Idaho Geological Survey (IGS) Modeling septic tank density in Idaho's Treasure Valley

Henry's Fork Watershed Council
Water Considerations in a Developing Watershed
St. Anthony, Idaho (virtual presentation)
December 16, 2025

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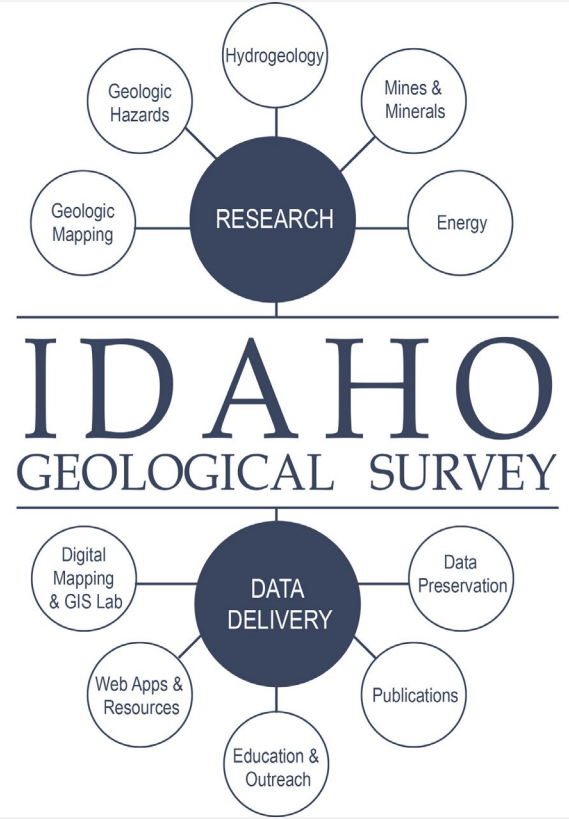
IDAHO GEOLOGICAL SURVEY

www.idahogeology.org

THE IDAHO GEOLOGICAL SURVEY (IGS)

University of Idaho



WHO WE ARE:

IGS's Statutory Authority is found in Title 47, Chapter 2 of the Idaho State Statute, A state agency to be administered as a special program at the University of Idaho.

OUR MISSION:

"The survey shall be the **lead state agency** for the collection, interpretation, and dissemination of geologic and mineral data for Idaho".

Non-regulatory.

Members of the IGS fulfill this mission through applied geologic research and strong collaborations with federal and state agencies, academia, and the private sector.

IGS research focuses on geologic mapping, geologic hazards, hydrogeology, geothermal energy, oil and gas, and metallic and industrial minerals.

The IGS is also engaged in the dissemination of historic mining records, community service, and earth science education.

Septic tank systems and groundwater

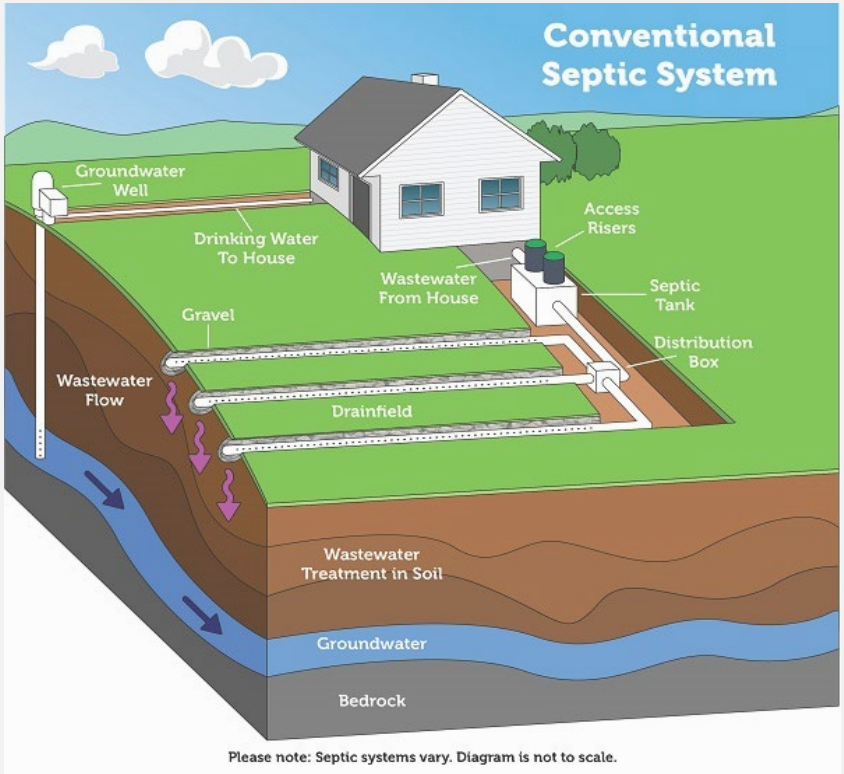


Image and information credit: https://www.epa.gov/septic/types-septic-systems

- Conventional system components:
  - Septic tank
  - Drainfield
- Partially treated wastewater discharges from septic tank to drainfield
- Drainfield provides additional microbial treatment
- Effluent infiltrates into the soil/subsurface
- Nitrate is not entirely removed during treatment and may reach the groundwater table

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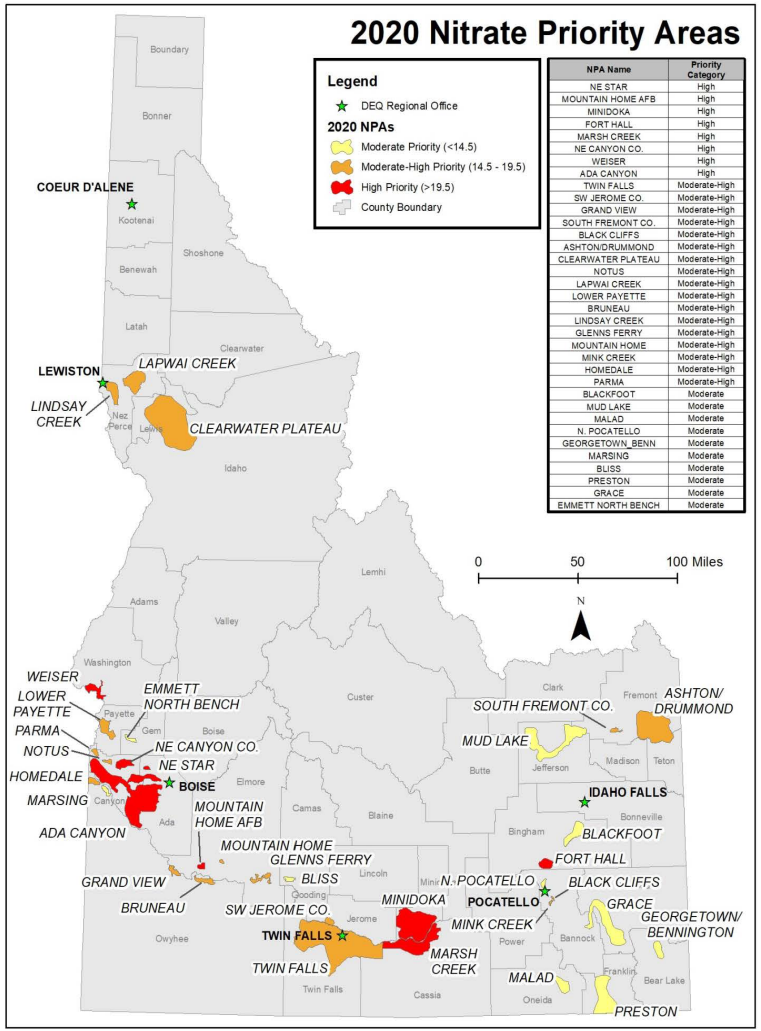

NPA Name	Priority Category
NE STAR	High
MOUNTAIN HOME AFB	High
MINIDOKA	High
FORT HALL	High
MARSH CREEK	High
NE CANYON CO.	High
WEISER	High
ADA CANYON	High
TWIN FALLS	Moderate-High
SW JEROME CO.	Moderate-High
GRAND VIEW	Moderate-High
SOUTH FREMONT CO.	Moderate-High
BLACK CLIFFS	Moderate-High
ASHTON/DRUMMOND	Moderate-High
CLEARWATER PLATEAU	Moderate-High
NOTUS	Moderate-High
LAPWAI CREEK	Moderate-High
LOWER PAYETTE	Moderate-High
BRUNEAU	Moderate-High
LINDSAY CREEK	Moderate-High
GLENNS FERRY	Moderate-High
MOUNTAIN HOME	Moderate-High
MINK CREEK	Moderate-High
HOMEDALE	Moderate-High
PARMA	Moderate-High
BLACKFOOT	Moderate
MUD LAKE	Moderate
MALAD	Moderate
N. POCATELLO	Moderate
GEORGETOWN_BENN	Moderate
MARSING	Moderate
BLISS	Moderate
PRESTON	Moderate
GRACE	Moderate
EMMETT NORTH BENCH	Moderate

Figure 2. 2020 ranked nitrate priority areas. From Elliott, 2021

Nitrate in Idaho's groundwater

- Human health and environmental issues
- Common nitrate sources (Wise, 2019)
  - Agricultural (fertilizer, livestock manure)
  - Developed land practices
  - On-site wastewater treatment
  - Point-source wastewater discharge
- State and federal regulatory MCL (10 mg/l)
- Nitrate priority areas (NPAs)
  - 35 areas (in 2020)
  - Ranked as 'moderate', 'moderate-high', and 'high'

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Nitrate loading modeling project (2023-2026)

- Drivers
  - Nitrate loading to groundwater due to developments utilizing individual septic tank systems
  - Emphasis on urban/agricultural and urban/undeveloped interface
  - Private well susceptibility
- Goals
  - Develop analytical predictive modeling tools to assess nitrate loading to groundwater
  - Provide an approach for future updates
  - Support decision making and planning about lot size density
- Approach
  - Part 1:
    - Analytical mass balance model development
    - Treasure Valley (3 selected subareas)
    - No new data collection
  - Part 2:
    - Data evaluation (no model development or new data collection)
    - Additional regions (7 selected counties)
- Details
  - Joint collaborative study (IGS contracted with Idaho Department of Environmental Quality)
  - 2 IGS publications (by December 2026)
  - Federal Bipartisan Infrastructure Law (state revolving fund)

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IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY

U.S. ENVIRONMENTAL PROTECTION AGENCY
BIPARTISAN INFRASTRUCTURE LAW

Analytical mass balance approach - Treasure Valley

(nitrate mass from additional septic tanks + background nitrate mass in groundwater)

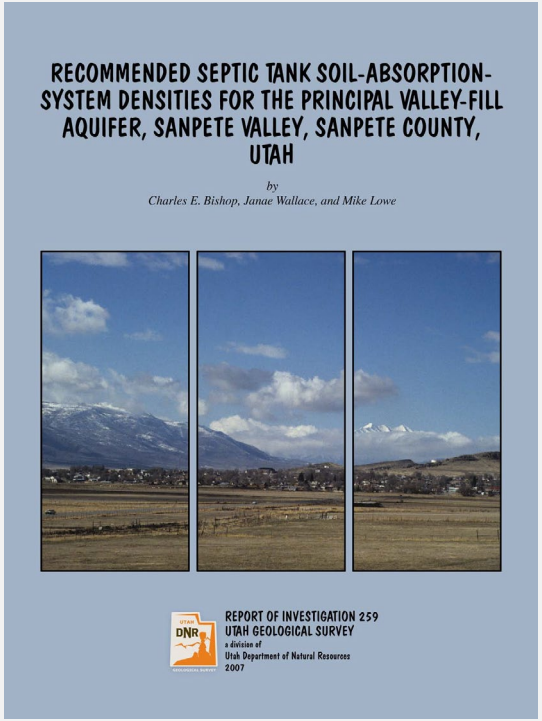
$$N_P = \frac{[[(ST_T - ST_C)Q_{ST}] * N_L] + [N_A(Q_M + [ST_T * Q_{ST}])]}{[ST_T * Q_{ST}] + Q_M}$$

(total septic tank effluent rate and groundwater flow rate)

$$Tank\ density = \frac{Total\ acres}{Total\ projected\ number\ of\ septic\ tanks\ (ST_T)}$$

where:

- N_P = nitrate concentration in groundwater, projected target (mg/L)
- N_A = nitrate concentration in groundwater, background (mg/L)
- N_L = nitrate concentration, est. average from each septic tank (mg/L)
- ST_T = number of septic tanks, total projected (-)
- ST_C = number of septic tanks, current (-)
- Q_{ST} = flow rate, from each septic tank (L/s)
- Q_M = flow rate, groundwater (L/s)



Nitrate mass balance and tank density equations (Utah Geological Survey investigations)
Summary report will address necessary assumptions and limitations

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Category	Datasets	Sources
Physical	Climatic	PRISM Climate Group *(precipitation)* METRIC/ET-IDWR *(evapotranspiration)*
	Soil properties	NRCS soil database and nitrate leaching potential
	Geologic/hydrogeologic*	IGS geologic maps and fault coverage IDWR well and water level databases USGS hydrogeologic framework *(lithologic records)* USGS TV numerical model *(as applicable - aquifer properties, flow rates)* Literature information
	Groundwater quality*	IDWR, DEQ, and USGS nitrate databases *(most recent mean value)*
	Nitrate sources and receptors	DEQ 2020 NPA coverage
	Individual septic tank effluent*	Literature review and local health districts *(flow rates and typical nitrate concentrations)*
Community	Land use *(historical, current, and future)*	NLCD and CDL coverage County websites
	Planning and zoning documents	County comprehensive plans and GIS datasets
	Population density	US census county statistics
	Existing sewered systems and tax parcels	ISTC datasets
	Existing number of septic tanks*	Existing subdivision coverage (county) Local health district datasets (DEQ annual reports)

*Mass balance model input

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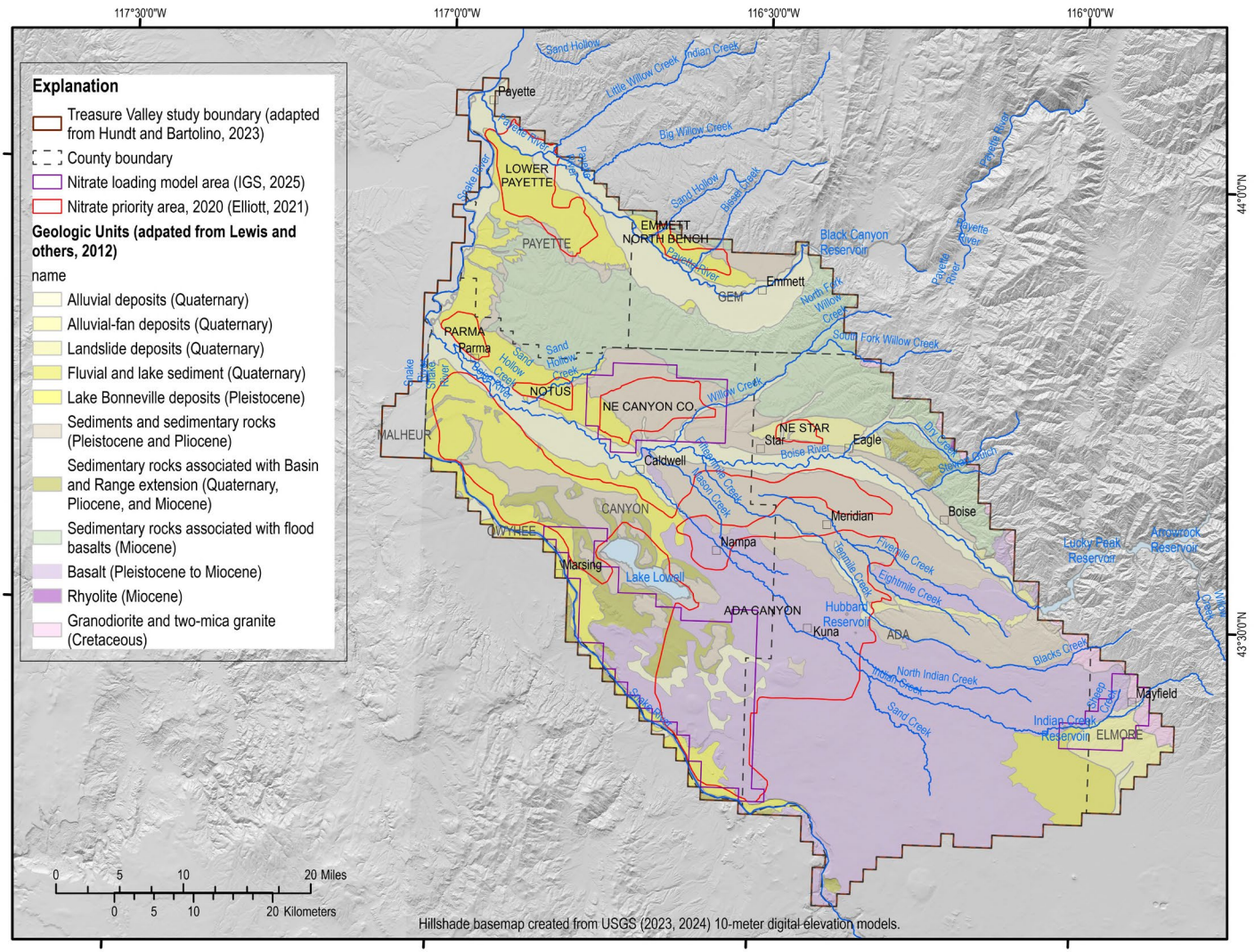

- Key geologic units:
  - Quaternary alluvial deposits
  - Basalt flows
  - Idaho Group formations
- Influences nitrate occurrence in groundwater
- Current understanding
  - > 44,000 wells
  - Well logs, groundwater levels, water quality data
  - Geophysical surveys
  - Geological maps
  - Hydrogeologic framework and numerical groundwater flow models

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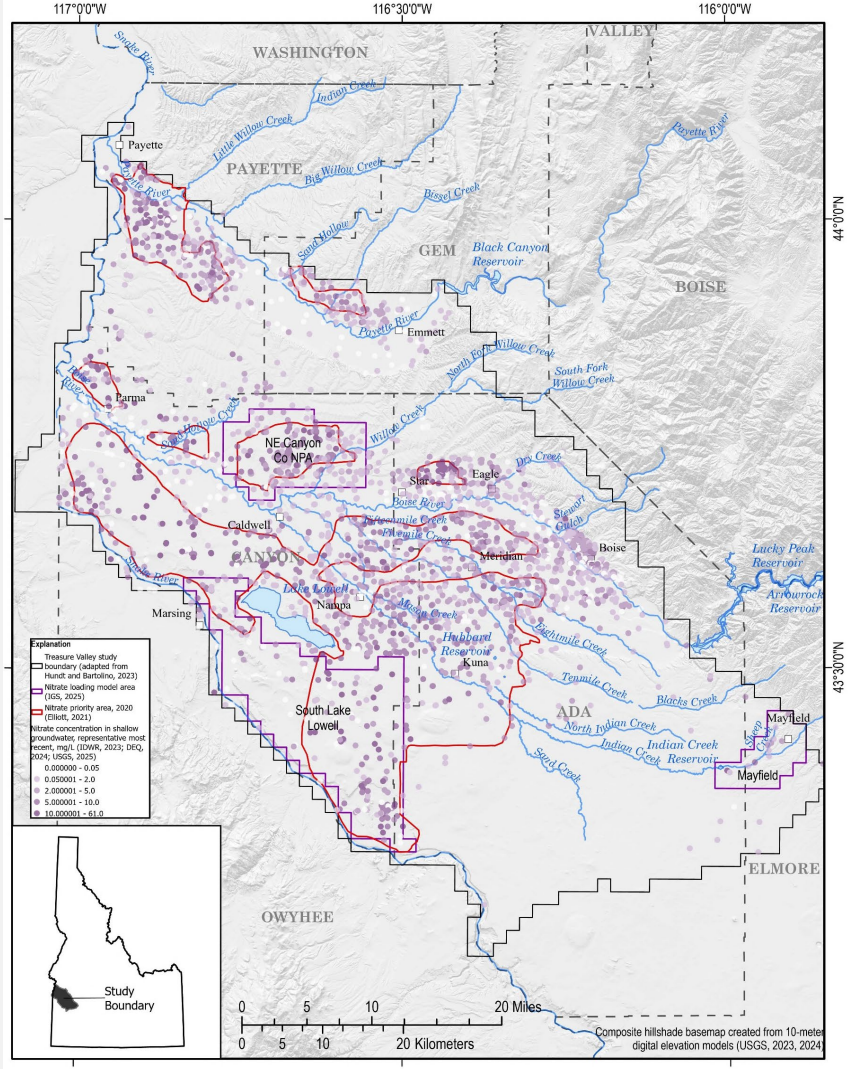
Part 1: Treasure Valley – Nitrate loading mass-balance models

- Analytical mass-balance nitrate loading models for 3 subareas:
  - NE Canyon Co NPA vicinity
  - South Lake Lowell vicinity
  - Mayfield vicinity
- Mass balance model inputs and output (projected number of tanks)
- Data gaps identification
- Suggestions for future work



NE Canyon Co NPA (fmr. Purple Sage NPA) – prior investigations

Table B-11. 2020 NE Canyon County (Purple Sage) NPA summary and scoring sheet.

2020 NE Canyon Co. (Purple Sage) NPA Summary	
DEQ Region	BRO
Size of NPA (acres)	18,653
Size of NPA (square miles)	29
Population within the NPA*	4,847
Number of Sites Sampled	176
Maximum Nitrate Value (mg/L)	27
Average Nitrate Value (mg/L)	5.9
Median (middle) Nitrate Value (mg/L)	5.4
Number of Public Water System sources within NPA	32
Number of source water assessment delineations intersecting the NPA	27
Number of sites with nitrate equal to or greater than (≥) 2 mg/L	149
Percent of sites with nitrate equal to or greater than (≥) 2 mg/L	85
Number of sites with nitrate equal to or greater than (≥) 5 mg/L	94
Percent of sites with nitrate equal to or greater than (≥) 5 mg/L	53
Number of sites with nitrate equal to or greater than (≥) 10 mg/L	17
Percent of sites with nitrate equal to or greater than (≥) 10 mg/L	10
Number of Sites Sampled by DEQ**	129
Number of Sites Sampled by IDWR	7
Number of Sites Sampled by USGS	8
Number of Sites Sampled by ISDA***	32
2020 Trend	Increasing Trend
2020 Total Score	21.35
Final Rounded 2020 Score	21
Priority Category	High
*Based on 2010 Census	
**Combination of private wells and public water system wells	
***Combination of private wells and dairy sites	

Image (from DEQ NPA delineation and ranking process; Elliott, 2021)

Ground Water Quality Monitoring Results for the Purple Sage Study Area, Canyon County, Idaho

Prepared by

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Idaho Department of Environmental Quality

Gary Bahr
Idaho Department of Agriculture

Craig Tesch, P.G.
Idaho Department of Agriculture

June 2009

South Lake Lowell vicinity (water rights applications)

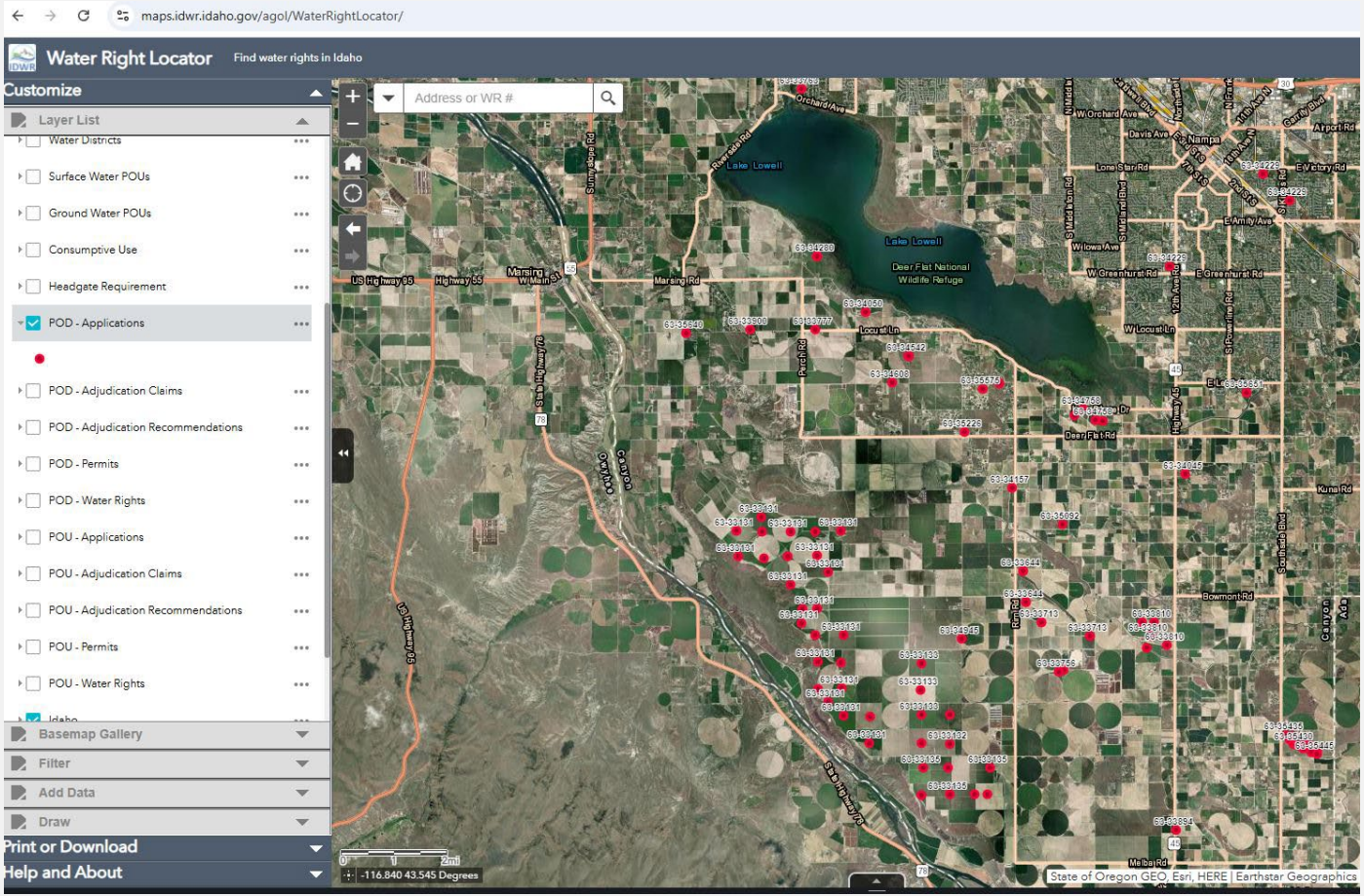

Image (IDWR water right locator database; accessed January 12, 2025)

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Mayfield vicinity (prior investigations)

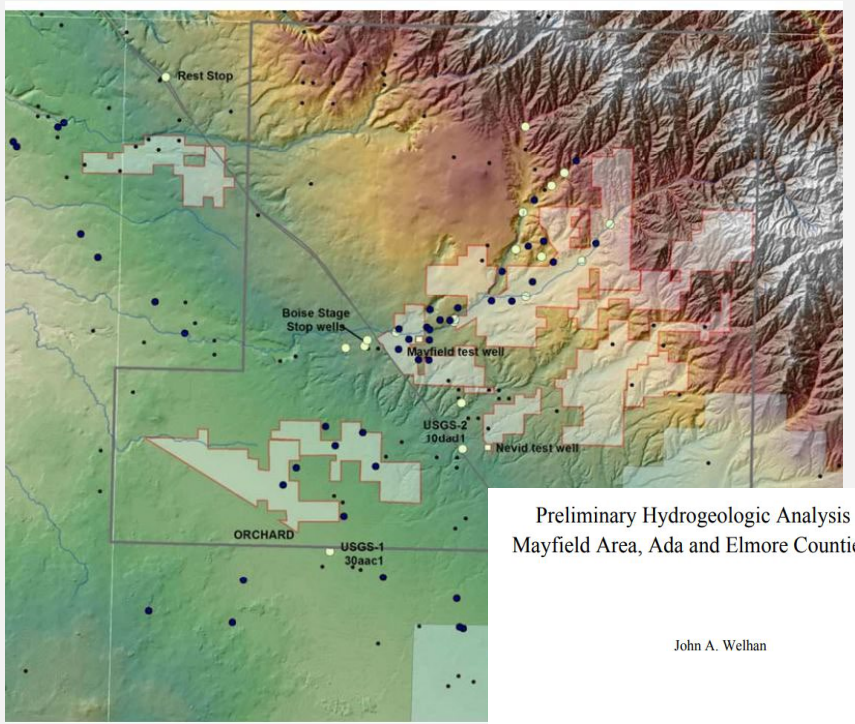

Image from Welhan (2012)
https://www.idahogeology.org/product/S-12-2

Preliminary Hydrogeologic Analysis of the Mayfield Area, Ada and Elmore Counties, Idaho

John A. Welhan

Staff Report S-12-2
August 2012

Idaho Geological Survey
Morrill Hall, Third Floor
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Moscow, Idaho
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USGS
science for a changing world

Prepared in cooperation with the Idaho Department of Water Resources

Recharge Sources and Residence Times of Groundwater as Determined by Geochemical Tracers in the Mayfield Area, Southwestern Idaho, 2011–12

Scientific Investigations Report 2013–5115

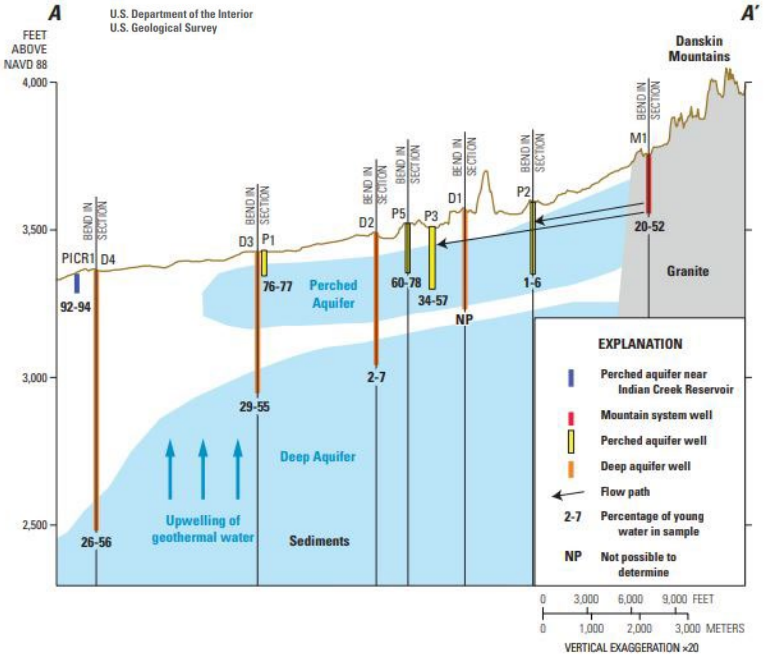
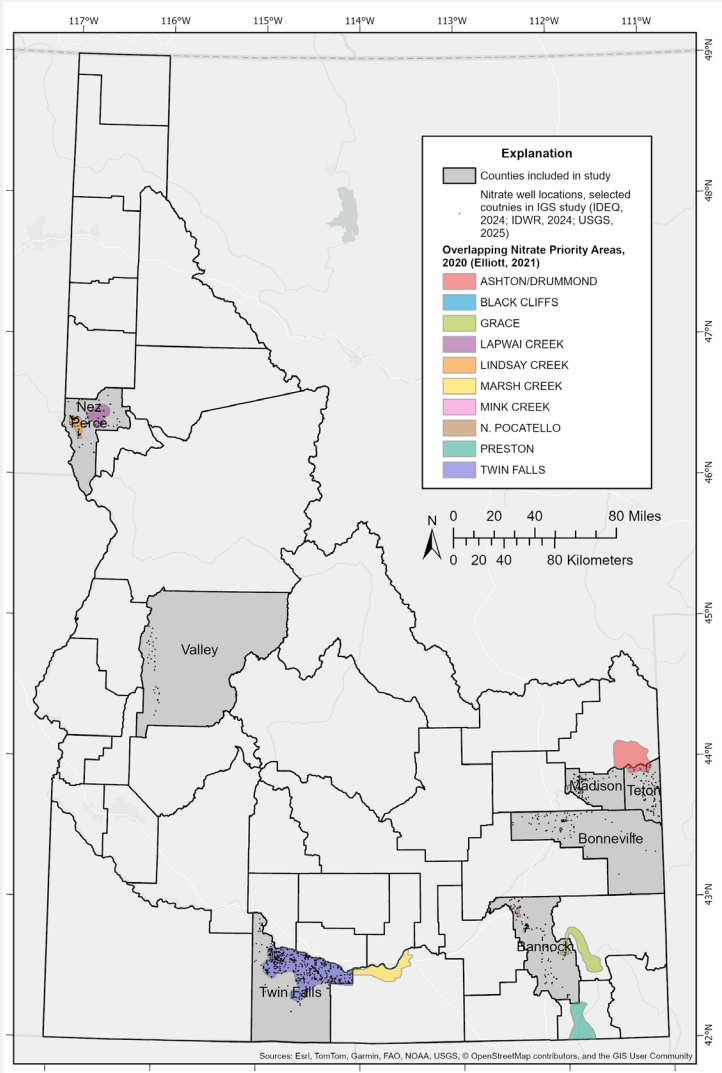


Figure 7. Selected wells and percentages of young water in samples collected in the Mayfield area, southwestern Idaho, 2011–12.

Part 2: Additional areas – data review

- County-level assessment
  - Bannock
    - Black Cliffs, Mink Creek, N. Pocatello, and Grace NPAs
  - Madison/Bonneville/Teton
    - Ashton/Drummond NPA (Teton/Fremont counties)
    - Recent high population growth in Bonneville and Teton counties
  - Nez Perce
    - Lapwai Creek and Lindsay Creek NPAs
  - Valley
    - Recent high population growth
  - Twin Falls
    - Twin Falls NPA
- Approach
  - Existing data compilation and review (no new data collection)
  - Use Treasure Valley template (mass balance model parameters)
  - Consider input from communities



Questions?

Thank you!

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Treasure Valley – near Old Penitentiary (IGS, 2018)

Treasure Valley – near Old Penitentiary (IGS, 2018)