Nevada Water Initiative

Updated Understanding of the Hydrology of Railroad Valley, NV

Community Update Meeting

Currant, NV

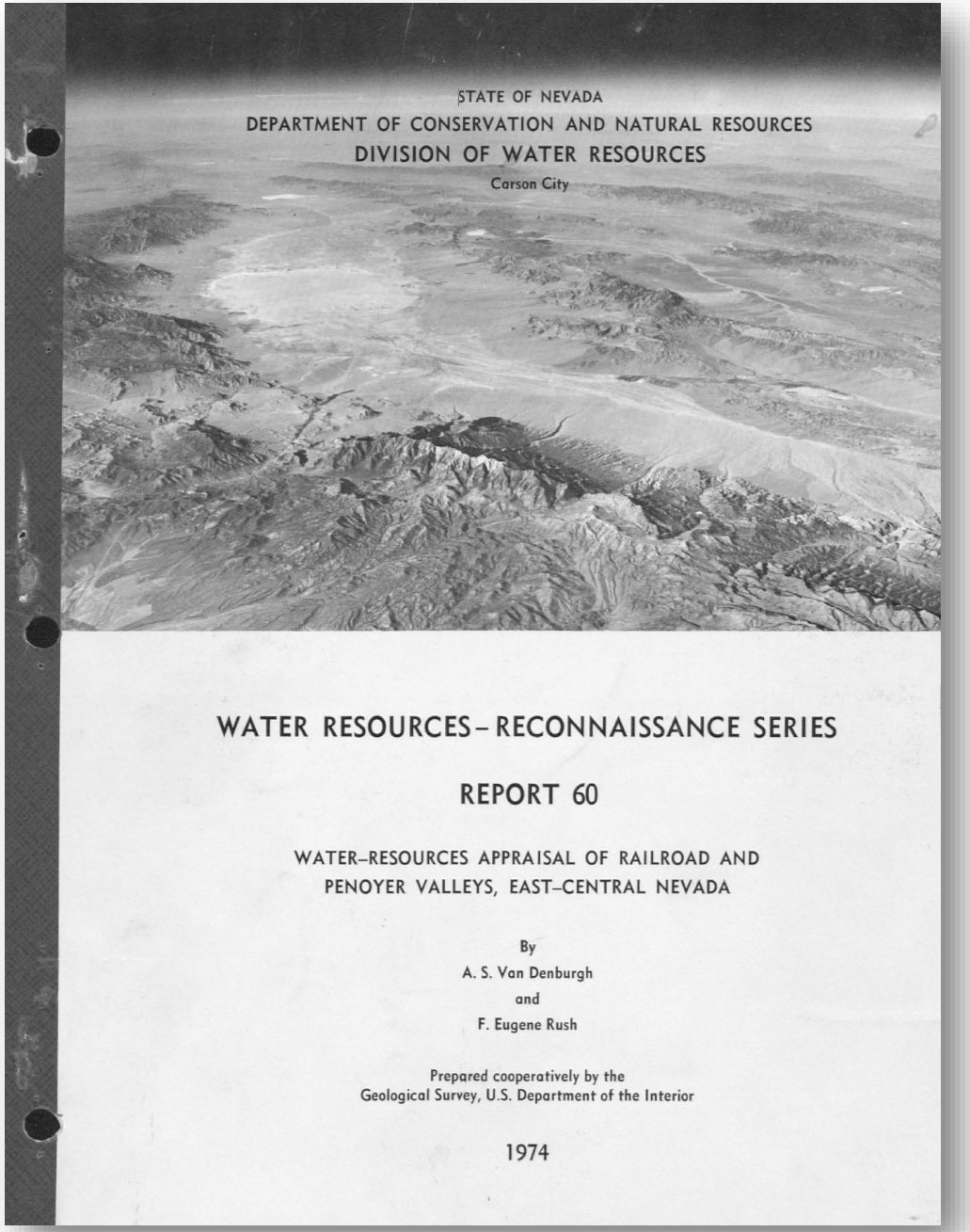
1/6/2025

DRI Desert Research Institute

USGS science for a changing world

Hydrology of Railroad Valley

- Water Resources Reconnaissance Report from 1974:
  - Data collected primarily between 1970-1972
  - Ancillary data between 1960s-1970s
  - Measured groundwater levels in about 80 wells
- Water budget
- Conceptual flow model


STATE OF NEVADA
DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF WATER RESOURCES
Carson City

WATER RESOURCES – RECONNAISSANCE SERIES

REPORT 60

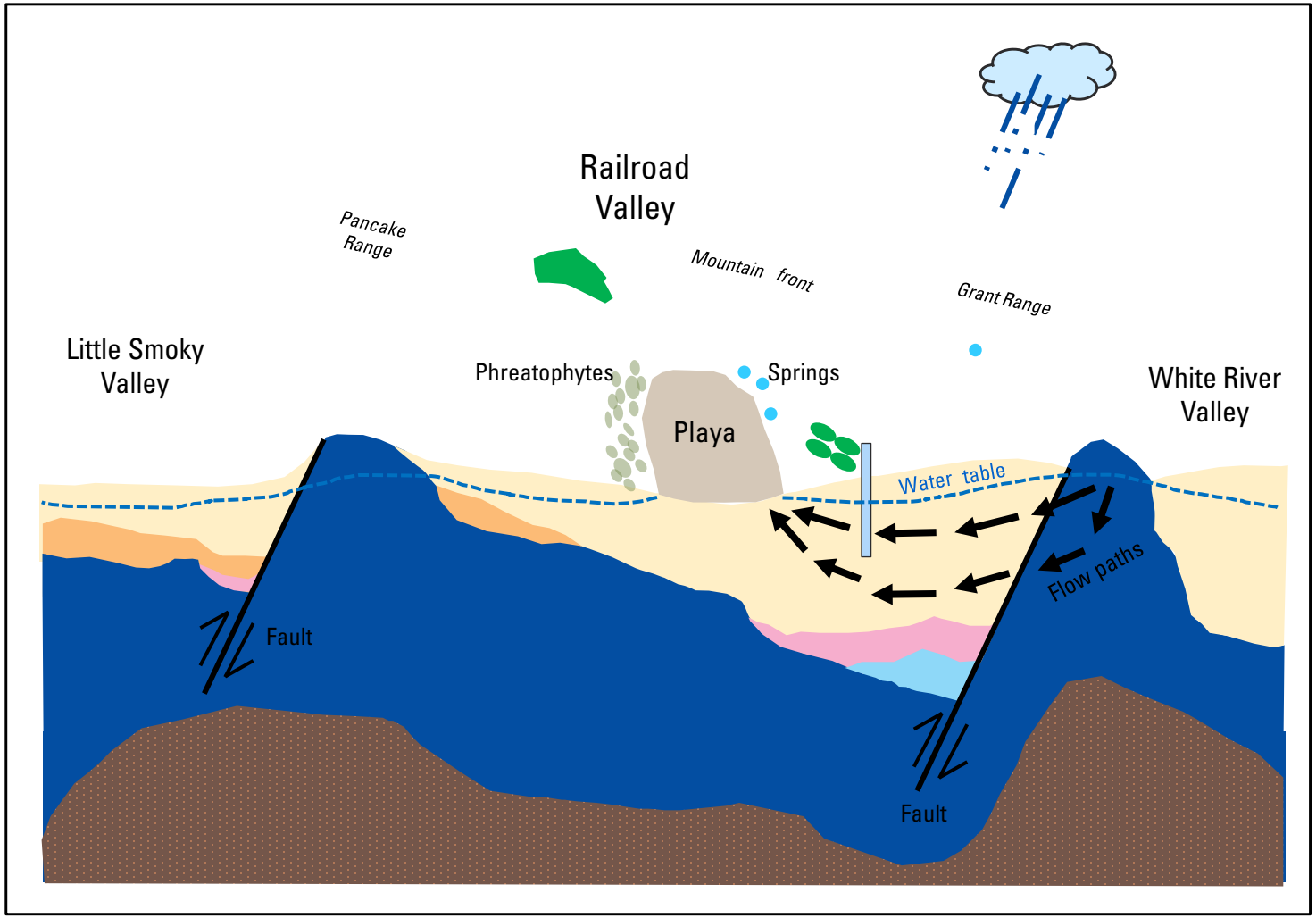
WATER–RESOURCES APPRAISAL OF RAILROAD AND PENOYER VALLEYS, EAST–CENTRAL NEVADA

By
A. S. Van Denburgh
and
F. Eugene Rush

Prepared cooperatively by the
Geological Survey, U.S. Department of the Interior

1974

How does water flow through Railroad Valley?



- Upper basin-fill aquifer
- Lower basin-fill aquifer
- Volcanic unit
- Upper carbonate aquifer unit
- Lower carbonate aquifer
- Noncarbonate confining unit

Modified from Heilweil and Brooks (2010)

Simplified schematic - Not drawn to scale

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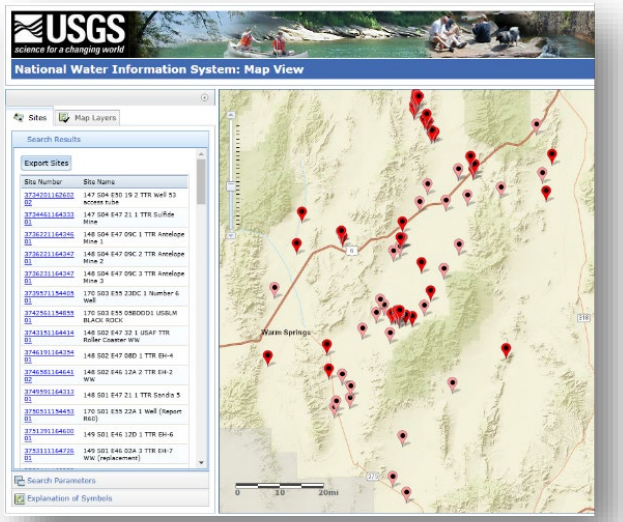
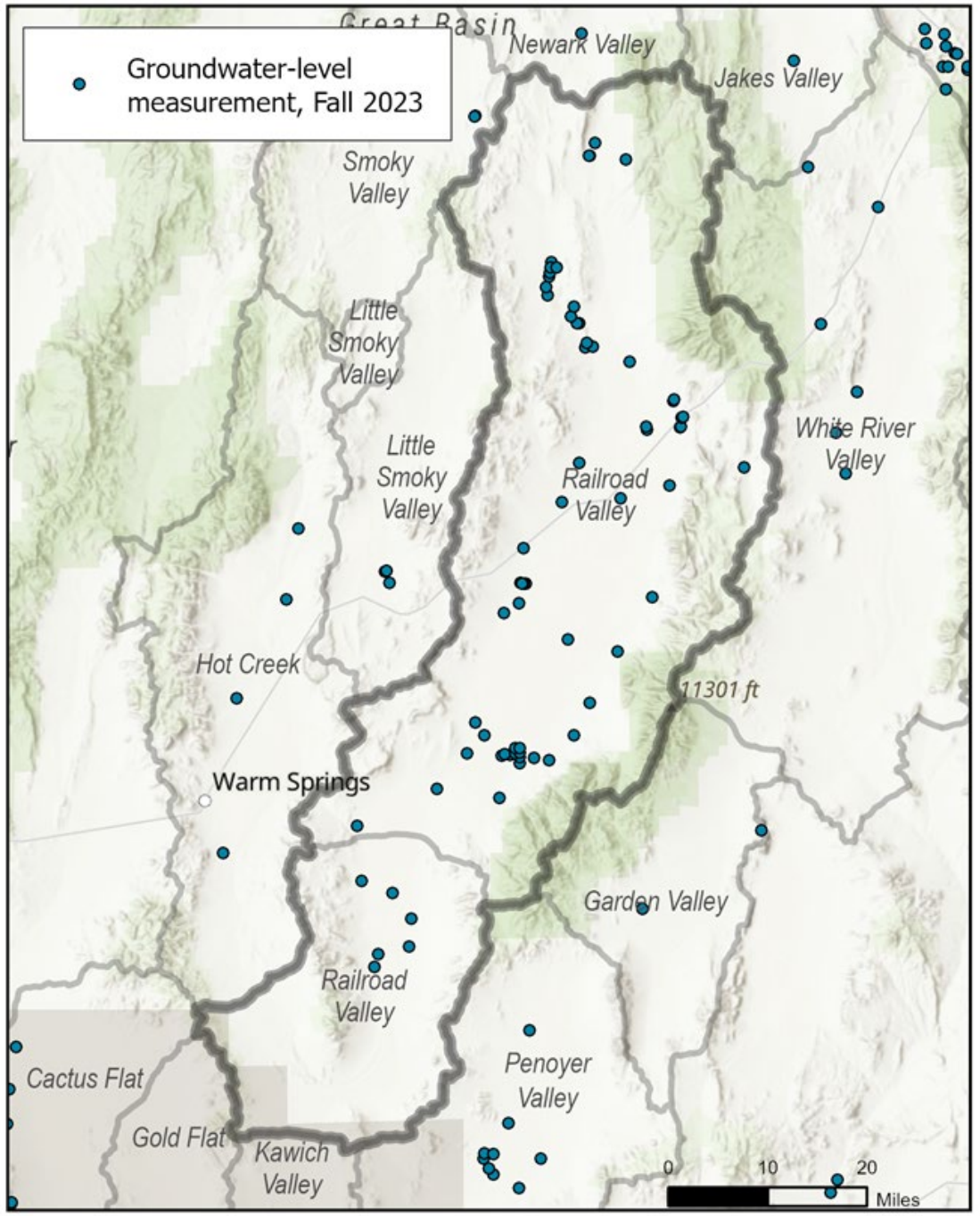
What have we been doing?

- Well reconnaissance (~150 wells)
- Groundwater levels measured at 100 wells in Fall 2023
- Link to groundwater level database





Preliminary Information-Subject to Revision.

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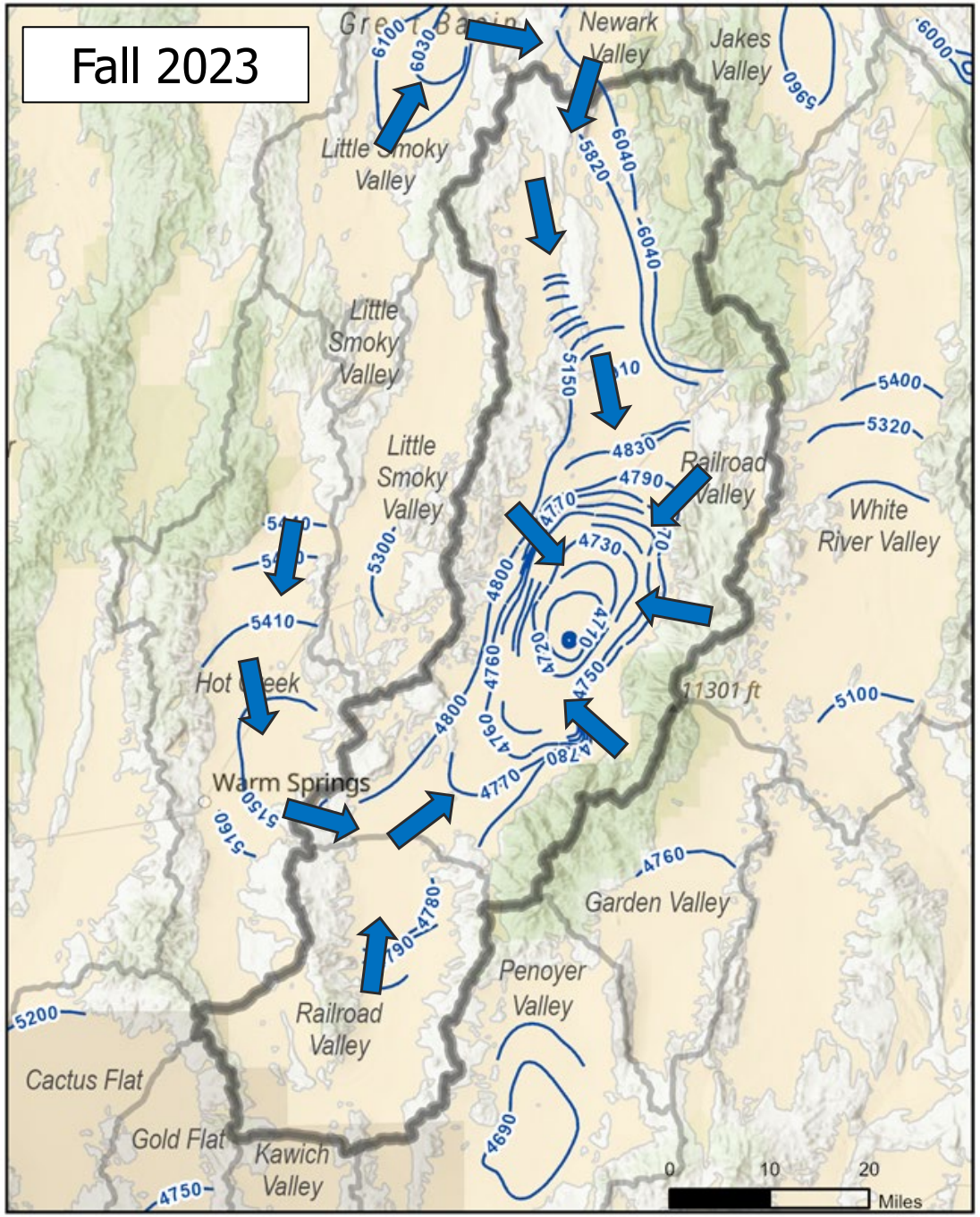
Groundwater Elevation Map

- Contoured-groundwater levels show the direction of groundwater movement
- Used to verify conceptual flow model
- Generally, groundwater levels lower today than in 1974



Unconsolidated rock

Groundwater elevation, ft

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Preliminary Information-Subject to Revision.

Groundwater Elevation Map

- Contoured-groundwater levels show the direction of groundwater movement
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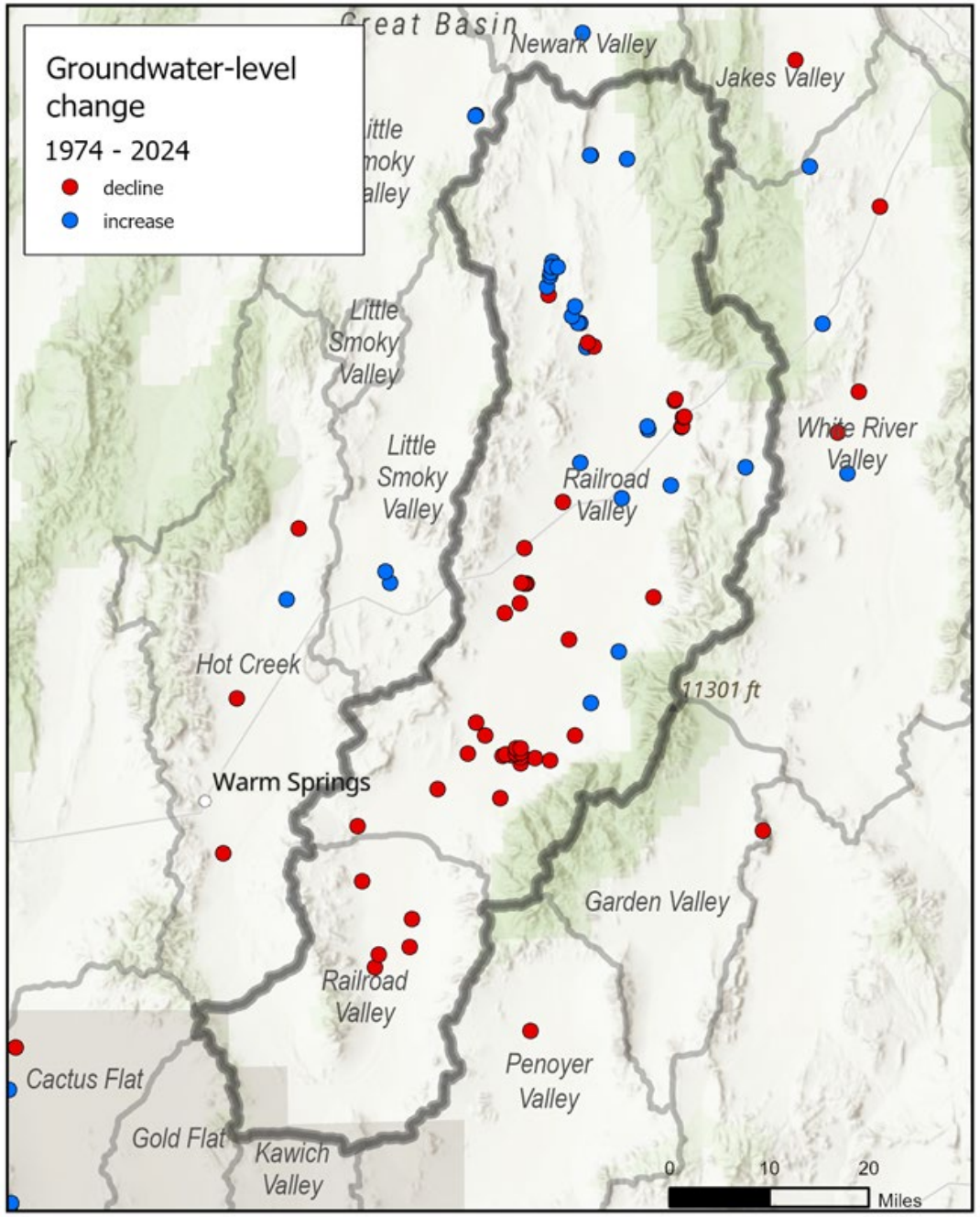
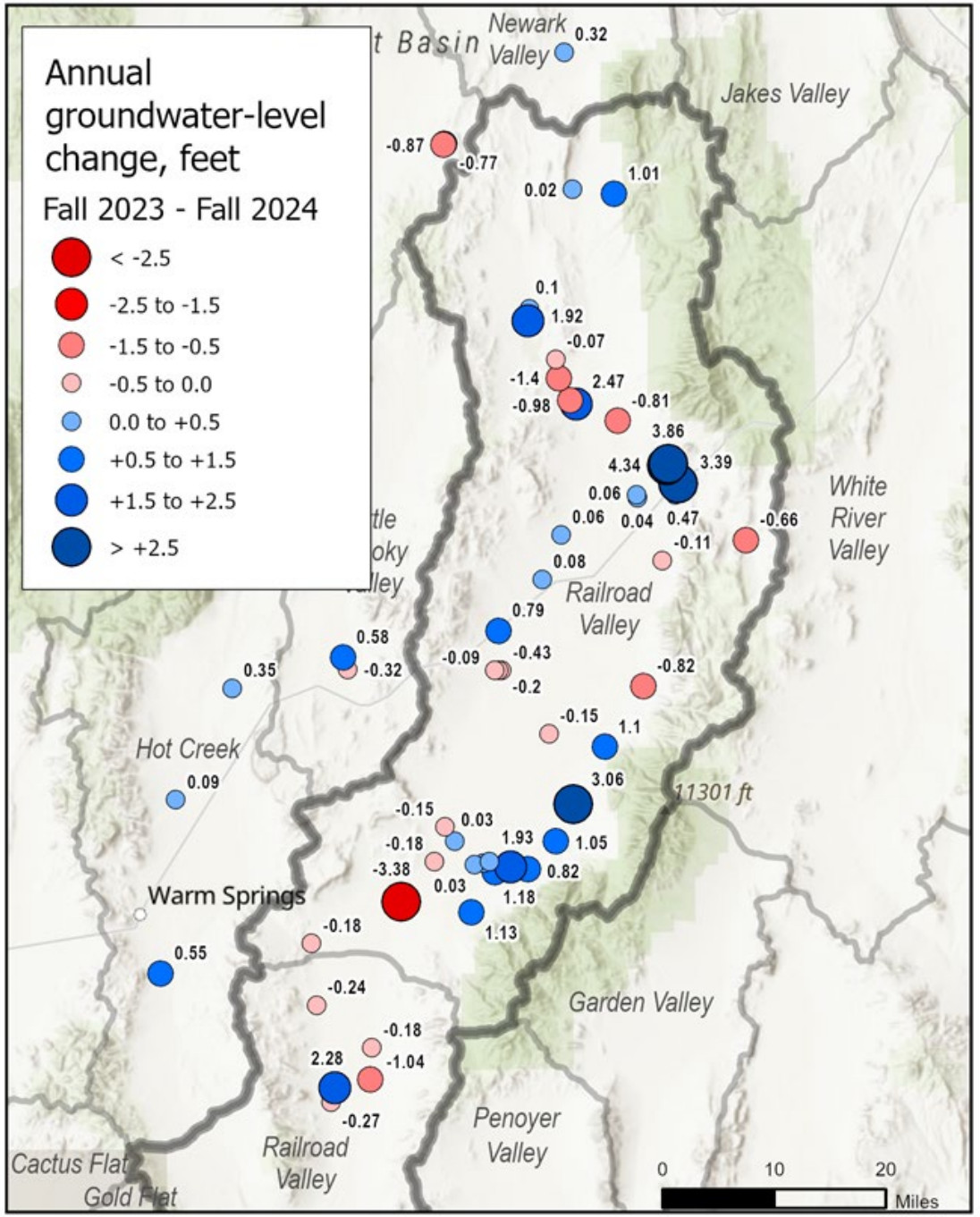


Preliminary Information-Subject to Revision.

Biannual Groundwater-level Monitoring

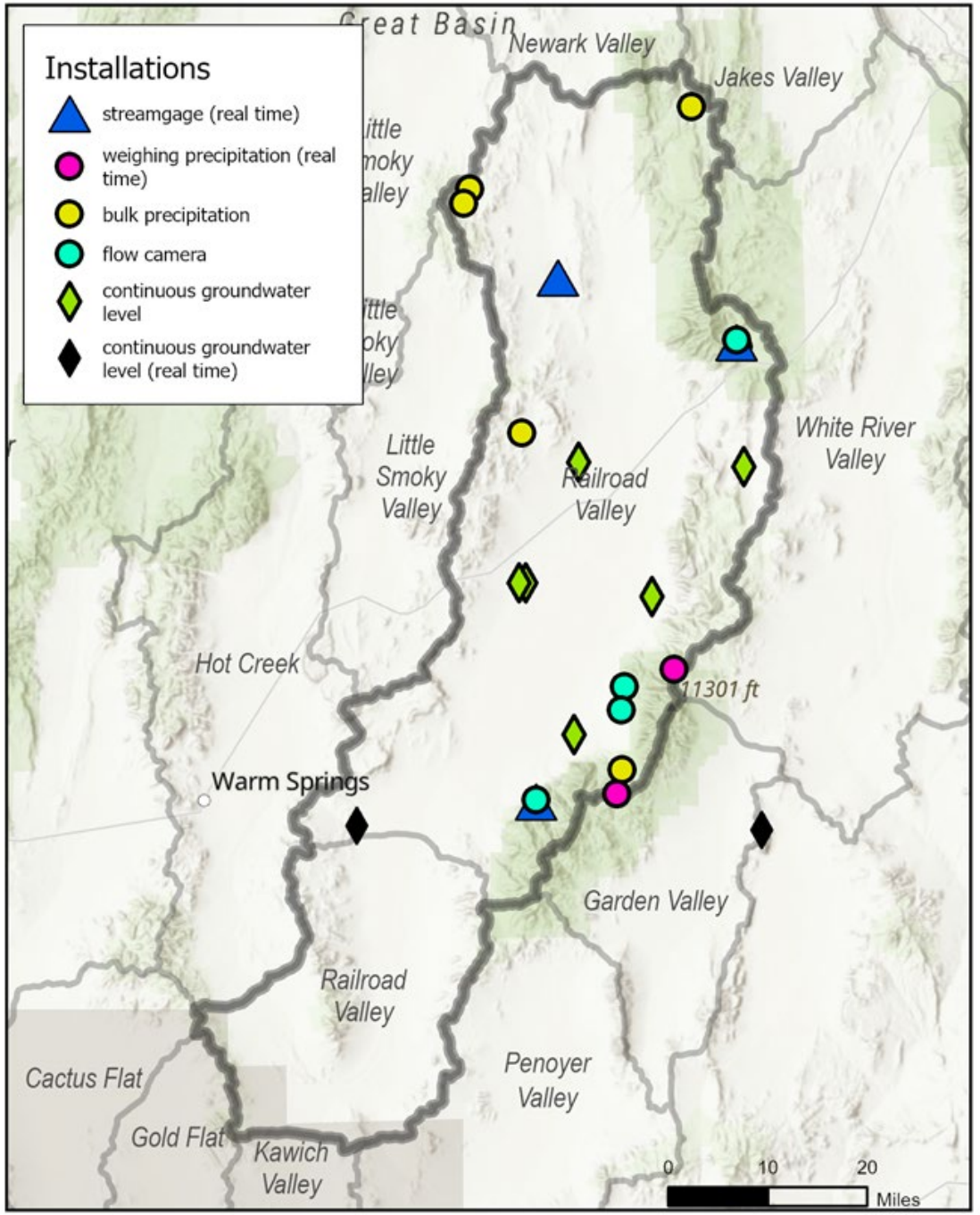
- Network of 55 wells, measured every Fall (Nov) and Spring (March)
- Generally, groundwater-levels increased between 2023-2024
- Largest groundwater-level rebounds occurred in eastern alluvial slopes (near mountain front)



Preliminary Information-Subject to Revision.

What else have we been doing?

- Equipment installations



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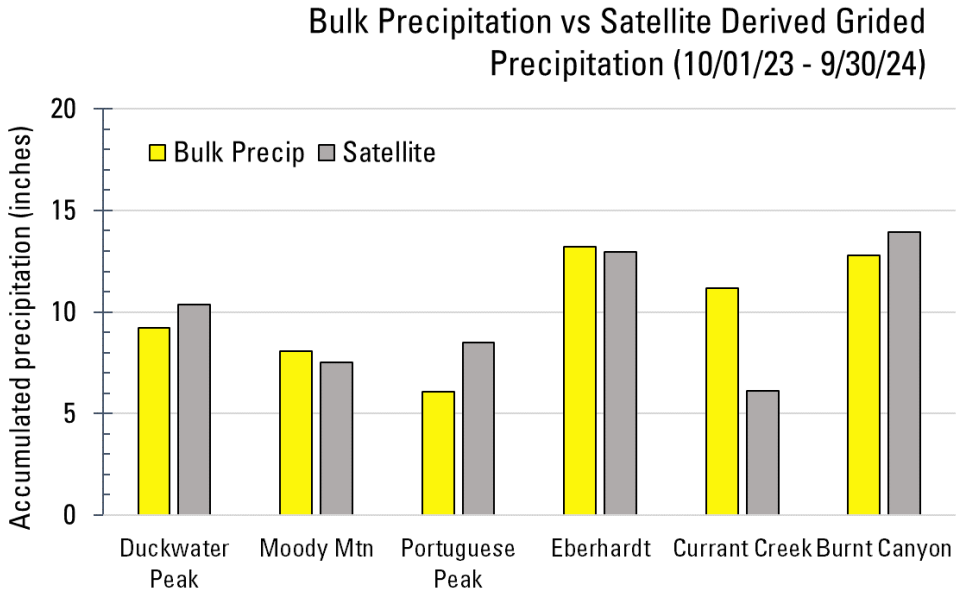
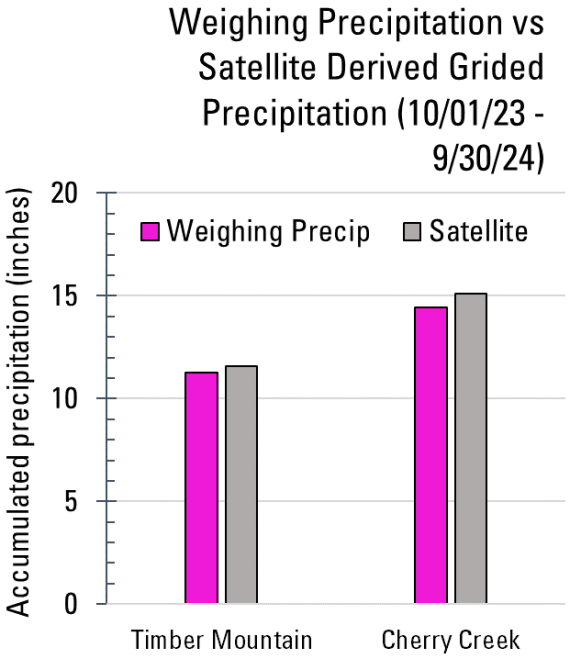
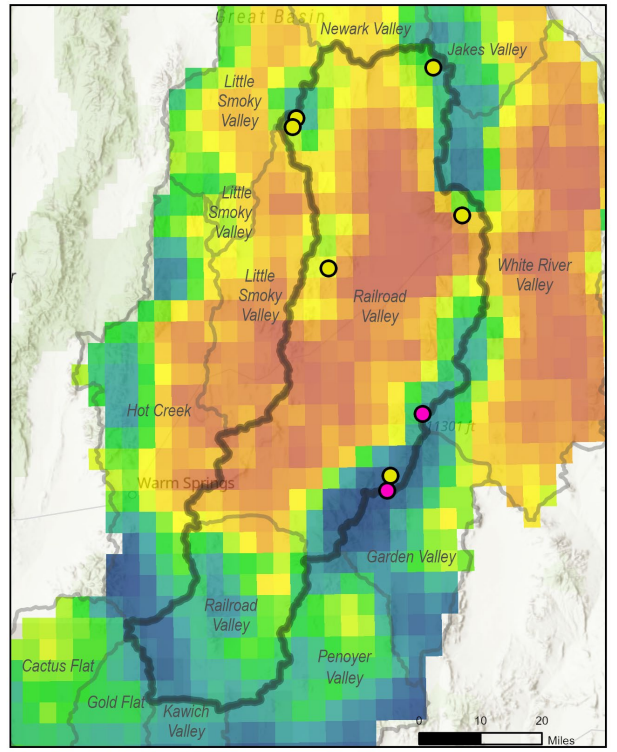
Precipitation







Grided Precipitation: Climate Hazards Group

InfraRed Precipitation with Station data (CHIRPS)

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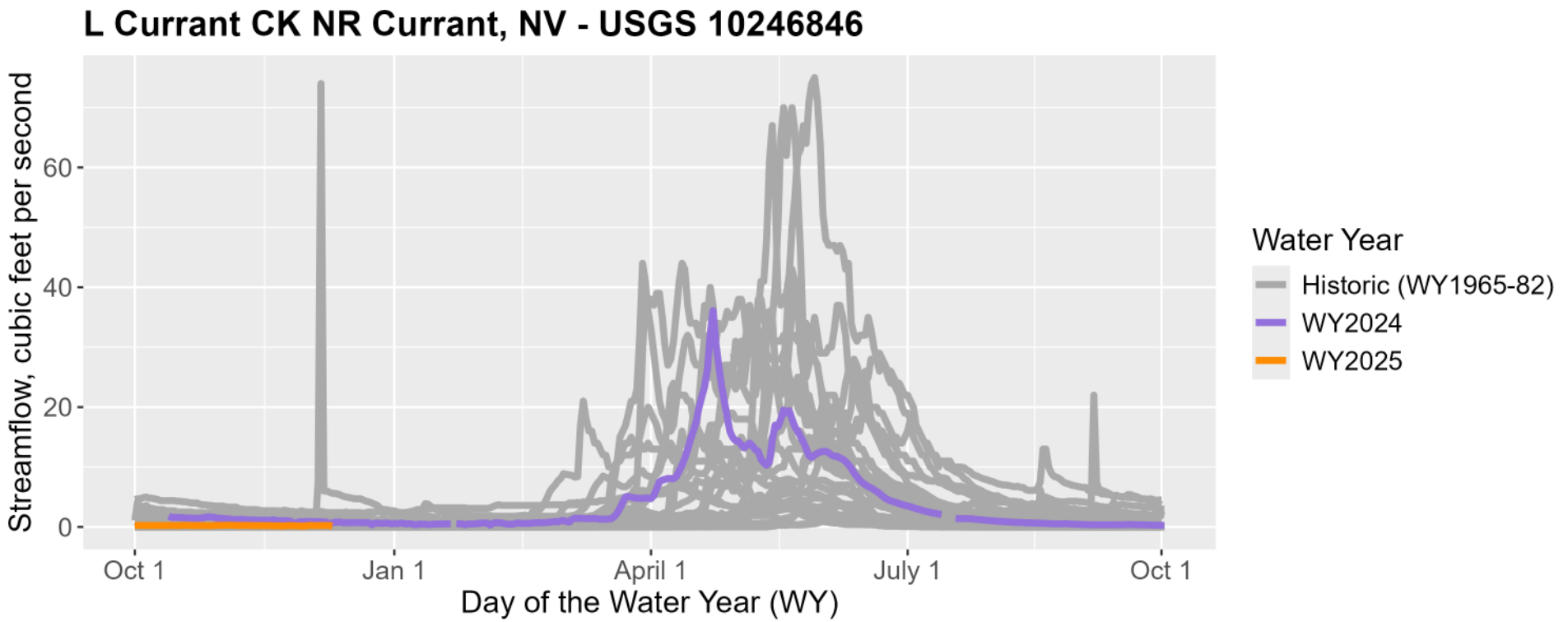
Streams



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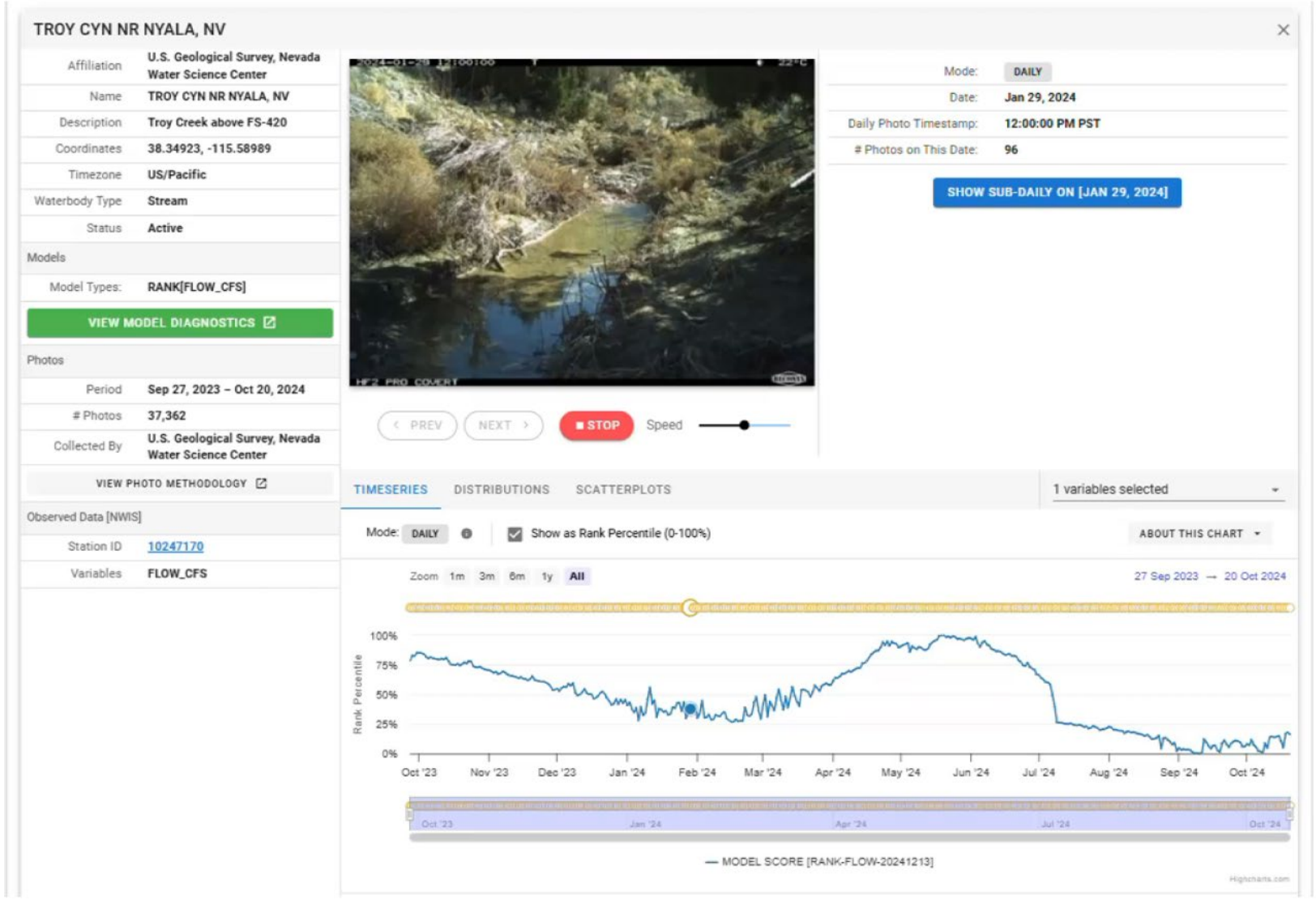
Streams


TROY CYN NR NYALA, NV
Affiliation
U.S. Geological Survey, Nevada Water Science Center
Name
TROY CYN NR NYALA, NV
Description
Troy Creek above FS-420
Coordinates
38.34923, -115.58989
Timezone
US/Pacific
Waterbody Type
Stream
Status
Active
Models
Model Types:
RANK[FLOW_CFS]
VIEW MODEL DIAGNOSTICS
Photos
Period
Sep 27, 2023 – Oct 20, 2024
Photos
37,362
Collected By
U.S. Geological Survey, Nevada Water Science Center
VIEW PHOTO METHODOLOGY
Observed Data [NWIS]
Station ID
10247170
Variables
FLOW_CFS
Mode:
DAILY
Date:
Jan 29, 2024
Daily Photo Timestamp:
12:00:00 PM PST
Photos on This Date:
96
SHOW SUB-DAILY ON [JAN 29, 2024]
PREV
NEXT
STOP
Speed
TIMESERIES
DISTRIBUTIONS
SCATTERPLOTS
1 variables selected
Mode:
DAILY
Show as Rank Percentile (0-100%)
ABOUT THIS CHART
Zoom
1m
3m
6m
1y
All
27 Sep 2023 → 20 Oct 2024
Rank Percentile
100%
75%
50%
25%
0%
Oct '23
Nov '23
Dec '23
Jan '24
Feb '24
Mar '24
Apr '24
May '24
Jun '24
Jul '24
Aug '24
Sep '24
Oct '24
— MODEL SCORE [RANK-FLOW-20241213]

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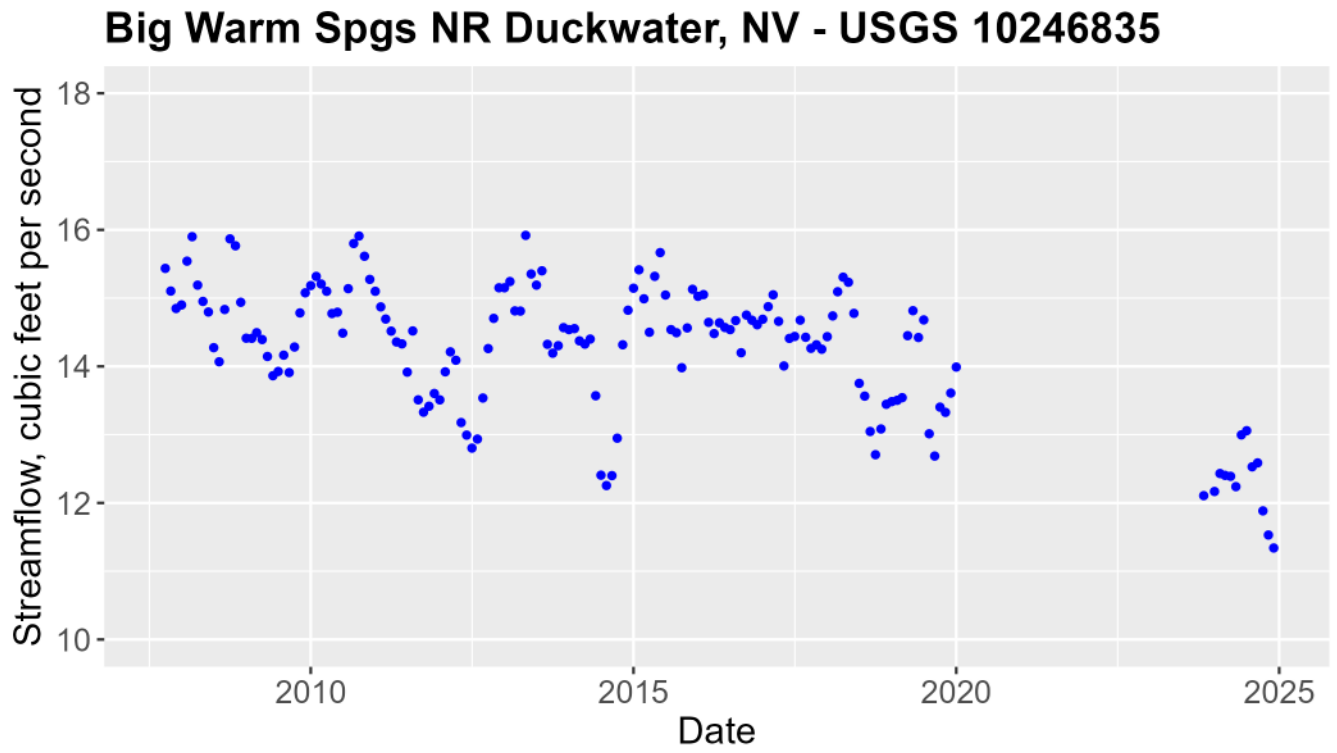
Springs



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USGS
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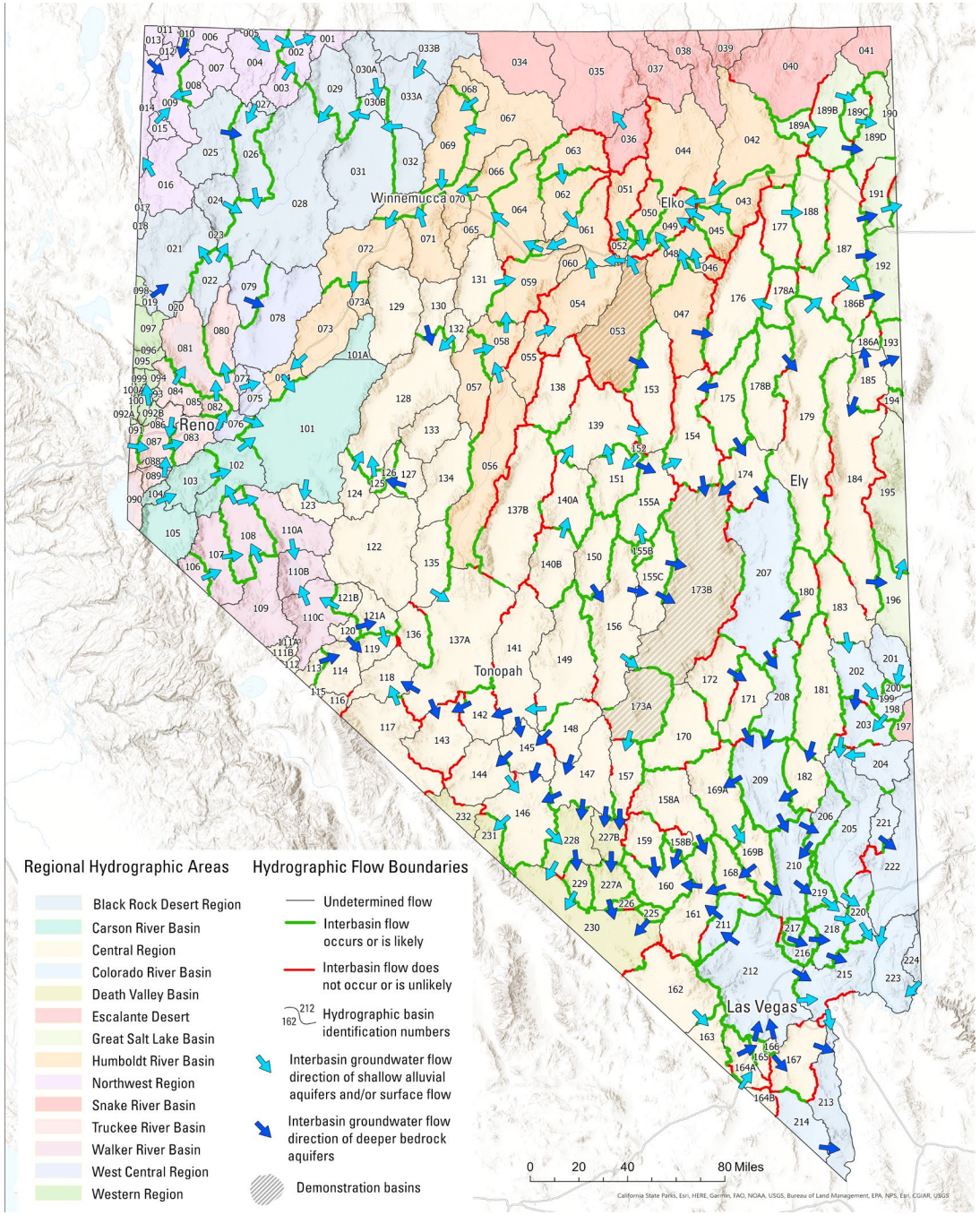
Nevada Water Resources Initiative: Investigating Interbasin Flow

Randy Paylor, rpaylor@usgs.gov

- In Nevada, subsurface flows between hydrographic basins are recognized across the state.
- Many interbasin flow estimates rely on old water budget components that are out of date.
- NDWR needs better data on interbasin flow in Nevada so the state can manage water resources using the best possible information.

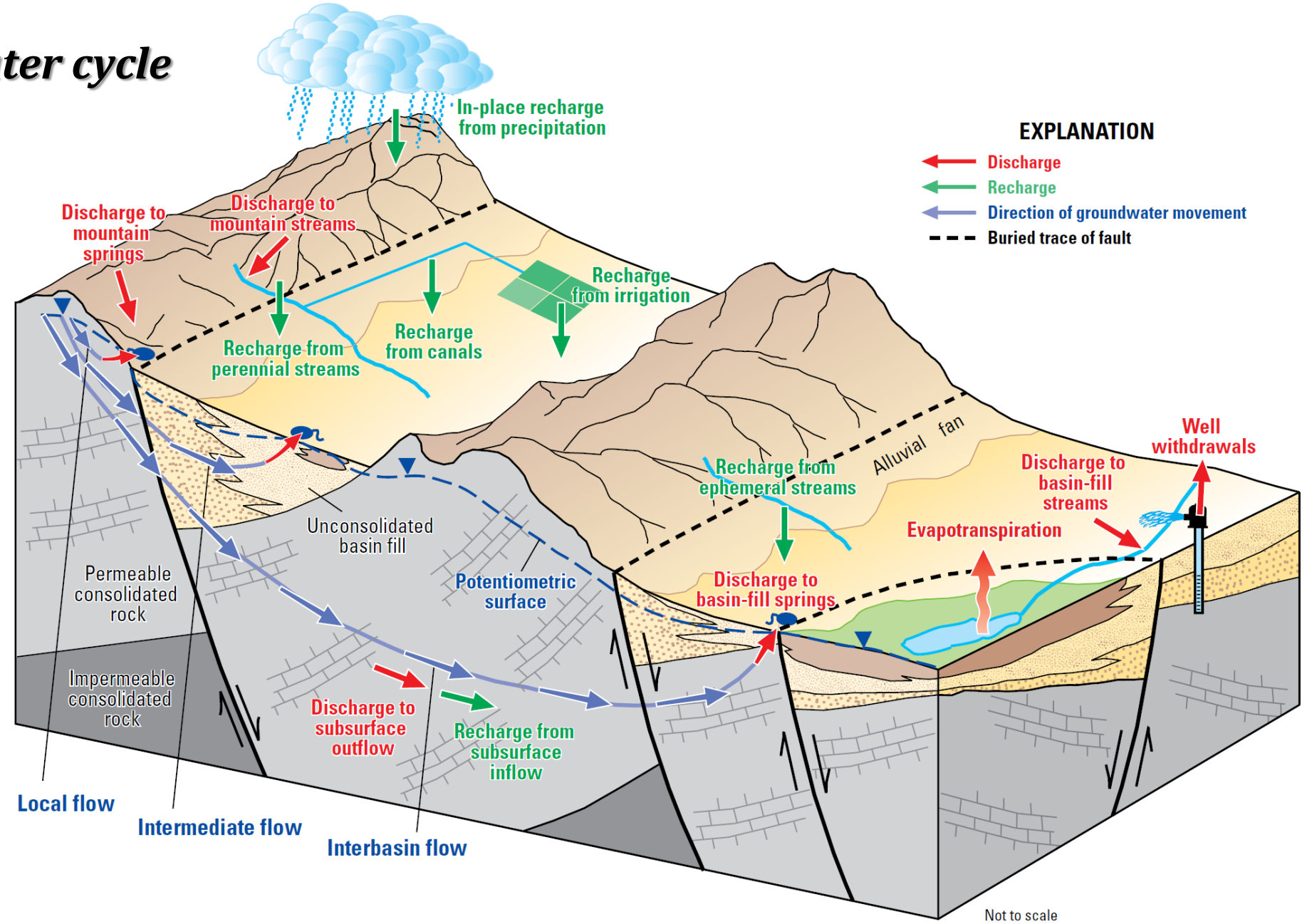


USGS/NDWR, 1960-1975; Rush, 1971; Harrill, 1988; Anning and Konieczki, 2005

U.S. Department of the Interior
U.S. Geological Survey

The Great Basin's water cycle

- Permeable limestone and volcanic rocks in mountain ranges can transmit water from one closed basin to another
- Groundwater flow between basins can take decades to centuries or more



Not to scale
Heilweil and Brooks, 2010.

USGS

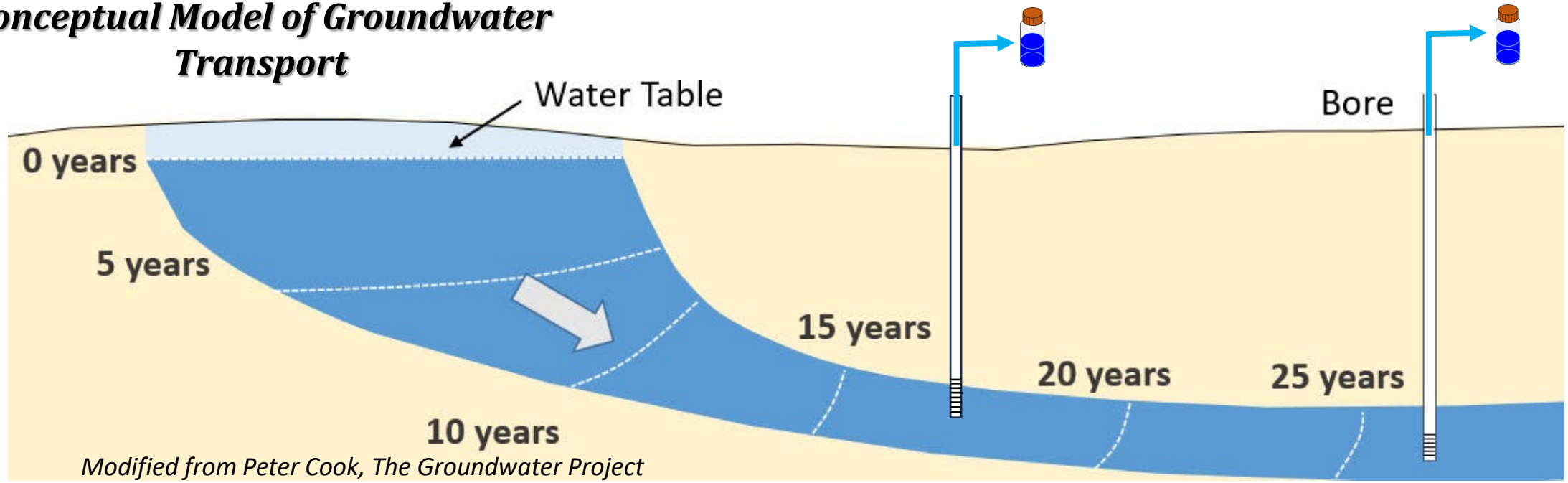
Sampling for Environmental Tracers

Taking water samples for environmental tracers allow us to:

1. Estimate **groundwater movement** using age tracers like carbon 14 and dissolved gasses**.**
2. Figure out **recharge temperature and elevation** using dissolved noble gasses.
3. Identify **recharge sources (snowmelt or monsoon)** from oxygen and hydrogen isotopes.
4. Evaluate **lithology along groundwater flow paths** using geochemistry (dissolved elements) and strontium isotopes.

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

Conceptual Model of Groundwater Transport



Modified from Peter Cook, The Groundwater Project

Interbasin flow – Railroad Valley

- Sampling is targeting estimated flow paths from previous studies.
- Estimates of interbasin flow from past studies vary, and our sampling will figure out if these connections are likely.

Estimated interbasin flow direction

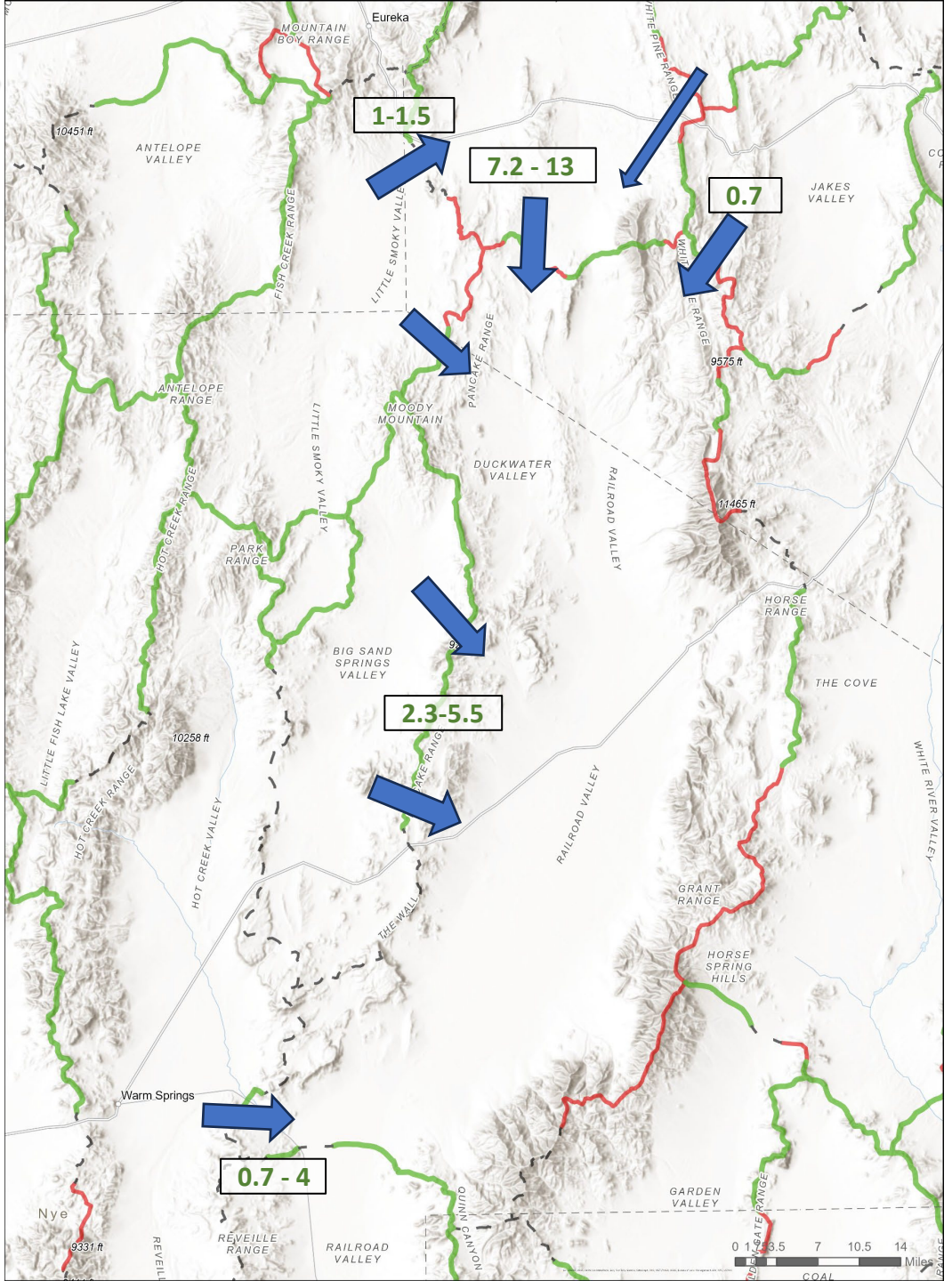
0.7 - 4

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.

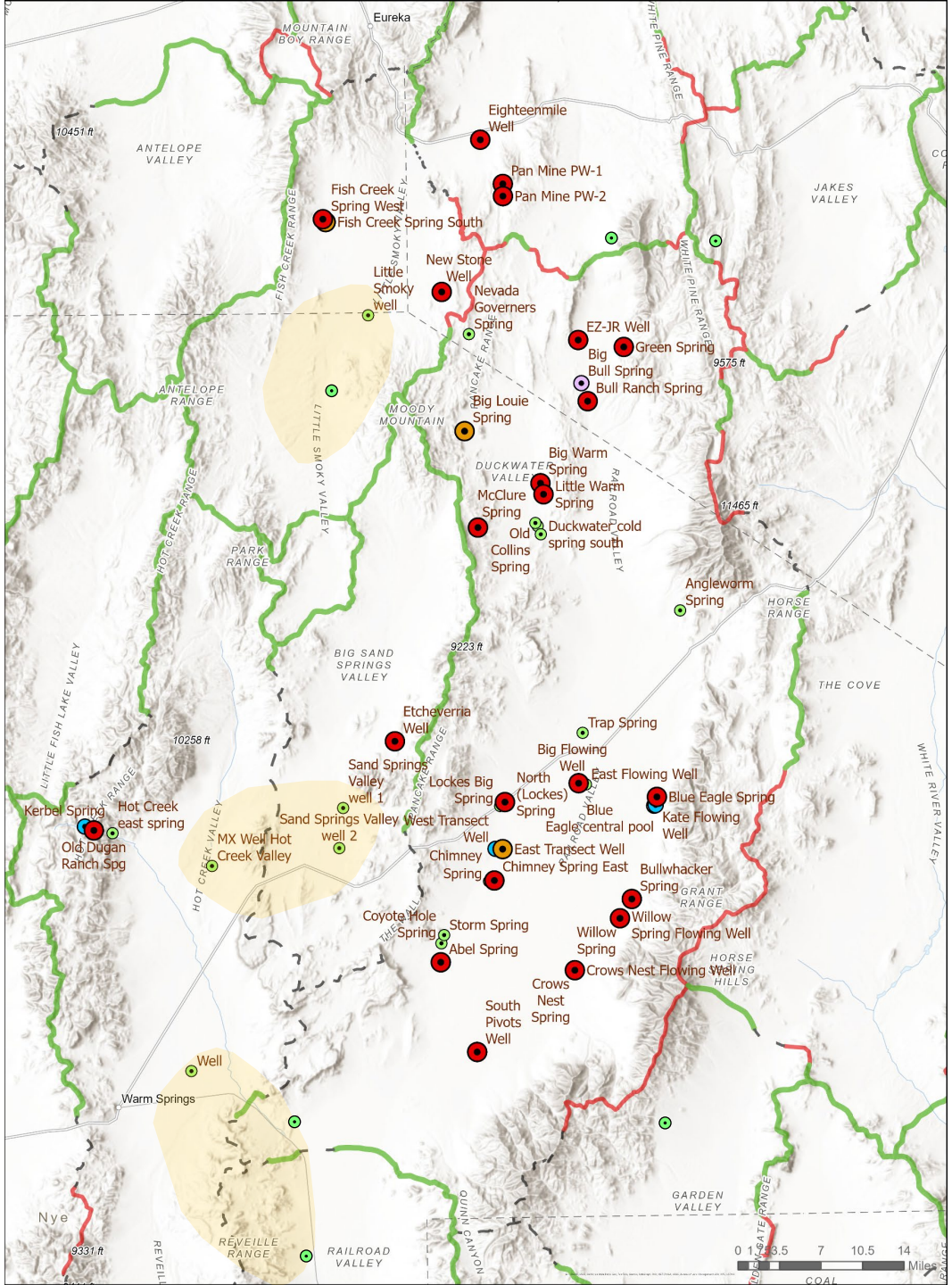
Eakin and others (1951); Rush and Everett (1966); Van Denburgh and Rush (1974); Harril and other (1988); Prudic and others (1995); Nichols (2001); Lopes and Evetts (2004)

USGS

Sites sampled – Railroad Valley area

- 29 sites have been sampled in Railroad Valley and surrounding areas so far.
- Locations in green are springs or wells we have visited and may still need to sample.

- Full sample suite
- Full suite minus dissolved gas
- Stable isotope samples
- Field parameters
- Reconned locations



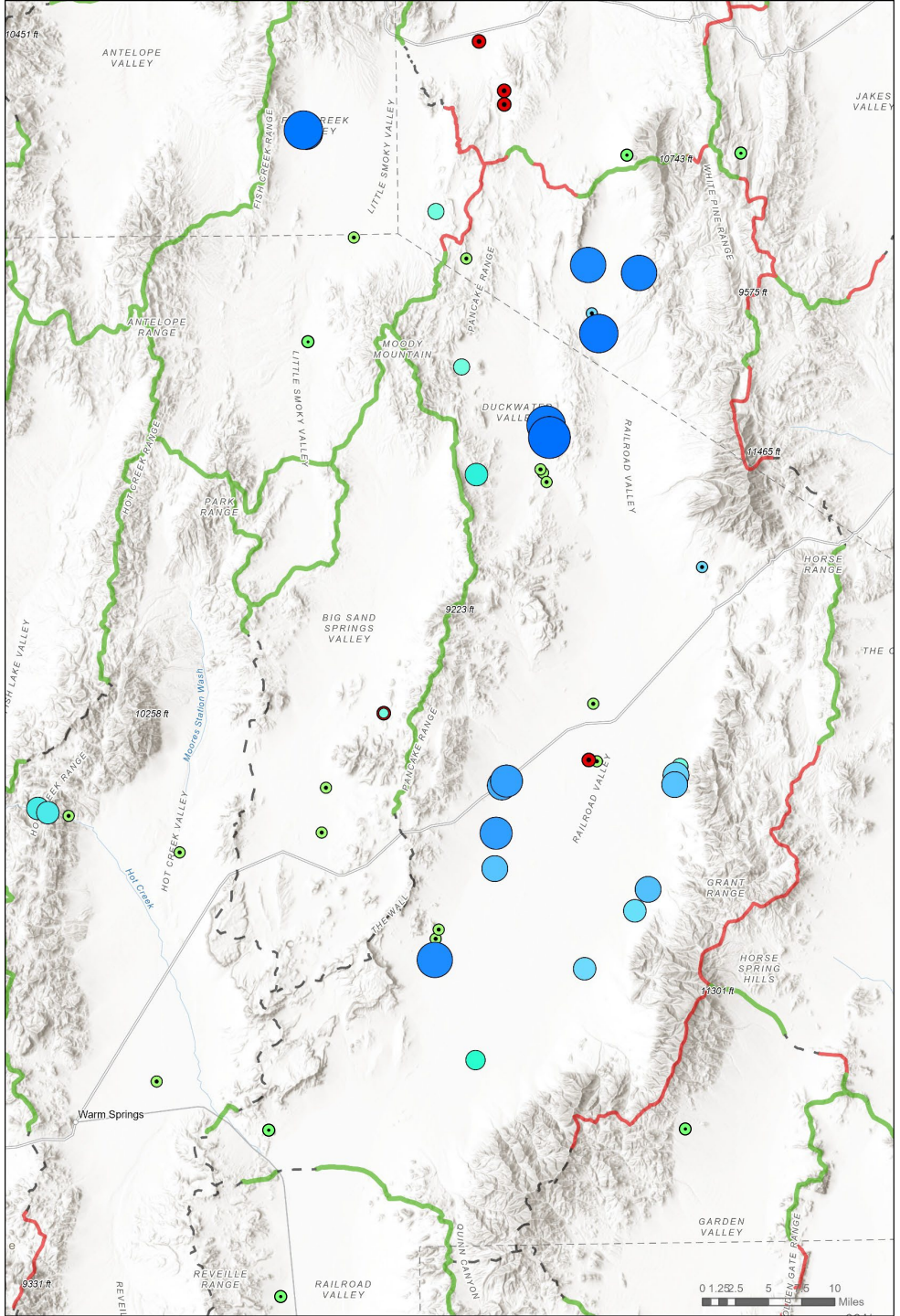
Example results– Railroad Valley area

- Oxygen and hydrogen isotopes of water can be used to identify groundwater source areas.
- Preliminary results suggest distinct sources for water in north, southwest, and southeast Railroad Valley.

Oxygen isotopes

Lighter - higher elevation or more northern source

Heavier - lower elevation or more southern source



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References

Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS), https://www.chc.ucsb.edu/data/chirps

Heilweil, V.M., and Brooks, L.E., eds., 2011, Conceptual model of the Great Basin carbonate and alluvial aquifer system: U.S. Geological Survey Scientific Investigations Report 2010-5193, 191 p.

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THE NEVADA WATER INITIATIVE

PROJECT ACTIVITIES

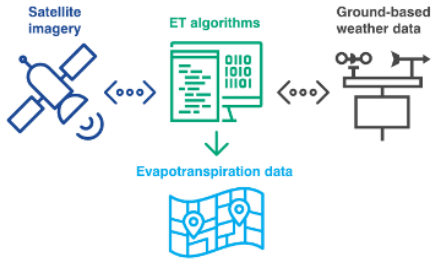
- DRI is developing and supporting statewide updates of
  - Agricultural Consumptive Use Inventory and Database
  - Groundwater Discharge Database
  - Meteorological and Hydrologic Monitoring
  - Recharge and Water Availability

- *This information is fundamental for ensuring adequate water supplies, supporting economic development, and protecting existing rights and the environment.*

Railroad Valley

CONSUMPTIVE USE INVENTORY & DATABASE

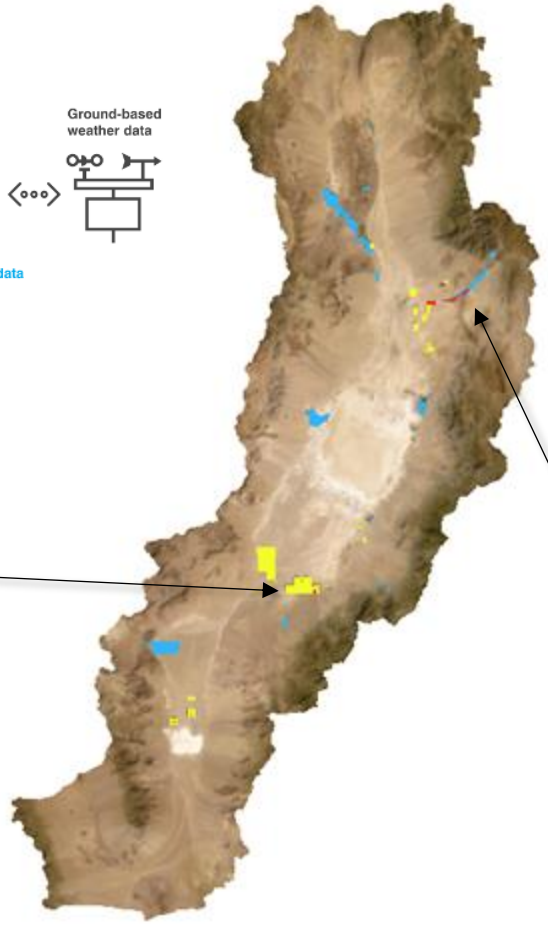
- Comprehensive Consumptive Use Database
  - Through time (Landsat satellite archive 1985-pres.)
  - Field boundaries
  - Irrigation status mapping
  - Irrigation system type
  - Water source mapping
  - Water Use Database

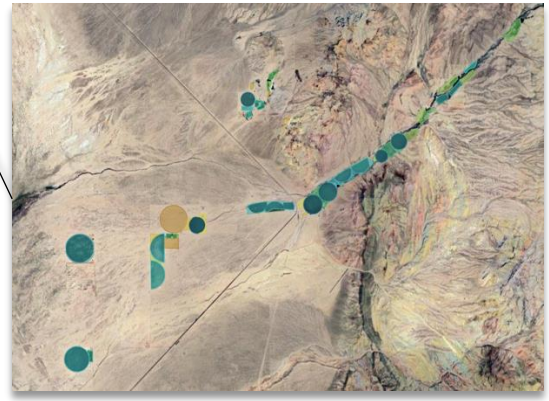


Railroad Valley

1990

2022





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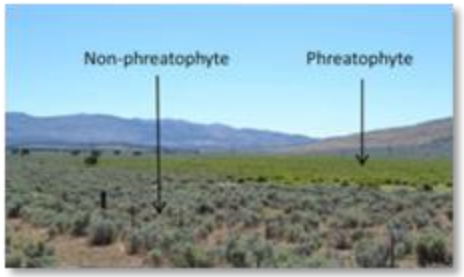
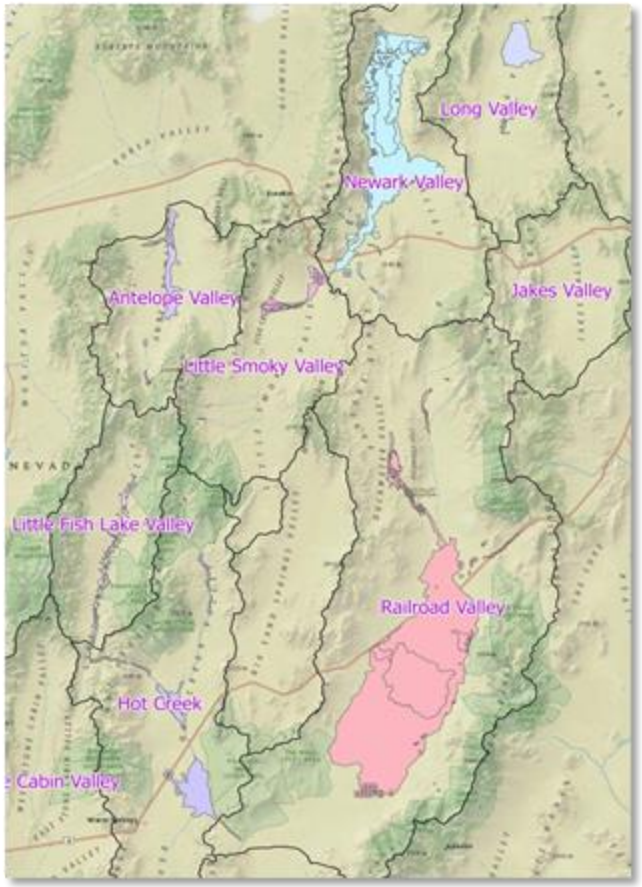
PHREATOPHYTE PLANT GROUNDWATER USE



- Update Groundwater Discharge and Water Budgets
  - Groundwater discharge from phreatophytes is used as a basis for determining groundwater budgets
  - Satellite and aerial imagery and field mapping used to revise the extent and amount of groundwater discharge
  - Constrain recharge estimates
  - Compare to previous estimates



"….discharge is of much more pragmatic concern than recharge."
- John Bredehoeft - USGS

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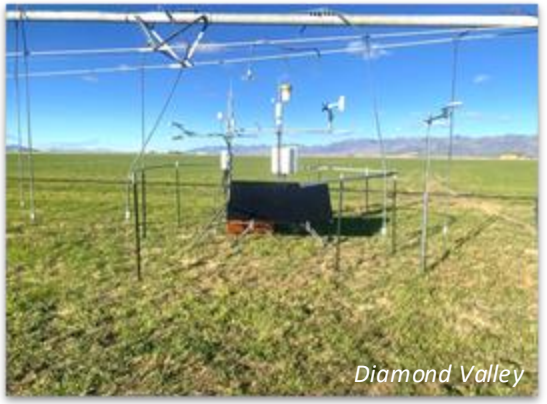
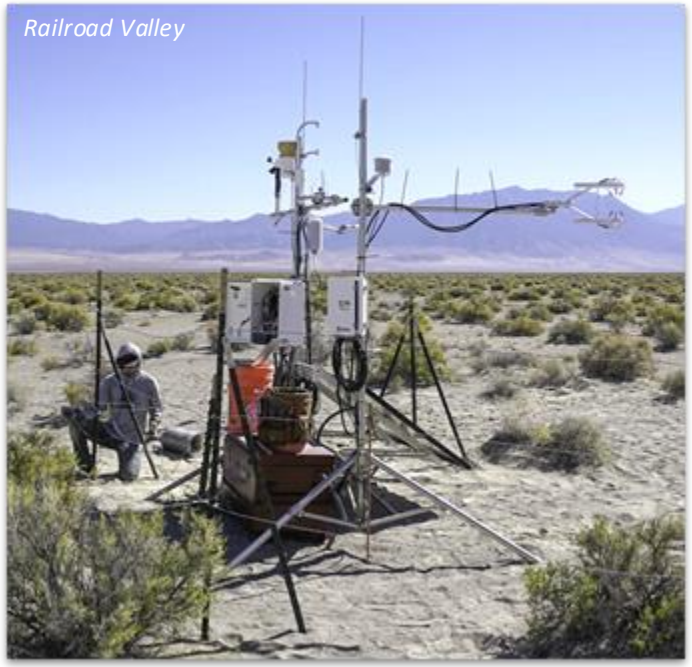
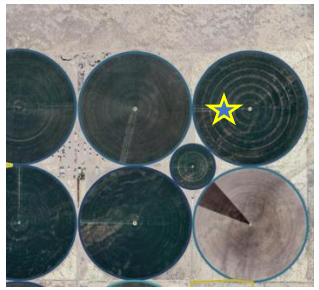
METEOROLOGICAL DATA AND MONITORING

- Monitoring weather and water use to compare with satellite-based water use, and support on-farm conservation, irrigation scheduling, and water use reporting.
- Upgrading Nevada Integrated Climate & Evapotranspiration Network (https://NICENet.dri.edu)







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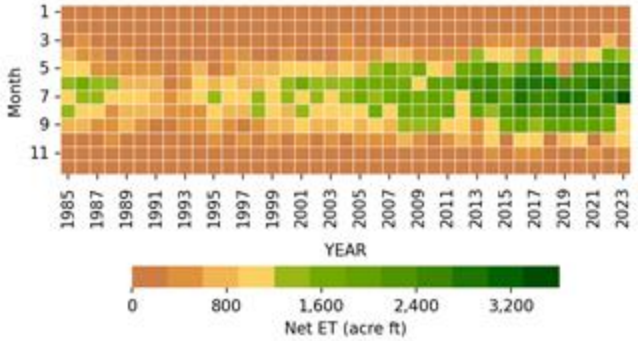
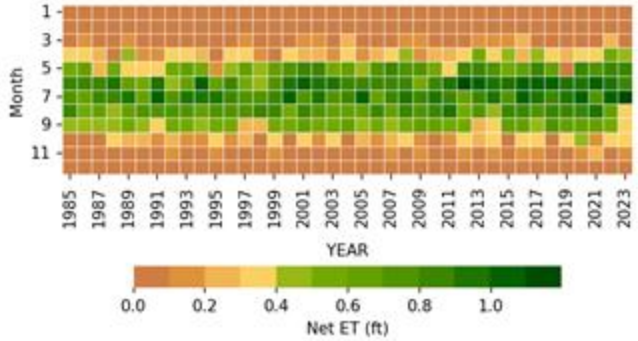
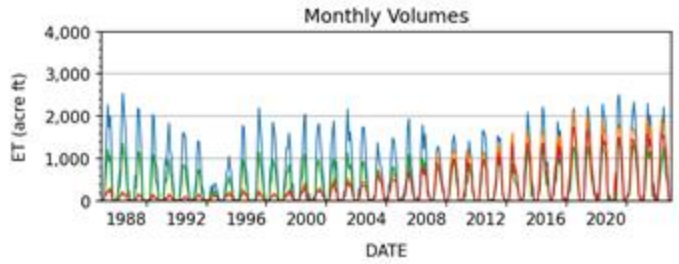
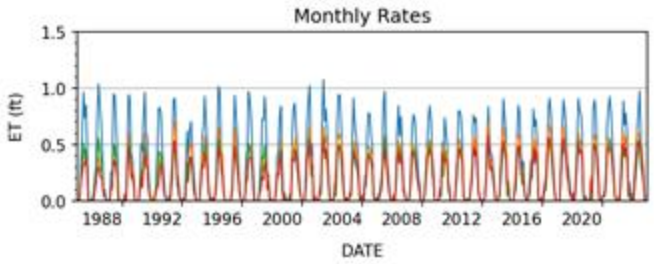
* PRELIMINARAY RESULTS *
CONSUMPTIVE USE INVENTORY & DATABASE

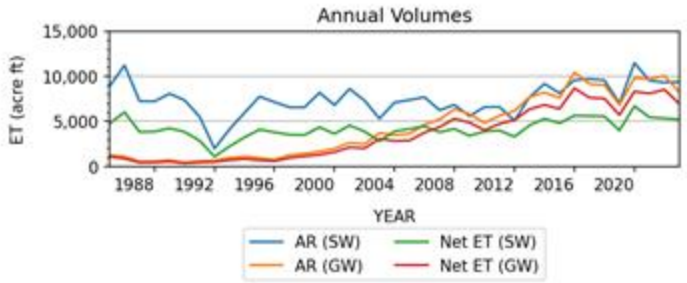
Railroad Valley North

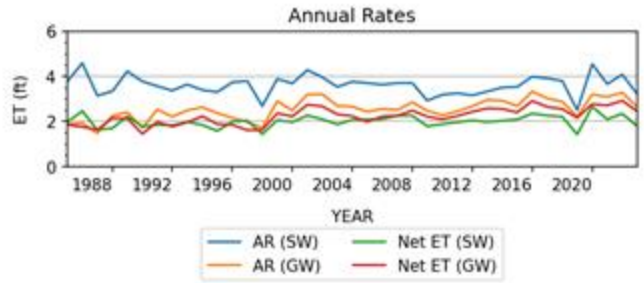


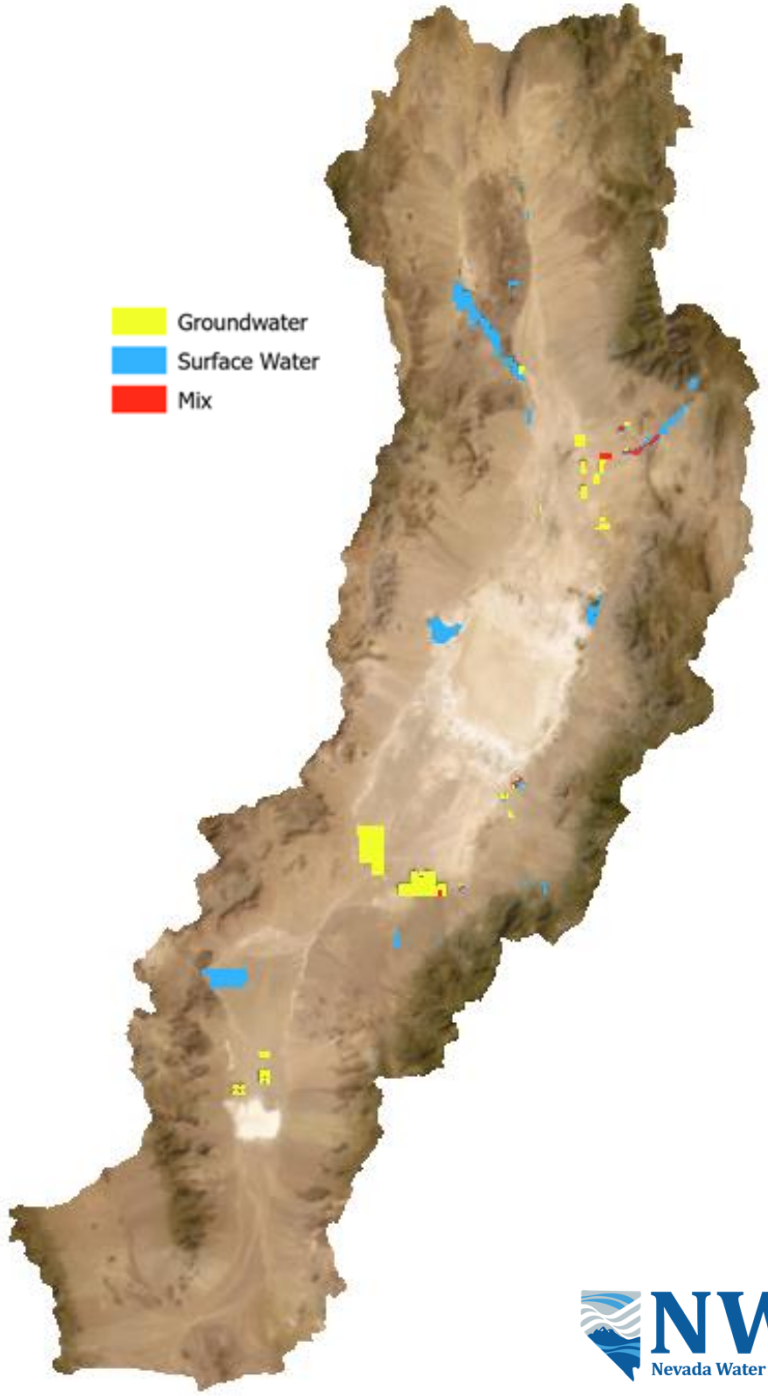












Mean groundwater use by period

	Net ET (acre-ft)	AR (acre-ft)	Net ET (ft)	AR (ft)
1985-1994	611	789	1.89	2.15
2012-2023	7,169	8,566	2.59	2.90

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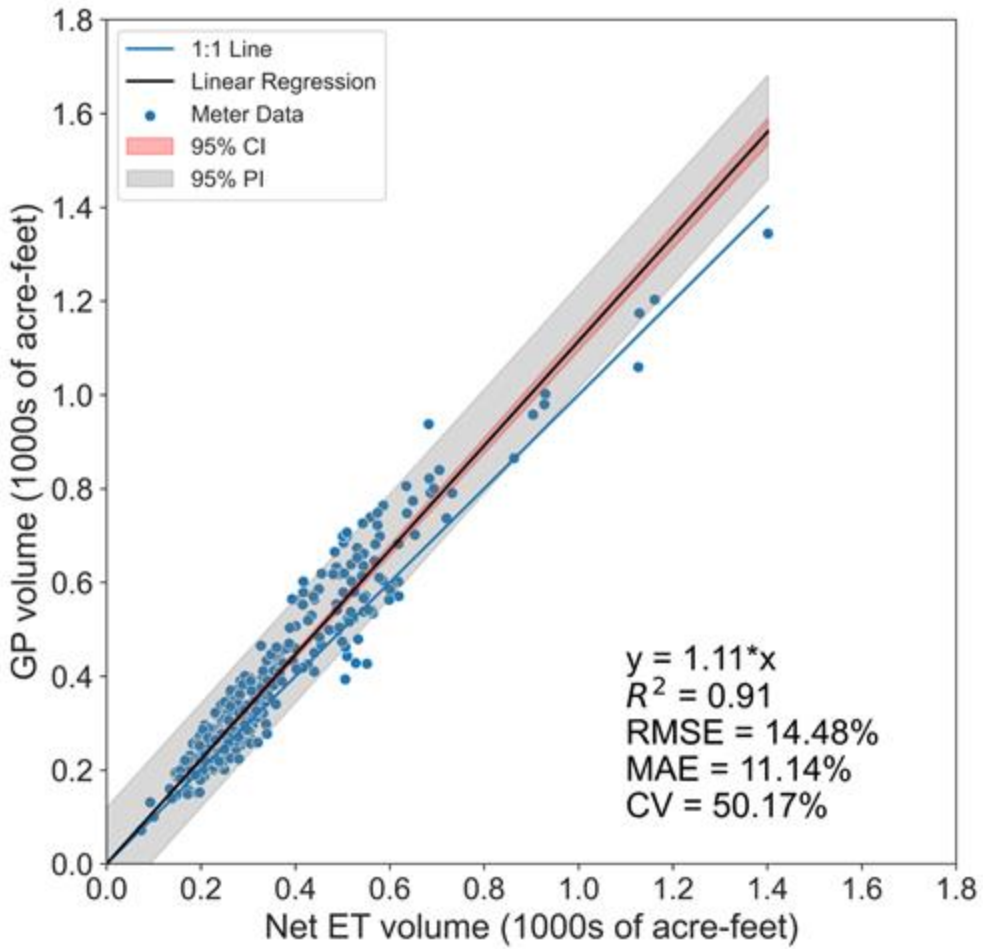
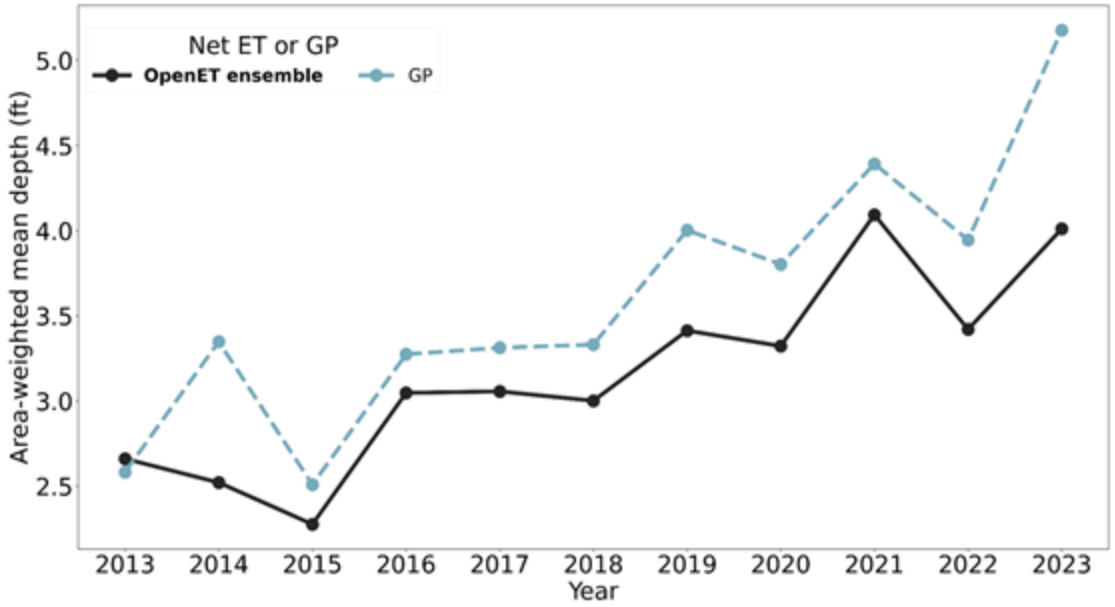
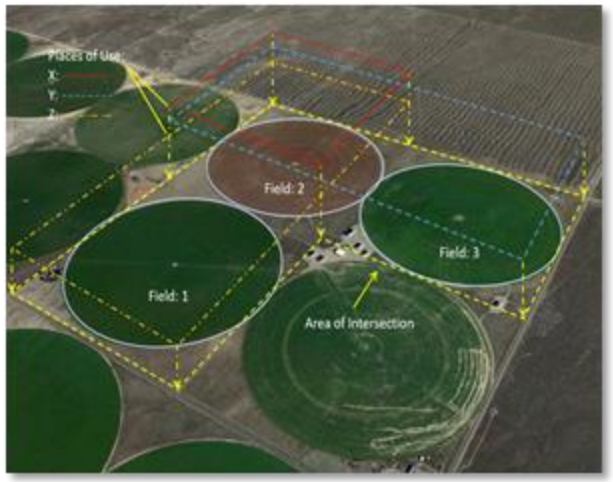
* PRELIMINARAY RESULTS *
CONSUMPTIVE USE INVENTORY & DATABASE

Diamond Valley



Humboldt River Basin





Diamond Valley

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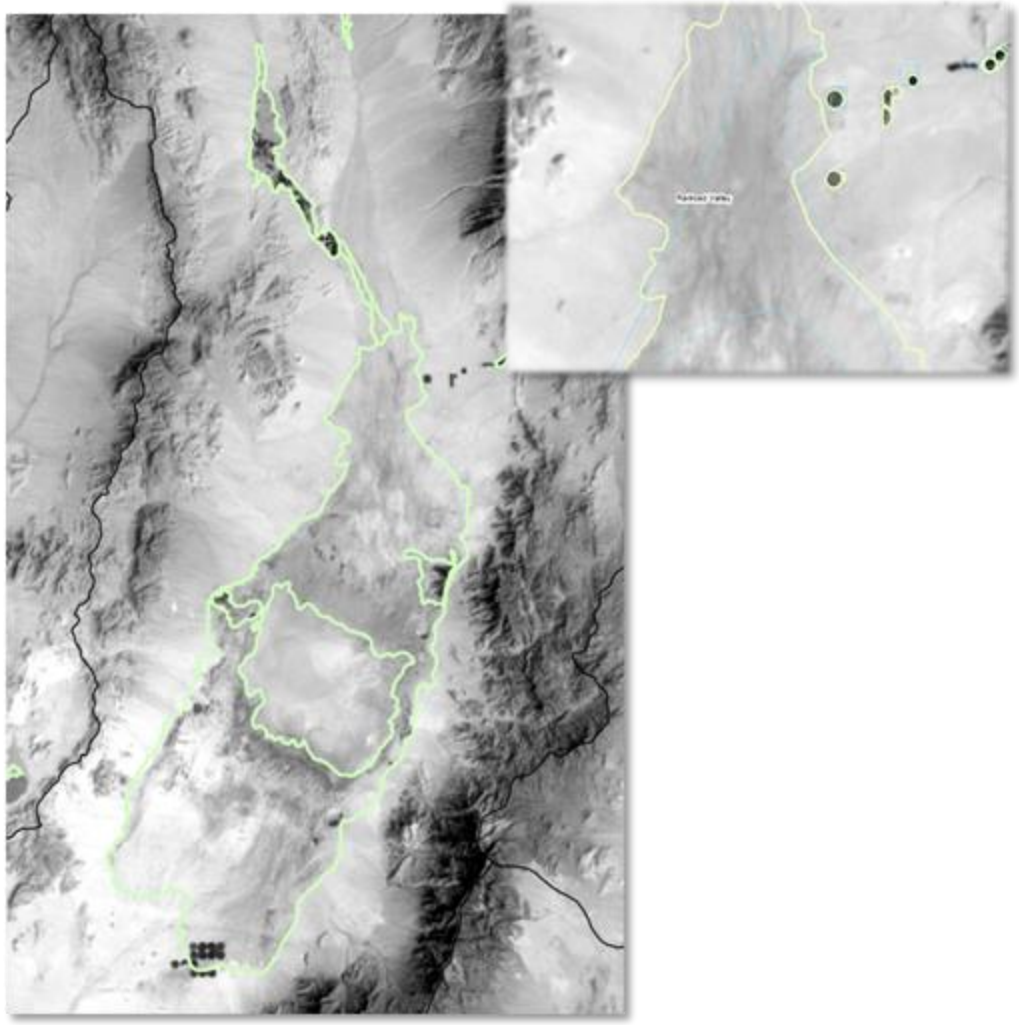
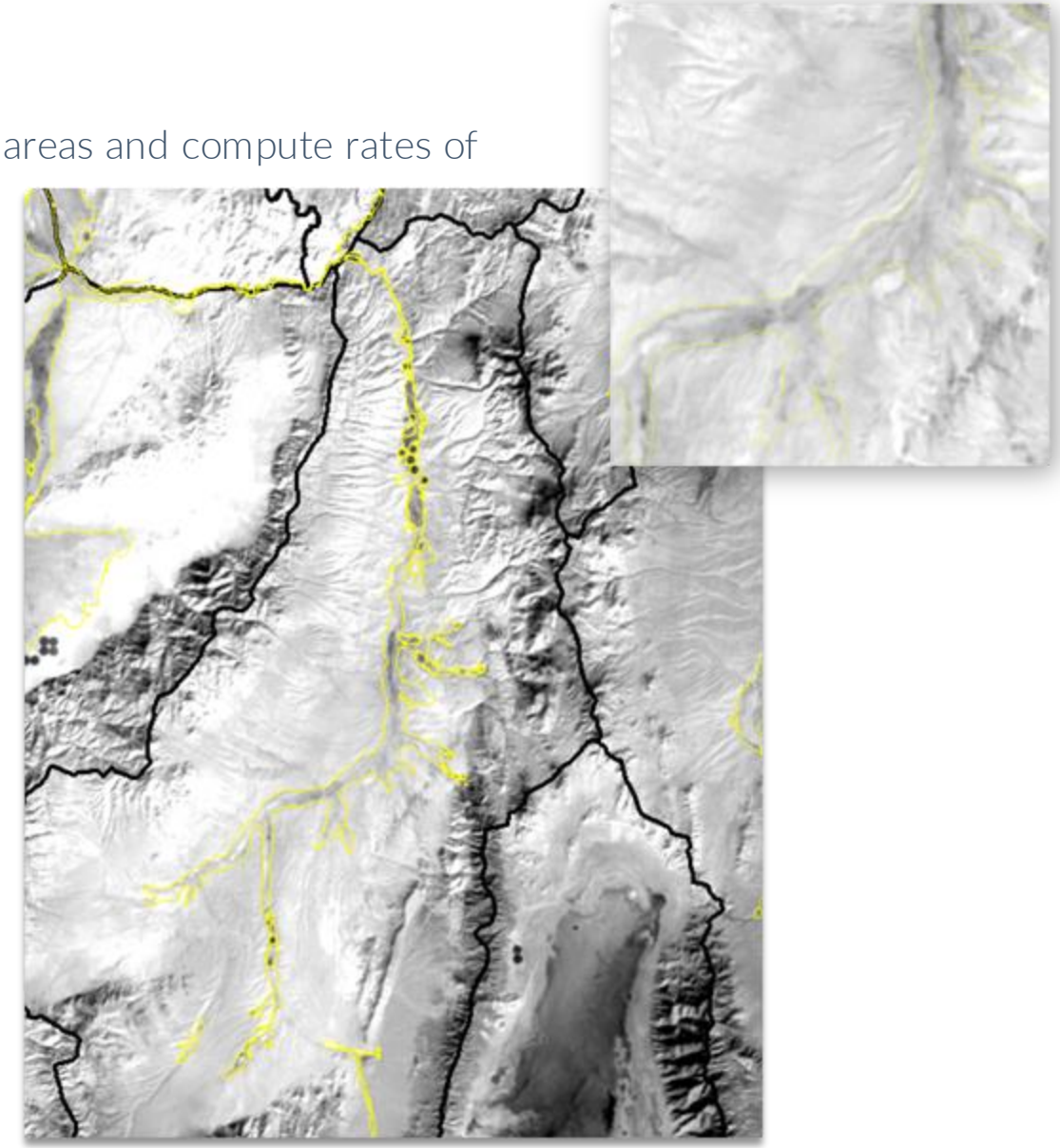
* PRELIMINARY RESULTS* GROUNDWATER DISCHARGE

- Update Groundwater Discharge and Water Budgets
  - Satellite and aerial imagery used to define groundwater discharge areas and compute rates of groundwater use by phreatophyte plants



Railroad Valley



Pine Valley

* PRELIMINARY RESULTS* GROUNDWATER DISCHARGE

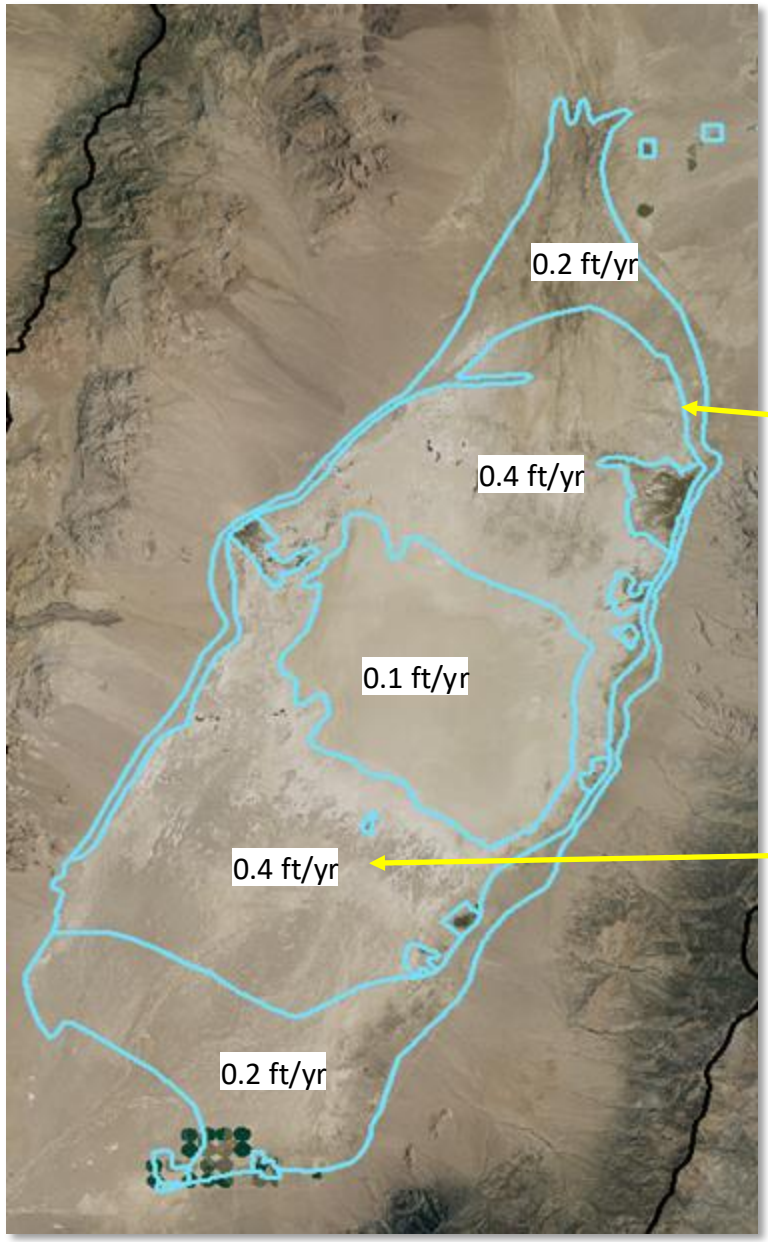
- Update Groundwater Discharge and Water Budgets
  - Preliminary updates compared to previous work

Railroad Valley Recon Report 60

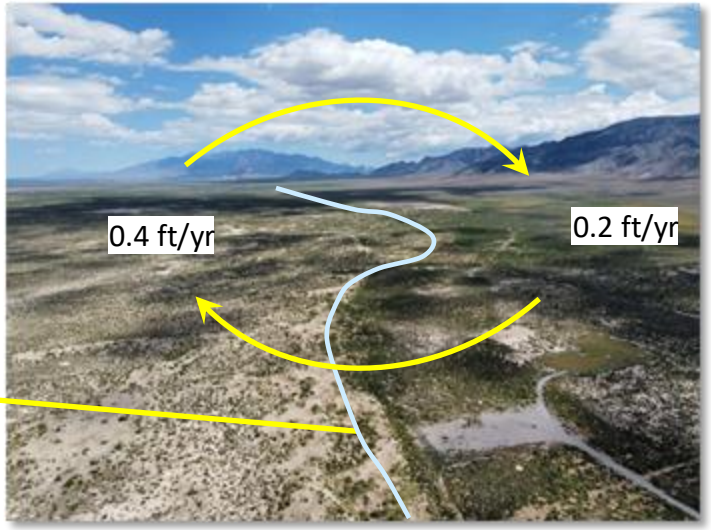
Table 8.--Estimated average annual ground-water evapotranspiration[1/]

Type of water loss	Area (acres)	Depth to water (feet)	Evapotranspiration Feet per year	Evapotranspiration Acre-feet per year
NORTHERN RAILROAD VALLEY				
Playa (bare soil)	38,000	0-10	0.1	3,800
Greasewood, rabbitbrush, saltbush, moderately dense to scattered	68,000	10-50	0.2	14,000
Saltgrass, with or without above phreatophytes, moderately dense to scattered	110,000	1-10	0.4	44,000
Meadowgrass, tules, willow, and other wet-area phreatophytes (includes areas of meadowgrass irrigated mostly with springflow)	12,000	0-5	1.5	18,000
Free-water surface	400	--	4	1,600
Total (rounded)	227,000	--	--	80,000

Recon Recharge ~ 55,000 – 60,000 ac-ft



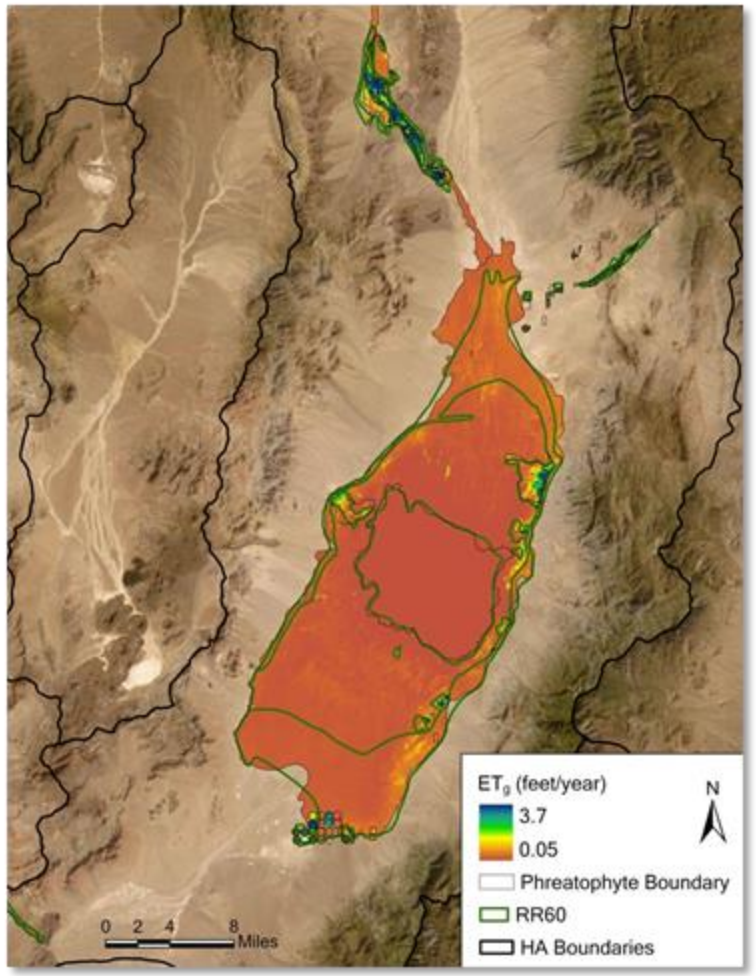
Van Denburgh & Rush, 1974

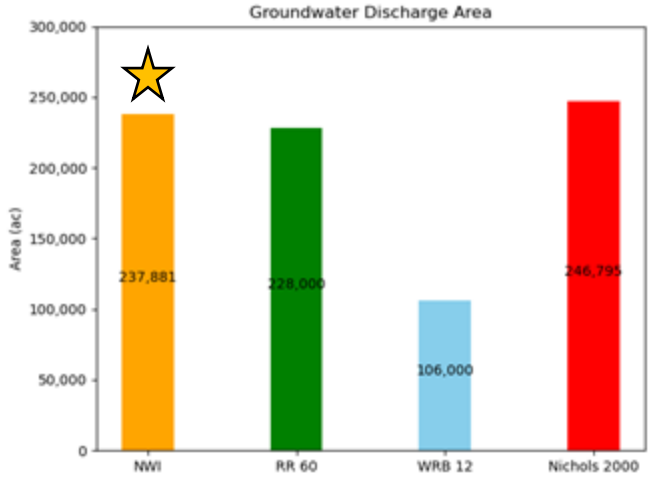


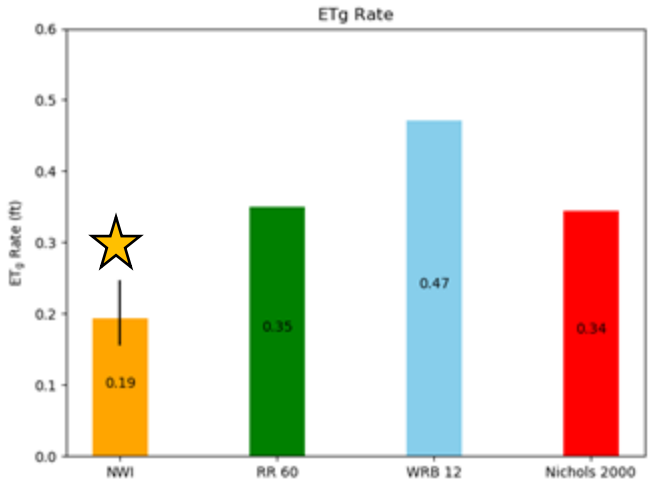
Railroad Valley

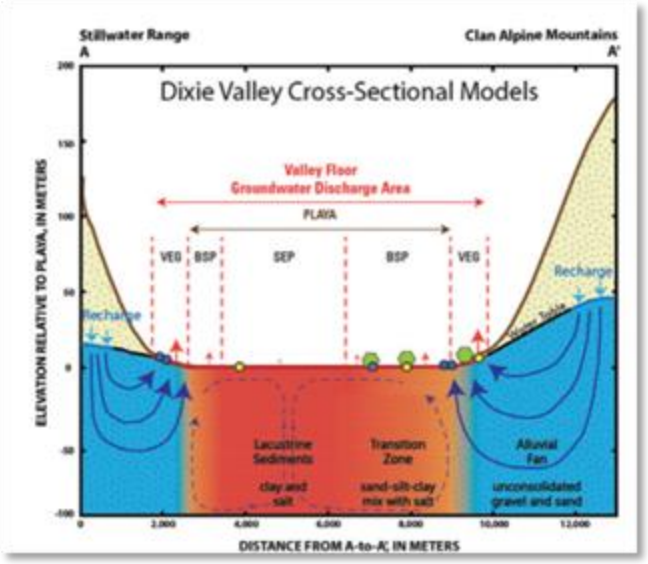
* PRELIMINARY RESULTS* GROUNDWATER DISCHARGE

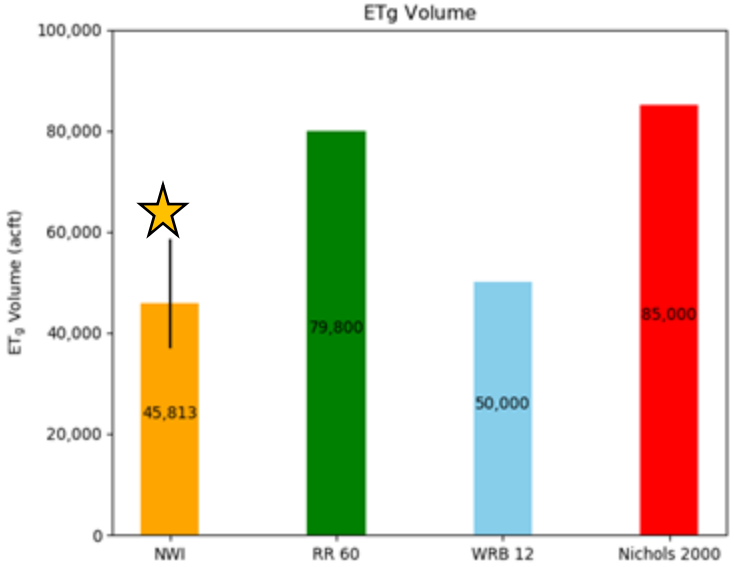
- Update Groundwater Discharge and Water Budgets
  - Preliminary updates compared to previous work







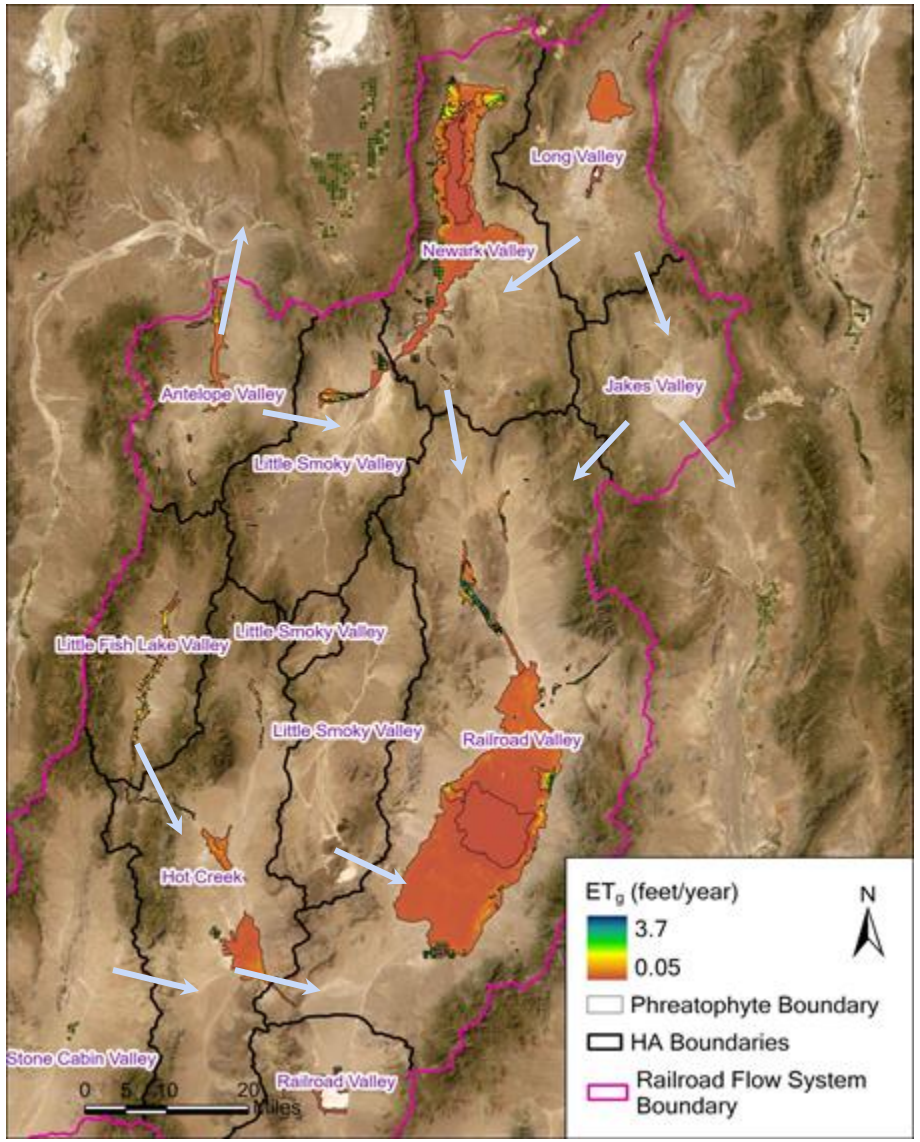




Jackson et al. (2018) - Groundwater

* PRELIMINARY RESULTS* GROUNDWATER DISCHARGE

- Update Groundwater Discharge and Water Budgets
  - Preliminary updates compared to previous work

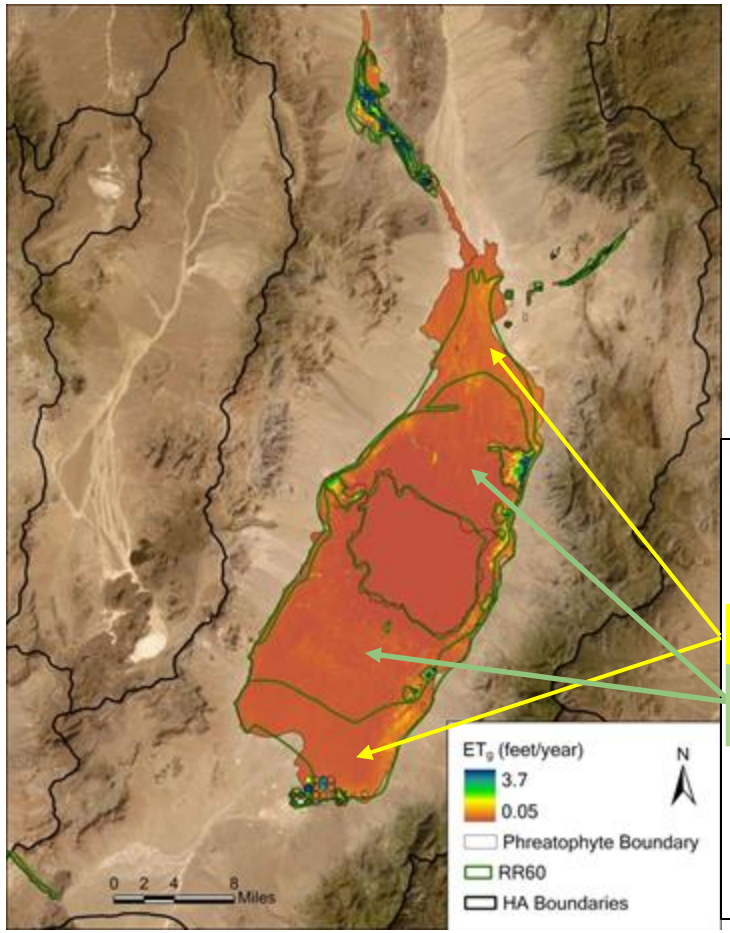


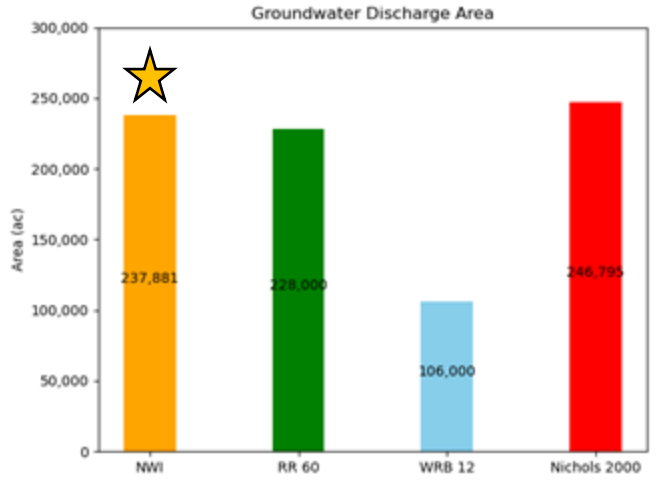
Preliminary groundwater discharge as percentage of mean annual precipitation

Hydrographic Area	Discharge Area (ac)	ETg (acft)	PPT (acft)	%
150 Little Fish Lake Valley	8,055	5,756	276,928	2.08
151 Antelope Valley	10,693	4,563	254,653	1.79
154 Newark Valley	97,402	30,848	531,469	5.80
155A Little Smoky Valley	6,038	3,304	300,806	1.10
156 Hot Creek	23,807	9,190	477,608	1.92
173A Railroad Valley South	2,841	308	294,596	0.10
173B Railroad Valley North	237,881	45,813	1,128,689	4.06
175 Long Valley	15,830	4,733	452,463	1.05
Total	402,547	104,514	3,717,213	2.81

* PRELIMINARY RESULTS* GROUNDWATER DISCHARGE

- Update Groundwater Discharge and Water Budgets
  - Preliminary updates compared to previous work





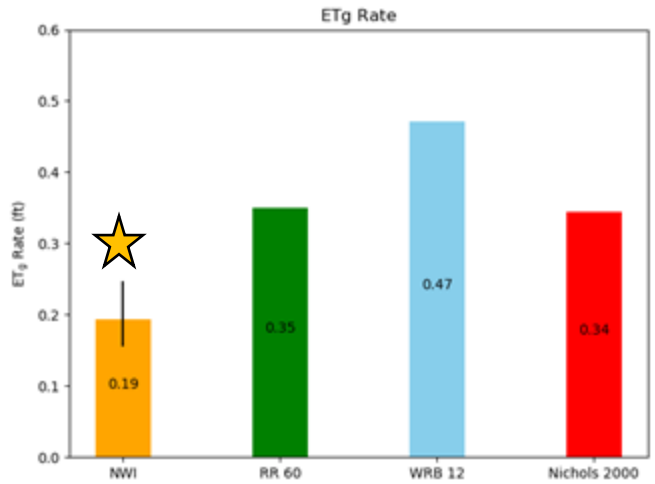
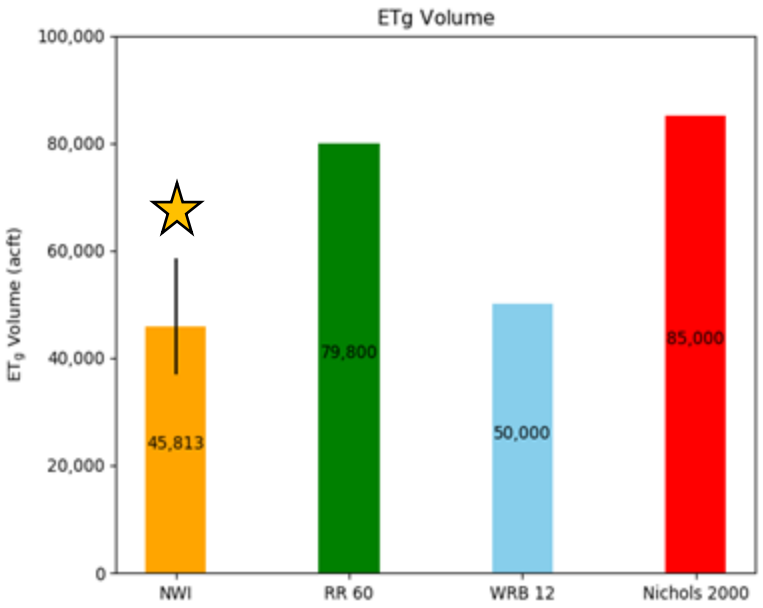


Table 8.--Estimated average annual ground-water evapotranspiration[1/]

Type of water loss	Area (acres)	Depth to water (feet)	Evapotranspiration Feet per year	Evapotranspiration Acre-feet per year
NORTHERN RAILROAD VALLEY				
Playa (bare soil)	38,000	0-10	0.1	3,800
Greasewood, rabbitbrush, saltbush, moderately dense to scattered	68,000	10-50	0.2	14,000
Saltgrass, with or without above phreatophytes, moderately dense to scattered	110,000	1-10	0.4	44,000
Meadowgrass, tules, willow, and other wet-area phreatophytes (includes areas of meadowgrass irrigated mostly with springflow)	12,000	0-5	1.5	18,000
Free-water surface	400	--	4	1,600
Total (rounded)	227,000	--	--	80,000

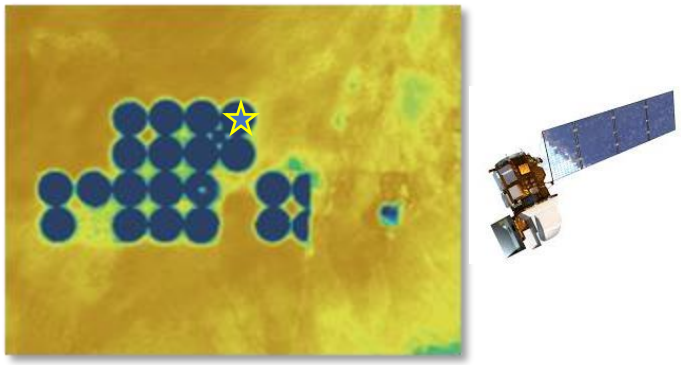
From Van Denburgh and Rush 1974 (RR 60)

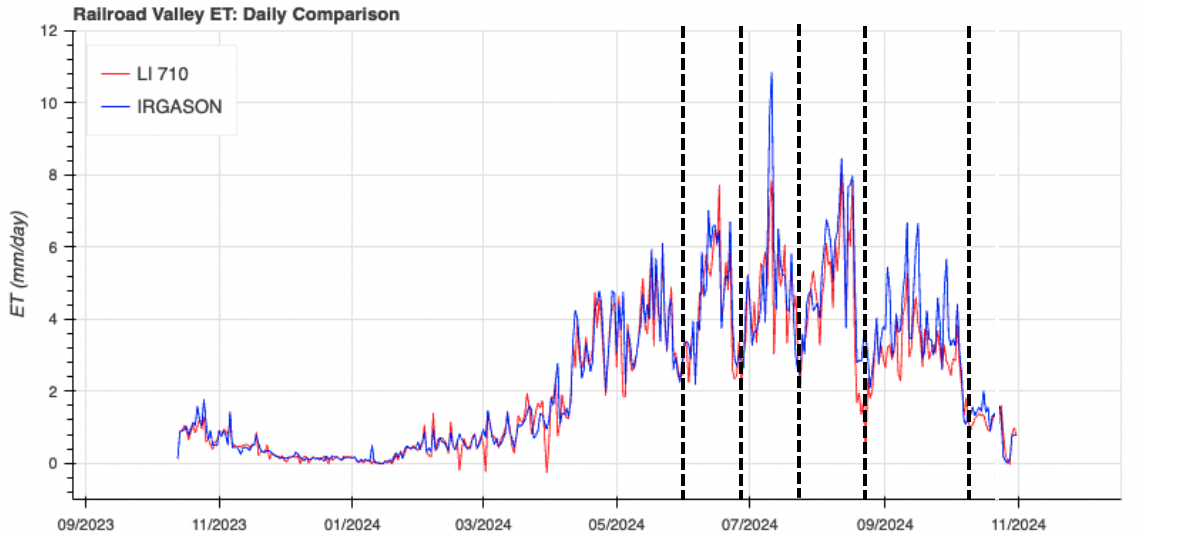


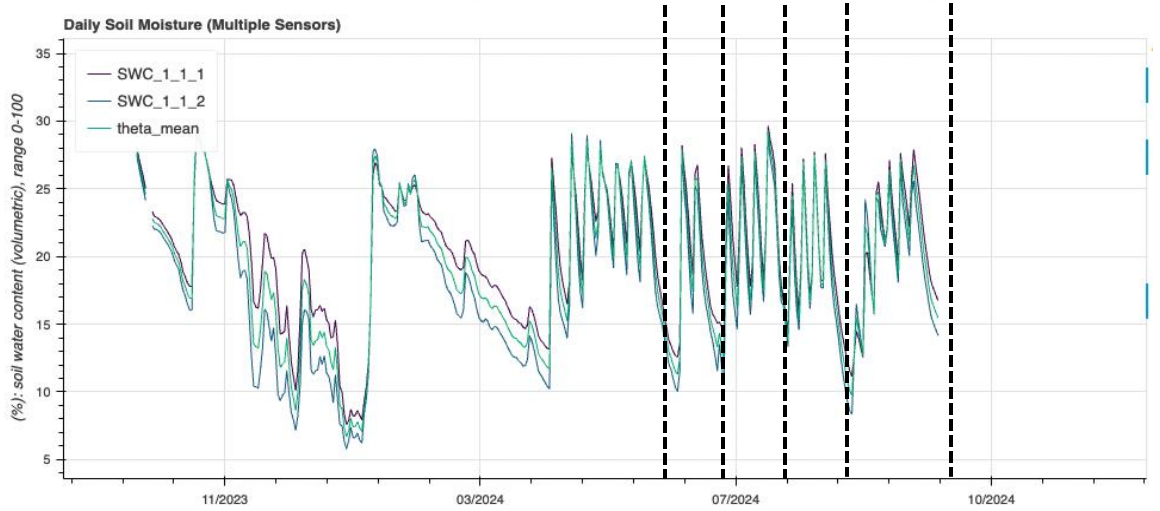
* PRELIMINARY RESULTS * - METEOROLOGICAL DATA AND MONITORING

- Comparison of two independent sensors look good
- LICOR-710 is $5K and IRGASON is $35K

Railroad Valley







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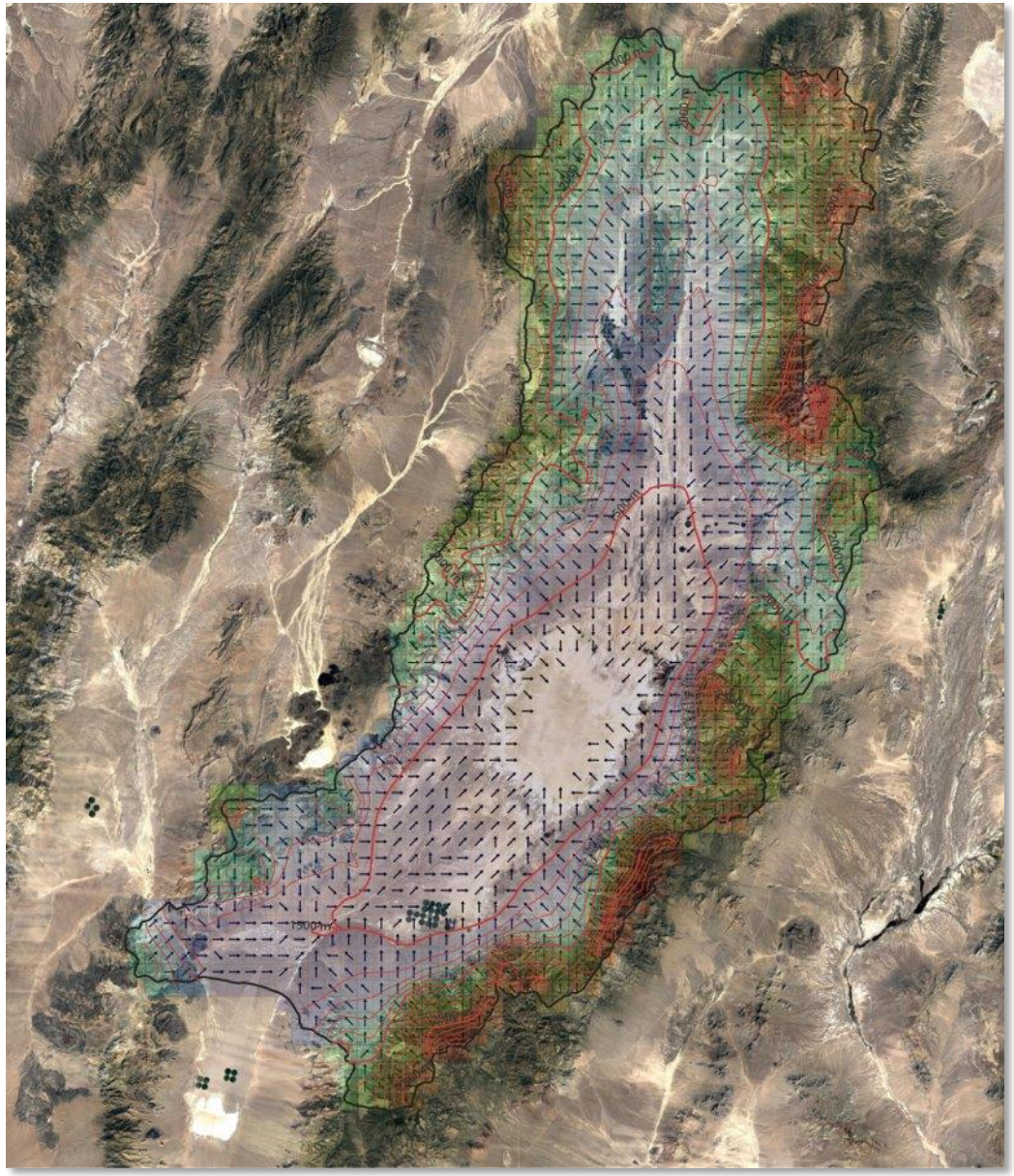
NWI Nevada Water Initiative

NEXT STEPS

- Investigate and finalize preliminary groundwater discharge and agricultural water use estimates
- Compile basin pumping inventories and data where available
- Continue to measure ET at weather stations
- Compare satellite-based estimates of ET to weather station data and basin pumping data and inventories
- Summarize future climate and hydrology projection information for each basin
- Summarize flow system water budgets in coordination with USGS
- Continue development and application of hydrology models for demo basins in coordination with USGS
- Draft reports for internal review Q4 2025 - Q1 2026



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USGS
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