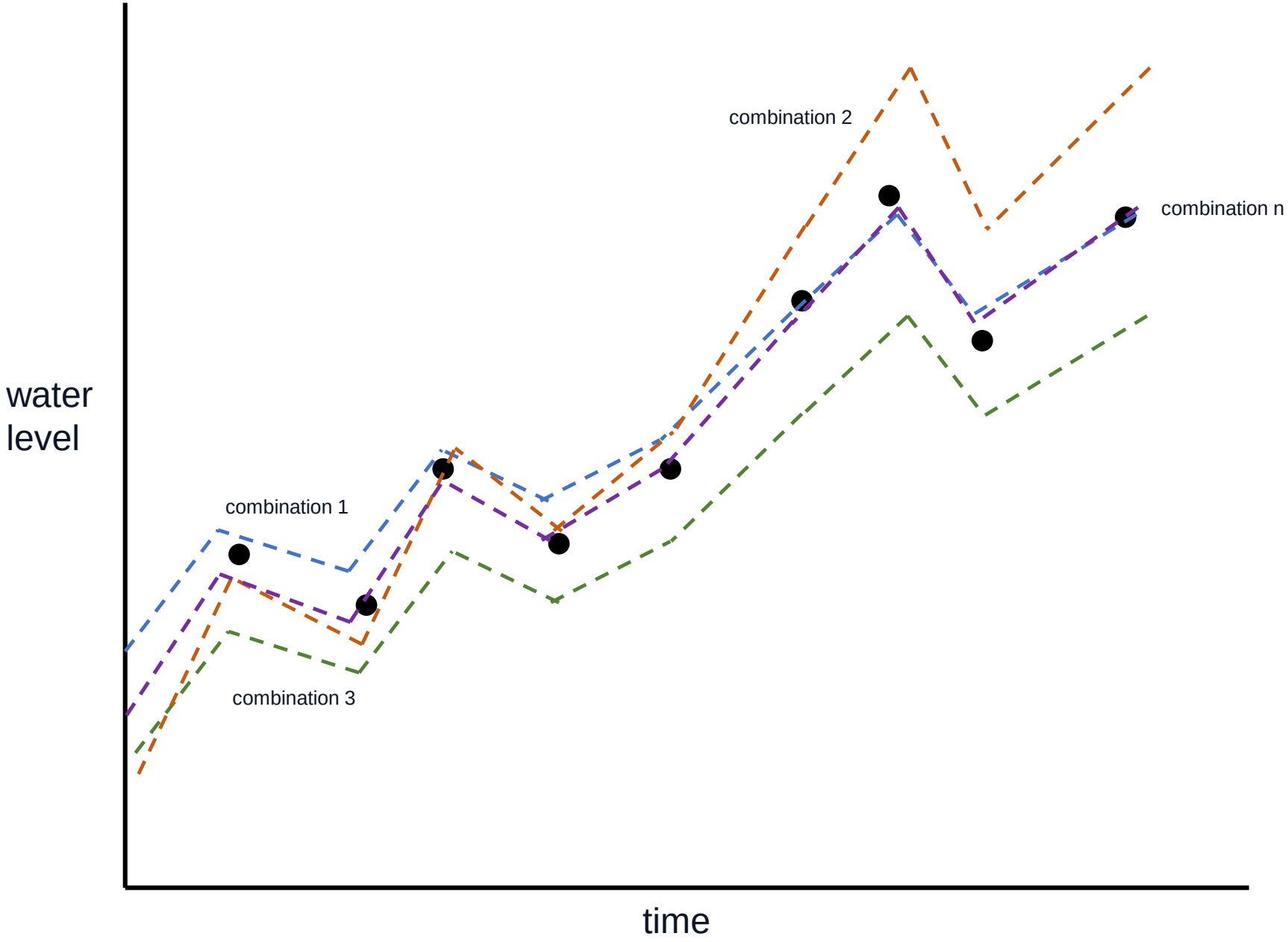
Parameter Estimation

briefly…



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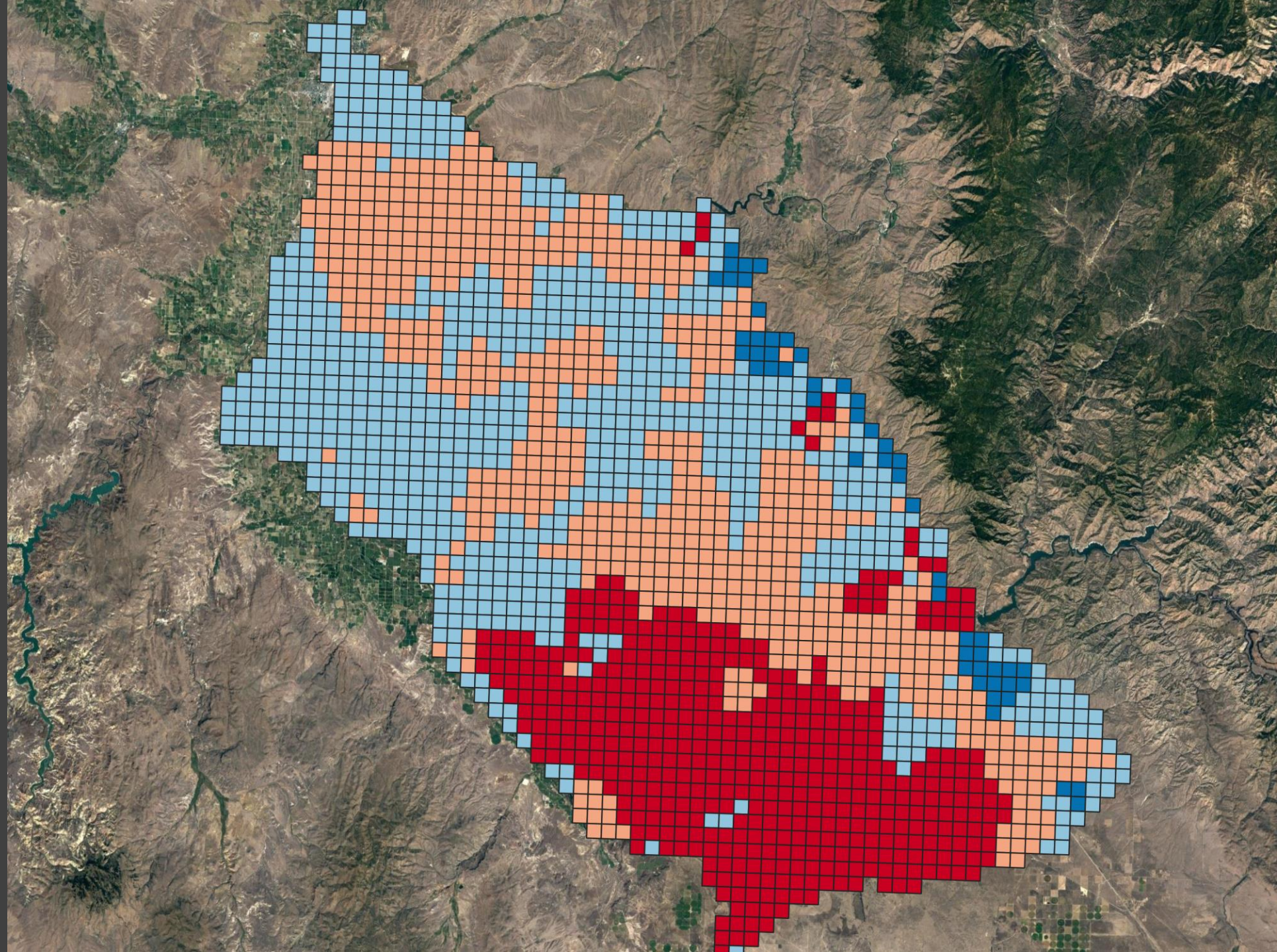
Why?

Parameter estimation tools can be told to prefer a certain parameter distribution to mimic lithology

Eases identification of ‘best’ parameters



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Pumping and Monitoring Well Locations on Model Grid

Stephen Hundt

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Soil moisture budget

Needed to figure out:

- Incidental recharge
- PPT recharge
- Canal leakage
- Pumping

Still working on:

- Data
- Cleaning data
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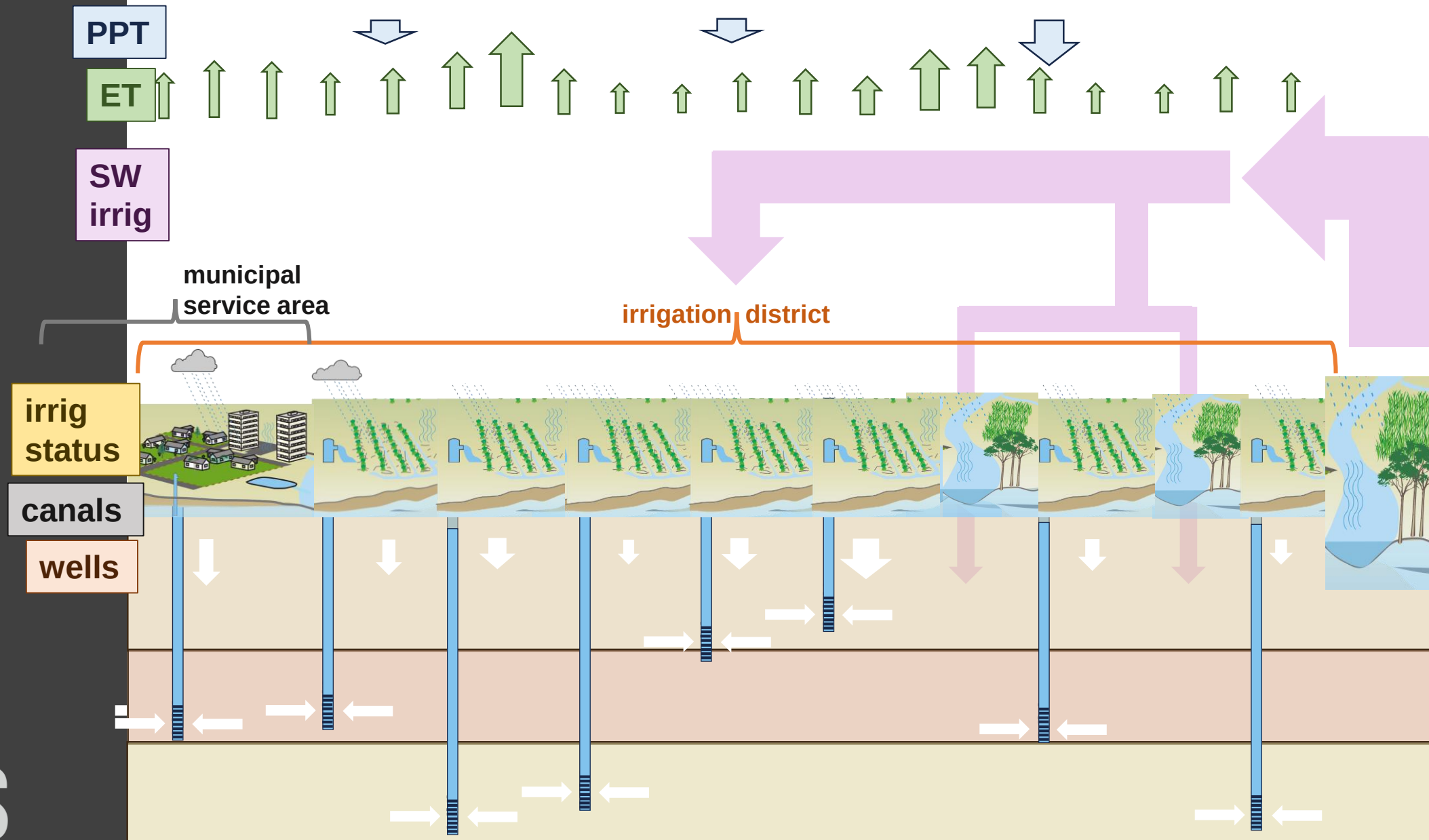

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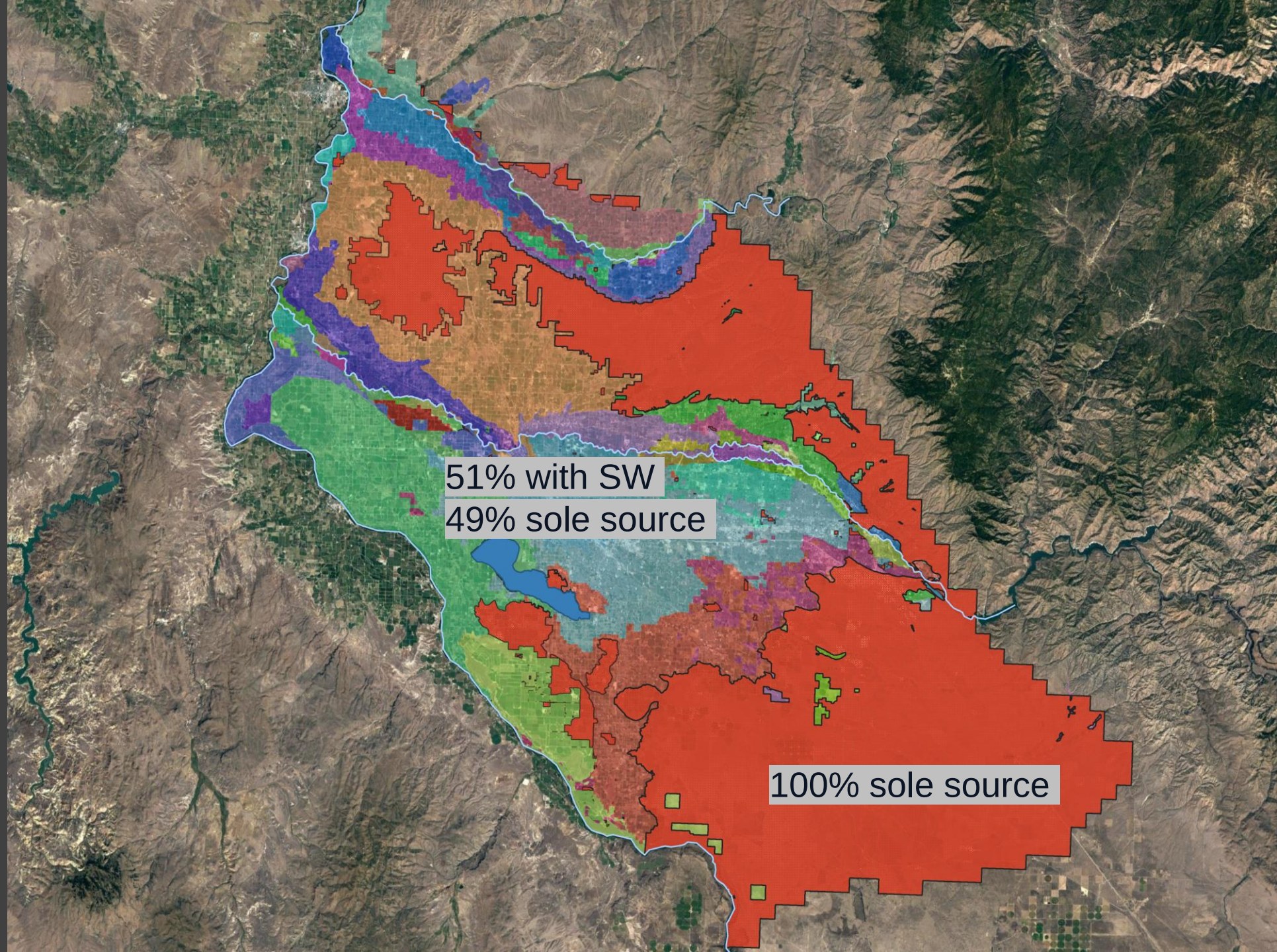
Groundwater Rights

- Sole Source Groundwater
- Groundwater with Surface Water
  - Supplemental to SW
  - Used with SW



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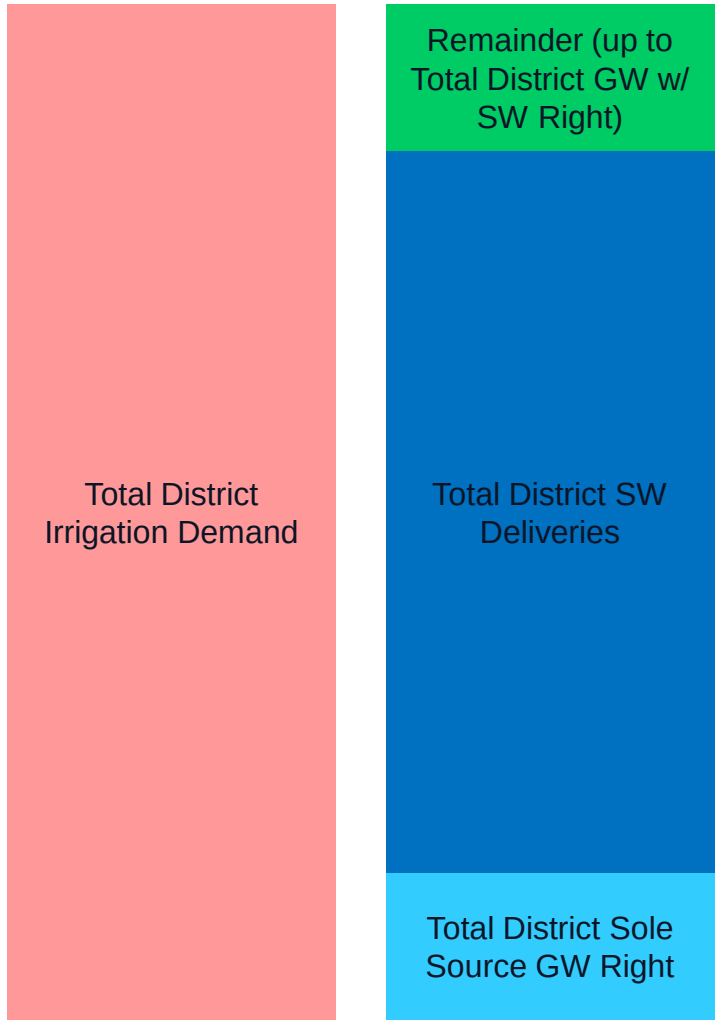
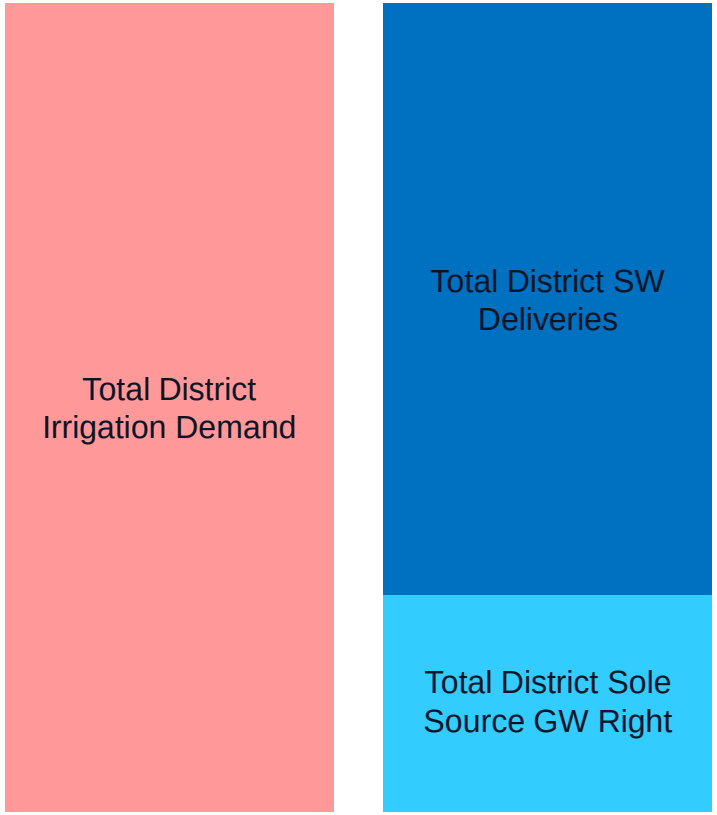
Estimating Pumping by Type of Right

- Sole Source Groundwater
  Always pumped

- Groundwater with Surface Water
  Pumped if needed



District 1



District 2

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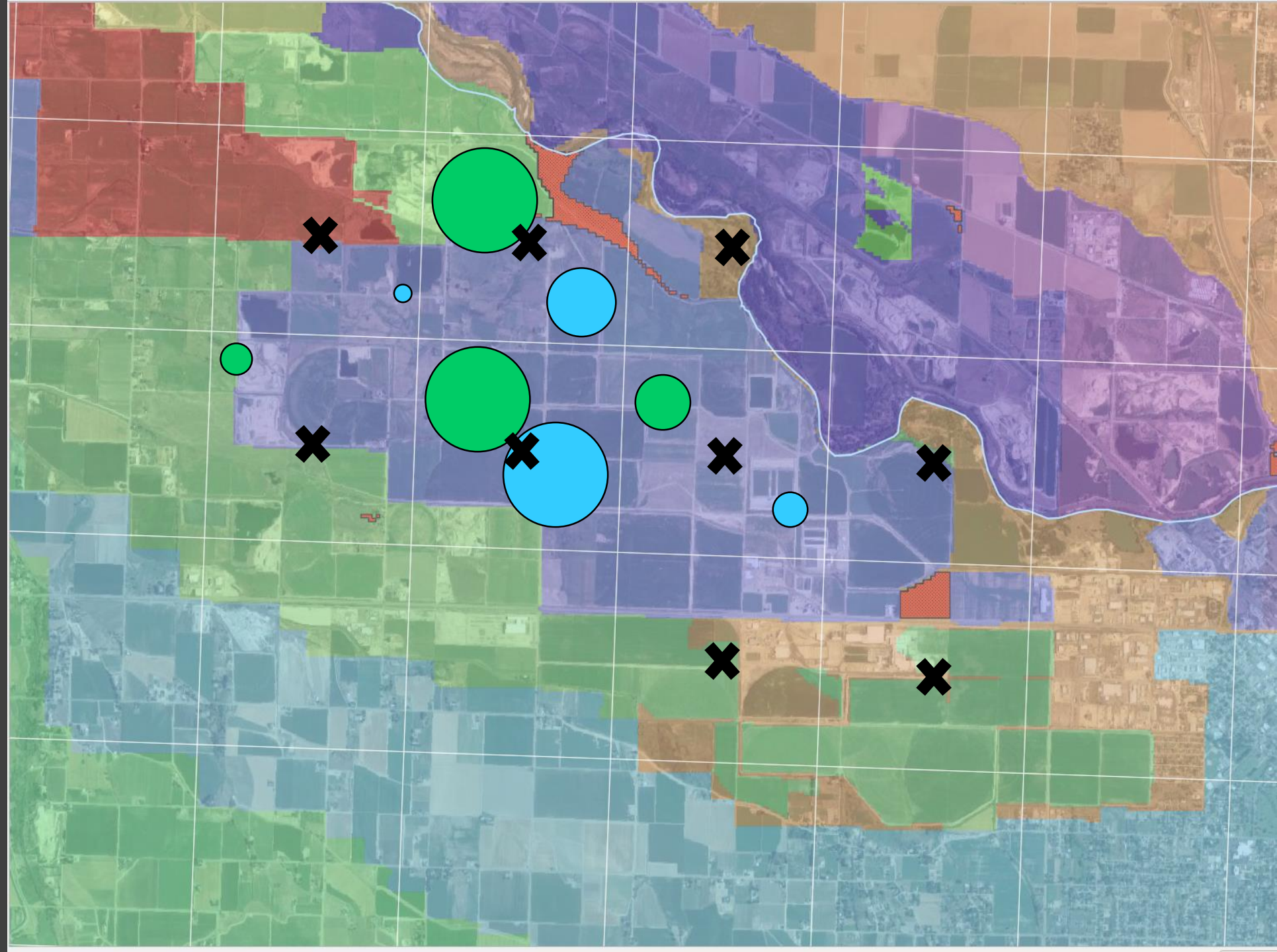
Pumping by Cell

- Sole Source Groundwater
  Always pumped

- Groundwater with Surface Water
  Pumped if needed



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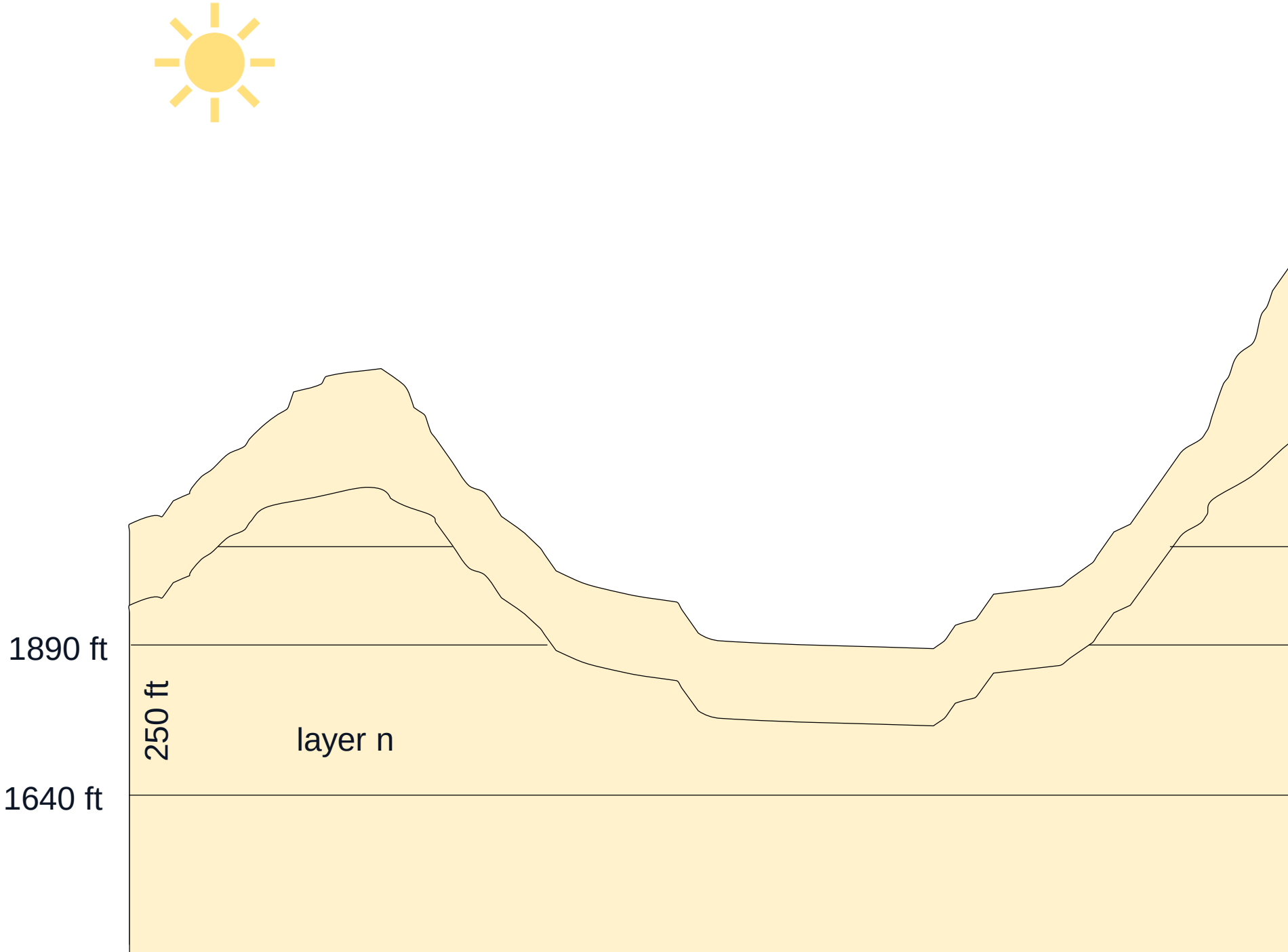
Flow model layer



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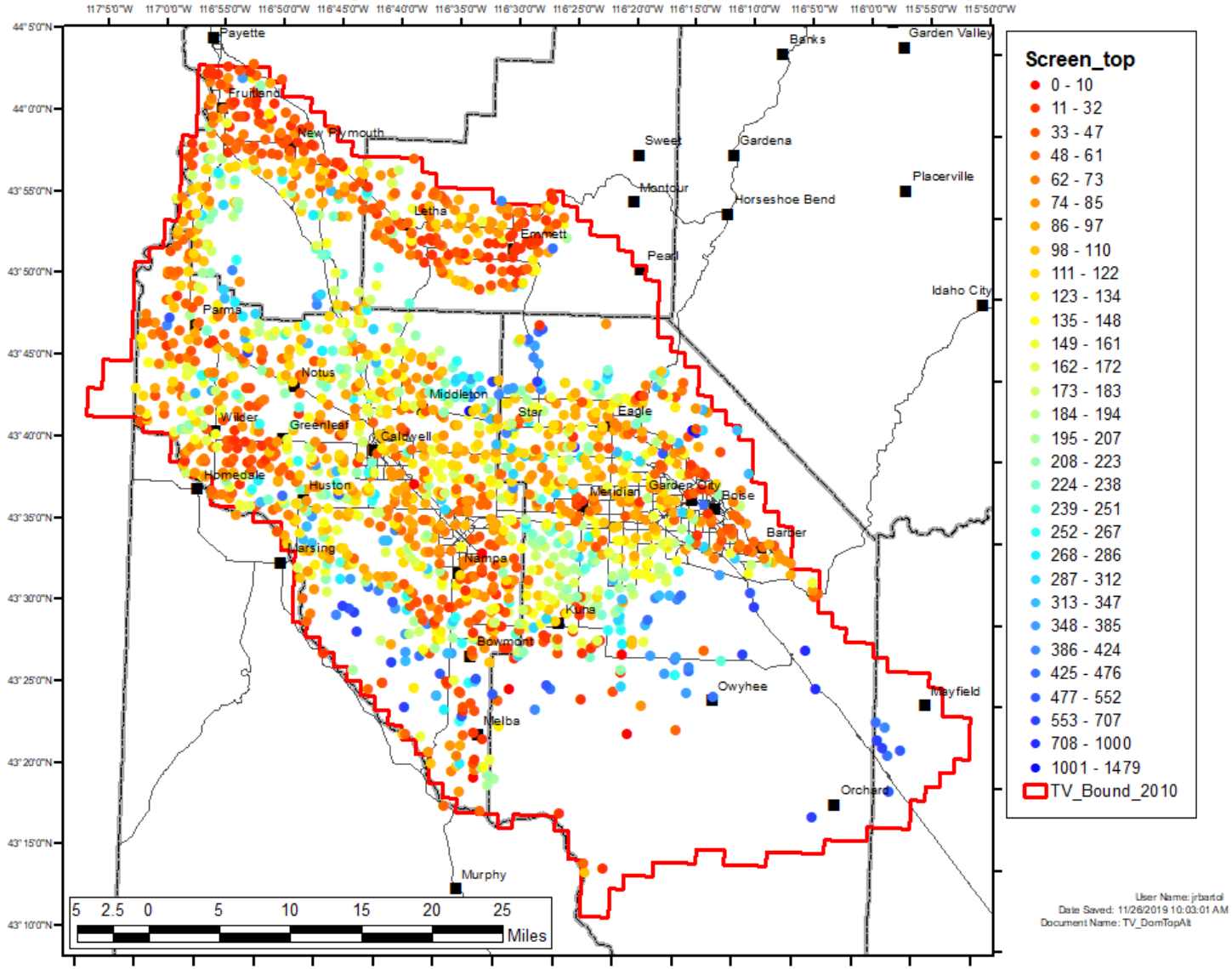
Treasure Valley domestic wells: top of screen depth



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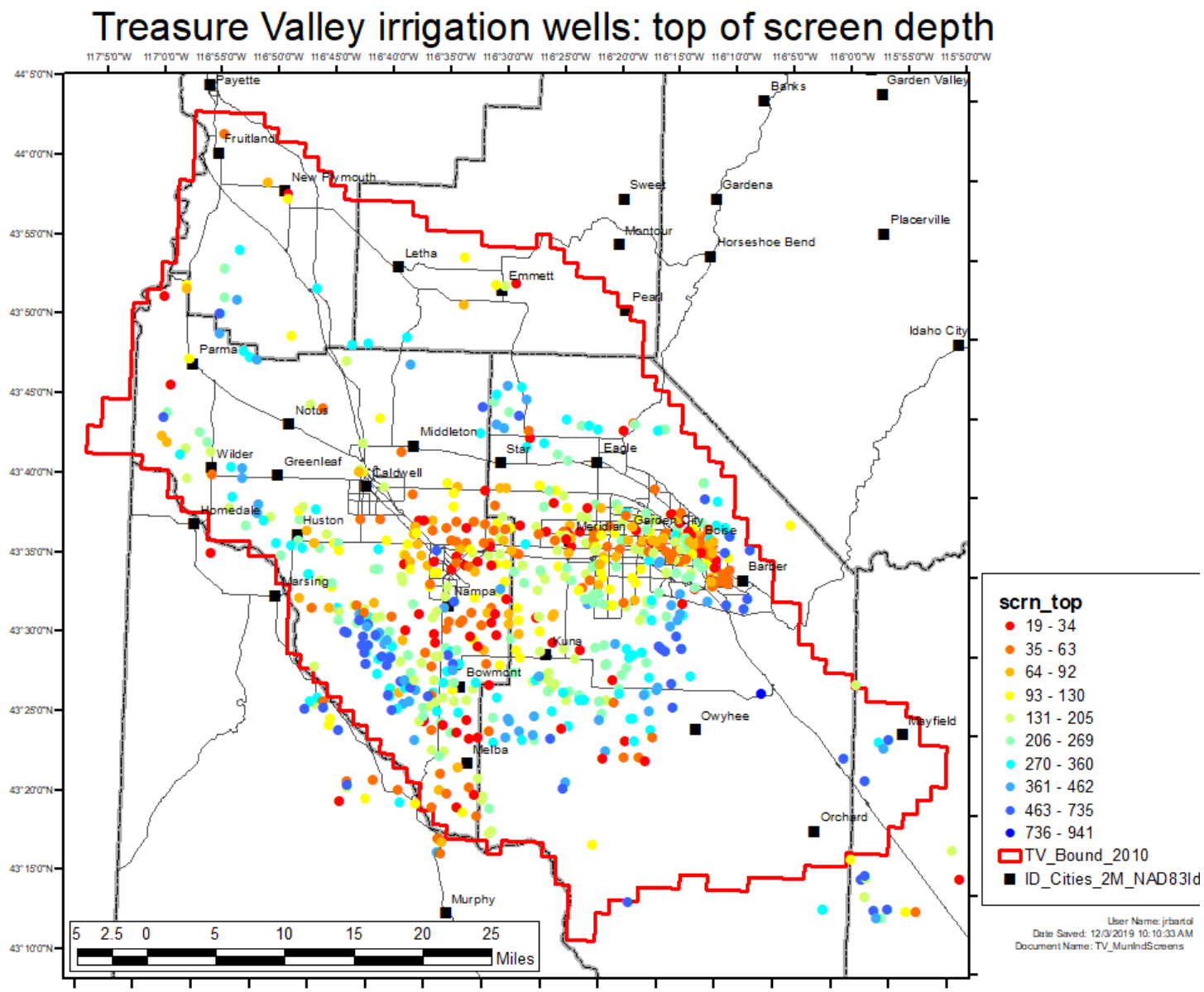

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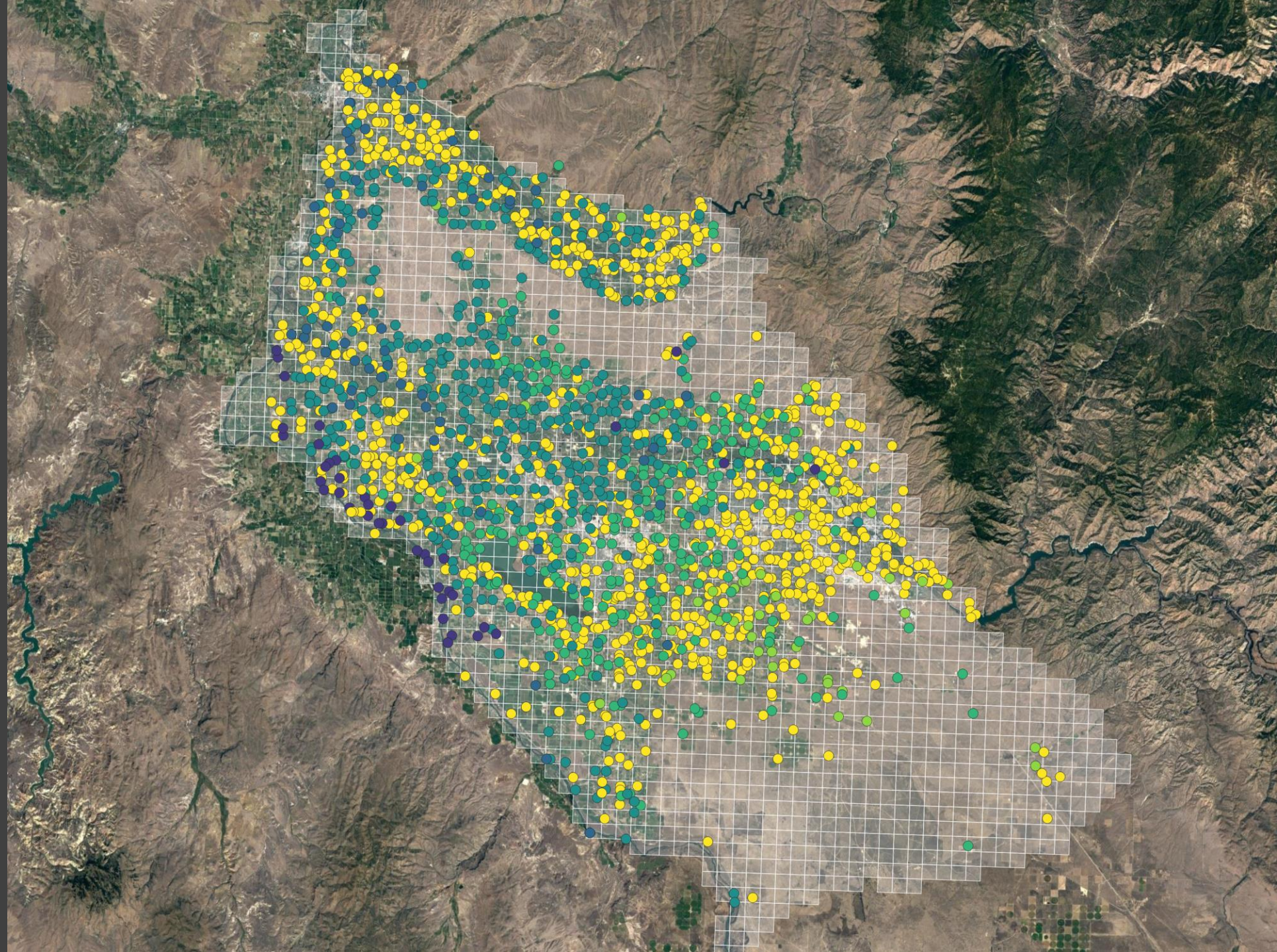
Domestic Wells: Primary Layer



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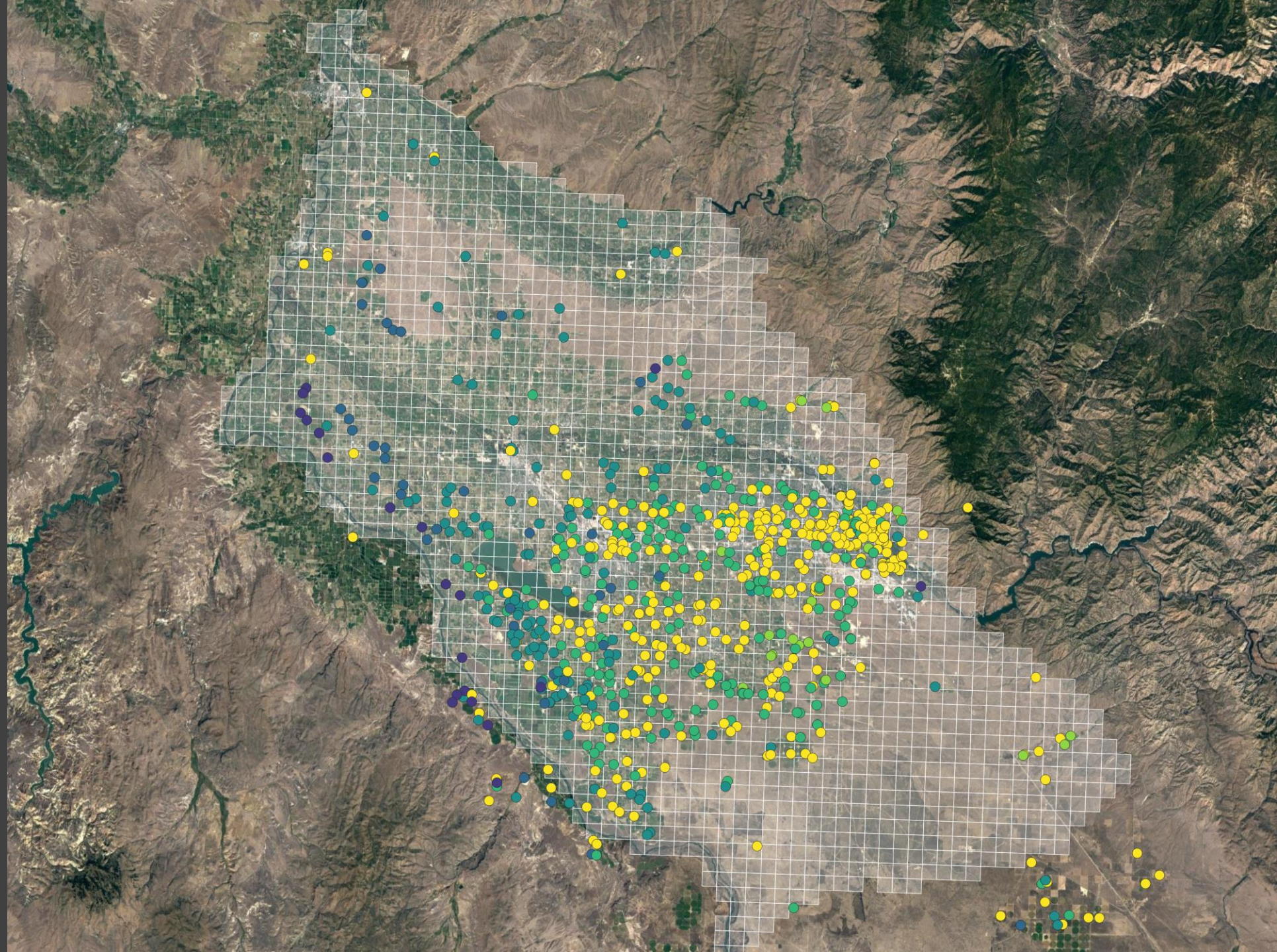
Irrigation Wells: Primary Layer



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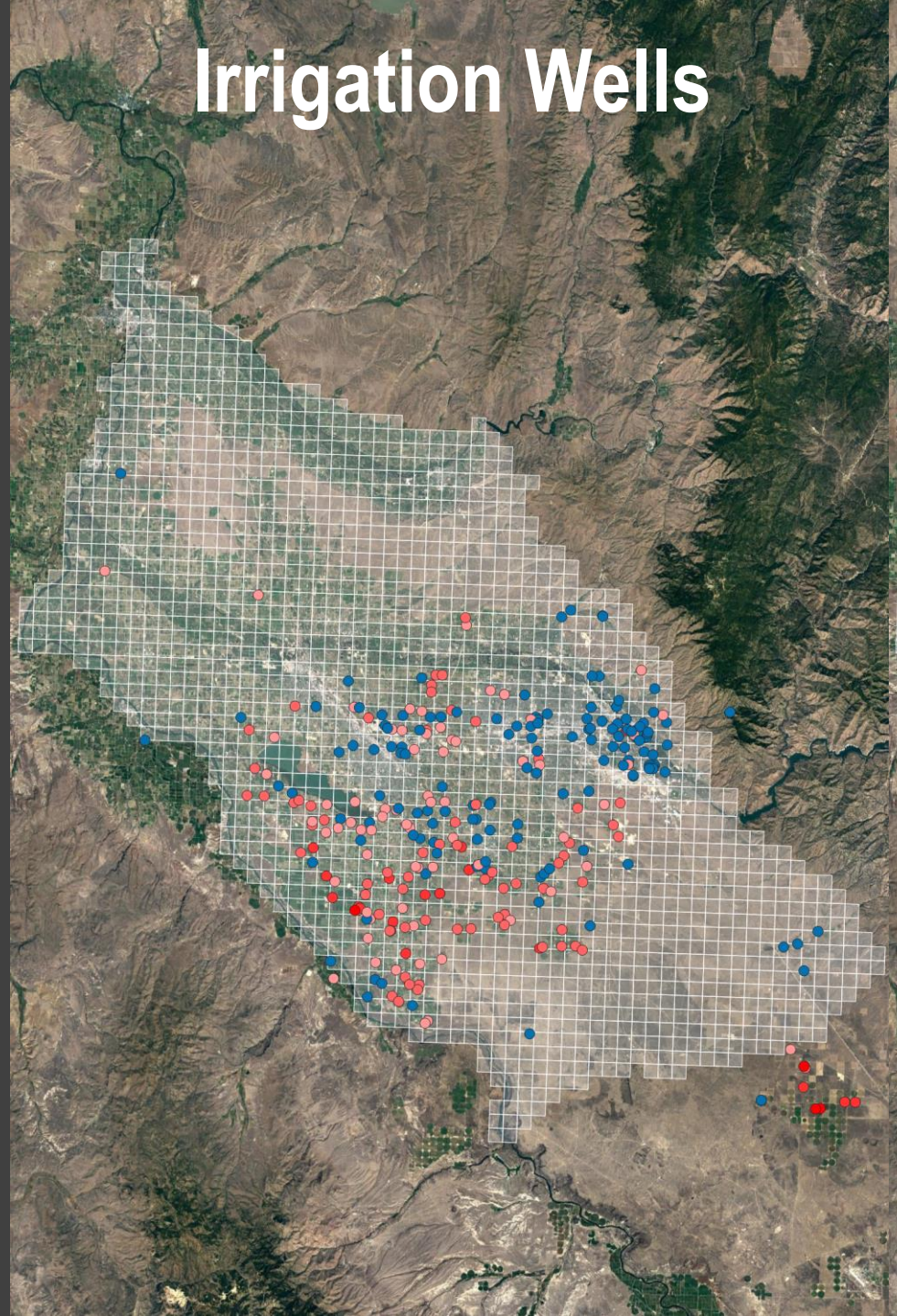
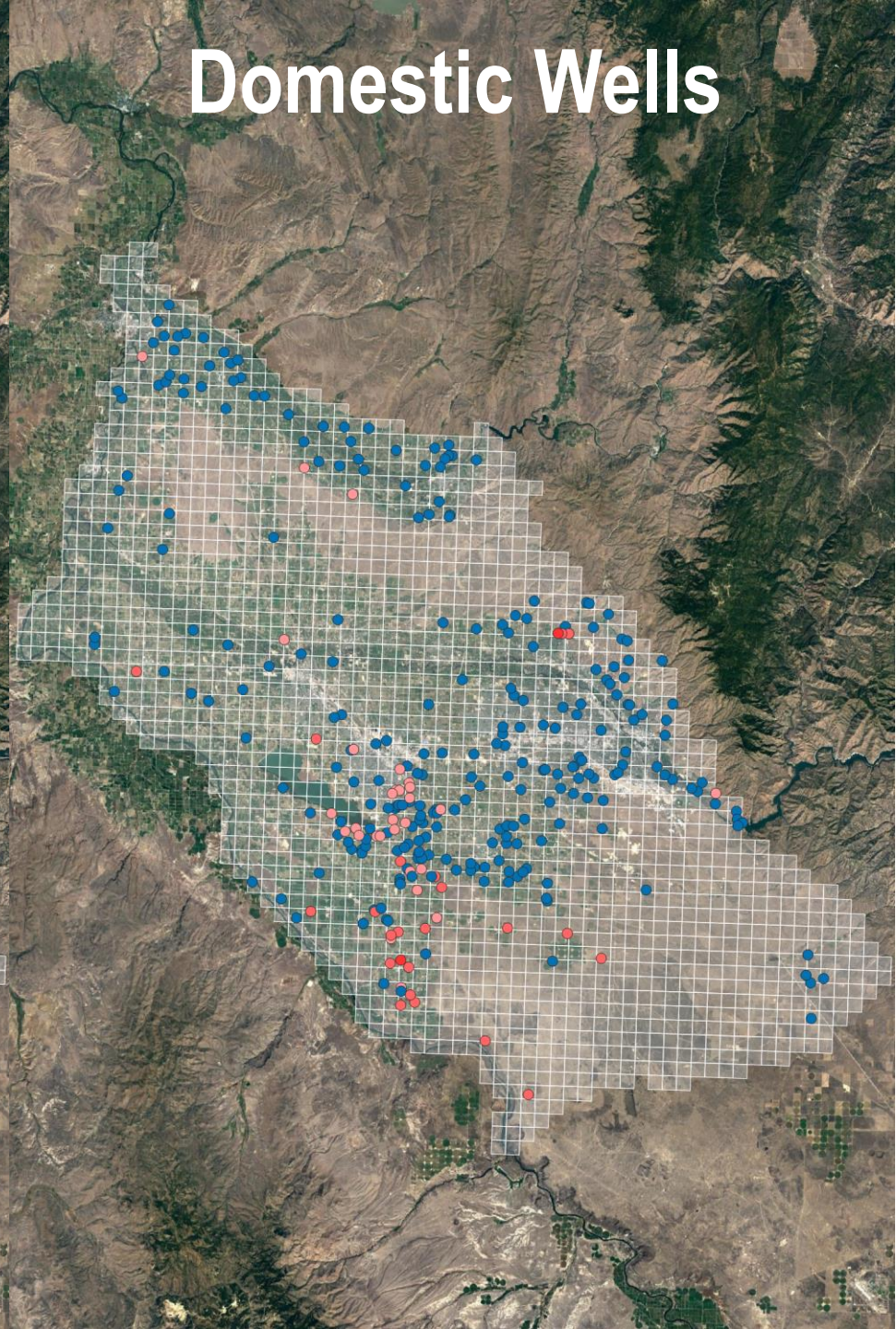
Domestic and Irrigation Wells: Layer 1

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4





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Domestic and Irrigation Wells: Layer 2

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4

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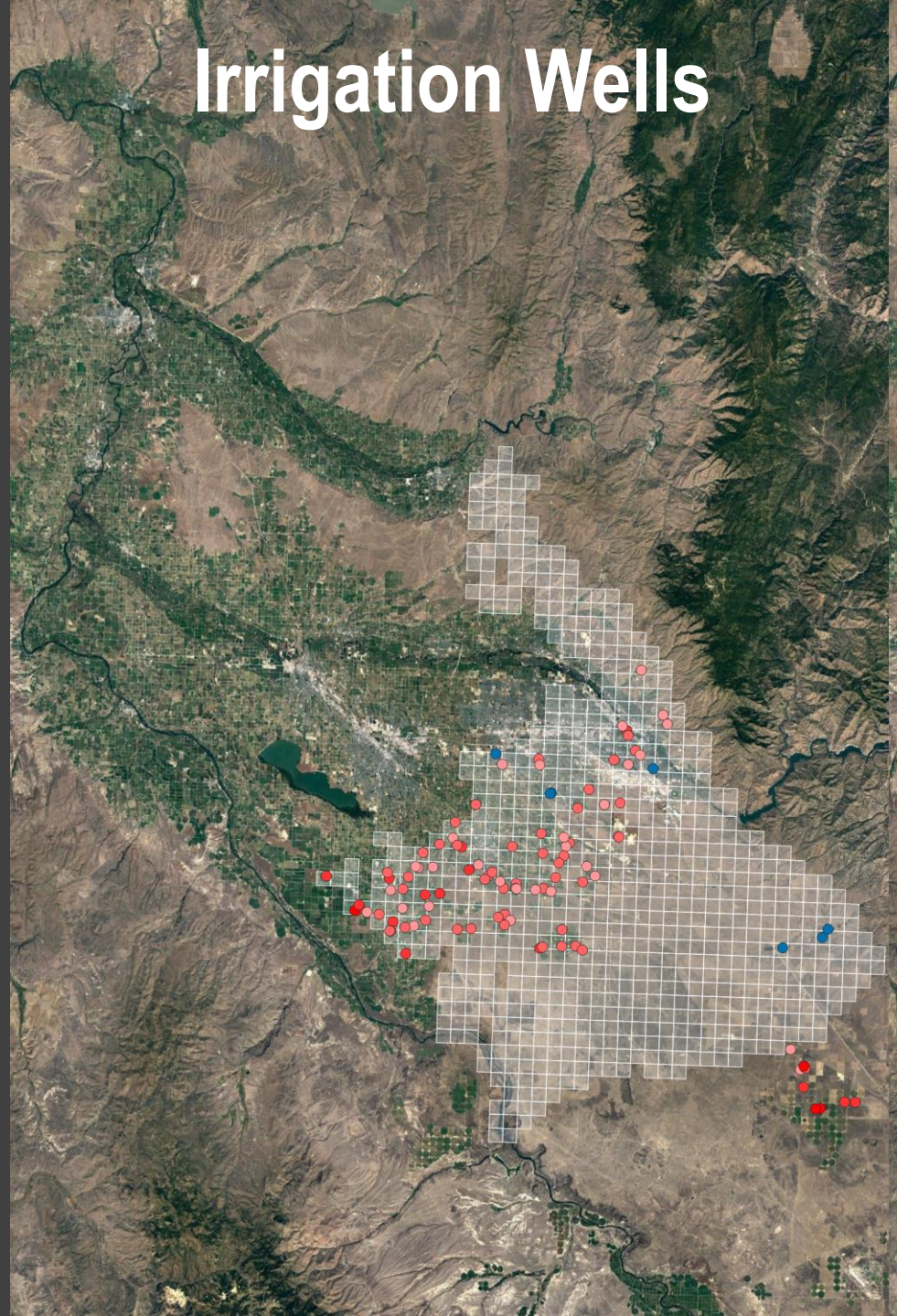
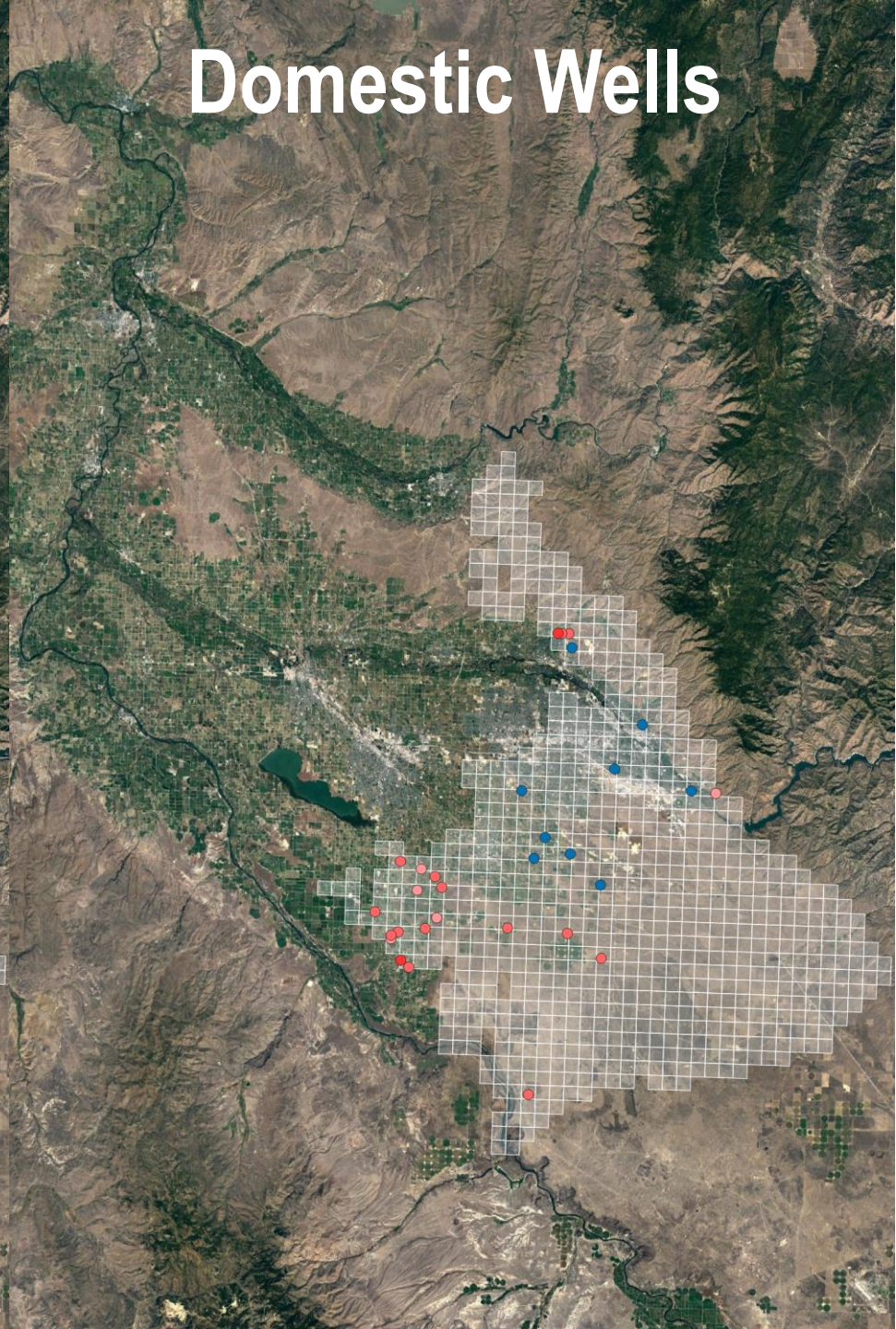
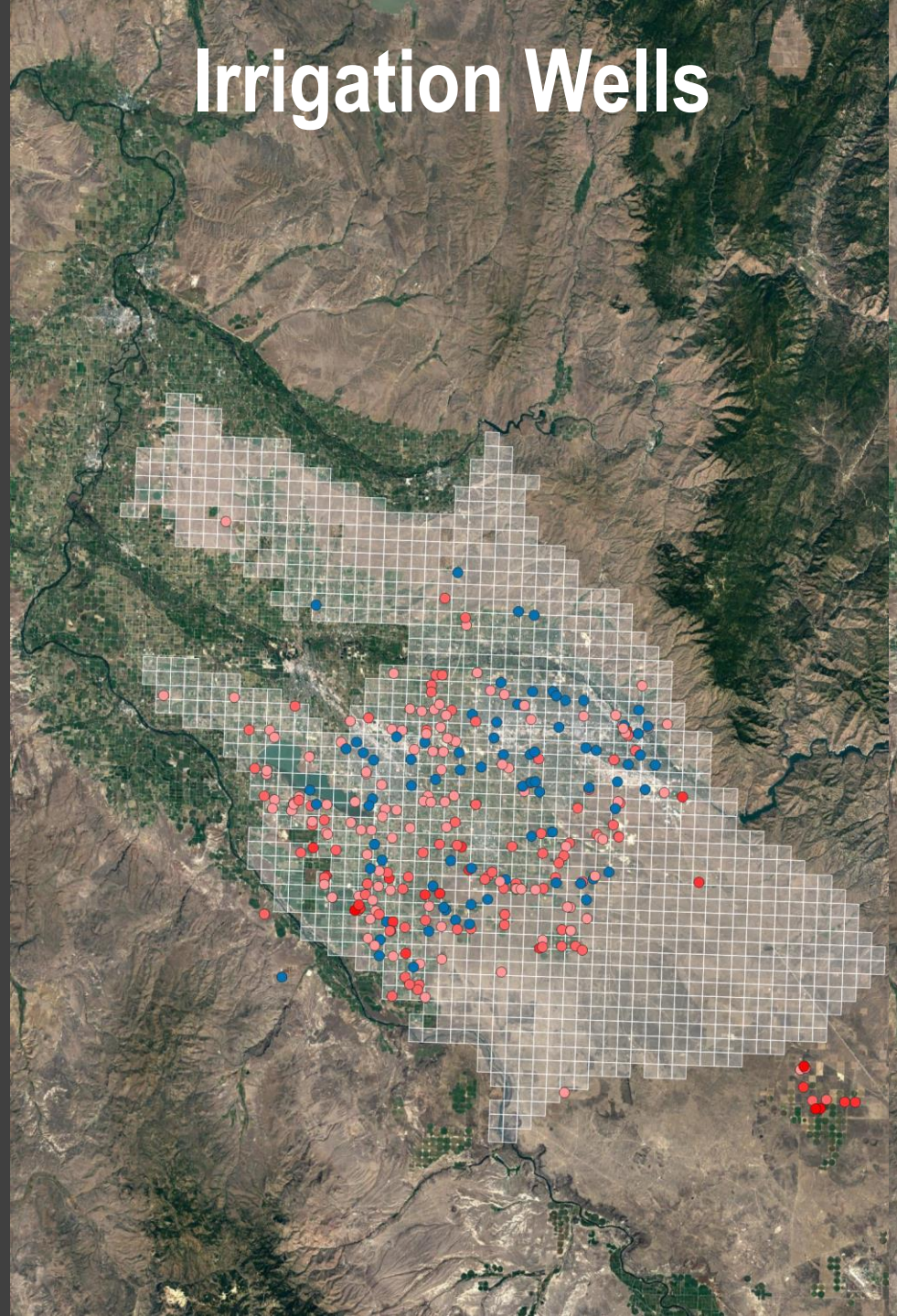


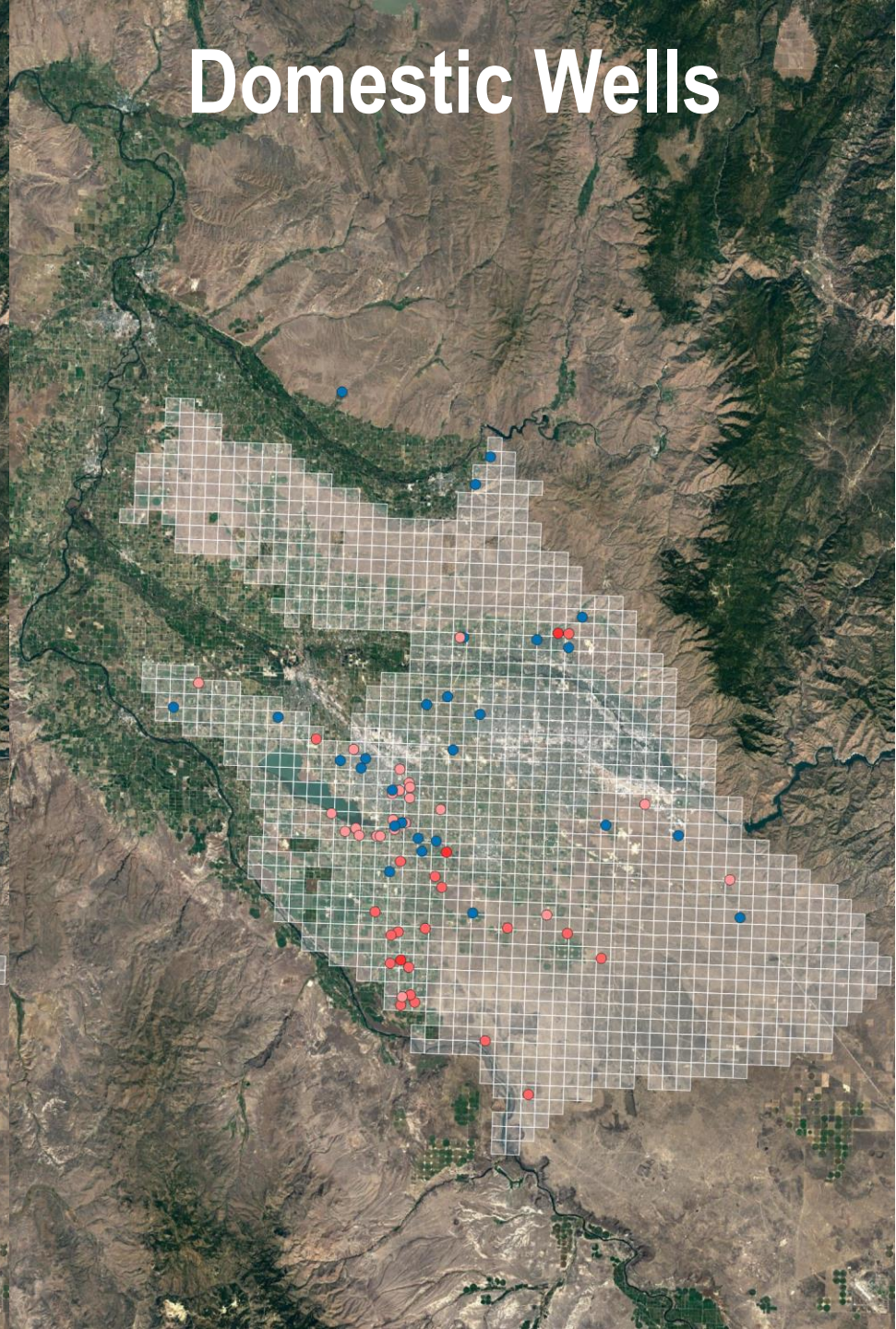


Domestic and Irrigation Wells: Layer 3

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4





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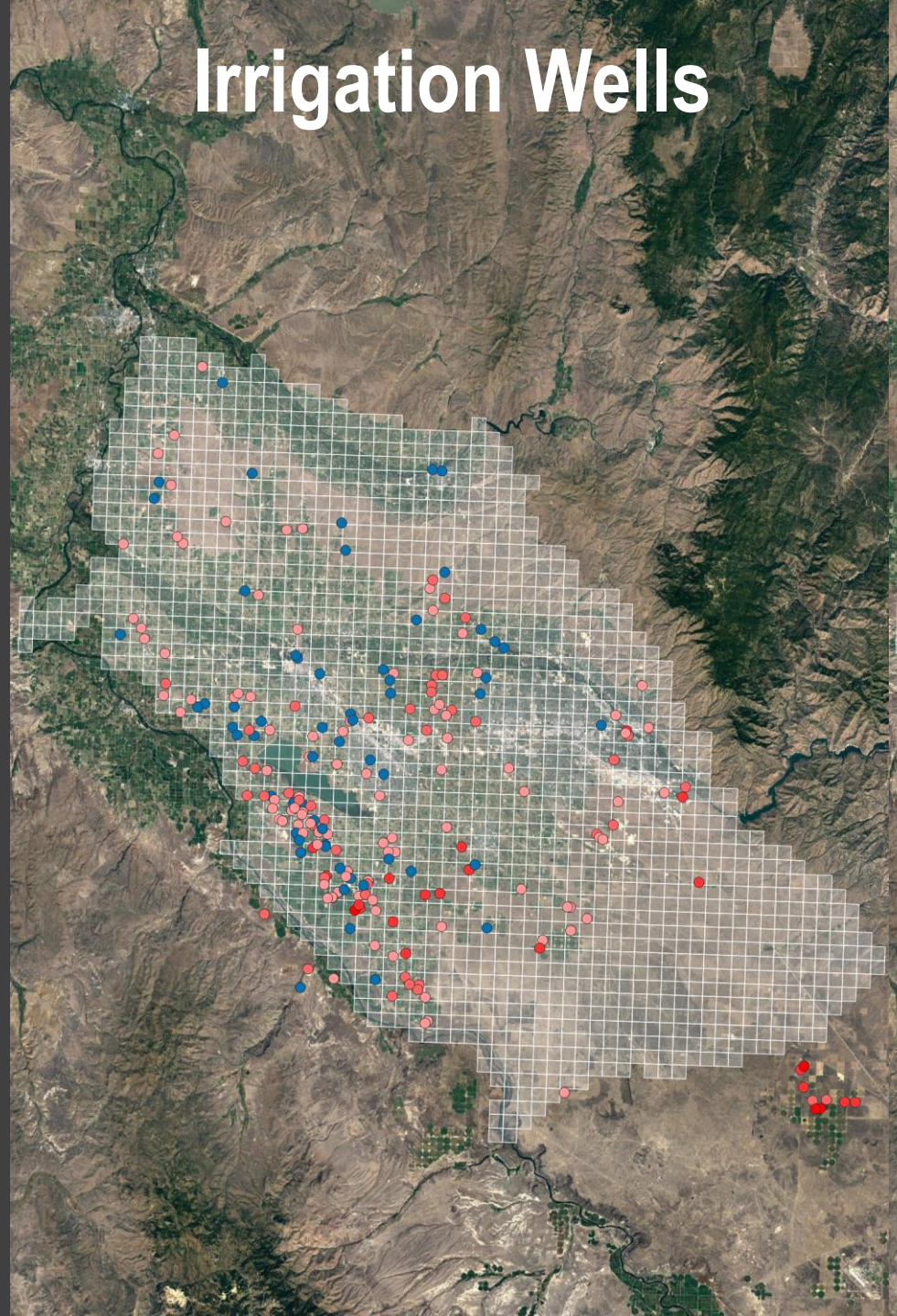
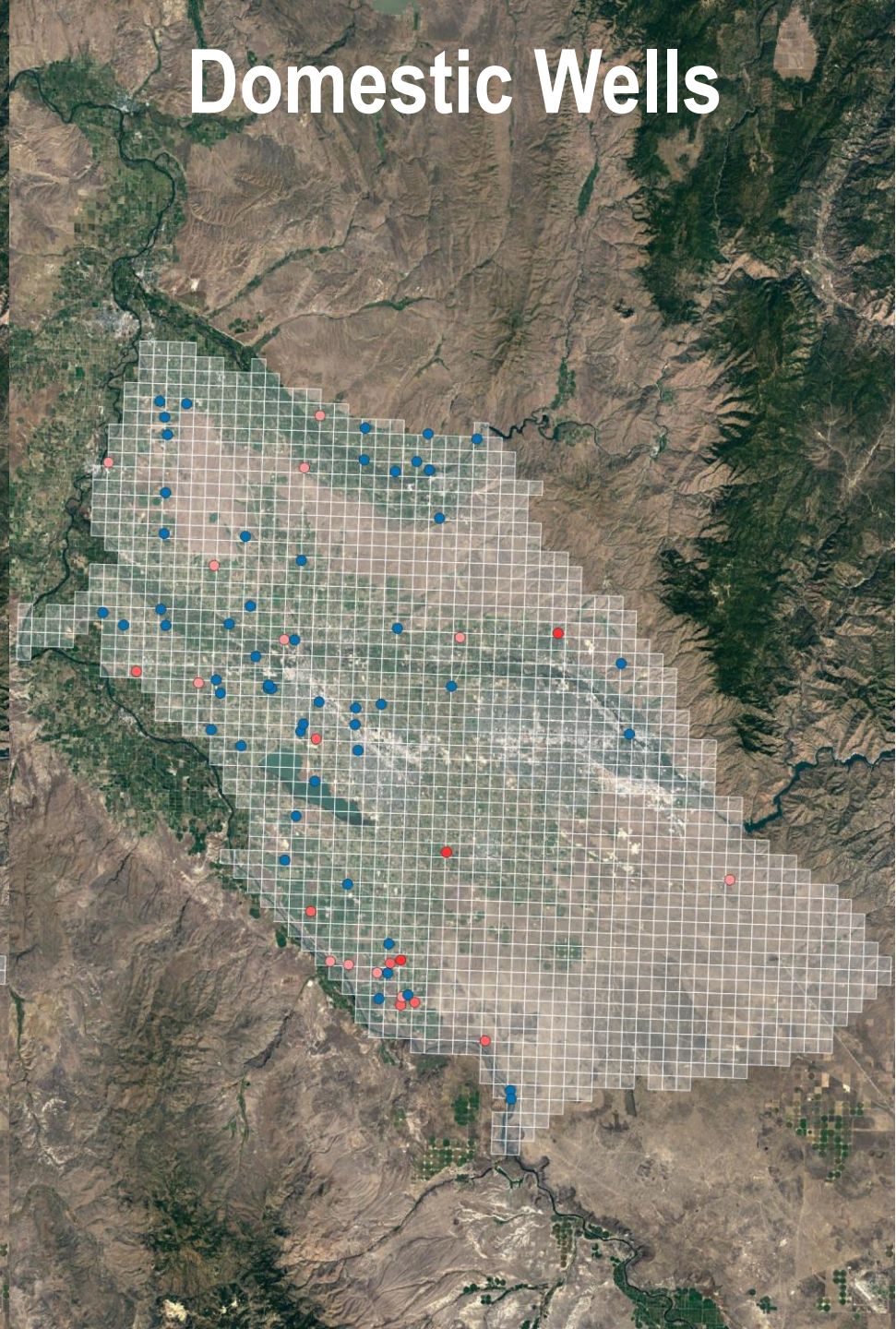
Domestic and Irrigation Wells: Layer 4

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4





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Domestic and Irrigation Wells: Layer 5

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4

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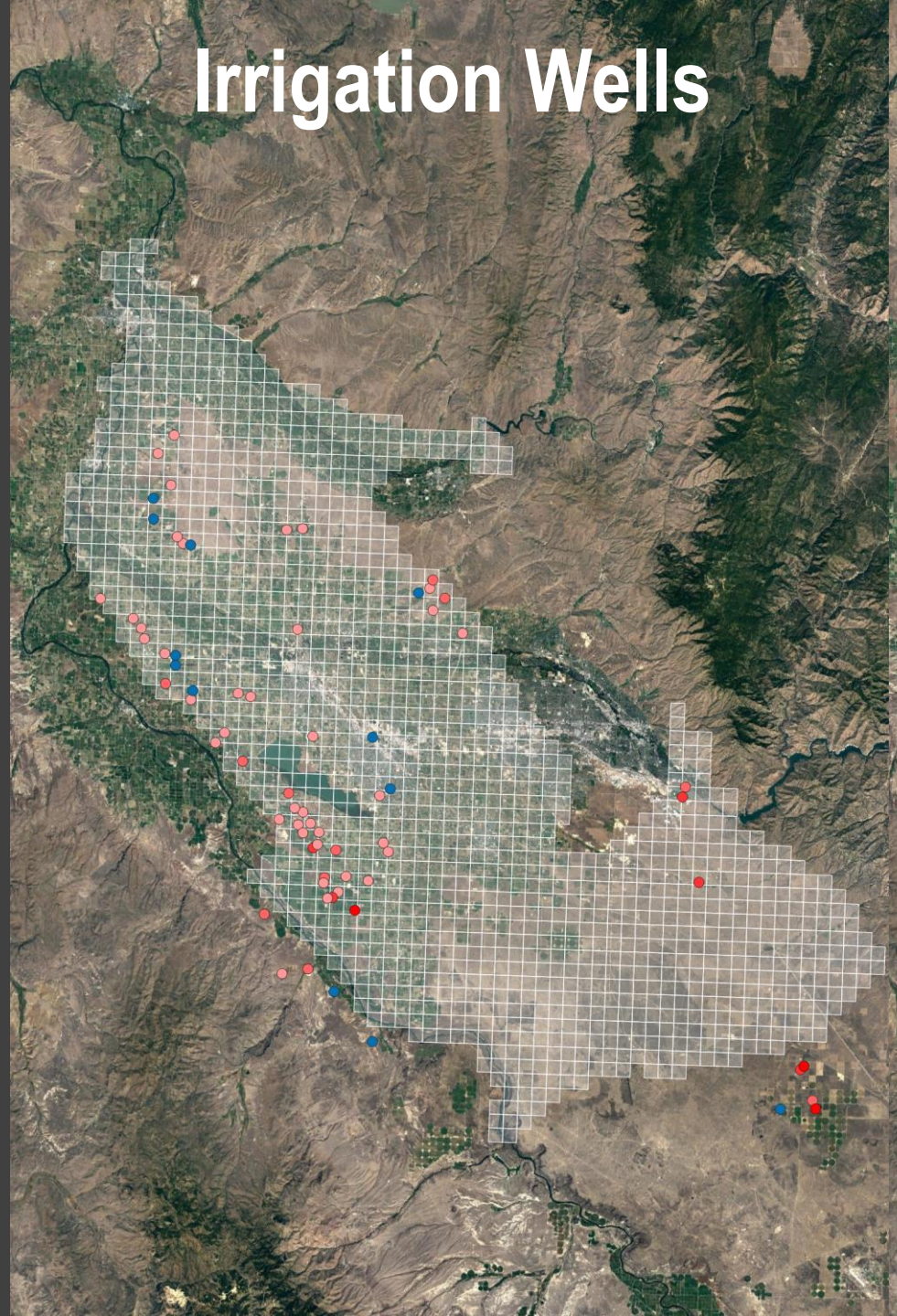

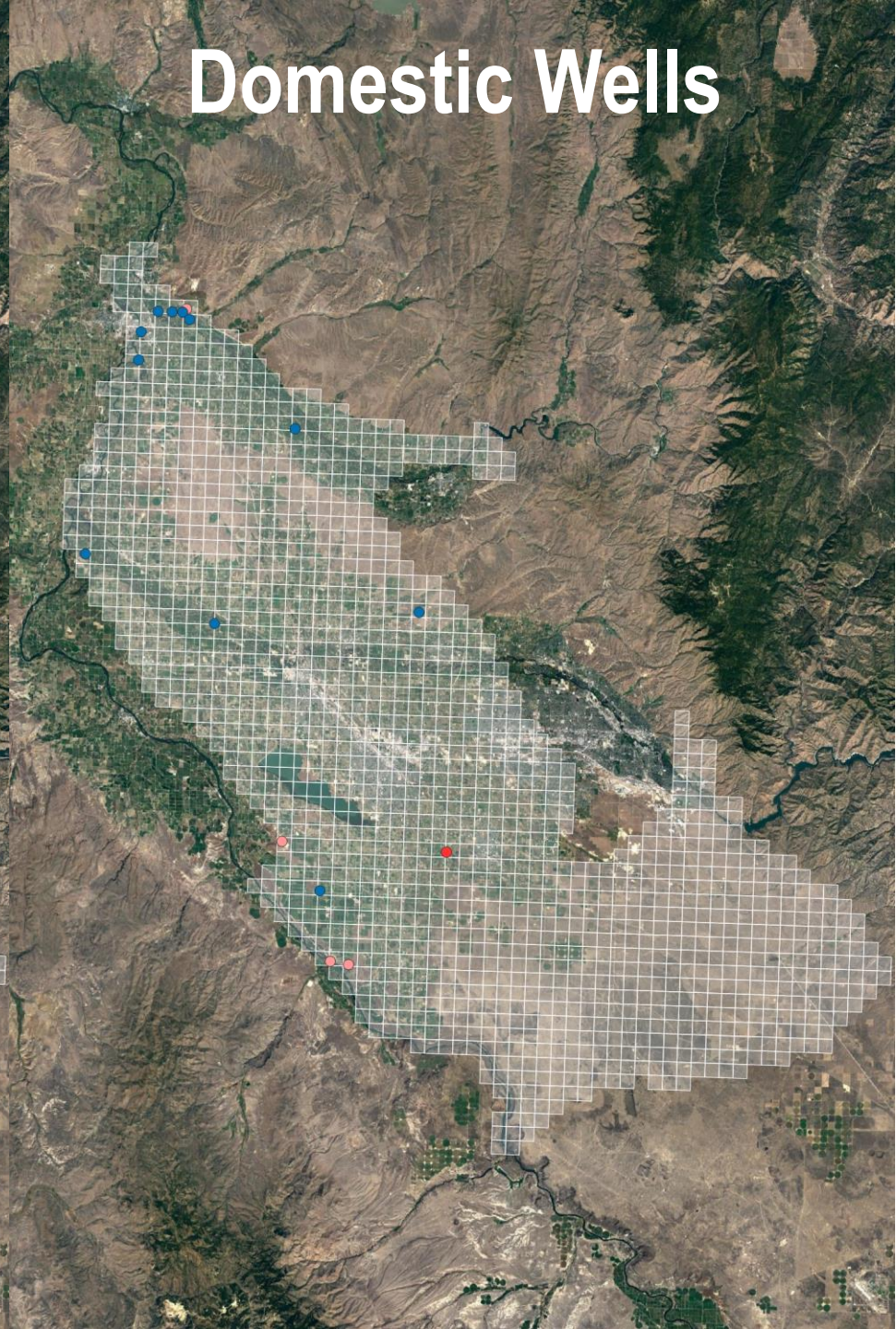

Domestic and Irrigation Wells: Layer 6

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4

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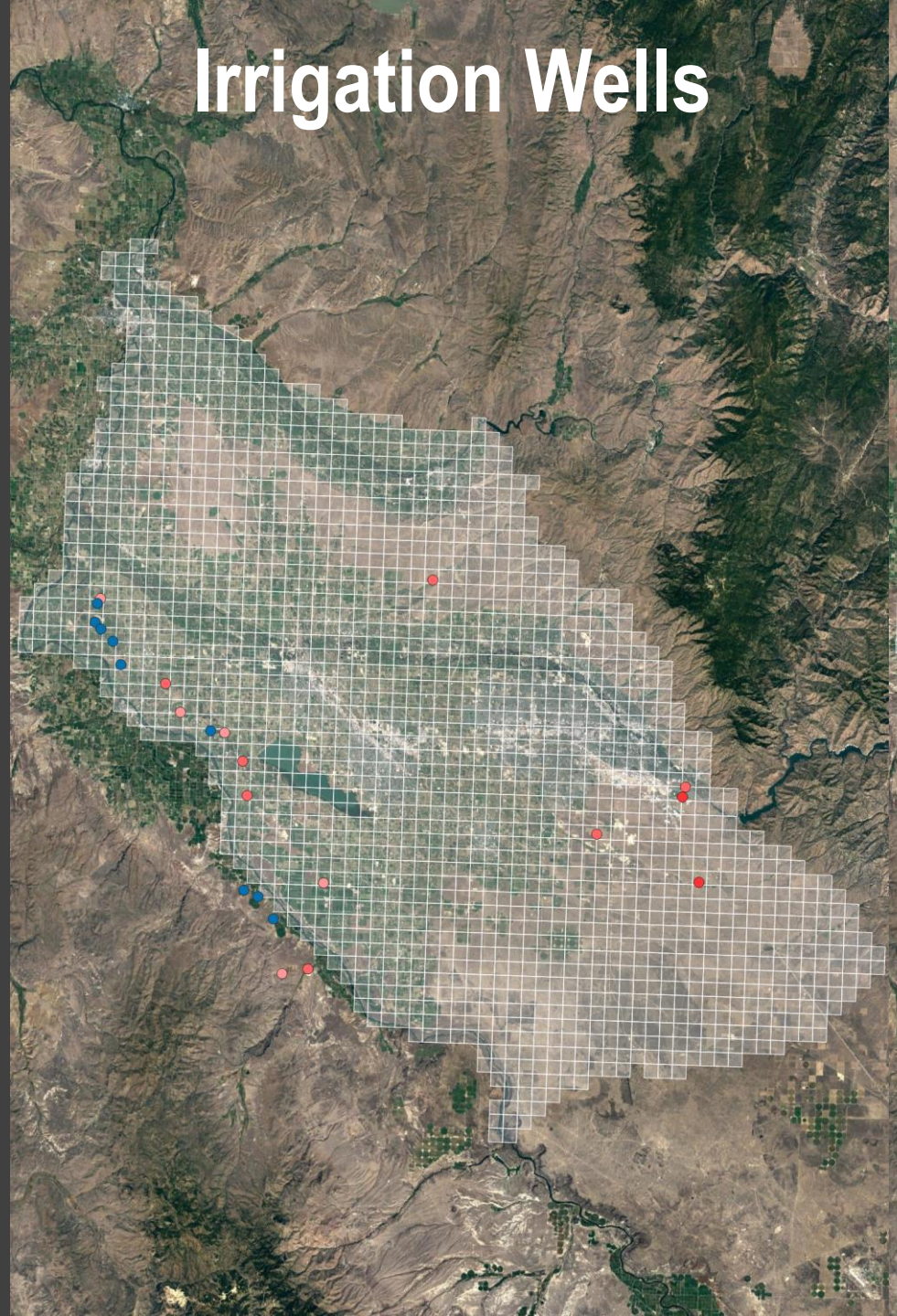
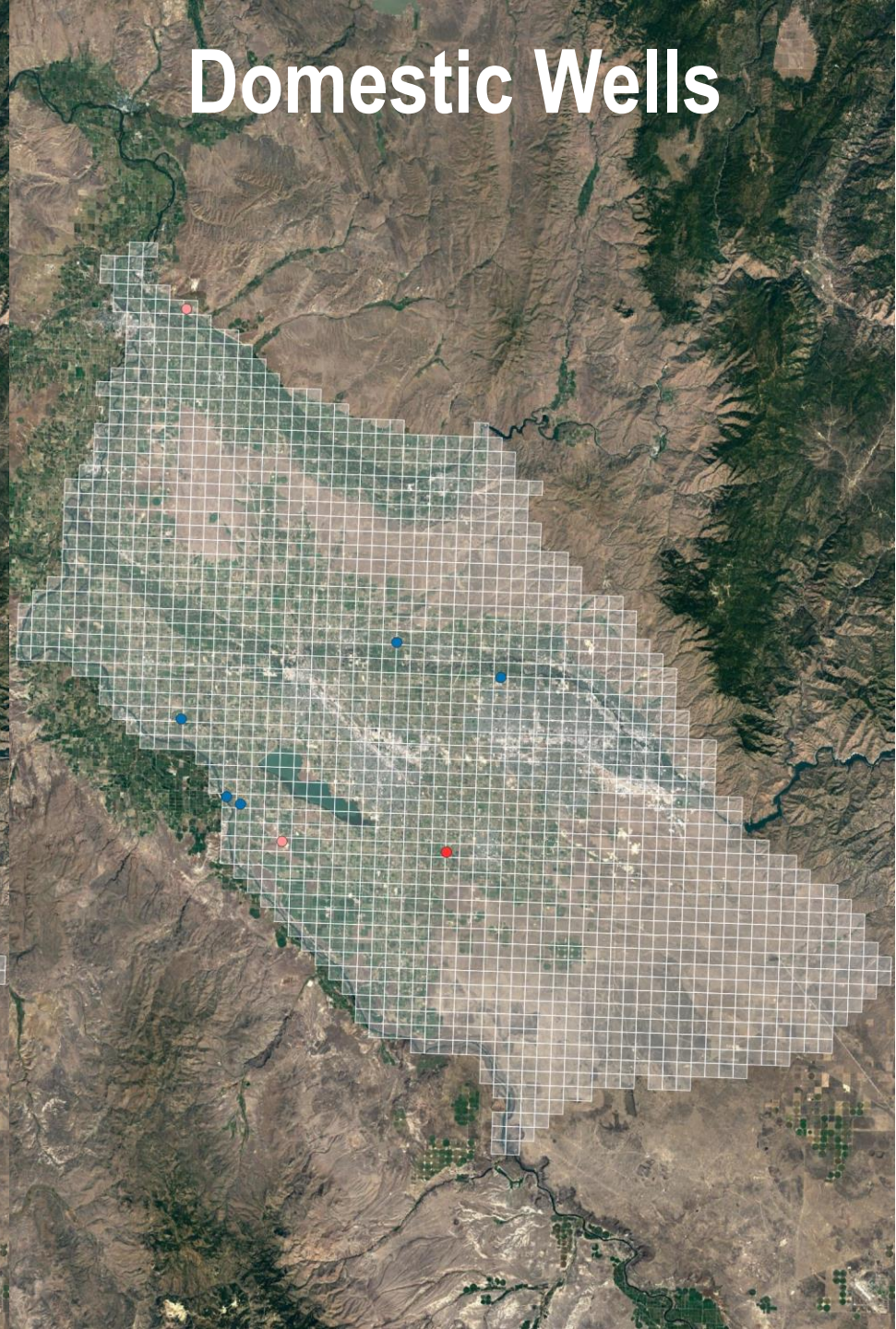
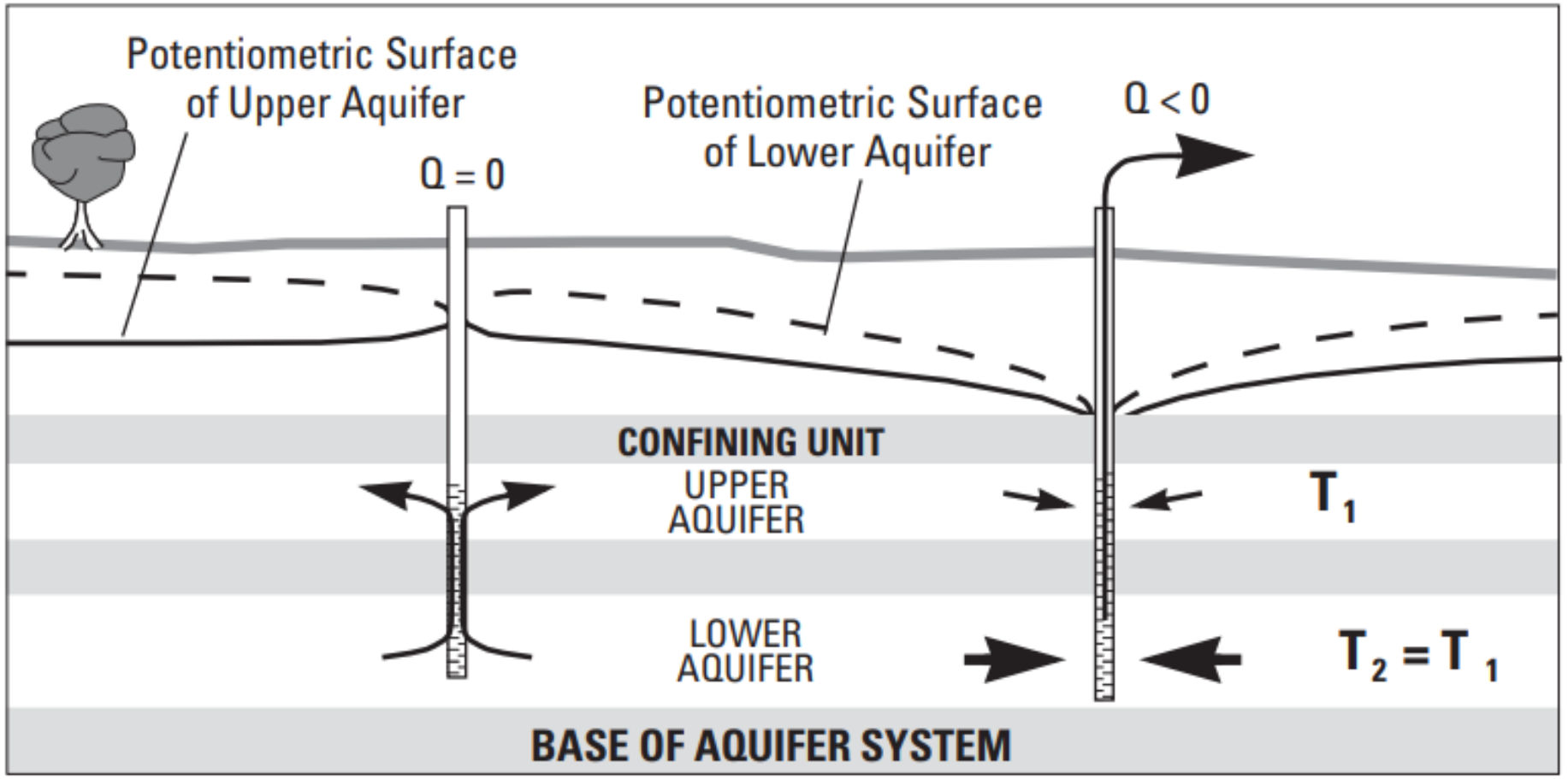




Multi-Layer Pumping

- How much is pumped from each layer?
- Well as conduit connecting layers?



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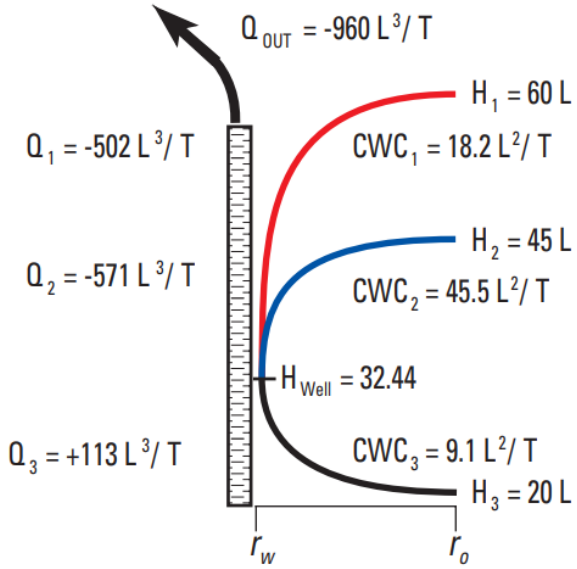
Multi-Layer Pumping

Typical Approaches

Solve well bore hydraulics (MAW package)

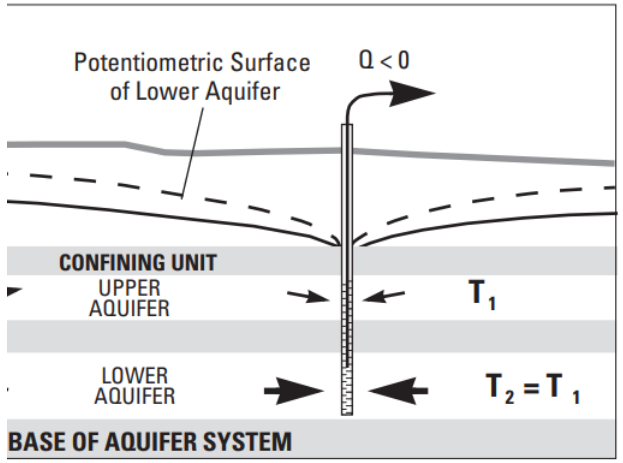
$$h_w = \frac{\sum_{b=m}^{n} T_{j,i,b} h_{j,i,b}}{\sum_{b=m}^{n} T_{j,i,b}} - \frac{Q_{TOT}}{\frac{2\pi}{\ln\left(\frac{r_{eff}}{r_w}\right)} \sum_{b=m}^{n} T_{j,i,b}}$$



High Kz

Proportional to transmissivity

$$Q_{j,i,k} = \frac{T_{j,i,k}}{\sum_{k=1}^{NL} T_{j,i,k}} Q_{TOT}$$



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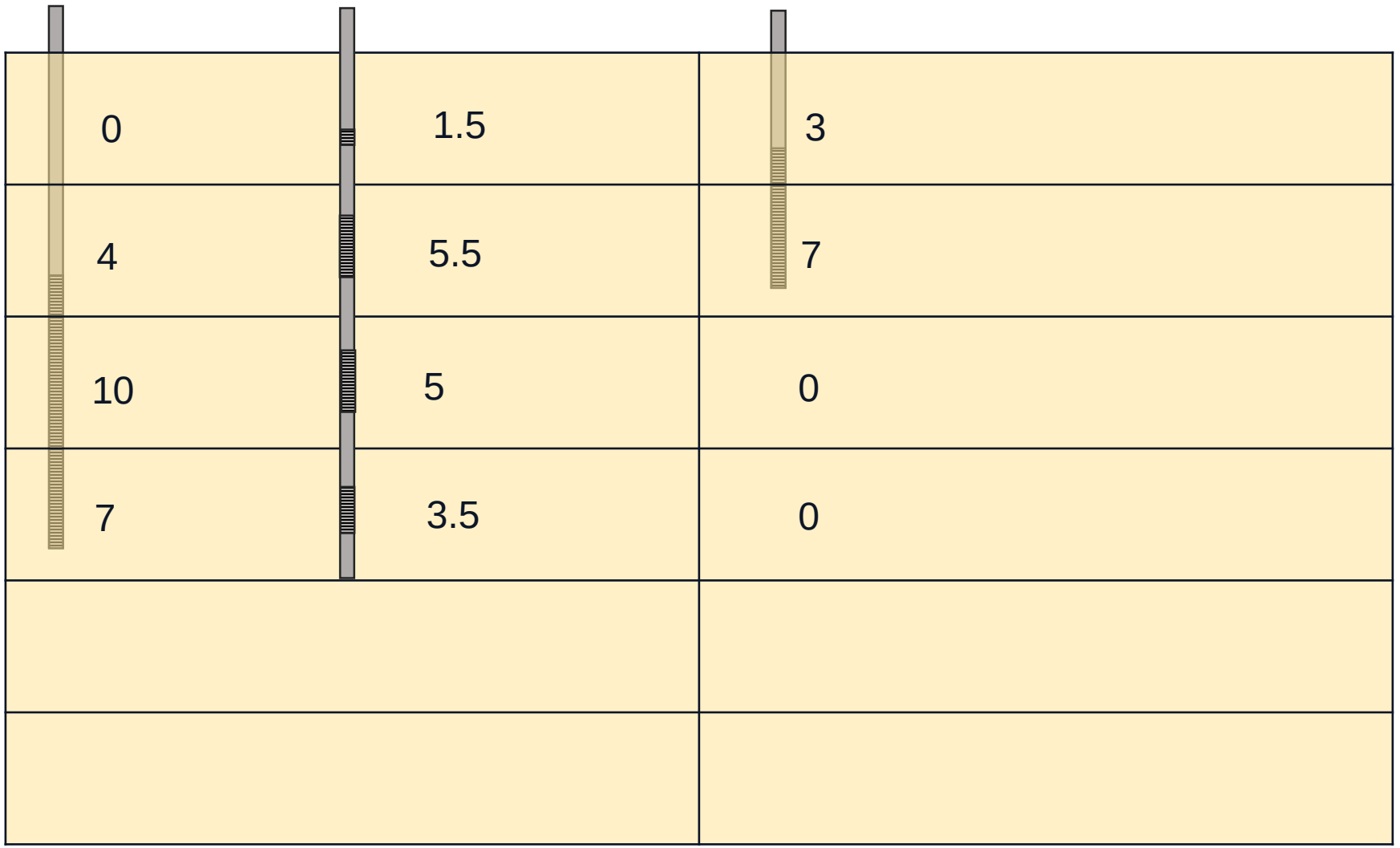
Pumping by Layer

- One representative pumping well in each cell based upon nearby well logs
  - Not all well logs checked



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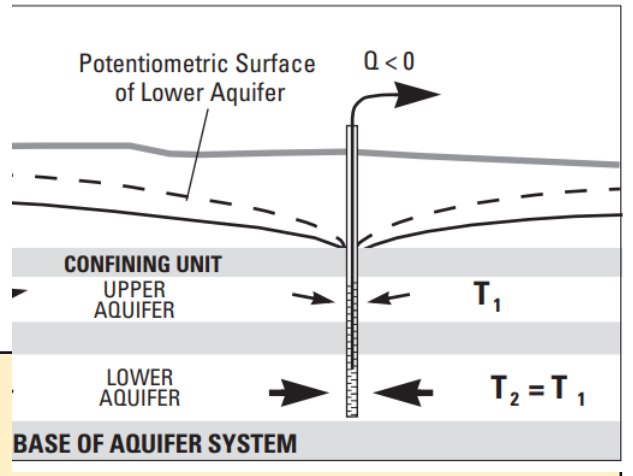
Pumping by Layer

Proportional to transmissivity $Q_{j,i,k} = \frac{T_{j,i,k}}{\sum_{k=1}^{NL} T_{j,i,k}} Q_{TOT}$



0	1.5	3
4	5.5	7
10	5	0
7	3.5	0

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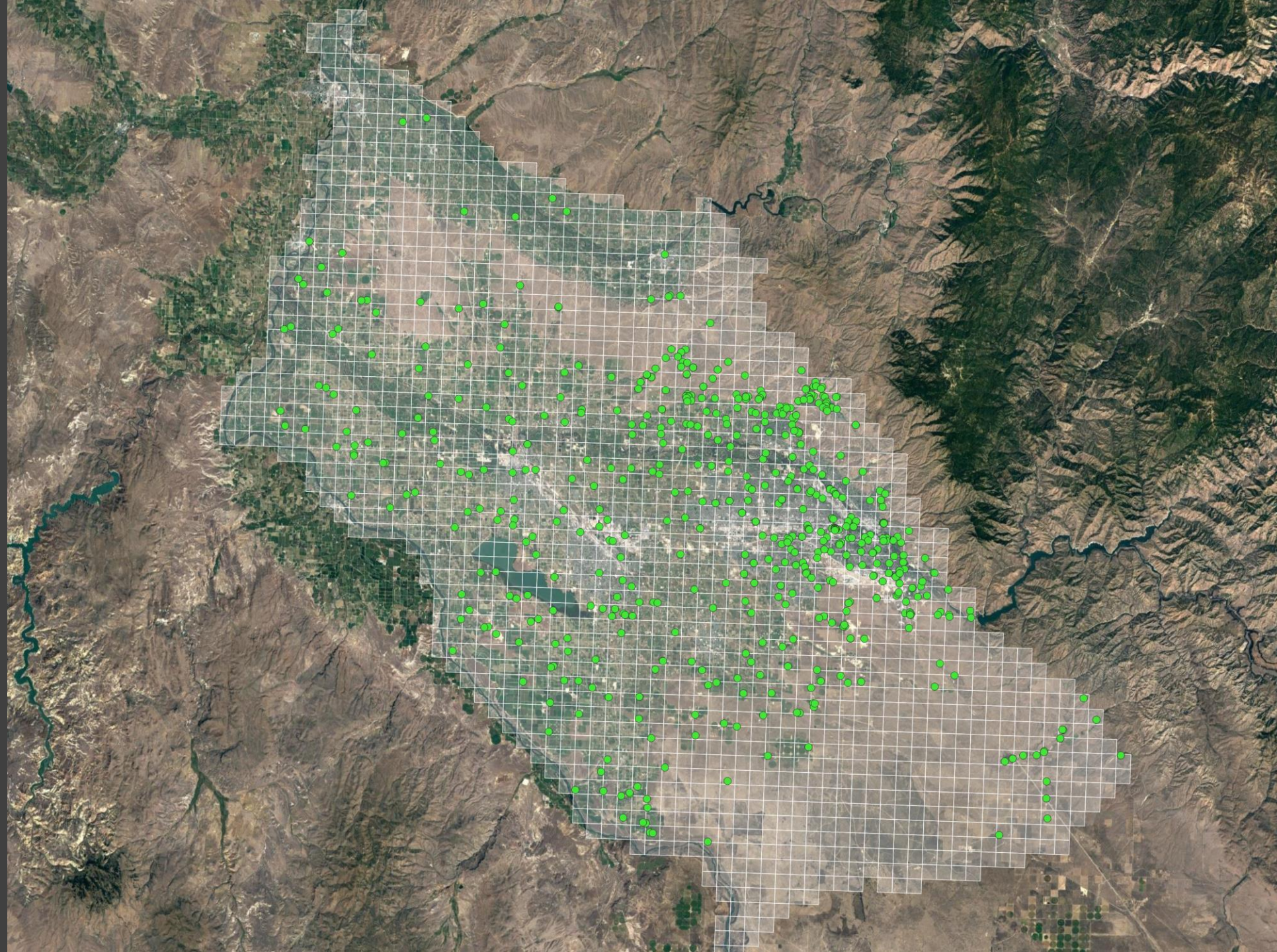
Monitoring Wells: All



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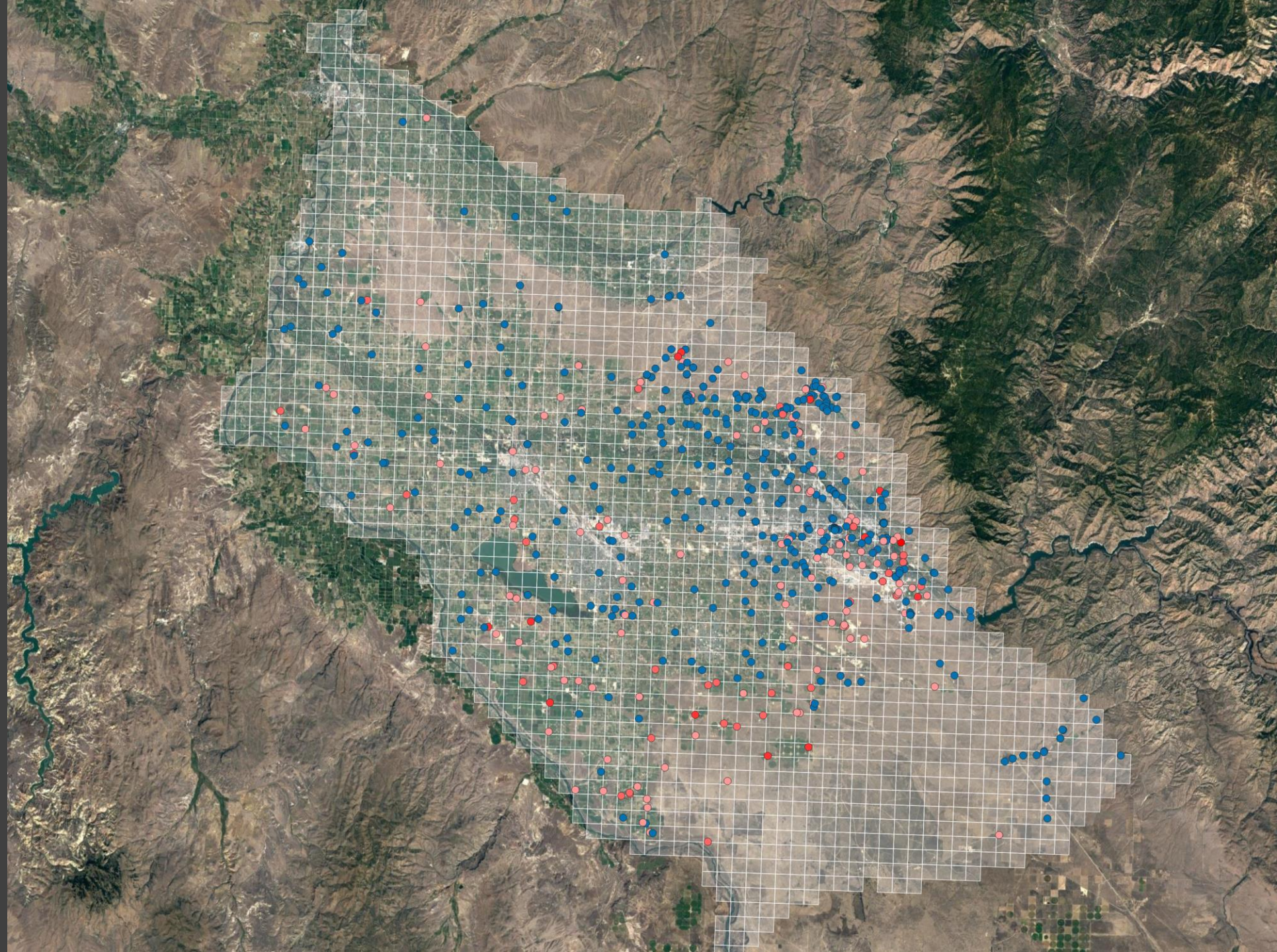
Monitoring Wells: All

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4



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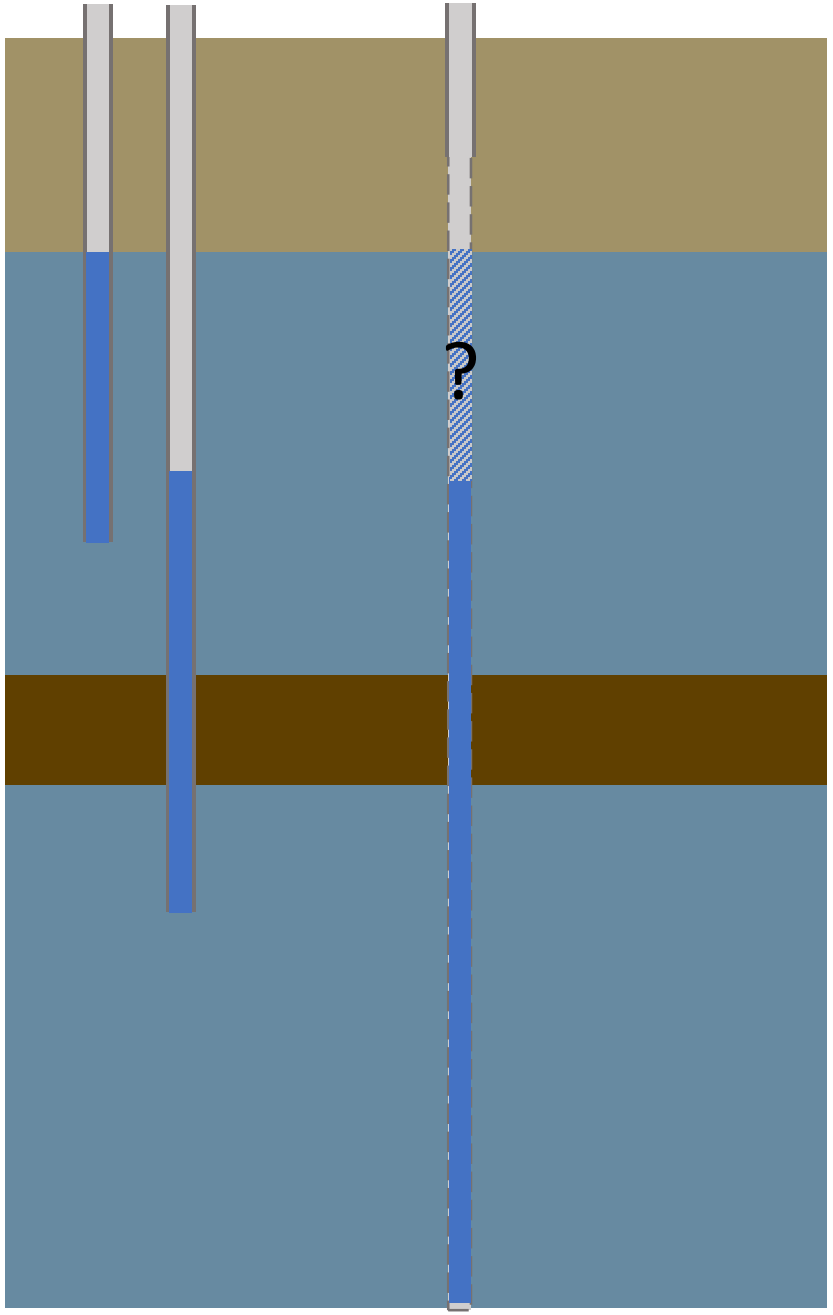
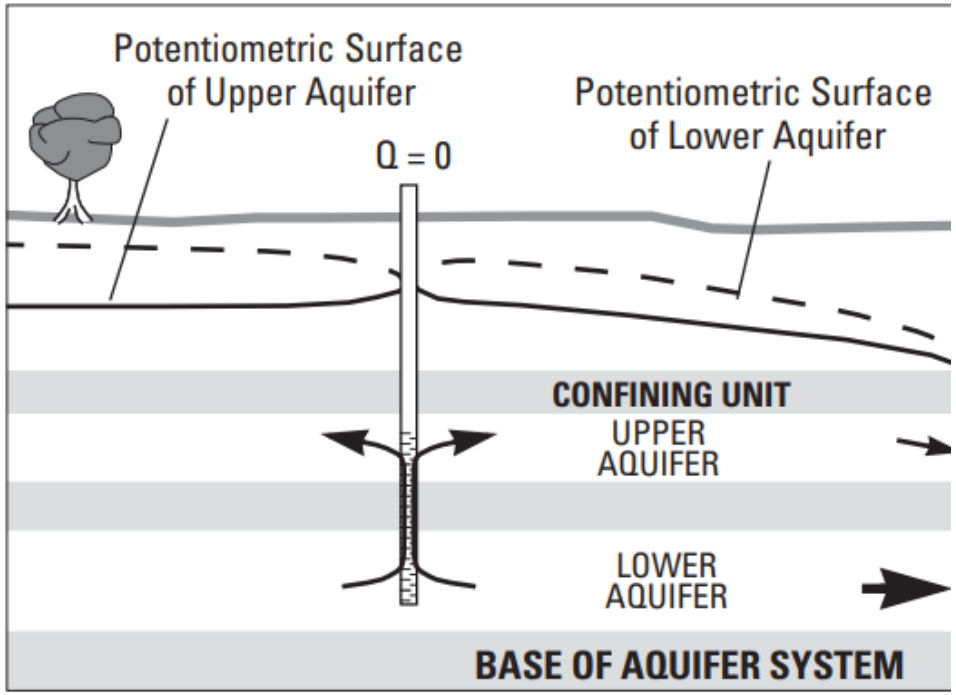
Multi-Layer Monitoring Wells





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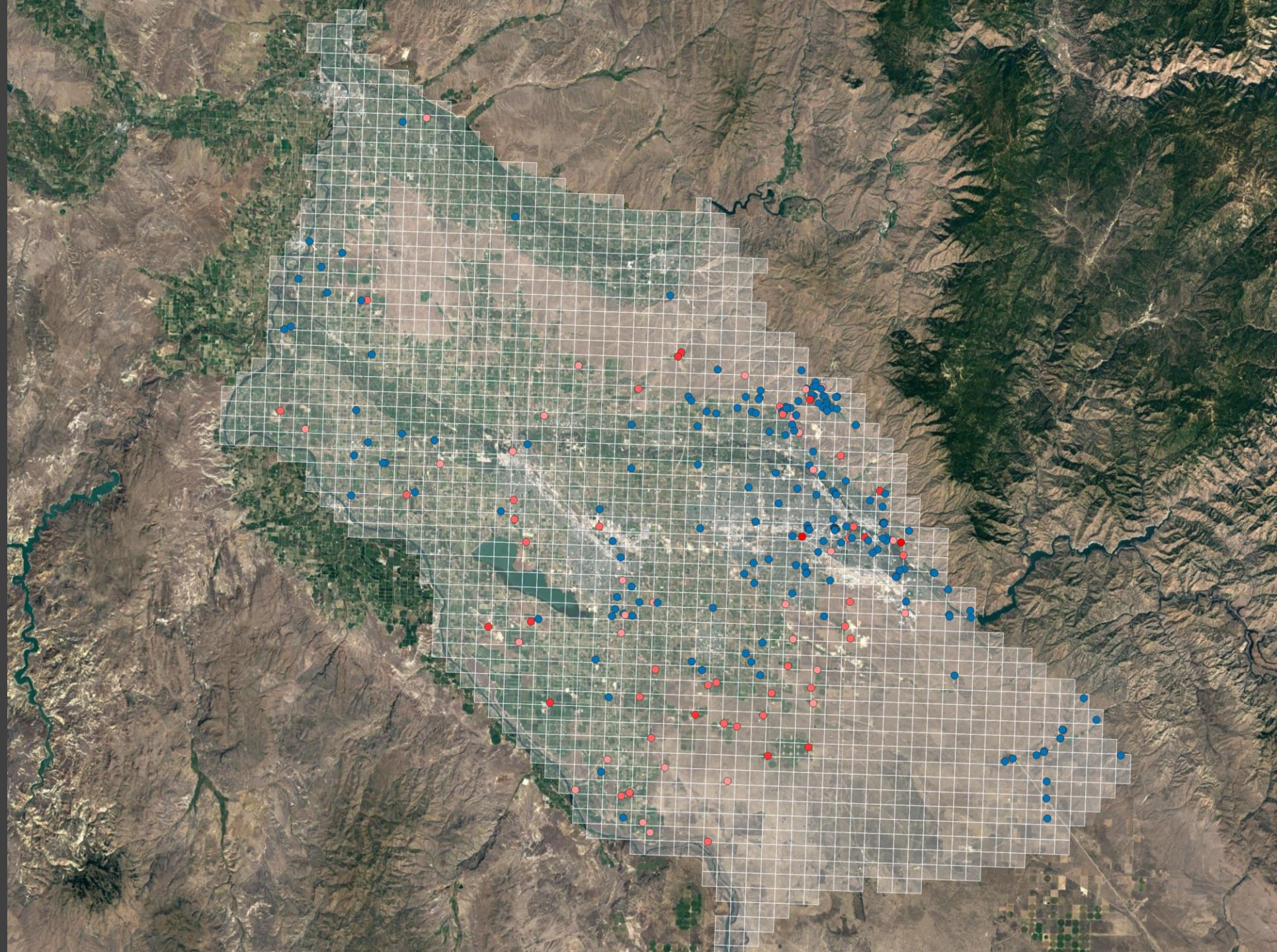
Monitoring Wells: Layer 1

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4



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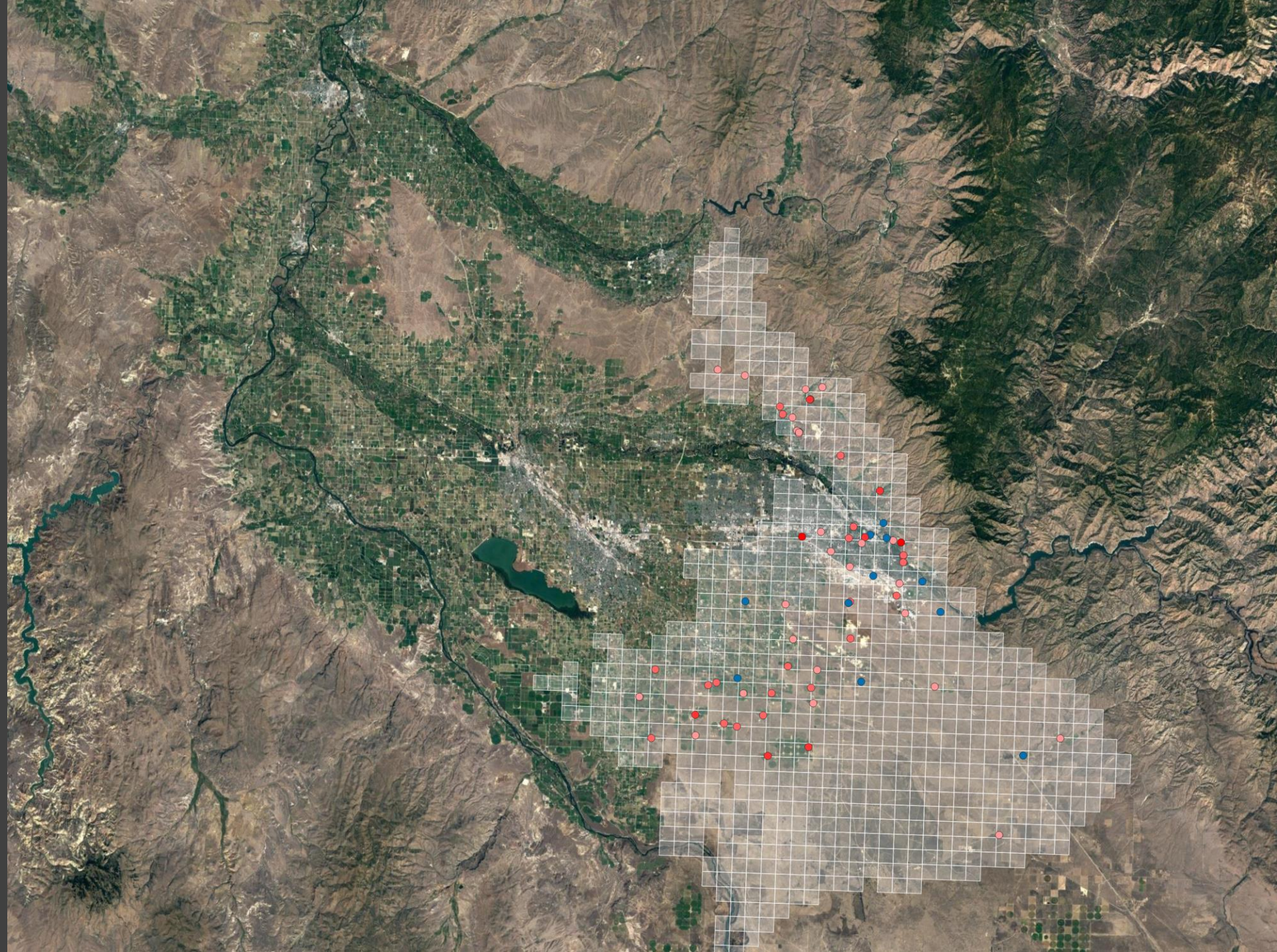
Monitoring Wells: Layer 2



Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4

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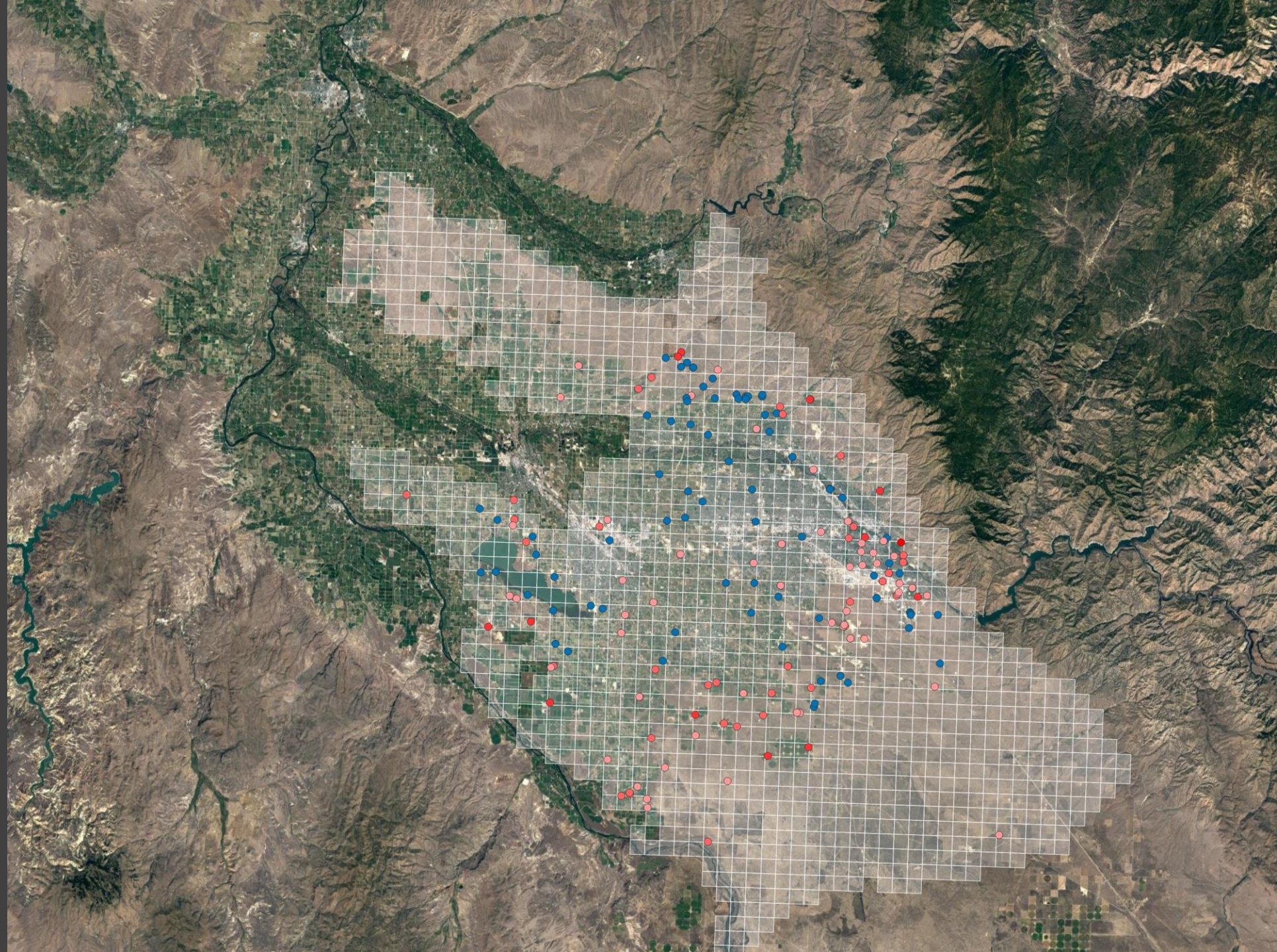
Monitoring Wells: Layer 3

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4



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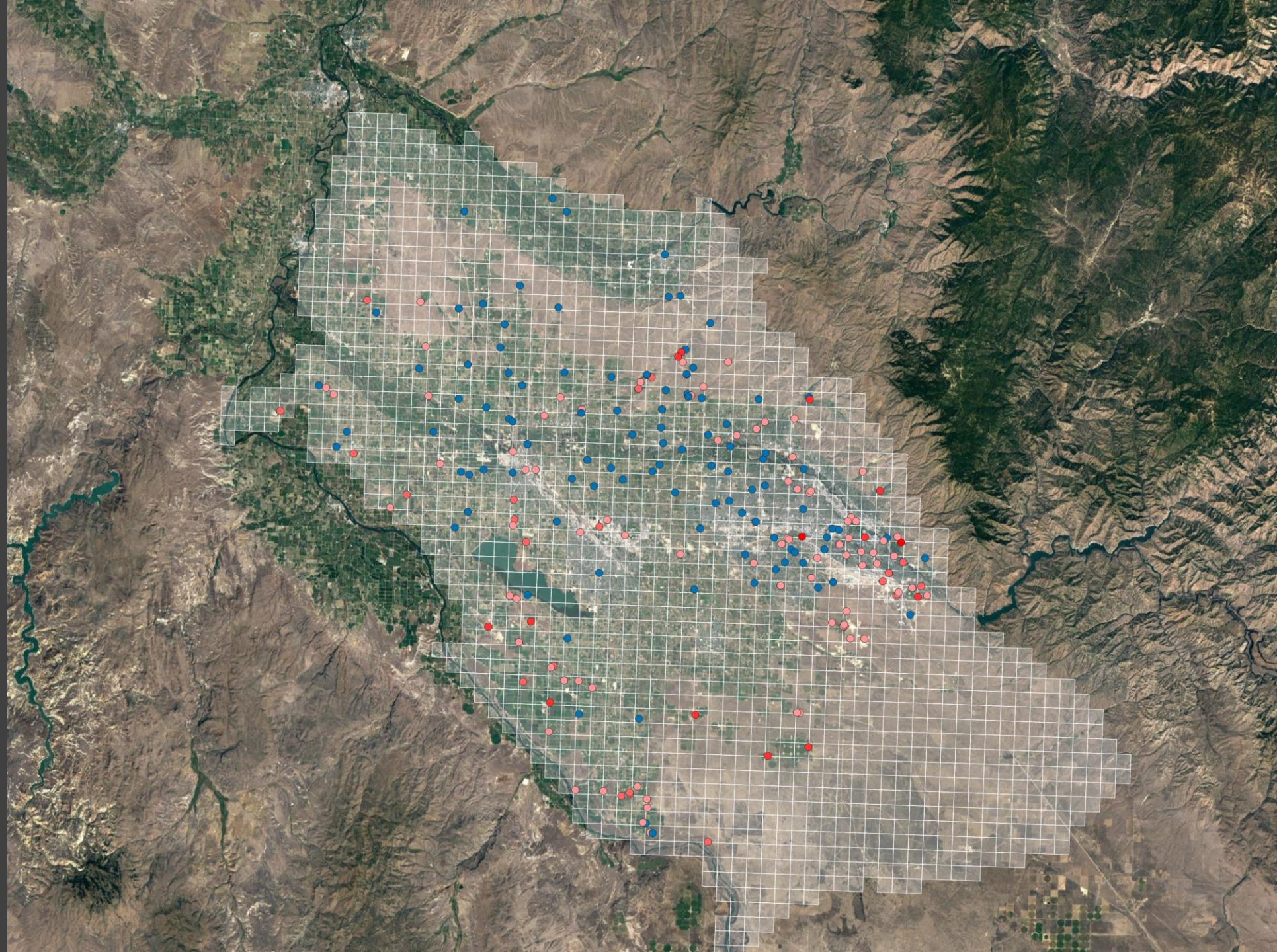
Monitoring Wells: Layer 4

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4



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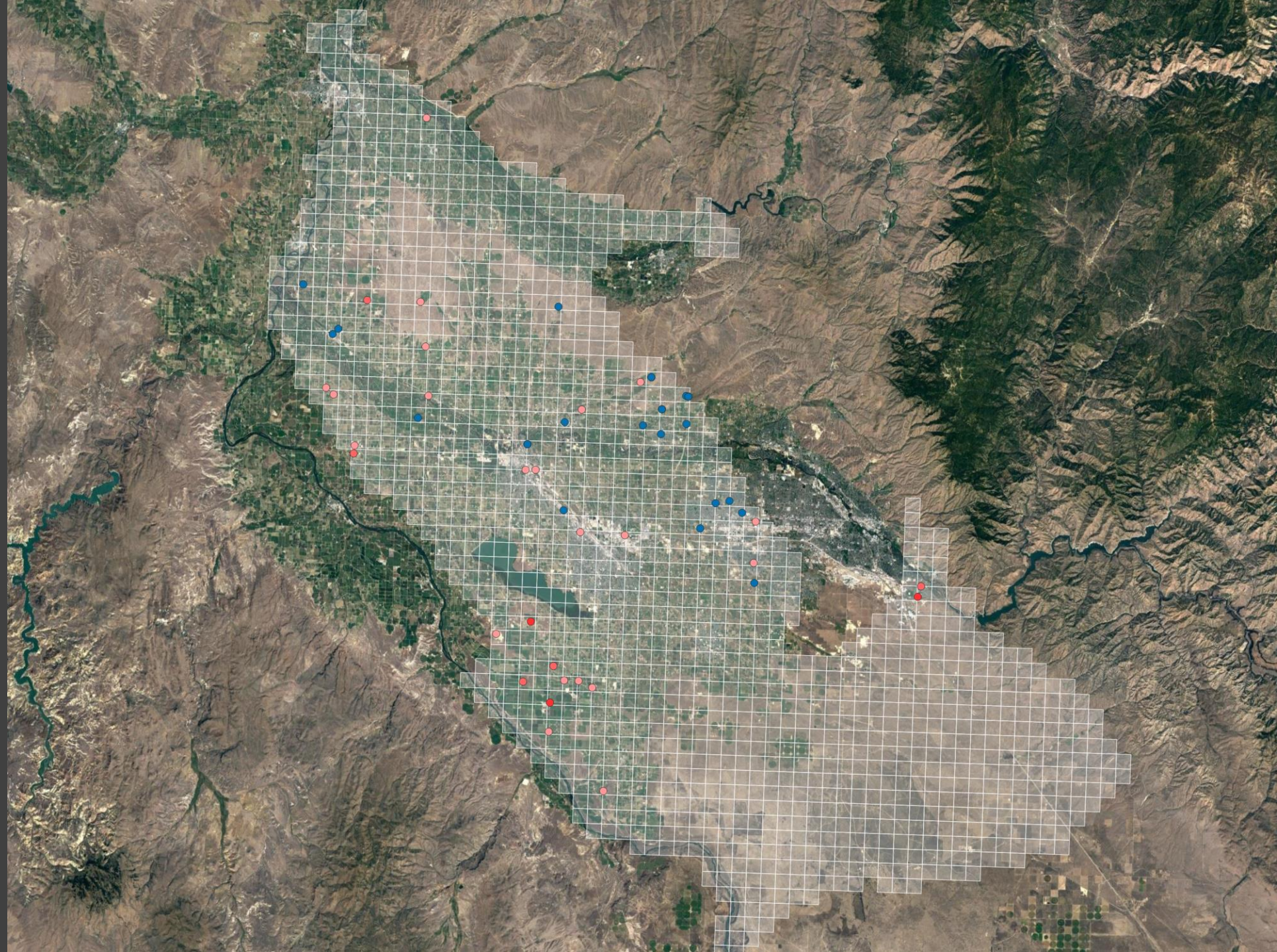
Monitoring Wells: Layer 5

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4



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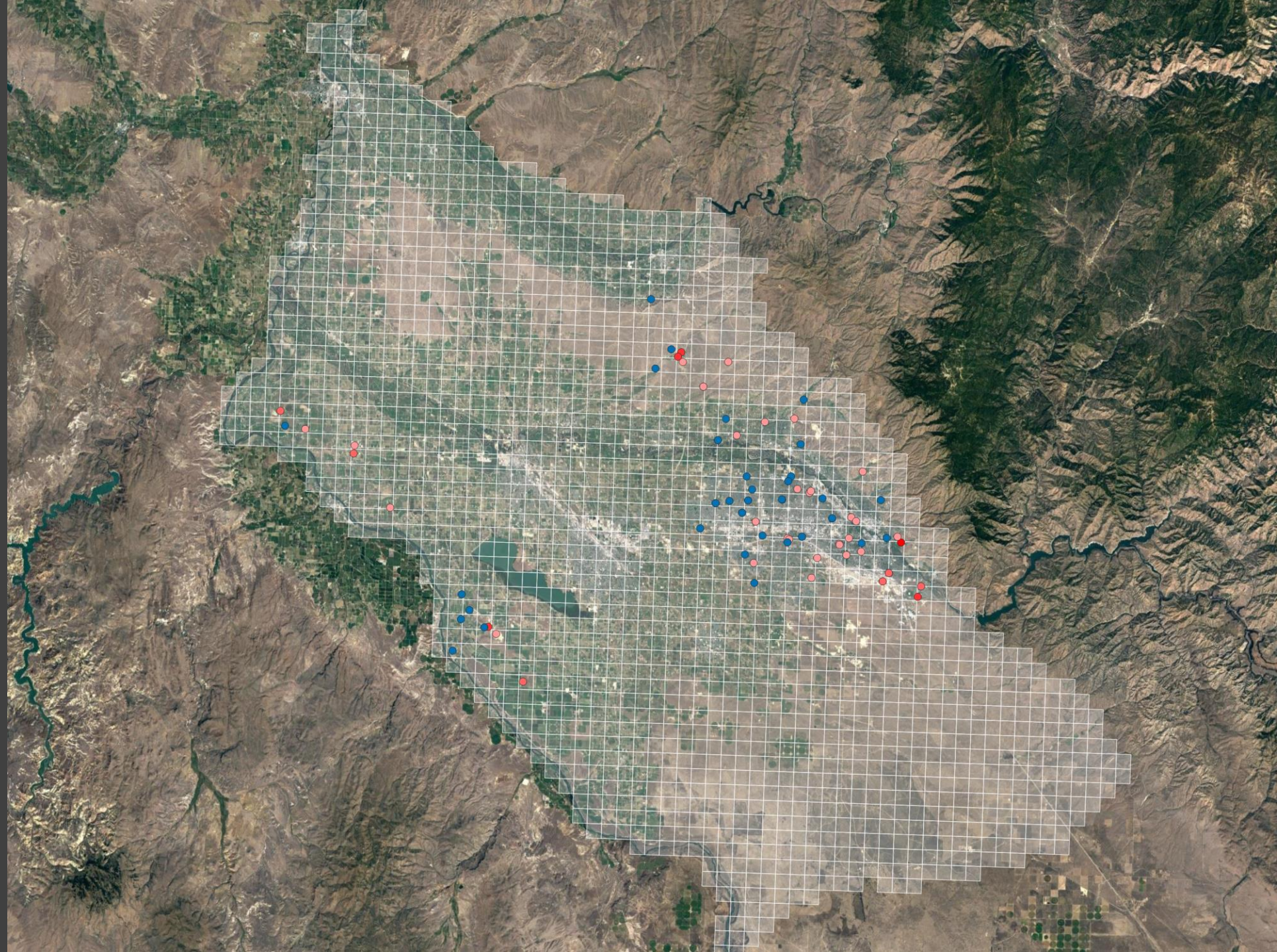
Monitoring Wells: Layer 6

Number of Layers Intercepted by Screened Interval(s)

- 1
- 2
- 3
- 4



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Thanks for Listening

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