Nevada Groundwater Dependent Ecosystems

Laurel Saito
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The Nature Conservancy
Nevada

Colorado River (T. Anderson, TNC)

What is the Nature Conservancy?

Mission
To conserve the lands and waters on which all life depends

Vision
A world where the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfill our needs and enrich our lives

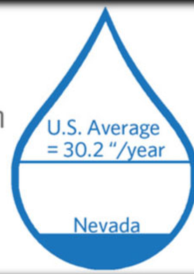
The Nature Conservancy

Protecting nature. Preserving life.

Why we are protecting

WATER IN NEVADA

Though Nevada's the **DRIEST STATE** in the union with **9.5** inches of suhflslwdwlrq on average each year,



it ranks **11th** in biodiversity.

The Silver State has more than **300** endemic species (species found nowhere else)

>40% of them are associated with WETLANDS and SPRINGS

Nevada's 3 million people

rely on nature for water.

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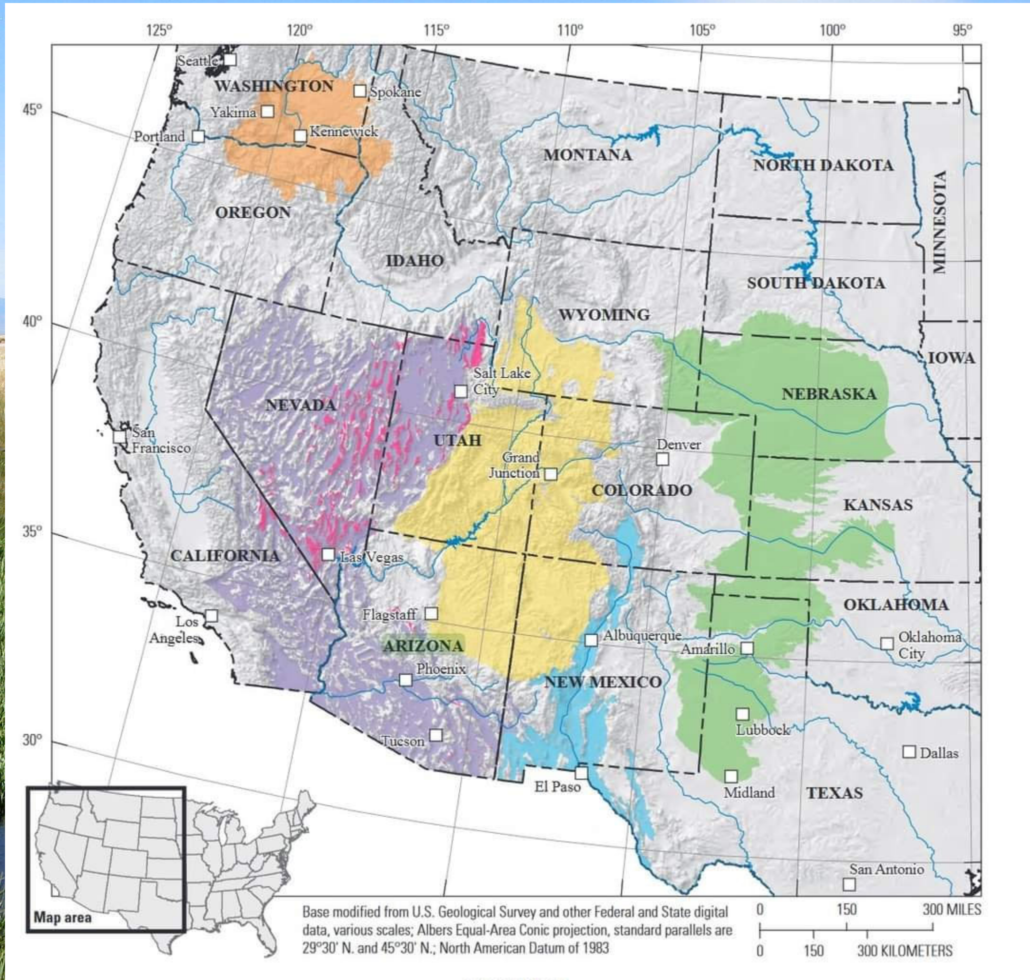
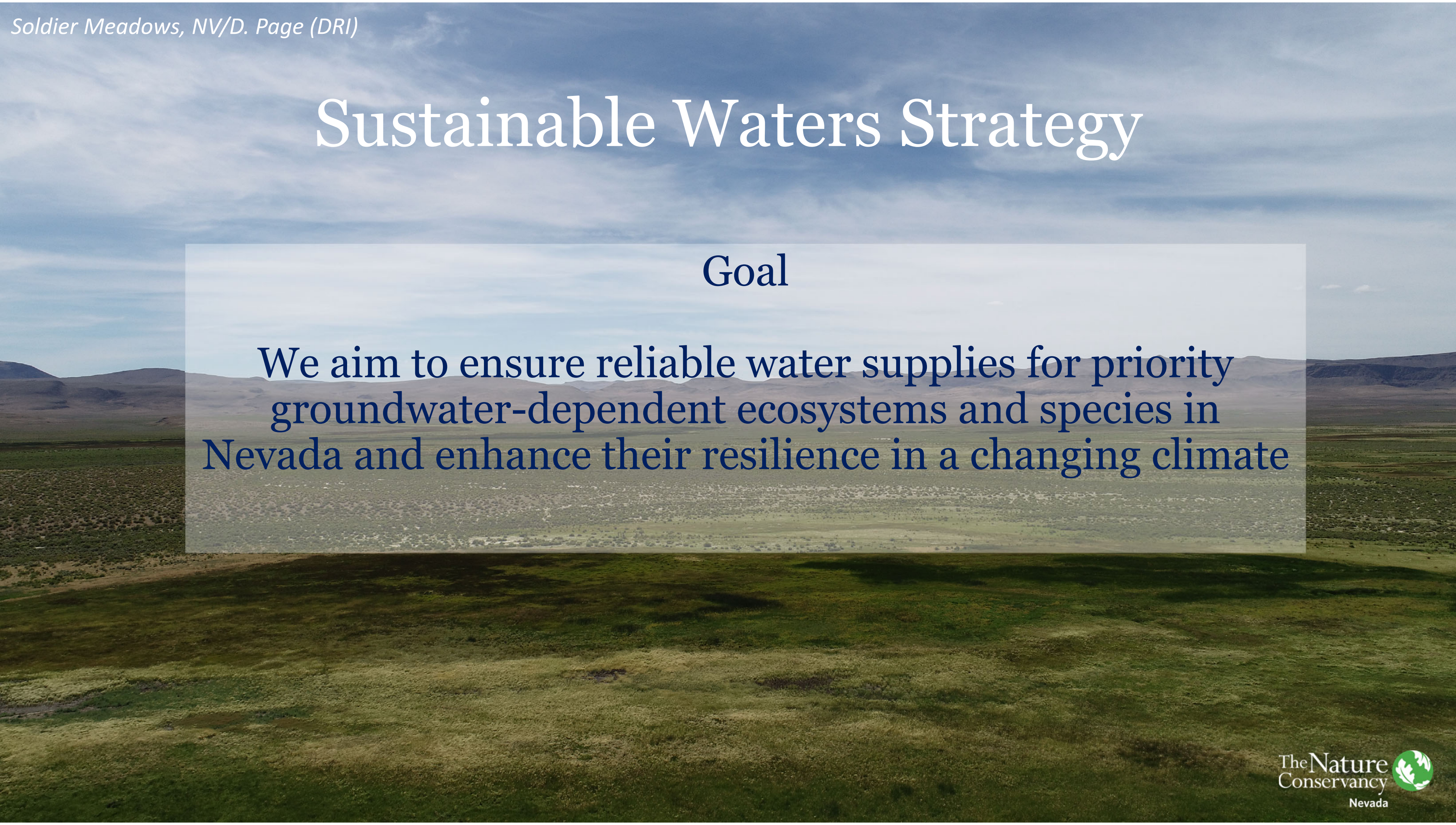
Big Smokey Valley, NV/J. Johnson (NDNH)

Groundwater-dependent ecosystems rely on groundwater to maintain ecological structure and function



Source: USGS

Nevada



Soldier Meadows, NV/D. Page (DRI)

Sustainable Waters Strategy

Goal

We aim to ensure reliable water supplies for priority groundwater-dependent ecosystems and species in Nevada and enhance their resilience in a changing climate

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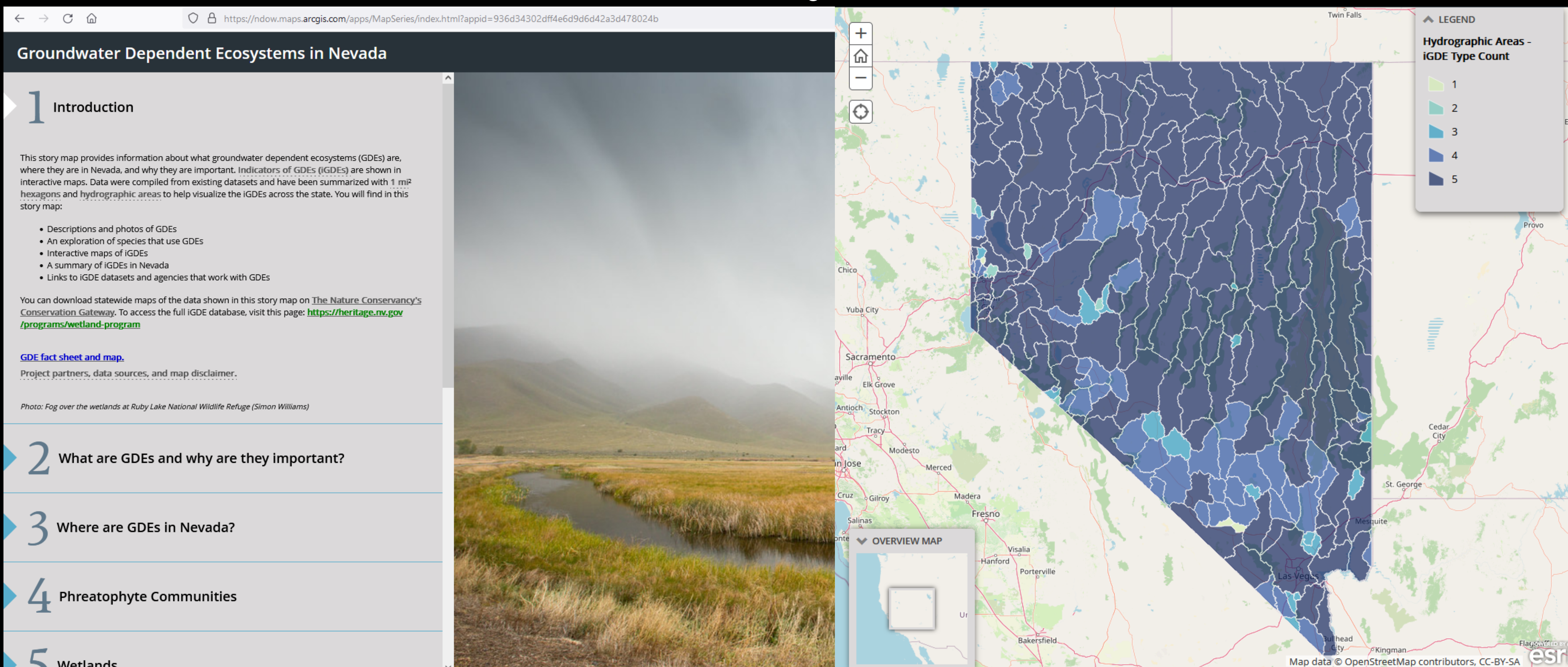
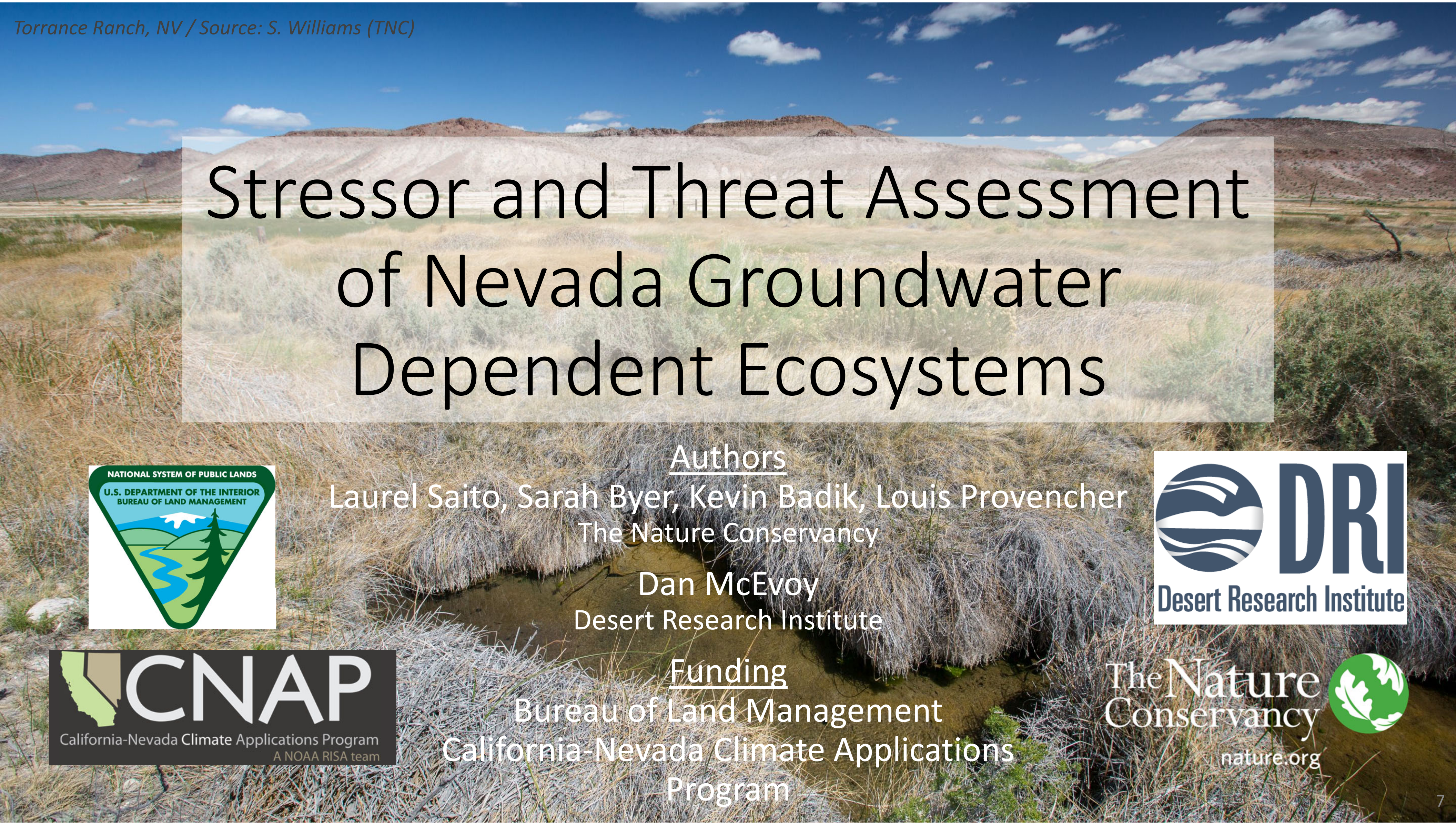
What GDEs exist in NV and where are they?





Torrance Ranch, NV / Source: S. Williams (TNC)

Stressor and Threat Assessment of Nevada Groundwater Dependent Ecosystems

Authors

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The Nature Conservancy

Dan McEvoy

Desert Research Institute

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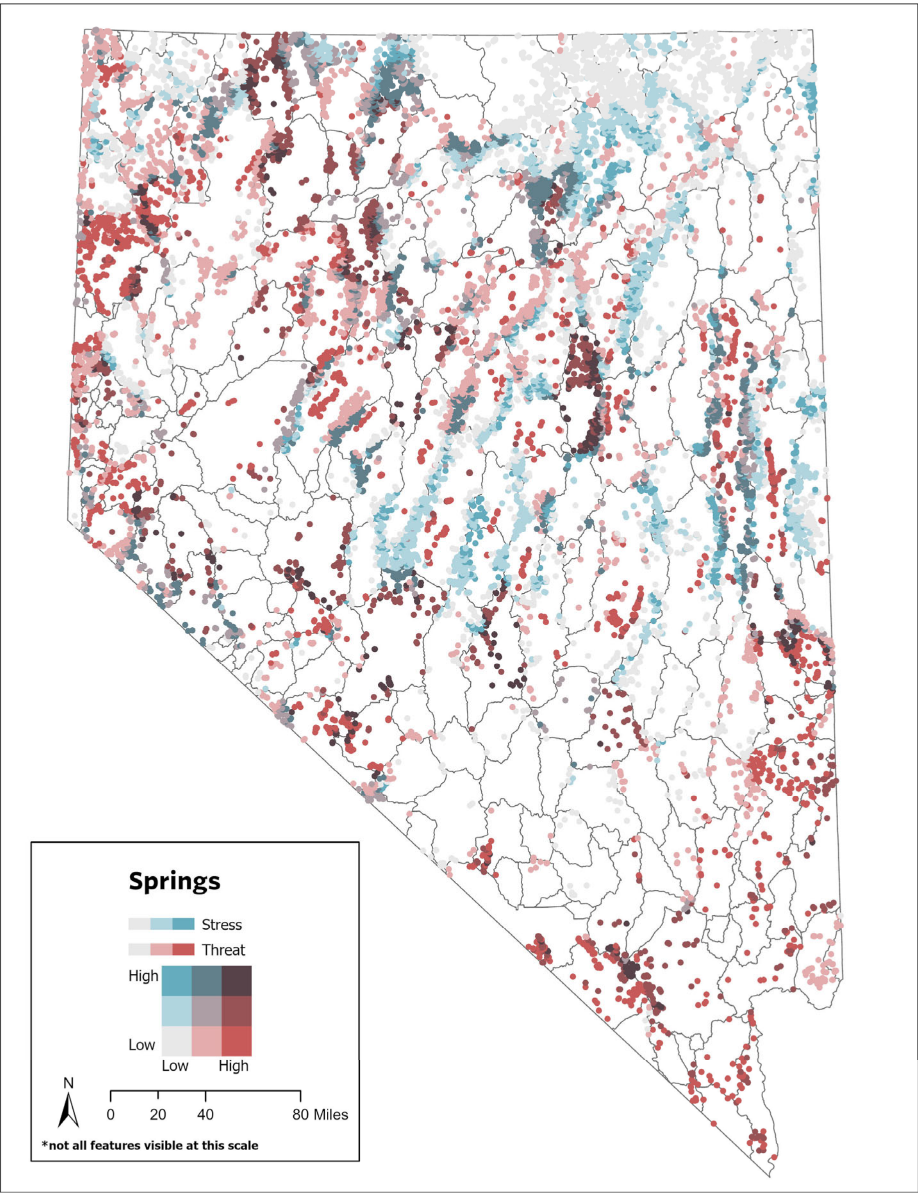
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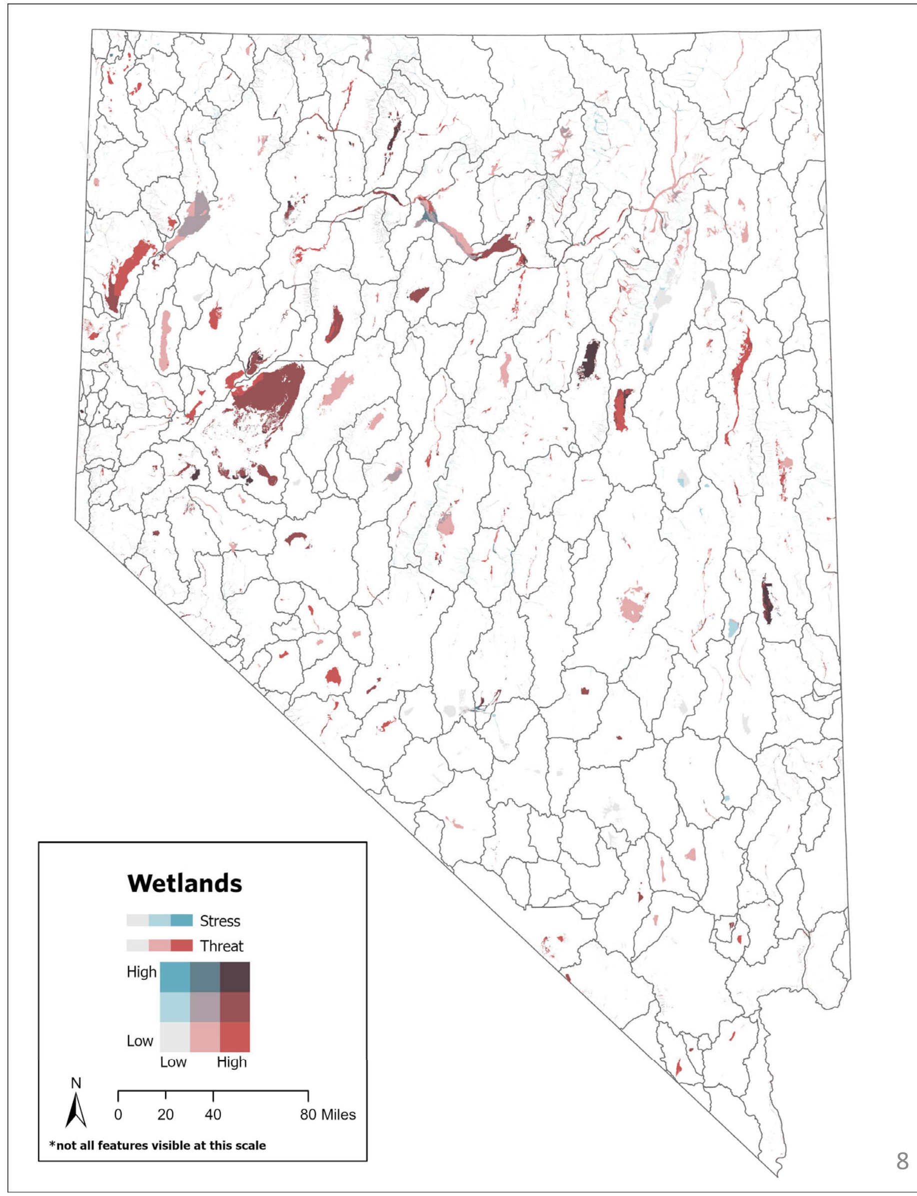
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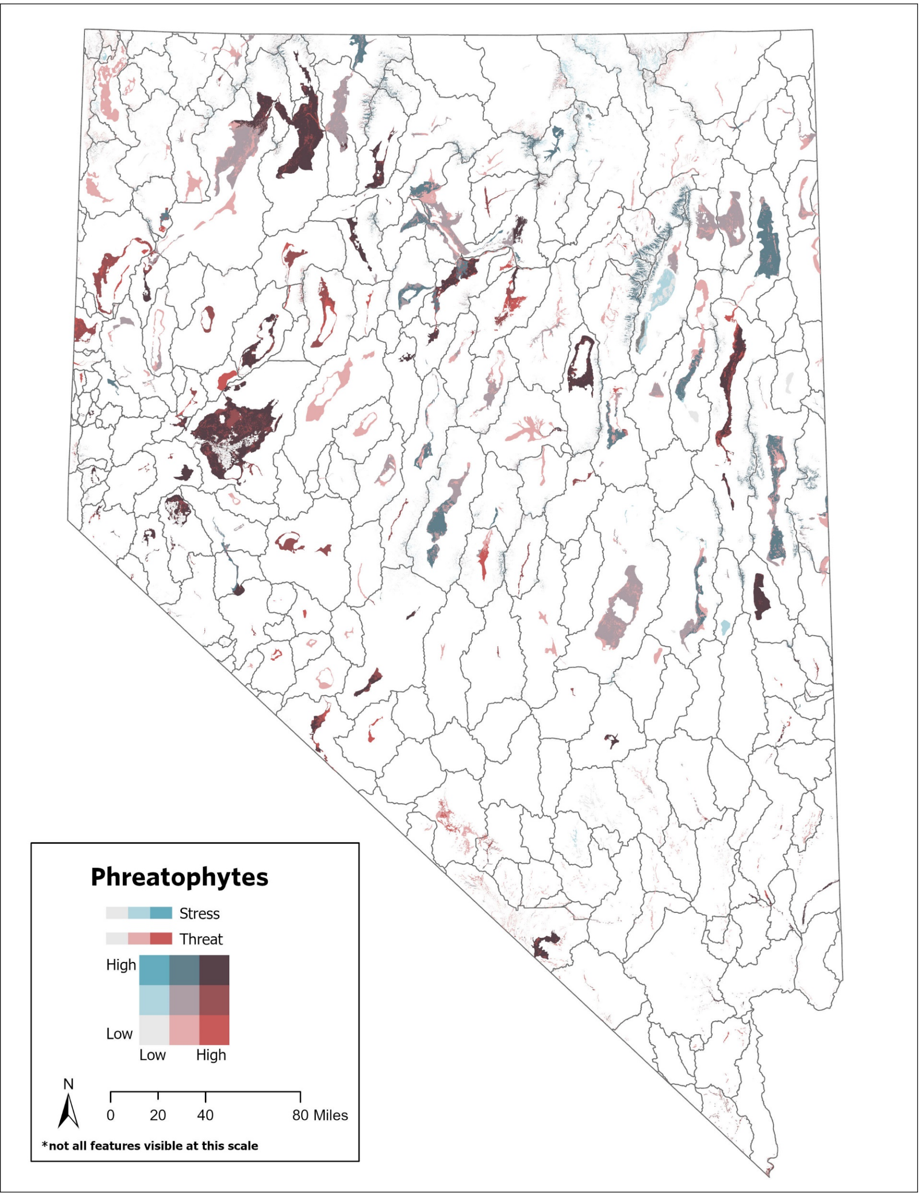
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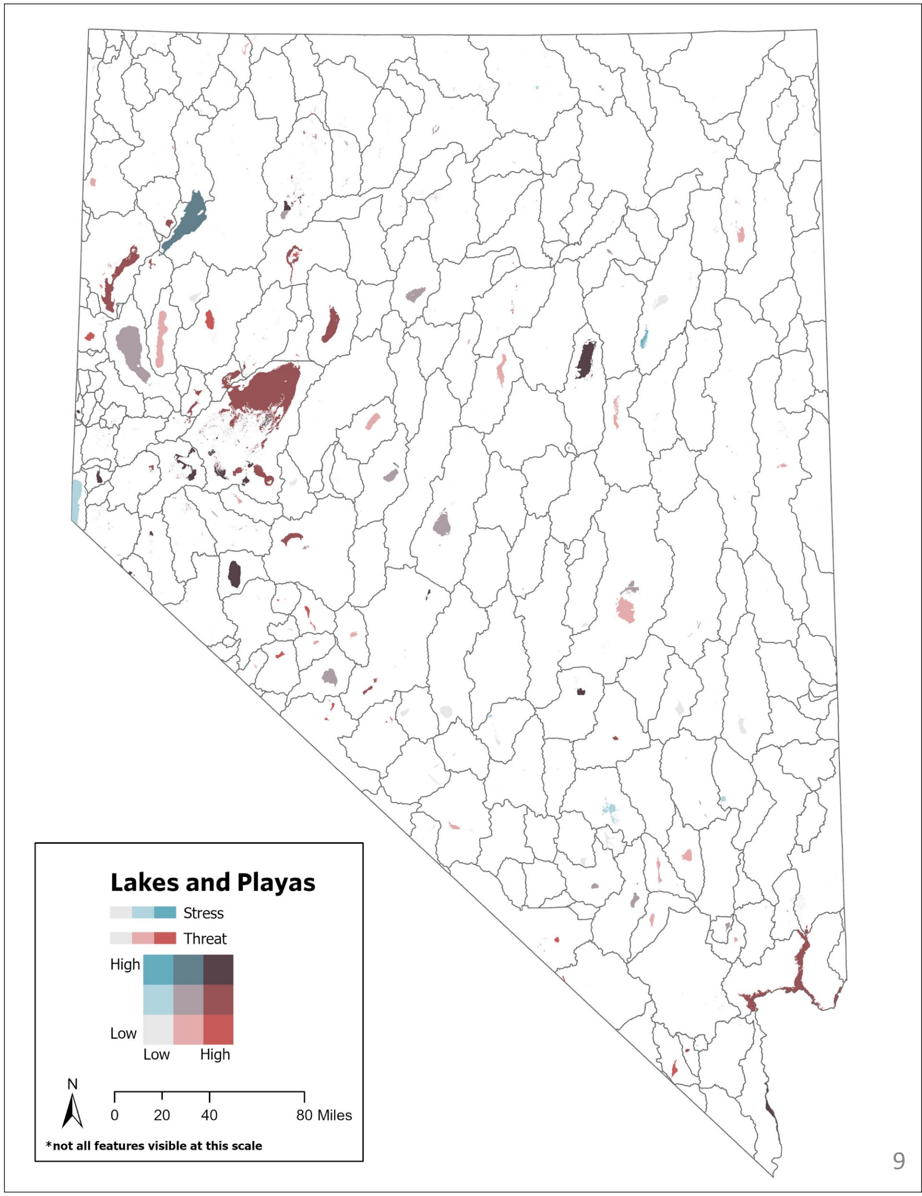
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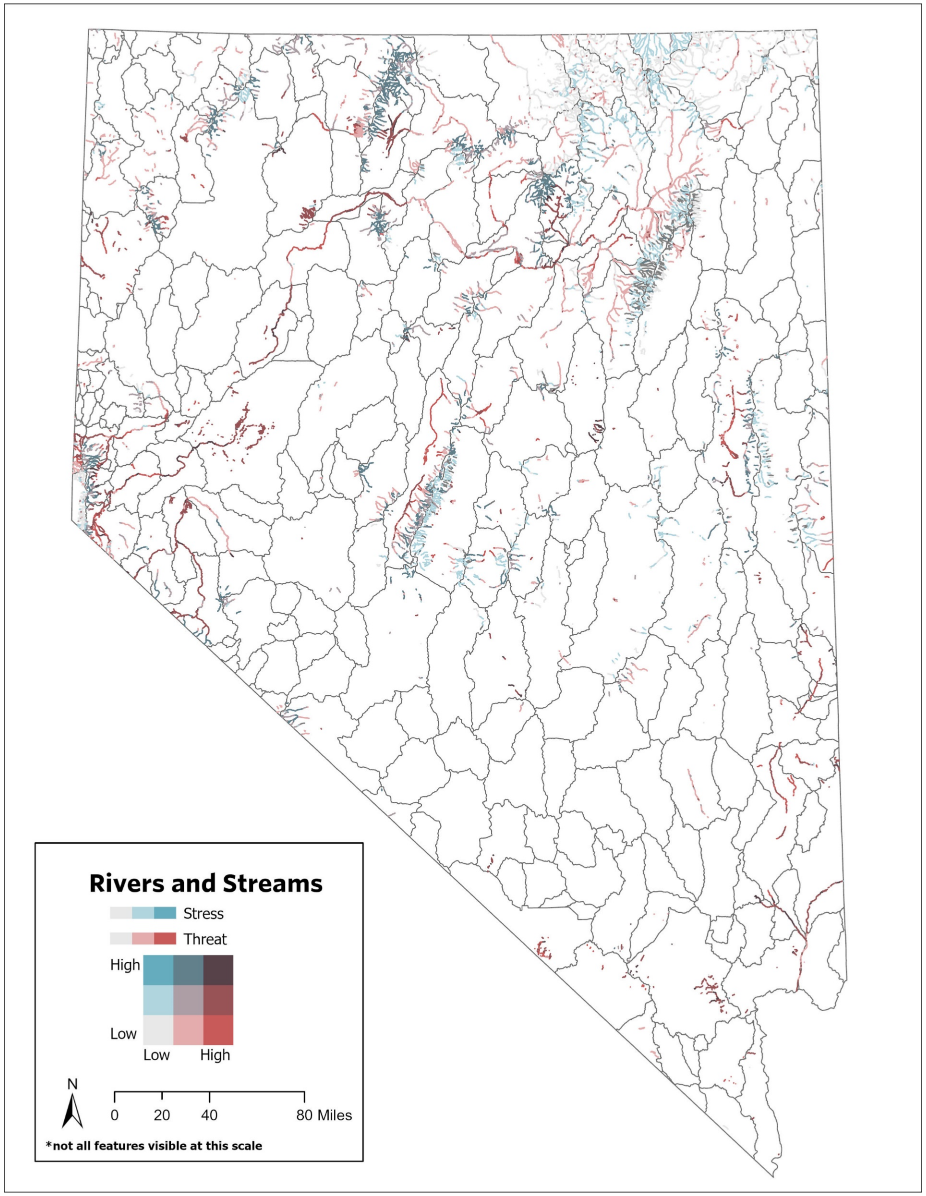

Rivers and Streams
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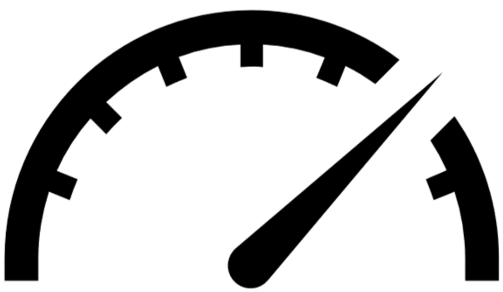
Simpson Park Range, NV/Source: J. Thompson
Five themes of stressors and threats
Stressor: currently impacting GDEs
Threat: potentially could impact GDEs in the future

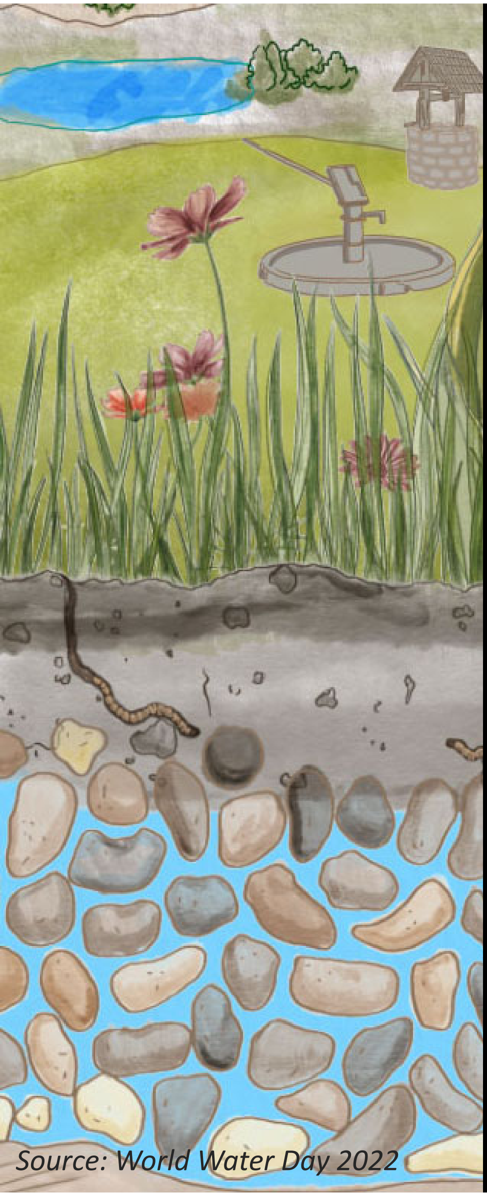


Rating approach

- Scale 0.00 (least risk) to 1.00 (high risk)
- Mostly qualitative assessment
  - Scores of 0.1 or 0.5 used to reflect uncertainty
  - Climate threat, housing density, and road density were continuous scales
- All stressors are also threats, but we chose to keep them separate from "future" threats
  - Exception: Ungulates were considered both stressors and threats

Caveats and limitations

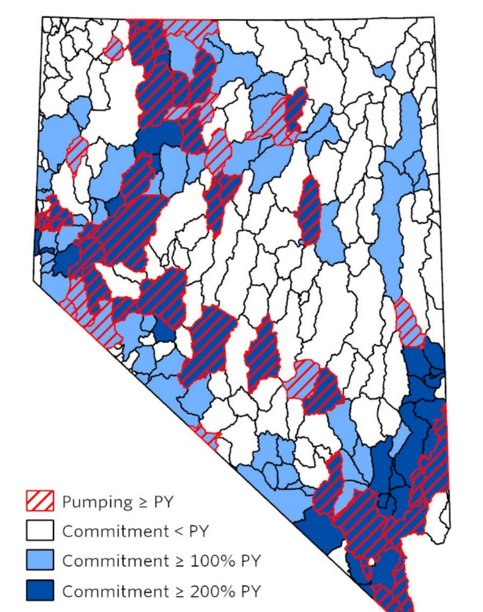
- Spatial analysis
- High-level “first cut” assessment



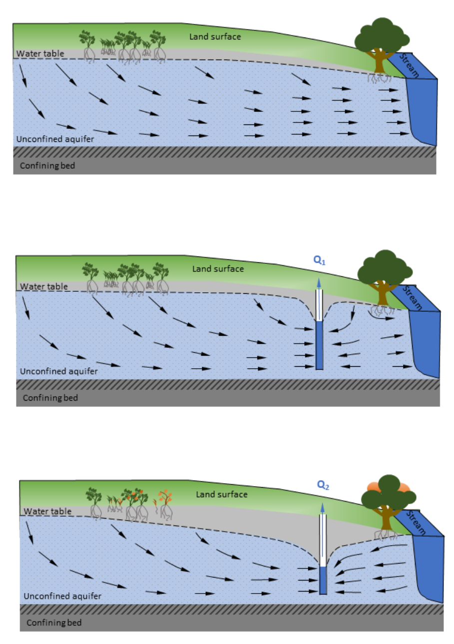
Source: World Water Day 2022

Groundwater withdrawals

Groundwater withdrawal impacts

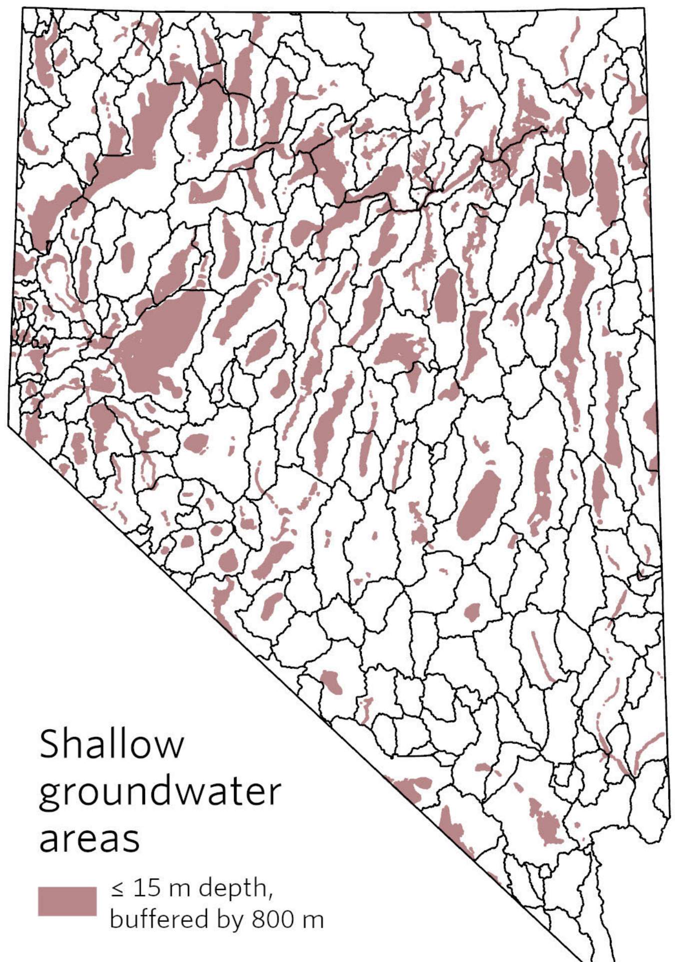


Source: Wilson (2020)



- Decline in water levels at and near a well that is withdrawing groundwater
- Lag times to impact
- Even longer times to recover
- Perennial yield approach can progressively eliminate GDEs
- Declining groundwater levels can detach water from GDEs

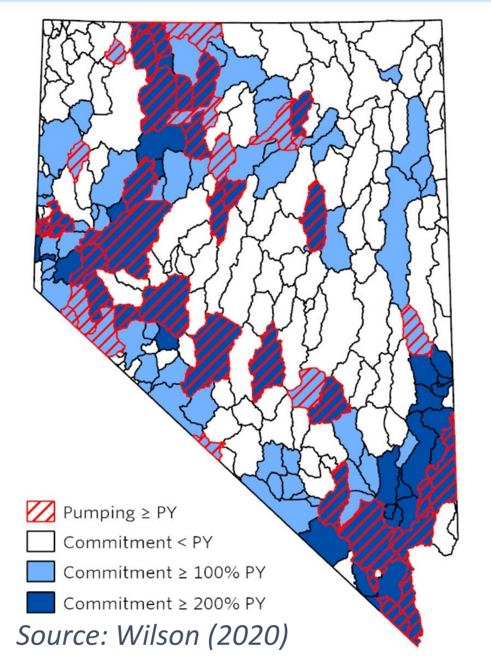
Groundwater withdrawals data



Shallow groundwater areas from Lopes et al. (2006)

- Hydrographic area appropriation and pumping status
- GDEs within 800 m (0.5 mi) of shallow groundwater from Lopes et al. (2006)
- USGS and NDWR groundwater levels (1984-2021)

Groundwater withdrawal stressors: Key takeaways



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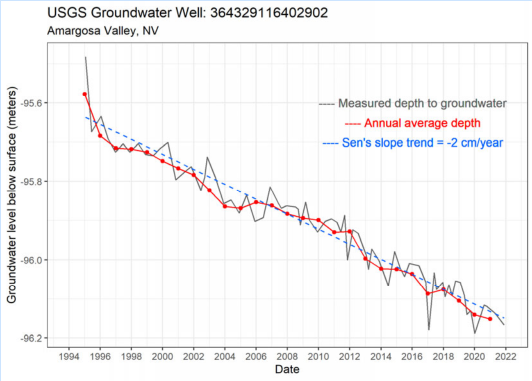
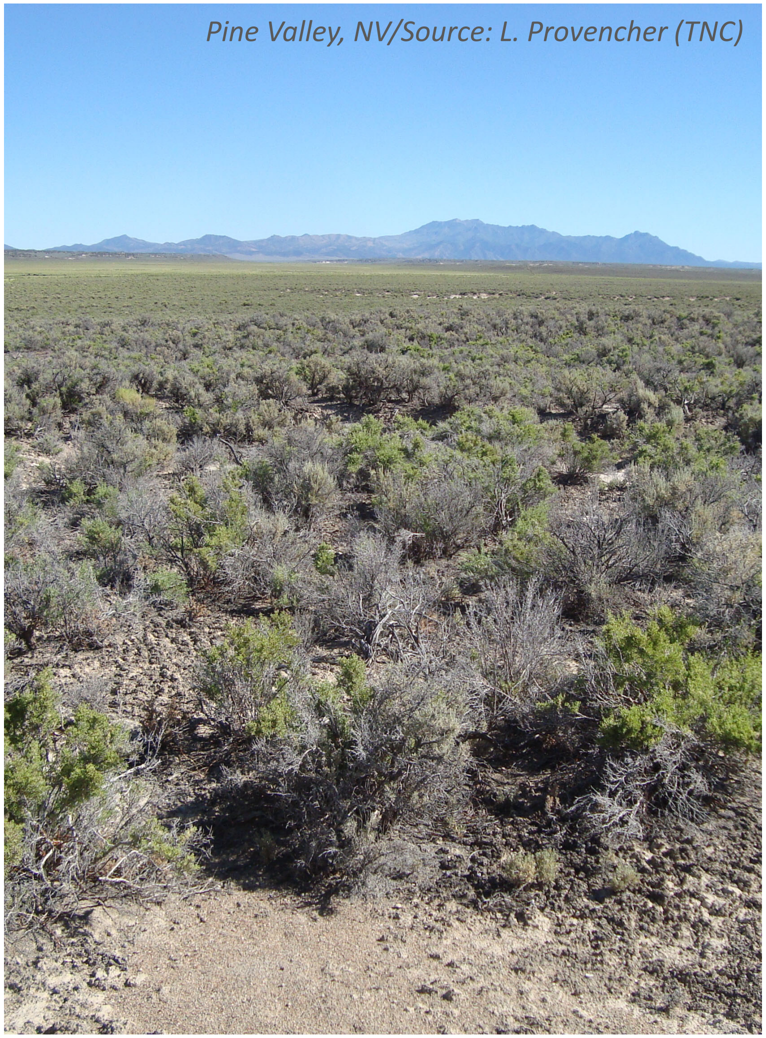


- ~20% of GDEs are in hydrographic areas that are over-pumped
- Over half of all hydrographic areas had at least one well site with significantly falling groundwater level trends
- 39% of the 6,536 wells analyzed had significantly falling groundwater level trends

Groundwater withdrawal threats:
Key takeaway

Over 70% of wetlands, phreatophyte communities, and lakes and playas are at high risk for potential groundwater withdrawals

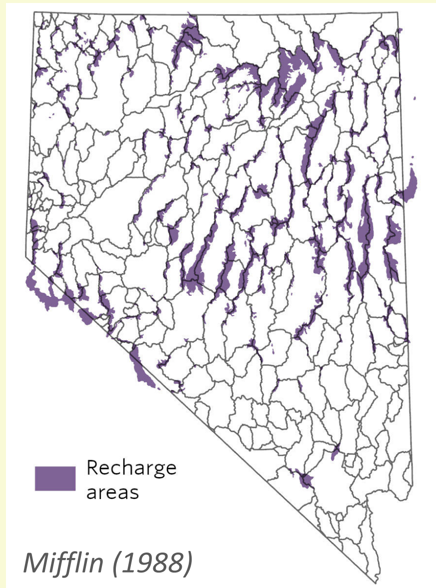


Climate

Climate impacts

- Climate can affect groundwater availability by affecting recharge rates and groundwater levels accessible to GDEs
- GDEs provide ecological stability if resilient to climate
- Warmer future climate will affect evapotranspiration and recharge

Climate data



Stressor: local flow paths

- Recharge areas from Mifflin (1988)

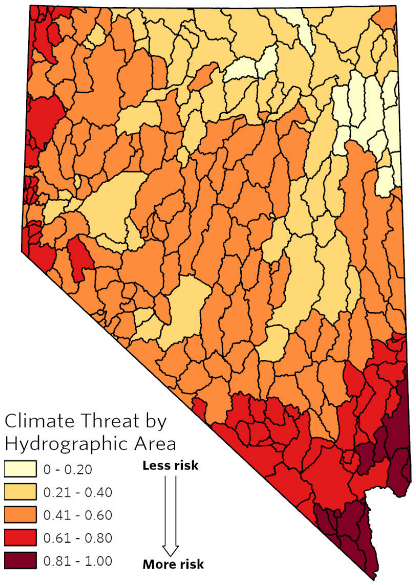
Threat: ecological drought conditions

- Downscaled global climate models at hydrographic area scale

Climate stressors: Key takeaway

Over 10,000 springs and over 3,700 miles of rivers and streams are at high risk for current drought and climate stresses

Climate threats: Key takeaways



Dixie Valley Playa, NV / Source: M. Rosen

- In the future (2022-2060), all hydrographic areas are projected to have more droughty conditions
- Almost 50% of lakes and playas are at moderate to high risk of future climate threat

Cortez, NV/Source: L. Provencher

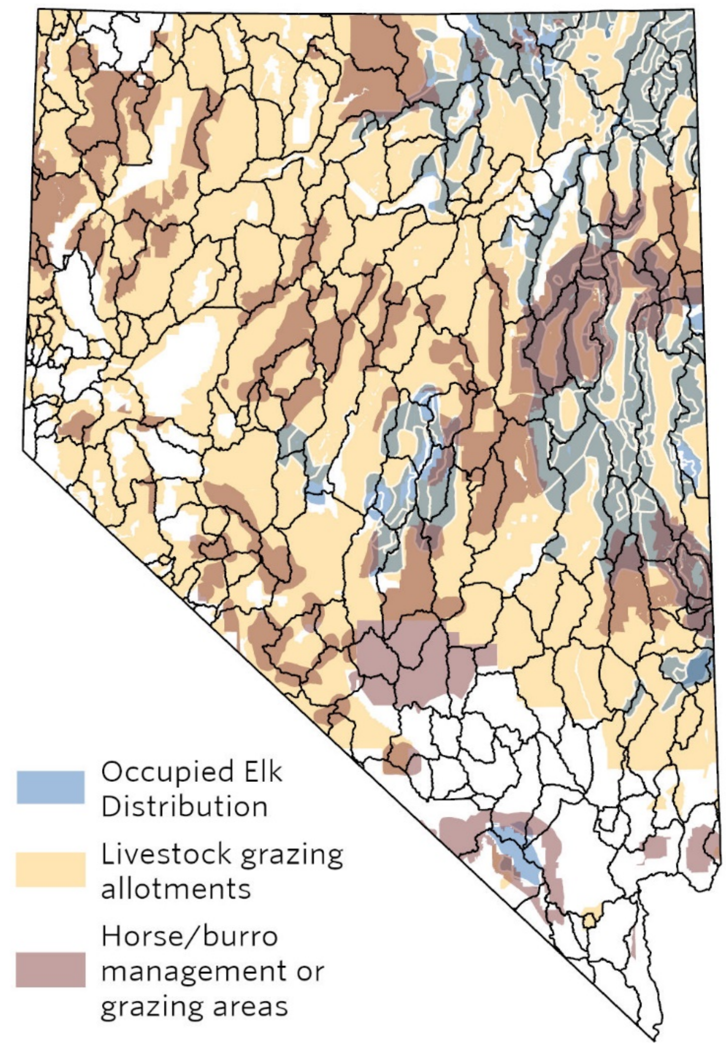
Ungulates

Ungulate impacts

Affect GDEs through trampling and grazing

Ungulate data sources

- Occupied elk distribution (NDOW)
- Herd management areas (BLM)
- Grazing allotments (BLM and USFS)



Ungulate stressors & threats: Key takeaways

7J Ranch, NV / Source: L. Warren

Boulder Mtn, UT / Source: L. Provencher

Almost 90% of springs and over 70% of rivers and streams are in ungulate areas

This is likely an over-estimate of impact

Non-native species

Torrance Ranch, NV / Source: L. Warren

Non-native species impacts

- Displace natural species, affect natural foodwebs, can cause population declines, extirpation or extinction
- Can affect local water balance, increase fire frequency
- Climate change may increase invasions and change GDEs
- Human contributions

Tamarisk at Humboldt River, NV / Source: L. Saito

Non-native species data

- Stressor: Non-native species presence
  - Non-indigenous Aquatic Species database (USGS)
  - Early Detection and Distribution Mapping System (EDDMapS)
  - Springs Stewardship Institute (SSI) data

- Threat: Road density
  - Road density: TIGER database of US Census data

Bullfrog at Corn Creek, NV / Source: L. Provencher

Russian knapweed at BLM Perkins, NV
Source: L. Provencher

Non-native species: Key takeaways


Walker Lake, NV / Source: L. Saito

Over 60% of lakes and playas are at high risk from the presence of non-native species

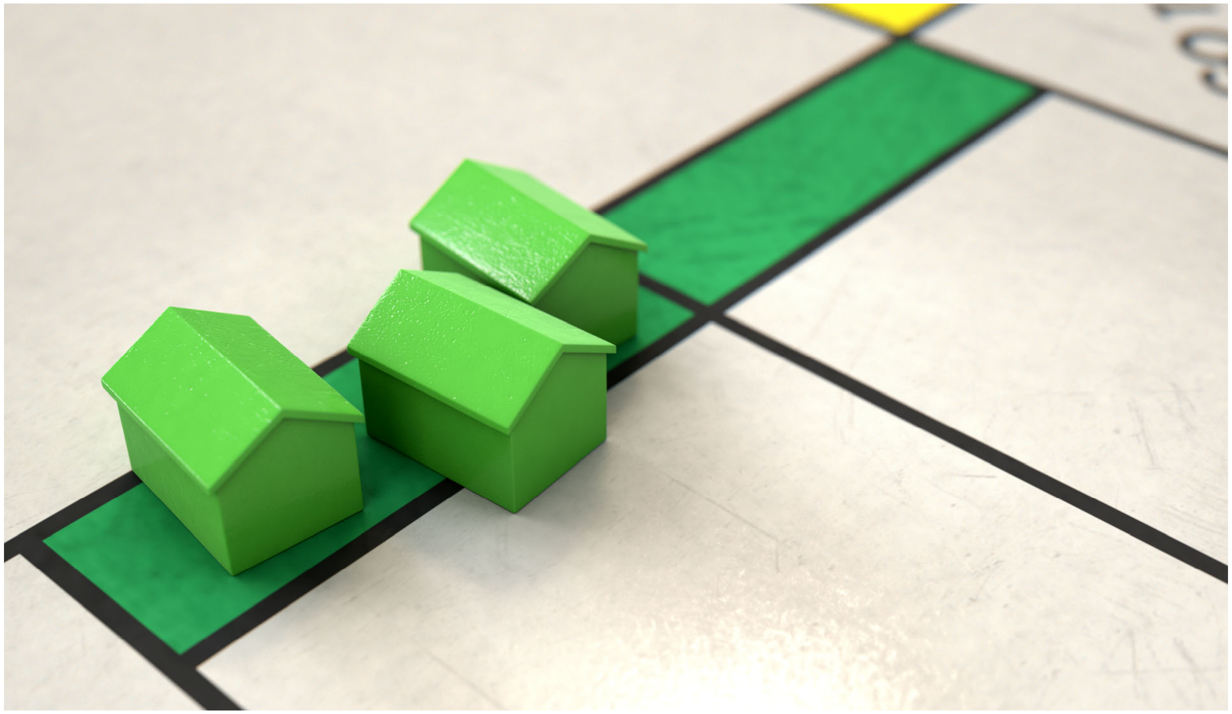
Springs had the lowest percentage at high risk

Additional impacts due to human development

Additional impacts due to human development

- Development can disturb GDEs, reduce recharge, alter local air temperature patterns
- Development can be source of groundwater contamination
- Surface diversions can affect species

Additional impacts due to human development data



Stressors

- Surface diversions (NDWR)
- 2010 housing density (Comer et al. 2013)

Threat

- Increased housing density in 2060 (Comer et al. 2013)

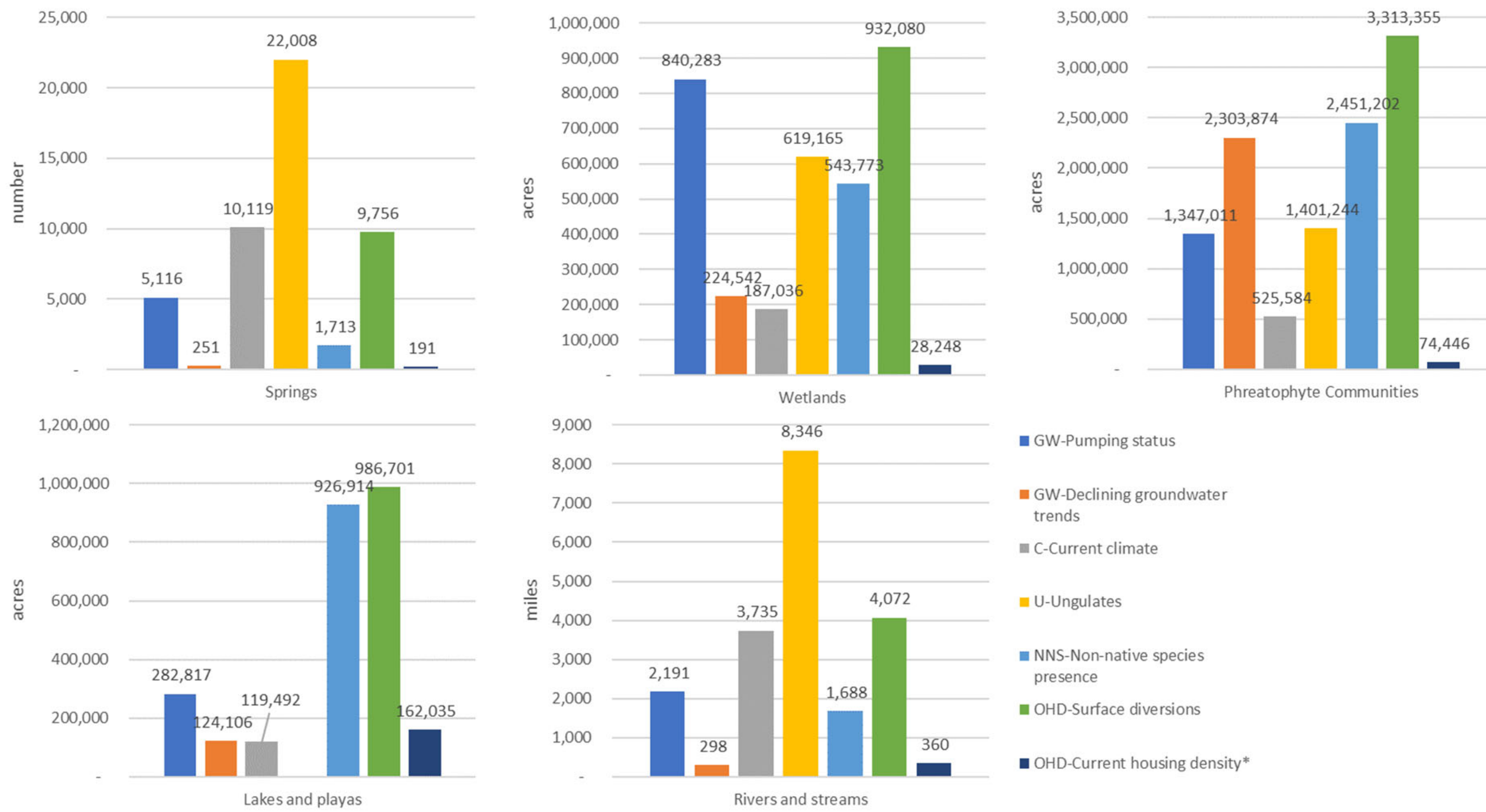
Additional impacts due to human development: Key takeaways

Bunkerville Diversion, NV / Source: L. Saito

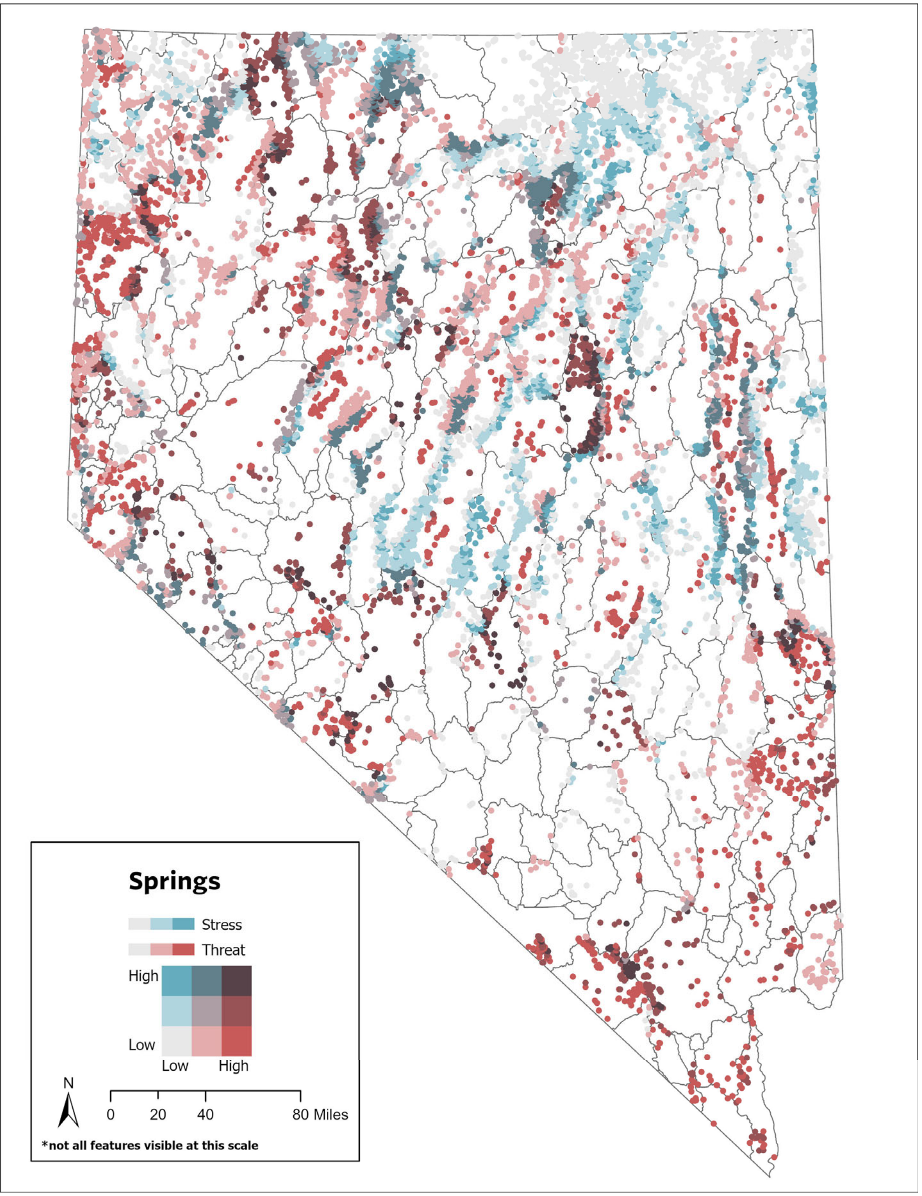
Over 60% of phreatophyte communities and lakes and playas are at high risk for surface water points of diversion

Over 100,000 acres of lakes and playas at risk for current housing density

Stressor risk factors



Threat risk factors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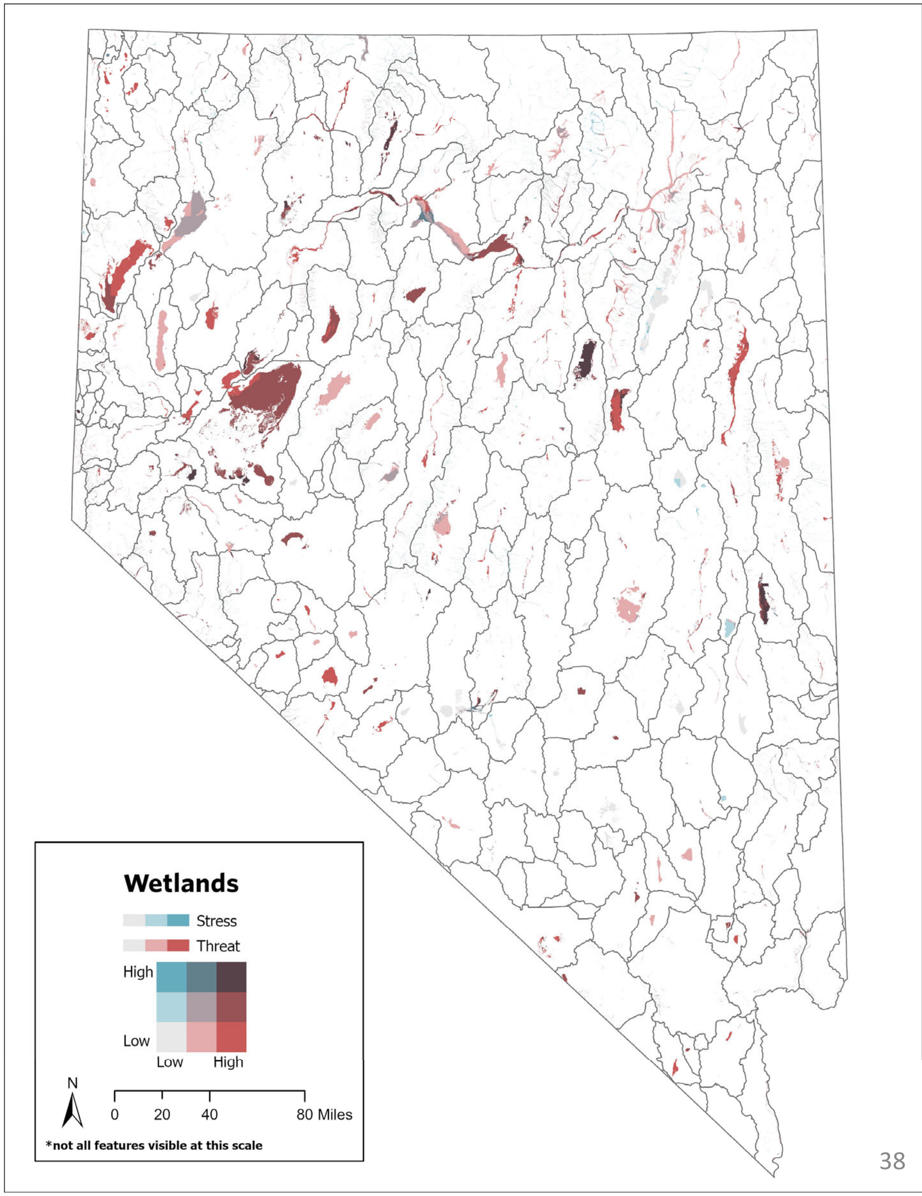
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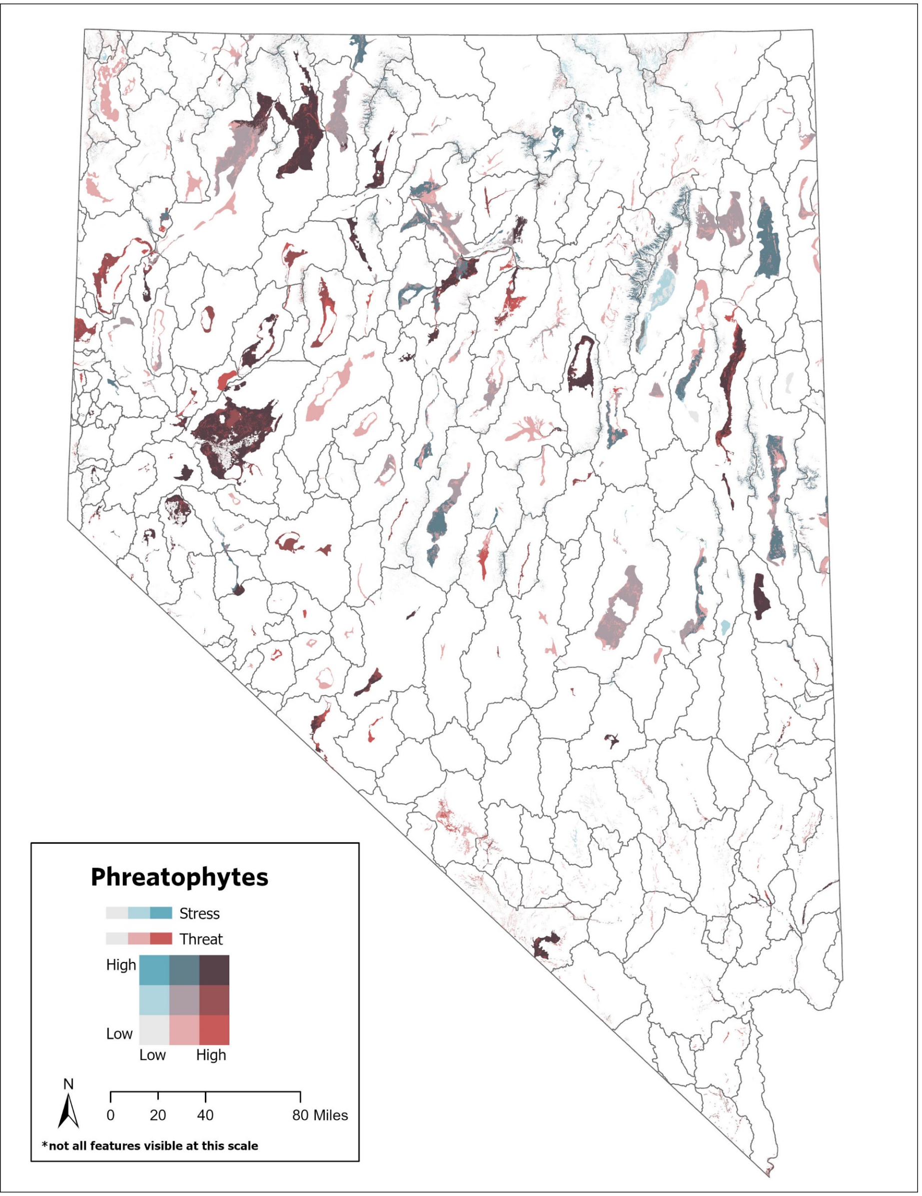
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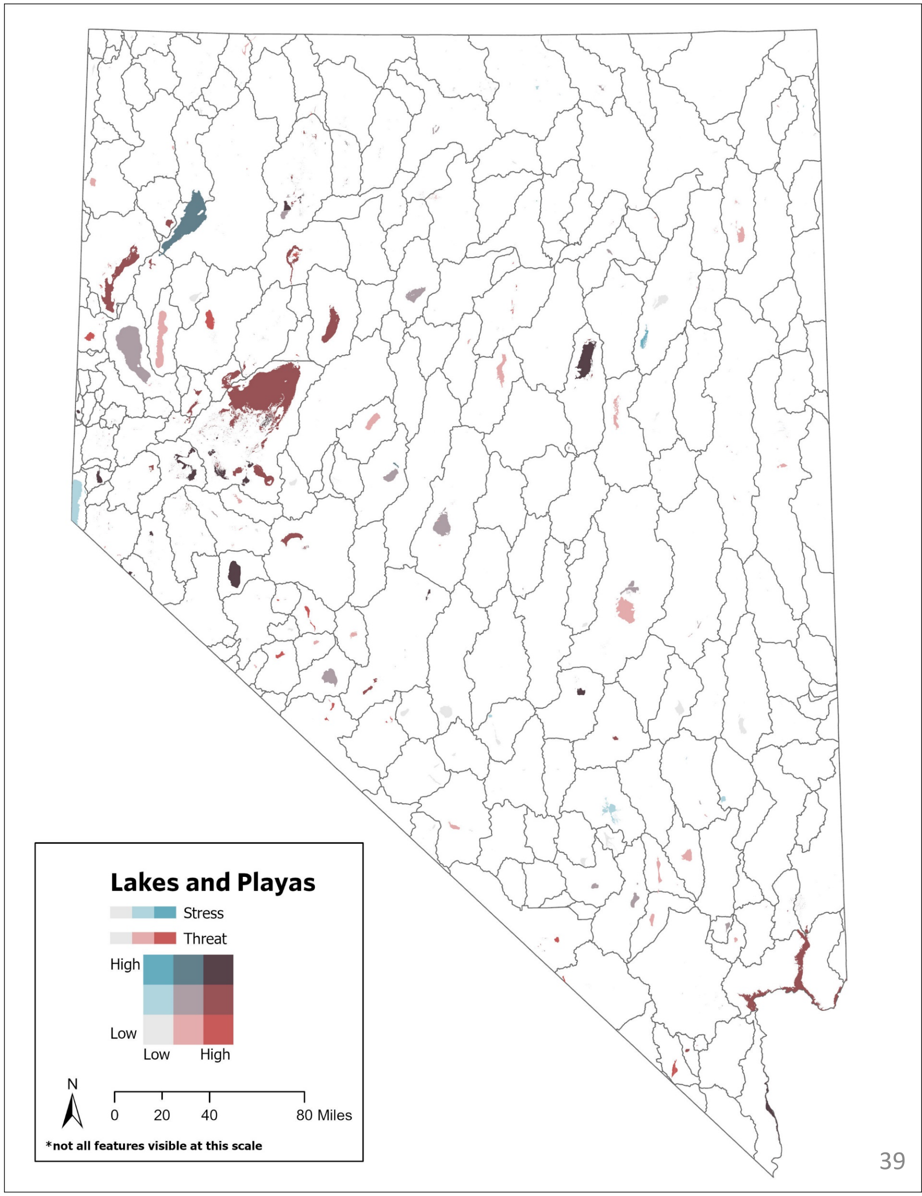
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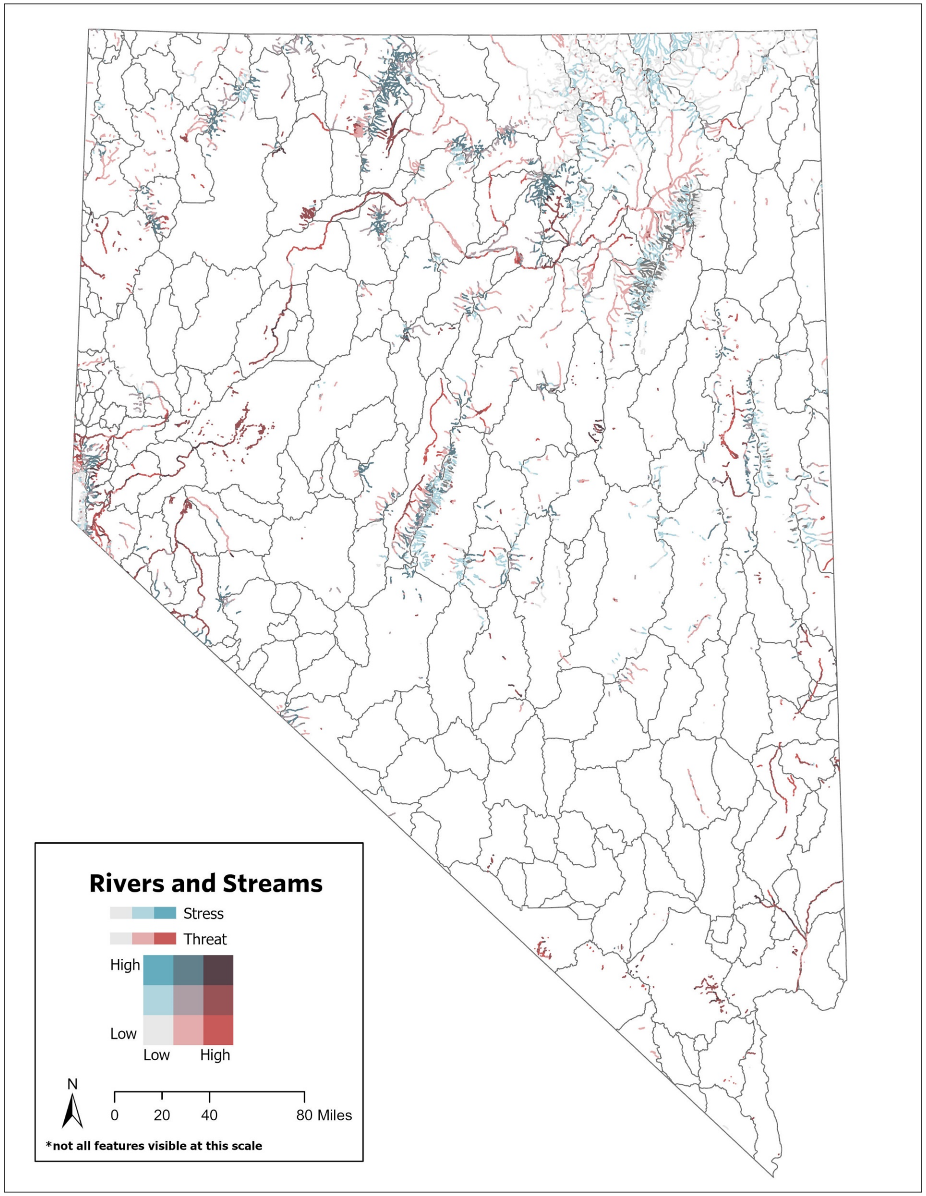

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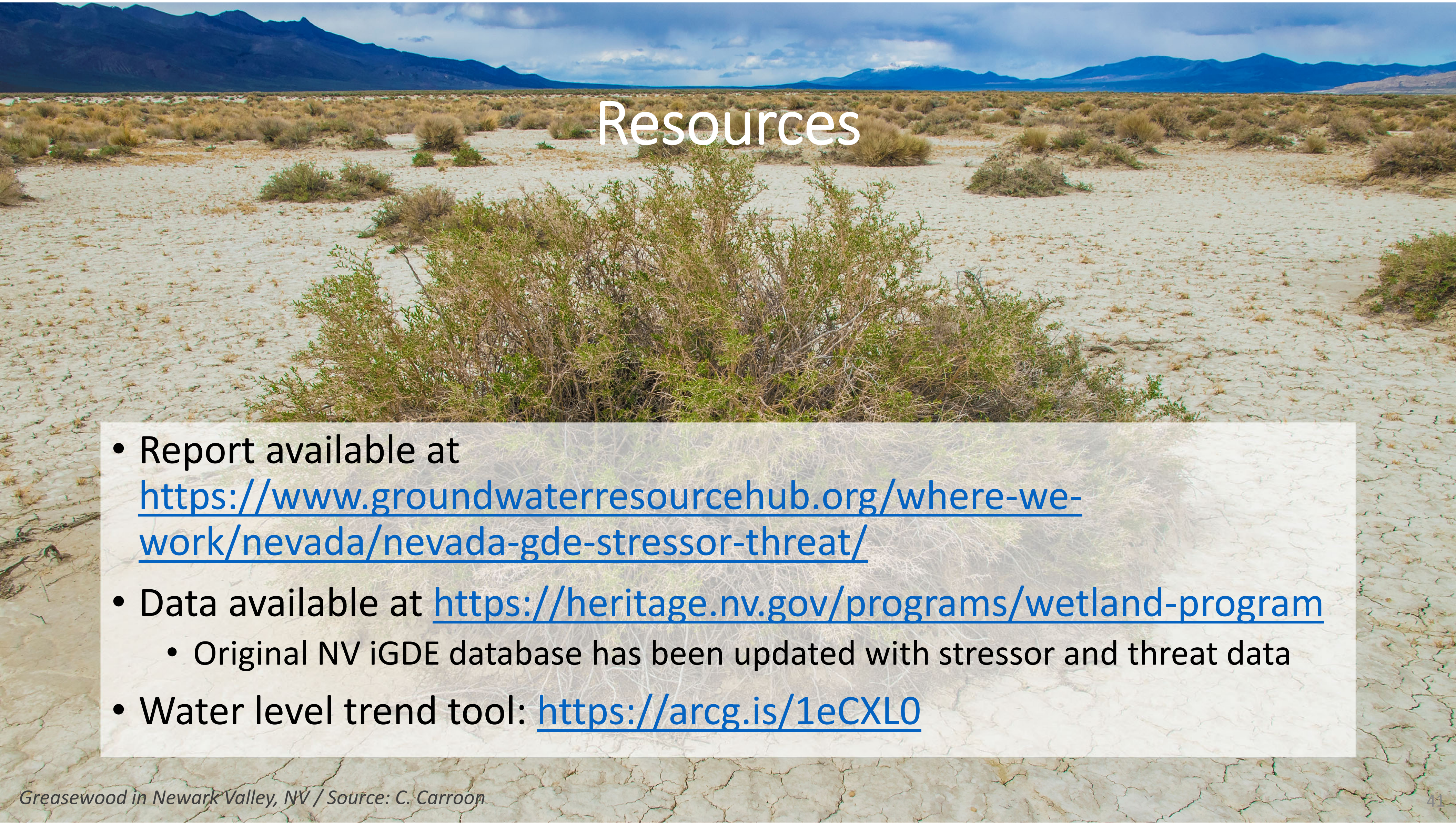
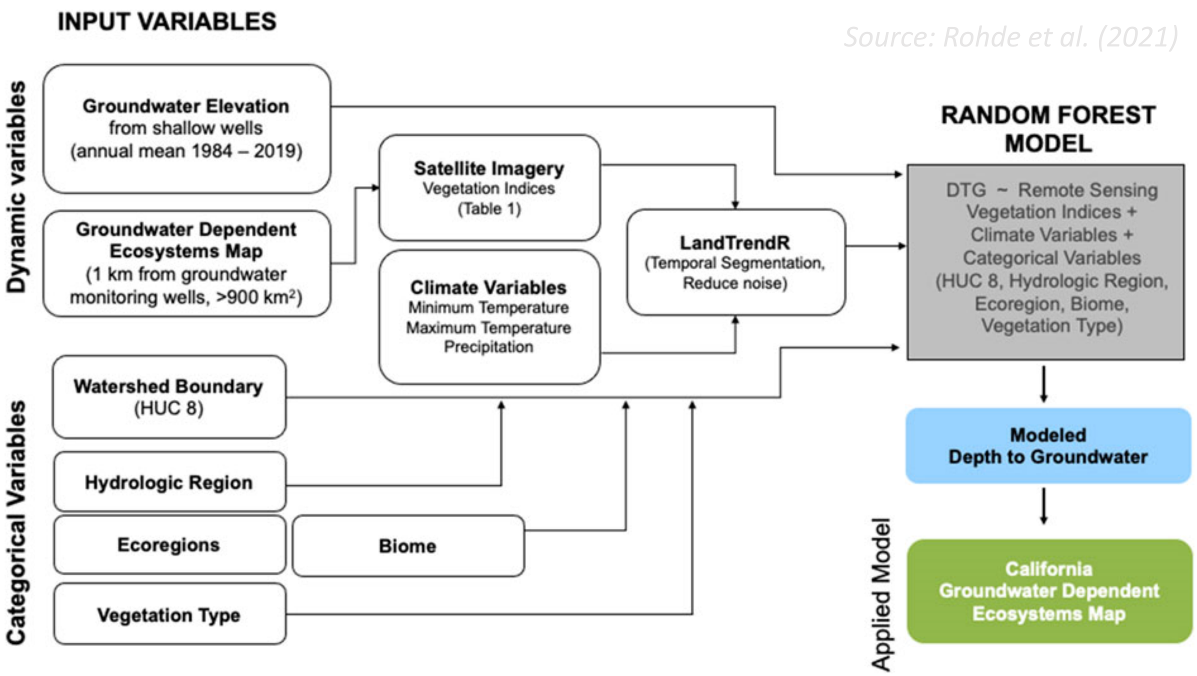
Resources

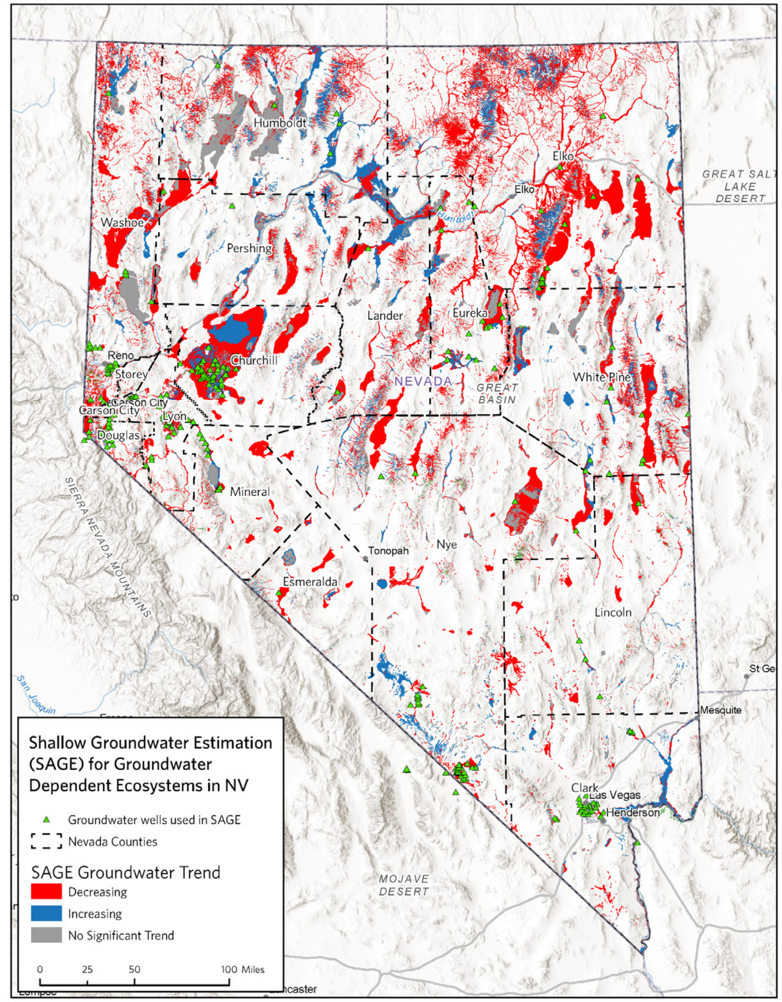
- Report available at https://www.groundwaterresourcehub.org/where-we-work/nevada/nevada-gde-stressor-threat/
- Data available at https://heritage.nv.gov/programs/wetland-program
  - Original NV iGDE database has been updated with stressor and threat data
- Water level trend tool: https://arcg.is/1eCXL0



Greasewood in Newark Valley, NV / Source: C. Carroon

What are risks to GDEs in Nevada?





Python code and methods doc: https://github.com/tnc-ca-geo/SAGE

Acknowledgements

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
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Christine Albano
Justin Huntington
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Dan McEvoy

The Nature Conservancy
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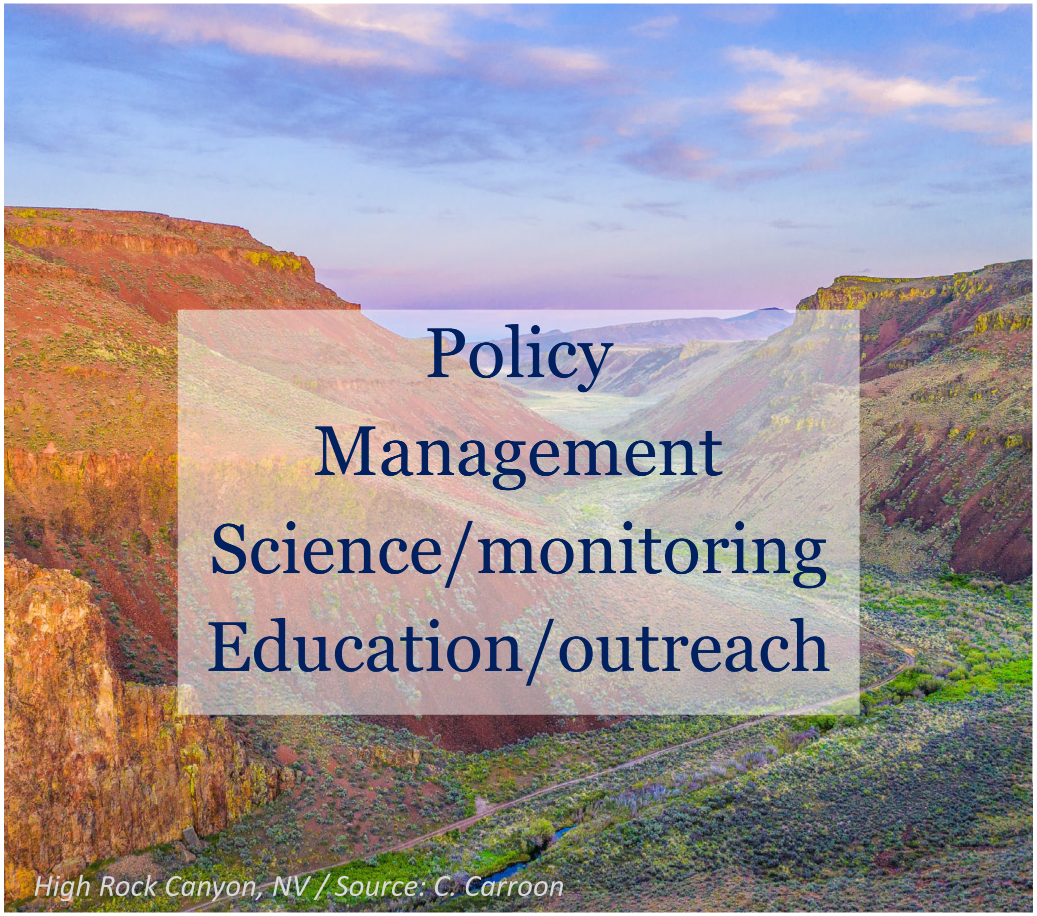
Sarah Byer
Kevin Badik
Louis Provencher
Liz Munn



High Rock Canyon, NV / Source: C. Carroon

Strategy discussion

- What strategies do you use for managing or sustaining GDEs?
- What are pros and cons of those strategies (e.g., cost, time, effort, logistics, etc.)?
- How can our strategy report be useful to you?

DRAFT

Approach: Matrix strategies with risk factors from stressor and threat report

Theme	Risk factor	Stressor	Threat
Groundwater withdrawals			
	Water right appropriation status of hydrographic area (HA)		X
	Pumping status of hydrographic area (HA)	X	
	Proximity of GDE to potential groundwater withdrawals		X
	Declining groundwater trends	X	
Climate			
	Current climate	X	
	Future climate		X
Ungulates			
	Herd management areas, elk distribution areas, grazing allotments	X	X
Non-native species			
	Known presence	X	
	Road density		X
Other human development			
	Housing density	X	
	Nearby surface water diversion	X	
	Future housing density		X

DRAFT

Qualitative risk reduction assessment

- Considering how likely it is that the strategy would result in reducing the impact of the stressor or threat on GDEs in Nevada
  - *Likely*: The strategy has a direct connection to the stressor or threat or is likely to lead to actions that would reduce the impact of the stressor or threat
  - *Possible*: The strategy may lead to actions that would reduce the impact of the stressor or threat

DRAFT

Categories of strategies

- Policy
  - Strategies that involve policy that enables actions to reduce impacts of stressors or threats to GDEs
- Management
  - Strategies that involve management actions to reduce impacts of stressors or threats to GDEs
- Science/Monitoring
  - Strategies to fill gaps in science/knowledge that can lead to policy or management strategies to reduce impacts of stressors or threats to GDEs
- Education/outreach
  - Strategies to provide education or outreach that can lead to reductions in impacts of stressors or threats to GDEs

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Example science/monitoring strategy: Improve understanding of co-benefits of healthy and restored GDEs, including carbon dynamics

Short description: Healthy GDEs are associated with water sustainability but also provide other benefits. Quantified multi-benefits for carbon storage and dynamics in GDEs have minimal data availability but are hypothesized to have exponentially more benefits that equivalent area of forest.

Potential actions: Carbon dynamics in GDEs study; develop models and framework tools to estimate co-benefits

Stressor risk	Risk reduction
Pumping status of HA	*Likely*
Declining groundwater trends	*Likely*
Current climate	*Likely*
Ungulates	*Likely*
Non-native species presence	*Possible*
Housing density	*Possible*
Nearby surface water diversions	*Likely*

Threat risk	Risk reduction
Appropriation status of HA	*Likely*
Proximity of GDEs to potential withdrawals	*Likely*
Future climate	*Likely*
Ungulates	*Likely*
Road density	
Housing density increase	*Possible*

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Example policy strategy: Enact policies to reduce excessive groundwater withdrawals and overappropriation to protect GDEs

Short description: Overuse of groundwater can reduce flows to springs and connected rivers and lakes, and lower groundwater levels beyond roots of vegetation. Policy is needed to reduce stresses and threats to GDEs due to such overuse.

Potential actions: Enable voluntary permanent retirement of groundwater rights, especially in basins that are overpumped; set policies for conjunctive management; secure water for the environment.

Stressor risk	Risk reduction
Pumping status of HA	*Likely*
Declining groundwater trends	*Likely*
Current climate	*Possible*
Ungulates	
Non-native species presence	
Housing density	
Nearby surface water diversions	*Possible*

Threat risk	Risk reduction
Appropriation status of HA	*Possible*
Proximity of GDEs to potential withdrawals	*Possible*
Future climate	*Possible*
Ungulates	
Road density	
Housing density increase	

DRAFT

Example management strategy: Reduce consumptive use

Short description: Reducing consumptive use of water is needed to reverse aquifer depletion, and can be done while preserving communities.

Potential actions: changes in infrastructure or equipment; crop switching; changes in land management.

Stressor risk	Risk reduction
Pumping status of HA	*Likely*
Declining groundwater trends	*Likely*
Current climate	*Possible*
Ungulates	
Non-native species presence	
Housing density	
Nearby surface water diversions	*Likely*

Threat risk	Risk reduction
Appropriation status of HA	*Likely*
Proximity of GDEs to potential withdrawals	*Possible*
Future climate	*Possible*
Ungulates	
Road density	
Housing density increase	

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Example management strategy: Manage for climate resiliency

Short description: All of Nevada is projected to be more “droughty” in the future, so climate resiliency for GDEs and species that depend on them is critical.
Potential actions: conserving climate refugia; targeting future conditions through habitat protection or restoration; managing for ecological transformation.

Stressor risk	Risk reduction
Pumping status of HA	*Possible*
Declining groundwater trends	*Possible*
Current climate	*Likely*
Ungulates	*Possible*
Non-native species presence	*Possible*
Housing density	*Possible*
Nearby surface water diversions	*Possible*

Threat risk	Risk reduction
Appropriation status of HA	*Possible*
Proximity of GDEs to potential withdrawals	*Possible*
Future climate	*Likely*
Ungulates	*Possible*
Road density	*Possible*
Housing density increase	*Possible*

Combined risk factors

- Weights applied to five themes of stressors and threats
  - Water withdrawals given highest weight
    - Without water, GDEs do not function
  - Climate given 2nd highest weight
    - Can create less water availability and exacerbate other stressors and threats

Theme	Weight
Groundwater withdrawals	3.0
Climate	2.0
Ungulates	1.0
Non-native species	1.0
Human activities	1.0

Scale for overall mean score is 0.00 (negligible risk) to 8.00 (high risk) after weights applied