The Fight for Water Rights between Eastern and Southern Nevada & the Impact of the Denial of Pipelines to Water Las Vegas

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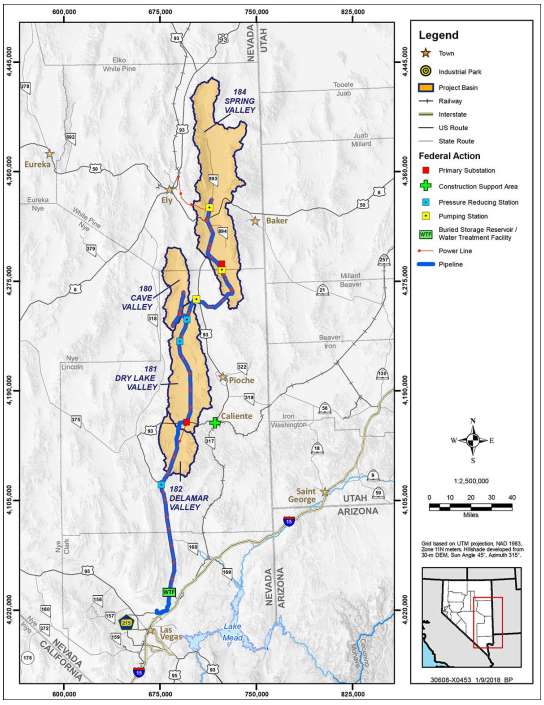
By
Natashja Atherton
Cole Eddy
Haley Rodekohr

Executive Summary

In August of 2018, the Nevada Division of Water Resources (NDWR) denied an application from the Southern Nevada Water Authority (SNWA) for water rights over groundwater from four valleys in rural Eastern Nevada. The reason for denying the water rights was due to ecological concerns for the environment surrounding the proposed pipelines, as well as the superseding water rights of the farmers and Native American tribes of the region. This decision is significant to the state of Nevada because Las Vegas is the largest city in the state, providing more than 71% of the GDP and more than 65% of the population as of 2017 ("World Population Review"). The pipeline would have enabled SNWA to construct a pipeline to bring water from Eastern Nevada to the city of Las Vegas (State Rejects Applications to Pump Rural Nevada Water to Las Vegas") (see Figure 1) [1]. In the decade leading up to this decision, Las Vegas had pooled its water from Lake Mead, aquifers in the Spring, Cave, Dry Lake, and Delamar Valleys, and water recycling processes; when the water rights for the pipelines from the Valleys was denied, Las Vegas faced a severe shortage in its water supply, especially considering the dwindling level of Lake Mead's water storage. In the wake of the NDWR's rejection, the city has made drastic conservation efforts, and considered various methods of finding new water sources,



[1] Figure 1. A blueprint of the pipeline plan which would run groundwater from aquifers in the Spring, Cave, Dry Lake, and Delamar Valleys in Eastern Nevada over 250 miles to Las Vegas (Rothberg).

pressure from progressing water shortages all the while rocking the region (Rothberg). In light of this issue, this paper discusses the current sources of Las Vegas's water and conservation efforts, water rights in Nevada and surrounding states, the economic ramifications of water shortage in the city, and potential solutions in lieu of the pipeline.

Introduction

Water is a necessary component of human life. A basic responsibility of every regional government is to ensure the provision of water at a level that sustains not only citizen life but also citizen productivity. As water is a scarce resource that must be made available to everyone in efficient and fair amounts, the government has the duty of allocating water and confronting the problem of its increasing scarcity. Fulfilling that duty gets trickier when the region over which the government presides is removed from water sources and must focus on conservation efforts and finding new sources to maintain the minimum water level necessary to sustain the area.

Las Vegas is one such region; because of its location in the dry and arid desert of Nevada, there is not enough groundwater or precipitation to provide water for almost two million people living in the metropolitan area. Having pulled most of its water from Lake Mead, Las Vegas is subject to a significant reduction in its water source as the water levels of the lake decline. In addition, the prior solution of running pipelines from Eastern Nevada to the city to make up for the water lost from the Lake Mead provisions have also been cut off, as the water authority's water rights for the pipelines have been denied by the Seventh District Court of Nevada as a result of concerns for the ecological impact and infringement on the established water rights of farmers and Native Americans. Consequently, Las Vegas does not have access to billions of acre-feet it used to have, and the city's economic situation is taking a turn for the worse. Comprising more than two-thirds of the state's GDP, the gaming and tourist industries anticipate a strong impact from cutting back water use. Moreover, intense regulations on residential water use have put a strain on the Southern Nevada Water Authority, landscaping, and the average household.

So while Las Vegas' loss of water may not affect the rest of the nation directly, it's important that this issue is highlighted for two reasons; first, the economic health of this city affects the economic health of the nation, and as an extension, the world, so there is a vested interest in ensuring the Las Vegas economy does not take a hard hit from a lack of water; and secondly, access to water is a basic human right, and our Constitution and moral system requires that the government look after all its citizens. This is best captured in the words of director of the Nevada Department of Conservation and Natural Resources, which oversees the state's Department of Water Resources, Bradley Crowell: "as the driest state in the nation, protecting Nevada's limited water resources for the benefit of all Nevadans is the foremost" priority of the state ("State Rejects Applications to Pump Rural Nevada Water to Las Vegas").

Because water is such a critical aspect and input of human civilization, the fact that Las Vegas is facing a barrier to obtain water is a huge concern. Las Vegas is one of the crowning jewels of the American West Coast and is generally one of the hot spots for economic activity. Within Nevada alone, the Las Vegas economy makes up for 71% of the state's GDP ("Total Gross Domestic Product for Nevada," "Total Gross Domestic Product for Las Vegas-Henderson-Paradise, NV"). Thus, it is critical to figure out how to maintain Las Vegas' need of water to promote its productivity and the health of its population. So while the Southern Nevada Water Authority has been fighting for this pipeline for decades and it is unlikely that it will surrender its efforts at this point, it's time the rest of the nation, or at least the rest of the state, got involved to combat this issue because it is unclear the extent to which a water shortage in Las Vegas will affect the local, state, national, and global economy (Deacon et. al).

Economic Perspective and Analysis

In the past, the vast majority of the water the city procures for use has been from Lake Mead, a man-made water storage replenished by the Colorado River. Beginning in the early 2000s, however, Lake Mead started to experience a significant decline in water levels (see Figure 2) because of corresponding declines in the water level of the Colorado River in the face of the decade-long drought in Southern Nevada. That drop implicates a smaller allocation of water not only to Las Vegas but also to the other areas which pull its water from the lake; according to the 2007 Seven States Agreement between the regions in the Colorado River Basin, if the level of Lake Mead drops below 1,075 feet, a shortage is declared and the allocation each state gets is cut significantly ("Lake Mead"). As is shown in Figure 2, levels in 2019 thus far dangerously near that level, and will continue to approach it in coming years. Although not that low in 2007, the city began its attempts to combat the water shortage then by constructing pipelines which would bring groundwater from four rural valleys to Las Vegas.

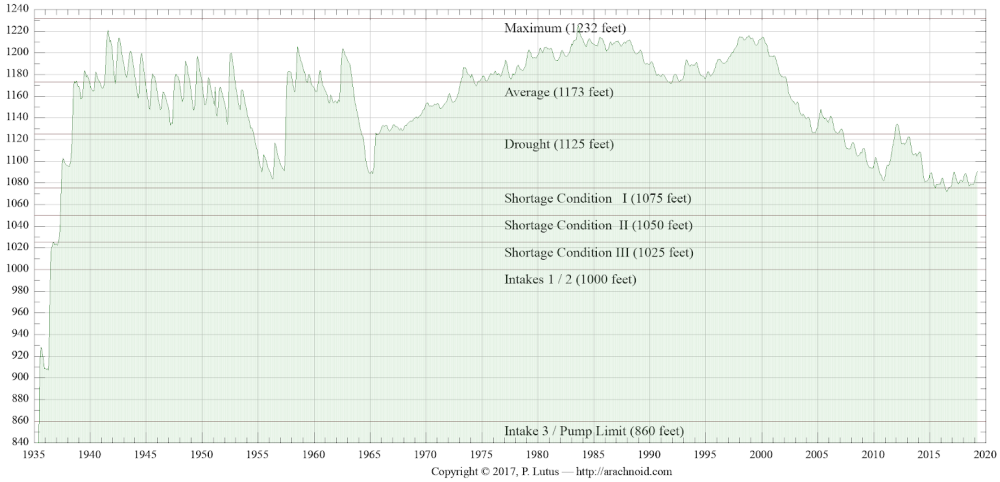


Figure 2. Lake Mead water levels from 1935 to 2020 (Lutus).

In 2007, the Southern Nevada Water Authority (SNWA), Las Vegas' primary water utility company, obtained water rights to build and use the pipelines. The rights were approved twice more in 2012 and 2013, before the Seventh Judicial District Court of Nevada ordered a remand on the approval and forced the NDWR to reevaluate the provision of water rights to the SNWA due to concerns about harm to the ecological landscape of the rural area from which the water water was being drawn, and potential infringement on the water rights belonging to Native Americans and farmers in the region, who use the water to maintain production of livestock and crops ("State Rejects Applications to Pump Rural Nevada Water to Las Vegas"). In fact, on a state level, due to the nature of Nevada's land and its capacity for agricultural production as well as the historical role Nevada has played in farming and ranching, the majority of water rights are tied up in agriculture. Alongside Nevada, Arizona, Idaho, Montana, Wyoming, Utah, Colorado, and New Mexico subscribe to the Prior Appropriations Doctrine, which assigns water rights based on seniority or "first in time, first in right," or the party using the water the longest "has senior right to continue using that water" (Singletary). That means that those parties who succeeded in gleaning water rights in the area before others have first access to the water in the region; so since the farmers and Native American tribes had water rights temporally before Las Vegas, which is currently in a junior water rights position, those parties have priority use of the groundwater in Eastern Nevada over the city. The remand of the 2013 approval seemed to be, in hindsight, a warning cry of what was to come.

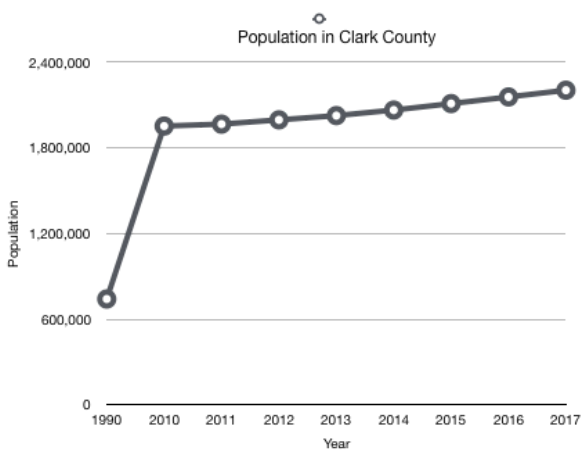
On August 17, 2018, NDWR rejected the SNWA's application for water rights over the groundwater in the Eastern valleys, which would have been used to construct more pipelines to relieve the increasing shortage; leaving Las Vegas in a tough position to supply their citizens

with enough water to satisfy baseline demand. The effect of such a shortage is a mass amount of conservation efforts on the part of Las Vegas citizens, mostly at the direction of the SNWA, which affect health, population, productivity, free market operation, and agricultural output; and a desperate attempt to find other sources of water in a city far removed from ground and surface water.

Since the city's population has been growing at an average rate of 1.5% per year from 2010 to 2017, with a huge spike over the twenty year period between 1990 and 2010 (see Chart 1 and corresponding Graph 1), there has been a higher frequency of projects to build new homes and suburbs every year; and along with it, more pressure than ever to have a water supply large enough to provide for the baseline demand of the citizens of Las Vegas (Singletary).

Year	Population	Growth Rate
2017	2,204,079	2.2
2016	2,156,724	2.2
2015	2,110,330	2.2
2014	2,064,991	1.92
2013	2,026,056	1.49
2012	1,996,290	1.51
2011	1,966,521	0.7
2010	1,952,906	163.39
1990	741,459	

Chart 1. Population growth in Clark County (Las Vegas region) from 2010 to 2017 with a Comparison 1990 value for a comparison sample. ("World"Population Review")



Graph 1. Year and corresponding population value from 2010 to 2017 with a 1990 value for sample.

In terms of residential use, citizens use water not only for potable use, such as drinking, cooking, bathing, and cleaning, but also for landscaping. In fact, fifty percent of the total residential use of water in Las Vegas goes towards maintaining gardens and lawns, in spite of the drought gripping the West Coast ("Water Use"). This considered, and with more than sixty-five percent of the total Nevada population living in the Las Vegas area and that number climbing, the demand for water is only increasing.

Additionally, the labor and tourism markets within the region have further attracted water consumers and contributed to the demand spike. With the tourist attractions on the Strip plentiful and world-famous (think of the fountains in front of the Bellagio, Lake Las Vegas, and the innumerous pools scattered across the area), over forty million visitors are brought to the city every year, which means provision of ready access to water to hotels and restaurants is crucial to the economic success of the region (National Park Service). In the 2018 fiscal year alone, tourism--namely gaming facilities and resorts--accounted for $67.6 billion of the state revenue (O'Connor). If those institutions were given less water to use in their operation, it would mean that casinos and resorts would be unable to serve as many tourists or suffer a reduction in the quality of their services and thus experience a decline in the demand for such services. This is a direct reflection of the economic principle which dictates that a reduction in input necessarily results in a reduction in output. Hence, less water for casino use means less tourism means less revenue for the state.

To put this into perspective then, in the tourism industry alone, significant reductions in water provision would have huge implications on the local and state economy. That small-scale impact, though weighing heavy on those of us who live nearby, will doubtless spread to affect

the national economy on some level as well. This premonition may be relatively easy to brush off, but consider that Las Vegas felt the detrimental effects of the 2008-2009 Financial Crisis at an accelerated level compared to other U.S. cities, and was in January 2018 predicted to see one of, if not *the,* largest booms in the nation (Sen). This said, it is simply not an option to turn our backs and dismiss the growing economic concern in Las Vegas; if this region's economic prosperity plummets--which is very possible in the jaws of dangerously high water scarcity--so do the economic bubbles that expand outwards from the Vegas-center economy.

In terms of the labor market, over the past twenty years, Las Vegas has had the largest employment growth in the country, largely due to the desire for businesses to start up in Nevada as opposed to other neighboring areas. With big businesses moving to the state in favor of tax breaks, the amount of jobs available has increased significantly. From 13.5% in 2010, unemployment has dropped to 4.5% as of 2018 (O'Connor). This is beneficial for production as well as an augmented standard of living for those in the Southern Nevada area, which invites even more people to move to the city. But it's a double-edged sword; with the surplus of jobs and a booming population comes a greater need of and thereby shortage of water. Las Vegas may be running into some slowdown in economic production due to the resources available, or rather lack of available resources, within the state, specifically the limited amount of groundwater accessible for city use.

In light of all the moving parts of the economy that are wrapped up in the water supply, the SNWA has recently realized that water use cannot go unbridled. To address the short-term problem that has cropped up in the last decade, the city has begun to practice conservation efforts that work towards ensuring there is enough water to sustain future generations and activity. Due

to the success of these objectives, despite population growth, water consumption has actually decreased. To demonstrate, from 2012 to 2016, the population has increased by 43% but water consumption, rather than increasing, has actually decreased by 26% (SNWA).

The drop in consumption can be attributed to the tier-pricing system of the region, wastewater management, and ICS credits. The tier-pricing system refers to the four levels of prices offered for water consumption based on the type of use of the water. The first tier corresponds to indoor usage and applies to most residential consumers. However, as the consumer moves up the tiers, using more water in their use, the rate increases. In light of price sensitivity, consumers are less inclined to use these higher tiers and thus reduce aggregate water demand and usage, permitting the water that would otherwise be used by them to be funneled into another sector of the city that values it more and likely uses it more efficiently.

Wastewater management practices come in several different forms, the most prominent being restrictions and regulations enacted by the SNWA on households and firms to encourage them to reduce their personal water usage at the potential cost of being fined for failure to obey. One such regulation is a limitation on watering lawns and gardens that prohibits residents from doing so on Sundays and between the hours of 11am and 7pm (SNWA). In the past year alone, the SNWA has increased fees associated with wasting water and violating restrictions enacted by the water authority in an attempt to incentivize households to use what little water they are allocated efficiently. Moreover, the city constructed a 2,000 mile pipeline which disinfects waste water used in toilets, sinks, washing machines, and showers, and recycles it back to Lake Mead for reuse (National Park Service). Finally, as of 2013, the SNWA has removed upwards of 172 million square feet of grass, consequently saving 9.6 billion gallons of water.

Further, Las Vegas participates in the ICS, or Intentionally Created Surplus, credit program, which enables the water authority to transfer water rights to other users in the region in years where allocation is higher than is needed to meet demand, and accrue ICS credit in exchange to allow for the city to use the surplus water it previously gave up in years where supply is especially lacking. In essence, it negates the "use it or lose it" mentality that accounts for much of the water waste in Prior Appropriation Doctrine states. Still, there is only so much benefit that can be milked from conservation efforts, and such benefits are more than likely just valuable in the short-run.

As it can be seen from the above points, the health of the Las Vegas economy and population relies heavily on having water available for use for residents, labor, markets, and the tourism industry. All of these sectors would be severely harmed by a shortage in the water supply. Fortunately, Las Vegas has so far been able to combat the brunt of these issues by successfully curbing water use and conserving millions of gallons without completely sacrificing the welfare of the population. But with the rejection of what was essentially a last ditch effort to provide water to the city, it is critical we find a different solution to guarantee needed water to Southern Nevada.

Solutions

Addressing the issue of water shortage requires more than just finding ways to supply a greater amount of water to the city. Unfortunately, the geography of the region around Las Vegas does not concede to natural bodies of water, and the costs of building infrastructure like man-made rivers, dams, aquifers and reservoirs would be incredibly taxing to the region's people because the water would have to travel a significant distance and result in large opportunity costs for other potential users. This is exactly why Native Americans and farmers are fighting so hard to retain their water rights; in any situation in which water is 'forcibly' provided to one area means that that water is being taken from somewhere else that, arguably, may need it just as much. So while it is important to supply more water, it is equally important to determine ways to use the water in the most efficient way possible and conserve the supply as much as possible without causing the economy of the state--not just Las Vegas--to take a hit.

The first and most obvious option is to fight for the pipeline. The court remand in 2013 and the 2018 NDWR rejection of the SNWA's application for water rights justified the decision in terms of arguments for ecological harm and interference with others' water rights. In using this justification, the two decisions confirmed that there is enough water in Eastern Nevada to supply Las Vegas if water rights were to be reallocated, which grants legal grounds to challenge the NDWR's rejection. A strategy which would likely result in a favorable outcome for Vegas would be if, rather than allocating water rights in fixed quantities, they are allocated in shares. Thus, as the water supply across the state increases, so do all holders' shares; as it decreases, shares reflect the drop. Reflect on the fact that despite being home to nearly 75% of the state's population, Southern Nevada uses less than 5% of the total water available in Nevada (SNWA).

This is an astounding statistic and should, at the very least, indicate there is room to improve the total welfare of the state by diverting some water away from agriculture and over-saturated right-holders to the city.

However, a change in Nevada water law and redistribution of water rights which is extremely unlikely. So was shown in the legislative session before the Assembly Committee on Natural Resources, Agriculture, and Mining in February of 2019, when a proposal to rewrite water laws to provide for urban and suburban development, hit the floor ("Plans to Rewrite Nevada Water Law Got Rough Reception at Legislature"). Farmers and Native Americans flocked to protest against the proposal out of fear that water laws would be revised at the expense of tribes, agricultural suppliers, ranchers, and wildlife; and nobody spoke in favor of the revision.

Even if this were to be achieved, a solution of this type is not guaranteed to fix or even address the problem because a shifting in water rights will necessarily take water away from right-holders who have historically had access to it to send it to Las Vegas. Not only does this jeopardize the integrity of the state's water laws under its Constitution, but it also disregards principles of fairness, equity, and justice in terms of giving one what one is due. There will always be issues with allocating water, whether it is with respect to Las Vegas or elsewhere, because of the nature of water as a finite and scarce resource. Plus, frankly, the allocation of water to agricultural areas is not arbitrary in that these areas and producers get the water just because they did in the past as it may seem; rather, the state economy still largely depends on the agricultural production, and aside from Vegas and small cities like Reno, Nevada is just open land. These areas need to keep their rights to water in order to keep producing and farming in those regions and maintain the portion of the economy is supports.

On the other hand, we don't have to deny that agriculture is important to the economy to acknowledge that the agricultural sector does not need the full amount of water it is currently being allocated. According to an education series put forth by the University of Nevada, Reno, "current economic growth in Nevada does not rely on agriculture," and almost 80 percent of the total water use in Nevada is dedicated to agriculture (Singletary). Historically, there's no dispute that ranching and farming was the sustaining life force of the state and provided the bulk of the economic prosperity in the region; but that has changed with the establishment of cities like Reno, Tahoe, and Vegas. Events like Burning Man and tourist visitations to the casinos and landmarks of the region now account for a relatively large--at least compared to past accounts--portion of economic growth. If cutting back on agriculture means cutting back on the total amount of water allocated to those efforts, then it means there is more water available for other purposes, like the daily bustle of Las Vegas living. If the state sought to reduce the agriculture sector--for instance, by limiting the amount of water farmers can use or the total output of crops or livestock or putting a quota on the total amount of farms permitted to lay stake to Nevada lands--it could go a long way in providing more water to Las Vegas. The argument that water cannot be transported from rural areas because farmers and ranchers need it would be nixed. Of course, there is the moral component to consider of forcing farmers and ranchers out of business to provide water to a urban area, but as far as the economic implications go, it's a start.

Another direction if the Nevada Division of Water Resources continues to block attempts to build the pipelines and renew water rights to the four valleys which have supplied water to Vegas for the past six years, is considering different infrastructure mechanisms. We propose that that water source could be a man-made lake exclusive for Las Vegas use, with devices to capture

rainwater and snow, however slight, and technological equipment that *makes* water from organic materials, which would then be stored in the lake. Combined with water banks, in which water exclusively for Las Vegas use from run-off and recycle efforts is stored, this particular solution could, over time, drastically reduce the duration and intensity of the water shortage. Further exploration may reveal more basins and valleys in which aquifers can be found or artificially placed which may, if proposed, gain approval from the Nevada Division of Water Resources.

Turning away from drastic changes, the best short-term solution to this issue is conservation, as can be seen from the city's efforts so far and looking at other places facing the same issues. One such area is China; starting in 2009 and into the present, China has been facing similar water shortages as Southern Nevada, albeit on a vastly larger level. The nation has been extremely successful in curtailing waste of its limited water and achieving maximum efficiency in its usage. The primary reason China, or at least parts therein, suffers from a lack of water is because of the "uneven spatial and temporal distributions of water resources" (Cheng et. al). In other words, the climate and geography make for a plentiful source of water in some areas but excessive drought in others. This is made worse by pollution, in that most of the country's ground and surface water are contaminated with waste and runoff. The uneven distribution of water is exactly the issue seen in Vegas, considering Nevada is a desert and Vegas qualifies as the driest city in the country (Rothberg). Since the geography of the regions cannot be altered in order to allow for a larger supply of water throughout, acting in ways that ensure the best use of the water available to the region seems to be a rational substitute. In light of the fact that Vegas and China are seeing similar causes of their water shortages, it is reasonable that Las Vegas could learn something from China's conservation efforts.

China has explored repricing water and quota systems to encourage households to cut back on their water usage out of personal interest in reducing expenses (Cheng et. al). This has been imposed by SNWA to some degree, but not at the level at which China is operating. Quota, or quantitative control, systems cap the amount of water each household receives. A study showing the comparative effectiveness of pricing versus quota systems asserted that the Chinese water companies were attempting to reduce aggregate demand of water, particularly of agricultural users, and succeeded with the quantitative control model (Shi et. al). This is a potential solution to the problem in Las Vegas, but it would doubtless raise social outcry and is certainly not a long-term solution. Plus, it requires the use of devices to measure how much water a household is using, which can be costly and inaccurate.

One technologically developed solution China has invested in is precipitation enhancement, or cloud seeding, to produce more freshwater 'naturally'. It is the process of stimulating clouds to produce more rainfall than they otherwise would through the use of chemical agents that interact with the natural properties of the condensed water. Combined with their desalination efforts, it provides 26 percent of the total demand in China's coastal region (Cheng et. al). While Southern Nevada cannot make use of ocean water as easily as China, it shows that there are ways in which water can be *made* rather than found or extracted.

Here it is notable to mention that China's main focus has been the reuse and recycling of water, mostly in the form of developing technology capable of reducing the amount of 'wasted' water (Cheng et. al). Las Vegas has excelled in this area; because of the extensive reuse of water that comes out of Las Vegas homes and businesses, any ideas concerning the reuse of water are already implemented andany enrichments to these reuse efforts, if possible at all, would likely be

insignificant. Exhausting the possibility, if there is one area that can be further targeted for wastewater, it's landscaping. According to the National Park Service, more than fifty percent of the total amount of water used in Las Vegas goes directly to maintaining gardens and other areas flush with plants. The water from this use is difficult to recycle because it drains out of plants, evaporating or seeping into the ground. Although outdoor commodities like plant gardens are pleasant and desirable, there comes a point when we must ask how valuable those things are. In a rational sense, the opportunity cost of essentially wasting water on landscaping is huge; if this type of water usage was severely reduced, it would likely result in at least some addition of available water for necessary use. So the city could extend regulation of homes within the area of and around Las Vegas, by enacting policies such as further increasing outdoor-use water prices, limiting the size of gardens or amount of plants a household may own, or re-assigning specific watering days--as Las Vegas already has a watering schedule in place--so that grass and plants are watered for less time during sessions or in less sessions during the week. We may also see regulations similar to those of California, such as meters in each individual home to measure water use and punish water hogs and enlighten water users as to just how much water they use in each of their tasks, hopefully decreasing total use of water.

Further efforts of enlightenment could be promoted by the casinos and resorts in the Las Vegas area to inform tourists about the extent of the impact their consumer choices make; for example, showing how many gallons are used per day washing towels so resort guests may choose to reuse their towels before turning them over for cleaning. Even though these efforts have seen little success in the parts of California which have attempted to enact them, every

potential solution should be explored with gusto if we hope to discover and end to the impending water shortage in Southern Nevada.

Conclusion

Certainly the water shortage in Las Vegas is not an easy issue to fix. Las Vegas has already undergone mass conservation efforts, and though the city is effectively reducing water usage even with a growing population, it cannot hope to offset the effects of population growth over the next century. Recycling water, limiting its use, and reducing demand have been effective, but they are short-term solutions. Las Vegas requires water not only for the daily preservation and prosperity of its citizens, but also for the tourist-based economy that boosts the local, state, and national economic outlook. The rejection of the application for renewed water rights to groundwater in the four major valleys of rural Eastern Nevada significantly crippled the city's long-term ability to function. An alternative source of water must be found or designed, otherwise one of the most popular West Coast destinations in America will flounder and dry up. We could dream of finding water deposits like the miners did of finding gold in the early eighteenth century, but it seems a far cry from establishing a system of solutions which will provide the city with water it needs. Legislative action granting the implementation of the pipelines to transport water from areas where it is abundant to Las Vegas would work, but there would need to be ways of maintaining wildlife and potentially settling for reducing the extent of agriculture in the state. Infrastructure solutions are not always the best way to go, but considering the economic goals of maximizing efficiency in water use have proved to be ineffective in the long-term, unless more natural water sources are found or we can cost-efficiently provide artificial water sources, the Southern Nevada Water Authority will need to find a way to restructure its proposal, or at the very least partner with groups that can address the negative consequences of the pipeline, in order to get the Nevada Division of Water Resources on board.

It comes down to a reframing of priorities. After all, water is the most important resource known to humanity, and arguably one of the hardest to come by. There is no doubt Las Vegas needs the water rights to the groundwater stored in the rest of the state; the question is how to get it, or how to procure a reasonable and realistic substitute. As of now, it looks bleak. But considering the nature of water, either the Nevada Division of Water Resources will concede, the sum of the solutions will turn out to be effective, or Las Vegas will be lost, only to be remembered as a legacy of the American West Coast.

Works Cited

Brean, Henry. “State allows pumping of groundwater from rural Nevada.” *Las Vegas Review.* 22 Mar. 2012. ://courses.washington.edu/ess454/ESS_454/DOCUMENTS_files/State%20allows%20pumping%20of%20groundwater%20from%20rural%20Nevada%20-%20News%20-%20ReviewJournal.com.pdf

Cheng, H., Hu, Y., Zhao, J. “Meeting China’s Water Shortage Crisis: Current Practices and Challenges.” *Environmental Science and Technology*, vol. 43, pp. 240-244. https://pubs-acs-org.unr.idm.oclc.org/doi/pdf/10.1021/es801934a

Deacon, J., Williams, A., Deacon Williams, C., Williams, J. “Fueling Population Growth in Las Vegas: How Large-scale Groundwater Withdrawal Could Burn Regional Biodiversity.” *BioScience*, Volume 57, Issue 8, September 2007, Pages 688–698, https://doi.org/10.1641/B570809 (4)

Dean, Kayla. “Where does Las Vegas get its water?” *Block Party*. 19 Sept. 2018. Web. https://www.neighborhoods.com/blog/where-does-las-vegas-get-its-water

“Lake Mead.” *Water Education Foundation.* Web. https://www.watereducation.org/aquapedia/lake-mead

Lutus, Paul. “Lake Mead Water Levels - Historical and Current.” *Arachnoid.com.* 2017. Web. https://arachnoid.com/NaturalResources/

National Park Service. “Water Use.” *Nps.gov*. Web. https://www.nps.gov/lake/learn/water-use.htm

O’Connor, Devin. “Nevada Tourism Industry Delivers State $67.6B Economic Impact During 2018 Fiscal Year.” 5 Mar. 2019. Web. https://www.casino.org/news/nevada-tourism-industry-delivers-state-67-6b-economic-impact

Rothberg, Daniel. “The Las Vegas pipeline is dead. The Las Vegas pipeline is alive.” *The Nevada Independent.* 23 Aug. 2018. ://thenevadaindependent.com/article/the-las-vegas-pipeline-is-dead-the-las-vegas-pipeline-is-alive

Sen, Conor. “Las Vegas’ Economy Is on the Brink of a Boom.” *Bloomberg.* 3 Jan. 2018. Web.https://www.bloomberg.com/opinion/articles/2018-01-03/las-vegas-s-economy-is-on-the-brink-of-a-boom

Shi, M., Wang, X., Yang H., Wang, T. “Pricing or Quota? A Solution to Water Scarcity in Oasis Regions in China: A Case Study in the Heihe River Basin.” *Sustainability,* Vol. 6, pp. 7601-7620. doi:10.3390/su6117601

Singletary, Loretta. “Public Policies Affecting Water Use in Nevada Water Issues Education Series - No. 1.” *Cooperative Extension.* 2019. ://www.unce.unr.edu/publications/files/nr/2005/FS0519.pdf

“Southern Nevada Water Authority.” *Southern Nevada Water Authority*, www.snwa.com/.

Spillman, Benjamin. “Plans to rewrite Nevada water law get rough reception at legislature.” *Reno Gazette Journal.* 28 Feb. 2019. Web. https://www.rgj.com/story/life/outdoors/2019/02/28/plans-rewrite-nevada-water-law-get-rough-reception-legislature/3009924002/

Spillman, Benjamin. “State rejects applications to pump rural Nevada water to Las Vegas.” *Reno Gazette Journal.* 17 Aug. 2018. Web. https://www.rgj.com/story/life/outdoors/2018/08/17/state-denies-applications-pump-rural-nevada-water-las-vegas/1025685002/ (1)

“Total Gross Domestic Product for Nevada.” GDP https://fred.stlouisfed.org/series/NVNGSP

“Total Gross Domestic Product for Las Vegas-Henderson-Paradise, NV.” https://fred.stlouisfed.org/series/NGMP29820

“World Population Review” http://worldpopulationreview.com/us-cities/las-vegas-population/