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A Quantitative Analysis of the Effect of Cash-4-Grass Programs on Water Consumption

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Abstract

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MPP, California Polytechnic State University, San Luis Obispo, 2010

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Dissertation Submitted in Partial Fulfillment

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Abstract

Water supplies in California are stretched to critical levels as a result of population growth, periodic drought, and climate change. The California legislature recognized that the best way to increase supply is to decrease demand so the Water Use Efficiency Senate Bill 7 (SBx7-7) was signed into law in 2009. The law requires water purveyors to reduce per capita water usage by 20% by the year 2020. To comply, water purveyors are searching for innovative ways to increase water conservation. A review of the literature has shown that many factors influence water consumption. However, the majority of household water consumption is attributable to outdoor landscaping, and traditional grass lawns have increasingly been targeted for conservation measures by municipalities. The purpose of this study was to determine if the receipt of a landscape rebate reduces water consumption. The theoretical frameworks for this study were Ajzen and Fishbein's theory of reasoned action and theory of planned behavior. Archival data were collected and analyzed utilizing an ordinary least squares regression analysis. The analyses determined that there was a significant reduction in water consumption for customers who received a rebate but there was no significant difference in water consumption in the 24 months before and 24 months after receipt of a rebate. While the results were mixed, a robust water conservation program, including Cash-4-Grass rebates, can have a significant impact on water consumption. This study is expected to promote positive social change via empirical data that allows water professionals to encourage alternative methods for extending California's water supplies.

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Dedication

Dedicated to my grandmother, Lula Marie Ellingson Atkins (1915-2013).

Grandma Lou was a strong, independent woman who made me believe that I could do anything and be anyone. She was very proud of my accomplishments and I am saddened that she was unable to see my doctoral journey come to fruition.

Acknowledgments

I would not have been able to do this without the support of my friends and family. Their belief in my ability to succeed gave me the motivation to keep plugging along when I was doubting myself.

I would like to give special thanks to Dr. Clare Battista, my capstone project advisor at California Polytechnic State University-San Luis Obispo, who planted the seed during my undergraduate studies that I could, and should, get my doctorate and Dr. Elizabeth Lowham, the Director of my Masters of Public Policy program at California Polytechnic State University-San Luis Obispo, for her encouraging words and for politely answering my statistical questions three years after I graduated from the program.

Finally, I would like to express my sincere gratitude to Dr. Christopher Burr Jones, my committee chair, for his guidance and support during my dissertation journey and Dr. Karen Shafer, my methodology advisor, for pushing me to learn as much as I could about my selected methodology. No matter how hard it was to sometimes hear, my dissertation only got better as a result of their feedback.

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Chapter 1: Introduction to the Study

Introduction

In the period 1950 to 2005, the population of the United States doubled, with the southern and western regions experiencing the largest population growth (Kenny et al., 2009). In California, the population grew 137% in the 50 years prior to the 2010 Census (United States Census Bureau, 1960, 2010a). While population increase on its own is a strain on a water supply, water pollution, climate change, and periodic drought have also had a profound impact on California's supplies (CDWR, 2009a; USEPA, 2002).

In the half-century prior to 2011, for over half of that period (29 years) California received annual rainfall below the average of 21.85 inches (see Figure 1; NOAA, 2013). Between 2007 and 2009, the driest period since California's historic 1986-1992 drought, the state averaged 15.39 inches of rain (CDWR, 2009a, 2010b; NOAA, 2013; Santa Barbara County, 2009). In the midst of this 3-year drought, Governor Arnold Schwarzenegger asked the California legislature to draft water conservation legislation and, on November 10, 2009, he signed into law the Water Use Efficiency Senate Bill 7 (SBx7-7; California Senate, 2009; CDWR, 2009c).

An important component of SBx7-7 is the requirement that water purveyors in California reduce their per capita water consumption by 20% by the year 2020 (CDWR, 2009c). According to Rogers (2009), "California now is the first state to set statewide targets for water conservation. The law also is expected to push cities such as Fresno and Sacramento—which still don't have water meters on all homes—to do more" (p. 2B). This innovative legislation encourages the implementation of new water conservation programs and inventive water saving solutions, if only for the purpose of complying with the new law.

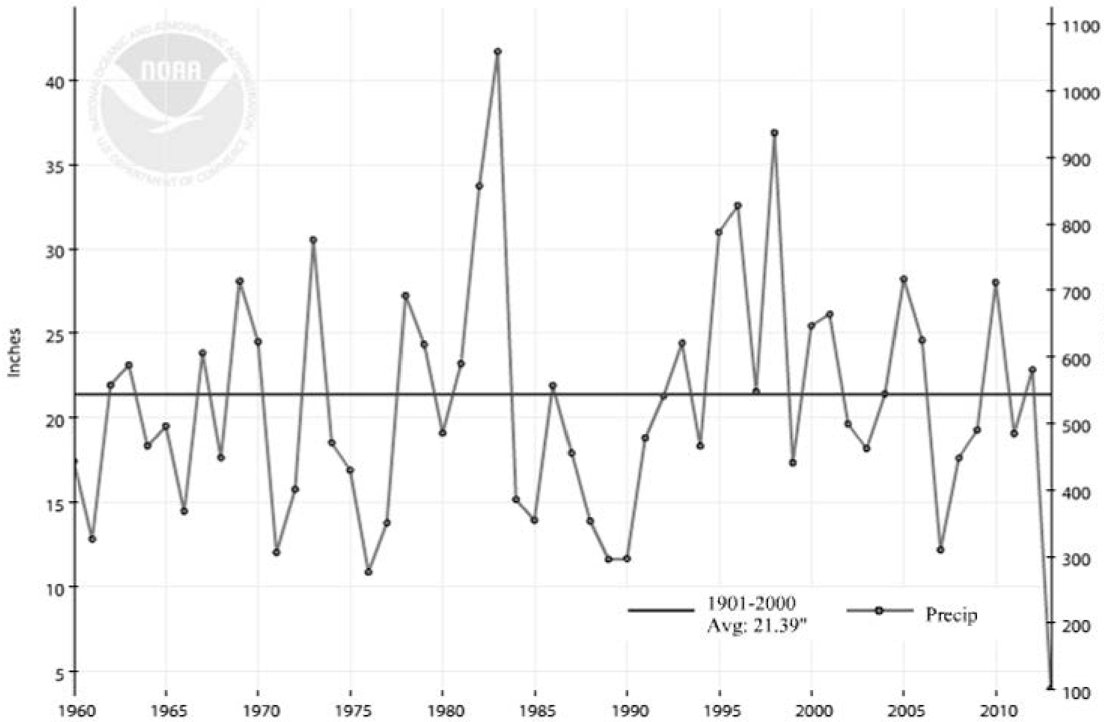

Figure 1. California, climate division 4, precipitation, January-December 1960-2011. Reprinted from "Temp, Precip, and Drought Time Series" NOAA, 2013. Retrieved from http://www.ncdc.noaa.gov/cag/time-series/us. Material is not subject to copyright protection within the United States.

Most commonly, elements of water conservation programs fall into three categories: restrictions, rates, and rebates. Water conservation restrictions provide authority to the water purveyor to encourage consumers to reduce their water consumption during droughts. Encouragement is attempted through the implementation and enforcement of water budgets. A water budget is an estimate calculated for the household so that the customer can achieve the most efficient use of water. Should the household use more water during the billing period than is specified in their water budget, the customer is billed at a punitively higher drought rate for the excess water. For example, in 2012, customers of Moulton Niguel Water District in southern California paid \$1.38 per unit (100 cubic feet or 1 CCF or 748 gallons) for the amount of water allotted to their indoor water budget, \$1.54 per unit for the water allotted to their outdoor water budget, and from \$2.75 to \$11.02 per unit for water used in excess of their water budget (see Figure 2).

Generally, water conservation rates are either tiered water rates designed to encourage water conservation year round or drought rates imposed only during declared drought emergencies. Rather than set an individual water budget for every household, the water purveyor sets its tiers based on their customers' cumulative average usage or industry standard tiers. For example, customers of Vandenberg Village Community Services District (VVCSD), on California's central coast, pay \$1.25 per unit of water for the first 10 units, \$1.43 per unit of water for the next 7 units, \$1.55 per unit of water for the next 32 units, and \$2.49 per unit of water for water usage above 49 units in a billing cycle (see Figure 3; VVCSD, 2013).

Water conservation rebates encourage the replacement of high-water-use features—such as toilets, washing machines, dishwashers, and grass—by providing cash incentives. Landscape rebates, also known as Cash-4-Grass rebates, encourage customers to reduce the amount of turf grass in their yard and thereby reduce outside watering. In 1994, the United States Environmental Protection Agency introduced the concept of landscape rebates:

Landscape rebate programs pay customers to install low-water-use landscaping or to convert all or part of their lawn to nonturf landscaping. Participation in this type of program is predominantly by residential customers. The amount of rebate paid in a landscape conversion program is usually based on the amount of land converted to water-efficient landscape. (Chapter 4, p. 6)

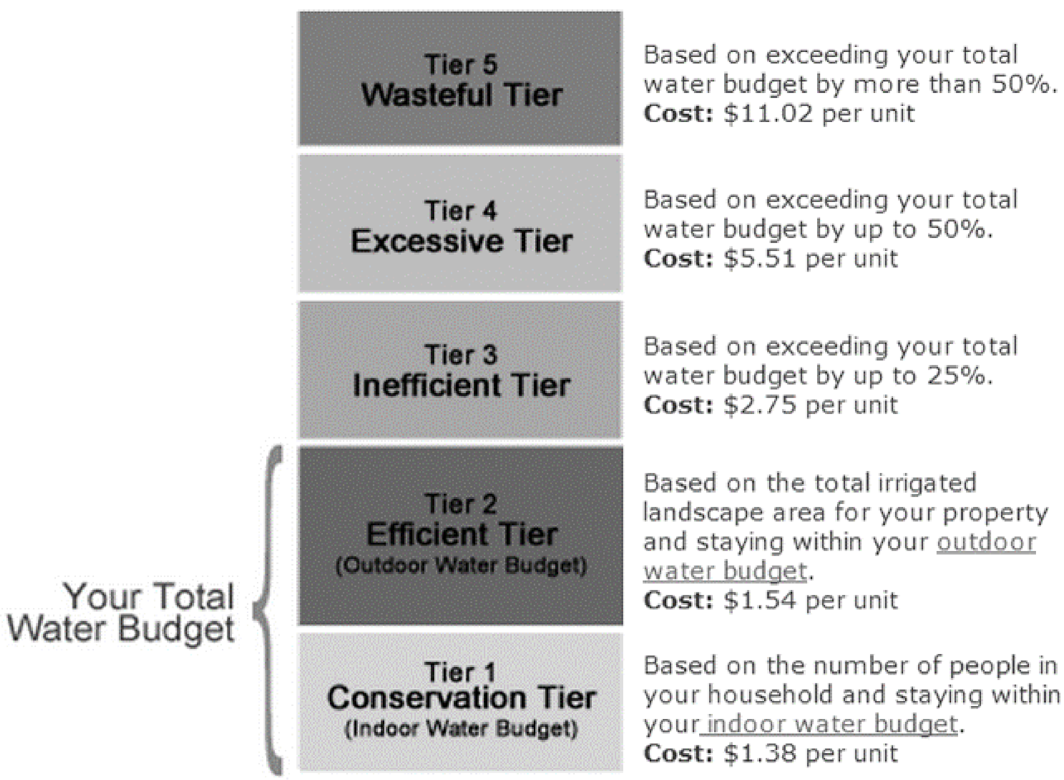

Figure 2. Residential water budget. Reprinted from “Understanding water-budget-based rates”, by Moulton Niguel Water District, 2012. Retrieved from http://www.mnwd.com/ customer-service/budget-based-rates.aspx. Copyright 2012 by Moulton Niguel Water District. Reprinted with permission.

However, it was more than a decade before water purveyors embraced the possibility of reducing water consumption by providing such rebates. In 2007, VVCSD was the first agency in Santa Barbara County to offer landscape rebates (J. Barget, personal communication, January 11, 2012). VVCSD provides rebates of $2.00 per square foot (up to $1,000) to replace grass with low water usage plants, rocks, or synthetic turf (VVCSD, 2012d).

Figure 3. Inclining block rate structure. Compiled from “Current residential water and wastewater rates (effective 7/13)” VVCSD, 2013. Retrieved from http://vvcsd.org/custserv/current.htm. Copyright 2013 by VVCSD. Reprinted with permission.

Developer in-lieu fees fund VVCSD’s water conservation program (VVCSD, 2007). In accordance with the program, developers must retrofit 10 existing homes for every new home built. Rather than soliciting volunteers and physically retrofitting those homes, developers pay an in-lieu fee to VVCSD which administers the water conservation program and coordinates retrofits. Additionally, from 2010 through 2012, VVCSD and other agencies in the county were awarded more than $160,000 in grant funds from the United States Bureau of Reclamation to encourage and promote landscape rebates (Santa Barbara County, 2010). VVCSD received almost $10,000 in reimbursements (VVCSD, 2012b). As a result, in the period from the program’s inception in November 2007 through November 2012, 46 rebates were issued for the replacement of 57,570 square feet of lawn (VVCSD, 2012b).

This chapter provides background information on global and local water supply and demand; it details threats to the water supply, such as pollution, population increase, climate change, and drought; and it presents solutions to increase supply and reduce demand, including water conservation. It also introduces the study area of Vandenberg Village, California, presents the theoretical framework, and includes the problem statement, purpose and nature of the study, research questions and hypotheses, definitions for terms, and assumptions, limitations, and delimitations.

This study is an important addition to the body of work on water conservation because of the current gap in the literature on landscape rebates. Attempting to control water demand through pricing structures is a very common research topic as are other types of elements of a water conservation program such as restrictions or indoor rebates (Gober & Kirkwood, 2010; Grafton & Ward, 2008; Harlan, Yabiku, Larsen, & Brazel, 2009; Kenney, Goemans, Klein, Lowrey, & Reidy, 2008). However, although introduced close to 2 decades ago, landscape rebates have only recently gained in popularity and have not yet been targeted for extensive research. Of the 17 water purveyors in Santa Barbara County, only 11 offer rebates as a part of their water conservation program and only three of those offer landscape rebates (Santa Barbara County, 2013a). Two of those programs were implemented in response to SBx7-7 (City of Lompoc, 2009; City of Santa Barbara, 2009). Only VVCSD began offering landscape rebates before the regulatory requirement to reduce water consumption was signed into law (VVCSD, 2007). As more water purveyors explore water conservation options, it is anticipated that this study will allow them to make an informed decision about innovative water conservation alternatives.

Background

Water Supply

Seventy percent of the earth's surface is covered in water (United States Geological Survey, 2012). However, 97.5% of the earth's water is saltwater. "It is the freshwater resources, such as the water in streams, rivers, lakes, and groundwater that provide people (and all life) with most of the water they need every day to live" (United States Geological Survey, 2012, para. 6). Of the 2.5% that is freshwater, 69% of the available water supplies are locked up in glaciers, icebergs, and permanent snow (see Table 1). This means that less than 1% of the earth's total water supply is drinkable and, of the available freshwater, almost all of it is located underground. The United States has over 3.5 million miles of rivers and streams and 40 million acres of lakes (USEPA, 2011, 2012) and many major U.S. cities were built, and thrived, along the banks of these rivers and lakes. Even though only about 0.3% of the world's freshwater is located in rivers and lakes, 80% of the water withdrawals in the United States come from these surface water sources (Kenny et al., 2009). The Schuylkill River, the largest tributary to the Delaware River, supplies drinking water to the City of Philadelphia (Philadelphia Water Department, 2012); New York City receives water for its residents from the Bronx, Delaware, and Croton Rivers through a series of dams, reservoirs, and aqueducts (Stony

Brook University, n.d.); and Lake Michigan provides nearly 60% of the drinking water used in the State of Illinois (University of Illinois at Urbana-Champaign, 2012).

Table 1

Global water distribution

Water source	Water volume, in cubic miles	Percent of freshwater	Percent of total water
Oceans, seas, and bays	321,000,000	--	96.54
Ice caps, glaciers, & permanent snow	5,773,000	68.6	1.74
Groundwater	5,614,000	--	1.69
Fresh	2,526,000	30.1	0.76
Saline	3,088,000	--	0.93
Soil moisture	3,959	0.05	0.001
Ground ice and permafrost	71,970	0.86	0.022
Lakes	42,320	--	0.013
Fresh	21,830	0.26	0.007
Saline	20,490	--	0.007
Atmosphere	3,095	0.04	0.001
Swamp water	2,752	0.03	0.0008
Rivers	509	0.006	0.0002
Biological water	269	0.003	0.0001

Note. Compiled from *Water in crisis: a guide to the world's fresh water resources* (pp. 13-24) by P. H. Gleick. New York, NY: Oxford University Press. Copyright 1993 by Pacific Institute for Studies in Development, Environment, and Security. Reprinted with permission.

Of the 20% of fresh water drawn from groundwater sources in the United States, 67% is for irrigation (Kenny et al., 2009). Only 18% is drawn for domestic water uses (Kenny et al., 2009).

California is home to more than 37 million people, has more than 800 miles of coastline, more than 400 groundwater basins, and uses more groundwater than any other state—nearly one sixth of the withdrawals in the nation (Bachman et al., 2005; CDWR, 2003; United States Census Bureau, 2010a). In California, in an average year, about 30% of the urban and agricultural water comes from groundwater (CDWR, 2003). During a drought year, the use of groundwater increases by 40% in some areas and up to 60% in others (CDWR, 2003).

On California's central coast, water supplies come from a variety of sources including groundwater, surface water, water imported from the State Water Project (SWP), and recycled water (CDWR, 2003). The CDWR (2009d) recognizes that California's central coast depends on its 28 groundwater basins for its water supply.

Santa Barbara County, the location of this study, receives about 77% (approximately 78,000 acre feet per year) of its domestic, commercial, industrial, and agricultural water from groundwater (Santa Barbara County, 2011). The county also has a combined allotment of 40,000 acre-foot per year (one acre-foot equals 325,851 gallons) of water from the SWP (Santa Barbara County, 2011). However, the voters of the city of Lompoc and the unincorporated areas of Mission Hills and Vandenberg Village rejected State Water, electing instead to rely solely on their groundwater wells (Santa Barbara County, 2011).

Threats to the water supply. These limited drinking water supplies are threatened by pollution, drought, climate change, and population growth (Anderson-Wilk, 2008; CDWR, 2009a; Harou et al., 2010; Larson, Gustafson, & Hirt, 2009;

USEPA, 2002). Although, even in California, a majority of the fresh water withdrawals are from surface water sources, both surface water and groundwater supplies are interconnected at the hydrologic level (see Figure 4). Therefore, pollution in the surface or groundwater supply or an overdraft, where more water is pumped out of the basin than is replenished (Hanak et al., 2011), can have an impact on a number of different communities regardless of their primary water source.

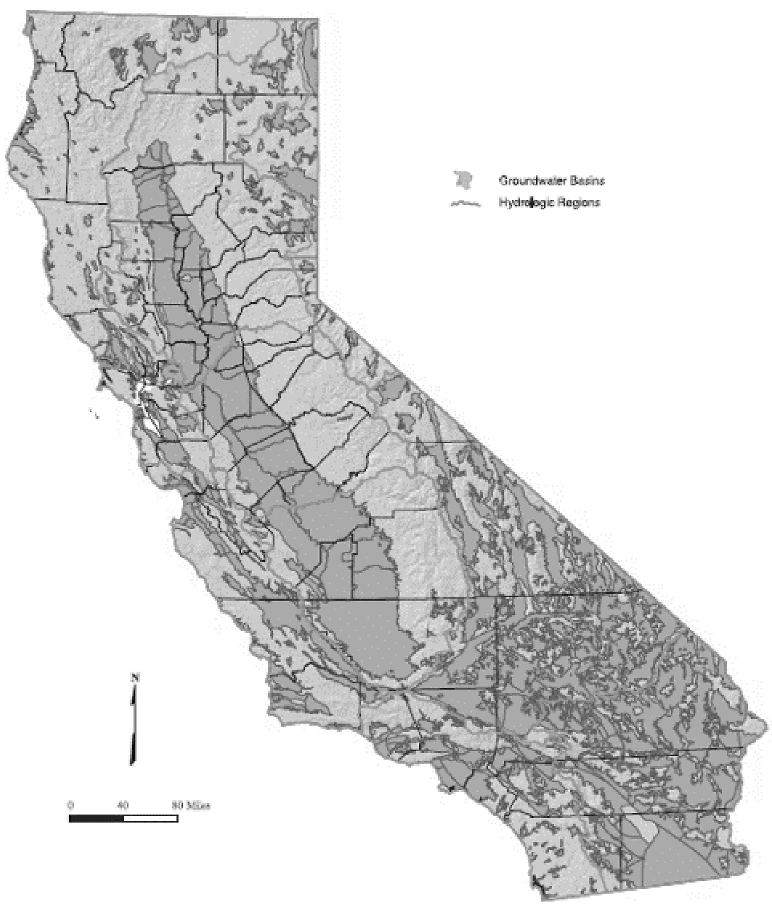

Figure 4. Map of the California basins and subbasins illustrating the interconnectivity of groundwater sources. Reprinted from *California's groundwater* (p. 108), by DWR, 1993. Sacramento, CA: State of California. Reprinted with permission.

Pollution. Water quality can be threatened by both natural and anthropogenic (man-made) contaminants (Bachman et al., 2005; Blette, 2008; Kumar, Adak, Gurian, & Lockwood, 2010; Pricope, 2009; Wilcox, Gotkowitz, Bradbury, & Bahr, 2010). Constituents occurring naturally include minerals that erode into the water such as arsenic, asbestos, fluoride, chromium, and cadmium (USEPA, 2009). Coastal communities are also at risk from seawater intrusion into groundwater basins (Bachman et al., 2005; CDWR, 2009b, 2009d). Man-made pollutants in the water supply include pesticides, nitrates, and perchlorates (Bachman et al., 2005; VanDerslice, 2011). The EPA requires periodic testing of all drinking water in the country to identify harmful constituents so that they can be removed from the drinking water supply, either during treatment or at the source, before the problem becomes so severe that it can no longer be remediated (Bachman et al., 2005; USEPA, 2009).

A contaminated water supply that cannot be remediated must be abandoned as a water source thereby reducing the available water to the region (Bachman et al., 2005; Millock & Nauges, 2010). Contamination may also be a threat to neighboring water sources if the migration of contaminated groundwater is not prevented (Bachman et al., 2005). Groundwater contamination can also result in higher treatment costs or well abandonment which would require alternative water sources and added capital costs (CDWR, 2009b).

Population. The California Department of Finance estimates that the state's population could increase by an additional 62% to 59.5 million by the year 2050 (see Table 2), and experts are concerned that California's water supplies will remain static or decrease (CDWR, 2009a). Population growth is a concern because it is a major factor for planning future water use (CDWR, 2009a). The Not in My Backyard (NIMBY) attitude exhibited by many urban residents demonstrates that some communities are resistant to reducing their water usage in response to population growth, even with encouragement from the purveyor (Atwood, Kreutzwiser, & De Loë, 2007; Cockerham & Leinauer, 2011; Nielsen-Pincus et al., 2010). This increase in population would reduce the available per capita water supply as urban development used more water for turf grass, golf courses, and backyard pools (Atwood et al., 2007; Balling, Gober, & Jones, 2008; Gober & Kirkwood, 2010). Although land-use planners make an effort to consider water supplies when approving new development, legislators will impose building moratoriums to limit new development in their jurisdiction (Marimow, 2007). However, the courts have been known to overrule a moratorium when there are housing shortages (Hanak, 2008; "Kawaoka v. the City of Arroyo Grande," 1994). This conflict in priorities increases the potential for overdraft in the region.

In reviewing the population growth scenarios delineated in Table 2, the CDWR (2009a) reports that, under the current trend of growth, an increase in population would result in an increase in urban water demand of 6 million acre-feet per year; slow and strategic population growth would increase demand by 1.5 million acre-feet per year; and expansive population growth would increase demand by as much as 10 million acre-feet per year.

Table 2

Scenario factors affecting urban water demand

Scenario factors for urban water demand	Year 2005	Future scenarios – Year 2050		
		Current trends	Slow and strategic growth	Expansive growth
Population (millions)	36.7	59.5	44.2	69.8
Single-family housing units (millions)	7.9	13.3	10	14.7
Multiple-family housing units (millions)	4.3	5.8	4.5	6.6
Commercial employees (millions)	19	36.5	28	40.4
Industrial employees (millions)	1.7	1.9	1.9	1.9

Note. Reprinted from *California water plan update 2009 Volume 1 - The Strategic Plan* (p. 5-28), by DWR, 2009. Sacramento, CA: State of California. Reprinted with permission.

Environmental. Environmental threats, such as climate change and periodic drought, also reduce the amount of available water and increase the possibility of overdraft (Gleick, 1993; Hall, 2009; Makki, Stewart, Panuwatwanich, & Beal, 2011; Polebitski & Palmer, 2010). Currently, during dry years, California's water supply does not adequately meet its current level of use (CDWR, 2009b; Hall, 2009). As the population continues to increase, this trend will only worsen. Additionally, the increased reliance on groundwater will increase the treatment cost while decreasing the available water (CDWR, 2009b). Droughts also result in economic harm from fire danger and loss of crops as well as degraded water quality and species collapse (CDWR, 2009a).

On California's central coast, one major climate change concern is sea-level rise due to climate change (Griggs & Russell, 2012). Griggs and Russell project an average sea-level increase of 7 inches by 2030, 14 inches by 2050, and as much as 55 inches by 2100. As a result of sea-level rise, the City of Santa Barbara faces a moderate risk of seawater flooding and inundation of low-lying coastal areas by the year 2050 and a high risk by the year 2100 (Griggs & Russell, 2012). Critical water and sanitary sewer infrastructure are vulnerable to the future sea-level rise and must be protected in order to maintain a reliable water supply (CDWR, 2008).

Water Consumption

According to the Pacific Institute for Studies in Development Environment and Security (2012), on average, a human requires a minimum of 1.3 gallons of water per day for survival. When daily drinking, cooking, bathing, and sanitation requirements are tallied, the minimum increases to around 13 gallons. In the United States, the average water use per person is 70 gallons per day, this is a large amount when compared to the Netherlands where the average use per person is 27 gallons, and in the African nation of Gambia where the average per person is only 1.17 gallons of water per day. According to the CDWR (2009c), in California, the average per capita water use is 192 gallons per day. Unfortunately, a majority of that total, approximately 60% of the state's treated drinking water, is used for outdoor irrigation (California Urban Water Conservation Council, 2007).

Hardin's (1968) concept of the tragedy of the commons can be applied to water consumption (Bachman et al., 2005; Harlan et al., 2009; Larson, Gustafson, et al., 2009). "Each party contributes [to the tragedy] by acting in their personal interest and maximizing their use of the resource" (Bachman et al., 2005, p. 14). Although an individual's total water consumption may be insignificant by itself, cumulatively, the water consumption of the community may not be sustainable for the long term (Harlan et al., 2009; Larson, Casagrande, Harlan, & Yabiku, 2009).

Solutions to the water supply shortage must either increase supply or decrease demand (CDWR, 2009b). Increasing supply generally involves a large monetary investment to build dams, reservoirs, pipelines, or desalination plants (CDWR, 2009b). A desalination plant to produce 300,000 acre-foot of water per year can cost between $1.5 and $2.0 billion (CDWR, 2009b). Some water supply projects, such as the California State Water Project, the largest state-built water conveyance system in the country, essentially move the water from one area to another (CDWR, 2010a). Although the net amount of water in the state is not increased, because this project moves the surplus water from a less populated area to the population center, it is seen as acceptable solution by regulatory agencies looking for ways to increase supply. In California, 75% of the precipitation falls in the northern half of the state while 75% of the population lives in the southern half (MacDonald, 2007). However, the cost of importing water can be very expensive. In 2009, a 45-mile pipeline project to transport water from Lake Nacimiento to communities in southern San Luis Obispo County had a price tag of $140 million (CDWR, 2009d).

Many factors can influence both indoor and outdoor household water consumption. The size of the yard is the primary factor in the amount of outdoor water that is used (Harlan et al., 2009; Willis, Stewart, Panuwatwanich, Capati, & Giurco, 2009) and an increase in temperature or a decrease in rainfall can cause a household to increase their outdoor water use (Harlan et al., 2009; Kenney et al., 2008; Lee, Tansel, & Balbin, 2011). The number of bathrooms and the age of the home are primary factors in the amount of indoor water consumption (Harlan et al., 2009; Mansur & Olmstead, 2012; Polebitski & Palmer, 2010; Polebitski, Palmer, & Waddell, 2011; USEPA, 2008).

Although water rate increases and usage restrictions are commonly used to decrease water consumption (Funk, 2007; Hill & Symmonds, 2011; Kenney et al., 2008; Mansur & Olmstead, 2012; Willis et al., 2009; Willis, Stewart, Panuwatwanich, Jones, & Kyriakides, 2010), decreasing demand through water conservation programs is a relatively low-cost solution that allows the region to subsist on less water (Freeman, Poghosyan, & Lee, 2008; Nelson, Cismaru, Cismaru, & Ono, 2011). Water use efficiency can reduce the impact of water shortages on a community by reducing treatment costs as well as increasing available water supplies (CDWR, 2008). In Southern California, urban water conservation could increase supply by about 1 million acre-feet per year–25% of the current annual demand (Freeman et al., 2008). Experts agree that a diverse water supply portfolio should include a robust water conservation program (CDWR, 2008).

Water Conservation

California has had a long water conservation history. One of the first steps in water conservation is metering household water consumption (Atwood et al., 2007; California Assembly, 2004a; Corbella & Pujol, 2009). Awareness by the consumer about how much water is being used is important to reducing consumption (Coleman, 2009; Funk, 2007; Olmstead & Stavins, 2009). In 2004, the California Assembly wrote legislature that encouraged water purveyors to use water metering and volumetric pricing as tools to encourage conservation.

On August 16, 1889, Los Angeles water baron William Mulholland installed the city's first water meter in an effort to curb water consumption (Mulholland, 2000). Because he knew how precious the resource was to Los Angeles, Mulholland believed that wasting water was an ultimate sin (Mulholland, 2000). Before metering, "Angelenos" were using 306 gallons per capita per day (Los Angeles Department of Water and Power, n.d.). In 1902, the Los Angeles Times reported that consumption had exceeded maximum supply and that Los Angeles was the fourth largest water user in the United States at that time (Los Angeles Times, 1902b). At the start of Mulholland's metering project, only those users whose grounds exceeded three times the floor area of the structures on the property were required to have their water metered (Los Angeles Times, 1902a, p. A7). However, in 2 years, Mulholland reduced per capita water usage by one-third (Kahrl, 1982). By the end of the project, usage in the city was a manageable 200 gallons per capita per day (Los Angeles Department of Water and Power, n.d.).

In 1928, in response to conflicts that were commonly seen in the courts between riparian and appropriative water rights, the state's constitution was amended. The resulting Reasonable Use Doctrine was drafted to settle the conflict between competing water rights, but also gave water purveyors the authority to enforce water conservation (Hanak et al., 2011).

> Water resources of the State [will] be put to beneficial use to the fullest extent … capable, and that the waste or unreasonable use … of water be prevented, and that

> the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare. (California Constitution, Article X, § 2)

It was not until the 1990s that the State of California enacted laws that targeted end users by requiring the installation of low-flow plumbing devices and appliances in new construction (Hanak et al., 2011). However, many communities in California enacted regulations encouraging water conservation as early as 1972 and the most aggressive water conservation regulations were passed during historic 1987-92 drought (Renwick & Archibald, 1998; Syme, Nancarrow, & Seligman, 2000). The drought was considered historic because of its duration and its impact on the entire state. By 1990, reservoirs were down 60% and storage did not return to normal until two years after the drought ended (CDWR, 2000). California's central coast was severely impacted by the 1987-92 drought (Dziegielewski, Garbharran, & Langowski, 1993; Renwick & Archibald, 1998; Syme et al., 2000). So much so that, in July 1990, for the first time in the state's history, Governor George Deukmejian declared a drought emergency for the City of Santa Barbara (Dziegielewski et al., 1993; Renwick & Archibald, 1998; San Francisco Chronicle, 1990). In response to the resulting water shortage, the City of Santa Barbara and its neighbor, Goleta Water District, enacted water conservation policies, which included restrictions, rates, and rebates, and resulted in statistically significant water reductions (Renwick & Archibald, 1998).

In the quinquennial California Water Plan, last updated in 2009, the California Department of Water Resources recommended that water purveyors make water conservation a priority (CDWR, 2009a). Returning to Hardin's (1968) theory, although a water user may not believe that their conservation efforts are significant, cooperative water conservation efforts at the community level have been shown to help sustain a community's water supply (San Francisco Chronicle, 1990).

Most water conservation programs contain a combination of price and non-price conservation elements (Booker, Howitt, Michelsen, & Young, 2012; Coleman, 2009; Halich & Stephenson, 2009; Nataraj & Hanemann, 2011; Tsai, Cohen, & Vogel, 2011; Worthington & Hoffman, 2008). Primarily, punitive water rates, consumption restrictions, and appliance rebates are utilized to encourage water conservation (Osgood, 2011; Pumphrey, Edwards, & Becker, 2008; Rosenberg, Howitt, & Lund, 2008).

Replacing a home's toilets with a low-flow toilet could save a household between 9,000 and 26,000 gallons of water per year (Vickers, 2001). Although still effective for homes built prior to 1992 with original fixtures, state and federal regulations are making toilet retrofit rebates ineffective for new homes. While the federal Energy Policy Act required all toilets sold, installed, or imported after January 1, 1994 in the United States be 1.6 gallons per flush (gpf) or less, California law enacted the standard on any house built after January 1, 1992 (CDWR, 2013; Vickers, 2001). In 2007, California law (AB 715) required that 50% of new homes built after January 1, 2010 install 1.28 gpf high-efficiency toilets. On January 1, 2014, that number increased to 100% (California Assembly, 2007).

As a result of these mandatory water reductions, landscape rebates are currently being added to water conservation programs across Santa Barbara County and are gaining in popularity throughout the state of California (City of Riverside, 2012; City of Santa Barbara, 2009; Santa Barbara County, 2013b; VVCSD, 2012b). However, although it makes sense that reducing irrigable yard area should reduce outdoor water consumption, there is very little empirical evidence to support the hypothesis. This study will fill the gap in the literature on landscape rebates by evaluating their effectiveness at reducing water consumption.

Landscape Rebates

Landscape rebates are a water conservation element that rewards residents who reduce the amount of irrigable lawn with cash reimbursements (St. Hilaire et al., 2008; USEPA, 1994; Vickers, 2001). Reducing the amount of lawn to be watered has the potential to save a significant amount of money because native and low-water-use turf grasses and plants can reduce or eliminate the need for supplemental irrigation (Anderson-Wilk, 2008; Gober & Kirkwood, 2010; Hanak & Davis, 2006; St. Hilaire et al., 2008; Vickers, 2001). By removing traditional lawns and replacing them with drought-tolerant plants a household can substantially reduce water usage (Hanak & Davis, 2006). However, many residents are afraid to move to a nontraditional lawn (Harlan et al., 2009; Robbins, 2009; St. Hilaire et al., 2008). The typical American grass lawn can be traced back to the vast green expanse of the Southern plantation or Medieval European estate where the landowner was so wealthy that he could use his slaves or serfs for beautification instead of agriculture (Robbins, 2009).

Grass lawns require a lot of time and money to maintain, and they can be harmful to the environment. Today, American homeowners spend approximately 40 hours per year maintaining their “perfect” lawns (National Wildlife Federation, n.d.). American use 67 million pounds of pesticides on their lawns annually and these petroleum-based fertilizers and pesticides add to the pollution in the community’s water supply (Robbins, 2009). Finally, grass lawns add to noise and air pollution through their requirement for periodic mowing, blowing, edging, and trimming (Cockerham & Leinauer, 2011; Robbins, 2009).

Many types of grass used in the United States require a significant amount of water to maintain. Outdoor water use can be substantially reduced by switching from traditional grass lawns to drought tolerant plants and grasses (Hanak et al., 2011). Native plants use several times less water than cool-season turf grass (Hanak & Davis, 2006). Wilson and Livingston (1932) tested the evaporation properties of 17 popular grass species and found few that were drought tolerant (see Table 3). The test found that certain varieties of fescue are much more environmentally friendly than the more popular varieties such as Kentucky bluegrass and Bermuda grass.

Table 3

Cubic centimeters of evaporation for 17 turfgrasses

Common name	Evaporation (cc)	Common name	Evaporation (cc)
Tall oat grass	100	Kentucky bluegrass	237
Orchard grass	107	Meadow fescue	249
Rhode Island bent grass	124	Chewing's fescue	252
Velvet bent grass	138	Redtop	275
Brome grass	168	Perennial ryegrass	281
Washington bent grass	178	Canada bluegrass	290
White clover	208	Vermont bent grass	300
Bermuda grass	209	Sheep's fescue	458+
Alsike clover	210	Red fescue	465+
Timothy	212		

Note. The higher the number, the more drought tolerant the grass species. From "Wilting and withering of grasses in greenhouse cultures as related to water-supplying power of the soil," by J. D. Wilson and B. E. Livingston, 1932, *Plant Physiology*, 7, p. 22. Copyright 1932 by Plant Physiology. Reprinted with permission.

Landscape rebates are a tool that can help water purveyors encourage the replacement of thirsty lawns (see Table 4). Although gaining in popularity in the 2000s, the Environmental Protection Agency (EPA) first recommended the benefits of landscape rebates in 1994 (Hanak & Davis, 2006; USEPA, 1994).

Table 4

*Turf Conversion Costs and Savings**

ETo superzone§	Water savings (gallons/square foot)		Customer years to recoup investment: Low net conversion costs ($1.00/square foot) I	II	III
Coastal	32		23	6	3
Inner coastal	39		17	6	2
Central	42		15	5	2
Desert	51		12	5	2
	Costs to utility ($/acre-foot)		High net conversion costs ($1.60/square foot)		
	Low rebate ($0.40/square foot)	High rebate ($1.00/square foot)	I	II	III
Coastal	363	907	76	10	4
Inner coastal	298	745	38	10	4
Central	276	690	32	9	4
Desert	232	580	23	8	4

* Assumes a retail water price of $678 per acre-foot. Scenario I includes only water savings, scenario II also includes garden supply savings, and scenario III includes labor cost savings. Both utility and customer investments are amortized at a rate of 4 percent. Baseline irrigation efficiency is 37.5 percent, with 25 percent of plant water needs met by rainfall (or alternatively, 50% irrigation efficiency with no rainfall contribution)

§ ETo = evapotranspiration

Note: From *Lawns and water demand in California* (p. 16), by E. Hanak and M. Davis, 2006. San Francisco, CA: Public Policy Institute of California. Copyright 2006 by Public Policy Institute of California. Reprinted with permission.

In recent years, the State of California has enacted regulations to help reduce the amount of water used on landscapes (California Assembly, 2004b). Assembly Bill 2717 (AB 2717), authored by Assemblyman John Laird and signed by Governor Arnold Schwarzenegger on September 22, 2004, asked the California Urban Water Conservation Council (CUWCC) to elicit stakeholders who would develop landscape efficiency recommendations (California Assembly, 2004b). The passage of AB 2717 made it possible for CDWR (2009a) to require local governments by the year 2010 to enact and enforce landscape water conservation legislation.

Vandenberg Village

Vandenberg Village is an unincorporated area of Santa Barbara County located on California's central coast. The bedroom community of 2,700 housing units covers approximately 5 square miles (United States Census Bureau, 2010c). The community is bounded on three sides by protected Burton Mesa Ecological Preserve and on the fourth by Vandenberg Air Force Base and City of Lompoc boundaries (California Department of Fish and Game, 2009; Santa Barbara County, 2012). As a result, development expansion is limited and the community is nearing build-out (VVCSD, 2003).

Household level demographics are not available for the area. However, an analysis of U.S. Census data indicates very little change in area demographics during the study period. In 2010, U.S. Census data indicates that there were 2.53 persons per household, 74.1% of residents own their home, and the median household income was 27% above the state median household income at $78,480 (United States Census Bureau, 2010b, 2010c). In 2000, these numbers were 2.49 persons per household, 81.2% owned their home, and the median household income was 24% above the state median household income at $58,700 (United States Census Bureau, 2000a, 2000b). Ethnicity and age demographics are detailed in Figure 5.

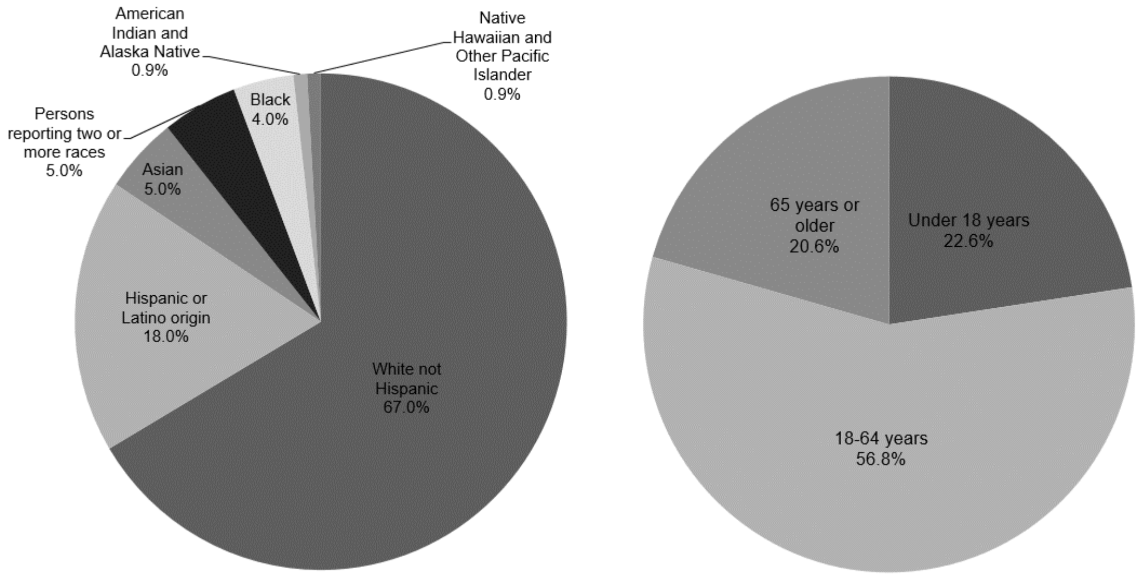

Figure 5. Ethnicity and age demographics for Vandenberg Village, California. Compiled from "Vandenberg Village CDP quickfacts", United States Census Bureau, 2010. Retrieved from http://quickfacts.census.gov/qfd/states/06/0682086. html#. USFT2ITCnxQ. Material is not subject to copyright protection within the United States.

The population of 6,497 is provided water service by VVCSD, a California special district. VVCSD draws all of its water from three groundwater wells (VVCSD, 2012e). The wells draw from the Lompoc Upland aquifer which is hydrologically connected to the Lompoc Plain aquifer and, in turn, connected to the Santa Ynez River (Santa Barbara County, 2011; VVCSD, 2012e; West Yost Associates, 2012). On average, VVCSD produces about 1,500 acre foot of water per year and delivers about 1,275 acre foot per year (VVCSD, 2012f). The difference between water produced and water delivered is the expected water loss during the treatment cycle as well as nonrevenue water (see Figure 6). Nonrevenue water includes authorized unbilled water usage, such as fire hydrant usage, and water losses from meter inaccuracies, data errors, leaks, breaks, and reservoir overflows (American Water Works Association, 2009).

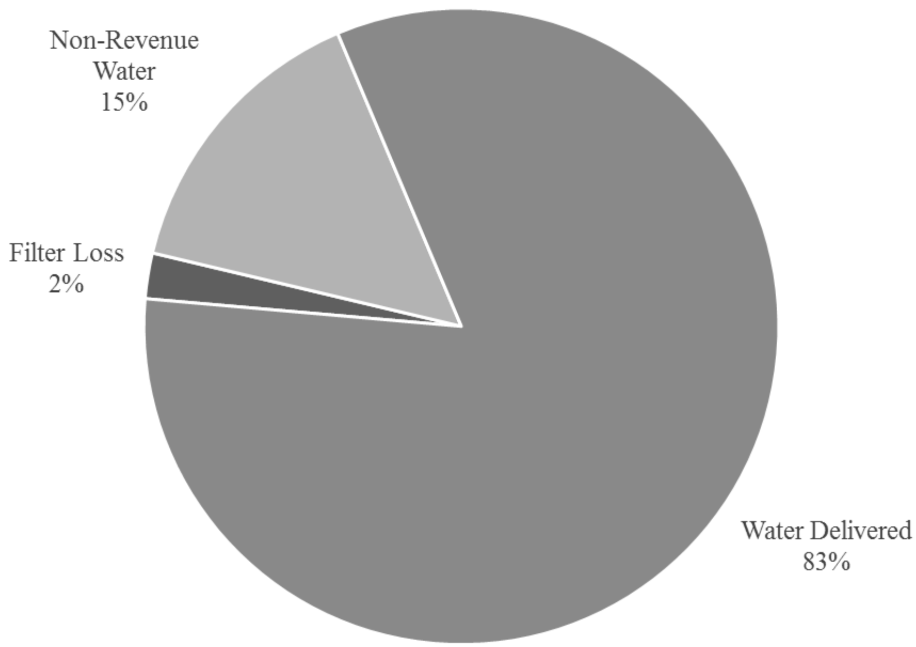

Figure 6. Average amount of water produced. Compiled from “Water produced and sold (1988-2011)”, by VVCSD, 2012. Lompoc, CA. Reprinted with permission.

Senate Bill x7-7 requires that urban retail water suppliers that provide potable water to more than 3,000 end users reduce per capita water usage by 20% by the year 2020 with an interim target of 10% reduction by 2015 (California Senate, 2009). Although possibly exempt from the SB x7-7 water reduction requirement, the VVCSD Board of Directors asked staff to calculate the 2015 and 2020 targets under the regulation (VVCSD, 2011a, 2011b). In accordance with the benchmark calculations delineated in California Water Code Section 10608.20, the 2015 target was determined to be 205 gallons per person per day and the 2020 target is 182 gallons (VVCSD, 2011a, 2011b). In 2011, VVCSD’s per capita water usage was 199 gallons per day (see Figure 7).

Of the three agencies in Santa Barbara County that offer landscape rebates, Vandenberg Village was the first to implement a program of its type (Santa Barbara County, 2013b). VVCSD adopted its program in 2007 while the City of Lompoc and the

City of Santa Barbara both adopted their programs in 2009 (City of Lompoc, 2009; City of Santa Barbara, 2009; VVCSD, 2007).

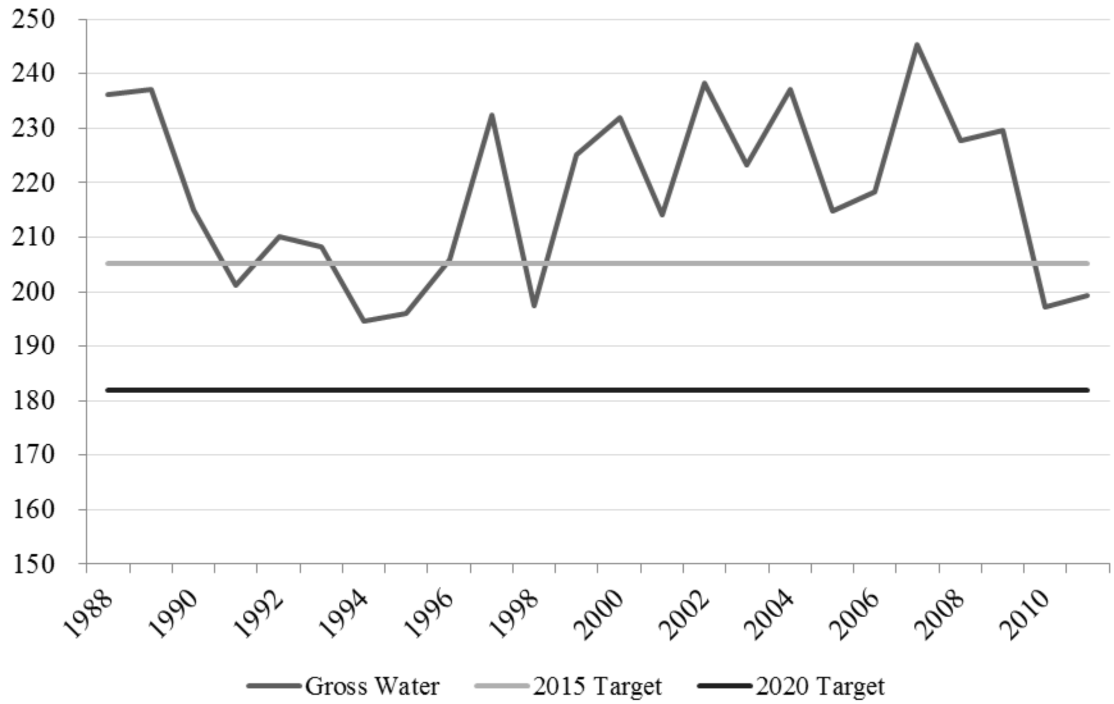

Figure 7. Vandenberg Village per capita water use (gallons per person per day). Compiled from “Water produced and sold (1988-2011)”, by VVCSD, 2012. Lompoc, CA. Reprinted with permission.

VVCSD’s water conservation program, which includes a landscape rebate program added in 2007, is making it possible for VVCSD to meet the 2015 goal of a 10% reduction in per capita water usage (California Senate, 2009; VVCSD, 2012d, 2012f). However, researchers have not studied the effectiveness of landscape rebates; therefore, there is no empirical evidence that landscape rebates are making a quantifiable contribution to the reduction in water consumption. This study will not only provide valuable information to the management staff and elected officials of VVCSD but it will also give future water conservation researchers the tools needed to evaluate other programs.

Problem Statement

Experts agree that California's domestic water supplies are threatened by population growth, drought, pollution, and climate change (Anderson-Wilk, 2008; Harou et al., 2010; Larson, Gustafson, et al., 2009). In response, the California legislature concluded that the most economical option to extend water resources is by using less water per capita (California Assembly, 2004b; CDWR, 2009a). Many different factors influence household water consumption. Bathrooms are the largest consumer of indoor water use (USEPA, 2008). Therefore, the age of the toilets, the number of bathrooms and the age of the home can influence the amount of indoor water consumption (Harlan et al., 2009; Mansur & Olmstead, 2012; Polebitski & Palmer, 2010; Polebitski et al., 2011; USEPA, 2008). To encourage household water savings, water conservation programs generally target indoor water use through toilet and washing machine rebates (USEPA, 2002). The current literature focuses on restrictions, pricing structures, and toilet rebates (Anderson-Wilk, 2008; Kenney et al., 2008; Mansur & Olmstead, 2012; Olmstead & Stavins, 2009; St. Hilaire et al., 2008).

However, outdoor water usage accounts for the majority of a household's water usage (Gober & Kirkwood, 2010; Harlan et al., 2009; Larson, Gustafson, et al., 2009; Millock & Nauges, 2010). The size of the yard is the primary factor in the amount of outdoor water used (Harlan et al., 2009; Willis et al., 2009); an increase in temperature or a decrease in rainfall can also cause a household to increase its outdoor water use (Harlan et al., 2009; Kenney et al., 2008; Lee et al., 2011). Experts hypothesize that elements from a water conservation program that target outdoor water use, such as landscape rebates, can have a significant impact on domestic water usage (Hanak & Davis, 2006; USEPA, 1994). Nevertheless, to date, water savings in response to landscape rebates are anecdotal and have not been scientifically tested (Anderson-Wilk, 2008; Funk, 2007; Goldstein, 2012; Harlan et al., 2009; St. Hilaire et al., 2008). Because of this substantial gap in the literature regarding landscape rebates, this quantitative study was designed to evaluate the effectiveness of landscape rebates on residential water consumption in Vandenberg Village, California. Secondary data has been collected from VVCSD, Santa Barbara County, and the National Oceanic and Atmospheric Administration.

Purpose of the Study

The purpose of this quantitative study was to determine if the receipt of a landscape rebate reduced water consumption while controlling for weather, irrigable yard size, home value, number of bathrooms, year home built, price per unit of water, receipt of toilet rebates and receipt of washing machine rebates. With the residents of Vandenberg Village, California as the study population, this research used regression analysis to evaluate the effectiveness of landscape rebates in reducing water consumption.

Research Questions and Hypotheses

The following research questions were examined in the process of testing the hypotheses:

1. Do consumers who receive landscape rebates use less water than those consumers who do not?

   H_0^1: There is no significant difference in water consumption between those who receive a landscape rebate and those who do not receive a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water.

   H_a^1: There is a significant difference in water consumption between those who receive a landscape rebate and those who do not receive a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water.

2. Do landscape rebate recipients use less water after receiving the rebate than before?

   H_0^2: There is no significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

H_a^2: There is a significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

Theoretical Perspective

The theoretical framework for this study was Ajzen and Fishbein's (1972, 1977) theory of reasoned action (TRA) which attempts to explain the psychological behavior of consumers by examining the relationship of beliefs and attitudes on behaviors (Liska, 1974; Petty & Cacioppo, 1981). The theory assumes that people make rational decisions based on the information available to them and that they consider the implications of their actions before engaging in the behavior (Ajzen, 1980).

The first step in the reasoned action process is to identify the behavior of interest. Then, the determinant of the action is identified. With this information—since the person intends to perform (or not perform) the behavior—the theory states that the behavior is not difficult to predict. "Barring unforeseen events, a person will usually act in accordance with his or her intention" (Ajzen, 1980, p. 5). TRA is based on a person's attitude toward expected behavior (Liska, 1974; Mueller, 1986; Petty & Cacioppo, 1981). The more a person is expected to exhibit a particular behavior, the more likely he or she is to behave in the expected manner.

TRA and its successor, the theory of planned behavior (TPB), have been used frequently to help explain the motivation to conserve water (Endter-Wada, Kurtzman, Keenan, Kjelgren, & Neale, 2008; Fielding, McDonald, & Louis, 2008; Graymore & Wallis, 2010; Hurlimann, Dolnicar, & Meyer, 2009; Jorgensen, Graymore, & O'Toole, 2009; Larson, Wutich, White, Muñoz-Erickson, & Harlan, 2011; Marandu, Moeti, & Joseph, 2010; Willis, Stewart, Panuwatwanich, Williams, & Hollingsworth, 2011). For example, America has a tradition of lush lawns that has been a symbol of wealth and power since colonial times (Endter-Wada et al., 2008; Harlan et al., 2009; Robbins, 2009). To reduce outdoor water consumption, consumers need to believe that reducing their turf is not only acceptable but also desirable (Endter-Wada et al., 2008; Gober & Kirkwood, 2010; Harlan et al., 2009; Robbins, 2009; St. Hilaire et al., 2008). An increase in the awareness that lush lawns waste drinking water may create a new expectation that native lawns are more acceptable (Gober & Kirkwood, 2010; Harlan et al., 2009; Knutson, 2008; Robbins, 2009; van Putten, Jennings, Louviere, & Burgess, 2011). Therefore, as more residents take advantage of landscape rebates the acceptance of nontraditional lawns increases.

Additionally, water conservation messages and rebate announcements during periods of reduced rainfall may encourage increased participation in water conservation rebate programs should customers believe it to be the right thing to do.

Nature of the Study

In this quantitative study, secondary data were used to test the effects of several independent variables on water consumption: monthly maximum daily temperature, total monthly rainfall, total square footage of irrigable yard, home value, number of toilets in home, year home built, price per unit of water, receipt of toilet rebates, receipt of washing machine rebates, and receipt of landscape rebates. Customers were divided into groups where each group comprised the same number of customers with similar rebate receipts and similar property characteristics, such as yard size, number of bathrooms, and age and value of home.

Regression analysis was performed on each group to determine if, and to what extent, certain leading indicators (independent variables) affect the dependent variable. Regression analysis was selected because (a) it is frequently used for water conservation studies and (b) because of the number of variables (landscape, washing machine and toilet rebates, price per unit of water, total monthly rainfall, average monthly temperature, size of yard, number of toilets, value of home, and age of home) that influence water consumption (Harlan et al., 2009; House-Peters, Pratt, & Heejun, 2010; Polebitski & Palmer, 2010). Because the study population targeted publicly available records, the data collection process required no direct contact with the study participants.

Operational Definitions of Terms

Evapotranspiration: "The loss of water to the atmosphere by the combined processes of evaporation (from soil and plant surfaces) and transpiration (from plant tissues)" (CDWR, 2009e, para. 1).

Irrigable yard size: The amount of a property's outdoor area subject to irrigation. Calculated by subtracting the square foot of the improvements from the square foot of the property.

Overdraft: "Overdraft occurs when more groundwater is removed from a basin than is replaced by recharge over a period of many years" (Bachman et al., 2005, p. 13).

Price: The amount per unit of water that the customer pays. In the United States, domestic water is generally measured in hundred cubic foot (CCF or HCF).

Rebate: A monetary incentive provided by the water purveyor to encourage the consumer to replace high water using features such as showerheads, toilets, washing machines and dishwashers, and turfgrass (American Water Works Association, 2006).

Water Consumption: The amount of water consumed by a customer, generally recorded on a monthly basis.

Water Demand: See water consumption.

Water Purveyor: A water purveyor is an agency or person that supplies water to end-users (Reclamation, 2009).

Water Rate: See price.

Assumptions

This study assumed that customers who have received a landscape rebate have not removed the low-water using plants and reintroduced turf grass to their lawns within the 24 months following the receipt of the rebate. Also, because California law requires that residential customers to request an investigation within 5 days of receiving a disputed bill (California, 1988), this study assumed that any issues of inaccuracy in the water consumption data would have a minor impact on the results of the study. Details on issues of accuracy can be found in the limitations section.

Scope and Delimitations

The delimitation of the study has been the public water agency and its customers in Vandenberg Village, California, an unincorporated bedroom community in Santa

Barbara County north of the City of Lompoc. Vandenberg Village was selected as a research area because, as the first agency in the county to offer landscape rebates, they have the longest period of data available for the study. Additionally, Vandenberg Village's size makes it an optimal location to include community variables, such as temperature and precipitation, since there is very little variation in the daily maximum temperature or the amount of rainfall received at different locations throughout the community. Finally, a previous study in the area (Allen, 2008) found that landscape rebates were statistically significant to water conservation but the sample size was too small to conclude that those savings could be applied to other properties within the study area.

Limitations

The study was subject to three limitations. First, there were data missing for some homes during periods of vacancy. Second, household level demographics that can impact water consumption—such as number of residents per household, their ages, and income—were not available for the community.

Third, there are normal issues of accuracy inherent to water consumption data. As meters age, their mechanical parts wear down and their accuracy declines (Jackson, n.d.). During the end of the study period, VVCSD replaced every meter in the community with automatic meter reading (AMR) capable meters (VVCSD, 2011c, 2012c). While meters that stopped recording any water consumption were targeted for early replacement, before being replaced with a new AMR water meter, the oldest meters may have simply been under-recording consumption data. Additionally, before the installation of the AMR meters, the employees of VVCSD read meters manually. While most meter readings are accurate, human error is possible where meter readings were entered into the meter reading device. Generally, these reading errors self-corrected the following month when the meter was read again, resulting in 1 month of higher than normal usage and 1 month of lower than normal usage. But the average was normal. At times, the higher than normal meter reading was higher than the reading the subsequent month. Per district policy, higher than normal meter readings that did not "catch up" within 3 months were adjusted accordingly and the customer service representative edited the customer's monthly water consumption data in the customer database so large meter reading errors were corrected in the data collected.

Significance of the Study

Groundwater and surface water sources are connected across multiple regions throughout the state of California (United States Geological Survey, 2009). As a result, the threat of population increase, pollution, drought, and climate change on the water supply source of one region can have negative effects on water supplies across many regions (Bachman et al., 2005). Water conservation, including newly regulated landscape rebates, can play an essential part in protecting water supplies from overdraft and nitrate pollution (Bachman et al., 2005; CDWR, 2009a; Robbins, 2009). The significance of this study is that it introduces the positive economic, environmental, and social impacts that water conservation programs and landscape rebates can have on local, regional, and state water supplies. As landscape rebates gain in popularity, this study will be beneficial to water professionals around the world who are exploring alternative methods of encouraging water conservation.

Social Change Implications

Maintaining a sustainable water supply has been an important part of California’s heritage for over a century (California Constitution; CDWR, 2009a; Mulholland, 2000). In the past decade, the state legislature recognized that landscape ordinances, through which landscape rebates can play an important role, need to be enacted to stop wasteful outdoor water use (California Assembly, 2004b). The success of landscape rebates relies heavily on the social acceptance of nontraditional lawns (Hanak & Davis, 2006; Robbins, 2009). Therefore, the future of water supply sustainability also relies heavily on the social acceptance of alternative lawns and landscapes. Currently, although water conservation has been sufficiently studied, the effectiveness of landscape rebates is an area that is missing from the literature (Anderson-Wilk, 2008; Funk, 2007; Gober & Kirkwood, 2010; Harlan et al., 2009; Kenney et al., 2008; St. Hilaire et al., 2008). This study is expected to add to the body of water conservation studies while filling a significant gap in the literature. It is the intent of this study to provide water professionals with empirical data to assist in their goal of providing safe, clean, dependable water to California’s residents in perpetuity.

Summary

Chapter 1 presented an in-depth introduction to water supply, water demand, water conservation, and landscape rebates and includes a comprehensive background; purpose statement; research questions and hypotheses; operational terms and acronyms;

assumptions, limitations, and delimitations; significance of the study; and social change implications.

This chapter explained that water supplies in California are stretched to critical levels as a result of population growth, periodic drought, and climate change and that the California legislature recognized that the best way to increase supply is to decrease demand. The Water Use Efficiency Senate Bill 7 (SBx7-7) was signed into law in 2009 which requires water purveyors to reduce per capita water usage by 20% by the year 2020. To comply, water purveyors are searching for innovative ways to increase water conservation and, as a result, Cash-4-Grass rebates are increasing in popularity. Although experts believe that Cash-4-Grass rebates can significantly decrease water consumption, there is no scientific evidence to substantiate the theory.

The chapter goes on to explain that the purpose of this study was to fill the gap in the literature and to determine if the receipt of a landscape rebate reduces water consumption in Vandenberg Village, California. The theoretical frameworks for this study were Ajzen and Fishbein’s TRA and its successor, TPB, which explains the motivation to conserve water. Secondary data were statistically analyzed to determine to what extent landscape, washing machine and toilet rebates, price per unit of water, total monthly rainfall, average monthly temperature, size of yard, number of toilets, value of home, and age of home influence water consumption. The significance of this study is the positive economic, environmental, and social impacts that water conservation programs and landscape rebates can have on the local, regional, and state water supply.

Finally, this chapter explains the social change implications in that this study is expected to add to the body of water conservation studies while filling a significant gap in the literature which will provide water professionals with empirical data to assist in their goal of providing safe, clean, dependable water to California's residents in perpetuity.

Chapter 2 will present the review of the existing literature for the study. Chapter 3 will present the research methodology that has been used for this project. Chapter 4 will present the results of the statistical analysis. Chapter 5 will present the interpretation of the findings, limitations of the study, recommendations, and implications.

Chapter 2: Literature Review

Introduction

California's domestic water supplies are threatened by population growth, drought, pollution, and climate change. In recent years, the California legislature concluded that the most economical option to extend the resources is by using less water per capita. To encourage household water savings, most water conservation programs utilize restrictions, rates, and rebates. Prior research has focused on water restrictions, pricing structures, and toilet rebates. Since outdoor water usage accounts for the majority of a household's water usage, elements of a water conservation program that target outdoor water use, such as landscape rebates, can have a significant impact on domestic water usage. To date, however, water savings in response to landscape rebates are anecdotal and have not been scientifically tested.

The purpose of this study was to evaluate the effectiveness of landscape rebates in Vandenberg Village, California. This chapter outlines the literature on water supply, water demand, water conservation, landscape rebates, and the theoretical perspective of water conservation. The available literature on landscape rebates is sparse and primarily focuses on the theoretical; no studies were found that examine the effectiveness of landscape rebates (Anderson-Wilk, 2008; Funk, 2007; Gober & Kirkwood, 2010; Harlan et al., 2009; Kenney et al., 2008; St. Hilaire et al., 2008). Other types of water conservation measures—such as incentive programs, public information campaigns, and pricing structures—have been thoroughly researched in California for many years. That research can be used to make some assumptions for research design (Atwood et al., 2007;

Booker et al., 2012; Coleman, 2009; Graymore & Wallis, 2010; Halich & Stephenson, 2009; Kenney et al., 2008; Mansur & Olmstead, 2012; Millock & Nauges, 2010; Nataraj & Hanemann, 2011; Nelson et al., 2011; Olmstead & Stavins, 2009; Tsai et al., 2011; Worthington & Hoffman, 2008).

This literature review was based on academic journals published between 2007 and 2012. The primary databases used were ABI/INFORM Complete, Academic Search Elite, Business Source Complete, Elsevier ScienceDirect Social Sciences, Free E-Journals, Highwire Press, JSTOR, ProQuest Central, ProQuest Science Journals, PsycARTICLES, SAGE Journals Online, and SSRN eLibrary. Some keyword phrases included: *water conservation* AND *California*, *water conservation* AND *theory of planned behavior*, *rebate* OR *incentive* AND *water conservation*, and *water conservation* AND *drought.*

Theoretical Perspective

Because the key to a successful Cash-4-Grass program is changing the perception of alternative landscapes, the theoretical framework used for this study was Ajzen and Fishbein's (1980, 1985; 1972, 1977; 1975) theory of reasoned action (TRA) and their theory of planned behavior (TPB). TRA attempts to explain the psychological behavior of consumers by examining the relationship of beliefs and attitudes on behaviors (Ajzen, 1980; Ajzen & Fishbein, 1972, 1977; Fishbein & Ajzen, 1975; Liska, 1974; Petty & Cacioppo, 1981). TPB adds the concept of perceived conscious choice to the previously explained TRA (Ajzen, 1985, 2011).

TRA and TPB have been used frequently to attempt to explain the motivation behind water conservation (Endter-Wada et al., 2008; Fielding et al., 2008; Graymore & Wallis, 2010; Hurlimann et al., 2009; Jorgensen et al., 2009; Larson et al., 2011; Marandu et al., 2010; Willis et al., 2011). Larson et al. (2011) use a modified version of the TPB to explain why more long-term residents of Phoenix, Arizona tend to prefer lush, well-watered landscapes to the native landscapes embraced by the area's newer residents. "Long-term residents … appear acculturated to the status quo of well-watered landscapes and few regulations in the Phoenix oasis, given heightened opposition to water-use restrictions among them compared to newcomers" (Larson et al., 2011, p. 85). Graymore and Wallis (2010) and Jorgensen et al. (2009) found that public trust in the water authority and trust in the water-using community increased the positive attitude of water conservation. Marandu et al. (2010) found that the TRA was a statistically significant indicator of water conservation behavior and that changing the attitude of influential members of the community would allow the process to gain critical mass and promote widespread attitudinal and behavioral changes.

Review of the Literature

Water Supply

Water supplies in the western United States are being threatened by population increase, climate change, water pollution, and periodic drought (Anderson-Wilk, 2008; Harou et al., 2010; Larson, Gustafson, et al., 2009; Larson et al., 2011; Olmstead & Stavins, 2009; Ward, Michelsen, & DeMouche, 2007; Willis et al., 2011). "The most significant determinants for increases in water demand are population growth, climate change, and the type of urban development that occurs" (House-Peters et al., 2010, p. 461). To help address a majority of these water supply concerns, the California legislature recently enacted Senate Bill 7 (SBx7-7) to require every water purveyor in the state to reduce their per capita water usage by 10% by 2015 and 20% by 2020 (California Senate, 2009). Working with another legislative act, which increases plumbing regulations for new homes (Millock & Nauges, 2010), the law encourages options to decrease demand such as water conservation opportunities including water restrictions, punitive water rates, and conservation rebates.

Population Increase. The rate of population growth is an important factor for planning future water needs. Funk (2007) believes that population growth alone "poses challenges beyond the capacity of current water resources" (p. 171) and Corbella and Pujol (2009) suggest that the rate of population growth is more important than population size in predicting future water consumption. Gleick, Christian-Smith, and Cooley (2011) report that water consumption in the United States has remained relatively level since 1980 despite substantial population growth. The authors feel that this is because of increased water conservation awareness and improved regulations. However, Harlan et al. (2009) report that global per capita water consumption has increased several times faster than the population due to increased water consumption by more prosperous nations. The authors believe that water conservation should focus on "reducing high-end urban household consumption" (Harlan et al., 2009, p. 692).

Climate change. Climate change increases the frequency and severity of droughts and causes substantial changes in rainfall patterns (Hall, 2009; Makki et al., 2011;

Polebitski & Palmer, 2010; Willis et al., 2011). As a result of these changes, experts believe that climate change will significantly reduce surface water availability, increasing dependence on groundwater supplies (Booker et al., 2012; Hall, 2009; Larson, Gustafson, et al., 2009; Polebitski & Palmer, 2010; Ward et al., 2007; Willis et al., 2010). Climate change can also have an alarming impact on water quality as contaminants are concentrated and waterborne diseases increase in the diminishing water supplies (Binder, 2011; Nelson et al., 2011). Knutson (2008) recommends that water managers look beyond the accepted statistical and managerial solutions and understand how climate change will impact future water supplies. Gober and Kirkwood (2010) advocate for informed climate change planning. The authors believe that designing a system for the worst case scenario would be cost prohibitive, if even feasible, but that planning for the best case scenario would leave the area “vulnerable to water shortage with little time to adapt” (Gober & Kirkwood, 2010, p. 21298).

Drought. Although lack of rain is a primary factor in drought, it is not the only cause (Corbella & Pujol, 2009). The Palmer Hydrological Drought Index (PHDI) utilizes precipitation, temperature, evapotranspiration, soil runoff, and soil recharge to categorize drought severity (see Figure 8; Balling, Gober, & Jones, 2008). Zero is normal, plus numbers indicate an increasing severity of rainfall, and minus numbers indicate an increasing severity of drought.

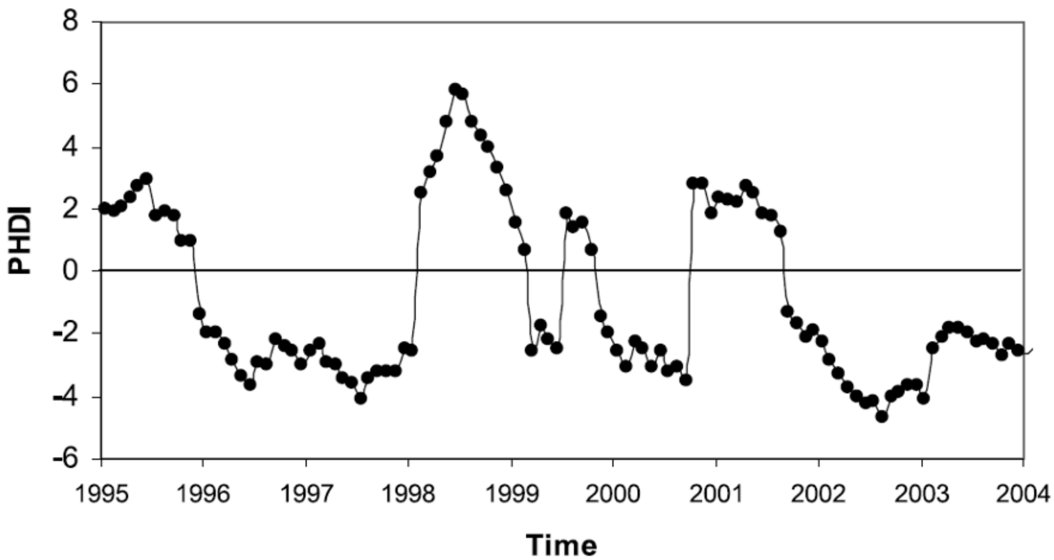

Figure 8. Monthly Palmer Hydrological Drought Index (PHDI) values for Phoenix, Arizona. Reprinted from “Sensitivity of residential water consumption to variations in climate: an intraurban analysis of Phoenix, Arizona,” by R. C. Balling, P. Gober, and N. Jones, 2008, *Water Resources Research*, 44, p. 5. Copyright 2008 by the American Geophysical Union. Reprinted with permission.

Periodic drought creates a natural competition for diminishing water supplies (Harlan et al., 2009) and, while it is expected that water usage increase during drought conditions (Balling et al., 2008; Bennear, Taylor, & Lee, 2011; Funk, 2007; Gober & Kirkwood, 2010; Polebitski et al., 2011), during these periods of drought, households may overwater their outdoor vegetation due to their perception of what the plant requires rather than the plant’s actual requirements (Endter-Wada et al., 2008). Temperature, precipitation, and humidity are major factors in outdoor water usage (Harlan et al., 2009). Additionally, House-Peters et al. (2010) report that properties in Hillsboro, Oregon with large outdoor landscapes are the most susceptible to drought with some census tracts “consuming up to 1.85 times more water for external purposes during a drought summer than an average summer” (p. 468). Polebitski, Palmer, and Waddell (2011) found that even in Seattle, a city with the nation's lowest outdoor watering rates, summer usage is 1.4 times higher than winter usage.

Water Consumption

Many of the factors that influence water consumption are beyond the control of the water purveyor. Factors such as household income, temperature and rainfall, number of bathrooms in the home, and the size, age, and value of the home and property can all impact the amount of water used by the household. Although outside their influence, prudent water planners must strategize for every variable that may influence residential water consumption. Those factors that the water purveyor can control, such as restrictions, rates, or rebates, are generally the most popular elements of water conservation programs.

Temperature. Ambient temperature can have a profound impact on outdoor water consumption (Lee et al., 2011). Higher outdoor temperatures can increase evapotranspiration, the combination of evaporation and plant transpiration, which increases the need for outdoor watering (Balling et al., 2008; Hall, 2009). As a result, many researchers utilize temperature to evaluate water usage patterns (Balling et al., 2008; Hall, 2009; Harlan et al., 2009; Kenney et al., 2008). Kenney et al. (2008) utilized daily weather data from NOAA to construct average maximum daily temperature. The authors discovered that, although the irrigation season saw an increase in water usage regardless of actual temperature, the average temperature can be a valuable tool for planning and management (Kenney et al., 2008).

Rainfall. A lack of rainfall can impact water storage by reducing recharge (Larson, Gustafson, et al., 2009; Rosenberg et al., 2008; Willis et al., 2010) but precipitation can also have varying impacts on outdoor water usage (Graymore & Wallis, 2010; Harlan et al., 2009; Kenney et al., 2008; Lee et al., 2011; Tsai et al., 2011; Willis et al., 2009). In Southwest Australia, Graymore and Wallis (2010) found no relationship between water usage and rainfall but Willis et al. (2009) discovered reduced irrigation during increased rainfall in Australia's Gold Coast region. In the United States, Harlan et al. (2009) found that water usage was sensitive to rainfall in Phoenix, Arizona and Lee et al. (2011) discovered significant seasonal effects on water usage in Miami-Dade County, Florida. A prior study in Vandenberg Village (Allen, 2008) found that only rainfall had a significant impact on water consumption. The study concluded that, in the model that evaluated aggregated water consumption for all customers, for every inch of rainfall, VVCSD customers conserved 2,655 CCF of water (Allen, 2008).

Yard size. The size of the household's yard is one of the primary factors in outdoor water consumption, along with landscape composition and irrigation technology (Harlan et al., 2009; Willis et al., 2009). Harlan et al. (2009) report that irrigable lot size had a significant effect on water usage. Many researchers (Balling et al., 2008; Hall, 2009; Harlan et al., 2009; Larson, Gustafson, et al., 2009; Mansur & Olmstead, 2012; Rosenberg et al., 2008) found that square footage of the structures subtracted from the lot size is an estimator of irrigable yard size. When yard size is not available, Mansur and Olmstead (2012) believe that lot size is a valuable proxy for outdoor water consumption preferences (e.g., lawns, gardens, and pools). Polebitski and Palmer (2010) and Polebitski et al. (2011) found that lot size was significant in explaining water demand.

Home value. Home value, land value, and property value have been used interchangeably with income as a predictor of water use (Dolnicar, Hurlimann, & Grün, 2012; Endter-Wada et al., 2008; Smith & Wang, 2008). Harlan et al. (2009) reported "appraised house value increased water consumption more than any other socioeconomic variable" (p. 692). House-Peters et al. (2010) found that homes with higher property values used more outdoor water and Harlan et al. (2009) attribute lower home values with lower income owners and higher home values with more affluent neighborhoods.

Number of Bathrooms. The United States Environmental Protection Agency (EPA) reports that the bathroom is the largest consumer of indoor water (USEPA, 2008). Because of the additional housing cost of multiple bathrooms, Mansur and Olmstead (2012) and Harlan et al. (2009) opine that the number of bathrooms can be used as a proxy for style of living that utilizes a higher water usage as well as a proxy for indoor water consumption.

Year built. The age of a home has been used frequently to predict the water efficiency of the home (Harlan et al., 2009; House-Peters et al., 2010; Jorgensen et al., 2009; Kenney et al., 2008; Mansur & Olmstead, 2012; Nataraj & Hanemann, 2011; Polebitski & Palmer, 2010; Polebitski et al., 2011). Mansur and Olmstead (2012) found that old and new homes use less water than 'middle aged' homes. The explanation is that "old homes may have smaller connections to water systems and fewer water-using appliances, such as dishwashers and hot tubs, than newer homes. The newest homes in the sample may have been constructed with water-conserving toilets and showerheads" (Mansur & Olmstead, 2012, p. 336).

Water Conservation

Water conservation programs generally consist of price and non-price elements in the form of rates, restrictions, and rebates. There is an ample supply of literature espousing the benefits of both price and non-price approaches (Atwood et al., 2007; Booker et al., 2012; Coleman, 2009; Halich & Stephenson, 2009; Kenney et al., 2008; Millock & Nauges, 2010; Nataraj & Hanemann, 2011; Olmstead & Stavins, 2009; Tsai et al., 2011; Worthington & Hoffman, 2008). Most experts believe that a comprehensive conservation program employs a balance of both.

Water rates. Price elasticity is a commonly researched measure of demand (Hall, 2009; Rosenberg et al., 2008). "Elasticity is the measure of the responsiveness of quantity demanded to the price level" (Munger, 2000, p. 232). Were water demand to follow a typical demand model, as the price of a commodity increased, the demand for that item would decrease. However, many researchers have concluded that, because the demand for water does not generally change in response to changes in price, which indicates the apparent inelasticity of water, the effect of water pricing on water consumption can be unpredictable (Graymore & Wallis, 2010; Olmstead & Stavins, 2009; Osgood, 2011; Pumphrey et al., 2008; St. Hilaire et al., 2008; Tsai et al., 2011). Munger (2000) has coined this the "diamonds and water" paradox:

> Diamonds face an elastic demand curve, and therefore involve only a modest amount of consumer surplus. Water, on the other hand, faces a

> highly inelastic demand, with enormous consumer surplus. Consequently, though the *prices* may seem backward, the *values* the market system places on diamonds, and on water, are exactly in line with what one would expect: water is far more valuable. (p. 215)

Nonetheless, Funk (2007) found that increasing block-rate pricing structures can encourage water consumption and Mansur and Olmstead (2012) found that outdoor demand was more price elastic than indoor water usage. Additionally, Kenney et al. (2008) concluded “residential water demand is largely a function of price, the impact of nonprice demand management programs, and weather and climate” (p. 204).

Restrictions. Water restrictions include individual household water budgets and regional limitations (Anderson-Wilk, 2008; Kenney et al., 2008; Knutson, 2008; Larson, Gustafson, et al., 2009; Lee et al., 2011; Makki et al., 2011; Mansur & Olmstead, 2012; Olmstead & Stavins, 2009; Pumphrey et al., 2008; Rosenberg et al., 2008; Willis et al., 2010). On Australia’s Gold Coast, water restrictions are commonly enforced during times of drought. Those restrictions “dictate a total outdoor watering ban and encourage residents to consume 140 L/p/d” (Willis et al., 2009, p. 2000). While restrictions have been an effective conservation tool, because VVCSD has implemented no policy restricting water usage, this water conservation element has not been tested in this study.

Monetary incentives. Monetary incentives, generally in the form of rebates, are a component of most water conservation programs (Anderson-Wilk, 2008; Bennear et al., 2011; Booker et al., 2012; Funk, 2007; Hall, 2009; Harlan et al., 2009; Harou et al., 2010; Kenney et al., 2008; Knutson, 2008; Larson, Gustafson, et al., 2009; Lee et al., 2011;

Makki et al., 2011; Mansur & Olmstead, 2012; Millock & Nauges, 2010; Olmstead & Stavins, 2009; Osgood, 2011; Rosenberg et al., 2008; St. Hilaire et al., 2008; Tsai et al., 2011; van Putten et al., 2011; Ward et al., 2007; Willis et al., 2009; Willis et al., 2010).

Monetary incentives are frequently utilized to encourage consumers to replace high water-using features—such as showerheads, toilets, washing machines and dishwashers, and turfgrass—or to install water saving products—such as climate controlled irrigation controllers and rainwater tanks. The EPA lists over 100 rebate programs across the nation (Bennear et al., 2011). Mansur and Olmstead (2012) are of the opinion that rebates "could make everyone better off" (p. 333) and Tsai et al. (2011) found that in the first four years of the water conservation program in Reading, Massachusetts, the town realized "an overall average savings of approximately 3,950 m^3 / quarter" (p. 700). Lee et al. (2011) discovered similar results in Miami-Dade County, Florida. However, Funk (2007) notes that rebates and retrofits do not typically "create enough incentive to maximize end-user participation" (p. 178) and van Putten et al. (2011) found that incentive programs with higher monetary rewards were more attractive to consumers. Prudent conservation planners need to design programs that "allow flexibility in terms of the legal arrangements, land use options, and other program attributes" (van Putten et al., 2011, p. 2653).

Landscape Rebates

The primary goal of this research is to answer the question *Can cash-4-grass programs save water?* Cash-4-Grass programs offer monetary incentives, in the form of landscape rebates, in exchange for the conversion of grass to low-water-using landscapes

(Anderson-Wilk, 2008; Funk, 2007; Goldstein, 2012; Harlan et al., 2009; St. Hilaire et al., 2008). Although “aesthetically pleasing landscapes and water-efficient landscapes are not mutually exclusive concepts….homeowners consistently show a preference for traditional, nonwater-conserving landscapes” (St. Hilaire et al., 2008, p. 2089). Larson, Casagrande, Harlan, and Yabiku (2009) found that cultural norms reinforcing the traditional lawn created a barrier against converting turfgrass to alternative landscapes. In Australia, the driest inhabited continent on Earth, Head (2007) discovered that, in Sydney, water was conserved inside the house so that it could be used outside to maintain the landscape. Harlan et al. (2009) reports that, even though ill-suited for arid climates and potentially damaging to the environment, water intensive turf grass remains the most popular residential landscape choice in the United States and Canada. By 2005, turfgrass had surpassed the area of any irrigated crop in the United States by 300% (Larson, Cook, Strawhacker, & Hall, 2010).

Because outdoor water usage typically accounts for more than half of a household’s water consumption, landscape rebates have the potential to significantly reduce overall household water use (Gober & Kirkwood, 2010; Harlan et al., 2009; Larson, Gustafson, et al., 2009; Millock & Nauges, 2010). Knutson (2008) predicts water savings of 15 to 100% when landscape conservation measures are employed.

Some researchers believe that restrictions on outdoor watering is a desirable solution (Atwood et al., 2007; Brennan, Tapsuwan, & Ingram, 2007; Halich & Stephenson, 2009). However, most experts acknowledge that the public is resistant to mandatory limits on water use and that the solution is not economically efficient

(Brennan et al., 2007; Grafton & Ward, 2008; Halich & Stephenson, 2009; Jones, Evangelinos, Gaganis, & Polyzou, 2011; Kallis, Ray, Fulton, & McMahon, 2010; Worthington & Hoffman, 2008). Another group of experts believe that reducing the amount of irrigable lawn through a rebate program is a more efficient method of long-term water conservation (Funk, 2007; Harlan et al., 2009; Kenney et al., 2008; Larson et al., 2011; St. Hilaire et al., 2008).

Existing Literature and the Literature Gap

There is a significant gap in the literature when focusing on the effectiveness of landscape rebates on water consumption. While it is possible to make some assumptions with the existing water conservation rebate research on other water saving features and the theoretical assumptions made by other researchers on the effectiveness of Cash-4-Grass programs, to date, water savings in response to landscape rebates are anecdotal and have not been scientifically tested (Anderson-Wilk, 2008; Funk, 2007; Gober & Kirkwood, 2010; Harlan et al., 2009; Kenney et al., 2008; St. Hilaire et al., 2008). Because landscape rebates can result in a significant monetary outlay for the agency, VVCSD pays up to $1,000 per household, empirical evidence of their effectiveness is important to the continuation of the programs (VVCSD, 2012d).

In response to this substantial gap in the literature regarding landscape rebates, this quantitative study has been designed to evaluate the effectiveness of landscape rebates on residential water consumption in Vandenberg Village, California. This paper contributes to the literature by providing empirical data on the effectiveness of landscape rebates that can be used by water professionals to expand their programs and by future researchers to expand on the subject of water conservation.

Summary

Chapter 2 presented a review of the existing literature on water supply, water demand, water conservation, landscape rebates, the effect of temperature, rainfall, yard size, home value, number of bathrooms, year home was built, price of water, restrictions, and rebates have on water consumption, the theoretical perspective of water conservation, and the literature gap.

This chapter reiterated that California's domestic water supplies are threatened by population growth, drought, pollution, and climate change and explained that a review of the literature has shown that many factors influence water consumption. The chapter further explains the theoretical frameworks for this study, Ajzen and Fishbein's TRA and its successor, TPB, and that TRA was found to be a statistically significant indicator of water conservation behavior. Temperature, rainfall, yard size, home value, number of bathrooms, and age of the home were also found to be significant influences on water consumption. Water rates, restrictions, and monetary incentives are primary components of water conservation programs. Because outdoor landscaping accounts for a majority of a household's water consumption, traditional grass lawns have increasingly been targeted for conservation measures by municipalities. However, scientific studies focusing on Cash-4-Grass rebates are missing from the literature. In closing, this chapter explains that this chapter will contribute to the literature by filling this gap.

Chapter 1 presented an in-depth introduction to water supply, water demand, water conservation, and landscape rebates. Chapter 3 will present the research methodology that has been used for this study. Chapter 4 will present the results of the statistical analysis. Chapter 5 will present the interpretation of the findings, limitations of the study, recommendations, and implications.

Chapter 3: Research Method

Introduction

This research was designed to measure the effectiveness of landscape rebates on water consumption in the bedroom community of Vandenberg Village, California. Analysis was performed on the public data requested from VVCSD, Santa Barbara County (SBC), and the National Oceanic and Atmospheric Administration (NOAA).

This chapter outlines the methodology used to collect and analyze the data to address the study's research questions and hypotheses. The chapter covers the following topics: a restatement of the problem; the research questions and hypotheses; research design and approach; target population; setting and sample; instrumentation and materials; data collection; protection of participants' rights; data analysis; and dependent, control, and independent variables.

Restatement of the Problem

Experts agree that California's domestic water supplies are threatened by population growth, drought, pollution, and climate change. In response, the California legislature concluded that the most economical option to extend water resources was to use less water per capita. Many different factors influence household water consumption but bathrooms are the largest consumer of indoor water use. Thus, the age of the toilets, the number of bathrooms, and the age of the home can influence the amount of indoor water consumption. To encourage household savings, water conservation programs generally target indoor water use through toilet and washing machine rebates. The current literature focuses on restrictions, pricing structures, and toilet rebates.

However, outdoor water usage accounts for the majority of a household's water usage. The size of the yard is the primary factor, but an increase in temperature or a decrease in rainfall can also cause a household to increase its outdoor water use. Experts hypothesize that elements of a water conservation program that target outdoor water use, such as landscape rebates, can have a significant impact on domestic water usage. Nevertheless, to date, water savings in response to landscape rebates are anecdotal and have not been scientifically tested. Because of this substantial gap in the literature, this quantitative study was designed to evaluate the effectiveness of landscape rebates on residential water consumption in Vandenberg Village, California. Secondary data was collected from VVCSD, SBC, and the NOAA.

Research Questions and Hypotheses

The following research questions have been examined in the process of testing the hypotheses:

1. Do consumers who receive landscape rebates use less water than those consumers who do not?

   H_0^1: There is no significant difference in water consumption between those who receive a landscape rebate and those who do not receive a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water.

   H_a^1: There is a significant difference in water consumption between those who receive a landscape rebate and those who do not receive a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water.

2. Do landscape rebate recipients use less water after receiving the rebate than before?

   H_0^2: There is no significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

   H_a^2: There is a significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

Research Design and Approach

The purpose of this study was to investigate the relationship between the dependent variable of monthly residential water usage and the independent variables of receipt of a toilet, washer, and/or landscape rebate, size of irrigable property, number of toilets, value of home, age of home, amount of monthly rainfall, average monthly high temperature, and price per unit of water. The primary goal of this research is to answer the question *Can cash-4-grass programs save water?* To answer the question this study has utilized a multiple time-series quasi-experimental research design to evaluate the effectiveness of landscape rebates on residential water consumption in Vandenberg Village, California.

This type of research design has been selected because participants cannot easily be randomly assigned for this type of study, as it would be cost-prohibitive to randomly select residential properties for turf reduction. Additionally, there is a significant amount, a minimum of ten years, of aggregated time-series and water conservation monthly rebate data available. Rebate recipients can also be easily isolated from the customer base for separate testing.

A time series “is a set of observations obtained by measuring a single variable regularly over a period of time” (IBM Corporation, 2011, p. 1). An aggregated time series is time series data whose values are combined over equal intervals of time. For this study, the aggregated time series observations are monthly water meter readings obtained for the customers of Vandenberg Village, California. The water meter reading represents the continuous water usage for the previous billing period. VVCSD Ordinance §2.9.1 et seq. allows for the water meter readings to be collected monthly at 25 to 35 day intervals provided the annual average is 30 days (VVCSD, 2010).

A time-series design “is the presence of a periodic measurement process on some group or individual and the introduction of an experimental change into this time series of measurements” (Campbell & Stanley, 1963, p. 37). According to Campbell and Stanley (1963), a multiple time-series design is the best of the quasi-experimental research designs. Also known as intervention analysis, this technique evaluates the impact of an event, the introduction of the experimental change, on the time series observations (Balkin & Ord, 2001; Harvey, 1989). The experimental change, or intervention, in this study is the introduction of landscape rebates. The customers initiate the intervention by replacing their turfgrass and requesting a rebate.

Autocorrelation is a common issue with time-series data. To decrease the likelihood of autocorrelation, the data for this research question *Do consumers who receive landscape rebates use less water than those consumers who do not?* has been split into separate models consisting of 12 months of data. Additionally, the data for the research question *Do landscape rebate recipients use less water after receiving the rebate than before?* has been limited to the data 24 months before and 24 months after the receipt of a landscape rebate.

Target Population, Setting, and Sample

Target Population

In water conservation research, a population is generally the customers serviced by the water purveyor or a random sampling of customers, if the service area is too large to reliably test each individual. The population for this study are the customers serviced by VVCSD. Ten years of historical data for its water customers has been gathered via a public records request. This study has been approved and sponsored by the general manager of VVCSD. A letter of cooperation can be found in Appendix A.

Setting and Sample

The setting for this research is Vandenberg Village, California. Vandenberg Village is a bedroom community of 6,497 (United States Census Bureau, 2010c) located in an unincorporated area of Santa Barbara County north of the city of Lompoc. Domestic water is supplied by VVCSD. Due to the water usage collection method utilized by VVCSD, analysis of usage at the individual resident level is not feasible. Therefore, this study has analyzed the monthly household water use. The population for this study has been limited to residential connections in Vandenberg Village. As of June 30, 2012, the number of residential connections served by VVCSD was 2,577 (VVCSD, 2012a).

Yanovitzky and VanLear (2008) state that time series data analysis "performs best when the number of sequential observations available for analysis is 50 or greater, the unit of time is consistent among all variables measured, and each time series is uniform and unbroken" (p. 108). A nonprobability convenience sample has been utilized for this research study because those customers who have received water conservation rebates can be easily isolated from those customers that have received no rebate. The available data includes monthly observations for a minimum of 10 years times the number of customers selected for each regression model. Therefore, all three conditions suggested by Yanovitzky and VanLear have been met.

Instrumentation and Materials

This quantitative research study has utilized available data that has been collected through public records requests to VVCSD and SBC as well as Internet searches. Table 5 details the variables and their measurements.

Table 5

Research variables

Variable	Source	Collection Method
Water use	VVCSD	Public records request
Rebate	VVCSD	Public records request
Price	VVCSD	Public records request
Temperature	NOAA	Internet search
Rainfall	SBC	Internet search
Yard Size	SBC	Public records request
Number of Toilets	SBC	Public records request
Age of Home	SBC	Public records request
Value of Home	SBC	Public records request

Data Collection

The following time-series data, at the household level, has been requested from VVCSD via a public records request:

- Domestic water use
- Rebates received
- Price/rate per CCF of water

The following information, at the assessor's parcel number (APN) level, has been requested from SBC clerk, recorder, and assessor via a public records request:

- Acreage of property
- Square footage of structures
- Number of bathrooms
- Value of land

- Value of structures
- Year built

The monthly rainfall for Vandenberg Village has been obtained from the SBC Flood Control District website (Santa Barbara County, 2008) and the monthly temperature for Vandenberg Village has been obtained from the NOAA website (NOAA, n.d.).

Protection of Participants' Rights

The confidentiality of the data collected through public records for this research has been protected at all times. The only individual identifier in the raw data is the APN. This identifier is assigned by the SBC clerk, recorder, and assessor's office and is unique to every house. The APN has been used to combine the data from VVCSD and SBC into a single database to be used in the IBM SPSS® Statistics software package for statistical analysis. Only the researcher has had access to the APN and it has not been referenced in the written report. The raw data and the combined database file has been stored electronically on a password-protected portable hard drive and will be kept in a fireproof safe for a minimum of 5 years. At that time, the data on the hard drive will be destroyed. Walden Institutional Review Board approval #09-13-13-0277917 was obtained prior to data collection.

Reliability and Validity

Reliability and validity refers to the credibility of the research measurement (McNabb, 2008). Measurement reliability is the extent that the research is reproducible and validity is the extent that the research measures what it is intended to measure

(Frankfort-Nachmias & Nachmias, 2008; Rossi, Lipsey, & Freeman, 2004; Trochim, 2006b). One threat to internal validity can be the passage of time. Water usage is measured constantly but the water purveyor generally reads the meter just once a month. Therefore, in order to collect enough data to make an informed analysis, many months, ideally years, of data must be analyzed. Additionally, during that passage of time, events occur that impact water usage. Drought increases the annual average water consumption while a rainy year decreases the average. To increase validity in this study, the regression equations have analyzed many factors that impact water consumption and each variable selected has been thoroughly researched to verify that it is contributing to the analysis. All of the data has been obtained through public records and, because California law requires that residential customers to request an investigation within 5 days of receiving a disputed bill (California, 1988), this study assumes that the data is reliable and accurate.

Measures

Dependent Variables

Domestic water use. Domestic water use [WATER] is a ratio measurement of time series data that represents the amount of water consumed by a residential customer on a monthly basis. Residential water usage in Vandenberg Village is recorded on a monthly basis by electronically reading the meter attached to the residential service line. Units of water are measured in increments of one hundred cubic foot (CCF).

Lagged Dependent Variables

Domestic water use – lagged. Lagged domestic water use [WATERt1] is a ratio measurement of time series data that represents the amount of water consumed by a residential customer on a monthly basis lagged one month. The lagged variable has been used to help predict the nonlagged version of the same dependent variable (Vogt & Johnson, 2011). Ruijs, Zimmermann, and van den Berg (2008) used this technique to correct for autocorrelation in their regression models.

Independent Variables

Landscape rebates. Landscape rebates [GRASS] is a nominal level dummy variable that focuses on the receipt of a rebate for the replacement of turf grass and is used to determine the impact of rebates on water consumption. A "1" has been used for the months following the receipt of the rebate. A "0" has been used for those months before the rebate was received. Because rebates are reimbursements there is a delay between the date that the eligible item was installed and the rebate received. Therefore, rebates are considered leading indicators and, subsequently, the variable has been lead by one month to account for water saved before the rebate was requested. A negative coefficient was expected on this variable because those customers who receive a rebate should reduce their total water consumption by actively reducing their water usage.

Control Variables

Rebates. Rebates [TOILET] [WASHER] are nominal level dummy variables that focus on the receipt of a rebate for the replacement of a toilet and/or washing machine and are used to determine the impact of rebates on water consumption. As mentioned above, a "1" has been used for the months following the receipt of the rebate. A "0" has been used for those months before the rebate was received. Again, because rebates are reimbursements there is a delay between the date that the eligible item was installed and the rebate received. Therefore, rebates are considered leading indicators and, subsequently, the variable has been lead by one month to account for water saved before the rebate was requested. A negative coefficient was expected on this variable because those customers who receive a rebate should reduce their total water consumption by actively reducing their water usage.

Price/rate. Price or rate [PRICE] is a ratio measurement that represents the amount per CCF of water that the customer pays. This variable is used to determine the impact of price on water consumed. VVCSD utilizes tiered water rates in an effort to encourage water conservation. As more water is used, the rate per unit increases until the customer reaches the punitive top tier. This study assumes that the highest tier is a deterrent against water waste. Therefore, this study has utilized the price at the highest tier. Because there is a delay between the month that the price change goes into effect and when a consumer takes notice and begins conserving, price is considered a lagging indicator and, subsequently, this variable has been lagged one month to account for this delay, in accordance with the Taylor-Nordin specification (Nordin, 1976; Taylor, 1975). As a basic human necessity, water is somewhat insensitive to price. Therefore, it was not expected that price increases would significantly impact water consumption. However, a negative coefficient would indicate a reduction in water consumption in response to the price change.

Yard size. Yard size [SIZE] is an ordinal measurement that represents the area that has the potential for outdoor water use. This variable is calculated by subtracting the square footage of the structures from the total square footage of the property. A positive coefficient is expected on this variable because water use increases as more outdoor area is landscaped with turf grass.

Number of bathrooms. Number of bathrooms [BATH] is an ordinal measurement that represents the number of bathrooms in a home. A negative coefficient is expected on this variable because as increased amounts of older toilets are replaced with low-flow toilets, water usage decreases. A positive coefficient is not unexpected on this variable because as the number of toilets in a home increases, water usage may also increase.

Age of home. Age of home [AGE] is a nominal level dummy variable that represents the year the home was built. A "1" has been used for homes built before 1992. A "0" has been used for homes built after 1991. A positive coefficient is expected on this variable for homes built in California before January 1992 because the older Plumbing Code results in a higher indoor water usage for the same tasks.

Rainfall. Rainfall [RAIN] is a ratio measurement that represents the monthly amount of rainfall. This variable is used to determine the impact that rainfall has on the amount of monthly residential water consumed. A negative coefficient is expected on this variable because water use increases as rainfall decreases.

Temperature. Temperature [TEMP] is an interval measurement that represents the monthly average high temperature. Because the average high temperature in Vandenberg Village ranges between 60° F and 80° F (The Weather Channel, 2012), temperature is not expected to be statistically significant to water consumption.

Value of home. Value of home [VALUE] is an ordinal measurement that represents the 2012 Assessed Value of the land and structures. This variable acts as a representative for income and has been adjusted from the 2013 SBC assessed value utilizing the ENR 20 Cities Construction Cost Index (Engineering News-Record, 2012). A positive coefficient is expected on this variable because water usage increases as the value of the home increases (Harlan et al., 2009).

Data Analysis

IBM SPSS® Statistics version 21 has been used to generate descriptive statistics and perform a linear regression analysis (IBM Corporation, 2012). Regression analysis is commonly utilized to measure direct effects and has been used in this study to predict the amount of water consumed as a function of landscape rebates while controlling for washing machine and toilet rebates, price per unit, total monthly rainfall, average monthly temperature, size of yard, number of toilets, value of home, and age of home. The statistical significance of the relationship between the amount of water consumed each month and landscape rebates has been used as an indicator of the effectiveness of VVCSD landscape rebates.

Descriptive Statistics Analysis

Descriptive statistics has been used to describe the basic features of the data in this study (Trochim, 2006a). The median, standard deviation, and correlation has been calculated for study variables where appropriate. The level of correlation has been examined for the relationship between the control variables and dependent variable.

Direct Effects Using Regression Analysis

The hypotheses assume that landscape rebates are positively associated with water conservation. Linear regression analysis has been utilized to test for the statistical significance of the hypothesized relationship.

Regression Analysis Equations

A review of the literature was used to identify factors that have a significant impact on water consumption. Some of these factors have been selected as regression analysis variables, detailed in a separate section. Additionally, because of the different assumptions for different types of customers, separate water demand regression models have been created. Table 6 details each model and its corresponding regression analysis equation.

The models have analyzed similar variables for two different sets of customers. Model RQ1 (All Customers) has analyzed the data for the landscape rebate customers as well as a comparable number of non-landscape rebate customers with similar property characteristics. The goal of this model is to determine the extent to which landscape rebate customers use less water than non-landscape rebate customers. Model RQ2 (Landscape Rebate Customers) has analyzed the data for landscape recipient customers to determine the extent to which their water consumption reduced as a result of receiving a landscape rebate.

Table 6

Regression Analysis Equations

Model	Equation
Rebate/Non-Rebate Customers (Model RQ1)	$WATER = \beta_0 + \beta_1 WATER_{t-1} + \beta_2 PRICE + \beta_3 SIZE + \beta_4 BATH + \beta_5 VALUE + \beta_6 AGE + \beta_7 TOILET + \beta_8 WASHER + \beta_9 GRASS + \varepsilon_t$
Landscape Rebate Customers (Model RQ2)	$WATER = \beta_0 + \beta_1 WATER_{t-1} + \beta_2 PRICE + \beta_3 SIZE + \beta_4 BATH + \beta_5 VALUE + \beta_6 AGE + \beta_7 TOILET + \beta_8 WASHER + \beta_9 GRASS + \beta_{10} RAIN + \beta_{11} TEMP + \varepsilon_t$

Summary

Chapter 3 presents the research methodology for this study and outlines the method that has been used to collect and analyze the data to evaluate the research questions and hypotheses developed for this study. It includes: a restatement of the problem; the research questions and hypotheses; research design and approach; target population; setting and sample; instrumentation and materials; data collection; protection of participants' rights; data analysis; and dependent, control, and independent variables.

This chapter explains that the purpose of this study is to investigate the relationship between the dependent variable of monthly residential water usage and the independent variables of receipt of a toilet, washer, and/or landscape rebate, size of irrigable property, number of toilets, value of home, age of home, amount of monthly rainfall, average monthly high temperature, and price per unit of water. The target population for this study was the customers of VVCSD. Secondary data were collected from VVCSD, SBC, and NOAA. The primary goal of this research is to answer the question *Can cash-4-grass programs save water?* through research questions which focused on the extent that water conservation rebates reduce water consumption.

Chapter 1 presented an in-depth introduction to water supply, water demand, water conservation, and landscape rebates. Chapter 2 presented the review of the existing literature for the study. Chapter 4 will present the results of the statistical analysis. Chapter 5 will present the interpretation of the findings, limitations of the study, recommendations, and implications.

Chapter 4: Results

Introduction

This research was designed to measure the effectiveness of landscape rebates on water consumption in the bedroom community of Vandenberg Village, California. The analysis was performed on public data obtained from VVCSD, SBC, and NOAA. This chapter presents the results of the statistical analysis. It includes: a description of the data collection process; an explanation of the data transformation performed; a description of the data analysis; a testing of the hypotheses; and a summary of the findings.

Data Collection

Data collection was consistent with the process outlined in Chapter 3 and per the terms of Walden IRB. The data were collected through public records requests to VVCSD and SBC and through data downloads from the NOAA and SBC websites. VVCSD and SBC responded to the request with electronic data. As a result, all of the data required for analysis were received in electronic format. Therefore, none of the data required manual transcription, which reduced the possibility of data entry errors.

VVCSD provided 15 separate data files including a separate water usage file for each fiscal year from 2002 through 2013 sorted by customer identification, one file containing all rebates by address, one file containing water rates from 1990 through present, and one file containing the key to convert the customer identification to APN.

The SBC assessor’s office provides to the public an ASCII text file containing for every property in the county: ownership, mailing and situs address, assessment, Tax Rate Area (TRA), and acreage information. By special request, SBC provided to the researcher a data file, which contained the standard information as well as property characteristic such as the square footage of the home, the year the home was built, and the number of bedrooms, bathrooms, and fireplaces.

On its website, the SBC Water Agency publishes daily, monthly, and annual rainfall data collected from rainfall stations placed throughout the county. The historic monthly and yearly rainfall records were downloaded for Station 205 at the Burton Mesa Fire Station #51 located within the service area of VVCSD.

On its website, NOAA provides access to the data collected at the weather stations within their land-based Automated Weather Observing System (AWOS). The historic hourly temperature data was downloaded for the AWOS stations near Lompoc and Vandenberg Air Force Base.

Data Transformation

Electronic data from VVCSD, SBC, and NOAA were transformed as needed and merged into single databases for each dataset. The data for water consumption (WATER) was provided by VVCSD separated by month, year, and APN. This format was used for the remainder of the data.

- WATERt1 – this variable constructed by lagging water consumption for each APN by one month.
- PRICE – no transformation was required.
- TOILET/WASHER/GRASS – month and year of rebate was matched with the corresponding APN in database containing all VVCSD Assessor Parcel Numbers by utilizing Microsoft Excel® 2013 IF function (Microsoft

Corporation, 2012). Further transformation included constructing dummy variables by converting date of rebate and subsequent dates to “1” and all dates prior to rebate to “0” in database separating all data by month, year, and APN. The final transformation included leading variable for each APN by one month.

- SIZE – this variable was constructed by subtracting size of structures (square footage) from size of lot (square footage).
- BATH – the number of bathrooms was rounded up to account for the number of toilets per home (e.g., 2½ bath = 3 toilets).
- VALUE – this variable was constructed by adding the land value and the improvement value for September 2013 and multiplying the sum by the ENR 20 Cities Construction Cost Index.
- AGE – this dummy variable was constructed by converting year built for homes built before 1992 to “1” and all dates after 1991 to “0” in database separating all data by month, year, and APN.
- RAIN – no transformation was required.
- TEMP – no transformation was required. However, the high temperature for each month was selected from the hourly temperature readings by utilizing Microsoft Excel® 2013 MAX function (Microsoft Corporation, 2012).

The Microsoft Excel® 2013 VLOOKUP function was utilized to combine all of the electronic files into single files for each dataset by matching month, year, and APN (Microsoft Corporation, 2012).

Model Formation

Autocorrelation is a common issue with time-series data. To decrease the likelihood of autocorrelation, annual models were formed so that the data could be analyzed by year rather than aggregated over 10 years. Individual datasets were created for RQ1 for the calendar years 2007 through 2012 and analyzed separately. Additionally, the data for RQ2 has been limited to the data 24 months before and 24 months after the receipt of a landscape rebate. Finally, the average number of bathrooms, yard size, value of home, and toilet and washing machine rebates was compared for each model against the database as a whole with the goal of being representative of the population in its entirety.

Data Analysis

IBM SPSS® Statistics version 21 was utilized to generate descriptive statistics and perform a linear regression analysis (IBM Corporation, 2012). Descriptive statistics include means, standard deviations, correlations, and frequencies and percentages. Regression analysis is commonly utilized to measure direct effects and was used in this study to predict the amount of water consumed as a function of landscape rebates while controlling for washing machine and toilet rebates, price per unit, total monthly rainfall, average monthly temperature, size of yard, number of bathrooms, value of home, and age of home. The statistical significance of the relationship between the amount of water consumed each month and landscape rebates has been used as an indicator of the effectiveness of VVCSD landscape rebates.

Hypothesis Testing

Research Question 1 and Hypothesis

Do consumers who receive landscape rebates use less water than those consumers who do not?

H_0^1: There is no significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water.

H_a^1: There is a significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water.

Descriptive statistics. For easier evaluation, each year's descriptive statistics results have been presented in two tables. The complete statistical results can be found in Appendix C.

Calendar Year 2007. Although washing machine and Cash-4-Grass rebates were added to the VVCSD water conservation program in July 2007, no rebates were issued that year. As a result, the variables for washing machine rebate and Cash-4-Grass rebate were constant at 0. Therefore, the mean and standard deviation are 0.00 and the correlation coefficients cannot be computed. The means, standard deviations, and correlations are presented in this section for reference only.

The mean water consumption was 19.98 (SD = 20.012), mean price was $1.33 (SD = $0.08), mean size was 10,584.20 sq. ft. (SD = 8,423.158), mean number of bathrooms was 2.41 (SD = .814), mean value of home was $180,352.60 (SD = $116,387.78), mean age was .98 (SD = .137), and mean toilet rebate was .29 (SD = .455). The correlation coefficients for number of bathrooms (.641), value of home (.583), size of yard (.559), and toilet rebate (.218) are statistically significant at the one percent level on a one-tailed test and indicate that those variables have a direct relationship with water consumption. The positive correlation suggests that as the amount of the variable increases, the amount of water consumption also increases. The size of the correlation coefficient for number of bathrooms indicates that the variable has a strong relationship with water consumption, the size of the correlation coefficients for value of home and size of yard indicate moderate relationships, and the coefficient for toilet rebate indicates a weak relationship.

Calendar Year 2008. The mean, standard deviation, and correlations between the variables for calendar year 2008 are shown in Table 7 and Table 8.

Table 7

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2008

Variable	*M*	*SD*	WATER	1	3	4	5
WATER	19.68	22.052	–	.803**	.458**	.619**	.526**
Predictor variable							
1.WATERt1	20.05	22.096	.803**	–	.469**	.622**	.538**
2.PRICE	$1.48	$0.06	.008	.112**	-.004	-.004	.037
3.SIZE	11132.04	9001.029	.458**	.469**	–	.615**	.600**
4.BATH	2.42	.806	.619**	.622**	.615**	–	.736**
5.VALUE	$193526.40	$123435.10	.526**	.538**	.600**	.736**	–
6.AGE	.98	.135	-.006	-.007	.081*	.072	-.030
7.TOILET	.33	.470	.199**	.203**	.073	.117**	.031
8.WASHER	.03	.168	.023	.012	.122**	.124**	.124**
9.GRASS	.02	.140	-.095*	-.086*	-.060	-.075	-.082*

* $p < 0.05$. ** $p < 0.01$.

Table 8

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2008

Variable	*M*	*SD*	2	6	7	8	9
WATER	19.68	22.052	.008	-.006	.199**	.023	-.095*
Predictor variable							
1.WATERt1	20.05	22.096	.112**	-.007	.203**	.012	-.086*
2.PRICE	$1.48	$0.06	–	.001	.031	.037	.168**
3.SIZE	11132.04	9001.029	-.004	.081*	.073	.122**	-.060
4.BATH	2.42	.806	-.004	.072	.117**	.124**	-.075
5.VALUE	$193526.40	$123435.10	.037	-.030	.031	.124**	-.082*
6.AGE	.98	.135	.001	–	.096*	.024	.020
7.TOILET	.33	.470	.031	.096*	–	.247**	-.007
8.WASHER	.03	.168	.037	.024	.247**	–	-.025
9.GRASS	.02	.140	.168**	.020	-.007	-.025	–

* $p < 0.05$. ** $p < 0.01$.

In calendar year 2008, the mean water consumption was 19.68 (SD = 22.052), mean price was $1.48 (SD = $0.06), mean size was 11,132.04 sq. ft. (SD = 9,001.029), mean number of bathrooms was 2.42 (SD = .806), mean value of home was $193,526.40

(SD = $123,435.10), mean age was .98 (SD = .135), mean toilet rebate was .33 (SD = .470), mean washing machine rebate was .03 (SD = .168), and mean Cash-4-Grass rebate was .02 (SD = .140).

The correlation coefficients for number of bathrooms (.619), value of home (.526), size of yard (.458), and toilet rebate (.199) are statistically significant at the one percent level on a one-tailed test and indicate that those variables have a direct relationship with water consumption. The positive correlation suggests that as the amount of the variable increases, the amount of water consumption also increases. The correlation coefficient for Cash-4-Grass rebate (-.095) is statistically significant at the five percent level on a one-tailed test and indicates that the variable has an indirect relationship with water consumption. The negative correlation suggests that as the amount of the variable increases, the amount of water consumption decreases. The size of the correlation coefficient for number of bathrooms indicates that the variable has a strong relationship with water consumption, the size of the correlation coefficients for value of home and size of yard indicate moderate relationships, and the coefficients for toilet rebate and Cash-4-Grass rebate indicate a weak relationship.

Calendar Year 2009. The mean, standard deviation, and correlations between the variables for calendar year 2009 are shown in Table 9 and Table 10.

Table 9

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2009

Variable	*M*	*SD*	WATER	1	3	4	5
WATER	18.40	22.746	–	.855**	.400**	.646**	.543**
Predictor variable							
1.WATERt1	18.24	22.705	.855**	–	.405**	.643**	.537**
2.PRICE	$1.90	$0.41	.037	.133**	.000	.000	.004
3.SIZE	11066.65	8965.708	.400**	.405**	–	.616**	.599**
4.BATH	2.42	.803	.646**	.643**	.616**	–	.735**
5.VALUE	$199685.46	$126391.14	.543**	.537**	.599**	.735**	–
6.AGE	.98	.134	.010	.012	.080*	.071	-.030
7.TOILET	.38	.486	.072	.081*	.016	.059	-.069
8.WASHER	.05	.208	.037	.055	.105**	.158**	.082*
9.GRASS	.14	.345	-.169**	-.161**	-.028	-.093*	-.081*

* $p < 0.05$. ** $p < 0.01$.

Table 10

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2009

Variable	*M*	*SD*	2	6	7	8	9
WATER	18.40	22.746	.037	.010	.072	.037	-.169**
Predictor variable							
1.WATERt1	18.24	22.705	.133**	.012	.081*	.055	-.161**
2.PRICE	$1.90	$0.41	–	.000	.003	.037	.090*
3.SIZE	11066.65	8965.708	.000	.080*	.016	.105**	-.028
4.BATH	2.42	.803	.000	.071	.059	.158**	-.093*
5.VALUE	$199685.46	$126391.142	.004	-.030	-.069	.082*	-.081*
6.AGE	.98	.134	.000	–	.107**	.030	.054
7.TOILET	.38	.486	.003	.107**	–	.279**	.058
8.WASHER	.05	.208	.037	.030	.279**	–	-.087*
9.GRASS	.14	.345	.090*	.054	.058	-.087*	–

* $p < 0.05$. ** $p < 0.01$.

In calendar year 2009, the mean water consumption was 18.40 (SD = 22.746), mean price was $1.90 (SD = $0.41), mean size was 11,066.65 sq. ft. (SD = 8,965.708), mean number of bathrooms was 2.42 (SD = .803), mean value of home was $199,685.46 (SD = $126,391.14), mean age was .98 (SD = .134), mean toilet rebate was .38 (SD = .486), mean washing machine rebate was .05 (SD = .208), and mean Cash-4-Grass rebate was .14 (SD = .345).

The correlation coefficients for number of bathrooms (.646), value of home (.543), and size of yard (.400) are statistically significant at the one percent level on a one-tailed test and indicate that those variables have a direct relationship with water consumption. The positive correlation suggests that as the amount of the variable increases, the amount of water consumption also increases. The correlation coefficient for Cash-4-Grass rebate (-.169) is statistically significant at the one percent level on a one-tailed test and indicates that the variable has an indirect relationship with water consumption. The negative correlation suggests that as the amount of the variable increases, the amount of water consumption decreases. The size of the correlation coefficient for number of bathrooms indicates that the variable has a strong relationship with water consumption, the size of the correlation coefficients for value of home and size of yard indicate moderate relationships, and the coefficient for Cash-4-Grass rebate indicates a weak relationship.

Calendar Year 2010. The mean, standard deviation, and correlations between the variables for calendar year 2010 are shown in Table 11 and Table 12.

Table 11

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2010

Variable	*M*	*SD*	WATER	1	3	4	5
WATER	15.58	16.225	–	.794**	.458**	.522**	.471**
Predictor variable							
1.WATERt1	15.82	16.453	.794**	–	.450**	.541**	.493**
2.PRICE	$2.38	$0.00	c	c	c	c	c
3.SIZE	11001.66	8905.403	.458**	.450**	–	.616**	.596**
4.BATH	2.41	.797	.522**	.541**	.616**	–	.722**
5.VALUE	$206161.60	$129577.88	.471**	.493**	.596**	.722**	–
6.AGE	.98	.132	-.003	-.001	.079*	.069	-.028
7.TOILET	.41	.493	.060	.061	-.011	.022	-.104**
8.WASHER	.08	.278	.105**	.118**	.122**	.272**	.072
9.GRASS	.22	.412	-.184**	-.182**	-.010	-.080*	-.079*

* p < 0.05. ** p < 0.01. c. variable is constant.

Table 12

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2010

Variable	*M*	*SD*	2	6	7	8	9
WATER	15.58	16.225	c	-.003	.060	.105**	-.184**
Predictor variable							
1.WATERt1	15.82	16.453	c	-.001	.061	.118**	-.182**
2.PRICE	$2.38	$0.00	–	c	c	c	c
3.SIZE	11001.66	8905.403	c	.079*	-.011	.122**	-.010
4.BATH	2.41	.797	c	.069	.022	.272**	-.080*
5.VALUE	$206161.60	$129577.88	c	-.028	-.104**	.072	-.079*
6.AGE	.98	.132	c	–	.113**	.041	.071
7.TOILET	.41	.493	c	.113**	–	.362**	.128**
8.WASHER	.08	.278	c	.041	.362**	–	.047
9.GRASS	.22	.412	c	.071	.128**	.047	–

* p < 0.05. ** p < 0.01. c. variable is constant.

In calendar year 2010, the mean water consumption was 15.58 (SD = 16.225), mean size was 11,001.66 sq. ft. (SD = 8,905.403), mean number of bathrooms was 2.41

(SD = .797), mean value of home was $206,161.60 (SD = $129,577.88), mean age was .98 (SD = .132), mean toilet rebate was .41 (SD = .493), mean washing machine rebate was .08 (SD = .278), and mean Cash-4-Grass rebate was .22 (SD = .412). The variable for price was constant at $2.38. Therefore, the mean was $2.38 and the standard deviation is 0.00.

The correlation coefficients for number of bathrooms (.522), value of home (.471), size of yard (.458), and washing machine rebate (.105) are statistically significant at the one percent level on a one-tailed test and indicate that those variables have a direct relationship with water consumption. The positive correlation suggests that as the amount of the variable increases, the amount of water consumption also increases. The correlation coefficient for Cash-4-Grass rebate (-.184) is statistically significant at the one percent level on a one-tailed test and indicates that the variable has an indirect relationship with water consumption (see Figure 9). The negative correlation suggests that as the amount of the variable increases, the amount of water consumption decreases. The size of the correlation coefficients for number of bathrooms, value of home, and size of yard indicate moderate relationships and the coefficients for washing machine rebate and Cash-4-Grass rebate indicate a weak relationship. The variable for price was constant during the analysis period. Therefore, the correlation coefficient cannot be computed for this variable.

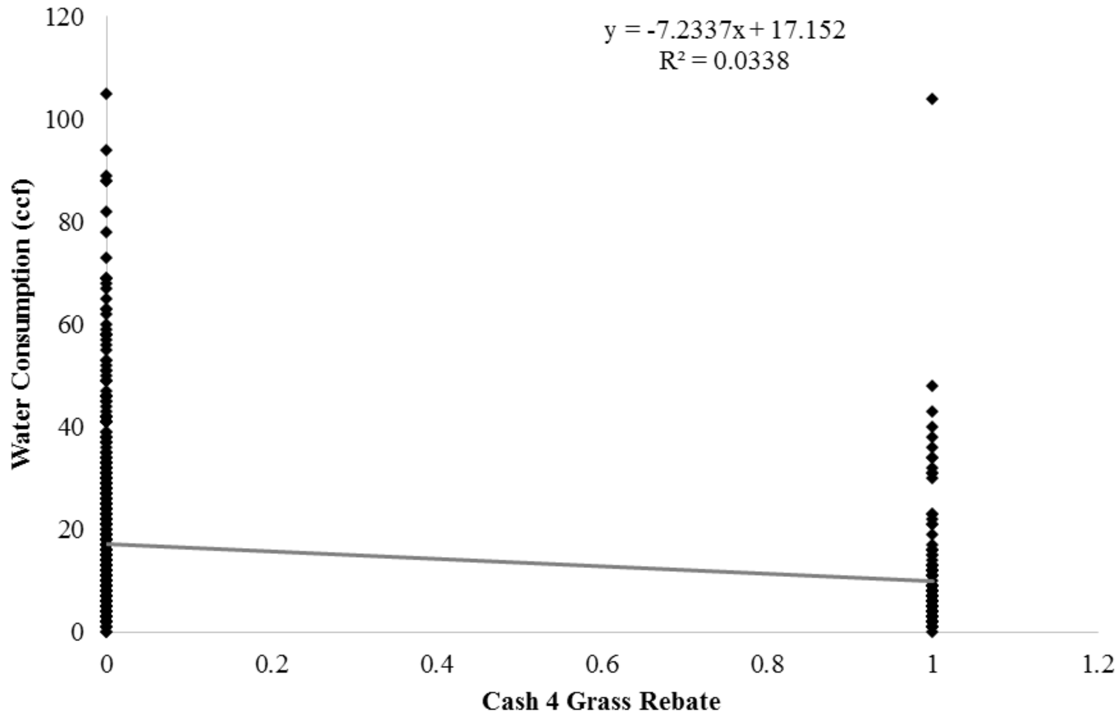

Figure 9. Water consumption (ccf per month) as a function of receipt of Cash-4-Grass rebate.

Calendar Year 2011. The mean, standard deviation, and correlations between the variables for calendar year 2011 are shown in Table 13 and Table 14.

Table 13

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2011

Variable	*M*	*SD*	WATER	1	3	4	5
WATER	15.83	18.175	–	.768**	.487**	.600**	.446**
Predictor variable							
1.WATERt1	15.66	18.050	.768**	–	.475**	.582**	.433**
2.PRICE	$2.38	$0.00	c	c	c	c	c
3.SIZE	10928.41	8811.361	.487**	.475**	–	.614**	.594**
4.BATH	2.40	.787	.600**	.582**	.614**	–	.700**
5.VALUE	$214669.16	$133483.71	.446**	.433**	.594**	.700**	–
6.AGE	.98	.130	-.005	-.012	.077*	.067	-.026
7.TOILET	.46	.499	.000	.003	-.053	-.028	-
8.WASHER	.13	.334	.232**	.227**	.148**	.327**	.121**
9.GRASS	.37	.484	-.111**	-.094*	-.027	-.015	-.071

* $p < 0.05$. ** $p < 0.01$. c. variable is constant.

Table 14

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2011

Variable	*M*	*SD*	2	6	7	8	9
WATER	15.83	18.175	c	-.005	.000	.232**	-
Predictor variable							
1.WATERt1	15.66	18.050	c	-.012	.003	.227**	-.094*
2.PRICE	$2.38	$0.00	–	c	c	c	c
3.SIZE	10928.41	8811.361	c	.077*	-.053	.148**	-.027
4.BATH	2.40	.787	c	.067	-.028	.327**	-.015
5.VALUE	$214669.16	$133483.71	c	-.026	-.118**	.121**	-.071
6.AGE	.98	.130	c	–	.123**	.051	.102**
7.TOILET	.46	.499	c	.123**	–	.318**	.213**
8.WASHER	.13	.334	c	.051	.318**	–	.087*
9.GRASS	.37	.484	c	.102**	.213**	.087*	–

* $p < 0.05$. ** $p < 0.01$. c. variable is constant.

In calendar year 2011, the mean water consumption was 15.83 (SD = 18.175), mean size was 10,928.41 sq. ft. (SD = 8,811.361), mean number of bathrooms was 2.40 (SD = .787), mean value of home was $214,669.16 (SD = $133,483.71), mean age was

.98 (SD = .130), mean toilet rebate was .46 (SD = .499), mean washing machine rebate was .13 (SD = .334), and mean Cash-4-Grass rebate was .37 (SD = .484). The variable for price was constant at $2.38. Therefore, the mean was $2.38 and the standard deviation is 0.00.

The correlation coefficients for number of bathrooms (.600), size of yard (.487), value of home (.446), and washing machine rebate (.232) are statistically significant at the one percent level on a one-tailed test and indicate that those variables have a direct relationship with water consumption. The positive correlation suggests that as the amount of the variable increases, the amount of water consumption also increases. The correlation coefficient for Cash-4-Grass rebate (-.111) is statistically significant at the one percent level on a one-tailed test and indicates that the variable has an indirect relationship with water consumption. The negative correlation suggests that as the amount of the variable increases, the amount of water consumption decreases. The size of the correlation coefficients for number of bathrooms, value of home, and size of yard indicate moderate relationships and the coefficients for washing machine rebate and Cash-4-Grass rebate indicate a weak relationship. The variable for price was constant during the analysis period. Therefore, the correlation coefficient cannot be computed for this variable.

Calendar Year 2012. The mean, standard deviation, and correlations between the variables for calendar year 2012 are shown in Table 15 and Table 16.

Table 15

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2012

Variable	*M*	*SD*	WATER	1	3	4	5
WATER	18.38	19.279	–	.874**	.505**	.689**	.498**
Predictor variable							
1.WATERt1	18.33	19.202	.874**	–	.513**	.687**	.508**
2.PRICE	$2.38	$0.00	c	c	c	c	c
3.SIZE	10928.41	8811.361	.505**	.513**	–	.614**	.594**
4.BATH	2.40	.787	.689**	.687**	.614**	–	.700**
5.VALUE	$220310.16	$136990.75	.498**	.508**	.594**	.700**	–
6.AGE	.98	.130	.030	.036	.077*	.067	-.026
7.TOILET	.47	.499	.015	.015	-.057	-.031	-
8.WASHER	.14	.351	.190**	.187**	.123**	.293**	.117**
9.GRASS	.49	.500	-.021	-.025	.000	.031	-.036

* p < 0.05. ** p < 0.01. c. variable is constant.

Table 16

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables for Calendar Year 2012

Variable	*M*	*SD*	2	6	7	8	9
WATER	18.38	19.279	c	.030	.015	.190**	-.021
Predictor variable							
1.WATERt1	18.33	19.202	c	.036	.015	.187**	-.025
2.PRICE	$2.38	$0.00	–	c	c	c	c
3.SIZE	10928.41	8811.361	c	.077*	-.057	.123**	.000
4.BATH	2.40	.787	c	.067	-.031	.293**	.031
5.VALUE	$220310.16	$136990.75	c	-.026	-.121**	.117**	-.036
6.AGE	.98	.130	c	–	.124**	.054	.129**
7.TOILET	.47	.499	c	.124**	–	.340**	.289**
8.WASHER	.14	.351	c	.054	.340**	–	.117**
9.GRASS	.49	.500	c	.129**	.289**	.117**	–

* p < 0.05. ** p < 0.01. c. variable is constant.

In calendar year 2012, the mean water consumption was 18.38 (SD = 19.279), mean size was 109,28.41 sq. ft. (SD = 8,811.361), mean number of bathrooms was 2.40 (SD = .787), mean value of home was $220,310.16 (SD = $136,990.75), mean age was

.98 (SD = .130), mean toilet rebate was .47 (SD = .499), mean washing machine rebate was .14 (SD = .351), and mean Cash-4-Grass rebate was .49 (SD = .500). The variable for price was constant at $2.38. Therefore, the mean was $2.38 and the standard deviation is 0.00.

The correlation coefficients for number of bathrooms (.689), size of yard (.505), value of home (.498), and washing machine rebate (.190) are statistically significant at the one percent level on a one-tailed test and indicate that those variables have a direct relationship with water consumption. The positive correlation suggests that as the amount of the variable increases, the amount of water consumption also increases. The size of the correlation coefficient for number of bathrooms indicates that the variable has a strong relationship with water consumption, the size of the correlation coefficients for value of home and size of yard indicate moderate relationships, and the coefficient for washing machine rebate indicates a weak relationship. The variable for price was constant during the analysis period. Therefore, the correlation coefficient cannot be computed for this variable.

Summary

A summary of significant descriptive statistics can be found in Table 17. Washing machine rebates and Cash-4-Grass rebates were added to the VVCSD water conservation program in 2007. Therefore, the values for those variables were constant at 0 for calendar year 2007 and are noted in the results. By comparing the means for years 2008 through 2012, it is apparent that both washing machine rebates and Cash-4-Grass rebates gained in popularity during the research period and, excluding year 2012, Cash-4-Grass rebates exhibited a statistically significant correlation with water consumption.

Table 17

Summary of Descriptive Statistics for Water Usage and Water Consumption Predictor Variables

	Means				Intercorrelations		
Year	Water	Toilet	Washer	Grass	Water/ Bath	Water/ Grass	Water/ Toilet
2007	19.98	0.29	c	c	.641**	c	.218**
2008	19.68	0.33	0.03	0.02	.619**	-.095*	.199**
2009	18.40	0.38	0.05	0.14	.646**	-.169**	.072
2010	15.58	0.41	0.08	0.22	.522**	-.184**	.060
2011	15.83	0.46	0.13	0.37	.600**	-.111**	.000
2012	18.38	0.47	0.14	0.49	.689**	-.021	.015

* $p < 0.05$. ** $p < 0.01$. c. variable is constant.

Regression Analysis

Ordinary Least Squares linear regression analysis has been utilized to test for the statistical significance of the hypothesized relationship. The results for calendar year 2008 can be found in Table 18, results for year 2009 in Table 19, results for year 2010 in Table 20, results for year 2011 in Table 21, and results for year 2012 in Table 22. The complete statistical results can be found in Appendix C.

Calendar Year 2007

Although washing machine and Cash-4-Grass rebates were added to the VVCSD water conservation program in July 2007, no rebates were issued that year. As a result, the variables for washing machine rebate and Cash-4-Grass rebate were constant at 0 and were deleted from the analysis equation. The analysis results presented in this section are for reference only.

For the year 2007, four of the eight coefficients have the expected signs and three are less than .05, which means they are statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645. The coefficient on price was negative, which, although not predicted, is not unexpected. Because the water consumption is somewhat insensitive to price, the research plan did not indicate an expected sign. The negative coefficient on price indicates that as the price of water increases, water consumption decreases.

Overall, the F-statistic of 249.294 is more than 2.21 which means that the model, as a whole, is statistically significant at the five percent level of significance and the adjusted R-squared is .735 which means that this set of variables explains almost 74 percent of residential water consumption in Vandenberg Village.

Calendar Year 2008

Table 18

Regression Analysis Summary for Water Consumption Variables Predicting Water Usage for Calendar Year 2008

Variable	*B*	*SE B*	*β*	*t*	*p*
Constant	33.141	13.350	–	2.482	.013
WATERt1	.670	.030	.671	22.051	.000
PRICE	-25.098	8.601	-.067	-2.918	.004
SIZE	.000	.000	.024	.805	.421
BATH	4.249	1.037	.155	4.098	.000
VALUE	.000	.000	.038	1.084	.279
AGE	-2.740	3.752	-.017	-.730	.466
TOILET	2.365	1.125	.050	2.102	.036
WASHER	-2.795	3.099	-.021	-.902	.367
GRASS	-1.482	3.614	-.009	-.410	.682

Note. R^2 = .67 (N = 651, p < .001).

For the year 2008, six of the eight coefficients have the expected signs and two are less than .05, which means they are statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645. Again, the negative coefficient on price indicates that as the price of water increases, water consumption decreases. The positive coefficient for number of bathrooms indicates that as the number increases, water consumption also increases. The variables for washing machine rebates and Cash-4-Grass rebates displayed the expected negative coefficient, which indicates that as rebates are received, water consumption decreases. However, the coefficients were not statistically significant with a p-value of 0.367 and 0.682 respectively.

Overall, the F-statistic of 149.340 is more than 2.21 which means that the model, as a whole, is statistically significant at the five percent level of significance and the adjusted R-squared is .672 which means that this set of variables explains almost 68 percent of residential water consumption in Vandenberg Village.

Calendar Year 2009

Table 19

Regression Analysis Summary for Water Consumption Variables Predicting Water Usage for Calendar Year 2009

Variable	*B*	*SE B*	*β*	*t*	*p*
Constant	.888	4.175	–	.213	.832
WATERt1	.749	.027	.747	28.100	.000
PRICE	-3.270	1.109	-.059	-2.948	.003
SIZE	.000	.000	-.017	-.644	.520
BATH	4.036	.968	.142	4.171	.000
VALUE	.000	.000	.049	1.576	.116
AGE	-.877	3.377	-.005	-.260	.795
TOILET	.849	.975	.018	.870	.384
WASHER	-3.736	2.264	-.034	-1.650	.099
GRASS	-1.995	1.325	-.030	-1.505	.133

Note. R^2 = .75 (N = 659, p < .001).

For the year 2009, five of the eight coefficients have the expected signs and two are less than .05, which means it is statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645. Again, the negative coefficient for price indicates that as the price of water increases, water consumption decreases. The variables for washing machine rebates and Cash-4-Grass rebates displayed the expected negative coefficient, which indicates that as rebates are received, water consumption decreases. However, the coefficients were not statistically significant with a p-value of 0.099 and 0.133 respectively.

Overall, the F-statistic of 220.508 is more than 2.21 which means that the model, as a whole, is statistically significant at the five percent level of significance and the adjusted R-squared is .750, which means that this set of variables explains approximately 75 percent of residential water consumption in Vandenberg Village.

Calendar Year 2010

Table 20

Regression Analysis Summary for Water Consumption Variables Predicting Water Usage for Calendar Year 2010

Variable	*B*	*SE B*	*β*	*t*	*p*
Constant	.267	2.989		.089	.929
WATERt1	.682	.028	.691	24.180	.000
PRICE	c	c	c	c	c
SIZE	.000	.000	.089	2.892	.004
BATH	1.678	.779	.082	2.154	.032
VALUE	.000	.000	.018	.505	.614
AGE	-1.725	2.866	-.014	-.602	.547
TOILET	1.144	.832	.035	1.374	.170
WASHER	-1.222	1.510	-.021	-.809	.419
GRASS	-2.027	.932	-.052	-2.175	.030

Note. R^2 = .65 (N = 673, p < .001). c. variables are constants or have missing correlations

For the year 2010, five of the eight coefficients have the expected signs and three are less than .05, which means they are statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645. The variables for price were constant and were deleted from the analysis equation. The variables for washing machine rebates and Cash-4-Grass rebates displayed the expected negative coefficient, which indicates that as rebates are received, water consumption decreases. The coefficient for Cash-4-Grass rebates was statistically significant. However, the coefficient for washing machine rebates was not statistically significant with a p-value of 0.419.

Overall, the F-statistic of 154.737 is more than 2.21 which means that the model, as a whole, is statistically significant at the five percent level of significance and the adjusted R-squared is .646, which means that this set of variables explains almost 65 percent of residential water consumption in Vandenberg Village.

Calendar Year 2011

Table 21

Regression Analysis Summary for Water Consumption Variables Predicting Water Usage for Calendar Year 2011

Variable	*B*	*SE B*	*β*	*t*	*p*
Constant	-3.743	3.445		-1.086	.278
WATERt1	.614	.029	.610	20.838	.000
PRICE	c	c	c	c	c
SIZE	.000	.000	.079	2.528	.012
BATH	4.499	.903	.195	4.983	.000
VALUE	.000	.000	-.007	-.189	.850
AGE	-2.085	3.304	-.015	-.631	.528
TOILET	.489	.924	.013	.529	.597
WASHER	1.087	1.434	.020	.758	.449
GRASS	-1.977	.899	-.053	-2.198	.028

Note. R^2 = .63 (N = 695, p < .001). c. variables are constants or have missing correlations

For the year 2011, three of the eight coefficients have the expected signs and all three are less than .05, which means they are statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645. The variables for price were constant and were deleted from the analysis equation. The variable for Cash-4-Grass rebates displayed the expected negative coefficient, which indicates that as rebates are received, water consumption decreases. The coefficient for Cash-4-Grass rebates was statistically significant.

Overall, the F-statistic of 147.245 is more than 2.21 which means that the model, as a whole, is statistically significant at the five percent level of significance and the adjusted R-squared is .627, which means that this set of variables explains almost 63 percent of residential water consumption in Vandenberg Village.

Calendar Year 2012

Table 22

Regression Analysis Summary for Water Consumption Variables Predicting Water Usage for Calendar Year 2012

Variable	*B*	*SE B*	*β*	*t*	*p*
Constant	-3.988	2.856		-1.397	.163
WATERt1	.756	.025	.753	29.997	.000
PRICE	c	c	c	c	c
SIZE	.000	.000	.027	1.128	.260
BATH	4.219	.782	.172	5.399	.000
VALUE	.000	.000	-.019	-.712	.477
AGE	-1.704	2.707	-.012	-.629	.529
TOILET	.566	.780	.015	.726	.468
WASHER	-.295	1.111	-.005	-.266	.791
GRASS	-.408	.727	-.011	-.561	.575

Note. R^2 = .78 (N = 695, p < .001). c. variables are constants or have missing correlations

For the year 2012, four of the eight coefficients have the expected signs but only number of bathrooms has a p-value less than .05. Again, the variables for price were constant and were deleted from the analysis equation. The variables for washing machine rebates and Cash-4-Grass rebates displayed the expected negative coefficient, which indicates that as rebates are received, water consumption decreases. However, the coefficients were not statistically significant with a p-value of 0.791 and 0.575 respectively.

Overall, the F-statistic of 304.369 is more than 2.21 which means that the model, as a whole, is statistically significant at the five percent level of significance and the adjusted R-squared is .777, which means that this set of variables explains almost 78 percent of residential water consumption in Vandenberg Village.

Summary

A summary of the regression analysis model results for the years 2007 through 2012 can be found in Table 23. All six models were statistically significant at the five percent level of significance and the variables selected explain between 63 percent and 78 percent of residential water consumption in Vandenberg Village.

Table 23

Regression Analysis Summary for Water Consumption Models

Model	R^2	*SE*	*F*
2007	.735	10.310	249.294**
2008	.672	12.625	149.340**
2009	.750	11.376	220.508**
2010	.646	9.649	154.737**
2011	.627	11.095	147.245**
2012	.777	9.096	304.369**

*$p < .05$. **$p < .01$.

As previously stated, in 2007, the variables for Cash-4-Grass rebates were constant and were deleted from the analysis equation. For the remaining 5 years, the Cash-4-Grass rebates exhibited the expected negative sign and the variable was statistically significant at the five percent level of significance for 2 of the 5 years analyzed (see Table 24).

Table 24

Regression Analysis Summary for Cash-4-Grass Rebates

Model	*B*	*SE B*	*β*	*t*	*p*
2007	c	c	c	c	c
2008	-1.482	3.614	-.009	-.410	.682
2009	-1.995	1.325	-.030	-1.505	.133
2010	-2.027	.932	-.052	-2.175	.030*
2011	-1.977	.899	-.053	-2.198	.028*
2012	-.408	.727	-.011	-.561	.575

*p < .05. c. variables are constants or have missing correlations

The results of the regression analyses indicate that receipt of a Cash-4-Grass rebate, size of property, number of bathrooms, and price per unit of water have varying degrees of statistical significance on water consumption. Additionally, the correlation between Cash-4-Grass rebates and water consumption was statistically significant for four of the five years analyzed. Although this does not imply causation, it is an indicator of a relationship between the variables.

The lagged domestic water use [WATERt1] has been used in these models to help predict the nonlagged version of the same dependent variable and to correct for autocorrelation (Ruijs et al., 2008; Vogt & Johnson, 2011). The lagged domestic water use also acts as a proxy for factors that are not able to be measured directly (e.g., number of household residents).

***t* test**

An independent samples *t* test was used to compare the differences in customers who receive a Cash-4-Grass rebate and those who do not. The results for calendar year 2008 can be found in Table 25, results for year 2009 in Table 26, results for year 2010 in Table 27, results for year 2011 in Table 28, and results for year 2012 in Table 29

Calendar Year 2008

Table 25

Group Differences for Water Consumption Between Groups That Did or Did Not Receive Cash-4-Grass Rebates for Calendar Year 2008

	No Grass Rebate		Grass Rebate				
	M	*SD*	*M*	*SD*	*df*	*t*	*p*
WATER	19.98	22.172	5.00	2.739	650	2.433	.015
PRICE	1.48	0.06	1.55	0.00	650	-4.332	.000
SIZE	11209.10	9074.49	7344.23	1145.77	650	1.534	.125
BATH	2.43	0.81	2.00	0.00	650	1.916	.056
VALUE	194970.39	124062.87	122548.38	51736.48	14.968	4.776	.000
AGE	.98	.136	1.00	.000	638	-3.494	.001
TOILET	.33	.47	.31	.48	12.473	.167	.870
WASHER	.03	.17	.00	.00	638	4.422	.000

In 2008, there was a significant difference in the scores for water consumption, price per unit of water, value of home, and age of home in customers who did not receive a Cash-4-Grass rebate and those that did. Washing machine rebate in customers who did not receive a Cash-4-Grass rebate was significant. However, none of the Cash-4-Grass rebate recipients had also received a washing machine rebate. Size of yard, number of bathrooms, and toilet rebate were not significant.

Calendar Year 2009

Table 26

Group Differences for Water Consumption Between Groups That Did or Did Not Receive Cash-4-Grass Rebates for Calendar Year 2009

	No Grass Rebate		Grass Rebate				
	M	*SD*	*M*	*SD*	*df*	*t*	*p*
WATER	19.93	23.912	8.80	8.476	658	4.394	.000
PRICE	1.88	0.41	1.99	0.42	119.092	-2.275	.025
SIZE	11166.39	8873.11	10443.01	9552.25	116.203	.677	.500
BATH	2.45	0.84	2.23	0.42	658	2.408	.016
VALUE	203779.08	128569.38	174089.10	108990.11	133.469	2.35	.020
AGE	.98	.144	1.00	.000	658	-1.398	.163
TOILET	.37	.48	.45	.50	658	-1.487	.138
WASHER	.05	.22	.00	.00	658	2.247	.025

In 2009, there was a significant difference in the scores for water consumption, price per unit of water, number of bathrooms, and value of home in customers who did not receive a Cash-4-Grass rebate and those that did. Washing machine rebate in customers who did not receive a Cash-4-Grass rebate was significant. However, none of the Cash-4-Grass rebate recipients had also received a washing machine rebate. Size of yard, age of home, and toilet rebate were not significant.

Calendar Year 2010

Table 27

Group Differences for Water Consumption Between Groups That Did or Did Not Receive Cash-4-Grass Rebates for Calendar Year 2010

	No Grass Rebate		Grass Rebate				
	M	*SD*	*M*	*SD*	*df*	*t*	*p*
WATER	17.15	16.89	9.92	11.991	672	4.847	.000
SIZE	11049.38	8757.196	10829.08	9451.398	218.624	.253	.800
BATH	2.44	.865	2.29	.454	672	2.093	.037
VALUE	211565.50	134242.111	186618.73	109284.213	277.929	2.317	.021
AGE	.98	.149	1.00	.000	672	1.840	.066
TOILET	.38	.486	.53	.501	672	-3.357	.001
WASHER	.08	.268	.11	.313	672	-1.227	.220

In 2010, there was a significant difference in the scores for water consumption and toilet rebate in customers who did not receive a Cash-4-Grass rebate and those that did. Size of yard, number of bathrooms, value of home, age of home, and washing machine rebate in customers who did not receive a Cash-4-Grass rebate were not significant. Price per unit of water was constant.

Calendar Year 2011

Table 28

Group Differences for Water Consumption Between Groups That Did or Did Not Receive Cash-4-Grass Rebates for Calendar Year 2011

	No Grass Rebate		Grass Rebate				
	M	*SD*	*M*	*SD*	*df*	*t*	*p*
WATER	17.39	17.703	13.21	18.682	521.599	2.912	.004
SIZE	11108.94	8900.998	10625.68	8667.550	556.218	.704	.481
BATH	2.41	.781	2.38	.799	534.742	.406	.685
VALUE	221941.04	138406.177	202474.76	124099.001	591.848	1.916	.056
AGE	.97	.164	1.00	.000	694	-2.709	.007
TOILET	.38	.486	.60	.491	540.499	-5.722	.000
WASHER	.11	.308	.17	.372	694	-2.294	.022

In 2011, there was a significant difference in the scores for water consumption, age of home, toilet rebate, and washing machine rebate in customers who did not receive a Cash-4-Grass rebate and those that did. Size of yard, number of bathrooms, and value of home in customers who did not receive a Cash-4-Grass rebate and those that did were not significant. Price per unit of water was constant.

Calendar Year 2012

Table 29

Group Differences for Water Consumption Between Groups That Did or Did Not Receive Cash-4-Grass Rebates for Calendar Year 2012

	No Grass Rebate		Grass Rebate				
	M	*SD*	*M*	*SD*	*df*	*t*	*p*
WATER	18.78	15.637	17.97	22.503	694	.553	.581
SIZE	10929.43	8955.952	10927.35	8669.716	693.741	.003	.998
BATH	2.37	.710	2.42	.861	655.746	-.821	.412
VALUE	225175.13	143479.667	215186.87	129822.171	692.398	.964	.335
AGE	.97	.180	1.00	.000	694	-3.429	.001
TOILET	.32	.469	.61	.488	694	-7.960	.000
WASHER	.10	.305	.19	.390	694	-3.107	.002

In 2012, there was a significant difference in the scores for age of home, toilet rebate, and for washing machine rebate in customers who did not receive a Cash-4-Grass rebate and those that did. Water consumption in customers, size of yard, number of bathrooms, and value of home in customers who did not receive a Cash-4-Grass rebate and those that did were not significant. Price per unit of water was constant.

Summary

Water consumption and washing machine rebates were statistically significant for 4 out of the 5 years tested; value of the home, age of the home, and toilet rebate for 3 out of the 5 years; and price per unit of water and number of bathrooms for 2 out of the 5 years. Size of yard was not significant in any of the years selected.

Research Question 1 Results

The null hypothesis (H_0^1) states that there is no significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water. The research hypothesis (H_a^1) assumes that there is a significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water. Based on the statistical results, the null hypothesis (H_0^1), which states that there is no significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption, is rejected and the research hypothesis (H_a^1) is accepted.

Research Question 2 and Hypothesis

Do consumers use less water after receiving a landscape rebate than before?

H_0^2: There is no significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

H_a^2: There is a significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

Descriptive Statistics. Frequencies and percentages were calculated for the household characteristics and the results summarized in Table 30. The analyzed data consists of a total of 48 months of records for 21 landscape recipients. The frequency for variables that remained constant for the data collection period (e.g., number of bathrooms, year home was built, size of yard) were divided by 48 to accurately represent the number of homes in the study. The complete statistical results can be found in Appendix D.

Table 30

Frequencies and Percentages for Household Characteristics

Variable	Frequency	Percent
Bathrooms		
2	14	66.7
3	5	23.8
4	1	4.8
6	1	4.8
Rebates Received		
Toilet	569	56.4
Washing Machine	136	13.5
Grass	504	50.0
Age of Home		
Post 1991	21	100.0
Value of Home		
$50,000-99,999	288	28.6
$100,000-149,999	132	13.1
$150,000-199,999	172	17.1
$200,000-249,999	192	19.0
$250,000-299,999	64	6.3
$300,000-349,999	40	4.0
$350,000-399,999	24	2.4
$400,000-449,999	32	3.2
$450,000-499,999	16	1.6
$500,000-549,999	25	2.5
$550,000-599,000	23	2.3
Size of Yard		
4,000-4,999 sq. ft.	4	19.0
5,000-5,999	2	9.6
6,000-6,999	7	33.3
7,000-7,999	1	4.8
8,000-8,999	2	9.5
9,000-9,999	0	0.0
10,000-19,999	2	9.5
20,000-29,999	3	14.3

Most of the homes in the study (90.5%) have either two or three bathrooms. A majority (66.7%) of the homes have two bathrooms and 23.8% have three bathrooms. More than 56% have retrofitted their bathrooms with new toilets. Size of the yard is a primary factor in how much water is used for irrigation. In this dataset, 28.6% have yards under 6,000 square feet, 33.3% have yards between 6,000 and 7,000 square feet, and 38.1% have yards larger than 7,000 square feet.

The means, standard deviations, and intercorrelations are presented in Table 31 and Table 32. In this dataset, the mean water consumption was 16.83 (SD = 22.262), mean size was 10,072.29 sq. ft. (SD = 7,217.827), mean number of bathrooms was 2.52 (SD = .958), mean value of home was $194,409.56 (SD = $126,397.419), mean price was $2.01 (SD = $0.46), mean toilet rebate was .56 (SD = .496), mean washing machine rebate was .13 (SD = .342), mean Cash-4-Grass rebate was .50 (SD = .500), mean temperature was 66.64 (SD = 3.68), and mean rainfall was 1.29 (SD = 2.15). The variable for age was constant at 1. Therefore, the mean was 1.0 and the standard deviation is 0.00.

Table 31

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables

Variable	*M*	*SD*	WATER	1	2	10	11
WATER	16.83	22.262	–	.841**	-.077*	-.141**	.118**
Predictor variable							
1.WATERt1	16.95	22.270	.841**	–	-.071*	-.097**	.140**
2.PRICE	$2.01	$0.46	-.077*	-.071*	–	.154**	-.042
3.SIZE	10072.29	7217.827	.620**	.621**	-.080*	-.013	.015
4.BATH	2.52	.958	.759**	.759**	.025	.002	-.013
5.VALUE	194409	126397	.681**	.682**	.041	.001	-.009
6.AGE	1.00	.000	c	c	c	c	c
7.TOILET	.56	.496	.136**	.136**	.257**	.028	-.049
8.WASHER	.13	.342	.303**	.299**	.215**	.007	-.045
9.GRASS	.50	.500	-.054	-.062*	.534**	.026	-.081**
10.RAIN	1.2872	2.15346	-.141**	-.097**	.154**	–	-.372**
11.TEMP	66.64	3.680	.118**	.140**	-.042	-.372**	–

* $p < 0.05$. ** $p < 0.01$. c. variable is constant.

Table 32

Means, Standard Deviations, and Intercorrelations for Water Usage and Water Consumption Predictor Variables

Variable	*M*	*SD*	3	4	5	7	8	9
WATER	16.83	22.262	.620**	.759**	.681**	.136**	.303**	-.054
Predictor variable								
1.WATERt1	16.95	22.270	.621**	.759**	.682**	.136**	.299**	-.062*
2.PRICE	$2.01	$0.46	-.080*	.025	.041	.257**	.215**	.534**
3.SIZE	10072.29	7217.827	–	.661**	.744**	-.023	.353**	.000
4.BATH	2.52	.958	.661**	–	.827**	.280**	.500**	.000
5.VALUE	194409	126397	.744**	.827**	–	.155**	.472**	.046
6.AGE	1.00	.000	c	c	c	c	c	c
7.TOILET	.56	.496	-.023	.280**	.155**	–	.347**	.122**
8.WASHER	.13	.342	.353**	.500**	.472**	.347**	–	.052
9.GRASS	.50	.500	.000	.000	.046	.122**	.052	–
10.RAIN	1.2872	2.15346	-.013	.002	.001	.028	.007	.026
11.TEMP	66.64	3.680	.015	-.013	-.009	-.049	-.045	-.081**

* $p < 0.05$. ** $p < 0.01$. c. variable is constant.

The correlation coefficients for temperature (.118), size of yard (.620), number of bathrooms (.759), value of home (.681), toilet rebate (.136), and washing machine rebate (.303) are statistically significant at the one percent level on a one-tailed test and indicate that those variables have a direct relationship with water consumption. The positive correlation suggests that as the amount of the variable increases, the amount of water consumption also increases. The correlation coefficient for rain (-.141) is statistically significant at the five percent level on a one-tailed test and indicates that the variable has an indirect relationship with water consumption. The negative correlation suggests that as the amount of the variable increases, the amount of water consumption decreases. The correlation coefficient for price (-.077) is statistically significant at the five percent level on a one-tailed test and indicates that the variable has an indirect relationship with water consumption. The negative correlation suggests that as the amount of the variable increases, the amount of water consumption decreases. The size of the correlation coefficients for size of yard, number of bathrooms, and home value indicate that the variables have a strong relationship with water consumption. The coefficients for price, rain, temperature, toilet rebates, and washing machine rebates indicate a weak relationship. The correlation coefficient for Cash-4-Grass rebate was not statistically significant when compared to water consumption.

Regression Analysis

Ordinary Least Squares linear regression analysis has been utilized to test for the statistical significance of the hypothesized relationship. The results of the regression analysis can be found in Table 33. The complete statistical results can be found in Appendix D.

Table 33

Regression Analysis Summary for Water Consumption Variables Predicting Water Usage

Variable	*B*	*SE B*	*β*	*t*	*p*
Constant	-12.919	7.402	–	-1.745	.081
WATERt1	.565	.026	.566	21.680	.000
PRICE	-.608	.975	-.012	-.624	.533
SIZE	.000	.000	.078	3.090	.002
BATH	6.319	.794	.272	7.954	.000
VALUE	.000	.000	.033	1.021	.307
TOILET	.058	.813	.001	.071	.944
WASHER	-2.705	1.279	-.042	-2.114	.035
GRASS	-.415	.843	-.009	-.492	.623
RAIN	-.828	.179	-.080	-4.631	.000
TEMP	.053	.105	.009	.500	.617

Note. R^2 = .75 (N = 1007, p < .001)

In this dataset, eight of the nine coefficients have the expected signs and four are less than .05, which means they are statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645.

WATERt1: The lagged domestic water use has been used in this model to help predict the nonlagged version of the same dependent variable and to correct for autocorrelation. The lagged domestic water use also acts as a proxy for factors that were not able to be measured directly (e.g., number of household residents).

PRICE: The coefficient on price was negative, which, although not predicted, is not unexpected. Because the water consumption is somewhat insensitive to price, the research plan did not indicate an expected sign. The negative coefficient on price indicates that as the price of water increases, water consumption decreases. However, the coefficient was not statistically significant with a p-value of 0.533.

SIZE: The coefficient on yard size displayed the expected positive sign, which indicates that as yard size increases, water consumption increases. This coefficient was statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645.

BATH: The coefficient on bathrooms was positive, which, although not predicted, is not unexpected. The research plan predicted that the coefficient would be negative because as increased amounts of older toilets are replaced with low-flow toilets, water usage decreases. However, this assumption was dependent on the home being built before 1992. Because all of the homes in the dataset were built after 1991, they were required to be built with low-flow toilets. Therefore, as the number of bathrooms in a home increase, water consumption also increases resulting in a positive coefficient. The coefficient was statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645.

TOILET: The coefficient on toilet rebates did not display the expected negative sign. This was not unexpected. Because all of the homes in the dataset were built after 1991 and, therefore, homes were required to be sold with low-flow toilets, the receipt of a toilet rebate would not significantly reduce water consumption.

WASHER: The coefficient on washer rebates displayed the expected negative sign, which indicates that as clothes washer rebates are received, water consumption decreases. This coefficient was statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645.

GRASS: The coefficient on Cash-4-Grass rebates displayed the expected negative sign, which indicates that as Cash-4-Grass rebates are received, water consumption decreases. However, the coefficient was not statistically significant with a p-value of 0.623.

RAIN: The coefficient on rainfall displayed the expected negative sign, which indicates that as rainfall increases, water consumption decreases. This coefficient was statistically significant at the five percent level on a one-tailed test with a critical t-value of 1.645.

TEMP: The coefficient on temperature displayed the expected positive sign, which indicates that as the ambient temperature increases, water consumption also increases. However, the coefficient was not statistically significant with a p-value of 0.617.

VALUE: The coefficient on home value displayed the expected positive sign, which indicates that as the value increases, water consumption also increases. However, the coefficient was not statistically significant with a p-value of 0.307.

AGE: The variable in the dataset is constant and was deleted from the analysis equation.

Overall, the F-statistic of 305.259 is more than 2.21 which means that the model, as a whole, is statistically significant at the five percent level of significance and the adjusted R-squared is .751 which means that this set of variables explains 75 percent of residential water consumption in Vandenberg Village.

***t* test**

An independent samples *t* test was used to compare the differences in water consumption before and after the receipt of a Cash-4-Grass rebate. The results are presented in Table 34. Comparison of water consumption for Cash-4-Grass rebate recipients (M = 15.62, SD = 21.77) and those customers not receiving Cash-4-Grass rebates (M = 18.03, SD = 22.701) showed a reduction in water consumption in average but revealed no significant differences between the groups t(1006) = 1.721, ns.

Table 34

Group Differences for Water Consumption Between Groups That Did or Did Not Receive Cash-4-Grass Rebates

	No Grass Rebate		Grass Rebate				
	M	*SD*	*M*	*SD*	*df*	*t*	*p*
WATER	18.03	22.701	15.62	21.770	1004.240	1.721	.086

Research Question 2 Results

The null hypothesis (H_0^1) states that there is no significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water. The research hypothesis (H_a^1) assumes that there is a significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

The descriptive statistics are presented in in Table 30, Table 31, and Table 32. The correlation coefficients for size of yard, number of bathrooms, and value of homes indicate that the variables have a strong relationship with water consumption. These coefficients are statistically significant at the one percent level on a one-tailed test.

The results of the regression analysis can be found in Table 33 and indicate that receipt of a washing machine rebate, size of property, number of bathrooms, and rainfall have a statistical significance on water consumption. The model was statistically significant at the five percent level of significance and the variables selected explain 75 percent of residential water consumption in Vandenberg Village. Because the coefficient on landscape rebates displayed the expected negative sign but was not statistically significant with a p-value of 0.623, a *t* test was used to compare the differences in water consumption before and after the receipt of a Cash-4-Grass rebate (see Table 34).

Although not statistically significant, the results indicate a reduction in water consumption after the receipt of a Cash-4-Grass rebate (Difference = 2.41).

Based on these statistical results, the null hypothesis (H_0^2), which states that there is no significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate, cannot be rejected.

Findings

The purpose of this study is to investigate the relationship between the dependent variable of monthly residential water usage and the independent variables of receipt of a toilet, washer, and/or landscape rebate, size of irrigable property, number of bathrooms, value of home, age of home, amount of monthly rainfall, average monthly high temperature, and price per unit of water. The primary goal of this research is to answer the question *Can cash-4-grass programs save water?*

Research Question 1

Based on the descriptive statistics and regression analyses conducted on the datasets, the null hypothesis (H_0^1), which states that there is no significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption, is rejected and the research hypothesis (H_a^1) is accepted.

Research Question 2

Based on the descriptive statistics and regression analyses conducted on the datasets, the null hypothesis (H_0^2), which states that there is no significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate, cannot be rejected.

Summary

Chapter 4 presented the results of the statistical analysis. It includes: a description of the data collection process; an explanation of the data transformation performed; a description of the data analysis; a testing of the hypotheses; and a summary of the findings. This chapter explained that data collected from VVCSD, SBC, and NOAA were transformed and combined into seven separate datasets for statistical analysis. IBM SPSS® Statistics version 21 was used to generate descriptive statistics and perform a linear regression analysis. The statistical results were mixed. However, according to hypothesis testing, a robust water conservation program, including Cash-4-Grass rebates, can have a significant impact on water consumption.

Chapter 1 presented an in-depth introduction to water supply, water demand, water conservation, and landscape rebates. Chapter 2 presented the review of the existing literature for the study. Chapter 3 presented the research methodology that was used for this project. Chapter 5 will present the interpretation of the findings, limitations of the study, recommendations, and implications.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

California's domestic water supplies are threatened by population growth, drought, pollution, and climate change. In recent years, the California legislature concluded that the most economical option to extend the resources was to use less water per capita. To encourage household water savings, most water conservation programs use restrictions, rates, and rebates. Prior research has focused on water restrictions, pricing structures, and toilet rebates. Since outdoor water usage accounts for the majority of a household's water usage, elements of a water conservation program that target outdoor water use, such as landscape rebates, can have a significant impact on domestic water usage.

This research was designed to measure the effectiveness of landscape rebates on water consumption in the bedroom community of Vandenberg Village, California. The analysis was performed on public data obtained from VVCSD, SBC, and NOAA. The purpose of this study was to investigate the relationship between the dependent variable of monthly residential water usage and the independent variables of receipt of a toilet, washer, and/or landscape rebate, size of irrigable property, number of bathrooms, value of home, age of home, amount of monthly rainfall, average monthly high temperature, and price per unit of water.

The primary goal of this research was to answer the question *Can cash-4-grass programs save water?* To answer this question the study used a multiple time-series quasi-experimental research design to evaluate the effectiveness of landscape rebates on residential water consumption in Vandenberg Village, California. Using descriptive statistics and regression analyses, the study addressed two research questions to evaluate the effectiveness of landscape rebates:

1. Do consumers who receive landscape rebates use less water than those consumers who do not?
2. Do consumers use less water after receiving a landscape rebate than before?

The findings for this study were mixed. Overall, the results show that Cash-4-Grass rebates do reduce water consumption. However, this reduction in water use was not consistently statistically significant. Therefore, the research hypothesis could not be accepted for both research questions. This chapter presents the interpretation of the findings, limitations of the study, recommendations for further research, and a conclusion.

Interpretation of the Findings

As explained in Chapter 1, TRA is based on a person's attitude toward expected behavior. The more a person is expected to exhibit a particular behavior, the more likely he or she will behave in the expected manner. During California's periodic dry periods, customers are inundated with messages to conserve water. Most recently, on January 17, 2014, Governor Jerry Brown officially declared a drought emergency for California and asked its residents to reduce their water consumption by 20% (York, 2014). Figure 10 illustrates that, except for anomalous calendar year 2012, water conservation expectations during dry periods were realized by an increase in Cash-4-Grass rebates during those years. An increase in rainfall in calendar year 2010 resulted in a decrease of Cash-4-Grass rebate requests.

Calendar year 2012 may have exhibited anomalous findings because of the heavy rainfall during the winter of 2011. Customers may have increased their irrigation regime in an effort to duplicate the lush, green lawns that occurred naturally during the previous year (Endter-Wada et al., 2008).

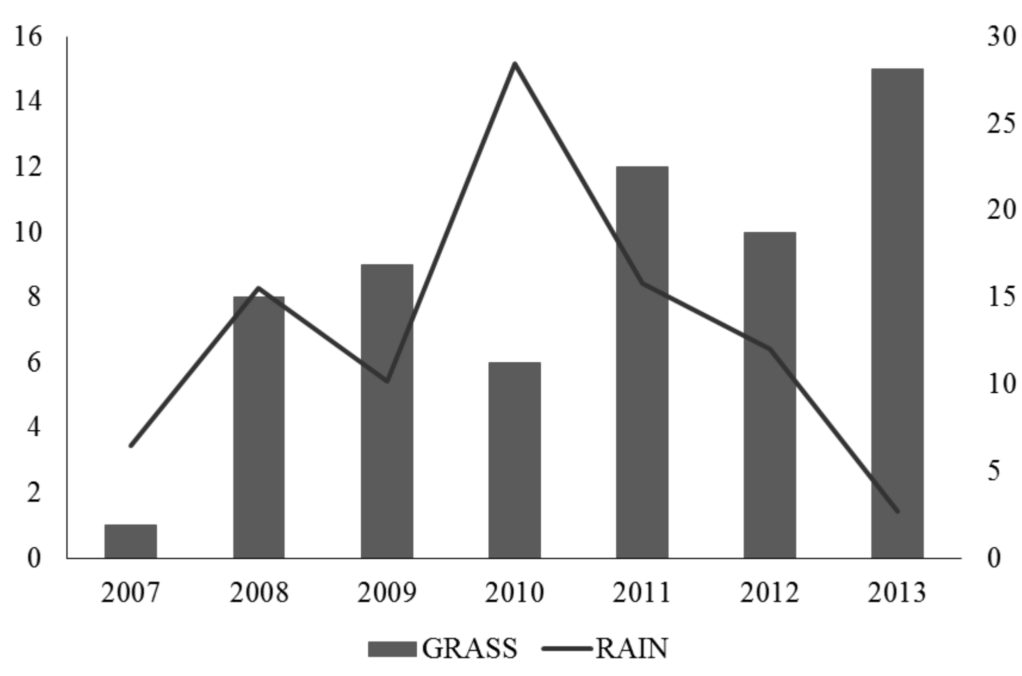

Figure 10. Comparison of the number of Cash-4-Grass rebates and annual rainfall.

Although not statistically significant, the results of the RQ2 *t* test demonstrate that Cash-4-Grass rebate recipients reduced their water consumption, on average, by 13.4%. Similarly, the results of the RQ1 *t* tests demonstrate that Cash-4-Grass rebate recipients used between 4% and 75% less water than their non-rebate counterparts (see Figure 11).

These savings are consistent with the predictions outlined by the literature review in Chapter 2.

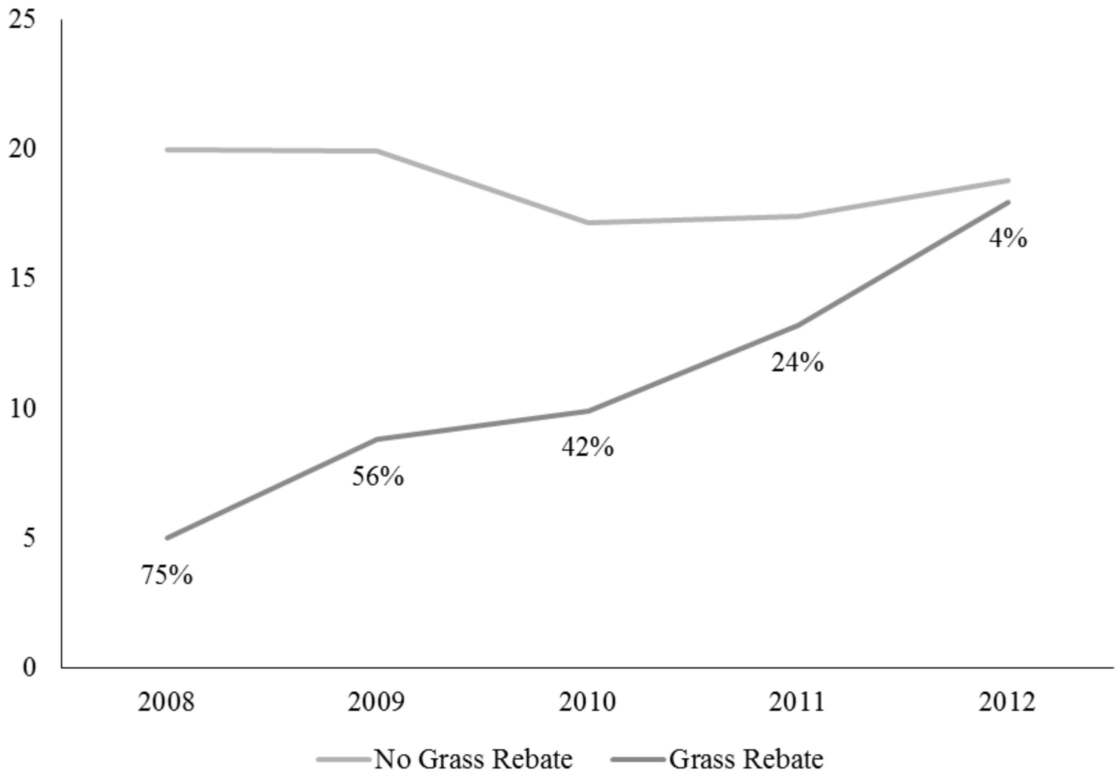

Figure 11. Comparison of water consumption for customers that have and have not received Cash-4-Grass rebates.

Research Question 1

The null hypothesis (H_0^1) states that there is no significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water. The research hypothesis (H_a^1) assumes that there is a significant difference between the receipt of landscape rebates and no receipt of landscape rebates on water consumption when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, and price per unit of water.

The results of the regression analyses indicate that receipt of a Cash-4-Grass rebate, size of property, number of bathrooms, and price per unit of water have varying degrees of statistical significance on water consumption. Additionally, the correlation between Cash-4-Grass rebates and water consumption was statistically significant for four of the five years analyzed. Based on these results, the null hypothesis (H_0^1) is rejected and the research hypothesis (H_a^1) is accepted.

Research Question 2

The null hypothesis (H_0^1) states that there is no significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water. The research hypothesis (H_a^1) assumes that there is a significant difference in water consumption in the 24 months before and 24 months after receipt of a landscape rebate when controlling for receipt of a toilet or washing machine rebate, size of property, number of bathrooms, value of home, age of home, amount of rainfall, average temperature, and price per unit of water.

Although the regression analysis model for the research question was statistically significant and the coefficient on Cash-4-Grass rebates displayed the expected negative sign, the Cash-4-Grass rebates variable was not statistically significant with a p-value of 0.623. Additionally, the correlation coefficient between Cash-4-Grass rebates and water consumption was not statistically significant. Based on these results, the null hypothesis (H_0^2) cannot be rejected.

Limitations of the Study

Upon a detailed review of the data received from VVCSD, it was discovered that some Cash-4-Grass rebate recipients may have replaced their lawns in an attempt to increase the home's curb appeal. Because the customer moved out of the home within a few months of receiving the rebate, and a new customer with a different family demographic benefitted from the reduction in irrigable lawn, the before and after water usage numbers may not have been measuring the same impacts to water consumption. A limitation identified in Chapter 1 was the impact of missing data for homes during periods of vacancy. Both of these limitations were addressed during the model formation stage and homes with periods of zero usage for 2 or more subsequent months were eliminated from the model.

Another limitation identified in Chapter 1 was meter reading accuracy. During the study period, VVCSD replaced every meter within their community with AMR capable meters (VVCSD, 2011c, 2012c). The maximum usage fluctuations detailed in Table 35 may be a result of normal household usage fluctuations and meter reading corrections brought on by automation because the usage does not gradually reduce as meters were replaced.

A final limitation that was discovered when the data from VVCSD was divided into models is that water consumption for some Cash-4-Grass rebate recipients began to decline months before the rebate was requested. The work plan attempted to take into account the time lag between the time the landscape was replaced and the rebate was received by leading the variable by one month. However, it seems as though some recipients prepared to remove their turf grass by turning off their irrigation systems and allowing their grass to die. This process could have taken many months.

Table 35

Number, Maximum, and Mean for Water Usage Variables

	N	Max	Mean
RQ1			
2007	629	158	19.98
2008	652	200	19.68
2009	660	225	18.40
2010	674	105	15.58
2011	696	169	15.83
2012	696	171	18.38
RQ2	1008	225	16.83

Recommendations for Further Research

When before and after consumption was tested by the RQ2 model, Cash-4-Grass rebate recipients did not exhibit a statistically significant water consumption reduction. However, when rebate and non-rebate consumption was tested in the RQ1 models, there was a statistically significant reduction. This may be explained by an untested "conservation attitude" (Dyckman, 2005) and that the Cash-4-Grass rebate was a monetary manifestation of their conservation efforts. Conversely, the inability to pinpoint the actual month of lawn replacement may have contributed to the lack of significance in the RQ2 model through imprecise before and after rebate data points.

It is my opinion that further research should focus on an in-depth analysis of select Cash-4-Grass rebate recipients. By focusing on specific recipients, additional elements, such as household demographics, can be included in the analysis and the rebate recipients can be surveyed to analyze their conservation attitude. Finally, the content of their water consumption history and rebate receipts can be individually analyzed to determine when the changes to the landscape were implemented. A companion study should be an in-depth analysis of non-rebate recipients. An evaluation of their conservation attitude may help determine the barriers to participation in the Cash-4-Grass rebate program.

Finally, to expand the knowledge regarding the effectiveness of landscape rebates, a similar study should be performed in other areas that offer rebates for lawn removal. Since 2009, the City of Los Angeles has paid for the removal of more than 1 million square feet of grass for a total of $1.4 million in rebates (Lovett, 2013). City officials expect to save 47 million gallons of water per year (Lovett, 2013). Since 2003, the Las Vegas Valley Water District has paid more than $200 million for the removal of 165.6 million square feet of grass (Lovett, 2013). District officials report that they have saved 9.2 billion gallons of water in the decade since the program’s implementation (Lovett, 2013). Studies in these areas will greatly expand the academic knowledge regarding water conservation and landscape rebates.

Implications

A comparison of all of the data collected revealed that in the decade from 2002 to 2012, overall, VVCSD customers reduced their average summer water consumption by 20%. While this consumption reduction cannot be attributed to Cash-4-Grass rebates alone, in this study, all of the water conservation rebates were statistically significant to varying degrees. Therefore, a robust water conservation program, including Cash-4-Grass rebates, can have a significant impact on water consumption.

This study has the potential to positively impact a multitude of water customers not only in California but around the world. While droughts get most of the press coverage, water conservation is a topic that water professionals deal with year round, during the rainy season as well as the droughts. Ideas for new and improved methods for encouraging customers to conserve water are continually being sought. This study adds new information to the topic of Cash-4-Grass rebates that may assist water conservation coordinators in broaching the subject with their elected officials in the future. The addition of Cash-4-Grass rebates to a water conservation program can help reduce water consumption locally and increase water supplies globally.

Conclusion

In 2014, California enters yet another drought and water conservation is once again in the local and national news. As Governor Brown is asking California residents to reduce their water consumption by 20%, the temperatures on the central coast in February are an unseasonably hot 80 degrees and residents throughout the area are turning on their sprinklers in an attempt to revive their thirsty lawns. This study has shown that reducing the amount of irrigable yards can significantly reduce water consumption. However, the results have also shown that, as theorized by Ajzen and Fishbein (1972, 1977), the person has to believe that the behavior is expected of them.

References

Ajzen, I. (1980). *Understanding attitudes and predicting social behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I. (1985). From intentions to actions: a theory of planned behavior. In J. Kuhl & J. Beckmann (Eds.), Action control, from cognition to behavior (pp. 11-39). New York: Springer-Verlag.

Ajzen, I. (2011). The theory of planned behaviour: reactions and reflections. *Psychology & Health, 26*(9), 1113-1127. doi: 10.1080/08870446.2011.613995

Ajzen, I., & Fishbein, M. (1972). Attitudes and normative beliefs as factors influencing behavioral intentions. *Journal of Personality and Social Psychology*, *21*(1), 1-9. doi: 10.1037/h0031930

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: a theoretical analysis and review of empirical research. *Psychological Bulletin*, *84*(5), 888-918. doi: 10.1037/0033-2909.84.5.888

Allen, C. (2008). *A study of water conservation in Vandenberg Village, California*. Unpublished Capstone Project. California Polytechnic State University, San Luis Obispo.

American Water Works Association. (2006). *Water conservation programs : a planning manual*. Denver, CO: American Water Works Association.

American Water Works Association. (2009). *Water audits and loss control programs* (3rd ed.). Denver, CO: American Water Works Association.

Anderson-Wilk, M. (2008). Rising expectations for conservation in water-scarce times. *Journal of Soil and Water Conservation, 63*(1), 4A. doi: 10.2489/jswc.63.1.4A

Atwood, C., Kreutzwiser, R., & De Loë, R. (2007). Residents' assessment of an urban outdoor water conservation program in Guelph, Ontario. *Journal of the American Water Resources Association, 43*(2), 427-439. doi: 10.1111/j.1752-1688.2007. 00033.x

Bachman, S., Hauge, C., McGlothlin, R., Neese, K., Parker, T., Saracino, A., & Slater, S. (2005). *California groundwater management* (2nd ed.). Sacramento, CA: Groundwater Resources Association of California.

Balkin, S., & Ord, J. K. (2001). Assessing the impact of speed-limit increases on fatal interstate crashes. *Journal of Transportation and Statistics, 4*(1), 1-26. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/journal_of_transportation_and_statistics/index.html

Balling, R. C., Gober, P., & Jones, N. (2008). Sensitivity of residential water consumption to variations in climate: an intraurban analysis of Phoenix, Arizona. *Water Resources Research, 44*(10), W10401. doi: 10.1029/2007wr006722

Bennear, L. S., Taylor, L., & Lee, J. (2011). Participation incentives, rebound effects and the cost-effectiveness of rebates for water-efficient appliances. *SSRN eLibrary*. doi: 10.2139/ssrn.1970011

Binder, B. (2011). Impact of climate change on public health. *Public Manager, 40*(1), 32-36. http://www.sciencedirect.com/science/journal/00333506

Blette, V. (2008). Drinking water public right-to-know requirements in the United States. *Journal of Water & Health, 6*, 43-51. doi: 10.2166/wh.2008.031

Booker, J. F., Howitt, R. E., Michelsen, A. M., & Young, R. A. (2012). Economics and the modeling of water resources and policies. *Natural Resource Modeling, 25*(1), 168-218. doi: 10.1111/j.1939-7445.2011.00105.x

Brennan, D., Tapsuwan, S., & Ingram, G. (2007). The welfare costs of urban outdoor water restrictions. *Australian Journal of Agricultural and Resource Economics, 51*(3), 243-261. doi: 10.1111/j.1467-8489.2007.00395.x

California. (1988). California Government Code Section 60370-60375.5 Retrieved from http://www.leginfo.ca.gov/cgi-bin/displaycode?section=gov&group=60001-61000&file=60370-60375.5

California Assembly. (2004a). Assembly Bill 2572. Retrieved from http://leginfo.ca.gov/pub/03-04/bill/asm/ab_2551-2600/ab_2572_bill_20040929_chaptered.pdf

California Assembly. (2004b). Assembly Bill 2717. Retrieved from http://www.water.ca.gov/wateruseefficiency/docs/ab_2717_bil.pdf

California Assembly. (2007). Assembly Bill 715. Retrieved from http://www.leginfo.ca.gov/pub/07-08/bill/asm/ab_0701-0750/ab_715_bill_20071011_chaptered.pdf

California Constitution. Article X, § 2.

California Department of Fish and Game. (2009). Burton Mesa Ecological Reserve. Retrieved from http://www.dfg.ca.gov/lands/er/region5/docs/BurtonMesaER.pdf

California Senate. (2009). Senate Bill x7-7. Retrieved from http://info.sen.ca.gov/pub/09-10/bill/sen/sb_0001-0050/sbx7_7_bill_20091110_chaptered.pdf

California Urban Water Conservation Council. (2007). *Statewide market survey: landscape water use efficiency final report*. Retrieved from http://www.cuwa.org/pubs/LandscapeMarketSurveyFinalRpt2007.pdf

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research*. Chicago, IL: Rand McNally & Company.

CDWR. (2000). *Preparing for California's next drought: changes since 1987-1992*. Sacramento, CA: State of California. Retrieved from http://www.water.ca.gov/ waterconditions/drought/docs/Drought_Report_87-92.pdf

CDWR. (2003). *California's groundwater*. (Bulletin 118). Sacramento, CA: State of California. Retrieved from http://www.water.ca.gov/pubs/groundwater/ bulletin_118/california's_groundwater__bulletin_118_-_update_2003_/ bulletin118_entire.pdf

CDWR. (2008). *Managing an uncertain future: climate change adaptation strategies for California's water*. Sacramento, CA: California Department of Water Resources. Retrieved from http://www.water.ca.gov/climatechange/docs/ClimateChange WhitePaper.pdf

CDWR. (2009a). *California water plan update 2009*. (Vol. 1). Sacramento, CA: State of California. Retrieved from http://www.waterplan.water.ca.gov/cwpu2009/ index.cfm

CDWR. (2009b). *California water plan update 2009*. (Vol. 2). Sacramento, CA: State of California. Retrieved from http://www.waterplan.water.ca.gov/cwpu2009/index.cfm

CDWR. (2009c). *California water plan update 2009*. (Vol. 4). Sacramento, CA: State of California. Retrieved from http://www.waterplan.water.ca.gov/cwpu2009/index.cfm

CDWR. (2009d). *California water plan update 2009*. (Vol. 3). Sacramento, CA: State of California. Retrieved from http://www.waterplan.water.ca.gov/cwpu2009/index.cfm

CDWR. (2009e). *ET overview*. Sacramento, CA: State of California. Retrieved from http://wwwcimis.water.ca.gov/cimis/infoEtoOverview.jsp

CDWR. (2010a). California state water project overview. Retrieved from http://www.water.ca.gov/swp/

CDWR. (2010b). *California's drought of 2007–2009*. Sacramento, CA: State of California. Retrieved from http://www.water.ca.gov/waterconditions/drought/docs/DroughtReport2010.pdf

CDWR. (2013). *California water plan update 2013*. Sacramento, CA: State of California. Retrieved from http://www.waterplan.water.ca.gov/docs/cwpu2013/2012mar-vol3-rms/Vol3_UrbanWUE_Apr_release.pdf

City of Lompoc. (2009). *Agenda - November 9, 2009*. Lompoc, CA: Lompoc Utility Commission. Retrieved from http://www1.cityoflompoc.com/utilitycommission agenda/2009/091109.pdf

City of Riverside. (2012). Waterwise landscape rebate. Retrieved from http://www.greenriverside.com/Green-Rebate-Programs-7/Residential/Water-Efficiency-113/Rebate-140/Waterwise_Landscape

City of Santa Barbara. (2009). *New smart landscape rebate program launched*. Santa Barbara, CA: Water Resources Division. Retrieved from http://www.santabarbaraca.gov/Documents/Sustainable_Santa_Barbara/In_the_News/01_Press_Releases/2009-06-02_Smart_Landscape_Rebate_Program.pdf

Cockerham, S. T., & Leinauer, B. (Eds.). (2011). *Turfgrass water conservation* (Second ed.). Richmond, CA: University of California, Agriculture and Natural Resources, Communication Services.

Coleman, E. A. (2009). A comparison of demand-side water management strategies using disaggregate data. *Public Works Management & Policy, 13*(3), 215-223. doi: 10.1177/1087724x08327648

Corbella, H. M., & Pujol, D. S. (2009). What lies behind domestic water use?: a review essay on the drivers of domestic water consumption. *Boletín de la Asociación de Geógrafos Españoles,* (50), 297-314. http://www.boletinage.com/

Dolnicar, S., Hurlimann, A., & Grün, B. (2012). Water conservation behavior in Australia. *Journal of Environmental Management, 105*(0), 44-52. doi: 10.1016/j.jenvman.2012.03.042

Dyckman, C. S. (2005). *Local government roles in water conservation*. 3210570. University of California, Berkeley. United States -- California.

Dziegielewski, B., Garbharran, H. P., & Langowski, J. F. (1993). *Lessons learned from the California drought (1987-1992)*. (IWR 93-NDS-5). Institute for Water Resources, Water Resources Support Center, U.S. Army Corps of Engineers.

Endter-Wada, J., Kurtzman, J., Keenan, S., Kjelgren, R., & Neale, C. (2008). Situational waste in landscape watering: residential and business water use in an urban Utah community. *Journal of the American Water Resources Association, 44*(4), 902. doi: 10.1111/j.1752-1688.2008.00190.x

Engineering News-Record. (2012). Construction cost index history.

Fielding, K. S., McDonald, R., & Louis, W. R. (2008). Theory of planned behaviour, identity and intentions to engage in environmental activism. *Journal of Environmental Psychology, 28*(4), 318-326. doi: 10.1016/j.jenvp.2008.03.003

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior : an introduction to theory and research*. Reading, Mass.: Addison-Wesley Pub. Co.

Frankfort-Nachmias, C., & Nachmias, D. (2008). *Research methods in the social sciences* (7th ed.). New York, NY: Worth Publishers.

Freeman, G., Poghosyan, M., & Lee, M. (2008). *Where will we get the water? Assessing southern California's future water strategies*. Los Angeles, CA: Los Angeles County Economic Development Corporation. Retrieved from http://www. cacoastkeeper.org/document/where-will-we-get-the-water.pdf

Funk, A. (2007). Suggestions for urban water conservation planning: a New Mexico perspective. *Bulletin of Science Technology Society, 27*(2), 170-181. doi: 10.1177/0270467606298410

Gleick, P. H. (Ed.). (1993). *Water in crisis: a guide to the world's fresh water resources*. New York, NY: Oxford University Press.

Gleick, P. H., Christian-Smith, J., & Cooley, H. (2011). Water-use efficiency and productivity: rethinking the basin approach. *Water International, 36*(7), 784-798. doi: 10.1080/02508060.2011.631873

Gober, P., & Kirkwood, C. W. (2010). Vulnerability assessment of climate-induced water shortage in Phoenix. *Proceedings of the National Academy of Sciences, 107*(50), 21295-21299. doi: 10.1073/pnas.0911113107

Goldstein, N. (2012). Innovation in water conservation. *BioCycle, 53,* 41-42.

Grafton, R. Q., & Ward, M. B. (2008). Prices versus rationing: Marshallian surplus and mandatory water restrictions. *Economic Record, 84*, S57-S65. doi: 10.1111/j.1475-4932.2008.00483.x

Graymore, M. L. M., & Wallis, A. M. (2010). Water savings or water efficiency? Water-use attitudes and behaviour in rural and regional areas. *International Journal of Sustainable Development & World Ecology, 17*(1), 84-93. doi: 10.1080/13504500903497249

Griggs, G., & Russell, N. (2012). *City of Santa Barbara sea-level rise vulnerability study*. (CEC-500-2012-039). Sacramento, CA: California Energy Commission. Retrieved from http://www.energy.ca.gov/2012publications/CEC-500-2012-039/CEC-500-2012-039.pdf

Halich, G., & Stephenson, K. (2009). Effectiveness of residential water-use restrictions under varying levels of municipal effort. *Land Economics, 85*(4), 614-626. http://uwpress.wisc.edu/journals/journals/le.html

Hall, D. C. (2009). Politically feasible, revenue sufficient, and economically efficient municipal water rates. *Contemporary Economic Policy, 27*(4), 539-554. doi: 10.1111/j.1465-7287.2009.00164.x

Hanak, E. (2008). Is water policy limiting residential growth? Evidence from California. *Land Economics, 84*(1), 31-50. http://uwpress.wisc.edu/journals/journals/le.html

Hanak, E., & Davis, M. (2006). Lawns and water demand in California. San Francisco, CA: Public Policy Institute of California.

Hanak, E., Lund, J., Dinar, A., Gray, B., Howitt, R., Mount, J., . . . Thompson, B. (2011). Managing California’s water: from conflict to reconciliation. San Francisco, CA: Public Policy Institute of California.

Hardin, G. (1968). The tragedy of the commons. *Science, 162*, 1243-1248. doi: 10.1126/science.162.3859.1243

Harlan, S. L., Yabiku, S. T., Larsen, L., & Brazel, A. J. (2009). Household water consumption in an arid city: affluence, affordance, and attitudes. *Society & Natural Resources, 22*(8), 691-709. doi: 10.1080/08941920802064679

Harou, J. J., Medellín-Azuara, J., Zhu, T., Tanaka, S. K., Lund, J. R., Stine, S., . . . Jenkins, M. W. (2010). Economic consequences of optimized water management for a prolonged, severe drought in California. *Water Resources Research, 46*(5), W05522. doi: 10.1029/2008wr007681

Harvey, A. C. (1989). *Forecasting, structural time series models, and the Kalman filter*. Cambridge ; New York: Cambridge University Press.

Head, L., & Muir, P. (2007). Changing cultures of water in eastern Australian backyard gardens. *Social & Cultural Geography, 8*(6), 889-905. doi: 10.1080/14649360701712651

Hill, T., & Symmonds, G. (2011). Sustained water conservation by combining incentives, data and rates to effect consumer behavioural change. In D. W. Pepper & C. A. Brebbia (Eds.), Water and Society (Vol. 153, pp. 409-420). Southampton, UK: WIT Press.

House-Peters, L., Pratt, B., & Heejun, C. (2010). Effects of urban spatial structure, sociodemographics, and climate on residential water consumption in Hillsboro, Oregon. *Journal of the American Water Resources Association, 46*(3), 461-472. doi: 10.1111/j.1752-1688.2009.00415.x

Hurlimann, A., Dolnicar, S., & Meyer, P. (2009). Understanding behaviour to inform water supply management in developed nations - a review of literature, conceptual model and research agenda. *Journal of Environmental Management, 91*(1), 47-56. doi: 10.1016/j.jenvman.2009.07.014

IBM Corporation. (2011). IBM SPSS Forecasting 20. Somers, NY: IBM Corporation. Retrieved from ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/20.0/en/client/Manuals/IBM_SPSS_Forecasting.pdf

IBM Corporation. (2012). SPSS Statistics Version 21. Somers, NY: IBM Corporation.

Jackson, J. (n.d.). Technical brief: considerations for testing large water meters. Uniontown, PA: Sensus Corporation.

Jones, N., Evangelinos, K., Gaganis, P., & Polyzou, E. (2011). Citizens' perceptions on water conservation policies and the role of social capital. *Water Resources Management, 25*(2), 509. doi: 10.1007/s11269-010-9711-z

Jorgensen, B., Graymore, M., & O'Toole, K. (2009). Household water use behavior: an integrated model. *Journal of Environmental Management, 91*(1), 227-236. doi: 10.1016/j.jenvman.2009.08.009

Kahrl, W. L. (1982). *Water and power: the conflict over Los Angeles' water supply in the Owens Valley*. Berkeley: University of California Press.

Kallis, G., Ray, I., Fulton, J., & McMahon, J. E. (2010). Public versus private: does it matter for water conservation? Insights from California. *Environmental Management, 45*(1), 177-191. doi: 10.1007/s00267-009-9403-8

Kawaoka v. the City of Arroyo Grande, 17 F.3d 1227 (9th Cir. 1994).

Kenney, D., Goemans, C., Klein, R., Lowrey, J., & Reidy, K. (2008). Residential water demand management: lessons from Aurora, Colorado. *Journal of the American Water Resources Association, 44*(1), 192. doi: 10.1111/j.1752-1688.2007.00147.x

Kenny, J. F., Barber, N. L., Hutson, S. S., Linsey, K. S., Lovelace, J. K., & Maupin, M. A. (2009). *Estimated use of water in the United States in 2005*. (Circular 1344). U.S. Geological Survey. Retrieved from http://pubs.usgs.gov/circ/1344/pdf/c1344.pdf

Knutson, C. (2008). The role of water conservation in drought planning. *Journal of Soil and Water Conservation, 63*(5), 154A. doi: 10.2489/jswc.63.5.154A

Kumar, A., Adak, P., Gurian, P. L., & Lockwood, J. R. (2010). Arsenic exposure in US public and domestic drinking water supplies: a comparative risk assessment. *Journal of Exposure Science & Environmental Epidemiology, 20*(3), 245-254. doi: 10.1038/jes.2009.24

Larson, K. L., Casagrande, D., Harlan, S. L., & Yabiku, S. T. (2009). Residents' yard choices and rationales in a desert city: social priorities, ecological impacts, and decision tradeoffs. *Environmental Management, 44*(5), 921-937. doi: 10.1007/s00267-009-9353-1

Larson, K. L., Cook, E., Strawhacker, C., & Hall, S. J. (2010). The influence of diverse values, ecological structure, and geographic context on residents' multifaceted landscaping decisions. *Human Ecology, 38*(6), 747-761. doi: 10.1007/s10745-010-9359-6

Larson, K. L., Gustafson, A., & Hirt, P. (2009). Insatiable thirst and a finite supply: an assessment of municipal water-conservation policy in greater Phoenix, Arizona, 1980-2007. *Journal of Policy History, 21*(2), 107-137. doi: 10.1017/S0898030609090058

Larson, K. L., Wutich, A., White, D., Muñoz-Erickson, T. A., & Harlan, S. L. (2011). Multifaceted perspectives on water risks and policies: a cultural domains approach in a southwestern city. *Human Ecology Review, 18*(1), 75. http://www.humanecologyreview.org/

Lee, M., Tansel, B., & Balbin, M. (2011). Influence of residential water use efficiency measures on household water demand: a four year longitudinal study. *Resources, Conservation and Recycling, 56*(1), 1-6. doi: 10.1016/j.resconrec.2011.08.006

Liska, A. E. (1974). *The consistency controversy: readings on the impact of attitude on behavior*. New York, NY: Halsted Press Division.

Los Angeles Department of Water and Power. (n.d.). A new supply. Retrieved from http://wsoweb.ladwp.com/Aqueduct/historyoflaa/newsupply.htm

Los Angeles Times. (1902a, June 17). Big changes in water-rate ordinance, *Los Angeles Times,* p. A7.

Los Angeles Times. (1902b, May 8). Water supply running low, *Los Angeles Times,* p. A1.

Lovett, I. (2013, August 11). Arid southwest cities' plea: lose the lawn, *New York Times*. Retrieved from http://www.nytimes.com/2013/08/12/us/to-save-water-parched-southwest-cities-ask-homeowners-to-lose-their-lawns.html?_r=1&

MacDonald, G. M. (2007). Severe and sustained drought in southern California and the west: present conditions and insights from the past on causes and impacts. *Quaternary International, 173–174*(0), 87-100. doi: 10.1016/j.quaint.2007.03.012

Makki, A. A., Stewart, R. A., Panuwatwanich, K., & Beal, C. (2011). Revealing the determinants of shower water end use consumption: enabling better targeted urban water conservation strategies. *Journal of Cleaner Production*(In Press, Corrected Proof). doi: 10.1016/j.jclepro.2011.08.007

Mansur, E. T., & Olmstead, S. M. (2012). The value of scarce water: measuring the inefficiency of municipal regulations. *Journal of Urban Economics, 71*(3), 332-346. doi: 10.1016/j.jue.2011.11.003

Marandu, E. E., Moeti, N., & Joseph, H. (2010). Predicting residential water conservation using the theory of reasoned action. *University of Botswana Journal of Communications, 1*(2), 87-100. www.ub.bw/ojs/

Marimow, A. E. (2007, January 17). Love-it-or-hate-it building moratorium draws crowd at hearing, *Washington Post*. Retrieved from http://www.washingtonpost.com/wp-dyn/content/article/2007/01/16/AR2007011601972.html

McNabb, D. E. (2008). *Research methods in public administration and nonprofit management : quantitative and qualitative approaches* (2nd ed.). Armonk, N.Y.: M.E. Sharpe, Inc.

Microsoft Corporation. (2012). Microsoft Excel 2013. Redmond, Washington: Microsoft Corporation.

Millock, K., & Nauges, C. (2010). Household adoption of water-efficient equipment: the role of socio-economic factors, environmental attitudes and policy. *Environmental and Resource Economics, 46*(4), 539-565. doi: 10.1007/s10640-010-9360-y

Moulton Niguel Water District. (2012). Understanding water-budget-based rates. Retrieved from http://www.mnwd.com/customer-service/budget-based-rates.aspx

Mueller, D. J. (1986). *Measuring social attitudes: a handbook for researchers and practitioners*. New York, NY: Teachers College Press.

Mulholland, C. (2000). *William Mulholland and the rise of Los Angeles*. Berkeley, CA: University of California Press.

Munger, M. C. (2000). *Analyzing policy: choices, conflicts, and practices*. New York: W.W. Norton and Company.

Nataraj, S., & Hanemann, W. M. (2011). Does marginal price matter? A regression discontinuity approach to estimating water demand. *Journal of Environmental Economics and Management*, *61*(2), 198-212. doi: 10.1016/j.jeem.2010.06.003

National Wildlife Federation. (n.d.). Cut your lawn - in half. Retrieved from http://www.nwf.org/Get-Outside/Outdoor-Activities/Garden-for-Wildlife/Gardening-Tips/Cut-Your-Lawn-In-Half.aspx

Nelson, K., Cismaru, M., Cismaru, R., & Ono, T. (2011). Water management information campaigns and protection motivation theory. *International Review on Public and Nonprofit Marketing*, *8*(2), 163-193. doi: 10.1007/s12208-011-0075-8

Nielsen-Pincus, M., Goldberg, C. S., Pocewicz, A., Force, J. E., Waits, L. P., Morgan, P., & Vierling, L. (2010). Predicted effects of residential development on a northern Idaho landscape under alternative growth management and land protection policies. *Landscape and Urban Planning*, *94*(3–4), 255-263. doi: 10.1016/j.landurbplan.2009.10.011

NOAA. (2013). Temp, Precip, and Drought Time Series. Retrieved from http://www.ncdc.noaa.gov/cag/time-series/us

NOAA. (n.d.). Automated weather observing system (AWOS). Retrieved from http://www.ncdc.noaa.gov/land-based-station-data/automated-weather-observing-system-awos

Nordin, J. A. (1976). A proposed modification of Taylor's demand analysis: comment. *The Bell Journal of Economics, 7*(2), 719-721. doi: 10.2307/3003285

Olmstead, S. M., & Stavins, R. N. (2009). Comparing price and nonprice approaches to urban water conservation. *Water Resources Research, 45*(4), W04301. doi: 10.1029/2008wr007227

Osgood, D. E. (2011). Water conservation technology: the adoption response to incentives. *Journal of Contemporary Water Research and Education, 121*(1), 34-39. http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1936-704X

Pacific Institute for Studies in Development Environment and Security. (2012). Facts on the world's water. Retrieved from http://www.pacinst.org/reports/water_fact_ sheet/

Petty, R. E., & Cacioppo, J. T. (1981). *Attitudes and persuasion--classic and contemporary approaches*. Dubuque, Iowa: W.C. Brown Co. Publishers.

Philadelphia Water Department. (2012). Schuylkill. Retrieved from http://www.philly watersheds.org/your_watershed/schuylkill

Polebitski, A. S., & Palmer, R. N. (2010). Seasonal residential water demand forecasting for census tracts. *Journal of Water Resources Planning and Management, 136*(1), 27-36. doi: 10.1061/(asce)wr.1943-5452.0000003

Polebitski, A. S., Palmer, R. N., & Waddell, P. (2011). Evaluating water demands under climate change and transitions in the urban environment. *Journal of Water Resources Planning and Management, 137*, 249. doi: 10.1061/(asce)wr.1943-5452.0000112

Pricope, N. G. (2009). Assessment of spatial patterns of sediment transport and delivery for soil and water conservation programs. *Journal of Spatial Hydrology, 9*(1), 21-46. http://www.spatialhydrology.net/index.php/JOSH

Pumphrey, R. G., Edwards, J. A., & Becker, K. G. (2008). Urban and rural attitudes toward municipal water controls: A study of a semi-arid region with limited water supplies. *Ecological Economics, 65*(1), 1-12. doi: 10.1016/j.ecolecon.2007.11.013

Reclamation, U. S. B. o. (2009). Glossary. Retrieved from http://www.usbr.gov/projects/glossary.jsp

Renwick, M. E., & Archibald, S. O. (1998). Demand side management policies for residential water use: who bears the conservation burden? *Land Economics, 74*(3), 343-359. doi: 10.2307/3147117

Robbins, L. B. (2009). *Lawn wars: the struggle for a new lawn ethic*. New York: Iuniverse Inc.

Rogers, P. (2009, November 10). Schwarzenegger signs water bill, *San Jose Mercury News (CA),* p. 2B.

Rosenberg, D. E., Howitt, R. E., & Lund, J. R. (2008). Water management with water conservation, infrastructure expansions, and source variability in Jordan. *Water Resources Research, 44*(11), W11402. doi: 10.1029/2007wr006519

Rossi, P. H., Lipsey, M. W., & Freeman, H. E. (2004). *Evaluation : a systematic approach* (7th ed.). Thousand Oaks, CA: Sage.

Ruijs, A., Zimmermann, A., & van den Berg, M. (2008). Demand and distributional effects of water pricing policies. *Ecological Economics, 66*(2–3), 506-516. doi: 10.1016/j.ecolecon.2007.10.015

San Francisco Chronicle. (1990, July 18). State declares emergency in Santa Barbara, *San Francisco Chronicle*, p. A7.

Santa Barbara County. (2008). Historical rainfall information. Retrieved from http://www.countyofsb.org/pwd/pwwater.aspx?id=3772

Santa Barbara County. (2009). Santa Barbara County climate. Retrieved from http://www.countyofsb.org/pwd/pwwater.aspx?id=27904

Santa Barbara County. (2010). *Regional water efficiency program (RWEP) for Santa Barbara county - annual report*. Santa Barbara, CA: Santa Barbara County Water Agency. Retrieved from http://www.sbwater.org/uploadedFiles/sbwater/09-10%20Annual%20Report%20August%202010.pdf

Santa Barbara County. (2011). *Groundwater report*. Santa Barbara, CA: Santa Barbara County Water Agency. Retrieved from http://www.countyofsb.org/uploadedFiles/pwd/Water/WaterAgency/Report%20Document%20DraftFINALSecured.pdf

Santa Barbara County. (2012). VVCSD boundaries. Retrieved from http://www.countyofsb.org/pwd/surveyor/downloads/specialdistrict/Vandenberg_Village_CSD.pdf

Santa Barbara County. (2013a). *Programs in my community*. Santa Barbara, CA: Santa Barbara County Water Agency. Retrieved from http://sbwater.org/interior.aspx?id=366

Santa Barbara County. (2013b). *Smart landscape rebates*. Santa Barbara, CA: Santa Barbara County Water Agency. Retrieved from http://www.sbwater.org/landscape.aspx?id=446

Shiklomanov, I. (1993). World fresh water resources. In P. H. Gleick (Ed.), Water in crisis: a guide to the world's fresh water resources (pp. 13-24). New York, NY: Oxford University Press.

Smith, W. J., & Wang, Y. D. (2008). Conservation rates: the best 'new'source of urban water during drought. *Water and Environment Journal, 22*(2), 100-116. doi: 10.1111/j.1747-6593.2007.00085.x

St. Hilaire, R., Arnold, M. A., Wilkerson, D. C., Devitt, D. A., Hurd, B. H., Lesikar, B. J., . . . Zoldoske, D. F. (2008). Efficient water use in residential urban landscapes. *HortScience, 43*(7), 2081-2092. http://hortsci.ashspublications.org/

Stony Brook University. (n.d.). New York City water supply. Retrieved from http://www.eserc.stonybrook.edu/cen514/info/NYC/WaterSupply.html

Syme, G. J., Nancarrow, B. E., & Seligman, C. (2000). The evaluation of information campaigns to promote voluntary household water conservation. *Evaluation Review, 24*(6), 539-578. doi: 10.1177/0193841x0002400601

Taylor, L. D. (1975). The demand for electricity: a survey. *The Bell Journal of Economics, 6*(1), 74-110. http://www.rje.org/

The Weather Channel. (2012). Monthly averages for Lompoc, CA (93436). Retrieved from http://www.weather.com/weather/wxclimatology/monthly/graph/93436

Trochim, W. M. (2006a, October 20). Descriptive statistics. Retrieved from http://www.socialresearchmethods.net/kb/statdesc.php

Trochim, W. M. (2006b, October 20). Reliability & validity. Retrieved from http://www.socialresearchmethods.net/kb/relandval.php

Tsai, Y., Cohen, S., & Vogel, R. M. (2011). The impacts of water conservation strategies on water use: four case studies. *Journal of the American Water Resources Association, 47*(4), 687-701. doi: 10.1111/j.1752-1688.2011.00534.x

United States Census Bureau. (1960). 1960 Census. Retrieved from http://www.census.gov/prod/www/abs/decennial/1960.html

United States Census Bureau. (2000a). California profile of general demographic characteristics. Retrieved from http://censtats.census.gov/

United States Census Bureau. (2000b). Vandenberg Village CDP profile of general demographic characteristics. Retrieved from http://censtats.census.gov/data/CA/1600682086.pdf

United States Census Bureau. (2010a). 2010 population finder. Retrieved from http://www.census.gov/popfinder/?fl=06

United States Census Bureau. (2010b). California profile of general demographic characteristics. Retrieved from http://censtats.census.gov/

United States Census Bureau. (2010c). Vandenberg Village CDP QuickFacts. Retrieved from http://quickfacts.census.gov/qfd/states/06/0682086.html#.USFT2ITCnxQ

United States Geological Survey. (2009). California coastal basin aquifers. Retrieved from http://water.usgs.gov/ogw/aquiferbasics/ext_calcobaq.html

United States Geological Survey. (2012). How much water is there on, in, and above the Earth? Retrieved from http://ga.water.usgs.gov/edu/earthhowmuch.html

University of Illinois at Urbana-Champaign. (2012). Surface water. Retrieved from http://www.isws.illinois.edu/wsp/wssurface.asp

USEPA. (1994). *Customer incentives for water conservation*. (EPA 230·R·94·001). Retrieved from http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=40000KLY.txt

USEPA. (2002). *Cases in water conservation: how efficiency programs help water utilities save water and avoid costs* (EPA 832-B-02-003). Retrieved from http://www.epa.gov/WaterSense/docs/utilityconservation_508.pdf

USEPA. (2008). *Indoor water use in the United States*. (EPA 832-F-06-004). Retrieved from http://www.epa.gov/WaterSense/docs/ws_indoor508.pdf

USEPA. (2009). *National primary drinking water regulations*. (EPA 816-F-09-004). Retrieved from http://water.epa.gov/drink/contaminants/upload/mcl-2.pdf

USEPA. (2011). Rivers and streams. Retrieved from http://water.epa.gov/type/rsl/index.cfm

USEPA. (2012). Clean lakes. Retrieved from http://water.epa.gov/type/lakes/index.cfm

van Putten, I. E., Jennings, S. M., Louviere, J. J., & Burgess, L. B. (2011). Tasmanian landowner preferences for conservation incentive programs: a latent class approach. *Journal of Environmental Management, 92*(10), 2647-2656. doi: 10.1016/j.jenvman.2011.06.002

VanDerslice, J. (2011). Drinking water infrastructure and environmental disparities: evidence and methodological considerations. *American journal of public health, 101*(S1), S109-S114. doi: 10.2105/ajph.2011.300189

Vickers, A. (2001). *Handbook of water use and conservation : [homes, landscapes, businesses, industries, farms]*. Amherst, Mass.: Waterplow Press.

Vogt, W. P., & Johnson, B. (2011). *Dictionary of statistics & methodology : a nontechnical guide for the social sciences* (4th ed.). Thousand Oaks, Calif.: Sage Publications.

VVCSD. (2003). *Resolution 163-03: establishing water distribution system capacity to serve additional connections*.

VVCSD. (2007). *Water conservation program*. Retrieved from http://vvcsd.org/pdf/Water%20Conservation%202007.pdf

VVCSD. (2010). *Code of ordinances*. Retrieved from http://vvcsd.org/pdf/Ordinances.pdf

VVCSD. (2011a). *Agenda - April 5, 2011*. Retrieved from http://vvcsd.org/pdf/agenda/2011/Agenda040511.pdf

VVCSD. (2011b). *Regular meeting minutes - April 5, 2011*. Retrieved from http://vvcsd.org/pdf/minutes/2011/Minutes040511.pdf

VVCSD. (2011c). *Your new water meter*. Retrieved from http://vvcsd.org/pdf/AMRNov2011.pdf

VVCSD. (2012a). *Customer count - June 2012*.

VVCSD. (2012b). *Landscape rebate summary - December 2007 through November 2012*.

VVCSD. (2012c). *Regular meeting minutes - August 7, 2012*. Retrieved from http://vvcsd.org/pdf/minutes/2012/Minutes080712.pdf

VVCSD. (2012d). Vandenberg Village CSD offers landscaping rebates. Retrieved from http://vvcsd.org/custserv/garden.htm

VVCSD. (2012e). VVCSD consumer confidence report for year ending December 31, 2011. Retrieved from http://vvcsd.org/publications/waterqual.htm

VVCSD. (2012f). *Water produced and sold (1988-2011).*

VVCSD. (2013). Current residential water and wastewater rates (effective 7/13). Retrieved from http://vvcsd.org/custserv/current.htm

Ward, F. A., Michelsen, A. M., & DeMouche, L. (2007). Barriers to water conservation in the Rio Grande basin. *Journal of the American Water Resources Association, 43*(1), 237-253. doi: 10.1111/j.1752-1688.2007.00019.x

West Yost Associates. (2012). *Alternatives for improving water-supply reliability and quality for Lompoc, Mission Hills, and Vandenberg Village*. (473-00-11-01).

Wilcox, J. D., Gotkowitz, M. B., Bradbury, K. R., & Bahr, J. M. (2010). Using groundwater models to evaluate strategies for drinking-water protection in rural subdivisions. *Journal of the American Planning Association, 76*(3), 295-304. doi: 10.1080/01944361003742403

Willis, R. M., Stewart, R. A., Panuwatwanich, K., Capati, B., & Giurco, D. (2009). Gold Coast domestic water end use study. *Water: Journal of the Australian Water Association, 36*(6), 79-85. http://www.awa.asn.au/AWA_Water_Journal/

Willis, R. M., Stewart, R. A., Panuwatwanich, K., Jones, S., & Kyriakides, A. (2010). Alarming visual display monitors affecting shower end use water and energy conservation in Australian residential households. *Resources, Conservation and Recycling, 54*(12), 1117-1127. doi: 10.1016/j.resconrec.2010.03.004

Willis, R. M., Stewart, R. A., Panuwatwanich, K., Williams, P. R., & Hollingsworth, A. L. (2011). Quantifying the influence of environmental and water conservation attitudes on household end use water consumption. *Journal of Environmental Management, 92*(8), 1996-2009. doi: 10.1016/j.jenvman.2011.03.023

Wilson, J. D., & Livingston, B. E. (1932). Wilting and withering of grasses in greenhouse cultures as related to water-supplying power of the soil. *Plant Physiology*, *7*(1). doi: dx.doi.org/10.1104/pp.7.1.1

Worthington, A. C., & Hoffman, M. (2008). An empirical survey of residential water demand modelling. *Journal of Economic Surveys, 22*(5), 842-871. doi: 10.1111/j.1467-6419.2008.00551.x

Yanovitzky, I., & VanLear, A. (2008). Time series analysis: traditional and contemporary approaches. In A. F. Hayes, M. D. Slater & L. B. Snyder (Eds.), The Sage sourcebook of advanced data analysis methods for communication research (pp. 89-124). Los Angeles: Sage Publications.

York, A. (2014, January 17). Gov. Jerry Brown declares drought emergency in California, *Los Angeles Times*.

Appendix A: Letter of Cooperation

VANDENBERG VILLAGE
COMMUNITY SERVICES DISTRICT
3757 Constellation Road • Vandenberg Village • Lompoc, CA 93436
Telephone: (805) 733-2475 • Fax: (805) 733-2109

"Pride in Community Service"
http://vvcsd.org
info@vvcsd.org

September 5, 2013

Cynthia Allen
1217 Aster Lane
Lompoc, CA 93436

Dear Cindy,

Based on my review of your research proposal, I give permission for you to conduct the study entitled *Can Cash-4-Grass Programs Save Water?* within the Vandenberg Village Community Services District. As part of this study, I authorize you to obtain from staff the monthly water usage, price per unit of water, and date of toilet, washing machine, and/or landscape rebate for each household in Vandenberg Village from January 2002 through December 2012.

We understand that our organization's responsibilities are to provide the requested information in accordance with California Government Code §§ 6250-6270. We reserve the right to withdraw from the study at any time if our circumstances change and to exempt records not covered by the California Public Records Act.

I confirm that I am authorized to approve research in this setting and I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University IRB.

Sincerely,

VANDENBERG VILLAGE COMMUNITY SERVICES DISTRICT

Joseph Barget

Joseph Barget
General Manager

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Original Wiley figure/table number(s)	Figure 6
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Expected size (number of pages)	220
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Diane McCauley
Publications Assistant
American Society of Plant Biologists
Tel: 301-251-0560, ext. 133
Fax: 301-279-2996
http://www.aspb.org

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Cynthia Allen
Ph.D. Candidate
Public Policy and Administration
cynthia.allen2@waldenu.edu

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Diane

Diane McCauley
Publications Assistant
American Society of Plant Biologists
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Fax: 301-279-2996
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You are welcome to use this information for your dissertation. Thank you for asking about this,

Maggie

Maggie Macias
Public Affairs Office
Department of Water Resources
mmacias@water.ca.gov
(916) 653-8743

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Sent: Tuesday, March 04, 2014 10:53 AM
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Subject: Re: Web Comment

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Cynthia Allen
Ph.D. Candidate
Public Policy and Administration
cynthia.allen2@waldenu.edu

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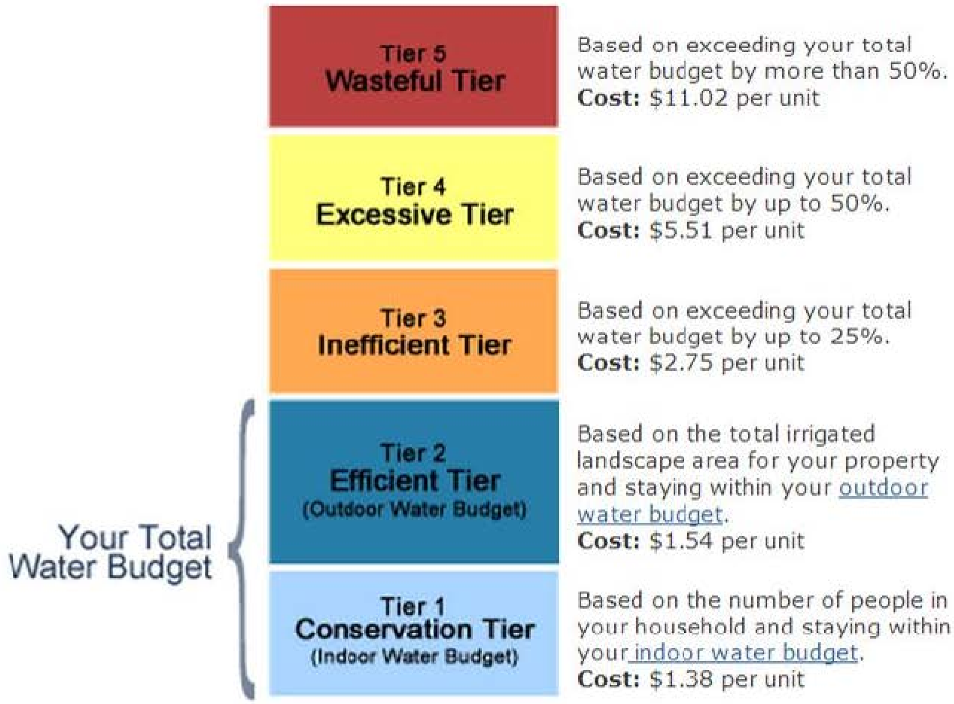

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Nancy

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Water source	Water volume, in cubic miles	Percent of freshwater	Percent of total water
Oceans, Seas, & Bays	321,000,000	--	96.54
Ice caps, Glaciers, & Permanent Snow	5,773,000	68.6	1.74
Groundwater	5,614,000	--	1.69
Fresh	2,526,000	30.1	0.76
Saline	3,088,000	--	0.93
Soil Moisture	3,959	0.05	0.001
Ground Ice & Permafrost	71,970	0.86	0.022
Lakes	42,320	--	0.013
Fresh	21,830	0.26	0.007

Saline	20,490	--	0.007
Atmosphere	3,095	0.04	0.001
Swamp Water	2,752	0.03	0.0008
Rivers	509	0.006	0.0002
Biological Water	269	0.003	0.0001

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CC : Joe Barget <JBarget@vvcsd.org>

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Joe Barget, General Manager
Vandenberg Village Community Services District (VVCSD)
3757 Constellation Road
Lompoc, CA 93436
Phone: (805) 733-2475
Email: jbarget@vvcsd.org

Appendix C: Research Question 1, Statistical Analysis

2007

Descriptives

Table C1

Descriptive Statistics, 2007

	N	Minimum	Maximum	Mean	Std. Deviation
WATER	629	1	158	19.98	20.012
WATERt1	629	1	158	20.01	20.155
PRICE	629	$1.26	$1.43	$1.3316	$0.08401
SIZE	629	4613	39202	10584.20	8423.158
BATH	629	2	6	2.41	.814
VALUE	629	53238	661536	180352.60	116387.781
AGE	629	0	1	.98	.137
TOILET	629	0	1	.29	.455
WASHER	629	0	0	.00	.000
GRASS	629	0	0	.00	.000
Valid N (listwise)	629				

Regression

Table C2

Regression Analysis Warnings, 2007

For models with dependent variable WATER, the following variables are constants or have missing correlations: WASHER, GRASS. They will be deleted from the analysis.

Table C3

Regression Analysis Variables Entered/Removed[a], 2007

Model	Variables Entered	Variables Removed	Method
1	TOILET, PRICE, VALUE, AGE, SIZE, WATERt1, BATH[b]	.	Enter

Note. a. Dependent Variable: WATER; b. All requested variables entered.

Table C4

Regression Analysis Model Summary, 2007

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.859[a]	.738	.735	10.310

Note. a. Predictors: (Constant), TOILET, PRICE, VALUE, AGE, SIZE, WATERt1, BATH

Table C5

Regression Analysis ANOVA [a], 2007

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	185483.974	7	26497.711	249.294	.000[b]
	Residual	66006.833	621	106.291		
	Total	251490.808	628			

Note. a. Dependent Variable: WATER; b. Predictors: (Constant), TOILET, PRICE, VALUE, AGE, SIZE, WATERt1, BATH

Table C6

Regression Analysis Coefficients [a], 2007

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.100	7.420		1.631	.103
	WATERt1	.700	.029	.705	23.982	.000
	PRICE	-9.949	5.006	-.042	-1.988	.047
	SIZE	.000	.000	.084	3.054	.002
	BATH	2.159	.857	.088	2.518	.012
	VALUE	9.586E-006	.000	.056	1.740	.082
	AGE	-2.540	3.064	-.017	-.829	.407
	TOILET	1.923	.938	.044	2.051	.041

Note. a. Dependent Variable: WATER

Correlations

Table C7

Correlations, 2007

		WATER	WATERt1	PRICE	SIZE	BATH	VALUE	AGE	TOILET	WASHER	GRASS
WATER	Pearson Correlation	1	.844**	.076	.559**	.641**	.583**	-.010	.218**	.[b]	.[b]
	Sig. (2-tailed)		.000	.056	.000	.000	.000	.802	.000	.	.
	N	629	629	629	629	629	629	629	629	629	629
WATERt1	Pearson Correlation	.844**	1	.160**	.549**	.645**	.587**	-.010	.217**	.[b]	.[b]
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.797	.000	.	.
	N	629	629	629	629	629	629	629	629	629	629
PRICE	Pearson Correlation	.076	.160**	1	.028	.007	.032	.001	.010	.[b]	.[b]
	Sig. (2-tailed)	.056	.000		.487	.864	.425	.974	.793	.	.
	N	629	629	629	629	629	629	629	629	629	629
SIZE	Pearson Correlation	.559**	.549**	.028	1	.622**	.564**	.079*	.096*	.[b]	.[b]
	Sig. (2-tailed)	.000	.000	.487		.000	.000	.046	.016	.	.
	N	629	629	629	629	629	629	629	629	629	629
BATH	Pearson Correlation	.641**	.645**	.007	.622**	1	.737**	.070	.141**	.[b]	.[b]
	Sig. (2-tailed)	.000	.000	.864	.000		.000	.079	.000	.	.
	N	629	629	629	629	629	629	629	629	629	629
VALUE	Pearson Correlation	.583**	.587**	.032	.564**	.737**	1	-.037	.042	.[b]	.[b]
	Sig. (2-tailed)	.000	.000	.425	.000	.000		.354	.297	.	.
	N	629	629	629	629	629	629	629	629	629	629
AGE	Pearson Correlation	-.010	-.010	.001	.079*	.070	-.037	1	.090*	.[b]	.[b]
	Sig. (2-tailed)	.802	.797	.974	.046	.079	.354		.025	.	.
	N	629	629	629	629	629	629	629	629	629	629
TOILET	Pearson Correlation	.218**	.217**	.010	.096*	.141**	.042	.090*	1	.[b]	.[b]
	Sig. (2-tailed)	.000	.000	.793	.016	.000	.297	.025		.	.
	N	629	629	629	629	629	629	629	629	629	629
WASHER	Pearson Correlation	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.		.
	N	629	629	629	629	629	629	629	629	629	629
GRASS	Pearson Correlation	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	
	N	629	629	629	629	629	629	629	629	629	629

Note. **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); b. Cannot be computed because at least one of the variables is constant

2008

Descriptives

Table C8

Descriptive Statistics, 2008

	N	Minimum	Maximum	Mean	Std. Deviation
WATER	652	0	200	19.68	22.052
WATERt1	652	0	200	20.05	22.096
PRICE	652	$1.43	$1.55	$1.4804	$0.05928
SIZE	652	4613	39202	11132.04	9001.029
BATH	652	2	6	2.42	.806
VALUE	652	54824	704946	193526.40	123435.103
AGE	652	0	1	.98	.135
TOILET	652	0	1	.33	.470
WASHER	652	0	1	.03	.168
GRASS	652	0	1	.02	.140
Valid N (listwise)	652				

***t* test**

Table C9

t test Group Statistics, 2008

	GRASS	N	Mean	Std. Deviation	Std. Error Mean
WATER	0	639	19.98	22.172	.877
	1	13	5.00	2.739	.760
PRICE	0	639	$1.4790	$0.05903	$0.00234
	1	13	$1.5500	$0.00000	$0.00000
SIZE	0	639	11209.10	9074.491	358.981
	1	13	7344.23	1145.768	317.779
BATH	0	639	2.43	.812	.032
	1	13	2.00	.000	.000
VALUE	0	639	194970.39	124062.866	4907.851
	1	13	122548.38	51736.482	14349.118
AGE	0	639	.98	.136	.005
	1	13	1.00	.000	.000
TOILET	0	639	.33	.471	.019
	1	13	.31	.480	.133
WASHER	0	639	.03	.170	.007
	1	13	.00	.000	.000

Table C10

t test Independent Samples Test, 2008

		Levene's Test for Equality of Variances		*t* test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WATER	Equal variances assumed	7.329	.007	2.433	650	.015	14.977	6.155	2.891	27.062
	Equal variances not assumed			12.908	63.225	.000	14.977	1.160	12.658	17.295
PRICE	Equal variances assumed	373.620	.000	-4.332	650	.000	-$0.07099	$0.01638	-$0.10316	-$0.03881
	Equal variances not assumed			-30.397	638.000	.000	-$0.07099	$0.00234	-$0.07557	-$0.06640
SIZE	Equal variances assumed	15.826	.000	1.534	650	.125	3864.866	2519.084	-1081.659	8811.392
	Equal variances not assumed			8.061	60.321	.000	3864.866	479.428	2905.973	4823.760
BATH	Equal variances assumed	16.133	.000	1.916	650	.056	.432	.225	-.011	.875
	Equal variances not assumed			13.444	638.000	.000	.432	.032	.369	.495
VALUE	Equal variances assumed	3.251	.072	2.100	650	.036	72422.008	34491.039	4694.703	140149.313
	Equal variances not assumed			4.776	14.968	.000	72422.008	15165.230	40092.071	104751.945
AGE	Equal variances assumed	1.031	.310	-.498	650	.619	-.019	.038	-.093	.055
	Equal variances not assumed			-3.494	638.000	.001	-.019	.005	-.029	-.008
TOILET	Equal variances assumed	.132	.717	.171	650	.865	.023	.132	-.237	.282
	Equal variances not assumed			.167	12.473	.870	.023	.135	-.269	.314
WASHER	Equal variances assumed	1.691	.194	.630	650	.529	.030	.047	-.063	.122
	Equal variances not assumed			4.422	638.000	.000	.030	.007	.017	.043

Regression

Table C11

Regression Analysis Variables Entered/Removed[a], 2008

Model	Variables Entered	Variables Removed	Method
1	GRASS, TOILET, VALUE, AGE, PRICE, WASHER, WATERt1, SIZE, BATH[b]	.	Enter

Note. a. Dependent Variable: WATER; b. All requested variables entered.

Table C12

Regression Analysis Model Summary, 2008

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.823[a]	.677	.672	12.625

Note. a. Predictors: (Constant), GRASS, TOILET, VALUE, AGE, PRICE, WASHER, WATERt1, SIZE, BATH

Table C13

Regression Analysis ANOVA[a], 2008

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	214240.748	9	23804.528	149.340	.000[b]
	Residual	102333.614	642	159.398		
	Total	316574.362	651			

Note. a. Dependent Variable: WATER; b. Predictors: (Constant), GRASS, TOILET, VALUE, AGE, PRICE, WASHER, WATERt1, SIZE, BATH

Table C14

Regression Analysis Coefficients[a], 2008

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	33.141	13.350		2.482	.013
	WATERt1	.670	.030	.671	22.051	.000
	PRICE	-25.098	8.601	-.067	-2.918	.004
	SIZE	5.911E-005	.000	.024	.805	.421
	BATH	4.249	1.037	.155	4.098	.000
	VALUE	6.852E-006	.000	.038	1.084	.279
	AGE	-2.740	3.752	-.017	-.730	.466
	TOILET	2.365	1.125	.050	2.102	.036
	WASHER	-2.795	3.099	-.021	-.902	.367
	GRASS	-1.482	3.614	-.009	-.410	.682

Note. a. Dependent Variable: WATER

Correlations

Table C15

Correlations, 2008

		WATER	WATERt1	PRICE	SIZE	BATH	VALUE	AGE	TOILET	WASHER	GRASS
WATER	Pearson Correlation	1	.803**	.008	.458**	.619**	.526**	-.006	.199**	.023	-.095*
	Sig. (2-tailed)		.000	.848	.000	.000	.000	.886	.000	.554	.015
	N	652	652	652	652	652	652	652	652	652	652
WATERt1	Pearson Correlation	.803**	1	.112**	.469**	.622**	.538**	-.007	.203**	.012	-.086*
	Sig. (2-tailed)	.000		.004	.000	.000	.000	.849	.000	.768	.028
	N	652	652	652	652	652	652	652	652	652	652
PRICE	Pearson Correlation	.008	.112**	1	-.004	-.004	.037	.001	.031	.037	.168**
	Sig. (2-tailed)	.848	.004		.912	.923	.341	.980	.434	.343	.000
	N	652	652	652	652	652	652	652	652	652	652
SIZE	Pearson Correlation	.458**	.469**	-.004	1	.615**	.600**	.081*	.073	.122**	-.060
	Sig. (2-tailed)	.000	.000	.912		.000	.000	.038	.062	.002	.125
	N	652	652	652	652	652	652	652	652	652	652
BATH	Pearson Correlation	.619**	.622**	-.004	.615**	1	.736**	.072	.117**	.124**	-.075
	Sig. (2-tailed)	.000	.000	.923	.000		.000	.066	.003	.002	.056
	N	652	652	652	652	652	652	652	652	652	652
VALUE	Pearson Correlation	.526**	.538**	.037	.600**	.736**	1	-.030	.031	.124**	-.082*
	Sig. (2-tailed)	.000	.000	.341	.000	.000		.448	.430	.001	.036
	N	652	652	652	652	652	652	652	652	652	652
AGE	Pearson Correlation	-.006	-.007	.001	.081*	.072	-.030	1	.096*	.024	.020
	Sig. (2-tailed)	.886	.849	.980	.038	.066	.448		.014	.545	.619
	N	652	652	652	652	652	652	652	652	652	652
TOILET	Pearson Correlation	.199**	.203**	.031	.073	.117**	.031	.096*	1	.247**	-.007
	Sig. (2-tailed)	.000	.000	.434	.062	.003	.430	.014		.000	.865
	N	652	652	652	652	652	652	652	652	652	652
WASHER	Pearson Correlation	.023	.012	.037	.122**	.124**	.124**	.024	.247**	1	-.025
	Sig. (2-tailed)	.554	.768	.343	.002	.002	.001	.545	.000		.529
	N	652	652	652	652	652	652	652	652	652	652
GRASS	Pearson Correlation	-.095*	-.086*	.168**	-.060	-.075	-.082*	.020	-.007	-.025	1
	Sig. (2-tailed)	.015	.028	.000	.125	.056	.036	.619	.865	.529	
	N	652	652	652	652	652	652	652	652	652	652

Note. **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).

2009

Descriptives

Table C16

Descriptive Statistics, 2009

	N	Minimum	Maximum	Mean	Std. Deviation
WATER	660	0	225	18.40	22.746
WATERt1	660	0	225	18.24	22.705
PRICE	660	$1.55	$2.38	$1.8958	$0.40951
SIZE	660	4613	39202	11066.65	8965.708
BATH	660	2	6	2.42	.803
VALUE	660	57792	706418	199685.46	126391.142
AGE	660	0	1	.98	.134
TOILET	660	0	1	.38	.486
WASHER	660	0	1	.05	.208
GRASS	660	0	1	.14	.345
Valid N (listwise)	660				

***t* test**

Table C17

t test Group Statistics, 2009

	GRASS	N	Mean	Std. Deviation	Std. Error Mean
WATER	0	569	19.93	23.912	1.002
	1	91	8.80	8.476	.889
PRICE	0	569	$1.8811	$0.40679	$0.01705
	1	91	$1.9878	$0.41667	$0.04368
SIZE	0	569	11166.39	8873.113	371.980
	1	91	10443.01	9552.251	1001.348
BATH	0	569	2.45	.844	.035
	1	91	2.23	.424	.044
VALUE	0	569	203779.08	128569.384	5389.909
	1	91	174089.10	108990.109	11425.268
AGE	0	569	.98	.144	.006
	1	91	1.00	.000	.000
TOILET	0	569	.37	.483	.020
	1	91	.45	.500	.052
WASHER	0	569	.05	.224	.009
	1	91	.00	.000	.000

Table C18

t test Independent Samples Test, 2009

		Levene's Test for Equality of Variances		*t* test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WATER	Equal variances assumed	22.594	.000	4.394	658	.000	11.131	2.533	6.157	16.105
	Equal variances not assumed			8.309	369.926	.000	11.131	1.340	8.497	13.765
PRICE	Equal variances assumed	3.274	.071	-2.315	658	.021	-$0.10668	$0.04608	-$0.19716	-$0.01619
	Equal variances not assumed			-2.275	119.092	.025	-$0.10668	$0.04689	-$0.19952	-$0.01383
SIZE	Equal variances assumed	2.678	.102	.714	658	.475	723.383	1012.607	-1264.949	2711.714
	Equal variances not assumed			.677	116.203	.500	723.383	1068.207	-1392.298	2839.063
BATH	Equal variances assumed	20.548	.000	2.408	658	.016	.217	.090	.040	.395
	Equal variances not assumed			3.828	226.117	.000	.217	.057	.105	.329
VALUE	Equal variances assumed	1.273	.260	2.086	658	.037	29689.978	14233.456	1741.509	57638.447
	Equal variances not assumed			2.350	133.469	.020	29689.978	12632.809	4703.578	54676.379
AGE	Equal variances assumed	8.166	.004	-1.398	658	.163	-.021	.015	-.051	.009
	Equal variances not assumed			-3.498	568.000	.001	-.021	.006	-.033	-.009
TOILET	Equal variances assumed	4.793	.029	-1.487	658	.138	-.081	.055	-.189	.026
	Equal variances not assumed			-1.449	118.410	.150	-.081	.056	-.193	.030
WASHER	Equal variances assumed	22.649	.000	2.247	658	.025	.053	.023	.007	.099
	Equal variances not assumed			5.623	568.000	.000	.053	.009	.034	.071

Regression

Table C19

Regression Analysis Variables Entered/Removed[a], 2009

Model	Variables Entered	Variables Removed	Method
1	GRASS, SIZE, TOILET, PRICE, AGE, WASHER, WATERt1, VALUE, BATH[b]	.	Enter

Note. a. Dependent Variable: WATER; b. All requested variables entered.

Table C20

Regression Analysis Model Summary, 2009

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.868[a]	.753	.750	11.376

Note. a. Predictors: (Constant), GRASS, SIZE, TOILET, PRICE, AGE, WASHER, WATERt1, VALUE, BATH

Table C21

Regression Analysis ANOVA[a], 2009

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	256834.255	9	28537.139	220.508	.000[b]
	Residual	84119.944	650	129.415		
	Total	340954.198	659			

Note. a. Dependent Variable: WATER; b. Predictors: (Constant), GRASS, SIZE, TOILET, PRICE, AGE, WASHER, WATERt1, VALUE, BATH

Table C22

Regression Analysis Coefficients[a], 2009

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.888	4.175		.213	.832
	WATERt1	.749	.027	.747	28.100	.000
	PRICE	-3.270	1.109	-.059	-2.948	.003
	SIZE	-4.224E-005	.000	-.017	-.644	.520
	BATH	4.036	.968	.142	4.171	.000
	VALUE	8.735E-006	.000	.049	1.576	.116
	AGE	-.877	3.377	-.005	-.260	.795
	TOILET	.849	.975	.018	.870	.384
	WASHER	-3.736	2.264	-.034	-1.650	.099
	GRASS	-1.995	1.325	-.030	-1.505	.133

Note. a. Dependent Variable: WATER

Correlations

Table C23

Correlations, 2009

		WATER	WATERt1	PRICE	SIZE	BATH	VALUE	AGE	TOILET	WASHER	GRASS
WATER	Pearson Correlation	1	.855**	.037	.400**	.646**	.543**	.010	.072	.037	-.169**
	Sig. (2-tailed)		.000	.343	.000	.000	.000	.790	.066	.345	.000
	N	660	660	660	660	660	660	660	660	660	660
WATERt1	Pearson Correlation	.855**	1	.133**	.405**	.643**	.537**	.012	.081*	.055	-.161**
	Sig. (2-tailed)	.000		.001	.000	.000	.000	.759	.037	.160	.000
	N	660	660	660	660	660	660	660	660	660	660
PRICE	Pearson Correlation	.037	.133**	1	.000	.000	.004	.000	.003	.037	.090*
	Sig. (2-tailed)	.343	.001		1.000	1.000	.918	1.000	.946	.344	.021
	N	660	660	660	660	660	660	660	660	660	660
SIZE	Pearson Correlation	.400**	.405**	.000	1	.616**	.599**	.080*	.016	.105**	-.028
	Sig. (2-tailed)	.000	.000	1.000		.000	.000	.040	.674	.007	.475
	N	660	660	660	660	660	660	660	660	660	660
BATH	Pearson Correlation	.646**	.643**	.000	.616**	1	.735**	.071	.059	.158**	-.093*
	Sig. (2-tailed)	.000	.000	1.000	.000		.000	.069	.133	.000	.016
	N	660	660	660	660	660	660	660	660	660	660
VALUE	Pearson Correlation	.543**	.537**	.004	.599**	.735**	1	-.030	-.069	.082*	-.081*
	Sig. (2-tailed)	.000	.000	.918	.000	.000		.446	.075	.035	.037
	N	660	660	660	660	660	660	660	660	660	660
AGE	Pearson Correlation	.010	.012	.000	.080*	.071	-.030	1	.107**	.030	.054
	Sig. (2-tailed)	.790	.759	1.000	.040	.069	.446		.006	.446	.163
	N	660	660	660	660	660	660	660	660	660	660
TOILET	Pearson Correlation	.072	.081*	.003	.016	.059	-.069	.107**	1	.279**	.058
	Sig. (2-tailed)	.066	.037	.946	.674	.133	.075	.006		.000	.138
	N	660	660	660	660	660	660	660	660	660	660
WASHER	Pearson Correlation	.037	.055	.037	.105**	.158**	.082*	.030	.279**	1	-.087*
	Sig. (2-tailed)	.345	.160	.344	.007	.000	.035	.446	.000		.025
	N	660	660	660	660	660	660	660	660	660	660
GRASS	Pearson Correlation	-.169**	-.161**	.090*	-.028	-.093*	-.081*	.054	.058	-.087*	1
	Sig. (2-tailed)	.000	.000	.021	.475	.016	.037	.163	.138	.025	
	N	660	660	660	660	660	660	660	660	660	660

Note. **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).

2010

Descriptives

Table C24

Descriptive Statistics, 2010

	N	Minimum	Maximum	Mean	Std. Deviation
WATER	674	0	105	15.58	16.225
WATERt1	674	0	105	15.82	16.453
PRICE	674	$2.38	$2.38	$2.3800	$0.00000
SIZE	674	4613	39202	11001.66	8905.403
BATH	674	2	6	2.41	.797
VALUE	674	58687	731842	206161.60	129577.884
AGE	674	0	1	.98	.132
TOILET	674	0	1	.41	.493
WASHER	674	0	1	.08	.278
GRASS	674	0	1	.22	.412
Valid N (listwise)	674				

***t* test**

Table C25

t test Group Statistics, 2010

	GRASS	N	Mean	Std. Deviation	Std. Error Mean
WATER	0	528	17.15	16.890	.735
	1	146	9.92	11.991	.992
PRICE	0	528	$2.3800	$0.00000	$0.00000
	1	146	$2.3800	$0.00000	$0.00000
SIZE	0	528	11049.38	8757.196	381.108
	1	146	10829.08	9451.398	782.203
BATH	0	528	2.44	.865	.038
	1	146	2.29	.454	.038
VALUE	0	528	211565.50	134242.111	5842.138
	1	146	186618.73	109284.213	9044.426
AGE	0	528	.98	.149	.006
	1	146	1.00	.000	.000
TOILET	0	528	.38	.486	.021
	1	146	.53	.501	.041
WASHER	0	528	.08	.268	.012
	1	146	.11	.313	.026

Table C26

t test Independent Samples Test, 2010

		Levene's Test for Equality of Variances		*t* test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
WATER	Equal variances assumed	25.504	.000	4.847	672	.000	7.234	1.492	4.303	10.164
	Equal variances not assumed			5.858	321.162	.000	7.234	1.235	4.804	9.663
PRICE	Equal variances assumed	.	.	47.760	672	.000	$0.00000	$0.00000	$0.00000	$0.00000
	Equal variances not assumed			70.437	526.447	.000	$0.00000	$0.00000	$0.00000	$0.00000
SIZE	Equal variances assumed	.188	.664	.264	672	.792	220.298	833.279	-1415.845	1856.442
	Equal variances not assumed			.253	218.624	.800	220.298	870.106	-1494.572	1935.169
BATH	Equal variances assumed	20.747	.000	2.093	672	.037	.156	.074	.010	.301
	Equal variances not assumed			2.923	455.547	.004	.156	.053	.051	.260
VALUE	Equal variances assumed	3.344	.068	2.064	672	.039	24946.763	12086.990	1213.953	48679.574
	Equal variances not assumed			2.317	277.929	.021	24946.763	10767.182	3751.175	46142.351
AGE	Equal variances assumed	14.194	.000	-1.840	672	.066	-.023	.012	-.047	.002
	Equal variances not assumed			-3.501	527.000	.001	-.023	.006	-.035	-.010
TOILET	Equal variances assumed	7.228	.007	-3.357	672	.001	-.154	.046	-.243	-.064
	Equal variances not assumed			-3.302	226.226	.001	-.154	.047	-.245	-.062
WASHER	Equal variances assumed	5.808	.016	-1.227	672	.220	-.032	.026	-.083	.019
	Equal variances not assumed			-1.123	207.155	.263	-.032	.028	-.088	.024

Regression

Table C27

Regression Analysis Warnings, 2010

For models with dependent variable WATER, the following variables are constants or have missing correlations: PRICE. They will be deleted from the analysis.

Table C28

Regression Analysis Variables Entered/Removed [a], 2010

Model	Variables Entered	Variables Removed	Method
1	GRASS, SIZE, AGE, WASHER, TOILET, WATERt1, VALUE, BATH[b]	.	Enter

Note. a. Dependent Variable: WATER; b. All requested variables entered.

Table C29

Regression Analysis Model Summary, 2010

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.807[a]	.651	.646	9.649

Note. a. Predictors: (Constant), GRASS, SIZE, AGE, WASHER, TOILET, WATERt1, VALUE, BATH

Table C30

Regression Analysis ANOVA[a], 2010

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	115256.020	8	14407.002	154.737	.000[b]
	Residual	61915.660	665	93.106		
	Total	177171.680	673			

Note. a. Dependent Variable: WATER; b. Predictors: (Constant), GRASS, SIZE, AGE, WASHER, TOILET, WATERt1, VALUE, BATH

Table C31

Regression Analysis Coefficients[a], 2010

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.267	2.989		.089	.929
	WATERt1	.682	.028	.691	24.180	.000
	SIZE	.000	.000	.089	2.892	.004
	BATH	1.678	.779	.082	2.154	.032
	VALUE	2.267E-006	.000	.018	.505	.614
	AGE	-1.725	2.866	-.014	-.602	.547
	TOILET	1.144	.832	.035	1.374	.170
	WASHER	-1.222	1.510	-.021	-.809	.419
	GRASS	-2.027	.932	-.052	-2.175	.030

Note. a. Dependent Variable: WATER

Correlations

Table C32

Correlations, 2010

		WATER	WATERt1	PRICE	SIZE	BATH	VALUE	AGE	TOILET	WASHER	GRASS
WATER	Pearson Correlation	1	.794**	.[b]	.458**	.522**	.471**	-.003	.060	.105**	-.184**
	Sig. (2-tailed)		.000	.	.000	.000	.000	.929	.119	.006	.000
	N	674	674	674	674	674	674	674	674	674	674
WATERt1	Pearson Correlation	.794**	1	.[b]	.450**	.541**	.493**	-.001	.061	.118**	-.182**
	Sig. (2-tailed)	.000		.	.000	.000	.000	.969	.113	.002	.000
	N	674	674	674	674	674	674	674	674	674	674
PRICE	Pearson Correlation	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]
	Sig. (2-tailed)	.	.		.	.	.	.	.	.	.
	N	674	674	674	674	674	674	674	674	674	674
SIZE	Pearson Correlation	.458**	.450**	.[b]	1	.616**	.596**	.079*	-.011	.122**	-.010
	Sig. (2-tailed)	.000	.000	.		.000	.000	.041	.784	.001	.792
	N	674	674	674	674	674	674	674	674	674	674
BATH	Pearson Correlation	.522**	.541**	.[b]	.616**	1	.722**	.069	.022	.272**	-.080*
	Sig. (2-tailed)	.000	.000	.	.000		.000	.072	.573	.000	.037
	N	674	674	674	674	674	674	674	674	674	674
VALUE	Pearson Correlation	.471**	.493**	.[b]	.596**	.722**	1	-.028	-.104**	.072	-.079*
	Sig. (2-tailed)	.000	.000	.	.000	.000		.464	.007	.063	.039
	N	674	674	674	674	674	674	674	674	674	674
AGE	Pearson Correlation	-.003	-.001	.[b]	.079*	.069	-.028	1	.113**	.041	.071
	Sig. (2-tailed)	.929	.969	.	.041	.072	.464		.003	.289	.066
	N	674	674	674	674	674	674	674	674	674	674
TOILET	Pearson Correlation	.060	.061	.[b]	-.011	.022	-.104**	.113**	1	.362**	.128**
	Sig. (2-tailed)	.119	.113	.	.784	.573	.007	.003		.000	.001
	N	674	674	674	674	674	674	674	674	674	674
WASHER	Pearson Correlation	.105**	.118**	.[b]	.122**	.272**	.072	.041	.362**	1	.047
	Sig. (2-tailed)	.006	.002	.	.001	.000	.063	.289	.000		.220
	N	674	674	674	674	674	674	674	674	674	674
GRASS	Pearson Correlation	-.184**	-.182**	.[b]	-.010	-.080*	-.079*	.071	.128**	.047	1
	Sig. (2-tailed)	.000	.000	.	.792	.037	.039	.066	.001	.220	
	N	674	674	674	674	674	674	674	674	674	674

Note. **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); b. Cannot be computed because at least one of the variables is constant.

2011

Descriptives

Table C33

Descriptive Statistics, 2011

	N	Minimum	Maximum	Mean	Std. Deviation
WATER	696	0	169	15.83	18.175
WATERt1	696	0	169	15.66	18.050
PRICE	696	$2.38	$2.38	$2.3800	$0.00000
SIZE	696	4613	39202	10928.41	8811.361
BATH	696	2	6	2.40	.787
VALUE	696	60571	749910	214669.16	133483.713
AGE	696	0	1	.98	.130
TOILET	696	0	1	.46	.499
WASHER	696	0	1	.13	.334
GRASS	696	0	1	.37	.484
Valid N (listwise)	696				

***t* test**

Table C34

t test Group Statistics, 2011

	GRASS	N	Mean	Std. Deviation	Std. Error Mean
WATER	0	436	17.39	17.703	.848
	1	260	13.21	18.682	1.159
PRICE	0	436	$2.3800	$0.00000	$0.00000
	1	260	$2.3800	$0.00000	$0.00000
SIZE	0	436	11108.94	8900.998	426.280
	1	260	10625.68	8667.550	537.539
BATH	0	436	2.41	.781	.037
	1	260	2.38	.799	.050
VALUE	0	436	221941.04	138406.177	6628.454
	1	260	202474.76	124099.001	7696.293
AGE	0	436	.97	.164	.008
	1	260	1.00	.000	.000
TOILET	0	436	.38	.486	.023
	1	260	.60	.491	.030
WASHER	0	436	.11	.308	.015
	1	260	.17	.372	.023

Table C35

t test Independent Samples Test, 2011

		Levene's Test for Equality of Variances		*t* test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WATER	Equal variances assumed	1.374	.241	2.952	694	.003	4.181	1.416	1.400	6.961
	Equal variances not assumed			2.912	521.599	.004	4.181	1.436	1.360	7.001
PRICE	Equal variances assumed	75.577	.000	4.956	694	.000	$0.00000	$0.00000	$0.00000	$0.00000
	Equal variances not assumed			5.114	598.323	.000	$0.00000	$0.00000	$0.00000	$0.00000
SIZE	Equal variances assumed	.503	.478	.700	694	.484	483.268	690.681	-872.806	1839.342
	Equal variances not assumed			.704	556.218	.481	483.268	686.049	-864.295	1830.831
BATH	Equal variances assumed	.614	.434	.408	694	.683	.025	.062	-.096	.146
	Equal variances not assumed			.406	534.742	.685	.025	.062	-.097	.147
VALUE	Equal variances assumed	1.094	.296	1.864	694	.063	19466.280	10440.726	-1032.917	39965.476
	Equal variances not assumed			1.916	591.848	.056	19466.280	10157.230	-482.321	39414.880
AGE	Equal variances assumed	31.084	.000	-2.709	694	.007	-.028	.010	-.047	-.008
	Equal variances not assumed			-3.509	435.000	.000	-.028	.008	-.043	-.012
TOILET	Equal variances assumed	.967	.326	-5.736	694	.000	-.219	.038	-.294	-.144
	Equal variances not assumed			-5.722	540.499	.000	-.219	.038	-.295	-.144
WASHER	Equal variances assumed	20.674	.000	-2.294	694	.022	-.060	.026	-.111	-.009
	Equal variances not assumed			-2.187	466.736	.029	-.060	.027	-.114	-.006

Regression

Table C36

Regression Analysis Warnings, 2011

For models with dependent variable WATER, the following variables are constants or have missing correlations: PRICE. They will be deleted from the analysis.

Table C37

Regression Analysis Variables Entered/Removed [a], 2011

Model	Variables Entered	Variables Removed	Method
1	GRASS, BATH, AGE, TOILET, WASHER, WATERt1, SIZE, VALUE[b]	.	Enter

Note. a. Dependent Variable: WATER; b. All requested variables entered.

Table C38

Regression Analysis Model Summary, 2011

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.795[a]	.632	.627	11.095

Note. a. Predictors: (Constant), GRASS, BATH, AGE, TOILET, WASHER, WATERt1, SIZE, VALUE

Table C39

Regression Analysis ANOVA[a], 2011

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	145002.646	8	18125.331	147.245	.000[b]
	Residual	84567.348	687	123.097		
	Total	229569.994	695			

Note. a. Dependent Variable: WATER; b. Predictors: (Constant), GRASS, BATH, AGE, TOILET, WASHER, WATERt1, SIZE, VALUE

Table C40

Regression Analysis Coefficients[a], 2011

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3.743	3.445		-1.086	.278
	WATERt1	.614	.029	.610	20.838	.000
	SIZE	.000	.000	.079	2.528	.012
	BATH	4.499	.903	.195	4.983	.000
	VALUE	-8.918E-007	.000	-.007	-.189	.850
	AGE	-2.085	3.304	-.015	-.631	.528
	TOILET	.489	.924	.013	.529	.597
	WASHER	1.087	1.434	.020	.758	.449
	GRASS	-1.977	.899	-.053	-2.198	.028

Note. a. Dependent Variable: WATER

Correlations

Table C41

Correlations, 2011

		WATER	WATERt1	PRICE	SIZE	BATH	VALUE	AGE	TOILET	WASHER	GRASS
WATER	Pearson Correlation	1	.768**	.[b]	.487**	.600**	.446**	-.005	.000	.232**	-.111**
	Sig. (2-tailed)		.000	.	.000	.000	.000	.885	.999	.000	.003
	N	696	696	696	696	696	696	696	696	696	696
WATERt1	Pearson Correlation	.768**	1	.[b]	.475**	.582**	.433**	-.012	.003	.227**	-.094*
	Sig. (2-tailed)	.000		.	.000	.000	.000	.758	.927	.000	.013
	N	696	696	696	696	696	696	696	696	696	696
PRICE	Pearson Correlation	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.
	N	696	696	696	696	696	696	696	696	696	696
SIZE	Pearson Correlation	.487**	.475**	.[b]	1	.614**	.594**	.077*	-.053	.148**	-.027
	Sig. (2-tailed)	.000	.000	.		.000	.000	.042	.162	.000	.484
	N	696	696	696	696	696	696	696	696	696	696
BATH	Pearson Correlation	.600**	.582**	.[b]	.614**	1	.700**	.067	-.028	.327**	-.015
	Sig. (2-tailed)	.000	.000	.	.000		.000	.078	.458	.000	.683
	N	696	696	696	696	696	696	696	696	696	696
VALUE	Pearson Correlation	.446**	.433**	.[b]	.594**	.700**	1	-.026	-.118**	.121**	-.071
	Sig. (2-tailed)	.000	.000	.	.000	.000		.499	.002	.001	.063
	N	696	696	696	696	696	696	696	696	696	696
AGE	Pearson Correlation	-.005	-.012	.[b]	.077*	.067	-.026	1	.123**	.051	.102**
	Sig. (2-tailed)	.885	.758	.	.042	.078	.499		.001	.181	.007
	N	696	696	696	696	696	696	696	696	696	696
TOILET	Pearson Correlation	.000	.003	.[b]	-.053	-.028	-.118**	.123**	1	.318**	.213**
	Sig. (2-tailed)	.999	.927	.	.162	.458	.002	.001		.000	.000
	N	696	696	696	696	696	696	696	696	696	696
WASHER	Pearson Correlation	.232**	.227**	.[b]	.148**	.327**	.121**	.051	.318**	1	.087*
	Sig. (2-tailed)	.000	.000	.	.000	.000	.001	.181	.000		.022
	N	696	696	696	696	696	696	696	696	696	696
GRASS	Pearson Correlation	-.111**	-.094*	.[b]	-.027	-.015	-.071	.102**	.213**	.087*	1
	Sig. (2-tailed)	.003	.013	.	.484	.683	.063	.007	.000	.022	
	N	696	696	696	696	696	696	696	696	696	696

Note. **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); b. Cannot be computed because at least one of the variables is constant.

2012

Descriptives

Table C42

Descriptive Statistics, 2012

	N	Minimum	Maximum	Mean	Std. Deviation
WATER	696	1	171	18.38	19.279
WATERt1	696	0	171	18.33	19.202
PRICE	696	$2.38	$2.38	$2.3800	$0.00000
SIZE	696	4613	39202	10928.41	8811.361
BATH	696	2	6	2.40	.787
VALUE	696	62184	769448	220310.16	136990.754
AGE	696	0	1	.98	.130
TOILET	696	0	1	.47	.499
WASHER	696	0	1	.14	.351
GRASS	696	0	1	.49	.500
Valid N (listwise)	696				

***t* test**

Table C43

t test Group Statistics, 2012

	GRASS	N	Mean	Std. Deviation	Std. Error Mean
WATER	0	357	18.78	15.637	.828
	1	339	17.97	22.503	1.222
PRICE	0	357	$2.3800	$0.00000	$0.00000
	1	339	$2.3800	$0.00000	$0.00000
SIZE	0	357	10929.43	8955.952	473.999
	1	339	10927.35	8669.716	470.874
BATH	0	357	2.37	.710	.038
	1	339	2.42	.861	.047
VALUE	0	357	225175.13	143479.667	7593.749
	1	339	215186.87	129822.171	7050.972
AGE	0	357	.97	.180	.010
	1	339	1.00	.000	.000
TOILET	0	357	.32	.469	.025
	1	339	.61	.488	.026
WASHER	0	357	.10	.305	.016
	1	339	.19	.390	.021

Table C44

t test Independent Samples Test, 2012

		Levene's Test for Equality of Variances		*t* test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WATER	Equal variances assumed	7.572	.006	.553	694	.581	.808	1.463	-2.064	3.680
	Equal variances not assumed			.548	599.387	.584	.808	1.476	-2.090	3.707
PRICE	Equal variances assumed	.	.	-.144	694	.886	-$0.00000	$0.00000	-$0.00000	$0.00000
	Equal variances not assumed			-.144	692.938	.886	-$0.00000	$0.00000	-$0.00000	$0.00000
SIZE	Equal variances assumed	.206	.650	.003	694	.998	2.078	668.692	-1310.825	1314.980
	Equal variances not assumed			.003	693.741	.998	2.078	668.130	-1309.722	1313.877
BATH	Equal variances assumed	2.517	.113	-.825	694	.409	-.049	.060	-.166	.068
	Equal variances not assumed			-.821	655.746	.412	-.049	.060	-.167	.069
VALUE	Equal variances assumed	.596	.440	.961	694	.337	9988.261	10389.283	-10409.933	30386.456
	Equal variances not assumed			.964	692.398	.335	9988.261	10362.492	-10357.414	30333.937
AGE	Equal variances assumed	50.480	.000	-3.429	694	.001	-.034	.010	-.053	-.014
	Equal variances not assumed			-3.519	356.000	.000	-.034	.010	-.052	-.015
TOILET	Equal variances assumed	11.065	.001	-7.960	694	.000	-.289	.036	-.360	-.217
	Equal variances not assumed			-7.952	688.334	.000	-.289	.036	-.360	-.217
WASHER	Equal variances assumed	40.070	.000	-3.107	694	.002	-.082	.026	-.134	-.030
	Equal variances not assumed			-3.088	640.334	.002	-.082	.027	-.134	-.030

Regression

Table C45

Regression Analysis Warnings, 2012

For models with dependent variable WATER, the following variables are constants or have missing correlations: PRICE. They will be deleted from the analysis.

Table C46

Regression Analysis Variables Entered/Removed [a], 2012

Model	Variables Entered	Variables Removed	Method
1	GRASS, SIZE, AGE, WASHER, TOILET, WATERt1, VALUE, BATH[b]	.	Enter

Note. a. Dependent Variable: WATER; b. All requested variables entered.

Table C47

Regression Analysis Model Summary, 2012

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.883[a]	.780	.777	9.096

Note. a. Predictors: (Constant), GRASS, SIZE, AGE, WASHER, TOILET, WATERt1, VALUE, BATH

Table C48

Regression Analysis ANOVA[a], 2012

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	201474.148	8	25184.269	304.369	.000[b]
	Residual	56844.191	687	82.743		
	Total	258318.339	695			

Note. a. Dependent Variable: WATER; b. Predictors: (Constant), GRASS, SIZE, AGE, WASHER, TOILET, WATERt1, VALUE, BATH

Table C49

Regression Analysis Coefficients[a], 2012

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-3.988	2.856		-1.397	.163
	WATERt1	.756	.025	.753	29.997	.000
	SIZE	5.943E-005	.000	.027	1.128	.260
	BATH	4.219	.782	.172	5.399	.000
	VALUE	-2.669E-006	.000	-.019	-.712	.477
	AGE	-1.704	2.707	-.012	-.629	.529
	TOILET	.566	.780	.015	.726	.468
	WASHER	-.295	1.111	-.005	-.266	.791
	GRASS	-.408	.727	-.011	-.561	.575

Note. a. Dependent Variable: WATER

Correlations

Table C50

Correlations, 2012

		WATER	WATERt1	PRICE	SIZE	BATH	VALUE	AGE	TOILET	WASHER	GRASS
WATER	Pearson Correlation	1	.874**	.[b]	.505**	.689**	.498**	.030	.015	.190**	-.021
	Sig. (2-tailed)		.000	.	.000	.000	.000	.436	.699	.000	.581
	N	696	696	696	696	696	696	696	696	696	696
WATERt1	Pearson Correlation	.874**	1	.[b]	.513**	.687**	.508**	.036	.015	.187**	-.025
	Sig. (2-tailed)	.000		.	.000	.000	.000	.348	.702	.000	.515
	N	696	696	696	696	696	696	696	696	696	696
PRICE	Pearson Correlation	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]	.[b]
	Sig. (2-tailed)	.	.		.	.	.	.	.	.	.
	N	696	696	696	696	696	696	696	696	696	696
SIZE	Pearson Correlation	.505**	.513**	.[b]	1	.614**	.594**	.077*	-.057	.123**	.000
	Sig. (2-tailed)	.000	.000	.		.000	.000	.042	.132	.001	.998
	N	696	696	696	696	696	696	696	696	696	696
BATH	Pearson Correlation	.689**	.687**	.[b]	.614**	1	.700**	.067	-.031	.293**	.031
	Sig. (2-tailed)	.000	.000	.	.000		.000	.078	.413	.000	.409
	N	696	696	696	696	696	696	696	696	696	696
VALUE	Pearson Correlation	.498**	.508**	.[b]	.594**	.700**	1	-.026	-.121**	.117**	-.036
	Sig. (2-tailed)	.000	.000	.	.000	.000		.499	.001	.002	.337
	N	696	696	696	696	696	696	696	696	696	696
AGE	Pearson Correlation	.030	.036	.[b]	.077*	.067	-.026	1	.124**	.054	.129**
	Sig. (2-tailed)	.436	.348	.	.042	.078	.499		.001	.153	.001
	N	696	696	696	696	696	696	696	696	696	696
TOILET	Pearson Correlation	.015	.015	.[b]	-.057	-.031	-.121**	.124**	1	.340**	.289**
	Sig. (2-tailed)	.699	.702	.	.132	.413	.001	.001		.000	.000
	N	696	696	696	696	696	696	696	696	696	696
WASHER	Pearson Correlation	.190**	.187**	.[b]	.123**	.293**	.117**	.054	.340**	1	.117**
	Sig. (2-tailed)	.000	.000	.	.001	.000	.002	.153	.000		.002
	N	696	696	696	696	696	696	696	696	696	696
GRASS	Pearson Correlation	-.021	-.025	.[b]	.000	.031	-.036	.129**	.289**	.117**	1
	Sig. (2-tailed)	.581	.515	.	.998	.409	.337	.001	.000	.002	
	N	696	696	696	696	696	696	696	696	696	696

Note. **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); b. Cannot be computed because at least one of the variables is constant.

Appendix D: Research Question 2, Statistical Analysis

Descriptives

Table D1

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
WATER	1008	0	225	16.83	22.262
WATERt1	1008	0	225	16.95	22.270
PRICE	1008	$1.18	$2.38	$2.0141	$0.45675
RAIN	1008	.00	10.44	1.2872	2.15346
TEMP	1008	58	74	66.64	3.680
SIZE	1008	4616	28757	10072.29	7217.827
BATH	1008	2	6	2.52	.958
VALUE	1008	58115	576475	194409.56	126397.419
TOILET	1008	0	1	.56	.496
WASHER	1008	0	1	.13	.342
GRASS	1008	0	1	.50	.500
AGE	1008	1	1	1.00	.000
Valid N (listwise)	1008				

***t* test**

Table D2

Group Statistics

	GRASS	N	Mean	Std. Deviation	Std. Error Mean
WATER	0	504	18.03	22.701	1.011
	1	504	15.62	21.770	.970

Table D3

t test Independent Samples Test

		Levene's Test for Equality of Variances		*t* test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
WATER	Equal variances assumed	.094	.759	1.721	1006	.086	2.411	1.401	-.338	5.160
	Equal variances not assumed			1.721	1004.240	.086	2.411	1.401	-.338	5.160

Regression

Table D4

Regression Analysis Warnings

For models with dependent variable WATER, the following variables are constants or have missing correlations: AGE. They will be deleted from the analysis.

Table D5

Regression Analysis Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	TEMP, VALUE, PRICE, TOILET, RAIN, GRASS, WASHER, WATERt1, SIZE, BATH[b]	.	Enter

Note. a. Dependent Variable: WATER; b. All requested variables entered.

Table D6

Regression Analysis Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.868[a]	.754	.751	11.101

Note. a. Predictors: (Constant), TEMP, VALUE, PRICE, TOILET, RAIN, GRASS, WASHER, WATERt1, SIZE, BATH

Table D7

Regression Analysis ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	376187.580	10	37618.758	305.259	.000[b]
	Residual	122865.729	997	123.235		
	Total	499053.309	1007			

Note. a. Dependent Variable: WATER; b. Predictors: (Constant), TEMP, VALUE, PRICE, TOILET, RAIN, GRASS, WASHER, WATERt1, SIZE, BATH

Table D8

Regression Analysis Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-12.919	7.402		-1.745	.081
	WATERt1	.565	.026	.566	21.680	.000
	PRICE	-.608	.975	-.012	-.624	.533
	SIZE	.000	.000	.078	3.090	.002
	BATH	6.319	.794	.272	7.954	.000
	VALUE	5.782E-006	.000	.033	1.021	.307
	TOILET	.058	.813	.001	.071	.944
	WASHER	-2.705	1.279	-.042	-2.114	.035
	GRASS	-.415	.843	-.009	-.492	.623
	RAIN	-.828	.179	-.080	-4.631	.000
	TEMP	.053	.105	.009	.500	.617

Note. a. Dependent Variable: WATER

Correlations

Table D9

Correlations

		WATER	WATERt1	PRICE	RAIN	TEMP	SIZE	BATH	VALUE	TOILET	WASHER	GRASS	AGE
WATER	Pearson Correlation	1	.841**	-.077*	-.141**	.118**	.620**	.759**	.681**	.136**	.303**	-.054	.[c]
	Sig. (2-tailed)		.000	.015	.000	.000	.000	.000	.000	.000	.000	.086	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
WATERt1	Pearson Correlation	.841**	1	-.071*	-.097**	.140**	.621**	.759**	.682**	.136**	.299**	-.062*	.[c]
	Sig. (2-tailed)	.000		.025	.002	.000	.000	.000	.000	.000	.000	.050	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
PRICE	Pearson Correlation	-.077*	-.071*	1	.154**	-.042	-.080*	.025	.041	.257**	.215**	.534**	.[c]
	Sig. (2-tailed)	.015	.025		.000	.186	.011	.431	.197	.000	.000	.000	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
RAIN	Pearson Correlation	-.141**	-.097**	.154**	1	-.372**	-.013	.002	.001	.028	.007	.026	.[c]
	Sig. (2-tailed)	.000	.002	.000		.000	.684	.944	.966	.366	.816	.417	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
TEMP	Pearson Correlation	.118**	.140**	-.042	-.372**	1	.015	-.013	-.009	-.049	-.045	-.081**	.[c]
	Sig. (2-tailed)	.000	.000	.186	.000		.631	.688	.784	.119	.151	.010	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
SIZE	Pearson Correlation	.620**	.621**	-.080*	-.013	.015	1	.661**	.744**	-.023	.353**	.000	.[c]
	Sig. (2-tailed)	.000	.000	.011	.684	.631		.000	.000	.464	.000	1.000	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008

(table continues)

		WATER	WATERt1	PRICE	RAIN	TEMP	SIZE	BATH	VALUE	TOILET	WASHER	GRASS	AGE
BATH	Pearson Correlation	.759**	.759**	.025	.002	-.013	.661**	1	.827**	.280**	.500**	.000	.c
	Sig. (2-tailed)	.000	.000	.431	.944	.688	.000		.000	.000	.000	1.000	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
VALUE	Pearson Correlation	.681**	.682**	.041	.001	-.009	.744**	.827**	1	.155**	.472**	.046	.c
	Sig. (2-tailed)	.000	.000	.197	.966	.784	.000	.000		.000	.000	.142	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
TOILET	Pearson Correlation	.136**	.136**	.257**	.028	-.049	-.023	.280**	.155**	1	.347**	.122**	.c
	Sig. (2-tailed)	.000	.000	.000	.366	.119	.464	.000	.000		.000	.000	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
WASHER	Pearson Correlation	.303**	.299**	.215**	.007	-.045	.353**	.500**	.472**	.347**	1	.052	.c
	Sig. (2-tailed)	.000	.000	.000	.816	.151	.000	.000	.000	.000		.097	.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
GRASS	Pearson Correlation	-.054	-.062*	.534**	.026	-.081**	.000	.000	.046	.122**	.052	1	.c
	Sig. (2-tailed)	.086	.050	.000	.417	.010	1.000	1.000	.142	.000	.097		.
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008
AGE	Pearson Correlation	.c	.c	.c	.c	.c	.c	.c	.c	.c	.c	.c	.c
	Sig. (2-tailed)	.	.	.	.	.	.	.	.	.	.	.	
	N	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008	1008

Note. **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed); c. Cannot be computed because at least one of the variables is constant.

Curriculum Vitae

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Career History and Accomplishments

VVCSD

Administrative Services Manager	**June 2000 to present**
Accounts Payable/Payroll Clerk	**October 1995 to June 2000**
Customer Service Representative	**April 1993 to October 1995**

Education

Walden University

Doctor of Philosophy – Public Policy and Administration	**December 2010 – present**

California State Polytechnic University

Master of Public Policy *[With Distinction]*	**June 2010**
Bachelor of Arts – Interdisciplinary Studies *[Magna Cum Laude]*	**June 2008**

Allan Hancock College

Associates in Science – Computer Business Information Systems *[Honors]*	**December 1999**
Associates in Science – Business Management *[Honors]*	**December 1999**
Associates in Science – Office Automation *[Honors]*	**December 1998**
Associates in Arts – Liberal Arts *[Honors]*	**May 1997**

Professional Qualifications		
Certificate – Special District Leadership and Management	Special District and Local Government Institute	**2006**
Certificate – Supervisor Certification Program	ACWA/Joint Powers Insurance Authority	**2004**
Certificate – Human Resources Certification Program	ACWA/Joint Powers Insurance Authority	**2004**
Certificate – Human Resource Management	Allan Hancock College	**2003**