Water

KEY PERFORMANCE MEASURES

- *Acre Feet of Treated Water Produced*
- *Flow Rates in Rivers and Streams*
- *Water Availability*
- *Macroinvertebrate Populations in Rivers and Streams*

The Aspen community has a sufficient supply of safe, clean water to satisfy a full range of municipal and other purposes while maintaining healthy streams and rivers. *Resources such as the Roaring Fork River and its tributaries are essential to the vitality of the Aspen area, providing high-quality water for a variety of purposes. Because of its heavy dependence on this limited resource, it is important for the City to have minimal negative impacts on water quality and quantity. Only if Aspen has a sufficient supply of clean water for drinking and recreation, will residents and visitors be able to continue enjoying the life and natural amenities for which the area is known. Aspen takes responsibility for and minimizes pollutants entering waterways through storm water and waste water pollution prevention.*

Water is a vital resource for all of those who live, work, and play in the Roaring Fork Valley. Responsible water consumption, as well as river and stream health and quality, is paramount to the current and future sustainability of Aspen's community. In the midst of the arid West, Aspen is a headwater community with relatively abundant supplies, but those supplies are constantly threatened. Accordingly, the City bares significant accountability not only to its residents and visitors, but to all of those downstream of Aspen as well.

In addition to the mountain landscape that surround it, the Roaring Fork River is one of the defining elements of Aspen. It carves through the center of town and eventually makes its way to confluence with the Colorado River in Glenwood Springs. Hunter, Castle, and Maroon are all significant creeks that join into the Roaring Fork River near town. Castle and Maroon creeks source the majority of Aspen's drinking water. All of these rivers and creeks, in addition to a variety of smaller waterways, ponds, and lakes provide vibrant ecosystems for wildlife habitat, ecological buffers and filters for pollution, and ample recreation opportunities.

The measures which represent and track the environmental sustainability of water-related issues in Aspen's Sustainability Report were carefully chosen by a collection of local stakeholders. This focus group decided upon the four following topics, which are introduced in the subsequent pages:

- *Acre Feet of Water Produced*
- *Flow Rates in Rivers and Streams*
- *Water Availability*
- *Macroinvertebrate Populations in Rivers and Streams*

Acre Feet of Treated Water Produced

The City of Aspen Water Department serves a total of 3910 potable (drinkable) water customer accounts, as well as 73 raw water accounts.[62] The water treatment plant is located in between Maroon and Castle Creeks and sources, filters, and treats the water used throughout the city. All potable water that exits the City of Aspen water treatment plant is measured as it leaves. These figures are presented in the following one-page dashboard:

- *Acre Feet of Treated Water Produced*

Acre feet (AF) is the unit in which water consumption is presented. One AF translates to 325,851 gallons of water, which can more easily be understood as the approximate annual usage of one suburban home.

Figure 1. Water storage and treatment facilities at the City of Aspen Water Department.[63]

Tracking Aspen's annual water consumption is an essential step in managing this precious resource, understanding the impact of population rise, and measuring the success of water efficiency efforts. Historically, Aspen has assumed a 1.8% increase in water demand each year.[64] To deal with this rising demand, the City will likely have to expand water delivery capacity and conservation measures in the future. A small selection of current water conservation projects is listed in the Current and Proposed Actions text box. In particular, irrigation and commercial indoor water use represent two areas of great potential for water conservation in Aspen.

[62] *City of Aspen Water Department.*
[63] *Armstrong, Laura. 2016.*
[64] *City of Aspen Water Supply and Availability Study: 2016 Update. Rep.: Wilson Water Group, 2016.*

Flow Rates in Rivers and Streams

In the 1970s, diversions to urban areas caused many of Colorado's rivers and streams to run at low and unhealthy levels, negatively impacting the vitality of river ecosystems and surrounding communities. In 1973, Colorado passed legislation to protect and maintain a designated level of instream flow (INF) throughout the entire length of rivers and streams.[65] An INF is the agreed upon level which water should never drop below to ensure healthy ecosystems. Stream flow is measured by the rate of cubic feet/second (cfs).

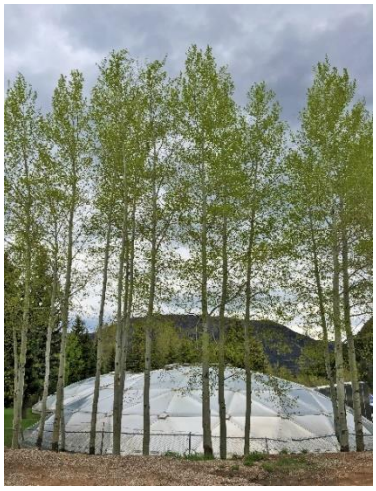


Figure 2. City of Aspen Water Treatment Facilities.[66]

The INF for the rivers and creeks near Aspen are as follows:

Roaring Fork River	32 cfs
Castle Creek	12 cfs: CWCB* 13.3 cfs: Aspen
Maroon Creek	14 cfs
Hunter Creek	15 cfs

*The Colorado Water Conservation Board established a 12 cfs INF for Castle Creek.[67] However, the City of Aspen observes an INF of 13.3 cfs, which is much healthier for stream ecology.[68]

Precipitation, weather patterns, and water use all contribute to whether these INF are satisfied. All of the waterways listed above are diverted for human consumption purposes. Aspen's treated water supply is chiefly sourced from senior water rights on both Castle Creek and Maroon Creeks,[69] though other water users claim rights on those creeks as well. The Roaring Fork River is principally diverted at the Twin Lakes Tunnel, 14 miles upstream of Aspen, and sent to the Arkansas River Basin.[70] Hunter Creek feeds a trans-mountain diversion through the Charles H. Boustead Tunnel.[71] All of these creeks and rivers are also used in local irrigation systems and ditches.

Just as measuring low flows in streams and rivers is important, so too is understanding the importance of peak flows, which flush out waterways and riparian areas, dispersing pollutants and promoting future

---

[65] *"Instream Flow Program." Colorado Water Conservation Board. Colorado Department of Natural Resources, Web.*
[66] *Armstrong, Laura.*
[67] *"CWCB Stream Cases." Colorado Water Conservation Board. Colorado Department of Natural Resources, Web. <http://cwcb.state.co.us/technical-resources/instream-flow-water-rights-database/Pages/main.aspx>.*
[68] *City of Aspen Water Supply and Availability Study: 2016 Update. Rep.: Wilson Water Group, 2016.*
[69] *Ibid.*
[70] *"Water-Year Summary for Site 09073400." National Water Information System. USGS. Web. <http://nwis.waterdata.usgs.gov/nwis/wys_rpt/?site_no=09073400>.*
[71] *Ibid.*

growth. The corresponding one-page dashboard presents data on annual 7-day minimum and maximum flows on the Roaring Fork River and Castle Creek:

- *Flow Rates in Rivers and Streams*

Water Availability (Data Pending)

Water availability compares the total demand on a water-delivery system with its estimated supply capacity. In Aspen, these values of demand and supply are influenced by a number of factors:

Impacts on Water Demand	Impacts on Water Supply
Number of Customers	Climate
Customer Behavior and Use	Precipitation, Weather, Temperature
Climate and Weather	Capacity of Water Treatment System
Water Conservation Measures	Water Storage
Water Rates	Upstream Diversions
Drought Regulation	Water Rights

Clearly, the interplay of these factors has the potential to be quite dynamic. Understanding current availability, in addition to analyzing and planning for the future, is critical to local water security.

One of the ways in which the City of Aspen measures water demand is by assigning each water account a specific number of equivalent capacity units (ECU) based on the number of fixtures in that building or space. For Aspen, "an ECU can be approximated by a one bedroom, one bathroom home with a fully equipped kitchen, an exterior hose bib, and a ¾-inch domestic service line."[72] As of December 31st, 2015, the ECU count in Aspen was 17,403.11.[73] The Water Department predicts future water needs and plans for expansions in treatment capacity and distribution by "tracking water demand factors for building permits for all new construction and remodels, as well as limiting the total water demand in all new extraterritorial water service contracts."[74]

The total ECU available is constrained by seasonal water volume in Maroon and Castle Creeks, as well as water storage capacity within Aspen. The City of Aspen sources drinking and raw water directly from rivers and creeks, and has very little ability (one 10 AF reservoir) [75] to store water to meet future or seasonal uses. Accordingly, the water flowing through Aspen's rivers and streams and into the treatment plant must be equal to or greater than the current ECU count.
Though data is currently pending to complete this measure, in future iterations of this report, the complementary one-page dashboard will the Aspen's current ECU commitments to the projected capacity of the current system:

- *Water Availability*

[72] *City of Aspen Water Supply and Availability Study: 2016 Update. Rep.: Wilson Water Group, 2016.*
[73] *City of Aspen Water Department.*
[74] *ELEMENT Water Consulting & WaterDM. Municipal Water Efficiency Plan. Rep.: City of Aspen, 2015, p. 18.*
[75] *City of Aspen Water Supply and Availability Study: 2016 Update. Rep.: Wilson Water Group, 2016.*

Hunter Creek Near Aspen.[76]

PERSPECTIVE

Historical water conservation in Aspen

"The City of Aspen's conservation program dates back to the early 1970s when water service began to be based on metered usage and the City completed an inventory of ECUs connected to the system. Aspen's water efficiency program has evolved over time, including the initiation of the water audit and leak detection programs in 1995 and the implementation of a tiered water rate structure in 2006." [77]

Macroinvertebrate Populations in Rivers and Streams (Data Pending)

One of the widely accepted standards for assessing river health is analyzing the macroinvertebrate (small insects and larvae) life that inhabits the waterway. The collection of species found, their diversity, and sensitivity to pollution, is analyzed as a proxy for overall stream condition.[78]

The federal Clean Water Act mandates that all states monitor and report on river and stream health, specifically listing all segments that are "too polluted or degraded to meet water quality standards"[79] on a State-wide 303d list. Aquatic life, measured by macroinvertebrate population sampling, is one of the categories by which river and stream segments are tracked. Under the Clean Water Act, the Roaring Fork River was designated as impaired in 2011, due to its unhealthy aquatic life.

For cases of pollution found in rivers, the EPA has a standard remediation process by which the pollutant source is identified and an analysis is conducted to determine needed reductions to bring the river back to healthy levels.[80] However, as of 2016, the EPA has not identified a specific procedure for remediation of aquatic life and it is unclear which pollutants and sources should be targeted to reduce degradation on the Roaring Fork. Continued study, as well as more comprehensive river stewardship, are important steps forward in understanding and improving the health of the Roaring Fork River.

At the time of publishing, data for the *Macroinvertebrate Populations in Rivers and Streams* one-page dashboard was not available. In future years, it is hoped that this report will include data that describes the results of aquatic life sampling in a number of locations along the Roaring Fork River near Aspen.

---

[76] *Photo: Babbie, Sheila. 2016.*
[77] *ELEMENT Water Consulting & WaterDM. Municipal Water Efficiency Plan. Rep.: City of Aspen, 2015, p. 28-29.*
[78] *"Indicators: Benthic Macroinvertebrates." EPA. Web. <https://www.epa.gov/national-aquatic-resource-surveys/indicators-benthic-macroinvertebrates>.*
[79] *2015 Annual Report. Rep. Basalt, CO: Roaring Fork Conservancy, 2015.*
[80] *"Overview of the Impaired Waters and TMDL Program." EPA. Environmental Protection Agency, Web. <http://www.epa.gov/tmdl/overview-impaired-waters-and-tmdl-program>.*

Current & Proposed Actions

- Water conservation actions being taken by the City of Aspen:
  - Landscaping ordinance: drafted ordinance to incentivize arid landscaping and efficient irrigation practices.
  - Tiered Water Rates: "inverted rate blocks" economically incentivize less water use. Water users who fit into the lowest use bracket pay significantly less than 2nd and 3rd tiers.
  - Home and Commercial Water Audits: "Slow the Flow" program is offered for free to residents and businesses. Identifies water saving opportunities and installs quick fixes.
  - Living Wise: hands-on water conservation curriculum taught in local middle school.
- In order to continue increasing water availability, a water utility can:
  - Increase the gallons allotted to each ECU and other water rate adjustments.
  - Increase water storage, and assess the future use of groundwater sources.
  - Anticipate and plan for periods where low flow and peak usage coincide.
  - Expand use of reclaimed and raw water (replacing treated) for irrigation and snowmaking.
- The Stormwater Program and Clean River Initiative has worked diligently since 2008 to decrease urban impacts on the Roaring Fork. This includes:
  - Large regional capital projects (such as the John Denver Sanctuary) at outfalls to remove urban pollutants through natural methods such as filtration, infiltration, settling, and plant uptake. Smaller projects throughout town that disconnect the City's impervious area and remove pollutants via the same methods but on a much smaller scale.
  - Regulation of construction and development to decrease the presence of pollutants and prevent or significantly reduce the discharge of pollutants from the site.
  - Inspection and enforcement against illicit discharges in the City's stormwater system.
  - Public education regarding the sources of pollution, connectivity of urban run-off to local waterways, and best management practices to reduce the introduction of pollutants.
  - Land development restrictions that encourage restoration of the river's riparian areas.

Figure 3. A head gate, which supplies water to the City of Aspen treatment plant.[81]

[81] *Armstrong, Laura. 2016.*

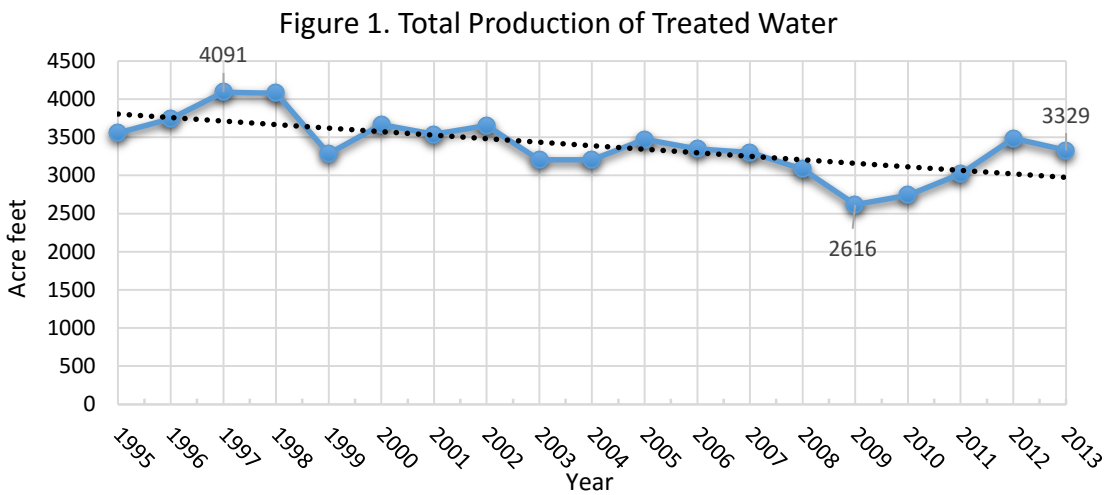
Acre Feet of Treated Water Produced

What is it? Why is it important?

Aspen has a finite amount of water available for indoor use, irrigation, drinking and sustaining life. By measuring the total amount of treated water that is produced in Aspen, the City can better understand current usage and future needs. The City of Aspen Water Department measures the clean water leaving the treatment plant in acre feet (AF). One AF is typically thought to represent the annual water use of a suburban home and is equal to 325851 gallons of water.

What does the data/trend say?

The data in Figure 1 represents the total treated water that leaves the City of Aspen treatment plant and wells each year to serve its 3910 customer accounts from 1995-2013. In recent years no well water has been added to the water supply.[1] The dotted black line represents an overall decreasing trend in treated water consumption from 1995-2013, with the lowest year (2009) corresponding with economic recession, as well as a wet summer. In general, low water use is most highly associated with high precipitation, which reduces irrigation use. The 2012 peak is most likely correlated to the drought in that year. The trend since 2009 has been increasing water consumption, with one drop in 2013.



Sampling at the City of Aspen Water Treatment Plant

Targets

In its Municipal Water Efficiency Plan, the City of Aspen establishes an average water efficiency goal of approximately 28 AF (0.7%) reduction in treated demand per year compared with a continuation of current demand. There is an assumed 1% increase in demand/year. By 2035, it is estimated that this program will reduce treated demand by about 583 AF – an overall 14% reduction.[2] Aspen's progress toward this target will be evaluated when current data is available.

Data Sourcing and Considerations

Water production figures from 2014-2015 were not available at the time of publishing. Production data includes all water that leaves the water treatment plant accounting for water used by customers as well as leaks or inefficiencies in the system. In the future, this measure could compare production data to consumption data (measured by consumer meters) and could also contain information about the raw water accounts that the City of Aspen serves.

Sources: [1] [Figure data] [2] ELEMENT Water Consulting & WaterDM. Municipal Water Efficiency Plan. Rep.: City of Aspen, 2015. [Photo] City of Aspen Water Department

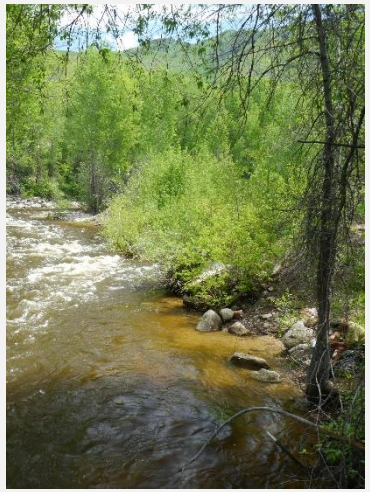
Flow Rates in Rivers and Streams

What is it? Why is it important?

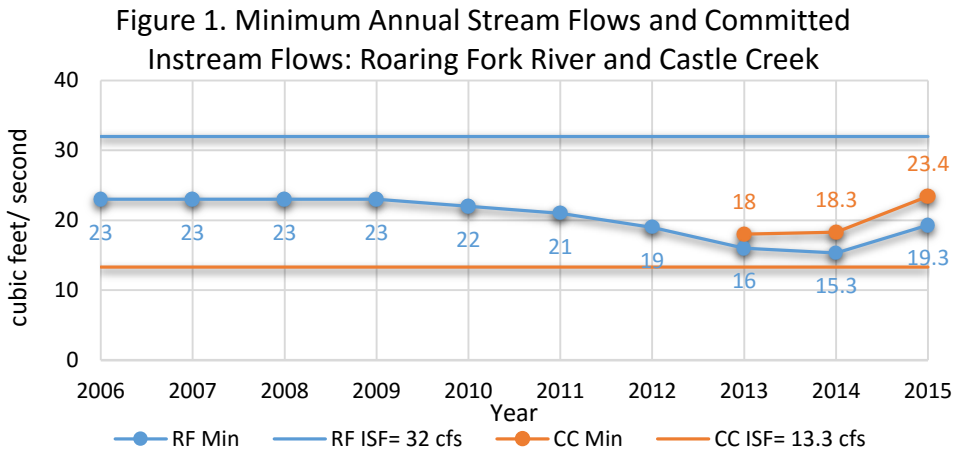
Aspen's rivers and streams are healthiest when the flow rates are kept above the minimum tolerable level, fluctuate with the seasons, and experience peak flows.[1] To protect water ways from reaching dangerously low levels, Colorado has designated **instream flows (INF)** below which no part of the river should fall. INF levels should be considered a bare minimum at which a river can maintain health for a short period of time. A river that runs at or near its INF for a sustained period is likely quite unhealthy. The INF for the **Roaring Fork River (RF)** is 32 cubic feet/second (cfs) and 13.3 cfs for **Castle Creek (CC)**.[2]

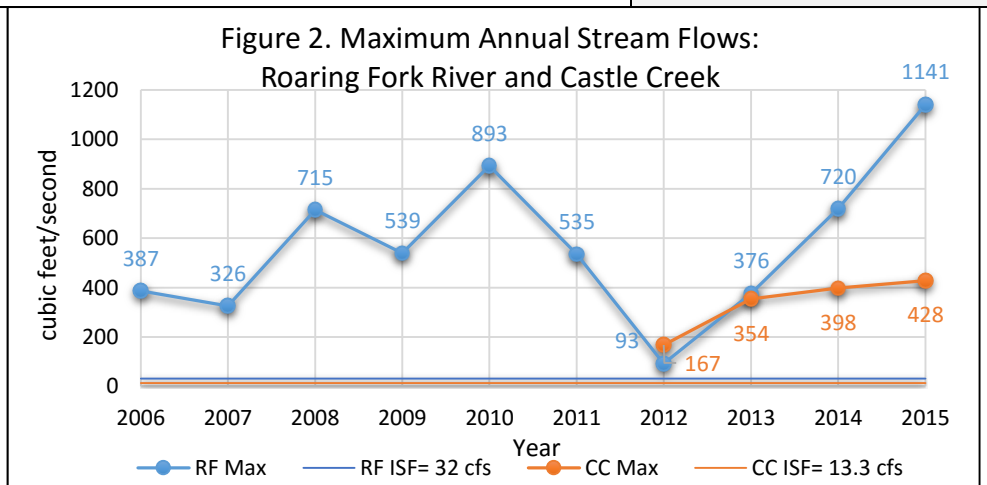
What does the data/trend say?

Figure 1 compares the annual 7-day minimum stream flows of the RF and CC with their respective INF. In the 2013-2015 water years (Oct-Sep), **CC flow rates did not drop below the INF**. The closest minimum flow was 18 cfs in 2013, which is 4.7 cfs above the INF. CC water is diverted for use by the City of Aspen and other local water users. In contrast, the INF has been violated on the RF every year from 2006-2015, varying from 9 cfs below (2006-2009) to 16.7 cfs below in 2014.[3] Since 1935, the majority of diversion from the RF goes through the Twin Lakes Tunnel to the Arkansas River Basin.[4] **The City of Aspen also uses water from the RF, but curtails use when INF is not satisfied.** Figure 2 shows the annual 7-day maximum flows of the RF and CC. Dramatic variation in RF data corresponds to yearly precipitation, both in the Roaring Fork Valley and elsewhere in Colorado. When water supplies are abundant on the Front Range, trans-mountain diversions can be shut down, as was the case in 2015. In contrast, 2012 was an extreme drought year in Colorado.



The Roaring Fork River





Targets

Aspen's target is that minimum flows will not fall below instream flow commitments. Between 2013 and 2015, Castle Creek met this target. In every year between 2006 and 2015, the Roaring Fork has failed to meet the instream flow during its annual 7-day low.

Data Sourcing and Considerations

Year-round USGS stream flow data on Castle Creek began in spring, 2012. Accordingly, maximum flow data is available (run-off is in late spring), but minimum flow (occurs in winter) was first available in 2013. In the 2015, the USGS began measuring year-round streamflow data for Hunter Creek. In future years, with more data, Hunter Creek could also be included in this measure. The City of Aspen is investigating partnership opportunities with the USGS to install a Maroon Creek gauge.

Sources: [1] "Instream Flow Program." Colorado Water Conservation Board. Colorado Department of Natural Resources, Web. <http://cwcb.state.co.us/environment/instream-flow-program/Pages/main.aspx>. [2] City of Aspen Water Department [3][4][Figure data] "USGS Water Data for Colorado." National Water Information System. Web. <http://waterdata.usgs.gov/co/nwis/>. [Photo] Babbie, Sheila. 2016.

Water Availability

What is it? Why is it important?

This measure compares how much water is used in Aspen with the quantity or capacity available for use during peak use times. This allows the City of Aspen to gauge if adequate water supply is available for Aspen's current and future needs. Water availability also demonstrates the success of water conservation efforts. Every water account in Aspen is assigned a specific quantity of equivalent capacity units (ECU), representing projected usage. Pay structures and plans for expanded infrastructure and conservation efforts are based on the difference between ECUs in use and the total number of ECUs that can be supported by the system.[1]

What does the data/trend say?

As of 12/31/2015, all of Aspen's treated water accounts totaled 17,403 ECUs.[2] According to the Municipal Water Plan, as of the fall of 2015, the total available supply of ECUs in Aspen was 18,250.[3] The City of Aspen is currently piloting a reclaimed water system program that uses treated wastewater effluent for irrigation and snowmaking at the Aspen Golf Course and Highlands Ski Area, respectively. If this program moves forward, it has the potential to expand the total available supply to 20,400 ECUs.[4] **The Water Department is in the midst of re-evaluating the current amount ECUs available in our system through a process that includes modifying the number of gallons assigned to an ECU.** The City plans to use that up-to-date data when it is complete.

Maroon Creek feeds Aspen's water supply

On June 6th, 2016 Aspen City Council approved an ***annual water availability study,*** *which would include:*

- ***Date of peak snowpack measured at the Independence Pass and Schofield Pass SNOTEL sites.***
- ***Date of peak snowmelt runoff measured at the Maroon Creek and Castle Creek intake structures.***
- ***Monthly rainfall at the City Water Treatment Plant.***
- ***Diversions by other in-basin water users including the Herrick Ditch.***

Thomas Reservoir: a small (~10 AF) storage area at Aspen's water treatment plant.

Targets

Aspen will not exceed 90% of its total available ECUs before planning for system capacity expansion.

Data Sourcing and Issues

When the first water availability study is complete, it will be evaluated for use in this measure.

Sources: [1][3][4] ELEMENT Water Consulting & WaterDM. Municipal Water Efficiency Plan. Rep.: City of Aspen, 2015. [2] City of Aspen Water Department [Photo] Armstrong, Laura.