



Randall Paylor

Nevada WSC, rpaylor@usgs.gov

Eric Humphrey

Utah WSC, chumphrey@usgs.gov

Philip Gardner

Nevada WSC, pgardner@usgs.gov

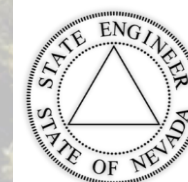
Laura Dye

Venus Cruz

Sade Cromratie Clemons

The Nevada Water Initiative: Interbasin Flow – Preliminary Interpretations for Demonstration Basins

Nevada Water Resources
Association Annual Meeting
February 4, 2026



Sampling for interbasin flow

Groundwater samples demonstrate geochemical evolution related to age, transport, and recharge source.

Background on sampling methods:



Aquifer chemistry and geology of flow paths:

Major ions and trace elements – provide a geochemical fingerprint to help determine water-rock interactions and potential mixing of sources.

Strontium isotope ratios ($^{87}\text{Sr}/^{86}\text{Sr}$) – reflect bedrock/groundwater interactions. Ratio is a blend of signals from lithologies the water traveled through.

Recharge source and conditions:

Stable isotopes ratios ($\delta^2\text{H}-\delta^{18}\text{O}$) – indicate precipitation latitude, altitude, and recharge patterns. Lighter isotope ratios generally indicate higher latitude or altitude.

Dissolved gases – noble gas concentrations in groundwater are a function of recharge temperature and altitude. Helium isotopes can gauge deep crustal or mantle influence.

Age tracers for groundwater movement:








Carbon-14 – decay of carbon isotope indicates time elapsed since the water was isolated from the atmosphere. Useful to about 30k - 40k years.

Tritium (^3H) – can distinguish water recharged in past ~70 years from older water. Sourced from weapons testing fallout in recharge precipitation.

Chlorofluorocarbons – synthetic gases with well-documented historical atmospheric levels. Can estimate recharge time back to ~1940.

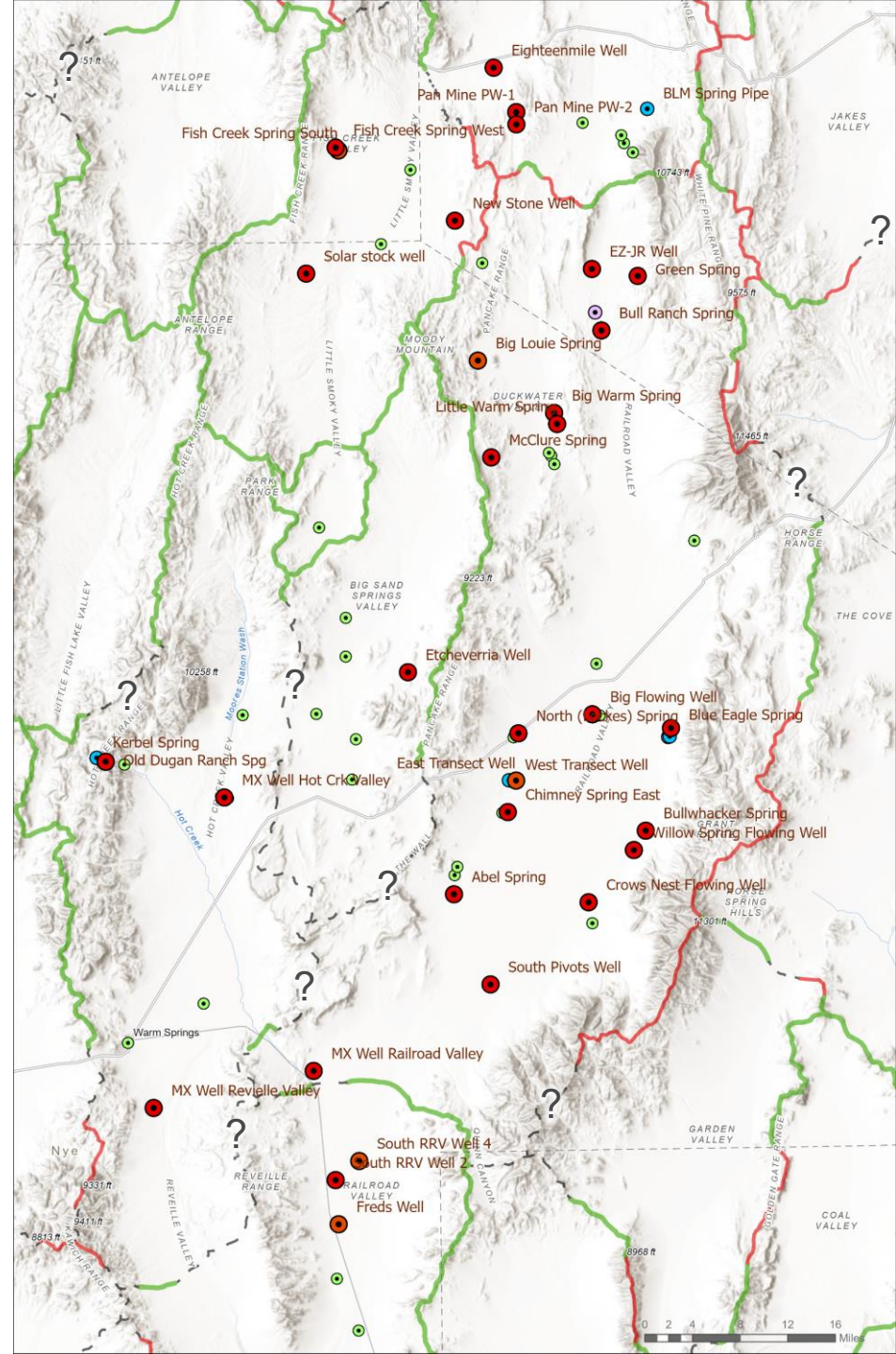
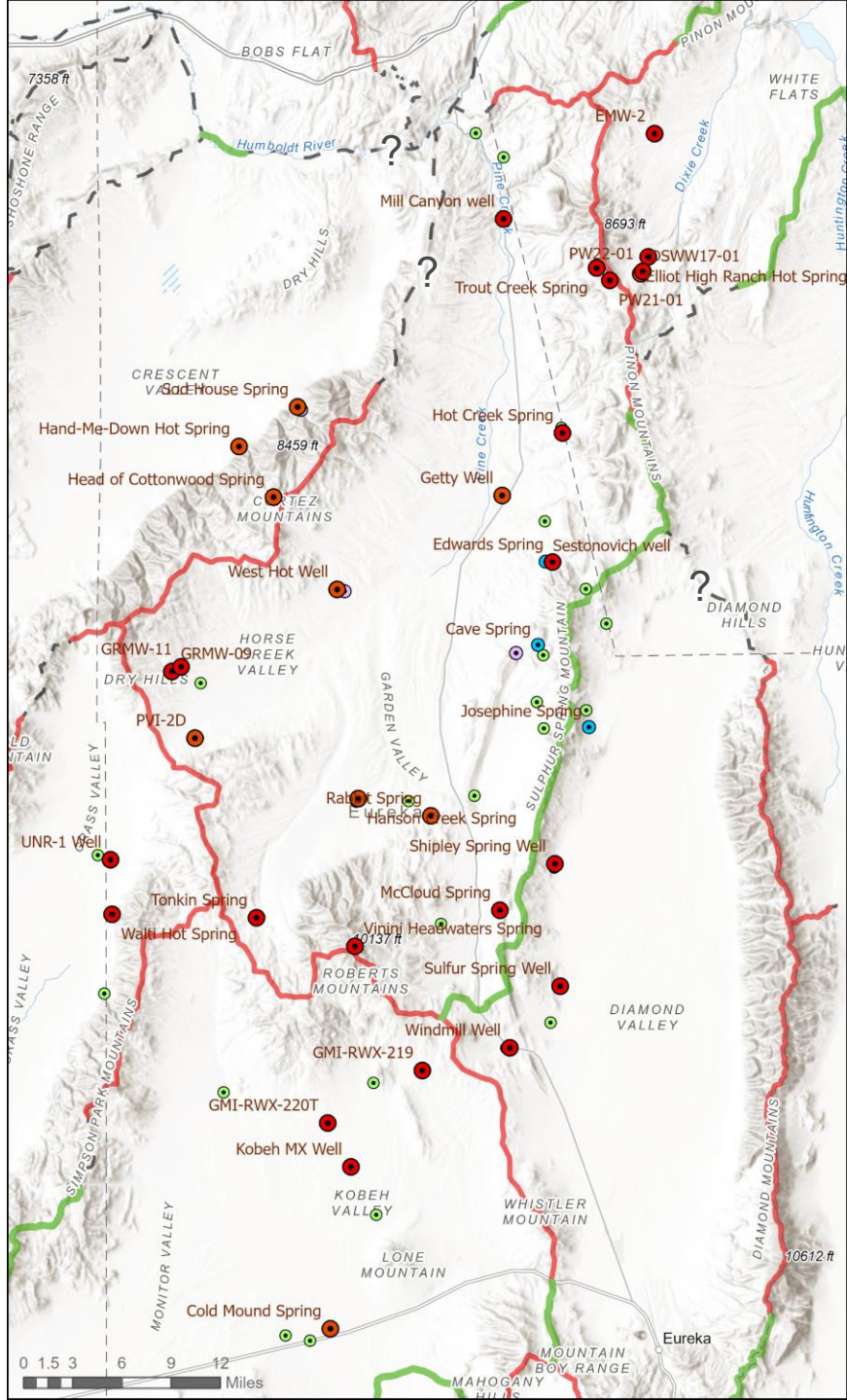
Sampling

- For the Railroad Valley demo basin, we sampled a total of 36 sites across 6 different hydrographic basins.
- For the Pine Valley demo basin, we sampled a total of 34 sites across 6 different basins.

-  Basin boundary favorable to interbasin flow
-  Basin boundary unfavorable to interbasin flow
-  Boundary favorability undetermined
-  Sampled sites
-  Stable isotope samples
-  Field parameters
-  Select recon locations

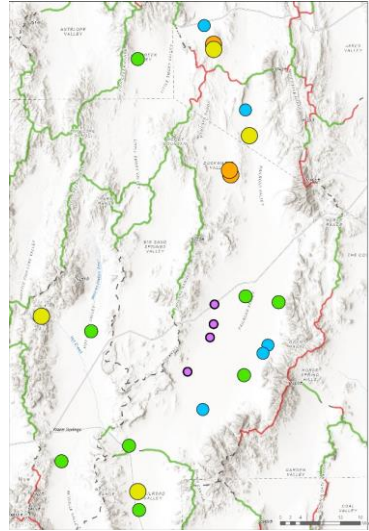
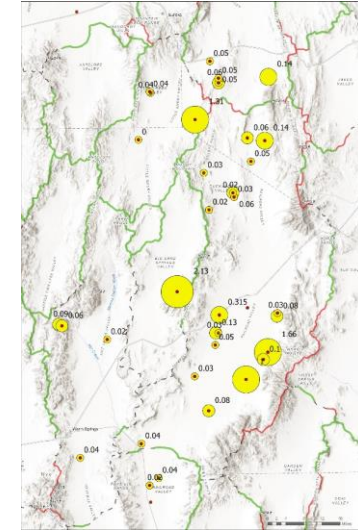
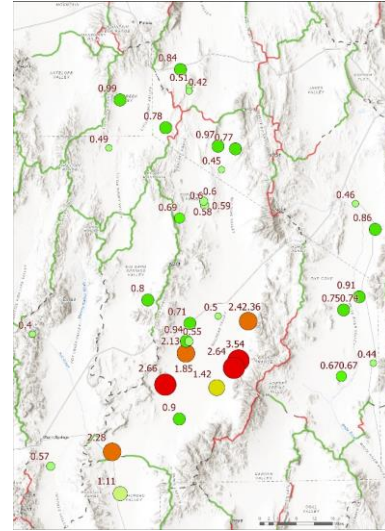
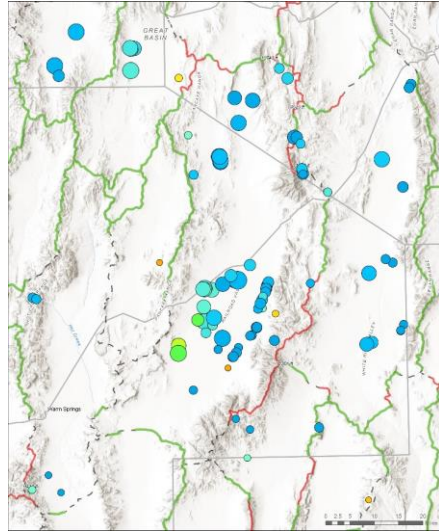
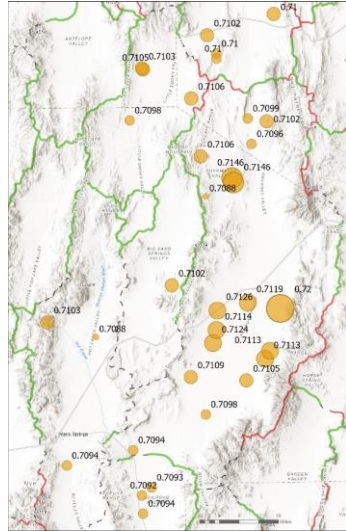
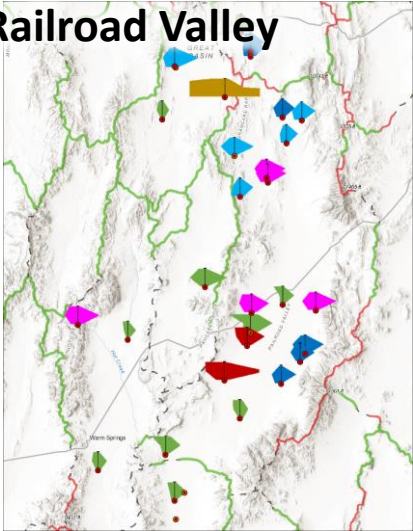


Railroad Valley sampling. R. Paylor



Data Analysis

Railroad Valley



Major ion chemistry

$^{87}\text{Sr}/^{86}\text{Sr}$ ratio

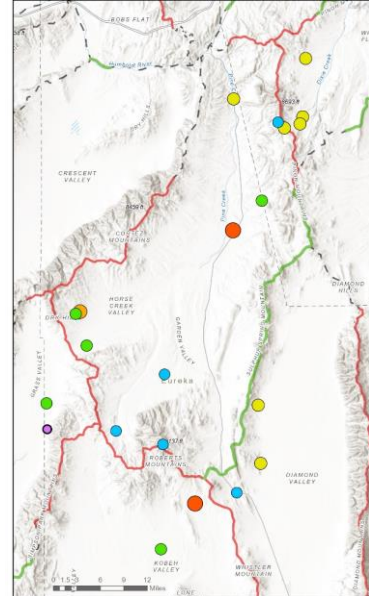
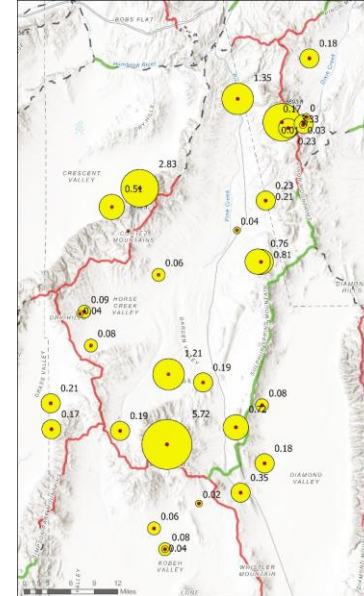
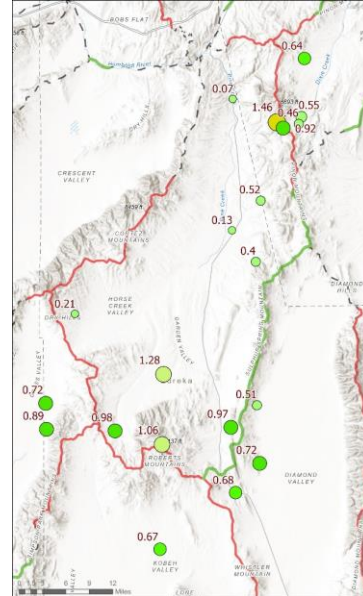
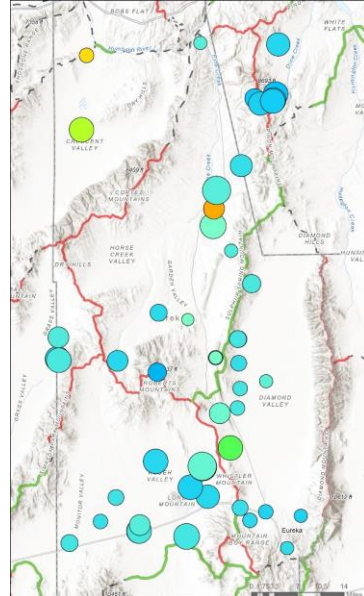
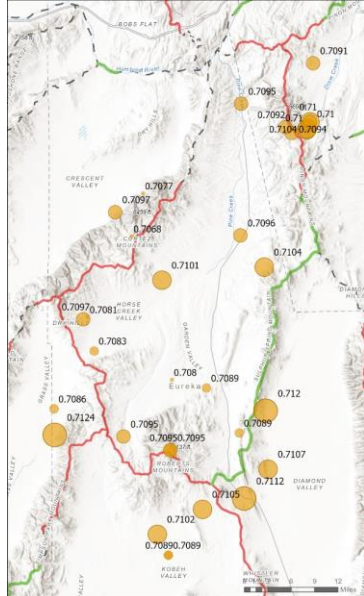
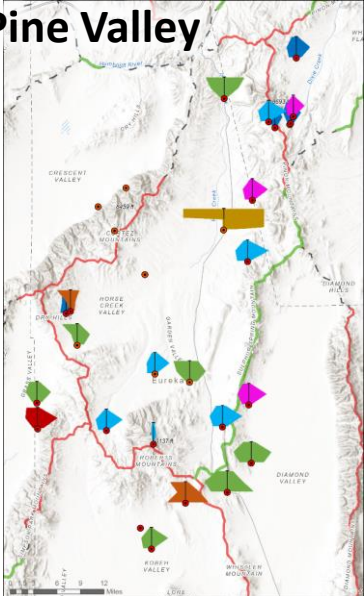
$\delta^2\text{H}-\delta^{18}\text{O}$ stables

Dissolved gases

^3H Tritium

^{14}C Carbon

Pine Valley



Previous IBF estimates

- Sampling targeted estimated flow paths from previous studies.
- Estimates of interbasin flow from past studies vary, and our sampling evaluates whether these connections are likely.



Estimated interbasin flow direction

0.7 - 4

Estimated interbasin flow, thousands of acre-feet per year



Basin boundary favorable to interbasin flow



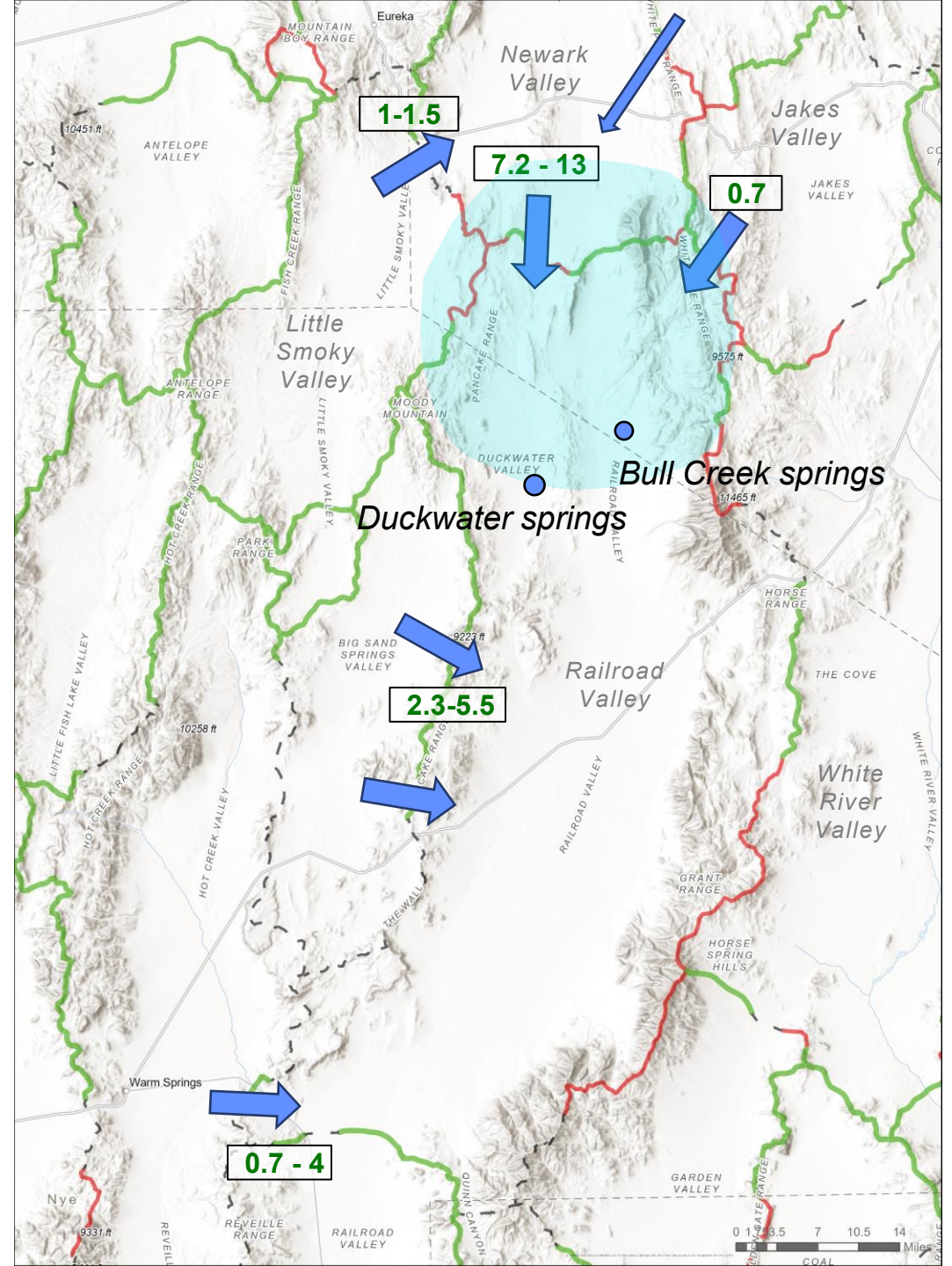
Basin boundary unfavorable to interbasin flow



Boundary favorability undetermined

Estimated interbasin flow from previous work.

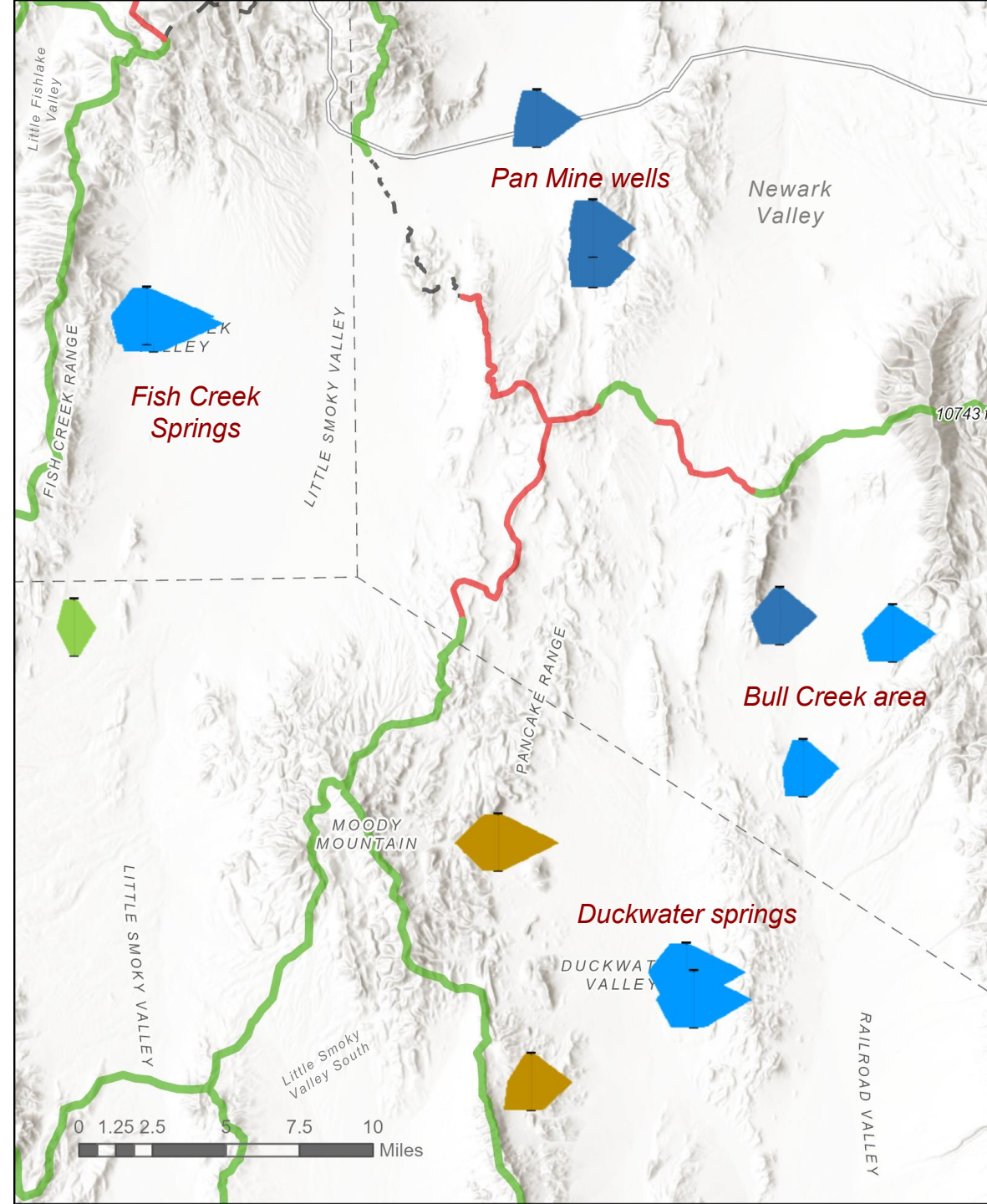
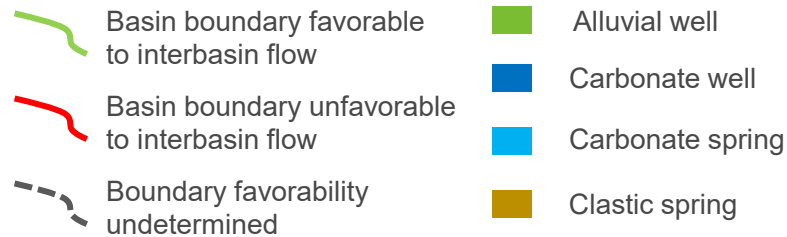
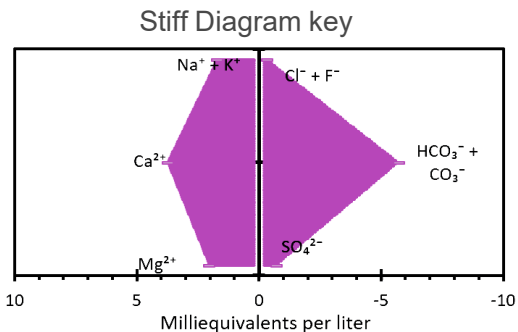
Eakin and others (1951); Rush and Everett (1966); Van Denburgh and Rush (1974); Harril and others (1988); Prudic and others (1995); Nichols (2000); Lopes and Evetts (2004); Heilweil and Brooks, 2011



Railroad Valley findings

Major ions

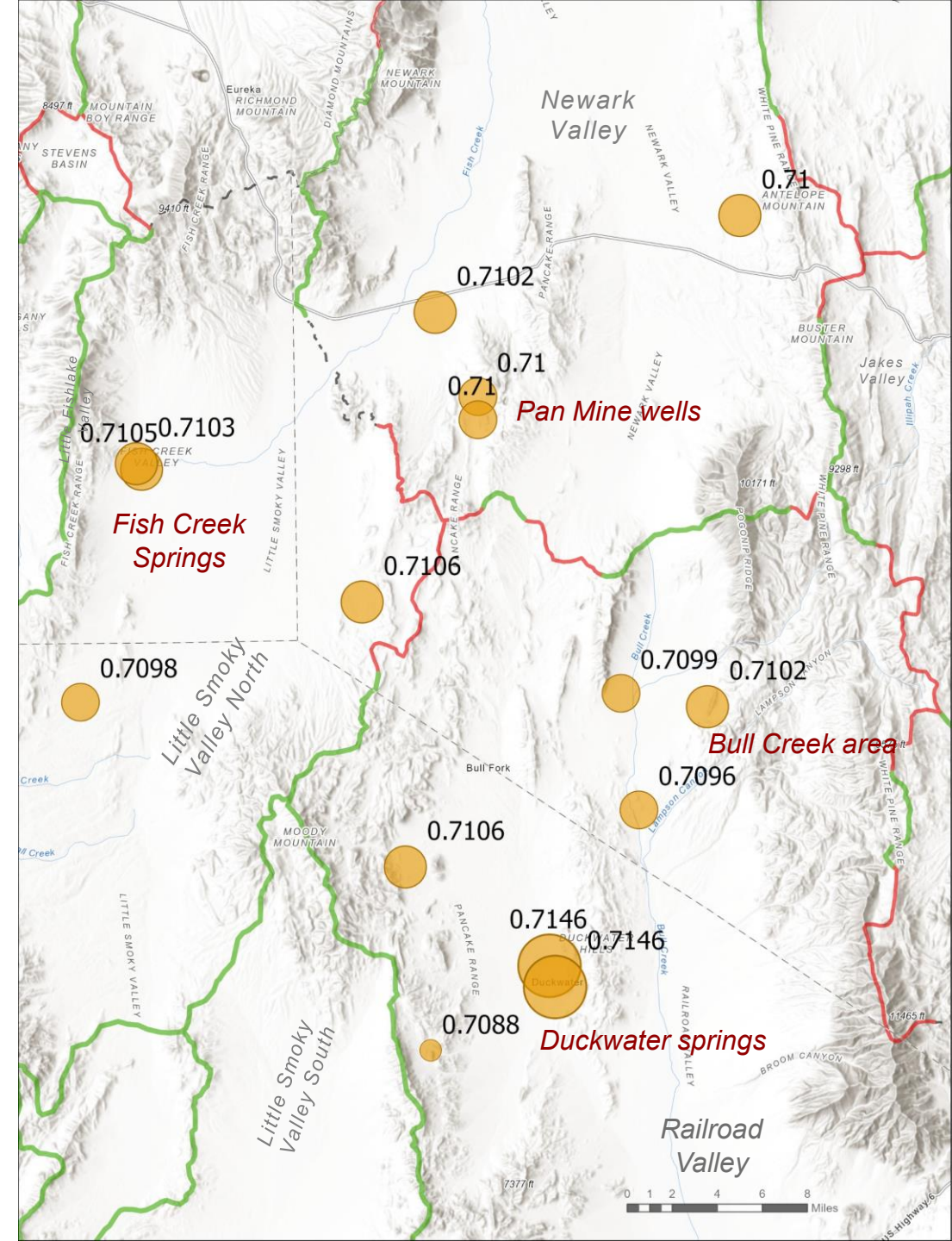
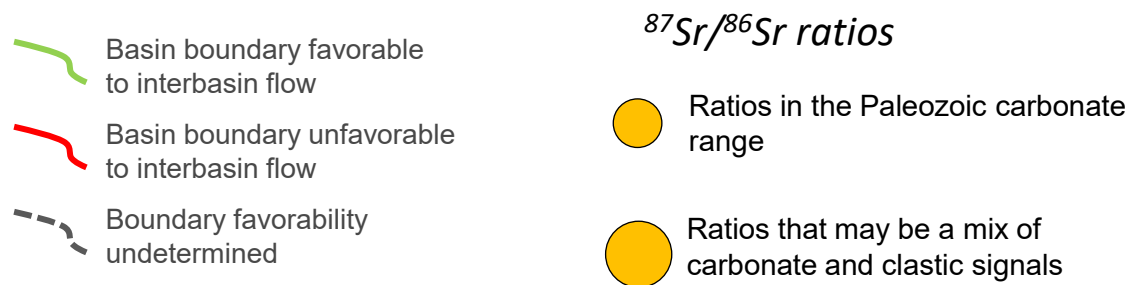
- Stiff diagrams show a graphical representation of major ion activities in groundwater.
- Most of the north Railroad area is dominated by calcium and carbonate. Duckwater springs have higher ionic strengths than carbonate waters to the north and east.
- Carbonate wells in southern Newark Valley have a higher magnesium component (likely more dolomitic).
- Springs draining the Pancake Range have chemistry associated with local stratigraphy.



Railroad Valley findings

Strontium isotopes

- Results show the range of $^{87}\text{Sr}/^{86}\text{Sr}$ isotopes in the north Railroad valley area is between 0.7088 and 0.7146.
- Paleozoic carbonate strontium isotope ratios are generally between 0.707 and 0.710 in Nevada, and most sites are in that range.
- Paleozoic clastic rocks, including the Chainman and Pilot shales that are extensive in the Newark/Railroad boundary area, can have a higher ratio from 0.715 to 0.724 (Paces and others, 2007)



Railroad Valley findings

Stable isotopes

- $\delta^2\text{H}$ and $\delta^{18}\text{O}$ isotopes from 33 new and old groundwater sites in northern Railroad Valley indicate diverse recharge sources.
- Preliminary results suggest high elevation or high latitude recharge and carbonate connectivity for much of the water around north Railroad Valley, with some local recharge and evaporation.



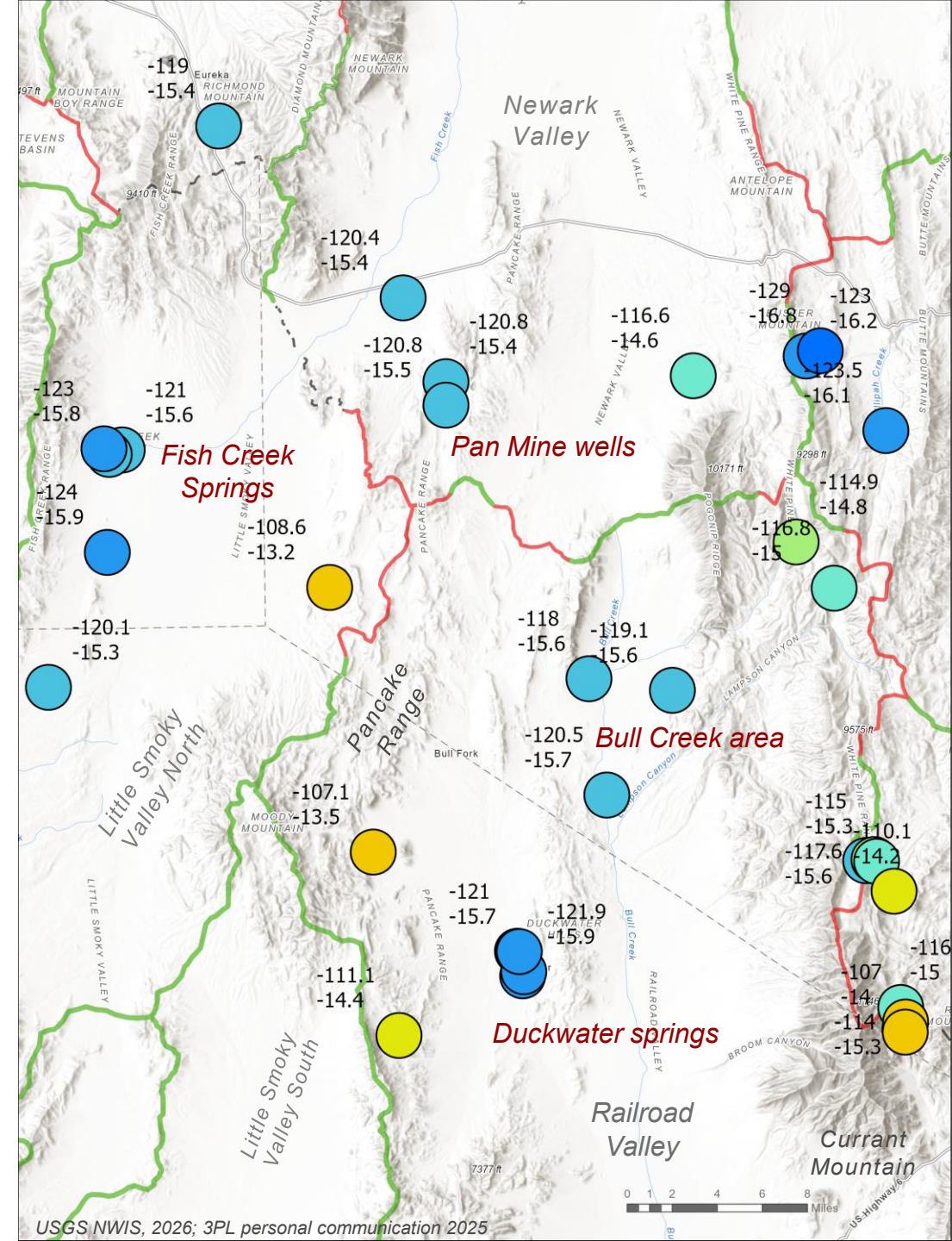
Big Warm Spring at Duckwater
R. Paylor

Preliminary Information-Subject to Revision. Not for Citation or Distribution.

Stable Isotopes

121.9 $\delta^2\text{H}$
-15.9 $\delta^{18}\text{O}$

- Lighter - higher elevation or more northern source
-
- Heavier - lower elevation or more southern source
-

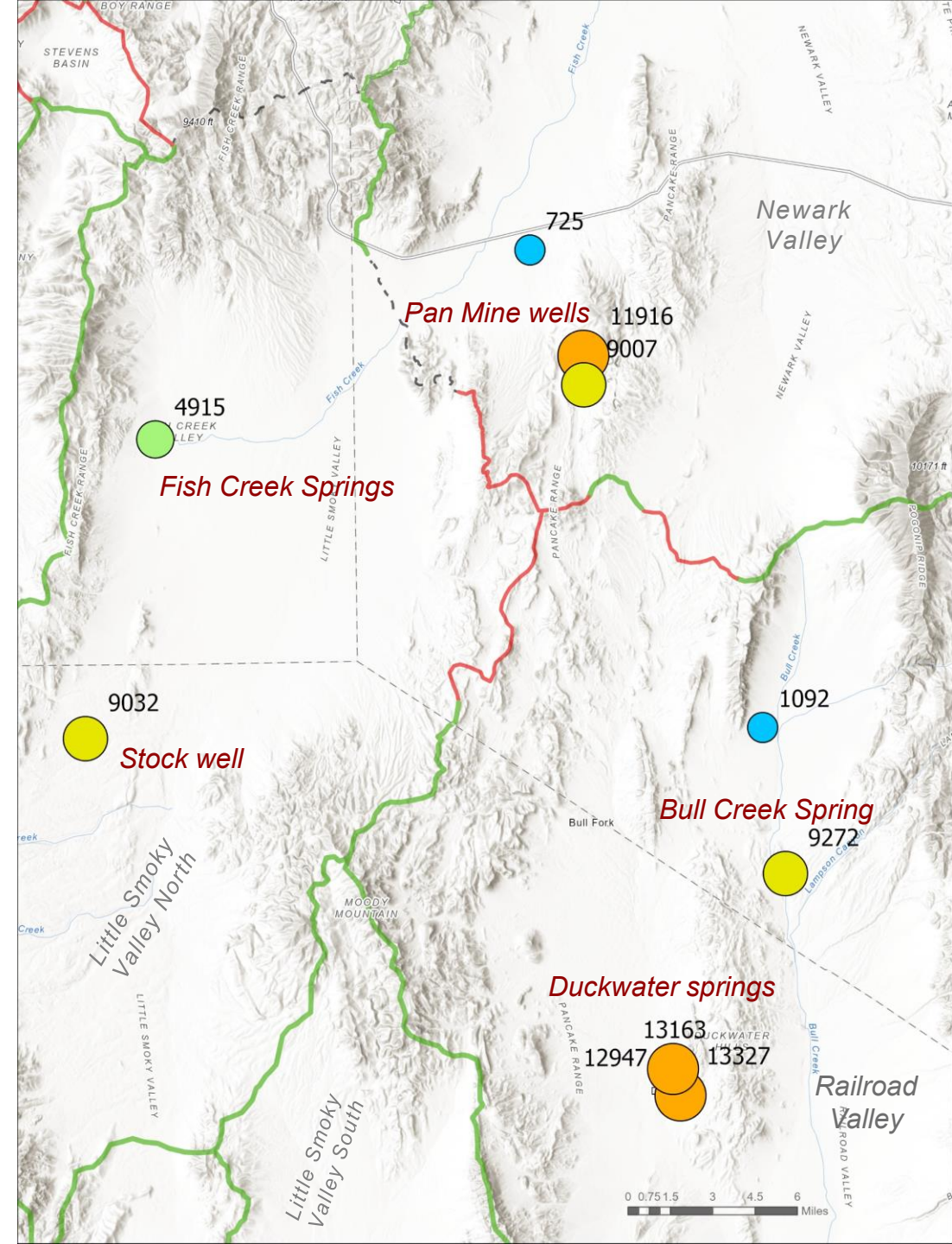


Railroad Valley findings

Carbon 14 age dating

- Reported carbon-14 ages were adjusted using the Revised Fontes and Garnier model of Han and Plummer (2013) that accounts for stable carbon isotopes and DIC concentrations.
- Adjusted ages in north Railroad Valley ranged from relatively modern waters in shallow wells to waters with low measurable ^{14}C in deep carbonate wells and the Duckwater warm springs.
- There are potential age gradients from deep carbonates in Newark Valley to the Duckwater springs, and from eastern mountain block recharge to Bull Creek springs.

Carbon 14 adjusted ages

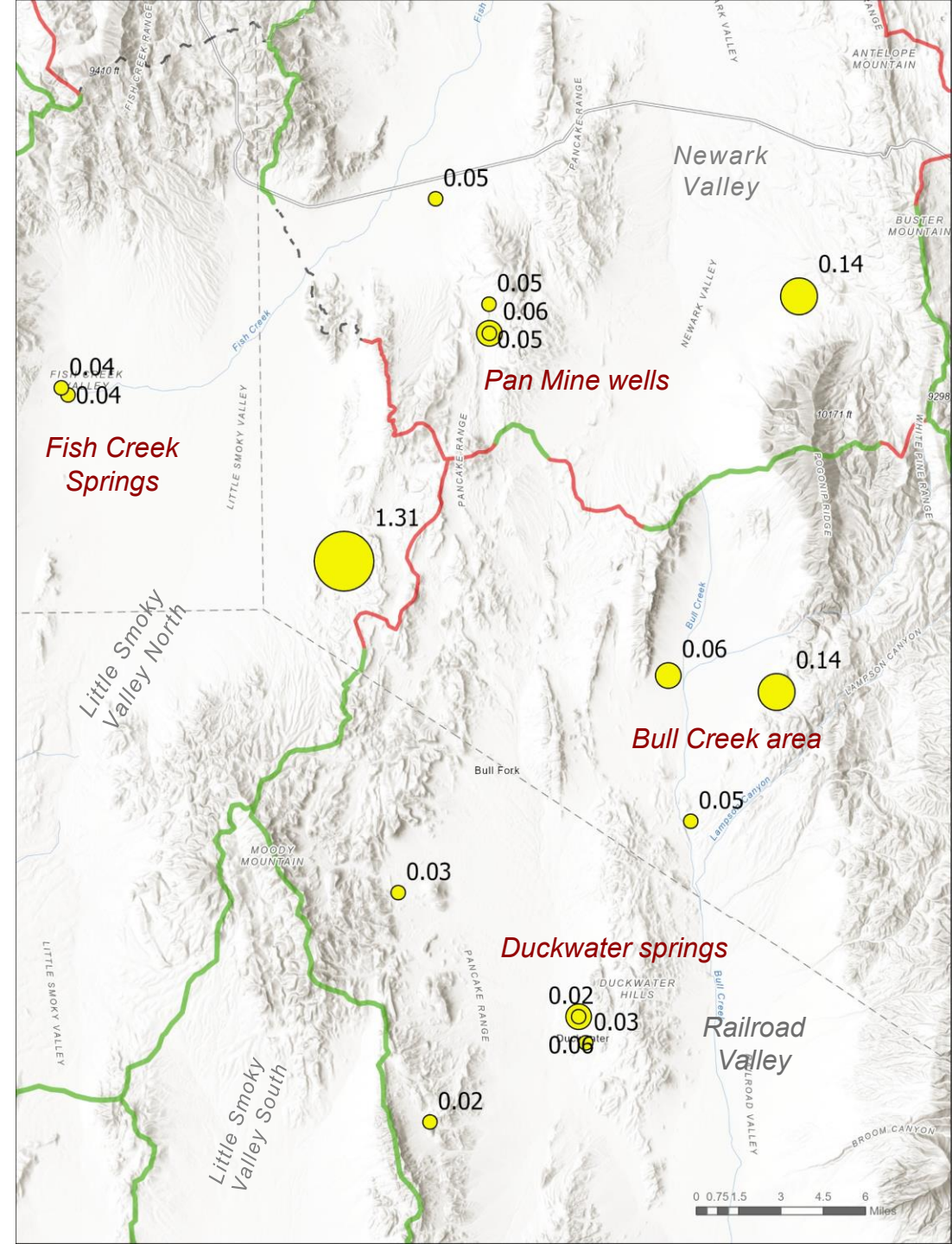
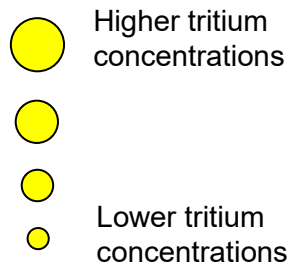


Railroad Valley findings

Tritium

- Results show most of the groundwater in Railroad Valley and surrounding basins is low to very low in tritium. Some mountain block springs are higher, including springs in south Newark and north Railroad valleys
- Any sites below about 0.06 tritium units are at the non-detect threshold.
- A shallow perched well in the Pancake Range significantly higher in ^3H than surrounding groundwater sites.

Tritium Units



Railroad Valley findings

Dissolved gases

- The R/Ra ratios ($^3\text{He}/^4\text{He}$)/($^3\text{He}/^4\text{He}$ atmosphere) are highly variable within Railroad Valley.
- A ratio over 1 indicates enrichment of ^3He over atmospheric level. Springs to the south are enriched in ^3He , likely from a deep fault-controlled source or local volcanism.
- Deep carbonate waters at Duckwater springs and the Pan Mine wells are below atmospheric ratios while shallow wells and mountain block springs are closer to atmospheric equilibrium.



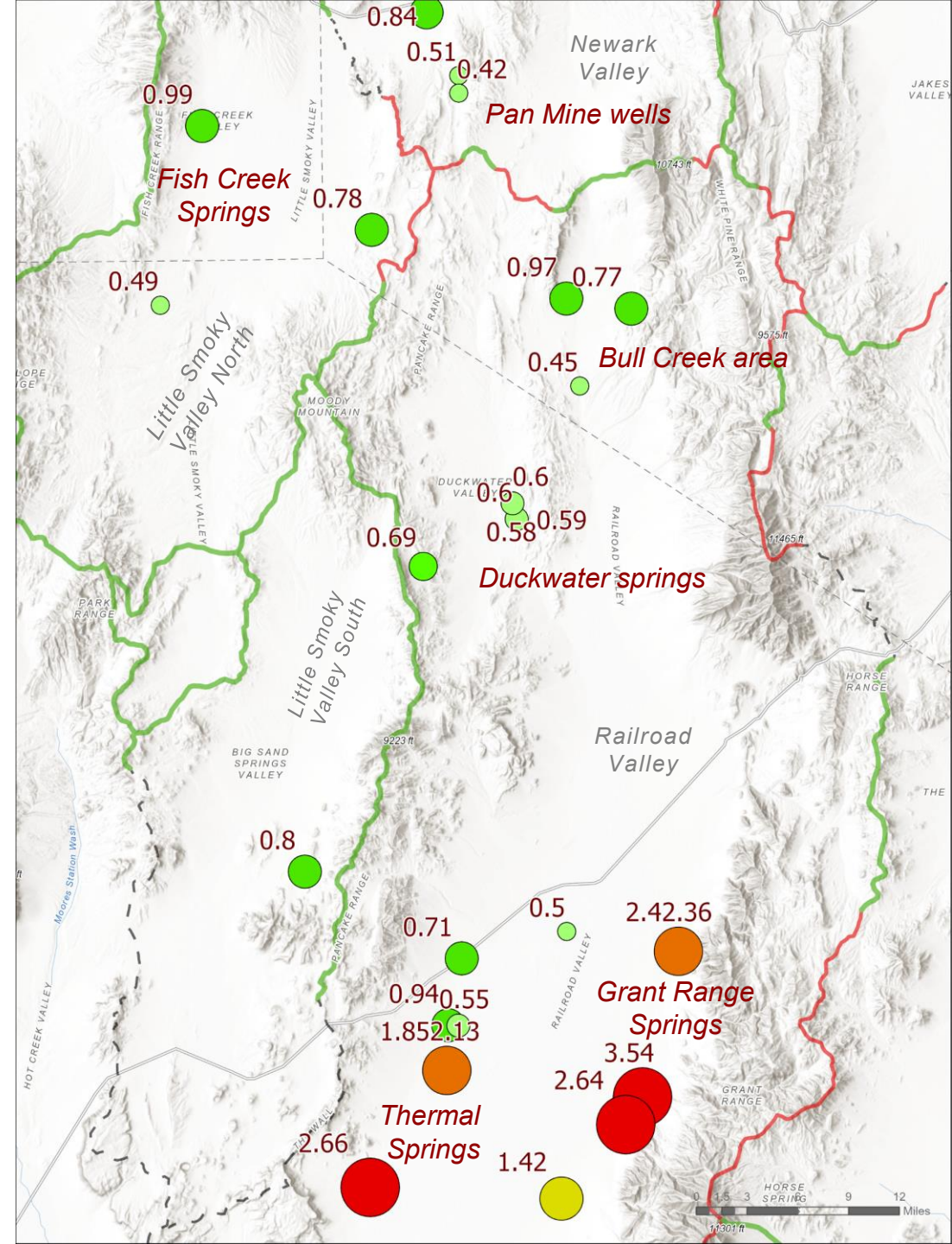
Little Warm Spring - R. Paylor



Big flowing well - R. Paylor

R/Ra ratios

- Significantly above atmospheric ratio
- Near atmospheric ratio
- Below atmospheric ratio



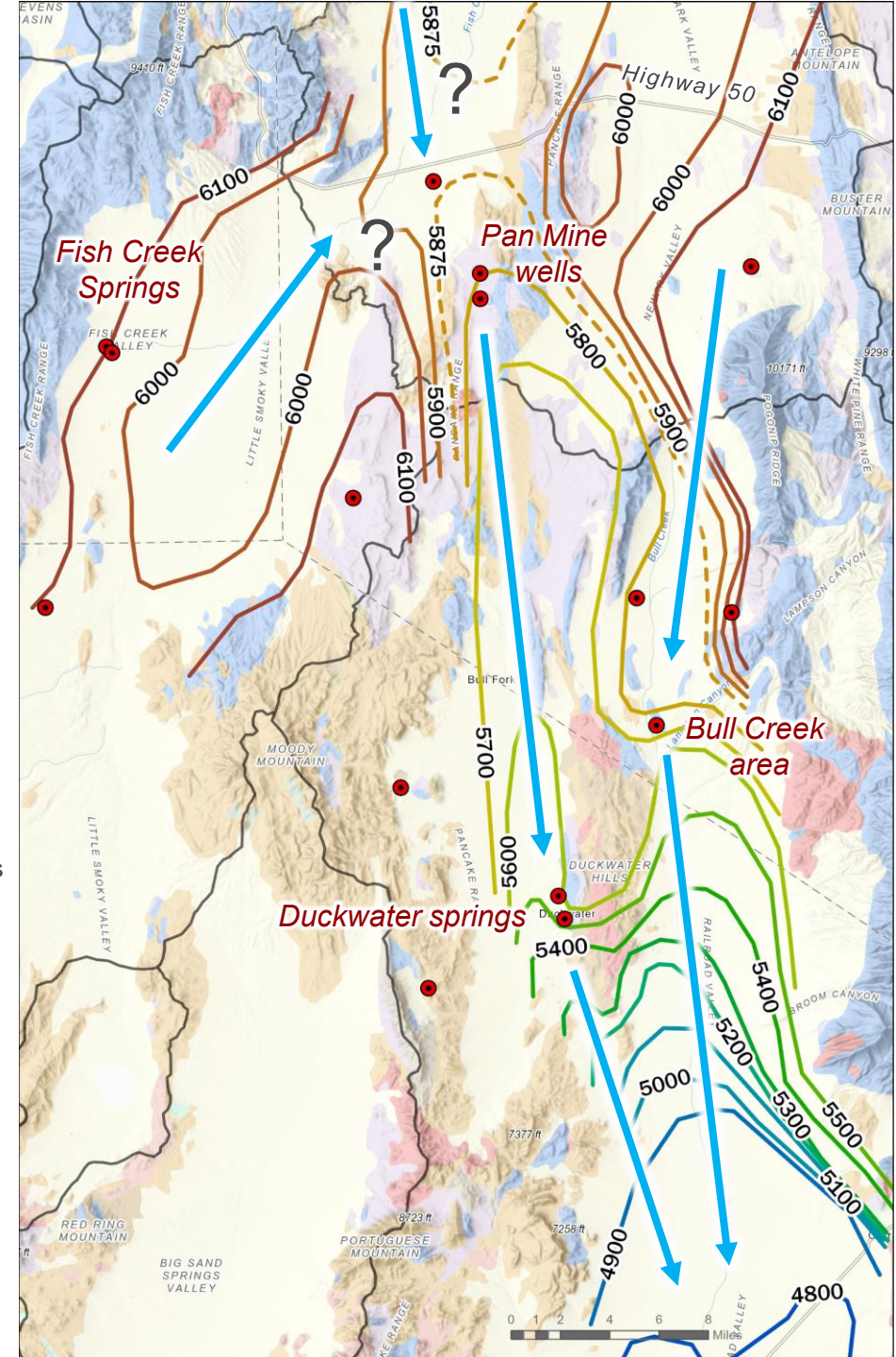
Railroad Valley Initial interpretation

- Duckwater and southwest Newark Valley, with predominantly carbonate geochemistry and connected carbonate rock, have low ^3H , light $\delta^2\text{H}-\delta^{18}\text{O}$ and similar R/Ra values. ^{14}C shows an age gradient toward Duckwater springs from deep carbonate wells.
- Springs and wells in northeast Railroad Valley have moderate ^3H , younger ^{14}C ages, light $\delta^2\text{H}-\delta^{18}\text{O}$, and similar $^{87}\text{Sr}/^{86}\text{Sr}$. Tracers suggest recharge from southeast Newark and possibly Jakes Valley.
- Preliminary potentiometric contours from new NWI measurements and prior data also suggest some water from Little Smoky Valley could be draining through Newark into Railroad. Heilweil and Brooks, 2011; NDOW water level data, 2026
- Contours also suggest interbasin flow from south Newark may be limited to areas south of Highway 50 because of a potentiometric divide and revised playa ET.

Potentiometric Contours (ft amsl)



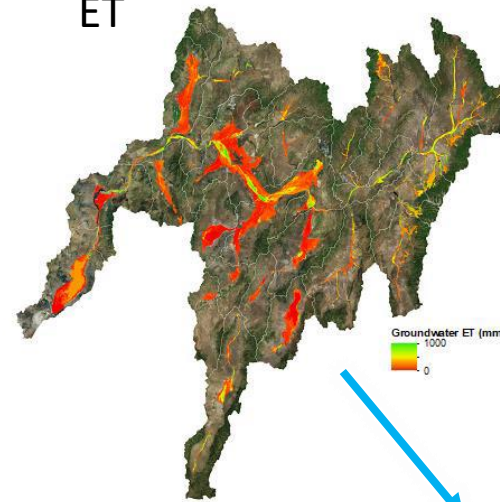
Major geologic formations



Next steps

- Revise interpretations with continued data analysis and addition of TracerLPM lumped parameter modeling, DGMETA dissolved gas modeling, and Darcy flux estimates.
- Integrate with other NWI components for recharge, discharge, pumping, and water level/flow measurements.
- The continued work of NWI will significantly improve our understanding of groundwater and surface water for future management.

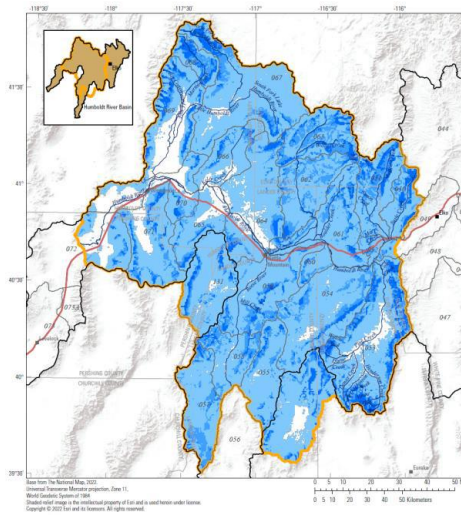
ET



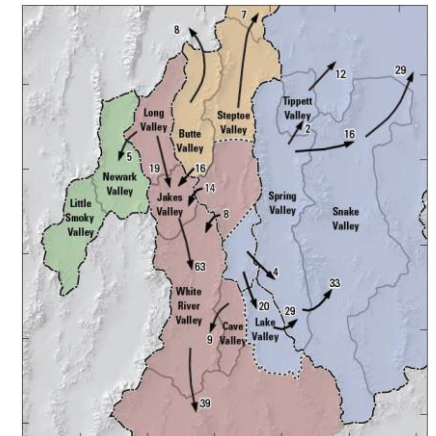
Pumping



NWI



Recharge



Interbasin flow



Field monitoring

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Big Bull Spring, Railroad Valley R. Paylor



Tonkin Spring, Pine Valley R. Paylor