Snake Valley Groundwater Studies

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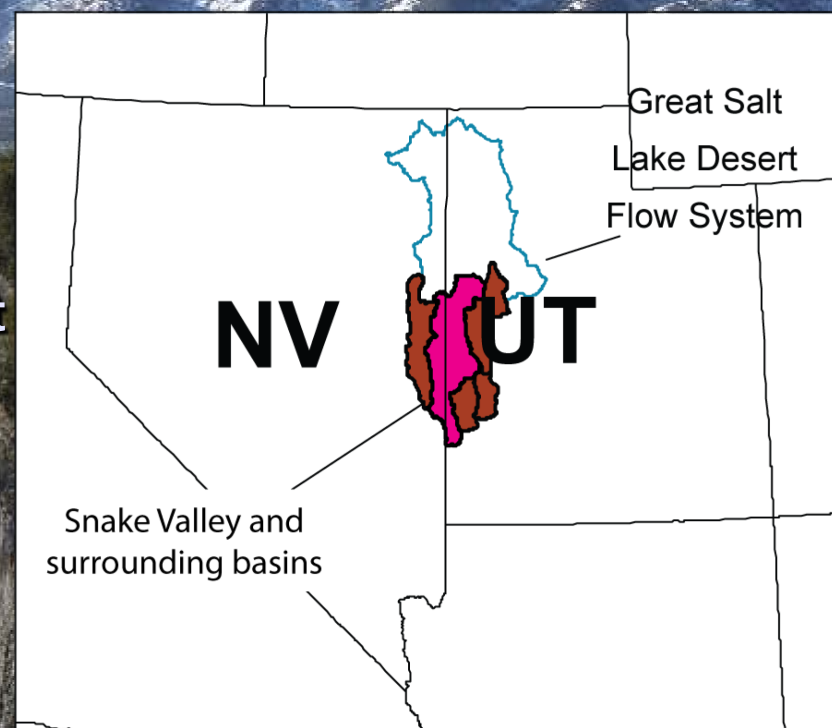
U.S. Geological Survey

Snake Valley Water Rights Development
Natural Resources Law Forum
April 12, 2011



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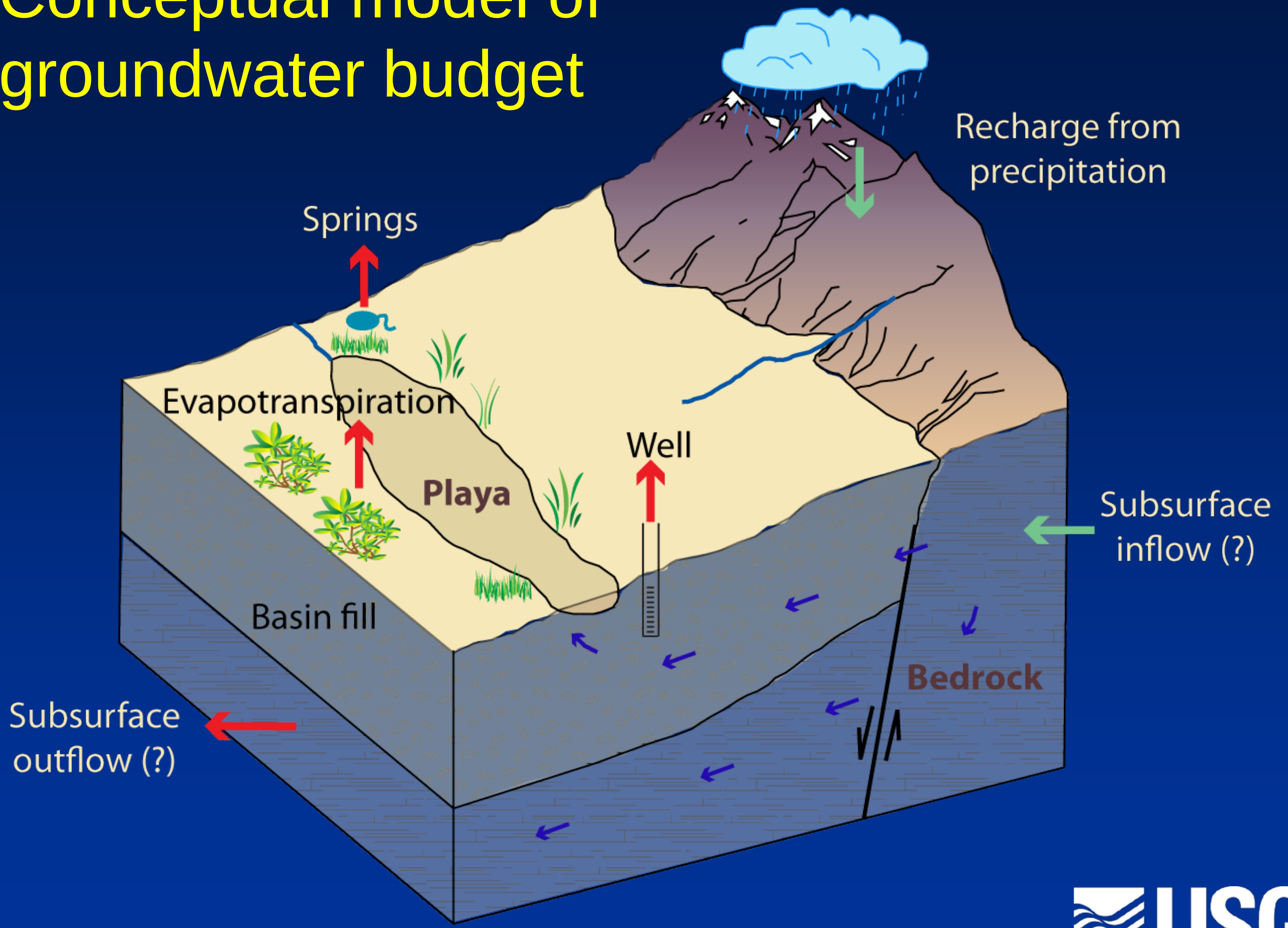
Conceptual model of groundwater budget



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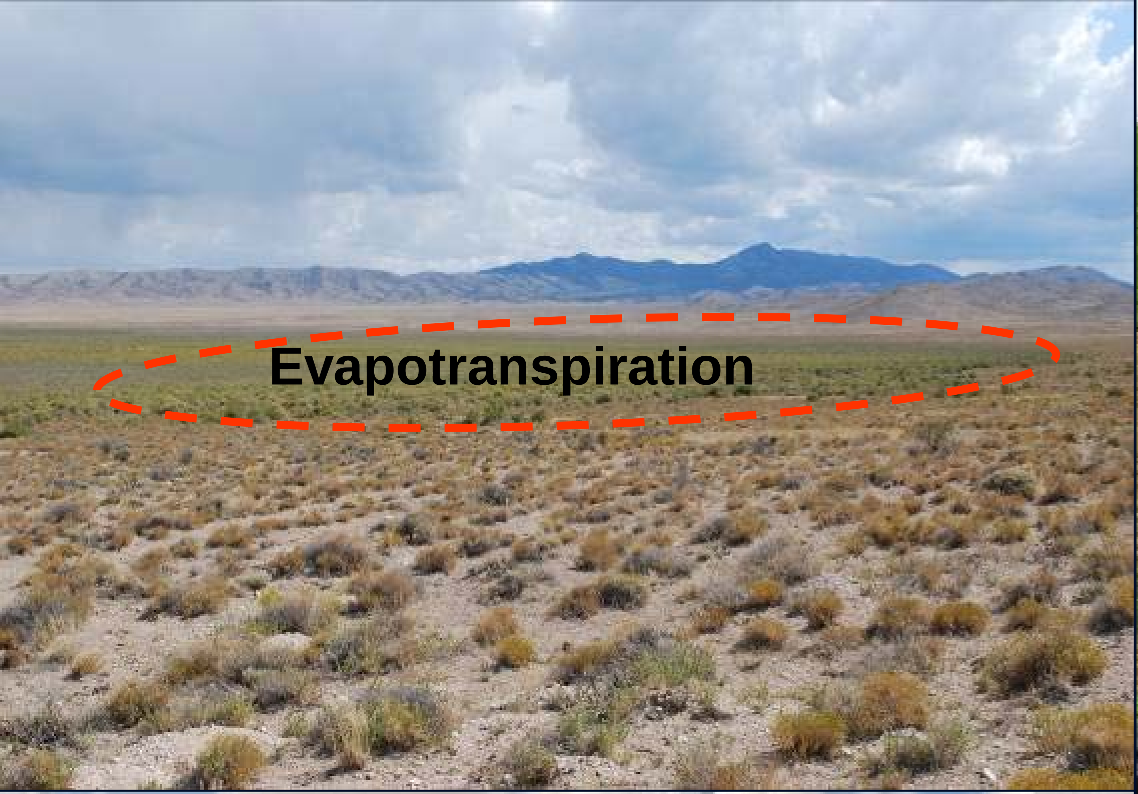
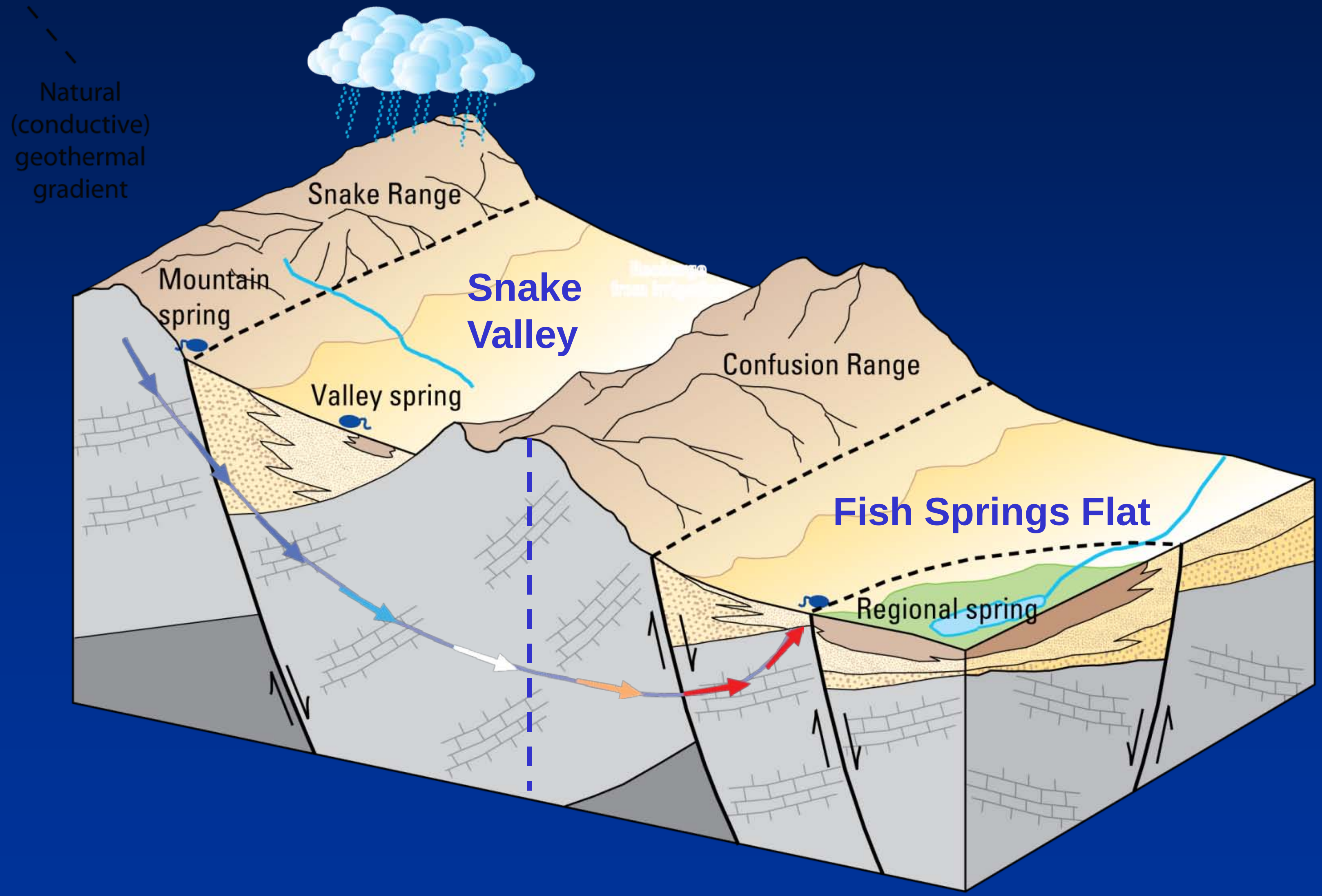
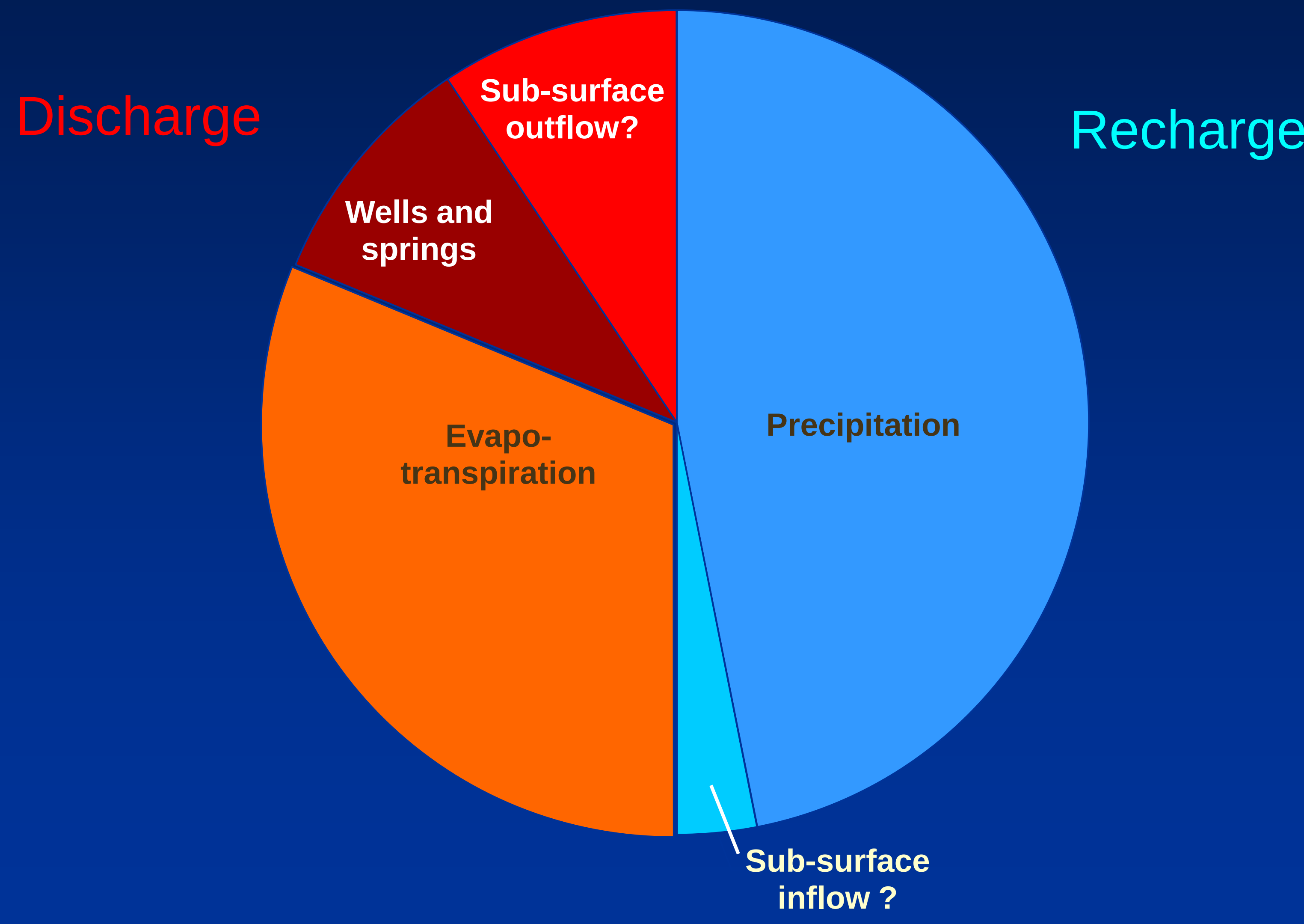


Forms of groundwater discharge

Likelihood of subsurface flow

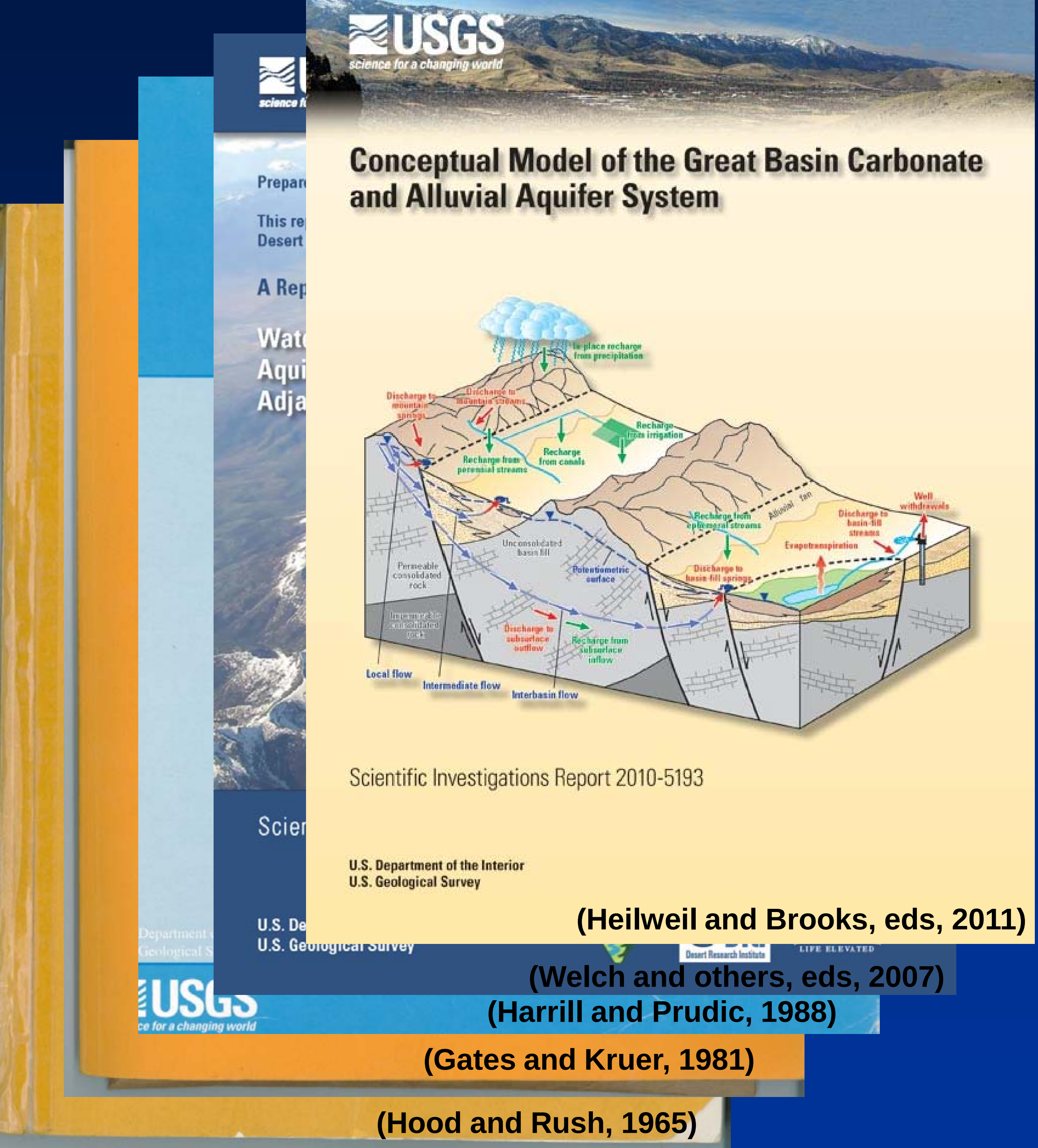


Preliminary Snake Valley Groundwater Budget



Previous USGS groundwater budget estimates

- Estimates of total recharge and discharge range from 100,000 to 160,000 acre-ft/yr



(Heilweil and Brooks, eds, 2011)

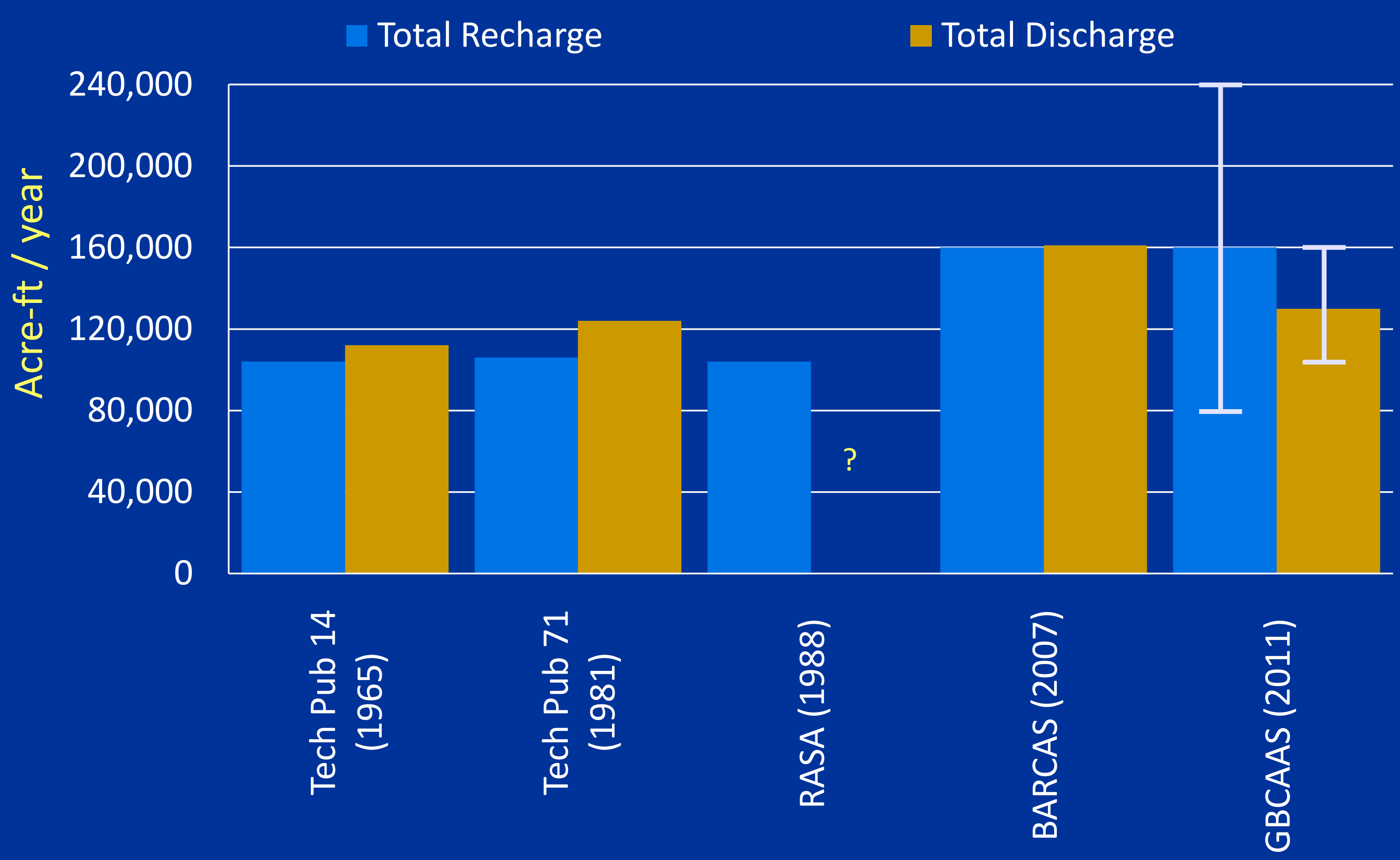
(Welch and others, eds, 2007)

(Harrill and Prudic, 1988)

(Gates and Kruer, 1981)

(Hood and Rush, 1965)

Snake Valley groundwater budget



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Groundwater Budget Concepts

- UT/NV Snake Valley agreement depends on available groundwater supply (sustainable yield)
- Sustainable yield is "the development of groundwater resources in a manner that can be maintained for an indefinite time without causing unacceptable consequences" (Alley and Leake, 2004)
- Sustainable yield for Snake Valley is based on estimated natural discharge: 108,000 acre-ft/yr (80% of BARCAS discharge estimate)
- Any additional groundwater development must come from a combination of increased recharge, water from storage (water-level declines), or captured natural discharge (springs or ET) (Bredehoeft, 2002)

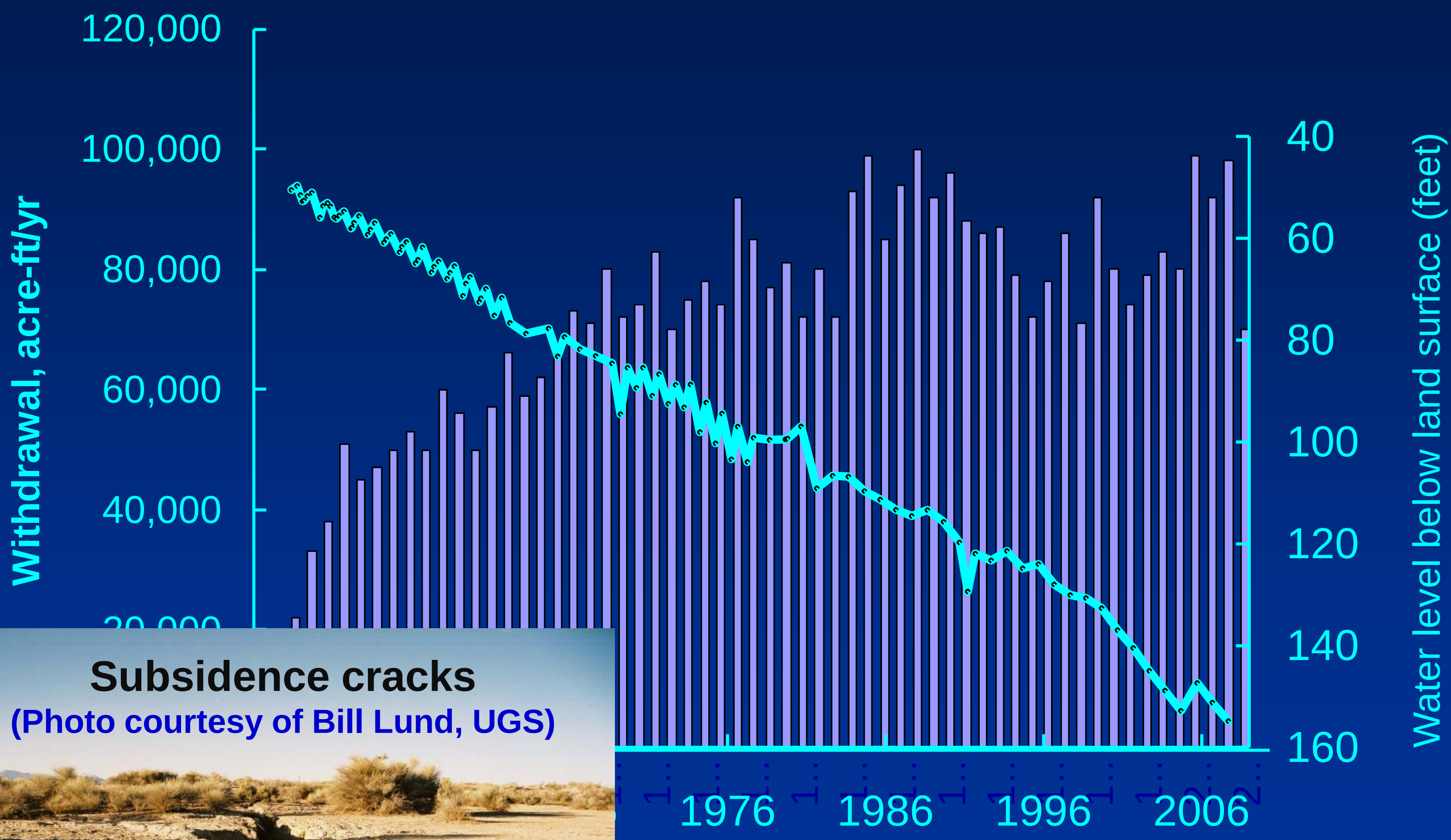
UT/NV Snake Valley Agreement (Section 5.4)

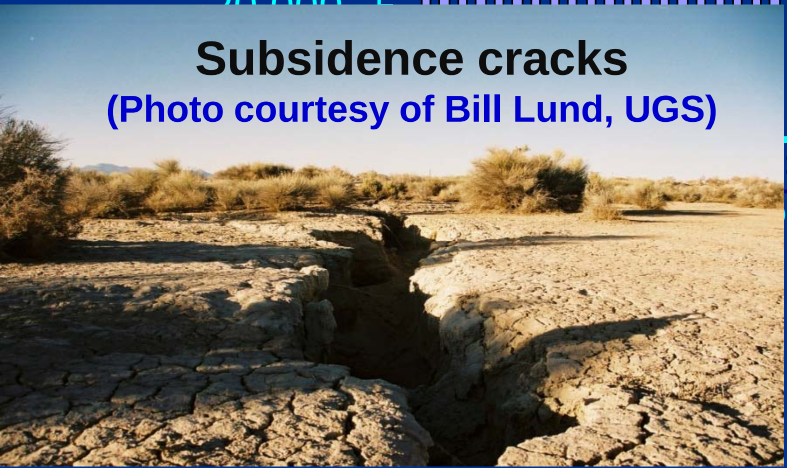
Agreement prohibits:

- Ground-water mining
- Impairment of water quality
- Compaction of aquifers or surface instability

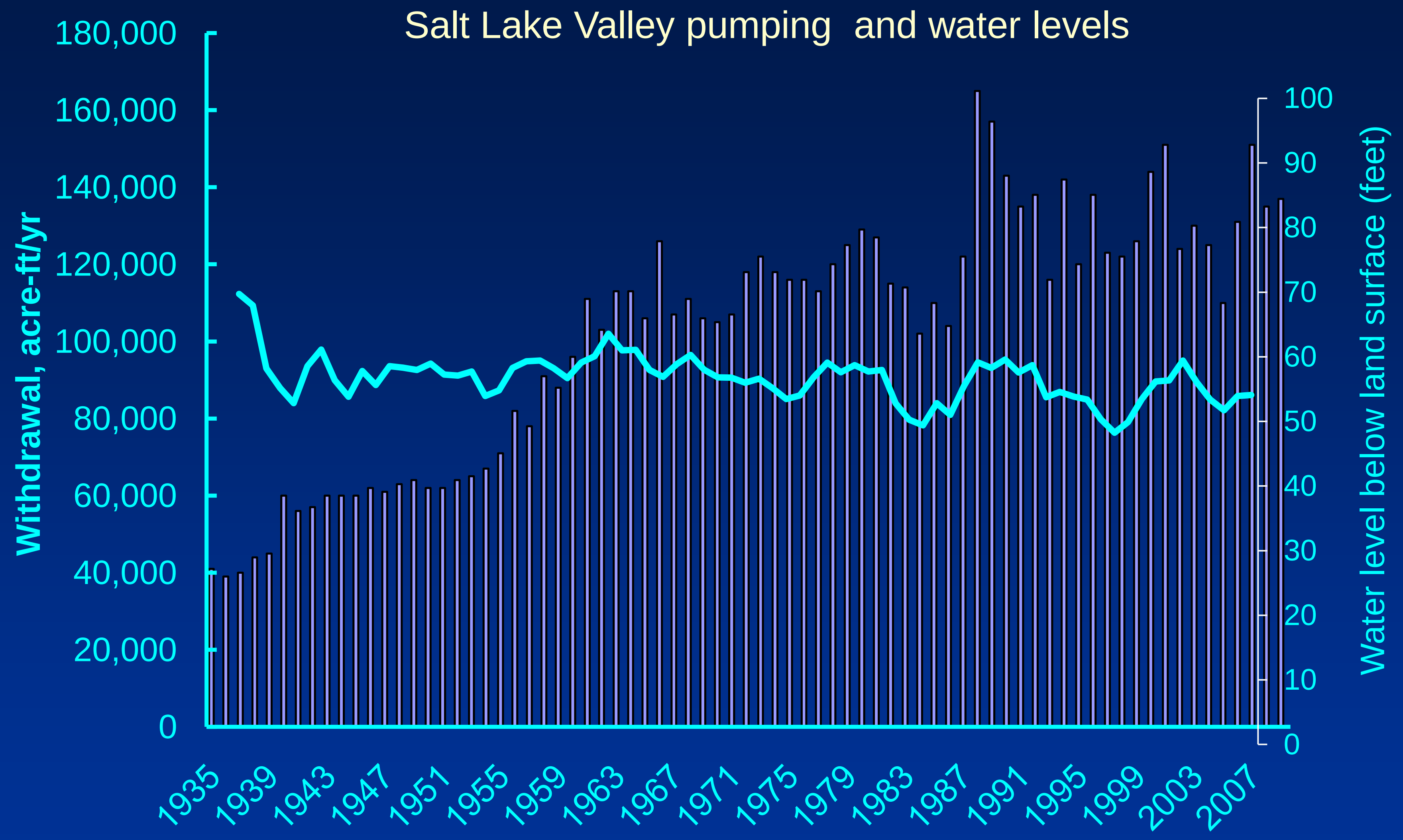
Potential mining/compaction effects

Beryl-Enterprise pumping and water levels





Subsidence cracks
(Photo courtesy of Bill Lund, UGS)



Impacts of additional pumping in Snake Valley will likely fall somewhere between these two end members

Approach: to improve knowledge of groundwater processes and refine groundwater budget

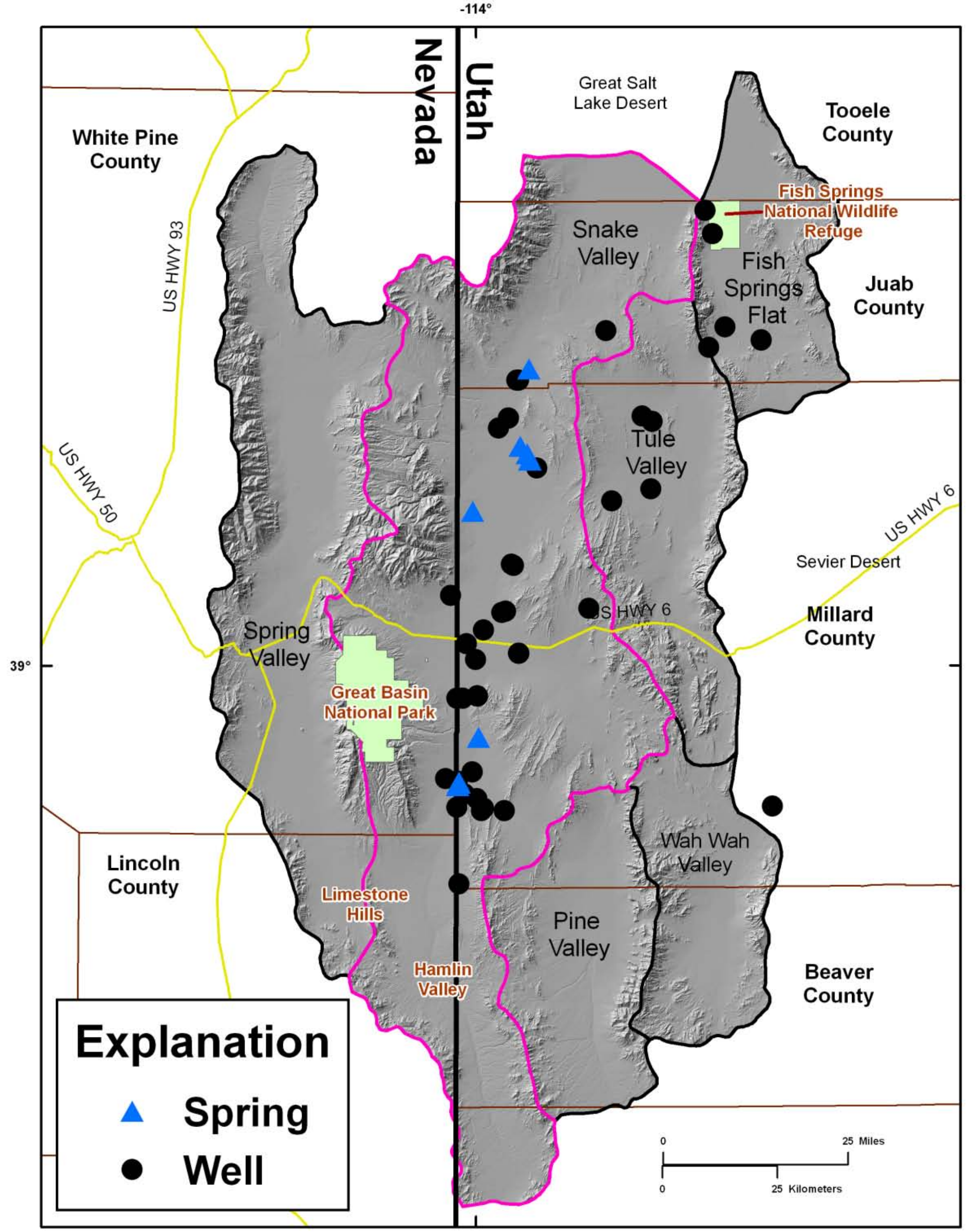
(establishing the framework for future evaluation effects of additional pumping)

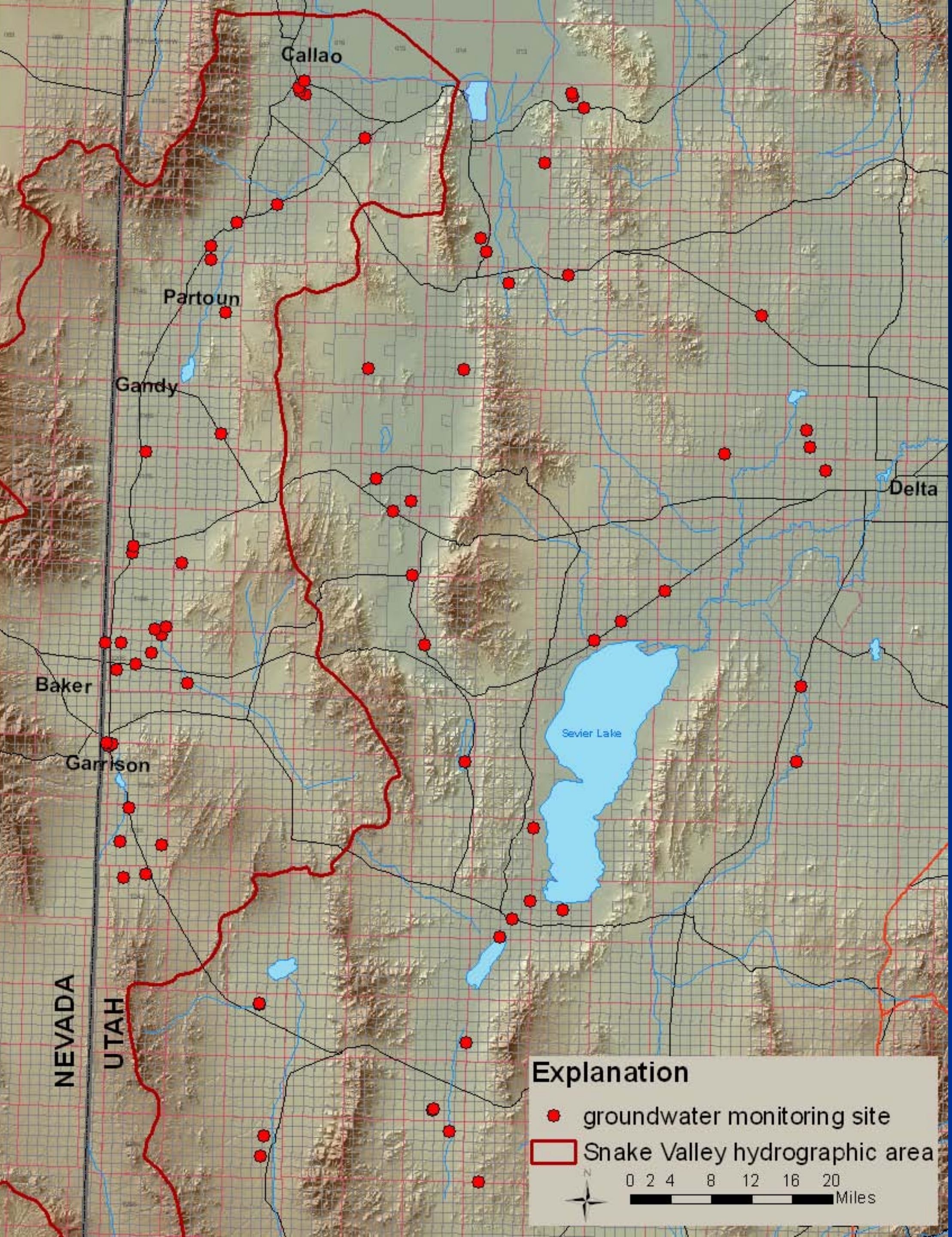
- Spring & water-level monitoring (UGS, USGS, SNWA)
- Well pumping (USGS)
- Water chemistry and age (UGS, SNWA, USGS)
- Groundwater modeling (SNWA, NPS, BLM, USGS)

UGS Groundwater Monitoring Network

H. Hurlow, L. Jordan, M. Lowe,
Utah Geological Survey

http://geology.utah.gov/databases/groundwater





SNWA/USGS Great Salt Lake Desert Water-level monitoring network:

76 monitoring wells measured quarterly

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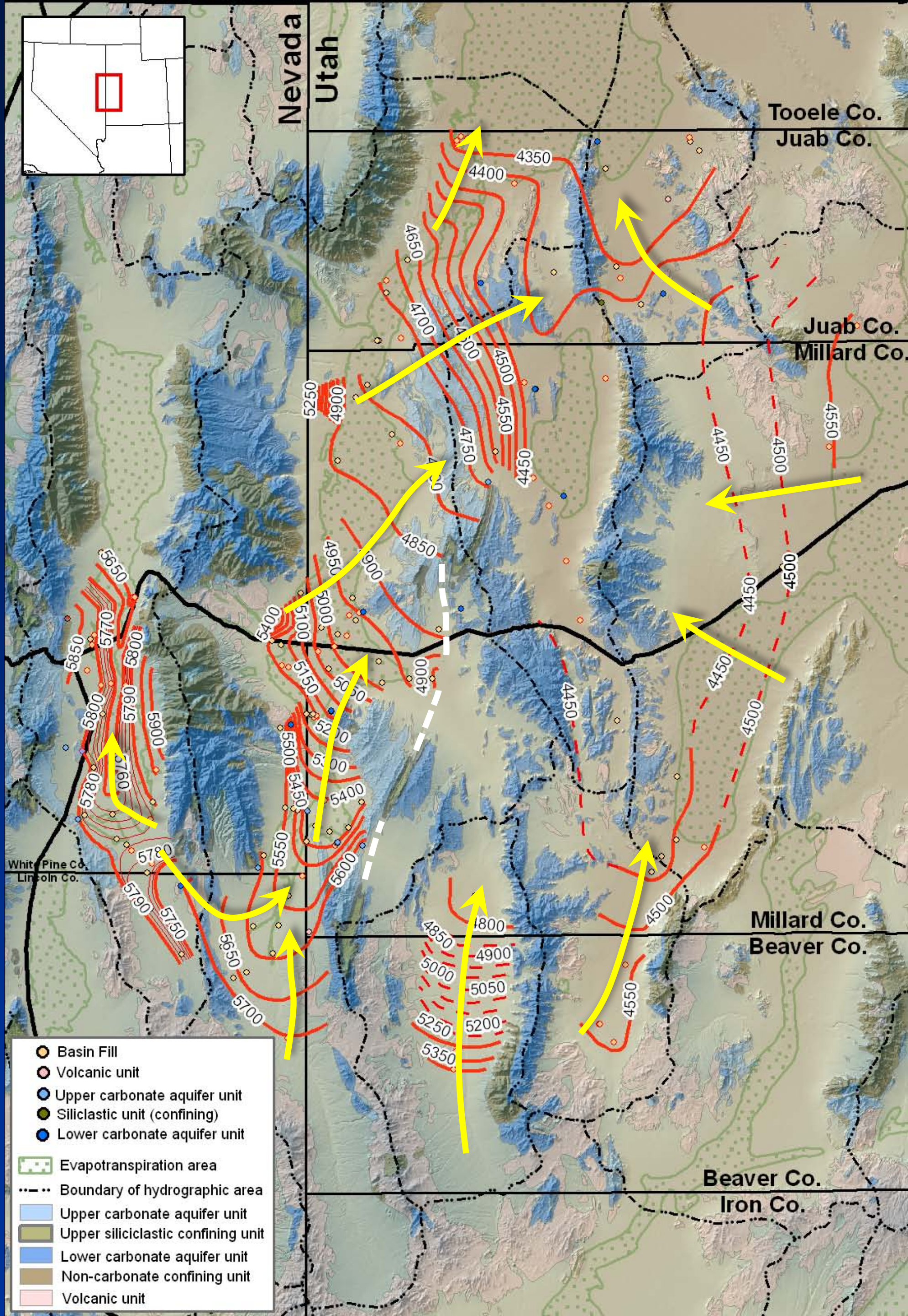
Potentiometric map

- Contour water levels to generate map of the water level surface
- Groundwater flow directions
- Used to develop numerical models and interpret geochemistry



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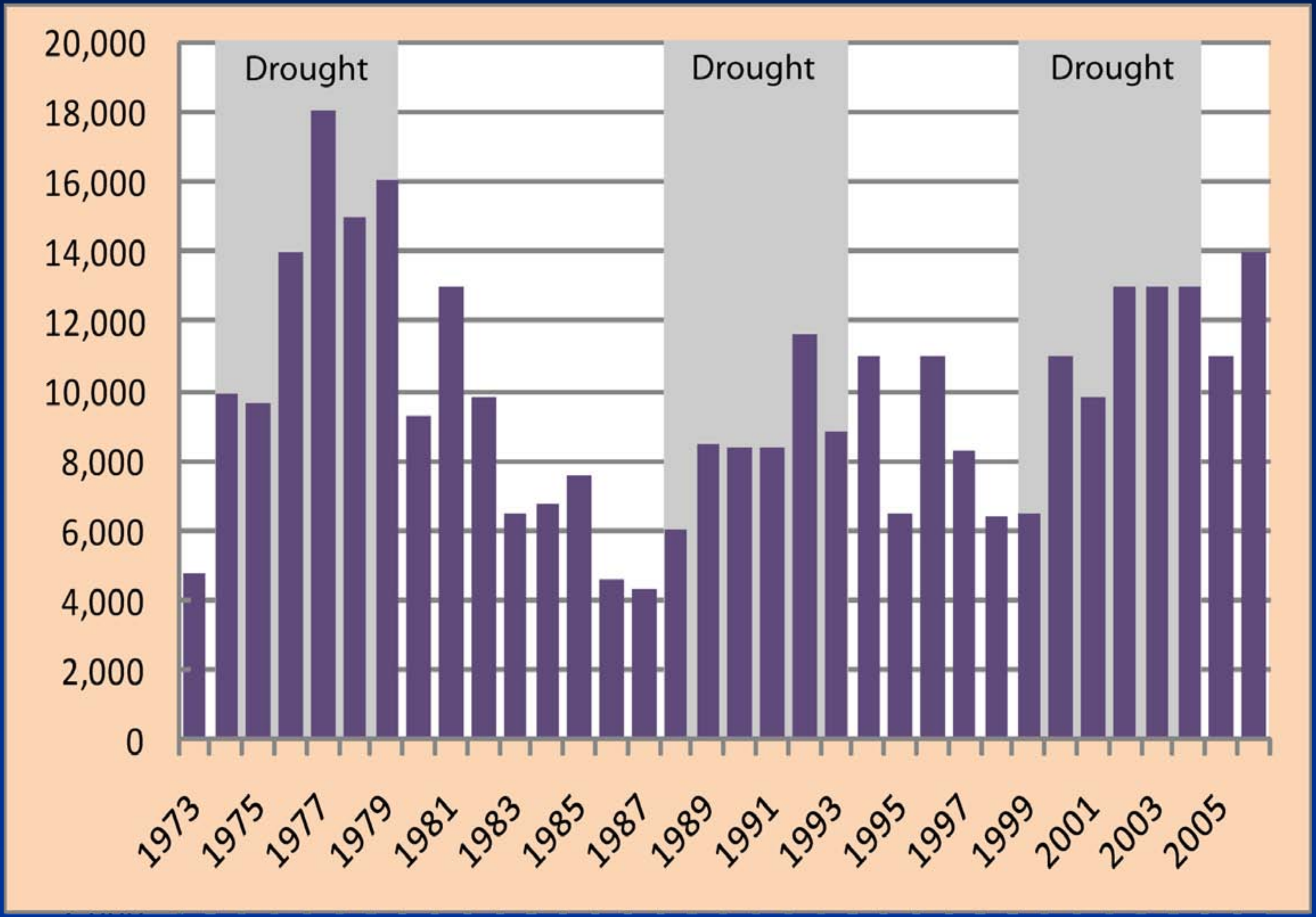
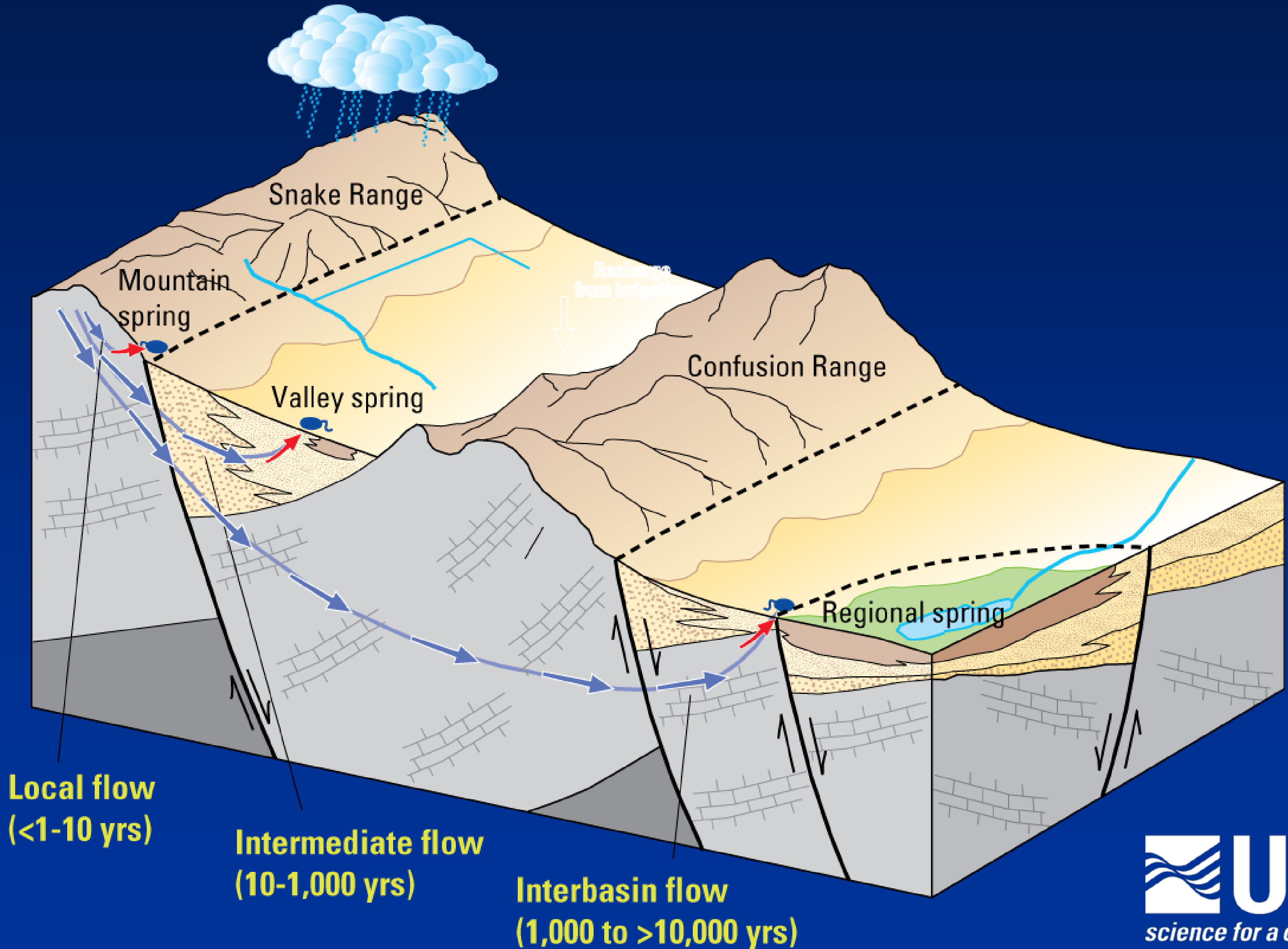
Historical pumping in Snake Valley



Geochemistry (^{3}H, ^{4}He, ^{14}C, noble gases) for determining groundwater flow paths and age



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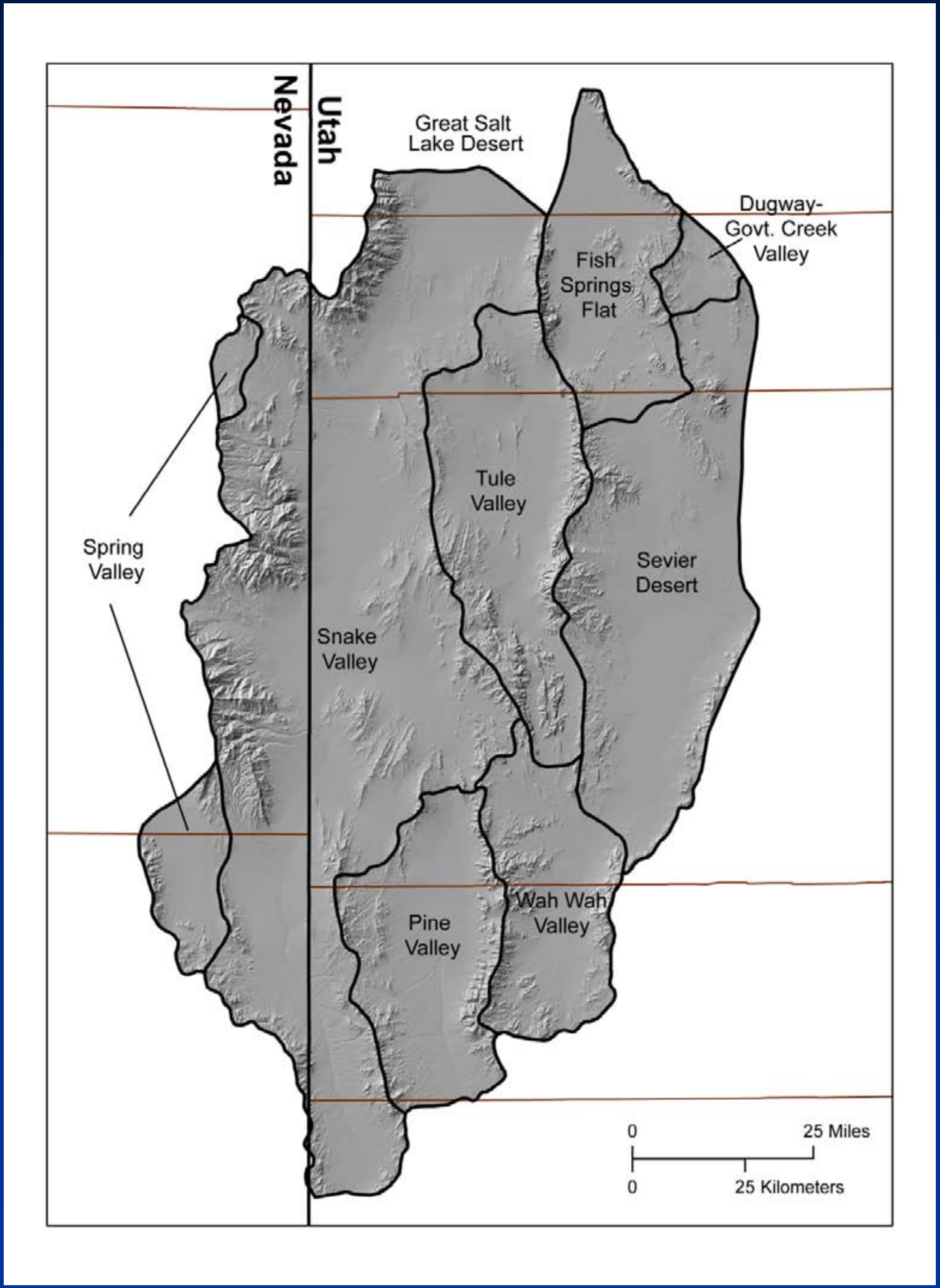
Numerical Model

Model construction:

- Model area > 8,000 mi^2



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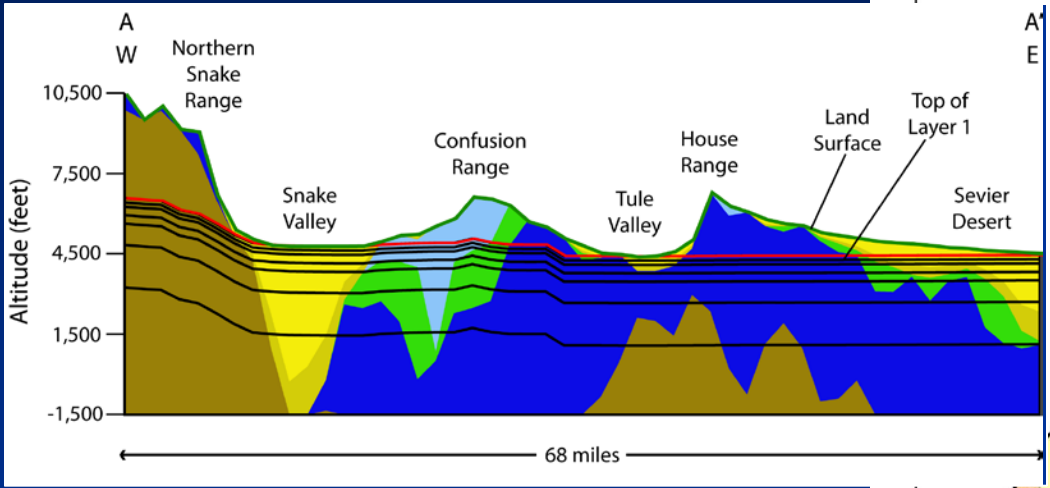
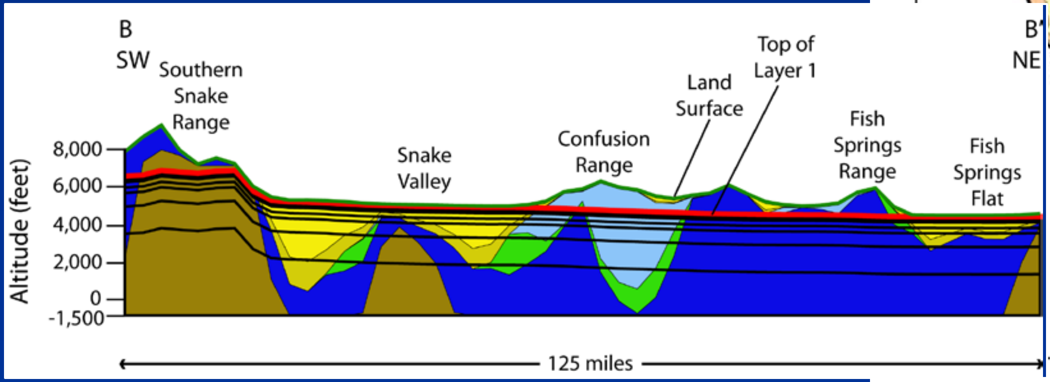
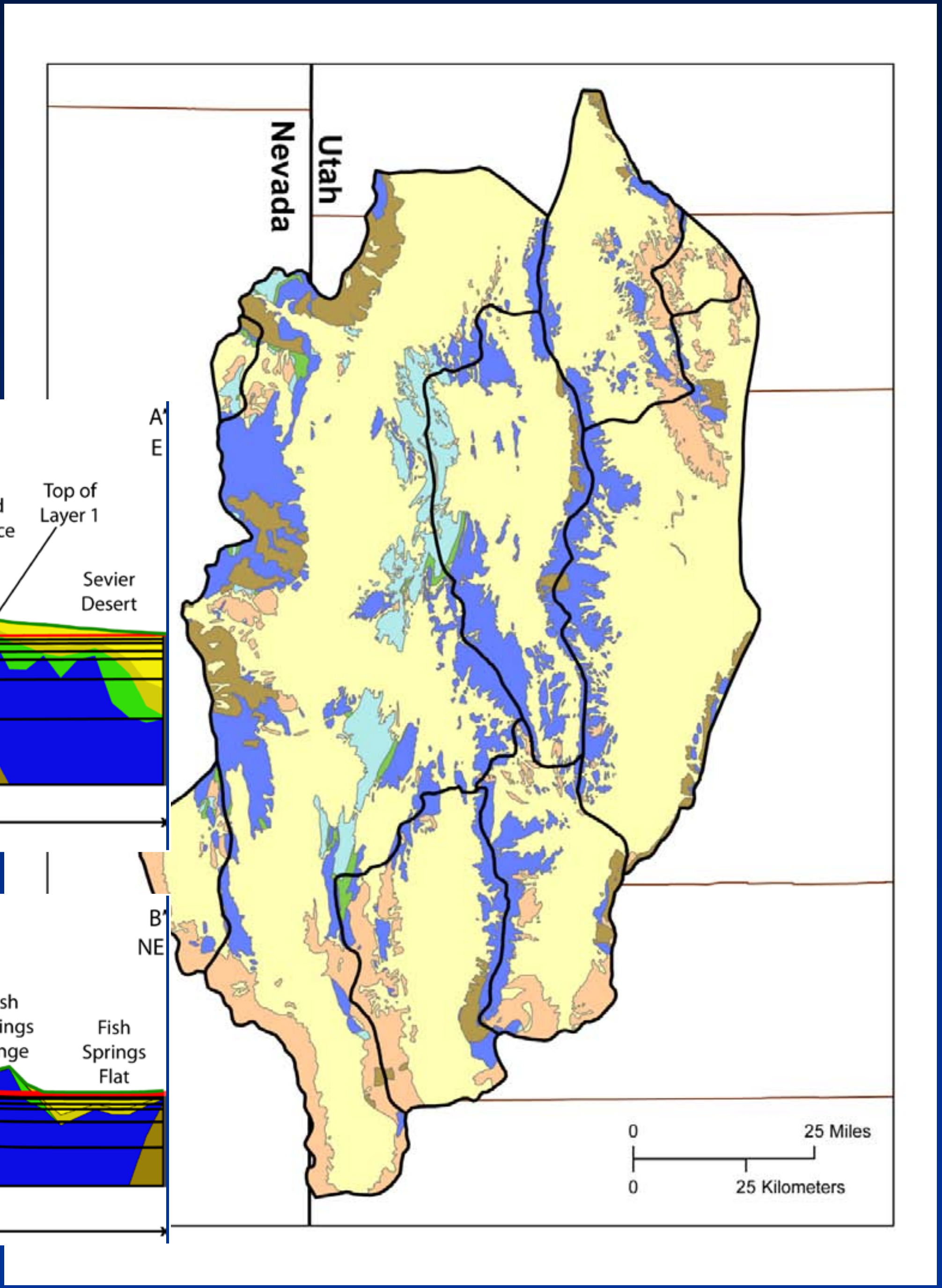
Model progress

Model construction:

- Model area > 8,000 mi²
- Geology represent as 7 units



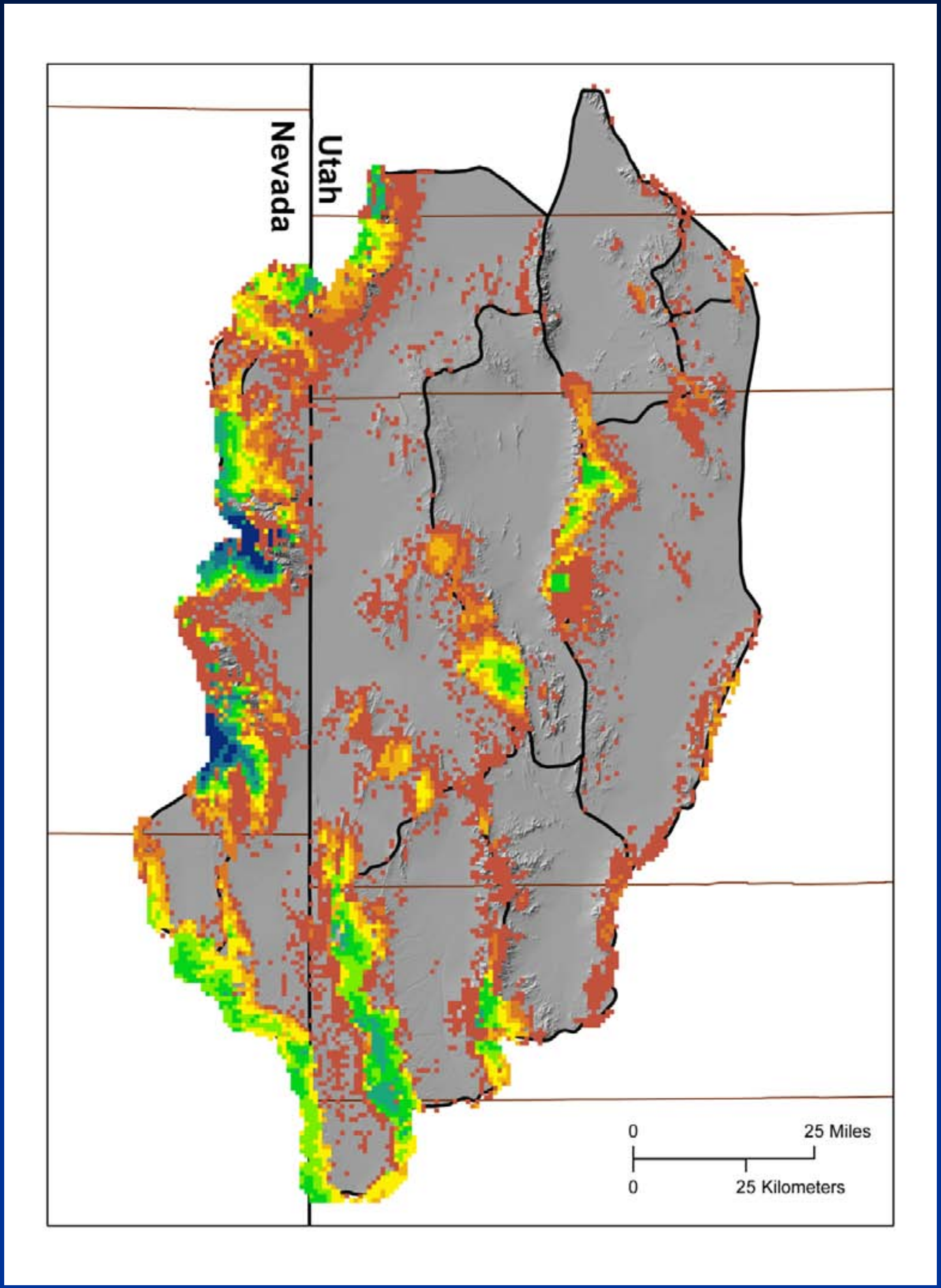




Numerical Model

Model construction:

- Model area > 8,000 mi^2
- Geology represent as 7 units
- Recharge (200,000 acre-ft/yr)



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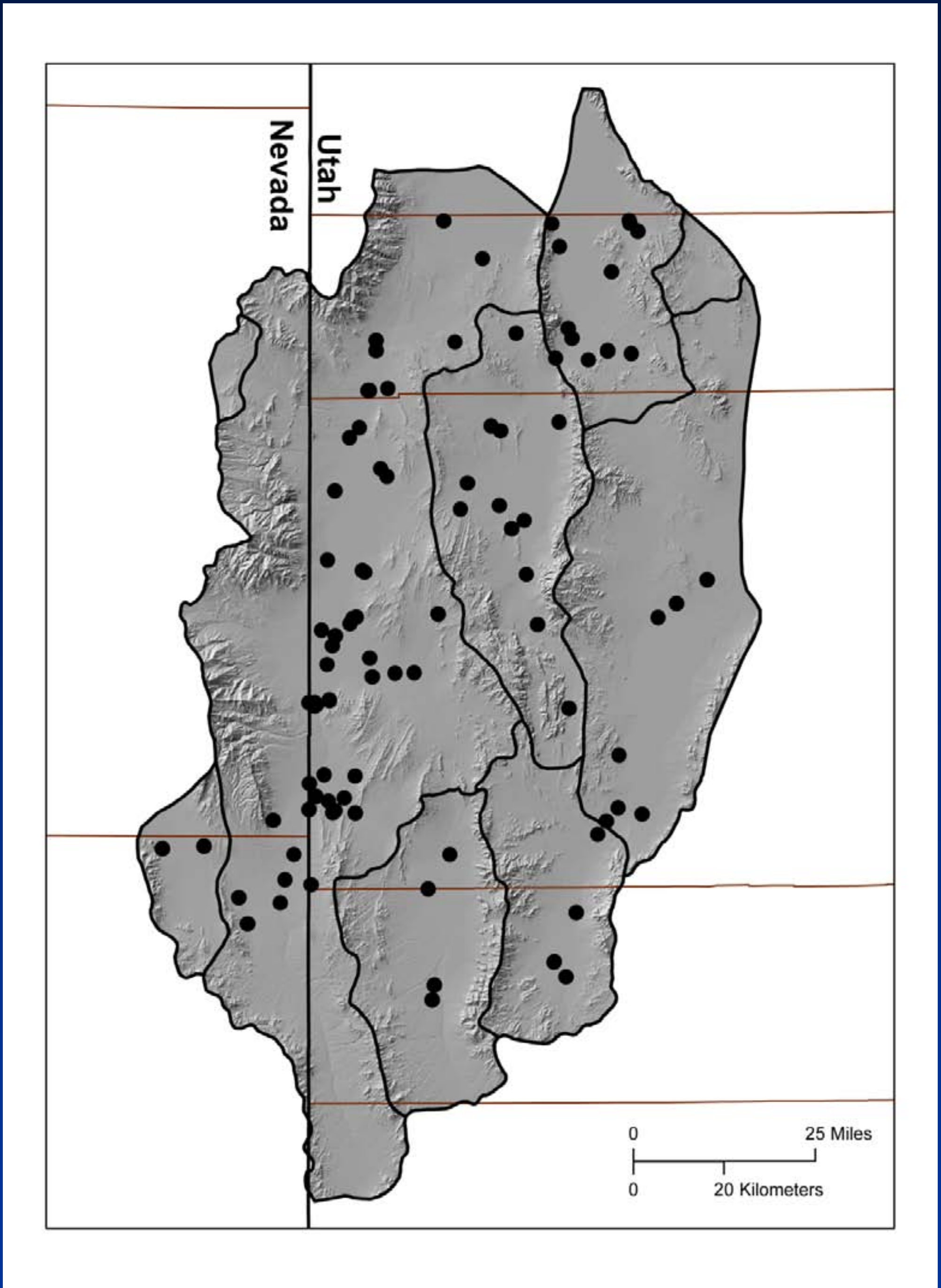
Numerical Model

Model construction:

- Model area > 8,000 mi^2
- Geology represent as 7 units
- Recharge (200,000 acre-ft/yr)
- Discharge
  - ET (130,000 – 160,000 af/yr)
  - Springs (60,000 af/yr)
  - Pumping (18,000 af/yr)

Model calibration:

- Water levels from 130 wells



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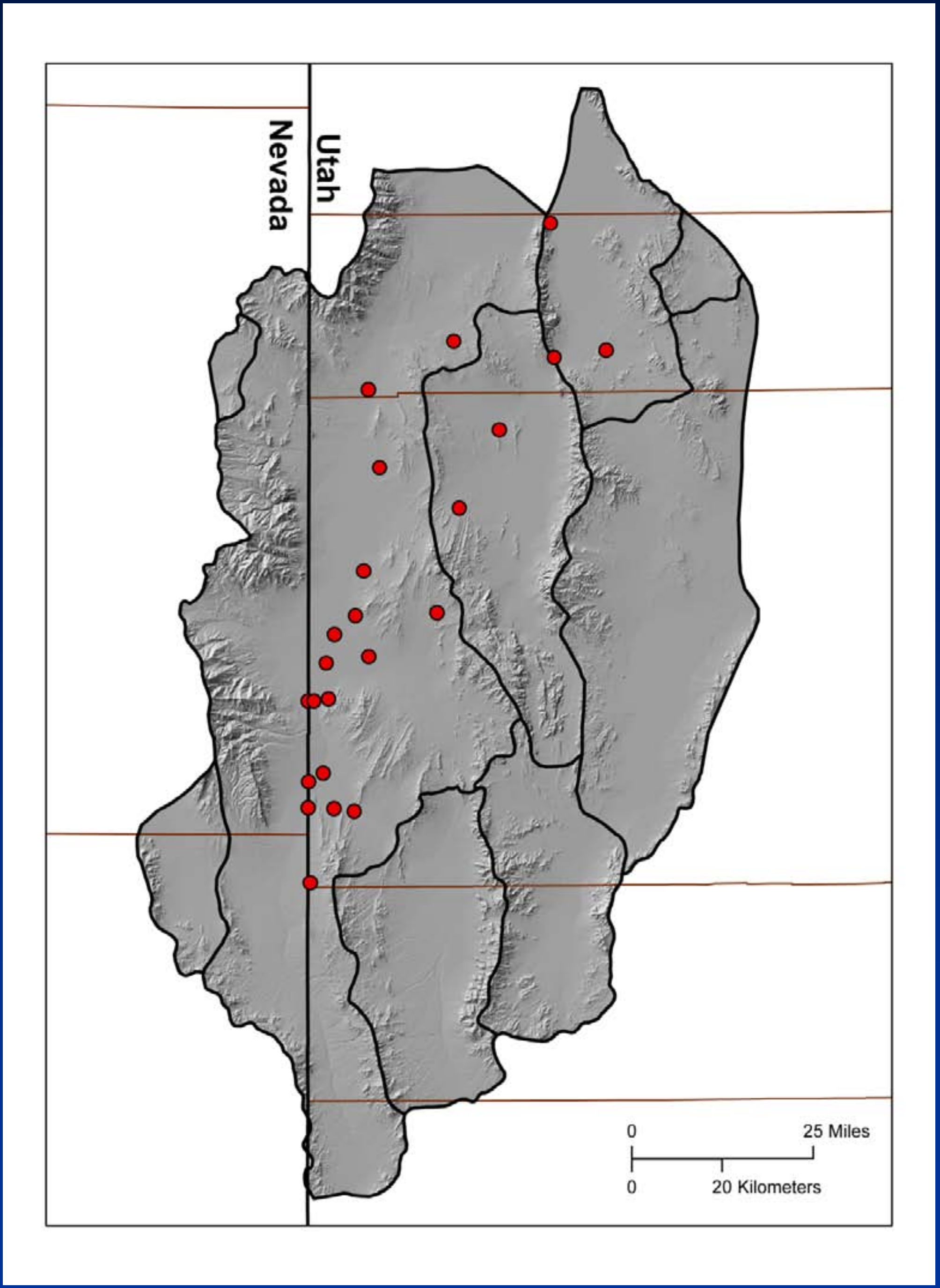
Numerical Model

Model construction:

- Model area > 8,000 mi^2
- Geology represent as 7 units
- Recharge (205,000 acre-ft/yr)
- Discharge
  - ET (130,000 – 160,000 af/yr)
  - Springs (60,000 af/yr)
  - Pumping (18,000 af/yr)

Model calibration:

- Water levels from 130 wells
- Temperature logs from 23 wells



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Summary

Current studies and data collection focused on:

- Baseline monitoring and variability
- Understanding groundwater processes and flow paths
- Reducing uncertainty in groundwater budget components

Such information will ultimately improve accuracy of numerical groundwater models and ability to predict effects of future pumping

For Additional Information

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801-908-5041

Hugh Hurlow, West Desert Monitoring Program
Utah Geological Survey
hughhurlow@utah.gov http://geology.utah.gov/databases/groundwater
801-537-3385

Snake Valley Groundwater Budget Comparison

Study	Recharge from Precipitation	Subsurface Inflow	**Total Recharge**	Evapotranspiration	Wells/ Springs	Sub-surface Outflow	**Total Discharge**
Tech Pub 14 (1965)	100,000	4,000	**104,000**	95,000	7,000	10,000	**112,000**
Tech Pub 71 (1981)	102,000	4,000	**106,000**	64,000	18,000	42,000	**124,000**
RASA (1988)	100,000	4,000	**104,000**	--	--	42,000	--
BARCAS (2007)	111,000	49,000	**160,000**	132,000*	--	29,000	**161,000**
GBCAAS (2011)	160,000 ± 80,000	??	**160,000± 80,000**	100,000 ± 25,000	30,000 ±7,500	??	**130,000± 30,000**

* pre-development and includes spring discharge

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