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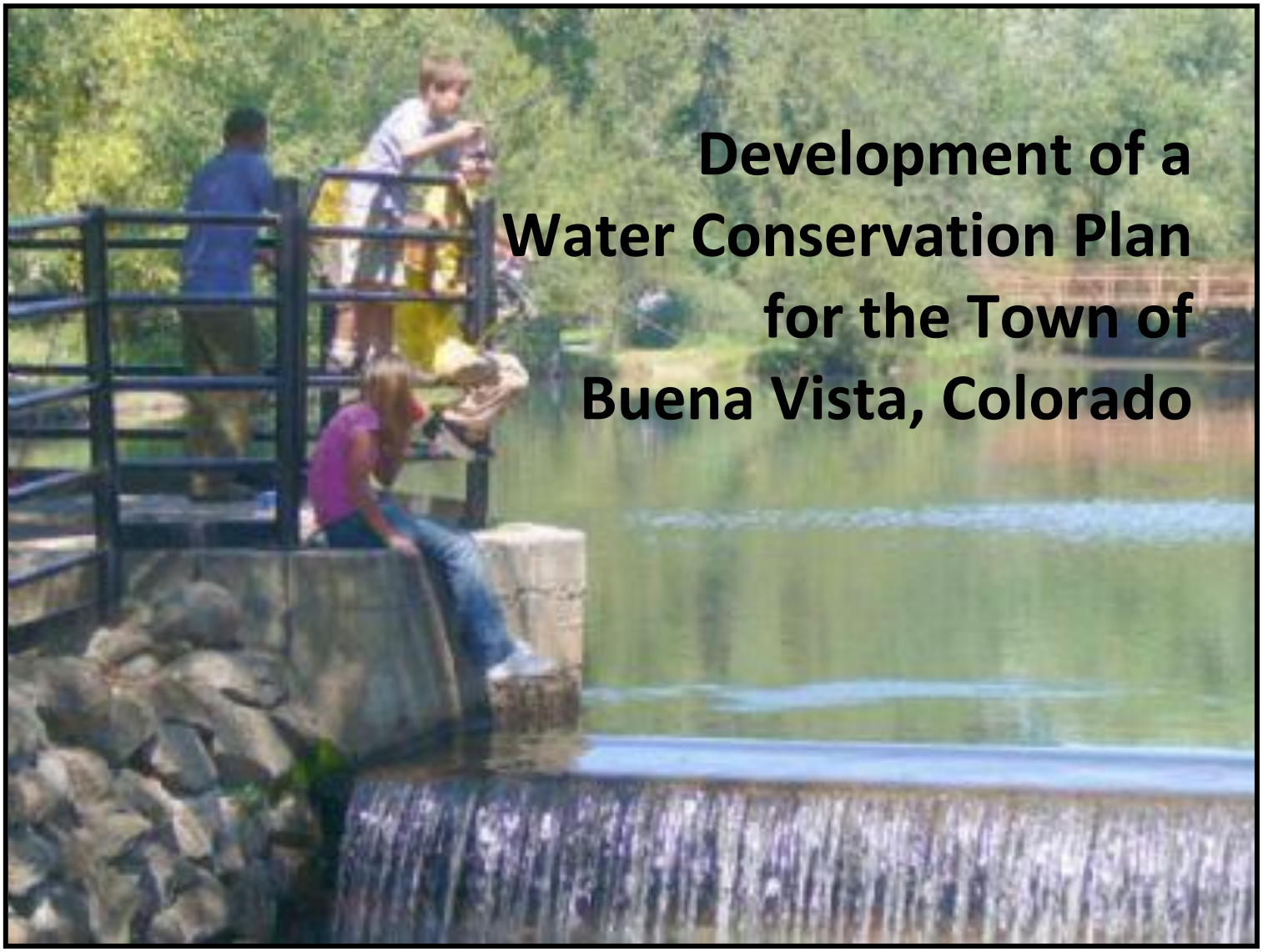
Development of a water conservation plan for the Town of Buena Vista, Colorado

Rachel Friedman



Development of a Water Conservation Plan for the Town of Buena Vista, Colorado

A Professional Project Report Submitted in Partial Fulfillment
of the Requirements for the Degree of Master of Water Resources
Hydroscience Concentration
Water Resources Program
The University of New Mexico
Albuquerque, New Mexico
May, 2012

Rachel Friedman, PE

THE UNIVERSITY of NEW MEXICO

Committee Approval

The Master of Water Resources Professional Project Report of **Rachel Friedman,** entitled **Development of a Water Conservation Plan for Buena Vista, Colorado,** is approved by the committee:

_____	_____
Chair	Date
_____	_____
_____	_____

WATER RESOURCES PROGRAM
UNIVERSITY COLLEGE
UNIVERSITY OF NEW MEXICO

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Acknowledgements

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Glossary of Terms and Abbreviations

AF - Acre-foot: the volume of water that would cover one acre to a depth of one foot. 1 AF = 325,851 gallons

ADD: Average Daily Demand: The total annual demand divided by 365 days

cfs: Cubic foot per second: Flow rate of water. 1 CFS = 0.6463 MGD

CDPHE: Colorado Department of Public Health and the Environment. State regulatory agency overseeing water quality.

CWCB : Colorado Water Conservation Board

Town: The Town of Buena Vista, Colorado

GPM: gallon per minute: Flow rate of water. 1 MGD = 1.547 CFS

HGL: Hydraulic Grade Line

MDD: Maximum Daily Demand: The highest water use day of the year

MG: Million Gallons

MGD: Million Gallons per Day

psi: Pounds per square inch. A measure of pressure in water mains.

SGM: Schmueser Gordon Meyer, Inc. Contract Engineers for the Town of Buena Vista.

Water Department: The staff of the Water Department for the Town of Buena Vista

WTP: Water Treatment Plant

Abstract

The Town of Buena Vista (Town) has a limited water supply, although Cottonwood Creek runs through the center of Town and the Arkansas River borders the Town to the east. The Town's water rights portfolio is entirely on Cottonwood Creek, and includes a reliable 10 cubic feet per second (cfs), or 6.46 million gallons per day (MGD) for the months of October to March, but only 3.88 cfs (2.51 MGD) senior water rights from April to September, which coincides with irrigation season. The Town does not own any water rights on the Arkansas River. The existing treatment and distribution capacity for the Town is approximately 2.15 MGD. The maximum daily demand in 2011 was 1.421 MGD, which is equivalent to 56% of total available water rights, and 66% of treatment capacity. Using a 3% growth rate, the Town will increase in size by 55% in 20 years or less, and there will be an insufficiency of water rights and of supply capacity to satisfy demands. In order to prevent a future shortage in the water system, a water conservation plan was approved by the Board of Trustees for commencement. The water conservation plan was developed following Colorado Water Conservation Board (CWCB) guidelines, and is intended to be adopted by the Board of Trustees and approved by the CWCB in order to be eligible for grants for water conservation implementation projects.

The twenty-year forecast for maximum day demand exceeds the existing supply capacity by 367,000 gallons a day, and exceeds the existing irrigation season water rights by 10,000 gallons per day. Prior to conservation, the ratios of demand to supply capacity and demand to water rights are 1.17 and 1.0, respectively.

The Town's Capital Improvement Plan contains $6M of production-related improvements between 2012 and 2018, including: Install well #3; install additional storage tank; install non-potable Arkansas River well #4; increase Water Treatment Plant capacity; and purchase additional senior water rights. If all of the proposed projects were installed, the monthly rate for water system customers would increase over nine dollars, or 34%.

Conservation measures were analyzed for implementation in order to reduce the need for the expensive projects proposed to meet growing demands, with the following goals: reduce the water loss rate from 26% to a more typical rate of 10-15%; reduce irrigation use to decrease peak use in the summer which coincides with the period when the Town has significantly less water rights; and reduce indoor use at residences, which comprise 81% of the water system customers. More than eleven specific measures

for conservation were considered per Colorado Revised Statutes (CRS) 37-60-126. The measures were screened for applicability, success rates in other municipalities, costs, and benefits, and the following measures were combined and recommended for implementation:

1. Toilet and/or showerhead and faucet rebate programs
2. Education/audits (public education, water-saving demonstrations)
3. Conservation (tiered) rate structure to encourage efficiency
4. Leak detection system purchase
5. Regulations/Ordinances regarding landscape efficiency (low water use landscapes, drought-resistant vegetation, and watering restrictions)
6. Regulations/Ordinances prohibiting once-through cooling for industrial and commercial efficiency

The implementation of the combination of measures will achieve the goals of reducing loss, irrigation use, and indoor use, with an estimated savings of 9.1 million gallons of water annually at a projected cost to the Town of approximately $13,000 per year. A one-time purchase of a $10,000 leak detection system could provide an additional 600,000 gallons per year savings. The decrease in maximum day demand after implementation of the proposed conservation measures is estimated to be over 392,000 gallons, a 16% reduction. The Town should install one proposed infrastructure project to provide a safety net for the supply system since the demand to supply capacity supply ratio is 1.0 after conservation. If non-potable well #4 on the Arkansas River was installed the Town would achieve diversification of the water rights portfolio, given that all the other Town-owned water rights are on Cottonwood Creek. Alternatively, the Town may wish to install well #3 to provide redundancy to the system and decrease the burden on the lift station. The addition of either well would suffice to provide a safety net in the supply capacity projections, and protect the Town against unexpected fluctuations in peak use by decreasing the ratio of demand to supply capacity of 0.9. The forecast for supply capacity and demand assumes that the conservation measures are implemented immediately in order to see expected results.

The costs to the Town should be negligible or nonexistent if grants are awarded to implement the conservation measures, and operation and maintenance costs are decreased due to less water needing treatment. The customer benefits from the conservation programs by receiving a reduction in annual water bills of nearly $100 if the customer participates in all the measures.

1. Introduction

The Board of Trustees for the Town of Buena Vista, Colorado (Town) has asked if the Town has the legal rights and capacity to divert, treat, and distribute water for future growth of the Town. From GIS data it is estimated that more than 50% of the property within Town limits are vacant of buildings and have not been built to their allowable maximum per zoning. Municipal Code Section 13-43 states that 'No new building, structure or facility of any nature that uses water shall be constructed within the Town unless connected to the Town's water system', therefore the Town must be able to provide water for all new developments that may be constructed, in addition to the existing customers.

The purpose of this water conservation plan is to determine implementation measures that will economically conserve water within the Town of Buena Vista in order to save water, money, and staff time for the next twenty years, and to prepare in the event of drought, unforeseen population growth, or natural disaster. The water conservation plan was developed following Colorado Water Conservation Board (CWCB) guidelines, and is intended to be adopted by the Board of Trustees and approved by the CWCB in order to be eligible for grants for water conservation implementation projects.

The planning steps outlined in Buena Vista's water conservation plan are:

1. Profile existing water system
2. Characterize water use and forecast demand
3. Profile proposed facilities and estimate capacity and costs
4. Identify conservation goals
5. Identify conservation measures and programs
6. Evaluate and select conservation measures and programs and determine costs and water savings
7. Integrate resources and modify forecasts and calculate revenue effects
8. Develop implementation plan

Following approval of the plan by the Board of Trustees, a plan to monitor, evaluate and revise conservation activities and the conservation plan will be developed.

2. Existing Water System Profile

2.1 Physical Characteristics of the Water System

The Town of Buena Vista, Colorado, is located in northern Chaffee County, central Colorado. Figure 2-1 displays the location of Buena Vista within the state of Colorado. Buena Vista is bordered to the east by the Arkansas River and BLM-owned land. Cottonwood Creek flows from the Continental Divide east through town into the Arkansas River. Although Cottonwood Creek runs through the center of Buena Vista and the Arkansas River borders the Town to the east, there is limited water supply. The Town owns a portfolio of water rights on Cottonwood Creek which vary in size, seniority, and season. The Town does not own any water rights on the Arkansas River.

Buena Vista is situated at approximately 8000 feet elevation, is considered to have an arid climate, and according to the Western Regional Climate Center receives only ten to fifteen inches of precipitation per year. The total size of the Town of Buena Vista (Town) is approximately 2217 acres, or 3.46 square miles. The population in 2010 was 2,617 according to the US Census Bureau.

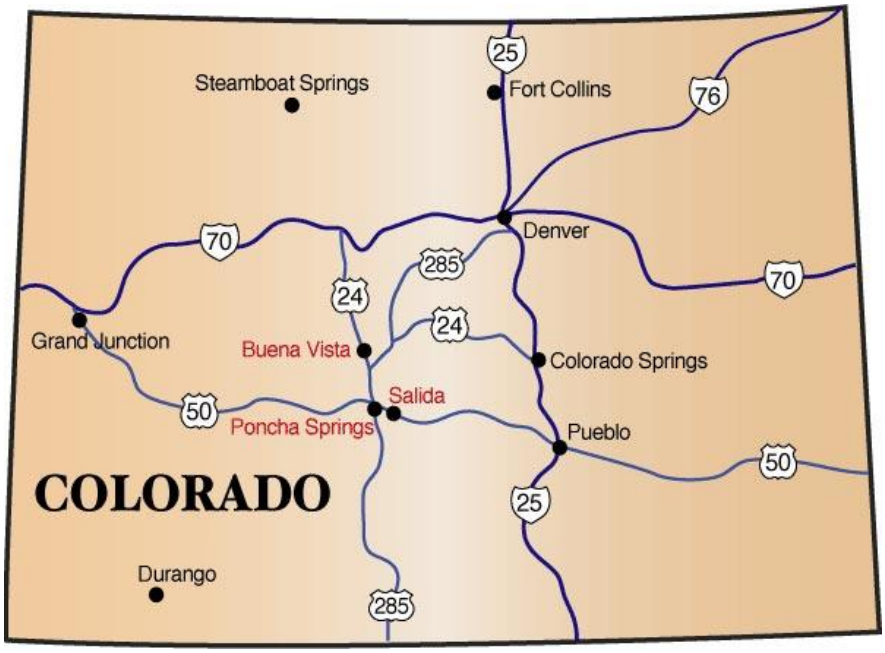

Figure 2-1: Map of Colorado

In July, 2011, there were 1,506 water service connections, including 15 fire service connections. Nearly eighty-one percent (81%) of the connections were residential, which consumed approximately sixty-five (65%) percent of the total annual demand, thereby making residential customers the substantial

majority of the water customers and source of demand. Table 2-1 displays the connection summary as of July 1, 2011.

TYPE OF SERVICE CONNECTION	Number of Services	Services % of Total	Gallons/Year /Type	Gallons % of Total	Gallons/ Service	Gallons/ Service/ Day*
Residential, single-family	1179	78.3%	97,950,005	61.2%	83,061	228
Residential, single-family, irrigation	2	0.1%	422,000	0.3%	211,000	578
Residential, multi-family	35	2.3%	6,137,000	3.8%	175,343	480
Commercial	190	12.6%	26,905,000	16.8%	141,979	389
Industrial	17	1.1%	1,367,000	0.9%	80,020	219
Public, governmental, church	51	3.4%	8,659,000	5.4%	169,784	465
Public, governmental, church irrigation	15	1.0%	18,653,000	11.7%	1,243,533	3407
Wholesale	0	0.0%	-	0.0%	-	-
Other - fire	15	1.0%	-	0.0%	-	-
Other - unmetered	2	0.2%	-	0.0%	-	-
TOTALS	1506	100.0%	160,093,005	100.0%		

*180 days/year used for irrigation connections

Table 2-1: Water service connections, July 1, 2011

The Town of Buena Vista did not meter water use until the 1990s. The installation of water meters created a decreasing trend in consumption from 1996 until 2004. Use from 2004-2011 was stable at nearly 400 gallons per day, as shown in Chart 2-1, which displays the average daily demand (ADD) per tap in Buena Vista from 1996 through 2010.

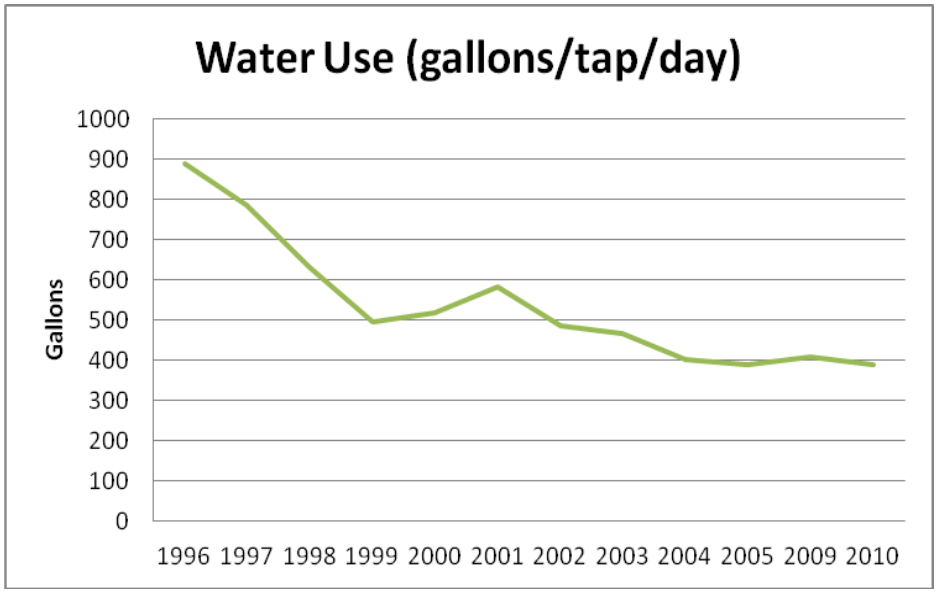

Chart 2-1: Average Daily Demand 1996-2010

The Town does not operate the wastewater system; the sanitation district is responsible for the wastewater system.

2.2 Water Sources

The sole source of municipal water for the Town of Buena Vista is Cottonwood Creek. The Town's water rights on Cottonwood Creek, in order of seniority, are shown in Table 2-2.

Water Right	Decreed Amount [CFS]	Appr. Date	Adj. Date	Ownership by Town [CFS]	Ownership by Town [MGD]	Allowed Diversion @ Town Intake and Infiltration Gallery [CFS]	Season of Use
Leesmeagh	4	11/30/1864	06/19/1890	1.833	1.19	Varies[(a)]	Irr.
Thompson	4	12/19/1864	06/19/1890	2	1.29	2	Irr.
Prior Right	2	04/30/1866	06/19/1890	1	0.65	1	Irr.
Gorrel	4	05/31/1866	06/19/1890	2.66	1.72	Varies[(b)]	Irr.
Cottonwood Irr.	6	07/31/1866	06/19/1890	0.88	0.57	0.88	Irr.
Cottonwood Irr.	13	12/31/1872	06/19/1890	0.12	0.08	0.12	Irr.
Town	4	06/01/1880	7/14/1903	4	2.59	2	Irr.
Supply	2	06/01/1880	7/14/1903	2	1.29	2	Irr.
Buena Vista Water Works	10	06/01/1883	9/10/1904	10	6.46	10.0[(c)]	Non-Irr.[(d)]

Table 2-2: Buena Vista Water Rights Portfolio (SGM, 2006)

(a) Ranges from 0.8 to 1.1 CFS during May-September, per Case 83CW88.
(b) Ranges from 0.6 to 0.9 CFS during May- September, per Case 83CW88.
(c) Town Well No. 1 is alternate point of diversion of 0.1 CFS of the Buena Vista Water Works right. This 0.1 CFS can only be diverted during the irrigation season.
(d) Year-round, but generally in priority in non-irrigation season.

The Town's senior water rights from 1864 and 1866 total 3.88 cfs (Thompson (2.0 cfs), Prior Right (1.0 cfs), and the senior Cottonwood Irrigating (0.88 cfs)), and can be relied on to be available, with rare exceptions, during the irrigation season, which is generally April through September. The Supply Ditch (2.0 cfs), the Town Ditch (2 cfs), and the Cottonwood Irrigating 1872 priority (0.12 cfs) are more junior and therefore less reliable (SGM, 2006). These junior irrigation season water rights total 4.12 cfs, but are not considered part of the Town's firm irrigation season water rights. During the non-irrigation

season, from November to March, the Town has its most junior water right, the Buena Vista Water Works right, which is 10 cfs. The Buena Vista Water Works water right generally cannot be used by the Town of Buena Vista during irrigation season, October through March, due to lack of priority. Therefore, the total senior water rights available during irrigation season, which coincides with peak use of the water system, is 3.88 cfs. The Town has historically been able to withdraw enough water needed to meet demands, even in the drought years of 1977 and 2002 (SGM, 2006).

The Town is required to demonstrate dry-up of approximately 111 acres of land historically irrigated by the Leesmeagh and Gorrel ditches prior to the use of the water rights for municipal purposes. (SGM, 2006) The Town installed piezometers in the field which was previously irrigated by the Leesmeagh water, and has been recording the depths of the groundwater in the piezometers in order to determine the amount of dry-up. At this time, the Town is in the process of converting a small percentage of the water to municipal use based upon the piezometers' records. An estimates of the volume of the proposed converted right is 0.19 cfs, or 0.124 MGD. The Gorrel land is the location of the infiltration gallery which is used for municipal purposes, and is not undergoing dry-up.

In summary, Buena Vista has a reliable 10 cfs (6.46 MGD) for the months of October through March (non-irrigation season, or winter water), but has only 3.88 cfs (2.51 MGD) senior water rights from April to September (irrigation season, or summer water). The additional Leesmeagh water, currently being converted to municipal use, will increase this irrigation season total to 4.07 cfs (2.63 MGD).

2.3 Water Distribution System

The Town can divert Cottonwood Creek directly at the Water Treatment Plant, pump groundwater at the well adjacent to the plant, or utilize groundwater from the nearby alluvium through the recharge gallery. Figure 2-2 displays the location of the three storage tanks, two pump stations, infiltration gallery, Water Treatment Plant, and 27 miles of water mains.

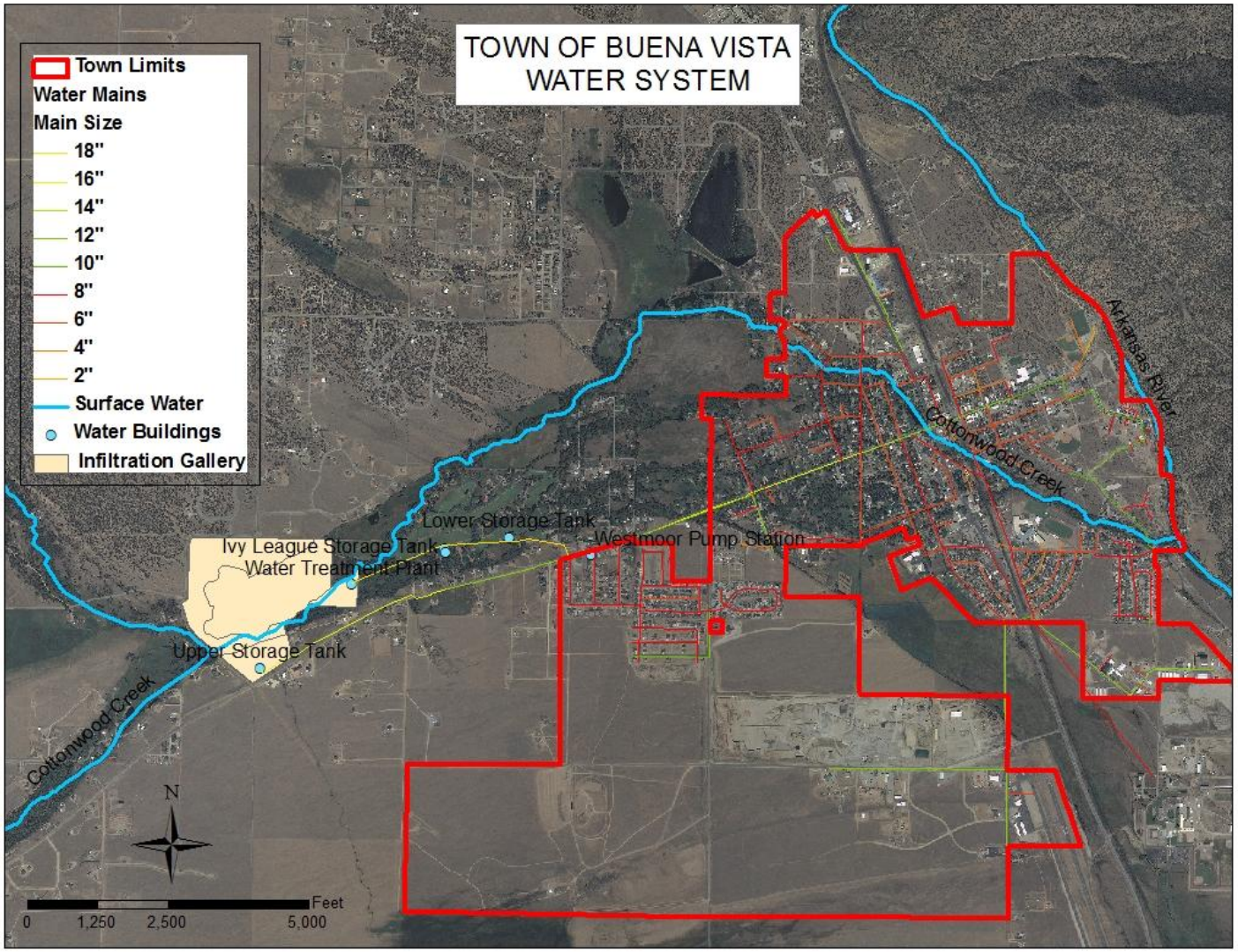

Figure 2-2: Water System, 2011

Two wells are located on Town-owned property; one well is at the Rodeo Grounds and one is at the Water Treatment Plant (WTP). The Rodeo Grounds well can pump approximately 15 gallons per minute (GPM), and is allowed for use solely at the Rodeo Grounds for activities on the property. The WTP well has the ability to pump approximately 150 GPM, and is used to supplement the irrigation gallery. The WTP well, called well #2, is used primarily during the electricity provider's non-peak hours in order to save on operating costs. The well is automated by the SCADA system to fill the storage tank when the level in the tank drops below a set point (SGM, 2006). There are no reservoirs in Buena Vista for municipal water supply.

The infiltration gallery is the Town's primary supply location because the gallery requires minimal treatment and no pumping. The infiltration gallery can produce at least 300 GPM without irrigating the field located above the gallery, or 800 GPM with irrigation. (Water Department staff has stated that the infiltration gallery produces approximately 400 GPM reliably; however the approved Water Master Plan (2006) for the Town of Buena Vista is based upon 300 GPM production. Therefore, this water conservation plan also uses a 300 GPM estimate for consistency and to be conservative.)

The WTP has the capacity to treat 520 GPM through one filter or 1040 GPM using both filters, although the plant has not been regularly utilized since 1998 (SGM, 2006). The infiltration gallery and well #2 require less manpower and electric power to treat water than the WTP, and can together satisfy current demands, thus are preferred over the WTP. The Water Department has ensured that the WTP remains compliant, and ready to be used if ever necessary.

Table 2-3 displays the water supply capacity of the current infrastructure. The maximum system production is currently 1470 GPM (2.12 MGD), using one filter at the treatment plant, well #2, and the infiltration gallery. With both filters at the plant, well #2, and infiltration from the gallery, the maximum capacity is 1990 GPM (2.87 MGD). The 2.87 MGD estimate assumes higher than conventional treatment plant production by running two filters continuously, which is not a reliable estimate. Filters require backwashing and other services frequently, which mean that two filters are not typically run together continuously.

The ability to use the infiltration at the gallery is currently (as of March 2012) in question by the Colorado Department of Public Health and the Environment (CDPHE), due to new 'groundwater under the influence of surface water' concerns. Currently the infiltration gallery is classified as a groundwater

source and the water is treated as such. If the CDPHE finds that the infiltration gallery is under the influence of surface water, the Town will need to determine and install new methods to treat the water from the gallery, if possible, in order to be in compliance with state regulations for surface water. The worst case scenario is that CDPHE may not allow use of the gallery as a surface water source. If the gallery can be used but without recharge, and two filters are used continuously at the WTP, the total supply capacity is 2.15 MGD. If the gallery continues to be permitted with infiltration and the treatment plant is utilized, it should be assumed that only one filter is used continuously, for a treatment supply capacity of 2.12 MGD. The two conservative options – no gallery recharge with the WTP at full system (2 filters) or allowable gallery recharge with the WTP running conservatively (1 filter) - have production capacities within 2% of each other, therefore 2.15 MGD was used in this water conservation plan as a estimate for total water supply capacity.

	Water System Capacity			
	Without Gallery Recharge		With Gallery Recharge	
	1 Filter	2 Filters	1 Filter	2 Filters
Source	**(GPM)**	**(GPM)**	**(GPM)**	**(GPM)**
Treatment Plant	520	1,040	520	1,040
Infiltration Gallery	300	300	800	800
Well #2	150	150	150	150
Total (GPM)	**970**	**1490**	**1470**	**1990**
Total (MGD)	**1.40**	**2.15**	**2.12**	**2.87**
Total (cfs)	**2.16**	**3.32**	**3.27**	**4.43**

Table 2-3: Water system supply capacity

The current average daily demand of approximately 400 gallons per tap per day multiplied by the existing connections is equivalent to 0.93 cfs (0.60 MGD), or 24% of the currently available irrigation season water, and 28% of treatment capacity. The maximum daily demand in 2011 was seen in August, at 2.20 cfs (1.421 MGD), which is equivalent to 56% of total available water rights, and 66% of treatment capacity. More than 50% of the Town area is vacant and with development the demand for water will increase. There will not be ample water rights or supply capacity to satisfy growing demands if water use trends continue unchanged.

The water distribution system is comprised of two main gravity feed zones and one constant pressure zone. The two gravity zones are the Lower Zone and the Upper Zone. The constant pressure zone

commences at the Ivy League Pump Station and is therefore referred to as the Ivy League Zone (SGM, 2006).

The Lower Zone is gravity fed from two storage tanks located immediately downstream of the WTP. The individual capacities of the tanks are 1,500,000 gallons and 270,000 gallons; the combined storage total for the Lower Zone is 1.77 million gallons (MG). All water supplied to the water system customers flows through the Lower Zone tanks. These tanks have a hydraulic grade line (HGL) of 8104 feet. This HGL can generally serve elevations below 8004 feet with minimum service of 40-psi. The third tank is the Upper Zone tank, which has a capacity of 750,000 gallons. The Westmoor Pump Station pumps water from the Lower Zone to the Upper Zone. The Upper Zone has an HGL of approximately 8198 feet, which can generally serve elevations below 8091 feet at minimum service of 40-psi (SGM, 2006).

The Upper Zone also connects to the Lower Zone through two Pressure Reducing Valves (PRVs). The PRVs from the Upper Zone to the Lower zone are for emergency service only, and are set to open only for low system pressures during fire flows. The two pressure reducing valves also allow emergency download from the Upper Zone to the Lower Zone (SGM, 2006).

The water main pipe types and diameters range from 4" cast iron to 18" ductile iron. Installation dates vary from the 1950's to 2011. The Town limits the use of PVC pipes in the system because the ground experiences considerable frost and heave during thaw, which causes ground and rock movement and could damage PVC pipes. It is also difficult to listen for leaks on PVC pipes.

The lack of water mains in the southern and northern regions of the Town in Figure 2-2 suggests that the water system will expand extensively in these directions. Buena Vista must prepare for providing water service within current Town limits to hundreds of undeveloped parcels.

2.4 System Limitations

The Town's water system is not in a designated critical water supply area, does not experience frequent shortages or supply emergencies, and is not experiencing a high rate of population and/or demand growth. Although increases to wastewater system capacity are anticipated within the planning horizon, wastewater is managed by the Buena Vista Sanitation District, not the Town of Buena Vista.

In 2006, engineering contractors SGM evaluated the water distribution system and determined that the existing system was generally sized appropriately, although upsizing existing 4" and 6"mains may be

needed to increase fire protection. Fire flows of over 1500 GPM were available to the majority of town. In the Lower Zone there were a few notable low fire flow (500 to 1000 GPM) locations that that were all associated with 4" and 6" mains. No other existing service concerns were identified in the Lower Zone. No excessive line velocities or excessive high or low pressures were indicated. Service pressures generally ranged from 40 to 80-psi in this zone under 2006 MDD conditions.

Additional looping is required to maintain service pressures and fire flow requirements. Identified future system loops in the Lower Zone included installing a water main and PRV in Gregg Drive for emergency download from Upper Zone to Lower Zone for emergency service and to supply water to a proposed Planned Unit Development on Gregg Drive.

No existing service concerns were identified in the Upper Zone (SGM, 2006). Fire flows of over 1000 GPM were available at all service locations in the Upper Zone. No excessive line velocities or excessive high or low pressures were indicated. Service pressures generally range from 55 to 90-psi in the Upper zone under MDD conditions.

A future conditions analysis was conducted by SGM (2006) to evaluate the Upper Zone. The evaluation indicated that the existing system is generally sized appropriately and that additional looping is required to maintain service pressures and fire flow requirements; upsizing existing mains is not needed.

2.5 Water Costs and Pricing

The water rate structure for monthly customer bills and fees is set at the beginning of each year. Monthly rates for 2012 are shown in Table 2-4.

Water System fees/Rates	*Effective with the March, 2012 billing*
Location/Type	Base monthly service fee
In-town rate	$28.16 plus $2.26/1000 gallons (or portion thereof) in excess of 5,000 gallons
Extraterritorial rate	1.5 x in-town rate ($42.23) plus $3.40/1000 gallons, or portion thereof, in excess of 5,000 gallons
Ivy League (Golf Course)	1.6 x in-town rate ($45.04) plus $3.62/1000 gallons, or portion thereof in excess of 5000 gallons
Qualifying Seniors	$21.12 plus $1.72/1000 gallons in excess of 5,000 gallons

Table 2-4: 2012 Water system monthly fees

Fees for connection to the water distribution system are based upon the size meter required for the property. The connection fee is termed a System Improvement and Development Fee, or SIDF. The total demand expected at a property due to the number of toilets, sinks, hose bibs, etc, or 'fixtures' is determined from a fixture count form, using a form developed by AWWA in M22 'Sizing Water Service Lines and Meters'. The meter is sized to provide for anticipated maximum demand determined by the fixture count form. The SIDF fees in 2012 are shown in Table 2-5.

5/8" meter	$4,000
¾" meter	$6,000
1" meter	$10,200
1 ½ meter	$20,219
2" meter	$32,459
3" meter	$64,859
4" meter	$121,558
6" meter	$253,315

Table 2-5: 2012 System Improvement and Development Fee

The 5/8" meter was introduced in 2010 per a request for a community garden meter. To date, no 5/8" meters have been installed. The majority of meters in the system are ¾" meters.

Properties that wish to annex into the Town limits or remain outside the limits but receive Town-supplied water (extraterritorial service) are required to provide water rights to supply the property, or a fee payment in lieu of water rights. The fee in lieu of water rights for extraterritorial service extensions and annexed properties are shown in Table 2-6.

Unit Type	Acre Ft/Yr /Unit	Fee in Lieu/Unit
Single Family Unit	0.3	$6,000
Duplex or Attached	0.24	$4,800
Multi-Family	0.18	$3,600
Irrigation Water per 1000 SF irrigated area	0.06	$1,200
Commercial	Case by case. $35,000 per acre	

Table 2-6: 2012 Fee in lieu schedule

The Town sells water from a fire hydrant at the Public Works shop for emergency and construction purposes within Town limits. The charges for this water service are one-hundred dollars ($100) for the permit fee plus $3.70 per 1000 gallons, or portion thereof, plus a meter security deposit.

Annually, the August and September water bills contain a message stating that water accounts that are three months or more delinquent will be certified to the Chaffee County Treasurer at the end of October. Once the charges are certified to the Treasurer they are posted to be paid with property taxes. The County adds a fee of 10% of the total amount certified. In 2011 there were 30 accounts that were delinquent more than 3 months, which is the average number of account certified per year.

2.6 Current Policies and Planning Initiatives

There are no provisions in the Buena Vista municipal code regarding drought conditions and water use. In 2002, there was a state-wide drought, and the water department requested that the water system customers follow voluntary water restrictions. In 2006, voluntary watering restrictions were again implemented, using odd- and even-number address watering schedules, which saved approximately 30% of total water during the period of implementation.

In 2011, the Water Department replaced 200 older radio-read meters with new remote-read meters. Not only does this save staff time each month during meter-reading, but the new meters are more accurate and therefore there is less water loss. Current estimates are that water meters lose 1% accuracy per year, therefore the older meters may have been reading a great deal less water than actually used, depending on age of the meter. In 2012, 200 additional meters are budgeted to be replaced.

Hydrants are tested annually, during which unmetered water is released into the streets in order to flush hydrants. By improving the monitoring of how much water is released during hydrant flushing the Town will be better able to quantify the amount of water loss each year due to this program.

In 2010, the Town upgraded the billing software. The upgrade improved account information retrieval and provided access to tools that improved the billing clerk's ability to track customer usage. The new software was utilized heavily during the creation of the tables and spreadsheets for this Water Conservation Plan.

2.7 Current Water Conservation Activities

There are no current conservation activities, conservation measures or programs implemented by the Town of Buena Vista. The municipal code Section 13-41(c) states:

> *In the interest of water management and conservation, the Town may impose reasonable restrictions upon the use of water, or otherwise regulate water usage. Such restriction or regulation shall apply equally to all water users and shall be enacted by proclamation by the Mayor or resolution by the Board of Trustees. Public notice shall be given to water users prior to the implementation of any such restriction or regulation.*

Section 13-42(a) states:

> *Unless authorized by the Town by appropriate proclamation or resolution, no person shall discharge, or cause to be discharged, any bleeding water flows. Consumers shall prevent unnecessary waste of water and shall keep all water outlets closed when not in actual use. Hydrants, outside water taps, urinals, water closets, bathtubs and other fixtures shall not be left running for any purpose other than the one for which they are intended.*

All violations of the municipal code are punishable by payment of a fine of not more than one thousand dollars ($1,000.00), or by imprisonment not to exceed one year, or by both such fine and imprisonment (Buena Vista Municipal Code, 2012). Citations have not been written since the 1980s for water violations, and the Town currently does not employ code enforcement staff.

3. Water Use and Forecast Demand

3.1 Current Water Use

Chart 3-1 displays the monthly production records for all metered supply connections in 2009, 2010, and 2011. The monthly averages produced between May through October were in the 20 to 35 million gallon range, while the averages in the months November through April were in the 5 to 10 million gallon range. The 400% increase between seasons is due to outdoor use, specifically lawn watering. All water used in Buena Vista is potable, treated water, including water used on lawns.

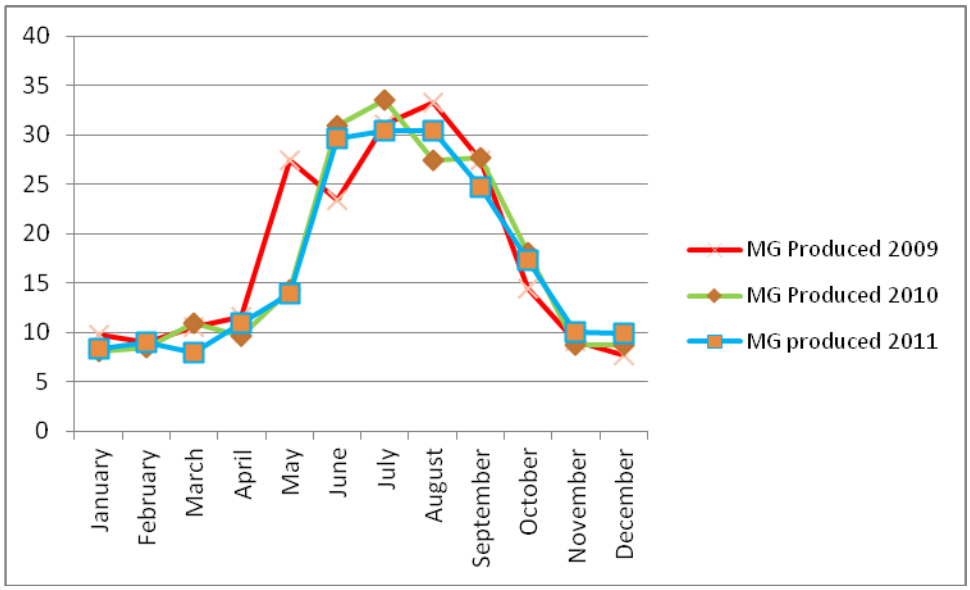

Chart 3-1: Monthly production records 2009, 2010, and 2011

Table 3-1 displays the type and number of service connections per sector, yearly billed consumption per connection type, and average daily use. The data is from the Town of Buena Vista's Water Billing Department records from July 1, 2010 through June 30, 2011. For irrigation connections the yearly use was divided by 180 days instead of 365 to represent the six-month watering season. The highest daily users, each with daily averages over 1000 gallons per service connection, were the school fields and parks, hotels/motels, irrigation use for residences, and school buildings.

Type of Service	Number of Services	Total Billed Consumption (gallons/yr)	Average Consumption/ Service* (gallons/day)
School Fields - irrigation	3	11,730,000	21,722
Government Parks - irrigation	12	6,923,000	3,205
Hotel/Motel	15	8,562,000	1,564
Residential - Single Family - irrigation	2	422,000	1,172
School Buildings	11	4,168,000	1,038
Apartments	16	4,798,000	822
Restaurant	24	6,913,000	806
Car Washes	4	767,000	548
Laundries	7	1,133,000	443
Church	14	2,058,000	403
Resident/B&B	3	308,000	281
Private School Buildings	3	390,000	356
Government Offices	23	2,043,000	243
Personal Services	30	2,511,000	229
Residential - Single Family	1176	97,642,005	227
Industrial	17	1,367,000	219
Residential - Multi-Family	19	1,339,000	193
Retail	58	3,980,000	188
Offices	51	3,039,000	162
Fire Systems	15	-	-
Flat Rate - no meter	2	-	-
Overall Totals	1505	160,093,005	291
* 180 days used if outside metering (irrigation)			(Average)

Table 3-1: Water Consumption Records July 1, 2010 – June 30, 2011

The overall total average, 291 gallons per tap per day, is less than the average per tap shown on Chart 2-1 of 400 gallons per tap per day, due to the water loss rate. The water loss is not evident in water consumption records because the water loss is not metered through customer meters.

3.2 Forecasting Method

United States Census Data reports that the Town of Buena Vista saw 2.53% growth between 1990 and 2000, and 1.92% growth between 2000 and 2010. The Department of Local Affairs (DOLA) State Demographers Office forecasts that the growth rate for Chaffee County will be 2.2% between 2010 and 2015, and 3% between 2015 and 2020, with a gradual decrease every five years thereafter until the rate

reaches 0.8% in 2040. The average DOLA-forecasted growth rate for the 20-year period of this conservation plan (2011-2031) is therefore 2.2%. A 3% growth rate was used in demand forecasting after considering the following factors: the State Demographer predicts a 3% county-wide growth rate between 2015 and 2020, and the growth rate may continue to increase due to the affordability of Buena Vista compared to similar areas in Colorado. If the population grows between only one and two percent, the number of taps would likely increase nearly twice as much. As residents relocate in Buena Vista new businesses must be opened to support the population, and the new businesses require water connections, in addition to the residential water connections. The number of taps increased by 2.8% per year in the years 2006 to 2011, and the population increased 1.9% per year between 2000 and 2010, therefore a 3% estimated growth rate does not appear excessively over-estimated. The calculated demands may be conservative due to the estimated growth rate, but it is imprudent to forecast 20 years in the future without being conservative.

A three percent growth rate was used for both residential forecasting and nonresidential forecasting, primarily because the three most recent large subdivisions (40, 166, and 237 acres) approved within the Town of Buena Vista have been for mixed-use developments, therefore comparable growth is expected in both sectors. Developers have realized that the high costs of gas, the inconvenience of vehicle trips for daily living, and the smaller carbon footprint of mixed-use developments are driving forces for the consumer, and the developers have responded strongly in Buena Vista.

The system experiences substantial water loss (formerly called 'unaccounted-for water'). The water loss rates are above 25% annually, or nearly fifty million gallons per year. The average annual unaccounted water volume ranged from 22% to 27% for the years from 2002 to 2004 (SGM, 2006). Calculations of water loss for twelve months of 2010 and 2011 determined the loss rate was 26% and 22%, respectively. The Water Department owns a sonic device to pinpoint leaks once problem areas have been identified, but the sonic device is not useful for finding a problem unless the location is known. Contractors have performed system-wide leak detections regularly every two to three years with a correlator device, the most recent in 2011. In 2011, six leaks were located and repaired, which did not decrease the system water loss significantly.

Non-metered water also contributes to water loss in the system. A leading cause of non-metered water is installation of lawn irrigation watering equipment prior to the meter on customer water services. This type of problem is identified when the Water Department staff is replacing meters or repairing leaks,

and is removed or repaired on a case by case basis. Water Department Staff do not consider non-metered water a significant contributor to the loss rate.

The master production meter was replaced in 2010 due to a recommendation made in the Water Master Plan:

> *Discrepancies between production meters and billing records could be a source of unaccounted water. This hypothesis has merit for two reasons: the production meter may not be reading a full pipe (due to its installation) that would result in over-estimation of production, and/or the production meter has not been calibrated since installation.*

Unfortunately, the replacement of the master meter did not reduce the lost water calculations. The Water Master Plan (SGM, 2006) did provide the caveat that '*While this is a potential source of discrepancy, it does not appear to be the sole source because the unaccounted water volume does not change with production; it is always around 150,000 gallon per day.'* It is not clear how the loss per day was determined, as customer water meters are read monthly, not daily. It is assumed that an average was used, but this does not appear to be accurate. The loss per month in 2010 varied from 8.75 MG to 18 MG; consequently the daily loss also varies greatly.

The reason for the water loss has not been successfully determined although numerous attempts were made, therefore the percent of lost water used in the demand forecasting was held at 26% for the next twenty years.

3.3 Demand Forecast

(Note: These forecasts do not include adjustment for water conservation activities identified in the plan that have not already been implemented, and such adjustments will be addressed later in the plan.)
Table 3-2 provides a forecast of the 20 year water demand using a 3% population growth rate in both residential and non-residential service connections. The assumption was made that the gallery would not be recharged, which generates a total supply capacity of 2.15 MGD.

As shown in Table 3-2, the average daily demand and maximum day demand can be met for the next ten years without the addition of infrastructure or water rights. However, the twenty year forecast for MDD (2.51 MGD, 3.89 cfs) exceeds the supply capacity (2.15 MGD) by 0.367 MGD, or 0.57 cfs. The 20-year MDD (3.89 cfs) exceeds existing irrigation season water rights (3.88 cfs) by 0.01 cfs. Prior to

conservation, the ratios of demand supply capacity and demand to water rights are 1.17 and 1.0, respectively. (A 2% growth rate would produce the same results in the 20 year forecast, with a demand to supply ratio above 1.0.) In order to protect the Town for high use, fires, leaks, or other unexpected uses, it is prudent to begin a conservation program in order to decrease the ratios. Conservation will also provide room for growth and/or unexpected high use, and reduce the need for the Town to purchase additional water rights or install additional supply capacity.

Item	Current year	5-yr forecast	10-yr forecast	20-yr forecast
RESIDENTIAL DEMAND				
Current annual water residential sales (total gallons)	104,509,005			
Current connections	1,216			
Residential sales per connection	85,927			
Projected population (3% growth)		1,410	1,635	2,197
Projected annual residential water demand		121,154,580	140,451,364	188,754,888
NONRESIDENTIAL DEMAND				
Current annual water nonresidential sales (total gallons)	55,584,000			
Current number of connections	273			
Water use per connection	203,916			
Projected number of connections (3% growth)		316	366	492
Projected annual nonresidential water demand		64,437,090	74,700,248	100,390,887
NONACCOUNT WATER (WATER NOT SOLD TO CUSTOMERS)				
Current and forecast amount (26%)	45,883,995	48,253,834	55,939,419	75,177,901
WATER SYSTEM TOTAL DEMAND				
Current total annual water demand	205,977,000			
Projected total annual water demand		233,845,504	271,091,031	364,323,676
Adjustments to forecast (+ or -)				
Current and adjusted total annual water demand forecast				
Current and projected annual supply capacity	784,750,000	784,750,000	784,750,000	784,750,000
Difference between total use and total supply capacity	578,773,000	550,904,496	513,658,969	420,426,324
Projected total annual water demand (5%)		112,690,924	130,639,667	175,568,788
Difference between total use and total supply capacity	-	672,059,076	654,110,333	609,181,212
AVERAGE-DAY AND MAXIMUM-DAY DEMAND				
Average-day demand	564,321	640,673	742,715	998,147
Current maximum-day demand	1,423,000			
Maximum-day to average-day demand ratio	2.52			
Projected maximum-day demand	1,423,000	1,615,531	1,872,843	2,516,944
Daily supply capacity without gallery recharge	2,150,000	2,150,000	2,150,000	2,150,000
Ratio of maximum-day demand to daily supply capacity	0.66	0.75	0.87	1.17

Table 3-2: Preliminary Water Demand Forecast

4. Proposed Facilities Profile

4.1 Identify and Cost Potential Facility Needs

Table 4-1 displays the differences between current (2011) and future (2013-2031) supply capacity, water rights, and projected maximum day demands. A possible re-classification of the infiltration gallery from a groundwater source to a source under the influence of surface water may require that advanced treatment is required for the infiltration gallery. This plan assumes that the upgrades due to the water quality regulations, if needed, are installed, and that the gallery continues to operate, but without recharge from irrigation. It appears that there will be sufficient water rights to meet the 20-year forecast demand if the Leesmeagh water is successfully converted, but there will not be sufficient supply capacity to meet the forecasted demand. The 20-year maximum day demand is approximately 367,000 gallons, or 0.57 cfs, higher per day than the supply capacity with the existing infrastructure.

	cfs	MGD
Supply Capacity 2011	3.32	2.15
Water Rights 2011	3.88	2.51
Water Rights 2013*	4.07	2.63
Max Demand 2011	2.2	1.42
Max Demand 2031	3.89	2.52

*includes expected conversion of 0.19 cfs Leesmeagh Water

Table 4-1: Supply capacity, water rights, and projected demands

The Town's Capital Improvement Plan (CIP) contains substantial production-related improvements or additions between 2012 and 2018, including the following projects which total nearly $6M:

- Upper Zone Well # 3 with chlorinator and controls (2012) – potential capacity increase of approximately 150 GPM (0.216 MGD). Well #3 will fill the Upper zone tank so that water does not need to be pumped from lower zone through Westmore pump station to fill upper zone. Well #3 will not only increase capacity by approximately 0.216 MGD, but it would provide reliability to the upper zone, which currently lacks redundant systems. Estimated cost of $200,000.
- Additional upper zone 1 MG tank (2013-2014). An additional 1 MG water tank in the upper zone would not be needed if Well #3 is installed. The current tank in the upper zone meets demands,

and will continue to do so for the foreseeable future. Currently both the tank and the well are included in the CIP. Estimated cost of $719,000.

- Arkansas River Well: Well #4 investigation & augmentation and storage options (2016). Estimated construction date TBD. Installing a non-potable well on the Arkansas River would help increase supply capacity, and would enable the Town to diversify its water portfolio. Currently all of Buena Vista's water rights are within the Cottonwood Creek watershed; therefore acquiring rights to water on the Arkansas River would provide reliability to the Town in times of drought and/or contamination issues on Cottonwood Creek. The cost of well #4, including distribution mains and water rights purchases and transfers, have not yet been fully analyzed. An estimate of nearly one million dollars ($1M) has been used. The well was estimated to provide 150 GPM based on the yield of existing well #2, or 0.216 MGD, which would increase supply capacity, but is projected to non-potable and to be used primarily on the Town-owned parks and ball fields. This well could supply water to meet the park demand of 6.9 million gallons per year, or an average of 0.038 MGD (Table 3-1). If the park irrigation system used non-potable water, it would equate to a daily treatment and storage savings of merely 10% of the entire surplus demand (0.367 MGD) estimated in the 20-year forecast, or a 2% reduction of the total MDD.
- WTP capacity increase (2017-2018), approximate 1.2 MGD increase. Estimated capital costs ($3.8 million) to retrofit the existing treatment plant with submerged membrane filtration capacity. A membrane filtration-based process improvement would allow the Town to meet Cryptosporidium requirements and future demands without expanding the existing plant footprint. The existing flocculation and filter basins in each process train at the plant are connected by two pipes. It may be desirable to split each of the two existing filter basins into two cells in order to have four independent membrane filter cells. Each cell could be outfitted with 1 MGD of membrane filtration capacity, to achieve an overall firm capacity of 3 MGD with one filter cell out of service. An additional building located adjacent to the main filter building would likely be needed for ancillary equipment such as filtrate pumps, backwash air blowers, backwash supply tank, membrane cleaning and waste neutralization, chemical storage and feed systems, and a membrane chemical cleaning waste neutralization basin (SGM, 2006).
- Purchase 0.66 MGD (1 cfs) of senior water rights. Estimated cost of $200,000 including legal fees for conversion to municipal use. New water rights to meet demands were estimated at

$100,000 per acre-foot due to recent attempts in 2011 to purchase rights, and includes the cost of the water right and the legal fees to convert the right to municipal use.

4.2 Incremental Cost Analysis

Table 4-2 provides cost estimates for the proposed improvements to meet future demands, which include the potable well #3, non-potable well #4, membrane filtration at the WTP, a new 1 MG storage tank, and purchasing additional water rights. The expected life of the facilities was estimated at 50 years for all improvements, although the lifespan is likely longer in most instances.

Well #3 will not only increase capacity by approximately 0.216 MGD, but would provide reliability to the upper zone which currently lacks redundant systems. This planned capacity improvement is therefore high on the priority list, and is estimated to cost $1.64 additional per month per connection.

Increases to the WTP would be sufficient to supply the 20-year demand forecast and beyond, but would have a significant cost to the ratepayer. The estimated cost per connection per month is nearly six dollars ($6), which is a 21% increase above the existing $28.16 monthly base rate.

An additional 1 MG water tank in the upper zone is estimated to cost the customers an additional $0.74 each per month.

Installing non-potable well #4 on the Arkansas River would help increase supply capacity, and would enable the Town to diversify its water portfolio. An estimate of nearly one million dollars ($1M) was used to determine that the additional cost per connection for well #4 would be $1.08 per month.

Table 3-2 assumes that the Leesmeagh water that is decreed for conversion by Case 83CW88 is not converted, but Table 3-3 assumes that a small percentage (11%) is converted. If the Leesmeagh water is converted, the Town will have sufficient water rights to meet demands for the 20-year forecast. If Leesmeagh water is not converted, the cost to purchase irrigation-season water rights is $0.19 per connection per month.

The total cost of the proposed projects is approximately $6M, and could cost each water service customer $9.48 per month additional. The incremental supply cost per gallon ($0.57) was determined by dividing the ‘Estimated total annual costs’ by the ‘Planned improvements and additions’. The calculations in Table 3-2 do not include a discount rate, an escalation rate, or an adjustment for inflation.

		Facilities for meeting average-day demand	Facilities for meeting max-day demand			Water purchases needed to meet demand
		Source of supply	Water treatment facilities	Treated water storage	Major transmission lines	
	SUPPLY CAPACITY IN ANNUAL GALLONS					
1	Current installed capacity or water purchases (MGD)	1.37	1.5	2.52		
		gallery & well	plant	tanks		
2	Planned improvements and additions (MGD)	0.216	1.5	1	0.072	0.66
		well #3	membranes	tank(s)	non-potable	1.02
					well #4	(MGD/cfs)
3	Planned retirements (MGD)	0	0	0	0	0
4	Future installed capacity or purchases (MGD)	1.586	3	3.52	0.072	0.66
	COST OF PLANNED IMPROVEMENTS AND ADDITIONS (MILLIONS)					
5	Approximate total cost of planned improvements ($M)	0.2	3.8	0.719	1.0	0.20
6	Expected life of new facilities (years)	50	50	50	50	50
7	Estimated annual capital costs	$ 4,000.00	$ 76,000.00	$14,380.00	$ 20,000.00	$4,049.37
8	Estimated annual operating costs	$ 30,000.00	$ 45,000.00	$ 1,000.00	$ 2,500.00	$ -
9	Estimated total annual costs	$ 34,000.00	$ 121,000.00	$15,380.00	$ 22,500.00	$4,049.37
10	Per gallon cost of new facilities	$ 0.16	$ 0.08	$ 0.02	$ 0.31	$ 0.006
	Per tap cost of new facilities per month (5 year pop. forecast)	$ 1.64	$ 5.83	$ 0.74	$ 1.08	$ 0.19
	Total per tap cost of new facilities per month	$ 9.48				
	Simple incremental supply cost	$ 0.57				

Table 4-2: Cost of proposed supply-side facilities

5. Conservation Goals

5.1 Water Conservation Goals

The 20 year forecast for maximum day demand is higher than available supply by approximately 367,000 gallons per day, or 15% of MDD, if no new supply capacity is installed. The goal of the water conservation program is to reduce peak use - maximum day demand - by at least 15%. A 15% reduction in peak use in the 20-year forecast could decrease the peak demand sufficiently that no new facilities for supply or water rights would be required in the 20-year forecast to meet demands.

Based on the water use characterization and demand forecast of Section 3, and the capacity and cost forecasts of Section 4, the following areas were considered for water conservation programs:

A. Loss – system-wide water loss management
B. Irrigation Use – parks, residential, and churches
C. Indoor use – schools and residences

A. Loss

The water loss rate of 26% of total production is greater than 46 million gallons annually. The loss rate affects both ADD and MDD. The loss rate in July in 2009, 2010, and 2011 were extremely high at 8.13, 8.75, and 4.46 million gallons, respectively.

A reduction to a typical loss rate of 15% would save nearly 15 million gallons annually, and a reduction to a 10% loss rate would save more than 25 million gallons annually. The average annual single-family residential use is 228 gallons per day per tap, (Table 2-1), therefore 15 million gallons would supply water for over 180 new residential service connections.

The water loss is currently being treated and distributed, but it has not been determined if the water is being lost through unidentified leaks, illegal connections, fire hydrants, a combination of these items, or some other issue entirely, such as meter calibration. The Town owns a sonic leak detection system which is used to locate a leak when a problem is identified by a customer. System-wide leak detections have been performed regularly every two to three years by hiring contractors with a correlator device. In 2011, the system-wide leak detection identified six leaks, but after repairing the leaks the loss rate did not reduce significantly. The Water Department has identified areas in Town that have not received proper leak detection either due to type of pipe (asbestos-cement), location of pipe (Department of

Corrections property), or lack of data regarding location of pipe. These areas should receive immediate leak detection.

During the course of replacing old touch-read meters with new radio-read models, water department staff identified numerous connections that were made illegally. It should be considered that a staff person be dedicated for a temporary basis to inspecting each service line for illegal (before the meter) connections. **The loss rate should be decreased by conservation measures by at least 10% to meet national standards of 10-15% loss.**

B. Irrigation Use

Over 7.4 acres of turf are irrigated by the Town in the parks, not including the cemetery. The Town also irrigates the soccer field and softball fields, which are 5.1 acres. School irrigation totals approximately 8.76 acres for the turf on the school campuses and the fields. The annual total irrigation for parks and school fields is 18.65 MG (Table 3-1). This equates to 57.2 AF of water being applied to 21.26 acres, or 2.69 feet of water per acre. This appears to be approximately half of the amount recommended by a Colorado turfgrass specialist of 2.25 inches per week, or 4.88 feet per acre per year (Duble, 2011). Therefore, the 'school and park irrigation' service connections, although the highest user per tap, are not calculated to be using an excessive amount of water. **No conservation measures appear necessary for school and Town park irrigation.**

There are only two residential properties that have a separate service connection and meter for the water used outside of the residence, which the municipal code calls a 'yard tap'. These two users have extremely high uses per day, with an average of 1172 gallons per day over an 180-day watering season. One of the residences has a large greenhouse, which may explain the high use, but the other residence is a property with a 5,000 square foot lot. The use at this single-family residence is between 23,000 and 118,000 gallons per month in the irrigation season, which is exceptionally high. The water billing department stated the following about the property owners: 'an elderly couple lives there and just lets the water run.' The lack of awareness and education of proper watering techniques may be one cause of above-average water usage in the irrigation season. Moreover, many of the water system customers are seasonal, and live in warmer states in the winter months. It is possible that the seasonal customers are not aware of the scarcity of senior water rights in Colorado, the effects of the arid, high-elevation climate, or native drought-tolerant vegetation options. Assumptions may be made that residential

irrigation use is high due to inadequate awareness or education regarding proper irrigation techniques. **It is recommended that conservation measures are directed to reduce residential irrigation.**

Fourteen church connections use 403 gallons per tap per day on average (Table 3-1). The daily average use varied between 122 gallons in February, 2011, to over 945 gallons in July, 2011. The difference in use is assumed to be irrigation, at over 822 gallons per day per church, or a monthly use of nearly half a million gallons. If all outdoor watering at the churches was completely removed the water conserved would equal only 1% of the total demand in July, therefore this may not be a significant concern. However, the peak use could be lowered by increasing education and awareness regarding proper irrigation techniques. I**t is recommended that conservation measures are directed to reduce irrigation at churches.**

C. Indoor Use

Water use at the school buildings is high, with over 1000 gallons per connection per day at 11 school connections (Table 3-1). This average was determined over a 365-day year, when realistically the school buildings are open less than 250 days per year. Thus, the average may be as high as 1500 gallons per day. The schools have separate yard and field connections; therefore irrigation is not the cause of the high use at the schools. It is assumed that bathroom and kitchen use for hundreds of students daily is the cause of the high average. This use may be appropriate considering the high number of daily users, but it could be lowered. Conservation measures such as fixture replacement with low-flow toilets, urinals, and faucets may be appropriate at the school building. **It is recommended that conservation measures are directed to reduce indoor use at the schools.**

Single-family residential daily use in July, 2011 was approximately 445 gallons per tap, or 18,000 gallons per month per tap. Compounded with the fact that residential use comprises 65% of the total system, this high use is significant. If conservation at residences, the majority user, is successful, the conservation program will be successful. **It is recommended that conservation measures are directed to reduce indoor use at residential properties.**

6. Conservation Measures and Programs

6.1 Conservation Measures and Program Identification

The following measures for conservation are considered, per Colorado Revised Statutes (CRS) 37-60-126:

a) Water efficient fixtures and appliances (toilets, urinals, showerheads, and faucets)
b) Landscape efficiency (low water use landscapes, drought-resistant vegetation, and efficient irrigation)
c) Industrial and commercial efficiency (water efficient processes)
d) Water reuse systems
e) Distribution system efficiency (leak repair, removal of phreatophytes)
f) Education/information dissemination (public education, water-saving demonstrations)
g) Customer water use audits
h) Rate structures & billing systems designed to encourage efficiency (volume billing, conservation (tiered) rate structure)
i) Regulations/Ordinances
j) Incentives (rebates)
k) Distribution system efficiency (leak identification)

Colorado WaterWise published a 'Guidebook of Best Practices for Municipal Water Conservation in Colorado' (hereafter referred to as the Guidebook), which provides details regarding fourteen best practices. Numbers 1-6 are considered 'foundational, no-excuse best practices', and include the following items, which are also considered in this plan: 1) Metering, conservation-oriented rates and tap fees, customer categorization within billing system; 2) Integrated resources planning, goal setting, and demand monitoring; 3) System water loss control; 4) Conservation coordinator; 5) Water waste ordinance; 6) Public information and education. The majority of the State mandated and Colorado Water Wise recommended practices overlap, and are therefore addressed simultaneously.

6.2 Develop and Define Screening Criteria

Costs to the Town and the customers, staff time, and applicability to the circumstances in Buena Vista were criteria used to screen measures and programs from further consideration. The Water Department

operates as an Enterprise Fund, and as such expenditures cannot exceed revenues. The staff is composed of two full-time employees and one part-time employee, and a Public Works Director who is the Operator Responsible in Charge. The Public Works Director is also responsible for the parks, streets, engineering, and facility maintenance departments, and therefore is typically not available for on-the-ground water projects such as line replacements or fire hydrant flushing.

Measures that appear to require large budgets, additional staff, or have high associated costs to the customers will be disqualified from consideration for implementation.

6.3 Screen Conservation Measures and Programs

The following items, required by the State and recommended by WaterWise, were screened for inclusion as conservation measures.

a) Water efficient fixtures and appliances (toilets, urinals, showerheads, and faucets: Best Practice 12 in the Guidebook is 'high-efficiency fixture and appliance replacement for residential and non-residential sectors'. The Guidebook states that 'Utilities with significant numbers of older homes (before 1994) might find properly targeted incentive programs particularly useful in curbing demand.' Buena Vista was founded in 1879, and the vast majority of the west half of town was built before 1994. These homes likely do not have 1.6 gallon-per-flush toilets, or low flow showerheads and faucets which were stipulated by a 1992 EPA act. Before the EPA act, some showerheads had flow rates of 5.5 gallons per minute (GPM). Federal regulations mandate that new showerhead flow rates cannot exceed more than 2.5 GPM …. New faucet flow rates cannot exceed 2.5 GPM at 80 psi or 2.2 GPM at 60 psi (US DOE). Average daily faucet use and shower use each account for approximately twelve percent of household use (EPA, 2005), therefore there could be significant water conservation via a replacement program.

   It has been hypothesized that the introduction of low flow showerheads and the subsequent reduction in shower flow rate could cause people to increase the length of time spent in the shower. Data does not support the hypothesis that the introduction of low flow showerheads and the subsequent reduction in shower flow rate could cause people to increase the length of time spent in the shower; in fact the showering duration actually decreased in all study groups. Furthermore, replacing showerheads and faucets creates a water savings that increases exponentially with the number of residents in the home (EPA, 2005).

The results of a study in Florida, California, and Washington found that toilet flushing is the single largest end use of water in single-family homes, comprising as much as 30 percent of the water used daily. Currently mandated toilets use only 1.6 gallons per flush, while older toilets use 3.5 to 5.5 gallons per flush. In the study comprising 96 households in three states, the volume of water used for toilet flushing decreased 55% daily overall, or 24.5 gallons per day, after replacing old toilets with new low-flow toilets. The total conservation per household in the study was 9,000 gallons per year (EPA, 2005).

The water savings from clothes washer retrofits ranges from 11.5 gallons per day to 15.1 gallons per day (EPA, 2005), which is nearly half as much reduction as a toilet retrofit program. Water conserving washing machines cost more than twice as much as low-flow toilets, making the payback period nearly 19 years for the customer. Therefore, washing machines were not considered for the conservation program.

Appliance replacement and incentive programs for water efficient fixtures and appliances (toilets, urinals, showerheads, and faucets) should be considered as part of the conservation program to benefit the goal (C) Indoor Use.

b) Landscape efficiency (low water use landscapes, drought-resistant vegetation, and efficient irrigation) could reduce consumption in Buena Vista significantly. Chart 6-1 displays the maximum day demand (MDD) compared to the average day demand (ADD) in Buena Vista between 2006 and 2010. The difference between the two averages is due primarily to landscape watering (also referred to as irrigation). In 2009, the MDD was nearly 2 MGD, which was nearing the supply capacity of the system.

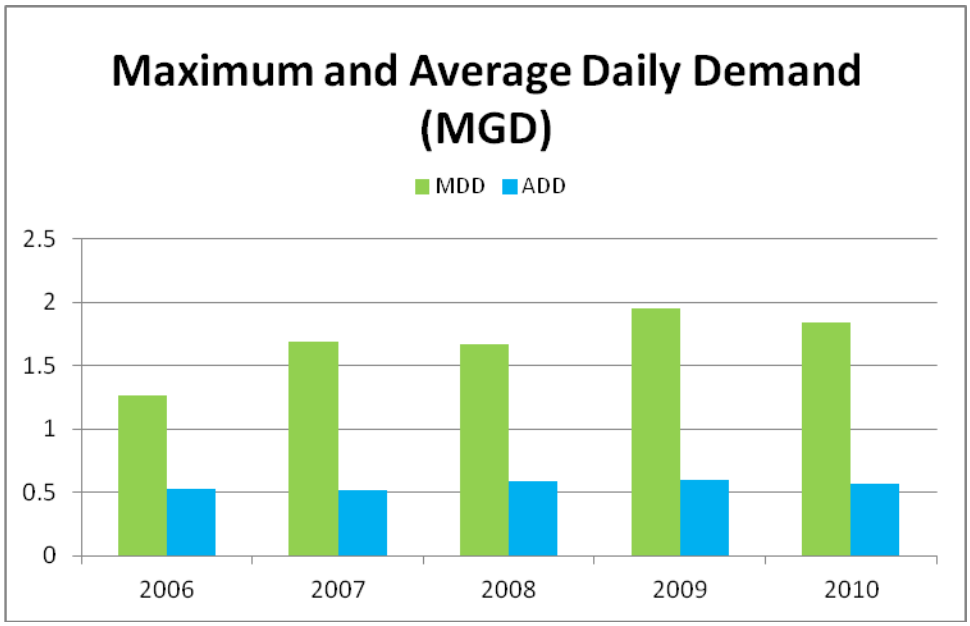

Chart 6-1: Maximum and Average Daily Demand 2006-2010 (MGD)

The estimate for MDD in 20 years is 9% higher than supply capacity. If the peaking factor were reduced 10% by reducing peak irrigation, the MDD in 20 years would be less than the supply capacity, which means no costly additional supply infrastructure would be needed to meet demands. Various methods to reduce irrigation use have been utilized in Colorado. The City of Alamosa plans as part of their conservation program to 'encourage residents to plant more water-hardy varieties of grass other than the bluegrass… One alternative would be sheep fescue which is popular in the Durango area and is a drought tolerant grass' (Heide, 2007). The Town of Buena Vista should consider a similar measure.

The Town of Crested Butte regulates that 'Property with an even numbered address may be watered on even numbered days. Property with an odd numbered address may be watered on odd numbered days. All watering is prohibited between the hours of 10 AM and 5PM and between the hours of 10 PM and 5AM.' Irrigation of lawns in Buena Vista could be limited to exclude the hours of 11 am to 5 pm, as the solar radiation, wind, and temperature heat of the day, can account for a 50 percent or greater loss of water (Duble, 2011). **Incorporating requirements for landscape efficiency (low water use landscapes, drought-resistant vegetation, and efficient irrigation should be considered as part of the conservation program to benefit goal (B) Irrigation Use.**

c) Industrial and commercial efficiency (water efficient processes) includes once-through cooling processes, which least two companies in Buena Vista utilize. Once-through cooling involves using

clean, treated water for industrial purposes, and the clean water is then sent to the waste collection (sanitation) system. The once-through process can use up to 5,000 gallons of water per day for each business. In order to save water, requiring that new businesses install recycled water or process chilled water systems for cooling should be considered, and new once through cooling processes should be prohibited. The businesses with existing once-through processes should be allowed to continue to operate as-is, to avoid the financial burden of replacing the system. I**ncorporating requirements for industrial and commercial efficiency (water efficient processes) should be considered as part of the conservation program to benefit goal (C) Indoor Use.**

d) Water reuse systems installation would be difficult for the Town of Buena Vista because the Town does not own or operate the sewer system; the sanitation district does. Wastewater is piped south of Town to the wastewater plant, which discharges treated effluent directly into the Arkansas River. The state awards return flow credits for a portion of the discharge to the Town. Without the return flow credits, the Town of Buena Vista would need to find additional water rights to offset consumptive use, among other potentially expensive legal ramifications. It does not appear economically practical to build a retrofit onto the treatment plant reuse water. Additionally, the cost for installing miles of new water distribution mains required to return the water to Town limits, or over seven miles to return the water to the tanks, is exceptionally high. I**ncorporating requirements for water reuse systems should not be considered as part of the conservation program due to economic and legal implications.**

e) Distribution system efficiency (leak repair, removal of phreatophytes) is similar to practice #3 from Colorado WaterWise, and should be addressed by the Water Department. The total amount of water lost in 2011 was nearly 40 million gallons, or nearly one-quarter of all water purchased by the utility's customers. According to the Colorado Municipal League and Colorado Water Resources and Power Development Authority (2007), summary of data collected from 83 municipalities regarding utility charges and practices in Colorado only 11% of participating municipalities have a loss rate greater than 20%. The majority of municipalities have a loss rate between five and nine percent. Buena Vista should strive to reach this loss rate of 5% to 9%. Not only does water loss reduce the availability of water for future connections, but the Water Department is spending time and money treating and distributing the lost water, which may never reach a faucet. It is possible that there are illegal connections contributing to the water loss calculations in addition to leaks, however as these

connections are found they are remedied immediately without a dramatic reduction in the amount lost water. American Water Works Association (1990) states in Manual 36 that 'most nonvisible underground leaks have an average life of two years. As water leaks, it creates an underground cavity. This increases the potential for damage to overlying property'. Damage to private property is yet another reason why the Water Department should continue to repair leaks as soon as they are discovered, and should focus more effort on leak detection. **Distribution system efficiency (leak repair) should be considered as part of the conservation program to benefit goal (A) Loss.**

Phreatophytes are not presently a concern in the watershed; there is limited presence of invasive species such as tamarisk. The native willows and cottonwood are desirable for the ecosystem for the climate type in Buena Vista, and should not be considered for removal. **Distribution system efficiency (removal of phreatophytes) should not be considered as part of the conservation program.**

f) Education/information dissemination (public education, water-saving demonstrations) is similar to practice #6 from the Colorado WaterWise Guidebook. The Chaffee County Energy Committee produced a 4-tab insert about energy conservation for the local newspapers in May, 2011, which included a segment regarding saving water. The water conservation segment of the insert provided the following tips for saving water and energy, which can be used by the Town of Buena Vista for the education campaign:

- *Turn off the water when you brush your teeth. Save up to 2.2 gallons for every minute the faucet is off.*
- *Shorten your showers by one or two minutes. A 4-minute shower uses approximately 20-40 gallons of water.*
- *Put a half-gallon milk carton filled with sand and gravel in your toilet tank. It could save more than 10 gallons of water per day.*
- *Run your clothes washer and dishwasher only when they are full or adjust wash load water levels to match the size of the load.*
- *Fix leaky faucets. It may be as easy as replacing a washer or tightening the faucet with a wrench. A drip every two seconds can waste 20 gallons of water a day.*

Sources: www.eartheasy.com; www.bewaterwise.com

EPA's Water Sense program provides some useful tips, such as:

- *Sweep driveways, sidewalks, and steps rather than hosing off.*
- *Wash the car with water from a bucket, or consider using a commercial car wash that recycles water.*

In 2011, the Water Department transitioned from postcard-type water bills to tri-fold bills within letter-sized envelopes. Inserts with information regarding upcoming events have been included in the envelopes with the water bills. Conservation education information, such as information listed above, should be considered for the water bill inserts. Additionally, the Town may consider newspaper articles and posting the information on the Town's website (buenavistaco.gov).

A more informative & understandable water bill should be researched, if the billing system allows. Currently the billing system does not have the capability to display a chart of a month-to month comparison of water use in the monthly bills, but there may be information that could make the water bill more understandable or educational for the customer.

School programs could be included in the conservation program. In 2011, the Town Engineer created a water resources and conservation educational program taught at Chaffee County High School during two one-hour sessions, which can be utilized throughout the district.

Water-saving demonstrations can be incorporated into existing parks in areas that have seen turf die-off, or in areas where turf may not be necessary for public use and may be replaced by drought-tolerant xeric species. There are plans to enhance the most focal corner of the town at the intersection of Main Street and Highway 24, which is the location of McPhelemy Park, which contains a popular pond. The pond in McPhelemy Park sees heavy use from anglers, paddlers in kayaks and on stand-up paddle boards, and tourists. Figure 6-1 displays the existing conditions at the corner of McPhelemy Park, and Figure 6-2 displays a draft proposal for upgrades at the focal corner, which includes hardscape and xeriscape for low-water demands. The Southeastern Colorado Water Conservancy District has installed a demonstration xeriscape garden in Pueblo, and with a grant from the Bureau of Reclamation published a map and key to explain the sixteen different types of landscaping areas in the garden and the principals of xeriscape. The Town of Buena Vista could consider a similar program once a xeriscape demonstration garden is installed.

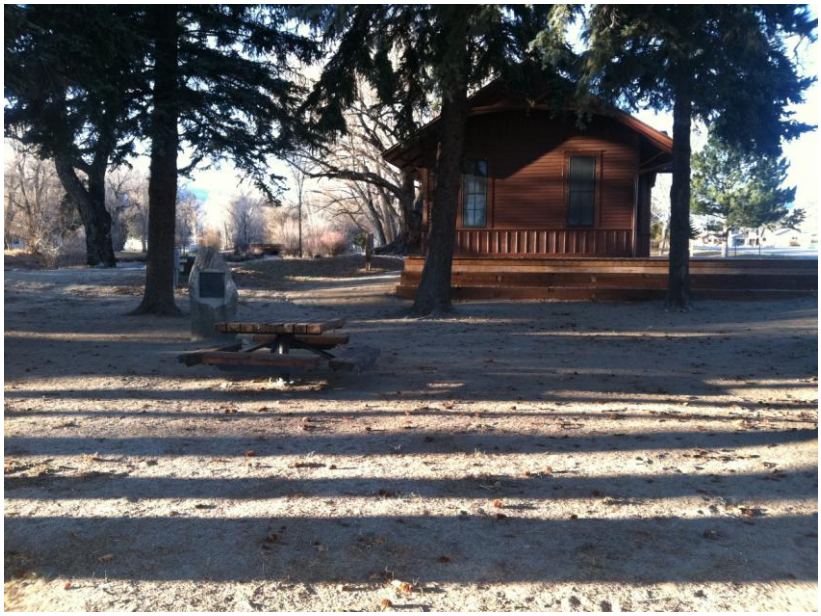

Figure 6-1: Existing conditions at McPhelemy Park

Figure 6-2: Draft proposal for McPhelemy Park upgrade

A conservation program suggested by the state and by Colorado WaterWise practice #4 is to have a water conservation expert available. Buena Vista presently has on staff a water resources engineer who has expertise in water conservation, as she prepared this water conservation plan and has completed the Masters of Water Resources Program coursework at the University of New Mexico. E**ducation/information dissemination (public education, water-saving demonstrations) should be considered as part of the conservation program to benefit goals (B) Irrigation Use and (C) Indoor Use.**

g) Customer water use audits are a desirable component of the water conservation program, although staffing constraints must be considered. The water department staff consists of two full-time

employees and one part-time employee, and a water clerk who produces bills and receives payments. The Town may consider offering a request-based audit for customers who use a higher than average amount of water monthly, or who see fluctuations between months of greater than three times their average. The Town may wish to target large users and/or large landscapes. **Customer water use audits should be considered as part of the conservation program to benefit goals (B) Irrigation Use and (C) Indoor Use.**

h) Rate structures & billing systems designed to encourage efficiency such as conservation (tiered) rate structure is an anticipated component of the town's water conservation plan. This method is similar to practice #1 from Colorado WaterWise. Currently all customers pay a base monthly fee for water service, then a fee for each 1,000 gallons in excess of 5,000 gallons. A monthly use of 5,000 gallons is approximately 166 gallons per day. The mean daily household indoor use for the groups in an EPA study (2005) was 107 gallons per day after the installation of the new high-efficiency fixtures and appliances, or approximately 3,300 gallons per month. Therefore, if a property is conserving water wisely, the monthly use could be less than 5,000 gallons most of the year, especially when there is no outdoor watering or conservation-minded watering practices are followed. Currently the fee for use in excess of 5000 gallons varies between $1.67 and $3.61 for each 1000 gallons depending on age, income, and location. However, the fee does not change if the use is 1,000 gallons excess or 10,000 gallons excess.

The Colorado Municipal League (2007) states that 'The ascending block rate structure assesses higher unit costs to customers who use higher volumes of water. Often, the objective of the ascending block structure is to encourage water conservation.' According to the publication, ascending block structures are used by 83 percent of the Colorado municipalities providing data, and billing measures are the most common conservation measure that municipalities undertake. The City of Steamboat Springs, Colorado has five tiers of water volumes. At the threshold of each tier, there is a higher price per 1,000 gallon. Mount Werner Water includes a base rate and three tiers of water volumes with the highest tiers' revenue specifically allocated to conservation (Environmental Solutions, 2011). In Erie, Colorado, volume billing has 'proven to be effective in making customers financially liable for the amount of water they use and consequently increased customers' awareness on water consumption' (CDM, 2008). In Phoenix, AZ, implementing a conservation (tiered) rate structure saved 7.5% of total water demand, while in Albuquerque, NM a landscaping

program and rate structure helped reduce peak water use by 14%. (EPA, 2002). A tiered structure should be incorporated in the Buena Vista water conservation program so that the customer is made aware of the excessive amount of water used, is penalized for doing so, and will learn to use less water. **Rate structures & billing systems designed to encourage efficiency should be considered as part of the conservation program to benefit goal (B) Irrigation Use.**

i) Regulations/Ordinances is similar to practice #5 from Colorado WaterWise, and can be combined with measures Water efficient fixtures and appliances (toilets, urinals, showerheads, and faucets) Landscape efficiency (low water use landscapes, drought-resistant vegetation, and efficient irrigation), and Industrial and commercial efficiency (water efficient processes).

Current building codes require low flow fixtures for new construction, but do not require that existing structures receive low-flow replacements when there is a building permit issued for an addition or other structural changes. Regulations requiring low-flow fixtures & appliance retrofits any time a building permit is issued to a parcel should be considered.

Turf restrictions should be added to the landscaping requirements for all parcels; currently the landscaping requirements encourage xeriscaping, but do not require it. The Buena Vista Planting Guide (2002) states:

> *The use of xeriscape landscape practices shall be encouraged in order to minimize the need for watering. The following techniques are strongly encouraged:*
> *(1) Soil improvement by loosening topsoil and incorporating appropriate organic matter.*
> *(2) Minimizing turf area.*
> *(3) The use of native and drought tolerant plants, and the clustering of plants with the same water requirements.*
> *(4) The utilization of properly designed and efficient irrigation systems with separate zones for each group of plants with different watering needs.*
> *(5) The use of organic mulches to reduce weed growth, promote soil cooling and reduce evaporation.*
> *(6) The consistent maintenance of landscape areas to encourage healthy, disease-free plants.*

Additionally, the Planting Guide allows some shrubs, grasses, and trees that require extensive and frequent irrigation, under the assumption that they are native to the local area. It is suggested that

they are '*placed only along watercourses and/or in areas prone to wet/moist conditions'*, but the location is not required, and the amount of these types of high-water using vegetation is not limited. Limits for turf area, types of plants allowed, and a percent limit of total vegetation to parcel area could be considered for the planting guide.

The Municipal Code contains 'Section 16-255 Landscaping Standards' regarding landscaping requirements, which references the Planting Guide. The section states that it does not apply to the majority of residential properties, only '*The construction, reconstruction, modification, conversion, structural alteration, relocation or enlargement of any nonresidential property in a nonresidential zone district, or a multi-family structure in an R-3 zone district'*. These properties *'shall provide a minimum landscaped area of five percent (5%) of the total property area.'* This Code section contains the following requirements for water conservation:

1. Landscaping must be designed to conserve water through application of Xeriscape landscaping principles in accordance with the Buena Vista Planting Guide.

2. The total amount of high water use zones on a property may not exceed fifty percent (50%) of the total landscaped area.

3. The total amount of high water use turf grass may not exceed thirty percent (30%) of the total landscaped area. Turf grass areas designated for high use or a specific recreational use shall be excluded from the total landscaped area under this requirement.

4. The use of high water use turf and plantings must be limited to high-use areas with high visibility or functional needs.

5. Plants or turf grass from a high water use zone may not be planted on slopes or berms at a 4:1 slope or greater.

The Landscaping Standards section also requires that *'A minimum of sixty percent (60%) of the required landscape area shall be live ground cover or other organic material (e.g., mulch, pecan shells). Expected mature shrub coverage will count towards this requirement; a tree's canopy shall not.'* The Code also states that *'Low-volume, drip or subsurface irrigation systems irrigation systems must be used in all nonturf grass areas and in landscaped areas where any one dimension is less than six feet in width and surrounded by impervious surfaces.'* These requirements should be expanded to cover residential properties, which are the majority of properties (81%). EPA's Water Sense program offers education information that could be used to create regulations for establishing new vegetation at properties.

Water waste prohibitions are present in the Municipal Code, but need to be revised to clarify that water that leaves a property and enters an adjacent property or Town right-of-way is not allowed, and the customer will be penalized. The code currently states that '*urinals, water closets, bathtubs and other fixtures shall not be left running for any purpose other than the one for which they are intended,'* which is difficult to enforce since these items are located within private property and cannot be monitored. This terminology should be removed.

Regulations requiring that new businesses install recycled water or process chilled water systems for cooling, and prohibits once-through cooling, should be considered.

Regulations/Ordinances should be considered as part of the conservation program to benefit Goals (B) Irrigation Use and (C) Indoor Use.

j) Incentives (rebates) can be used in conjunction with the methods Water efficient fixtures and appliances (toilets, urinals, showerheads, and faucets, Landscape efficiency (low water use landscapes, drought-resistant vegetation, and efficient irrigation), and Customer water use audits. If the Town's budget allows, rebates could be offered for customers who replace high water-using items such as showerheads, faucets, toilets, etc, with water conserving (efficient) items. An average customer in Buena Vista may see an annual savings of approximately $50 from replacing the toilets, showerheads, and faucets in his or her residence, but may be helpful to offer a rebate incentive up front to increase participation in the program. Replacing turf with low-water use vegetation using xeriscape principles could be costly to the customer; offering a rebate or incentive may make the program more desirable for the customer. A voluntary customer water use audit will not cost the Town or the customer anything, but there is a time requirement for both parties. The customer must be willing to spend time with the conservation coordinator in order to determine an individualized water conservation program for the customer, and must be willing to implement the proposed conservation measures. The customer should see a reduction in the water bills following implementation of the measures; a rebate for volunteering to participate in the program would be an extra incentive. **Incentives (rebates) should be considered as part of the conservation program benefit to Goals (B) Irrigation Use and (C) Indoor Use.**

k) Distribution system efficiency (leak identification) is an ongoing task in the Water Department. The Town owns a sonic device to listen for leaks when a concern is raised in a particular area, which

works quite well for the purpose. According to AWWA M36, 'in a valve-exercising program, leaks may be discovered during the exercising of valves'. The Water Department should create and maintain a regularly scheduled valve exercising program. Every two to three years the Town hires an outside contractor with a correlator device to perform system-wide leak identification, which in 2011 found what appeared to be 14 leaks in the system. Once researched, there were actually 7 leaks in hydrants and service lines. The Town should consider purchasing a system to perform system-wide leak identification more frequently. **Distribution system efficiency (leak identification) should be considered as part of the conservation program to benefit Goal (A) Loss.**

WaterWise measure 2) Integrated resources planning, goal setting, and demand monitoring appears to be satisfied by the creation of this Water Conservation Plan.

6.4 Measures Excluded from Conservation Plan

a) Rainwater Harvesting was not considered as a conservation measure due to legal water rights issues in Colorado. Although it is permissible to direct your residential property roof downspouts toward landscaped areas, unless you own a specific type of exempt well permit, you cannot collect rainwater in any other manner, such as storage in a cistern or tank, for later use (CO DWR, 2012). Senate Bill 09-080, which was passed and signed during the 2009 legislative session, allows limited collection and use of precipitation for Colorado residential properties that are supplied by a well or could qualify for a well permit (Waskom 2009). All landowners in Buena Vista are required by Municipal Code to connect to the water distribution system and abandon personal wells; the laws regarding wells do not apply within Town limits.

b) Rain Sensors. Many municipalities implement a program in which rain sensor are free to the public. A problem with the program, however, is that there is no guarantee that the rain sensors are used by the customers. A faucet/showerhead rebate program, on the other hand, could require that the old showerhead/faucet is brought to the Town staff for disposal in order to receive the rebate. Therefore, although the cost for rain sensors may be small, the sensors may not be utilized by the customers and therefore may not be money well spent by the Town.

7. Evaluate and Select Conservation Measures and Programs

7.1 Combinations of Measures and Programs

In summary, the following measures could be combined and considered for implementation:

1. Water efficient fixtures and appliances (toilets, urinals, showerheads, and faucets), which can be combined with the measure Incentives (rebates)
2. Landscape efficiency (low water use landscapes, drought-resistant vegetation, and efficient irrigation) which can be combined with the measures Regulations/Ordinances and Incentives (rebates) for turf replacement
3. Distribution system efficiency (leak identification combined with leak repair)
4. Education/information dissemination (public education, water-saving demonstrations)
5. Rate structures & billing systems designed to encourage efficiency (conservation (tiered) rate structure)
6. Industrial and commercial efficiency (water efficient processes) can be combined with the measure Regulations/Ordinances

Industrial and commercial efficiency (Measure 6) can be implemented for new businesses via municipal code requirements, but may not be economically justifiable to require businesses to retrofit existing systems. It is not possible to estimate how many new businesses would have water systems applicable to the measure; therefore the measure was not included in demand forecasting, but regulations should be considered that prohibit any additional once through cooling processes.

The proposed measures have been found to be extremely successful in numerous studies. An EPA report from 2002 summarized 17 conservation programs across the nation. Some examples of the results are: a conservation program in Albuquerque, NM that created a reduction in peak use of 14% in seven years with a combination of measures limiting high-water using turf to 20% of the property (Measure 2) and instituting higher rates when customers' use exceeded 200 percent of their winter average (Measure 5). Irvine Ranch Water District, CA also implemented a tiered rate structure (Measure 5) and water use declined by 19 percent in the first year. Irvine then implemented other conservation programs such as irrigation workshops (Measure 4), water audits (Measure 4), and fixture rebates (Measure 1). Due to the additional measures, the estimated savings in avoided water purchases was more than six times greater than the cost of implementing the measures. Houston, TX installed 8,000 conservation kits with high-

efficiency showerheads and faucet aerators, and in 60 homes replaced 5 gallons-per-flush toilets with 1.6 gallons-per-flush toilets, fixed leaks, and installed aerators (Measure 1). At a total cost of $22,000, the Houston program reduced water consumption by 72%. In Massachusetts, a program which combined detecting and repairing leaks (Measure 3), retrofitting homes with low-flow plumbing devices (Measure 1), conducting extensive public information and school education programs (Measure 4), using conservation-minded water rate structures (Measure 5), and a few other policy items resulted in a water conservation of 24% in ten years. Using a combination of proposed measures, the Town of Buena Vista can also expect to see beneficial results of the proposed water conservation measures.

7.2 Estimate Costs and Water Savings of Conservation Options

Table 7-1 shows a comparison of the costs and benefits of the proposed conservation measures prioritized from the greatest amount of water saved to the least. The number listed parenthetically after each conservation measure corresponds to the number in Section 7.1. The Customers column refers to how many customers per year would implement the measures. Although Watering Restrictions (Measure 2), Education (Measure 4), and Conservation (tiered) rates (Measure 5) would apply to all customers at no additional cost to the Town, it was estimated that 200 customers a year would successfully implement the measures. It was estimated that Toilet rebate (Measure 1) and Audits (Measure 2) could be limited to implemention for 200 service connections per year, or approximately 13% of total connections, due to the cost of the rebates per customer. The lifespan of all the measures except Leak Detection (Measure 3) was estimated to be 30 years. The lifespan for Leak Detection was estimated to be 15 years because technology may be outdated within 15 years or sooner, and software or technical support to accompany the software may be no longer available.

The Total Cost for Measure and Annual Water Savings per Customer are discussed for each line item in the subsequent sections. All calculations were performed following the worksheets provided by the Colorado Water Conservation Board. The Net Benefit of Measure was determined by the following calculation:

$$X = (A \times B) - C$$

Where:

X = Net Benefit of Measure

A = Total life span estimated savings for the measure (gallons)

B = Simple incremental cost of water supply

C = Total program costs for the life of the measure

The simple incremental supply cost was calculated by adding the cost per gallon due to construction and maintenance of the proposed supply facilities listed in Table 4-3, which totals $0.57 per gallon. The Total program costs for the life of the measure were determined by summing the following recurring operation and maintenance costs over the life of the measure:

C = D + E + F + G + H + I

Where:

C = Total program costs for the life of the measure

D = Materials

E = Labor +

F = Rebates or other payments

G = Marketing and advertising

H = Administration

I = Consulting or contracting

The net benefit calculation for each conservation measure is summarized in Table 7-1.

Line	Conservation Measure	Customers	Total Annual Cost to Town for Measure	Annual Water Savings per Customer (gallons)	Total Annual Water Savings (gallons)	Net Benefit of Measure	'Lost' Annual Revenue Due to Measure
A	Toilet rebate (1)	200	$ 6,600.00	17,200	3,440,000	$ 58,841,633.93	$ 7,774.40
B	Education/audits (4)	200	$ 5,500.00	12,000	2,400,000	$ 41,025,442.28	$ 5,424.00
C	Conservation (tiered) rates (5)	200	$ 500.00	10,950	2,190,000	$ 37,571,278.58	(10,050.60)
D	Turf replacement rebate (2)	200	$40,600.00	8,104	1,620,777	$ 26,598,885.47	$ 3,662.96
E	Faucet/showerhead rebate (1)	200	$ 6,600.00	13,500	920,000	$ 15,591,669.54	$ 2,079.20
F	Leak detection system (3)	1	-	604,800	604,800	$ 5,189,995.58	$ -
G	Watering restrictions (2)	200	$ 500.00	2,400	480,000	$ 8,223,088.46	$ 1,084.80
	TOTAL		$61,400.00		12,060,771	$ 199,963,215.20	$ 10,890.50

Table 7-1: Costs/benefits of conservation measures

A. Toilet rebate

The average savings for replacing a toilet is 9,000 gallons per year, not including the elimination of leaks which has been found to be a direct result of toilet retrofits. The average annual savings from leakage as

an incidental effect of replacement of fixtures and appliances is 8,200 gallons per year (EPA, 2005); which brings the Annual Water Savings per Customer total to 17,200 gallons.

The Total Cost for Measure was calculated with a $30 rebate for the first 200 customers per year that bring their older model toilet for disposal to a Town-staffed facility, and provide a receipt showing the purchase of a low-flow toilet. The cost for a customer to replace a toilet is estimated to average approximately $350 per toilet (EPA, 2005) prior to rebates, $320 after rebates, which creates an eight year payback period to the customer for a new toilet. Replacing 200 older model toilets with low-flow toilets would save approximately 3.4 million gallons of water per year, and would have a Net Benefit of nearly $59M over 30 years. The Annual Water Savings and Net Benefit of Measure advances toilets to become the most beneficial water conservation measure proposed, both to the Town and the customer. Due to the remarkable results seen in other municipalities from a toilet rebate program, the Town of Buena Vista should definitely consider implementation of this program, at a Total Annual Cost to the Town of $6,600 per year.

B. Education/audits

Customer audits appears to be the second most beneficial measure, which would save a significant amount of water (2.4 million gallons) for an estimated Total Annual Cost to Town for Measure of $5,500.00. The Total Cost for Measure was determined by estimating that a $25 rebate would be given to participants on their water bill if they requested an audit, were eligible, and implemented the audit's recommendations. Eligibility criteria are: residential customers per year with a monthly use greater than 15,000 gallons, or commercial properties with monthly use greater than 20,000 gallons. All schools and churches should be allowed to participate in the program, regardless of monthly use. The total limit of participants could be set to 200 per year. Implementation could be proven by a reduction of use in the water bills for a three month period, from June to August, compared to the previous year. This program would be used in place of a full system audit which may be difficult due to staff constraints.

Other education/information dissemination could include newspaper articles, the Town's website, and water bill inserts which educate the public about methods to save water, such as information in Section 6.2(f), at no additional cost to the Town.

Another facet of education/information dissemination is a conservation coordinator. A conservation coordinator is currently available on the Town of Buena Vista staff, the Town Engineer. The Engineer

could be utilized to help customers determine how to reduce water use via the voluntary audit program, at no additional cost to the Town of Buena Vista.

The net benefit of the education/audits measure is estimated at $41M over 30 years. With a cost of only $500 per year to the Town for the education component, at the minimum the Town should implement the education component of the program. The audit component is estimated to cost $5000 if 200 customers participate; the audit component can be implemented if the Town has the budgetary means to do so.

C. Conservation (tiered) rates

The Town has the capacity to treat approximately 2.15 MGD at maximum production, and the demand projection for peak use (MDD) in 2031 (2.52 MGD) exceeds the treatment capacity. Use in the summer irrigation months is currently more than three times higher than average use in the non-irrigation months. The average use per tap in February, 2011, was approximately 5,000 gallons and was approximately 17,000 gallons in July. The goal of a tiered rate structure is that water demand at peak use is decreased, while revenues are increased by penalizing those customers who chose to use more than twice the average monthly use. Implementing a tiered rates structure would be virtually no cost to the Town, and could save significant amounts of water. A tiered rate structure could be implemented by simply changing the rates from the current flat rate of $2.26 per 1,000 gallons in excess of the first 5,000 gallons, to a tiered increase in the charges for each additional 5,000 gallons used. Table 7-2 displays possible options for a tiered rate structure; the final rate structure should be determined after further discussion with the Board of Trustees.

	1-5000 gallons	5001-10,000 gallons	10,000 - 15,000 gallons	15,001 or more gallons
		(per 1000 gallon)	(per 1000 gallon)	(per 1000 gallon)
Current	$28.16	$2.26	$2.26	$2.26
Option A	$28.16	$2.26	$3.25	$4.25
Option B	$28.16	$2.26	$4.00	$5.50

Table 7-2: Rate structure options

The possible financial effects to the customer of the options listed in Table 7-2 are shown in Table 7-3:

Gallons	Current	Option A	% change	Option B	% change
5000	$ 28.16	$ 28.16	0%	$ 28.16	0%
7500	$ 33.81	$ 33.81	0%	$ 33.81	0%
12000	$ 43.98	$ 50.91	16%	$ 56.16	28%
17000	$ 55.28	$ 79.16	43%	$ 94.16	70%

Table 7-3: Financial effects of rate structures

The Total Annual Water Savings was estimated using a 7.5% reduction of average use, as seen in Phoenix, for 200 units per year, which is equivalent to 2.19 million gallons. Those customers who desire to continue using more than 5,000 gallons a month may chose to do so, for a slightly higher fee. The Total Annual Cost to the Town for the measure is estimated to be $500 for education of the public of the changed rate structure, and the Net Benefit is $37.5M. Considering the low cost to the Town and the successful results seen in other municipalities from implementing a tiered rate structure, there appears to be substantial reasons for the Town to implement the measure.

There is not a surfeit of information regarding rate studies for the Town, which is due in part to the fact that water was not metered until 1998. The monthly base rate has increased $4.14 since 2006, or 3% per year. The adopted Water Resources Master Plan (2006) recommends that 'the metered expense start at the first gallon of water used, so that the customer is charged for exactly how much water is used.' This has not been implemented. The Water Resources Master Plan suggests the implementation of an increasing block structure (tiered rate) to 'encourage conservation by increasing the rate as more water is used. It costs the Town more to add new sources of supply, treatment and storage. Therefore, the other advantage of an increasing block structure is to help defer future capital expenditures for wholesale infrastructure.' The Water Resources Master Plan does not detail specifics regarding a proposed rate structure, but does recommend raising rates $6.12 per month per customer to pay for proposed capital improvements, for all customers. The Board of Trustees adopted this Plan in 2006, and although the proposals were not implemented, the proposals within the Plan were discussed in detail in public meetings. Therefore, the Town may readily restart the conversation regarding implementing a tiered rate structure to encourage conservation and raise revenues for proposed projects.

D. Turf replacement rebates

The rebate program to replace turf is expensive both to the Town and the Customer, based on estimates that it would cost a property owner $750 to replace 500 square feet of turf, for which the Town would offer a $200 rebate for the first 200 customers. With the addition of marketing and advertising, the Total Cost to the Town for the Measure would be $40,600 for an estimated Annual Water Saving of 1.6 million gallons. The Water Savings per Customer is equivalent to one inch of irrigation water savings per week over 500 square feet, which is approximately 8,100 gallons per year. Based upon the cost of paying the water bills for the irrigation water compared to the cost for the turf replacement, the payback period for the customer is thus 30 years. It does not appear that the turf replacement program is cost effective for the customer or the Town, and therefore should not be implemented.

E. Faucet/showerhead rebates

A rebate program for faucets/showerheads could conserve nearly one million gallons annually, and have a large Net Benefit ($16M) at a low Total Annual Cost to Town ($6,600). Annual Water Savings per Customer was calculated as between 1,100 and 2,500 gallons per year for faucets, and 2800 gallons per year for showerheads (EPA, 2005). It is assumed that a $30 rebate would attract 200 requests per year since the average faucet and showerhead can be replaced for this price (EPA 2005). After the rebate, there would be no end cost to the customer, and there would be appreciable savings in water consumption, and therefore a decrease in the customer's water bills of approximately $30 per year. Implementation can be guaranteed by requiring the customer bring the old faucet or showerhead for disposal to a Town-staffed facility, and provide a receipt showing the purchase of a low-flow faucet or showerhead. The Town could experiment with combining the faucet/showerhead rebates program with the toilet rebate program, if the budget allows. As previously mentioned, the Town should also consider requiring low flow fixtures and appliance retrofits with all building permits.

F. Leak detection system

The estimated Annual Total Cost to Town for Measure does not include the one-time purchase of new correlator-type leak detection equipment ($10,000) including associated hardware and software. Currently the Water Department hires a contractor to perform system-wide leak detection every two to three years, which means that there could be leaks for years that are not identified and repaired. In 2012, the Water Department found a leak that averaged nearly 40 gallons per minute, and water loss data shows that it was probably leaking for over six months. The Total Annual Water Savings was

calculated from an estimate that five leaks are found a year, each leaking one gallon per minute for twelve weeks before being identified, which is equivalent to 604,800 gallons conserved annually, but is likely underestimated. The Net Benefit of Measure ($5M) is low compared to the other measures, but the majority of the cost for the measure is a one-time cost, while all the other measures carry an annual cost. As stated earlier, undetected leaks not only cost the Water Department money and time, but could cause damage to property. Purchasing a correlator leak detection device for system-wide scans may therefore be more cost effective than estimated in Table 7-1, and would save the Town money and water. The Town should implement this measure when there is budget for the one-time purchase of a leak detection system that could be used system-wide frequently, such as a correlator device, in order to decrease the water loss.

G. Watering restrictions

Ordinances and regulations regarding new landscaping would have virtually no cost to the Town and could save significant amounts of water in future developments. As previously mentioned, the Town should consider expanding landscaping standards (Section 16-255) to include residential properties.

In 2006, the Town implemented voluntary watering restrictions, which saved 30% of typical water use in one month. The community was very receptive to the voluntary ordinances because it was clear that the state was experiencing a drought, and water saving campaigns were prevalent. It was estimated that a watering restriction allowing watering on odd days for odd addresses and even days for even addresses, and prohibiting outside watering between 11 am and 5 pm would reduce irrigation by 10% in a non-drought year. The average monthly use per tap in July, 2011, was over 4,000 gallons per tap; a 10% reduction would conserve 400 gallons per tap. If 200 properties see a reduction in use due to the ordinance throughout the six-month irrigation season, the estimated Total Annual Water Savings would be nearly 500,000 gallons, at a cost to the Town of only $500 in education/awareness. With such a low annual cost, and a high Net Benefit ($8M), the Town should implement temporary or permanent watering restrictions as soon as possible.

7.3 Select Conservation Measures and Programs

Implementation of a combination of measures including toilet and faucet/showerhead replacement rebates, education/voluntary audits, conservation (tiered) rate structure, and landscaping and watering restrictions are estimated to cost the Town approximately $13,000 per year, and could save 9.1 million

gallons annually. Once the Town purchases a leak detection system there could be an additional 600,000 gallons per year savings. The implementation of the combination of measures will address the goals of reducing loss, irrigation use, and indoor use.

Table 7-1 prioritizes the conservation measures based upon total annual water savings, which is correlated to the net benefit of measure. The measures that can be implemented with little cost to the Town, including conservation (tiered) rates, watering restrictions, and education should be considered for implementation first. Staff can include conservation tips in the next water bill and add conservation information to the Town's website immediately, at no cost to the Town, and without public meetings or Board hearings. In order to revise the Municipal Code to include voluntary (or mandatory) water restrictions, the Board of Trustees must hold a public hearing following posting requirement. If so desired, staff could begin the process for code amendments via Ordinances immediately. Consecutively, the Board could vote to change the monthly water rates to a tiered structure via Resolution. It is recommended that the Board participate in a work session with the Town Engineer prior to adopting a Resolution regarding the rates, in order to make an informed decision that will be accepted by the community and best benefit the goal of water conservation. The estimated timeline to implement these measures is one to six months.

In order to implement incentive programs the Town must have dedicated funds for rebates, as well as staff to implement the measure. To be practical, the measures toilet rebate, faucet/showerhead rebate, and audits should be implemented after proper budgeting and programming. If the Town wishes to apply for grants through the state, the first step is to adopt this conservation plan via a vote by the Board of Trustees. Then the conservation plan must be submitted to the Colorado Water Conservation Board for approval. Following approval, the Town may apply for grants to implement the conservation measures. The grant cycle is ongoing, therefore the grant applications may be submitted within the year. It is possible that the Town will receive funding to implement the conservation measures that include rebates before the end of the calendar year. Alternatively, the Town may chose to include funding for the conservation programs in the 2013 budget. A system will be necessary to track the participation in the measures, collect and dispose of the replaces fixtures, and provide the rebate on the participants' water bills. The audit program will take more staff time. The Town Engineer can perform the audits for those customers that qualify, or the Engineer can train other staff to perform the audits. The audits will require at least an hour of staff time per participant, in order to review the customer's

water use trends and habits, and educate the customer on conservation measures. A return visit with staff will be required of the customer, to analyze the success of the audit. For this reason, audits may be the last program implemented.

Additionally, the Town should consider implementing regulations prohibiting new once-through cooling processes, to create industrial and commercial efficiency (water efficient processes), which would not cost the Town anything.

8. Integrate Resources and Modify Forecasts

8.1 Revise Demand Forecast

Table 8-1 displays the modified demand forecast following implementation of the proposed water conservation measures. The proposed toilet rebate conservation measure will reduce average day demand 365 days per year. Maximum day demands will be reduced by the implementation of conservation (tiered) rates, education and audits, and watering restrictions, 180 days per year. If the Town purchases a new leak detection system the loss rate may be reduced 365 days per year, decreasing the average day demand. It was assumed in the revised demand forecast that the Town purchases a leak detection system within the next ten years.

It was estimated that 200 customers each year would begin implementing one or more measures. If 200 customers join the program each year, after 10 years 2,000 customers will have joined the program. It is estimated that in 10 years there will be 2001 customers (Table 3-2). Since it may be unrealistic to assume that every customer will participate in the conservation program by year 10, the 5-year and 10-year forecast are equal. It is estimated that in 20-years there may be 2,689 customers; it is possible that in 20 years there will be 2,000 participants in the conservation program. Furthermore, it is likely that customers will implement more than one program.

Item	Current year	5-yr forecast	10-yr forecast	20-yr forecast
Average-day demand before conservation	564,321	640,673	742,715	998,147
Reduction in average-day demand	9,425	47,123	48,780	110,816
Average-day demand after conservation	554,896	593,549	693,935	887,331
Maximum-day demand before conservation	1,423,000	1,615,531	1,872,843	2,516,944
Reduction in maximum-day demand	37,591	187,957	187,957	392,483
Maximum-day demand after conservation	1,385,409	1,427,574	1,684,886	2,124,461
Reduction (%)	3%	12%	10%	16%
Ratio MDD to ADD before conservation	2.52	2.52	2.52	2.52
Ratio MDD to ADD after conservation	2.50	2.41	2.43	2.39

Table 8-1: Modified demand forecast

The reduction in maximum day demand after implementation of the proposed conservation measures is estimated to be over 392,000 gallons, a 16% reduction, which exceeds the goal set in Section 5.1 to reduce the demand by 367,000 gallons, a 15% reduction.

The modified demand forecast contains the following assumptions:

- Continuous 3% growth rate per year (although a 2% growth rate would cause equivalent 20-year estimated results)
- 200 customers per year participant in each of the following conservation programs: toilet rebate, faucet/showerhead rebate, watering restrictions, audit, and conservation tiered rates. It is probable that the watering restrictions and tiered rates, since applicable to all customers, will be followed by the majority of the water service customers. It is also likely that faucet/showerhead rebates would be widely utilized because the measure would not cost the customers any money, and would save the customers tangible ($30 per year) money annually. The 20-year forecast includes a total enrollment of 2000 customers in each program, which is an average of 100 new participants per year, rather than 200. Therefore, it may be safe to assume that between 100 and 200 customers participate in the programs each year.
- The Board of Trustees will approve the conservation plan in 2012 for immediate implementation.
- The Town will receive grants or will dedicate funding to implement the measures.
- Buena Vista will observe success rates for the implementation measures similar to other communities throughout the nation.

8.2 Identify Project-Specific Savings

The Town of Buena Vista currently owns 2.51 MGD of firm irrigation season water. The existing treatment and distribution capacity for the Town is 2.15 MGD without gallery recharge, and 2.12 MGD with gallery recharge and one filter at the WTP. If the 20-year forecast for maximum day demand with conservation is accurate at 2.12 MGD (Table 7-1) then limited new sources of supply or increases to treatment will be necessary to meet demands. The Town should install one of the proposed new infrastructure projects to provide a safety net for the supply system, since the demand and supply are within 1%. If non-potable well #4 on the Arkansas River were installed, the Town would have a safety net in the supply projections, and would achieve diversification of the water rights portfolio, since all the other Town-owned water rights are on Cottonwood Creek. Alternately, the Town may wish to install

well #3 to provide redundancy to the Upper Zone and decrease the burden on the Westmore lift station. The addition of either well would suffice to protect the Town against unexpected fluctuations in peak use. The remainder of the projects identified in Table 3-2, which have a total estimated price tag of approximately $5M, would not be necessary, which would save the customers over $8 per month for the next 20 years. This savings is in addition to the money the customers would be saving by conserving water, which is estimated to be nearly $100 per month if a customer implemented all the proposed measures, including toilet replacement, education/audits, watering restrictions, and conservation (tiered) rate structure.

8.3 Revise Supply-Capacity Forecast

Implementation of the conservation measures and reduction of the loss rate could save millions of dollars in infrastructure installations and water rights purchases. There would be no need for the new one million gallon tank in the Upper zone, which is expected to cost over $700,000 for construction. New water rights would not need to be purchased, saving hundreds of thousands of dollars for the rights and the associated legal fees. Most importantly, the existing WTP would not need to be expanded, saving $3.8M for the rate payers (customers). Of the five supply improvements proposed in the Capital Improvement Plan, only one well would be necessary to provide a margin of safety in the supply capacity if the conservation measures are successful as estimated. If the Town installed another 150 GPM well, water treatment and supply capacity would increase by 0.216 MGD to a total of 2.36 MGD. Irrigation season water rights would increase to a total of 2.84 MGD (including Leesmeagh conversion of 0.12 MGD). The estimates for treatment and water rights with the addition of one well exceed the forecasted demands, with a ratio of demand to supply of 0.9. Chart 8-1 displays the capacity of the supply and the expected maximum day demand (MDD) with, and without, conservation measures for the 5-year, 10-year, and 20-year forecast. The supply capacity for 2031 assumes that a new 150 GPM well is installed between 2012 and 2031.

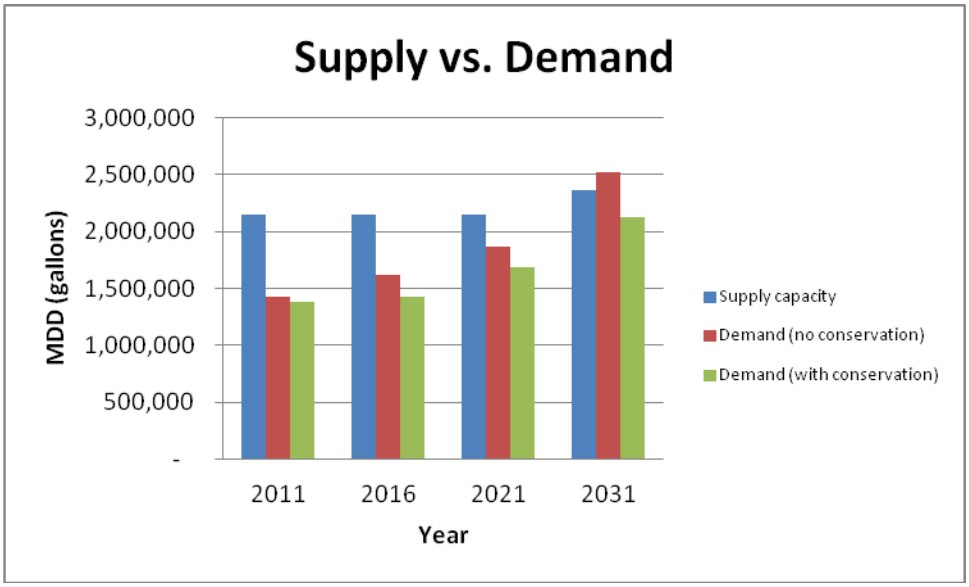

Chart 8-1: Supply vs. Demand 2011 - 2031

8.4 Consider Revenue Effects

Table 8-2 provides a comparison of the costs to implement the conservation measures for the Town, the customer, and the effect on the Water Department's Enterprise Fund.

Conservation Measure	Total Annual Cost to Town for Measure	Total Annual Water Savings (gallons)	'Lost' Annual Revenue Due to Measure	Annual Water Savings per Customer (gallons)	Annual Savings to Customer for Measure
Toilet rebate (1)	$ 6,600.00	3,440,000	$ 7,774.40	17,200	$ 38.87
Education/audits (4)	$ 5,500.00	2,400,000	$ 5,424.00	12,000	$ 27.12
Conservation (tiered) rates (5)	$ 500.00	2,190,000	(10,050.60)	10,950	$ 24.75
Leak detection system (3)	-	604,800	$ -	604,800	$ -
Watering restrictions (2)	$ 500.00	480,000	$ 1,084.80	2,400	$ 5.42
TOTAL	$13,100.00	9,114,800	$ 4,232.60		$ 96.16

Table 8-2: Revenue vs Loss for conservation measures*

*The total cost for the measures does not include the one-time cost of $10,000 for the leak detection system

It is expected that the Town can seek grants to offset the Total Cost to Town for Measure, which is up to $13,100 each year depending on which of the measures are implemented, and how many customers participate. The Total Annual Water Savings multiplied by the 2012 water fees of $2.26 for each 1,000 gallons over 5,000 gallons determined the 'Lost' Annual Revenue due to Measure. The 'Lost' Annual Revenue Due to Measure was calculated by multiplying the Annual Water Savings by the water fee per

1000 gallons. For example, the conservation measure Toilet rebate (1) is estimated to conserve approximately 3.4 million gallons a year. If 3.4 million gallons of water were not conserved through low-flow toilets, but rather used by the customers and paid for, the annual revenue would be less than $8,000. In comparison, the annual costs operating costs for the proposed supply infrastructure to meet forecasted demands is $78,500 (Table 4-3). These operating costs will be saved if the conservation plan is implemented and is successful at reducing the peak demand to levels below the supply capacity.

It is estimated that the increase in the rate due to the Conservation (tiered) rate structure measure will provide an increase in revenue for the Enterprise Fund, as customers will pay a higher fee if they use over 5,000 gallons per month. It is estimated that implementation of a tiered rate structure would net an additional $10,500 per year, bringing the total 'Lost' Annual Revenue to approximately $4,200 per year. The total operating revenue for the water enterprise fund has been over $700,000 for the past few years, with a slight increase seen each year. A loss of approximately $4,200 per year due to water conservation would reduce the total operating budget by less than 1%. The reduced demand on the water system due to conservation will reduce the electric bills for pumping and distributing the water, and reduce the chemical bills for treating the water, which will save money in operating and maintenance costs. A net difference in the water enterprise fund is not anticipated, as the savings from operating and maintenance should offset the revenue decrease from less water being sold.

The Annual Water Savings per Customer for Measure multiplied by the water fees for 2012, which are $2.26 for each 1,000 gallons over 5,000 gallons, determined the Annual Savings to Customer for Measure. For the Conservation (tiered) rate structure measure, if the customer decides to use less water rather than pay extra to use more than 5,000 gallons, it is estimated that the customer could save nearly $25 a year.

In summary, if grants are awarded to implement conservation measures, and operation and maintenance costs are decreased due to less water needing treatment, the costs to the Town should be negligible or nonexistent. The customer benefits from the conservation programs by receiving a reduction in the water bill of nearly $100 per year.

9. Develop Implementation Plan

9.1 Develop Implementation Schedule

The forecast for supply and demand assumes that the conservation measures are implemented immediately, and more customers participate in the measures each year for the next twenty years, unless otherwise specified previously.

The conservation measures that require changes in regulations, such as those regarding watering restrictions, landscape guidelines, and one-through cooling processes, could begin the process set forth for Municipal Code revisions at any time. The Town is required to notice ordinances for at least 15 days, and then have a public hearing and approval of the ordinance at one of the Board of Trustees bi-monthly meetings. After approval the ordinance is effective pending a 30 day waiting period. This process could be used for adding permanent or temporary watering restrictions to the Municipal Code, and has no associated costs. It would be beneficial if the watering restriction measure were implemented before June of this year, to help reduce peak use. Landscape and industrial and commercial efficiency process regulations are not as critical, but should be added to the Municipal Code as soon as time permits.

The measure conservation (tiered) rates can be implemented via a resolution changing the current fees for water usage. Resolutions are also approved by the Board of Trustees, but do not have the timeline requirements that an ordinance carries. It would be beneficial if the conservation (tiered) rates measure were implemented before June of this year, to help reduce peak use. There are no expected costs to the Town to implement the measure.

Education could be implemented immediately and at no cost by adding conservation information to the water bill inserts, requesting articles be printed in the local newspaper, or putting information on the Town's website regarding conservation education. The educational information suggested in Section 6.2 (f) can be implemented via these methods at no cost to the Town. The public would also need to be educated about the changes to the regulations regarding watering restrictions and landscape guidelines, and changes to the fee schedule when the conservation (tiered) rate structure is set.

Audits could also be offered immediately as a voluntary consultation with the Town Engineer. No rebates would be offered in 2012 without a budget amendment, but it could still be cost-effective for customers to receive a personal audit if the eligibility criteria are met. The Board should consider adding

funds into the budget for 2013, or seeking grants, to implement the audit rebate program and the toilet rebate program.

The leak detection system should be budgeted or a grant requested in the next five to ten years, sooner if possible, to reduce the water loss rate.

9.2 Develop Plan for Public Participation in Implementation

The ordinances will involve the community in decisions regarding the ordinance language prior to adopting the ordinance at the public hearing. Once implemented, the Town should send notices in the water bills to alert the customers of the changes regarding water restrictions, landscaping, and industrial and commercial efficiency process.

The audits measure will require continued community involvement. Participants must volunteers to meet with the Town Engineer to determine individualized methods for conservation at the participant's property. The participant will be required to retain their monthly water bills for a period of three months, to track the use and implementation of the measures determined by the audit. Education via water bills, newspaper, website, etc, could be utilized to attract participants. The audit rebate and toilet rebate program, once funded, should be advertised to seek participants from the community for implementation.

The leak detection system measure can be implemented by the Water Department without involvement from members of the community, although education can be utilized to make customers aware that if there is a noticeable change in water pressure, or an unusual noise in the water pipes, to alert the Water Department. This education and community involvement may help proactively locate leaks and lower the water loss rate.

10. Conclusion

The Town of Buena Vista will have a shortage of water supply and supply capacity in 20 years if demand trends do not decrease. Water loss rates, irrigation use, and indoor use collectively exceed the capacity of the water system, and must be managed. The Capital Improvement Plan includes $6M dollars of proposed projects to address the deficit in the water system, which would cost each customers over $9 additional per month. The implementation of conservation measures can reduce the demand, thereby saving the Town, and the water system customers, millions of dollars in water system projects.

The following conservation measures are recommended:

- Toilet rebate program: Provide a $30 rebate to 200 customers annually who replace toilets with low-flow (1.6 gallons per flush or less) toilets. Conserve 3.4 MG per year.

- Education and audits: Provide a $25 rebate to 200 customers annually who volunteer to participate in a personalized audit program with the Town. Educate the public about water conservation methods via water bill inserts, newspaper articles, and the Town's website. Install a xeriscape demonstration garden on Town property. Conserve 2.4 MG per year.

- Conservation (tiered) rates: Change the current monthly billing rate from a flat rate to a tiered rate. Water demand at peak use is decreased, while revenues are increased by penalizing those customers who chose to use more than twice the average monthly use. Board of Trustees will determine rate structure. Conserve 2.19 MG per year.

- Regulations: Revise the Municipal Code to restrict outdoor watering during the hours of 11 AM to 5 PM. Limit the use of high-water use vegetation. Prohibit the use of once-through cooling processes at industrial and commercial properties. Expand landscaping standards (Section 16-255) to include residential properties. Require low flow fixtures and appliance retrofits with all building permits. Conserve approximately 0.5 MG per year.

- A one-time purchase of a $10,000 leak detection system could provide an additional 600,000 gallons per year savings. The Water Department has identified areas in Town that have not received proper leak detection either due to type of pipe (asbestos-cement), location of pipe (Department of Corrections property), or lack of data regarding location of pipe. These areas

should receive immediate leak detection. The Water Department should create and maintain a regularly scheduled valve exercising program, as leaks may be discovered during the exercising of valves. Education can be utilized to make customers aware that if there is a noticeable change in water pressure, or an unusual noise in the water pipes, to alert the Water Department.

The implementation of the combination of conservation measures will address the goals of reducing loss, irrigation use, and indoor use, with an estimated cost to the Town of approximately $13,000 per year, and save 9.1 million gallons of water annually. The decrease in maximum day demand after implementation of the proposed conservation measures is estimated to be over 392,000 gallons, a 16% reduction.

The estimated demand to supply capacity ratio is 1.0 after conservation; no new sources of supply or increases to treatment will be necessary to meet demands. To provide a safety net for the supply system, the Town should consider installing one proposed infrastructure project. If non-potable well #4 on the Arkansas River was installed the Town would achieve diversification of the water rights portfolio since all the other Town-owned water rights are on Cottonwood Creek. Alternatively, the Town may wish to install well #3 to provide redundancy to the system and decrease the burden on the lift station. The addition of either well would suffice to provide a safety net in the supply projections and protect the Town against unexpected fluctuations in peak use. If the Town installed another 150 GPM well, water treatment and supply capacity would increase by 0.216 MGD to a total of 2.36 MGD. Irrigation season water rights would increase to a total of 2.84 MGD (including Leesmeagh conversion of 0.12 MGD). The estimates for treatment and water rights after the addition of one well exceed the forecasted demands, with a ratio of demand to supply of 0.9. The forecast for supply and demand assumes that the conservation measures are implemented immediately, in order to see expected results.

The costs to the Town should be negligible or nonexistent if grants are awarded to implement the conservation measures, and operation and maintenance costs are decreased due to less water needing treatment. The customer benefits from the conservation programs by receiving a reduction in annual water bills of nearly $100 if the customer participates in all the measures. The remainder of the proposed projects in the Capital Improvement Plan, which have a total estimated price tag of approximately $5M, would not be necessary, which would save the customers over $8 per month for the next 20 years.

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