Blue Wing Flat, Pershing County; source: nbmg.unr.edu

NEVADA DIVISION OF WATER RESOURCES

Nevada Department of CONSERVATION & NATURAL RESOURCES

Management Implications of Changing Groundwater Discharge Rates from Playas

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water.nv.gov

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NWRA Panel Presentations

- "Methods, Limitations, and Uncertainties of Estimating Groundwater Discharge from Playas" – Justin Huntington
- "Recent Hydrologic Perspectives on Groundwater Discharge from Playas and Evidence for Previous Overestimates" – Philip Gardener
- "Geochemical Evidence of Groundwater Discharge to Playas Over Long Temporal Scales" – Michael Rosen

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USGS Reconnaissance Reports

- "Focused studies" authorized by the 1960 Nevada Legislature and conducted by USGS (in cooperation with DCNR) to cover all valleys of the state where development opportunities existed and more information about available groundwater was needed.
- In most cases, these studies were conducted prior to groundwater development.
- Used to determine groundwater budgets and perennial yields of groundwater basins.

- Other studies included Bulletins, Open-File Reports, and Information Series Reports

Groundwater Budgets

USGS Recon Reports

Budget elements	Railroad Valley Northern Part	Penoyer Valley
INFLOW		
Groundwater recharge from precipitation	46,000	4,300
Subsurface inflow	7,000	--
Total	53,000	4,300
NATURAL OUTFLOW		
Evapotranspiration	80,000	3,800
Subsurface outflow	--	--
Total	80,000	3,800
IMBALANCE		
Excess of outflow over inflow	-27,000	500
VALUE SELECTED TO REPRESENT INFLOW AND OUTFLOW	75,000	4,000

Evapotranspiration and Groundwater Discharge from Playas

- "Evapotranspiration" in Recon Report water budgets includes various components, depending on the report, e.g.:
  - Greasewood
  - Saltgrass and saltbush
  - Meadowgrass, tules, willows and other wet-area phreatophytes
  - Bare soil
- This analysis includes only the bare soil playa in consideration of direct groundwater discharge (no transpiration component).

Perennial Yield

- Reflects the water budget; this is the maximum amount of groundwater that can be withdrawn and consumed economically each year for an indefinite period without depleting the reservoir.
- Cannot exceed the natural recharge to an area, and may be less, depending on certain limitations:
  - Well distribution
  - Salvage times
  - Water quality
- Used as one guideline by the State Engineer regarding the amount of groundwater available for development in a basin.
- Note on use of “best available science” - NRS 533.024 (c).

Criteria for Approving or Rejecting an Application

NRS 533.370 (2):

- The State Engineer is prohibited from granting a permit where:
  - There is no unappropriated water at the proposed source, or
  - The proposed use conflicts with existing rights, or
  - The proposed use conflicts with domestic wells, or
  - The proposed use threatens to prove detrimental to the public interest

USGS ET Studies

Garcia et al., 2014

- Used eddy-covariance methods (which measure sensible heat flux and latent-heat flux directly from eddies) were used to estimate ETg
- Results indicated ETg rates of 0.02±0.023 m/yr

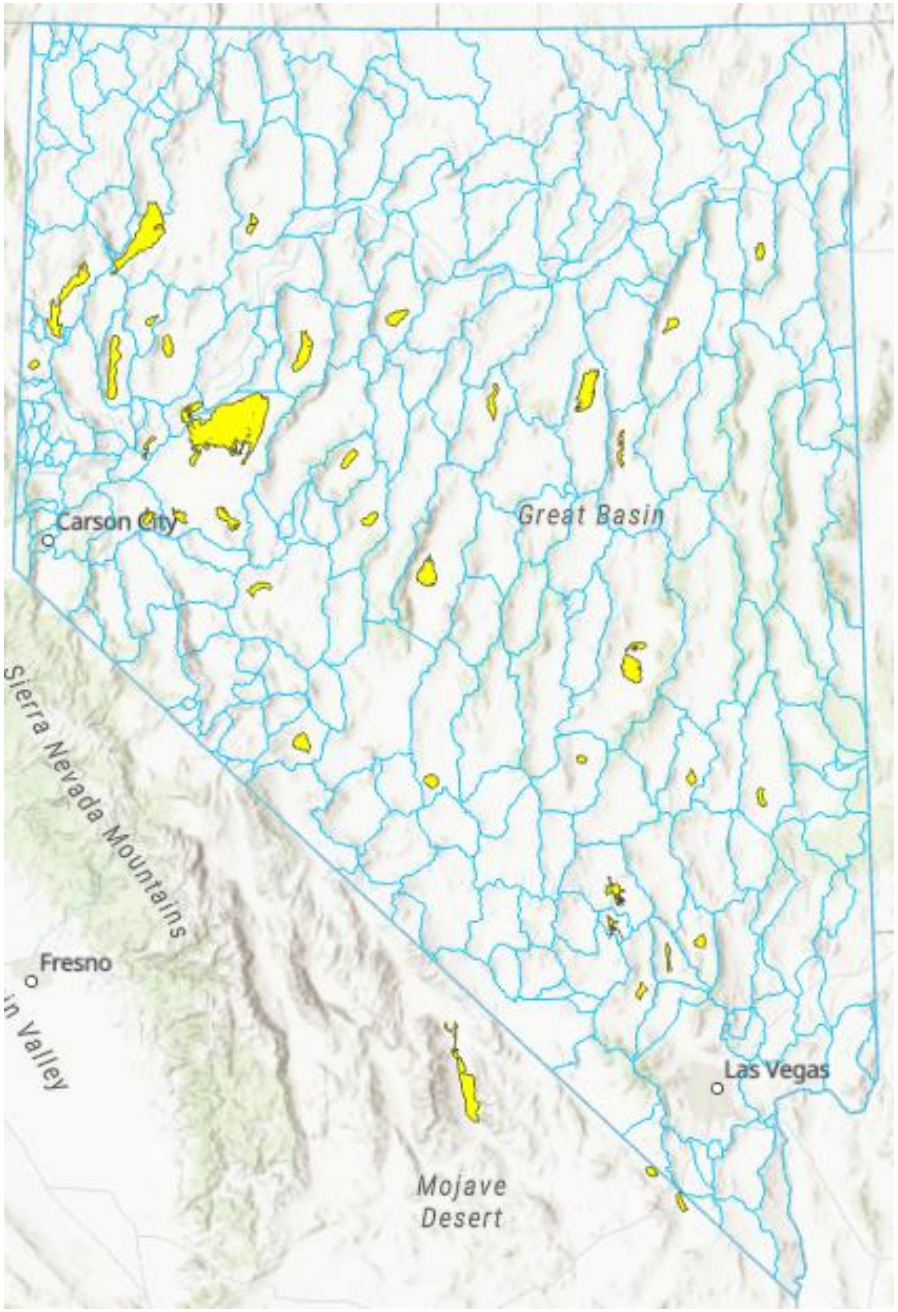
Jackson et al., 2018

- Used cross-sectional groundwater flow modeling to constrain the uncertainty associated with the field ET measurements, using two different sets of discharge values:
  - -ET (assumes reported playa ETg rates are good approximations of groundwater discharge from desert playas)
  - -HYDK (assumes that hydraulic properties of playa sediments are better known than reported playa ETg rates

NDWR Project

Playas considered for this project

- Selected from the National Hydrography Dataset
- Larger than 20 km^2
- Bare soil areas were taken from the corresponding Recon Reports, for consistency
- Playas outside the State of Nevada were not considered



NDWR Project

Basin Number	Basin Name	PY Source	PY	Reported Playa Area (acres)	Reported discharge rate (feet/y	Reported discharge (AFY	DIXIE-ET discharge calc (AFY)	DIXIE-HYDK discharge calc (AFY)	Committed GW (AFY)	PY minus Committed (AFY)
021	Smoke Creek Desert	R44	16,000	114,000	0.10	11,000	5,423	468	56,082	-
028	Black Rock Desert	WFN3, R20	30,000	200,000	0.04	10,000	9,515	820	32,479	-
080	Winnemucca Lake Valley	B15, R57	3,300	40,000	0.10	4,000	1,903	164	669	2,631
129	Buena Vista Valley	B13	10,000	9,000	0.16	1,500	428	37	29,645	-
137B	Big Smoky Valley (Northern Part)	B41	65,000	23,300	0.10	2,300	1,108	96	73,044	-
153	Diamond Valley	B35, R6	30,000	50,000	0.10	5,000	2,379	205	136,655	-
173B	Railroad Valley (Northern Part)	R60, B12	75,000	38,000	0.10	3,800	1,808	156	31,803	43,197
128	Dixie Valley	R23	15,000	29,400	0.10	2,940	1,399	121	12,345	2,655
078	Granite Springs Valley	R55, Ruling 5782	4,500	14,200	0.10	1,400	676	58	4,678	-
131	Buffalo Valley	OFR78-768	8,000	18,000	0.10	1,800	856	74	21,297	-

- Discharge rate and reported discharge were also taken from the Recon Reports, if available
- Mean ETg rates (-ET and –HYDK) for Dixie Valley modeled by Jackson et al. (2018) were used to determine a range of ETg values based on the playa acreages
- The committed resource was compared to the perennial yield of each basin to determine where water might be available for appropriation

Results

Of the basins considered (containing the playas), only seven have groundwater available for appropriation:

- Winnemucca Lake Valley, Railroad Valley (Northern Part), Dixie Valley, Ralston Valley, Emigrant Valley (Groom Lake Valley Subarea), Ruby Valley, and Bradys Hot Springs Area
- In some basins, there is significant change in the ETg fraction of the water budget

Basin Number	Basin Name	PY Source	PY	Reported Playa Area (acres)	Reported discharge rate (feet/yr)	Reported discharge (AFY)	DIXIE-ET discharge calc (AFY)	DIXIE-HYDK discharge calc (AFY)	Committed GW (AFY)	PY minus Committed (AFY)
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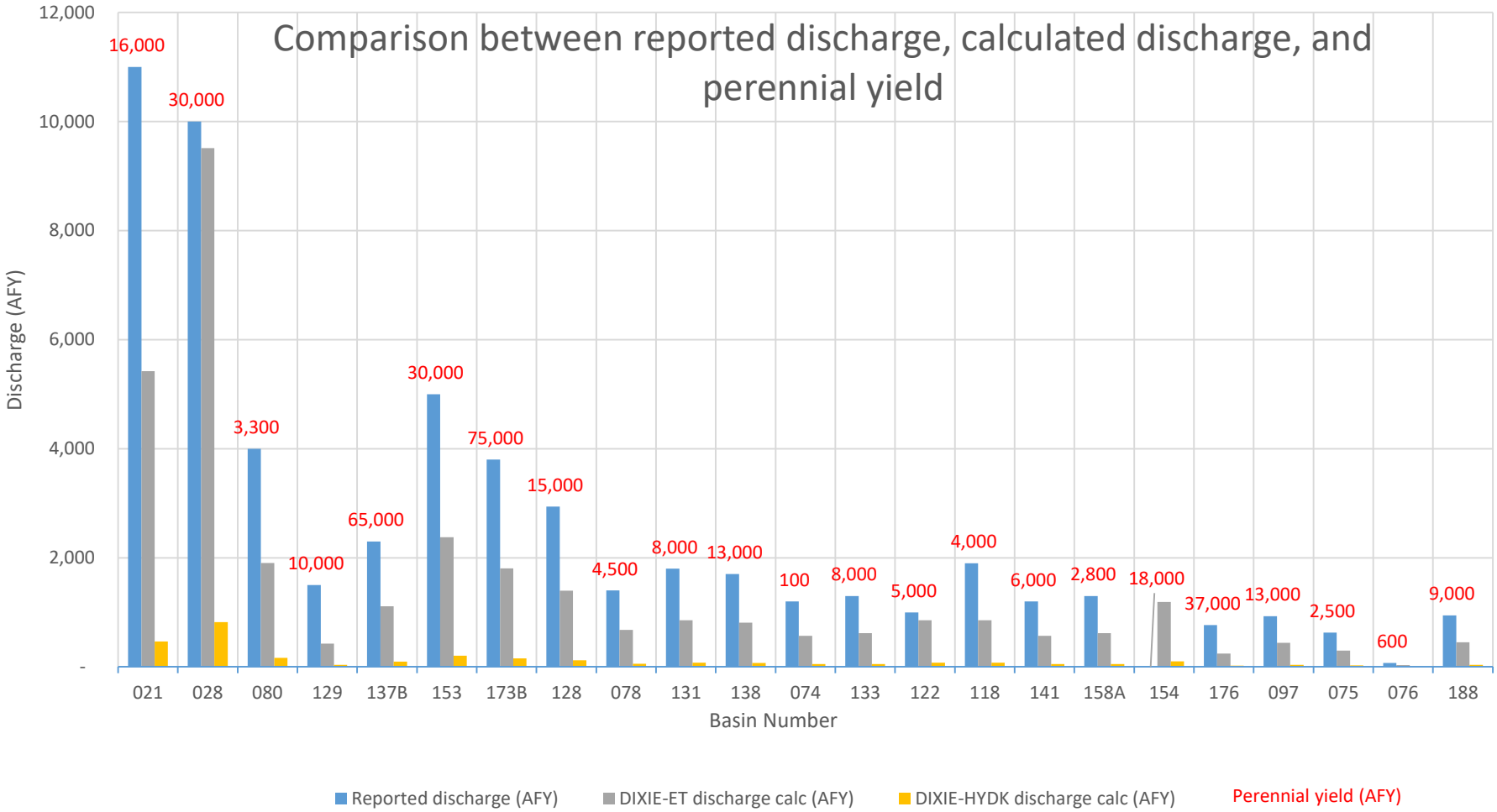
128	Dixie Valley	R23	15,000	29,400	0.10	2,940	1,399	121	12,345	2,655
141	Ralston Valley	WFN3, R12	6,000	12,000	0.10	1,200	571	49	4,354	1,646
158A	Emigrant Valley (Groom Lake Valley Subarea)	DWR Report 3, R54	2,800	13,000	0.10	1,300	618	53	12	2,788
176	Ruby Valley	Ruling 6277	37,000	5,100	0.15	765	243	21	23,224	13,776
075	Bradys Hot Springs Area	R55	2,500	6,300	0.10	630	300	26	2,145	355

Results


Comparison between reported discharge, calculated discharge, and perennial yield
Discharge (AFY)
12,000
10,000
8,000
6,000
4,000
2,000
-
16,000
30,000
3,300
10,000
65,000
30,000
75,000
15,000
4,500
8,000
13,000
100
8,000
5,000
4,000
6,000
2,800
18,000
37,000
13,000
2,500
600
9,000
021
028
080
129
137B
153
173B
128
078
131
138
074
133
122
118
141
158A
154
176
097
075
076
188
Basin Number
Reported discharge (AFY)
DIXIE-ET discharge calc (AFY)
DIXIE-HYDK discharge calc (AFY)
Perennial yield (AFY)

Management Implications

Would decreased ETg affect the amount of groundwater available?

- Depends on how the PY was determined, other technical considerations, and the criteria the State Engineer must follow when considering whether to approve or reject an application
- Rulings on applications could change the PY of a basin (e.g., Ruling 6277)
- New studies utilizing different ETg rates could be considered “best available science” in future decisions
- If basins are overappropriated, analyses such as this one could inform designation of critical management areas, or other management strategies by the State Engineer

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Dry Lake, Kumiva Valley; source: nbmg.unr.edu

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