Appendix A

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Investors and Environmentalists
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Rebuttal Comments on SNWA's Evidence Concerning Financing for the Groundwater Development Project Associated with SNWA's Water Rights Applications in Spring, Cave, Dry Lake and Delamar Valleys

Prepared for the Office of the Nevada State Engineer on behalf of the Great Basin Water Network

Submitted by Sharlene Leurig, Senior Manager, Water Infrastructure, Ceres

August 25, 2011

On the basis of my review of the materials submitted on July 1, 2011, by the Southern Nevada Water Authority relating to financing for its Groundwater Development Project in connection with the above-mentioned applications, and on the basis of my work with Ceres on water infrastructure financing, as reflected in the report titled The Ripple Effect: Water Risk in the Municipal Bond Market, I have prepared the following review and response to financing material submitted by the Southern Nevada Water Authority (SNWA). We are submitting this information to be considered in the Nevada State Engineer's review of the Southern Nevada Water Authority's applications for water rights in Spring, Cave, Dry Lake and Delamar Valleys.

Ceres leads a national coalition of investors, environmental organizations and other public interest groups working with companies to address sustainability challenges such as global climate change and water scarcity. For more on Ceres, see http://www.ceres.org.

The Investor Network on Climate Risk (INCR), a project of Ceres, supports 100 institutional investors with assets totaling $10 trillion by identifying the financial opportunities and risks in climate change and by tackling the policy and governance issues that impede investor progress toward more sustainable capital markets. For more on INCR, see http://www.ceres.org/incr.

In October 2010, Ceres issued a study on water risks that may affect the valuation and performance of long-term bonds issued by public water authorities to build and maintain their capital assets. The report, *The Ripple Effect: Water Risk in the Municipal Bond Market*, can be found at www.ceres.org/resources/reports/water-bonds/view.

The report revealed trends of relevance to the long-term water security of the State of Nevada and the continued creditworthiness of the Southern Nevada Water Authority along with its members and joint issuers. Those trends are discussed below.

Key Trends

Rising regional demand for water is colliding with less reliable supplies, with the potential to make utility balance sheets more volatile. In many parts of the United States, utilities are facing water supply constrictions that create revenue challenges. Emerging risks fall into two basic categories:

- **Physical factors**, including *quantity* reductions due to drought or drawdown by other users and *quality* impairments from pollution or intrusion of salt water driven by excessive groundwater pumping, land subsidence, and sea level rise, and
- **Regulatory factors**, including changing allocations of water rights among users, preservation of environmental flows to protect endangered or threatened species, or quality standards that impose additional costs or limit use of a water resource.

Climate change is expected to exacerbate both physical extremes and regulatory responses intended to protect water supplies for human uses and threatened species.

SNWA is developing its long-term plan to diversify supplies driven by awareness of these risks within its own portfolio and within the portfolios of water utilities drawing from the same water resources. Yet it is worth considering whether the Importation Project proposed by SNWA is resilient or vulnerable to these very risks.

While these emerging water risks can damage the value of investors' public utility assets, many of these risks remain invisible in the present marketplace. Increased resource competition, more intense droughts, and regulations to ensure reliable water supplies are all likely to translate into additional capital expenditures and increased operating costs for already highly-leveraged utilities. In the most extreme cases, emerging water risks may force capital assets into early retirement or saddle utilities with stranded assets. Any of these scenarios may impair a utility's liquidity, undermining its ability to honor debt obligations to investors. Yet today's utility disclosure and credit analysis fails to consistently incorporate these trends, placing investors at risk.

Investors will increasingly have access to information on water risks, including over-abstraction and legal challenges. As investors make movements to identify hidden risks in traditionally stable markets like municipal bonds, financial intermediaries and specialized consultancies will bring more data tools to the market to enable credit risk assessment. An example is the Aqueduct Alliance, a project of the World Resources Institute with support from Goldman Sachs, Dow Chemical, Coca-Cola, General Electric, Bloomberg, and United Technologies. The Alliance will make freely available a database for users to assess water availability in stressed river basins, including the Colorado River. Its metrics incorporate hydrological data along with social, economic and governance conditions in specific regions. These sorts of tools are likely to shift investor risk perceptions in the public finance markets. In turn, more water utilities may seek to make available enhanced performance and financial data to remain competitive in a market that will increasingly price in these risks.

SNWA's ability to implement its plan in part depends upon its ability to continue its practice of refinancing debt, which hinges on market perception of its creditworthiness. Like many systems, SNWA has managed cash flows by refinancing existing debt to take advantage of lower interest rates. This approach also allows SNWA to smooth out rate increases, yet even so water rates have increased significantly in recent years. The feasibility of the Importation Project hinges on future refinancing of SNWA's debt, as described in Appendix D of SNWA's *Ability to Finance Report*. The assumptions behind SNWA's refinancing plan include 1) preservation of current market rates, which are at all-time lows unlikely to be sustained throughout the lifetime of the required debt, and 2) sustained market perception of SNWA as a good credit. Over the lifetime of the debt that SNWA will be obligated to service for the Importation Project, it is likely that markets will more aggressively price in factors like energy intensity of water provided, legal threats from human users or endangered species, and potential conflict between wholesale providers and retail customers, trends described in more detail below. To the extent that the Importation Project disadvantages SNWA in these regards compared to other credits on the market, SNWA's cost of capital is likely to increase and the cash flow benefits of refinancing may diminish.

Transporting water from water-rich to water-poor regions is an energy-intensive practice that makes regional economies vulnerable to energy price volatility. Beyond the high construction costs that accompany conveyance projects like the Importation Project, these systems frequently have significant operating costs through their exposure to volatile energy prices. The compounded effects of high construction and operating costs may reduce issuer liquidity, straining utility capacity to honor existing and future debt obligations. The assumed increase in energy costs over the life of the debt obligations is not clear in SNWA's *Ability to Finance Report*.

Supply projects with high marginal costs can limit a utility's financial flexibility, leaving it unable to adjust to future changes in supply, demand, or

governance structure. If this forces water rates past a certain point, regional economic competitiveness may be compromised. Capital projects are financed on the expectation that revenues in the service area will grow or stay fixed over the lifetime of debt service. While utilities can set rate structures that allow them to simultaneously grow revenue and suppress consumption, decoupling revenue streams from increasing gallons delivered, debt repayment for high-capital supply projects can pin utility financial health to high-population and consumption growth.

Differences between projected and actual consumption growth can result in lower debt service coverage unless utilities increase rates. In Southern Nevada, as in other areas of the country, rates and water-related charges have had to adjust upward significantly to make up for unrealized growth stymied by the economic downturn. If the debt obligations incurred by the Importation Project are high enough, the pressure on water rates and charges can compromise the affordability of water, along with regional economic competitiveness.

The projected monthly water bill of $59.30 for plans not including the Importation Project (page 33 of the *Ability to Finance Report*) already far exceeds present household costs in Las Vegas or other cities. Yet as SNWA projects, the rate increase that may be required to repay even SNWA's conservative estimated total -- $7.283 billion in expected debt that would be assumed to undertake the Importation Project—to $90.62 per month for the average household—is nearly three times the average bill of a residential customer in its service area today.

SNWA has pledged to set rates to maintain debt service coverage of 1.00 times revenues. This target, along with the projected debt service coverage including obligations from implementing the plan, is considerably lower than the 10-year historic minimum of 2.69 times annual debt service (page 29 of *Ability to Finance Report)*. Such a slim ratio provides very little financial flexibility for SNWA to pursue other necessary investments if actual water delivered falls below expectations or if other pressures arise elsewhere in the system.

Relying on growth to pay for system reliability is fundamentally unsustainable. For the past decade, SNWA has depended on regional connection charges to service debt obligations. As noted in the SNWA finance report, the burst of the housing bubble caused revenue from connection charges to decline by more than 97% from its 2006 level, as measured by 2010 figures. While economic recovery may revive housing starts in Southern Nevada, such recovery is not on the near-term horizon, and there is nothing to preclude future volatility of similar magnitude. Like all water providers, it is essential that SNWA restrict capital expenditures to what can be recovered through sustainable and consistent revenue sources.

Per capita urban water demand has consistently declined for decades, a trend that is expected to persist. Per capita urban water use has consistently declined across the United States, including in Southern Nevada. In part this is due to efforts by water providers like SNWA to encourage water conservation and efficiency. Conservation and efficiency programs can actually hold total demand constant even as population increases, as shown by historical water demand in Southern California. The declining demand trend is exacerbated by increasing water rates. Declining per capita use presents a challenge to utilities such as SNWA, as it can diminish the revenue secured through water rates. Because demand for water is elastic, capital projects that significantly increase water rates can actually reduce revenues from water rates. While a number of utilities are testing rate structures that can cover fixed costs even in the face of declining water sales, cost recovery and revenue stabilization under declining demand projections remains a significant challenge across the country. Yet in developing its financing assumptions, SNWA assumes that the per capita consumption level of 69,097 gallons per year will remain constant going forward (page 37 of *Ability to Finance Report).* This deterministic approach does not provide much insight into the range of possible rate increases that may be necessitated if water demand fails to meet SNWA's projections, nor the size of the potential burden that could be transferred to other consumers or residents who do not directly benefit from the proposed project.

Retail providers are not necessarily bound to purchase water from their wholesale provider, creating credit risk for the wholesale entity. While wholesale water providers can provide significant economies of scale for their member agencies, the confluence of increasing costs of wholesale water systems and evolving water treatment technologies can lead member agencies to develop alternative sources. When member agencies are not required to assume the debt obligations of their wholesale providers or to purchase water over the lifetime of the wholesale entity's debt obligations, this poses a credit risk to the wholesale entity. Metropolitan Water District of Southern California is a case in point. Since 2008, MWD's water sales have declined 32%, while its rates have increased by 55%. One of MWD's largest members, Los Angeles Department of Water and Power, plans to reduce its reliance on MWD's water by nearly 50%.[1] Many other member agencies are pursuing development of their own water sources.

Although SNWA is younger than its southern California counterpart, the dynamics of increasing water costs, declining demand and changing opportunities for local water production and treatment provide a view of a possible future against which the

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[1] San Diego County Water Authority, "What We Need in a Bay-Delta Fix: A Perspective by MWD's Largest Customer," Presentation, May 11, 2011, http://org2.democracyinaction.org/dia/track.jsp?v=2&c=BmTOoeS5YbMbjJ78rnEfviImzCkpt1W%2F

authority should plan. Already without necessary investments in the third Lake Mead intake pipe or other proposals advanced in the MCCP, SNWA has had to increase commodity charges six-fold from 2000-2011 (page 20 of the *Ability to Finance Report*) and water rates more than 40% since 2002 (page 19 of *Ability to Finance Report*). The anticipated rate increases are significant enough to consider whether SNWA's member agencies may seek alternative and more cost-effective sources.

Key Questions

As the State Engineer considers the feasibility of the Importation Project, several questions should be considered:

- **Is the project adaptive?**
  - If climate variability and climate change intensify pressure on other users or endangered species, is the project adaptive to legal barriers?
- **Will the project make SNWA and its joint issuers more resilient or less?**
  - If the project falls short of its projected service delivery—whether from physical or legal pressures—what flexibility would SNWA have in pursuing other resources, given the expected debt obligations the project entails?
- **How likely is it that the project's costs will be borne by its beneficiaries?**
  - If demand declines or fails to meet the anticipated growth rate, whether from slower population growth or behavioral change, can the cost of the SNWA pipeline feasibly be internalized by the rate base? What is the possible burden that could be placed on the state as a whole to make the revenue shortfall?
  - If the cost of the project increases SNWA's costs relative to other sources, do its members have the ability to opt out? How would SNWA recover costs under such a scenario?

As the preceding discussion indicates, the assumptions behind SNWA's financial analysis should not be taken as representing the most likely economic or market conditions. The sensitivity of the Importation Project's cash flows to water demand, refinancing conditions and the other dynamics discussed herein should be assessed in order to ensure the continued financial strength of the parties involved and the enhanced flexibility and security of Nevada's water infrastructure.

Appendix B

Rebuttal Report on Water-Use Efficiency in the Las Vegas Area

August 25, 2011

Prepared for the Office of the Nevada State Engineer
on behalf of
Great Basin Water Network

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August 25, 2011

Peter Gleick

Introduction

This rebuttal report revisits the points made in my June report, taking into account the materials submitted by the Southern Nevada Water Authority (SNWA) on July 1, 2011, relating to water conservation, water use efficiency and the purported need for the groundwater development project associated with SNWA's water rights applications in Spring, Cave, Dry Lake and Delamar Valleys.

The Las Vegas Valley has been one of the fastest growing regions in the United States, although the recent economic downturn has greatly reduced growth rates. To meet projected long-term water demand, the regional water authority, SNWA, is pursuing a range of options, including the development of additional in-state resources in the form of surface water from the Muddy and Virgin Rivers and groundwater from counties north and east of Las Vegas. One such proposal consists of building a 300-mile pipeline to move groundwater from five valleys, including Snake Valley, which spans the Nevada-Utah border. Acquisition of these resources is already creating social and political tension throughout Nevada and bordering states, particularly Utah. The environmental and economic implications of these projects may also be high.

Conservation and efficiency efforts have reduced Las Vegas per-capita demand in recent years, from 315 gallons per capita per day (gpcd) in 2000 to 223 gpcd in 2010 but despite these efforts the Las Vegas Valley still has much higher than average per-capita water use than most of the western United States, suggesting that significant cost-effective conservation potential still remains. An estimated 60 percent of all water used in SNWA's service area is applied outdoors.

The Pacific Institute is one of the nation's leading independent research centers for assessing water conservation and efficiency potential. In this analysis, the Pacific Institute evaluates water demand projections and conservation and efficiency efforts in SNWA's service area. The analysis reveals the following:

- Long-term planning efforts fail to include substantial conservation improvements that have been successfully and economically implemented widely in other western arid cities, and thus appear to overestimate future demand.

- Given recent economic and demographic trends, the population projections used for the water demand projections now appear too high, thereby further overestimating future demand.

- Las Vegas could significantly expand efforts to reduce inefficient and wasteful water use.

- Cost-effective water conservation and efficiency improvements in Las Vegas can defer or eliminate the need for new water supply facilities and investments.

- Increased indoor and outdoor water-use efficiency improves the reliability of the existing supply and does not result in so-called "demand hardening."

Per Capita Water Use is Declining But More Can Be Done

Recent reductions in per capita demand suggest that while water agencies in Southern Nevada have made significant water-use efficiency improvements over the past thirty years, far more can and should be done.[1] In 1990, per capita demand was 347 gpcd. By 2000, demand had declined to 315 gpcd. By 2010, per capita water use in SNWA's service area had fallen to 223 gpcd,[2] a dramatic reduction from the extremely high rate of 1990. The current goal, which drives future water demand projections, is to reduce water demand to 199 gpcd by 2035, still substantially above average for cities in similar climates. As shown by the trend line in Figure 1, the current goal is very unambitious and suggests a significant retreat from trends over the past 20 years.

SNWA's per capita demand has declined more quickly than that most other agencies within the Colorado River Basin. However, absolute per capita demand remains significantly higher than the median per capita demand (180 gpcd in 2008) for these agencies.[3] Denver, Phoenix, and

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[1] Per capita demand trends over time should be viewed with some caution, as changes in the level and type of industry, income, the mix of single-family and multi-family homes may affect per capita demand.
[2] SNWA. 2011. SNWA's Conservation Program. Presentation to the Office of the Nevada State Engineer.
[3] Cohen, MJ. 2011. *Municipal Deliveries of Colorado River Basin Water*. Pacific Institute. Oakland, California.

Tucson, for example, already have much lower per capita demand today than SNWA is projecting for its service area in 2035 – more than two decades from now.

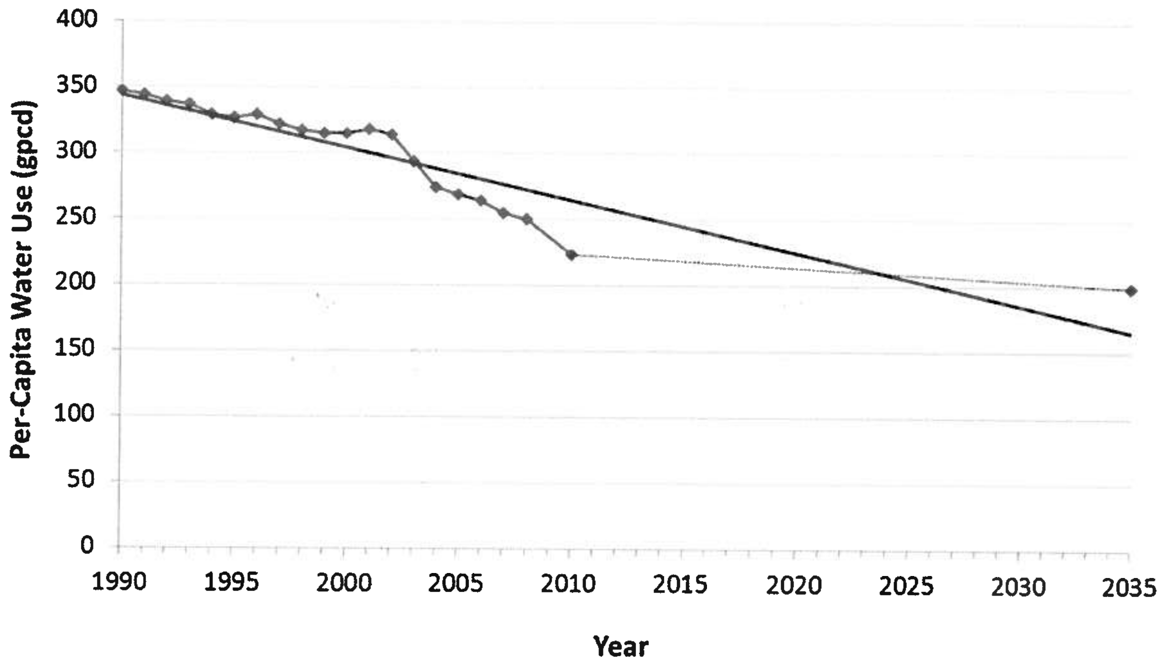

Figure 1. Per Capita Demand in the Southern Nevada Water Authority Service Area, 1990–2035.
Note: 1990 to 2010 reflect actual data. The value for 2035 represents the SNWA projections.
Source: Southern Nevada Water Authority. 2009. Appendix C in Conservation Plan: 2009-2013. Las Vegas, Nevada.

Reliance on Return Flow Credits Inflates Future Demand Projections

SNWA earns return flow credits for treated wastewater that is returned to Lake Mead via the Las Vegas Wash. These return flow credits allow SNWA to withdraw water in excess of Nevada's 300,000 acre-feet basic consumptive use apportionment from the Colorado River. Because SNWA receives credit for return flows, it has long argued that any water-efficiency improvement that reduces indoor, non-consumptive water demand reduces return flow credits and thus does not increase Southern Nevada's water resource portfolio. This argument, however, ignores six points. Increasing indoor water-use efficiency:

- permits more people to be served with the same volume of water, without affecting return flows;

- reduces dependence on water sources vulnerable to drought and political conflict;

- delays or eliminates the need for significant capital investment to expand conveyance and treatment infrastructure;

- reduces energy and chemical costs associated with pumping water from Lake Mead, treating it for use, transporting it, and treating it again as wastewater;

- reduces energy-related greenhouse gas emissions; and

- saves the customer money over the life of those improvements through reductions in energy, water, and wastewater bills.

Furthermore, SNWA projects future water demand based on total deliveries rather than consumptive use. Thus, both excessive use of water for return flow credits and projections based on delivery rather than actual consumption, inflate water demand estimates. These demand estimates are then used to justify the development of new water supplies. Reductions in indoor water demand thus represent a real savings based on SNWA's own demand projections and can help delay or defer the need to develop new, expensive water resources.

Additional Effort is Needed to Expand Indoor Conservation Efforts

According to their Water Conservation Plan, "SNWA has developed and implemented one of the most progressive and comprehensive water conservation programs in the nation."[4] Yet as noted above, water conservation efforts in Las Vegas largely ignore the potential for indoor efficiency improvements, particularly for single-family homes. Those measures targeting indoor water waste have been poorly implemented. While many water agencies in the western United States offer homeowners rebates and other incentives to replace wasteful fixtures and appliances with

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[4] Southern Nevada Water Authority. 2009. Conservation Plan: 2009 – 2013. Las Vegas, Nevada.

more efficient models, these incentives are not available to many Las Vegas residents. The Water Efficient Technologies (W.E.T.) Program provides rebates for some efficient appliances to multi-family, commercial, and industrial customers, but only 29 projects are currently enrolled in the program.[5] Expanding indoor efficiency efforts and improving implementation could provide substantial water and energy savings.

Recent conservation assessments indicate that there are a substantial number of cost-effective technologies that can dramatically reduce residential water demand – both indoor and outdoor – to levels far below those projected for SNWA service area. For example, a 1997 study by the American Water Works Association (AWWA) found that conservation could reduce indoor water use from an average of 65 gpcd to 45 gpcd for single-family homes, a savings of over 30 percent.[6] The largest reductions were realized by replacing inefficient toilets and clothes washers with more efficient models and reducing leaks.

Similarly, a 2000 Seattle study found that conservation and efficiency could substantially reduce indoor water use. Installing new, water-efficient fixtures and appliances reduced single-family indoor water use from 64 gpcd to 40 gpcd, a savings of nearly 40 percent. Again, the largest reductions were achieved by installing efficient toilets and clothes washers. Further, homeowners rated the performance, maintenance, and appearance of the efficient appliances higher than the older appliances.[7] It is of note that these studies were completed 6–10 years ago and do not include newer, more efficient appliances, such as dual-flush toilets, that would reduce per capita demand even further.

Furthermore, other conservation assessments have concluded that there is significant water savings in the non-residential sector. A 2004 report by the Pacific Institute finds that existing, cost-effective technologies could reduce California's current (2000) water use for the non-residential sector by 26 percent. Savings vary by industry, but are largest for schools, office buildings, golf courses, retail stores, and restaurants. Recirculating cooling towers, x-ray water recycling units, and restaurant pre-rinse spray valves are among a few of the most promising

[5] Southern Nevada Water Authority. 2010. 2010 Annual Report. Las Vegas, Nevada.
[6] AWWA WaterWiser. 1997. Residential Water Use Summary – Typical Single Family Home.
[7] Mayer, P.W., W.B. DeOreo, and D.M. Lewis. 2000. Seattle Home Water Conservation Study: The Impacts of High Efficiency Plumbing Fixture Retrofits in Single-Family Homes. Aquacraft, Inc. Water Engineering and Management.

technologies.[8] Similarly, the Santa Clara Valley Water District , a water agency serving communities along the southern edge of the San Francisco Bay, commissioned a survey of 26 commercial, industrial, and institutional facilities and found that water conservation measures could reduce water use by 38 percent.[9]

Outdoor water savings potential is also large. While estimates for efficient outdoor water demand will vary regionally according to local climate, reducing Las Vegas' outdoor water demand to the levels achieved in Tucson or Albuquerque, e.g., 57 and 42 gpcd, respectively, could cut consumptive use substantially. While some progress has been made by SNWA in outdoor residential and commercial water efficiency improvements, far more can be done. Recent ordinances in the Las Vegas area prohibiting turf in front yards and limiting turf in backyards in new developments will help reduce overall outdoor water demand in coming years, and could be expanded to gradually apply to existing homes (upon resale, for example). Furthermore, existing, cost-effective technologies can reduce demand from the non-residential sector by 25 percent to 40 percent.[10,11] In summary, significant indoor and outdoor conservation potential exists for the Las Vegas Valley.

Population Projections Overestimate Future Water Demand

Future water demand and use depend on many factors. One of the most important and influential is the size of the population that will have to be served. Population and water demand in SNWA's service area have grown tremendously since 1990 but future population remains uncertain. The 2009 Water Resource Plan forecasts water demands based on the June 2008 Clark County Population Forecast prepared by the University of Nevada Las Vegas Center for

[8] Gleick, P.H., D. Haasz, C. Henges-Jeck, V. Srinivasan, G. Wolff, K. Cushing, and A. Mann. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California." Pacific Institute for Studies in Development, Environment, and Security. Oakland, California.

[9] Pollution Prevention International, Inc. 2004. Commercial, Institutional, and Industrial Water Use Survey Program: Final Report. Prepared for the Santa Clara Valley Water District. http://www.cuwcc.org/uploads/tech_docs/CII_H2OUse_Survey_Prgrm_Final_Rpt_04-05-25.pdf

[10] Gleick, P.H., D. Haasz, C. Henges-Jeck, V. Srinivasan, G. Wolff, K. Cushing, and A. Mann. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California." Pacific Institute for Studies in Development, Environment, and Security. Oakland, California.

[11] Pollution Prevention International, Inc. 2004. Commercial, Institutional, and Industrial Water Use Survey Program: Final Report. Prepared for the Santa Clara Valley Water District. http://www.cuwcc.org/uploads/tech_docs/CII_H2OUse_Survey_Prgrm_Final_Rpt_04-05-25.pdf

Business and Economic Research (CBER). In 2007, an estimated 2.0 million people lived in Clark County. According to CBER, the population within Clark County was projected to reach an estimated 3.65 million people by 2035.[12] Based on this forecast, SNWA projects that water demand will increase by nearly 34 percent during this period, from an estimated 553,000 acre-feet per year in 2010 to 739,000 acre-feet per year in 2035.

More recent analyses suggest that the population assumptions in the 2009 Water Resource Plan are significantly higher than are likely to materialize and that this assumption alone has a large influence on future water demand projections. Newer population projections released by CBER in June 2009 and again in June 2010 project that the Clark County population will reach 3.13 million people by 2035, about half a million fewer people than was the basis of the 2009 Water Resource Plan.[13,14] If we assume that per capita demand in 2035 is 199 gallons per person per day and that about 97 percent of the population in Clark County is served by SNWA and its member agencies, then 500,000 fewer people in the region would reduce water demand within SNWA's service area by about 100,000 acre-feet per year. This dramatic result alone strongly suggests the need for a re-evaluation with another, more realistic population projection.

Furthermore, combining reductions in both projected population ***and*** per capita demand may completely eliminate the need for the new supplies. If SNWA reduced per capita demand to about 166 gpcd – higher than Los Angeles's *current* rate, and comparable to the *current* delivery rates of Albuquerque and Phoenix – by the year 2035, and population within Clark County grows to 3.13 million people instead of 3.65 million,[15] total water demand in SNWA's service area would be about the same as it is now.

The recent economic downturn has resulted in a significant reduction in future population, and thus water demand. When and how the region will recover is not known. Rising temperatures

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[12] "Clark County Nevada Population Forecast 2008-2035," June 2008, Center for Business and Economic Research (CBER) at the University of Nevada, Las Vegas.
[13] Center for Business and Economic Research (CBER). 2009. Population Forecasts: Long-Term Projections for Clark County, Nevada: 2009 – 2050. University of Nevada, Las Vegas.
[14] Center for Business and Economic Research (CBER). 2010. Population Forecasts: Long-Term Projections for Clark County, Nevada: 2009 – 2050. University of Nevada, Las Vegas.
[15] We assume that SNWA and its member agencies provide water to about 97 percent of the population of Clark County.

and changes in precipitation patterns resulting from climate change will also affect water supplies and demand. Given this uncertainty, it is wise to consider pursuing water supplies or demand management options that can be expanded incrementally. Unlike most other water supply options, water conservation and efficiency can be expanded when water demand pressures are high and relaxed when demand pressures subside.

Significant Conservation Potential Remains in the Las Vegas Valley

While per capita demand comparisons can be extremely valuable in gauging an agency's performance in promoting water conservation and efficiency and evaluating the strengths and weaknesses of a city's water conservation efforts, they also have limitations.[16] Per capita demand, for example, is affected by a variety of factors, including the level and type of industry, income, climate, and mix of single-family and multi-family homes. Thus, a city with a high degree of water-intensive industrial or commercial development would tend to have a higher per capita demand than a largely residential city. Likewise, a city in a hot, dry climate, like Las Vegas, would likely have higher outdoor demand requirements than a city in a cool, wet climate, all other things being equal.

An end-use analysis, which evaluates the potential savings for every water use within a given region, provides a means to evaluate the conservation potential. A 2007 analysis by the Pacific Institute found that water demand in Las Vegas is substantially higher than in many other western communities. While data limitations prevented a full end-use analysis of all water users in the Las Vegas Valley, our review of single-family residential customers, hotels, and casinos indicates that installing water-efficient fixtures and appliances could reduce current *indoor* water demand by 40 percent in single-family homes and nearly 30 percent in hotels and casinos. Installing water-efficient landscapes could further reduce current *outdoor* demand by 40 percent in single-family homes. In total, water conservation and efficiency improvements for just these three sectors could reduce current water diversions by more than 86,000 acre-feet per year. While behavioral changes and efforts in other water-using sectors can produce even greater reductions, these were not included in the 2007 Pacific Institute analysis, but they are often

[16] Cooley, H., T. Hutchins-Cabibi, M. Cohen, P.H. Gleick, and M. Heberger. 2007. Hidden Oasis: Water Conservation and Efficiency in Las Vegas. Pacific Institute and Western Resource Advocates.

included in the conservation portfolios of western municipal water agencies and should be evaluated for SNWA.

Demand Hardening

Both the 2009 Water Resource Plan and the 2009 Conservation Plan raise concerns about demand hardening. Specifically, the report states that

> "While conservation is an important water management tool, the more aggressive and responsive a community is to calls for conservation, the more difficult it becomes to realize additional conservation gains. This phenomenon of diminishing returns is referred to as 'demand hardening.' For communities where a majority of the water supply comes from one source (such as Southern Nevada), the prospect of demand hardening requires development of additional alternative water supplies regardless of conservation levels achieved" (SNWA 2009).

Demand hardening refers to the concern that implementation of short term drought response measures may be ineffective if permanent water-use efficiency measures have previously been employed. Some water planners, including SNWA, argue that extensive conservation removes the slack in the system, hindering their ability to reduce demand in the event of a water shortage.

Demand hardening could be a concern for water providers in certain situations, but its importance has been overstated.[17,18] The demand hardening argument ignores a number of key points:

- Most providers can use a significant portion of water they conserve to serve new customers without harming reliability, provided that the overall demand does not increase during a shortage.

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[17] Chesnutt, T., D. Pekelney, and D. Mitchell. (1997). Valuing Conservation. Proceedings of AWWA Annual Conference, 1997, Atlanta, GA. American Water Works Association.
[18] Howe, C.W. and C. Goemans. (2007). The Simple Analytics of Demand Hardening. Journal of the American Water Works Association, October 2007, Volume 99 Number 10.

- Customers who participate in long-term conservation measures and reduce their demand through technological improvements, such as low-flow toilets and efficient clothes washers, can still reduce their water use through behavioral changes during a shortage.[19]

- The technologies and economics of water-use efficiency are constantly changing. New, more efficient technologies are coming on to the market, and the price of those that are already on the market is dropping, thereby continuing to expand the cost-effective conservation savings potential of existing and new customers.

- For many water providers, conservation allows more water to be kept in storage (either in reservoirs or in aquifers underground), thereby reducing the risk and potential impacts of drought.

Furthermore, a recent AWWA article notes the economic pitfalls of relying upon the demand hardening concept: "to ignore long-term conservation benefits and to build excess water supply capacity simply to facilitate cutbacks during drought can be highly uneconomical."[20]

Conclusions

Our analysis concludes that there are a number of flaws with current water planning efforts in the SNWA service area that overestimate future water demand and underestimate the importance of conservation and efficiency, including the failure to incorporate cost-effective conservation improvements, the use of outdated population projections, and the concern about "demand hardening." As a clear example of this, simple forecasts that use more up-to-date population projections and a per capita water demand target of 166 gpcd (lower than the current SNWA estimate but well in line with current practice in most western, arid-climate cities, total water demand in SNWA's service area would be about the same as it is now. This approach would delay or even eliminate the need for new water supplies, with substantially lower economic and

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[19] Mayer, P., D. Little, and A. Ward. (2006). System Reliability and Demand Hardening. Colorado Statewide Water Supply initiative, Conservation and Efficiency Technical Roundtable, March 2006.
[20] Howe, C.W. and C. Goemans. (2007). The Simple Analytics of Demand Hardening. Journal of the American Water Works Association, October 2007, Volume 99 Number 10.

political risks. These factors deserve equal consideration in any long-term water planning strategy.

Appendix C

Comments to BLM DEIS

Section 3.7 (Aquatic Biological Resources and Appendix F3.7) of the Clark, Lincoln, and White Pine Counties Groundwater Development Project DEIS completed by BLM is a thorough examination and evaluation of the probable effects of the proposed project on aquatic biological resources within the area of impact. The area of impact is defined by a groundwater model used for analysis of the project. The groundwater model used by BLM estimates impacts over a smaller geographic area than is estimated by other models that have been used to examine this problem (Elliott et al. 2006, Myers 2006, 2007, 2011a,b, Schaefer and Harrill 1995). This suggests that the very serious impacts to Aquatic Biological Resources described in the DEIS may be considerably understated. The EIS should address the issue of underestimating the geographic area over which impacts may occur.

The effects of the project on Aquatic Biological Resources are controversial enough, and uncertain enough to anticipate a relatively high probability of litigation under provisions of the Endangered Species Act as a consequence of the proposed action. The EIS should evaluate the consequences (i.e. construction delays, increased costs) of this kind of litigation. In addition, the EIS should evaluate the high probability that the proposed action and all the alternatives (including Alternative A) are likely to result in violations of Federal law (Endangered Species Act).

The DEIS recommends using Alternative A (including the mitigation and monitoring identified in Chapter 3) as a starting point in reviewing the draft EIS. Alternative A proposes somewhat reduced groundwater pumping and a Monitoring, Management, and Mitigation process representing extensive and comprehensive efforts by SNWA and federal agencies to minimize environmental effects of the groundwater project. The DEIS and numerous other studies, analyses, and scientific papers (e.g. Bredehoeft and Durbin 2009, Deacon et al. 2007, Mayer and Congdon 2007, Patten et al. 2007, Walton 2011, and others) make it obvious that there will be far-reaching, permanent and extensive adverse effects to the Aquatic Biological Resources of the region. While the MMM effort is commendable and may temporarily reduce some impacts to the Aquatic Biological Resources of the region, it is clearly incapable of avoiding or mitigating unacceptable environmental consequences to these Resources. Principal reasons for this are as follows:

1. The MMM (Monitoring, Management, and Mitigation) program is structured so that an Executive Committee comprised of one manager from SNWA and one from each of the DOI (Department of Interior) Bureaus will have final decision-making authority.

This structure ensures that, over the long run decisions will be biased toward delivering water to Las Vegas. This is because the SNWA representatives' primary job responsibility is to deliver water to Las Vegas, while DOI Bureau managers have responsibilities to implement the policies of the federal administration for whom they work. One example of the effect of DOI Bureau managers attempting to discharge their primary responsibilities is that people holding these positions have, in the past, filed protests with the Nevada State Engineer against the SNWA applications for groundwater rights, and under a different federal administration, requested withdrawal of those same protests. The EIS must propose a different final decision-making system for the MMM program, or explain how this inherent structural bias toward delivering water to Las Vegas is to be balanced in a way that will not lead to increased jeopardy for Special Status species, or increased probability that federal (ESA) and state (water law) laws and regulations will not be violated.

2. The Stipulated Agreements governing the MMM program include the following provision: "Any commitment to funding by the DOI bureaus or the SNWA in the stipulation, including specifically any monitoring, management, and mitigation actions provided for in Exhibit A is subject to appropriations by Congress or the governing body of the SNWA as appropriate."

In the present political climate, funding from public sources is under extreme pressure. Long-term survival of the MMM program is therefore highly unlikely. The program as contemplated will make Aquatic Biological Resources in the area of impact increasingly dependent on continuation of the MMM program as the MMM program itself becomes increasingly unlikely to exist. The EIS must acknowledge that fact and explain how it is to be overcome.

3. The MMM program, because of problems described as "Aquifer Response Time" (Walton 2011) or "time to full capture" (Bredehoeft and Durbin 2007), is capable of identifying groundwater supply problems that will get worse downstream in the groundwater flow system. It is not capable of preventing those problems from getting worse. The EIS must explain how the MMM program can overcome this inherent problem stemming from the physics of how groundwater flow systems function.

4. The Aquatic Biology MMM program focuses on Special Status Species and game species. This approach overlooks the numerous recently described species whose status has yet to be evaluated, as well as the numerous as yet undescribed species occurring in the area of impact. Because numerous new species have recently been described from the area of impact, and biodiversity in the area is poorly known, the EIS must explain how the MMM program will deal with species yet to be evaluated or even discovered.

5. Shoshone Ponds in Spring Valley and Big Springs in Snake Valley are two habitats specifically identified as aquatic habitats likely to disappear as a consequence of the proposed action. Alternative A will not change that outcome. Mitigation measures include the possibility of creating alternative or substitute aquatic habitats intended to replace those unavoidably lost. While such a strategy could conceivably be considered appropriate for Shoshone Ponds (an artificial habitat intended to help maintain one or more specific Special Status species), it cannot be considered appropriate for Big Springs. This is because Big Springs is a natural habitat presently supporting a rich biodiversity which includes Special Status species and probably includes some species as yet unrecognized, undescribed, or whose status has yet to be evaluated. The interactions and interdependencies helping to support those Special Status species and

influencing the evolutionary trajectory of all species within that habitat are only incompletely known. At present it is inconceivable to even contemplate developing sufficient knowledge to permit construction of an artificial habitat that would come close to duplicating ecological conditions capable of supporting the biodiversity of any natural habitat/ecosystem. The EIS must recognize this distinction between mitigation for artificial habitats and natural habitats, including recognition of the fact that replacement of natural habitats cannot be accomplished.

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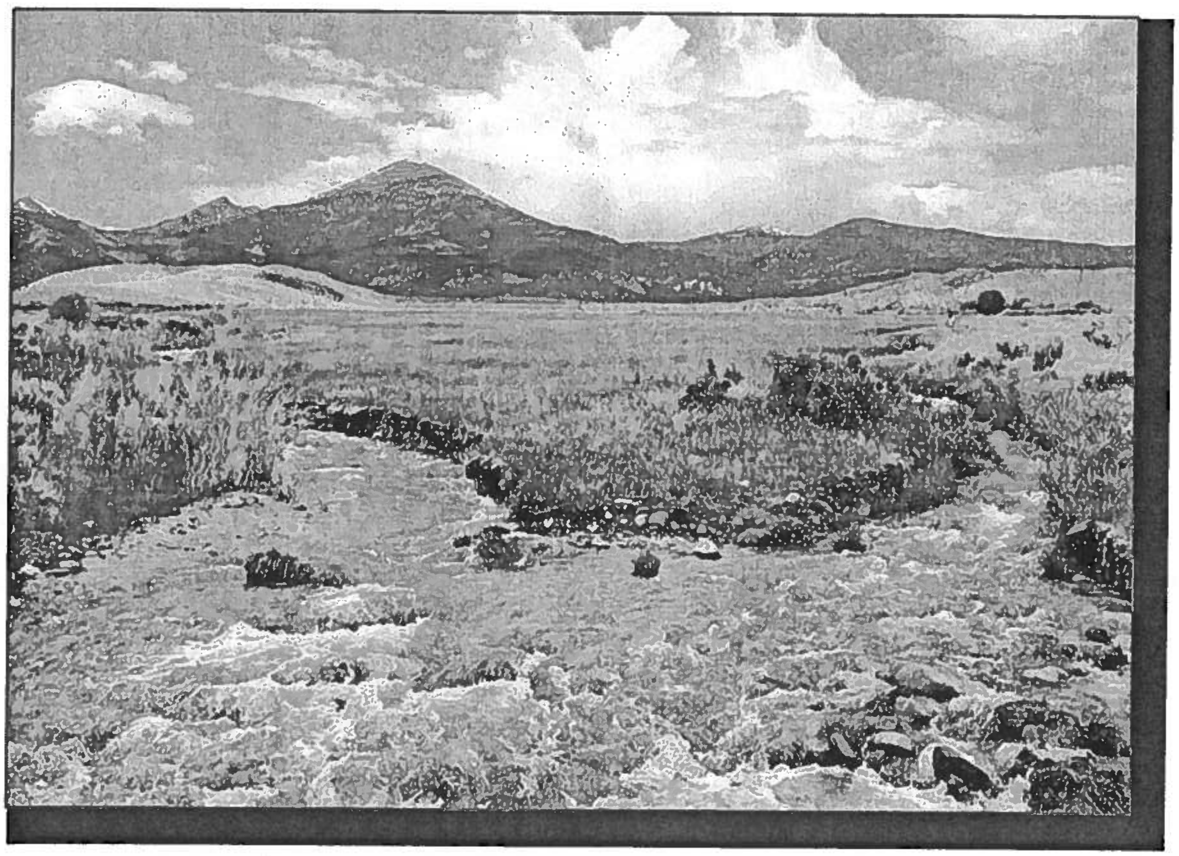
Partial Appendix D

USGS
science for a changing world

Prepared in cooperation with the National Park Service

Characterization of Surface-Water Resources in the Great Basin National Park Area and Their Susceptibility to Ground-Water Withdrawals in Adjacent Valleys, White Pine County, Nevada



Scientific Investigations Report 2006–5099

U.S. Department of the Interior
U.S. Geological Survey

Characterization of Surface-Water Resources in the Great Basin National Park Area and Their Susceptibility to Ground-Water Withdrawals in Adjacent Valleys, White Pine County, Nevada

By Peggy E. Elliott, David A. Beck, and David E. Prudic

Prepared in cooperation with the
National Park Service

Scientific Investigations Report 2006–5099

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Dirk Kempthorne, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

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Contents

Plate

[In pocket]

Figures

Figures — Continued

Tables

Conversion Factors and Datums

Inch/Pound to SI

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per mile [(ft^3/s)/mi]	0.01760	cubic meter per second per kilometer [(m^3/s)/km]
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]
foot (ft)	0.3048	meter (m)
foot per second (ft/s)	0.3048	meter per second (m/s)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8 \times °C)+32.$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C = 0.556(°F-32).$$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Instantaneous discharge is the discharge at a particular instant of time.

Datums

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88). Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD83).

Altitude, as used in this report, refers to distance above the vertical datum.

Characterization of Surface-Water Resources in the Great Basin National Park Area and Their Susceptibility to Ground-Water Withdrawals in Adjacent Valleys, White Pine County, Nevada

By Peggy E. Elliott, David A. Beck, and David E. Prudic

Abstract

Eight drainage basins and one spring within the Great Basin National Park area were monitored continually from October 2002 to September 2004 to quantify stream discharge and assess the natural variability in flow. Mean annual discharge for the stream drainages ranged from 0 cubic feet per second at Decathon Canyon to 9.08 cubic feet per second at Baker Creek. Seasonal variability in streamflow generally was uniform throughout the network. Minimum and maximum mean monthly discharges occurred in February and June, respectively, at all but one of the perennial streamflow sites. Synoptic-discharge, specific-conductance, and water- and air-temperature measurements were collected during the spring, summer, and autumn of 2003 along selected reaches of Strawberry, Shingle, Lehman, Baker, and Snake Creeks, and Big Wash to determine areas where surface-water resources would be susceptible to ground-water withdrawals in adjacent valleys. Comparison of streamflow and water-property data to the geology along each stream indicated areas where surface-water resources likely or potentially would be susceptible to ground-water withdrawals. These areas consist of reaches where streams (1) are in contact with permeable rocks or sediments, or (2) receive water from either spring discharge or ground-water inflow.

Introduction

Great Basin National Park, in east-central Nevada (fig. 1), is home to an abundance of natural resources and scenic attractions. The park encompasses Lehman Caves; Wheeler Peak, the second highest peak in Nevada at 13,063 ft; many glacial features, such as a remnant glacier, a rock glacier, cirques, and tarns; a bristlecone forest; subalpine lakes; as well as abundant wildlife (National Park Service, 1991, 2002; Miller and others, 1995a). Water from streams, springs, and seeps within Great Basin National Park is an important resource that maintains the diverse biological communities, enhances the abundance of geologic features, and provides for park operations.

The water resources of sparsely populated valleys in eastern Nevada and western Utah have received attention as potential sources of supply because of the increased demand for water in distant urban centers, in particular Las Vegas, Nevada. Several water-rights applications, including those filed by Las Vegas Valley Water District and Vidler Water Company, a private water-development firm, currently (2006) are pending before the Nevada State Engineer for large-scale ground-water withdrawals from Spring and Snake Valleys adjacent to the park. Streams, springs, and seeps in the park potentially could be affected because of the close proximity to the pending withdrawals. Any decreases in flow could adversely affect water-dependent biological and geological resources within the park as well as the park's water supply. The National Park Service (NPS) needs information on how the proposed withdrawals might affect water resources important to the park. The U.S. Geological Survey (USGS) is working, in cooperation with the NPS, to assess the park's surface-water resources and determine where the resources are most susceptible to ground-water withdrawals. The information presented in this report will assist NPS in managing and protecting the natural resources that may be affected by proposed ground-water withdrawals outside of the park's boundary.

Purpose and Scope

The purpose of this report is to document the results of a study to characterize surface-water resources in the Great Basin National Park area, and to evaluate the susceptibility of those resources to ground-water withdrawals in adjacent valleys. Characterization of surface-water resources included quantifying the discharge of streams and springs within the study area, and assessing the natural variability of their flow.

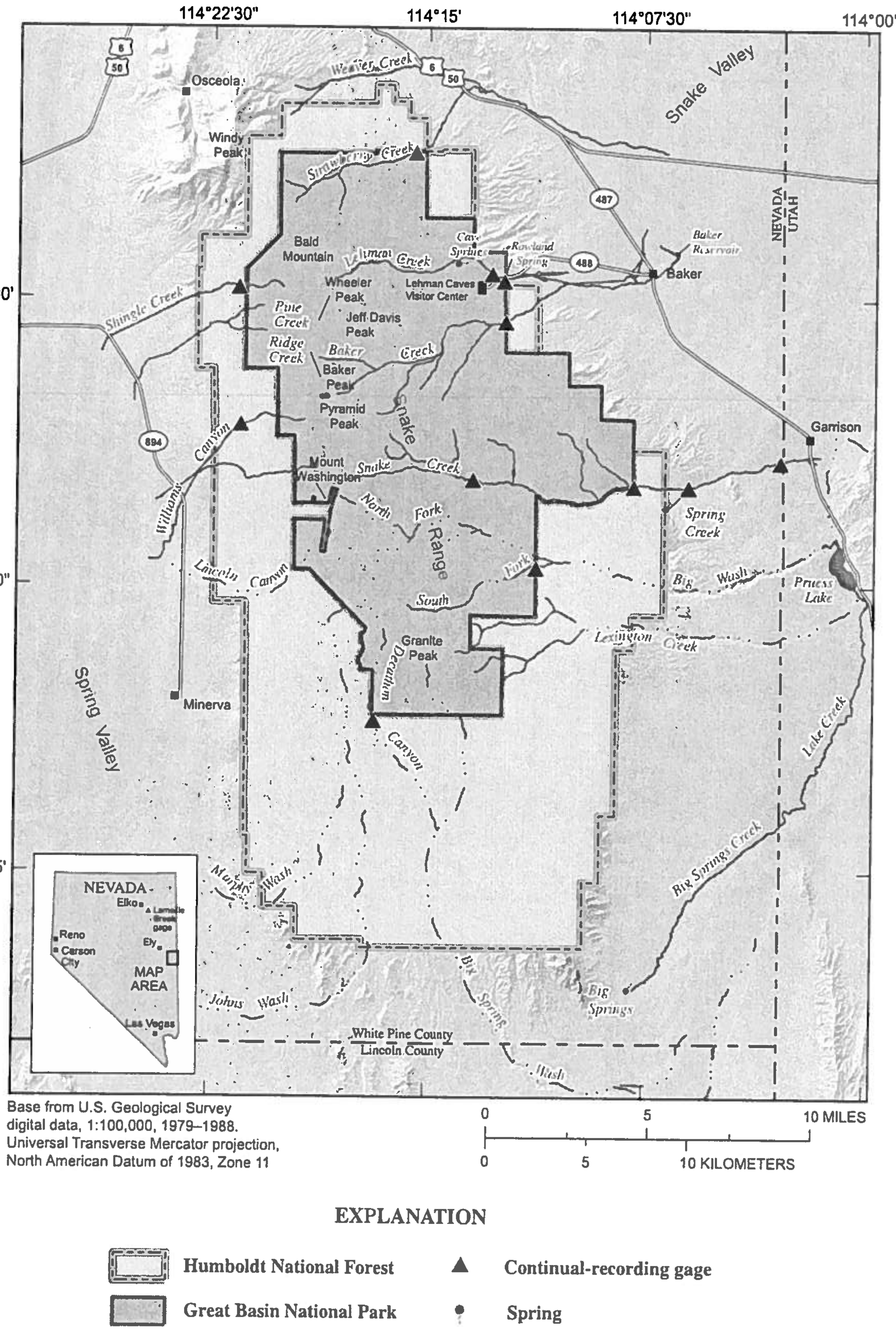

Figure 1. Location of Great Basin National Park, physiographic and geographic features, and continual-recording streamflow gages, White Pine County, Nevada, and Lamoille Creek gage near Elko, Nevada. See inset map for location of Elko, Nevada.

Appendix E

To: Terry Marasco
Silver Jack Inn & LectroLux Cafe
POB 69, Baker NV 89311
POB 69,
Baker NV 89311

From: Thomas A. Cahill
Professor of Physics and Atmospheric Sciences and
Head, DELTA Group

Re: Impacts of water withdrawals

I have considerable experience with drying lake playas and the dust they generate, and am strongly concerned that water withdrawals from existing lakes and playas will cause vast violations of US EPA air quality standards from blowing dust.

I was principal investigator of extensive studies of Owens (dry) lake and Mono Lake for the Air Resources board, 1978 – 1984, principal investigator for the CA State lands Commission at Owens lake 1991 – 1994, expert for the Mono lake Committee 1982 – 1992, and expert witness for the CA State Lands Commission (which controls Owens lake bed) in the CA Water Resources Control Board hearings, from 1992 – 1994.

In the first ARB report 1979, we documented the impact of LA Water and Power's drying up of the playa of Owens Lake in the 1920s, which was causing massive dust storms for 50 years with no hint of ever stopping. The flat dried lake bed erodes in strong desert winds, generating not just sand but inhalable fine particles that, in the cases of Owens and Mono playas, contain toxics such as arsenic.

It is my expert opinion that these potential impacts be fully investigated prior to any decision to withdraw any water from desert valleys, and if as I suspect such problems will occur, withdrawals can not be tolerated without violations of federal air quality statues. Sevier Lake, in particular, causes me concern.

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