WATER CONSERVATION PLAN
GLENWOOD SPRINGS, COLORADO

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EXECUTIVE SUMMARY

The City of Glenwood Springs (City), Colorado is a municipality established in 1885. The City adopted a Home Rule Charter in 1966. Glenwood Springs is located at an elevation of 5,600 feet at the intersection of I-70 and SH-82. The City is home to approximately 9,000 residents. It hosts the largest natural hot springs pool in the world and is a popular tourist destination often accommodating 1,000 to 2,000 visitors on any given day.

The City is expanding slowly and anticipates growth between 1 and 2 percent per year over the next 20 to 30 years. More accelerated growth would be unlikely given the steep slopes, flood plains, river canyons, and federal lands along the City borders. In 2030, 20 years from now, it is estimated Glenwood Springs will have a population 12,679 people.

Glenwood Springs owns and operates its own water and wastewater utilities. It provides potable water to all customers in the service area and raw water for irrigation to a small subset of customers. Glenwood Springs obtains potable water through senior water rights on No Name and Grizzly Creeks in the Flat Tops Wilderness Area. The City also holds the rights to 500 acre-feet (af) of water in Ruedi Reservoir. The City's raw water system is largely gravity fed, eliminating the need for costly pumping. Only two areas of the City require pumping for treated water service.

The analysis done for this water conservation plan indicates that the likely yield of the City's direct flow water rights on Grizzly Creek and No Name Creek plus their contract water in Ruedi Reservoir equal 10,026 af in an average year and 7,525 af in a dry year. The maximum annual demand for water in Glenwood Springs over the past eight years was 2,352 af and the forecast baseline demand 20-years in the future is 2,828 af. Hence, the dry year yield of the City's water rights at 7,525 acre-feet is sufficient to meet current and forecast future demands.[1]

The City of Glenwood Springs does not have a dedicated conservation staff member and their conservation program is implemented by the Water and Wastewater Superintendent and other staff members. The City has demonstrated a commitment to water use efficiency, and even without a dedicated staff member, has implemented many of the most essential water conservation program measures including metering, a conservation oriented water rate structure, utility water loss reduction, and public education and information about water efficiency.

To fulfill Colorado's statutory water conservation planning requirements a series of water conservation program scenarios were developed that incorporated a wide variety of indoor and outdoor efficiency measures that have been cost-effective when implemented in other Colorado utility service areas. For Glenwood Springs, there is very little (if any) cost savings for the utility or customers associated with reducing water demands because the City's water rights are ample and treatment costs are relatively low. Consequently, it is not cost-effective for Glenwood Springs to increase their water conservation program, beyond the basic program described in this report at this time.

[1] The "dry year" is based on an average historic dry years and is not intended to represent any specific set of drought probabilities or return intervals. Such considerations would be part of a separate drought response plan.

In spite of the lack of a real financial incentive for water efficiency, Glenwood Springs remains committed to water efficiency and to current conservation efforts, which include many of the most important and effective measures such as metering and conservation pricing.

INTRODUCTION AND SERVICE AREA CHARACTERISTICS

The City of Glenwood Springs (City), Colorado is a municipality established in 1885. The City adopted a Home Rule Charter in 1966.

Glenwood Springs was originally known as Defiance, Colorado. Defiance was established in 1883 and consisted of a camp of tents, saloons, cabins and various lodging establishments. Town Founder Isaac Cooper's wife Sarah was having a hard time adjusting to the frontier life and in an attempt to make her environment somewhat more comfortable, persuaded the founders to change the name to Glenwood Springs, Colorado after her beloved hometown of Glenwood, Iowa.

The City's unique location at the confluence of the Colorado River and the Roaring Fork River as well as a stop on the railroad historically have made it a center of commerce in the area.

Glenwood Springs is located at an elevation of 5,600 feet at the intersection of I-70 and SH-82. The City is home to approximately 9,000 residents. It hosts the largest natural hot springs pool in the world and is a popular tourist destination often accommodating 1,000 to 2,000 visitors on any given day.

The City is expanding slowly and anticipates growth between 1 and 2 percent per year over the next 20 to 30 years. More accelerated growth would be unlikely given the steep slopes, flood plains, river canyons, and federal lands along the City borders. In 2030, 20 years from now, it is estimated Glenwood Springs will have a population 12,679 people.[2]

WATER SYSTEM PROFILE

Glenwood Springs owns and operates its own water and wastewater utilities. It provides potable water to all customers in the service area and raw water for irrigation to a small subset of customers. The initial components of the Glenwood Springs water system date back to the early 1900's when the first public water system in the town was established to provide potable water for domestic use and fire fighting purposes. The system has been continually upgraded and improved since that time.

Raw Water Supply

Glenwood Springs obtains potable water through senior water rights on No Name and Grizzly Creeks, which drain the south side of the Flat Tops Wilderness Area. The locations of these basins are shown in Figure 1. These upstream tributaries are in a protected, non-urbanized watershed and the raw water is of excellent quality with respect to both organic and inorganic constituents. The City also holds the rights to 500 AF of water in Ruedi Reservoir. Raw water

[2] This assumes a constant growth rate of 1.6% per year.

from the No Name and Grizzly Creek basins flows by gravity, while only the Ruedi supply, used as a back up, requires pumping. Only two areas of the City distribution system require pumping for treated water service.

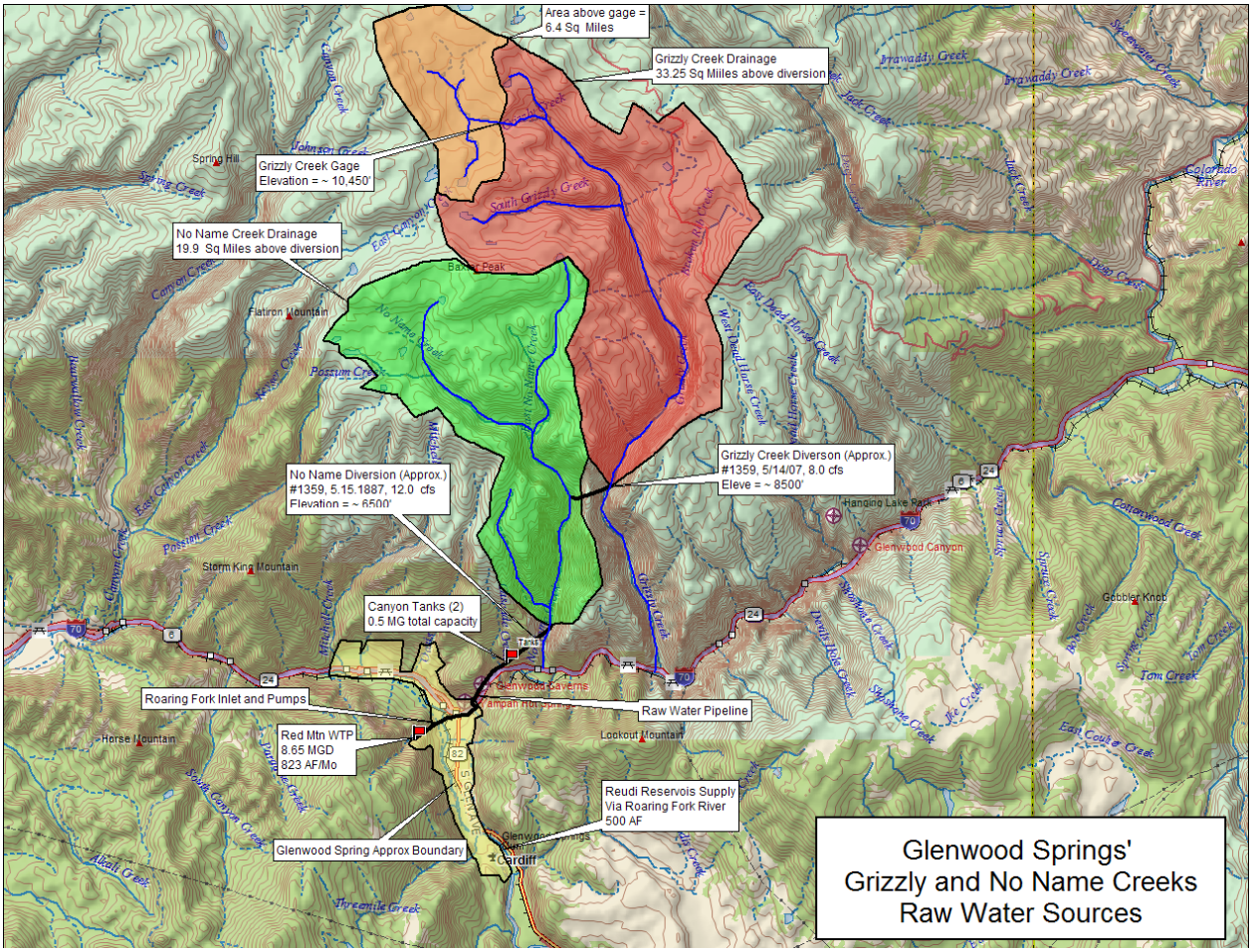


Figure 1: Primary Raw Water Sources for Glenwood Springs

Grizzly Creek

The Grizzly Creek diversion is located on the west bank of Grizzly Creek, approximately 3.5 miles above its confluence with the north bank of the Colorado River. The City owns a right to 8.0 cfs with an appropriation date of 5/14/1907. This is the senior right on Grizzly Creek.[3] The Grizzly Creek basin contains a total of 33.5 square miles of timbered watershed located above the City's diversion point.

The city owns a storage right on Grizzly Creek, Grizzly Creek Reservoir No. 391 with a conditional decree for 3979.8 AF and an appropriation date of July 9, 1960.

There is a USGS gage on Grizzly Creek with available diversion data for the period from 1976 to 1996. The location of this gage is shown in Figure 1. The elevation of the gage is approximately

[3] Broadwell, D. W. (1990). "City of Glenwood Springs Water Rights Portfolio." City Attorney, Glenwood Springs.

10,450 ft, and its tributary area is approximately 6.4 sq miles. The average monthly flows for the gage are shown in Table 1. The average monthly flows for the gage are shown graphically in Figure 2, and the minimum monthly flows are shown in Figure 3. These minimum month flows are for 1977, which was a dry year in Colorado, but not the driest on record. Therefore, the minimum flows should not be considered the absolute firm yield of the system, but as an indicator for dry year conditions. It is not known how accurate the flows for this gage are, or whether they are impacted by ice during the winter.

Table 1: Streamflow statistics for Grizzly Creek gage[4]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average (cfs)	0.55	0.41	0.37	1.83	41.17	92.53	16.07	2.41	1.80	2.19	1.54	0.96
Std. Deviation (cfs)	0.63	0.54	0.50	2.84	23.48	52.42	18.49	1.36	1.08	2.19	1.49	0.94
Minimum (cfs)	0.00	0.00	0.00	0.00	3.12	13.00	1.33	0.55	0.55	0.44	0.25	0.14
Count (years)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0

The average monthly flows for the gage for average and dry year conditions are shown in Figure 2 and Figure 3 respectively. The majority of the annual flow occurs during the three-month period from May through July. Flows drop off significantly from August through April, and are at their minimum during the winter and early spring. Late summer flows (August and September) are also much lower than the peaks. In order to aid interpretation of the data, a table of conversions has been provided in Table 2

Water is diverted from Grizzly Creek into No Name Creek through the Grizzly Creek pipeline and tunnel. The pipeline was recently replaced and is approximately 870 feet long. The tunnel is up to 4 feet in diameter and runs approximately 2,700 feet west to No Name Creek where it discharges above the City's No Name diversion and tunnel. The Grizzly Creek tunnel is locked at one end to prevent unauthorized entry, and is considered a highly reliable structure.[5] Its capacity is 5 to 10 MGD (8 to 15 cfs), which is adequate to convey the City's water right on Grizzly Creek.

No Name Creek

No Name Creek is located south and west of Grizzly Creek. Glenwood Springs owns priority 1,359 with an appropriation date of May 5, 1887 for 12 cfs. The total area of the creek above the City's diversion point is just less than 20 square miles. There is no gage on No Name Creek.

Water is collected at the No Name diversion point from the creek and from the discharge from the Grizzly Creek tunnel. Water is conveyed through a series of flumes and settling basins and screens to the No Name tunnel, which is approximately 4,500 feet in length and 5' in diameter with a capacity of ~20 MGD (31 cfs).[6] This is adequate to convey the City's combined rights on Grizzly and No Name Creeks.

[4] USGS National Water Information System. Gage 009071300 Grizzly Creek Near Glenwood Springs, CO
[5] WWE. (1996). "Glenwood Springs Raw Water Report." Page 7
[6] WWE. (1996). "Glenwood Springs Raw Water Report." Table II-1

Canyon Tanks
The City has two raw water tanks of 250,000 gallons each, for a total raw water storage of 0.5 MG (1.5 AF). These tanks provide flow regulation for the pipeline rather than long-term raw water storage.

Roaring Fork Intake and Red Mountain Water Treatment Plant
From the canyon tanks the raw water flows in a pipeline across the Colorado River and under the Roaring Fork River (in new pipelines) and up to the Red Mountain Water Treatment Plant. At the crossing of the Roaring Fork River, there is a pump station and inlet, which allows Ruedi water from the Roaring Fork to be delivered to the Red Mountain Water Treatment Plant should water not be available from the No Name/Grizzly system for any reason. The City owns a contract for 500 af of water from Ruedi Reservoir, which would provide the water by reservoir releases. The pump house on the Roaring Fork has a 5 MGD (7.75 cfs) capacity. The capacity of the Red Mountain Water Treatment Plant is 8.65 MGD.[7]

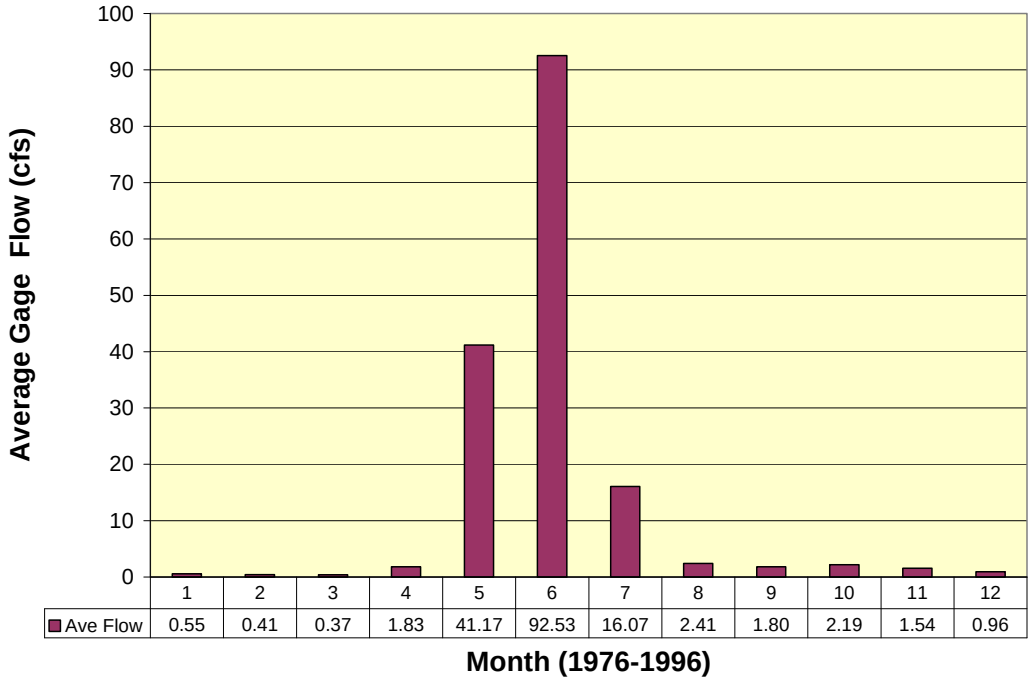


Figure 2: Average monthly flows at Grizzly Creek gage (1976-1996)

[7] Glenwood, City of (1996, 2008). "Water Conservation Master Plan." Pg 9

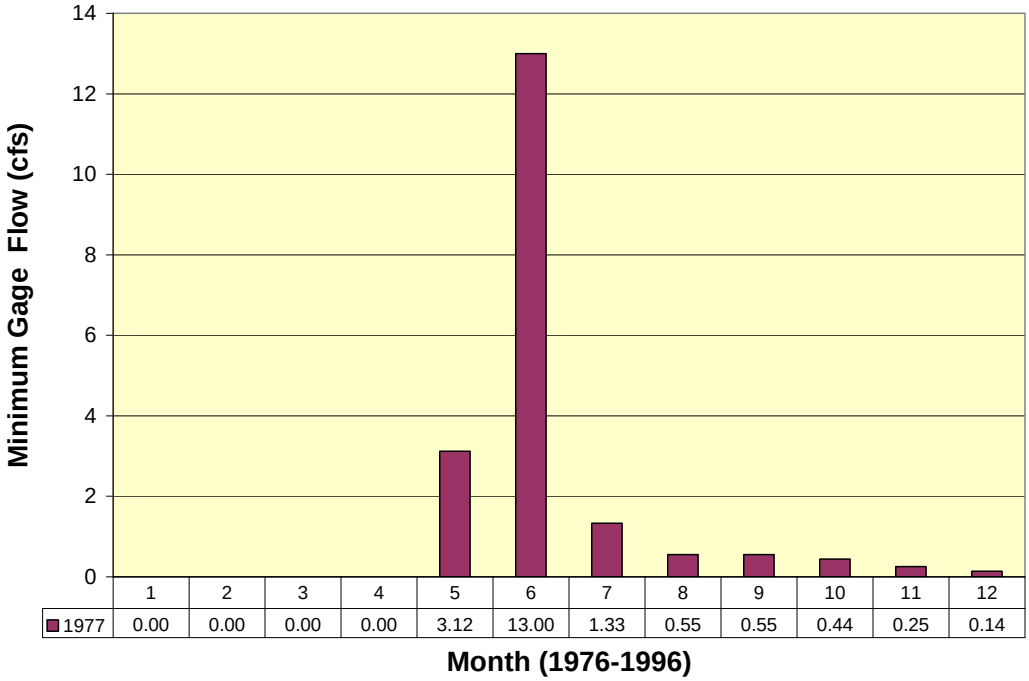


Figure 3: Dry Year (1977) gage flows at Grizzly Creek

Table 2: Flow and volume conversions

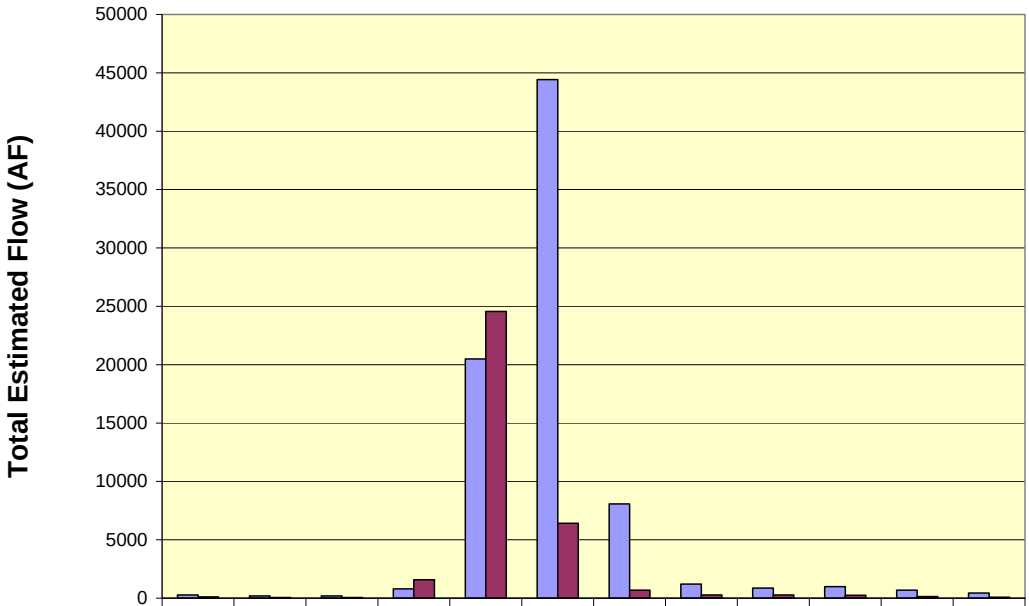
Unit	Equivalent
1 CFS =	**1.98 AF/D** **449 GPM** **0.65 MGD**
1 MGD =	**1.55 CFS** **3.07 AF/D** **95 AF/Mo**
1 AF =	**325,651 gallons**
1 inch water =	**0.623 gpsf**
1 gpsf =	**1.60 inches of water**

Estimating Available Flows at No Name Inlet

Using the gage flow and area information from the computerized mapping analysis (Figure 1 above), estimates were prepared of the available flows at the City's No Name diversion point for the period of the gage record. In order to make this estimate the gage flows were multiplied by the ratio of the area of the diversion point to the gage area. Using this technique, the estimated available flows from both watersheds are shown in Figure 4. This analysis shows that average flows available to the No Name diversion from Grizzly and No Name Creeks range from as little as 60 af in February of a dry year to over 44,000 af in June of an average year. The current average monthly water demand, including losses, for the city ranges from a low of 170 af during the winter to a maximum of 400 af during the summer.

By these estimates, the City should have been short of water in 1977 and 2002, which were both recent dry years. According to City personnel, the two watersheds met the demands even during these dry years. The July 1990 water rights report by City Attorney David Broadwell mentions that there was a degree of nervousness about the yield of the system in dry years, but that no shortages occurred. There is a good possibility that the gage data from the USGS gage may be under recording flows during the winter due to icing. Also, the technique used for this report to scale up the gage flows based on area ratios may have under estimated the flows at the diversion points.

In the absence of additional gage readings or more extensive hydrological studies, it is difficult to determine precisely what the true flows were at the diversion points. The fact remains, however, that the runoff patterns are spiky. During average years, Glenwood Springs is unlikely to experience a water shortage of any kind. If it were to occur it would most likely happen in the winter and early spring. The main demands for water occurring during these periods are indoor uses rather than irrigation. During dry years, the time of maximum potential shortages runs from August through March. If shortages did occur in these months, water would be diverted from the Roaring Fork intake to supply the City.



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average af	276	181	174	781	20494	44415	8079	1204	858	984	670	430
1977	109	60	64	1564	24570	6413	678	282	272	246	125	71

Figure 4: Estimated flows available to Glenwood Springs at No Name Creek from gage data.

There is another source of information on flows at the City's No Name intake: the diversion records for the No Name intake maintained by the State Engineer's office. Aquacraft staff have not visited this diversion, but we have been told by Mr. Wade of the City water department[8] that

[8] Email from Jerry Wade to Bill DeOreo, May 26th 2009

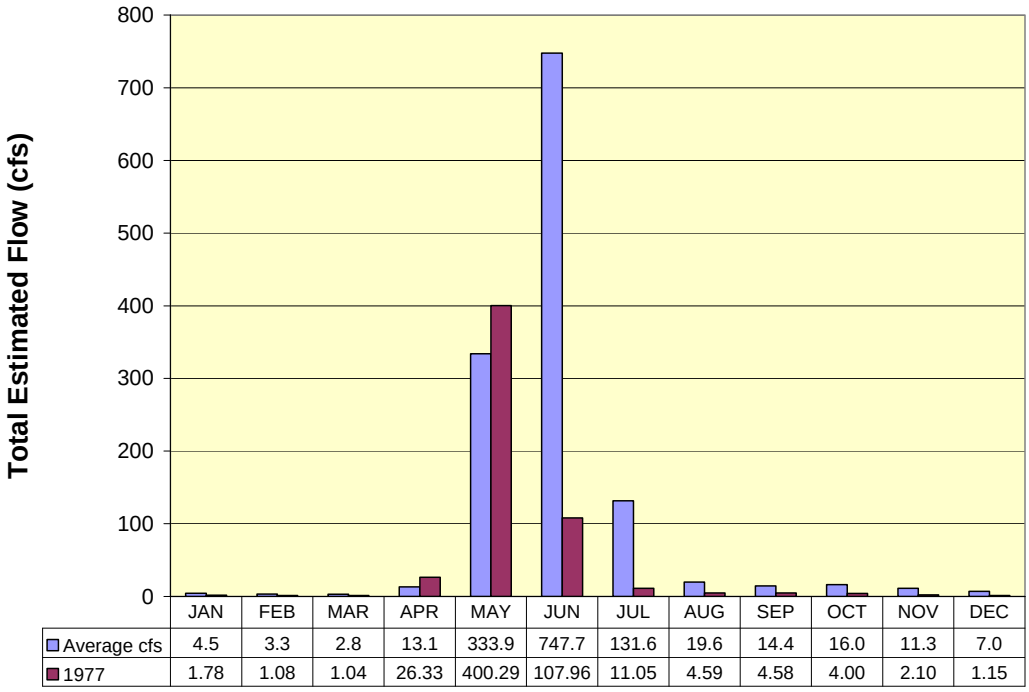
the diversion is set to pick up all flow available at the point of diversion up to the 5.8 MGD in order to prevent icing during the winter. Unused water is then returned to the stream at a point below the diversion. Based on this operation there must be at least as much water available in the creek as recorded by the diversion. Any water in the creek over the upper limit of the diversion would overflow and continue down to the Colorado River in the channel of No Name Creek.

Jerry Wade provided a photograph of the No Name Creek diversion structure. This is shown in Figure 5. The diversion gate for the City is in the foreground of the photo and the by-pass to creek channel is in the background. Note the staff gage on the far wall of the structure, which is used for setting low flows.

Figure 5: No Name diversion structure

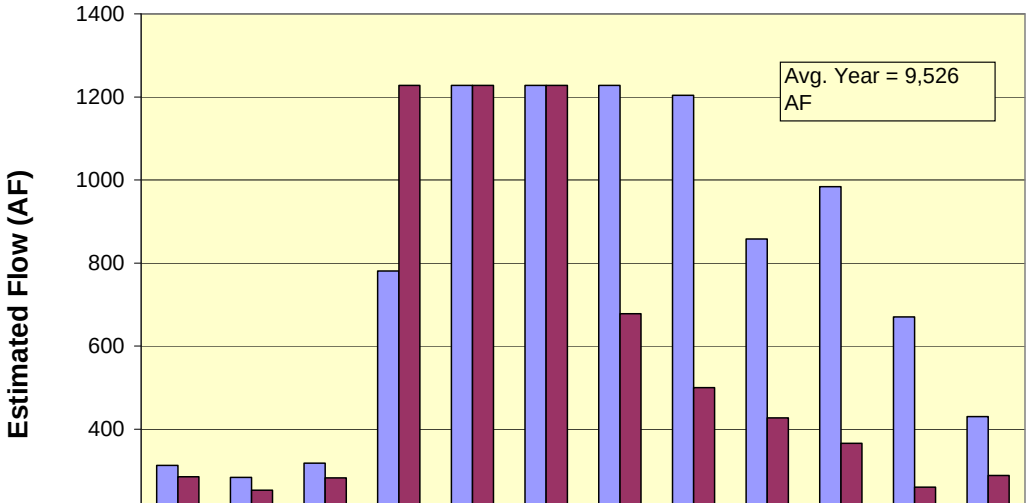
By using the recorded diversions as the measure of the low flows and the gage flow estimates as the high flows then the actual flow in the No Name diversion would be the maximum of the recorded diversions or the estimated flows from the gage analysis. The resulting estimated physical flows are shown in Figure 6. By setting the upper limit on the diversions based on Glenwood Springs' 20 cfs water right, the maximum allowed in any month would be 1,228 af[9]. The legally available monthly flows are the minimum of the actual physical flow and the legal limit of the right, 1,228 af, which is shown in Figure 7. These flows were used for modeling the water system operations in Aquacraft's integrated conservation model. The 500 af of water from Ruedi Reservoir is assumed to be available in the six-month window of October through March.

[9] 20 cfs x 1.98 afd/cfs x 31 days/month



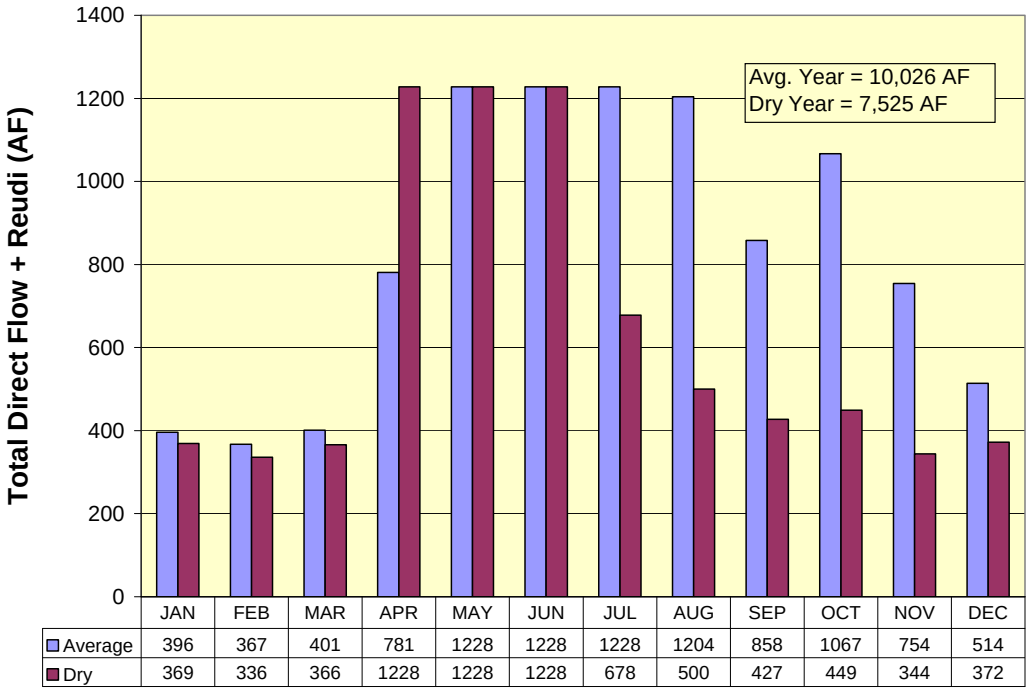
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average cfs	4.5	3.3	2.8	13.1	333.9	747.7	131.6	19.6	14.4	16.0	11.3	7.0
1977	1.78	1.08	1.04	26.33	400.29	107.96	11.05	4.59	4.58	4.00	2.10	1.15

Figure 6: Estimated flows at No Name from max of gage and diversion data



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average	313	284	318	781	1228	1228	1228	1204	858	984	670	430
Dry	285	253	283	1228	1228	1228	678	500	427	366	260	289

Figure 7: Estimated flows available for diversion under Glenwood Springs's water rights and stream flow estimates



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average	396	367	401	781	1228	1228	1228	1204	858	1067	754	514
Dry	369	336	366	1228	1228	1228	678	500	427	449	344	372

Figure 8: Total estimated water rights yields under direct flow rights and Ruedi contract

Summary of Raw Water Yields

The analysis done for this water conservation plan indicates that the likely yield of the City's two direct flow water rights on Grizzly Creek and No Name Creek plus their contract water in Ruedi Reservoir equal 10,026 af in an average year and 7,525 af in a dry year.[10] The estimated average monthly flows are shown above in Figure 8. Please keep in mind that these are just engineering estimates and additional data could show that these estimates should be revised. In addition, the peak day demands of the system will be greater than the average flows. Fortunately, peak demands in Glenwood Springs are due to irrigation that occurs in the summer months when available flows are greatest.

The dry year flows estimated in this study are based on the years 1977, 1988, 1990, 1992 and 2002. When drier years occur, shortages to the system could follow. These infrequent shortages are addressed as part of the City's current drought response plan. While the water conservation plan can and should be an integral part of the drought response plan in this case the City appears to have a sufficient supply that an extraordinary effort in this area does not appear to be warranted, but should be pursued as part of the City's normal water resources planning process.

There are a number of other water rights mentioned in the Broadwell report, which discusses Mitchell Creek, Oasis Creek, Four Mile Creek, Three Mile Creek. However, these rights are not currently used for municipal supply and there are no current plans to include them in the system; nor does there appear to be any immediate or future need to do so.

[10] The maximum annual demand for water in Glenwood Springs over the past 8 years was 2,352 acre-feet. Hence, the dry year yield of the City's water rights at 7,525 acre-feet is easily sufficient to meet current and future demands as shown later in this plan document except under more severe drought conditions.

Water and Wastewater Treatment

The raw water in the system does not have salinity problems and is essentially free of turbidity for ten months out of the year. The City treats all potable water at the Red Mountain Water Treatment Plant, which was constructed in 1974 and has the capacity to treat 8.65 mgd. In 1995, the Red Mountain WTP was upgraded with new pre-treatment facilities that included chemical treatment, flocculation, and sedimentation.

The City is in the process of constructing a new wastewater treatment plant to replace the current facility, which is situated at a high value location near downtown and the Colorado River. Much of the impetus for developing this water conservation plan is to fulfill the necessary requirements to secure a construction loan from the Colorado Rural Water and Power Authority (CRWPA).

Red Mountain Water Treatment Plant

Metering

The City is fully metered (99.5% of all customers) and is in the process of installing the Badger Orion AMI (automatic metering infrastructure) throughout the system. The City has already begun to take advantage of some of the features of the Orion system, and has been interrogating AMI meters at frequent intervals to help identify leaks and water waste in buildings where the first 296 meters have been installed. Eventually, all customers will be equipped with these meters. The Orion AMI system can also provide customers with real time water use data, on demand, and alert them to leaks in their systems through a coded water meter monitor. The City is aware of these capabilities and is evaluating them.

Organization

The Glenwood Springs water and wastewater utility currently employs 18 people including the Public Works Director and Water and Wastewater Superintendent. The City does not have a staff member dedicated to water conservation. Water conservation program responsibilities typically fall to the Water and Wastewater Superintendent and the billing staff member.

Capacity and Reliability

Glenwood Springs is fortunate to have one of the finest water systems on Colorado's Western Slope. The City has physically abundant, high quality water sources that primarily drain a pristine, protected watershed. No Name and Grizzly Creeks provide source diversity and redundancy in the primary supply with the Roaring Fork River as a reliable backup. The City's water rights are senior and are sufficient to meet the supply needs of the community beyond a 50-year planning horizon, even if minimal or no additional conservation measures are implemented.

Glenwood Springs' water supply infrastructure (including the water treatment plant, transmission mains, and storage facilities) is of adequate capacity to meet the supply needs of the community beyond the 20-year horizon of this conservation plan. The design of the treated water system utilizes gravity for most water delivery except for two small high elevation zones that require

pumping. The City staff has done an excellent job of maintaining the infrastructure over the years, implementing an aggressive water main replacement program as well as a leak detection and repair program.

Overall Glenwood Springs has low operating costs. Construction of the new wastewater treatment plant is by far the most significant waste water infrastructure investment the City will likely require for the foreseeable future.

The City has an existing Water Conservation Master Plan, which was originally approved in 1996 and revised in 2003. However, this plan did not meet all of the current statutory planning requirements, hence Aquacraft, Inc. was contracted to develop an updated water conservation plan for Glenwood Springs.

BASELINE WATER USE

Water use in Glenwood Springs has increased by 4.9% (106.3 acre-feet) over the past six years. This amounts to an increase in demand of approximately 0.8% per year. In 2003, total retail deliveries amounted to 2,132 af and in 2008, they had risen to 2,283 af. Annual water use by customer category for the period from 2003-08 is shown in Table 3. The total retail deliveries are also shown in graphical format in Figure 9.

Table 3: Historic annual water deliveries, Glenwood Springs (2003-2008)

	Customer Category							Total Retail Deliveries
	Residential	Commercial	Hospital	Schools	Bulk	Potable Total	Raw Water Irrigation	
Year	Acre-Feet							
2003	1131.3	582.5	33.6	20.2	13.4	1781.0	351	2132.0
2004	1176.2	560.1	33.6	15.7	6.7	1792.2	376	2168.2
2005	1120.1	649.7	22.4	12.3	7.8	1812.4	343	2155.4
2006	1153.7	604.9	33.6	12.3	2.2	1806.8	380	2186.8
2007	1221.0	683.3	44.8	13.4	1.1	1963.6	388	2351.6
2008	1183.4	623.0	51.8	12.4	1.5	1872.2	366	2238.3

Water use increased at a slightly higher rate in 2007, but the 2008 demands returned to more or less the same level of increase the City experienced from 2003-06. Such slight fluctuations are typical when examining municipal water use data.

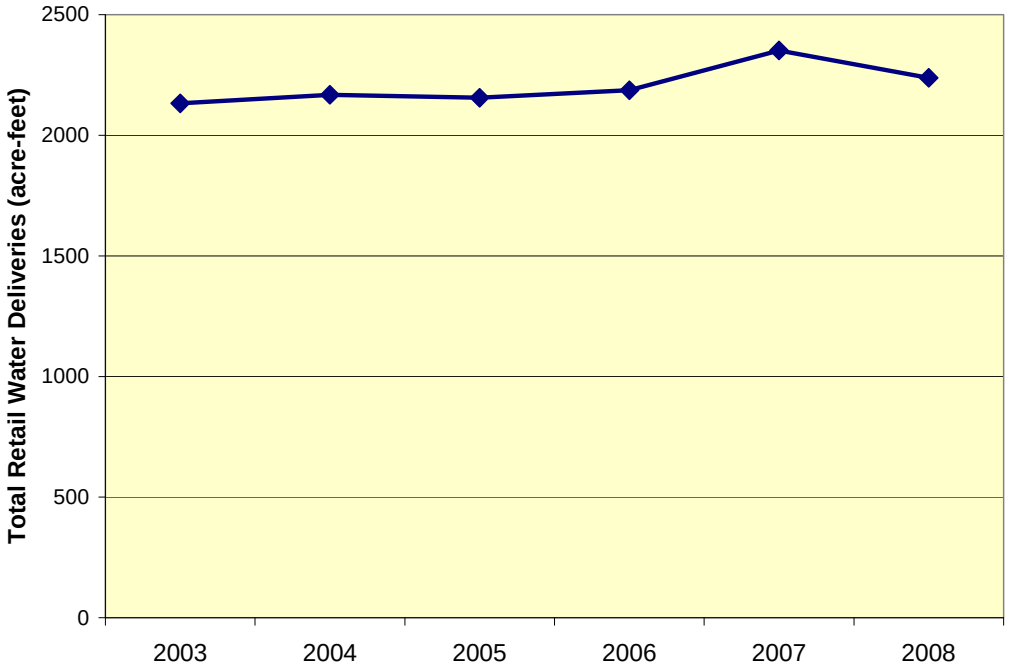


Figure 9: Historic total retail water deliveries, Glenwood Springs

A pie chart showing the percentage of connections by customer category in Glenwood Springs is provided in Figure 10. Residential customers are most prevalent in Glenwood Springs, accounting for 84.1% of all service connections in 2008. Commercial customers account for 13.0% of connections, dedicated irrigation accounts account for 2.4% of connections and schools, hospitals, and bulk customers combined account for 0.5% of connections.

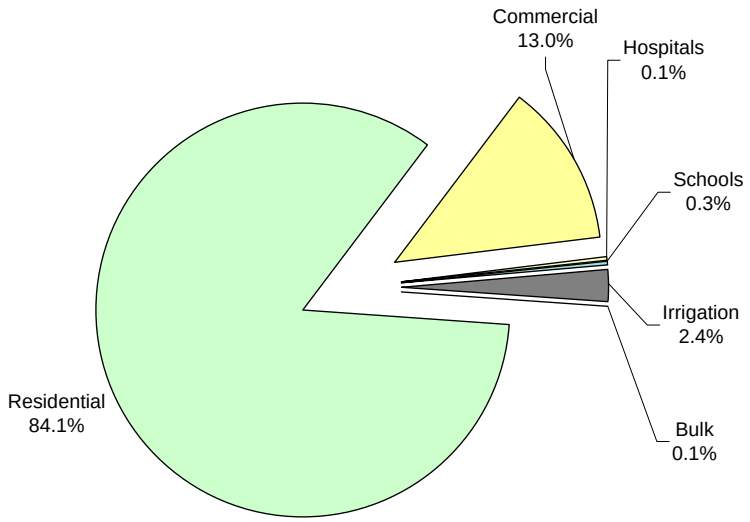


Figure 10: Customer connections in Glenwood Springs

Figure 11 shows the 2008 water use by customer category. Although residential customers make up more than 84% of customer connections, they comprise only 52.9% of the total annual demand. Commercial customers (13% of connections) account for 27.8% of annual demand. Dedicated irrigation accounts make up 2.4% of connections but account for 16.4% of annual demand.

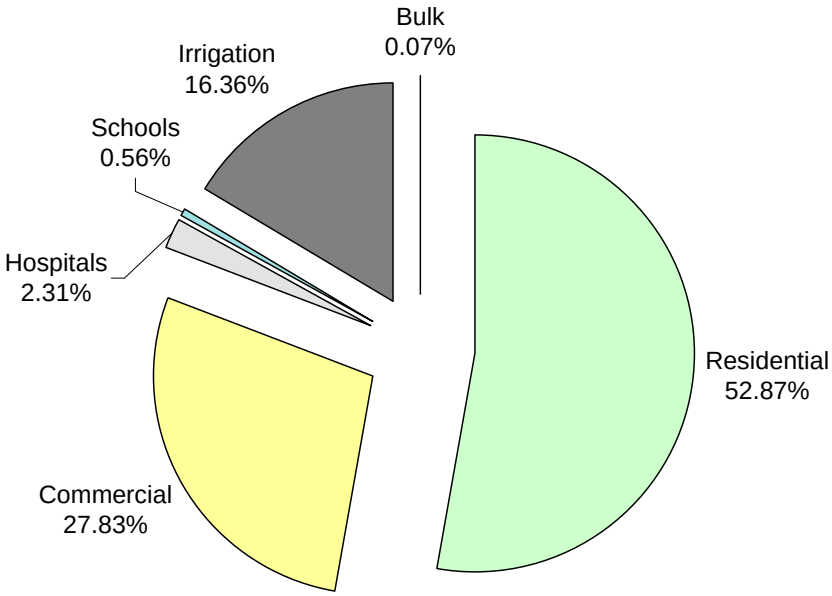


Figure 11: 2008 water demand by customer category, Glenwood Springs

SEASONAL AND PEAK DAY DEMANDS

In 2008, the average day water demand was 2.46 mgd and the peak day demand was 5.31 mgd. This indicates a peaking factor in the neighborhood of 2.15 is reasonable for Glenwood Springs. The Red Mountain Water Treatment Plant has a maximum rated capacity of 8.65 mgd so the City has an excess capacity of 3.34 mgd on the peak day and consequently has no problem meeting current peak demands for water. In addition, the City has the ability to store 5.65 million gallons in treated water storage tanks, which can be used to meet short-term peak demands. As is discussed later in this plan, peaking capacity is not a constraining factor for Glenwood Springs in any of the future demand scenarios.

WATER RATE STRUCTURE, COSTS, AND PRICING

Glenwood Springs is a fully metered community and currently bills its customers on a monthly basis using a three tier inclining block rate structure. This rate structure has been in place since January 2000. The City's rate structure provides for 5,500 gallons of water per month in tier 1, an additional 12,000 gallons of water per month in tier 2, and all monthly usage greater than

17,500 gallons is billed at the tier 3 rate. Separate rate structures apply to bulk water purchases and raw water customers. These are described below along with an explanation of Glenwood Springs' wastewater rates, which for many customers comprises the lion's share of the overall bill.

Billing System and Water Rates

The City utilizes a computerized billing system and is in the process of upgrading the entire metering infrastructure to the Badger Orion AMI system. This system enables frequent remote interrogation of water meters. The City is already taking advantage of this capability to help identify leaks and abnormal usage in the 296 sites where the meters have been installed. The meter replacement project will be implemented over a 4 – 5 year timeframe.

The standard schedule of rates and charges for water customers in Glenwood Springs is shown in Table 4. In this rate structure, tier 2 represents a 33% increase over tier 1 and tier 3 represents a 33% increase over tier 2. The rates themselves are set based on the cost of service requirements of the City.

Table 4: 2009 water rates and rate structure, Glenwood Springs

Rate Tier	Water Rate Per 1,000 gallons
Tier 1 – up to 5,500 gallons/month	$1.60
Tier 2 – from 5,501 – 17,500 gallons/month	$2.13
Tier 3 – over 17,500 gallons/month	$2.83
Fixed monthly service fee	$9.32/month

The schedule of rates and charges for bulk water customers is shown in Table 5. Bulk water sales are made to residents and visitors filling up water tanks and other large containers. Charges for bulk water are more than eight times higher than the tier 1 charges for regular Glenwood Springs' customers. There are only 3 bulk water accounts in the entire City and bulk demand summed to less than 0.1% of total demand in Glenwood Springs in 2008.

Table 5: 2009 bulk water rates, Glenwood Springs

Rate Tier	Water Rate Per 100 gallons
Per 100 gallons	$1.33
Fixed customer charge	$9.32

The schedule of rates and charges for raw water customers is shown in Table 6. Raw water is sold to a limited number of parks and dedicated irrigation sites that are located with convenient access to raw water supply infrastructure. Charges for raw water are 16.8% lower than tier 1 water rates, reflecting the lower cost of service for providing that water (i.e. no treatment).

Table 6: 2009 raw water rates, Glenwood Springs

Rate Tier	Water Rate Per 1000 gallons
Per 1000 gallons	$1.33
Fixed customer charge	$9.32

Wastewater Rates

Wastewater charges comprise the largest chunk of the combined monthly bill for many Glenwood Springs customers. The minimum monthly wastewater bill for customers inside corporate limits is $30.67 regardless of how little water is used during the billing period. Wastewater charges are typically based on the winter average billing for each customer (except for restaurants and hotels or motels with beverage service in which case it is based on actual year round consumption). The schedule of wastewater rates and charges for customers inside corporate limits is shown in Table 7. Charges for customers outside the corporate limits are approximately 50% higher.

Table 7: 2009 inside corporate limits wastewater rate, Glenwood Springs

Customer Category	Volume Charge ($/1000 gallons)	Billing Period
Minimum monthly bill – all users regardless of consumption (i.e. volumetric charges only apply if they exceed this minimum amount)	$30.67 (not volumetrically based)	Billed monthly, 12 months/year
Restaurant	$4.18	Billed monthly, 12 months/year
Hotel or motel with food & beverage service	$3.36	Billed monthly, 12 months/year
Hotel or motel without food & beverage service	$2.90	Billed monthly, 12 months/year
All others (residential, commercial, etc.)	$2.90	Billed monthly, 12 months/year. Volumetric charges during the summer months are based on the winter average water consumption.

PROPOSED WATER AND WASTEWATER PROJECTS

Glenwood Springs has two major infrastructure projects on the planning horizon: construction of the first phase of a new 3.9 mgd wastewater treatment plant, and construction of the south service area water main loop and water storage tank. The wastewater treatment plant project is discussed in detail below.

Southern Service Area Water Study

The City is conducting a southern service area water study that will address pressure and volume issues associated within this area. The south service area water main loop and water storage tank

project is a proposed improvement to the City's distribution system and water service in the south service area that will not be impacted by water demands or any conservation program the City could implement.

In addition to these projects, the City is in the process of upgrading all water meters to the Badger Orion AMI system. Aside from these efforts, there are no other water and wastewater infrastructure project planned beyond standard maintenance and repair efforts.

Wastewater Treatment Plant

The City of Glenwood Springs has begun preliminary construction on a new 3.9 mgd wastewater treatment plant. This $37-million dollar facility (estimated cost), when completed in a few years, will replace the current wastewater treatment plant, which will be decommissioned. The current wastewater treatment plant in Glenwood Springs is located near the downtown area, close to the Colorado River. The current plant has operated for 30 years and has outlived its usefulness; it wasn't designed to meet today's water quality standards. According to press reports, the Colorado Department of Public Health and Environment has insisted Glenwood Springs must have a new plant by 2014 to meet health requirements. Glenwood Springs' officials believe the facility will be finished well before that deadline.

The new wastewater treatment plant is expected to increase the wastewater capacity from about 1.8 million gallons per day to around 3.9 million. The current plant runs about 1.2 million gallons per day.

The location of the current plant is problematic because of its proximity to downtown and the Colorado River. Smell and odor from the plant can often be detected in town .

The new wastewater treatment plant will be located West of the Meadows Shopping Center, which is at a higher elevation than the current facility. Preliminary designs call for two 16-inch diameter 14,000-foot pipes from the current wastewater treatment plant to the new site. These plans include a pump station to pump the wastewater approximately 50 feet up to a high point before reaching the site.

The City is seeking a loan from the Colorado Rural Water and Power Authority to help finance this project, which is one of the largest in the City's history. Part of the impetus for developing this conservation plan is to comply with CRWPA loan application requirements.

POPULATION PLANNING PROJECTIONS

The population of Glenwood Springs is approximately 9,085 residents in 2009. According to Glenwood Springs Community Development Director Andrew McGregor, the City plans for growth of 1.6% per year, but in the past few years, this rate has not been achieved. Table 8 shows the historic population from 2004 – 2008 and the projected population growth in Glenwood Springs over the next 20 years through 2030. These data are shown as a graph in Figure 12.

Table 8: Population growth projections through 2030, Glenwood Springs

Year	Population	Population Growth Rate
2004	8517	N/A
2005	8601	1.0%*
2006	8743	1.7%*
2007	8887	1.6%*
2008	8942	0.6%*
2009	9085	1.6%**
2010	9230	1.6%
2011	9378	1.6%
2012	9528	1.6%
2013	9681	1.6%
2014	9836	1.6%
2015	9993	1.6%
2016	10153	1.6%
2017	10315	1.6%
2018	10480	1.6%
2019	10648	1.6%
2020	10818	1.6%
2021	10991	1.6%
2022	11167	1.6%
2023	11346	1.6%
2024	11527	1.6%
2025	11712	1.6%
2026	11899	1.6%
2027	12090	1.6%
2028	12283	1.6%
2029	12480	1.6%
2030	12679	1.6%

*Actual growth rate
**Projected growth rate

Glenwood Springs does not currently have a build-out population planning projection. However, the physical characteristics of the City's setting will likely function as an effective limit to large-scale future growth. Steep canyon walls, the Colorado and Roaring Fork River flood plains, and federal lands that abut City boundaries are all likely to limit future growth and development. As such, the City's population planning projections, while conservative by the standards of many

Colorado communities, may over-estimate future population. In the forecasts shown here, a 1.6% annual growth rate is anticipated. The actual growth rate (pre-recession) over the past few years has been closer to 0.6% per year. For water and conservation planning purposes, the projections used by the City and presented here are responsible and adequate. Furthermore, since this plan will be updated every 5 – 7 years there is ample opportunity to adjust these forecasts to match actual growth trends in Glenwood Springs.

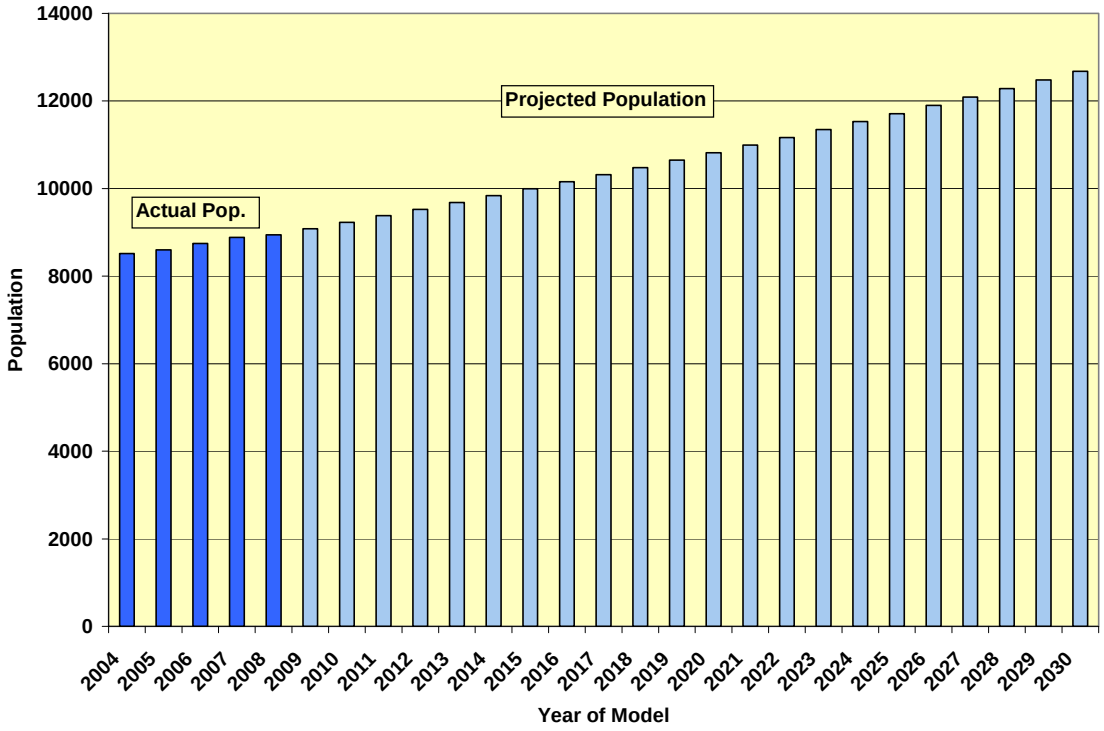


Figure 12: Population and growth projections, Glenwood Springs

WATER CONSERVATION PROGRAM

This section of the conservation plan describes current and ongoing water conservation efforts in Glenwood Springs. The City of Glenwood Springs does not have a dedicated conservation staff member and their conservation program is implemented by the Water and Wastewater Superintendent and other staff members. The City has demonstrated a real commitment to water use efficiency, and even without a staff member dedicated to water conservation, has implemented many of the most essential water conservation program measures.

In 1996, Glenwood Springs approved their first Water Conservation Master Plan, which was subsequently updated in 2003. This plan however did not contain all of the necessary elements to meet approval by the CWCB, and Aquacraft was contracted to develop this 2009 plan. A full evaluation of a broad number of conservation measures is presented in the following sections.

Metering

A good metering program is fundamental to the success of water conservation efforts. Colorado statute requires all water providers to meter the water use of their customers and to bill based on metered consumption. In Glenwood Springs, 99.5% of the customers (including all municipal facilities) are metered and billed based on metered consumption. Municipal customers including City parks, the local cemetery, and wastewater treatment plant all pay for the water they use.[11]

Recently the City has embarked on an ambitious project to replace all water meters in Glenwood Springs with the Badger Orion AMI[12] system. This is an effort that will take several years to complete, but the City is already taking advantage of the capabilities of this system where the meters have already been installed. City staff is using information from the Orion system to identify customer side leaks at 296 sites and for general water management and system improvements. By gaining experience with the 296 sites, Glenwood Springs hopes to be able to take more full advantage of the information provided by the AMI system.

As mentioned above, the Badger Company makes a water meter-monitoring device that can be provided to the customers. This attaches to the refrigerator magnetically and works like the odometer of a car. It has three registers that display volumes recorded by the meter. The main register ("=") displays the total volume that has flowed through the meter since it was installed. In addition there are two other registers ("A" and "B") that display the volume recorded since the last time these were reset (like trip registers on an odometer). The customer can use these to track annual, monthly or daily water use. In addition, the monitors have a light that flashes if a period of zero flow has not occurred in the last 24 hours. This alerts customers of a leak in their system.

The City is evaluating the usefulness of this device as part of its conservation and drought response efforts and considering providing these devices on a limited basis after the meters are updated.

[11] Some agencies in Colorado provide unlimited, free water to some municipal customers.
[12] AMI = advanced meter infrastructure. This term is replacing AMR (automated meter reading) in the water industry.

Conservation Oriented Water Rate Structure

Glenwood Springs currently bills its customers on a monthly basis using a three-tier inclining block rate structure. This conservation oriented rate structure has been in place since January 2000. The City's rate structure provides for 5,500 gallons of water per month in tier 1, an additional 12,000 gallons of water per month in tier 2, and all monthly usage greater that 17,500 gallons is billed at the tier 3 rate. The 5,500-gallon block one allotment represents a reasonable estimate of indoor water use for the single-family sector (the largest customer class in the City) and as a result, the rate structure sends an effective price signal that differentiates between indoor and outdoor use for many customers. Separate rate structures apply to bulk water purchases and raw water customers. The Glenwood Springs rate structure is described in detail earlier in this plan document.

Water Loss Reduction

System leakage in Glenwood Springs is currently estimated to be between 5 and 7%, well below the 10% threshold that is often estimated as the national average. This low rate of system leakage is not an accident, but rather the product of an aggressive water main replacement program in Glenwood Springs. According to Buddy Burns, Water and Wastewater Superintendent, water mains in the City are in good shape.

The City annually contracts with a leak detection firm that utilizes sophisticated listening equipment to locate leaks in approximately 25% of the water mains each year. Repairs are then made based on this analysis. The program has been so effective that the City is considering the purchase of their own listening equipment so that they can increase the frequency and breadth of leak detection efforts.

Probably the largest loss of raw water in the Glenwood Springs system is intentional bleeder losses from one aerial pipe that crosses the Colorado River. Because this pipe is exposed to the ambient air temperature, freezing is a real threat. To prevent freezing the City must continually bleed raw water from this aerial pipe during the winter (November – April) to ensure that water is always moving through the pipe. The raw water bled from the pipe simply drains into the Colorado River.

The largest loss of finished water in the Glenwood Springs system is the result of intentional bleeder losses from aerial pipes that cross the Colorado and Roaring Fork Rivers along various bridges. As with the raw water pipe described above, these finished water pipes are exposed to the ambient air temperature and freezing is a real threat. To prevent freezing the City must continually bleed finished water from these aerial pipes during the winter (November – April) to ensure that water is always moving through the pipes. The finished water simply drains into the rivers.

A few years ago, the City temporarily metered these aerial pipes to determine the extent of the water loss associated with the required bleeding. From this metering effort, bleeder losses were estimated at 500,000 gallons per day. Currently there are no ready options for reducing or eliminating the losses associated with these bleeder valves. By metering the aerial pipes from time to time, the City is able to ensure that these losses are kept to an acceptable level. In the

future, it may be possible to further reduce these losses through new technologies, insulation, or other methods, but for the present the City's efforts are adequate and represent best practices based on industry standards.

The practice of bleeding raw water from the raw water pipelines to the Colorado River is a planned procedure and really does not constitute a "loss" to the system since reducing the amount of bleed would not increase the available water supply. Water from No Name diversion is simply being diverted over and above the requirement for water by the system, and then returned to the river through the bleed valves. The reason this is necessary is that demand in the water system is so low during the winter that flow in the pipe would drop to the point where it could freeze. If the demand in the system were greater then the bleed would be reduced accordingly and the flow into the treatment plant would be increased. Since the water is available for use if needed, it does not represent a loss to the system.

Public Education and Information

A key component of Glenwood Springs' water conservation efforts is public education and information. The City regularly provides information to customers about ways to conserve water and avoid water waste through flyers and bill stuffers and the utility maintains conservation materials and information that are available upon request. Education efforts focus on both indoor and outdoor water demands and the City maintains a Xeriscape demonstration garden at the Community Center.

Glenwood Springs' education efforts extend annually into the local public schools and community college. Since the City is built at the confluence of two major rivers, water appears plentiful and abundant at first glance. A regular series of field trip tours of the water and wastewater treatment plants and conservation demonstration project are provided to K-12 students and teachers. During these tours discussions of water conservation behaviors and water efficiency figure prominently.

Outdoor Water Efficiency

Glenwood Springs experiences high summer peak water demands due in part to the regular influx of tourists, but largely due to irrigation demands from customers with automatic sprinkler systems. The City has taken a number of steps to help reduce irrigation demands starting with customer education. The City actively promotes efficient irrigation practices. In the spring, the City often sends outdoor efficiency information as a bill stuffer and encourages customers to tune up their irrigation systems for maximum efficiency and beauty and to avoid water waste.

Glenwood Springs' staff works to set an example through the efficient irrigation of parks and public lands. All City parks, medians, and other irrigated areas are metered and billed based on their actual consumption. The City has established a Xeriscape demonstration garden at the Community Center. The demonstration garden features a variety of plants that are suitable to the local region and climate and require less water than traditional turf landscapes.

The City delivers and sells raw water to a number of parks and large irrigation sites that are located in close proximity to the City's piped raw water supply. It is cost prohibitive to extend

the raw water system much beyond its current reach, but sites located on or very near the raw water pipe network are encouraged to join the raw water system and to remove their treated water irrigation demands from the system.

The City's rate structure encourages outdoor water efficiency for its largest customer class, single-family residential, by setting the tier 2 break point at 5,500 gallons which effectively distinguishes indoor use (tier 1) and outdoor use (tier 2 and tier 3).

The City has also considered developing and implementing an irrigation efficiency program targeted at high volume water users. The lack of staff resources and the sufficiency of the current water supply have put this effort on the back burner for the time being.

While not a long-term water conservation measure, in the event of a climatological drought that affects the City's supply, Glenwood Springs is prepared to implement outdoor watering restrictions to reduce demands as required.

Commercial, Institutional, and Industrial Water Efficiency

Without a formal water conservation program and accompanying staff, Glenwood Springs seeks to encourage commercial, institutional, and industrial (CII) water efficiency through education and pricing mechanisms.

Pricing water and wastewater services appropriately has been shown to be an effective method for reducing water demands (Mayer et. al. 2008), (Mayer et. al. 2004), (Howe, 1982). In Glenwood Springs, CII customers are billed for water using the same rate structure as residential customers, which means that large users pay for most of their water at the tier 2 and tier 3 rates. Wastewater rates, presented above in Table 7, are tailored to specific customer categories such as restaurants and the hospitality industry (typically the largest water users in Glenwood Springs). Restaurants pay the highest wastewater charges because of the cost associated with treating the wastewater from these customers, which includes significant amounts of food waste.

The hospitality industry in Glenwood Springs, the largest block of non-residential water customers, has adopted a number of the best management practices regarding unnecessary washing of towels and sheets promoted through the US EPA WAVE program as well as other hospitality related efficiency efforts. Guests at many Glenwood Springs lodging establishments are encouraged not to change their sheets and towels every day unless necessary. The City also encourages the replacement of old and inefficient toilet fixtures in hotels and motels through education, information, and price signals, but does not have a rebate program to incent fixture replacement.

Regulatory Measures

The most significant conservation-oriented regulatory measure enacted in Glenwood Springs is the requirement for all new construction to include a pressure-reducing valve (PRV). PRV's have been shown to dramatically reduce indoor and outdoor leakage in communities with high water pressure. In a city such as Glenwood Springs that has high irrigation demands, PRV's can reduce the frequency of blown sprinkler heads and valves and can improve overall irrigation

system efficiency. PRV's have also been shown to have an impact on indoor demands in both the residential and commercial sectors and a PRV requirement is included in the EPA WaterSense New Home specification.

The City has adopted the Uniform Plumbing Code (UPC) as a requirement for new construction, which includes a number of standard efficiency measures. The City regularly reviews local codes and regulations for opportunities to specify water conservation requirements.

Water Reuse and Recycling

Glenwood Springs reuses treated effluent at the wastewater treatment plant. This is the only formal utility sponsored reuse effort in the City.

Fixtures, Appliances, and Incentives

In Glenwood Springs' case, the major threat of water shortages occur during low flow times in the late fall through early spring before the runoff takes place. This means that for Glenwood Springs there is a substantial value in reducing its non-seasonal, or indoor, water uses. The gradual replacement of inefficient fixtures and appliances and other water using devices is an excellent way to accomplish this objective.

Glenwood Springs promotes the replacement of old and inefficient toilets, showerheads, faucets, and clothes washers through its regular education efforts. The City is considering updating promotional materials to include WaterSense and Energy STAR labeled fixtures and appliances that represent an efficiency improvement over Energy Policy Act requirements.

In the past Glenwood Springs has sponsored a retrofit program for showerheads, toilets, and faucets but does not currently implement this program because it is not cost effective given the water supply conditions (see Cost Effectiveness section below). For the same reasons, Glenwood Springs has not implemented a rebate program to encourage and accelerate installation of efficient fixtures and appliances, preferring instead to rely on natural replacement.

WATER DEMAND FORECASTS

Colorado statute requires a full evaluation of nine different water saving areas to be considered when developing a water conservation plan. Five different conservation scenarios were developed for this plan and from these scenarios, future demands were forecast out 20 years. A description of each scenario and the forecasting methodology is presented below. The costs and benefits associated with these scenarios are considered in the next section of this plan document.

Forecast Methodology

Demand forecasts were prepared for Glenwood Springs using a customized demand model called the Integrated Conservation Model (ICM) developed by Aquacraft specifically for evaluating the impacts of various water conservation strategies on future water demands. The model operates at a monthly time step and uses a number of input parameters. The version developed for Glenwood Springs also tracks costs for conservation programs.

The first input information consists of monthly demands and the number of customers broken down into the following categories: single family, multi-family, IC (industrial, commercial), public (governmental), institutional (schools and hospitals), and irrigation only accounts. In Glenwood Springs' case their billing data does not split single family and multi-family so it was necessary to estimate this split based on discussions with the City. The combination of accounts and billed consumption data from the billing database were used to adjust the model so that its predicted demands matched the historical demands for the baseline year (year 0 of the model projection time series).

Next, growth rate projections for each category were inserted. Growth typically drives demand for water - it is a fundamental forecasting parameter. Population growth and growth rates are presented earlier in Table 8. These projections are based on the average of annual growth observed from 1996 to 2006 provided by Community Development Director, Andrew McGregor. The growth rate over the last two years has been closer to 0.6% based on a 2007 population of 8,887 and a 2008 population of 8,942. The City plans using a 1.6% growth rate so this was selected for developing demand forecasts. No build-out date has yet been determined by Glenwood Springs, but City staff indicated that undeveloped land, redevelopment and infill could absorb the 1.6% growth rate for at least 10 to 15 years.

It was assumed that growth in non-residential accounts would be proportional to growth in the population. Numbers of different types of accounts were provided from billing records. Table 9 shows the number of accounts by customer category for 2007 and 2008. Because use patterns differ, the forecasting model differentiates between multi-family accounts and single-family accounts, while hospitals and nursing accounts were grouped together as institutional accounts. Since the billing system does not distinguish between single family and multi-family accounts it was necessary to estimate the number of multi-family accounts through discussions with the City.

Once account data were gathered and growth rates determined, a logistic growth algorithm was used to extrapolate the number of future accounts by customer category. While it was assumed that different types of accounts would have corresponding growth rates, the k-factor used in the logistic growth model was not assumed to be the same for each category. As a result, residential growth continues steadily over the life of the model at between 44 and 58 new accounts per year, but growth in the number of institutions (hospitals and schools) flattens out. It should be noted that not all account types actually fit modeled growth; for example, the number of commercial accounts dropped from 452 in 2007 to 450 in 2008. This negative – if only slightly – growth pattern was ignored in the modeling effort and a 1.6% increase was assumed.

Table 9: Number of accounts by customer class in Glenwood Springs, 2007-08

Year	Residential	Commercial	Hospitals and nursing	Schools	Irrigation	Bulk Users
	Number of Water Customers					
2007	2892	452	4	14	79	3
2008	2919	450	4	12	84	3

Historic consumption data were provided for 2007 and 2008 from the City's billing database. Total billed demand for Glenwood Springs in 2008 was 2,238 acre-feet. The model takes into account non-billed use as well. It was assumed that 7% of water is lost due to treatment, system and storage losses. The breakdown of use by sector was shown earlier in Figure 11.

Once total demand for a customer sector is determined, end uses are disaggregated using available data sets. For example, residential use is disaggregated by end use such as toilets, clothes washing, showers/bathing, leaks, faucets and other domestic use. The forecasting model is also sensitive to changes in technology. Newer homes equipped with fixtures that meet 1992 Energy Policy Act (EPAct) standards use less water for toilet flushing, faucets, and showers than older homes. The forecasting model considers these differences.

The forecasting model includes three categories of single-family homes:

(1) older homes equipped with older more inefficiency fixtures;
(2) newer and retrofit homes meeting EPAct standards;
(3) homes using best available technology (for example 1.2 gallon per flush toilets and high-efficiency clothes washers).

Per capita consumption volumes for each category of home are based on Aquacraft's extensive research studies including the *Residential End Uses of Water* (AWWA 1999), the EPA single-family retrofit study (DeOreo et. al. 2005), and the pending EPA study comparing standard and efficient new homes.

Matching modeled demand with billed consumption set the model's baseline. This was done on a sector-by-sector basis. The first year of modeled consumption was targeted to be 1.6% higher than the most recent billing data. This effectively set the zero year of the forecasting model to 2008.

Another critical demand forecasting parameter was seasonal/outdoor use. Averaging billed demands from January and February and then annualizing this presumably entirely indoor usage established non-seasonal use. Seasonal use was then determined as the use exceeding the non-seasonal use. These forecasting models were calibrated by comparing the forecast monthly seasonal demand profiles with known consumption volumes from dedicated irrigation accounts.

The model allows an indefinite number of scenarios to be evaluated. The user sets up each scenario by varying assumptions about how the various water conservation programs modify the demand patterns for existing and new customers. For example, a program to retrofit existing homes with best available technologies is modeled by defining the percent of the existing homes that will be retrofit each year and the upper limit on percent of homes that will be affected. When the model is run it will move this number of homes from the standard category of existing homes to the BAT category each year and adjust the demands accordingly.

Scenarios are stored separately so that they can be recalled and compared as needed for the analysis. The following demand scenarios were run for Glenwood Springs.

Demand Forecasts

Over the 20-year span projected with the forecasting model, Glenwood Springs' population is expected to rise from 8,492 to 12,283 as shown in Table 8. Likewise, the number of water-using accounts is also expected to increase as shown in Table 10. Schools, hospitals, and nursing facilities have been grouped together into an "institutional category" for this analysis.

Table 10: Projected customer accounts in Glenwood Springs, model year 10 and 20

Model Year	Residential	Commercial	Institutional: Schools, Hospitals and Nursing	Irrigation	Bulk Users
	Number of Water Customers				
10	3409	515	18	95	3
20	3950	567	18	102	3

Five future demand scenarios were explored as part of the forecasting process. Each scenario and the associated forecast demands are discussed below. Figure 15 compares all five demand scenarios. Scenario 2 forecasts future demands for Glenwood Springs under current conditions that is the proposed conservation program. As is discussed later in this document, because of the excellent water supply situation in Glenwood Springs, scenario 3, 4, and 5 are simply not cost effective or necessary. The current conservation program (scenario 2) does not require any increased expenditure by the City and meets the current community goals for wise use of resources and cost effectiveness.

Demand Scenario A – No Conservation

The Demand Scenario A forecast represents a 20-year demand projection without any water conservation program and assumes the immediate cessation of all conservation efforts in Glenwood Springs. This forecast provides a way to examine the impacts of the current conservation program and other more aggressive programs against a hypothetical baseline of no conservation. All five forecasts, including Scenario A incorporate anticipated changes in growth rates based on current planning projections. Under Scenario A, average annual demand rises to 2,958 acre-feet after twenty years.

Demand Scenario B – Current Conservation Program

Demand Scenario B forecasts future demand under Glenwood Spring's current conservation program. This forecast uses a 1% per year rate of replacement for residential fixtures. This replacement rate is higher than the natural replacement rate (0.5%) utilized in Demand Scenario A and accounts for the effect of conservation education programs implemented by the City.

The current conservation program, which focuses on metering, rates, and education, is expected to accelerate the retrofit rate of efficient fixtures and appliances in existing homes and businesses. In the forecasting model, Glenwood Springs' conservation efforts also affect how replacement of old and inefficient fixtures occurs. It is assumed that most replacements are of EPAct fixtures (1.6 gpf toilets, 2.5 gpm showerheads, 2.2 gpm faucets, and Energy Star clothes washers), but a significant fraction of the replacements will be WaterSense labeled fixtures and

high-efficiency appliances (1.28 gpf toilets. 2.0 gpm showerheads, 1.5 gpm faucets, and high-efficiency Energy Star clothes washers).

Another impact of the City's conservation efforts is a small reduction in irrigation application rates for single-family homes. Commercial, institutional and irrigation accounts were assumed not to be impacted in this scenario.

Over the twenty-year forecasting period under Scenario B, annual demand rises from 2,467 acre-feet to 2,828 acre-feet and results in a savings of 130 af (4.3%) over Scenario A. The demands by sector are shown in Figure 13.

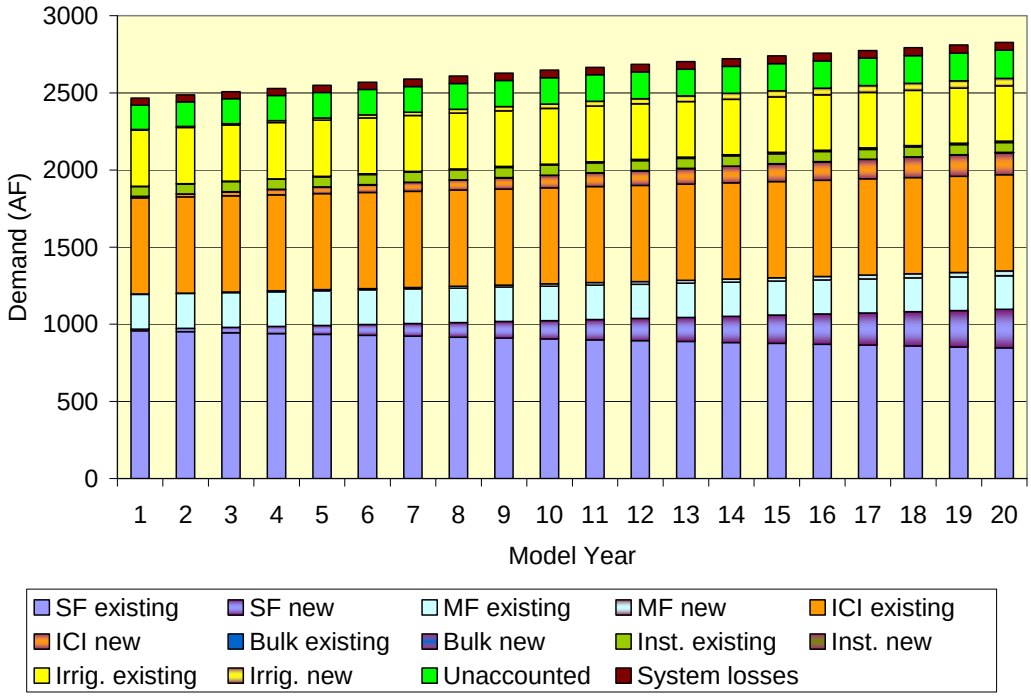


Figure 13: Forecast demands by sector under Scenario B, current and recommended water conservation program

Table 11 shows where the estimated water savings in Scenario B will come from over a 20 year period (vs. Scenario A). The gradual reduction in irrigation application rate resulting from education programs, the City's conservation oriented rate structure, and anticipated irrigation improvements in the coming years result in the largest component of the estimated savings. Fixture replacements in new and existing residential properties and a small reduction in the irrigated area of new properties account from the remainder of the water use reductions estimated from this scenario.

Table 11: Estimated water savings from Scenario B

Conservation Measure - Changes from Scenario A to Scenario B	Level of Change	Estimated Savings over 20 years (AF)	% of Savings vs. Scenario A	% of Total Savings
Gradual reduction in irrigation application rate in Glenwood Springs.	0.0% to -1%	82	2.8%	63.1%
Replacement of old, inefficient fixtures and appliances - Existing SF homes.	1% if fixtures per year are retrofit. 80% of retrofits are to EPA standards, 20% are to BAT.	22	0.7%	16.9%
Reduction in average irrigated area of new SF residential landscapes (sf)	2100 to 1900	9	0.3%	6.9%
Installation of BAT fixtures and appliances in new SF homes.	1% change from EPA to BAT	8	0.3%	6.2%
Replacement of old, inefficient fixtures and appliances - Existing MF homes.	1% if fixtures per year are retrofit. 80% of retrofits are to EPA standards, 20% are to BAT.	5	0.2%	3.8%
Reduction in average irrigated area of new MF residential landscapes (sf)	8000 to 7200	3	0.1%	2.3%
Replacement of old, inefficient fixtures and appliances - New MF homes.	1% change from EPA to BAT	1	0.0%	0.8%
TOTAL		130	4.3%	100%

Demand Scenario C – Expanded Conservation Program

Scenario C forecasts demand in Glenwood Springs under an expanded "medium level" conservation program. In this scenario, fixture and appliance retrofits in existing homes are accelerated through rebates and education to 1.5% per year. Additional homes adopt WaterSense and high-efficiency fixtures and appliances that exceed current plumbing code standards. It is also assumed that the program raises awareness about water conservation that in turn prompts a few single-family homeowners each year to reduce the amount of water applied to their landscape. In Scenario C, commercial, institutional and irrigation accounts are unaffected by the program.

Over the twenty-year forecasting period under Scenario C, annual demand rises to 2,748 acre-feet after 20 years and results in a savings of 210 af (7.0%) over Scenario A.

Demand Scenario D – Aggressive Conservation Program

Scenario 4 forecasts demand in Glenwood Springs under an expanded "aggressive" conservation program. This scenario is identical to scenario 3, but includes new building codes that limit the amount of irrigated landscape for new multi-family and single-family homes. Additionally, residential irrigation application rates are assumed to decrease by 1%.

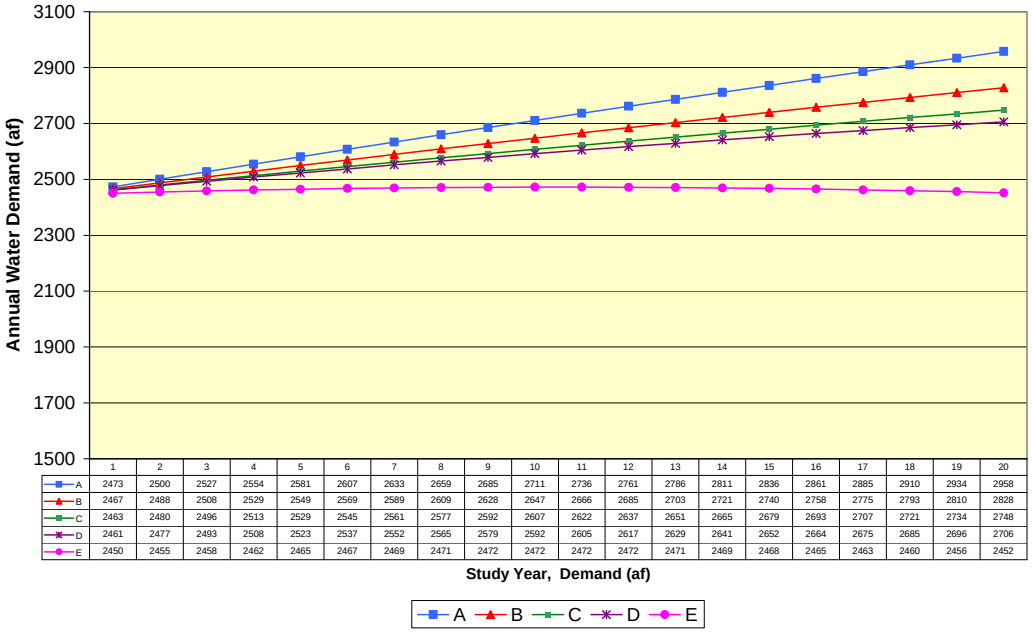
Over the twenty-year forecasting period under scenario 4, annual demand rises to 2,706 acre-feet after 20 years and results in a savings of 252 af (8.5%) over Scenario A.

Demand Scenario E – No-Growth in Demand Conservation Program
The final contemplated conservation model looked at measures needed to hold water demand flat for the next twenty years. While this program is not cost effective, it presents an alternative way to conceptualize adding more supply to the system. Under this scenario, 2.5% of all existing residential accounts retrofit their water using fixtures every year and these retrofits are entirely WaterSense and high-efficiency fixtures and appliances.

Building codes would reduce new residential landscapes to two-thirds the size of existing landscapes. Irrigation rates would be reduced by 2.5%. Five percent of commercial accounts would reduce water use by 10 percent each year. This could be accomplished by creating a retrofit program targeting commercial accounts. Some (2.5%) of irrigation accounts would also reduce irrigation by 20%.

Over the twenty-year forecasting period under scenario 5, annual demand rises to 2,452 acre-feet after 20 years (an increase of only 2 af) and results in a savings of 506 af (17.1%) over Scenario A. This scenario would allow Glenwood Springs to grow over the next 20 years with very little chance it would need to add new supply or make significant modifications to its current raw water supply system. It would also preserve the ability of the best quality water available to the system in its Grizzly and No Name Creek watersheds to serve the system demands.

Results of the five scenarios are compared in Figure 14. Forecast demands under scenario B – the current and recommended program – are compared against the average and dry year yield of Glenwood Springs' water rights in Figure 15. Here it can be clearly seen that the City has ample water to meet the 20 year forecast demand and in all likelihood, the 100-year forecast demand.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	2473	2500	2527	2554	2581	2607	2633	2659	2685	2711	2736	2761	2786	2811	2836	2861	2885	2910	2934	2958
B	2467	2488	2508	2529	2549	2569	2589	2609	2628	2647	2666	2685	2703	2721	2740	2758	2775	2793	2810	2828
C	2463	2480	2496	2513	2529	2545	2561	2577	2592	2607	2622	2637	2651	2665	2679	2693	2707	2721	2734	2748
D	2461	2477	2493	2508	2523	2537	2552	2565	2579	2592	2605	2617	2629	2641	2652	2664	2675	2685	2696	2706
E	2450	2455	2458	2462	2465	2467	2469	2471	2472	2472	2472	2472	2471	2469	2468	2465	2463	2460	2456	2452

Figure 14: Comparison of demands under five conservation scenarios

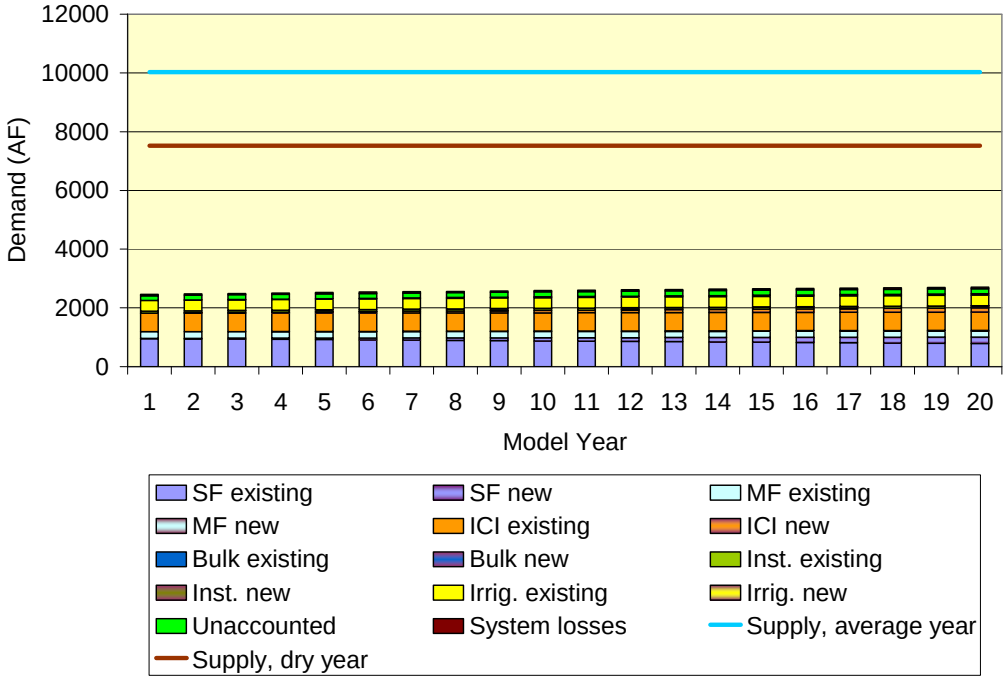


Figure 15: Forecast demands under Glenwood Springs conservation program (Scenario B) and average and dry year yields from water rights portfolio

COST EFFECTIVE CONSERVATION MEASURES

The City of Glenwood Springs has an ample raw water supply and excess water treatment capacity to meet current demands and all projected future demands over the next 20 years. There are no infrastructure projects that could be delayed or eliminated if the City were to adopt a more aggressive water conservation program. Because of the City's fortunate position regarding their water supply and delivery system, the financial benefits of increased water efficiency in Glenwood Springs are essentially non-existent. Some small cost savings might be achieved through reduced chemical costs and a small amount of reduced pumping, but these would most certainly be offset by the decrease in revenue associated with demand reductions. In Glenwood Springs, there is not a significant financial benefit (from the City's perspective) to increased water use efficiency at this time.

A cost effectiveness analysis was conducted to compare the economic benefits of the four proposed water conservation scenarios. This analysis did not assume any new costs to be associated with the current program, but new costs were associated with scenarios 3-5. Since Glenwood Springs has no pending water supply infrastructure projects and because the raw water supply is ample to meet anticipated future demands, there are now avoided costs associated with demand reductions. The results are shown in Table 12.

Table 12: Cost effectiveness analysis of water conservation programs

Conservation Program Scenario	Estimated Additional Annual Program Costs ($)	Estimated Annual Water savings (af)	Avoided Cost for Water ($/af)	Estimated Total Avoided Costs ($)	Benefit/ Cost Ratio
Current conservation program-Scenario B	$ -	130	$0	$0	NA
Expanded conservation program- Scenario C	$23,300	210	$0	$0	NA
Aggressive conservation program-Scenario D	$33,200	252	$0	$0	NA
No-growth in demand conservation program-Scenario E	$44,100	506	$0	$0	NA

Table 13 includes a matrix with the nine required State planning elements and indicates which elements are included as a feature of each scenario developed for Glenwood Springs. Detailed descriptions of each scenario are provided in the text above.

Because Glenwood Springs has an ample water supply to meet all projected future demands and because there are no major infrastructure improvements (beyond normal maintenance) planned for the Glenwood Springs treated water delivery system, there are no calculable avoided costs for new water. Consequently it is not possible to calculate a benefit/cost ratio for any of the conservation scenarios developed in this study. For his conservation plan, all required elements

were considered, but ultimately the current conservation program was selected as the best option for Glenwood Springs.

Table 13: Conservation measures included in scenarios and benefit-cost evaluation

Savings Measures and Programs Considered	Conservation Program Scenario			
	Current conservation program- Scenario B	**Expanded conservation program- Scenario C**	**Aggressive conservation program- Scenario D**	**No-growth in demand conservation program- Scenario E**
I. Fixtures and appliances		X	X	X
II. Waterwise landscapes, efficient irrigation, etc.			X	X
III. CII processes				X
IV. Water reuse	X	X	X	X
V. System leaks	X	X	X	X
VI. Information & education	X	X	X	X
VII. Rate structure	X	X	X	X
VIII. Regulatory measures	X	X	X	X
IX. Incentives & rebates		X	X	X
Estimated Additional Annual Program Costs	$ -	$23,300	$33,200	$44,100
Estimated Annual Water savings	130	210	252	506
Avoided Cost for Water	$0	$0	$0	$0
Estimated Total Avoided Costs	$0	$0	$0	$0
Benefit/Cost Ratio	Cannot be calculated since avoided costs = $0			

In spite of the lack of a real financial incentive for water efficiency, Glenwood Springs remains committed to their current conservation efforts, which include many of the most important and effective measures such as metering and conservation pricing.

There are a few enhancements to the City's conservation/water management program that the consultants recommend for consideration.

- Modify the billing database to distinguish between single family and multi-family customers.
- Modify the billing database to distinguish between different sub-categories of commercial and institutional end users - especially hospitality customers
- Consider providing the Orion Water Meter Monitors to customers when their meters are upgraded. This will help customers manage their water use better and will greatly increase the response of customers to leaks. (The WMM's will add approximately 20% to the cost of the new AMI units.)
- Develop water budgets for all irrigation accounts showing the monthly volumes of water needed by the landscapes based on irrigated areas, plant types and local ET.

CONSERVATION PLAN IMPLEMENTATION

The City of Glenwood Springs does not have a dedicated conservation staff member or a formal, stand alone water conservation program. However, the City has demonstrated a real commitment to water use efficiency, and even without a formal program has implemented many of the most essential water conservation program measures. The elements of this program are described in detail in this plan document.

Even though Glenwood Springs has ample water supply to meet all forecast future needs in the absence of any water conservation efforts, the City believes water efficiency and demand management are important values to instill in the utility and citizenry. The City plans to continue to promote wise water use and efficiency through a variety of efforts most notably their conservation oriented rate structure, automatic meter reading infrastructure, utility water loss control efforts, and public education.

Monitoring and Evaluation

Glenwood Springs will review and update this water conservation plan every five to seven years or as needed. The City monitors water use on a regular basis and will maintain consumption records. Progress towards meeting the conservation goal can be evaluated when the conservation plan is next updated and into the future using empirical data. This tracking analysis will help determine what (if any) additional conservation program measures are necessary to help Glenwood Springs meet their stated goal by 2030.

Beyond tracking conservation progress every five years, the City produces monthly and annual demand reports for each customer sector and the system as a whole and keeps close track of demand. Unexpected or abnormal water usage by a customer or sector is quickly identified and

investigated. The City is already using the new Badger AMI system to identify customer-side leaks and plans to expand this effort as more Orion meters are installed.

When the conservation plan is updated, new forecasts will be developed and the adequacy of the City's water supplies will be compared against forecast future demand. If necessary, the City will adopt additional demand management measures. The evaluation done for this plan indicates that Glenwood Springs has ample raw water supply to meet all forecast future demands.

Conservation Plan Review Process, Public Participation, and Adoptions

The City of Glenwood Springs rules requires a 30 day review process for public hearings and planning as stated in City Ordinance 020.030.060[13]. The public review process for this conservation plan commenced on June 5, 2009 and was concluded on July 6, 2009.

The plan document was made available on the City web site for download and was placed on review in hard copy form at utility offices. Residents and interested parties were invited to submit comments on the City web site (http://www.ci.glenwood-springs.co.us/) or via hard copy.

The following methods were used to announce the conservation plan and public comment period:

- The City placed a legal advertisement in the Glenwood Springs Post Independent announcing the plan and comment period. The announcement appeared in three separate issues of the newspaper.
- An announcement notice about the conservation plan and comment period was broadcast daily on the Glenwood Springs public access television Channel 12 from June 5-July 6, 2009.
- An announcement was broadcast on the local Glenwood Springs radio station KMTS from June 5-July 6, 2009.
- The plan was posted on the City's web page, with a link to provide written comments, and a phone number to provide verbal comments directly to the City's Public Works Director and Water & Wastewater Superintendent from June 5, 2009 until August 12, 2009.

No comments from the public were received during the comment period.

COMPLIANCE WITH STATE PLANNING REQUIREMENTS

Colorado Revised Statute § 37-60-126 requires a covered entity to develop, adopt, make publicly available, and implement a water conservation plan that will encourage its domestic, commercial, industrial, and public facility customers to use water more efficiently. Key elements that must be fully evaluated in development of the plan are listed as follows:

[13] http://www.ci.glenwood-springs.co.us/code/html/020.htm#Public_hearings

1. Water-saving measures and programs including: (I) water-efficient fixtures and appliances; (II) water-wise landscapes; (III) water-efficient industrial and commercial water-using processes; (IV) water reuse systems; (V) distribution system leak identification and repair; (VI) information and education; (VII) conservation oriented rate structure; (VIII) technical assistance; (IX) regulatory measures designed to encourage water conservation; (X) incentives to implement water conservation techniques including rebates.
2. Role of conservation in the entity's supply planning.
3. Plan implementation, monitoring, review, and revision.
4. Future review of plan within 5-7 years.
5. Estimated savings from previous conservation efforts as well as estimates from implementation of current plan and new plan.
6. A 60-day minimum public comment period (or other time period based on local ordinance).

The following section of the plan details Glenwood Springs' compliance with this statute.

Glenwood Springs Compliance

The City of Glenwood Springs developed this conservation plan in order to comply with C.R.S. § 37-60-126. Each element of compliance is documented below.

1. **Consideration of specific conservation measures** -

(I) *Fixture and appliances* – The City actively promotes the installation of water efficient fixtures and appliances through their regular conservation education efforts. The City has carefully considered and evaluated the costs and benefits associated with rebates and incentives to encourage more rapid adoption of efficient technology, but no additional expenditures are economically justified because of the ample raw water supply available.

(II) *Water wise landscape* – The City actively promotes water wise landscaping practices through their regular conservation education efforts and conservation-oriented rate structure and the City maintains a Xeriscape demonstration garden at the Community Center. The City irrigates a number of properties using raw water and will continue to seek new opportunities for raw water irrigation. The City has carefully considered and evaluated the costs and benefits associated with rebates and incentives to encourage more efficient irrigation and water wise landscaping, but no additional program expenditures are economically justified because of the ample raw water supply available.

(III) *Commercial, Industrial and Institutional (CII) measures* – The City actively promotes CII water conservation through their regular conservation education efforts and conservation oriented rate structure. The hospitality industry – the biggest water users in Glenwood Springs – has voluntarily adopted a variety of water efficiency measures and practices. The City has carefully considered and evaluated the costs and benefits associated with rebates and incentives to encourage CII retrofits and efficiency, but no additional program expenditures are economically justified because of the ample raw water supply available.

(IV) *Water reuse systems* – Water from the wastewater plant is reused and this practice will continue at the new wastewater plant. Glenwood Springs has limited opportunity (and need) to further expand water reuse efforts.

(V) *Water loss and system leakage reduction* – Current program includes an active utility water loss and leak detection program. The new metering system is being used to help ID customer side leaks. The City has worked hard to replace aging water mains and reduce water loss wherever possible.

(VI) *Information and public education* – A key component of Glenwood Springs' water conservation efforts is public education and information. The City regularly provides information to customers about ways to conserve water and avoid water waste through flyers and bill stuffers and the utility maintains conservation materials and information that are available upon request.

(VII) *Water rate structure* – Glenwood Springs currently bills its customers on a monthly basis using a three-tier inclining block rate structure. This conservation oriented rate structure has been in place since January 2000.

(VIII) *Technical assistance* – none was requested for development of this plan.

(IX) *Regulatory measures* – Glenwood Springs requires all new construction to include a pressure-reducing valve. The City has adopted the 2003 IRC and the 2003 IPC as requirements for new construction, which includes a number of standard efficiency measures. The City regularly reviews local codes and regulations for opportunities to specify water conservation requirements.

(X) *Incentives* – Glenwood Springs promotes the replacement of old and inefficient toilets, showerheads, faucets, and clothes washers through its regular education efforts. In the past Glenwood Springs has sponsored a retrofit program for showerheads, toilets, and faucets but does not currently implement this program because it is not cost effective given the water supply conditions.

2. Role of conservation in Glenwood Springs supply planning. This water conservation plan represents Glenwood Springs' most comprehensive effort to integrate water conservation into water supply planning. Through this plan, the City has clearly established that their raw water supply is sufficient to meet future growth under all current planning scenarios.

3. Plan implementation, monitoring, review, and revision. The City monitors water use on a regular basis and will continue to do so. The City produces monthly and annual demand reports for each customer sector and the system as a whole and keeps close track of demand. Glenwood Springs will review and update this water conservation plan every five to seven years or as needed. During this review, progress towards achieving the stated conservation goal will be evaluated.

4. **Future review of plan within seven years.** Glenwood Springs will review and update this water conservation plan every five years or as needed.

5. **Estimated savings from previous conservation efforts and current plan.** Over the twenty-year forecasting period under the City's conservation program, annual demand rises from 2,467 acre-feet to 2,828 acre-feet and results in a savings of 130 af (4.3%). The impact of past water conservation efforts have not been evaluated, but such evaluation is superfluous given the ample water supply available to the City.

6. **Public comment period.** As per local City practice and policy, the City of Glenwood Springs conducted a 30 day public comment period on this water conservation plan. The public comment period began on June 5, 2009 and was concluded on July 6, 2009. Citizens and interested parties were invited to comment via legal advertisement, radio spots, and public access TV announcements. The plan was posted on the City's web site and hard copies were made available at public offices. In an effort to fully comply with state guidelines, the plan remained available to the public on the City's web site until August 12, 2009. No comments were received from the public during this time period. Upon completion of the public comment period, the conservation plan was finalized and approved by the Glenwood Springs City Council. After council approved the plan, it was submitted to the Colorado Water Conservation Board in compliance with state statute.