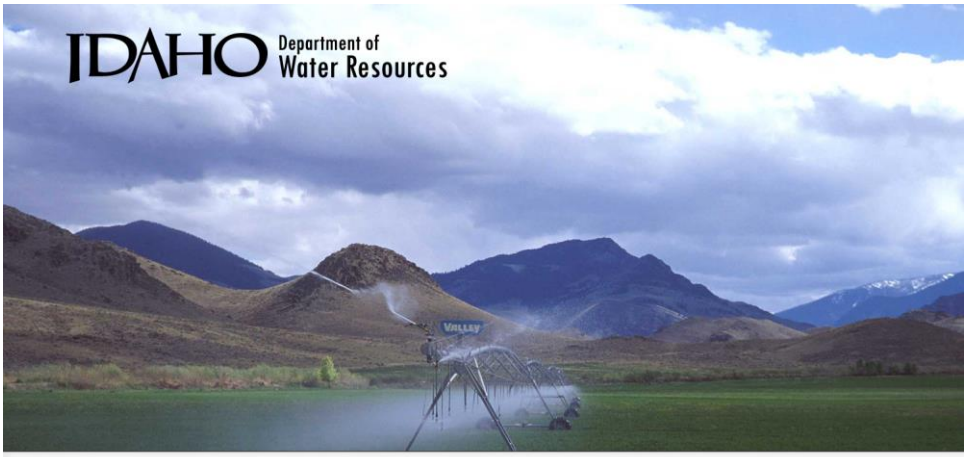


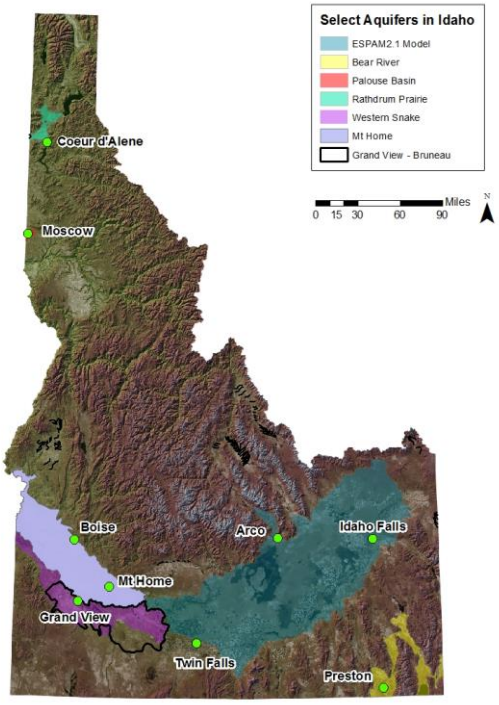
Select Aquifers and Vulnerability to Contamination

Presented by Mike McVay P.E., P.G. – December 4, 2014

IDAHO Department of Water Resources

Topics for Today

- Information on selected aquifers around the state.
  - General vulnerability factors
  - Geology
  - Groundwater flow
  - Nitrate Priority Areas



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DRASTIC Model of Potential Contamination

- One of many models
- Widely used
- Illustrates common factors influencing vulnerability
- Flexible, can be adjusted to fit circumstances

DRASTIC Factors

Depth to Water
Net **R**echarge
Aquifer Media
Soil Media
Topography
Impact of Vadose Zone Media
Hydraulic **C**onductivity of Aquifer

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Anthropogenic Activities Influence Vulnerability

DRASTIC Factors
Depth to Water
~~Net Recharge*~~
Aquifer Media
Soil Media
Topography
Impact of Vadose Zone Media
Hydraulic Conductivity of Aquifer

Land Use	
Urban	3
Irrigated Agriculture	2
Dryland Agriculture	1
Rangeland	1
Forest	1

*Adjustment made for ESPA vulnerability mapping by USGS.

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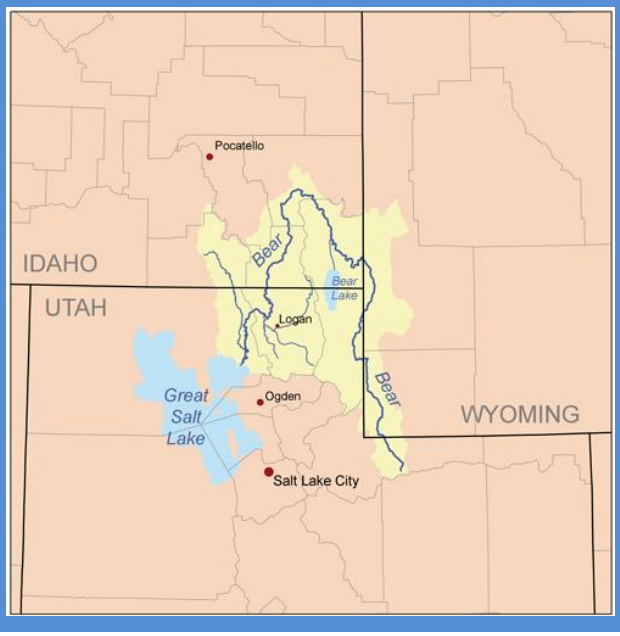
Physical Environment Influences Vulnerability

DRASTIC Factors
Depth to Water
~~Net Recharge~~ Land Use
~~Aquifer Media~~
Soil Media
~~Topography~~
~~Impact of Vadose Zone Media~~
~~Hydraulic Conductivity of Aquifer~~

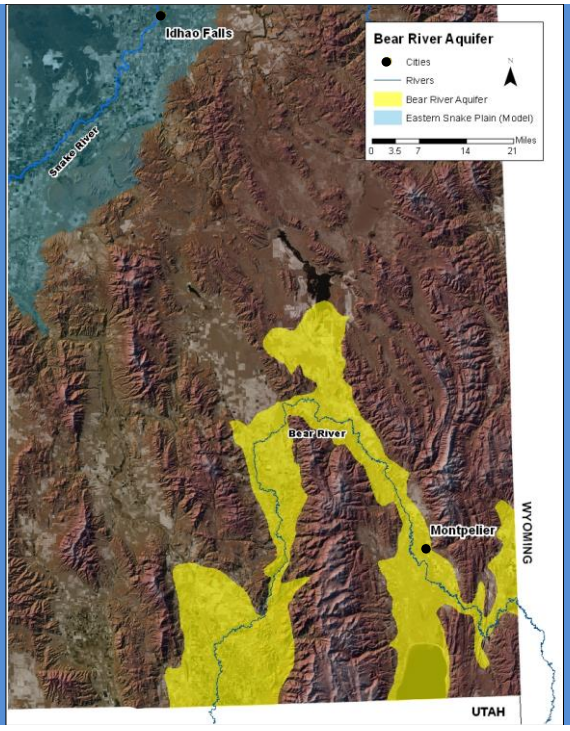
ESPA Physical Factors
Soils (drainage)
Depth to Water

The Bear River Aquifer



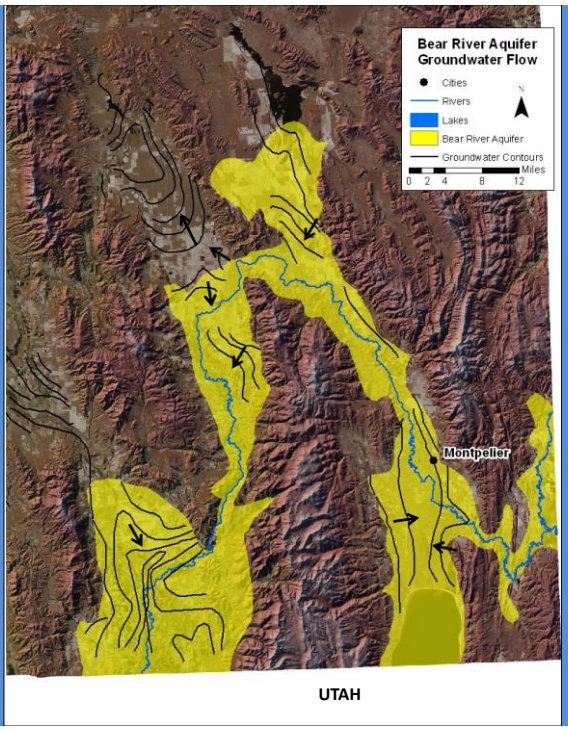
Bear River Aquifer:

- Generally exists in the mountain valleys that the Bear River follows.
- Depth to water is typically less than 100 ft - often just a few tens of feet deep.
- The Bear River aquifer is unconfined.
- Recharge is primarily by seepage of surface water near the basin margins. Some recharge due to direct precipitation and irrigation seepage.
- The Bear River and groundwater are directly connected.



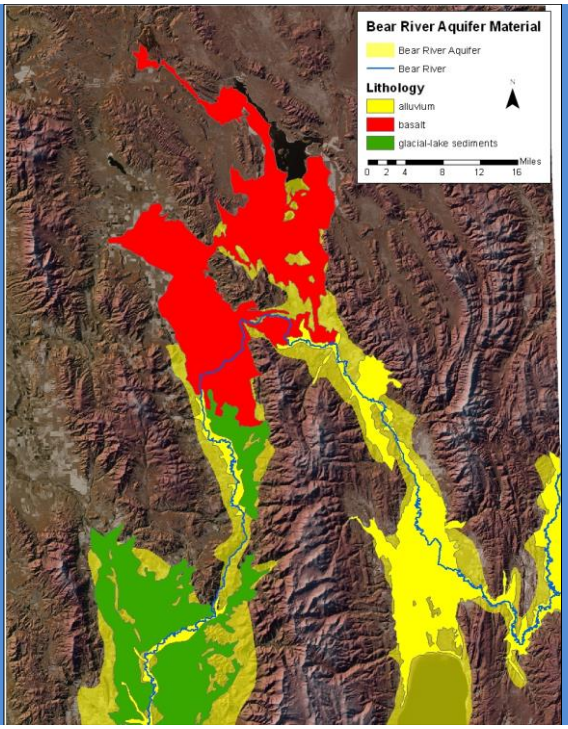
Bear River Aquifer:

- Groundwater flows to the river.
- A small amount of flow exits the aquifer to the northwest into the Bancroft-Lund aquifer.
- A small amount of water enters the aquifer from Blackfoot Reservoir leakage.



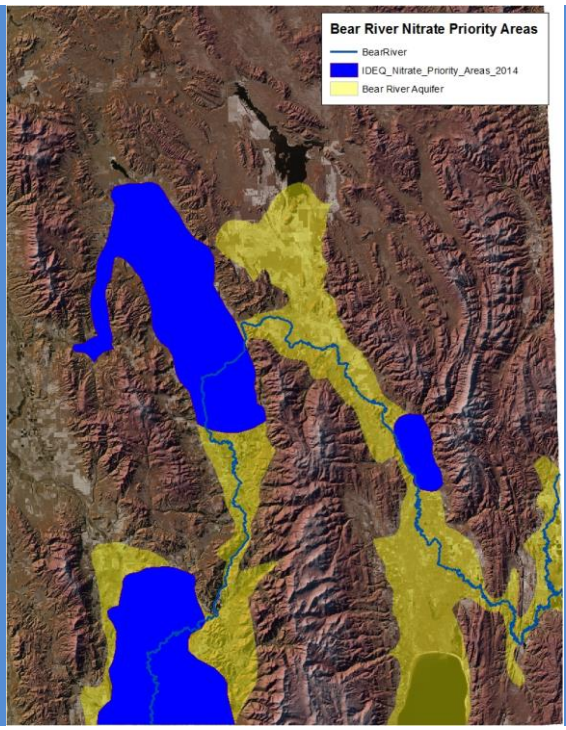
Bear River Aquifer:

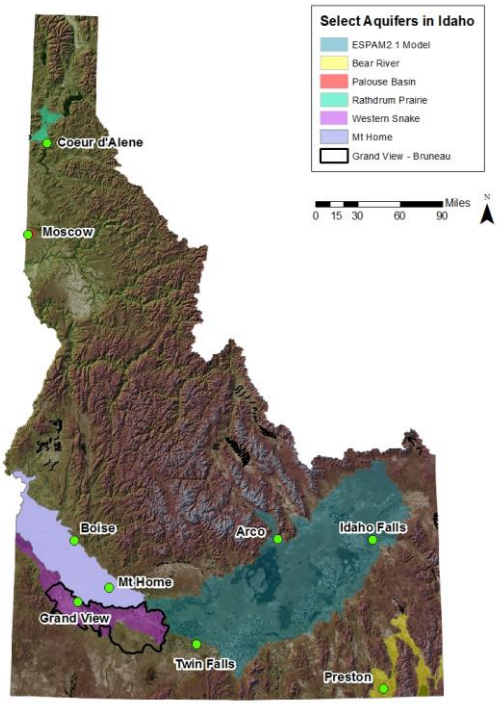
- Aquifer generally composed of unconsolidated sediments and alluvial material.
- Aquifer is basalt in the northern "bend" section.
- Basalt allows some water to enter the aquifer from the Blackfoot Reservoir and allows some water to exit the aquifer to the northwest.



Bear River Aquifer NPAs:

- Surface-Water Irrigated Agriculture
- Shallow groundwater
- Well drained soils



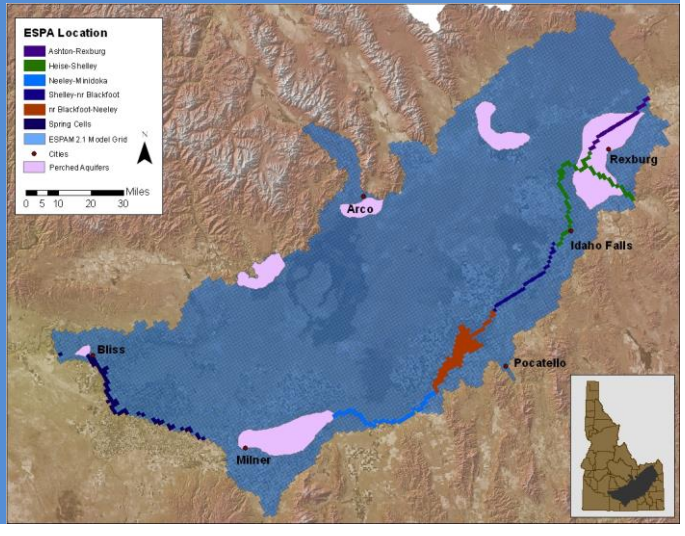


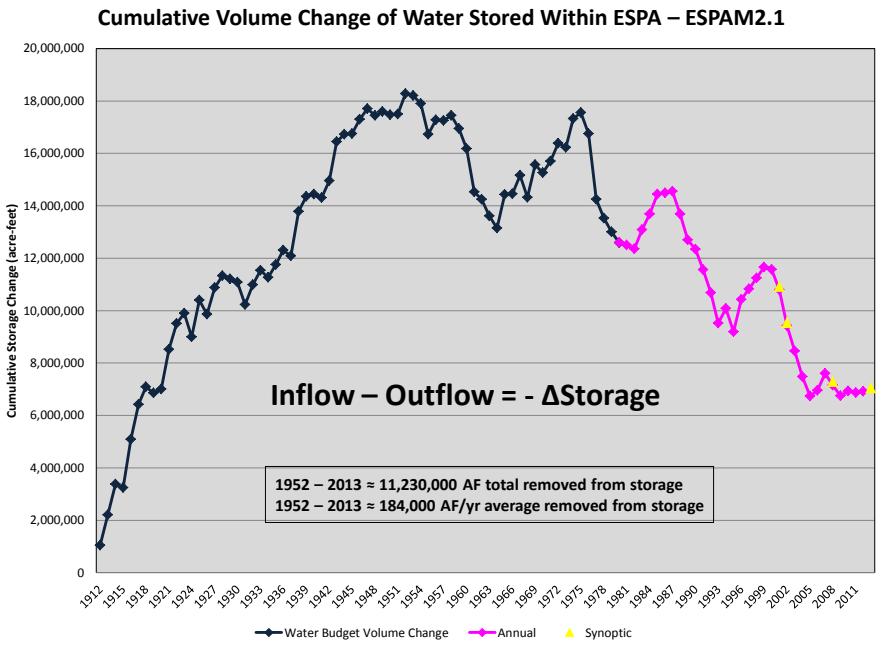
Eastern Snake Plain Aquifer

Big Southern Butte

Eastern Snake Plain Aquifer:

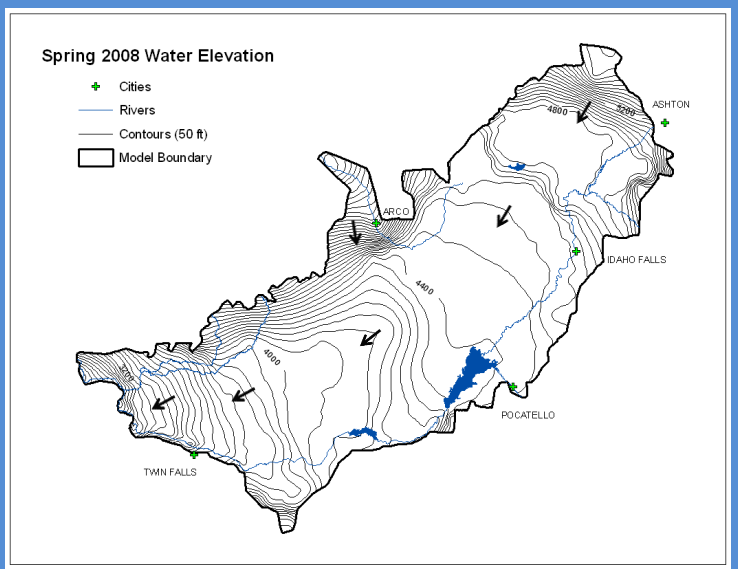
- Aquifer composed primarily of basalt.
- Aquifer is generally unconfined with local confined conditions.
- Some locally perched areas.
- Depth to water ranges from a few feet in places near the river to over 1,000 feet in the center of the plain.
- Recharge due primarily to irrigation and stream seepage, tributary underflow, and precipitation.
- Water moves very easily (fast) through this aquifer
- Largest aquifer in Idaho.
- Very important to Idaho.



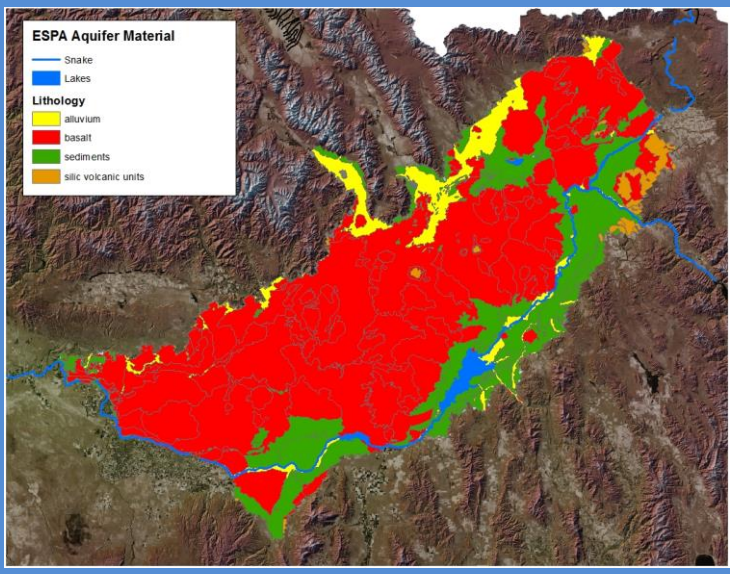


Eastern Snake Plain Aquifer:

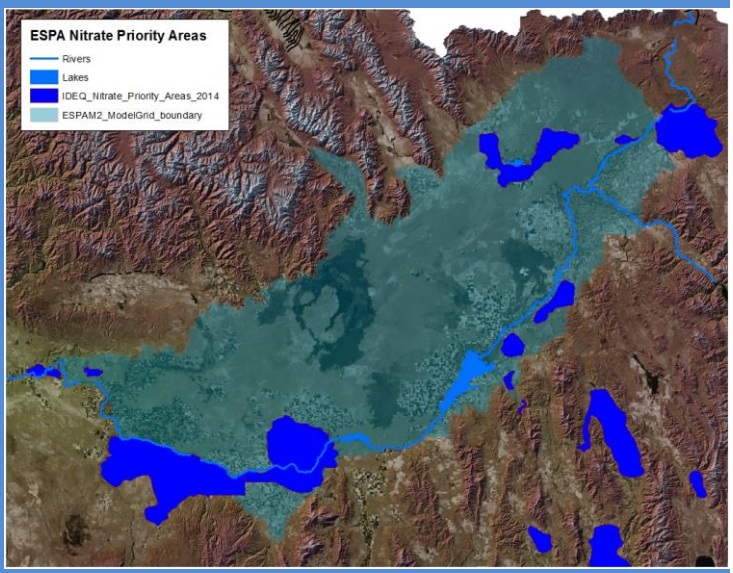
- Groundwater flow is generally to the west-southwest.
- Groundwater flows from the margins of the aquifer toward the central axis and down to exit at the springs.

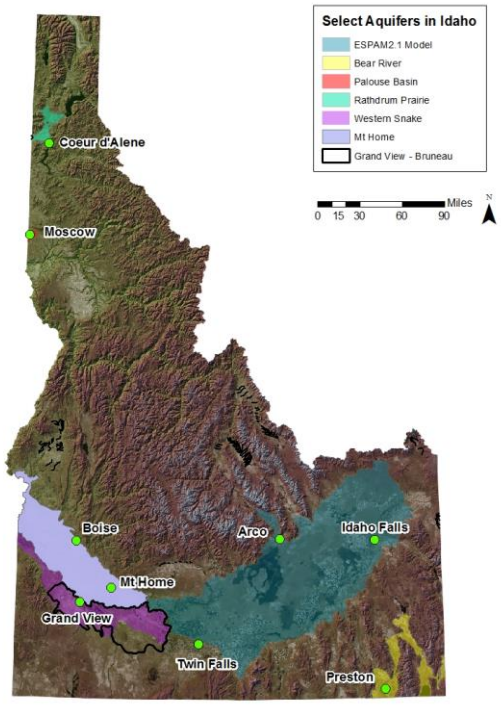


ESPA Aquifer:
•Aquifer generally composed of primarily of basalt.
•Perched Aquifers in sediments.
•Basalt extremely high transmissivity, sediments less transmissive.



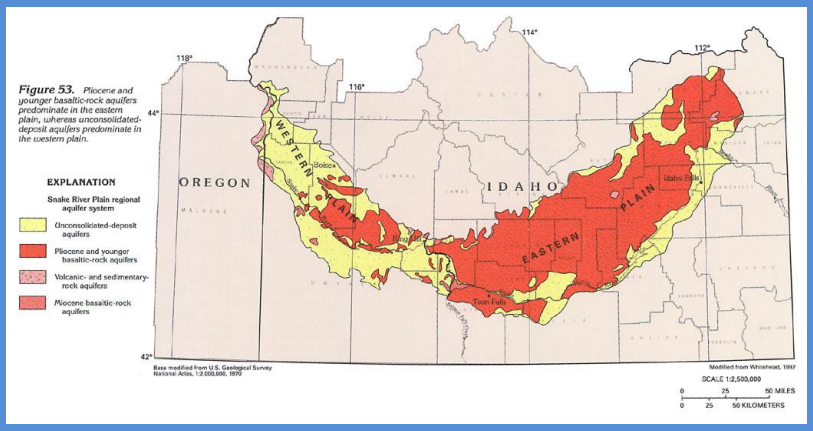
ESPA Aquifer:
•NPAs located in areas dominated by sediments.
•NPAs located in perched or shallow groundwater areas.
•NPAs located in areas of irrigated agriculture (surface water dominated).





The Eastern and Western Snake Plains formed by entirely different processes.

- Eastern Snake Plain formed as the area passed over the Yellowstone Hotspot.
- The Western Snake Plain formed as the area has been stretched and pulled apart.

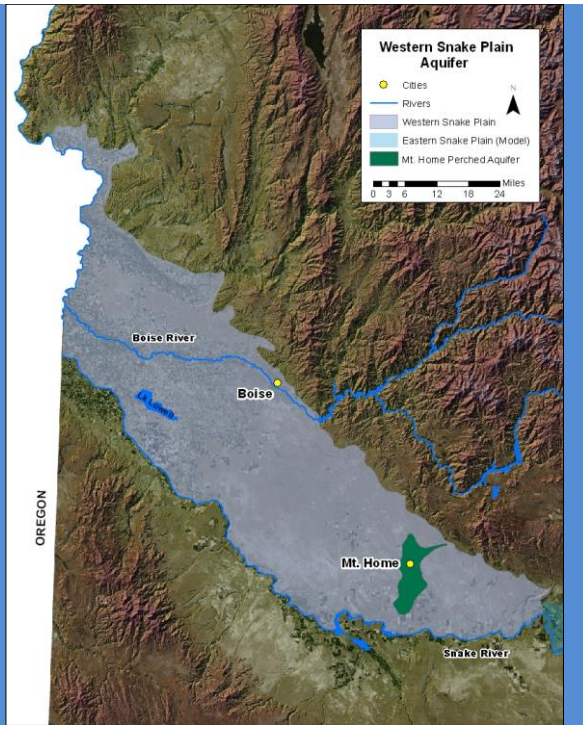


Mountain Home Aquifer

Crater Rings – 5 miles west of Mt. Home

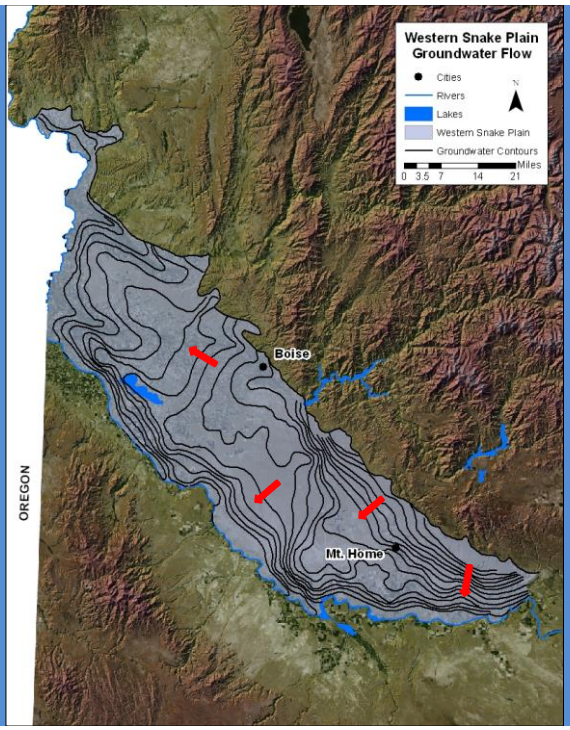
Mountain Home:

- Mountain Home regional aquifer is part of the larger Western Snake Plain Aquifer.
- Depth to water in the Mountain Home regional aquifer is generally in excess of 300 ft.
- Regional aquifer is unconfined.
- Recharge is limited and occurs primarily through underflow and perched aquifer leakage. Small amounts of recharge due to precipitation, effluent and irrigation seepage.
- Perched aquifer around Mountain Home has water levels from a few feet to hundreds of feet.



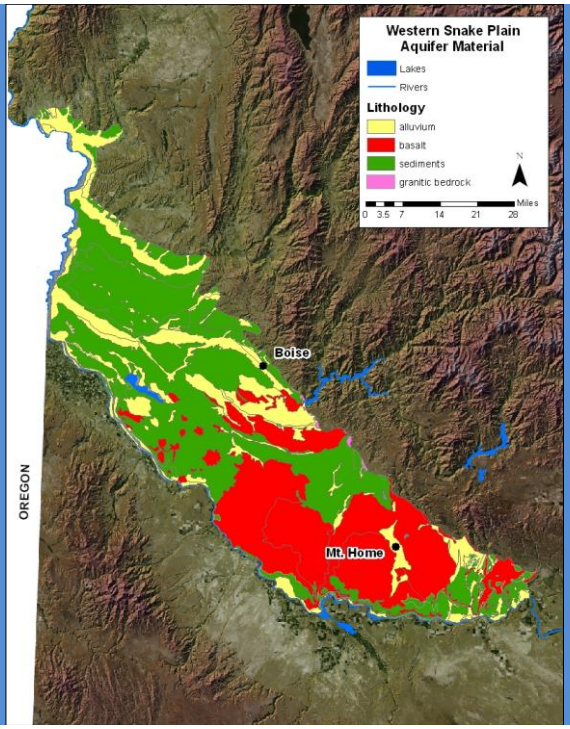
Mountain Home:

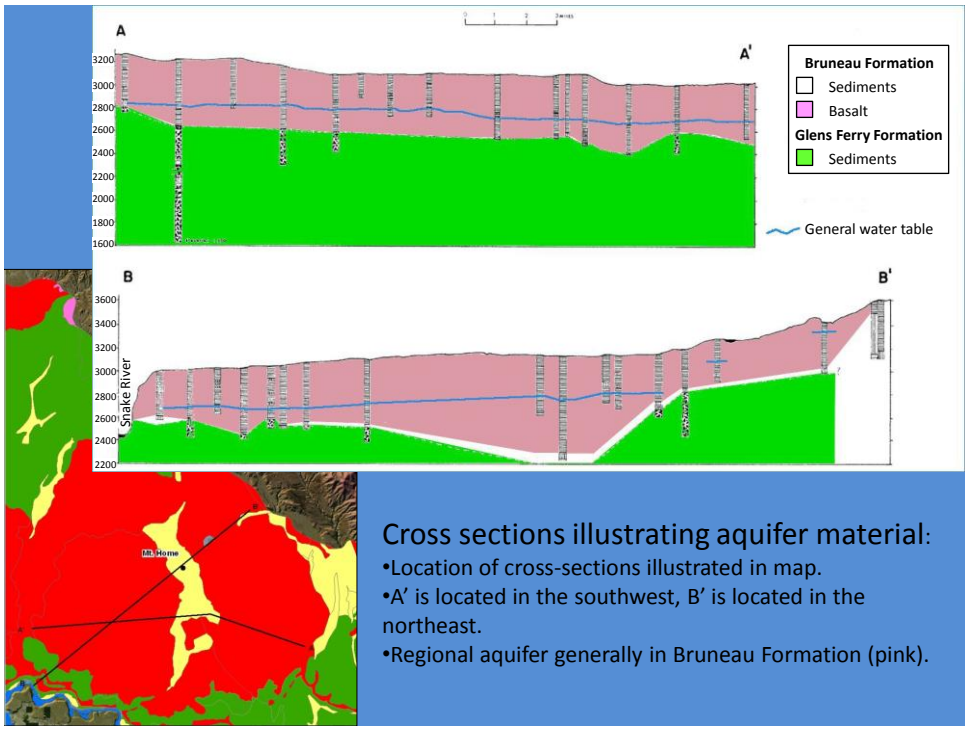
- Groundwater flow is generally southwest in the Mountain Home portion of the aquifer.
- Perched aquifer flow is generally south-southwest (not pictured).



Mountain Home:

- Aquifer located primarily in basalt and sediments of the Bruneau Formation.
- Bruneau Formation is a unit of the Idaho Group made of stream and lake sediments, layers of ash, and basalt flows.



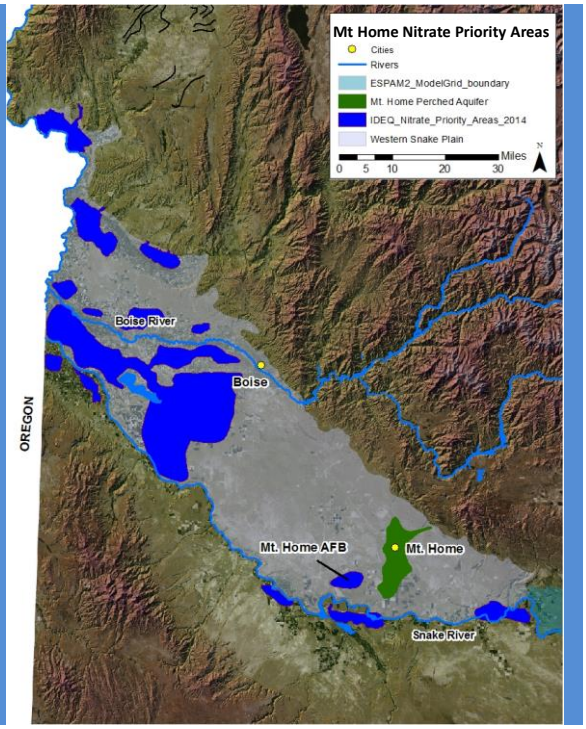


Cross sections illustrating aquifer material:

- Location of cross-sections illustrated in map.
- A' is located in the southwest, B' is located in the northeast.
- Regional aquifer generally in Bruneau Formation (pink).

Mountain Home NPA:

- Located in an area dominated by basalt.
- Located in an area of deep groundwater.
- Located in an area with low-density agriculture and outside of urban area.
- Underlies Mt Home Air Force Base.



Use of Human Pharmaceuticals to Determine a Sewer Water Nitrate Source to the Regional Aquifer, Mountain Home Air Force Base, Idaho

by D.L.Schwarz[1] and D. J. Parliman[2]

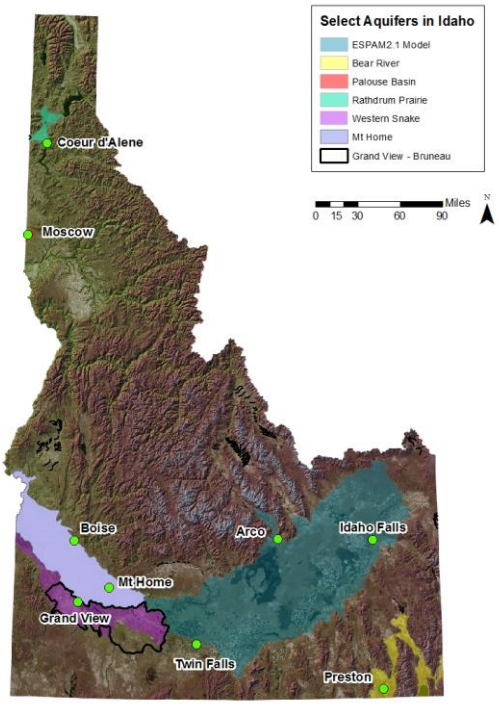
October 29, 2010

[1] URS GROUP, INC.
720 Park Boulevard
Boise, ID 83712

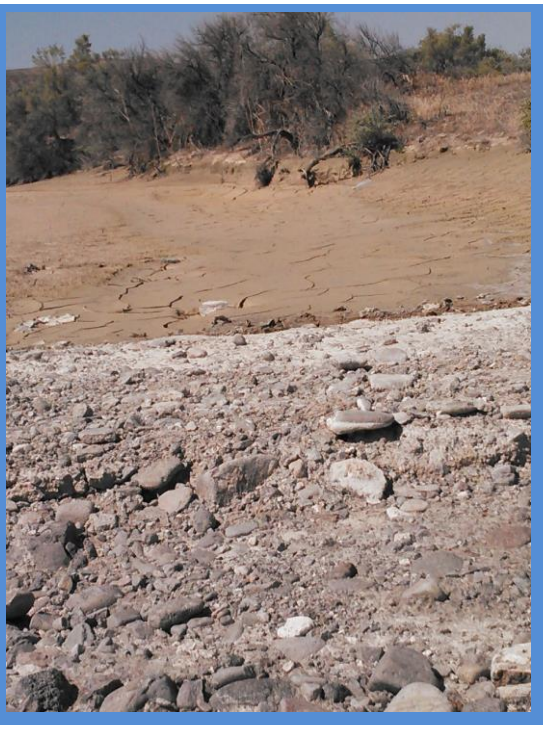
[2] US DEPARTMENT OF THE INTERIOR
US GEOLOGICAL SURVEY
230 Collins Road
Boise, ID 83702

"…clean, unambiguous indication that sewer wastewater is a source of some, if not all of the nitrate."

Land use appears to be an issue, despite the deep water table.



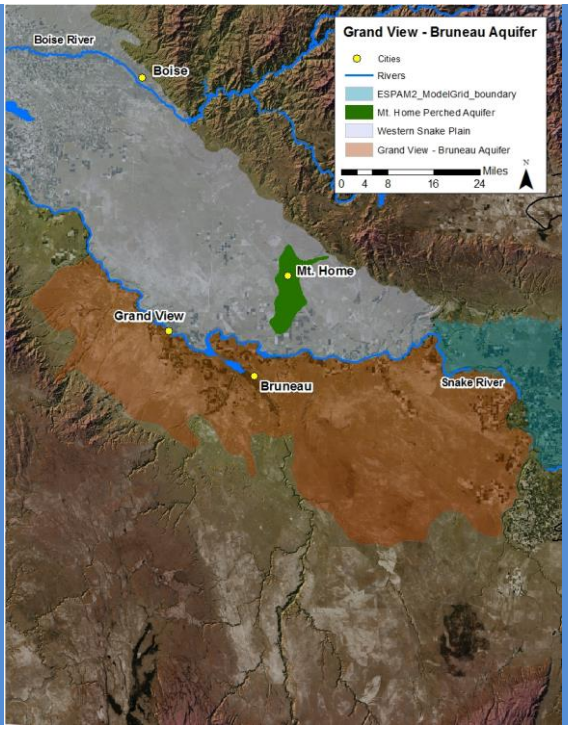
Grand View – Bruneau Aquifer



Mud Flow near Bruneau

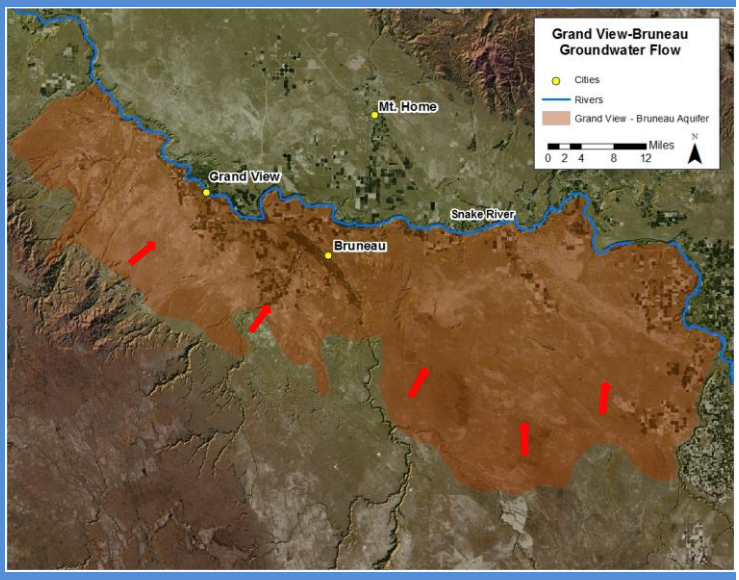
Grand View-Bruneau:

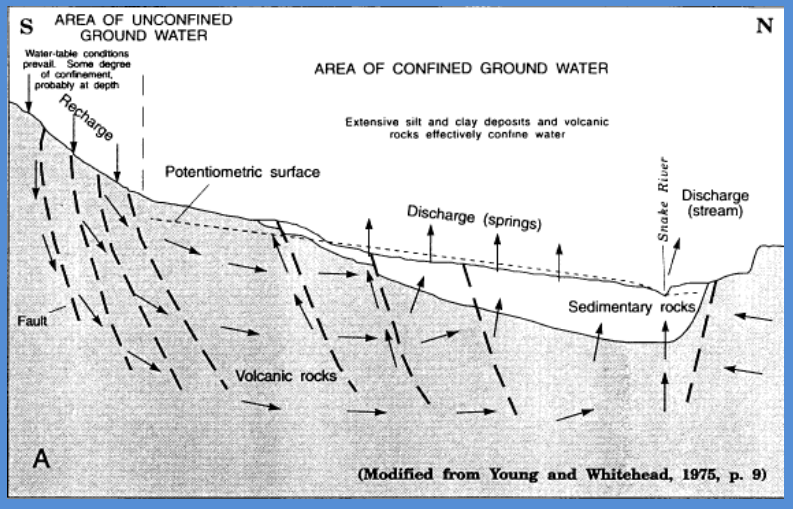
- Grand View-Bruneau (GV-B) regional aquifer is part of the larger Western Snake Plain Aquifer.
- Depth to water in the GV-B central sedimentary aquifer is generally deep.
- Regional sedimentary and volcanic aquifers are confined.
- Regional aquifers are highly faulted.
- Recharge is due to precipitation in mountains.
- Recharge is limited and occurs primarily through upwelling. Small amounts of recharge due to precipitation, effluent and irrigation seepage.
- Locally unconfined, recharge via irrigation.



Grand View-Bruneau:

•Groundwater flow is generally to the north; from recharge in the mountains to discharge at the Snake River.





Grand View-Bruneau

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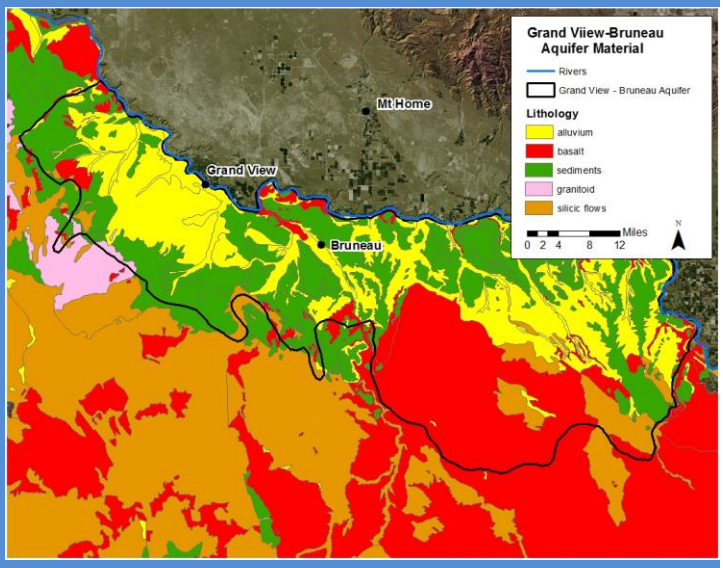
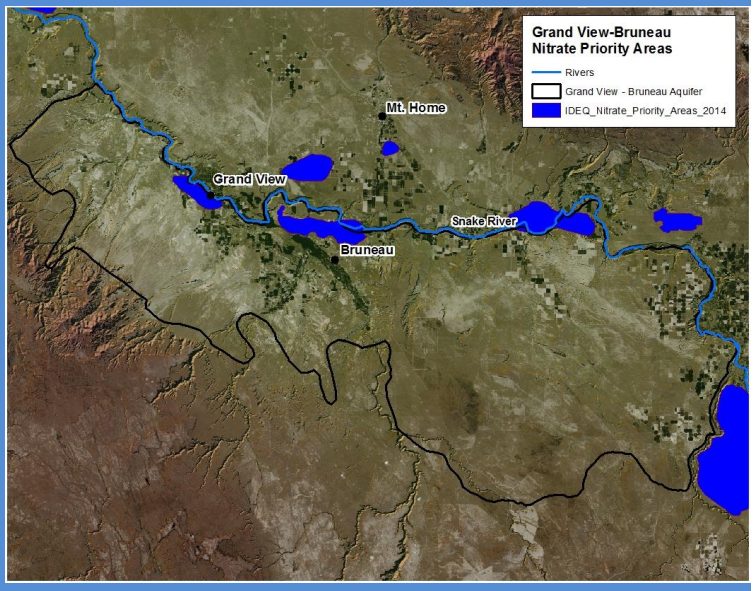
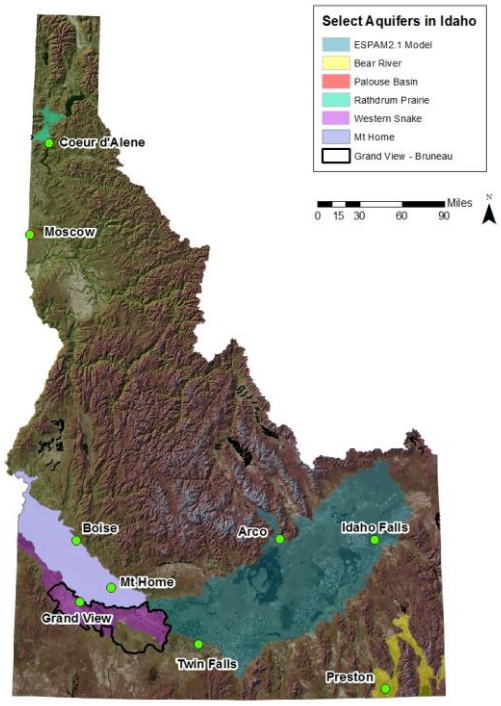


Grand View-Bruneau NPAs:

- Located in unconfined areas.
- Located in surface-water irrigation areas.

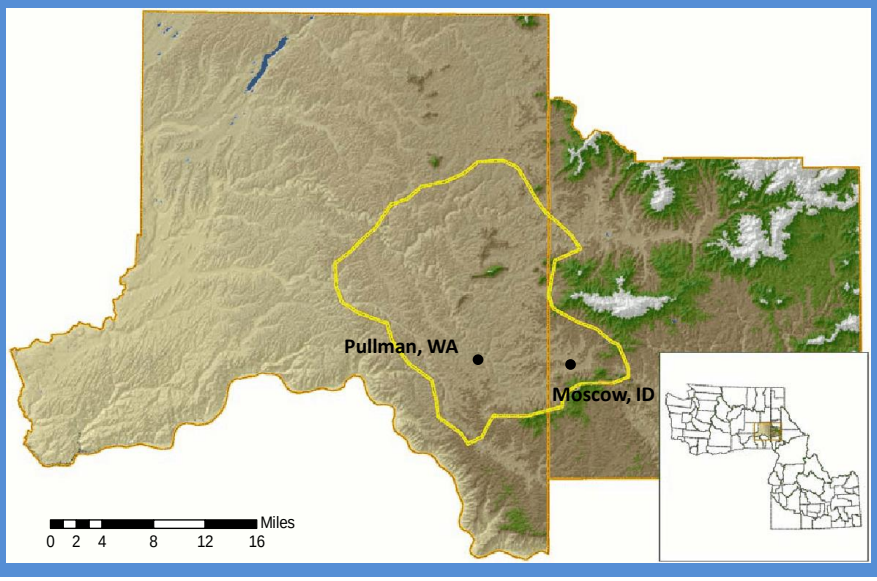




Palouse Basin Aquifer (Moscow)

Palouse Basin Aquifer:

•The aquifer in Idaho is only a small fraction of the larger regional aquifer.

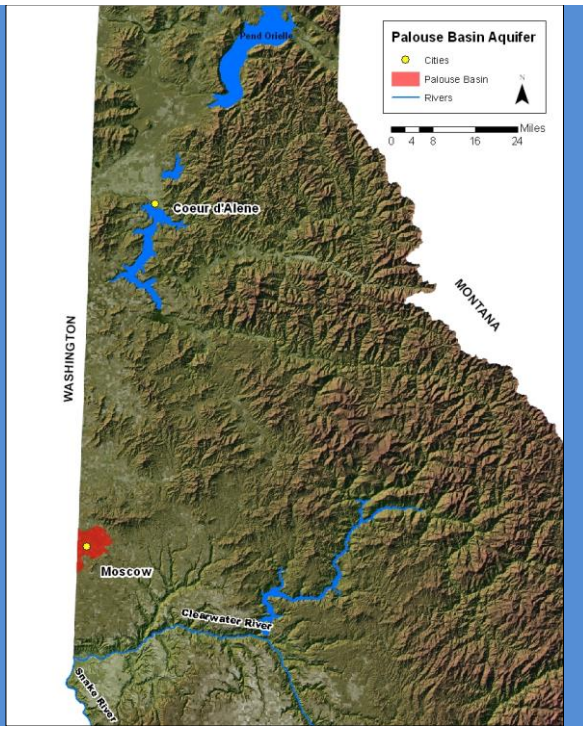


17 million years ago

Today – valleys filled with basalt and covered with loess

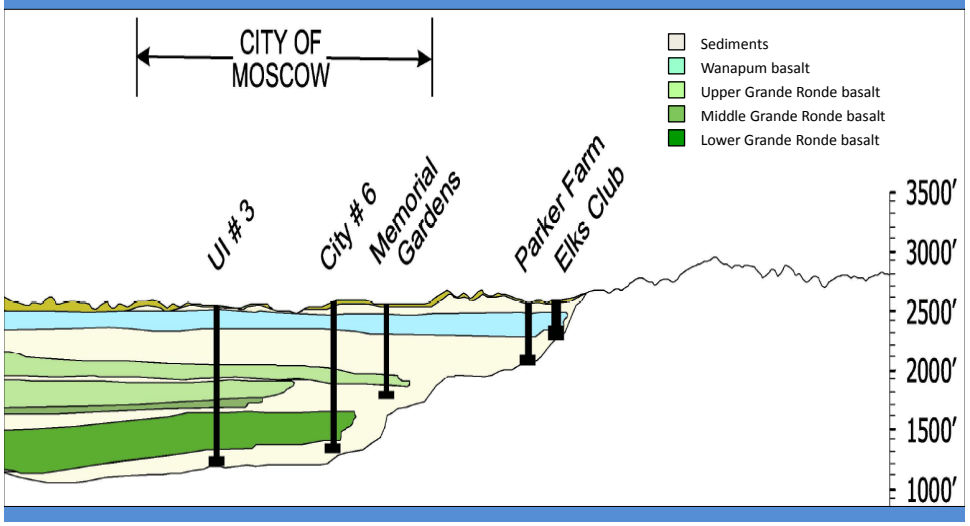
Palouse Basin Aquifer:

- Generally made up of two aquifers:
  - Upper unconfined: located in surface sediments (limited extent, only minor stock water uses), and in shallow basalts (Wanapum) and interbeds to approx. 500 feet. Some domestic and municipal development.
  - Lower confined: located in deeper basalts (Grande Ronde) to approx 1,000 ft. Accounts for 95% of municipal and university supply.
- Limited recharge from precipitation and stream leakage.



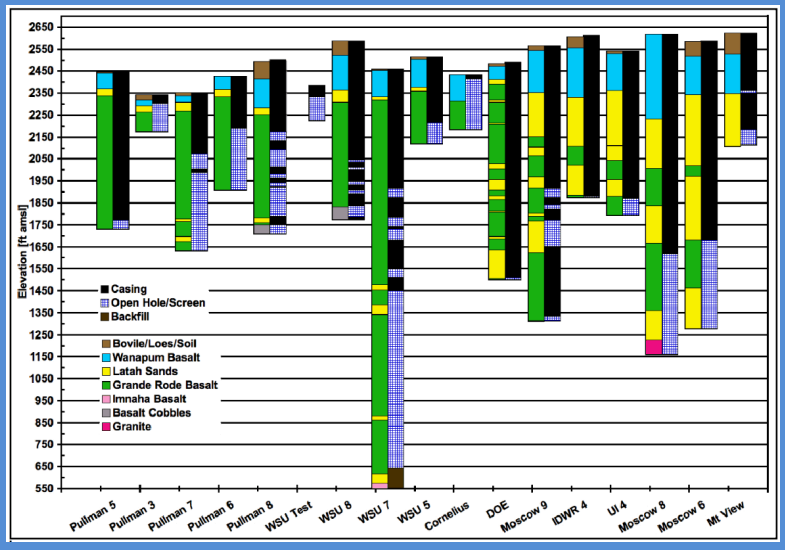
Cross-section illustrating Palouse Basin Aquifer Material:

- Upper 200 ft generally unconfined, local confined conditions. Referred to as Wanapum aquifer.
- Water located primarily in basalts.
- Below 600 feet is confined. This is the major aquifer, referred to as the Grande Ronde aquifer.



Palouse Basin Aquifer:

- Groundwater flow is difficult to determine.
- Significant vertical gradient means the deeper you go, the lower the water level.
- Wells completed over multiple zones creates "mixed" water level.
- Water generally flows to pumping centers (Moscow, ID and Pullman, WA).



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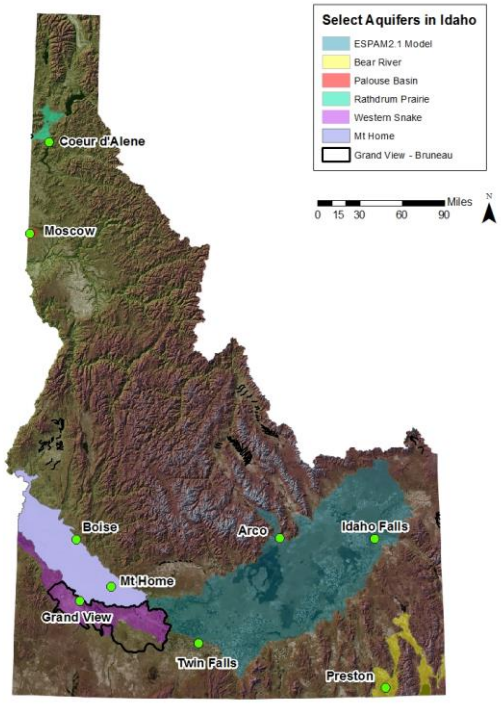
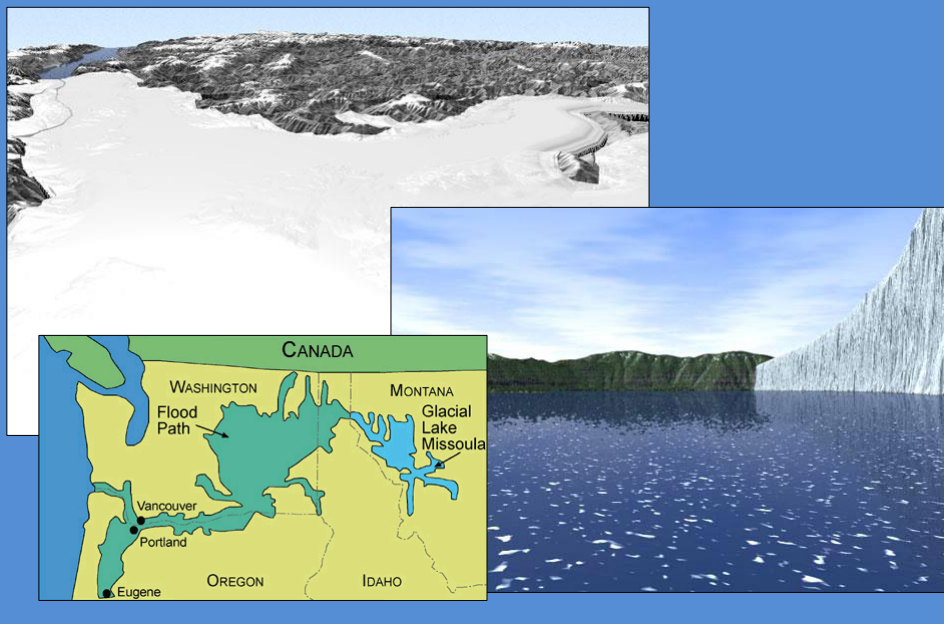
No NPAs in Palouse Basin Aquifer:

- Loess can be over 200 feet thick.
- Significant slope (Topography in original DRASTIC).
- Dryland Agriculture.

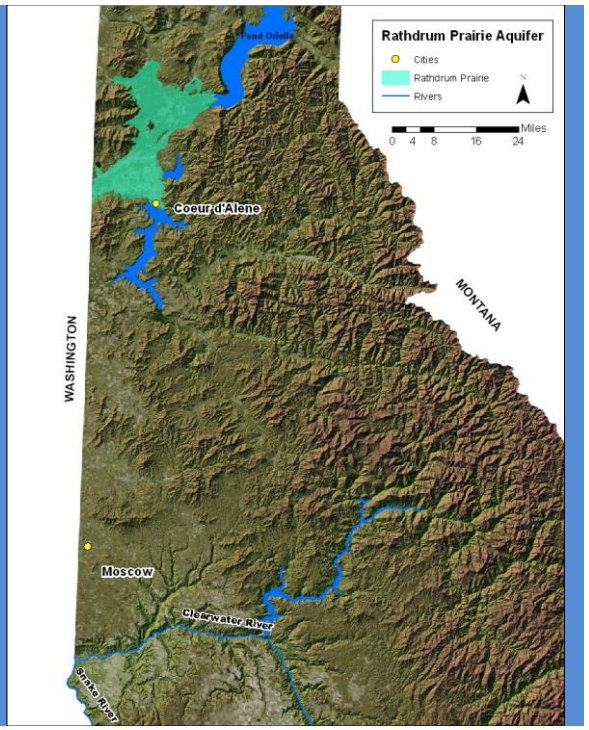


Rathdrum Prairie Aquifer



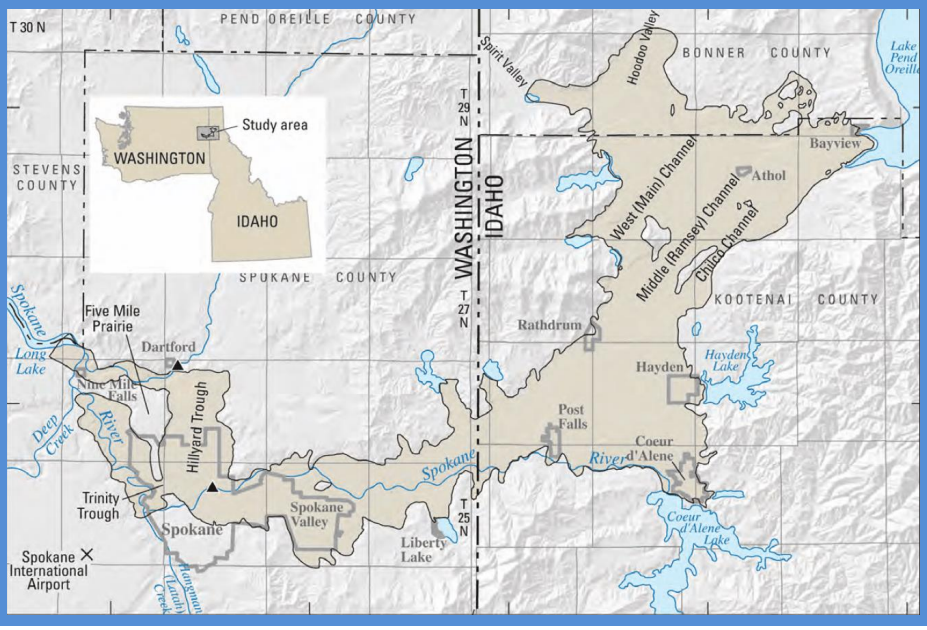
Rathdrum Prairie Aquifer:

- Aquifer composed of unconsolidated coarse sediments.
- Water move very easily (fast) though this aquifer.
- Deposition a result of catastrophic glacial flooding.
- Depth to water generally 200-300 feet.
- Although deep, contamination is a big concern.
- Recharge due primarily to precipitation and lateral leakage from perimeter lakes.



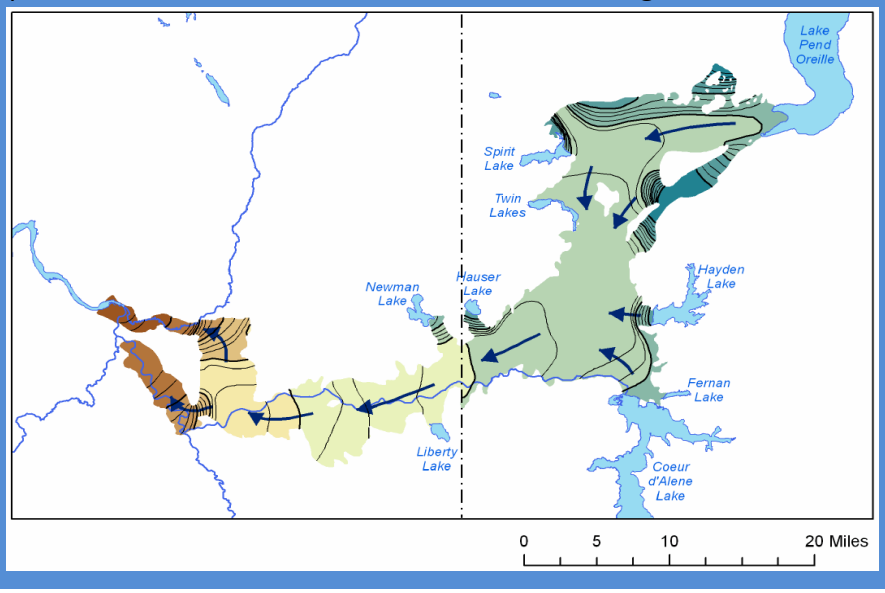
Rathdrum Prairie Aquifer:

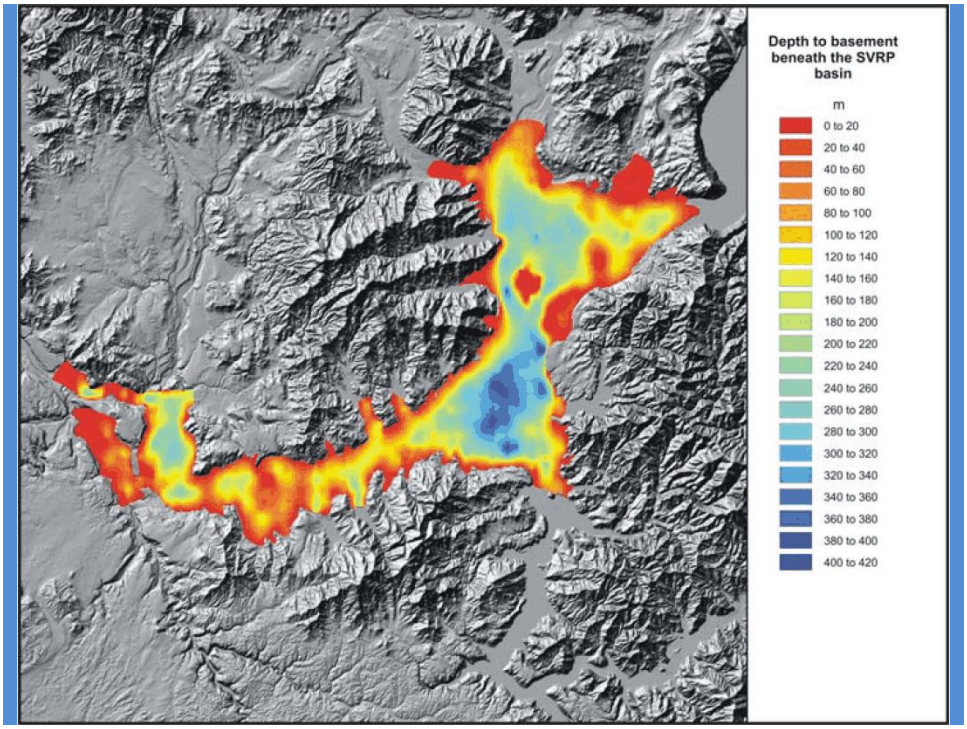
- Aquifer extends across Idaho and Washington.



Rathdrum Prairie Aquifer:

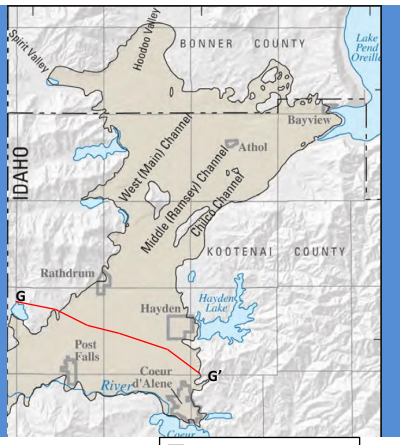
•Groundwater flows from the margins toward the center of the aquifer, and to the west-southwest toward Washington.

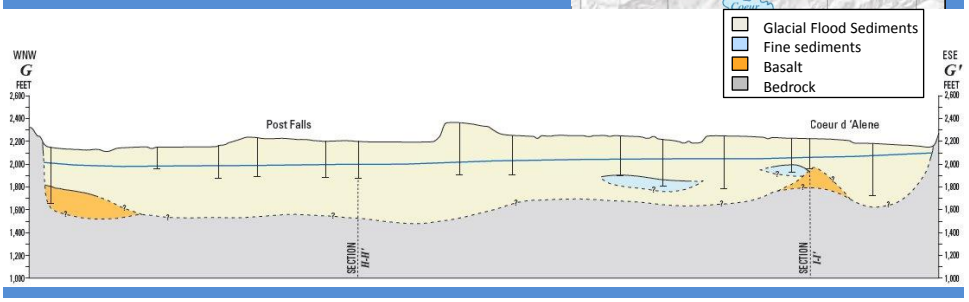




Cross-section illustrating Rathdrum Prairie Aquifer Material:

- Aquifer is made of sand and gravel up to 1,300 ft deep.
- Location of cross-section shown on map.
- Groundwater is not tributary to any surface water in Idaho, it is in Washington.





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No NPAs in Rathdrum Prairie Aquifer:

- Depth to water around 300 feet.
- Area is dominated by forest.
- Dryland Agriculture.
- Sensitive Resource Aquifer.

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Thank You.

Any Questions?