Effectiveness of Los Angeles Department of Water and Power Water's Conservation Efforts in Minimizing Outdoor Water Use for Urban Households

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Table of Contents:

Executive Summary:

Implementing effective water conservation policy and programs that reduce water use in Los Angeles has been a source of debate for many years. This paper explores LADWP's outdoor water conservation programs and gives suggestions on what actions LADWP can take to achieve maximum outdoor water reductions in the residential sector. Interviews were conducted with leading water policy experts to provide a perspective of current water issues in L.A. and a framework for policy recommendations. The purpose of this paper is to inform future LADWP efforts to promote outdoor water conservation through education campaigns, permanent outdoor water use restrictions, and increased water rates.

Chapter One: Introduction

Water supply can seem limitless and is often taken for granted in the United States. The repercussions of unsustainable development and, consequently, climate change are coming to the forefront of global issues. Water insecurity is a growing problem and sustainable measures to combat dwindling natural resources are absolutely imperative to meet global water needs. Water scarcity is turning into a permanent problem that city governments and residents will face. Though most Americans may not feel or see the global water crisis, the U.S. is not immune to water shortages. According to the U.S. Drought Monitor, 18 states are facing droughts and Western states are facing the warmest summers in decades. Increased frequency of droughts in arid areas, and the consequent increased water demands that are characteristic of droughts, has drastic implications for state and local water supplies.

Specifically, Los Angeles is experiencing a time where urban water conservation is crucial as the city continues to grow. In the face of drastic climate change issues, freshwater resources are dwindling and low water supplies are becoming a harsh reality that effects both businesses and residents. L.A. draws its water from a variety of sources but most of its sources are oversubscribed and face serious water quality issues (CUWCC). The future of L.A.'s water crisis lies in water conservation efforts put forth by the Los Angeles Department of Water and Power (LADWP) and the Metropolitan Water District (MWD). Though LADWP and MWD provide many conservation programs for indoor water conservation, such as the Ultra-Low Flush Toilet Rebate Program, there is not enough advocacy for water efficiency in regards to outdoor water use. As Los Angeles continues to thrive and grow, it will be imperative that better

consumer education programs are provided by LADWP and MWD to increase water efficiency in every facet of a home.

The challenges of examining the effectiveness of LADWP's outdoor water conservation programs is the lack of data of households' actual outdoor water use estimates. Further, LADWP is challenged by educating and motivating residential homeowners to participate in outdoor rebate programs. Dealing with the uncertainty of California's future water supply and managing the water demand of a growing population for decades to come is dependent on the water conservation efforts of today. The City of Los Angeles recognizes water conservation as the core of improving water supply reliability and aims to significantly reduce its dependence on imported water over the next two decades (Urban Management). Currently, two major sources of water are imported water from the Metropolitan Water District and the Los Angeles Aqueduct, LADWP receiving 52% and 36% of its total water supply respectively. By 2034-2035, LADWP plans to expand its water resources and obtain more water through local sources, such as groundwater, recycled water, and conservation efforts. Of local water sources, LADWP is relying heaviest on conservation efforts (LADWP).

The thesis of this paper will examine the current outdoor water use in L.A.'s residential sector, the effectiveness of LADWP's current water conservation initiatives, and determine key factors that can improve LADWP's outdoor water conservation efforts. The goal of this thesis is to offer improvements and adaptations to LADWP's outdoor water conservation efforts that will encourage more public participation and effectively reduce residential outdoor water use.

This report is organized as follows. Chapter 2 provides background information on the characteristics of Southern California's growth complex that fostered the development of a green

megalopolis in an arid climate and the creation of water agencies that made Southern California's growth and water availability seem unlimited. Further, Chapter 2 includes an analysis of California's two major droughts with specific focus on the water management lessons that can be learned from those periods. Chapter 3 examines conceptual debates surrounding water conservation programs. Specifically, Chapter 3 reviews research on consumer education of water conservation campaigns, consumers' perspective of water conservation efforts, and the effectiveness of different outdoor water conservation models. Chapter 4 analyzes LADWP's current outdoor water conservation efforts. The findings from data analysis, as well as interviews with water policy experts, is discussed in Chapter 5. Finally, this paper concludes with policy recommendations for LADWP to effectively reduce homeowner's outdoor water use.

Chapter Two: Historical Background and Literature Review

Historical Background:

The Growth Machine: Control of Water as a Source of Power

The emergence of any modern city is dependent on the availability of water. Water systems are the lifeline to urban development. In the mid-twentieth century, urban interests gained national prominence and were seen as the future of development (Gottlieb, 1988). It became clear that water availability and development would be the most important factor to expand in dry Western states (Gottlieb, 1988). The urban water industry is largely responsible for the development of Southern California's arid landscape. The need to supply water and continue searching for new water sources created the urban water industry (Gottlieb, 1988). As a result, public water agencies are invaluable to urban centers and, therefore, carry significant political clout. In order to understand LADWP's prominent role in L.A. politics, as well as its active role in Los Angelenos everyday lives, it is important to understand the history of urban expansion in the West that led to the development of urban water agencies.

In the early nineteenth century, many cities suffered from water shortages due to urban expansion and population growth. Rapid urban expansion created a need to expand water sources. Imported water was the method by which water agencies created additional supplies. The scandal and corruption of privately-owned water companies led to the shift from private ownership to public. It was during this shift that major metropolises, such as L.A., developed. Public water utilities and the feasibility of imported water on the east coast set the stage for the development of water agencies, supplies, and distribution in the developing West (Gottlieb, 1988). The development of Western metropolises was largely based on the availability of water

from imported supplies. This time period marks the emergence of the urban water industry. Cities were being created all over the arid West, which was only made possible by having a reliable water source. The water industry emerged as the driver for expansion and growth. The key players in expansion became the decision-makers in water politics in order to encourage growth (Gottlieb, 1988). Developers and the water industry had common goals that allowed them to align their interests and resources towards the same objective: providing a continuing source of water for business and urban expansion across the West.

L.A. has often been regarded as the most unique example of urban-development. The most notable obstacle was the lack of rainfall and water supply that is characteristic of desert landscapes. The L.A. area did not have the water resources that could facilitate rapid urban expansion and industrial development. As L.A. was developing into a thriving metropolis, it was clear among businesses and the Los Angeles Water Department that "the future development and prosperity [of the area] will be measured largely by the available water supply" (Gottlieb, 1988). The availability of water in such an arid area had an inherent political dynamic that proved to be very controversial. The result of these political conflicts can be seen in the intricate and complex infrastructure that provides L.A. with its water supply. The Los Angeles Water Department and developers were desperately searching for new water supplies that would accommodate urban expansion. Los Angeles voters approved the financing of an aqueduct that would be constructed from the Owens Valley to Inyo County (Gottlieb, 1988). The critics of the aqueduct questioned the motives behind the location of the aqueduct. The claim was that there was a conflict of interest between those who advocated for the aqueduct on the business and public service sides. Advocates for the aqueduct had land holdings in the San Fernando Valley that needed an

additional water supply to support development (Gottlieb, 1988). The aqueduct project was created in such a way that the additional water to those areas would allow for development and massive profits for the land owners. The land rush in California was based on the availability of water. Both industry and land businesses employed a strategy that would encourage and facilitate growth by providing a source of imported water, an inexpensive energy source, and by attracting industries to come to the region (Gottlieb, 1988).

In the early 1900's, L.A. started to take a different shape. The completion of the Aqueduct and the reliability of water distribution allowed for L.A to increase its land area. L.A. was able to expand their land area by a process of annexation and "water blackmail" (Gottlieb, 1988). If land areas annexed to L.A. then they would receive imported water. If they resisted annexation, then those areas were forced to limit expansion due to a lack of water supplies since water from the aqueduct could not be sold outside of L.A.'s city limits (Gottlieb, 1988). As L.A. forced areas into annexation, it became one of the biggest land masses in the country. A new source of imported water was absolutely necessary to serve the needs of a growing city. L.A. looked to the Colorado River to meet that need. The Metropolitan Water District (MWD) was created to secure this new water source (Gottlieb, 1988). The financial burden of building the Colorado River aqueduct was placed on the city's tax revenue. The L.A. representatives that were on the MWD Board of Commissioners designed water policy that was favorable to developing land areas rather than the city. The idea was to collect taxes from developed areas and create pricing incentives for water use that would encourage development of new land (Gottlieb, 1988). LADWP and MWD's current water allotment method is reflected in MWD's 1952 Laguna Declaration. The Laguna Declaration was a document produced by MWD that expanded the

basis for annexation and, essentially, provided water to anyone who requested it (Gottlieb, 1988). The Declaration was the result of agricultural areas that showed signs of urbanization in the 1950s. These areas chose to annex to MWD in order to secure their future water needs. Southern California's water industry dominated the area for 25 years after the Laguna Declaration. Suburbanization, or sprawl, came to define Southern California on the basis that growth could remain uninterrupted as long as there was a constant water supply.

Decades later, LADWP is a water utility giant. L.A. has a history of creating new water sources to meet population demand. However, L.A. is now in a time where current water sources are depleting at a rate that cannot meet water demand. Over-appropriation and legal issues make new water sources nearly impossible. LADWP has a long tradition of providing cheap water to anyone who requests it. The idea that the arid landscape of L.A. had plentiful water is rooted as far back as 100 years. This perception is still prevalent today and plays a major role in the disconnect between customers wasteful practices and dwindling water supplies. Currently, LADWP is pushing its customers to participate in water conservation programs in order to reduce wasteful water uses.

Creation of Los Angeles Department of Water and Power and the Metropolitan Water District:

In 1928, the electorate of eleven Southern California cities created the Metropolitan Water District under the Metropolitan Water District Act. MWD imports its water from Northern California through the State Water Project's California Aqueduct and the Colorado River Aqueduct. MWD serves 18 million people (CUWCC). Collectively, the MWD services residents and businesses of more than 300 cities (CUWCC). The MWD Water Supply Allocation Plan was adopted in 2008 by the MWD, which allocated LADWP a specific amount of MWD water.

LADWP relies heavily on imported water from the MWD. In 2009, regulatory measures forced the MWD Board to reduce supply deliveries to its member agencies by 10 percent (CUWCC). However, the Board approved an extension to the reduced allocation to LADWP in 2010.

One of MWD's biggest public agencies is LADWP. LADWP is now the largest municipally-owned water utility in the nation. LADWP services approximately 3.81 million residents (CUWCC). The water agency is run by a board of five member who are individually appointed by the Los Angeles mayor. LADWP is almost completely funded by user fees from the sale of water and electricity. The total revenue of the water system in 2010/2011 was approximately $783 million (EIA). Examining what percentage industry, agriculture, and residents comprise LADWP total consumer accounts sheds light on just how important outdoor water conservation efforts of individual households is to L.A.'s overall effort to conserve water. Almost 70% of LADWP's water demands are single family accounts (EIA). Single family residents take up 42% of the department's service area, whereas commercial and industrial only take up 18% of the service area (EIA). Further, single family homes use an average of 350 gallons of water per household per day (EIA). This enormous water demand is mainly attributed to lawn and pool maintenance (EIA). Interestingly, LADWP claims that "the bulk of conservation is expected to occur in the indoor section of the commercial/government sector followed by the industrial sector" (EIA). However, LADWP estimated that approximately 39% of the Los Angeles area is covered by landscape surfaces. Irrigation is responsible for 38-40% of the City's water supply (EIA). Though LADWP acknowledges that outdoor water usage is one of the most inefficient water behaviors, the agency does not treat outdoor water conservation as one of the most effective conservation tools for ensuring the future of L.A. water supply.

LADWP and MWD are the managers of the City's water. The policies and programs LADWP and MWD implement and enforce have huge impacts on household water use. For example, LADWP implemented effective indoor water conservation programs since the early '90s. One of the most successful indoor rebate programs is the Ultra-Low Flush Toilet Rebate Program, which was initiated in 1990 (UWMP 2010). Further, in 2003, LADWP offered free installation for ULF toilets, water-efficient showerheads, and faucet aerators. Customers not only received rebates for indoor water-efficient technologies, but also received free installation. LADWP had huge success in targeting and motivating homeowner's to participate in indoor water conservation rebate programs. The technologies were relatively cheap and only required modest behavioral changes. The realm of outdoor water conservation programs has not been extensively studied by LADWP. As mentioned previously in this paper, there is huge potential to reduce outdoor water use in the residential sector. Water conservation policy needs to shift focus from indoor water reduction to outdoor water reduction. With the power to implement, monitor, and enforce outdoor water conservation policy and programs, LADWP should be the leader of this change.

LADWP's desperate need to create effective outdoor water conservation programs begs the question: how does the American lawn contribute to the national, state, and local water crisis? The image of a lush, all-green lawn is deeply embedded in the American psyche and has become an icon of the American Dream. Turf grass is the quintessential American landscape (Steinberg, 2006). The environmental consequences of maintaining a vibrant green lawn has taken a backseat to its symbolic power. The promotion of a perfect turf aesthetic that keeps its color year round, regardless of climatic and weather conditions, has been sold as a realistic

American ideal. In the U.S., 25 to 45 million acres of land is covered in turf grass lawns and approximately 58 million homes are surrounded by this kind of landscape (Bormann, 2001). Lawns are the most irrigated crop in the U.S. Studies estimate that watering lawns requires 200 gallons of water per day (Steinberg, 2006). The environmental implication of unrestrained outdoor water use that is dependent on a finite resource is troubling. The number one water use of urban households is outdoor water use (Hilaire et al, 2008).

Vibrant Green Lawns in a Desert Landscape

The American obsession with lawns and its detrimental environmental consequences raises the question: what is the purpose of a lawn? It is time to revise the purpose of the American lawn and view it in the context of its environmental costs. The most effective ways to repurpose lawns and minimize their environmental impact are through outdoor water conservation policies, consumer education, and landscape alternatives. Even though water scarcity may seem to encourage the use of turf grass alternatives there is evidence that the idea of the perfect American lawn is still alive and well (Bormann, 2001). This can most clearly be seen in L.A. through the residents' mismanagement of irrigation practices, excessive outdoor water use, and lack of native plant landscaping.

The rise of suburban identity, single-use zoning ordinances, and the "American Dream" all play a pivotal role in the development of L.A.'s unsustainable water ethics and values. Suburban sprawl and excessive water use have come to be defining characteristics of L.A. Federal policies, such as the Federal Housing Administration and Veterans administration, are responsible for the development of single-family suburban communities. Government programs funded housing and highway projects that instilled an unsustainable value system in the public

that is the source for many environmental issues today. Values began to be centered on social class and image. Most families had single-family homes that were surrounded by green, luscious grass. The movement of water played a major role in this new phenomenon. Paradises were formed out of virtually uninhabitable landscapes, like Los Angeles, “Millions of people and green acres took over a region that, from appearances, is unforgivably hostile to life” (Reisner, 1986; 503). The L.A. region became an unrecognizable megalopolis. The sprawling city of L.A. has become an unnatural phenomenon. The illusion of L.A. as a lush paradise only makes sense in the context of water management.

In order to better understand Los Angelenos perception of water issues and water conservation, it is important to understand how the rise of urbanism and unlimited growth in Southern California that was reliant on unlimited water availability shaped public perception of water as an infinite resource. As previously discussed, the development of the City was dependent on water politics and policy. Water policy and politics continue to shape the culture and landscape of L.A. today. However, the landscape of growth is drastically different now. Urban water demand is outpacing water supply. The water agencies that were foundational in developing Southern California since its birth are the same agencies that currently provide water to the City. At the birth of Los Angeles, water did seem limitless. When demand increased, water agencies found new ways to supply that demand. Complex waterways were constructed to import water to the desert city. This complex web still exists today and funnels water into L.A. However, its deteriorating infrastructure and the depleting water supply in California is posing an immediate and urgent threat to the ability of LADWP to meet customer’s water demand. The most effective method for LADWP to meet essential water needs of its customers is to encourage

customers to reduce non-essential water practices. LADWP can maximize water reductions through promoting outdoor water conservation programs. The purpose of outdoor water use is to uphold an aesthetic. It is inherently wasteful, particularly in a desert landscape and, therefore, LADWP needs to actively give its customers the necessary resources to reduce their wasteful outdoor water behavior.

California Droughts

Climate change is drastically affecting water sources and supplies in the United States. Summer droughts are increasing across the nation. There are reports that outdoor water use in the United States is responsible for 40-70% of water use (USGS, 2010). Clearly, efficient outdoor water use needs to be part of long-term strategies to conserve water resources (Hilaire et al., 2008). Policy regarding outdoor water use has huge potential to change the current water crisis L.A. is experiencing. Recently, California has been dealing with what is thought to be the worst drought in the last 100 years. However, California has a long history of dealing with droughts. Its Mediterranean-type climate makes dry summers and wet winters the norm (USGS, 2010). The severity of the current drought can best be understood when put in the context of two of California's most severe drought periods, the drought of 1987-1992 and 1976-1977. These drought periods brought the issue of water management and supply to the forefront of public media, introduced water shortages as a national crisis, and led to the rise of extensive water conservation policies unlike any previous time.

The drought of 1987-1992 was characterized by statewide low precipitation on a completely different scale than the drought a couple decades earlier. It was unique in its duration which prompted the conservation policies that resulted. In the five year period, precipitation was

75% less than the historical average (Dixon and Moore, 1996). California's local urban water agencies, like LADWP, were unable to meet the demand of their customers and, as a result, introduced a mix of drought management policies that aimed to reduce demand and manage the reduced water supply. Examples of some mixed-use drought management policies are raised water prices, education programs, and type-of-use restrictions, such as restricting lawn irrigation to specific days of the week and time of day, in order to reduce excessive water use (Dixon and Moore, 1996).

The drought induced a sort of public anxiety and brought the political turmoil surrounding water supply to the forefront of news cycles and other modes of media. These droughts highlighted deep-seeded dichotomies, like environmental concerns versus urban water demand, and issues in Southern California region that have come to define water policy issues and L.A.'s built environment (Dixon and Moore, 1996). These droughts brought into question the duration and uncertainty of a shortage of such an invaluable resource, the conflict of values between advocates of growth, environment, and agriculture, as well as the conflicting opinions of jobs versus environment. In order to move forward with the current challenges of water shortage in California, it is important to understand the lessons learned from California's previous droughts and draw connections between past water management practices and management of the current water crisis.

The public's response to the '76-'77 drought was remarkable. It was unique in two ways: public awareness of the drought statewide and the active role of public media in promoting awareness and conservation programs. California's Department of Water Resources found that the average per capita outdoor use by homeowner's reduced a remarkable 90% from '76-'77

(DWR). Since the drought of ’76-’77, the media and public have not responded to a drought or water shortage in the same way. The California Department of Water Resources partnered with water utility agencies all over the state to launch education campaigns with the purpose of raising public awareness of the uncharacteristically dry winter and the state’s dwindling water supply. The campaign included mass distribution of water conservation pamphlets that outlined water saving techniques and widespread media coverage through TV, radio, and newspaper campaigns (DWR, 1978). The public were constantly confronted with ads, illustrations, and broadcastings of the state and seriousness of the drought and dwindling water supplies. The public was not only given information about the drought and water shortage, but they were also given the necessary resources and knowledge to effectively reduce their excessive water use. Both public and elected officials reacted in a variety of ways to manage the dry period and conserve as much water as possible. Water conservation played a pivotal role in the efforts to manage a scarce resource (DWR, 1978). Interestingly, though the entire state mobilized on all levels to combat the effects of drought on California’s water supply, the Los Angeles region had a mixed response to water conservation efforts. L.A.’s passive response to the ’76-’77 drought sheds light on the City’s current perception of water supply.

Over the past 40 years, there has been little change in Southern Californians perception of the urgency of California’s water supply crisis. A document produced by the California’s Department of Water Resources attributes L.A.’s current indifference towards water conservation programs to the region’s public perception of the drought and the consequent water shortage as non-threatening. Developing a water conscious among the public was key to the success of the ’76-’77 water conservation efforts. The Department of Water Resources attributes the success of

the program to user motivation, “Californians recognized that they live in an arid land and there is a lot more to meeting water needs and sustaining life than turning on a water tap or flushing a toilet” (DWR, 1978). The extensive role media played in water conservation efforts had the biggest impact on reducing overall urban water use. Being confronted with the severity of the drought and diminishing water availability was part of everyday life. During the drought, the L.A. conservation rate was significantly less than cities that were located closer to the state’s water resources. L.A. had multiple water resources that met their demands and, therefore, many people in the region did not feel that they were directly affected by the water shortage. This sentiment is still prevalent in L.A. The question becomes how can LADWP appeal to the environmental conscious of its customers who cannot physically see the severity of California’s water resources?

As droughts become more severe and frequent, LADWP will continue to be challenged to cope with depleting reservoirs and meeting the water demand of their customers. LADWP can combat this by implementing effective outdoor water conservation programs that aim to reduce homeowner’s excessive outdoor water use. The immediate benefit is two-fold: it will increase water supply reliability and reduce average and peak water demands.

Both these droughts impacted agricultural, industrial, and residential consumers on unprecedented levels. In economic terms, each sector suffered huge costs in both droughts. Specifically in the five year drought period in the early ‘90s, the agriculture sector suffered from increased water costs and reduced agricultural output. The “Green Industry”, which includes gardening and landscaping, suffered the most drastic losses during the drought by losing $460 million in gross revenue and over 5,000 full-time jobs (Dixon and Moore, 1996). Lastly, an

estimated 90% of economic losses in the residential sector was attributed to replacing dead grass and purchasing irrigation water for lawns (Dixon and Moore, 1996). While economic losses caused by drought are often thought to be the most noticeable impact, the most significant impact of the two droughts just discussed was its impact on the public's perception of water use (Dixon and Moore, 1996).

California Water Sources

California has been one of the top four states with the largest total water withdrawals for the past fifteen years. In addition, California is also one of the leading states with the most public-supply withdrawals. California is constantly on the national stage for its high water demand and high water usage across agricultural, industrial, and residential sectors. The Golden State withdraws approximately 36,800 million gallons of freshwater per year, according to the 2005 USGS data (USGS, 2005). Approximately 93% of Californians are served by public water agencies and 57% of the public-supply deliveries are used for domestic use (USGS, 2010). Domestic water use involves any kind of water use that takes place inside or outside a home. Such uses include, cooking, toilet flushing, watering lawns, and washing cars, among other things. The United States Environmental Protection Agency (USEPA) found that although the amount of indoor water use is relatively constant throughout the year, outdoor water use drastically varies across the country and, specifically, in Western arid states. Throughout the country, a large percentage of publicly-supplied water goes towards outdoor uses. The EPA found that approximately 30% of household water use across the nation goes towards outdoor water use. However, in arid climates, such as Southern California, outdoor water use accounts for 60-70% of outdoor water usage (LADWP). Analyzing outdoor water use and creating

conservation measures that reduce household's outdoor water use is integral as urban water availability becomes increasingly of concern.

The average Californian uses about 325,851 gallons of water per year, and the majority of urban water usage is for lawn irrigation purposes (Gray, 2014). There is huge potential for water savings in outdoor water use of the residential sector. Irrigating lawns takes about 300 gallons of water every watering. Saving water is an easy and effective way to "stretch" water supplies and consumers can save an average of 16,000 gallons of water each year by not overwatering lawns (Gray, 2014). Southern Californians insatiable quench for water continues to rise every year. California's water crisis is barely noticed in Southern California because the region is covered with green lawns, vast golf courses, and monstrous swimming pools (Gray, 2014). The California attitude towards water is seen in their desperate effort to change the natural desert landscape into a green paradise. Regardless of depleting water resources, Southern California residents still use an excessive amount of water in the summer in order to keep their lawns vibrant green. Californians use approximately 50% more water than people who live in Eastern states (Gray, 2014). Even though water agencies, such as the Los Angeles Department of Water and Power (LADWP), issue warnings and caution consumers about their water consumption, few residents follow the recommendations (Gray, 2014). Southern California's water issues are compounded by the fact that water agencies do not effectively enforce their water regulations. In order for the Southern California region to survive another century, it is absolutely imperative that the region adopt a variety of water conservation strategies (Gray, 2014). The ability to supply water for future generations depends on the water conservation efforts of today.

Literature Review:

This section of the chapter outlines the conceptual framework for analyzing LADWP's outdoor water conservation efforts. This section will first examine consumer attitudes towards conservation efforts. Further, it analyzes the economic aspect of conservation programs by comparing price and non-price conservation programs. The findings of this research will be compared against the responses of interviewees in the Chapter 5.

Consumer Perspective of Water Conservation Efforts:

There is a wealth of literature that focuses on consumer's attitudes towards conservation efforts. The majority of the studies found that consumers typically participate in conservation practices because good environmental behavior is socially desirable. However, a common theme in the literature measuring residents' water conservation efforts was that most respondents felt inclined to exaggerate their water conservation efforts. Both the desire to appear environmentally conscious and the exaggeration of actual conservation efforts offer insight into how LADWP can create effective water conservation policies that have both economic and idealistic incentives. Furthermore, insight into consumer attitudes towards water conservation will help understand the lack of awareness and deterrence LADWP consumers have towards reducing outdoor water use.

Relationship between Demographics and Water Conservation

DeLorme, Hagen, and Stout (2003) interviewed six focus groups in Florida during a time of extreme drought to gather information of the consumers' experiences regarding the relationship between population growth and water resources (DeLorme et al., 2003). The function of this information was to help guide future education campaigns. The researchers found that most of the subjects in the study group perceived the problems of the current water condition as stemming from several factors including: lack of caring by individual residents,

social norms, and a lack of knowledge about water resources (DeLorme et al., 2003). The focus groups suggested that future water conservation education campaigns should work to raise consumers awareness and personal connection to water crisis issues, create a stronger sense of community by strengthening the connection between the individual interest and the community, as well as combine short-term social appeals (e.g. economic-based incentives to conserve water) with long-term motivational appeals (e.g. conserving water for future generations) (DeLorme et al., 2003). The researchers identified several gaps in their research: qualitatively examining water resource management perspectives, experiences with water education campaigns of consumers across different sociodemographic and geographic backgrounds, and administering a survey guided by the findings of the qualitative research mentioned before (DeLorme et al., 2003).

Hamilton attempted to explain household water conservation through studying demographic variables, previous water consumption, and economic versus idealistic incentives to conserve water in Concord, New Hampshire. Hamilton found that idealistic incentives were more important to consumers than economic incentives on self-reported water saving behaviors. However, in reality, economic incentives played a larger role in actual water saving behavior (Hamilton). This research is significant in designing education campaigns for outdoor water conservation. It will be imperative that the campaign design have idealistic incentives to conserve water that will appeal to consumer's environmental consciousness and economic incentives that will encourage consumers to reduce water use for practical, money-saving reasons.

Miguel De Oliver (1999) conducted a case study to research the role of demographics of urban water conservation in San Antonio, Texas. Oliver found that residents with a higher

household income had a greater ability to pursue water conservation technology changes (Oliver, 1999). He also found that most of the residents' overstated their self-reported conservation efforts, which represents "an impediment to effective design and implementation of water conservation policies" (Oliver, 1999; 373). Interestingly, Oliver found that many San Antonio residents thought that regulatory approaches of monetary fines and higher water rates were the best methods for advocating water conservation. However, many of the residents (83.8%) did not believe that those methods were sufficient enough to actually motivate people to conserve (Oliver, 1999). He found that educated residents with a high-income responded more favorably to water conservation efforts (Oliver, 1999). Oliver did not specify what type of water conservation policy he was examining. Though his main area of focus was demographic variables (e.g. income and education) in relation to mandatory and voluntary water conservation measures, his research raises an interesting question about what motivates people to participate in water conservation programs.

Berk, Schulman, McKeever, and Freeman (1993) examined water conservation efforts in California and, similar to Oliver's San Antonio case study, found that income and education had a heavy impact on household's water conservation activity. After conducting their study, Berk et al findings seemed too good to be true (Berk et al., 1993). A quarter of households in Los Angeles and Bay Areas claimed to have installed water saving technologies for irrigating their lawns and gardens (Berk et al., 1993). Astonishingly, over half of the respondents claimed that they had stopped flushing their toilet after every use (Berk et al., 1993). The self-reported, exaggerated conservation efforts of Los Angeles and Bay Area residents highlight the role of social desirability to participate in water conservation practices. The social desirability to appear

environmentally conscious has a potentially significant role in further understanding and creating educational initiatives that promote outdoor water conservation among LADWP customers.

Further, Renwick and Archibald (1996) found that low-income households were more responsive to price changes than high-income households. Therefore, if water agencies raise water prices, then low-income households will contribute more to water reduction than higher-income households because their water expenses take up a larger portion of the household budget (Renwick and Archibald, 1996). Renwick and Archibald made an important note about the distributional aspect of non-price policies. The researchers stated that requiring water-efficient landscape technologies will result in demand reductions mainly in high-income households.

Role of Lot Size in Water Conservation Responsiveness

Most of the discussion surrounding water conservation policy in Los Angeles is centered on long-term or short-term measures that aim to induce a permanent change in the behavior of households. Hanemann and Nauges (2005) performed a study on the effectiveness of mandatory and voluntary water conservation programs in Los Angeles' urban households. The researchers found that households were responsive to water conservation programs; however, the degree of their response was largely based on the size of their lot (Hanemann and Nauges, 2005). Hanemann and Nauges (2005) found that consumers were more responsive to increased prices and stringent mandatory water conservation programs. The researchers concluded that voluntary programs were more effective in low temperature seasons because households largely benefitted from the ULF toilet rebate program (Hanemann and Nauges, 2005). In times of mandatory conservation programs, the percentage of decreased water use was the same across all lot sizes (Hanemann and Nauges, 2005). This suggests that smaller lot sizes, which are typically lower-

income households, reduced their water use by a bigger percentage than larger lot sizes. The reduction of water demand on larger lot sizes suggests that those households decided to reduce their outdoor water use to comply with mandatory conservation policies. However, with voluntary conservation policies, larger lot size households chose not to conserve their outdoor water use. Further, the researchers found that smaller lot sizes suffered more welfare losses during mandatory and voluntary conservation programs (Hanemann and Nauges, 2005).

Another study by Mansur and Olmstead (2006) examined the distributional impact of water demand policies in 11 North American cities. The researchers studied the effects of outdoor watering restrictions and the effects of raising water prices that would result in the same total water use reduction. During drought, households with a median income and lot size increased their water consumption by 35% to 48% (Mansur and Olmstead, 2006). While water consumption for low-income households dropped from 23% to 16% (Mansur and Olmstead, 2006). This research supports earlier research that demonstrates how if water prices raise, then low-income households are responsible for greater reduction in water use.

Hanemann and Nauges (2005) research provides insight into LADWP water conservation policy and the lack of emphasis on reducing outdoor water use, which is a significant portion of daily household water use. Further, the welfare loss of smaller lot size households and the larger change in water use of small lot sizes in comparison to larger lot size households highlights a major gap in LADWP's understanding of its consumer's different proportions of water demands. In addition, it highlights the hole in LADWP's information distribution regarding water conservation and the ineffectiveness of LADWP motivating its consumers to conserve both indoor and outdoor water use.

Environmental Economics of Water Conservation Programs

There are two concepts that are commonly used in economic literature to evaluate the economic effect of water conservation: elasticity and willingness-to-pay (DWR, 1978). Elasticity is "the percent decrease in demand that can be expected to occur when price is raised by one percent" (DWR, 1978; 16). Price and demand are inversely related. In other words, an increase in the price of water results in a decrease in demand by consumers. This is best reflected in inelasticity, which is a one percent increase in price that results in a one percent decrease in demand.

LADWP is currently struggling with competing demands of a limited resource across industrial, agricultural, and residential sectors. Typically, in markets, prices of scarce resources demonstrate the value of their use and the relative scarcity of the supply (Olmstead and Stavins, 2006). However, water is unique in that a true market for such a resource rarely exists. Rather, prices are determined administratively and are a politically volatile issue (Olmstead and Stavins, 2006). Thus, LADWP has approached water conservation policy through non-price techniques rather than price-based approaches. Non-price based approaches include the adoption of water-saving technology or education campaigns, among other things. Price-based approaches are centered on adjusting water rates in order to send price signals to customers to encourage water conservation (Olmstead and Stavins, 2006). It is important to examine the comparative effectiveness of non-price versus price-based approaches to water conservation policy to gain valuable information about the best approach to achieve maximum water use reduction.

Lens of Conservation Economics: Efficiency and Cost-Effectiveness

The economics of water conservation policy must by analyze through two lenses: efficiency and cost-effectiveness (Olmstead and Stavins, 2006). Olmstead and Stavins (2006) propose that the first question water agencies should ask before creating water conservation policy is if it "is worth the devotion of resources, broadly defined, necessary to achieve a particular quantity of water savings" (Olmstead and Stavins, 2006). In other words, water agencies spend a large amount of resources to "generate water savings, such as by upgrading its transmission and distribution infrastructure ... such actions would not be economically efficient unless the value of the resources used in this process is less than the value of water conserved" (Olmstead and Stavins, 2006). The question of efficiency is intricately related to cost-effectiveness. In an economic perspective, the best water conservation policy is the proposal that will achieve maximum water savings with the least cost. The best water conservation policy in economic terms is price-based approaches because of the substantial reduction of water use with minimal cost. The most effective programs are measured by the cost per gallon saved. Olmstead and Stavins (2006) pointed out that there is a lack of literature and research of the benefit-cost analysis of popular rebate programs, such as the installation of toilet retrofits (Olmstead and Stavins, 2006). The authors argue that in order for price and non-price programs to be effectively compared, there needs to be more research about the magnitude of price increases that would be necessary to achieve water reduction equivalent to that achieved by technological upgrades.

Effects of Non-price Conservation Programs on Water Demand

Due to the inherent controversy of raising water prices, urban water utilities typically rely on non-price based approaches to water conservation. Such programs are typically aimed at urban residential areas in three different methods: voluntary, mandatory, or mixed-use programs.

Voluntary

Literature regarding the effect of voluntary programs on outdoor water demand is nearly non-existent. However, research has been conducted that examines the effect of voluntary indoor conservation programs on water demand. The results of such studies are widely varied. Some studies found that the installation of indoor water-saving technologies had significant water savings while others had little to no savings.

Lucas Davis (2006) found that water-efficient washers had an adverse effect on consumer behavior by examining consumers' behavioral changes after installing front-loading clothes washers. Davis discovered that household's with front-loading washers increased their clothes-washing by 5.6% (Davis, 2006). Thus, the water savings from such programs have been less than anticipated because of behavioral changes that ended up offsetting the water savings of using a water-efficient technology. However, other studies have found that the installation of water-efficient technology has resulted in significant water savings. One such study found that households that had low-flow toilets used 20% less water than houses that did not have low-flow toilets (Mayer *et al*., 1998). Another study found that low-flush toilets rebates did not have a significant effect in Santa Barbara, California (Renwick and Green, 2000).

The lack of research surrounding the effect of voluntary programs on outdoor water demands has huge potential and implications for future outdoor water conservation policy. Studies that resulted in adverse behavioral changes should act as a cautionary marker for future

outdoor water conservation policy. Further, it raises an interesting question surrounding household's economic versus environmental motives for conserving water. In theory, customers would participate in a rebate program in order to reduce their water usage and save money. However, it appears that there is potential for rebate programs to have the opposite effect. Even though rebate programs appeal to both environmental and economic motives, the installation of water-efficient technologies can create a misconception that water-efficient technology allows for more water usage.

Mandatory

Mandatory water use restrictions is another example of a non-price based approach that aims to reduce water usage. Restricting lawn-watering and car-washing for specific times during the week are just two examples of mandatory water use restrictions. Similar to the effects of voluntary programs on water demand, the effect of mandatory programs is mixed. Research conducted by Schultz *et al* found that during lawn-watering and car washing restrictions in Corpus Christi, Texas, there was not a significant reduction in water use in residential areas. Whereas Renwick and Green found that mandatory water restrictions in Santa Barbara, California resulted in a 29% water reduction in residential areas (Dixon et al., 2000). Dixon *et al* (2000) conducted a study of drought management policies in California during the late '80's and early '90's and found that many utility agencies combined mandatory conservation programs with surcharges for using excess water. However, the study concluded that such restrictions were difficult to regulate and enforce.

Mixed-use

There have been several studies that examine the effect of mixed non-price conservation programs. A study performed by Leonardo Corral found significant reductions in total water use due to landscape education programs and other types of outdoor watering restrictions. The same study found that there was little reduction in water use that was attributed to non-landscape conservation education programs, water-efficient technologies such as low-flow fixtures, or bills that presented drought or conservation information (Corral, 1997). Renwick and Green (1996) found that water conservation programs, such as information campaigns and water use restrictions, had significant impacts on average monthly water use in the residential sector. They also found that stricter policies had a stronger effect on reducing residential water use than voluntary conservation programs and information campaigns.

The research conducted on the effectiveness of voluntary, mandatory, and mixed-use conservation programs is important in helping LADWP design effective outdoor water conservation programs. Research conducted on voluntary programs demonstrate that though water-efficient technologies may result in reduced water use, customers need to be educated how the technology reduces their water use and how to ensure that their behavior does not offset the benefits of water-saving technology. The mandatory conservation programs had similar mixed results. The success of mandatory campaigns could be attributed to customer knowledge and efficient enforcement of restriction whereas the failure of such programs could be attributed to the opposite. Mixed-use programs seemed to be the most effective in that such programs encourage behavioral change but also achieved actual water reduction by forcing change.

Compare Price and Non-Price Conservation Programs

One of the clearest advantages of price-based conservation programs is that it does not require potential administrative costs for regulating and enforcing policies. On the other hand, non-price water management requires that water agencies monitor restrictions on specific fixtures or specific days and times that residents are allowed to use outdoor water. The advantage of monitoring outdoor water usage is that if an administrator were to patrol a neighborhood, it would be easy to see if a household were violating outdoor water restrictions, for example, watering their lawn during the wrong time of day (Olmstead and Stavins, 2006).

Viewing water conservation through an economic lens gives an interesting perspective on how to assess the effectiveness of water conservation programs. LADWP needs to do a cost-benefit analysis of their outdoor water campaigns to identify which programs are the most effective in reducing outdoor water use. The least effective conservation programs should either be defunded or restructured so they are more cost-effective to the agency. Further, this research gives an interesting perspective on the politically controversy of raising water prices, even though it may be the most effective conservation tool. The political reality and inherent controversy of raising water prices will be discussed later in this paper.

Major Findings of Literature Review

Most of the research surrounding household water conservation examines consumer behavior and attitudes towards voluntary water conservation mandates. There is a wealth of literature centered on the psychological aspect of what motivates people to conserve water in their household. However, there is a clear gap in research surrounding the role of water agencies in motivating consumers to conserve outdoor water use. The literature about consumers' perception of water conservation is vast, but lacks an analysis of actual application. This paper

aims to fill those gaps. The major findings of this literature review are: social desirability can be translated into how people view outdoor water use and people's attitudes and behaviors towards outdoor water conservation change through education campaigns. This research provides a framework for analyzing the effectiveness of current LADWP education and policy initiatives reduce household outdoor water use and a comparative benefit and cost analysis of mixed-use water conservation practices. The findings of the reviewed literature is important because understanding how to motivate customers to participate in conservation programs and what water conservation technique is the most economically efficient for both the customers and the water agency will help mold effective outdoor water conservation policy.

Chapter Three: How L.A. gets its Water - The Complex Web of California's Water Supply

Water development, management, and supply have shaped the city of Los Angeles into what is today. A secure water source to an arid region has allowed for expansion and growth that would otherwise be impossible in such a dry, desert region. LADWP's overwhelming dependence on imported water supplies highlights the dramatic and unprecedented effects of climate change on L.A.'s water resources, the enormous water demands of its customers, as well as the urgent need to encourage consumers to conserve water not only for environmental integrity but also out of economic and environmental necessity.

Imported Water

L.A.'s dependence on imported water from MWD cannot be understated. LADWP has purchased water from MWD for decades to make up for the deficit of the city's local water supplies. Though the percentage of L.A.'s total water supply from MWD has varied throughout the past few decades, LADWP purchased approximately 52% of its total water needs from the fiscal years 2005/06 to 2009/10 (Urban Water Management Plan). MWD delivers water through the State Water Project and the Colorado River Aqueduct. The State Water Project carries water 444 miles from the Sacramento-San Joaquin Delta to central California and then over the Tehachapi Mountains and into the Southern California region. The Colorado River Aqueduct carries water 242 miles across the Mojave Desert and into MWD's reservoirs located throughout the Southern California region (Kos, 2011). In one year, MWD distributes 1.5 billion gallons of water every day to its member agencies.

L.A. has three main sources of water: the Los Angeles Aqueducts (LAA), local groundwater supplies, and imported water that are purchased from MWD. Most of L.A.'s water is imported through the LAA and the water purchased from MWD. MWD is L.A.'s whole-sale water retailer. The LAA is one of the primary resources for L.A.'s water. From the fiscal years 2005/06 to 2009/10 the LAA provided 36% of L.A.'s overall water supply (Urban Water Management Plan). However, due to environmental mitigation in the last 10 years, L.A. is required to reallocate 50% of their LAA water supply to the Owens Vally and Mono Basin regions for environmental rehabilitation. This has severely stressed L.A.'s water supply and has made the city more dependent on imported water resources from MWD (Urban Water Management Plan).

Local Water Supply

Los Angeles Aqueduct

The LAA was constructed in 1913 to meet the growing water demands of L.A.'s exploding population. In 1970, a second aqueduct was constructed that had 75% more capacity than the first (Urban Water Management Plan). LADWP used to rely heavily on the LAA as a water source. From the years 1970 to 1993, LADWP received 65% of its water supply from that source (Urban Water Management Plan). However, since environmental mitigation in 1994, LAA now only delivers approximately 35% of water to L.A. (LADWP). The LAA stretches 340 miles and carries water from the Owens basin in the Sierra Nevada Mountains.

Groundwater

L.A. has relied heavily on its groundwater resources to meet the fluctuating demand of its customers. Over the last decade groundwater has been responsible for approximately 12% of L.A.'s water supply. Historically, groundwater has been responsible for an impressive 30% of L.A.'s overall water supply during times of drought and when L.A. has been unable to obtain enough imported water (Urban Water Management Plan). However, over the past few years LADWP has run into some environmental problems in its groundwater resources. Due to environmental contamination and urban expansion, groundwater elevations have been consistently declining (Urban Water Management Plan).

Over the next 20 years, LADWP plans to reduce their need for imported water and develop more reliable local water supplies. However, L.A.'s local water supplies are threatened by contamination, environmental mitigation, and dwindling supplies. Therefore, LADWP needs to heavily rely on its customers participating in water conservation programs in order to save the water the City already has. LADWP has an obligation to provide its customers with water for essential uses, such as flushing the toilet. LADWP has achieved great success in reducing indoor water use through cheap water-efficient technologies and building codes that require new developments to install indoor water-saving technologies, such as low-flow showerheads. However, LADWP has not taken an aggressive or extensive approach to outdoor water conservation. Outdoor water use is a non-essential water use for homes. Water conservation programs that effectively reduce wasteful outdoor water behavior will tremendously help LADWP to supply water to its customers in the future.

Chapter Four: LADWP's Water Conservation Efforts

LADWP Water Conservation Efforts

LADWP's water conservation efforts have been thorough and well-funded but the overall impact of reducing their customer's water usage has been less than ideal. LADWP uses a multi-prong approach to educate consumers about their water usage and provides incentives to reduce their water demands. Their efforts include: water pricing, ordinances, financial incentives to install water conserving devices both inside and outside the home, landscape efficiency systems, as well as education and information programs (Blanco et al). Official data examining the effectiveness of LADWP's conservation approaches is limited. However, the fact that 70% of household water use continues to be outdoors, indicates that LADWP's outdoor conservation efforts have been ineffective (Blanco et al).

There is a stark contrast between the successes of indoor water conservation campaigns in comparison to outdoor water conservation campaigns. The ineffectiveness of outdoor water conservation programs can be attributed to LADWP's lackadaisical approach to voluntary mandates and their superficial advocacy for outdoor conservation alternatives and devices. The sheer number of rebates for indoor conservation programs in comparison to outdoor rebates reflects this argument. The Ultra-Low Flush (UTF) Toilet Rebate Program was implemented in the early 1990s where LADWP distributed free ULF toilets to LADWP customers (Blanco et al). In 2003, LADWP implemented a program that installed low-flow shower heads and faucet aerators. LADWP claims that through these programs they replaced more than 1.27 million toilets (Blanco et al). From 1999 to 2008, LADWP distributed 292,769 low-flow shower heads

and 415,363 aerator faucets (Blanco et al). During the same time period, the water agency provided 122,155 financial rebates for ultra-low flush toilets (Blanco et al). Further, LADWP has established interdepartmental partnerships with key utilities agencies to support indoor water conservation rebates and programs, including the City of Los Angeles Sanitation Department and the Southern California Gas Company. LADWP established the High Efficiency Washer Rebate Program with these agencies in 1998. Between 1999 and 2004, LADWP (in partnership with the Sanitation Department and California Gas Company) distributed $8,005,888 in financial rebates for high-efficiency clothes washing machines to 31,121 customers (Blanco et al).

Clearly, there are extensive and effective rebate programs available to LADWP customers for indoor water conservation devices. However, LADWP lacks outdoor water conservation programs that are equivalent to their indoor conservation efforts. The data on the success of the agencies outdoor water conservation campaigns is limited to say the least. Since the creation of the SoCal Water$mart Program, which MWD started in 2008, there have only been 285 rebates for the installation of synthetic turf and 76 rebates for the installation of weather based irrigation controllers (Blanco et al). The low number of rebates distributed for LADWP's turf removal program is especially surprising because LADWP is offering $2 for every square foot of grass that is removed. In other words, if a household removed 800 square feet of grass, then LADWP would pay them $1,600. The ineffectiveness of LADWP's outdoor water conservation efforts can further be seen by the fact that the number one water use in households remains to be outdoor water use. Recommendations to encourage customers to participate in outdoor conservation programs will be discussed later in this paper.

Pricing System

Water is one of the most precious and valuable resources in the arid landscape of Southern California. However, the pricing system of LADWP and MWD does not convey this message. Rather, the pricing system of both water agencies provides the public with the illusion that California's water supply is limitless. MWD has a complex pricing system to ensure that the company has enough funds for maintenance and operational costs (Kos, 2011). Each member agency pays a different price for water depending on how much water the member agency chooses to purchase and whether the member agency purchases treated or untreated water. MWD's pricing policy charges its member agencies more money for purchasing a small portion of water. Thus, MWD encourages water districts to purchase a large allotment of water for a cheaper price (Kos, 2011). Further, there are 2 tier supply rates for different agencies. Tier 1 prices cover the essential costs of maintaining and operating the existing amount of water supplies while tier 2 prices are set by MWD's cost of developing an additional water supply (Kos, 2011). Many agencies choose to purchase water at tier 2 prices in order to ensure future water supplies in times of shortages. This system has been likened to a kind of "water insurance" (Kos, 2011). In a time of drought or water crisis, member agencies that purchased tier 2 water are guaranteed their allotted water whereas member agencies that purchased tier 1 water will suffer cutbacks (Kos, 2011). Thus, it is to the benefit of the member agency to buy more water than may be needed at a cheaper price.

In addition, MWD offers purchase orders to their 26 member agencies (Kos, 2011). MWD's purchase orders are 10 year contracts in which member agencies agree to purchase a

specified amount of water (Kos, 2011). LADWP has a "take or pay" contract with MWD which allows the water agency to vary the amount of water purchased from the MWD year to year. However, LADWP is under contract to meet the minimum commitment during the ten year contract period. Whether, LADWP uses the entire quantity of water in the contract or not, the water agency is required to pay for the entire purchase order. This encourages LADWP to use the entire water allotment whether they need to or not.

LADWP is funded through user fees and the selling of water and electricity. The water agency uses a price tiered system that is separated by customer classes, lot size, temperature zones and, lastly, household size (Blanco et al). Single family billing is dependent on several different factors. Single family customers living in high temperature zones, larger lot sizes, or have a high number of household members are assigned a larger allotment of water to fulfill their increased water demands and needs. If an account exceeds their allotment, then they are billed at a higher rate, such customer's compromise tier 2. The tier 1 rate is $3.703 per hundred cubic feet (HCF) of water. In contrast, the tier 2 rate is higher at $5.937/HCF (Blanco et al). When LADWP operates under droughts or dry winters the rates of tier 1 prices are reduced by 15% and tier 2 rates increase 1.442 times in an effort to encourage water conservation (Blanco et al). LADWP has proposed a new tier pricing structure that will reflect a water conservation pricing system. This system would decrease the allotment for tier 1 and increase the price ratio between the two tiers. The purpose of such a system is to send more effective price signals to its customers (Blanco et al). However, the criticism with this system is that it still does not reflect a full water conservation pricing system because for tier 1, pricing is still contingent on factors such as lot size. Therefore, regardless of the new pricing structure, those with a larger lot size

will get a larger allotment of water (Blanco et al). Furthermore, the tiered rate structure has been criticized because it allows water users to make decisions on what kind of conservation method they are going to use rather than having the water district or municipality dictate what conservation method should be used (Addink). This allows customers to choose to conserve indoor water use rather than outdoor water use. Such a system may send price signals to its customers but it does not send an effective or clear message about importance of outdoor water conservation. Ultimately, LADWP is a business whose function is to supply water to its users. Being a business, it's important that LADWP makes enough revenue to pay for its operational costs. However, these efforts compromise conservation efforts.

Alternate Models of Water Conservation

There are effective alternative models to grass landscapes that address the issues with the unattractiveness of xeriscape landscapes, are cost effective, and have a positive public perception. One such alternative is edible gardens. Cities like Portland and Vancouver are experimenting with urban agriculture policy that supports small-scale urban farming (Worrel, 2009). Portland's Department of Food Policy and Programs offers over 700 courses that teach food production skills. The courses include organic gardening, container gardening, and beekeeping (Worrel, 2009). Vancouver has taken a different approach and issues design guidelines for edible gardens. Los Angeles zoning code allows for the construction of edible gardens with minor restrictions, such as a maximum height for vegetation (Worrel, 2009). However, edible gardens have proven to be problematic in Southern California due to Homeowner Association (HOA) restrictions. Some HOAs prohibit unconventional landscaping

due to aesthetic concerns and decreasing property values (Worrel, 2009). Further, edible gardens are not widely promoted as a viable landscape alternative.

Another alternate model of outdoor water conservation is the Efficient Irrigation Goal (EIG). Santa Rosa, California has an efficient irrigation rebate program for commercial landscapes that has the potential to be incredibly effective for residential landscape water conservation programs. In Santa Rosa, commercial customers can earn a cash reward for each acre-foot of water saved below their EIG (Addink, 2009). Each customers EIG is based on landscape and weather data (Addink, 2009). This method of water conservation equitably applies to all water users. Currently, water prices for LADWP residential customers are based on percent reduction of historical water usage. This means that some water users still use an excessive amount of water. Most customers already use an excessive amount of outdoor water, even with a percent reduction of their outdoor water use; they end up still using too much water (Addink, 2009). However, with the EIG, if the goal is based on a water budget, then all the customers will be treated equally since the EIG is based on landscape area (Addink, 2009).

Chapter Five: Methodology, Findings, and Recommendations

Methodology

The purpose of this study is to analyze how effective LADWP's outdoor water conservation initiatives in changing household's outdoor water uses. Further, this study will offer recommendations for current policy that will help reduce outdoor water use and promote different lawn care practices for Los Angeles residents.

I performed data analysis to better understand current household outdoor water uses, the effectiveness of current water conservation initiatives, and where new outdoor water conservation initiatives should be targeted. The primary research of this study included five interviews with LADWP's Manager of Water Conservation Policy, a professor of environmental economics from Occidental College, a former L.A. Water Master, the former Director of Sustainability for Mayor Villaraigosa, and the former General Manager of Southern Nevada Water Authority. The interviews were conducted in January through March 2014 and will be semi-structured which allowed for further questioning that guided the interview to a more in-depth and open dialogue. The interviews were mostly successful in shedding light on the current bureaucracy of LADWP, public perception issues surrounding the water crisis, and issues with LADWP's current water conservation efforts.

Findings

The purpose of this study was to analyze the effectiveness of LADWP's outdoor water conservation policy and rebate programs for households, examine the successes and failures of LADWP's approach towards reducing household outdoor water use, and how LADWP can improve its residential outdoor water conservation efforts. Interviews were conducted from

experts across government and non-government sectors in order to get diverse and unique insights into LADWP's outdoor water conservation policy. There were three prominent issues that each interviewee addressed: the importance of public engagement in rebate programs that aim to reduce outdoor water use, the public perception of Los Angeles' water supply and lawn alternatives, and the controversy of increasing water rates as a conservation tool. Each theme is intricately impacted by the other and the interaction between these drastically impacts the effectiveness of outdoor water conservation policy and rebate programs. This section outlines the findings of this research project that stem from responses coming from interviews conducted with administrative staff from LADWP and the Southern Nevada Water Authority, an environmental economics expert, former Los Angeles Director of Sustainability, as well as a former Los Angeles Water Master.

Interviewees:
Richard Rhone - former Water Master
Penny Falcon - Manager of Water Conservation Policy
Bevin Ashenmiller - Professor of Environmental Economics
Romel Pascual - Former Director of Sustainability for Mayor Villaraigosa
Patricia Mulroy - Former General Manager of Southern Nevada Water Authority

Finding One: LADWP's outreach efforts are integral to educating the public of the severity of the current water crisis and the types of resources available for household's to reduce their outdoor water use.

Each interviewee mentioned the role of public perception in understanding California's water crisis, motivating consumers to participate in rebate programs, and creating an environmental conscious in LADWP customers. Rhone and Pascual were similar in that they both thought people's attitudes towards the environment greatly shape their thoughts about water conservation. Both Rhone and Pascual noted that communicating the severity of the water crisis

in Los Angeles and the entire state is difficult because people are unable to physically see the diminishing water supply of, for example, Lake Meade or the Colorado River.

Pascual illustrated this point by using the example of a power outage. If Los Angeles were to have a power outage, the public would immediately notice the problem and understand its impact because they are able to see the problem. However, Los Angeles has never had water outages in the same way as it has had power outages. Pascual pointed out that Los Angelenos have not been challenged by water shortages in a significant way. He suggested that Los Angelenos understanding of water is simplistic in that when they turn on their faucet water comes out and, as a result, they do not perceive a threat to their water supply. Pascual and Rhone suggested that there is a disconnect between the perception of the water crisis in California and the actual severity of the water crisis.

Penny Falcon, LADWP's Manager of Water Conservation Policy, pointed to the common perception of native California plants as being ugly and undesirable as reasons for why LADWP customers do not take full advantage of the California Friendly Landscape Incentive Program, even though the program offers financial incentives. The California Friendly Landscape Incentive Program is a rebate program that offers customers $2.00 per square foot of turf that is removed and replaced with drought tolerant plants and desert landscaping. Falcon commented that the most important aspect of conservation policy is educating customers on how much water they use outdoors and teaching customers about programs and technologies that would reduce their outdoor water use. Falcon claims that one of the biggest barriers to the Landscape Incentive Program is the perception that desert plants are undesirable. She suggested that educating the public on different design templates for their yards that use beautiful and vibrant desert plants

was one method to overcome this negative perception. Falcon noted that LADWP was currently working on creating a more user-friendly website that will have desert landscape design templates. One of the chief goals of the newly designed website is to demonstrate to customers that desert landscapes can be beautiful. She referenced the Southern Nevada Water Authority landscape website as an example of an effective and user-friendly website. Further, she noted that education was the foundation of every conservation policy. LADWP's outreach efforts that focus on educating the public about water and the resources available to them to reduce their water use have the potential to motivate customers to conserve.

Rhone, Falcon, and Pascual all mentioned the negative publicity of the "toilet-to-tap" campaign that attacked the repurposing of recycled water as a conservation method. Each interviewee touched on the impact of this media strategy in shaping the public perception of an otherwise effective conservation tool. This suggests that media campaigns can play a pivotal role in shaping public perception. The ability for the "toilet-to-tap" campaign to mobilize LADWP customers, and effectively shut down a viable conservation method that had huge potential to reduce water use, has significant implication for future media campaigns lead by LADWP.

In order to understand the impact of the "toilet-to-tap" campaign on the public's perception of water, it is important to understand how the campaign was started. In the mid-1990s, the L.A. City Council unanimously approved a water conservation project that would use treated wastewater as an alternate water source for the City. The idea was that the recycled water could help refill local groundwater sources and be distributed to water users throughout the City. Unfortunately, LADWP announced the completion of the project at a politically vulnerable time. LADWP released their announcement in 2000 during the beginning of the open mayoral

election (Haefele and Sklar, 2007). Council members who had approved the project in its nascent stages suddenly objected the project and created a negative media campaign called "toilet-to-tap". LADWP pleaded with the oppositional forces and tried to explain that the wastewater would be as pure as unpolluted rain water by the time it reached Valley Wells. However, the public, and elected officials, would not listen. A mayoral candidate remarked, "Go tell somebody in North Hollywood that they have to drink toilet water but the mayor [Richard Riordan] won't have to drink it in [his] Brentwood [home]" (Haefele and Sklar, 2007). This candidate's comments reflect the lack of understanding the public has about the City's water sources. L.A.'s groundwater reaches all areas of the City depending on the need and supply of the community, even Brentwood. Soon, other oppositional forces, such as the Homeowners of Encino, joined the "toilet-to-tap" campaign and effectively defeated the project. LADWP was defeated because its customers and elected officials were not educated on the flow of L.A.'s water system or how reliable, efficient, and sustainable, purified wastewater is (Haefele and Sklar, 2007). The "toilet-to-tap" campaign highlights the importance of educating the public about different aspects of water conservation. Public perception of where water comes from and how it makes its way to a faucet is easily persuaded by media campaigns. The "toilet-to-tap" campaign evoked an emotional response from the public. The public did not have a clear understanding of the safe and reliable processes of purified wastewater and, therefore, actively opposed a sustainable, water-efficient project.

On the other hand, Mulroy, the former General Manager of the Southern Nevada Water Authority, took an aggressive stance towards Southern Californians perception of the current water crisis. She too complained that Southern Californians do not understand the water crisis

that its neighboring states are in and, therefore, Southern Californians are unable to see the bigger environmental implications of water shortages. She commented that Southern Californians need to develop a better understanding of today's urgent water issues. She believes that LADWP needs a mosaic of mandatory and voluntary water conservation measures in combination with education campaigns to raise awareness about water overuse. Further, she argued that Southern Californians are unable to understand the devastation of overusing its water sources because they are unable to physically see Lake Meade and the Colorado River deteriorate.

Mulroy gives a unique outside perspective on California water issues. Her critical eye towards Southern California's excessive water use is grounded in two water issues: dwindling water supplies in the Colorado Basin and tensions over water allocations based on an outdated document. L.A. and Las Vegas share the Colorado Basin as one of each City's primary water source. Las Vegas overwhelmingly relies on the Colorado Basin for 90% of its total water supply (Southern Nevada Water Authority). This has huge implications for Lake Meade and Lake Powell, which are the two reservoirs of the Colorado Basin. Seven western states divide the Colorado Basin into two basins: the Upper and Lower Basins. The Colorado River serves seven states and approximately 25 million people (SNWA). The states that comprise the Lower Basin are California, Nevada, and Arizona. In the past few decades, the Colorado Basin water reservoirs have drastically declined. As a result, all seven western states served by the Basin have suffered from limited water supply. In the nine year period between 1999 and 2008, the inflow of water in the Colorado Basin was 66% of normal. During the same nine year period, those reservoirs were at 52% of total capacity (SNWA).

In 1922, the seven western states that used the Colorado River entered a compact that allocated a certain amount of water to each of the states. For the Lower Basin, Nevada received 300,000 acre feet per year (AFY), Arizona received 2.8 million AFY, and California received an impressive 4.4 million AFY. Since the adoption of the compact and in spite of massive population growth and urban development, the water allocations for each state have not changed. In order for the allocations of the 1922 compact to change, each state would have to agree on a how to change the allocations of the original agreement. With the uncertainty of future water supplies and controversy inherent in water politics, it is unlikely that any state would be willing to give up part of their allocation. In fact, California has entered an agreement with Arizona that would ensure that California receives its entire water allocation in times of drought and water shortages (SNWA). In 1960, California supported the Central Arizona Project, which constructed a system of canals to irrigate farms and cities in Arizona. As a condition for supporting the Central Arizona Project, California essentially secured water supplies for any future water shortage. For example, if Lake Meade continues to fall, Arizona will lose over half of their Colorado River water supply before California would have to reduce any of their Colorado Basin water supplies (SNWA).

The tense relationship between Southern California and Southern Nevada demonstrates that water shortages are not just a local or regional issue. It impacts every western state at every level. Conservation measures are not just for the benefit of Los Angelenos. Water conservation measures have both environmental and economic benefits. Conservation measures have an environmental benefit of reducing water over-appropriation and economic benefit of household's

lowering their water bills, but also fulfill the City's responsibility to neighboring states that share the same water source.

Finding Two: The most significant barrier to effective outdoor water conservation rebate programs is changing consumers' consciousness by appealing to both economic and environmental motives. In addition, though price signals are often used to encourage water conservation, raising water rates is the most controversial water conservation tool.

Four out of the five interviewees discussed consumers' consciousness as a barrier to effective outdoor water conservation measures. Rhone, Falcon, Pascual, and Mulroy agreed that one of the largest obstacles to motivating consumers to participate in water conservation programs is the lack of environmental consciousness. Pascual commented that people want a low water bill and a green lawn, which implies that Los Angelenos are more motivated by economic factors rather than environmental ones. L.A. has one of the lowest water rates in all of California. The issue of negative public discourse surrounding raised rates speaks to how LADWP customers perceive the value of water.

On the other hand, Mulroy suggested that the most effective outdoor water conservation practices combine environmental and economic factors. She argued that outdoor water conservation programs need to have a financial incentive that encourage customers to participate in the programs and an educational element that informs customers about how their conservation efforts have a positive impact. Rhone framed the issue differently and argued that the difficulty with conservation efforts is that they are a matter of environmental ethics versus economic incentives rather than the two working together. Pascual, Falcon, and Rhone all mentioned the difficulty of changing lawn practices of the highest outdoor water users because typically those users have the disposable income to pay their higher water bills. When asked if the inexpensive

price of water in L.A. encouraged more water use and if raising water rates was a viable option to reduce excessive water use, Falcon remarked, "When people have to pay more for something, sometimes they think about it twice, but not all your customers. Some customers have unlimited resources and funds. Any rate change has to go through the approval process so it's not easy to change rates. That's why we work so much with educating the customers, that's a lot easier to do" (Falcon, 2014). Thus, the challenge to appeal to customer's environmental conscious becomes even more difficult. Further, her comments and clear emphasis on the importance of educating customers suggests that consumer education should be the focus and foundation of water conservation programs.

Rhone, Falcon, Pascual, and Mulroy all mentioned that raising water rates as a conservation tool is always met with public outrage. Ashenmiller, an environmental economics professor at Occidental College, viewed the issue of raising water rates through a purely economic lens. She argued that raising water rates will not necessarily fix the problem of households irresponsible outdoor water use. Rather, the real savings are in fixing the water pipe infrastructure. She claims that the biggest water losses are in pipe leakages. Ashenmiller commented that raising water rates is not enough and LADWP needs to deal with their leaky water system first and foremost. She proposes that LADWP raise the fixed cost of delivery and funnel that revenue towards fixing the agency's 100 year old water lines.

The urgent need to fix the water pipe leaks is best understood in the context of number of gallons lost per year. The amount of water lost due to infrastructure breaks is absolutely outrageous and will have irreversible consequences if water supplies continue to dwindle at the rate they are now. *Los Angeles Daily News* reported that in 2009 LADWP lost 5.28% of water

deliveries due to leaks and poorly maintained pipes. This percentage may seem small but, put into context, it is astronomical. Los Angeles uses approximately 195 billion gallons of water per year. 5.28% of 195 billion gallons is around 10 billion gallons (Beckman, 2009). In other words, LADWP loses 10 billion gallons of water each year due to pipe leaks. Those 10 billion gallons could provide water for between 31,000 and 63,000 households in Southern California (Beckman, 2009). In a time of severe drought and dwindling water supplies, saving as much water as possible should be an absolute priority to LADWP and its customers. This sheds light on two different issues. First, the value of water does not correlate with the real worth of water, which may partly explain homeowner's lack of motivation to participate in outdoor water conservation measures. Second, in the face of large water losses due to infrastructure inefficiencies, implementing effective water conservation programs are of the utmost importance in order to save water wherever possible (Beckman, 2009). Unless drastic water conservation measures are taken and the pipes are properly maintained, the consequences of losing this much water will have the potential to induce a kind of water panic in the future that will be unlike any other time.

A presentation released by the Board of LADWP commissioners, called "2011 Rates Process", stated that the average lifespan of a water pipe is less than 100 years and the current LADWP budget can only afford to replace the pipelines once every 340 years. Further, the presentation argues that the current water rates are not enough to support the cost of LADWP's business needs. The Board's presentation argues that current rates are not high enough to meet the basic business needs of LADWP, which include both operational and maintenance costs. The presentation states that LADWP will need to invest $1.5 billion from 2010-2015 in order to

provide adequate power and water services, pay for legal mandates, and pay for infrastructure needs (LADWP). To meet these needs, LADWP needs to increase its revenue. LADWP's primary form of revenue is through fees and sale of water and electricity. This means that LADWP needs to increase its water rates in order to increase revenue. The Board suggested that a high-use single-family residence's bill should increase $2.24 more per month over a 3 year period (LADWP). In other words, by the third year after rates increase, water bills will have raised by $6.06 per month. The question becomes: where will this increased revenue go? According to the "2011 Rates Process", the increased revenue will be distributed as follows: $0.24 towards regulatory mandates, $0.13 towards replenishing local water supply, $1.12 towards protecting LADWP's ability to borrow water, $0.43 towards inflation, $0.43 towards pensions, $0.40 towards purchased water, -$0.22 towards infrastructure investments, and -$0.29 towards water conservation (LADWP). The distribution of funds gives an interesting insight into the values and priorities of LADWP. A significant amount of revenue from increased water rates will be funneled into protecting the City's ability to borrow water in the case of future water shortages or increased water demands. There is a clear difference between the perspective of the interviewees and the data outlined in LADWP's Board of Commissioners presentation. This discrepancy could reflect the differences between the data and the reality of implementing it. The data demonstrates that rates need to increase to meet LADWP's business needs. However, the interviewees have first-hand experiences of implementing such policy and, therefore, may have a better understanding of the difficulty that is inherent with such change.

In addition to economic changes, Ashenmiller stated that LADWP should focus on targeting the customers who have the highest water usage. She criticized Governor Jerry Brown's

Water Conservation Act of 2009 that requires all cities and counties in California to reduce their water usage 20% by 2020 (Urban Water Management Plan). Water agencies are required to set an interim goal for 2015 using one of four methods. LADWP has chosen to set its interim goal using the method that takes into account past conservation efforts achieved by the water agency and, therefore, allows the City to achieve minimal reduction in water use. Water conservation measures are invaluable to achieving the City's 20% water reduction goal. Finding effective ways to target household's excessive water uses, which is mainly outdoor use, will be integral. If LADWP fails to reach its 2020 goal of reducing water usage to 138 gallons per capita per day (GPCD), then LADWP will not receive water grants or loans distributed by the State (UWMP). When asked about the impact the Water Conservation Act will have on homeowner's, Ashenmiller commented that some customers are already reducing their water usage and those that use the most amount of water are not reducing their water use at a high enough percentage. In other words, LADWP could achieve more water reduction if the agency targeted people who have the highest water usage.

Further, Hamilton's research, which was discussed earlier in this paper, found that when comparing the role of idealistic versus economic incentives in motivating homeowner's to reduce their water use, economic incentives played a larger role in actual water savings. In addition, Hanemann and Nauges (2005) found that customers were more responsive to increased water prices and mandatory water conservation programs. This presents an interesting juxtaposition between research surrounding the effect of increasing water prices on customer's water use behavior and the opinion of the interviewees about the potential public backlash of increasing water rates. Though research suggests that increasing water rates and mandatory conservation

policy is the most effective conservation tool to reduce water use, the consensus from the interviewees suggests that that conservation tool is too controversial. However, it is important to note that none of the interviewees said that increasing water rates would not have a positive effect on reducing homeowner's outdoor water use. Rather, the interviewees were hesitant to support water rates because of the public outrage and political resistance.

In addition, in 2011, LADWP redesigned their water bill to have more of a visual impact on their customers in hopes that it would encourage customers to reduce their water use. The newly designed bill includes a chart that shows household water use from month to month. This graph gives customers a visual representation of their water use variance from month to month. Below the graph, LADWP lists the household's daily average use in gallons. However, Pascual, Rhone, and Ashenmiller argue that regardless of the new bill design, LADWP needs to improve their communication about water overuse and the state of the water crisis. Pascual and Ashenmiller also touched on the technical difficulty of understanding how much outdoor water households are using. All residential homes have a mixed-use meter, which means that the amount of water a home uses indoors and outdoors flows through the same meter. This means that households are unable to know how much water they are using outdoors.

Ashenmiller's remarks about the need to target high water users in order to achieve greater water reduction is reflected in the research performed by Hanemann and Naugues (2005), Renwick and Archibald (1996), as well as Mansur and Olmstead (2006). Hanemann and Naugues (2005) found that the degree of response to water conservation measures was dependent on lot size. They found that during a mandatory conservation program, the percentage of water use was the same across all lot sizes, which suggests that households with a smaller lot size

achieved greater water reductions. Similarly, Mansur and Olmstead (2006) found that when water prices increased, low-income households were responsible for larger water reductions. Renwick and Archibald noted that low-income households were more responsive to price changes. Renwick and Archibald (1996) suggest that requiring water-efficient landscaping technologies to be installed will result in larger water reductions in high-income households that presumably have larger lot sizes. This means that in order for LADWP to achieve maximum water reduction in the residential sector, the agency needs to target households with a large lot size rather than creating blanket conservation measures that unfairly target homeowner's who already reduce massive amounts of water where they can. In doing so, LADWP will be able to achieve water reductions where they are needed most, which is household's with large lot sizes and excessive outdoor water use.

Finding Three: LADWP needs to launch a media campaign that has a human interest component surrounding Los Angeles' identity as a city that was founded on water. This campaign would have the potential to reshape Los Angeles' identity as a city of people who understand, value, and conserve water.

Each of the interviewees discussed the public's lack of understanding of Los Angeles' long history with water. Both Rhone and Pascual mentioned how they found it ironic that Los Angeles was founded around water yet the public does not have any connection to it. Mulroy drew a connection between the public's perception of the water crisis and their overuse of a finite resource as reasons why people are unable to see how water connects them to the larger environment. Mulroy commented that because Southern Californians are unable to see their impact on water environments, they are unable to understand the interdependence of neighboring states who share water sources with L.A. and how the water crisis is affecting those states. Mulroy looked to education campaigns to combat this problem. She saw education campaigns to

raise consumer awareness and shape public perception about the water crisis as one solution to this problem.

Pascual remarked that one of the biggest challenges of water conservation rebate programs is motivating people to participate. He raised questions about changing people's consciousness through media campaigns. Pascual believes that one potential method to improve public engagement is through a media campaign that creates a common identity between Los Angelenos and the city that is based on water. Using the "I Love NY" campaign as an example, he commented that Los Angeles does not have a campaign that makes people love the city. Further, he argued that LADWP needs to address conservation in people's day-to-day life by introducing a human interest component into their conservation campaigns. Rhone emphasized the importance of addressing conservation in people's day-to-day lives when he reflected on the powerful images used during the '76 – '77 drought that dramatically affected the public's perception of the water shortage.

Additional Findings

It is important to note that during my interview with LADWP's Manager of Water Conservation Policy, Penny Falcon, the Director of Public Affairs was present. Her presence affected the mood of the interview. This speaks volumes about the underlying controversy of LADWP's conservation programs. In the last 5 years, LADWP has received a lot of negative attention in the media for the agency's messy bureaucracy and lack of transparency. Though she did not interrupt the interview at any point, the Director of Public Affairs took notes throughout my conversation with Falcon. In addition, Falcon's attitude toward LADWP's water conservation efforts was significantly more optimistic than any of the other interviewees. This could be a

representation of LADWP's desperate need for a positive image, especially as the region deals with one of the worst droughts the area has ever seen.

Ashenmiller and Pascual both address LADWP needing innovation with their outdoor water conservation programs. Ashenmiller suggested that LADWP create more rebate options for their customers and find new ways to address the infrastructure issues without putting the cost on the backs of households. On the other hand, Pascual questions if innovation is practical in times of urgency like the current drought. He questions if it is more efficient for LADWP to work with programs that they know work or innovate new programs that have greater potential to reduce water usage. His argument against exploring innovative techniques is that those kinds of programs need time to develop in order to see if they are effective. Thus, both Ashenmiller and Pascual agree that LADWP needs find a model that assesses the effectiveness of their rebate programs so the agency has a better understanding of what programs to continue investing in.

Recommendations:

There is huge potential for reducing outdoor water usage in L.A. Outdoor water use is the most excessive and nonessential use of water in the residential sector. Reducing outdoor water use will reduce LADWP's dependence on imported water, reduce wasteful and unnecessary water demand, and increase local water supply. The purpose of these recommendations is to outline how to most effectively reduce urban outdoor water use. Massive outdoor water reductions can be achieved through: launching an extensive education campaign that educates customers on L.A.'s water supplies and provide customers with the resources available to reduce wasteful water behavior, increase water rates and partially restructure LADWP's tiered rate structure, and implement mandatory, permanent restrictions instead of voluntary programs.

Creating a Culture of Water Conservation through Education Campaigns

As seen in the "toilet-to-tap" campaign, media can play a pivotal role in shaping water policy and public perceptions about water. LADWP should create a campaign with clear language about the current water crisis so that the public can easily understand the current water conditions. LADWP needs to use media as a channel of communication to the public. Media, like TV broadcasts, billboards and newspaper articles, can shape public perception by facilitating the public's understanding of how their individual actions affect water supply and demand. As previously discussed in this paper, the residential sector achieved massive water reduction during the '76 - '77 drought because LADWP launched an extensive media campaign. On a daily basis, customers were exposed to images and news cycles about the severity of the water shortage. The research on the '76 - '77 media campaign covered in this paper found that images of depleted reservoirs resonated with customers. Customers were able to visually understand the impact their water behavior had on the water crisis. It connected the public to the crisis and encouraged conservation. More research needs to be done on the elements of LADWP's '76 – '77media campaign that were the most successful in motivating customers to decrease their water use.

Providing the public with knowledge about the severity of California's water shortage has the potential to motivate behavioral changes in customers' wasteful water practices. Focusing on wasteful lawn practices will be key. In addition, indoor water-efficient retrofits have been effective for the past 20 years. However, the indoor technologies have almost reached saturation in the market, meaning there is little room for new and innovative indoor water savings.

Therefore, education campaigns surrounding urban water conservation techniques need to focus on reducing outdoor water use.

LADWP's education campaign should contain an element that examines what future water conditions will be like if customers do not take immediate action to reduce their water use. The function of this is not to induce fear in customers but to provide a context and understanding of why reducing excessive water use is so important. One method to directly confront homeowner's about their water use is to give each household a letter grade on their utility bill. Currently, LADWP has a bar graph on water bills that show the variance of a household's water use from month-to-month. However, the bar graph appears on the second to last page of the utility bill, which perhaps reflects LADWP's low priority of water conservation. For paperless billing, customers can log on to their LADWP online account and immediately pay their utility bill using the "Pay Now" button without even viewing the breakdown of their water bill. They see how the cost of their bill is distributed across water, electric, and sewage charges but they are not given direct information about their usage of each utility unless they actively explore the website for it. This completely removes customers from their water usage. Further, the visual impact of the bar graph is not as effective as it could be. The bar graph only allows customers to compare their current water use to their previous water use. The graph lacks any kind of water conservation goal or standard of comparison. For example, a large lot size homeowner could see that their water use decreased a certain amount between two months. If that customer is already a high water user, then the chart does not help them see their excessive water use in the context of other household's water use.

The education campaign should serve as an adjunct with other measures, such as rate increases and mandatory restrictions. LADWP's Urban Water Management Plan states "One of LADWP's most effective conservation tools is the sustained conservation ethic of its customers" (47). As the City's water manager, it is LADWP's responsibility to give its customers the necessary resources to understand why water conservation is urgent and necessary. LADWP needs to implement more outreach efforts to facilitate a better conservation ethic in its customers by educating the public about L.A.'s water sources and wasteful water behaviors. In order for customers to participate in outdoor water conservation rebate programs, LADWP needs to tell their customers why, for example, installing water-efficient landscape technologies is important. LADWP can provide economic and environmental incentives by informing customers of the environmental benefit of reducing wasteful water uses and of the economic benefit of a cheaper water bill. The function of this campaign will be to create a foundation of knowledge about water supplies and help the public draw a correlation between water scarcity and, ultimately, the need to increase water rates. The larger goal of this campaign will be to create a culture of water conservation in L.A., a culture where every LADWP customer has a water conscious that makes them think twice about how they can minimize unnecessary water uses.

Permanent Restrictions with Clear Conservation Message

LADWP does not have a clear and consistent water conservation message. This is most clearly seen in the fluctuation between voluntary and mandatory water conservation programs, as well as the different drought phases of the Emergency Water Conservation Plan. LADWP restricts customers' water use behaviors depending on climatic conditions. For example, in the

summer time, when the climate is driest and LADWP experiences peak water demands, the water agency requires homeowner's to water their lawns during certain periods of the day and only certain days of the week. However, during wet periods, homeowners' lawn-watering behaviors are not restricted. This sends customers the message that water conservation is only important during dry periods and at all other times during the year water can be used freely and excessively. Further, LADWP rarely monitors or enforces water restrictions.

LADWP prohibits different water use behaviors depending on the drought phase in effect. Each of the five phases has varying degrees of water restrictions that are based on the severity of the drought. Phase I is always in effect regardless of climate conditions. It recommends homeowner's reduce excessive outdoor uses, such as abstaining from watering lawns between 9 am and 4 pm. The other four phases only truly vary with irrigation restrictions. Phase II allows lawn watering on three days out of the week for eight minute periods whereas Phase III allows lawn watering one day a week. Phase IV and V are slightly more extreme by requiring that absolutely no lawn irrigation be allowed along with other restrictions. However, the insignificant differences between the phases and the fluctuation of which phase is in effect depending on climatic conditions, signals to customers that water shortages are not a permanent pattern and, therefore, overall water behaviors do not need to change. LADWP cannot expect their customers to participate in conservation programs if the agency themselves does not have a strong and consistent conservation message. Therefore, the research from this paper suggests that LADWP implement permanent restrictions on outdoor water behavior. For example, LADWP should require that homeowner's may only water their lawns for two days a week throughout the entire year.

Outdoor Use Quantified: Required Sub-Meter Installation for Large Lot Sizes

LADWP lacks real data of urban outdoor water use because most homes have mixed-use meters. The flow of water from indoor and outdoor use goes through the same meter. Therefore, LADWP customers are incapable of identifying how much outdoor water they use. Since it is unclear how much water is used outdoors in urban households, there are substantial problems in understanding which customers to target with outdoor water conservation measures and how LADWP can create effective outdoor water conservation programs. Another significant issue LADWP needs to address is water allotments for individual households. By providing more water to households that have large lots, LADWP is encouraging those household's to use more water than necessary. In order to provide households with information about their outdoor water use, identify what areas and households to aggressively target with outdoor water conservation programs, and, ultimately, reduce outdoor water use, this paper suggest that all household's above a certain square footage be required to install a sub-meter. Sub-meters divide indoor and outdoor water use. The installation of a sub-meter would show homeowner's how much water they use indoor versus outdoors. However, further research needs to be done that identifies what areas are zoned for large lot sizes and how much of the lot is dedicated to landscaping in L.A. That research would help indicate what standard to use when identifying which houses in L.A. would require the installation of a sub-meter. This knowledge is invaluable in motivating customers to participate in outdoor conservation campaigns. Currently, homeowner's do not have a grasp on how much water they use outdoors because even their water agency doesn't know that information.

Sub-meters are expensive and LADWP does not currently offer any kind of subsidy to purchase a sub-meter or offer free installation. The burden of purchasing and installing this complex technology is placed on the individual customer. Sub-meters cost in between $235 - $690, depending on a variety of factors. LADWP should offer free installation and a subsidy to customers who purchase the sub-meter. Further, LADWP should require household's with a certain square footage to install the sub-meter. The purpose of this suggested mandate is that it targets customers with the highest water usage and provides the homeowner with information about exactly how much water is being wasted on non-essential uses.

Raising Water Prices: An Aggressive Approach towards Outdoor Water Conservation

LADWP has only taken an aggressive approach to conservation measures during times of drought and extreme water shortages. In an effort to avoid political resistance and public outrage, LADWP has avoided implementing aggressive water conservation policies. This is best reflected in the amount of voluntary programs LADWP offers that only require passive and modest behavioral changes. LADWP needs to overcome political apprehension and implement increased water rates that will result in actual reductions in water use. Though four out of the five interviewees advised against raising water prices as a conservation tool to reduce urban water use, the research from this paper concludes that raising water rates is the most effective method for reducing outdoor water use. LADWP needs to send more effective price signals to customers who excessively use water. LADWP can achieve this by restructuring its rate structure to target high-usage customers with large lot sizes. Well-designed rate structures should encourage water conservation through sending effective price signals. LADWP's current rate structure does not

encourage water conservation because the ratio between tier 1 and tier 2 prices does not send effective price signals to customers who use an excessive amount of water.

The price of tier 2 rates, which accounts for non-essential water uses, need to be high enough that customers realize the value of conserving. The price of water is inelastic. The price elasticity of water is -0.51 (Olmstead et al). In other words, if there were a 10% increase in water prices, water consumption would decrease by 5.1%. This has huge implications for potential water savings. Tier 1 prices should remain low in order to cover essential indoor water uses, like flushing, and not penalize customers who do not use a copious amount of outdoor water.

LADWP's rate structure is not effective because lot size is one of the most influential factors in determining the water allotment for each household, meaning that customers that have large lot sizes, and typically have the highest excessive water uses, receive larger water allotments. The water allocation for each household should be based on the number of members in the household in order to ensure that every household receives enough water for essential needs. However, this data may be difficult for the water agency to verify. A possible solution could be to use occupancy data for different census tracts (Veverka). This method would make sure that low-income customers with larger households do not have to pay more just to meet essential indoor needs.

Further, LADWP does not equitably distribute the cost of water among its customers. The financial burden of increasing prices of purchased water will fall on the backs of tier 1 customers. In LADWP's current tiered structure system, tier 2 prices do not include the fluctuating cost of purchased water. This seems counter-intuitive since tier 2 prices are set for

customers who use excessive water and, consequently, increase LADWP's need to purchase more imported water. As water sources continue to dwindle, the cost of imported water will inevitably increase. The revenue from increased tier 2 rates can help fund replenishing local water supplies, fix infrastructure leaks, and other conservation programs. Research discussed earlier in this paper suggests that low-income households are responsible for a greater percentage of overall water reduction than high-income households. Further, the research shows that with the current rate structure, low-income households are more responsive to price signals. The weight of the research demonstrates that LADWP does not effectively target its highest water users, its rate structure does not send effective price signals to its highest-water usage customers, and, lastly, the rate structure does not equitably distribute the cost of water to its customers. Further research needs to be done that examines what the ratio difference should be between tier 1 and tier 2 prices that will send an effective price signal to customers.

Each recommendation works in tandem with the other to effectively reduce urban outdoor water use. At the root of water conservation programs is educating the public about water. Public involvement is key for the implementation process of these recommendations. Educating customers on the current water conditions fosters a relationship between Los Angelenos water use behaviors and L.A.'s water supply. Instead of perceiving the current water shortage as non-threatening, these measures make the water shortage more of a reality and emphasize the effectiveness and rationality of outdoor water conservation programs.

Chapter 6: Conclusion

The relative absence of massive outdoor water reduction and the unnecessary nature of lawn irrigation in the residential sector provides great potential for LADWP to achieve significant water reductions. Pascual represented L.A.'s relationship to water issues best in his interview when he said "people talk about what they see". A main theme throughout this paper has been L.A.'s perception of the current water crisis as non-threatening and possibly nonexistent because the city is not located near its water sources and, therefore, does not physically see the rapid depletion of the Colorado Basin or Los Angeles Aqueduct. Los Angeles is often times praised for leading the nation in water conservation efforts. Los Angeles has the lowest water consumption per capita of any major city in the nation. The question becomes: What more can the City do? Los Angeles has achieved this title without effectively targeting the sector of the City with the most excessive and non-essential water use: urban outdoor water use.

This paper has outlined the history of water availability in Los Angeles and how it facilitated limitless growth, the complex web of imported water that has facilitated the idea that water in an arid region is always available, and the importance of water conservation in urban areas during a time of uncertainty surrounding future urban water availability. This research used the findings from interviews with leading water policy experts to provide a framework for policy recommendations that aim to reduce urban outdoor water use. This paper concluded with recommendations to reduce outdoor water usage by effectively targeting high outdoor water uses through requiring the installation of private sub meters and water efficient technologies, creating an education campaign that aims to create a culture of water conservation in Los Angeles and,

finally, raising water rates by increasing the ratio of tier 1 and tier 2 prices with the intention of sending a more effective price signal to the highest water users.

The need to reduce excessive water use and save as much water as possible cannot be overstated in this time of drastic climate change impacts and dwindling finite resources. As L.A.'s water utility agency, LADWP needs to provide its customers with the necessary tools to reduce their inessential water uses. LADWP has the power to implement real change in Los Angeles. As the City's water supplier, it is LADWP's duty to create a culture of conservation through effective outdoor conservation policy and programs.

Bibliography:

2011 Rate Process. (2011, June 14). . Retrieved January 8, 2014, from http://www.ladwpneighborhoodnews.com/external/content/document/1643/1114111/1/2011%20Rates%20Process.pdf

Addink, S. (n.d.). “CASH FOR GRASS” - A Cost Effective Method to Conserve Landscape Water?. . Retrieved January 16, 2014, from http://agops.ucr.edu/turf/topics/Cash-for-Grass.pdf

Beckman, D. (2009, April 28). Wasting LA's Water During a Drought. *Home*. Retrieved February 16, 2014, from http://switchboard.nrdc.org/blogs/dbeckman/wasting_las_water_during_a_dro.html

Bormann, H. Rethinking the American Lawn. *Natural Science* , *9*.

Building a New Los Angeles: Water and Power Budget Presentation. (2011, June 7). . Retrieved February 16, 2014, from http://www.ladwpneighborhoodnews.com/external/content/document/1643/1109759/1/Budget_Presentation_FY11-12_06072011_FINAL%20%5BCompatibility%20Mode%5D.pdf

Consumers' Perspectives on Water Issues: Directions for Educational Campaign. *The Journal of Environmental Education*, *34*, 28-35.

Dixon, L., Moore, N., & Pint, E. Drought Management Policies and Economic Effects in Urban Areas of California, 1987-1992. *Rand*.

Domestic water use. (n.d.). *Domestic Water Use, the USGS Water Science School*. Retrieved January 10, 2014, from http://water.usgs.gov/edu/wudo.html

Freeman, H. E. Measuring the impact of water conservation campaigns in California. *Climatic Change*, *24*, 233-248.

Gleick, P., Haasz, D., Henges-Jeck, C., Wolff, G., Cushing, K. K., & Mann, A. Waste Not, Want Not: The Potential for Urban Water Conservation in California. *Pacific Institute*.

Gray, H. (n.d.). Illumin - California's Water Crisis. *Illumin - California's Water Crisis*. Retrieved January 16, 2014, from http://illumin.usc.edu/printer/167/california39s-water-crisis/

Hamilton, L. C. Saving Water: A Causal Model of Household Conservation. *Sociological Perspectives*, *26*, 355-374.

Hamilton, L. C. Self-Reported And Actual Savings In A Water Conservation Campaign. *Environment and Behavior*, *17*, 315-326.

Hanemann, M., & Nauges, C. Heterogeneous Responses to Water Conservation Programs: The Case of Residential Users in Los Angeles. *Department of Agricultural and Resource UC Berkeley*.

Hilaire, R. S. et al. Efficient Water Use in Residential Urban Landscapes. *HortScience*, *43*, 2081-2092.

Hudson, S. J. Challenges For Environmental Education: Issues And Ideas For The 21st Century. *BioScience*, *51*, 283-288.

Kos, Blake, "Southern California Water Management: Practical Adoptions and Policy Recommendations" (2011). *CMC Senior Theses.* Paper 208. http://scholarship.claremont.edu/cmc_theses/208

Oliver, M. D. Attitudes and Inaction: A Case Study of the Manifest Demographics of Urban Water Conservation. *Environment and Behavior*, *31*, 372-394.

Olmstead, S., & Stavins, R. Managing Water Demand: Price vs. Non-Price Conservation Programs. *Pioneer Institute for Public Policy Research*.

Olsen, M. E. Consumers' Attitudes Toward Energy Conservation. *Journal of Social Issues*, *37*, 108-131.

Public-supply water use. (2005, January 1). *Public supply Water Use, the USGS Water Science School*. Retrieved January 22, 2014, from http://water.usgs.gov/edu/wups.html

Quick Facts about Water Use in California -- And Why You Should Conserve. (n.d.). Save Our Water. Retrieved January 22, 2014, from http://www.saveourh2o.org/content/quick-facts-about-water-use-california-and-why-you-should-conserve

Schein, R. H. The Place Of Landscape: A Conceptual Framework For Interpreting An American Scene. *Annals of the Association of American Geographers*, *87*, 660-680.

Spross, J. (2013, February 25). Study: Climate Change May Dry Up Important U.S. Reservoirs Like Lake Powell And Lake Mead. *ThinkProgress RSS*. Retrieved May 22, 2014, from http://thinkprogress.org/climate/2013/02/25/1638541/study-climate-change-dry-up-us-reservoirs-lake-powell-lake-mead/

Steinberg, T. Lawn and Landscape in World Context, 1945-2000. *OAH Magazine of History*, *19*, 62-69.

Tavares, S. (2009, May 1). Pat Mulroy. *LasVegasSun.com*. Retrieved February 16, 2014, from http://www.lasvegassun.com/news/2009/may/01/pat-mulroy/

"The Hydrology of the 1987-1992 California Drought" October, 1992. http://water.ca.gov/waterconditions/docs/hydrology_drought-1987-1992.pdf

"The 1976 – 1977 California Drought Review" May, 1978. http://www.water.ca.gov/watertransfers/docs/9_drought-1976-77.pdf

Total Water Use in the United States, 2005. (2005, January 1). *, the USGS Water Science School*. Retrieved January 22, 2014, from http://water.usgs.gov/edu/wateruse-total.html

Water Resource Plan 09. (2009, January 1). . Retrieved January 16, 2014, from https://www.snwa.com/assets/pdf/wr_plan.pdf

Water System Rate Proposal. (2012, June 5). . Retrieved January 16, 2014, from http://www.reliablewaterandpower.org/uploads/3/7/7/0/3770006/ladwp_water_system_rate_proposal

Wines, M. (2014, January 5). Colorado River Drought Forces a Painful Reckoning for States. *The New York Times*. Retrieved January 16, 2014, from http://www.nytimes.com/2014/01/06/us/colorado-river-drought-forces-a-painful-reckoning-for-states.html?_r=1

Worrel, G. (2009, September 1). Lawn Be Gone. . Retrieved November 11, 2013, from http://jubilee101.com/subscription/pdf/Organic-Gardening/Lawn-Be-Gone---35pages.pdf