

# Motivation

- Surface water resources are limited
- Groundwater levels are declining

# Goals

- Improve hydrogeologic understanding
- Inform water management
- Support future groundwater-flow modeling



# Approach

- Hydrogeologic framework, [Zinsser and Ducar \(2025\)](#)
  - Groundwater occurrence, movement, change
    - Hydrogeologic framework model
    - Groundwater-level synoptic
    - Long-term groundwater level monitoring
- Groundwater budget – [Thomas \(2026\)](#)



# Groundwater Occurrence: Hydrogeologic Framework Model

## Methods

- Literature review
- Digitize well-driller reports
- Interpret hydrogeologic units
- Develop 3D hydrogeologic framework model
- Create conceptual diagrams



# Previous Hydrogeologic Work

First extensive hydrogeologic investigation specific to Mountain Home:

- Ralston and Chapman, 1962

Review of hydrogeology around Cinder Cone Butte and included groundwater-levels:

- Norton and others, 1982

Mayfield studies:

- Aquifer recharge: Tesch and Vincent, 2009, Hopkins, 2013
- Geology: Phillips and others, 2012
- Hydrogeologic conditions: Welhan, 2012 and Tesch, 2013



Groundwater levels, delineated perched groundwater extent, and first to describe declining groundwater levels near Cinder Cone Butte:

- Young, 1977

Snake River Plain regional aquifer studies:

- GW-levels: Lindholm and others, 1988
- GW budget and flow model: Newton, 1991
- Geohydro Framework: Whitehead 1992

Water supply studies MHAFB and Elmore County:

- SPF, 2016
- SPF, 2017

# Borehole database

- Digitize paper logs
  - 540 boreholes
  - Location details
  - Lithology
  - Water level
  - Well construction
- Lithologies used to define hydrogeologic unit and build 3D model

781282

IDAHO DEPARTMENT OF WATER RESOURCES  
**WELL DRILLER'S REPORT**

Form 238-7  
3/95-C76

Inspected by \_\_\_\_\_ Office Use Only  
Twp. \_\_\_\_\_ Rge. \_\_\_\_\_ Sec. \_\_\_\_\_  
E. \_\_\_\_\_ S. \_\_\_\_\_  
Lat. \_\_\_\_\_ Long. \_\_\_\_\_

1. DRILLING PERMIT NO. \_\_\_\_\_  
Other IDWR No. **D0912562**

2. OWNER:  
Name \_\_\_\_\_  
Address \_\_\_\_\_  
City Mtn Home State ID \_\_\_\_\_ Zip **83647**

3. LOCATION OF WELL by legal description:  
Sketch map location must agree with written location  
N  
W  
E  
S  
Twp. 5 North  or South   
Rge. 8 East  or West   
Sec. 3 1/4 NE 1/4 NW 1/4  
Gov't lot \_\_\_\_\_ County Elmore

Lat. \_\_\_\_\_ Long. \_\_\_\_\_  
Address of Well Site Bennett Crk Rd. (10 miles down on Right hand side. City Mtn Home  
(Use the first three numbers to find the location.)  
Lr. \_\_\_\_\_ Blk. \_\_\_\_\_ Sub. Name \_\_\_\_\_

4. USE:  
 Domestic  Municipal  Monitor  Irrigation  
 Thermal  Injection  Other \_\_\_\_\_

5. TYPE OF WORK check all that apply (Replacement etc.)  
 New Well  Modify  Abandonment  Other \_\_\_\_\_

6. DRILL METHOD  
 Air Rotary  Cable  Mud Rotary  Other \_\_\_\_\_

7. SEALING PROCEDURES

Material	SEAL/FILTER PACK		METHOD
	From	To	
Bentonite	0	18	overbase

Was drive shoe used?  Y  N Shoe Depth(s) \_\_\_\_\_  
Was drive shoe seal tested?  Y  N How? \_\_\_\_\_

8. CASING/LINER:

Diameter	From	To	Ground	Material	Casing	Linier	Welded	Threaded
6.625	2	502	250	Steel			<input checked="" type="checkbox"/>	<input type="checkbox"/>
5.563	495	506	350	Steel			<input type="checkbox"/>	<input type="checkbox"/>

Length of Headpipe 6' Length of Tailpipe 5'

9. PERFORATIONS/SCREENS  
 Perforations Method \_\_\_\_\_  
 Screens Screen Type \_\_\_\_\_

10. STATIC WATER LEVEL OR ARTESIAN PRESSURE:  
356 ft below ground Artesian Pressure \_\_\_\_\_ lb.  
Depth flow encountered \_\_\_\_\_ ft Describe access port or control device: \_\_\_\_\_

11. WELL TESTS:  
 Pump  Bailor  X Air  Flowing Artesian  
Yield gal/min. Drawdown Pumping Level Time  
20+ \_\_\_\_\_ \_\_\_\_\_ 2 hr \_\_\_\_\_  
Water Temp. \_\_\_\_\_ Bottom hole temp. \_\_\_\_\_  
Water Quality test or comments: \_\_\_\_\_  
Depth first Water Encountered \_\_\_\_\_

12. LITHOLOGIC LOG: (Describe repair or abandonment)

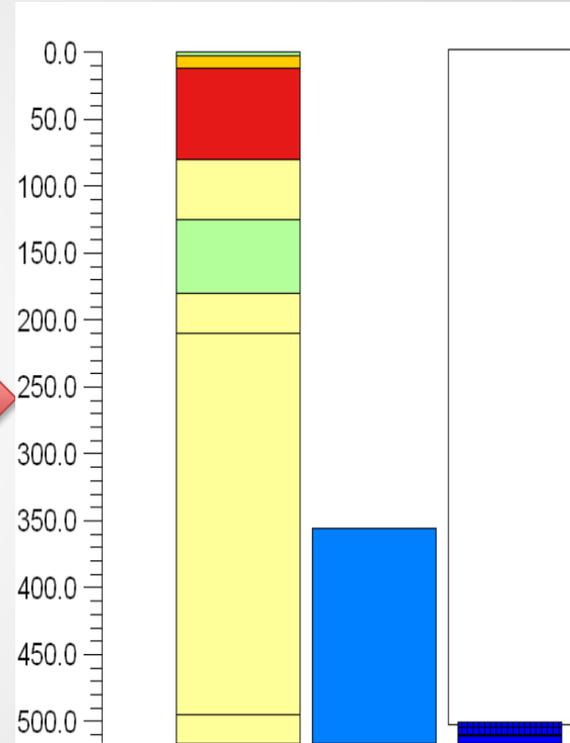
Bore Log	Water			Remarks: Lithology, Water Quality & Temp.	Y	N
	From	To				
10	0	2		Top Soil		<input checked="" type="checkbox"/>
10	2	12		Gravel & Sand		<input checked="" type="checkbox"/>
10-8	12	80		Gray Lava		<input checked="" type="checkbox"/>
6	80	125		Sand & Gravel		<input checked="" type="checkbox"/>
6	125	180		Tan Clay		<input checked="" type="checkbox"/>
6	180	210		Silty Sand		<input checked="" type="checkbox"/>
6	210	495		Gray Clay		<input checked="" type="checkbox"/>
6	495	516		Gray & White Sand to fine Sand		<input checked="" type="checkbox"/>

**RECEIVED**  
**SEP 10 2002**  
WATER RESOURCES  
WESTERN REGION

Completed Depth: 516' (Measurable)  
Date Started 08/05/02 Completed 08/10/02

13. DRILLER'S CERTIFICATION  
I/We certify that all minimum well construction standards were complied with at the time the rig was removed.

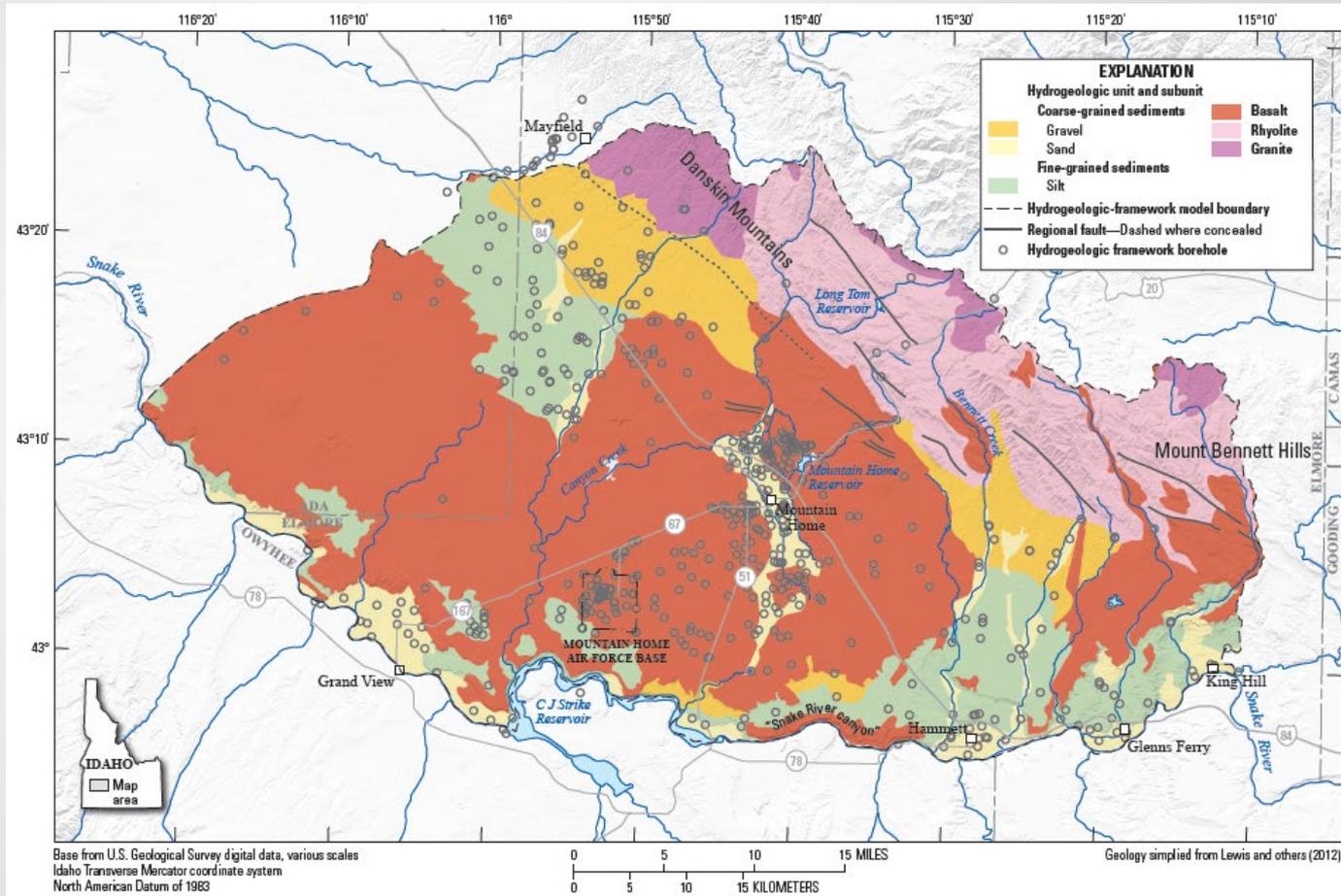
Firm Name Hiddleston & Son, Inc. Firm No. 35  
Firm Official Ken J. Kelly Date 9-6-02  
Supervisor or Operator John H. Hiddleston Date 9-3-02  
(Sign once if Firm Official & Operator)



# Hydrogeologic Units

1. Granite
2. Rhyolite
3. Basalt\*
4. Fine-grained sediments\*
5. Coarse-grained sediments

\*host main regional aquifer



# Hydrogeologic Units

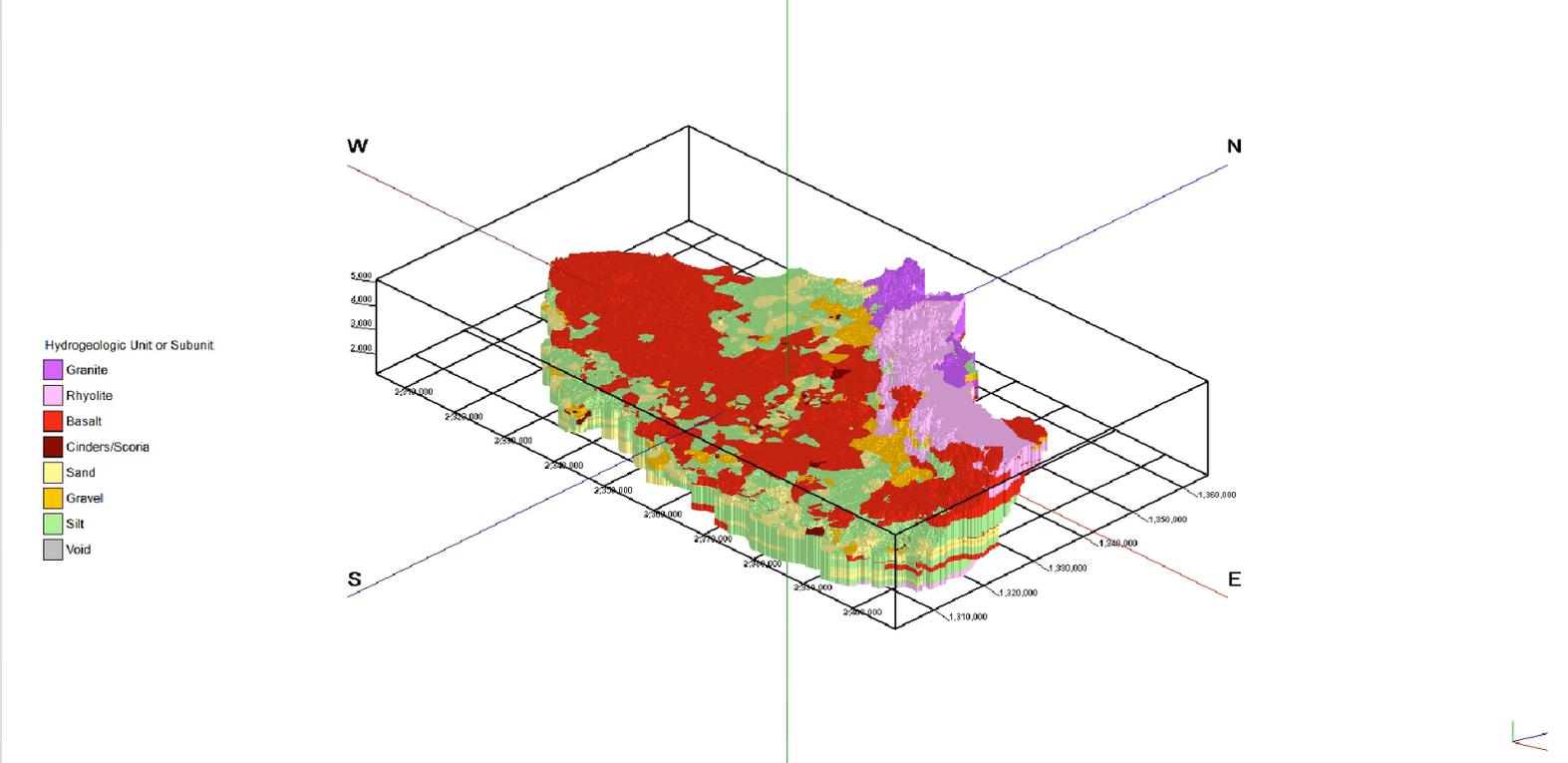
1. Granite
2. Rhyolite
3. Basalt\*
4. Fine-grained sediments\*
5. Coarse-grained sediments

\*host main regional aquifer

Divisions of geologic time					Stratigraphy (from Malde and Powers 1962)		Geology (from Lewis and others 2012)				Hydrogeology (from Zinsser and others, this publication)																	
Age, in Ma	Era	Period	Series/Epoch		Group	Formation	Geologic map unit				Hydrogeologic unit																	
0.0117	Cenozoic	Quaternary	Holocene		Snake River Group	Recent lava flows <sup>1</sup>	Alluvial deposits (Ca)	Alluvial-fan deposits (Caf)	Landslide deposits (Cls)	Lake Bonneville deposits (Obs)	Sediments and sedimentary rocks (Qts)	Fluvial and lake sediment (Qs)	Pleistocene and Pliocene Basalt (QTb)	Fine-grained sediments	Coarse-grained sediments	Basalt												
			Pleistocene	Upper		Malon Gravel <sup>2</sup>											Bancroft Springs Basalt <sup>3</sup>	Sand Springs Basalt	Crowsnest Gravel <sup>2</sup>	Thousand Springs Gravel	Sugar Bowl Gravel <sup>2</sup>	Madson Basalt						
						Middle											Black Mesa Gravel	Bruneau Formation <sup>2</sup>	Tuana Gravel									
2.58																	Lower	Glenns Ferry Formation <sup>2</sup>	Chalk Hills Formation	Banbury Basalt <sup>2</sup>	Poison Creek Formation							
						Idavada Volcanics <sup>2,4</sup>												Undifferentiated rocks <sup>5</sup>	Rhyolite (Tmr)	Sedimentary rocks (QTpms)	Pliocene and Miocene Basalt (T prmb)							
						Tertiary												Pliocene	Upper									
																			Middle									
5.33			Lower																									
			Tertiary	Miocene		Upper and Middle																						
						Lower																						
23.03		Oligocene		Eocene	Paleocene																							
34.09																												
55.9																												
66.0		Mesozoic	Cretaceous	Jurassic to Triassic																								
~145																												
251.9	Paleozoic		Permian to Ordovician	Cambrian																								
485.4																												
541	Neoproterozoic																											
1,000																												

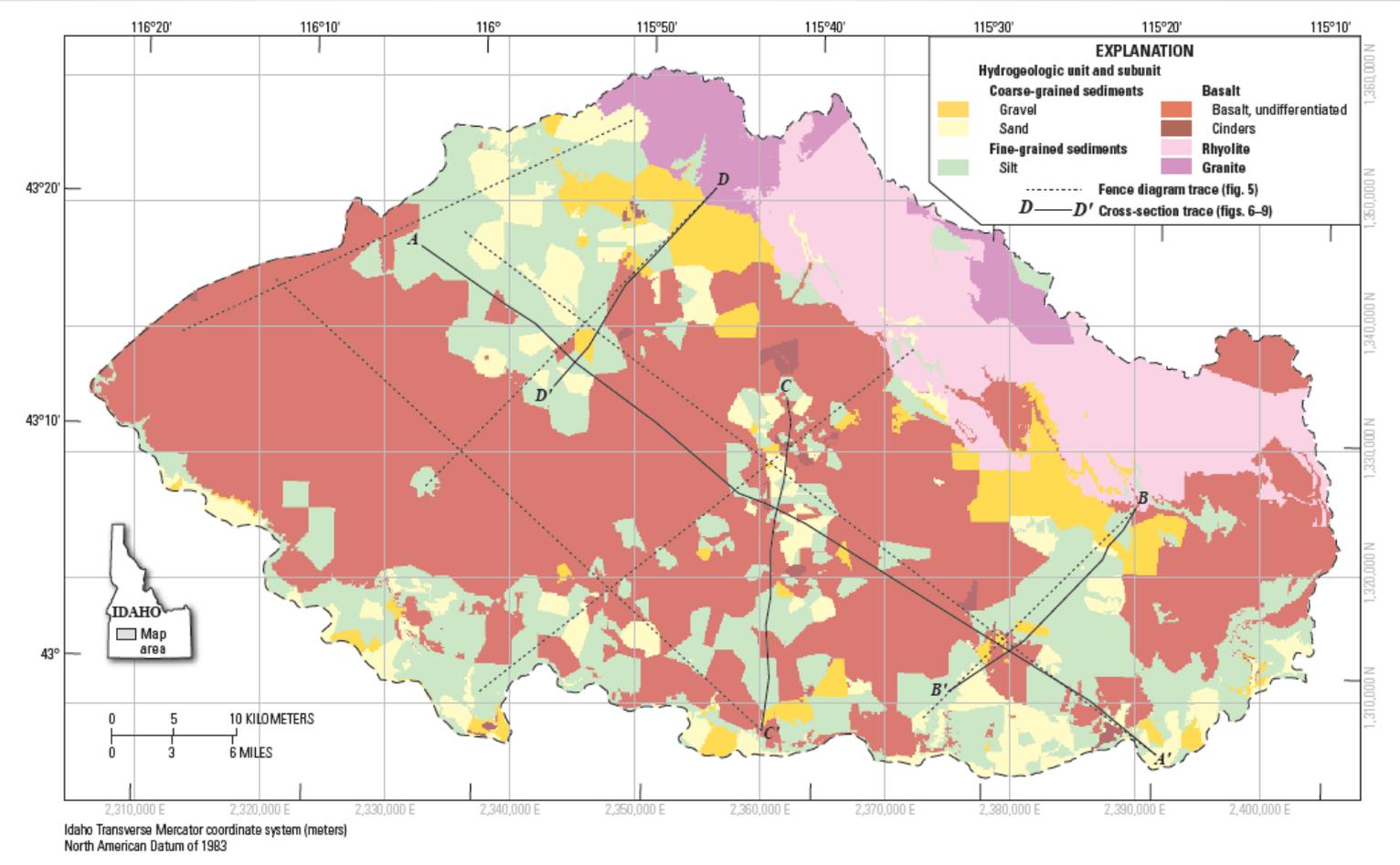


# 3D Hydrogeologic Framework Model



Use model and database to understand occurrence, connectivity, and properties of units

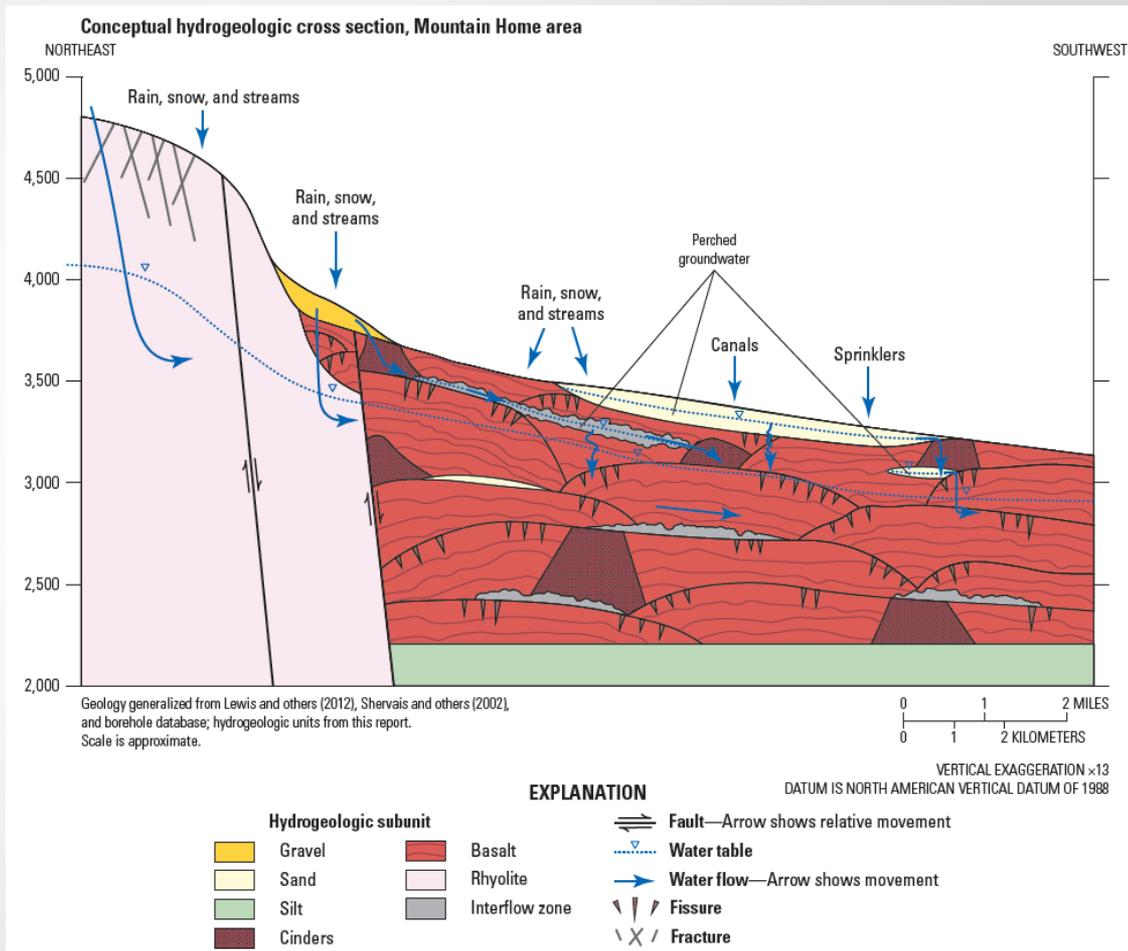
# 3D Hydrogeologic Framework Model





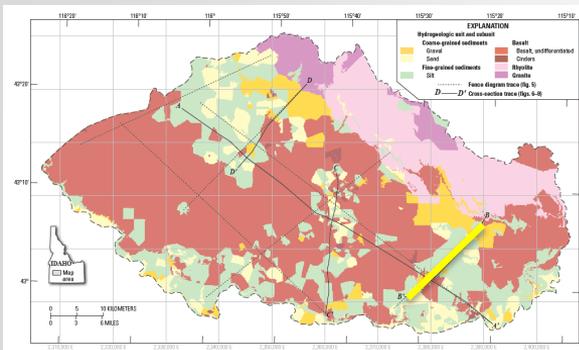
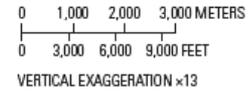
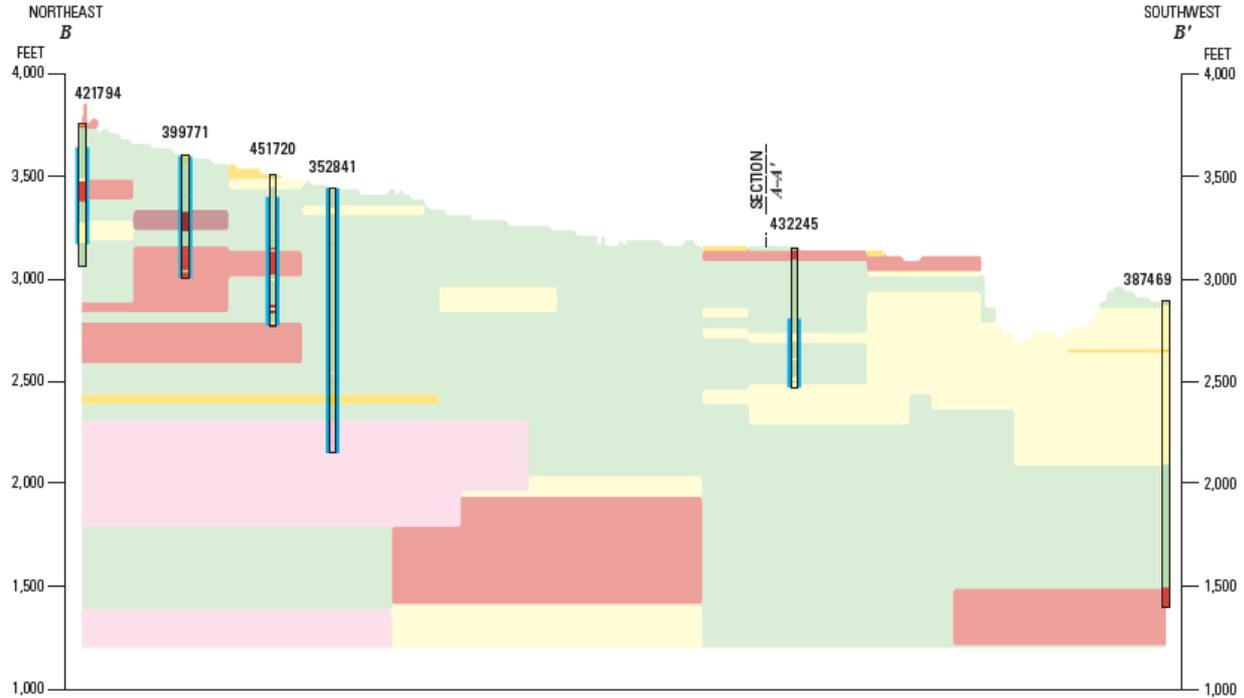
# Conceptual Diagrams: Groundwater Movement Through Basalt

- Heterogeneity in basalt unit impacts movement:
  - Vertical movement through fissures, near-vent scoria
  - Horizontal movement through interflow zones, cinder horizons, coarse sediment interbeds
- Perching associated with surface water recharge



# East cross-section

- Fine-grained sediments dominate area
- Rhyolite intersected in flowing geothermal wells



**EXPLANATION**

**Hydrogeologic unit and subunit**—Some units are defined by boreholes that are not on the section line. Blank space (white areas) in boreholes represent areas of no data

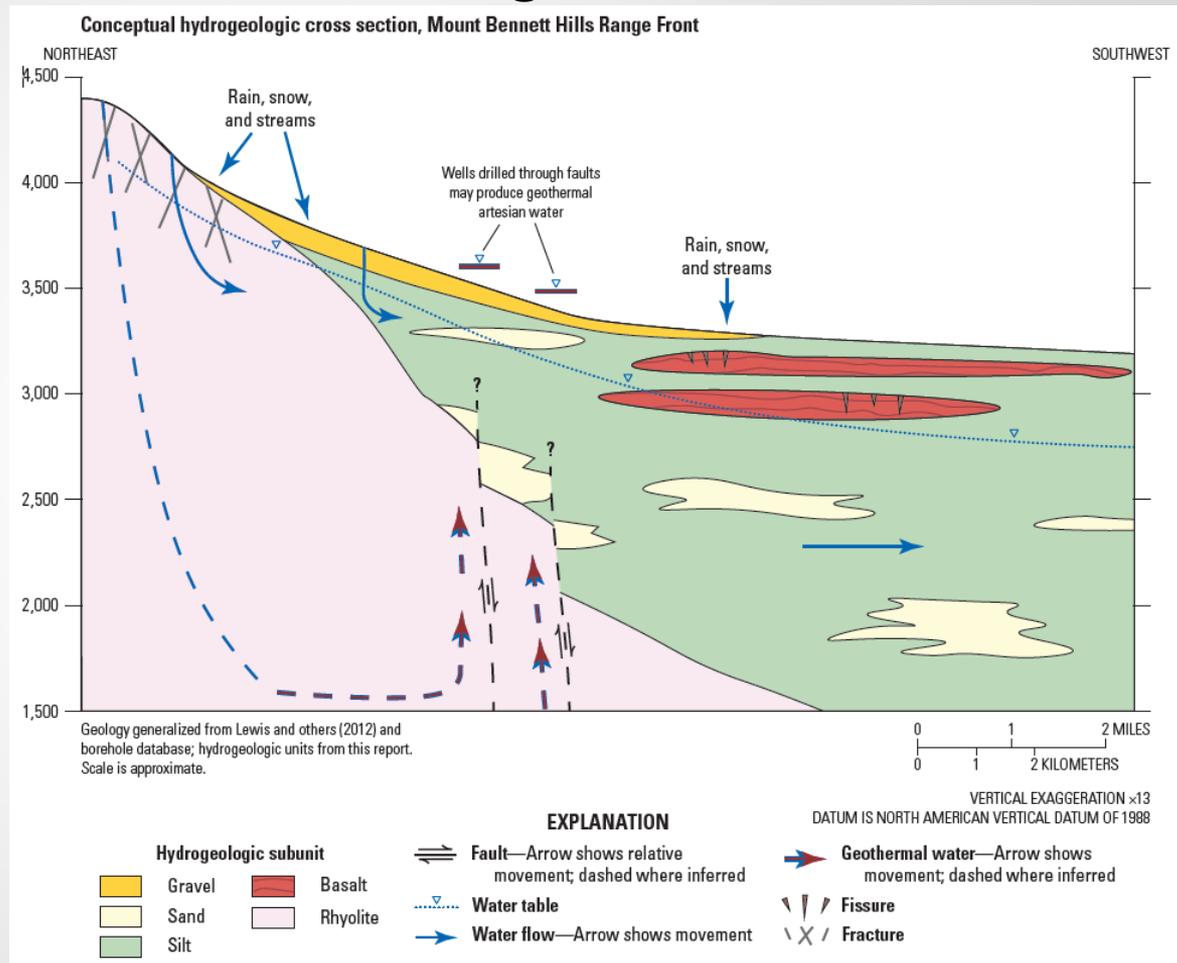
<b>Borehole Model</b>	<b>Coarse-grained sediments</b>	<b>Borehole Model</b>	<b>Basalt</b>
	Gravel		Basalt, undifferentiated
	Sand		Cinders
	<b>Fine-grained sediments</b>		<b>Rhyolite</b>
	Silt		

- 352841
- Borehole**—Fill color shows hydrogeologic unit; labeled with borehole identifier
  - Groundwater level when drilled**

Map: Terrence Mouton (modified version) owned North American Edition of 1993

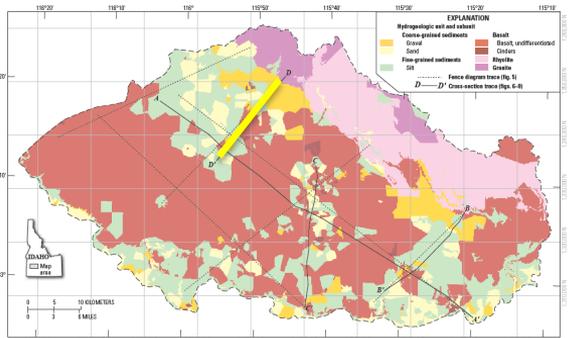
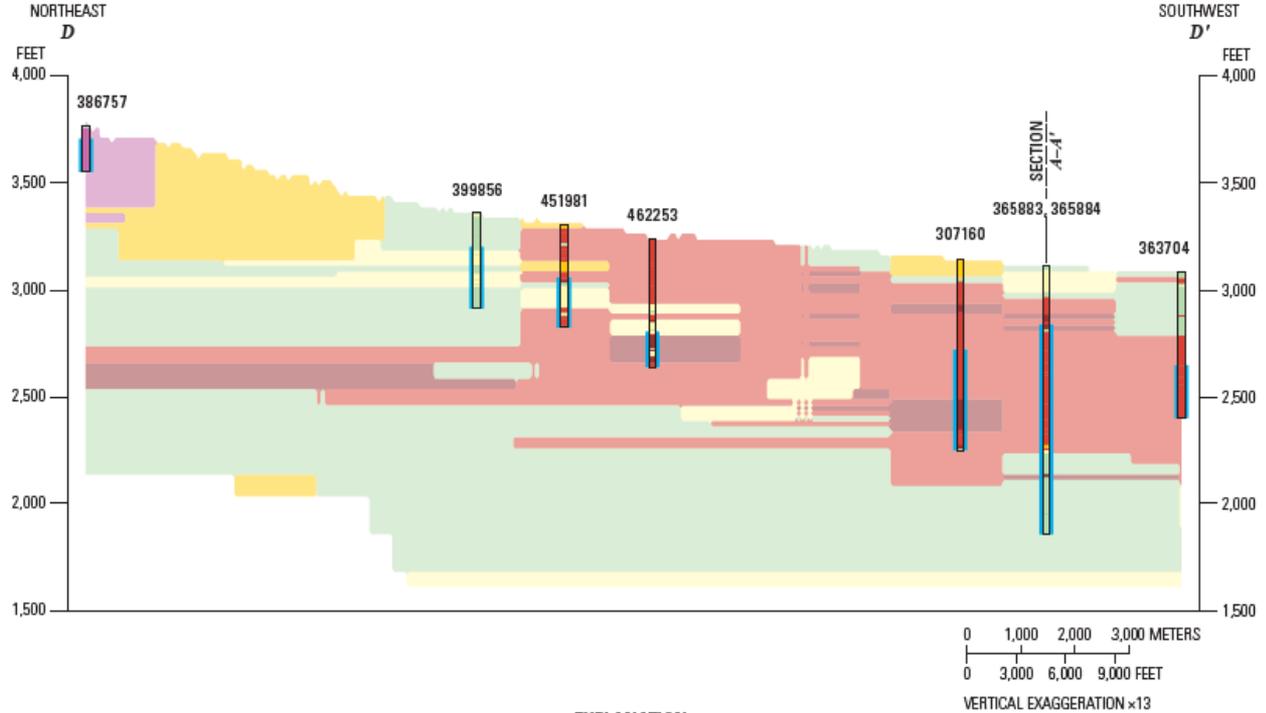
# Conceptual Diagrams: Effects of Faulting on Groundwater

- Represent more realistic regional geology at depth
- Faults can impede or enhance groundwater movement
  - Some faults associated with artesian, geothermal water
  - Some faults associated with offset water table



# West cross-section

- Granitic rock in foothills
- Extensive basalt flows
- Fine-grained sediment underlie basalt



**EXPLANATION**

**Hydrogeologic unit and subunit**—Some units are defined by boreholes that are not on the section line. Blank space (white areas) in boreholes represent areas of no data

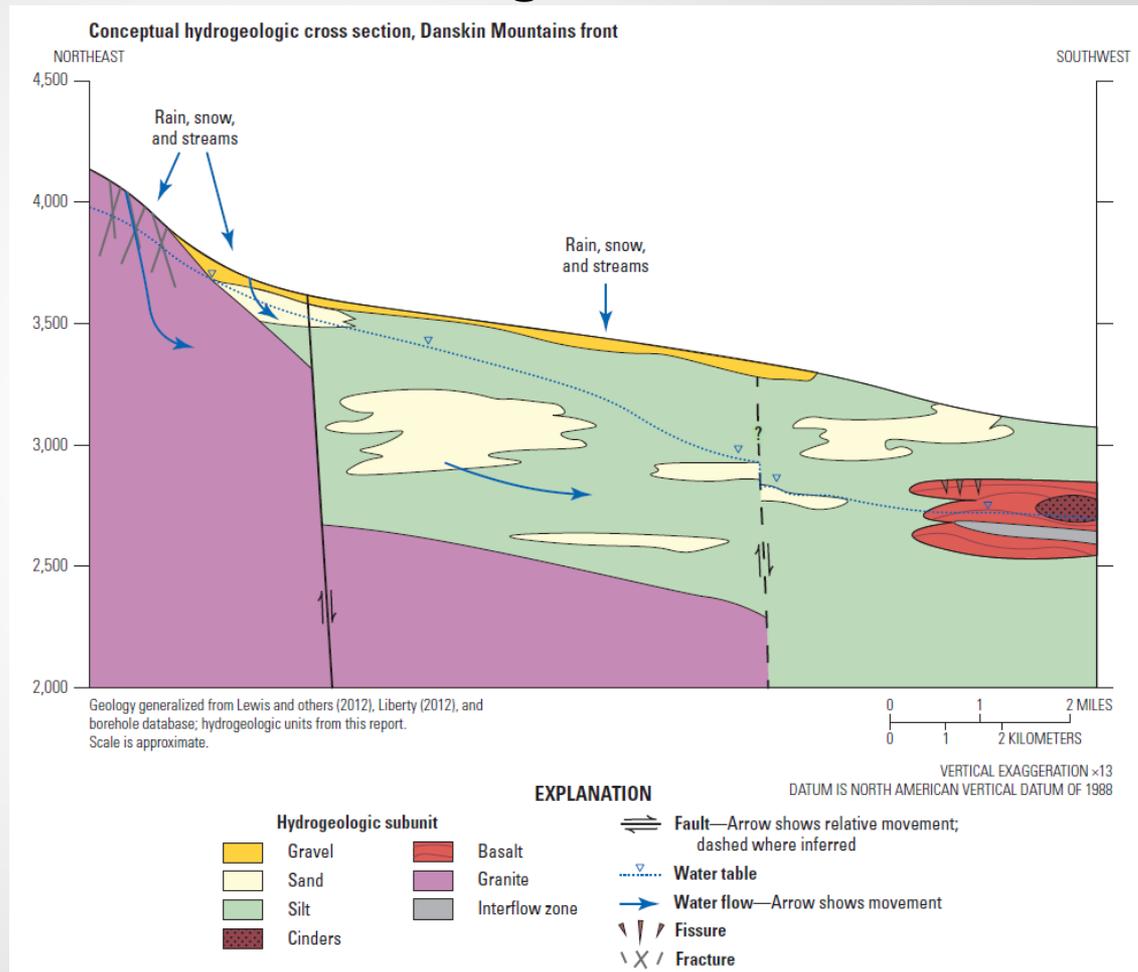
Borehole	Model	Coarse-grained sediments	Basalt
		Gravel	Basalt, undifferentiated
		Sand	Cinders
		Fine-grained sediments	Granite
		Silt	

**399856**

	<b>Borehole</b> —Fill color shows hydrogeologic unit, labeled with borehole identifier
	<b>Groundwater level when drilled</b>

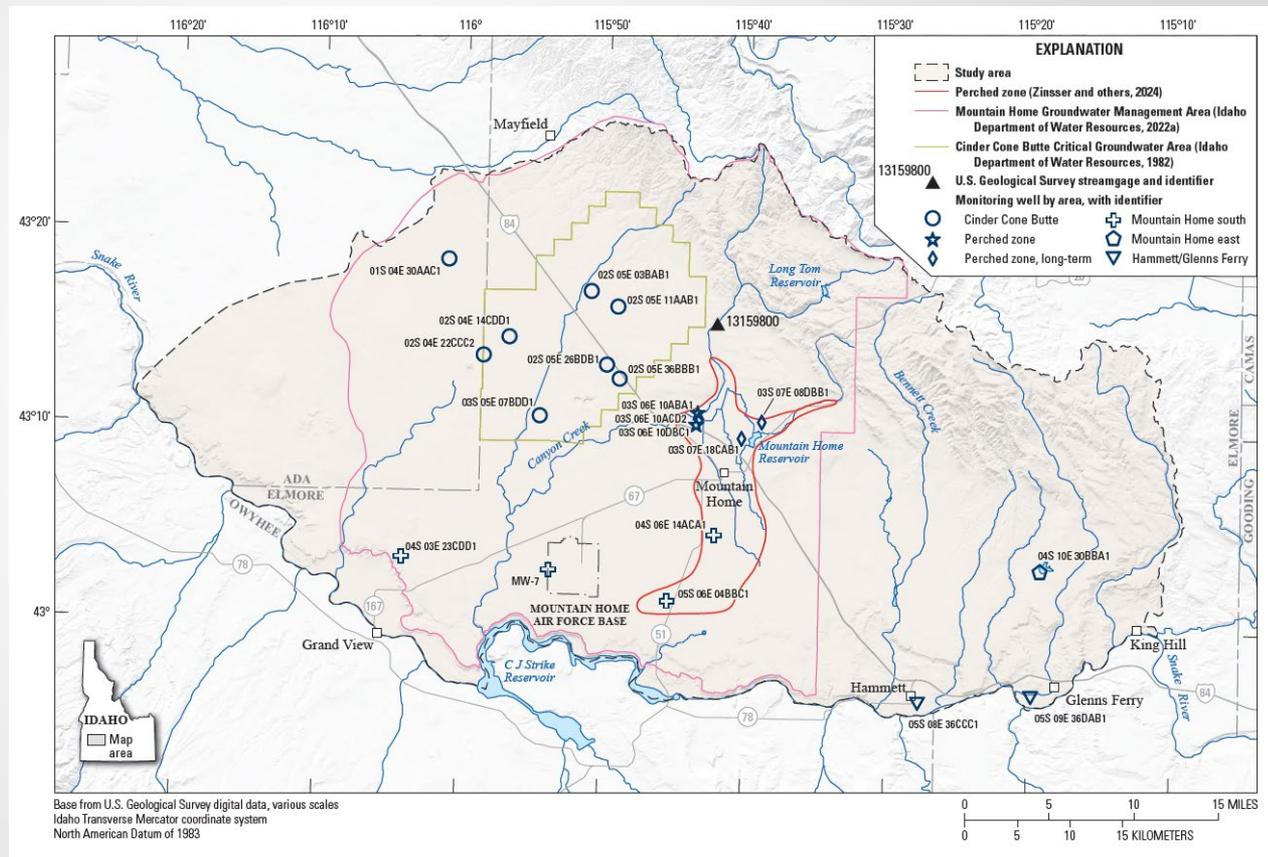
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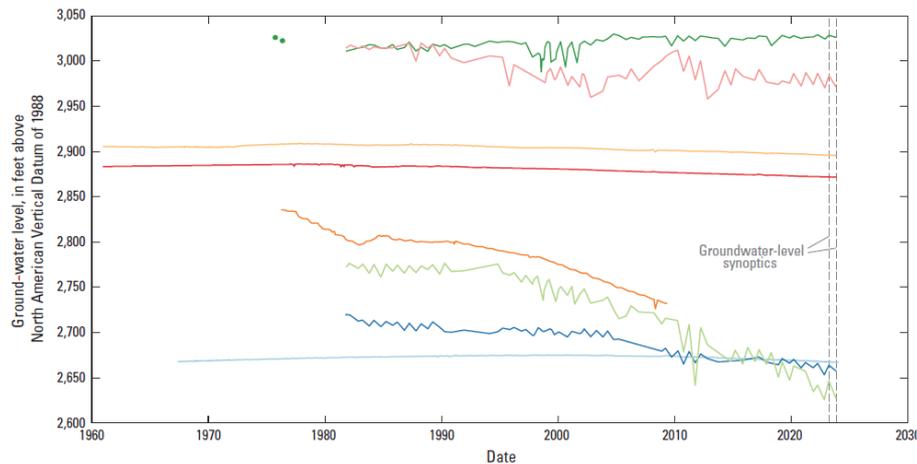
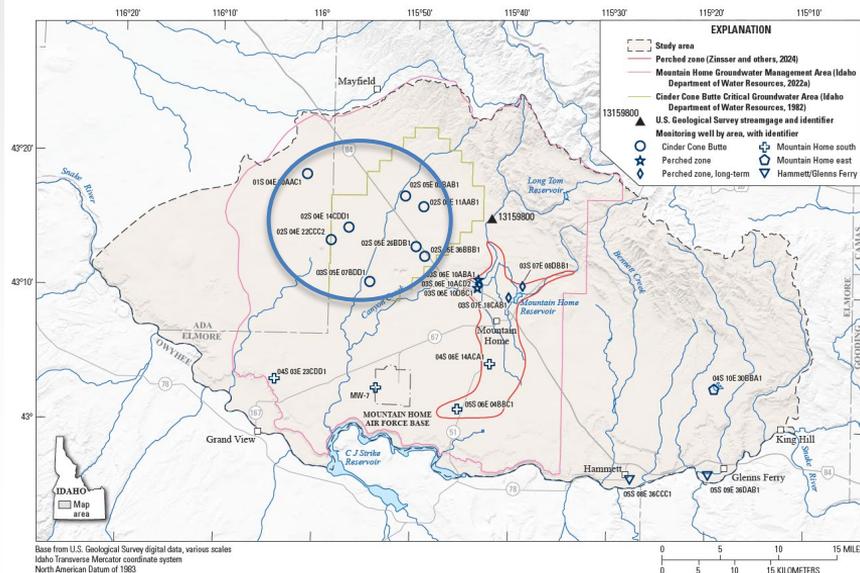
# Groundwater Change: Long-Term Groundwater Levels

- IDWR network of long-term records
- Manual measurements and continuous measurements
- Data available in IDWR [Ground Water Data Portal](#)



# Long-Term Groundwater Levels: Cinder Cone Butte

- Water level declines since 1980
- Greatest declines in southwestern part of CGWA (over 100 ft since 1980)
- North of I-84 no or slight decline
- Well in northwest declines since 2000



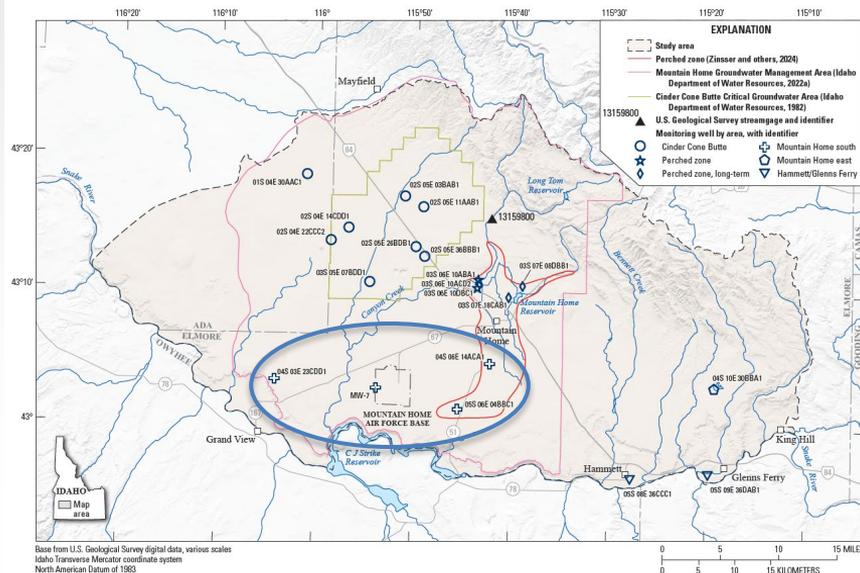
**EXPLANATION**

U.S. Geological Survey site name

01S 04E 30AAC1	02S 05E 11AAB1
02S 04E 14CDD1	02S 05E 26BDB1
02S 04E 22CCC2	02S 05E 36BBB1
02S 05E 03BAB1	03S 05E 07BDD1

# Long-Term Groundwater Levels: Mountain Home South

- Water level declines since 1980
- Over 50 ft of declines



## Modernizing Idaho's Water Infrastructure

An Ongoing Story Series on Idaho Water Resource Board Regional Water Sustainability Projects ISSUE No. 2

### MHAFB Water Resilience Project

**Project description:** Mountain Home Air Force Base (MHAFB) currently relies on groundwater wells to meet its municipal water demand for military and residential needs. Water is currently pumped from the Mountain Home Plateau Aquifer, which has been declining at an unsustainable rate. Furthermore, some MHAFB wells have been closed due to concerns about nitrate contamination.

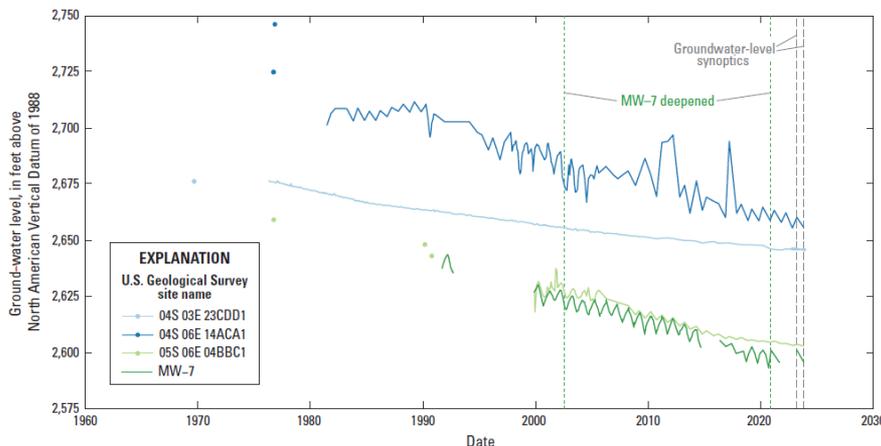
Given the importance of MHAFB to national security and its estimated \$1 billion annual contribution to the Idaho economy, the Idaho Water Resource Board (IWRB) has been working for more than 10 years to develop a long-term, sustainable water supply to the base.



IMCO welds sections of HDPE pipe together along Idaho State Highway 167. The new pipeline will convey water to Mountain Home AFB. (photo by Steve Stuebner/IWRB)

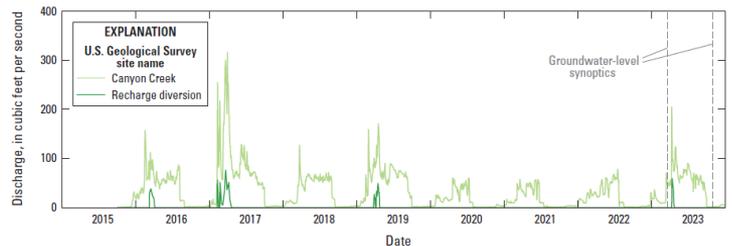
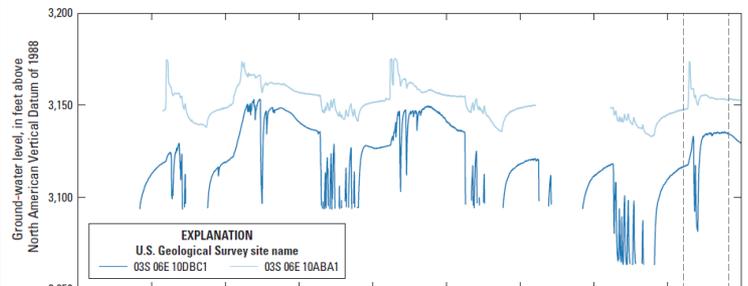
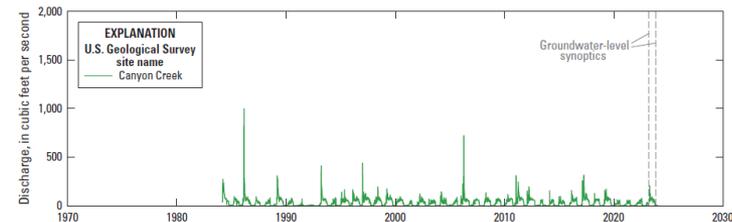
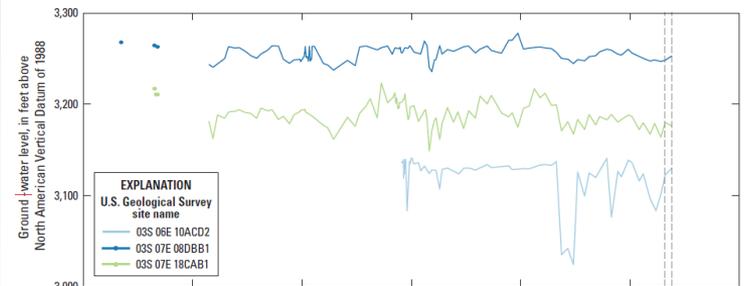


<https://idwr.idaho.gov/iwrw/projects/mhafb/>



# Long-Term Groundwater Levels: Perched Groundwater Zone

- Periods of decline followed by recovery
- Related to the abundance or lack of surface water
- Managed groundwater recharge started in 2016
- Sharp increase in groundwater level during times of diversion
- Surface-water supply is important to recharge perched groundwater zone



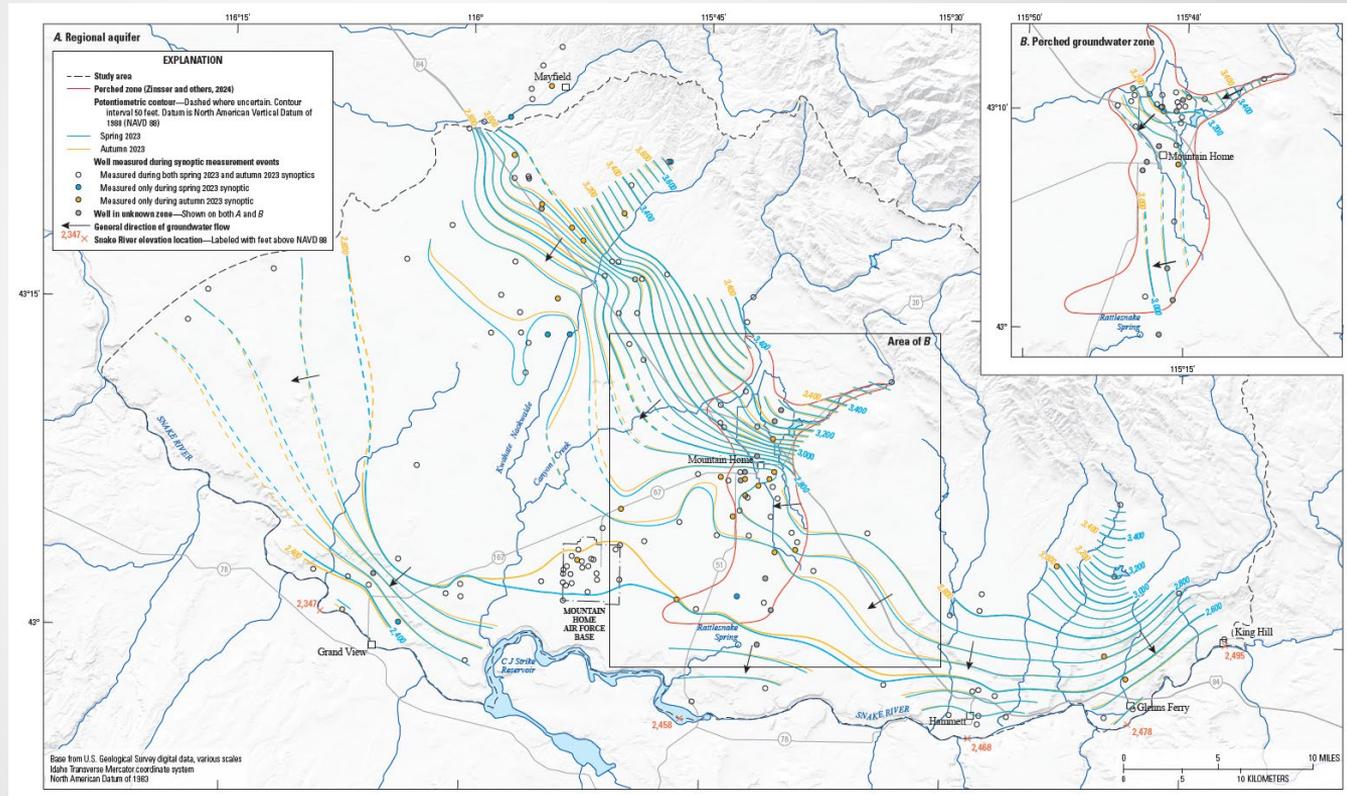
# Groundwater Movement and Change: Groundwater-Level Synoptics

- USGS and IDWR measured water levels in 180 wells
  - Spring and autumn 2023
  - Surveyed wellheads
- Developed water-level maps
  - Regional and perched surfaces
  - Cokriging or spline interpolation
- Developed change maps
  - Spring to autumn 2023
- Data in USGS [NWIS](#) and IDWR [Ground Water Data Portal](#)



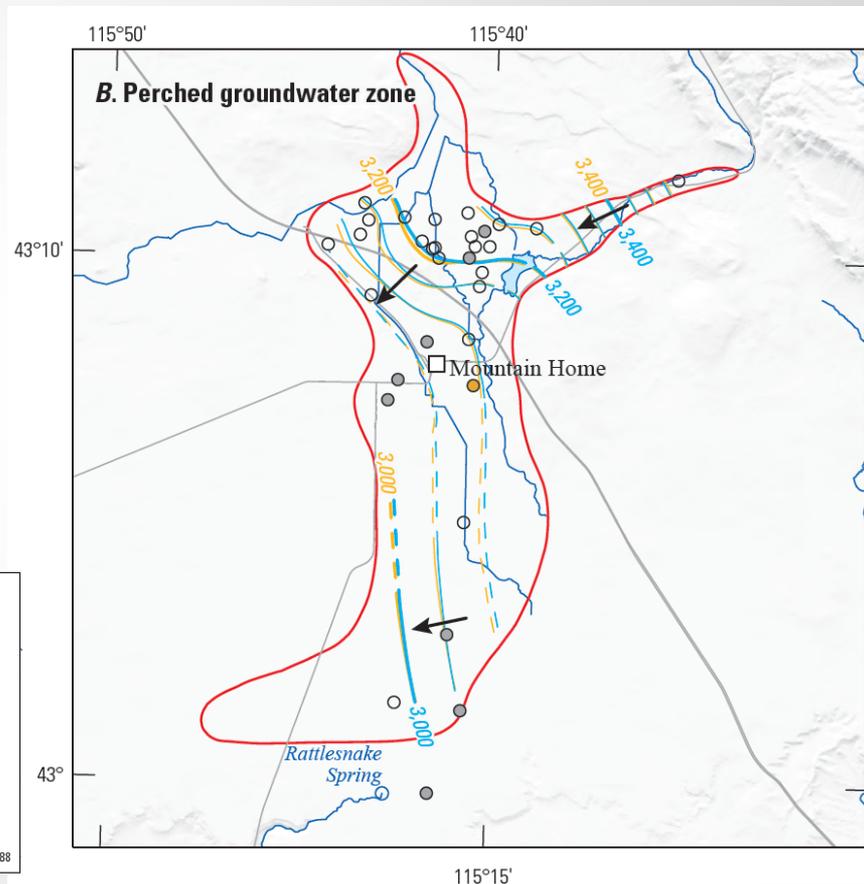
# Water Table: Regional Aquifer

- Depth to water 150 to 765 ft
- Groundwater flows south-southwest
- Gradients steep in north, flatten, then steepen at Snake River canyon
- Groundwater discharge at Snake River based on altitudes



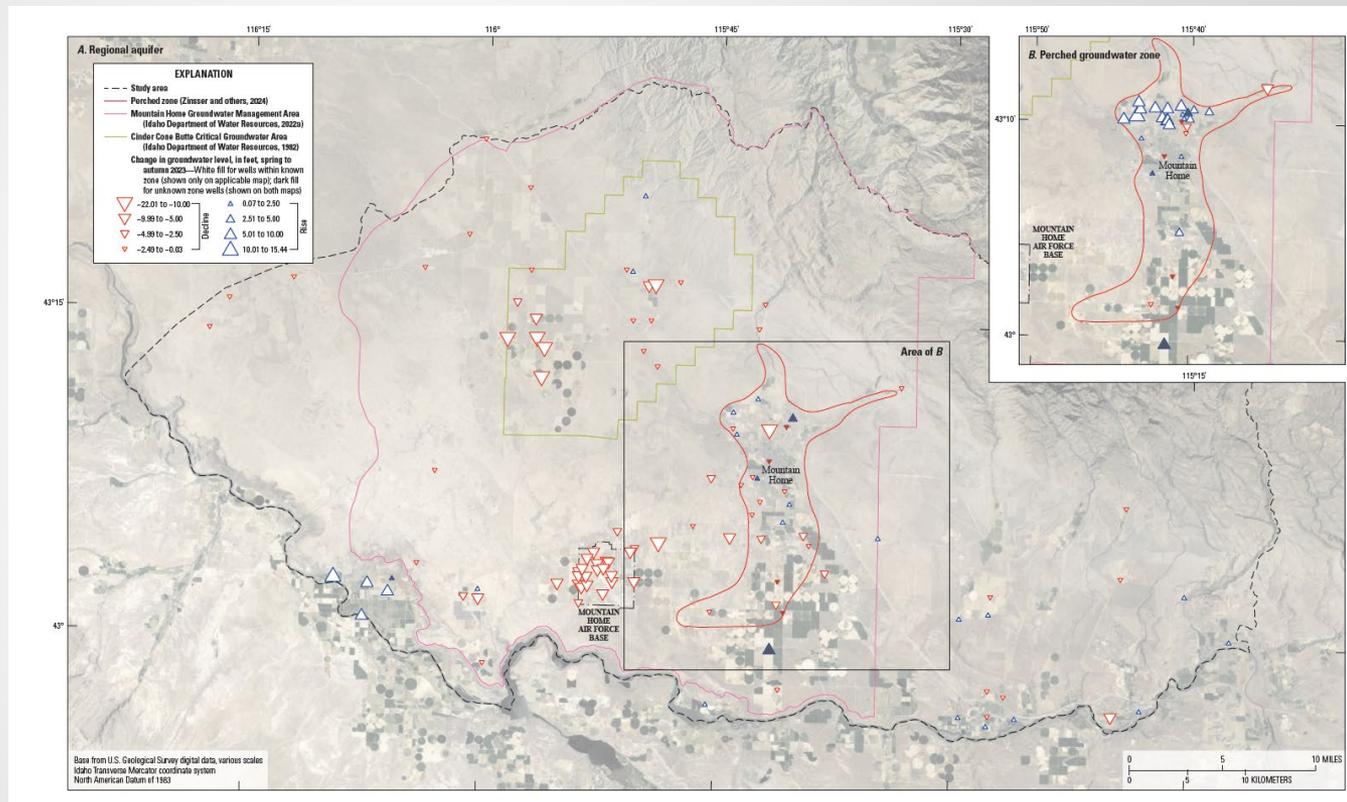
# Water Table: Perched Groundwater Zone

- Depth to water 30 to 100 ft
- Multiple perched zones
- Westerly flow south of I-84
- Approximately 50 ft above regional aquifer
- Additional perched groundwater in Cinder Cone Butte CGWA and below MHAFB



# Water Level Change: Spring to Autumn 2023

- Declines in Cinder Cone Butte CGWA and near MHAFB
- Less change east of Mountain Home and far west
- Rise in Snake River canyon
- Rise in perched area with variability related to heterogeneity, groundwater use, and surface water recharge



# Groundwater Storage Change: Spring to Autumn 2023

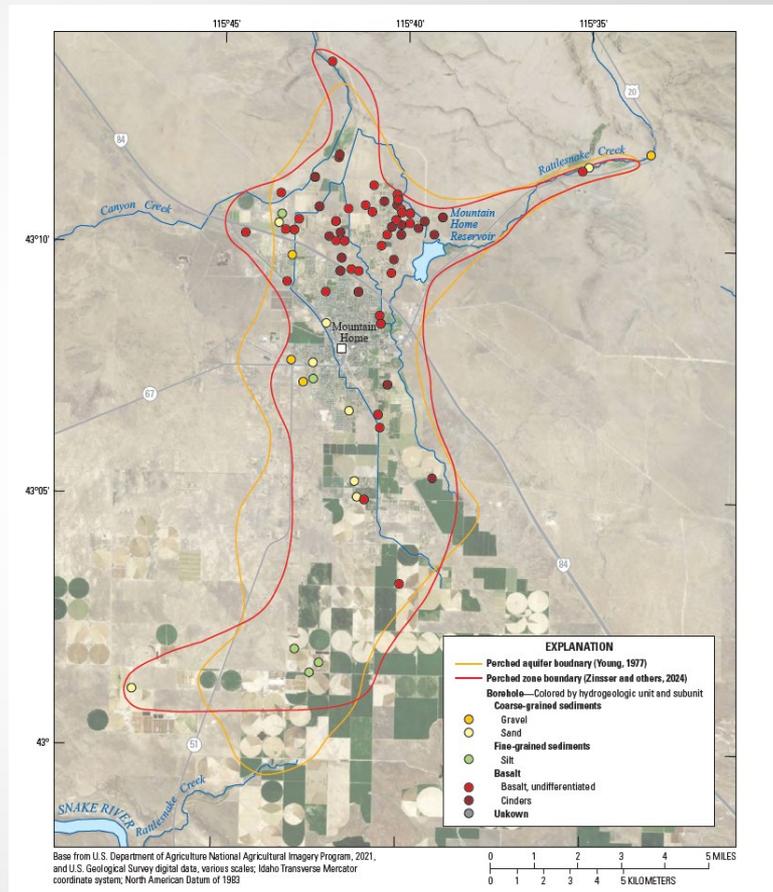
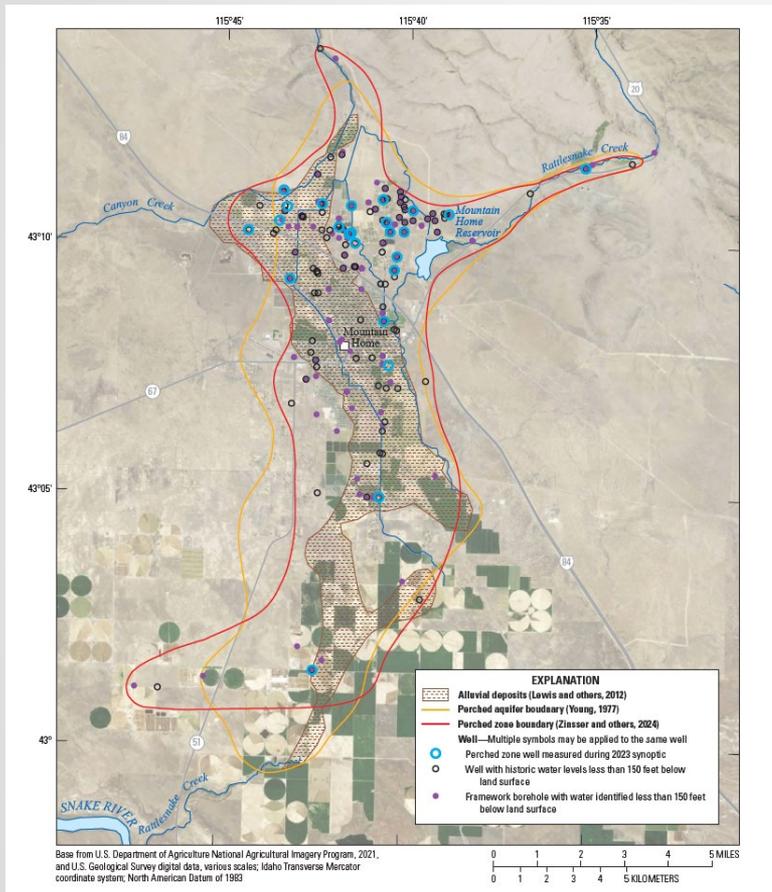
- Developed groundwater level change raster
- Intersected autumn 2023 water level with 3D model to calculate unit volume
- Estimated storage change using feet of water level change and unit storativity
- Storage change is consistent with annual withdrawal estimates (43,000 acre-ft SPF, 2017) and an annual water-budget deficit (30,900 acre-ft Harrington, 2004)

Table 6. Estimated change in groundwater storage between spring and autumn 2023, Mountain Home area, southern Idaho.

[Data are from Zinsser and others, 2024]

Area	Storage change: Estimated using the storativity presented in table 2		Storage change: Estimated using uniform specific yield of 0.1	Area (acres)
	Total change (acre-feet)	Change range (acre-feet)	Total change (acre-feet)	
Cinder Cone Butte Critical Groundwater Area	-13,620	-3,620 to -23,250	-10,080	80,080
Mountain Home Groundwater Management Area	-23,690	-5,240 to -41,680	-18,910	359,120
Combined groundwater management areas	-37,310	-8,860 to -64,930	-28,990	439,200
Regional aquifer excluding the combined groundwater management areas	4,810	1,230 to 10,670	2,550	265,140
Perched groundwater zone	6,390	1,410 to 11,690	4,820	34,020

# Perched Groundwater Zone Delineation



# Conclusions

- **Groundwater occurrence:**

- Main regional aquifer hosted in basalt and fine sediments
- Perched groundwater zone mainly hosted in basalt
- Faulting affects groundwater flow (impeding, enhancing)
- Heterogeneity in basalt creates preferential pathways

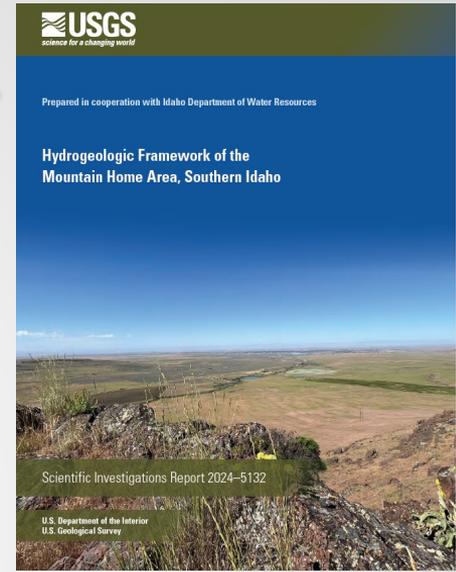
- **Groundwater movement:**

- Regional groundwater flows to the south-southwest
- Perched groundwater flows west

- **Groundwater change:**

- Long-term declines in Cinder Cone Butte, south of Mountain Home, MHAFB
- Surface-water irrigation contributes to recharge in some areas
- Negative storage change consistent with long-term declines

[Read](#) all about it!



Check out the [data](#)!



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ScienceBase Catalog → USGS Idaho Water Science → Hydrogeologic framework of...

Hydrogeologic framework of the Mountain Home area, southern Idaho - three-dimensional hydrogeologic framework model, borehole database, well data, water-level contours and groundwater storage change

Dates

Publication Date : 2024-12-27  
Start Date : 1952-09-05  
End Date : 2024-04-11

Citation

Zisser, L.M., Ducar, S.D., and Thomas, P.M., 2024. Hydrogeologic framework of the Mountain Home area, southern Idaho - three-dimensional hydrogeologic framework model, borehole database, well data, water-level contours and groundwater storage change. U.S. Geological Survey data release. <https://doi.org/10.26666/1HK3XW5>.

Summary

Groundwater in the arid Mountain Home area is vital to agricultural, municipal, industrial and other water users who are concerned about declining groundwater levels. The U.S. Geological Survey, in cooperation with the Idaho Department of Water Resources, developed a hydrogeologic framework to provide a conceptual understanding of groundwater resources in the Mountain Home area, which is published in the companion report, SIR 2024-5132 (hydrogeologic framework of the Mountain Home area, southern Idaho by L.M. Zisser and S.D. Ducar). This data release contains data generated for this report, including data supporting the three-dimensional hydrogeologic framework model and the water-table contour and groundwater-level change maps.

Map »

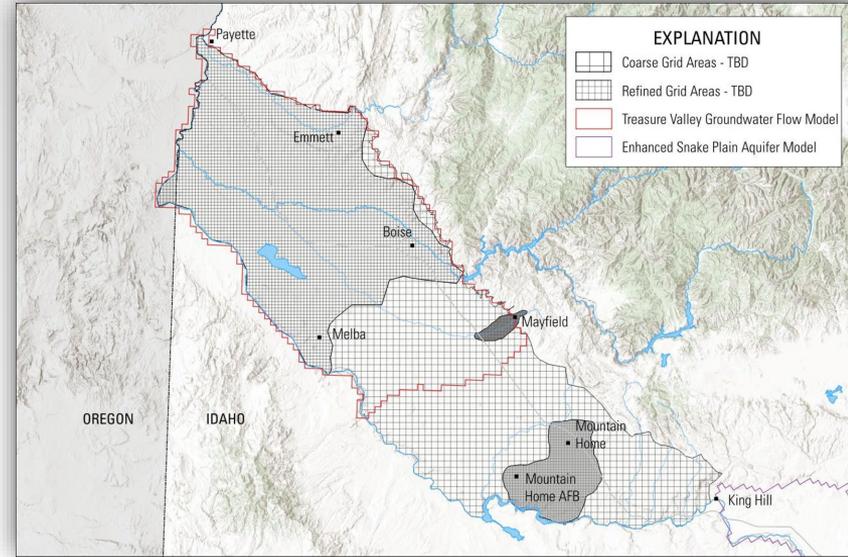
Spatial Services

ScienceBase WMS : <https://www.sciencebase.gov/catalog>

Communities

# Implication for WeSPAM

- **3D hydrogeologic framework model:**
  - Informs the choice of number and thickness of groundwater flow model layers
- **Perched groundwater zone:**
  - Updated the mapped extent of the perched groundwater zone
  - Identified perched groundwater is approximately 50 ft above regional aquifer
  - Provided conceptual description of how water percolates to regional aquifer
- **Groundwater movement and change:**
  - Defined groundwater flow directions across the study area
  - Identified zones of positive and negative groundwater storage change during the 2023 irrigation season
  - Described how faulting can either restrict or enhance groundwater movement



# Questions?



In cooperation with the  
Idaho Department of Water Resources

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**Scott Ducar**  
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