CITY OF ALAMO HEIGHTS, TEXAS

WATER CONSERVATION PLAN

April 27, 2009

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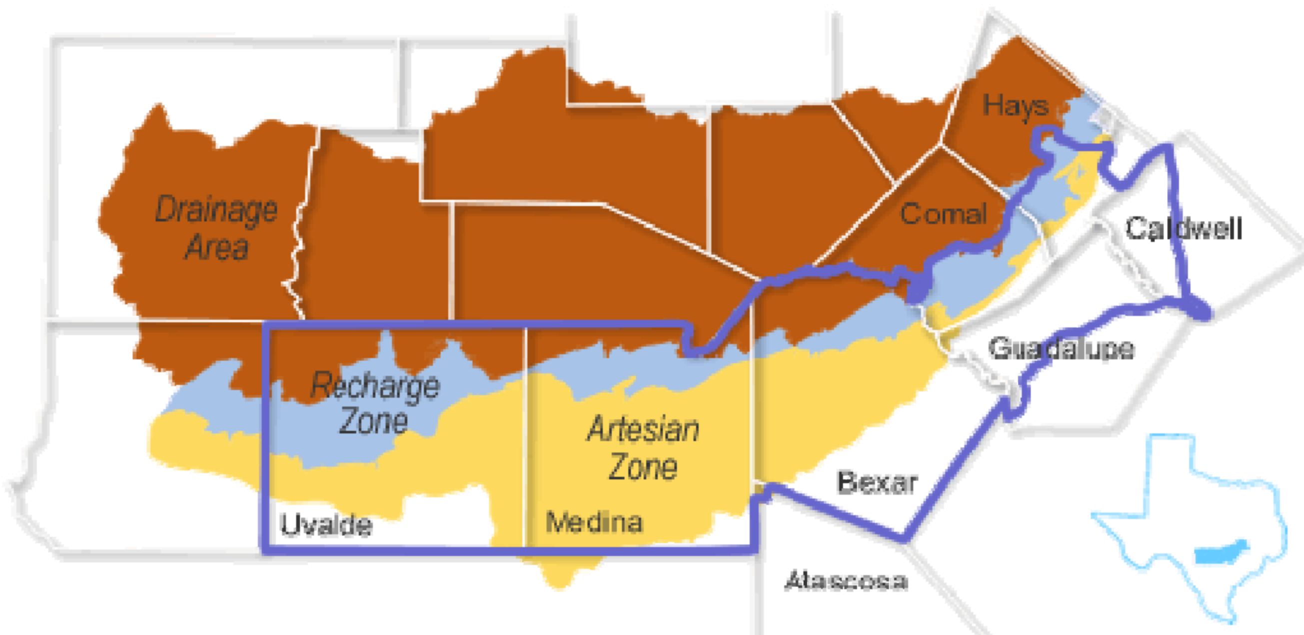
1 EXISTING WATER PROFILE

1.1 Sources of Water

1.1.1 Edwards Aquifer

The City of Alamo Heights' sole source of water is the Edwards Aquifer which is one of the world's most unique groundwater resources. The Edwards Aquifer has supported civilization for more than 8,000 years and today is the primary source of water for 1.3 million people. The aquifer is about 180 miles long and five to 40 miles wide at different points. It reaches from Bracketville in the west to Kyle in the east. The aquifer covers over a 3,000 square mile area. The primary geologic component of the Edwards Aquifer is Edwards Limestone. It occurs in three distinct segments: the drainage area, the recharge zone and the artesian zone (see map). Each area is equally important to the health and viability of the Edwards Aquifer as a whole.



1.1.2 Drainage Area

The area north and west of the aquifer is called the Edwards Plateau, or more commonly, the Texas Hill Country. It serves as the catchment or drainage area for the aquifer. The drainage area spans approximately 4,400 square miles and is the largest component of the aquifer system. It is located in Edwards, Real, Kerr, Bandera, and Kendall Counties. Rain falling in the drainage area soaks into the limestone of the plateau, forming spring-fed streams. These streams flow downhill, over relatively impermeable older formations, until they reach the recharge zone.

1.1.3 Recharge Zone

The recharge zone encompasses 1,500 square miles and forms the northern boundary of the artesian area in Kinney, Uvalde, Medina, Bexar, Comal and Hays Counties. Although precipitation is greater in the eastern counties, the largest amount of recharge to the Edwards Aquifer occurs in the catchment basins of the western counties. The Nueces River basin, the Frio-Sabinal basins and the Seco-Hondo-Medina basins (located in Medina, Uvalde and Kinney Counties) supply about 70 percent of the total recharge to the aquifer. The western basins are characterized by larger catchment areas and larger recharge areas than those in the east.

The recharge zone is geologically known as the Balcones Fault Zone. This area has an abundance of Edwards Limestone exposed at the surface, which provides the path for water to reach the artesian area. Recharge is water which enters the reservoir through features such as fractures, sinkholes and caves. Rain falling on the Edwards Plateau forms spring-fed streams that flow downhill, enter the recharge zone and disappear into the ground. Rain falling directly on the recharge zone also percolates into the ground and enters the underground reservoir.

1.1.4 Artesian Zone

The Edwards Aquifer has a great capacity for storing and moving water. The artesian area is a complex network of interconnecting spaces varying from microscopic pores to open caverns. This area underlies the six counties south and east of the Balcones Fault Zone. Those counties are Kinney, Uvalde, Medina, Bexar, Comal and Hays. The artesian area spans approximately 180 miles from west to east and covers 2,100 square miles of land. Water cannot seep straight down into the artesian area from the ground surface due to impermeable layers of younger limestone and clay between the surface and the aquifer.

In certain places where there is enough artesian pressure, some of the water is forced to the surface through geologic faults, also known as springs. Flowing wells are also the result of artesian pressure. A record well drilled in 1991, in southwest Bexar County near the Medina River, produces more than 23,000 gallons per minute through a 30-inch bore. Water leaving the aquifer is referred to as discharge. Water is discharged from the aquifer naturally by springs or through flowing wells and pumped wells.

The water harvested from the artesian area is superb. Even untreated, it surpasses environmental protection agency quality standards for drinking water. Those standards list maximum allowable concentrations of contaminants and consider other qualities such as: color, taste, odor, hardness and dissolved minerals. This can not be said of water drawn from wells south and east of the artesian zone. A boundary called the bad or saline water line divides the artesian zone from water that contains much more minerals and contamination. This is because water in these areas moves slower through denser and less porous limestone and collects higher concentrations of calcium, iron, and sulfides. Some scientists argue that if too much water is drawn from the artesian zone, the bad water line could move north and limit the supply of drinkable water. This theory, however, is subject to conjecture among scientists. Other scientists believe that the line is stationary is not likely to move since the line follows an underground division of highly porous and less porous rock.

1.1.5 Aquifer Management and Conservation

Water resource planners project that by the year 2020 demand for water in the Edwards Aquifer region could exceed 850,000 acre feet per year. Since average annual recharge is only about 640,000 acre feet, it is obvious that measures need to be taken to conserve the water of the Edwards Aquifer. Efficient management of the Edwards Aquifer is crucial to the future of San Antonio and the surrounding communities that use its waters. It is currently the responsibility of the Edwards Aquifer Authority (EAA) which regulates pumping through the issuance of permits, encourages conservation and prevents pollution of this unique groundwater system. The effective management of the Edwards Aquifer is a pivotal component to the continued success of the City of Alamo Heights and the larger San Antonio metropolitan area, which depends solely on the aquifer for the vital resource of water.

1.2 Physical Characteristics

1.2.1 Legal Requirements

The City of Alamo Heights is the legal purveyor of potable water to customers within its city limits and is regulated by the U.S. Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ). It maintains 2,904 active water meters and 215 fire hydrants along 46.5 miles of water mains.

As defined by the TCEQ, the City of Alamo Heights has 3,483 effective water connections, which includes all residential, commercial and institutional units and excludes irrigation and fire sprinkler connections. The Texas Legislature recently required municipalities with over 3,300 effective connections to develop and adopt a Water Conservation Plan.

Legal purveyors of potable water in Texas are required to provide customers with water that is disinfected, safe to drink and suitable for community use (quality), in ample supply (quantity) and delivered at adequate pressure without interruption (pressure).

1.2.2 Water Quality

The City utilizes chlorine gas to disinfect the water pumped from the Edwards Aquifer at each well site and maintains a chlorine residual level between 0.2 and 4.0 mg/L throughout the system.

1.2.3 Water Quantity

The City is required by the TCEQ to provide a minimum of 200 gallons of storage per effective connection (3,483 effective connections x 200 gallons = 696,600 gallons). Adequate storage provides uniform pumping rates, provides time for disinfection and ensures supplies for fire fighting. At the date of this report, the City has only 550,000 gallons of storage and is 146,600 gallons short of meeting the TCEQ requirement. As a result, the City Council has approved the construction of a new 600,000 composite elevated water tank at the City Hall property.

1.2.4 Water Pressure

The City is required to maintain a minimum normal operating pressure of 35 pounds per square inch (psi) and a minimum pressure of 20 psi during emergencies to prevent backflow contamination. All customers in Alamo Heights are provided water at required pressures. However, a 2005 study revealed that pressures in the northeast section of the City could fall below the required pressure when a three-hour fire event was modeled using water distribution software. As a result, several water line improvements have been approved by the City Council, along with the new elevated storage tank, to enhance the distribution of water and provide more consistent pressures throughout the system in the event of such an emergency.

1.2.5 Well Pumps

The City owns and operates six (6) wells that have the combined capacity to draw 5,545 gallons of water per minute (gpm) from the Edwards Aquifer. Four (4) wells are located at the City Hall property at Broadway and Blue Bonnet Boulevard, one (1) is located at Alamo Heights High School at E. Fair Oaks Drive and Vanderhoven Drive and one (1) at the former Texas Military Institute (TMI) property at Evans Avenue and Penny Lane. The City exceeds the TCEQ requirement to maintain a minimum pumping capacity of 2,090 gpm which is calculated as 0.6 gallons per minute per connection.

Well No.	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**
Location	City Hall	City Hall	H.S.	TMI	City Hall	City Hall
Pumping Rate	670 gpm	1,171 gpm	970 gpm	906 gpm	732 gpm	1,096 gpm

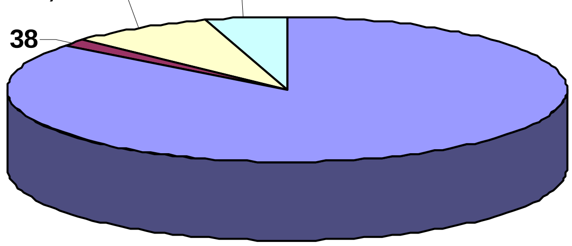
1.2.6 Storage Tanks

The City currently owns and operates three (3) elevated water tanks that have the combined storage capacity of 550,000 gallons of water. The 100,000 and 300,000 gallon tanks are located at the City Hall property at Broadway and Blue Bonnet Boulevard and the 150,000 gallon tank is located at the former Texas Military Institute (TMI) property at Evans Avenue and Penny Lane. In order to meet mandated storage requirement and improve system pressures, the City Council has approved the construction of a new 600,000 composite elevated water tank at the City Hall property. Upon the completion of the construction of the new 600,000 gallon elevated water tank, the City will be able to retire and remove from service the 80-year old 100,000 gallon tank and 70-year old 150,000 gallon tank which have exceeded their operational lifespans.

Tank Location	City Hall	TMI	City Hall	City Hall
Year Built	1928	1938	1963	2010
Storage Capacity	100,000 gallons	150,000 gallons	300,000 gallons	600,000 gallons

1.2.7 Water Meters

The City currently has 2,904 active water meters which were all replaced in 2006. Meter-reading services are currently provided under contract by the San Antonio Water System (SAWS).



Active Water Meters

1.3 Water Rights and Historic Usage

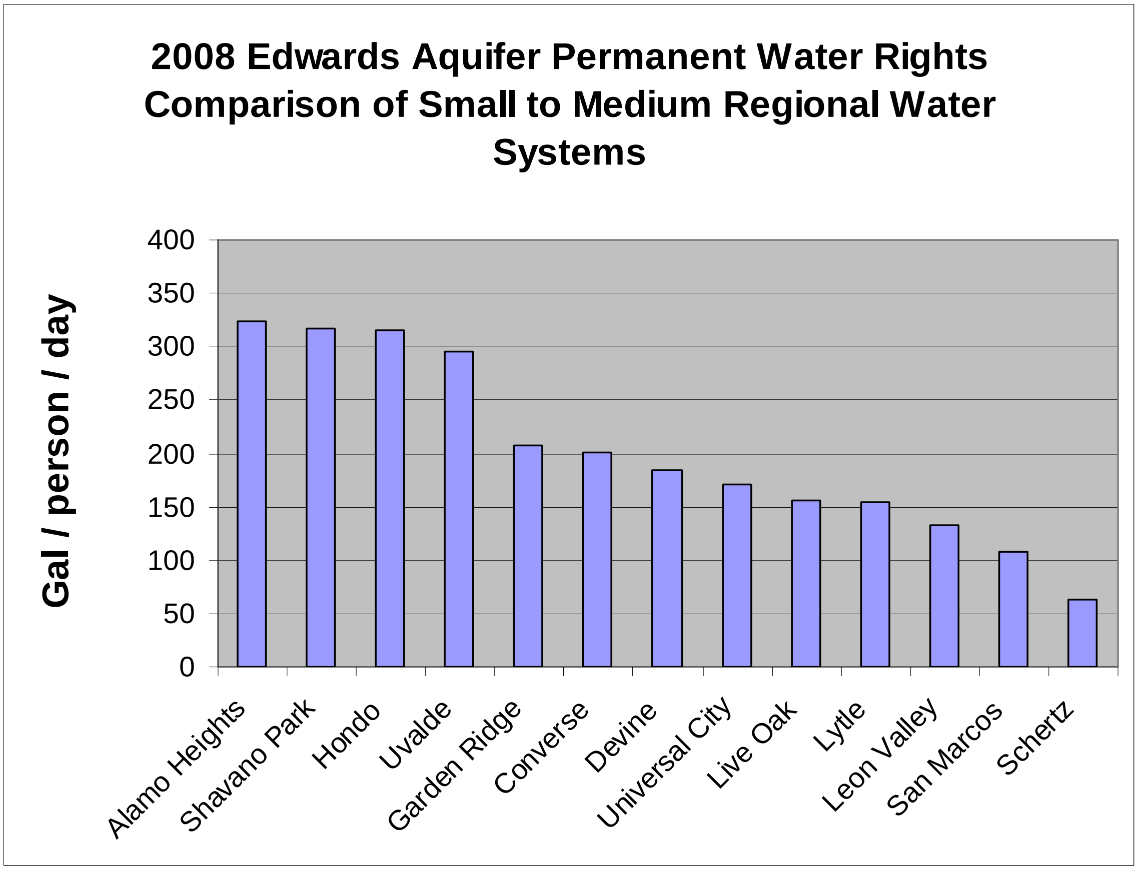
1.3.1 Pumping Rights

As of January 1, 2008, the City holds the rights to annually pump 2,887 acre feet of Edwards Aquifer water consisting of:

- 2,658 acre feet of permanent water rights owned by the City (of which 25 acre feet are leased to Universal City, Texas until 2012)
- 229 acre feet which have been leased by the City of Alamo Heights until 2012

With no additional purchases or leases, 2,862 acre feet are available until 2012 and 2,658 acre feet will be available thereafter.

The City of Alamo Heights has water rights to provide 324 gallons of water per person per day. The graph below shows that the City of Alamo Heights has more per capita water rights than most, if not all, small to medium water systems in the region. On average, Texans use 180 gallons per person per day and SAWS customers average 142 gallons per person per day. Alamo Heights' customers averaged 252 gallons per person per day over the last 10 years. This amount of per capita use is relatively high in comparison to other communities its size, but is not abnormal for communities with above average median incomes and a high number of irrigation systems.



1.3.2 Historic Pumping

Over the last ten (10) years, the City of Alamo Heights has pumped an average of 2,072 acre feet of water per year from the Edwards Aquifer.

COAH Historical Usage	
1999	2,265
2000	2,024
2001	2,094
2002	2,253
2003	1,966
2004	1,819
2005	2,118
2006	2,166
2007	1,812
2008	2,202
10-Yr Avg.	**2,072**

1.3.2 EAA Stage Water Restrictions

In 2008, the Edwards Aquifer Authority (EAA) implemented new Stage Water Restrictions which reduce the amount of water that may be pumped by a water utility during drought conditions. The adopted Stage Water Restrictions are as follows:

Critical Period (Reduction) Stage*	Index Well J-17 Level (MSL)	San Marcos Springs Flow (CFS)	Comal Springs Springs Flow (CFS)	Withdrawal Reduction – San Antonio Pool
I	<660	<96	<225	20%
II	<650	<80	<200	30%
III	<640	N/A	<150	35%
IV	<630	N/A	<100	40%

** Implementation of Stage I is based on a 10-day average. A change to a critical period stage with higher withdrawal reduction percentages is triggered if the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs or the 10-day average of daily aquifer levels at the J-17 Index Well drops below the lowest number of any of the trigger levels. A change to a critical period stage with lower withdrawal reduction percentages is triggered only when the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs and the 10-day average of daily aquifer levels at the J-17 Index Well are all above the same stage trigger level.*

1.3.3 Drought Conditions

A scientific study of tree rings (Extended Chronology of Drought in the San Antonio Area, Revised Report 3/30/06) reveals that during 1537-1972, the catastrophic drought experienced by this region in the 1950's ranked as one of the worst droughts in 436 years.

Category	Rank	Year(s)
1 year	17th	1951
2 year	2nd	1950-51
3 year	16th	1949-52
4 year	3rd	1950-53
5 year	2nd	1950-54
10 year	2nd	1950-59

The tree ring study and over 75 years of daily J-17 well level records indicate that while an extended drought would require water restrictions for this community, the City of Alamo Heights has adequate water rights to continue to provide water to its customers during even extreme drought conditions. The following graph represents the number of acre feet that the City would be able to pump under current EAA Stage Water Restrictions based on the level of the J-17 well as a 75 year average, during the second worst drought period in recent history (1984) and the worst drought year in recent history (1956).

Drought Restrictions Under Current Guidelines		
Years	**2008-11**	**2012+**
Avail. Acre Ft	2,862	2,658
75 year avg. of J-17 well	2,603	2,417
1984 (122 days below 630 ft.)	1,954	1,814
1956 (312 days below 630 ft.)	1,743	1,619

1.4 Water Rates and Fees

1.4.1 Water Use Customer Categories

It is recommended that the City establish the following categories for water customers:

(1) *Residential.* Customers with a meter serving only a one-family or two-family residential dwelling.
(2) *Multi-Family.* Customers with a meter serving a structure that contains three (3) or more dwelling units.
(3) *Commercial.* Customers conducting retail, manufacturing and other business activities, including, but not limited to, restaurants, laundries, offices and stores. Includes hydrant meter consumption.
(4) *Institutional.* Customers that are churches, public and private schools and other facilities for training and educational purposes.
(5) *Irrigation.* Customers with a meter that is utilized solely for the irrigation of landscaping or other exterior uses. Irrigation meters shall be required for any irrigation systems providing coverage to more than 2,500 square feet of turf or other landscaping.

The monthly charge for water service is determined by adding the base charge for meter size to the charge for water consumed. Water bills to customers, which may include other authorized charges for city services are rendered monthly.

1.4.2 Monthly Water Meter Fees

The City has established the following monthly charges for each water meter size:

Meter Size	Charge
5/8"	$3.00
3/4"	$9.00
1"	$15.00
1 1/2"	$37.50
2"	$60.00
3"	$150.00
4" or more	$225.00

1.4.3 Water Volumetric Rates

In 2007, Water Resources Management, L.P. conducted an analysis of the City's utility rates based on the cost-of-service principle recommended by American Water Works Association (AWWA). The study determines rates which are fair and equitable among all customers. The following tables reflect the current monthly volumetric rates adopted by the City for the consumption of water based on and recovering the cost associated with providing service to each customer from that particular customer.

Consumption in Cubic Feet (cf)	Residential Rate Per 100 cf	Multi-Family Rate Per 100 cf	Commercial Rate Per 100 cf	Institutional Rate Per 100 cf	Irrigation Rate Per 100 cf
500 or less	$0.83	$0.83	$0.83	$0.83	$0.83
501 to 1,000	$1.13	$1.13	$1.13	$1.13	$1.13
1,001 to 2,300	$1.63	$1.63	$1.63	$1.63	$1.63
2,300 or more	$2.7631	$1.63	$1.63	$1.63	$2.7631

1.4.4 Water Bill Comparison

Based on the water rates and fees adopted for 2009 by the City of Alamo Heights and the San Antonio Water System (SAWS)**,** the following table calculates a residential monthly water bill for customers from each entity based on the current typical Alamo Heights customer monthly use of 2,300 cubic feet.

Residential Monthly Water Bill Comparison for Typical 2,300 cf Water Usage			
Itemized Fees	**COAH**	**SAWS (Standard)**	**SAWS (Seasonal)***
Water Meter Fee (5/8')	$3.00	$6.56	$6.56
Water Volume Charge	$30.99	$22.16	$23.43
Water Supply Fee **	$0	$25.58	$25.58
Water Conservation Fee ***	$2.36	$0	$0
Total Typical Monthly Water Bill	$36.35	$54.30	$55.57

* *Seasonal rates apply July 1-Oct 31*
** *$1.11 per 100 cu. ft.*
*** *$.1024 per 100 cu. ft*

It is important to note that the majority of the difference between the two bills is the Water Supply Fee that SAWS charges to acquire additional water supplies for its growing customer base. Alamo Heights' population is generally stable and the community is considered to be fully developed, although there is the possibility of some increased density through redevelopment projects.

1.5 Water Conservation Requirements

1.5.1 Year-Round Allowable Hours for Landscape Watering

During periods when staged water restrictions have not been declared, the City has established allowable hours for the year-round application of groundwater for landscape purposes by means of automatic or manual irrigation systems any day of the week between the hours of 8:00 p.m. to 10:00 a.m. Watering with a handheld hose, soaker hose, drip irrigation system or bucket is allowed at any time except during periods when stage II or greater water restrictions have been declared.

1.5.2 Sprinkler System Rain Sensors

The City requires that all sprinkler systems shall be equipped with rain sensors to prevent the systems from operating during periods of rain.

1.5.3 Washing Vehicles and Run-Off Prohibited

The City prohibits automatic or hand watering in amounts sufficient to run into the streets and alleys. Non-commercial washing of vehicles and washing of impervious cover such as parking lots, driveways, streets or sidewalks is allowed on any day at any time, but should be done to avoid excessive run-off. The use of commercial vehicle wash facilities is allowed on any day at any time.

1.5.4 Declaration of Alamo Heights Water Stage Restrictions

The City has established the following staged water restrictions that may be declared when drought conditions are present. The City adopted the restrictions recommended by the EAA and also utilized by SAWS. The City Code requires water stage restrictions be declared as follows:

Critical Period (Reduction) Stage*	Index Well J-17 Level (MSL)	San Marcos Springs Flow (CFS)	Comal Springs Springs Flow (CFS)	Withdrawal Reduction – San Antonio Pool
I	<660	<96	<225	20%
II	<650	<80	<200	30%
III	<640	N/A	<150	35%
IV	<630	N/A	<100	40%

** Implementation of Stage I is based on a 10-day average. A change to a critical period stage with higher withdrawal reduction percentages is triggered if the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs or the 10-day average of daily aquifer levels at the J-17 Index Well drops below the lowest number of any of the trigger levels. A change to a critical period stage with lower withdrawal reduction percentages is triggered only when the 10-day average of daily springflows at the Comal Springs or the San Marcos Springs and the 10-day average of daily aquifer levels at the J-17 Index Well are all above the same stage trigger level.*

1.5.5 Alamo Heights Stage I Water Restrictions

(1) No resident, person or business shall waste groundwater.
(2) Groundwater shall only be used for residential landscape watering by means of an automatic or manual irrigation system between the hours of 12:01 a.m. and 10:00 a.m. and between the hours of 8:00 p.m. and 11:59 p.m. during one day per week according to the last digit of a resident's, person's or business' address, as follows:

Address Ending In Watering Day Each Week
0 or 1 Monday
2 or 3 Tuesday
4 or 5 Wednesday
6 or 7 Thursday
8 or 9 Friday

Multi-family premises, schools, churches and commercial users shall use groundwater for landscape watering only on Wednesdays, and only during the same hours listed above for residential users. Groundwater may be used for landscape watering by means of drip irrigation, soaker hose, hand-held hose or pail during any day at any time.
(3) No resident, person or business shall use groundwater to wash an impervious out-door ground covering such as a parking lot, driveway, street, or sidewalk unless for health or safety reasons.
(4) No resident, person or business shall allow landscape or irrigation water to escape from that person's land.
(5) Restaurants and other eating establishments are prohibited from serving groundwater to customers except upon request of the customer.
(6) Every resident, person or business that owns or has possession of a swimming pool must cover the pool with an effective evaporation cover or screen, or evaporation shields covering at least 25% of the surface of the pool, when the pool is not in active use. Inflatable pool toys or floating decorations may be used to shield the water from evaporation. Active use includes necessary maintenance that requires removal of the cover, screen, or shields. Active use of public, commercial and apartment pools is whenever the pool is not officially closed.
(7) No resident or person shall wash an automobile at any location except on their designated watering day and during the specified times, and in no event shall groundwater used for automobile washing be allowed to run into the streets or alleys of the city.
(8) Charity car washes are prohibited except at a commercial car wash that recycles at least 75% of the groundwater it uses or that is certified as a conservation car wash.
(9) The use of commercial vehicle wash facilities is allowed on any day at any time.
(10) No resident, person or business shall use groundwater for an ornamental outdoor fountain or similar feature, unless the water is recycled and the only additional groundwater used for the feature is to compensate for loss due to evaporation.

1.5.6 Alamo Heights Stage II Water Restrictions

(1) No resident, person or business shall waste groundwater.
(2) Groundwater shall only be used for residential landscape watering by means of an automatic or manual irrigation system between the hours of 3:00 a.m. and 8:00 a.m. and between the hours

of 8:00 pm. and 10:00 p.m. during one day per week according to the last digit of a person's address, as follows:

Address Ending In Watering Day Each Week
0 or 1 Monday
2 or 3 Tuesday
4 or 5 Wednesday
6 or 7 Thursday
8 or 9 Friday

Multi-family premises, schools, churches and commercial users shall use groundwater for landscape watering only on Wednesdays, and only during the same hours listed above for residential users. Groundwater may be used for landscape watering by means of drip irrigation, soaker hose, hand-held hose or pail only on any day specified hereinabove but only between the hours of 3:00 a.m. and 8:00 a.m. and between the hours of 8:00 p.m. and 10:00 p.m. (3) All prohibitions (3) through (10) in stage I shall apply to stage II.

1.5.7 Alamo Heights Stage III Water Restrictions

(1) No resident, person or business shall waste groundwater.
(2) Groundwater shall be used for residential landscape watering by means of an automatic or manual irrigation system only on the one (1) designated watering day in
every other calendar week, and only between the hours of 3:00 a.m. and 8:00 a.m. and between the hours of 8:00 p.m. and 10:00 p.m., except that landscape watering with groundwater is permitted to maintain shrubs, trees, and other ornamental plants, but not grass or turf, on any day within the above prescribed hours and only by means of a bucket, hand held hose, soaker hose, or drip irrigation system.
(3) Designated watering days.
a. Properties zoned "residential", in accordance with the last digit of the property address:

Address Ending in Watering Day, Every Other Week
0 or 1 Monday
2 or 3 Tuesday
4 or 5 Wednesday
6 or 7 Thursday
8 or 9 Friday

b. Properties zoned other than "residential", without regard to address: Wednesdays, every other week, between the hours of 3:00 a.m. and 8:00 a.m., and between the hours of 8:00 p.m. and 10:00 p.m.
(4) All prohibitions (3) through (10) in Stage I apply to Stage III.
(5) Filling of new pools or refilling of existing pools is prohibited unless at least 30% of the water is obtained from a source other than the Edwards Aquifer. In addition, refilling is allowed only if the pool has been drained for repairs.
(6) Newly planted landscape may qualify for a three-week variance from the stage III one-day-every-other-week watering schedule, but only with a variance as may be granted herein by the City Council.

1.5.8 Alamo Heights Stage IV Water Restrictions

(1) No resident, person or business shall waste groundwater.
(2) All prohibitions (3) through (10) in stage I and prohibitions (2), (3), (5) and (6) in stage III shall apply to stage IV.
(3) When stage IV is in effect, the City Council may convene emergency sessions to consider other rules that may be necessary to further restrict groundwater use or to allow special uses, such uses including, but not limited to, the following:
Use necessary for public health or safety.
Notwithstanding any provision of these rules, groundwater may be used when and to the extent it is necessary to prevent danger to public health, safety, or welfare, or to the extent required by state or federal law.
Athletic fields.
a. An owner or operator of an athletic field who files with the city a groundwater conservation and reuse plan which has been approved by the City Council may apply groundwater to the field in accordance with this section. Athletic fields that are not covered by an approved groundwater conservation and reuse plan must comply with all maximum allowable and specific restrictions provided in these rules.

2 WATER CONSERVATION GOALS

2.1 Stated Goals

Staff recommends that the City Council adopt a five (5) year water conservation goal to achieve a ten percent (10%) reduction from the 1998-2007 annual pumping average of 2,070 acre feet to achieve a new annual pumping average of 1,863 acre feet per year by end of 2013. An additional five percent (5%) reduction is recommended to be adopted as the ten (10) year water conservation goal to achieve a new annual pumping average of 1,770 acre feet per year by the end of 2018. A permanent reduction of approximately 300 acre feet per year should allow the City to be able to withstand the demands of a reasonably sustained drought period even with statutory reductions in pumping rights.

The Texas Water Development Board mandates that water conservation goals be expressed in gallons per capita per day. The U.S. Census calculated the population of Alamo Heights to be 7,319 in 2000 and estimated the population of Alamo Heights to be 7,438 in 2007. The 2007 estimate represents the only year since 2000 that the population was estimated to be higher than the 2000 census. As a result of this limited growth (+1.6%) over a seven (7) year period, staff recommends that the city utilize the 2000 census population as the denominator for determining the gallons per capita per day measurement. As a result, the ten (10) year average for water usage in Alamo Heights is 252 gallons per capita per day. The five (5) year water conservation goal is 227 gallons per capita per day and the ten (10) year goal is to achieve 216 gallons per capita per day.

2.2 Funding

Recent changes made by the Texas State Legislature restored water rights previously owned by the City of Alamo Heights and largely eliminated the need for the City to acquire additional water rights. As part of the FY 2008-09 Operating Budget, the City Council approved the conversion of the City's Water Supply Acquisition Fee to a Water Conservation Fee. The Water Conservation Fee of $.1024 per 100 cubic feet is proposed to raise about $62,400 per year. The conversion of the fee was proposed in order to generate funds to implement this Water Conservation Plan and other conservation efforts and maintain an adequate water supply for future generations. The City Council may choose to increase this fee in the future or to authorize additional funds for this purpose from the Net Available Utility Fund Balance.

3 SUPPLY SIDE WATER CONSERVATION MEASURES AND PROGRAMS

3.1 Water Audit Methodology

The International Water Association (IWA) and the American Water Works Association (AWWA) recommend a newly developed Water Audit Method to provide an accurate assessment of how much of each type of water loss occurs and how much that loss is costing the water utility. Recent research has found that the practices of calculating "unaccounted-for" water varied so widely in utilities around the world that the term has no consistent meaning.

The IWA/AWWA Water Audit Method features sound, consistent definitions for the major forms of water consumption and water loss encountered in drinking water utilities. It also has a set of rational performance indicators that evaluate utilities on system-specific features such as the average pressure in the distribution system and miles of water main.

3.1.1 Unaccounted-For Water

A fundamental concept of this method is that all drinking water can be accounted-for, via metering or estimation, as either a form of consumption or a loss. As a result, the IWA and the AWWA recommend against the continued use of the imprecise term "unaccounted-for" water, referring instead to the specifically defined Non-revenue water, included in the IWA/AWWA Water Audit Method. All water supplied is accounted for in the components listed by using either measured or estimated quantities. A quantity is determined for the major components of water consumption and water loss, and a cost is placed on each component in order to assess its financial impact to the water utility. These features allow water utilities to make a meaningful assessment of their water loss standing, benchmark themselves with other water utilities and set performance targets.

3.1.2 Apparent and Real Water Losses

According to the IWA/AWWA Water Audit Method, all water losses in a water utility can be divided into two broad categories: apparent losses and real losses.

Apparent losses are the paper losses that occur in utility operations due to customer meter inaccuracies, billing system data errors and unauthorized consumption. In other words, this is water that is consumed but is not properly measured, accounted or paid for. These losses cost utilities revenue and distort data on customer consumption patterns.

Real losses are the physical losses of water from the distribution system, including leakage and storage overflows. These losses inflate the water utility's production costs and stress water resources since they represent water that is extracted and treated, yet never reaches beneficial use.

3.1.3 IWA/AWWA Water Balance

<table>
<tr><td rowspan="10">System Input Volume (corrected for known errors)</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption (including water exported)</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td><td rowspan="8">Non-Revenue Water (NRW)</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="6">Water Losses</td><td rowspan="3">Apparent Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Metering Inaccuracies</td></tr>
<tr><td>Data Handling Errors</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to point of Customer metering</td></tr>
</table>

3.1.4 Components and Definitions of the IWA/AWWA Water Balance

Water Balance Component	Definition
System Input Volume	The annual volume input to the water supply system
Authorized Consumption	The annual volume of metered and/or unmetered water taken by registered customers, the water supplier and others who are authorized to do so
Water Losses	The difference between System Input Volume and Authorized Consumption, consisting of Apparent Losses plus Real Losses
Apparent Losses	Unauthorized Consumption, all types of metering inaccuracies and data handling errors
Real Losses	The annual volumes lost through all types of leaks, breaks and overflows on mains, service reservoirs and service connections, up to the point of customer metering.
Revenue Water	Those components of System Input Volume which are billed and produce revenue
Non-Revenue Water (NRW)	The difference between System Input Volume and Billed Authorized Consumption

3.1.5 Performance Indicators for Non-revenue Water and Water Losses

Performance Indicator	Function	Comments
Volume of Non-revenue water as a percentage of system input volume	Financial - Non-revenue water by volume	Can be calculated from a simple water balance; good only as a general financial indicator
Volume of Non-revenue water as a percentage of the annual cost of running the water system	Financial - Non-revenue water by cost	Allows different unit costs for Non-revenue water components
Volume of Apparent Losses per service connection per day	Operational - Apparent Losses	Basic but meaningful indicator once the volume of apparent losses has been calculated or estimated
Real Losses as a percentage of system input volume	Inefficiency of use of water resources	Unsuitable for assessing efficiency of management of distribution systems
Normalized Real Losses - Gallons/service connection/day when the system is pressurized	Operational: Real Losses	Good operational performance indicator for target-setting for real loss reduction
Unavoidable Annual Real Losses (UARL)	UARL (gallons/day) = (5.41Lm + 0.15Nc + 7.5Lp) x P where Lm = length of water mains, miles Nc = number of service connections Lp = total length of private pipe, miles = Nc x average distance from curbstop to customer meter P = average pressure in the system, psi	A theoretical reference value representing the technical low limit of leakage that could be achieved if all of today's best technology could be successfully applied. A key variable in the calculation of the Infrastructure Leakage Index (ILI) It is not necessary that systems set this level as a target unless water is unusually expensive, scarce or both
Infrastructure Leakage Index (ILI)	Operational: Real Losses	Ratio of Current Annual Real Losses (CARL) to Unavoidable Annual Real Losses (UARL); good for operational benchmarking for real loss control.

3.2 Meter Replacement and Reading

In 2006, the City of Alamo Heights of Alamo Heights contracted with the San Antonio Water System (SAWS) to replace all of the water meters in the City's water distribution system. The meters were estimated to be more than fifteen (15) years old prior to this meter replacement. In order to ensure proper calibration and effective monitoring of water use, water meters should be replaced every ten (10) to fifteen (15) years.

The City currently contracts with SAWS to provide monthly meter reading services. This contract has yielded more consistent and more accurate meter readings than the City was able to achieve with internal personnel prior to initiating the contract. Additional efficiencies may be able to be achieved by implementing automated meter reading (AMR) services that will report meter readings wirelessly several times during a billing period. AMR systems provide the most accurate readings available, assist with leak detection and are extremely helpful in diagnosing excessive water bills for customers. Unfortunately, AMR services are not yet cost-effective to implement in smaller water distribution systems.

3.3 Improved Water Accounting and Billing

The City has purchased and implemented the utility billing module for its InCode financial management and accounting system. This module helps ensure consistent and accurate billing for the City's water, sewer and solid waste services. The module has the capability to identify potential meter reading errors or measurable water leaks on the customer side of the meter.

3.4 Leak Identification and Repair

The City has purchased and implemented new technology to detect water leaks at night by measuring the sound of water passing through the City's mains. The MLOG leak detection system utilizes sensors on water lines to accurately identify and locate potential leaks. The recording is done at night when little water use normally occurs to avoid "noise" in the system. The detection system not only identifies the presence and size of water leaks but also provides crews with a good estimate of their location. After a pilot installation proved that the technology operated reliably, the City installed the technology throughout Alamo Heights. Over a two-year period in 2007-2008, the system identified thirty-two (32) service and eight (8) main water leaks which have been repaired by Public Works staff.

4 DEMAND SIDE WATER CONSERVATION MEASURES AND PROGRAMS

The following includes a number of best management practices for demand side water conservation measures and programs utilized by utilities around the country to improve water conservation. Not all of the following measures and programs are recommended for implementation in Alamo Heights, but the information is provided in an effort to provide readers with information on the best management practices that are being implemented by the industry.

4.1 Tiered Rate Structures

In an effort to provide customers with monetary incentives to conserve water, many water utilities have adopted tiered rate structures in which customers pay a higher fee rate for water after predetermined amounts of water are consumed. The City of Alamo Heights has adopted a tiered rate structure for each customer category (see 1.4.3 Water Volumetric Rates**)** that includes an even higher fee rate for residential and irrigation customers that exceed 2,300 cubic feet of consumption within a billing cycle.

4.2 Prohibitions on Wasting Water

The Code of Ordinances does currently include several specific prohibitions on wasting water which include sprinkler system rain sensors (see 1.5.2), restrictions on washing vehicles and run-off (see 1.5.3) and more severe prohibitions on water wasting that are enacted only during periods of stage water restrictions (see 1.5.5-1.5.8). The City Council has also recently authorized staff to discontinue water service if any person fails to repair a minor, moderate or major water leak in an area owned or controlled by that person after receiving written notice.

4.3 Landscape Watering Restrictions

The Code of Ordinances does currently include several specific prohibitions on wasting water which include year-round allowable hours for landscape watering (see 1.5.1) and more restrictive landscape watering rules that are enacted only during periods of stage water restrictions (see 1.5.5-1.5.8).

4.4 Residential Toilet Replacement

Residential toilet replacement programs are generally regarded as one the most popular and cost effective water conservation programs available to water system customers. The replacement of all residential toilets in the household typically results in about **22 gallons of water saved per toilet per day**.

Since state and federal requirements have prohibited the installation of toilets using more than 1.6 gallons per flush since 1995, residential toilet replacement programs are recommended for communities in which at least twenty percent (20%) of the residential units in its service area were constructed prior to that year.

Residential toilet replacement programs typically consist of one or more of the following:
1) Credits, rebates or vouchers for the installation of new low volume flush toilets;
2) A retrofit ordinance which requires the replacement of high flush volume toilets (greater than 1.6 gallons) upon any plumbing upgrades, interior renovations or even change in ownership; and/or
3) A retrofit ordinance which requires the replacement of high flush volume toilets by a date certain no later than five (5) years from adoption of the ordinance.

Residential toilet replacement programs are often implemented in conjunction with the showerhead, aerator and toilet flapper retrofit programs.

4.5 Showerhead, Aerator and Toilet Flapper Retrofit

The retrofit of showerheads and toilet flappers and the installation of kitchen and bathroom faucet aerators have proved to be an effective method of conserving water. The program is recommended communities in which at least twenty percent (20%) of the residential units in its service area were constructed prior to 1995 and for which there has not been an active retrofit program for efficient showerheads and faucet aerators.

The replacement of toilet flappers typically results in water savings of up to **12.8 gallons per day** over the estimated five (5) year lifespan of the device. Showerheads and faucet aerators typically save **5.5 gallons of water per day** over their five (5) to fifteen (15) year lifespan, but such savings are considered permanent since inefficient fixtures can no longer be purchased.[1]

Showerhead, aerator and toilet flapper retrofit programs typically consist of one or more of the following:
1) Purchase and distribution of showerheads, toilet flappers or faucet aerators;
2) Credits, rebates or vouchers for the installation of showerheads, toilet flappers or faucet aerators;
3) A retrofit ordinance which requires the replacement of showerheads, toilet flappers or faucet aerators upon any plumbing upgrades, interior renovations or even change in ownership; and/or
4) A retrofit ordinance which requires the replacement of showerheads, toilet flappers or faucet aerators by a date certain no later than five (5) years from adoption of the ordinance.

[1] Texas Water Development Board Report 362: Water Conservation Best Management Practices Guide, November 2004.

4.6 Residential Clothes Washer Replacement

Residential clothes washer replacement programs encourage customers to purchase energy and water efficient clothes washers. Water efficiency in clothes washers is determined by *water factor* (WF) which calculated by dividing the gallons of water used to wash a full load of clothes by the capacity of the washer tub in cubic feet. Clothes washers with a WF of 7.5 or less are considered to be an efficient washing machine.[2]

Efficient residential clothes washing machines typically result in water savings of **5.6 gallons per household member per day**.[3]

Residential clothes washer replacement programs typically consist of credits or rebates for the installation of an efficient washing machine. The level of rebate that is set for this program is important and easily the most significant cost of the program. If the rebate cost for the clothes is set too low, only those customers already planning to buy an efficient washer will do so. If the rebate is set too high, the City will be overpaying for customers to retrofit. Most water systems that implement this program have found a rebate between $50 to $100 to be effective. SAWS currently offers a rebate of $100 for each efficient washing machine purchased with a WF of 4.5 or below.

4.7 Residential Hot Water On-Demand System Rebate

Residential hot water on-demand circulating pumps deliver hot water to users eighty percent (80%) faster than conventional water heaters and are easy to install.

Residential hot water on-demand systems are estimated to save about **10,000 gallons of water per year per household**.[4]

Residential hot water on-demand system rebate programs typically consist of credits or rebates for the installation of a hot water on-demand system. SAWS currently offers a rebate of $150 for the installation any approved hot water on-demand system.

4.8 Water Saver Landscape Rebate

Landscape irrigation continues to be one of the most significant areas in which water conservation can be achieved. Water saver landscape rebate programs have been implemented by a large number of water systems to promote the installation of turfs and indigenous plants that require less watering to maintain but still have a colorful and lush appearance year-round.

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[2] Consortium for Energy Efficiency Clothes Washer Page, http://www.cee1.org/resid/seha/rwsh/rwsh-main.php3.
[3] Texas Water Development Board Report 362: Water Conservation Best Management Practices Guide, November 2004.
[4] San Antonio Water System Hot Water On-Demand Rebate. http://www.saws.org/conservation/h2home/hotwater/.

Water saver landscape rebate programs adopt specific criteria and requirements for qualification for the program and typically offer rebates or gift certificates as incentives. The water conservation achieved from the installation and maintenance of water saver landscapes varies widely.

Registering water saver landscapes with the system allows for continuing communication with property owners through which additional incentives or programs may be shared. These customers are also good candidates for customer water use audits.

4.9 Customer Water Use Audits

Many water systems have hired and trained staff to provide water conservation audits for customers. Auditors typically check all water connections for leaks, evaluate existing turf, landscape and soil conditions and check irrigation systems for performance issues, provide low-cost fixtures such as efficient showerheads and aerators and make recommendations on effective ways for customers to conserve water.

Customer water use audits are typically offered to the highest water users based on customer category and are then provided to customers on a first-come, first-serve basis. Customers that have taken advantage of other programs such as the water saver landscape rebate may also welcome water use audits.

The water savings generated by customer water use audits vary widely, but most of the savings may be realized from audits of the highest water users and through repairs of irrigation systems and modification of watering practices. The savings generated by audits are also multiplied if customers implement other water conservation measures as a result of the audit.

4.10 Commercial Conservation Retrofit

Some water systems, like SAWS, offer comprehensive commercial conservation retrofit programs. Water systems target commercial customers because their average water use is often higher than average use of residential customers. As a result, overall reductions in water demand can be more rapidly achieved by developing conservation programs for commercial customers. Such programs often consist of the replacement of high flow toilets installed prior to 1992 with high-efficiency toilets, audits of cooling towers to maximize the efficiency of commercial cooling towers, the replacement of pre-rinse kitchen spray valves and the installation of air-cooled ice machines.

Commercial conservation retrofit programs typically offer a wide variety of incentives including credits, rebates and the resulting water savings depends largely on the initiatives offered and implemented by customers.

Stainless steel pre-rinse kitchen sprayers are estimated to save **100-300 gallons of water per day**, low-flow toilets are estimated to save about **80 gallons of water per day** and air-cooled ice machines are estimated to save **150 gallons of water for every 100 pounds of ice produced daily**.[5]

4.11 Public Outreach and Education

Programs the provide water conservation information to the public are an effective means of both promoting water conservation programs and practices and educating the public about the importance of using water efficiently. Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short and long-term water savings. Evidence shows that customers will change their behaviors if a reasonable yet compelling case can be presented with sufficient frequency to be recognized and absorbed by customers.

School education programs, while not directly related to an equipment change, may result in both short and long-term water savings. Information provided to students are often shared with parents and implemented in the home. To be effective, school education programs should be age-appropriate and complement existing educational materials and curriculum.

Public outreach and education can take many forms to include: messages in utility bills, newsletters, emails, newspapers, websites, radio, television, signs, press releases, public service announcements, news conferences, direct distribution of materials, door hangars, informational booths, special events, public presentations and facilitated tours.

Like any other effective marketing or public information program, water conservation public information should be well planned and implemented in a consistent and continuous manner.

[5] San Antonio Water System Restaurant Certified WaterSaver Program. http://www.saws.org/conservation/commercial/restaurants/.

5 IMPLEMENTATION PLAN

5.1 Proposed Supply Side Measures

The City has implemented a number of the best management practices on the supply side of the water system over the past few years. However, the following additional measures are recommended to be explored and/or further implemented in an effort to improve water conservation.

5.1.1 Implement the IWA/AWWA Water Audit Methodology

Staff recommends the adoption and implementation of the Water Audit Method recommended by the International Water Association (IWA) and the American Water Works Association (AWWA). The method provides an accurate assessment of how much of each type of water loss occurs and how much that loss is costing the water utility. The IWA/AWWA Water Audit Method features sound, consistent definitions for the major forms of water consumption and water loss encountered in drinking water utilities.

5.1.2 Conduct regular audits of water system customer accounts

Regular audits of water system customer accounts will be conducted by staff in an effort to ensure proper billing and minimize water loss from improper customer classification, illegal connections or failure to read meters.

5.1.3 Utilize the MLOG leak detection system to minimize losses from leaks

Now that the MLOG leak detection system has been installed, the system should be fully utilized to minimize water loss by regularly identifying all potential water leaks in mains or service lines.

5.1.4 Requirement to repair water leaks upon notice

In the interest of the health, safety and general welfare of all residents, the City Council recently authorized staff to discontinue water service if any person fails to repair a water leak in an area owned or controlled by that person after receiving:

a) thirty (30) days written notice for a minor water leak;
b) ten (10) days written notice for a moderate water leak; or
c) three (3) days written notice for a major water leak.

The Director of Public Works or his designee shall have sole discretion to determine whether a leak is minor, moderate or major.

5.1.5 Explore opportunities to implement automated meter reading (AMR)

Emerging technology is making the installation and operation of automated meter reading (AMR) technology more cost effective for water systems. SAWS is currently in the process of developing a pilot program for the installation and evaluation of meters featuring AMR technology. Staff will monitor technological developments in this area and evaluate the cost-effectiveness of implementing AMR for Alamo Heights customers.

5.1.6 Conduct regular water cost of service and rate design studies

To offset the loss of revenue from the implementation of conservation measures and provide adequate funding for the capital renewal of utility infrastructure and the effective provision of water and sewer services, staff recommends conducting regular analyses of the City's utility rates based on cost-of-service principles and recovering the cost associated with providing service to each customer from that particular customer.

5.2 Proposed Demand Side Measures

The City does not currently have any demand side measures or programs in place. The following measures and programs are recommended to be explored and/or implemented in an effort to improve water conservation on the demand side. The City is exploring a partnership with the San Antonio Water System to provide demand side customer water conservation audits.

5.2.1 Toilet replacement program

The City proposes to partner with Morrison Supply, a local plumbing supply company and Caroma, Inc., an international toilet manufacturer specializing in water-efficient fixtures, to provide vouchers for the purchase of water-efficient replacement toilets for all water customers at a reduced cost in addition to qualifying for a $50.00 water bill credit with original proof of purchase. The vouchers will be limited to Alamo Heights customers and two (2) vouchers and credits per occupied unit.

Eligible toilets will be required to be High Efficiency Toilets (HET) as defined by the Environmental Protection Agency (EPA) which currently requires that the toilet utilize no more than 1.28 gallons per flush. In addition, each toilet shall have a MAPflush rating of 500 grams or better, meaning that it must be able to flush at least 500 grams of material with each flush.

First, if we assume that the average toilet being replaced uses between 3.5 or 5 gallons per flush, then we could estimate that each toilet to be replaced would currently average approximately 4.25 gallons per flush.

Next, let's assume that the average home in Alamo Heights has an average of 3 people and that each of those people average 5 flushes per day. So, the average Alamo Heights home has 15 flushes per day or 5,475 flushes per year.

Now, if we assume that those toilets were replaced with high efficiency toilets that use no more than 1.28 gallons per flush and that each home has at least 2 toilets. Each household would save 16,261 gallons per year by installing 2 high efficiency toilets or 8,130 gallons per toilet or about **22 gallons of water per toilet per day**.

By offering a rebate of $50.00 per toilet or $100.00 per household, our calculated cost per acre-foot is:

$$\frac{\$100.00}{(16{,}261 \text{ gallons per year x 10 Years}) / 325{,}851} = \$200 \text{ per acre-foot of water saved}$$

Based on these calculations, the City is estimated to save 16,261 gallons per home per year at a cost of $200 per acre-foot. In conservation programs, any savings under $400 per acre-foot is considered cost effective. It is also important to note that the savings would be even higher if customers install the even more efficient dual flush toilets or more than 2 toilets in their homes.

5.2.2 Efficient showerheads and faucet aerators

The City proposes to purchase efficient showerheads and faucet aerators from the same vendors currently utilized by SAWS. The City would store and staff would distribute the units to customers at no cost. The efficient showerheads and faucet aerators are also proposed to be provided to customers as part of a free customer water use audit (see 5.2.5). Showerheads and faucet aerators typically save **5.5 gallons of water per day** over their five (5) to fifteen (15) year lifespan, but such savings are considered permanent since inefficient fixtures can no longer be purchased.[6]

5.2.3 Customer water use audits

The City is negotiating an interlocal agreement with SAWS for SAWS staff to provide customers with water audits for a negotiated flat fee under a pilot program. The City would proactively contact the top ten percent (10%) of water users within their respective customer classes and then provide audits to other customers at their request. Customer water use audits would also provide an opportunity to distribute efficient showerheads and faucet aerators (see 5.2.2). The water savings generated by customer water use audits vary widely, but most of the savings may be realized from audits of the highest water users and through repairs of irrigation systems and modification of watering practices.

5.2.4 Conservation retrofit program

The City proposes to develop a grant program to which customers could submit applications for the City to fund the retrofit of schools, churches, businesses and multi-family developments. Each application would be considered based on conservation effectiveness and available funding. Also, develop a single-family retrofit program based on need for low-income residents and utilize SAWS contractors to actually do the retrofits. The water savings generated by retrofits vary widely, but water conservation advocates cite commercial and institutional retrofits as some of the most cost-effective conservation programs that can be implemented.

[6] Texas Water Development Board Report 362: Water Conservation Best Management Practices Guide, November 2004.

5.2.5 Public outreach and education program

Utilize the City's website and newsletter to provide customers with information concerning the initiatives included in this conservation plan. Both public information tools are an effective means of both promoting water conservation programs and practices and educating the public about the importance of using water efficiently. Public information programs can result in both short and long-term water savings if a compelling case can be presented to convince customers to change their behaviors.