STRATEGY 7

Increase the pace and scale of restoration of GDEs in time and space

Why this strategy is needed

Land and water management can disturb or alter groundwater-dependent ecosystems and their functions. For example, roads can alter hydrology, groundwater recharge, fish passage, wildlife habitat, water quality, and spread of non-native species (NRC 2005; Coffin et al. 2021). The stressor and threat assessment of Nevada GDEs found that 39% of the over 6,500 wells analyzed had significantly falling groundwater level trends between 1984 and 2021 (Saito et al. 2022a), which means that already there are many areas in Nevada where groundwater levels are declining. While many of those declines are likely due to groundwater pumping, stream incision resulting from land use and water management can also cause groundwater level declines in riparian areas (Miller et al. 2011a). The assessment also found that >10,000 springs and >3,700 miles of groundwater-dependent rivers and streams are associated with short groundwater flow paths (Saito et al. 2022a), so they are sensitive to changes in hydrology and are less resilient to drought (Miller et al. 2011b). Stressors and threats like these are contributing to precipitous declines in freshwater biodiversity, with freshwater species declining more than twice as fast as terrestrial or marine species (WWF 2014; Tickner at al. 2020). Tickner et al. (2020) point out that wetlands are vanishing 3 times faster than forests and restoring critical habitats is an important part of bending the trajectory of biodiversity loss. Nature-based solutions like managed aquifer recharge and restoring floodplains and riparian areas can provide important co-benefits to people and nature that make systems and species more resilient and adaptable to changing climates and other disturbances (Seddon 2022; United Nations 2022). For example, research in Sierra meadows with shallow groundwater tables has indicated that healthy meadows sequester more carbon than equivalent areas of forest, but degraded meadows emit carbon, and restoration may turn emitting meadows back into locations of sequestration (Reed et al. 2021). To improve resiliency and retain multiple benefits of healthy GDEs, restoration of GDEs is needed.

Examples of actions associated with this strategy

- Prepare programmatic environmental impact statements/assessments (EIS/EAs) to specify actions that can conserve or improve resiliency for GDEs
- Invest in or fund GDE restoration projects
- Integrate incentives for restoring GDEs in land or water management funding opportunities

Challenges and considerations

Funding for restoration work is often limited, and new environmental impact statements or assessments will likely be needed for much of the work on public lands. Guidance for where the most effective restoration can be done will be helpful (see Chambers et al. (2021) for an example on geomorphic conditions), including under specific circumstances like non-native fish presence or ungulate overuse. Identifying and quantifying the full suite of ecosystem services from restoration projects may unlock new funding streams for this work, but likely require additional science. While restoration may be able to address impacts of stressors and threats in the short term, the strategy needs to be done in conjunction with other strategies that address causes of GDE degradation (e.g., Policy Strategies and other Management Strategies) to ensure long-term benefits.

Qualitative assessment of the effectiveness of Strategy 7's ability to reduce the impacts of each GDE stressor and threat.

STRESSOR RISK	EFFECTIVENESS
S1: Groundwater pumping status	
S2: Declining groundwater level trends	*Somewhat Likely*
S3: Current climate	*Somewhat Likely*
S4: Ungulate impacts	*Highly Likely*
S5: Non-native species presence	*Highly Likely*
S6: Surface diversions	*Somewhat Likely*
S7: Urbanization	
THREAT RISK	**EFFECTIVENESS**
T1: Appropriation status	
T2: Potential withdrawal proximity to GDEs	
T3: Future climate	*Highly Likely*
T4: Non-native species spread	*Somewhat Likely*
T5: Future urbanization