Legislative Commission's Subcommittee to Study Water

(*Nevada Revised* Statutes 218E.200)

WORK SESSION DOCUMENT

(Includes Exhibits)

August 26, 2016

Prepared by the Research Division
Legislative Counsel Bureau

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Legislative Commission's Subcommittee to Study Water
(*Nevada Revised Statutes* 218E.200)

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This "Work Session Document" has been prepared by the Chair and staff of the Legislative Commission's Subcommittee to Study Water. It is designed to assist the Subcommittee members in determining which recommendations will be forwarded to the 2017 Session of the Nevada Legislature and what other actions the Subcommittee will endorse. Each item in this document may be the subject of further discussion, refinement, or action.

The inclusion of recommendations does not imply the support of the Subcommittee. Rather, these possible actions are compiled so the members may review them to decide if they should be adopted, changed, rejected, or further considered. The members of the Subcommittee may vote to send as many Subcommittee statements or letters as they choose; however, pursuant to *Nevada Revised Statutes* (NRS) 218D.160, the Subcommittee is limited to five bill draft requests, including requests for the drafting of legislative resolutions. The recommendations have been grouped by topic and are not preferentially ordered.

Additionally, although possible actions are identified for each recommendation, the Subcommittee may choose to recommend any of the following actions: (1) draft legislation; (2) draft a resolution; (3) send a letter; or (4) include a position statement in the final report.

The source of each recommendation is noted in parentheses. Please note that a recommendation may have been modified during the preparation of the

Work Session Document for a variety of reasons, including without limitation: (1) through combination with similar proposals; (2) to propose a different type of action; or (3) by the addition of details needed for drafting purposes. Further, some recommendations may contain unquantified or unknown fiscal impacts. Subcommittee members are advised that Legislative Counsel Bureau staff will coordinate with the interested parties to obtain fiscal estimates, where appropriate or feasible, for inclusion in the final report.

Finally, please note that during the legislative drafting process, specific details of approved requests for legislation or other Subcommittee action may be further clarified by Subcommittee staff in consultation with the Chair or others, as appropriate. Also, some recommendations may include references to specific chapters or statutes. However, as part of the bill drafting process, amendments to other related chapters or sections of the NRS may be added to fully implement the recommendation.

Cloud Seeding

1. **A. Request the drafting of a bill** to appropriate $740,250 per year ($1,480,000 for the fiscal year 2017-2018 Biennium) to cover 75 percent of the estimated cost for cloud-seeding activities in Nevada during the 2017 and 2018 winters utilizing fully automated generators, as proposed by Desert Research Institute (DRI), within the following areas in Nevada: Upper Walker River watershed; Upper Truckee River/Lake Tahoe watershed; Mount Charleston; and cloud seeding by aircraft in the Upper Walker River Basin, the Upper Carson River Basin, and the Upper Truckee River and Lake Tahoe basins; and cloud-seeding activities in the Humboldt River Basin during the 2017 and 2018 winters utilizing manually operated ground-based generators, as proposed by North American Weather Consultants, within the following areas of the Humboldt River Basin: Independence Range; Ruby Mountains; Toiyabe Range; Santa Rosa Range; Sonoma Range; Humboldt Range; and Diamond Mountains (just outside of the Humboldt River Basin); and direct the State Department of Conservation and Natural Resources (SDCNR) to develop and operate a matching grant program (requiring at least a 25 percent match) to which local stakeholders could apply for funds to undertake cloud-seeding programs. (*Humboldt River Basin Water Authority* [*HRBWA*], see Tab A.)

   B. Alternatively, **request the drafting of a bill to** amend the statutes to expand the allowable uses of the existing grant program for water projects (NRS 349.980 et seq.), otherwise known as the "AB 198 Grant Program," (Assembly Bill 198, *Statutes of Nevada* 1991) to include a cloud seeding program as an allowable use of grant funds. (*HRBWA,* see Tab A.)

Domestic Use

2. **A. Request the drafting of a bill** to provide that at times of curtailment by priority by the Office of the State Engineer, Division of Water Resources (DWR), SDCNR, only outdoor use withdrawals from domestic wells are curtailed and indoor use remains authorized. (See NRS 534.110.) *(Jason King, P.E., State Engineer, DWR, SDCNR*, see Tab B.)

   B. Alternatively, **request the drafting of a bill** to provide that at times of curtailment by the Office of the State Engineer, only withdrawals from domestic wells for outdoor water use are curtailed, with an excepted allowance for outdoor watering of pets and livestock. (*Nye County Water District*, see Tab C; *Utilities Inc. of Central Nevada, Pahrump Utility Co. Inc., and Desert Utilities Inc.*, see Tab D.)

3. **A. Request the drafting of a bill** to provide that in severely over-appropriated basins and designated critical management areas (CMAs), the Office of the State Engineer may limit withdrawals from new domestic wells to 0.5-acre-feet annually. According to proponent, this restriction would be applicable to "new" domestic wells on parcels that do not currently have a domestic well. This restriction would not be applicable to currently existing domestic wells. (*Nye County Water District,* see Tab C.)

   B. Alternatively, **request the drafting of a bill** to provide that no new domestic wells may be drilled in severely over-appropriated basins and designated CMAs. (*Discussion at July 11, 2016, meeting in Pahrump*.)

   C. Request the drafting of a bill to provide that in severely over-appropriated basins and designated CMAs, the Office of the State Engineer may require meters on all new domestic wells. (*Nye County Water District,* see Tab C.)

4. **Request the drafting of a bill** to provide that the priority date of a domestic well is the date of land possession and remove the provision in statute that provides that the priority date of a domestic well is the date of completion of the domestic well. See NRS 534.080(4). (*Private Well Owners Cooperative of Nye County*, see Tab E.)

5. **Request the drafting of a bill** to allow for de minimus rainwater collection for domestic use or wildlife guzzlers (*Discussion with Jason King, P.E., State Engineer, DWR, SDCNR, at July 11, 2016, meeting in Pahrump*.)

Basin Management

6. **Request the drafting of a bill** to provide that metering is required on all users in the State. (*Southern Nevada Water Authority [SNWA]; Utilities Inc. Subcommittee discussion with Jason King, P.E., State Engineer, DWR, SDCNR, at July 11, 2016, meeting in Pahrump [and others]*.)

7. **A. Request the drafting of a bill** to clarify that the Office of the State Engineer is authorized to utilize adaptive management approaches to mitigate potential conflicts. According to proponent, current law (NRS 533.3705) allows the Office of the State Engineer to limit the initial use of water under a permit to a quantity that is less than the total amount approved under the application and provides that the use of an additional amount of water may be authorized by the Office of the State Engineer at a later date if additional evidence demonstrates to the satisfaction of the Office of the State Engineer that the additional amount of water is available and may be appropriated in accordance with Nevada water law.

This proposed revision to the water law would expand that authority to include adaptive resource management, which provides for additional monitoring and management in the use of the water, and provides for augmentation or mitigation to avoid conflicts with existing rights in order to maximize the beneficial use of a shared and limited resource. (See NRS 533.3705) (*SNWA*; *Jason King, P.E., State Engineer, DWR, SDCNR*, see Tab F.)

B. Alternatively, **request the drafting of a bill** to provide that the Office of the State Engineer may not utilize adaptive management approaches to mitigate potential conflicts. According to proponents, the Office of the State Engineer's proposed amendment to NRS 533.370(2) should be opposed for a number of reasons, including that the existing "no conflict" requirement in NRS 533.370(2) protects a senior water right holder from potential destruction of an already existing water right, and there is no guarantee a promised mitigation plan will keep a senior water rights holder whole. (This recommendation combines concepts received by Eureka County, see Tab H; *Central Nevada Regional Water Authority* [*CNRWA*], see Tab G, *HRWBA*, see Tab A; *Great Basin Water Network [GBWN]*, see Tab I.)

8. **Include a position statement** in the final report to acknowledge surface-groundwater connectivity and the need for the Office of the State Engineer to utilize conjunctive management of surface water and groundwater resources where connected. (*This recommendation combines concepts in recommendations received by the Office of the State Engineer, CNRWA, The Nature Conservancy, GBWN, and Pershing County Water Authority, and others*.)

9. **Request the drafting of a bill** to require the claimant of a pre-statutory water right to submit proof of the claim to the Office of the State Engineer on or before December 31, 2025, regardless of whether an adjudication has been ordered for a water source. If the claimant fails to submit such proof, the claim is deemed to be abandoned. According to proponent, intent is to ensure that the Office of the State Engineer will have a correct accounting of groundwater and surface water rights in a basin, including vested water rights. (*CNRWA*, see Tab G.)

10. **Include a position statement** in the final report recommending a statewide Nevada water future discussion and strategy. Include a statement in the Subcommittee's final report encouraging the executive branch of the State government, the Nevada Legislature, Nevada's local governments, Nevada's business community, the environmental community, and the public to come together in a partnership to discuss Nevada's water future and develop a Nevada water future strategy and to utilize the work of the Legislative Commission's Subcommittee to Study Water, the Governor's Drought Summit, and the Nevada Drought Forum as a foundation for a meaningful statewide water future discussion and strategy. (*CNRWA*, see Tab G.)

11. **Include a position statement** in the final report calling for local government land-use plans to be based on identified sustainable water resources. According to proponent, many local government land-use plans have been developed without consideration of the amount and source of water needed to implement the plans. Such plans create property owner expectations that cannot be supported by available water resources. (*CNRWA*, see Tab G.)

12. **Send a letter** to the Office of the State Engineer recommending the use of the independent and peer-reviewed United States Geological Survey (USGS), U.S. Department of the Interior, estimates of a basin's groundwater resources (sustainable water resources or perennial yield) instead of using a water right applicant's estimate of a basin's groundwater resources. Where an updated estimate of a basin's groundwater resources is required, as a result of an application or applications to transfer a substantial amount of groundwater from one basin to another basin, the applicant should provide funds to the Office of the State Engineer to pay for the update, and the update should be performed by the USGS. (*CNRWA*, see Tab G.)

13. **Include a position statement** in the final report recommending the Office of the State Engineer replace the perennial yield concept of groundwater availability with a sustainability concept for groundwater development and management. According to proponents, a sustainability concept would provide a determination of acceptable capture of groundwater discharge, as opposed to maximum capture of all groundwater discharge. (*This recommendation combines concepts received in recommendations from CNRWA*, see Tab G; *The Nature Conservancy*, see Tab J; *and GBWN*, see Tab I.)

14. **Request the drafting of a bill** to authorize the Office of the State Engineer to suspend cancellation and forfeiture of water rights under the "use it or lose it" doctrine during times of drought in severely over appropriated basins or designated CMAs. According to proponents, the "use it or lose it" doctrine provides disincentive for conservation of water. (This recommendation combines concepts in recommendations received by *Utilities Inc. of Central Nevada [UICN], Pahrump Utility Co. Inc., and Desert Utilities Inc.*, see Tab D; *Jason King, P.E., State Engineer, DWR, SDCNR, Winnemucca Farms; and Joe Ratliff.*)

15. **Include a position statement** in the final report supporting the Office of the State Engineer's use of flexible and innovative tools for managing over-appropriated basins and in approving Groundwater Management Plans (GMPs). (*This recommendation combines concepts in recommendations received by Jason King, P.E., State Engineer, DWR, SDCNR, SNWA, the Diamond Valley Groundwater Management Plan Advisory Board, The Nature Conservancy, Walt Kuver, and others.*)

16. **Request the drafting of a bill** to authorize the implementation of a GMP that converts existing water rights to a credit system. According to proponents, the system would have priority built in to provide senior rights that would receive more water than junior rights. (See NRS 534.110 (7), NRS 534.037 and NRS 534.120). Background: Diamond Valley, Basin 153, is the only basin in the State to be designated as a CMA. A GMP is being developed for the Diamond Valley and stakeholders are considering use of a credit system. (*The Diamond Valley Groundwater Management Plan Advisory Board and the Diamond Natural Resources Protection and Conservation Association*, see Tab K.) (*Statutory authorization of "unbundled market-based pilot projects" was also recommended by The Nature Conservancy, and Winnemucca Farms*.)

17. **Request the drafting of a bill** to clarify that an approved GMP applies to all water users in basin. (UICN, *Pahrump Utility Co. Inc., and Desert Utilities Inc.*, see Tab D.)

Mine Dewatering

18. **Request the drafting of a bill** to require owners of mining pit lakes to secure water rights for mining pit lake evaporative loss. (*HRBWA*, *Pershing County Water Conservation District [PCWCD]*.)

19. **Request the drafting of a bill** to require temporary rights for mine dewatering be renewed every five years, with a required assessment of water used in the past five years and projections for future use. (*This recommendation combines concepts received from Great Basin Resource Watch (GBRW), Progressive Leadership Alliance of Nevada (PLAN), and PCWCD*).

20. **Draft a resolution** to require a long-term analysis of the Humboldt River Basin, including effects of mine dewatering, filling of pit lakes and pit lake evaporation and require that mine dewatering be included in calculation of basin budget. (*This recommendation combines concepts received from GBRW, PLAN*, see Tab L, *and PCWCD*.)

Tab A

Humboldt River Basin Water Authority

Humboldt River Basin Water Authority
c/o Intertech Services Corporation
P.O. Box 2008
Carson City, Nevada 89702

Elko County
Eureka County
Humboldt County
Lander County
Pershing County

July 6, 2016

Senator Pete Goicoechea
Chairman
Nevada Legislative Commission's Subcommittee to Study Water
Legislative Building
401 S. Carson Street
Carson City, Nevada 89701-4747

Sent Via Email

RE: Submission of Estimated Costs of Proposed Cloud Seeding Operations for Various Locations in Nevada

Dear Senator Goicoechea:

On behalf of the five-county Humboldt River Basin Water Authority (HRBWA) and various other cloud-seeding stakeholders in Nevada and in response to a request to me by Senator Ford during the March 9, 2016 Legislative Commission's Subcommittee to Study, I am pleased to estimated costs of proposed cloud seeding operations for various locations in Nevada. As indicated during my testimony before the Subcommittee on March 9, 2016, HRBWA is being joined by the Southern Nevada Water Authority, Truckee Meadows Water Authority, Carson Water Subconservancy District, Walker River Irrigation District, Truckee-Carson Irrigation District, Pershing County Water Conservation District and the Central Nevada Water Authority in asking that the Subcommittee submit a bill draft request seeking a legislative n appropriation to fund a comprehensive program of cloud seeding during the 2017 and 2018 winters.

Since the Subcommittee's March 9, 2016 meeting, representatives of the aforementioned stakeholders have met via teleconference to discuss continuing support for cloud seeding and

areas in Nevada at which cloud seeding operations should be conducted. This information was provided to staff of the Desert Research Institute (DRI) which were asked to develop a summary proposal and estimate of costs for conducting such operations during the winters of 2017 and 2018. As a result, DRI has developed the document which is attached to this memorandum entitled, "***Preliminary Proposal and Scope of Work for a Cloud Seeding Project for the State of Nevada for WY2017 – WY2018***". The DRI proposal envisions installing, operating and maintaining 19 fully automated silver iodide ground-based generators and 7 fully automated liquid propane generators at sites within the following areas: Ruby Mountains, Upper Walker River watershed, Upper Truckee River/Lake Tahoe watershed; the Toiyabe Range; Mt. Charleston; the Tuscarorra area and the Lower Humboldt River Basin. In addition, DRI suggests cloud seeding by aircraft occur in the Ruby Mountains; Upper Walker River Basin; the Upper Carson River Basin; and the Upper Truckee River and Lake Tahoe basins. Collectively, **DRI estimates that cloud seeding using the techniques and in the areas outlined above will cost an estimated $1,140,000.00 per year or $2,280,000.00 over the FY 17-18 biennium. DRI estimates that the proposed program of cloud seeding would produce water augmentation yields ranging from an absolute minimum of 32,130 acre-feet to an absolute maximum of 189,027 acre-feet, with an estimated median water augmentation of 106,300 acre-feet. Based upon data in Table 1 of the aforementioned DRI document, the estimated median cost of the additional snow water resulting from the DRI proposed cloud seeding program ranges from a low of $7.27 per acre foot to $17.86 per acre foot.** DRI's use of fully automated ground-based generators is unquestionably state of the art and is proven effective. Such fully automated systems are critical for use in areas such as the high Sierra Mountains where access to generator sites in the winter can be very difficult.

Where water is being used primarily for irrigation, the affordability of water, particularly given the variability in the amounts and distribution of snow water created, require that cloud seeding costs be minimized relative to potential benefits. The State of Utah has instituted a comprehensive program of cloud seeding comprising in excess of 140 manually operated ground-based generators located at many locations along the Wasatch Mountains. These generators are typically operated and maintained by volunteers or paid part-time staff recruited from among benefitting stakeholders such as irrigation districts, ski resorts, or small communities. Generators in Utah are typically located in areas easily accessible during the winter months.

If water users and other beneficiaries in the Humboldt River Basin are to secure the benefits of cloud seeding relative to the uncertainties of how much additional snow water is created and the distribution of same, it is imperative that the costs per acre foot be as low as possible. Accordingly, the HRBWA has obtained a feasibility study and costs for a program of cloud seeding modeled after that in Utah from North American Weather Consultants (NAWC) a primary cloud seeding contractor in Utah and several other western states. I have attached the NAWC document which is entitled "***Updated Preliminary Feasibility Study and Cost Estimates for a Possible Winter Cloud Seeding Program in the Humboldt River Basin, Nevada***". The NWAC cloud seeding program would involve 50 manually operated ground based generators located in the following areas of the Humboldt River Basin:

- Independence Range

- Ruby Mountains
- Toiyabe Range
- Santa Rosa Range
- Sonoma Range
- Humboldt Range
- Diamond Mountains (just outside of the Humboldt River Basin)

NAWC estimates the cost of installing and operating the 50 manually operated ground based generators located at sites in the areas listed above to be on the order of $487,000.00 per year or $974,000.00 over the FY 17-18 biennium. NAWC further estimates that the aforementioned 50 generators would produce 153,220 acre feet of additional snow water each year. As shown in Table 3 of the aforementioned NAWC feasibility study, the firm has estimated the cost of additional water generated to range from $2.11 to $3.33 per acre foot. Again, these costs are for a manually operated, ground based collection of generators.

As I described during my testimony before the Subcommittee on March 9, 2016, cloud seeding provides a variety of benefits to Nevada including drought resiliency and drought recovery; improved vegetation for the Bi-State and Greater Sage Grouse populations in Nevada; reductions in the risk of catastrophic wildfire; enhanced snowpack to support winter sports; enhanced runoff to support recreation on Nevada's rivers and streams; and the possibility of enhanced water supply to meet the demands of a growing population throughout Nevada.

Finally, please recall that the State of Nevada provided significant funding for cloud seeding in the state for over 30 years, ending such funding in 2008 during the height of the recession. The Humboldt River Basin Water Authority and other cloud seeding stakeholders would greatly encourage and appreciate the Legislative Commission's Subcommittee to Study Water requesting a bill draft seeking a legislative appropriation to fund a comprehensive program of cloud seeding during the 2017 and 2018 winters.

During our teleconference discussions, the aforementioned cloud seeding stakeholders discussed various approaches to funding cloud seeding in Nevada. One option would be to provide an appropriation for all or a portion (for example 75 percent) of two years' worth of cloud seeding costs to the Department of Conservation and Natural Resources, which pursuant to existing statutory authority under NRS 544, Weather Modification, could develop and operate a matching grant program (requiring at least a 25 percent match) to which local stakeholders could apply for funds to undertake cloud seeding programs in various areas of Nevada. Alternatively, legislation could be requested to expand the allowable uses of the existing grant program for water projects (NRS 349.980 et seq.) otherwise known as the AB 198 Grant Program to include a program of cloud seeding as an allowable use of said grant funds.

Unfortunately, due to a prior commitment, I will be unable to attend the Subcommittee's work session on August 26, 2016. I would however, be available by phone to answer questions the

Subcommittee may have regarding the benefits and costs of cloud seeding. Thank you for your consideration.

Sincerely,

Mike Baughman, Ph.D
Executive Director
(775) 315-2544
mikebaughman@charter.net

Preliminary Proposal and Scope of Work

for a Cloud Seeding Project for the State of Nevada for WY2017 – WY2018

Submitted to

Mr. Mike Baughman
Executive Director
Humboldt River Basin Water Authority

By

Division of Atmospheric Sciences
Desert Research Institute
2215 Raggio Parkway
Reno, NV 89512

July 2016

DRI Project Contact: Mr Frank McDonough
Director of Weather Modification 775-674-7140
frank.mcdonough@dri.edu

Executive Summary

The goal of the Nevada State Cloud Seeding Program is to enhance snowfall (Fig. 1) from winter storms and increase the snowpack across the State of Nevada (Fig. 2) through the application of wintertime cloud-seeding technology. Three technological approaches are proposed with respect to wintertime cloud seeding: ground-based silver iodide (AgI) generators (Fig. 3), airborne AgI cloud seeding (Fig. 4), and liquid propane (LP) dispensers for lower elevation mountains with storm temperatures often closer to 0^{o}C (Fig. 5).

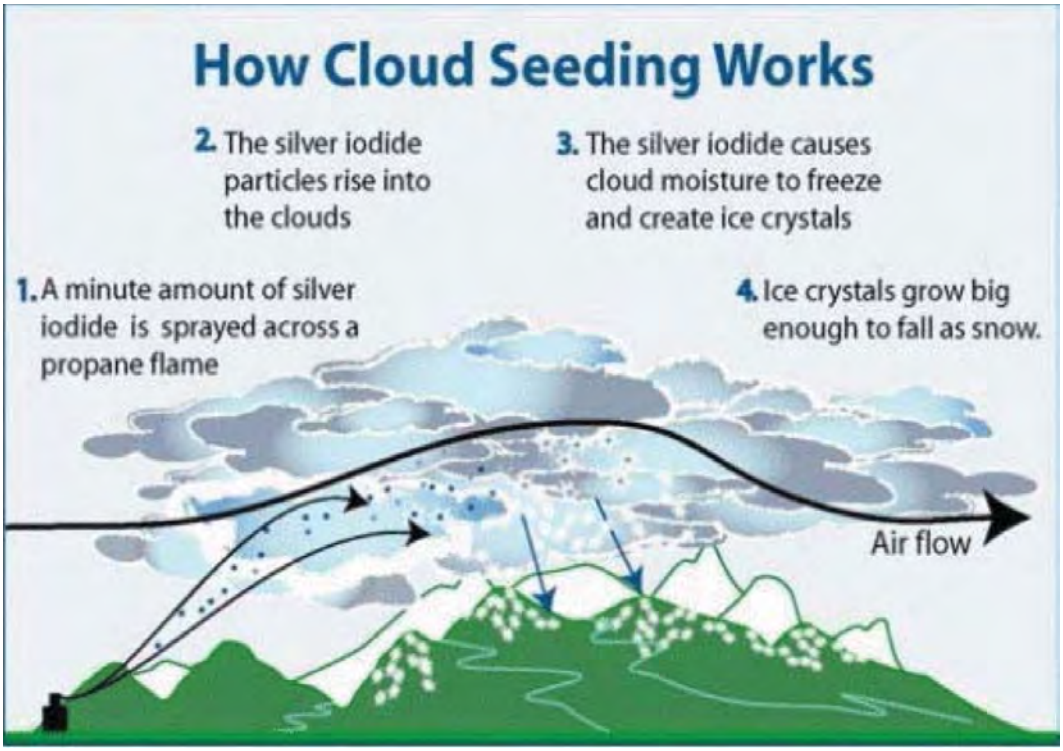

Figure 1. Cloud seeding conceptual model.

In the mature program cloud seeding could be conducted from 26 ground-based AgI generators, 4 aircraft operations, and 7 liquid propane dispensers at a cost of approximately $1,140,000 (Table 1). It is unknown if this cost will be shared in a 50/50 division between the State of Nevada and the Nevada State Consortium of Water Authority Managers, with the Consortium determining internally the allocation of costs between its various members, or if the State of Nevada would fund the work. Ground-based AgI generators will be situated in the higher elevations upwind of the central Sierra Nevada, Ruby, Tuscarora/Owyhee, Mt Charleston and Toiyabe range crests. Aircraft seeding is proposed for the Ruby, Tahoe-Truckee, Walker, and Carson drainages. While liquid propane seeding would be conducted over the Sonoma, Santa Rosa, Diamond and Humboldt Ranges. Much of the ground AgI generator program is modeled after the

former State of Nevada Cloud Seeding Program.

The costs in Table 1 are for a nearly turnkey program that includes all equipment, consumables, equipment installation, maintenance, project management, development of forecasting tools, 24/7 operations from November though at least April 30, validation, and reporting.

Figure 2. Cloud seeding areas for Nevada water production. Red shading are silver iodide locations (both aircraft and/or ground based). Black shading locations are the lower elevation mountains suitable for warmer liquid propane cloud seeding.

With respect to aircraft cloud seeding technology, if the project elects to pursue this option, a subcontract will be issued to a qualified vendor to provide supplemental aircraft seeding primarily to the Tahoe-Truckee, Walker, Carson, and Ruby drainages with an aircraft equipped

with ejectable and burn-in-place (BIP) flares. The flights will occur during a two-month period (most likely January-February). The proposed budget for this component is $200,000 for a range of 8-12 seeding flights per area to take place during the 2-month period.

The cloud seeding effort will help improve water storage supplies within the State of Nevada. The increased snowfall from cloud seeding is expected to enhance the water supply of the Truckee, Carson, Walker, Owyhee, Lee Canyon, and Humboldt River systems. Historical research results from ground-based cloud seeding projects have documented the hourly increases in precipitation rate due to seeding to be in the range of a few hundredths to greater than 2 mm per hour. As an example, a conservative estimate of the effect for the Tahoe-Truckee project, a value of 0.25 mm per hour is used for the enhancement estimates. Such values lead to estimates of approximately 10% overall water augmentation. Based on the history of the State of Nevada Cloud Seeding Program from 1994-2009 and incorporating adjustments for the larger number of AgI, aircraft, and liquid propane generators proposed here, as well as greater efficiencies developed recently at DRI compared to operations under the prior state program, water augmentation yields should range from an absolute minimum of 32,130 acre-feet to an absolute maximum of 189,027 acre-feet, with an estimated median water augmentation of 106,300 acre-feet.

Trace chemical analyses of snow samples from the northern Carson Range over the east side of Lake Tahoe in 2004 and 2005 showed that 34% to 52% of samples contained enhanced concentrations of silver (Huggins et al, 2006), indicative of snow frequently being created by cloud seeding with AgI. Such sampling provides one method of validation for the program. Trace chemical analysis can be included within the proposed program if desired but is currently not incorporated within the project budget. All past environmental assessments have all indicated that no negative impacts to watersheds are produced by cloud seeding operations.

The projects can be scaled to targeted prices based on equipment. The approximate costs for annual maintenance, consumables, and technicians time for each type of equipment are available from DRI. The project management, development of forecast tools, forecasting, operations, and reporting are priced per project area based on the relative size of the project.

Figure 3. High altitude remote controlled ground-based silver iodide cloud seeding generator.

Figure 4. Cloud seeding Burn in Place (BIP) silver iodide flares mounted on a cloud seeding aircraft.

Figure 5. Solar powered liquid propane cloud seeding underway in Utah.

Table 1 Seeding equipment, methods, expected results and costs.

Location	Number of proposed ground generators	Aircraft	Estimate median acre-feet added	Estimated Costs ($)
Ruby Mtns.	7	Y	26,475	260,000
Walker Basin	4	Y	17,075	200,000
Carson Basin	0	Y	6,875	50,000
Tahoe-Truckee	6	Y	23,675	230,000
Toiyabe Range	4	N	11,200	140,000
Mt Charleston	1	N	2,800	50,000
Tuscarorra	4	N	11,200	135,000
Lower Humblodt	7*	N	7,000	75,000
Total	**26 (7*)**	**4**	**106,300**	**1,140,000**

* LP generators

North American Weather Consultants, Inc.

UPDATED PRELIMINARY FEASIBILITY STUDY AND COST ESTIMATES FOR A POSSIBLE WINTER CLOUD SEEDING PROGRAM IN THE HUMBOLDT RIVER BASIN, NEVADA

Prepared for

Humboldt River Basin Water Authority

by

North American Weather Consultants, Inc.
8180 South Highland Dr., Suite B-2
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Report No. WM 16-7

June 2016

1.0 INTRODUCTION

Representatives from the Utah Division of Water Resources (UDWR) and North American Weather Consultants (NAWC) were invited attend a meeting of the Humboldt River Basin Water Authority (HRBWA) on May 9, 2014 in Winnemucca, Nevada. Mr. David Cole (UDWR) and Mr. Don Griffith (NAWC) attended this meeting and gave Power Point presentations on Utah cloud seeding regulations, UDWR support of winter operational cloud seeding programs and discussions on four major long-term winter cloud seeding programs being conducted in Utah over selected mountain barriers. These discussions touched on the theory of winter cloud seeding in mountainous areas and the design, conduct, evaluation and cost of these Utah programs. These programs employ manually operated cloud seeding generators that disperse Silver Iodide particles into selected clouds that are considered to be "seedable." Indications of increases in either precipitation or snow water content from these programs average from 5% to 15%. A question was raised during this meeting whether a program might be conducted to benefit the Sonoma Range south of Winnemucca.

Following this meeting Mr. Griffith with NAWC offered to perform a preliminary feasibility assessment of conducting winter cloud seeding programs in mountainous areas of interest in the Humboldt drainage and to provide some preliminary cost estimates for these areas. On June 25, 2014 Dr. Baughman, Executive Director of the HRBWA, provided NAWC with this list of areas of interest:

Independence Mountains

Ruby Mountains

Toiyabe Range

Santa Rosa Range

Sonoma Range

Humboldt Range

Diamond Range (not in Humboldt Basin but of interest to Eureka County, a member of the HRBWA)

Figure 1 provides the locations of these areas.

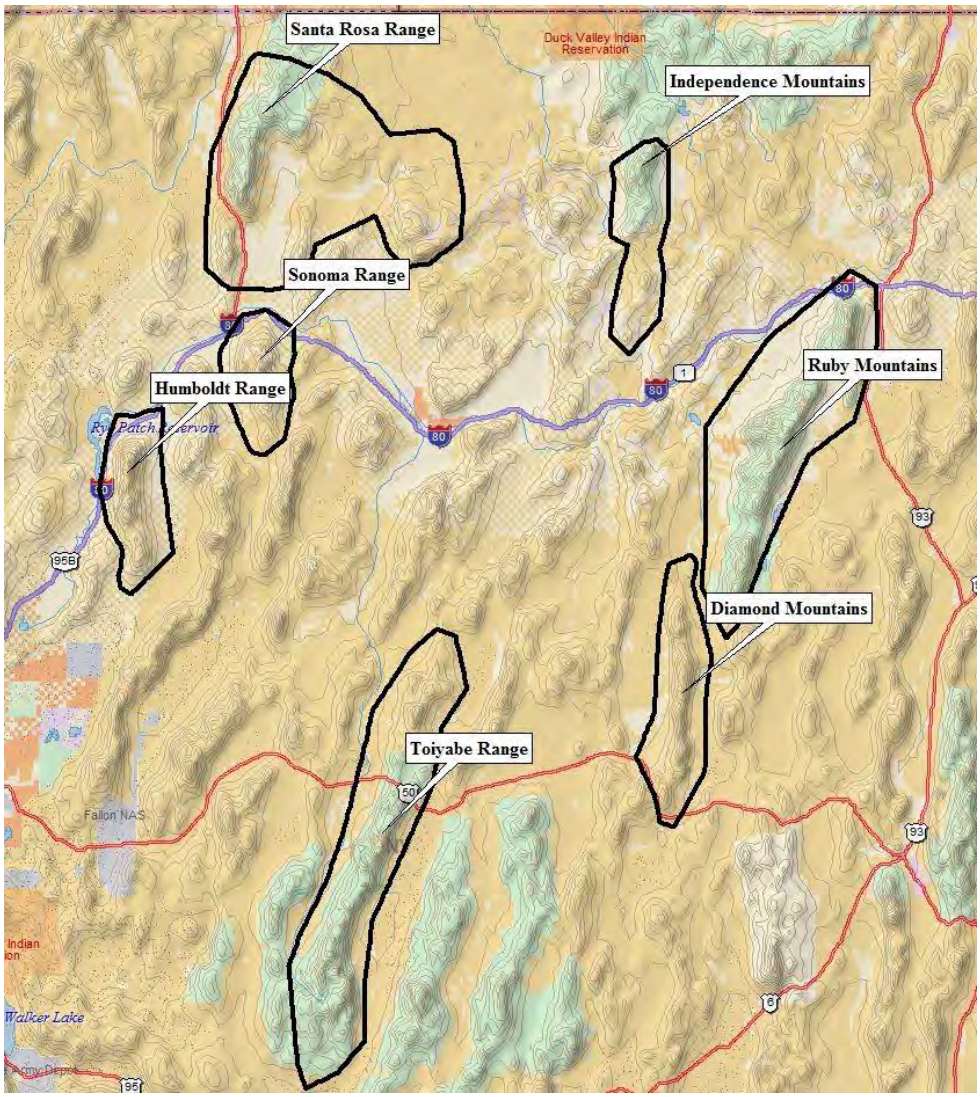

Figure 1 Possible Target Areas for Winter Cloud Seeding Programs in the Humboldt River Drainage

Table 1 provides some statistics on each of these potential target areas.

NAWC has performed a preliminary cloud seeding feasibility assessment for the areas identified in Figure 1 and has also prepared some preliminary cost estimates for the conduct of programs in these areas. This information has recently been updated and will be discussed in the following sections.

Table 1 Characteristics of the Seven Potential Target Areas

Independence Mountains - Basin 44
Wheeler Mountain (9,057 ft (2,761 m),
Jack's Peak (10,198 ft (3,108 m),
McAfee Peak (10,439 ft (3,182 m), highest point
Center lat/lon: 41° 14' N; 116° 2' W
Extent: ~ 73 miles N-S, 22 miles E-W

Ruby Mountains - Basins 43,45,46,47
Ruby Dome 11,387 feet (3,471 m), highest peak
Center lat/lon: 40° 12' N; 115° 32' W
Extent: 103 miles N-S, 39 miles E-W

Toiyabe Range - Basin 56
Arc Dome 11,773 feet (3,588 m), highest peak
Center lat/lon: 39° 7' N; 117° 7' W
Extent: 117 miles N-S, 50 miles E-W

Santa Rosa Range - Basins 67,68,69
Granite peak (9732 feet, 2966 m), highest peak
Santa Rosa Peak (9701 feet, 2957 m).
Lat /lon : 41° 27’ N; 117° 41’ W
75 miles north of Winnemucca

Sonoma Range - Basin 71
Sonoma Peak (9,396 feet, 2864 m), highest peak
Center lat/lon: 40° 47' N; 117° 37' W
Extent: 35 miles N-S, 23 miles E- W

Humboldt Range - Basin 72
Star Peak (9,836 feet, 2,998 m), highest point
Center lat/lon: 40° 25' N; 118° 8' W
Extent: 45 miles N-S, 19 miles E-W

Diamond Range - Basin 153
Diamond Peak (10,614 feet, 3,235 m), highest point
Center lat/lon: 39° 48' N; 115° 49' W
Extent: 63 miles N-S, 19 miles E-W

2.0 Preliminary Analysis of the Feasibility of Winter Cloud Seeding in the Humboldt River Basin

An initial analysis was conducted of weather conditions during storm days for the November – April seasonal period, and resulting estimates of cloud seeding potential. Precipitation data from the Lamoille #3 SNOTEL site in the Ruby Range southeast of Elko, Nevada was used to identify periods of significant storm activity during the past 4 winter seasons (2010-11 through 2013-14). This site was selected to identify storm occurrences that impacted the possible target areas as identified in Figure 1. Storm events were broken down into periods of approximately 4-6 hours duration in order to collect/estimate relevant data for analysis. A total of 145 of these periods (on 68 different calendar days) were identified over the 4-season period, roughly representing storm events during which 0.5" or more of total storm precipitation occurred at the Lamoille #3 SNOTEL site. Data used in the analysis includes 700-mb (approximately 10,000 feet MSL) temperatures and winds, cloud top temperature, and estimates of lower-level thermodynamic stability of the atmosphere (an important consideration in the likely transport of ground based seeding material releases rising to altitudes where silver iodide begins acting as an ice nucleant) for each of the time periods identified. Data were collected from archived RAOB (weather balloon) sounding profiles from the twice daily observations taken at Elko, Nevada, as well as archived maps of weather parameters available for a variety of atmospheric levels (with particular focus on the 700-mb level). Interpolation/estimation of these parameters was necessary for some of these time periods.

The analysis considered three potential seeding modes: Ground-based seeding from lower-elevation sites, remote ground-based seeding from elevations slightly below the crest height, and aircraft seeding. The analysis first identified the likely potential increase (as a percentage of the total November – April precipitation) for ground-based seeding only; then the additional potential increase from remote, high-elevation seeding sites; and finally, the additional potential increase from aircraft seeding beyond what could be achieved from the first two seeding modes. If aircraft seeding is considered secondary to ground-based seeding without consideration of remote sites, the remote seeding category and the aircraft seeding category could be summed. These potential seeding increases assume that a suitable array of seeding sites could be attained in both ground based seeding modes.

The methodology from this analysis is based on results from Climax I and II in Colorado, which was intended to relate seedability to cloud top temperature during storm events. The underlying (and obviously very simplified) assumption, based on the results of this study, is a 25% potential seeding increase for cases with cloud top temperatures of -20 C or warmer; a 10% increase for cloud top temperatures between -20 and -25 C; and no increase in cases of

cloud tops colder than -25 C. Realistically, cloud tops would be defined as the top of the cloud deck involved in the active precipitation process, so that higher (clearly separate) cloud layers not involved in the precipitation process are ideally not considered. Once the overall seedability was categorized in this manner, "seedable" cases for each period were partitioned into one of the three seeding modes. If conditions appeared favorable for ground-based seeding (the most economical seeding mode), the potential seedability was placed in that category. If conditions appeared favorable for remote, high-elevation seeding but not ground-based seeding, potential seeding effects were included in that mode. If conditions appeared seedable from aircraft only, potential seeding effects were placed in that category.

Two basic criteria were used to select the potential seeding mode: 700-mb (or approximate crest-height) temperature, and lower-level thermodynamic stability based on sounding data. The 700-mb temperature criterion is used to determine if the crest-height temperature is within the favorable seeding window (-5 to -15 C). If the 700-mb temperature is colder than -15 C, the overall seedability is assumed to be 0 (as it was for periods with cloud tops colder than -25 C). If the 700-mb temperature is warmer than -5 C, it is assumed that only aircraft seeding would be effective. An exception was made for spring (March/April) cases where the atmosphere appeared well-mixed, which often allows ground based seeding to be effective in somewhat warmer conditions as the seeding material may quickly be carried much higher than the crest height. In this limited number of applicable March/April cases, a 700-mb temperature threshold of -3 C was used. The second criterion (lower – level atmospheric stability) is used to differentiate between cases seedable from lower-elevation ground sites versus those likely seedable from only higher elevation sites and/or aircraft. Stability was rated as either well-mixed, slightly stable, moderately stable, or very stable. Well-mixed or slightly stable cases were considered to be seedable via lower elevations ground-based sites, while the remainder were generally not. Well-mixed or slightly stable cases are analagous to situations where surface warming (or crest height cooling) of less than 2 degrees C would be necessary for complete, free mixing of the atmosphere. Although ground-based seedability may be marginally inhibited in some of the "slightly stable" cases, modeling dispersion studies have suggested that a significant amount of seeding material would likely reach the crest height within an hour or two in these cases.

After the data were partitioned in this manner, the potential seedability (defined in terms of percentage increase of precipitation) was averaged for all the time periods in the analysis, which of course includes 0% values for those periods assumed to have no seedability. This is intended to provide a reasonable approximation of the likely seasonal (November – April) precipitation percentage increase that could be obtained based on the seeding mode. Results suggest that an approximate 4.5% increase could be obtained from ground-based seeding alone; an additional 0.7% increase with the addition of remote, high-elevation sites;

and a further 2.0% increase with the addition of aircraft seeding. Figure 2 provides a graphic portrayal of this information. This implies a potential 7.2% increase with all three seeding modes, or possibly with aircraft alone (since any of these situations may be **theoretically** seedable with aircraft, although more than one seeding aircraft might be required to do so). Applying these percentages to the long-term average precipitation for the Lamoille SNOTEL (a total of 21.5" for the November – April period) yields a potential increase of just under an inch; 0.97" for ground-based seeding only; 0.15" additional for remote seeding sites; and 0.44" additional seeding potential beyond this if using aircraft. Figure 3 provides a graphic portrayal of this information. This would suggest a total potential increase of about 1.56" if all three seeding modes are considered. Of course, seeding target areas with higher or lower seasonal precipitation than the Lamoille SNOTEL site would have proportionally higher or lower total potential average increases of additional water, respectively.

The wind data at 700-mb were used to make some generalized comparisons of cloud top temperature and lower-level stability as they relate to likely pre- and post-frontal storm situations. Figure 4 shows the results of this categorization where 700-mb wind directions with a southerly component (less than 270 degrees) may be generally representative of pre-frontal storm periods, and those with a northerly component (e.g. > than 270 degrees) of post-frontal storm periods. This figure illustrates that southwesterly (pre-frontal) storm periods tend to have colder cloud-top temperatures and more low-level stability than the post-frontal periods. Thus, the post-frontal periods are believed to have more seedable conditions overall, particularly from ground-based sites. This may be an important consideration for determining locations of ground-based seeding sites.

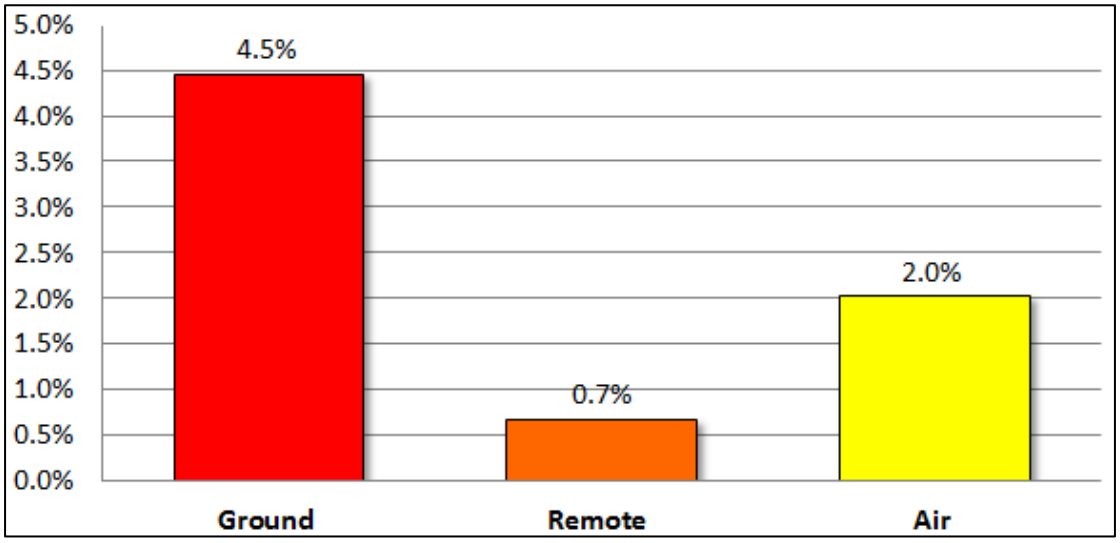

Figure 2 Estimated Percent Increases by Seeding Mode

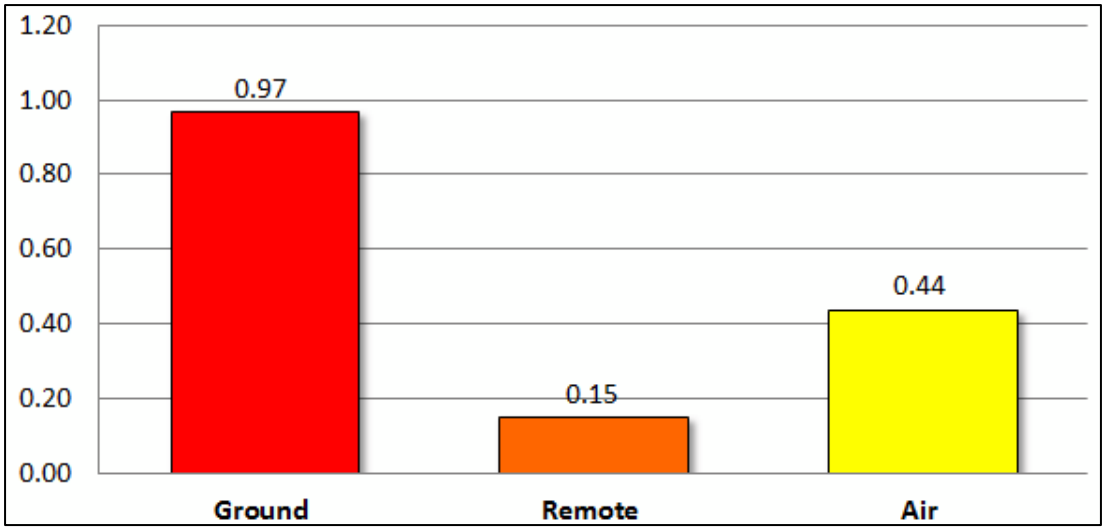

Figure 3 **Estimated Average Seasonal Increases in Inches for the Three Seeding Modes**

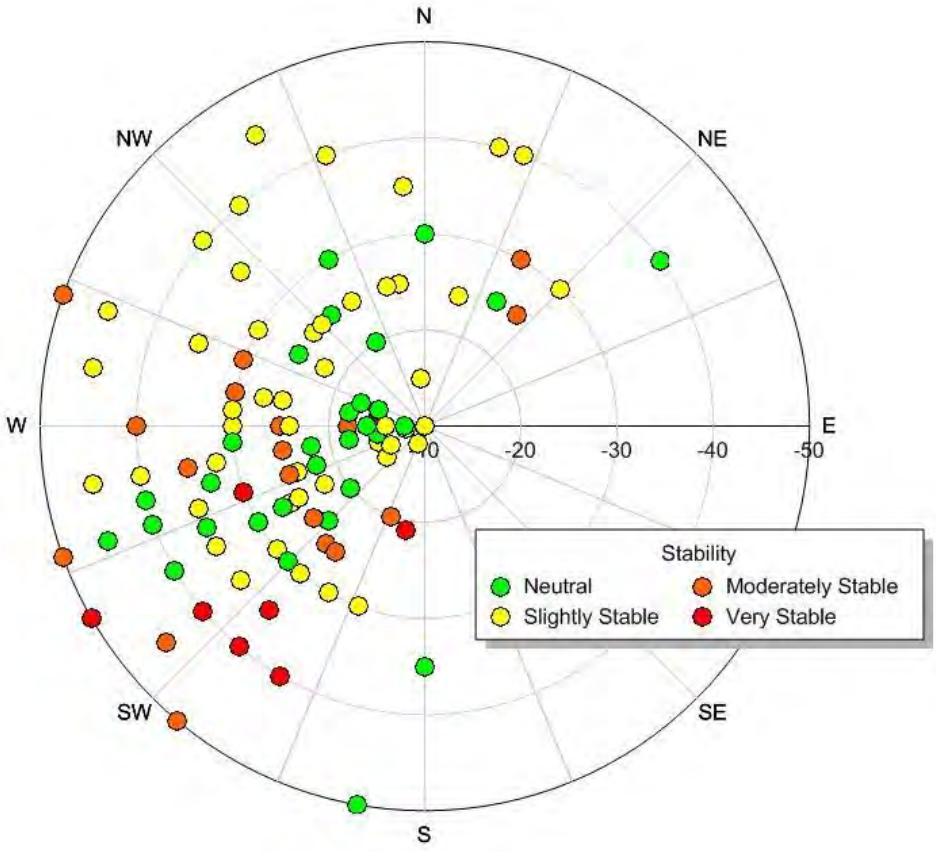

Figure 4. Plot of wind direction vs cloud top temperature and low-level stability. The cloud top temperature corresponds to the radial axis shown to the right of center (-10 to -50 C), and stability to the color of the data point as shown in the legend.

Figure 5 shows potential precipitation increases from ground-based seeding for an average November – April season, based on an estimated 4.5% increase to the natural precipitation at five representative SNOTEL sites. Natural precipitation averages for this seasonal period range from about 17.5” at Big Creek Summit in the south, to 26.2” at Jacks Peak in the north.

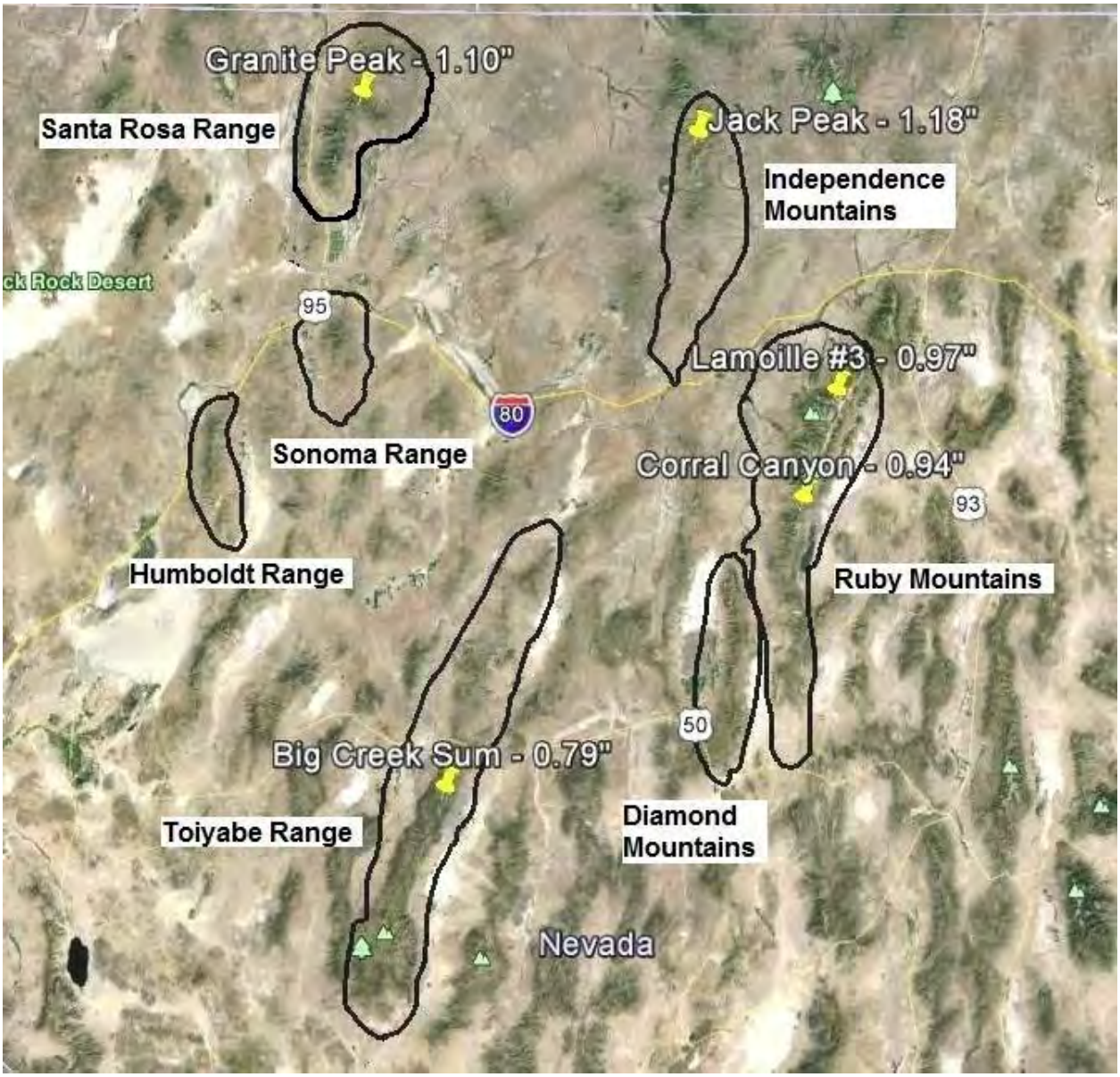

Figure 5 Potential Ground-based Seeding Precipitation Increases for November – April Based on an Estimated 4.5% increase

NAWC developed a map that provides idealized locations of ground-based seeding generators for each of the potential target areas. Based upon some results obtained in a research program conducted in Central Utah in the early 2000's, the desirable spacing between generators is approximately 5 miles. Figure 6 provides this information. As suggested in Figure 4 the low-level winds in winter storms affecting the potential target areas predominately have a westerly component. In other words these winds are generally blowing from west to east. This fact explains why all the proposed generator locations are on the west side of the mountain barriers. Seeding materials released from these locations will normally be transported over the target mountain barriers. The natural progression of wind directions during winter storms in the western United States is for surface (and low level winds) to be from the southwest in pre-frontal conditions, switching to westerly at frontal passage, and then blowing from the northwest under post-frontal conditions. NAWC meteorologists take changing wind directions into account when seeding winter storms. Some generators are turned on under pre-frontal southwesterly winds, some of these generators may be turned off and others turned on as winds switch to westerly then northwesterly directions. This approach is usually referred to as "targeting" of the seeding effects.

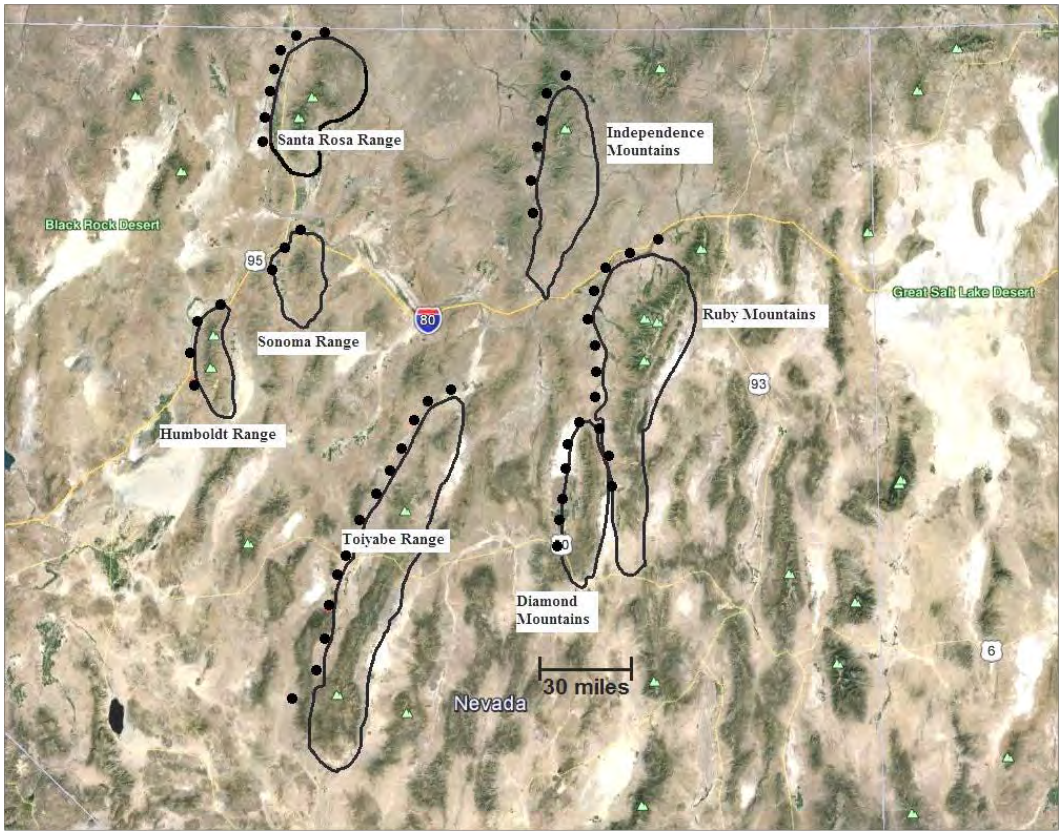

Figure 6 Map showing idealized ground-based seeding locations (approximately every 5-7 miles, 50 sites shown)

3.0 Summary and Preliminary Project Design

Information in section 2.0 suggests there is cloud seeding potential in some winter storms or portions of winter storms that impact the seven potential mountainous target areas in the Humboldt River Basin. Better seeding potential is expected under post-frontal conditions due to lowering cloud tops, decreasing atmospheric stability concerns and lowering temperatures favoring silver iodide particles released from ground sources reaching the silver iodide activation temperature of -5^0 C sooner. The estimated seeding potential of the three possible seeding modes; manually operated ground-based generators (4.5%), higher elevation remotely controlled ground-based generators (0.7%) and airborne seeding (2.0%) suggest that a seeding design using manually operated ground-based generators would achieve 63% of the total precipitation increases as opposed to if all three seeding modes were used. This fact coupled with the higher costs associated with remotely controlled generators and seeding aircraft would argue in favor of a project design that relies upon networks of manually operated ground-based generators.

Figure 6 provided idealized generator networks for the seven potential target areas. The hypothetical number of generators for each area was:

- Independence Mountains 6
- Ruby Mountains 11
- Toiyabe Range 13
- Santa Rosa Range 7
- Sonoma Range 3
- Humboldt Range 4
- Diamond Range 6

These are idealized numbers. One concern is the low populations in the areas on the west sides of the mountains or ranges. NAWC needs local residents at these locations that are willing to be trained and then to operate our generators when they are called by our meteorologists to do so. Because of the population density we are likely not to find operators at all these locations. An alternate approach might be possible where generators are installed in areas without any habitation. A technician could then be hired to travel to these sites to turn them on and off during storm periods. The feasibility of this approach may depend on the land ownership of these uninhabited locations. Approval to site them on private property could hopefully be arranged. Placing them on State or Federal property may be more problematic possibly raising licensing or permitting questions and possibly some form of environmental review process.

Considering the size and proximity of these areas it may make sense to consider combining some of these areas into larger project areas. For example, combining the Diamond and Ruby Mountains into one program and the Humboldt and Sonoma Ranges into one program could result in some economy of scale. One could go even further with this approach by combining the:

- Diamond, Independence and Ruby Mountains
- Independence Mountains and Santa Rosa Range
- Humboldt and Sonoma Ranges

Combining areas would not only need to be considered in the terms of technical feasibility but also in terms of the political feasibility. Can partnerships between different districts be developed to support this economy of scale approach? How would the program costs be allocated between the participating districts? It might even be feasible to conduct a program designed to seed all seven potential target areas for additional economies of scale. This approach has been used successfully in central and southern Utah to represent 11-12 separate counties since 1974. Perhaps the HRBWA could administer such a program. Additional questions would no doubt arise when considering the above approaches.

Another technical question could be important; can the estimated potential increase in precipitation be applied equally to the seven potential target areas? Our professional judgment is that these seeding increases would be more likely to occur over the longer, wider, higher target areas. **Our subjective rating of the overall "seedabilty" of these areas using manually operated ground generators would be, in the order of <u>most</u> to <u>least</u> "seedable":**

- Toiyabe Range
- Ruby Mountains
- Independence Mountains
- Santa Rosa Range
- Diamond Mountains (should probably be considered joined to the Ruby Mountains).
- Sonoma Range
- Humboldt Range

This subjective listing does not mean there is no seeding potential in those areas lower on the list, but these areas likely have less seeding potential than those higher on the list. Several meteorological considerations went into the ranking order in the above list. For example, when considering small barriers, the low level wind flow may flow around instead of over the barrier.

Seeding materials released at ground level would be carried by these winds going around instead of over the barrier. Wider barriers would provide for more time for the creation, growth and fall out of snowflakes making it more likely these snowflakes would fall on the barrier while carried along by the lower elevation winds passing over the barrier. Aircraft seeding to impact the smaller barriers might provide better seeding results but would be considerably more expensive than a manually operated ground generator program. An economy of scale might be possible linking several adjacent areas into one program area that could be treated by one seeding aircraft.

In order to conduct such programs in Nevada, NAWC would need to obtain a license from the Nevada State Department of Conservation and Natural Resources according to NRS Chapter 544 – Modification of Weather. This regulation is split into two parts; one for research programs and one for operational programs. The key part for operational programs is worded as follows:

NRS 544.140 Qualifications of licensees; issuance and renewal of licenses; fee. [Effective until the date of the repeal of 42 U.S.C. § 666, the federal law requiring each state to establish procedures for withholding, suspending and restricting the professional, occupational and recreational licenses for child support arrearages and for noncompliance with certain processes relating to paternity or child support proceedings.]

1. Licenses to engage in activities for weather modification and control must be issued to an applicant who:

(a) Pays the fee required pursuant to subsection 2;

(b) If the applicant is a natural person, submits the statement required pursuant to NRS 544.132; and

(c) Demonstrates, to the satisfaction of the Director, competence in the field of meteorology reasonably necessary to engage in activities for weather modification and control.

2. If the applicant is an organization, the requirements set forth in paragraphs (a) and (c) of subsection 1 must be met by the person or persons who are to be in control and in charge of the operation for the applicant.

3. The Director shall issue licenses in accordance with such procedures and subject to such conditions as the Director may by regulation establish to effectuate the provisions of NRS 544.070 to 544.240, inclusive. Each license must be issued for a period to expire at the end of the calendar year in which it is issued and, if the licensee possesses the qualifications necessary for the issuance of a new license, the license must, upon application, be renewed at the expiration of that period. A license must be issued or renewed only upon the payment to the Director of $100 for the license or the renewal thereof.

Other parts of this regulation outline procedures to be followed in order to obtain a license (e.g. notice of intent, proof of financial responsibility, etc.).

Concerning cloud seeding feasibility studies to augment precipitation, a recent publication from the American Society of Civil Engineers (ASCE 2016) contains the following recommendations:

1. *"When possible, the feasibility study for a program should draw significantly from previous research and well-conducted operational programs that are similar in nature to the proposed program (e.g. similar topography, similar precipitation occurrences, etc.)."*
2. *"The primary purpose of the feasibility study is to answer two questions. First, does it appear that a cloud seeding program could be implemented in the intended target area that would be successful in achieving the stated objectives of the program? Second, are the estimated increases in precipitation expected to produce a positive benefit-cost ratio?"*

NAWC's response to the first recommendation (technical feasibility) is positive for winter cloud seeding programs conducted in the Humboldt River Basin of Nevada using ground-based manually operated silver iodide generators. This seeding technique has been used in several similar mountainous target areas in Utah one of which has operated nearly continuously since 1974. Evaluations of this program have consistently shown an average seasonal increase in precipitation of 14% (Griffith, et al, 2009). In addition, several years of research conducted in central and southern Utah identified seeding potential in winter storms that impact these areas as well as the transport of seeding material into the seedable portions of these storms (Super 1999).

Response to the second recommendation (economic feasibility) is more difficult to assess. NAWC typically estimates seasonal increases in precipitation from a proposed program then correlates target area precipitation with streamflow. Average increases in precipitation are then inserted into the regression equation correlating precipitation with streamflow to estimate an average increase in streamflow. If the value of the additional streamflow can be estimated, a benefit/cost ratio can be established based upon the estimated costs of conducting the program. NAWC did not attempt this type of analysis. It would require long-term unimpaired streamflow records from the target areas and estimated values of the augmented streamflow. The ASCE recommends a 5/1 ratio for a program to be considered economically feasible.

NAWC did perform a less comprehensive analysis to estimate the amount of runoff that might be produced from some of the potential target areas from cloud seeding. This analysis is covered in the following section.

4.0 Preliminary Cost Estimates

We have made some preliminary cost estimates for some of the proposed target areas. NAWC typically contracts to conduct operational cloud seeding programs on both a fixed price and cost reimbursable fashion. Our fixed costs cover 1) the set-up, take-down and reporting (state and federal reports and a seasonal final report on operations) and 2) Cost reimbursement for actual hours of generator usage (a unit cost per hour and an estimated number of generator hours is established in an agreement. The following cost estimates could be used for:

1. The combined Diamond and Ruby Mountains Target Areas
2. The Toiyabe Range Target Area
3. The combined Independence Mountain and Santa Rosa Range Target Areas.

Diamond and Ruby Mountains or Toiyabe Range or Independence Mountains and Santa Rosa Range

1. Set-Up, Take-down, reporting fixed costs	$64,000
2. Monthly Fixed Costs	$10,000
3. Estimated Reimbursable Costs, 2000 generator hours @ $9.00/hr.	$18,000
Total Estimated Costs for a five-month program	$132,000

Important note, the above costs assume that NAWC would need to fabricate additional ground based manually operated generators. If NAWC had generators in stock for a given up-coming winter season, the set-up costs could be reduced.

Humboldt and Sonoma Ranges

1. Set-Up, Take-down, reporting fixed costs	$36,000
2. Monthly Fixed Costs	$ 9,000
3. Estimated Reimbursable Costs, 1200 generator hours @ $9.00/hr.	$10,800
Total Estimated Costs for a five-month program	$91,800

4.1 Preliminary Estimates of Runoff Increases and Estimated Costs per Acre Foot

The estimated average increases in precipitation for some of the potential target areas, as provided in Figure 5, may be used to develop some ballpark estimates of the amount of surface runoff that might be produced from these potential target areas. The HRBWA provided NAWC with some estimates of the size of some of the proposed target areas expressed in acres. There were no size estimates for the Humboldt or Sonoma Ranges. This information can be combined with the estimated average precipitation increases to provide ballpark average annual runoff values. For example, for the Ruby Mountains target area: 880 $mi.^2$ x 1.00 inch/12 inches/foot x 640 $ac./mi.^2$ = 46,930 acre-feet. Table 2 provides these calculated increases for barriers for which we were provided size estimates. These estimates are for an average year both in terms of estimated increases in precipitation and runoff.

Table 2 Estimated Increases in Runoff (Acre-Feet)

Target Area	Target Size Miles ^{2}	Est. Precipitation Increase inches	Est. Runoff Increase Acre-feet
Independence Mts.	280	1.18	17,620
Ruby Mts.	880	1.00	46,930
Toiyabe Range	1200	0.80	51,200
Santa Rosa Range	375	1.10	22,000
Diamond Range	290	1.00	15,470

The estimated runoff increases may be combined with the annual estimates of conducting these programs to provide preliminary estimates of the costs per acre foot of producing the additional runoff in an average year. These calculations are provided in Table 3.

There are several assumptions being made to provide the information contained in Tables 2 and 3 including the following:

- That the estimated precipitation increases for the Ruby Mountains can be applied to the Diamond Mountains.
- That the estimated increases summarized in Figure 5 can actually be achieved.
- That these estimated increases in additional precipitation will be spread evenly over the entire targeted mountain barrier.
- That the estimated increases in precipitation end up generating additional runoff and are not subject to increasing underground aquifer storage or evapotranspiration processes.

- That these estimates are for an average year. In an above average year, the additional runoff numbers would likely increase and the estimated costs per acre foot would decrease. The reverse would be true in a below average year.

Due to the uncertainties, it might be wise to cut the estimated runoff increases in half to hopefully provide conservative estimates. This would have the effect of doubling the cost per acre-foot numbers which would then be in the approximate range of $4.20 to $6.60 per acre-foot range. If there were some estimates of the value of surface runoff from these mountain barriers, rough benefit/cost estimates could be developed. For example, let's say the value of the water originating in the Diamond and Ruby Mountains has a value of $15.00/acre-foot then the estimated benefit to cost ratio would be: $15.00/$2.11 or 7.1 to 1. This would mean for each dollar spent on cloud seeding the benefits would be roughly seven dollars. It is easy to look at the cost of conducting a cloud seeding program but it is important to put these costs in their proper perspective by comparing costs versus the likely return on the investment.

Table 3 Estimated Cost per Acre Foot of Additional Runoff

Target Area(s)	Est. Runoff Increase Acre Feet	Est. Annual Cost	Est. Cost/Acre Foot
Diamond & Ruby	62,400	$132,000	$2.11
Independence & Santa Rosa	39,620	$132,000	$3.33
Toiyabe	51,200	$132,000	$2.58

5.0 NAWC Experience and Qualifications

Corporate Background of
North American Weather Consultants

North American Weather Consultants (NAWC) is one of the longest-standing private meteorological consulting firms in the United States. In 1970, NAWC received the American Meteorological Society's prestigious *Award for Outstanding Services to Meteorology by a Corporation* "for its pioneering the practice of private meteorology in the United States..." We have been providing high quality, innovative consulting services to clients domestically and abroad for more than 50 years. This page provides some background on NAWC, describes who we are, what we do, and the underlying philosophy that drives our business approach and corporate standards.

Corporate History - NAWC has provided meteorological, weather modification, and air quality consulting services since its establishment in 1950. We have a long, proud history of providing our clients with complete, focused consulting services. Our underlying corporate philosophy and business approach have withstood the test of time. NAWC operated as a private corporation until being acquired by a large, publicly-traded corporation in 1992. In 1999, NAWC separated from the parent firm, resuming its operations as a private corporation.

NAWC was established in the Santa Barbara, California area in 1950 and maintained its headquarters there until 1980, when the corporate offices were relocated to Salt Lake City, Utah. Our offices are currently located in Sandy, Utah, a suburb of Salt Lake City.

Our Corporate Philosophy - NAWC's corporate philosophy hinges on pride in our work and a clear focus on our clients' specific needs. Clients hire consultants to help them find answers to their problems/needs, each within a context of specific circumstances. Our simple approach is to listen very closely to our clients from the outset, and then tailor our work to address their specific needs. This approach leads to focused, timely, and cost-effective solutions for our clients.

Our Corporate Structure - NAWC consists of two primary divisions: 1) Weather Modification, including a broad spectrum of operations and research projects and 2) Applied Meteorology, involving a wide variety of activities in the areas of extreme precipitation (probable maximum precipitation), forecasting, climatology, and forensics.

---NAWC FAST FACTS---

- Incorporated in 1950, NAWC has nearly 60 years of continuous involvement in weather modification.
- NAWC was founded as a weather modification company. Weather modification has always been NAWC's primary specialty.
- NAWC is recognized internationally as a leader in the weather modification field, in research and operations.
- NAWC received the American Meteorological Society's prestigious "Award for Outstanding Services to Meteorology by a Corporation" in 1970 for pioneering the practice of private meteorology in the United States.
- NAWC has conducted weather modification projects and provided consulting services in many countries outside the United States, including Europe, South America, Central America, Asia, and the Middle East.
- Our weather modification activities and contributions are well known, through our hundreds of publications and reports.
- Our extensive client list includes hydroelectric utilities, government agencies, water districts, universities and private entities.
- NAWC's client satisfaction rating is consistently very high, due to NAWC's ongoing commitment to carefully determine and fully address each client's specific needs. We always tailor our services to our clients' interests and circumstances.
- NAWC offers the full spectrum of weather modification services, ranging from basic research to feasibility studies and reviews of existing projects, and from start-up services to full-service operational projects.
- We offer the full range of cloud seeding capabilities, including ground-based and airborne seeding systems, appropriate support systems, and ground-based and airborne seeding plume tracking, using tracer technology.

NAWC is well known in the weather modification arena for designing, operating and evaluating winter cloud seeding programs. We operate long-term programs in California, Colorado, and Utah. Our staff members are certified by the Weather Modification Association (WMA) and NAWC’s President is also certified by the American Meteorological Society as a Certified Consulting Meteorologist (CCM). NAWC staff members have published numerous technical papers in professional journals and staff members also make technical presentations

at meteorological conferences. Our company is active in the non-profit Weather Modification Association: www.weathermodification.org. Our web site provides additional information on our company: www.nawcinc.com. Table 4 provides work references for some of our cloud seeding clients. Appendix A provides a summary of previous and on-going operational cloud seeding programs.

Table 4

Some Representative NAWC Weather Modification Programs

- Santa Barbara County operational winter seeding program, 2001-2016 winter seasons. Airborne seeding and ground seeding using three to six high output, ground based flare sites and a cloud seeding aircraft. NEXRAD weather radar output used in place of project specific radar.

- Santa Barbara County operational winter seeding program, most winters 1978-1997. Seeding conducted using both ground based and aerial seeding. Weather radar support was provided by the Air Force from Vandenberg Air Force base until 1988. NAWC installed independent weather radar for program operations beginning in 1989.

- Upper Kings River winter seeding program for the Kings River Conservation District, ground based and aircraft seeding with weather radar control, 1988-1993, 2007-2016. NAWC recently awarded a new five year contract under a competitive bid process. Contact Mr. Steve Stadler, 559-237-5567 main x 115.

- Southern California Edison winter and summer seeding program for the Upper San Joaquin River Basin in the southern Sierra Nevada 1951-1987; 1990-1992. Ground based and airborne seeding.

- Los Angeles County Flood Control District winter operational seeding program in the San Gabriel Mountains. Ground based seeding program conducted each winter from 1961-1975. Program began again in spring of 1991 and continued in 1992, 1993, and 1997 to 2002 then suspended due to fire burn areas. This program was re-started last winter. Contact Mr. Keith Hala, .

- Sacramento Municipal Utility District winter weather forecast support and recommendations of silver iodide generators to be used during storm periods for their internally operated cloud seeding program; three year contract which began in the spring of 2004. Contract renewed and work continued through 2014 (contact, Dudley McFadden, 916-732-5953).

- California Department of Water Resources, Northern California Drought relief program conducted during the 1988-89 winter season. NAWC conducted

airborne seeding utilizing two seeding aircraft and supported with on-site weather radar.

- Southern and Central Utah, State of Utah Division of Water Resources, operational winter cloud seeding program 1974-1983 and 1984-present. Ground generators used supplemented with aircraft seeding (up to four aircraft) in some of the winters. (contact, David Cole, 801-538-7269).

- Northern Utah, State of Utah Division of Water Resources, operational winter cloud seeding program 1988-present. Ground generator program (contact, David Cole, 801-538-7269).
- High Uinta Mountains, Utah, State of Utah Division of Water Resources, operational winter cloud seeding program 1977, 1989, 2003-2011 (contact, David Cole, 801-538-7269).
- Upper Boise River, Idaho, Boise Project Board of Control, operational winter cloud seeding program 1992-1996, 2007-2009, 2010-2011, 2013-2014 (contact Tim Page, 208-344-1141).
- Upper Gunnison River, Colorado, operational winter cloud seeding program 2002-2014 (contact Jane Wyman, 970-641-7671).

- El Cajon Dam drainage area, Honduras, 1993-95, and 1997. Airborne and ground based seeding program supported with on-site weather radar

Additional information can be furnished upon request.

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Griffith, D.A., M.E. Solak and D.P. Yorty, 2009: 30+ Winter Seasons of Operational Cloud Seeding in Utah. WMA, Journal of Weather. Modification, Vol. 41, pp. 23-37.

Super, A.B., 1999: Summary of the NOAA/Utah Atmospheric Modification Program. WMA, Journal of Weather. Modification, Vol. 31, pp. 51-75.

Appendix A

NORTH AMERICAN WEATHER CONSULTANTS OPERATIONAL CLOUD SEEDING PROGRAMS
Partial Listing (through April 2016)

Project Area: **Gunnison County, Colorado**
Sponsor: Gunnison County
Technique: Ground based silver iodide seeding
Time Period: 2003-present
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Little Cottonwood Canyon, Utah**
Sponsor: Alta and Snowbird Ski Areas
Technique: Ground based silver iodide seeding
Time Period: 1996 - present
Goal: Enhanced winter snowfall for skiing

Project Area: **Wellsville and Wasatch Mountains of Northern Utah**
Sponsor: Utah Division of Water Resources and Cache County
Technique: Ground based silver iodide seeding
Time Period: 1997 - 2000, 2002-present
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Upper Ogden River and Lost Creek Watersheds, Utah**
Sponsor: Weber Basin Water Conservancy District and Utah Division of Water Resources
Technique: Ground based and airborne silver iodide seeding
Time Period: 1991 - 1993
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Upper San Joaquin River Drainage, Southern Sierra Nevada of California**
Sponsor: Southern California Edison Company
Technique: Ground based and airborne silver iodide seeding with radar surveillance
Time Period: 1951 - 1987 and 1990 - 1992
Goal: Enhanced winter and summer precipitation for hydroelectric power production

Project Area: **Mountain Watersheds in Central and Southern Utah**
Sponsor: Utah Water Resources Development Corporation Utah Division of Water Resources, 13 Utah Counties
Technique: Airborne and ground based silver iodide seeding
Time Period: 1973 - 1983, 1987, 1988-present
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Bear Lake Drainage, Smith & Thomas Forks, Southwestern Wyoming and Southeastern Idaho**
Sponsor: Utah Power and Light Company
Technique: Ground based silver iodide seeding
Time Period: 1954 - 1970; 1979 - 1982, 1989 - 1990
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Santa Barbara County, California**
Sponsor: Santa Barbara County Water Agency
Technique: Ground based and airborne silver iodide seeding with radar surveillance; ground-based flare seeding
Time Period: 1950-1953; 1955; 1956-1960; 1978; 1982 – 1997; 2002-2007; 2008-present
Goal: Enhanced winter precipitation for municipal and agricultural water supplies

Project Area: **Grouse Creek, Raft River, Wellsville and Wasatch Mountains of Northern Utah**
Sponsor: Utah Water Resources Development Corporation,Utah Division of Water Resources, and Cache and Box Elder Counties
Technique: Ground based silver iodide seeding
Time Period: 1989 - 1997, 2001-present
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Provo and Weber River Drainages in Western Uinta Mountains of Utah**
Sponsor: Utah Water Resources Development Corporation, Utah Division of Water Resources, Provo River Water Users Association and Weber Basin Water Conservancy District
Technique: Ground based silver iodide seeding
Time Period: 1989 - 1995, 2000-present
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Wasatch Mountains in Eastern Salt Lake County, Utah**
Sponsor: Utah Water Resources Development Corporation; Utah Division of Water Resources; Salt Lake City Water Division; and Alta, Brighton, and Snowbird Ski Areas
Technique: Ground based silver iodide seeding
Time Period: 1989 - 1996
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Upper Kings River Drainage in the Southern Sierra Nevada of California**
Sponsor: Kings River Conservation District and Kings River Water Users Association
Technique: Airborne and ground based silver iodide seeding with radar surveillance
Time Period: 1989 – 1993, 2007-present
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Upper Feather River Drainage in the Northern Sierra Nevada of California**
Sponsor: California Department of Water Resources
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1989
Goal: Enhanced winter precipitation for municipal and irrigation water supplies

Project Area: **Grand Mesa and West Elk Mountains of Western Colorado**
Sponsor: Grand Mesa Water Users Association
Technique: Ground based silver iodide seeding
Time Period: 1990 - 1991
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **San Gabriel Mountains, California**
Sponsor: Los Angeles County Flood Control District
Technique: Ground based silver iodide seeding
Time Period: 1959 - 1973, 1991 - 1993, 1997-2001, 2016.
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Bannock, Portneuf and Bear River Mountain Ranges of Southeastern Idaho**
Sponsor: Bear River RC&D and Bannock, Bear Lake, Caribou, Franklin, and Oneida Counties
Technique: Ground based silver iodide seeding
Time Period: 1988 - 1989, 1992, 1993
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Uinta Mountains of Northeastern Utah**
Sponsor: Uinta County, Duchesne County and Utah Division of Water Resources
Technique: Airborne and ground based silver iodide seeding
Time Period: 1977, 1989, 2003-present
Goal: Increased winter spring, and summer precipitation for irrigation water supplies

Project Area: **Boise River Drainage, Idaho**
Sponsor: Boise Project Board of Control
Technique: Ground based silver iodide seeding
Time Period: 1992 - 1996, 2002-2005, 2007-present
Goal: Enhanced winter precipitation for irrigation water supplies and hydroelectric power production

Project Area: **Willow Creek Drainage, Colorado**
Sponsor: Northern Colorado Water Conservancy District
Technique: Ground based silver iodide seeding
Time Period: 1992 - 1995
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Higher Elevation Watersheds of Nine Eastern Idaho Counties and One Western Wyoming County**
Sponsor: High Country RC&D
Technique: Ground based silver iodide seeding
Time Period: 1993, 1995
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Santa Clara County, California**
Sponsor: Santa Clara Valley Water District
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1992
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Mornos River Drainage, Greece**
Sponsor: Greater Athens Water Authority
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1992, 1993
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Chixoy River Drainage, Guatemala, C. A.**
Sponsor: Empresa Electrica and Instituto Nacional de Electrificacion
Technique: Airborne and ground based silver iodide seeding with radar surveillance
Time Period: 1991, 1992, 1994
Goal: Enhanced summer precipitation for hydroelectric power production

Project Area: **El Cajon Drainage Basins, Honduras, C. A.**
Sponsor: Empresa Nacional De Energia Electrica
Technique: Airborne and ground based silver iodide seeding with radar surveillance
Time Period: 1993, 1994, 1995, 1997
Goal: Enhanced summer precipitation for hydroelectric power production

Project Area: **Tsengwen Dam Drainage, Taiwan**
Sponsor: Taiwan Central Weather Bureau
Technique: Ground based silver iodide seeding
Time Period: 1992, 1994
Goal: Enhanced summer precipitation for irrigation water supplies

Project Area: **West Central Texas Near San Angelo**
Sponsor: City of San Angelo, Texas
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1985, 1986, 1987, 1988
Goal: Enhanced summer precipitation for municipal water supplies

Project Area: **Edwards Plateau Northwest of San Antonio**
Sponsor: Edwards Underground Water District, San Antonio, Texas
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1985, 1986
Goal: Enhanced summer precipitation for municipal water supplies

Project Area: **South Central Texas North of Corpus Christi**
Sponsor: City of Corpus Christi, Texas
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1985
Goal: Enhanced summer precipitation for municipal water supplies

Project Area: **Pine Valley Mountains in Southwestern Utah**
Sponsor: Washington County Water Conservancy District and Utah Division of Water Resources
Technique: Ground based silver iodide seeding
Time Period: 1985-1987
Goal: Enhanced winter precipitation for municipal and irrigation water supplies

Project Area: **Southern Delaware**
Sponsor: Delaware Department of Agriculture
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1985
Goal: Enhanced summer precipitation for agricultural water supplies

Project Area: **Abu Dhabi, United Arab Emirates**
Sponsor: Abu Dhabi Municipality
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1982
Goal: Enhanced winter precipitation for agricultural water Supplies

Project Area: **Catalina Island, California** Sponsor: Southern California Edison, Co.
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1977 - 1978
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Bulloch County, Eastern Georgia**
Sponsor: Drought Relief Fund
Technique: Airborne silver iodide seeding with radar Surveillance
Time Period: 1977
Goal: Enhanced summer precipitation for agricultural water supplies

Project Area: **Southern Georgia**
Sponsor: Southern Georgia Rain Gain
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1977
Goal: Enhanced summer precipitation for agricultural water supplies

Project Area: **Burke County, Eastern Georgia**
Sponsor: Burke County
Technique: Airborne silver iodide seeding with radar surveillance
Time Period: 1977
Goal: Enhanced summer precipitation for agricultural water supplies

Project Area: **Polk County, Oregon**
Sponsor: Polk County
Technique: Airborne dry ice seeding
Time Period: 1977
Goal: Enhanced winter precipitation for agricultural water supplies

Project Area: **Deschutes River Drainage, Central Oregon**
Sponsor: Portland General Electric Company Technique: Ground based silver iodide seeding
Time Period: 1964-1965; 1974-1976
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Chelan Lake Drainage, Central Washington**
Sponsor: Chelan Public Utility District
Technique: Airborne dry ice seeding
Time Period: 1976 - 1977
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Baker River Drainage, Northern Washington**
Sponsor: Puget Power Company
Technique: Airborne dry ice seeding
Time Period: 1976 -1977
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Skagit River Drainage, Northern Washington**
Sponsor: Seattle City Light Company
Technique: Airborne dry ice seeding
Time Period: 1976 - 1977
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Lake Spalding Drainage, in the Northern Sierra Nevada of California**
Sponsor: Pacific Gas and Electric Company
Technique: Airborne silver iodide seeding
Time Period: 1976 - 1977
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Heritage and Mona Reservoir Areas, Central Jamaica**
Sponsor: Kingston Water Commission
Technique: Airborne silver iodide seeding
Time Period: 1976
Goal: Enhanced summer precipitation for municipal water supplies

Project Area: **Port of Ensenada, Mexico**
Sponsor: Insisa
Technique: Ground based silver iodide seeding
Time Period: 1970 - 1976
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Northwestern South Dakota**
Sponsor: South Dakota Weather Control Commission
Technique: Airborne silver iodide seeding
Time Period: 1975
Goal: Enhanced summer precipitation and hail suppression for agricultural crops

Project Area: **Coeur D'Alene Lake Watershed, Northern Idaho**
Sponsor: Washington Water and Power Company
Technique: Ground based silver iodide seeding
Time Period: 1950-1951; 1952-1960; 1966-1971; 1973-1974
Goal: Enhanced fall - early winter precipitation for hydroelectric power production

Project Area: **Hungry Horse Reservoir Area, Northwestern Montana**
Sponsor: Bonneville Power and Light Company
Technique: Ground based silver iodide seeding
Time Period: 1966 - 1971
Goal: Enhanced winter precipitation for hydroelectric power generation

Project Area: **San Benito County, California**
Sponsor: San Benito County
Technique: Ground based silver iodide seeding
Time Period: 1964 - 1966
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Owyhee Reservoir, Southwestern Idaho**
Sponsor: Board of Control - Owyhee Project
Technique: Ground based silver iodide seeding

Time Period: 1954-1956; 1959-1962
Goal: Enhanced winter precipitation for irrigation water supplies

Project Area: **Ventura County, California**
Sponsor: Ventura County
Technique: Ground based silver iodide seeding
Time Period: 1957 - 1960
Goal: Enhanced winter precipitation for irrigation and municipal water supplies

Project Area: **Santa Ana River Basin, California**
Sponsor: Santa Ana River Weather Corporation
Technique: Ground based silver iodide seeding
Time Period: 1956 - 1960
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Lake Almanor Drainage, in the Northern Sierra Nevada of California**
Sponsor: Pacific Gas and Electric Company
Technique: Ground based silver iodide seeding
Time Period: 1952 - 1960
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Mokelumne & Stanislaus Rivers, in the Central Sierra Nevada of California**
Sponsor: Pacific Gas and Electric Company
Technique: Ground based silver iodide seeding
Time Period: 1952 - 1960
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Campbell River Drainage, British Columbia**
Sponsor: British Columbia Hydro Company
Technique: Ground based silver iodide seeding
Time Period: 1954 - 1960
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Southern Cascades, Oregon**
Sponsor: California-Oregon Power Company
Technique: Ground based silver iodide seeding
Time Period: 1951 - 1960
Goal Period: Enhanced winter precipitation for hydroelectric power production

Project Area: **Crane Valley in the Central Sierra Nevada of California**
Sponsor: Pacific Gas and Electric Company
Technique: Ground based silver iodide seeding
Time Period: 1954 - 1959
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **San Diego County, California**
Sponsor: San Diego County Weather Corporation
Technique: Ground based silver iodide seeding Time Period: 1950-1951; 1956-1957
Goal: Enhanced winter precipitation for municipal water supplies

Project Area: **Ocean Falls, British Columbia**
Sponsor: Crown-Zellerbach Paper Company
Technique: Ground based silver iodide seeding
Time Period: 1955 - 1957
Goal: Enhanced winter precipitation for hydroelectric power production

Project Area: **Decatur and Clarke Counties, Iowa**
Sponsor: The Decatur County Weather Modification Association
Technique: Ground based silver iodide seeding
Time Period: 1957
Goal: Enhanced summer precipitation for agricultural water supplies

Project Area: **Greene, Boone and Story Counties, Iowa**
Sponsor: Central Iowa Modification Association
Technique: Ground based silver iodide seeding
Time Period: 1957
Goal: Enhanced summer precipitation for agricultural water supplies

Project Area: **Dallas County, Iowa**
Sponsor: Dallas County Weather Modification Group
Technique: Ground based silver iodide seeding
Time Period: 1957
Goal: Enhanced summer precipitation for agricultural water supplies

Project Area: **Southeastern Idaho**
Sponsor: Salmon River Canal Company, Oakley Canal Company, Cedar Mesa Reservoir and Canal Company
Technique: Ground based silver iodide seeding
Time Period: 1953 - 1955
Goal: Enhanced winter precipitation for irrigation water supplies

North American
Weather Consultants, Inc.

8180 South
Highland Dr., Suite
B-2
Sandy, Utah 84093
801-942-9005

Humboldt River Basin Water Authority
c/o Intertech Services Corporation
P.O. Box 2008
Carson City, Nevada 89702

Elko County
Eureka County
Humboldt County
Lander County
Pershing County

Sent Via Email 8/8/16

MEMORANDUM

TO: Senator Pete Goicoechea, Chairman, Legislative Commission's Subcommittee to Study Water
Members, Legislative Commission's Subcommittee to Study Water
Alysa Keller, Legislative Counsel Bureau

FROM: Mike Baughman, Executive Director, Humboldt River Basin Water Authority

DATE: August 8, 2016

SUBJECT: REACTIONS TO SUGGESTIONS BY THE NEVADA STATE ENGINEER FOR WATER RESOURCE RELATED BILL DRAFT REQUESTS

During its August 5, 2016 meeting, the Humboldt River Basin Water Authority (HRBWA) Board of Directors took the following positions regarding suggestions offered by the Nevada State Engineer in his April 19, 2016 Memorandum to the Legislative Commission's Subcommittee to Study Water for water related legislation.

TOOLS FOR MANAGING OVER-APPROPRIATED GROUNDWATER BASINS

In his April 19th memo, the Nevada State Engineer stated, "The State Engineer encourages this committee to consider legislation that continues to refine Nevada water law and provide flexibility in the development and acceptance of Groundwater Management Plans, whether in a Critical Management Area or not." (Page 2 of April 19, 2016 Memorandum)

The Humboldt River Basin Water Authority Board of Directors voted during their August 5, 2016 meeting to support the Nevada State Engineer's call for legislation "that continues to refine Nevada water law and provide flexibility in the development and acceptance of Groundwater Management Plans" but only in Critical Management Areas. The Authority does not support said flexibility in areas outside of Critical Management Areas.

The Authority believes Nevada has one of the strongest and most effective water laws in the western United States and believes that strict adherence to said laws by former Nevada State

Engineers would have likely avoided the over-appropriation of groundwater basins which has occurred in so many areas of Nevada. Until such time as a hydrographic basin is designated as a Critical Management Area, such a basin should be managed strictly according to existing Nevada water law.

CONJUNCTIVE WATER MANAGEMENT

The Nevada State Engineer's April 19, 2016 memorandum to the Subcommittee included the following statements, "The State Engineer believes that legislation addressing conjunctive water management is imperative to Nevada's future. It is also important to recognize that the Legislature has declared that it is the policy of this State to encourage the State Engineer to consider the best available science in rendering decisions concerning the available surface-water and groundwater resources in Nevada. NRS 533.024. Therefore, before any conjunctive water management would be implemented, significant scientific work must precede it. While the State Engineer believes the Prior Appropriation Doctrine already provides the authority to consider whether the use of groundwater is impacting a senior water right on a surface-water source, what is lacking is a statutory acknowledgment that the two water sources can be hydrologically connected; and therefore, the State Engineer seeks guidance from the Legislature on tools that can be used to address this connectivity problem that are more balanced and equitable for all, rather than just completely prohibiting the use of water by the junior groundwater users." (Page 4 of April 19, 2016 Memorandum)

On Page 7 of the April 19, 2016 Memorandum the Nevada State Engineer states, "The goal for Nevada would hopefully be one that would allow continued groundwater use while addressing ways to make the senior surface-water right holders whole. Any such program must be individually tailored to the stream system and groundwater resources involved. Tools that might be considered are aquifer storage and recovery programs, State-approved augmentation programs, forbearance agreements, direct financial compensation, and water banking programs.

The State Engineer encourages this committee to consider legislation to address conjunctive water management of Nevada's surface-water and groundwater resources." (Page 7 of April 19, 2016 Memorandum)

The Board of Directors of the Humboldt River Basin Water Authority concur with the Nevada State Engineer's call for legislation to address conjunctive water management of Nevada's surface-water and groundwater resources.

ADAPTIVE WATER MANAGEMENT

In his April 19, 2016 Memorandum, the Nevada State Engineer stated, "The State Engineer encourages this committee to consider legislation to clarify that adaptive water management is a tool that can be employed in the appropriation, development and use of Nevada's waters. Additionally, prior to issuing a water right permit, NRS 533.370(2) requires the State Engineer make a determination that the proposed water right will not conflict with existing rights. As part of the adaptive management process, the State Engineer encourages this committee to consider legislation that allows *mitigation* of a potential conflict to avoid the conflict, thereby allowing the

full development of the available water resources in the state." (Pages 8-9 of April 19, 2016 Memorandum)

During their August 5, 2016 meeting, the Board of Directors of the Humboldt River Basin Water Authority voted to oppose the Nevada State Engineers recommendation that the Subcommittee to Study Water "consider legislation to clarify that adaptive water management is a tool that can be employed in the appropriation, development and use of Nevada's waters" and "consider legislation that allows *mitigation* of a potential conflict to avoid the conflict, thereby allowing the full development of the available water resources in the state."

The Authority Directors further voted to adopt the document entitled, " Eureka County Input on Mitigation of Conflicts and Adaptive Management" submitted to the Subcommittee during its June 7, 2016 meeting in Dyer as their reasons and basis for opposing the Nevada State Engineer's call for legislation to clarify that adaptive water management is a tool that can be employed in the appropriation, development and use of Nevada's waters and that allows *mitigation* of a potential conflict to avoid the conflict, thereby allowing the full development of the available water resources in the state.

DOMESTIC WELLS

Page 9 of the Nevada State Engineer's April 19, 2016 Memorandum to the Subcommittee includes the following recommendation, "The State Engineer encourages this committee to consider legislation to provide an exception to the current law that would require complete curtailment of junior priority domestic wells if curtailment by priority was required in a groundwater basin."

On Page 10 of said memorandum the Nevada State Engineer states with regard to NRS 534.110(6), "This statute requires that, in times of curtailment, the State Engineer is required to regulate water use by priority including domestic well use. The State Engineer believes that it would be held unthinkable to restrict people from water use inside their homes and therefore would like to see this provision amended to restrict outdoor use only in times of curtailment."

During its August 5, 2016 meeting, the Board of Directors of the Humboldt River Basin Water Authority voted to support the Nevada State Engineer's recommendation for the Subcommittee "to consider legislation to provide an exception to the current law that would require complete curtailment of junior priority domestic wells if curtailment by priority was required in a groundwater basin."

Please feel free to contact me should you have questions regarding the positions of the Humboldt River Basin Water Authority put forth in this memorandum. Please note that due to prior commitments I will be unable to attend the Legislative Commission's Subcommittee to Study Water work session to be held August 26, 2016 but would likely be available by cell phone (775) 315-2544 to respond to Subcommittee questions on the positions put forth in this memorandum.

Tab B

State Engineer's Office
Domestic Wells

RECOMMENDATION FOR POSSIBLE CONSIDERATION BY THE LEGISLATIVE COMMISSION'S SUBCOMMITTEE TO STUDY WATER

DOMESTIC WELL USE IN TIMES OF CURTAILMENT

The recommendation is to change the current statutory requirement regarding the regulation of water from domestic wells in groundwater basins being regulated by priority. The intent of this recommendation is to protect the health, safety and welfare of homeowners by curtailing **ONLY** outdoor water use. It is proposed that in-house water use **NOT** be curtailed during times of regulation.

The priority of domestic wells is found in NRS 534.080(4):

> "(a) The date of priority for the use of underground water from a well for domestic purposes where the draught does not exceed 2 acre-feet per year is the date of completion of the well as recorded by the well driller on the log the well driller files with the State Engineer pursuant to NRS 534.170; or
> (b) Demonstrated through any other documentation or evidence specified by the State Engineer. "

As such, the vast majority of domestic wells drilled in the state are junior-in-time to senior rights in the respective basins. If regulation by priority is ordered, the domestic well use would be among the first to be curtailed.

Under current law, NRS 534.110(6) provides that:

> "except as provided in subsection 7, the State Engineer shall conduct investigations in any basin or portion thereof where it appears that the average annual replenishment to the groundwater supply may not be adequate for the needs of all permittees and all vested-right claimants, and if the findings of the State Engineer so indicate, the State Engineer may order that withdrawals, **including, without limitation, withdrawals from domestic wells, be restricted to conform to priority rights**."

Additionally, curtailment of domestic wells shows up in subsection 7 that provides for designating a groundwater basin as a critical management area:

> "…any basin in which withdrawals of groundwater consistently exceed the perennial yield of the basin … and that if a basin has been designated as a critical management area for at least 10 consecutive years, the State Engineer shall order that withdrawals, **including, without limitation, withdrawals from domestic**

wells, be restricted in that basin to conform to priority rights, unless a groundwater management plan has been approved for the basin pursuant to NRS 534.037."

Does the recommendation revise one or more current *Nevada Revised Statues* (NRS)? If "Yes," please provide the reference to the NRS citation(s) affected by the recommendation, if known.

Yes, 534.110(6) and 534.110(7).

Potential draft language:

NRS 534.110 Rules and regulations of State Engineer; statements and pumping tests; conditions of appropriation; designation of critical management areas; restrictions.

6. Except as otherwise provided in subsection 7, the State Engineer shall conduct investigations in any basin or portion thereof where it appears that the average annual replenishment to the groundwater supply may not be adequate for the needs of all permittees and all vested-right claimants, and if the findings of the State Engineer so indicate, the State Engineer may order that withdrawals , including, without limitation, withdrawals from domestic wells, be restricted to conform to priority rights. The curtailment of domestic wells only extends to outside water use.

7. The State Engineer:

(a) May designate as a critical management area any basin in which withdrawals of groundwater consistently exceed the perennial yield of the basin.

(b) Shall designate as a critical management area any basin in which withdrawals of groundwater consistently exceed the perennial yield of the basin upon receipt of a petition for such a designation which is signed by a majority of the holders of certificates or permits to appropriate water in the basin that are on file in the Office of the State Engineer.

Ê The designation of a basin as a critical management area pursuant to this subsection may be appealed pursuant to NRS 533.450. If a basin has been designated as a critical management area for at least 10 consecutive years, the State Engineer shall order that withdrawals, including, without limitation, withdrawals from domestic wells, be restricted in that basin to conform to priority rights, unless a groundwater management plan has been approved for the basin pursuant to NRS 534.037. If curtailment is ordered, the curtailment of domestic wells only extends to outside water use.

What group or person is making the recommendation?

Nevada State Engineer Jason King

What is the name and contact information of the person who can provide additional information for the recommendation, if necessary?

Jason King, jking@water.nv.gov, 775-684-2861

Tab C

Nye County Water District

To:
Legislative Subcommittee to Study Water
Senator Pete Goicoechea, Chair

Regarding proposed changes in statute(s) for regulation of domestic wells

The Nye County Water District is currently working on a Pahrump Basin 162 Groundwater Management Plan which, in part, includes a domestic well component. The Pahrump basin currently has more than 11,000 domestic wells and the basin has sufficient parcels to drill an additional 8,500. This discussion centers on priority doctrine, curtailment and limitations on future domestic wells in the Pahrump basin.

First: Based on the fact that a domestic well a.) Has a priority date and b.) Under priority doctrine is subject to curtailment (NRS 534.110.6); the overwhelming majority of domestic wells in the Pahrump basin are junior in priority. The Nye County Water District is confident that we can all agree that no person in their right mind would completely deny access to water from more than 11,000 existing domestic wells in the Pahrump basin. In context: This discussion centers on areas where a public water system does not exist, or by extension is dis-proportionally expensive for the individual to connect to a public water system.

Second: The Pahrump Groundwater Management Plan seeks to limit withdrawals from "new" domestic wells, as the local water resource is insufficient to support further drilling of domestic wells at 2 AF per in perpetuity. (The Pahrump Basin has a Perineal Yield of 20,000 AFA)

It is apparent that *existing* powers of the State Engineer [particularly with regard to regulation of domestic wells] remains the subject of confusion and debate. (A domestic well is defined in NRS 534.013)

We would respectfully request that the Subcommittee to Study Water receive clarification from the LCB regarding legislative intent on the appropriate statutes together with an AG's opinion on the following:

1.) It is our understanding that the State Engineer currently has the power to completely curtail pumping of domestic wells under priority doctrine [emphasis on curtailment, priority doctrine and domestic well priority date]. (Reference to NRS 534.080.4(a)&(b), NRS 534.110.6, NRS 534.110.7(b) and NRS 534.037)
2.) Clarify if the State Engineer has the power to a.) Limit domestic well pumpage/duty to less than 2 AFA and b.) If so, does this constitute a "takings"? (Reference to NRS 534.120.1)
3.) Clarify if the State Engineer has the power to require meters on domestic wells. (NRS 534.180.4(a)(2) provides for limited powers to require meters)

Depending upon clarification of the existing powers of the State Engineer as outlined previously:

In reference to item 1.) Based on the fact that a domestic well a.) Has a priority date and b.) Under priority doctrine is subject to curtailment: It is of utmost importance to provide for an *exception to complete curtailment* of junior priority domestic wells if curtailment by priority was required in a groundwater basin. It is our understanding that the State Engineer would like to see the statutes amended to "*restrict outdoor use of domestic well water in times of curtailment*" [no curtailment of indoor use].

The Nye County Water District would respectfully request this exception be expanded to allow for the *"watering of pets and livestock"*. This is based on the fact that irrigation is the largest use of water; therefore curtailment of irrigation has the greatest impact to conservation efforts if curtailment by priority was required in a groundwater basin.

In reference to items 2 and 3.) Based on recommendations drafted in the Pahrump Basin 162 Groundwater Management Plan; we are requesting a provision in statute to "*limit withdrawals from "new" domestic wells to 0.5 AFA and meters be required on those domestic wells limited to 0.5 AFA"*.
In context: The Pahrump basin currently has more than 11,000 domestic wells and the basin has sufficient parcels to drill an additional 8,500. The Pahrump Groundwater Management Plan seeks to limit withdrawals from "new" domestic wells as the water resource is insufficient to support further drilling of domestic wells at 2 AF per in perpetuity. It is not our intent to request this amendment to statute for *all* domestic wells in Nevada. This amendment should only apply to severely over appropriated basins where steady water level decline is observed -and- where the data supports that the density/pumpage of domestic wells are a significant contributing factor to water level decline in a specific geographic area.

Further: How can the State Engineer manage groundwater withdrawals without the benefit of totalizer meter readings to determine pumpage? And by extension; how can local government participate in management of something we cannot quantify? At the moment DWR uses an actual pumpage *estimate* of 0.5 AF per domestic well for the Pahrump Basin. The State Engineer will be making decisions on management of the water resource without hard data, if we fail to face the metering issue.

The Nye County Water District would support an amendment to the statute(s) allowing for meters to be required on "new" domestic wells as outlined in the Pahrump Groundwater Management Plan. This amendment should only apply to severely over appropriated -and- over pumped basins where steady water level decline is observed -and- where the data supports that the density/pumpage of domestic wells are a significant contributing factor to water level decline in a specific geographic area.

List of attachments:
Backup showing references to statutes with regard to domestic wells

Note: The Pahrump Groundwater Management Plan with appendices can be accessed online at: http://nyecountywaterdistrict.net/attachments/File/documents/GWMP_Draft_6__Stage_1__October_2015.pdf

Respectfully submitted by:

Nye County Water District
2101 E. Calvada Blvd., Ste. 100,
Pahrump, Nevada
89048

Contact Information
Oz Wichman, General Manager, Nye County Water District
Phone: 775-761-5307
Email: ohwichman@gmail.com

Dave Hall, Chair, Nye County Water District Governing Board
Phone: 775-764-0964
Email: davidt1147@gmail.com

Tab D

Pahrump Utilities

Utilities, Inc. of Central Nevada
1240 E. State St., Ste. 115
Pahrump NV 89048

Pahrump Utility Company Inc.
5250 Hafen Ranch Rd.
Pahrump NV 89061

Desert Utilities Inc.
4060 N. Blagg Rd. #110
Pahrump NV 8906

August 5, 2016

Senator Pete Goicoechea
Attn: Alysa Keller, Subcommittee Policy Analyst
Legislative Commission's Subcommittee to Study Water
Research Division
Legislative Counsel Bureau
401 South Carson Street
Carson City, Nevada 89701-4747

Re: Recommendation for Possible Consideration by the Legislative Commission's Subcommittee to Study Water

Dear Honorable Chairman Goicoechea,

Water and sewer service is provided to many areas of the Pahrump Valley by three privately owned publicly regulated utilities, Desert Utilities Inc. (DUI), Pahrump Utility Company Inc. (PUCI) and Utilities, Inc. of Central Nevada (UICN). The utilities own the majority of the permitted/appropriated water rights in Pahrump. There are approximately 60,000 acre feet of permitted/appropriated water rights in the Pahrump basin, Basin 162. There are also many sections of the Pahrump Valley which are served by domestic wells and septic tank systems. There are 11,000 domestic wells and septic systems in Pahrump. It is estimated that there are approximately 9,000 additional lots that would qualify for domestic wells. The State Water Engineer at the Nevada Division of Water Resources (NWDR) has estimated the annual water recharge to the Pahrump Valley aquifer at 20,000 acre-feet. Clearly the Pahrump Valley basin is over appropriated.

The three utilities are keenly aware of the over appropriation issue and have been working diligently with the State Engineer and the Public Utilities Commission of Nevada to try to balance projected water use with the annual aquifer recharge. In pursuit of that goal utilities have:

1. Worked with and supported the State Engineer's implementation in 2009 of a graduated dedication of water rights schedule that requires larger dedications of water rights as lots increase in size. This has resulted in a 2 to 1 and in some cases a 3 to1 dedication in excess of actual usage;
2. Implemented a comprehensive conservation plan for all development within the utilities service areas that has been approved by the state engineer. The conservation plan requires use of low-flow fixtures, drought tolerant plants, and limits the amount of turf that can be planted;
3. Implemented Tiered Water Rates to promote water conservation; and
4. Participated in the Pahrump Basin 162 Groundwater Management Advisory Committee for implementation of a groundwater management plan for the Pahrump basin.

It has become quite clear that for any groundwater management plan to balance the basin, it will require not only the cooperation of the three utilities, but all members of the community in the Pahrump Valley basin. It has also become clear that the State Engineer needs additional tools to best manage water in over appropriated basins. At the last legislative session the three utilities and other major

permitted/appropriated water right holders supported SB 81, a bill proposed to give the State Engineer additional tools that would be helpful in managing an over appropriated basin. Because of the over appropriation issue in the Pahrump Valley basin, the three utilities and major permitted/appropriated water right holders support Bill Draft Requests by the State Engineer that would further the path, which the utilities have been pursuing, to a balanced Pahrump Valley basin.

On behalf of the three utility companies in the Pahrump Valley, we would respectfully recommend that the Subcommittee to Study Water support the following recommendations from the State Engineer for Bill Draft Requests (BDRs).

1. Suspend the "Use It or Lose It" law in over appropriated basins. Suspending or eliminating the "Use It or Lose It" law in over appropriated basins is important to conservation of our limited resource. The "Use It or Lose It" statute is simply counterintuitive to conservation. Water right holders, when faced with losing the water right, will put it to use even though that use could be, and should be, postponed. There are agricultural water right holders, who farm to put their water rights to Beneficial Use. These farmers have no incentive to conserve because conservation would jeopardize their water rights. In addition, the "Use It or Lose It" law can be unworkable in a utility service area. A prime example is the person who purchased a lot with water dedicated to it and a will serve from the utility. Because the owner does not intend to retire and build on his lot for another 5-7 years, he and the utility could be in the predicament of losing the water dedicated to serve the lot under the "Use It or Lose It" law and the owner would be unable to build on the lot. It is also fundamentally unfair to require a 2-1 or 3-1 over dedication by the lot owner to balance the basin and the owner still be faced with the prospect of losing the water rights entirely if not promptly used.
2. In times of curtailment, allow indoor domestic well water use without regard to the priority date of the well. In addition to the State Engineer's recommendation, we also recommend domestic well water use for domestic animals (i.e. horse, dog, cat, etc.) without regard to the priority date of the well. These uses are health and safety issues that must be protected even in time of curtailment.
3. Clarify that a Groundwater Management Plan applies to everyone in the basin. To be effective, it is imperative that any groundwater management plan require the involvement of the community in its entirety to be effective in an over appropriated basin. Without the participation of all the parties in an over appropriated basin, the aquifer cannot be balanced.

Thank you for the opportunity to provide these comments. If you have any questions please feel free to contact Wendy Barnett at 844-694-4404, Gregory T. Hafen II at 775-727-1629 or Lenny Badger at 702-242-4949.

Sincerely,

Wendy Barnett
President
Utilities, Inc. of Central NV

Gregory T. Hafen II
General Manger
Pahrump Utility Co. Inc.

Lenny Badger
Manager
Desert Utilities Inc.

Tab E

Private Well Owners Cooperative of Nye County

RECOMMENDATION FOR POSSIBLE CONSIDERATION BY THE LEGISLATIVE COMMISSION'S SUBCOMMITTE TO STUDY WATER

Amend NRS 534.080 by deleting subsection 4 the date of priority for the use of underground water from a well for domestic purposes where the drought does not exceed 2 acre feet per year is the completion of the well.

Nevada Supreme Court **Mosier v. Caldwell 7 Nev. 363, 363 (1872); Percolating Water a Part of the Soil.** Water percolating through the soil is not, and cannot be, distinguished from the soil itself; and of such water, the proprietor of the soil has the free and absolute use, so that he does not directly invade that of his neighbor, or, consequently, injure his perceptible and clearly defined rights.

NRS 534.080 Section 1 is a legal right to appropriate underground water for beneficial use from an artesian aquifer subsequent to the March 22, 1913 Water Act. This act created the Office of the State Engineer. Section 18 gives the State Engineer the power to issue water rights to any stream or stream system. The act does not give the State Engineer any power over wells.

Ormsby County v. Kearney Dec. 31, 1914 the sections 18-58 of said Water Act 1913 and each section are unconstitutional.

March 24, 1915 Water Act Chap. 210- Sec. 1. All underground waters, save and except percolating water, the course and boundaries of which are incapable of determination, are hereby declared to be subject to appropriation under the laws of the state relating to appropriation and use of water and Sec. 4. District Attorney is to enforce this act.

March 8, 1917 the District Court, D, Nevada Bergman et al. v. Kearney, State Engineer; Legislative declaration contained in section 1 of said Water Law of 1913, which reads, **'The water of all sources of water supply within the boundaries of the state, whether above or beneath the surface of the ground, belongs to the public,' is insufficient to, and does not, warrant or authorize the acts done and threatened to be done by defendant, as state engineer, as alleged in the bill of complaint, because the waters of all sources of water supply within the boundaries of the state are appropriated or unappropriated; if appropriated, they belong to the appropriator thereof; if unappropriated, they belong to the United States government, by virtue of the treaty of the United States of America and the United Mexican States in 1848, and by virtue of the Enabling Act, approved March 21, 1864.**

April 1, 1935 Water Act Chap. 184 is an Act to amend the March 24, 1915 Water Act. Sec.4. the State Engineer shall administer this act. This is the first time the State Engineer has power over Artesian Wells.

March 25, 1939 Water Act Chap. 178 is an Act to provide for the conservation and distribution of underground artesian water. Sec. 3. Exemption: This act shall not apply to developing and use of underground water for domestic purposes where the draught does not exceed two gallons per minute (3.28 acre-feet) and where the water developed is not from an artesian well.

The State Engineer is given the power over artesian wells only and has no control over non-artesian wells for domestic purposes.

Jason King's April 19, 2016 MEMORANDUM page 1 10th line submitted to the Legislative Commission Sub-Committee to Study Water; **"Currently written, the law does not provide for input by domestic well owner, and they have no vote for the approval of a GMP."** This is an admission that **water use for domestic purposes on the land is not a water right issued by the State Engineer.**

NRS 534.180 requires No application to made by the land owner to drill a well for domestic purposes.

Real property is land and ordinarily anything erected on, growing on, or affixed to it, including buildings and crops. The term is also used to declare any rights that issue from the ownership of land. The terms *real estate* and *real property* generally refer to land. The term *land*, in its general usage, includes not only the face of the earth but everything of a permanent nature over or under it, including water, minerals, oil, and gases.

Water is real property.

There has been a steady movement to reduce **rights, or immunities**, to privileges, and to restrict or withdraw them by exercise of the State's "police powers."

From the United States Constitution Section 2 Clause 1: ***The Citizens of each State shall be entitled to all Privileges and Immunities of Citizens in the several States.***

It is Private Well Owners Cooperative of Nye County opinion that **NRS 534.080 subsection 4 is unconstitutional and should be deleted. The possession of the land is the priority of water for domestic purposes and use.**

Respectfully submitted,

John F. Bosta,
Vice President

Tab F

State Engineer's Office
Adaptive Management

RECOMMENDATION FOR POSSIBLE CONSIDERATION BY THE LEGISLATIVE COMMISSION'S SUBCOMMITTEE TO STUDY WATER

ADAPTIVE MANAGEMENT

Adaptive management is a decision-making process that promotes learning while doing. It allows for and encourages flexibility in the face of uncertainties. The approach involves exploring alternative ways to meet objectives, predicting outcomes based on the available information, implementation of an action, and learning from the results and adjusting management's actions if necessary. It is **NOT** a mechanism to simply approve water rights and figure out at a later time how to mitigate conflicts. It is a prudent water management approach in the driest state in the nation. All too often it cannot be known with absolute certainty whether a particular water development application(s)/project can be developed without impacting existing water rights until pumping and subsequent monitoring occurs. Courts have held that water right applications should not be granted in the face of uncertainty or without specific established triggers for action without knowing how a water system will react. Using adaptive management would allow for the beneficial use of water while striking a balance between long-term knowledge gained to protect and utilize the resource and achieving the best short-term outcomes based on current knowledge.

Recognizing an adaptive management approach in law will provide legal support to State Engineer decisions on water right applications in the face of uncertainty.

NRS 533.3705 currently allows the State Engineer to limit the initial use of water under a permit to a quantity that is less than the total amount approved for under the application and provides that the use of an additional amount of water may be authorized by the State Engineer at a later date if additional evidence demonstrates to the satisfaction of the State Engineer that the additional amount of water is available and may be appropriated in accordance with Nevada water law. This proposed revision to the water law would expand that authority to include adaptive resource management, which provides for additional monitoring and management in the use of the water, and provide for augmentation or mitigation to avoid conflicts with existing rights to maximize the beneficial use of a shared and limited resource.

It is important for the reviewer to note that the State Engineer's Office is currently litigating aspects of adaptive management in both the Southern Nevada Water Authority's groundwater importation project from rural, eastern Nevada and in KVR's applications in Kobeh Valley that proposes a large molybdenum mine.

Does the recommendation revise one or more current *Nevada Revised Statues* (NRS)? If "Yes," please provide the reference to the NRS citation(s) affected by the recommendation, if known.

Yes, NRS 533.3705

What group or person is making the recommendation?

Nevada State Engineer Jason King

What is the name and contact information of the person who can provide additional information for the recommendation, if necessary?

Jason King, jking@water.nv.gov, 775-684-2861

Tab G

Central Nevada Regional Water Authority

August 4, 2016

Senator Pete Goicoechea, Chairman
Nevada Legislative Commission's Subcommittee to Study Water
Legislative Building
401 South Carson Street
Carson City, Nevada 89701-4747

Sent Via Email

RE: Response to Subcommittee to Study Water Solicitation of Recommendations for Possible Consideration at the Subcommittee's August 26, 2016 Meeting

Dear Senator Goicoechea:

The purpose of this letter is to respond to your July 27, 2016 request to interested parties for recommendations that might be considered at the August 26, 2016 Legislative Commission's Subcommittee to Study Water meeting in Carson City.

The Central Nevada Regional Water Authority would like to thank you and the Subcommittee for the opportunity to submit recommendations for consideration at the August 26th meeting.

The Authority's recommendations come from Authority positions taken over time, including the Authority's discussion and action on recommendations to the Subcommittee at the last two Authority meetings (March 18, 2016 and June 17, 2016). Each Authority recommendation will fall into one of three categories: 1) recommended legislation, 2) recommended position statement, and 3) recommended letter. The following are the Authority's recommendations to the Subcommittee:

A. **Recommended Legislation:**

1. Amend state water law to require the State Engineer to consider the possible connection between surface water and groundwater when making a decision on a water right application. Scientifically, there is no question that surface water and groundwater are a single source of water in many water basins. In addition, courts have linked surface water and groundwater in a number of cases. It is recommended state water law be amended to require the State Engineer make a finding when processing an application to appropriate water (groundwater or surface water) that the proposed use or change does not adversely affect the nearby surface water and groundwater source.
2. Senate Bill 485 in the 2015 Nevada Legislative Session should be passed in the 2017 Session. Senate Bill 485 in the 2015 Session pertains to the adjudication of vested water rights. SB 485 requires the claimant of a pre-statutory water right to submit proof of the claim to the State Engineer on or before December 31, 2025, regardless of whether an adjudication has been ordered for a water source. If the claimant fails to submit such

proof, the claim is deemed to be abandoned. SB 485 is needed since it will ensure in time that the State Engineer will have a correct accounting of groundwater and surface water rights in a basin, including vested water rights.

B. **Recommended Position Statements:**

1. Include a position statement in the final report that NRS 533.370 should not be amended to allow the State Engineer to approve a water right application that conflicts with an existing water right. Nevada water law has been guided by fundamental principles that have served the State well for more than 100 years. One of these principals involves the protection of a senior water right holder; that is, the first person to take a quantity of water from a water source for beneficial use – agricultural, industrial, quasi-municipal, etc. – has the right to continue to use that quantity of water for that purpose. And, subsequent users can take the remaining water for their own beneficial use provided they do not impinge on the rights of previous users. This principal – first in time, first in right – is the prior appropriation doctrine that serves as a critical component of western water law. NRS 533.370(2) says the State Engineer shall reject an application for water if any of the following occur: a) there is no unappropriated water in the proposed source of supply, b) the proposed use or change conflicts with an existing water right or with protectable interests in existing domestic wells, or c) the proposed use or change threatens to prove detrimental to the public interest. At the April 22, 2016 Subcommittee to Study Water meeting the State Engineer provided the Subcommittee a memorandum with recommended changes to Nevada water law. One change, under the heading *Mitigation of Conflicts*, pertains to NRS 533.370(2), and it reads as follows: *When considering the approval of a water right application, the right of mitigation is hereby granted to any appropriator whose appropriation may conflict with an existing water right, domestic well or vested claim. The mitigation measure negates the conflict. No mitigation may be made until application in writing has been made to and approved by the state engineer. In all cases replacement shall be at the sole cost and expense of the applicant and subject to such rules and regulations as the state engineer may prescribe*.

   The Central Nevada Regional Water Authority is opposed to the State Engineer's proposed amendment to NRS 533.370(2) for a number of reasons, including the following: a) granting a "right of mitigation" to an applicant for a water right places a burden on an existing water right holder, who has developed a property right, to demonstrate he has a right to mitigation should a conflict occur, and therefore elevates the right of an applicant with no rights above the right of an existing water right holder; b) the "no conflict" requirement in NRS 533.370(2) protects a senior water right holder from potential destruction of an already existing water right and there is no guarantee a promised mitigation plan will keep a senior water rights holder whole; c) the definition of mitigation in the Merriam-Webster Dictionary is "to make (something) less severe, harmful, or painful," and therefore the presence of a mitigation plan means the senior water right holder may suffer adverse impacts, but the adverse impacts could have been a lot worse without the mitigation plan; d) the State Engineer has erroneously

characterized the "adaptive management" process, and he is depending on his understanding of "adaptive management" to make a mitigation plan protect a senior water right holder from a conflict; e) the State Engineer's proposed amendment to NRS 533.370(2) presents serious legal challenges associated with the Takings and Due Process clauses of the United States and Nevada constitutions; and f) there is a place for a mitigation plan, and it is to be used to address unpredicted, unknown or uncertain impacts found by monitoring.

2. Include a position statement in the final report recommending a statewide Nevada water future discussion and strategy. Ensuring a secure water future for the State of Nevada has to be a top priority for State government, the Nevada Legislature, Nevada's local governments, Nevada's business community, the environmental community and the public. The Authority recommends there be a statement in the Subcommittee's final report calling for these interests to come together in a partnership to discuss Nevada's water future and develop a Nevada water future strategy. The work of the Legislative Commission's Subcommittee to Study Water, the Nevada Drought Summit, the Nevada Drought Forum and the AB 198 Study could be a foundation for a meaningful statewide water future discussion and strategy. As would be expected, the States of Arizona, California and Utah are also facing a projected water supply shortfall in the near future. In the last few years these states have been actively addressing the problem by way of statewide programs focused on ensuring a secure water future.
3. Include a position statement in the final report calling for local government land use plans to be based on identified sustainable water resources. Nevada, the driest state in the nation, has a finite sustainable water supply for its communities and ecosystems, and therefore local government land use plans (master plans) should be based on identified sustainable water resources. It is safe to say many local government land use plans have been developed without consideration of the amount and source of water needed to implement the plans; hence, one sees land use plans that require water resources far in excess of the known available water supply. Such plans create property owner expectations that cannot be supported by available water resources, and therefore lead to significant pressure on local governments to try to find water, at great cost to the water-gaining and water-losing areas.

C. **Recommended Letters:**

1. Send a letter to the Nevada State Engineer recommending he consider a new perspective for groundwater management. At the February 8, 2016 Subcommittee to Study Water meeting the State Engineer provided the Subcommittee a presentation on Nevada water resource issues. One issue identified by the State Engineer is the over appropriation of groundwater resources in at least 84 water basins (out of 256 water basins). The imbalance between a water basin's appropriated groundwater relative to its perennial yield will likely be exacerbated in a number of water basins by a determination of vested water right claims. In addition, the perennial yield concept provides an over estimate of a water basin's sustainable groundwater resources. The U.S. Geological Survey does not support the use of the perennial yield concept for groundwater development. The USGS feels full implementation of the perennial yield concept will result in the following: a) all groundwater discharge will be intercepted, b)

no phreatophytic vegetation will remain in the water basin, c) all springs will dry up, d) no riparian areas around springs, and e) stream baseflows will disappear. The USGS feels a new perspective for groundwater management is needed, and it is sustainability of groundwater resources. The change from the perennial yield concept to sustainable groundwater use is to change from maximum capture of all groundwater discharge to what is an acceptable capture of groundwater discharge. For example, sustainability decisions include a) how much depletion should there be to surface water systems (streams, springs, etc.), b) how much reduction should there be in natural vegetation and wildlife habitat, and c) what is an acceptable water level change. The bottom line is the use of the perennial yield concept provides an over estimate of how much groundwater can be appropriated by the State Engineer, and the State Engineer should have sustainable use of groundwater as a goal.

2. Send a letter to the Nevada State Engineer recommending a water basin's groundwater resources should be determined by an independent, third party. The letter should recommend the State Engineer use the independent and peer-reviewed USGS estimates of a basin's groundwater resources (sustainable water resources or perennial yield) instead of using a water right applicant's estimate of a basin's groundwater resources. If there is a need for an updated estimate of a basin's groundwater resources as a result of an application or applications to transfer a substantial amount of groundwater from one basin to another basin, the applicant for the water right(s) should provide funds to the State Engineer to pay for the update, and the update should be performed by the USGS.

If you have any questions, or need additional information, please do not hesitate to contact me or the Authority's Chairperson, Joni Eastley.

Respectfully,

Steve Bradhurst
Executive Director
(775) 747-2038
sbradhurst@gmail.com

c: Central Nevada Regional Water Authority Board of Directors

Tab H

Eureka County

Eureka County Input on Mitigation of Conflicts and Adaptive Management

The State Engineer provided testimony at previous meetings of this Committee and referenced a Nevada Supreme Court decision that causes some concern for his office. This decision was over a case in which Eureka County was involved. The State Engineer provided a memorandum to this Committee at your April 22 meeting that stated:

> "[N]o one can with absolute certainty know how a groundwater system will react in response to the pumping and whether there will be impacts to existing water rights or not. This is even more true in large basins where little pumping has occurred. Unless the water is pumped (and many times at large volumes), and data collected and the science improved, the uncertainty in the use of Nevada's resources remains. However, challenges have been raised to the use of the groundwater at all in the face of the uncertainty, which in effect means that the use of Nevada's groundwater is held hostage to the uncertainty....Without adaptive management, attempts to appropriate Nevada's resources could be stymied. It allows for the use of water while trying to find a balance between long-term knowledge gained to protect and utilize the resource and achieving the best short-term outcomes based on current knowledge. It allows for mitigation to avoid conflicts based on knowledge gained in the face of initial uncertainty....Additionally, prior to issuing a water right permit, NRS 533.370(2) requires the State Engineer make a determination that the proposed water right will not conflict with existing rights....the State Engineer encourages this committee to consider legislation that allows mitigation of a potential conflict, to avoid the conflict, thereby allowing the full development of the available water resources in the state." (Emphasis in original)

The memo then outlined a statute change for the Committee to consider:

> **NRS 533.370(X). Mitigation of Conflicts**
> When considering the approval of a water right application, the right of mitigation is hereby granted to any appropriator whose appropriation may conflict with an existing water right, domestic well or vested claim. The mitigation measure negates the conflict. No mitigation may be made until application in writing has been made to and approved by the state engineer. In all cases replacement shall be at the sole cost and expense of the applicant and subject to such rules and regulations as the state engineer may prescribe.

This proposal is of major concern to Eureka County. Eureka County is a strong advocate of water monitoring, management, and mitigation plans (3M plans). This is evidenced in the legislation we spearheaded in the 2013 session (SB 68) that creates the only reference in the Water Law to 3M plans and the State Engineer's apparent ability to require "a monitoring, management and mitigation plan as a condition of appropriating water for a beneficial use" (NRS 533.353). We agree that mitigation must be part of the equation in managing Nevada's scarce water resources, but it should be a tool of last resort. Mitigation is appropriate to address impacts that come to pass over time that were not known, or were not likely or probable, or were not predicted or highly certain when the water rights applications were considered. 3M plans should only be used to ascertain, identify, and mitigate unknown or highly uncertain impacts; not the known, predicted, or highly certain impacts of a new water application. While the State Engineer testified in front of this Committee that no impact or conflict from water pumping is known with "absolute certainty," there are situations where impacts and conflicts are very likely to occur. Some impacts and conflicts can be predicted to a high degree of certainty based on the data considered and an understanding of the hydrogeology of the area. This was the case in the recent Supreme Court decision referenced by the State Engineer.

The figure below is the predicted water drawdown by the proponent in the above referenced case that is part of the record. This depicts an area approximately 220 square miles which is the predicted 10-foot drawdown extent (i.e., where the water level will drop by 10 feet or greater; in the center of the drawdown area, water level

drawdown is predicted to exceed 100 feet). You will notice that many existing water rights and water features fall into this predicted drawdown area – 22 springs, 2 perennial stream segments, and 9 wells not "owned" by the proponent of the new water applications. Impacts on some of these waters are, indeed, highly uncertain. However, specific springs and wells on the valley floor were identified by all parties present for the water rights application process as subject to impact and conflict. In a couple of instances, the existing water resource would dry up completely if the applications were granted and the water pumped. Of the total number of 33 waters predicted to be impacted through water pumping by the proposed project, less than 5 of these impacts were identified as highly certain to occur.

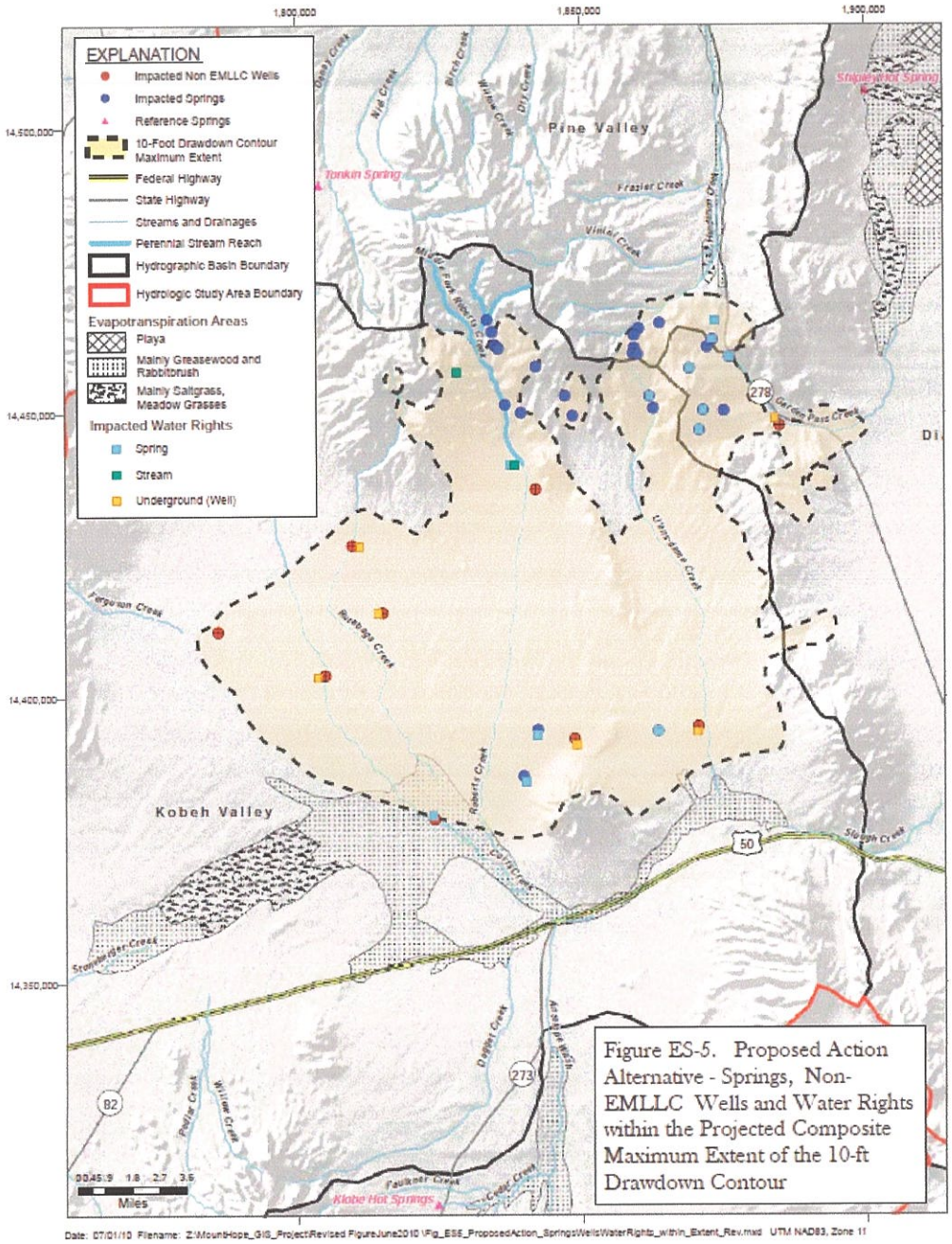

Figure ES-5. Proposed Action Alternative - Springs, Non-EMLLC Wells and Water Rights within the Projected Composite Maximum Extent of the 10-ft Drawdown Contour

These five highly certain impacts, in our opinion (and in the opinion of the Nevada Supreme Court), identify a conflict under NRS 533.370(2), and the applications must be denied. This result does not hold use of Nevada's groundwater hostage, as the State Engineer asserts. There are multiple options available to any water

appropriator (working with the State Engineer) to remove conflict and let projects move forward through appropriate and properly applied adaptive management.

The State Engineer noted the need for adaptive management and included mitigation at the time applications for water are considered as a necessary component of adaptive management. We agree that adaptive management is important when managing complex natural resources, including water use. But, we do not agree with how adaptive management has been described as including "up front" mitigation rights by the appropriator and used as "trial and error." This is dangerous thinking and is not what adaptive management is. Using adaptive management as "trial and error" is actually maladaptive management. The dictionary defines maladaptive as "not providing adequate or appropriate adjustment to the environment or situation." Proper adaptive management is actually "learning by doing" with clear and explicit management objectives to avoid conflict and adverse impact, thereby negating the need for mitigation. If adverse impacts are already known or highly certain, adaptive management is not appropriate. Proper adaptive management plans should always be in practice 2M plans – monitoring and management. If mitigation is needed, this would be a failure of proper adaptive management. In the Supreme Court case referenced above, if proper adaptive management had been implemented, adjustments would have been made years ago to remove the predicted and highly certain conflicts and the project could have moved forward. Eureka County clearly outlined these options in briefing to the Nevada Supreme Court, but there was no appetite on behalf of the applicant or the State Engineer to adopt this approach:

> In this appeal, EUREKA COUNTY is requesting that this Court apply the plain language of NRS 533.370(2) to the facts of this case. If this Court agrees with Appellants' position and reverses the District Court's judgment and vacates the STATE ENGINEER's Ruling 6127, KVR can still proceed with its project. KVR simply must either: (1) reconfigure the points of diversion of its proposed wells to eliminate the conflicts; (2) reduce the size of its project or improve water-use efficiency to eliminate the conflicts; or (3) work cooperatively with senior water rights holders to resolve the conflicts before KVR's Applications are considered and approved by the STATE ENGINEER. Further, the STATE ENGINEER will have clear direction on the mandates of NRS 533.370(2) and his authority to approve applications.

The US DOI Adaptive Management Applications Guide (Adaptive Management Working Group, 2012) states:

- "Often the uncertainty about management impacts is expressed as disagreements among stakeholders who have differing views about the direction and magnitude of resource change in response to management. An adaptive approach explicitly articulates these viewpoints, incorporates them into the decision making process, and uses management itself to help identify the most appropriate view about resource dynamics. In this way, understanding of the resource can be enhanced over time, and management can be improved."
- Adaptive management "involves a systems approach with explicit and agreed upon objectives, management alternatives, and analytical approaches that can identify the most appropriate management

strategies. Adaptive management exemplifies such an approach; however, its focus is not only on making good decisions in the present, but also on gaining experience and knowledge so that future management decisions can be improved."

Again, where there is a need for mitigation, there is a failure of adaptive management. Adaptive management is being confused with "hedging" or "optimal control." This hedging or optimal control is proposed by the State Engineer to shift to the junior or new appropriator, and away from the prior existing right holder, which is contrary to a basic principle of the prior appropriation doctrine.

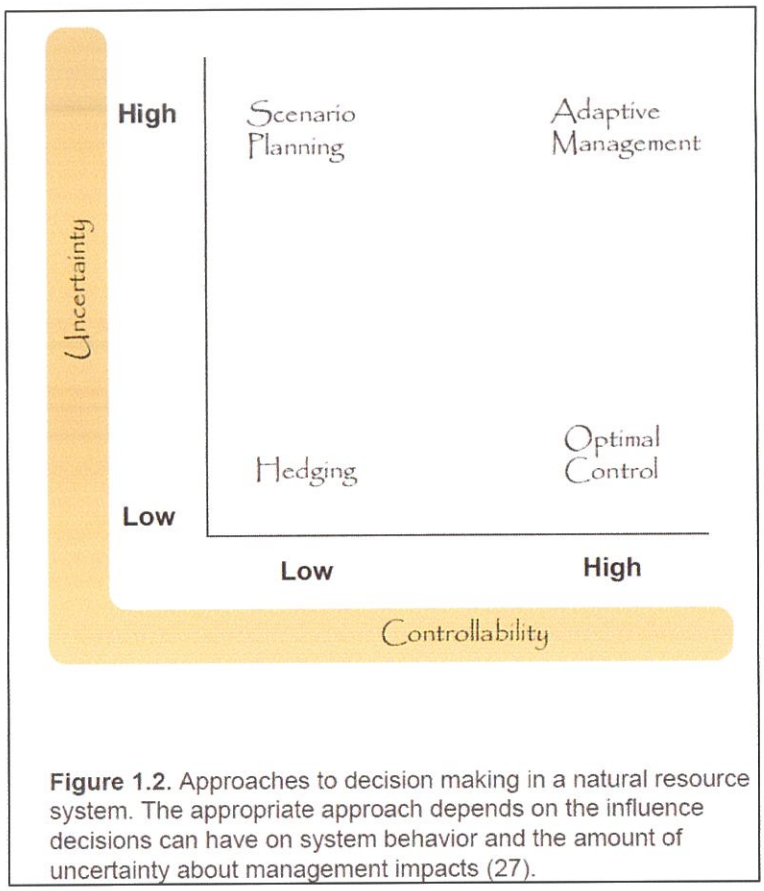

Figure 1.2. Approaches to decision making in a natural resource system. The appropriate approach depends on the influence decisions can have on system behavior and the amount of uncertainty about management impacts (27).

US DOI Adaptive Management Applications Guide (Adaptive Management Working Group, 2012)

Proper adaptive management starts with good decisions and progress toward explicit objectives or desired outcomes. Successful adaptive management precludes the need for mitigation, and does not use mitigation as a crutch to justify impacts and conflicts to existing rights. Mitigation should only be employed when impacts occur that were not expected or known at the time the applications were approved.

In closing, we request the Subcommittee never support mitigation as an excuse to grant applications that conflict with existing rights. Mitigation should never be an excuse for unreasonable and conflicting appropriations of water. Granting a right of mitigation to any appropriator whose appropriation may conflict with an existing water right, as requested by the State Engineer, subverts the prior appropriation doctrine. We support the concept that mitigation is available for unknown or highly uncertain impacts and conflicts that may occur which are identified over time by a formally established and required 3M plan. Putting mitigation ahead of properly applied adaptive management abuses existing water right holders, ignores the hard work that proper adaptive management demands, and makes the State of Nevada pay lip service to the prior appropriation doctrine in name only.

Tab I

Great Basin Water Network

ADVOCATES FOR COMMUNITY AND ENVIRONMENT

Empowering Local Communities to Protect the Environment and their Traditional Ways of Life

94 Highway 150, Suite 8
P.O. Box 1075
El Prado, New Mexico 87529
Phone (575) 758-7202 Fax (575) 758-7203

To: Great Basin Water Network
From: Simeon Herskovits and Iris Thornton
Date: August 3, 2016
Re: Statutory Changes Proposed to Legislative Commission Sub-Committee to Study Water

INTRODUCTION:

A number of governmental, quasi-governmental, and non-profit entities have raised legal concerns associated with the State Engineer's proposed change to Nevada's water law related to monitoring and mitigation of conflicts with existing rights in the water rights permitting process. In recognition of those concerns, at the request of the Great Basin Water Network we have prepared this memorandum to address the salient legal implications of the proposal, which appears designed to allow the State Engineer to grant water rights applications without first making a determination either that there is water available in the source to satisfy the proposed new use or that the proposed new use will not conflict with already existing water rights. Rather than making those two fundamental determinations about the viability of a requested new water right, which have been at the core of Nevada's water law since it first was codified more than a century ago, the proposed new statutory language would authorize the State Engineer to premise the grant of a new water right on the applicant's promise to develop a monitoring and mitigation program after the water right already has been granted to identify and address problematic impacts or conflicts that are likely to result from the grant of the new water right.

As explained below, this proposed statutory amendment would undermine the foundation of sustainable water development that has undergirded Nevada's water rights system since the State's early days and acted as a brake on the destructive over-appropriation of water sources in the State. The proposed new language is inconsistent with some of the most elemental principles governing Nevada's water law. In addition, the proposed statutory change would open the door to an administrative decisionmaking process that does not satisfy the requirements of the Takings and Due Process clauses of the United States and Nevada constitutions. As such, the statutory proposal would subject the State Engineer, and thus the State itself, to constitutional challenges under both of those clauses that would have a substantial likelihood of success and could expose the State to potentially open-ended legal and financial liability in connection with the grant of new water rights that cannot be squared with the rights of existing water rights holders.

EXECUTIVE SUMMARY

The Nevada State Engineer has proposed new statutory language that allows him to grant new water rights applications even if there has not been a showing either that water is available for the new use or that the new use will not conflict with senior existing water rights, so long as the State Engineer says he is satisfied that the applicant will engage in mitigation of such conflicts. The State Engineer has proposed that he be given essentially carte blanche discretion to determine what kind of "adaptive management" will be satisfactory, and that new water rights applicants be given a "right of mitigation" that would put the burden on the owners of senior existing water rights to prove that the new applicant needs to mitigate a conflict.

Deficiencies Compared to the Standards of other States and Federal Agencies and Courts:

The State Engineer's proposal falls far short of the requirements that sister western states and federal agencies have insisted on before relying on mitigation or adaptive management. Both federal agency guidance and federal case law require that specific information be developed and provided up front concerning the ability to manage affected natural resources, the thresholds that will trigger mitigation action, the specified concrete mitigation measures that will be implemented, and how the effectiveness of those mitigation measures will be assessed and improved as necessary. Similar specific information and demonstrable scientific viability also are required by other states in the West.

Because the State Engineer's proposed statutory changes do not provide any of the minimal requirements and safeguards that other agencies and legal authorities hold to be necessary, the Sub-Committee should reject those proposals of the State Engineer.

Constitutional Defects and Exposure to Likely Claims for Constitutional Violations:

Because the State Engineer's proposed amendment of NRS § 533.370 would allow water rights applications to be approved without opposing parties having an opportunity to challenge evidence regarding the effectiveness of the applicant's proposed mitigation plan, the change would result in violations of the Due Process Clause of the United States and Nevada Constitutions. Under binding U.S. and Nevada Supreme Court decisions stretching back decades it is clear that merely changing the statutory language as requested by the State Engineer will do nothing to remedy the procedural deficiency of the after-the-fact approach to mitigation that he seeks to take.

The proposed new statutory language also would encourage the State Engineer to approve water rights applications where there is not adequate unappropriated water available, which would result in new water uses taking water from already existing, senior, water rights. This approach would result in a plethora of gradually worsening conflicts between new and senior water rights holders, and in a proliferation of claims of unconstitutional takings by senior water rights holders. A review of the applicable federal and Nevada law indicates that there is a substantial likelihood that such takings claims by senior water rights holders would be successful and would expose the State to potentially immense financial liability and onerous court orders to restore water rights and depleted water systems on which those rights depend.

These constitutional defects provide an even more compelling reason why the Sub-Committee should reject the State Engineer's proposals concerning mitigation plans and a "right of mitigation" in the water right application review process.

I. OVERVIEW OF NEVADA WATER LAW

For over 100 years, Nevada's water law has been structured and written to ensure that the State's water resources are soundly managed not only to serve the State's current population but also to preserve the scarce resource for use by future generations. Nevada water law, codified at NRS §§ 533 and 534, is guided by fundamental principles that have served the State and its limited water resources well by encouraging prudent decision making grounded in science. In addition, under the prior appropriation doctrine, which antedates Nevada's statehood, Nevada water law properly protects senior water rights by directing the State Engineer to grant new rights to appropriate water only where there is unappropriated water at the source of supply and only if the proposed appropriation will not conflict with existing rights to the use of that water.[1]

In addition to these limitations designed to ensure prudent water management, Nevada law also gives the State Engineer a substantial amount of discretion in water management decisions. For example, Nevada law permits the State Engineer to issue groundwater permits subject to "express conditions" that will serve to avoid potential conflicts.[2] However, the State Engineer's discretion is not boundless in this area and properly has been limited by the Supreme Court of Nevada which recently held that the State Engineer may not support a finding of no conflict with existing rights under NRS § 533.370(2) with an undeveloped monitoring and mitigation plan, because (1) doing so would violate the due process rights of protestants, and (2) because there must be substantial evidence that actually supports a finding of no conflict. Thus, any monitoring and mitigation plan must be sufficiently detailed and developed to support a determination by the State Engineer based on substantial evidence that a proposed appropriation will not conflict with existing rights.[3] Thus, the State Engineer's discretion is necessarily limited not only by Nevada's water law but also by its Constitution.

II. THE STATE ENGINEER'S PROPOSAL: LEARNING BY DOING

In a memorandum to the Legislative Counsel Bureau dated April 19, 2016, the State Engineer requested that the Legislature grant greater flexibility in permitting by allowing the State Engineer to grant water rights on the basis of undeveloped adaptive management or mitigation plans.[4] Specifically, the State Engineer has proposed a new subsection of NRS § 533.370 titled "mitigation of conflicts" which would give the State Engineer discretion to grant applications based on a commitment from applicants to develop mitigation plans after the application already has been granted that purportedly would address conflicts with existing rights under NRS § 533.370(2). Further, by granting a "right of mitigation" to an applicant, who holds no property right, the State Engineer's proposed language also places the burden on a senior water rights holder to demonstrate an entitlement to mitigation should a conflict occur, effectively elevating the rights of an applicant above those of a water rights owner.

The State Engineer's office already has the ability to approve applications with conditions, including a monitoring and mitigation plan.[5] So a provision like that proposed by the State Engineer is not necessary. The State Engineer, in effect, appears to be requesting that flexibility

[1] NRS § 533.370(2).
[2] *See* NRS § 534.110(5).
[3] *Eureka County v. State Engineer*, 131 Nev. Adv. Op. 84, 359 P.3d 1114, 1120-21 (Oct. 29, 2015).
[4] *See* Jason King Memorandum to Alysa Keller (April 19, 2016).
[5] *See* NRS § 533.110(5).

to grant water rights be boundless and that the mere proposal to develop and implement an actual monitoring and mitigation plan in the future should be sufficient to support the granting of an application as consistent with existing rights. This request appears to be based on the erroneous characterization of adaptive management as nothing more than "learning by doing" without the laying of a proper foundation first. However, that position is overly simplistic and indicates a need for clear limitations on the State Engineer's discretion. Adaptive management is not merely "learning by doing." Rather, it necessarily involves a number of components, including "(1) establishing the desired objectives for management of any particular resource, (2) proposing a management regime designed to achieve the desired objectives; (3) developing hypotheses and experiments to test whether the proposed management regime is in fact achieving the objectives; (4) setting up monitoring and testing programs to carry out the experiments and test the hypotheses 'on the ground;' and (5) adjusting the management regime in response to the information received from the monitoring and testing, if the outcomes turn out not to be as desired."[6] Importantly, proper implementation of adaptive management requires that, before deciding whether to grant an application significant up front planning must have taken place, including the identification of specific concrete mitigation measures to be implemented and thresholds that will trigger implementation of those measures. It would be simply, and fundamentally, unsound to allow the State Engineer to use the phrase "adaptive management" as a tool to avoid making the required finding of no conflicts at the time of deciding whether to grant an application. Absent a requirement that substantial evidence in the record must demonstrate that adaptive management will avoid impacts to existing rights, any statute providing for adaptive management will run afoul of both the Due Process Clause and the Takings Clause of the United States and Nevada Constitutions as explained below. As further outlined below, ample guidance exists to define proper adaptive management, including guidance from Department of Interior policy, Nevada's sister states, and federal caselaw.

III. CONSTITUTIONAL IMPLICATIONS OF THE STATE ENGINEER'S PROPOSED STATUTORY CHANGE

As explained below, nothing in Nevada's existing water law prevents the State Engineer from relying on a monitoring and mitigation plan in approving water rights applications, as long as that plan satisfies the basic minimum standards that both federal and state courts have held to be required in such circumstances. Despite this fact, the Legislature is being asked to change Nevada's statutory law so as to include language that would authorize the State Engineer to approve new applications, without first having to make the age-old basic determinations about the availability of water and the potential destruction of already existing water rights, based only on vague assurances that a mitigation plan with meaningful specific and concrete provisions will be developed in the future.

Such a change to Nevada's law would eliminate the basic guarantee of scientific integrity and reliability in the management of Nevada's most vital natural resource that has served the State reliably for over a century since it first was put into place in 1913. It would significantly

[6] Janet C. Neuman, *Adaptive Management: How Water Law Needs to Change*, 31 Envtl. L. Rep. 11432 (2001); *see also* National Research Council, Comm. on Endangered & Threatened Fishes in the Klamath River Basin, *Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery*, 333-35 (2004) (outlining eight key steps of adaptive management); J.B. Ruhl & Robert L. Fischman, *Adaptive Management in the Courts*, 95 Minn. L. Rev. 424, 430 (2010).

increase the already evident tendency to approve applications where there is not sufficient water available.

Authorizing the State Engineer to rely on a vague promise of a future monitoring and mitigation plan, and to approve applications without the kind of concrete specific information that has uniformly been held to be necessary to support such decisions, would set the State Engineer up for a process that would not be consistent with the requirements of the Takings and Due Process Clauses of the Fifth and Fourteenth Amendments of the United States Constitution, and Article I, Sections 8(5) and 8(6) of the Nevada State Constitution.

A. Due Process Problems

As noted, the requested new statutory language would allow the State Engineer to grant a water right application on the basis of a vague determination that conflicts can be mitigated without substantial evidence demonstrating that mitigation is feasible and will be effective. Yet, under the law, those who protest an application are limited in their opportunity to review and contest the evidence supporting the decision to grant the application to the "up front" administrative review process. Once an application has been granted, protestants are not provided with, let alone guaranteed, any opportunity to challenge the adequacy of the monitoring and mitigation plan or the evidence regarding the viability or efficacy of any proposed mitigation measures. As both the Nevada and United States Supreme Courts have held, basic notions of fairness and due process require that evidence be presented and subjected to challenge before an agency makes a decision on an application or claim.[7]

This is not to say that a monitoring and mitigation plan could not provide for its own refinement and improvement, as contemplated under proper definitions and applications of adaptive management. However, as discussed above, certain minimum data and concrete mitigation measures and triggers must be present at the time of the State Engineer's decision for that decision to provide both an adequate factual basis for sound decisionmaking and an adequate opportunity for interested parties to present opposing evidence.

As discussed above, the Nevada Supreme Court, in its recent decision in *Eureka County v. State Engineer*, has confirmed that the State Engineer's request for the authority to approve applications based on future unwritten monitoring and mitigation plans would violate the due process rights of protestants in State Engineer proceedings.[8] In that case, the State Engineer granted applications based on a monitoring and mitigation plan that would not be developed until a later date. In striking down the State Engineer's reliance on this undeveloped monitoring and mitigation plan, the Court noted that "the opportunity to challenge the evidence must be given before the State Engineer grants proposed use or change applications," because "'[t]he due process clause forbids an agency to use evidence in a way that forecloses an opportunity to offer

[7] *Eureka County v. State Engineer*, 131 Nev. Adv. Op. 84, 359 P.3d 1114, 1120 (Oct. 29, 2015); *Ohio Bell Tel. Co. v. Public Utilities Comm'n of Ohio*, 301 U.S. 292, 301-05 (1937)(Cardozo, J.); *Bowman Transp., Inc. v. Arkansas-Best Freight Sys., Inc.*, 419 U.S. 281, 288 n.4 (1974) ("the Due Process Clause forbids an agency to use evidence in a way that forecloses an opportunity to offer a contrary presentation"); *Revert v. Ray*, 95 Nev. 782, 786-87, 603 P.2d 262, 264-65 (1979) (judicial review of State Engineer decisions presupposes that those decisions be based on evidence presented before the decision is made, that all interested parties have a full and fair opportunity to be heard concerning that evidence, and that decisions not be made on the basis of "post hoc" evidence and analysis conducted after the decision already has been made).

[8] *Eureka County*, 131 Nev. Adv. Op. 84, 359 P.3d at 1120-21.

a contrary presentation."[9] Thus, "allowing the State Engineer to grant applications conditioned upon development of a future 3M Plan when the resulting appropriations would otherwise conflict with existing rights, could potentially violate protestants' rights to a full and fair hearing on the matter, a rule rooted in due process.[10] Consistent with federal caselaw, the Court further held that the State Engineer must base a decision to grant a water rights application on substantial evidence, and further, a finding of no impact to existing rights can only be made based on a mitigation plan that is substantial enough to support such a finding.[11]

In his request for legislative changes to the NRS § 533, the State Engineer has not addressed the due process concerns of the Nevada Supreme Court in *Eureka County v. State Engineer* and has in effect requested the Legislature to override them.

B. Takings Problems

Concerns have been raised over whether allowing new water rights applications to be granted on the basis of what would amount to a promise of mitigation – without a determination having been made that there actually is unappropriated water available to satisfy the application or that mitigation actually is feasible and can be effective enough to allow the new appropriation to be put to use without conflicting with existing water rights – would run afoul of the Constitutional Takings Clause. The Takings Clause provides that "private property [shall not] be taken for public use, without just compensation."[12] A review of the applicable law suggests that the proposed change to Nevada's statutory water law will expose the State Engineer, and thus the State itself, to two types of takings challenges, both of which appear to have good prospects for success.

The first type of challenge would be based on the fact that under the State Engineer's proposed language the State Engineer would be permitted to rely on a monitoring and mitigation plan that is only at a preliminary conceptual stage of development (the efficacy of which therefore cannot even be assessed) as a substitute for the analytically necessary and fundamental determinations that (1) unappropriated water actually is available at the source of supply for the new use; and (2) the proposed new use actually can occur without conflicting with existing water rights (i.e., that it will not result in an unsustainable double appropriation that effectively would take away the water already committed to senior water uses). Granting a new water right application where it cannot be demonstrated that there is water available or that it will not conflict with existing rights creates a high likelihood, if not a certainty, that the new water use in fact will be premised on taking water that already is subject to prior appropriations by senior water rights holders. Permitting such a double appropriation of water properly would be viewed as a physical taking of the property rights of senior water rights holders and would be subject to a per se takings analysis and a strict obligation on the part of the State of Nevada to compensate senior water rights holders.[13]

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[9] *Id*. at 1120 (quoting *Bowman Transp.,* 419 U.S. at 288 n.4).
[10] *Id*. (citing *Revert v. Ray*, 95 Nev. at 787, 603 P.2d at 264).
[11] *Id*. at 1121.
[12] U.S. Const. Amend. V; *see also* Nevada Const., Art. I, § 8(3). ("Private property shall not be taken for public use without just compensation").
[13] *See Tahoe-Sierra Preservation Council, Inc. v. Tahoe Reg'l Planning Agency*, 535 U.S. 302, 322 (2002) ("[w]hen the government physically takes possession of an interest in property for some public purpose, it has a categorical duty to compensate the former owner, regardless of whether the interest that is taken constitutes [the whole interest]

The holders of affected senior water rights would have a substantial basis to sue the State Engineer for an unconstitutional takings if the State Engineer were permitted to grant new water rights absent a showing that unappropriated water is available or that the new water use would not conflict with existing water rights. It seems likely that such water rights holders would sue for violation of the Takings Clause at the time of the State Engineer's decision, before waiting for the destruction of their water rights, on the basis of the evidence that tended to show the unavailability of additional, or "new," water for the new water rights – the type of facts the State Engineer has sought to circumvent through reliance on vague future monitoring and mitigation proposals.

It is hard to predict whether courts will view such takings challenges as ripe upon the State Engineer's decision or whether they will require the passage of time and the accrual of evidence that the new water rights are reducing the availability of water for the senior water rights. But it seems certain that either at the outset or after impacts have occurred courts will find that the practical elimination of some or all of the senior water right constitutes an unconstitutional taking under the *per se* test. This eventuality will expose the State to an unascertainable but potentially immense level of financial liability to provide "just compensation" to such harmed senior water rights holders.

The State Engineer's proposed change also could give rise to a second type of legal challenge under the Takings Clause, because it would allow the State Engineer to grant a new water right where there may not be sufficient water available, effectively taking water away from existing water rights owners and granting it to other private parties. The absolute prohibition of a governmental taking for any purpose other than a public purpose is one of the most fundamental rules under the Takings Clause.[14] Unlike the more commonly encountered type of takings claims, violation of the public use clause of the Takings Clause does not merely require compensation to be repaid to the injured property owner, rather the public use clause prevents the governmental confiscation in the first place. Therefore, enforcement of the public use clause would require that the government restore the taken or destroyed property to the owner.

As explained, the proposed new statutory language would authorize the State Engineer to grant new water rights to applicants in situations where neither the availability of water not the ability to avoid conflicts with existing rights can be demonstrated, and where no demonstrably effective monitoring and mitigation program is in place. By opening the door to such ungrounded decisions, the proposed new language would lead to an unpredictable number of instances in which the property rights of existing water right holders effectively have been taken in order to confer the benefit of using that same water on other new private water right owners. Any such decision would violate the public use clause within the Takings Clause, and consequently would

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or merely a part thereof.") (citations omitted); *United States v. Causby*, 328 U.S. 256, 265-66 (1946); *Transportation Co. c. Chicago*, 99 U.S. 635, 642 (1878) ; *ASAP Storage Inc. v. City of Sparks*, 123 Nev. 639, 647-648, 173 P.3d 734, 740 (2007); *Culley v. Elko County*, 101 Nev. 838, 841-42, 711 P.2d 864, 866 (1985); *see also Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419, 436-37 (1982) (per se takings rule applies regardless of how small a portion of the property is physically removed from the owner's control); *United States v. General Motors Corp.*, 323 U.S. 373, 378-84 (1945) (per se takings rule applied to temporary deprivation of owner's right to occupancy and use); *Tulare Lake Basin Storage Dist. v. United States*, 49 Fed. Cl. 313, 318-205 (2001).

[14] *See Kelo v. City of New London*, 545 U.S. 469, 477 (2005); *Hawaii Hous. Auth. v. Midkiff*, 467 U.S. 229, 245 (1984); *Mo. Pac. Ry. Co. v. Nebraska*, 164 U.S. 403, 417 (1896); *Calder v. Bull*, 3 U.S. (3 Dall.) 386, 388 (1798); *Armendariz v. Penman*, 75 F.3d 1311, 1320-21 (9th Cir. 1996); *99 Cents Only Stores v. Lancaster Redevelopment Agency*, 237 F.Supp.2d 1123, 1128-29 (C.D. Cal. 2001).

be subject to judicial relief that either would prevent the new water right from being permitted or would force the State to rescind the permit and reverse any effects that have been caused to the senior water rights holder. In the context of groundwater systems that already will have suffered depletion and damage from the decisions to grant unsustainable new water rights, the constitutional requirement to restore senior water rights could well present nightmarish difficulties for the State.

IV. PROPER MITIGATION OR ADAPTIVE MANAGEMENT: FEDERAL AND STATE GUIDANCE

A. U.S. Department of Interior and U.S. Bureau of Reclamation Adaptive Management Guidance

According to DOI and BOR, adaptive management is not simply "learning by doing" as the State Engineer would suggest. Rather it is "much more than simply tracking and changing management direction in the face of failed policies, and, in fact, such a tactic could actually be maladaptive. An adaptive approach involves exploring alternative ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions."[15] DOI notes that adaptive management is appropriate where (1) natural resources are responsive to management, but (2) there is uncertainty about the impacts of management interventions.[16] Adaptive management generally can be divided into two phases: (1) the setup phase; and (2) an iterative phase.[17] The DOI and BOR include five components in the set-up phase of adaptive management, which would be applicable to the State Engineer's permitting process: (1) Stakeholder involvement; (2) Objectives; (3) Management alternatives; (4) Predictive models; and (5) Monitoring protocols.[18] The iterative phase "uses these elements in an ongoing cycle of learning about system structure and function, and managing based on what is learned."[19] It is a process that involves assessment of the problem, designing a management program, implementing that program, monitoring results, evaluating those results, and adjusting management in response to those results.[20] According to the DOI, "[a]n adaptive approach actively engages stakeholders in all phases of a project over its timeframe, facilitating mutual learning and reinforcing the commitment to learning-based management."[21]

Contrary to the State Engineer's suggestion, guidance from the DOI and BOR make it clear that adaptive management is far more than simply learning by doing, and that a valid adaptive management plan requires significant work up front identifying specified mitigation measures as well as thresholds and triggers for implementation of those measures before an assessment of the plan's adequacy can be made. Consistent with the adaptive management guidance provided by

[15] U.S. Dep't of the Interior Adaptive Management Technical Guide, at 1.
[16] Dep't of Interior Adaptive Management Applications Guide, at v (2012), available at https://www2.usgs.gov/sdc/doc/DOI-Adaptive-Management-Applications-Guide-27.pdf.
[17] U.S. Bureau of Reclamation Adaptive Management Workshop Manual to Assist in the Prevention, Management, and Resolution of Water Resource Conflicts ("USBR Adaptive Management Manual"), at 1 (2011).
[18] *See* Dep't of Interior Adaptive Management Applications Guide, at vi (2012); *see also* USBR Adaptive Management Manual, at 1.
[19] USBR Adaptive Management Manual, at 1.
[20] U.S. Dep't of the Interior Adaptive Management Technical Guide, at 5.
[21] *Id*. at v.

DOI and BOR, when conditioning the grant of an application on monitoring and mitigation, the State Engineer first, at the very least, must be required to make a determination that the subject natural resources will be responsive to management (i.e., can be managed in a way that would make mitigation feasible and effective in eliminating or preventing any potential conflicts). If he determines that they will be responsive to management, then he must be presented with a developed adaptive management plan which includes the above five components of the set-up phase of an adaptive management program *prior to* issuing permits. Such an approach would be consistent with the sound approach adopted by the DOI and BOR and upheld by courts.

B. Adaptive Management Guidance from Sister States

Several states in the West utilize adaptive management in the context of water management. Adaptive management provisions enacted by sister states provide valuable guidance to Nevada and uniformly require far more substance than the Nevada State Engineer suggests is necessary in terms of a monitoring and mitigation plan. In general, states that permit adaptive management have imposed concrete requirements on water managers which are designed to guide agencies in the permitting process. For example, in Colorado, a "'[p]lan for augmentation' means a detailed program, which may be either temporary or perpetual in duration, to increase the supply of water available for beneficial use in a division or portion thereof by the development of new or alternate means or points of diversion, by a pooling of water resources, by water exchange projects, by providing substitute supplies of water, by the development of new sources of water, or by any other appropriate means."[22] Similarly, Montana has enacted detailed guidelines for the use of monitoring and mitigation plans in the context of water permitting.[23] Oregon also views adaptive management as requiring more concrete specifics and scientific rigor than the State Engineer's proposal.[24]

The approaches taken by these other western states provide more meaningful guidance to water managers as well as requiring concrete safeguards to protect the property rights of existing water rights holders. The frameworks implemented in these states also make clear that adaptive management may not be used as a tool to avoid an assessment of whether there will be injury to existing water rights holders, but rather as a tool to ensure that injury to existing rights is avoided in the first place. The approach taken by these other western states provides useful guidance to Nevada as it contemplates the potential addition of monitoring and mitigation or adaptive management provisions to its water law.

C. Adaptive Management Guidance from Federal Caselaw

The State Engineer's proposed change to Nevada law runs contrary to long-standing legal precedent related to monitoring and mitigation in the context of federal environmental law. For instance, in the NEPA context federal courts have held that an EIS must discuss a mitigation plan and proposed mitigation measures thoroughly enough to ensure that the environmental effects of a project have been meaningfully analyzed.[25] Merely listing potential mitigation measures

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[22] Colo. Rev. Stat. § 37-92-103; *see also* Colo. Rev. Stat. § 37-92-305(3), (6), (8); *see also Weibert v. Rothe Bros, Inc*., 618 P.2d 1367, 1373 (Colo. 1980) (noting that the sufficiency of a plan for augmentation is judged by the no injury standard applicable to the evaluation of the application itself).

[23] Mont. Code Ann. § 85-2-362.

[24] Or. Rev. Stat. § 541.890(1).

[25] *Okanogan Highlands Alliance v. Williams*, 236 F.3d 468, 473 (9th Cir. 2000); *Neighbors of Cuddy Mountain v. U.S. Forest Serv.*, 137 F.3d 1372, 1380 (9th Cir. 1998); *see* 40 C.F.R. §§ 1508.20, 1508.25(b)(3).

without analyzing or evaluating their effectiveness is not sufficient to fulfill the requirements of NEPA.[26] The 9th Circuit's decision in *Pacific Coast Federation of Fishermen's Associations v. Blank*, also makes clear that "[m]itigation must 'be discussed in sufficient detail to ensure that environmental consequences have been fairly evaluated.'"[27] The court in *Pacific Coast* further underscored the fact that "[s]uch discussion necessarily includes an assessment of whether the proposed mitigation measures can be effective."[28] As a general matter, in the NEPA context, an agency cannot defer its assessment of the effectiveness of mitigation measures until after a decision is made, as the "courts have ruled that agencies should discuss mitigation measures, along with an assessment of whether they can be effective, in the EIS."[29] Additionally, the "omission of a reasonably complete discussion of possible mitigation measures would undermine the 'action-forcing' function of NEPA. Without such a discussion, neither the agency nor other interested groups and individuals can properly evaluate the severity of the adverse effects."[30]

The logic driving this consistent line of federal court decisions is as straightforward as it is inexorable. At a minimum, prior to granting a water rights application, the State Engineer must have sufficient information to enable him to determine what the likely impacts of the proposed new use will be, what thresholds or triggers for mitigation are acceptable, what mitigation measures will be used, and when and how the effectiveness of those mitigation measures will be measured and evaluated. Because it lacks any of those specific requirements, the State Engineer's proposal falls far short of the basic standard of soundness, or acceptability, established by this substantial body of federal caselaw in analogous agency decisionmaking contexts.

V. CONCLUSION

Nevada is the driest state in the nation, and its water law is designed both to reflect that fact and to encourage prudent decision-making based on sound science. Nevada's water law is carefully designed to balance the limited nature of Nevada's water resources with the demands Nevada's population places on them. The State Engineer already has had ample discretionary authority and flexibility in allocating water, while being limited by certain minimal statutory and Constitutional requirements. Those minimal statutory constraints were established with sober foresight by the legislators and water managers who carefully shaped Nevada's water law and water policy with the State's long term health and economic wellbeing in mind. While the need to at least meet those bottom line requirements has occasionally been inconvenient for the proponents of unsustainable proposals, those minimal standards of sustainability generally have served Nevada well, and cannot be weakened without seriously jeopardizing Nevada's long-term future.

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[26] *South Fork Band Council of Western Shoshone of Nev. v. U.S. Dep't of Interior*, 588 F.3d 718, 727 (9th Cir. 2009) (requiring "an assessment of whether the proposed mitigation measures can be effective"); *Okanogan Highlands*, 236 F.3d at 473; *Idaho Sporting Congress v. Thomas*, 137 F.3d 1146, 1151 (9th Cir. 1998).
[27] 693 F.3d 1084, 1103 (9th Cir. 2012) (citing *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 353 (1989)).
[28] 693 F.3d at 1084 (citing *S. Fork Band Council of W. Shoshone of Nev.*, 588 F.3d at 727).
[29] *Methow Valley Citizens Council*, 490 U.S. at 352; *Neighbors of Cuddy Mountain*, 137 F.3d at 1381 (finding that agency failed to provide "an estimate of how effective the mitigation measures would be if adopted"); *see also S. Fork Band Council of W. Shoshone of Nev.*, 588 F.3d at 727 (a discussion of mitigation measures necessarily includes "an assessment of whether the proposed mitigation measures can be effective.").
[30] *Methow Valley Citizens Council*, 490 U.S. at 352.

While acknowledging that his predecessors have permitted significant overappropriations across the State, the State Engineer now asks for even looser standards in granting new water rights. However, the State Engineer already enjoys significant flexibility in water management and permitting that allows him to prudently and sustainably manage the water resources of the State. The historical record of overappropriation illustrates why it is essential for the law to restrain and guide the State Engineer in a well-grounded manner to prevent the uninformed approval of applications and further overappropriation of Nevada's scarce water resources.

In addition, the State Engineer's proposal would expose the State to burdensome Constitutional challenges and would jeopardize the property rights of Nevadans who have relied on their water rights for generations. It is critical that the Legislature carefully consider the impacts to property owners' rights under the Takings and Due Process clauses in order to avoid exposing the State to these challenges.

Tab J

The Nature Conservancy

Recommendations on Nevada Water Law and Policy

submitted to the

Nevada Legislative Commission's Subcommittee to Study Water

by

The Nature Conservancy, Nevada Chapter

August 5, 2016

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Executive Summary

The Nature Conservancy (TNC), a leading international conservation organization, has been working in Nevada for more than 30 years, with a particular focus on conserving freshwater ecosystems such as the Truckee River, Ash Meadows, and Ruby Marsh.

A recent TNC study concluded that most of Nevada's freshwater ecosystems—rivers, streams, wetlands, and springs—are significantly degraded, and their health is declining. Over the past century, expanding water usage and alterations to habitat are prominent among the historical causes for this decline. Looking ahead, unsustainable groundwater use looms as one of the greatest future challenges to Nevada's natural heritage. TNC therefore offers the following 13 recommendations, which emphasize ways to achieve sustainable groundwater management, under six major categories of reform (A through F):

A. Redefine Perennial Yield to Include Surface Water Needs. Nevada employs a "perennial yield" policy that defines the amount of groundwater available for extraction as the amount of discharge that a particular groundwater basin produces. Importantly, the quantities of water necessary to sustain surface water rights, sustain groundwater flows and groundwater levels depended upon by ecosystems, and sustain other uses of surface flows are *not* taken into account or subtracted from the available amount.

As currently defined, "perennial yield," if fully developed in a groundwater basin, risks drying up many, most, or all of the basin's springs, seeps, and groundwater-fed wetlands, meadows, and streams. To address the shortcomings of the current perennial yield approach, and to develop the information necessary for sustainable groundwater management, TNC recommends that the Legislature direct the State Engineer to:

1. **Develop Provisional Flow Standards** that include the flows and groundwater levels necessary to meet critical ecosystem needs and surface water rights. Such standards will vary from basin to basin, depending on local environmental and hydrologic conditions, and will vary in their spatial and temporal scales. These standards would necessarily lead to the setting aside of a portion of the water budget as an "environmental water allocation" and would ensure that sufficient water is provided for necessary surface flows and groundwater levels.
2. **Apply Predictive Modeling to Set Provisional Flow Standards.** Predictive groundwater models must be applied, at the appropriate spatial and temporal scales, to determine what level of pumping can be sustained without violating these provisional flow standards.
3. **Develop and Implement Monitoring Programs.** Taking into account the inherent uncertainty of setting flow standards and of predictive modeling, develop and implement flow and habitat monitoring programs to provide decision-support information for adaptive water management.

4. **Redefine Perennial Yield to Achieve Provisional Flow Standards.** To protect the human, economic, and environmental interests that depend on the surface expression of groundwater and the near-surface groundwater table, redefine "perennial yield" to withhold from future groundwater appropriation that portion of the perennial yield that is necessary to meet the provisional flow standards.

B. Authorize Conjunctive Management. As a matter of hydrologic reality, groundwater and surface water are a single resource, but in Nevada they are largely managed separately. Without conjunctive management, under which they would be managed as a single resource, fundamental conflicts between groundwater rights and surface water rights will continue.

5. **Plan and Regulate Surface and Groundwater Conjunctively.** As the administrator of water law and water rights, the State Engineer should treat surface and groundwater as a single connected resource and give consideration to the hydrology of each basin and the hydrologic connectivity between basins.

C. Authorize Basin Management Goals and Designation of Active Management Areas. Given the connectivity of ground and surface water, avoiding conflicts among users will require tailoring the administration of water rights to the specific needs of each basin. One approach is to establish basin-specific goals and flexible management tools through a new Active Management Area (AMA) designation that would apply to any basin where groundwater consumption exceeds perennial yield, or where groundwater decline is evident.

6. **Authorize the Designation of Active Management Areas** like those in Senate Bill 81 (2015) and create basin-level management goals and flexible, forward-looking tools to meet these goals.

D. Authorize New Management Tools for Overallocated Basins. Today, 53 of Nevada's 256 groundwater basins are appropriated at more than 200 percent of their basins' perennial yield. In these and all other overappropriated basins steps must be taken to "walk allocations back" to balanced levels. Currently, the State Engineer has only limited and reactive authority to bring basins back into balance. We recommend several additional mechanisms:

7. **Implement Reductions or Curtailments Based on Thresholds and Targets**
8. **Implement Share-Based Allocations**
9. **Implement Ratcheting of Conservation Requirements**
10. **Authorize Water Use Offsets and/or Mitigation**
11. **Fund Buy-Backs**

E. Authorize Unbundled Market-based Pilot Projects. An interesting effort in Diamond Valley seeks to convert current water rights into unbundled shares that could be managed and traded, with the intent of bringing clarity to water rights, revealing the true value of the water, and providing a mechanism to finance innovative water use. The project does not, however, include provisional flow standards to maintain any surface expressions of groundwater or groundwater levels required by groundwater-dependent ecosystems; nor does it contemplate conjunctive

management. The Legislature should consider expanding this pilot approach to more complex basins with important groundwater-dependent human and environmental values. Such basins would be suitable for pilot testing of conjunctive management and of the redefining of "perennial yield" proposed above.

12. Develop and Implement Pilot Projects to Increase Water Market Efficiency and Protect the Environment.

F. Increase State Investment in Water Management and Ecosystem Restoration. Historical levels of funding for the administration of water law and water rights are inadequate. Minimal requirements include water meters; surveys of water resources and ecological values; ecological models; hydrologic and geological studies; and the development of predictive models to anticipate the impacts of different groundwater pumping scenarios. In addition, most of the State's freshwater ecosystems are degraded and need restoration to increase their resiliency, especially given pressure for new water development and the likelihood of extended drought.

13. Increase Appropriations to Fund Necessary Water Management Infrastructure and Habitat Restoration.

All these recommendations are intended to bring Nevada's groundwater usage into line with a sustainable level of consumption. They outline a road map for staying within the reality of our water budget. We recognize the challenges of implementing these recommendations, but we consider them reasonable, balanced, and fully warranted because of the high economic, social, and environmental stakes. We also believe that if these reforms are administered effectively, their burdens can be fairly distributed among all of the potentially affected stakeholders as well as the natural environment. Too much is at risk to miss this opportunity to steward the water resources on which Nevada's future depends.

We appreciate the Subcommittee's consideration of The Nature Conservancy's recommendations.

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I. Introduction

The Nature Conservancy (TNC), an international conservation organization, has been working in Nevada for more than 30 years. Our mission is to conserve the lands and waters on which all life depends. To achieve this mission, the Conservancy engages constructively with public agencies, private landowners, local communities, and others. The Conservancy is well known for its science-based, non-confrontational, and solution-oriented approach and methods.

No issue is more important to protecting the ecosystems and natural resources of Nevada than managing the use and conservation of the State's limited water resources as effectively as possible. Most of TNC's signature achievements in Nevada have involved some of the State's most important freshwater ecosystems, including such places as the Truckee River, Ash Meadows, and Ruby Marsh. Regrettably, the large majority of freshwater systems around the State are in relatively poor health and continue to decline.

Nevada's water resource management policies and authorities have important implications for the vitality of Nevada's freshwater ecosystems and all the services they provide to people and nature. The work of the Subcommittee to Study Water is of the greatest importance to this State, its residents, its economy, and its natural resource values.

This document includes TNC's policy recommendations to the Subcommittee. We hope that they may be incorporated into the legislative measures that the Subcommittee will be drafting and introducing to the 2017 legislative session.[1]

We believe that there are multiple ways in which State water policy and State funding for water management could be enhanced. Here are six suggestions for the Subcommittee, for which we offer 13 specific recommendations, that focus on the critical need to improve groundwater management:[2]

- Redefining "perennial yield" to account for surface water needs for human, economic, and environmental purposes.
- Authorizing conjunctive management of surface water and groundwater.
- Authorizing basin-level management goals and designating Active Management Areas.
- Authorizing new tools for managing overallocated basins.
- Authorizing market-based pilot projects.
- Increasing State investment in water management and ecosystem restoration.

[1] For further information about this testimony, please contact Michael Cameron, Associate State Director for TNC in Nevada, at mcameron@tnc.org.

[2] Most of the material in this document regarding groundwater management and reforms is based on a report prepared for The Nature Conservancy by Peter Culp, Jennifer Diffley, and Mary Kelly: "Sustainable Water Management for Nevada: Considerations and Recommendations for Environmental Water Allocation, Conjunctive Management, and Policy Reform in America's Driest State – DRAFT," Culp & Kelly, LLP (July 2016).

II. What's at Stake — Nevada's Economy, Environment, and Quality of Life

Because Nevada is the driest state in the U.S., water scarcity is a primary limiting factor for the vitality of Nevada's economy, natural environment, and way of life.

Water is the lifeblood for all residents and communities across the State. People rely on water resources for domestic use, ranching, agriculture, mining, business, industry, hunting, fishing, and recreation. Millions of visitors come to Nevada to experience its unique landscapes for outdoor adventures and sporting opportunities.

Water is also the lifeblood of Nevada's natural environment. All of our plants, fish, and wildlife depend on freshwater resources. More than 80 percent of Nevada's endemic species (species found nowhere else in the world) depend on freshwater spring ecosystems. Our freshwater wetlands host large numbers of migratory bird species, and our mountain meadows provide vital habitat for mule deer, sage-grouse, and other native species. Nevada's rivers, including those flowing from the Eastern Sierra in northern Nevada as well as those in the Mojave Desert, provide critical habitat for native fish and streamside riparian vegetation for resident and migratory birds.

Like other western states, Nevada has experienced a severe drought over most of the past decade. Regulators are curtailing use of certain water rights because of insufficient water supplies. Wetlands, meadows, and domestic wells are drying up. Federal grazing permits are being curtailed. Late-season base flows in streams are disappearing. Wildfires are becoming larger and more frequent as soils and vegetation lose their water content. Climate models suggest that drier patterns are likely to persist and become the new norm for decades to come. Against this backdrop, Nevada's economy, population, and demand for water are growing, as evidenced by the major new industrial developments near Reno (Tesla) and Las Vegas (Faraday Future).

These challenges have brought into sharper focus the shortcomings and limitations of current water management practices. Perhaps paramount among those problems is that throughout the

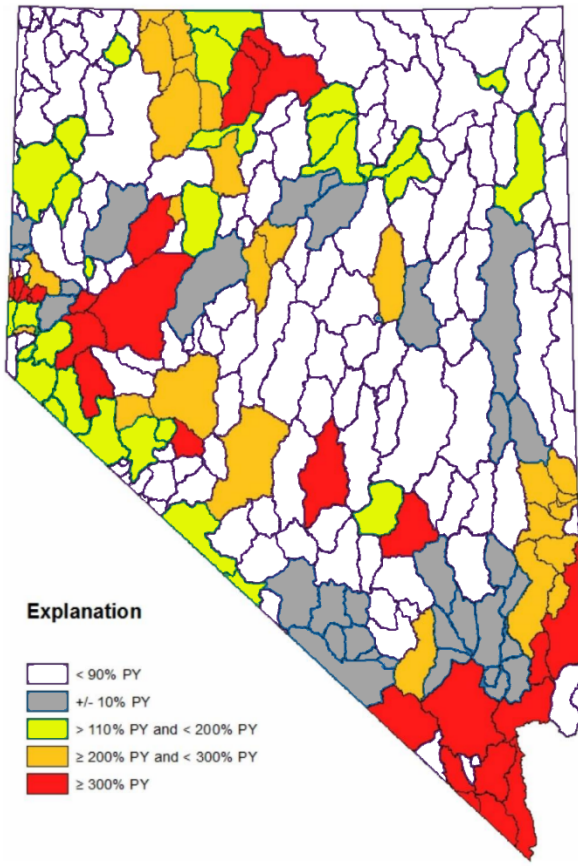

Figure 1. Several of Nevada's groundwater basins are already significantly overappropriated, meaning that permits have been issued for more water use than is sustainable. (PY refers to perennial yield.) *Graphic adapted from Nevada State Engineer*.

State, many rivers, streams, and groundwater basins are legally or physically overallocated, meaning that permits have been issued for the use of more water than is physically sustainable from that particular source. Of Nevada's 256 groundwater basins, more than half are designated as needing additional administration by the State Engineer, and 53 basins are appropriated at more than 200 percent of their perennial yield, or annual rate of replenishment (see **Figure 1**).[3]

Most of these imbalances between available water and permitted water-use rights developed during the 1950s and 1960s from a combination of miscalculations of the volumes of water actually available and sustained development pressure for new permits. Most importantly, however, this pattern of overallocation has led to economic risks and uncertainty for many users, has inhibited the most efficient use of water resources, and has resulted in negative impacts on ecosystems.

In the face of these problems, the regulatory authorities of the State Engineer are in many ways outdated, reactive, and inadequate. With communities across Nevada already feeling the impacts of drought, overappropriation, and severely stressed water resources, statewide interest in water resource issues is growing, and momentum is building for the exploration of new approaches to water management.

The Nature Conservancy believes that developing a more sustainable water management framework is critically important for Nevada's communities, economies, and environment.

[3] Minutes of the Assembly Committee on Natural Resources, Agriculture, and Mining, 78th Session of the Nevada Legislature, at 21 (February 24, 2015) (Statement of Jason King, Nevada State Engineer).

III. Nevada's Freshwater Ecosystems — A Resource Worth Conserving

Table 1 - Freshwater Ecosystem Health

Freshwater Systems		Overall Health					
		Poor	Fair-	Fair	Good-	Good	Very Good
Eastern Sierra Nevada	Truckee River		Fair-				
	Carson River		Fair-				
	Walker River		Fair-				
Mojave Desert Rivers	Muddy River		Fair-				
	Amargosa River				Good-		
	Virgin River			Fair			
Desert Springs	Soldier Meadows			Fair			
	White River Valley			Fair			
	Pahranagat Valley	Poor					
Wetlands	Lahontan Valley		Fair-				
	Argenta Marsh		Fair-				
	Montane Meadows			Fair			

Protection and restoration of Nevada's freshwater ecosystems—including rivers, streams, springs, seeps, wetlands, and wet meadows—are among The Nature Conservancy's highest priorities in Nevada. Most of TNC's signature conservation achievements in Nevada have concerned high-priority freshwater ecosystems, including Ash Meadows, the Amargosa River, and the Muddy River in the Mojave Desert; the Truckee River, the Carson River, Independence Lake, and the Lahontan Wetlands in the Sierra Nevada ecoregion; and Soldier Meadows and Ruby Marsh in the Great Basin ecoregion. Most of these achievements were based on land protection and habitat restoration projects.

However, we recognize that the future viability of Nevada's freshwater ecosystems will increasingly depend on the continued availability of water at these and other places. Water availability, in turn, will be largely determined by management decisions governed by Nevada State law and policy.

A recent TNC assessment found that Nevada's freshwater ecosystems are currently in poor health and declining throughout the State.[4] The assessment evaluated 12 priority freshwater landscapes that are representative of major types of freshwater ecosystems in Nevada, including Eastern Sierra Rivers, Mojave Desert Rivers, Springs, and Wetlands/meadows (**Table 1**). We ranked the health of each landscape based on five factors: (1) adequacy of water flows, (2) health of riparian vegetation, (3) health of native aquatic animals, (4) the physical integrity of river channels, wetlands, and springs, and (5) water quality.

We concluded that more than 90 percent of the landscapes were rated at "Fair" health or lower. More than half are projected to decline further in the future due to a combination of human and environmental threats discussed below. All of these landscapes are in need of restoration.

In short, the freshwater ecosystems on which so much of Nevada's wildlife and natural heritage depend are in serious trouble.

[4] "Nevada Freshwater Ecosystems Conservation Action Plan — Review Draft," February, 2016, The Nature Conservancy. Appendix 1 is a map of the landscapes evaluated by the plan.

The current relatively poor condition of these freshwater systems is the result of numerous alterations and impacts. **Table 2** ranks the most significant threats to these landscapes.[5]

Table 2 - Threats to Nevada Freshwater Ecosystems

Channel Modification	Very High
Surface Water Diversion	
Excessive Groundwater Withdrawal	
Invasive Aquatic Animals	
Warmer & Drier Climate	High +
Incompatable Livestock Grazing, Wild Horses & Burros	
Invasive Plants	
Incompatable Forest Management	High
Incompatable Development	
Incompatable Agriculture	Medium
Dam and Reservoirs	

Four threats were rated as "Very High": channel modification; surface water diversion; invasive aquatic species; and excessive groundwater withdrawal.

The likely prospect of a warmer and drier climate was considered a highly ranked future threat, primarily as a result of its projected resulting reductions in surface flows (especially during periods of highest need) combined with increased irrigation and other water demands.

Other important threats included invasive plant species, incompatible forest management practices, incompatible livestock grazing, and wild horses and burros.

Of the four most highly ranked threats, three reflect continuing ecological stress as a result of ***historical actions*** or problems**.** Most of the patterns of surface water use and stream channel alteration are long established, as are the ecosystem impacts from those patterns and alterations. In many cases the impacts of these historical threats can be at least partially mitigated over time by investments (including investments by the State of Nevada) in ecological restoration projects.

In contrast, potential large-scale groundwater withdrawal reflects a significant ***future challenge*****.** Many of the State's most ecologically important desert streams, springs, and wetlands depend either on the near-surface groundwater table or on surface expressions of groundwater—places where underground water comes to the surface. Insofar as groundwater extraction for human uses can result in the lowering of the water table and reduction of surface expressions of water (discussed at length in the next section), it poses a risk for those systems and the plants and animals that depend upon them.[6]

[5] The rankings in Table 2 are aggregate results taken from individual threat rankings at each of the 12 landscapes. Thus, for example, incompatible forest management is considered a "High +" threat in the Truckee River, but since it wasn't as important in many of the other landscapes in the aggregate, across all systems it averaged out to a "High" threat. On the other hand, the four "Very High" threats are pervasive, registering as important threats in 10 or more the 12 landscapes we considered.

[6] See Springs Conservation Plan Working Group., S.L. Abele (ed.), *Nevada Springs Conservation Plan*, 10, 17 (The Nature Conservancy, 2011).

Given that most of the State's limited surface water resources have been fully appropriated, growing water demand will necessarily focus on greater use of groundwater. While increasing human needs for water are valid and indeed critical, collectively we need to develop methods to meet those needs without further impairing natural ecosystems any more than they already have been. Insofar as the threat to the environment from future unsustainable groundwater management is still preventable to some degree, TNC has prioritized groundwater management reform as the most immediate and important issue for the Legislature, the State Engineer, and all water users to address.

IV. Groundwater Hydrology and Freshwater Ecosystems

This section explains briefly how groundwater management is essential to Nevada's freshwater ecosystems and to a broad array of surface water users and economic sectors. Groundwater is water that has infiltrated into the earth, filling the spaces and cracks in bedrock and sediments to form aquifers—underground reservoirs that store groundwater.[7] This infiltration is known as ***recharge***.[8] In some places, aquifer systems are hundreds or thousands of feet deep and underlie enormous areas of the surface. Where groundwater intersects the surface, water is ***discharged*** in springs, seeps, and streams (see **Figure 2**).[9] Groundwater flows can take days,

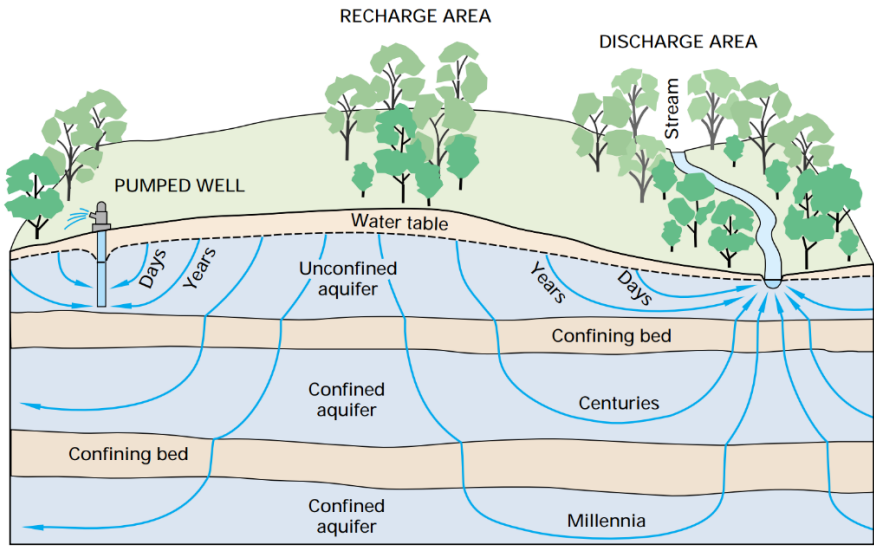

Figure 2. "Ground-water flow paths vary greatly in length, depth, and travel time from points of recharge to points of discharge in the ground-water system." *Source*: Winter, T.C., Harvey, J.W., Franke, O.L., and Alley, W.M., 1998, *Ground water and surface water—A single resource*: U.S. Geological Survey Circular 1139, 79 p. 5.

[7] U.S. Geological Survey, Nevada Water Science Center, *Groundwater*, available at http://nevada.usgs.gov/water/groundwater/groundwater.htm.

[8] See generally Winter, T.C., Harvey, J.W., Franke, O.L., and Alley, W.M., 1998, *Ground water and surface water—A single resource,* U.S. Geological Survey Circular 1139, 79 p. 6; Barton H. Thompson, Jr., John D. Leshy, and Robert H Abrams, *Legal Control of Water Resources* (5th ed.), 1199 (Thomas Reuters, 2013). Groundwater recharge is "the flow of water into an aquifer."

[9] See generally *Ibid.*; Sonoran Institute, *Sustainable Water Management: Guidelines for meeting the needs of people and nature in the arid West*, 5 (2007).

years, decades, centuries, or even millennia to move from points of recharge to points of discharge. Flow paths can run from a few hundred feet to many miles.[10]

Under undisturbed conditions, groundwater systems operate in a dynamic equilibrium, in which the natural discharges from the system to the surface—"surface expressions" including springs, seeps, discharge to surface streams, and the consumption of groundwater by surface vegetation—approximate the long-term natural recharge into the groundwater system. [11]

Any diversion or development of groundwater (as well as the capture of surface water that would otherwise have recharged groundwater) will almost inevitably reduce the amount and extent of near-surface groundwater expressions and lower the water table.

Pumping groundwater from a well, which is a primary type of diversion, forms a "cone of depression" in which the water table is drawn down, producing an underground gradient sufficient to drive water into the "hole" in the aquifer created by the pumping out of water. This "driven" water replaces the water that was pumped out (**Figure 3**). Because groundwater typically moves slowly through the aquifer—sometimes only a few inches or feet per day—this cone of depression will initially be confined to the immediate vicinity of the well and may affect water levels only in neighboring wells or nearby surface features supported by groundwater.

Over time, however, the cone of depression will spread outward through the aquifer, ultimately affecting water tables at considerable distance from the well. If pumping at a significant level continues for long periods, a substantial cone of depression may be formed that can take years, decades, or even centuries to

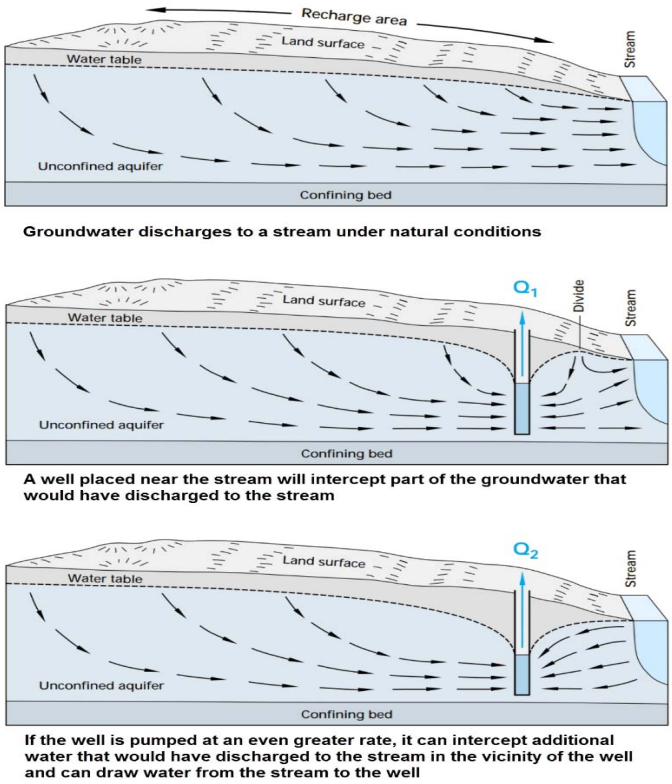

Figure 3. *Source:* Same as for Figure 2.

[10] Winter, T.C., Harvey, J.W., Franke, O.L., and Alley, W.M., 1998, *Ground water and surface water—A single resource*, U.S. Geological Survey Circular 1139, 79 p. 5.

[11] *Ibid.*, 79 p. 14 (1998).

stabilize even after pumping stops.[12] Thus many of the impacts of groundwater extraction can extend over months, years, decades, or centuries, and the resulting lowering of the water table may manifest itself at a significant distance from the point of use.

Groundwater pumping can also pull water away from stream systems fed by surface water. In an area where groundwater discharges into a surface stream (known as a "gaining reach"), the initial effect of a cone of depression is to "capture" water flowing underground that would otherwise have reached the stream, thus reducing the amount of stream flow. Once the cone of depression intercepts the stream, it draws water away from the stream, converting it into a "losing reach" (**Figure 4**). If the cone of depression lowers water tables to the point where they become disconnected from the stream, the stream may cease to flow altogether. This phenomenon is partly responsible for the extremely low flows in the lower Humboldt River.

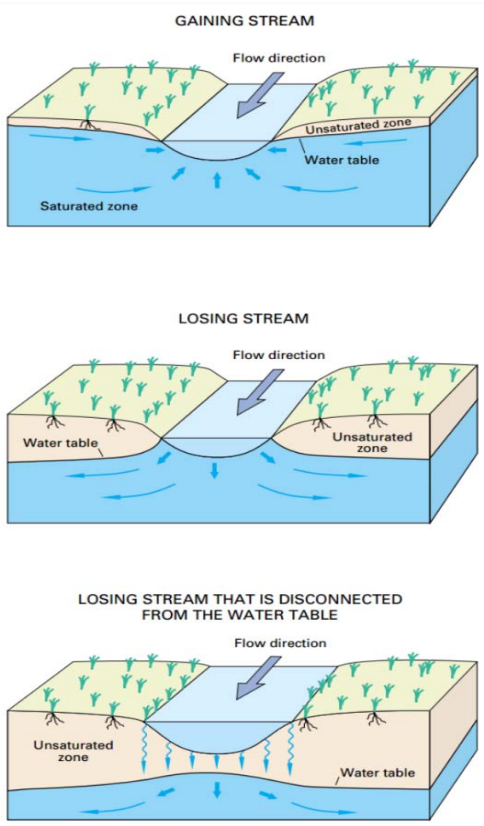

Figure 4. *Source:* William M. Alley, Thomas E. Reilly, and O. Lehn Franke, *Sustainability of Ground-Water Resources*, U.S. Geological Survey Circular 1186, p. 31.

In the many instances where groundwater supports ecologically important freshwater systems, including desert streams, springs, and wetlands, groundwater extraction can quickly create grave threats to the plants and animals that depend on them.[13]

Figure 5 shows the extent of some (but not all) of these systems in Nevada. Extracting groundwater reduces the amount of water available to them.[14] These systems, especially in areas where natural recharge and natural discharge are quite small, often depend on the "top" of the aquifer and cannot utilize deeper-lying groundwater. So modest changes in water levels or pumping small amounts of groundwater can have significant adverse effects by drawing

[12] Groundwater pumping can also result in a phenomenon known as subsidence, where the removal of water from the porous spaces in underground materials causes these materials to become compressed, resulting in the sinking of the land surface above them and reducing the aquifer's storage capacity if it ever refills.

[13] See Springs Conservation Plan Working Group., S.L. Abele (ed.), *Nevada Springs Conservation Plan*, 10, 17 (The Nature Conservancy, 2011).

[14] *Ibid.*

down surface water or lowering water tables below the root zones of trees and other vegetation.[15]

This means that endemic species in Nevada that rely on spring-fed habitat are in many ways the first users to face the real risk of unsustainable extraction from groundwater aquifers. In addition to the obvious ecological consequences, loss of these important habitats can degrade recreational opportunities and quality of life; can have important regulatory implications under the federal Endangered Species Act, Migratory Bird Treaty Act, and other environmental laws.

Conversely, because these habitats are frequently associated with the "top" of the aquifer system, actions that protect their sustained access to groundwater can also help to sustain valuable surface water rights and property values that would otherwise be threatened by long-term, unsustainable groundwater use.

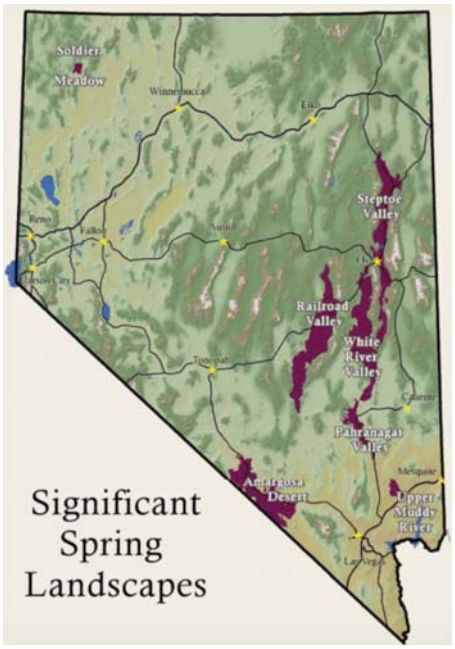

Figure 5. *Source*: Nevada Natural Heritage Program. *Nevada Springs Conservation Plan*. 2011

With respect to the Endangered Species Act, it is worth emphasizing that an ounce of prevention is likely worth more than a pound of cure. By definition an endemic species is a native species that occurs nowhere else on earth. Their highly localized occurrence makes them vulnerable to extinction if their key environments are significantly disturbed. As we noted earlier, a large majority of Nevada's endemic species are dependent on groundwater ecosystems. Mismanagement of groundwater therefore carries significant risk of triggering the ESA and bringing on all of the economic risks and uncertainties associated with the regulatory environment that would ensue. As detailed in the next section, the establishment and successful implementation of provisional flow standards is, in our opinion, the most effective single step the State can take to avoid a spate of ESA regulatory decisions in the future.

[15] See William M. Alley, Thomas E. Reilly, and O. Lehn Franke, *Sustainability of Ground-Water Resources*, U.S. Geological Survey Circular 1186, p. 43 (1999).

V. Recommended Reforms for Groundwater Management in Nevada

At this point we have established that groundwater-dependent ecosystems are of critical importance in Nevada, that they are generally in poor and declining condition, and that unsustainable groundwater pumping is one of the greatest threats to their future viability. While the awareness of policy makers and others about these systems has vastly increased in recent years, the basic legal underpinnings that have led to systemic overallocation of groundwater are still in place and need to be modernized.

This section presents TNC's recommended reforms. In order of importance, the first three recommendations focus on redefining perennial yield, authorizing conjunctive management, and enabling a new Active Management Area designation. They are followed by recommendations to expand the tools available to bring overallocated basins back into balance, implement pilot projects to improve the efficiency of water markets, and increase funding levels for water management and ecosystem restoration.

A. Redefine Perennial Yield to Include Surface Water Needs

To be effective, groundwater management needs to operate within the limits of a water budget that reflects the hydrologic reality that groundwater development almost inevitably affects water table levels, surface flows and surface expressions of groundwater like springs and wetlands. Determination of how much groundwater is available for appropriation must begin with a science-based decision about what impacts from groundwater pumping will be acceptable.

Presently, Nevada employs a "perennial yield" policy that defines the amount of groundwater available for extraction as the amount of ***recharge*** that a particular groundwater basin receives. The amount of available groundwater is usually limited to the maximum amount of natural ***discharge*** from that basin.[16] *It is important to note that the quantities of water necessary to sustain surface water rights, sustain groundwater flows and groundwater levels depended upon by ecosystems, and sustain other uses of surface flows are* ***not*** *taken into account or subtracted from the available amount.* —a recipe for overallocation of water. Thus, in most cases, the perennial yield policy has allowed for appropriation of all available natural groundwater discharge, including that portion necessary to support plants and animals.

As currently defined, "perennial yield," if fully developed in a groundwater basin, would risk drying up many, most, or all of the basin's springs, seeps, and groundwater-fed wetlands, meadows, and streams. It would result in senior surface water rights being "shorted" (not entirely fulfilled) and would deny water to other users of surface expressions of groundwater. Hunters and anglers throughout the State would suffer substantial losses of sporting

[16] While "perennial yield" is not specifically defined by statute, the definition given here is currently applied by the State Engineer for a variety of groundwater management activities. Nevada Dept. of Conservation and Natural Resources, *Water Law 101*. Available at http://dcnr.nv.gov/documents/documents/nevada-water-law-101/.

opportunities. The effect of this loss on the State would be severe, wide-ranging, and in many cases irreversible.

Groundwater-dependent ecosystems may be in the gravest peril. The loss of near-surface aquifers and spring-fed habitats would devastate Nevada's most valuable desert habitats—habitats on which important endemic and threatened species rely. Much of what makes Nevada beautiful and a special place to live could be lost forever.

However unlikely this outcome may seem, the path we are on is leading in this direction.

Ultimately, the question of groundwater management is not an "either/or" proposition where society must choose between extracting groundwater for certain human uses versus leaving it in the ground to maintain surface flows for other human needs and the environment. Rather, the question is one of balance. As a practical matter, some loss of surface flows—and attendant reductions in human uses and environmental degradation—will have to be accepted in connection with groundwater development and use. On the other hand, there must also be limits on the loss of surface flows and the consequent magnitude and locations of the impacts on human uses and on the environment. The question of where the balance lies is ultimately a social, economic, and political question that must be decided by the people of Nevada and their elected representatives in the Legislature.

To find this balance point, it is necessary to develop science-based information that reveals the tradeoffs between different levels of groundwater development and their effects on surface flows and ecosystems. At present, such information is largely incomplete or missing, and while surface water rights readily define certain human needs, most environmental flow needs are not well understood or quantified.

To address the shortcomings of the current definition of perennial yield, and to develop the information necessary to support informed groundwater management, TNC recommends that the Legislature require the State Engineer to:

1. **Develop Provisional Flow Standards** that include the flows and groundwater levels necessary to meet critical ecosystem needs and surface water rights. The State should appoint a scientifically credentialed body under the auspices of the State Engineer to determine how to set such standards. The body will work in cooperation with local communities, wildlife managers, and ecological researchers to *establish provisional flow standards for each hydrographic basin*.

   Such standards—and their spatial and temporal scales—will vary from basin to basin based on local environmental and hydrologic conditions. If such standards are implemented, it will be necessary to set aside a portion of the water budget as an "*environmental water allocation*" that will ensure that sufficient water is provided for necessary surface flows and groundwater levels. These provisional flow standards would apply to the regulation of groundwater within single basins and to transfers of groundwater between basins. They should also recognize the hydrologic connectivity

between basins. As discussed further below, provisional flow standards can be an important input for setting goals for conjunctive water management.

TNC as an international science-based organization, and the Nevada the Chapter in particular, have technical capacities to contribute to the development of these standards. In Nevada, TNC helped facilitate the development of monitoring plans under the stipulation agreements governing groundwater development for the Southern Nevada Water Authority, using its Conservation Action Planning methodology as a framework. The monitoring plans identified groundwater-influenced ecosystems and their associated special status biota as well as the "Key Ecological Attributes" and Indicators for assessing the condition of each system. Key Ecological Attributes represent the critical factors that capture the likelihood that the ecosystem or species will persist for a century or longer. These factors include elements such as ecological processes, composition, structure, and size. Indicators are whatever is measured for each key attribute.

The attributes and indicators serve as a foundation for informing provisional flow standards, but setting the standards themselves requires additional ecological modeling steps to determine the amount of water required to maintain ecosystem viability; and as discussed next, requires hydrologic modeling to determine what level of groundwater pumping is compatible with meeting those ecosystem water requirements.

2. **Apply Predictive Modeling to Set Provisional Flow Standards.** Given what we noted earlier about (1) the time lag between pumping and its impacts on groundwater elevations and surface water expressions and (2) the spatial disconnect between points of withdrawal and points of impact, we also recommend that the Legislature require the State Engineer to *apply predictive groundwater models, at the appropriate spatial and temporal scales, to determine what level of pumping can be sustained without violating these provisional flow standards*.

   The types of impacts that need to be predicted include, for example, spring flow reduction, stream flow reduction, lowered groundwater levels, and reduced evapotranspiration by native plants. If little or no pumping is possible without violating these environmental flow standards, then the reasonableness or necessity of some adverse impacts and ways to offset or "walk back" adverse impacts should be evaluated using the same predictive modeling.

3. **Develop and Implement Monitoring Programs.** Given the inherent uncertainty involved in the setting of flow standards and in predictive modeling, *develop and implement flow and habitat monitoring programs*, again at the appropriate spatial scale, to provide decision-support information for adaptive management.

4. **Redefine Perennial Yield to Achieve Provisional Flow Standards.** To protect the human, economic, and environmental interests that depend on the near-surface groundwater table and surface expression of groundwater, and in light of recommendations 1, 2, and 3 above, TNC recommends that the Legislature clarify and redefine by statute "perennial yield" so that the State Engineer *will withhold from future appropriation for*

> *groundwater development that portion of perennial yield that is necessary to meet provisional flow standards*.

TNC recognizes that the establishment of provisional flow standards will be especially difficult in groundwater basins that are already fully allocated or overallocated. In our recommendations below, we suggest how to achieve environmental standards in such basins. However, most basins have not yet been fully appropriated by the current standard of perennial yield (see **Figure 1** above), so it is imperative to set these standards as quickly as possible before water that is needed for human and environmental purposes is otherwise appropriated for other future unsustainable uses.

TNC further recognizes the complexity and challenge of establishing and implementing flow standards. Below, we recommend in some detail that the State develop several pilot projects to test new methods for bringing overallocated basins back into balance. Similarly, it may be prudent to begin with pilot projects to implement these recommendations for flow standards, predictive models, monitoring, and redefining perennial yield.

Criteria that could be considered for selecting basins for pilot projects could include these:

- Basin has not yet been fully appropriated
- Presence of important groundwater-dependent ecosystems
- Presence of important human and economic uses of surface expressions of groundwater
- Relatively well-understood groundwater hydrology
- Local community's receptivity to implementing new, sustainable groundwater management practices

The Nature Conservancy would be interested in partnering with the State of Nevada and other stakeholders in identifying and developing such pilot projects.

B. Authorize Conjunctive Management

As discussed above, as a matter of hydrological reality, groundwater and surface water are a single resource.[17] However, in Nevada as in most western states, although surface water and groundwater are both appropriated and permitted through the same kind of state regulatory framework, they are largely managed as separate resources.[18]

Conceptually, "conjunctive management" reflects an approach in which surface water and groundwater are managed together as a single resource—or at a minimum, it indicates a management framework that recognizes the interconnection between groundwater and surface water sources and takes that interconnection into account when permitting water rights and managing groundwater basins. Without some aspect of conjunctive management, there will be fundamental conflicts between groundwater rights and surface water rights, since

[17] Winter, T.C., Harvey, J.W., Franke, O.L., and Alley, W.M., 1998, *Ground water and surface water—A single resource*, U.S. Geological Survey Circular 1139, 79 p. 2.

[18] *See* N.R.S. 534.020 (underground waters are subject to appropriation for beneficial use).

the exercise of rights under one system will almost inevitably affect the availability of water in the other system.

This issue has become particularly acute over the last few years as drought has reduced the availability of surface water supplies and brought into sharp relief the growing adverse impacts of groundwater use on those supplies. Rights to surface water are generally the oldest, highest-priority rights in the stat—and, accordingly, legally the best protected rights. However, legal priorities mean nothing if groundwater use is allowed to deplete surface water streams and deprive those high-priority users of water.[19]

The State Engineer is on record saying that conjunctive management will be necessary for proper groundwater management in the future. [20] Our recommendation therefore, is for the legislature to authorize the State Engineer to:

5. **Plan and Regulate Surface and Groundwater Conjunctively.** The administration of water law and water rights should recognize surface and groundwater as a single interconnected resource and give consideration to the hydrology of each basin and the hydrologic connectivity between basins.

C. Authorize Basin Management Goals and Designation of Active Management Areas

Taken together, TNC's recommendations above to redefine perennial yield to account for human, economic, and environmental groundwater needs and to authorize conjunctive management will require another policy innovation: the creation of basin-specific management goals. We have already indicated that environmental water goals will vary from basin to basin and will need to be site-specific based on the unique ecological values associated with each basin and on an allowance for some level of impacts on surface flows.

Similarly, incorporating the connection of ground and surface water into the management framework will also entail localized goal-setting. That is, to the extent that the use of groundwater results in the reduction of surface water flows, one cannot have both groundwater extractions in a particular basin and unaffected surface values in that same basin. Pumping may occur for a time without noticeable changes in groundwater levels, and surface

[19] Currently, the State Engineer is responding to some of these situations by granting supplemental groundwater rights to the affected surface right holder. This practice risks exacerbating the problem further by causing additional declines in the water table and affecting other surface and groundwater rights in the future.

[20] The State Engineer has requested that the Legislature consider reforming Nevada water law to allow the State Engineer's office to manage groundwater and surface water conjunctively. In a memorandum to the Legislative Commission's Subcommittee to Study Water, the State Engineer described the fundamental hydrologic reality that groundwater use has an effect on surface water sources somewhere else in the system, noting that the "separate management appears to be a relic of the history of how water was developed in the state and the policy focus that the use of water was beneficial for the growth of the state; however, current science and events are challenging this management scheme." Memorandum from Jason King, State Engineer, to Alysa Keller, Legislative Counsel Bureau (April 19, 2016), available at https://www.leg.state.nv.us/interim/78th2015/Committee/StatCom/LCWater/Other/22-April-2016/11KingMemo.pdf

expressions may remain unaffected for a time, but eventually, hydrological reality will catch up with both.

For example, certain basins in Nevada now face complex legal and political issues arising from the growing conflict over surface water-groundwater connectivity. As a result of the established users' interests in these basins—whose ability to access water will be threatened either by the failure to manage water conjunctively (in the case of many surface water users) or by the decision to manage water conjunctively (in the case of many groundwater users)—conjunctive management is a complicated issue.

Avoiding or minimizing conflicts will require a basin-by-basin approach that tailors water rights administration to the specific circumstances and needs of each particular basin. Basin-level goals will almost certainly differ from place to place. These goals must take into account current uses, planned development, clearly articulated environmental values that need to be maintained, and the underlying hydrological system that will be relied upon to meet all needs.

Additionally, the use of management tools—including issuing permits for water appropriations, designating groundwater basins for management, and curtailing some existing uses—must also proceed under this same logic. Nevada currently employs a "reactive" approach in which designation of groundwater basins occurs only after those basins are already in trouble and which then seeks to curtail use based on priority ranking. This approach is inadequate in the face of the fundamental hydrological realities and overallocation problems that are creating the "trouble" in the first place.

One approach to establishing basin-specific goals and more flexible management tools is through a new type of basin designation: Active Management Areas. With the support of the State Engineer, the Legislature incorporated this approach in the text of Senate Bill (SB) 81 in 2015. Had that bill become law, the State Engineer could have designated as an Active Management Area (AMA) any basin where groundwater consumption consistently exceeds perennial yield, or where an unreasonable level of groundwater decline is evident. Other important provisions of the bill would have authorized the State Engineer to:

- Convert groundwater certificates from diversion rates to volumetric quantification
- Approve plans to limit withdrawals
- Avoid cancellations or forfeitures during a conservation period
- Establish a fund to retire water rights or implement conservation practices
- Adopt rules or regulations to further groundwater management plans

The AMA concept is worthy of reconsideration by the 2017 Legislature, and should include the concept (discussed above) of basin-level management goals. Local communities should be involved in the planning process, which for consistency should take place under the oversight of

the State Engineer's office.[21] The AMAs would need to address specifically both surface and groundwater resources to allow for comprehensive conjunctive management. AMAs should be authorized not only where basins are already overappropriated, but also in places that have significant water use and may be in need of additional administration and proactive management to balance uses and competing interests.

A very similar approach has been adopted the State of Arizona and may serve as a useful template for review by the Nevada Legislature. The Arizona AMAs have provisions for management goals, conservation targets, requirements to prepare water management plans, requirements for developers to demonstrate 100-year assured water supply for new growth, prohibitions on new irrigation uses, and metering and reporting requirements. The Arizona AMA legislation grandfathers in certain irrigation uses through a system of groundwater rights combined with incentives for retiring those groundwater rights or converting them for development use while reducing their volume in the process. Through statutory requirements and management plans, a laddered process was created that gradually ratchets down both the amount of existing water rights and associated water conservation requirements applicable to their use. In this respect Arizona now has mechanisms to "walk back" overappropriated basins and reestablish sustainable levels of water use.

TNC's recommendation is for the Legislature to adopt many of the provisions of SB 81 and the additional provisions noted above, and to authorize the State Engineer to:

6. **Designate Active Management Areas** that should be similar to those described in SB 81 (2015 Nevada Legislature) and should include provisions for creating basin-level management goals and flexible, forward-looking tools to meet those goals.

D. Authorize New Management Tools for Overallocated Basins.

Once a water budget has been established, existing water allocations must be adjusted if they don't fit within the budget. As noted above, 53 of the 256 groundwater basins in Nevada are appropriated at over 200 percent of the perennial yield of the basin. In these basins significant steps must be taken to "walk back" these allocations and ensure that overappropriation doesn't lead to overdraft and further decline of the aquifer. Further decline could lead to increased costs for pumping groundwater; loss of surface vegetation, habitats, wildlife, and recreational opportunities; diminished surface water rights; domestic well failures; and land subsidence and ground fissures.

To bring overallocated basins back into balance, at present the State Engineer has only a single authority which is to curtail water use according to water-rights seniority or priority. While this provides a predictable and lawful means of reducing consumption, it is largely reactive and inflexible. With the addition of the Critical Management Areas and associated groundwater

[21] Having local planning processes governed by the State Engineer would address the concern raised by Senator Aaron Ford (D-Las Vegas) regarding the potential problem of many different local groundwater boards coming up with varying rules and solutions that don't really solve a statewide problem. Comments attributed to Senator Ford at the meeting of the Legislative Commission's Subcommittee to Study Water on June 7, 2016.

management plans authorized during the 2011 legislative session, local communities presently do have the ability to work together to develop local solutions and plans to address the worst cases of overdraft. However, if after 10 years of management under the groundwater management plan, results do not justify lifting the Critical Management Area designation (i.e., if withdrawals still consistently exceed the perennial yield of the basin), then the State Engineer must begin curtailing use based on priority ranking. However, there is significant uncertainty about what other mechanisms communities can include in these groundwater management plans.[22]

Based upon activities already taking place around Nevada, ongoing policy discussions, and examples from other jurisdictions, we suggest for consideration several different mechanisms that could be included in statutory provisions or, with legislative authorization, could be adopted by the State Engineer via promulgating regulations. These tools are presented in a progression from relatively strict priority-based or prescriptive, regulatory requirements to more incentive-based, voluntary approaches.

The Legislature should further evaluate and consider authorizing the State Engineer to:

7. **Implement Reductions or Curtailments Based upon Thresholds and Targets.** This mechanism would allow the State Engineer to institute curtailments (or other types of reductions not specifically based on strict priority) based upon thresholds or targets to be established. The State Engineer recently did exactly this in conditional curtailment orders for the Smith and Mason Valleys on the Walker River. This proposal is also similar to the reductions that are made under current Lake Mead operational guidelines governing Colorado River shortages, adopted pursuant to the 2007 Shortage Guidelines.[23] Under these guidelines, system shortages are declared based on "trigger" elevation levels of Lake Mead. Once those trigger elevations are hit (based on an August forecast for the upcoming water year), Nevada and Arizona must take agreed-upon reductions in their water deliveries. By establishing specific, elevation-based trigger points, this approach has created a highly visible physical indicator that everyone can understand and has provided points to aim for when conducting conservation measures and voluntary reductions.
8. **Implement Share-based Allocations***.* Currently, Nevada water rights can be quantified volumetrically based on seasonal rates of flow and diversion or consumptive allocations. Within a given basin, a share-based allocation would convert a user's volumetric right into a corresponding "share" of the available resource, essentially based upon the user's

[22] Specifically, this issue has been discussed in the context of Diamond Valley, which was designated as a Critical Management Area in 2015. Community members in Diamond Valley have expressed interest in establishing a pilot project for a market in water shares (discussed below). However, both the community and the State Engineer have expressed uncertainty regarding whether or not the State Engineer could legally approve such a plan because it was based on a water market rather than curtailments by priority. See Legislative Commission's Subcommittee to Study Water, presentation regarding Diamond Valley water resources, June 7, 2016.

[23] See U.S. Department of the Interior, Record of Decision, Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operation of Lake Powell and Lake Mead (December 2007).

percentage interest in the total resource. For example, if an irrigator holds water rights consisting of eight percent of a basin's total allocated rights, the irrigator's "share" is eight percent of the total resource. However, instead of being based upon a fixed quantity of water, the actual allocation would be based on the availability of the resource as determined each water year. During times of shortage, shareholders' deliveries and allowable pumping limits would be reduced proportionately.[24] Some irrigation districts already operate under share-based systems.[25]

9. **Implement Ratcheting of Conservation Requirements.** After basin management goals have been established, minimum conservation requirements could be developed, and associated laddering or "ratcheting" steps could be taken in order to meet the management goals over time. Active Management Areas—discussed above and already being implemented in Arizona—can, where appropriate, prohibit new irrigation uses and limit most new residential and industrial uses through a permit system designed to meet management goals. For "grandfathered" irrigation users, a specific maximum water duty can be set that reflects reasonably achievable improvements in irrigation efficiency. Municipalities can be required to achieve reasonable reductions in per capita use, and industrial users can be required to employ the latest commercially available conservation technology. For all these users, the minimum conservation requirements can be ratcheted up to gain additional water savings during each successive 10-year management period.

10. **Authorize Water Use Offsets and/or Mitigation.** This mechanism would enable local governments to institute water use offset requirements for new development projects. Based upon basin management goals and water budgets, cities or counties could enact ordinances to ensure that development projects and their associated future water uses have a neutral impact on the overall water budget and basin health. Offset programs would enable the municipalities to create a mitigation "bank" that enables transfers of offset credits between new water users and conservation projects in order to achieve a neutral or positive impact on the basin's water resources. The City of Santa Fe, New Mexico has followed this approach, adopting ordinances that require development projects to offset new demands on the city's water system.[26] The program, together with tiered water rates, has driven down water use per person in Santa Fe by 42 percent since 1995.[27] The Truckee Meadows Water Authority has also required water rights offsets through its "will-serve" process, and this policy is now complemented by a shared water bank under the Truckee River Operating Agreement for municipal and/or fishery needs.

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[24] *Ibid*., 770.

[25] Professor Michael Young's proposal for how this concept could be applied in the Diamond Valley is discussed below.

[26] City of Santa Fe, *Development Water Budgets* (http://www.santafenm.gov/development_water_budgets). See also Santa Fe Land Development Code, Section 14.8-13.

[27] *Ibid* (internal citations omitted).

11. **Fund Buy-backs.** With specific legislative authorization, State, county, and municipal government agencies could purchase water rights directly or provide funding to qualified entities for the purpose of converting some current uses to instream flows or more broadly to environmental purposes. Nevada is one of the few western jurisdictions that allows private parties to change water rights to instream flow rights for the benefit of wildlife, riparian systems, and overall water security.[28] This important authorization could be broadened and incentivized to help bring overallocated basins back into balance.

    While buy-backs are an important tool for reducing water use in already overallocated systems, provisional flow standards and conjunctive management should always be built into the water budget from the outset whenever feasible. The management goals set for any hydrologic system then govern the regulatory requirements and market dynamics for the tools described above (offsets, storage credits, etc.).

E. Authorize Unbundled Market-Based Pilot Projects

As noted in previous testimony to the Subcommittee,[29] an effort is underway in Diamond Valley that would convert current water rights into unbundled shares with separate components that could be managed and traded, with the intent of bringing clarity to water rights, revealing the true value of the water, and providing a mechanism to finance innovative water use.[30] Diamond Valley is a basin that has been designated as a Critical Management Area, and the goal of the project is to establish a structure for trading "shares" of water and for retiring shares in order to manage water and to bring overallocated basins back into balance.

To be successful, the Diamond Valley pilot project is expected to require legislative authority to allow the State Engineer to authorize and support plans if they are pursued through the mechanism of groundwater management plans. If water markets are pursued as a direct management tool, then even more specific enabling legislation will be necessary. Although the project does not include provisional flow standards to maintain any surface expressions of groundwater, this pilot effort has useful components. Expanding this approach to additional basins with different conditions should be considered.

Diamond Valley has relatively few groundwater-dependent environmental values, a large percentage of the same type of water use (agricultural), and few surface water-groundwater

[28] "Beneficial use" includes "wildlife purposes"—for example, providing water for wildlife and establishing and maintaining wetlands, fisheries, and other wildlife habitats. N.R.S. 533.023.

[29] Legislative Commission's Subcommittee to Study Water, presentation regarding Diamond Valley water resources (June 7, 2016) (meeting minutes forthcoming).

[30] This effort is based on a report written by water economist Michael Young of the University of Adelaide, in cooperation with the Nicholas Institute for Environmental Policy Solutions, on developing water markets in the West that would be modeled on Australia's water market system. See Michael Young, *Unbundling Water Rights: A Blueprint for Development of Robust Water Allocation Systems in the Western United States* (Nicholas Institute for Environmental Policy Solutions, September 2015).

interconnections. This makes it a relatively simple system in which to pilot the market concept while avoiding the need for flow standards and conjunctive management.

However, because Diamond Valley does not have significant environmental values that would need to be addressed through a market system, it is worth considering one or more pilot projects in a more complex basin with important groundwater-dependent human and environmental values. Working in such a basin would require conjunctive management and the redefinition of perennial yield proposed above. In fact, the "Australian model" of water management on which the Diamond Valley pilot is based *starts with a set-aside of water for the environment*, so these proposed additional pilot projects already have an existing model that could be followed.[31]

The types of basins for testing additional pilot projects should be those with a relatively simple groundwater situation and identifiable surface expressions of groundwater with strong associated environmental, social, and cultural values. Ideally, one of these pilots might involve a basin that is not yet fully allocated or one where a minimal amount of "walking back" would be required, while another might involve an overallocated system where a market system or similar mechanism like that proposed in Diamond Valley could be the means of bringing the basin back into balance and sustaining ecological values dependent on surface flows. Undertaking such pilot projects will be essential to ensuring that, in the event that the market reforms proposed for Diamond Valley are subsequently broadened, the management structure allows for consideration and management of surface water and environmental values.

TNC therefore recommends that the Legislature authorize the State Engineer to:

12. **Develop and Implement Pilot Projects to Increase Water Market Efficiency and Protect the Environment.** In addition to authorities necessary for implementation of the Diamond Valley pilot project, authorize the State Engineer to identify and develop additional pilot projects in hydrologic basins with important groundwater-dependent ecosystems and human uses of surface expressions of groundwater. These pilot projects should be used to test and develop provisional flow standards, predictive modeling, redefined perennial yield, conjunctive management, and Active Management Areas.

F. Increase State Investment in Water Resource Management and Ecosystem Restoration

Proper management of the State's water resources requires data and infrastructure. Informed and effective management requires, at a minimum:

- Water meters to measure usage and enforce rights, and use of remotely sensed imagery
- Surveys of surface water resources and important ecological values
- Ecological models to establish the minimum water requirements of ecosystems and species

[31] However, implementing these allocations in Australia ultimately involved the buy-back of significant quantities of water rights from existing users in order to secure the necessary allocations for environmental users.

- Hydrological and geological studies to identify the characteristics of local aquifer systems, recharge rates, and interconnections between groundwater systems and surface water systems
- Development of predictive models necessary to anticipate the impacts of different groundwater pumping scenarios

All of these elements of water resource management will require funding, as will targeted improvements and buy-backs in overallocated basins. Given the importance of water to Nevada's economy, environment, and way of life, to underfund these management capacities would be penny-wise and pound-foolish. *We recommend that the Legislature request budget information from the State Engineer on the level of resources necessary to manage the State's water resources fully and effectively, and then take action to appropriate the necessary level of funding.*

While this document has focused on critical water law, policy, and management reforms, TNC would be remiss not to point out the critical need for investment in habitat restoration and management. As noted in **Table 1**, past human actions in freshwater systems have left most of these landscapes in poor condition, and their overall trend is downward. In the face of increasing water development pressures and long-term forecasts of hotter and drier conditions, it is imperative not only to include the environment in the water budget but also to invest in habitat restoration and increase the resilience of these ecosystems. The restoration of the lower Truckee River downstream from Truckee Meadows is an example of how targeted restoration investments can yield multiple types of dividends and prepare an ecosystem for the challenges ahead.

TNC therefore recommends that the Legislature:

13. **Increase Appropriations to Fund Necessary Water Management Infrastructure and Habitat Restoration.** Historical levels of funding for the administration of water law and water rights have been inadequate relative to the importance of good water management. The degraded condition of the State's remarkable freshwater ecosystems also calls for an increased investment in habitat restoration, especially to improve ecosystem resilience in the face of growing human demands for water and forecasts of more frequent and extreme drought conditions.

VI. Conclusion

In this document The Nature Conservancy has made the case that effective water management—particularly groundwater management—is critical to the future of the State of Nevada, its natural environment, its economy, its businesses, its residents, and their quality of life. We have provided recommendations that are in line with the views of many stakeholders who have appeared before the Subcommittee to Study Water over the past nine months.

We have elevated groundwater management as the most urgent issue among many other important and worthy water issues. To underline this point, we offer the analogy of prudent

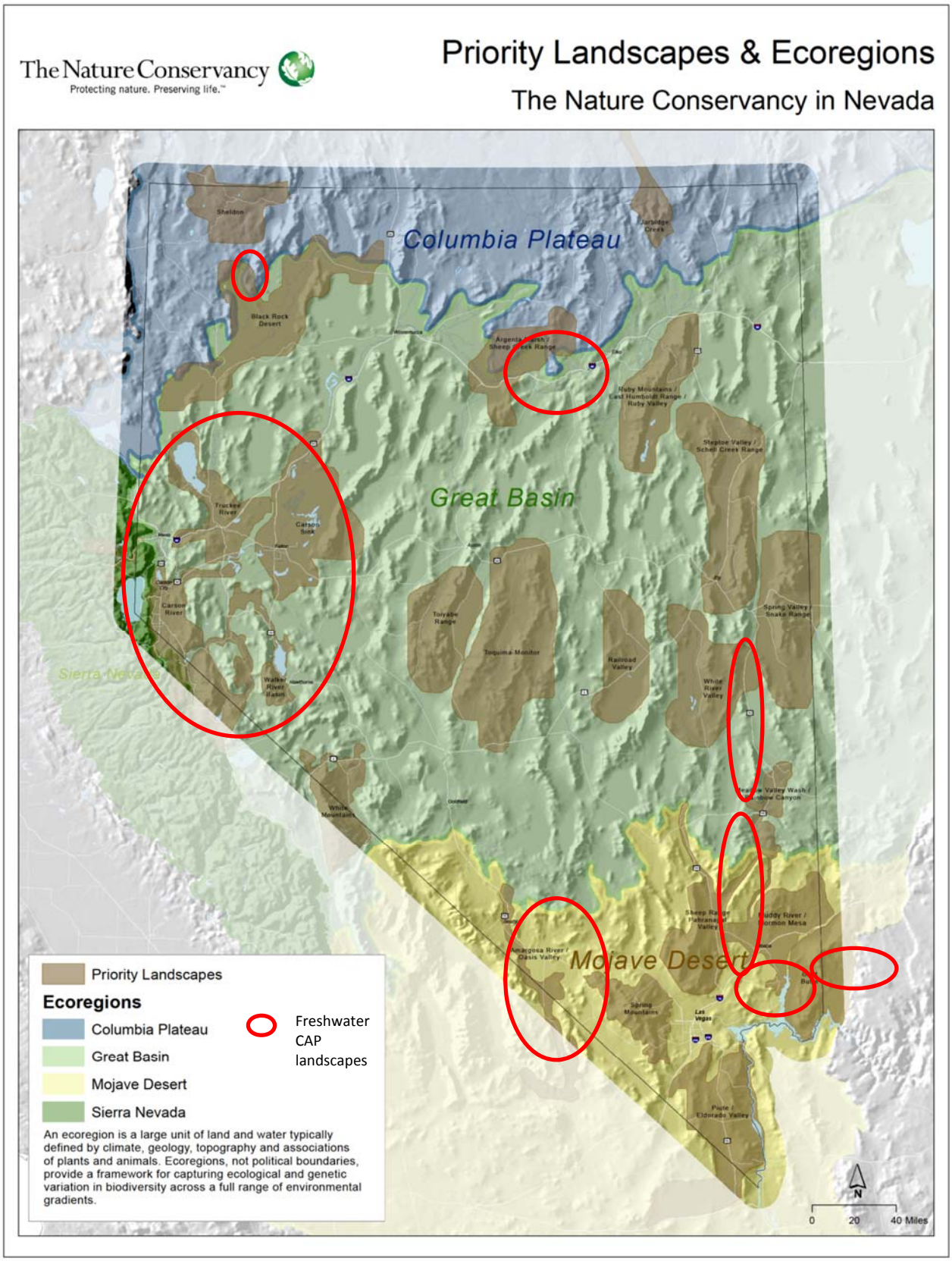
personal finance and retirement planning. The State's groundwater reserves are like the principal of a family's savings, and the annual recharge is similar to the interest on which a family needs to live.

TNC, along with many Nevadans, is firmly convinced that our collective obligation to future generations of Nevadans is not to draw down the principal and not to use more interest—that is, groundwater—than is replenished each year. Half of Nevada's groundwater basins are already drawn down or are at risk of being so, and we know that the full impacts of today's excessive pumping will not be felt for many years. The recommendations we offer are intended to bring Nevada's water usage back into line with a sustainable level of consumption. These recommendations outline a road map for staying within the reality of our water budget.

Too much is at risk to miss this opportunity to steward the water resources on which Nevada's future depends. While TNC understands that implementation of our recommendations may be technically complex and politically challenging, we also believe they are reasonable, balanced, and warranted because of the high stakes. We also believe that if these reforms are administered effectively, their burdens can be fairly distributed among all of the potentially affected stakeholders as well as the natural environment.

We appreciate the Subcommittee's consideration of The Nature Conservancy's recommendations.

Appendix 1


The Nature Conservancy
Protecting nature. Preserving life.™
Priority Landscapes & Ecoregions
The Nature Conservancy in Nevada
Columbia Plateau
Great Basin
Mojave Desert
Sierra Nevada
Priority Landscapes
Ecoregions
Columbia Plateau
Great Basin
Mojave Desert
Sierra Nevada
Freshwater CAP landscapes
An ecoregion is a large unit of land and water typically defined by climate, geology, topography and associations of plants and animals. Ecoregions, not political boundaries, provide a framework for capturing ecological and genetic variation in biodiversity across a full range of environmental gradients.
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Tab K

Diamond Natural Resources Protection and Conservation Association

RECOMMENDATION FOR POSSIBLE CONSIDERATION BY THE LEGISLATIVE COMMISSION'S SUBCOMMITTEE TO STUDY WATER

The Diamond Valley Groundwater Management Plan Advisory Board (DVGMPAB) and the Diamond Natural Resources Protection and Conservation Association (DNRPCA), representing a majority of the Diamond Valley agricultural water users that are currently developing the Diamond Valley Groundwater Management Plan, requests revision of the Nevada Revised Statutes to allow the implementation of a Groundwater Management Plan to address the over-pumping of groundwater in the Diamond Valley Hydrographic Basin – 153, the only basin in the state to be designated as Critical Management Area per NRS – 534.110 (7).

The intent of this request is to change the statute to allow a change in management of the water rights within the Diamond Valley Hydrographic Basin by converting existing water rights to a system that provides maximum management flexibility in efficiently using and trading groundwater. This system would allow groundwater to be flexibly used within Diamond Valley, under a Groundwater Management Plan, with limited restraints on manner of use, place of use, and point of diversion while protecting against forfeiture for non-use and allowing rapid water trading and "banking" of groundwater not used in any given year. The system would have some priority built in where senior rights would receive more water than junior rights. Once the conversion occurs, water pumping will be reduced annually with the intent of reducing groundwater pumping to address long-term sustainability of the water resource. The Groundwater Management Plan currently being developed, as required by NRS 534.037, will provide specific details of the water management system. The Groundwater Management Plan is expected to be submitted to the State Engineer this fall. A specific requirement of this plan is all agricultural and mining wells in Diamond Valley (approximately 200) will be metered using the best available technology that allows instantaneous pumping records to monitor water use.

The recommendation, if implemented, would possibly revise NRS 534.110 (7), NRS 534.037 and NRS 534.120.

Specifically the people making the recommendation on behalf of the above referenced entities are:

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Tab L

Progressive Leadership Alliance of Nevada

August 5, 2016

Recommendation for Possible Consideration by the Legislative Commission's Subcommittee to Study Water

What is the recommendation? What is its intent? What is the problem the recommendation will address?

Recommendations:

- **Require temporary rights for mine dewatering be renewed every five years as with other state permits to ensure groundwater used for mining operations does not infringe unnecessarily on other water uses.** The renewal would involve an assessment of water used in the past 5 years and projections for future use. The recommendation addresses the over-allocation of hydrographic basins due to temporary nature of mine dewatering permits in the state of Nevada.

- **Incorporate effects of mine dewatering, refilling of pit lakes and evaporation in perpetuity into a long-term analysis of the Humboldt River Basin.** This will ensure complete and impartial analysis of the medium to long-term impacts of open-pit mine dewatering and pit lake formation in order to responsibly plan for the future. There is ample evidence to indicate that mine-dewatering is having and will continue to have a significant affect on ground water and river flows in the state.

- **Develop specific language regarding water rights for pit lakes.** The recommendation will clarify confusion regarding the nature of water in pit lakes and allow for regulations on quality and beneficial use. The definition of water in pit lakes is currently unclear thus current permitting and regulation does not satisfy the necessity to protect the health of people and wildlife.

- **Creation of a NRS, or inclusion in reclamation language that already exists, special closure permits for projects proposing very long-term water treatment that is effectively "treatment of water in perpetuity**." This recommendation would protect the state from costly mine clean-ups down the road, and better protect the environment. Nevada is facing numerous mine projects that are likely to propose very long-term treatment of toxic water (mining impacted waters) and there is no process to ensure corporations will fulfill commitments hundreds of years into the future. Newmont's Phoenix project, for example, currently has plans for water treatment for 500 years and beyond.

Background information attached:

Effect of Open Pit Mine Dewatering and Cessation on a Semi-arid River Flows, June 2016
Tom Myers, Ph.D. Hydrologic Consultant
tom_myers@charter.net

Presentation - *Effect of Open Pit Mine Dewatering and Cessation on a Semi-arid River Flows*

Executive Summary: Hydrogeology of the Humboldt River Basin, Impacts of Open-Pit Mine Dewatering and Pit Lake Formation, June 2015

Tom Myers, Ph.D. Hydrologic Consultant
tom_myers@charter.net

Does the recommendation revise one or more current Nevada Revised Statues (NRS)? If "Yes," please provide the reference to the NRS citation(s) affected by the recommendation, if known.

NRS 533.324 - 533.435
NRS 534.110

What group or person is making this recommendation?

Progressive Leadership Alliance of Nevada - Ellen Moore
Great Basin Resource Watch - John Hadder

What is the name and contact information of the person who can provide additional information for the recommendation if necessary?

Ellen Moore
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John Hadder
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