ECCV

Water & Sanitation District

WATER CONSERVATION PLAN 2018

Prepared by DiNatale WATER CONSULTANTS

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Abbreviations

acre-foot (AF)	Unit of volume to measure water, equivalent to an acre of area covered with one foot of water (325,850 gallons)
AFY	Acre-feet per year
ASR	Aquifer storage and recovery
AWWA	American Water Works Association
BP	Best Practice
CII	Commercial, Industrial, and Institutional
CWCB	Colorado Water Conservation Board
ECCV	East Cherry Creek Valley Water & Sanitation District
ET	Evapotranspiration, a combination of water evaporation from soil and exposed surfaces and plant transpiration that is the loss of water from plants
GIS	Geographic Information System
GPM	Gallons per minute
GPCD	Gallons per capita per day
HE	High efficiency
HOA	Homeowner's Association
LIRFs	Lawn irrigation return flows
MG	Million gallons
MGD	Million gallons per day
RO	Reverse Osmosis
SCADA	Supervisory Control and Data Acquisition
SFE	Single family equivalent
UCCWUA	Upper Cherry Creek Water Users Association
ULF	Ultra Low-Flow
WTP	Water Treatment Plant

Barr Lake, Brighton, CO. Photo: Shutterstock

Section 1 : Introduction

1.1 : Purpose

The East Cherry Creek Valley Water & Sanitation District (ECCV) has been proactive in promoting water conservation and efficiency and has implemented ongoing water conservation, public education, residential customer rebate, and nonpotable irrigation system programs. In response to the State requirements for water conservation planning, coupled with new developments in the field of water conservation, ECCV has updated its 2011 Water Conservation Master Plan with this 2018 Water Conservation Master Plan (the Plan). The development of this Plan has been funded in part by a grant from the Colorado Water Conservation Board.

The purposes of the Plan are to:

1. Assess the overall characteristics of current and future ECCV water use.
2. Summarize the current status of raw water supply and treatment capacity.
3. Use this information to frame ECCV's water conservation and efficiency program with respect to current and ongoing water supply needs and water demand management.
4. Provide a detailed assessment related to the identification and selection of future water conservation and efficiency measures and programs that ECCV may choose to implement.

Throughout its history, ECCV has provided safe, reliable, potable water to its residential, commercial, irrigation, and institutional water users. ECCV is committed to sustainable and efficient use of its water resources and uses an integrated water resources planning approach by implementing and integrating both water supply additions and water conservation measures to manage demands. In response to the sustainability commitment, ECCV has developed a renewable water rights portfolio. Although it has made a major effort to develop significant renewable water supplies, ECCV is constantly aware of the need to evaluate and refine its water supply and demand management efforts in light of developing trends and the state of the science. Water conservation technology has improved to the point that water use efficiency can be planned and implemented more reliably and predictably than at any time in the past.

This Plan recommends water conservation and efficiency measures and programs that will continue to promote, support, and sustain efficient water use by ECCV's residential, commercial, irrigation, and institutional customers. The Plan identifies the various stages of water conservation and efficiency for the next seven years and has been prepared in adherence with state statutory requirements.

1.2 : Organization

This Plan was prepared following the six steps outlined in the Colorado Water Conservation Board (CWCB) Municipal Water Efficiency Plan Guidance Document (2012). The six steps are as follows:

1. Profile of Existing Water System
2. Profile of Water Demands and Historical Demand Management
3. Integrated Planning and Water Efficiency Benefits and Goals
4. Selection of Water Efficiency Activities
5. Implementation and Monitoring Plan
6. Adoption of New Policy, Public Review, and Formal Approval

Each step of the planning process is incorporated in the Plan, noting that Step 5 will occur only after the Plan has been accepted, approved, and implemented.

The Plan is organized as follows:

1. Introduction
2. Profile of existing system and proposed facilities
3. Historical and current water use
4. Existing conservation efforts
5. Identification and screening of proposed conservation measures
6. Demand forecasts with different conservation programs
7. Impacts of conservation programs
8. Implementation and Monitoring Plan

Although the Plan is organized differently than the CWCB Water Conservation Planning Guidance Document, each of the six steps has been incorporated into the Plan.

Section 2 : Profile of Existing System and Proposed Facilities

2.1 : District Formation

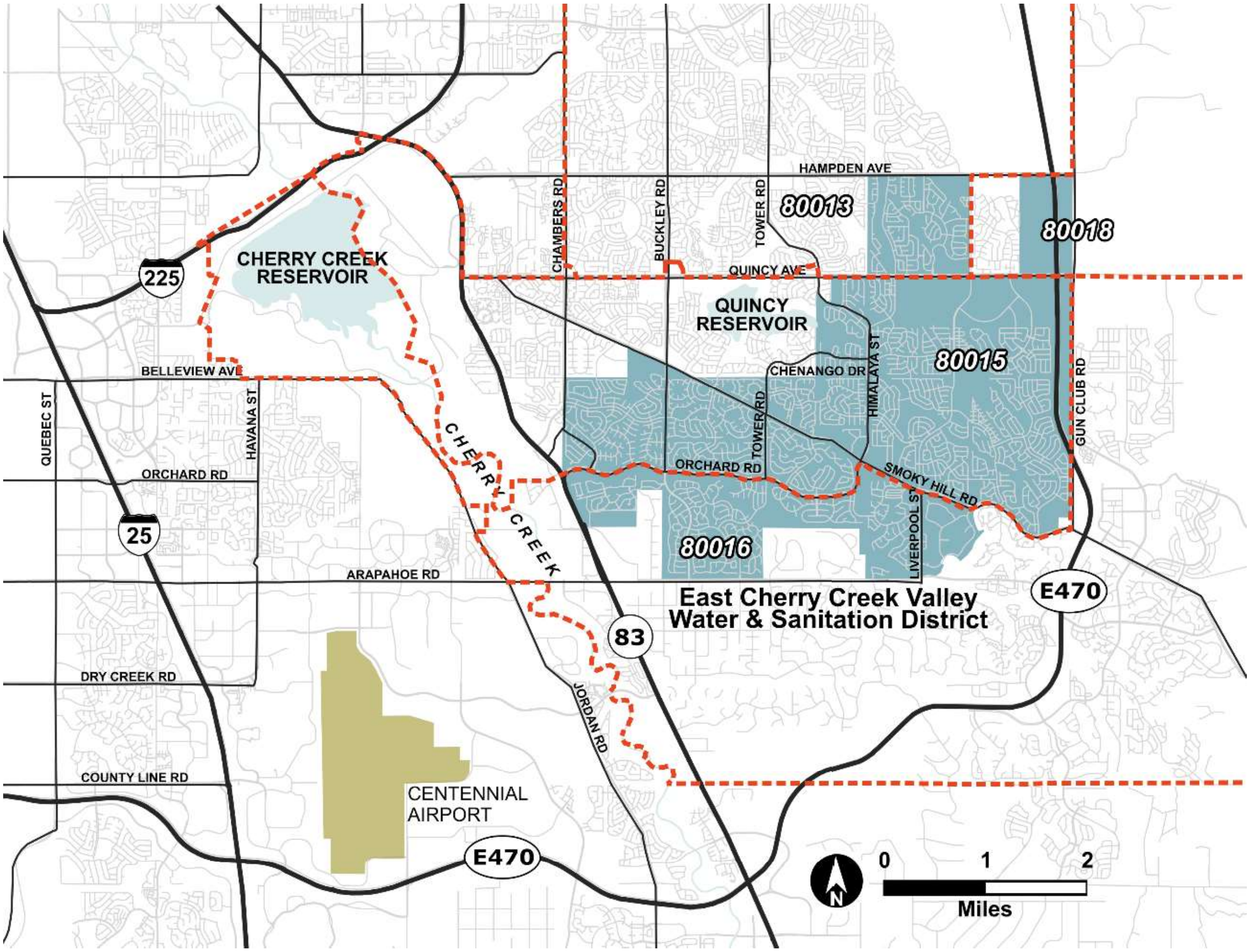
The East Cherry Creek Valley Water & Sanitation District is a quasi-municipal corporation and a political subdivision of the State of Colorado. ECCV was created pursuant to Article 1 of Title 32 C.R.S. for the purpose of providing a complete water supply system, complete sanitary sewer system, and a regional storm drainage system for the inhabitants of ECCV. ECCV was formed in 1962.

2.2 : Geography, History of Area, and Demographics

ECCV encompasses approximately 8,725 acres located in unincorporated Arapahoe County and the City of Centennial. It is located approximately 11 miles southeast of downtown Denver, Colorado and immediately south of the City of Aurora, Colorado. ECCV's service area includes both urban and rural areas of four ZIP codes. Census and demographic tracking by ZIP code is problematic because the ECCV service area covers portions, but not the entirety, of multiple ZIP codes. ECCV's service area is highlighted in blue in Figure 2-1.

FIGURE
2-1

Location of East Cherry Creek Valley Water & Sanitation District



ECCV is located along the historic Smoky Hill Trail. As noted in the description below, the geographic area of ECCV is characterized by dry streams and a lack of surface water. The portion of the Smoky Hill Trail through ECCV was known as the Starvation Trail. Legends of America (**http://www.legendsofamerica.com/ks-smokyhillstrail.html**) provides the following description of the history of the Smoky Hill Trail: Originally an age-old Indian trail along the Smoky Hill River traversing Kansas, the Smoky Hill Trail became an emigrant “highway” in 1859 when news of the discovery of gold in Colorado (Kansas Territory at the time extended to Kansas City). Ten years earlier, California-bound ‘49ers had turned either north (Oregon Trail) or south (Santa Fe Trail) to avoid the high barriers of the Colorado Rockies. The Smoky Hill Trail was virtually unused for that western migration. With the discovery of gold east of the Rockies, cutoff routes were made to Denver from both the Oregon and the Santa Fe Trails, but the main flow of the ‘59 gold rush was over the most direct route, the Smoky Hill Trail. Due to the scarcity of water and the danger of Indian attacks, it was by far the hardest and most dangerous of the three great prairie trails from the Missouri River to the Rockies.

The Smoky Hill Trail emigrants outfitted in Leavenworth, Kansas City, Abilene, or Salina and followed the Smoky Hill River to its headwater in southeast Colorado, near Old Cheyenne Wells. Here the Trail divided into the North Smoky, which took a cutoff to Hugo, and the South Smoky, which followed Big Sandy Creek to Hugo. They continued on the same route to Lake (just south of Limon), at which point the North Smoky continued on a route similar to present U.S. 40 through Buick (Bueck), coming into Denver from the east. The South Smoky took a more western route to present Kiowa and then northwest to Parker and Denver. Along this route were built the Mile Houses: 20 at Parker and 17 just north of the Arapahoe-Douglas County line; continuing on into Denver were the 12-, 9-, 7-, and 4-Mile Houses.

The third section of the Smoky Hill Trail in Colorado was the fateful Middle Smoky Hill Trail, often called the “Starvation Trail.” It was a direct western cutoff from the North Smoky near present Buick to the Kiowa Creek crossing and then a northwest route to Denver, meeting the South Smoky near what is now Quincy Avenue. The Smoky Hill Road of today, on which Smoky Hill High School was constructed, runs on the ridge of Sampson Gulch and coincides very closely with the Starvation Trail. It gained this nickname because so many people died on this route. They came in covered wagons and on foot, even with pushcarts and wheelbarrows. They were poorly equipped and scantily fed, and they faced the chilling winds and the snow and mud of early spring in their eagerness to reach the gold fields. This route was lined with abandoned property, broken wagons, dead horses, and many unmarked graves. They had met hostile Indians and had run out of water. Many of the creeks were dry, and when they did find water, they could not carry a long-lasting supply.

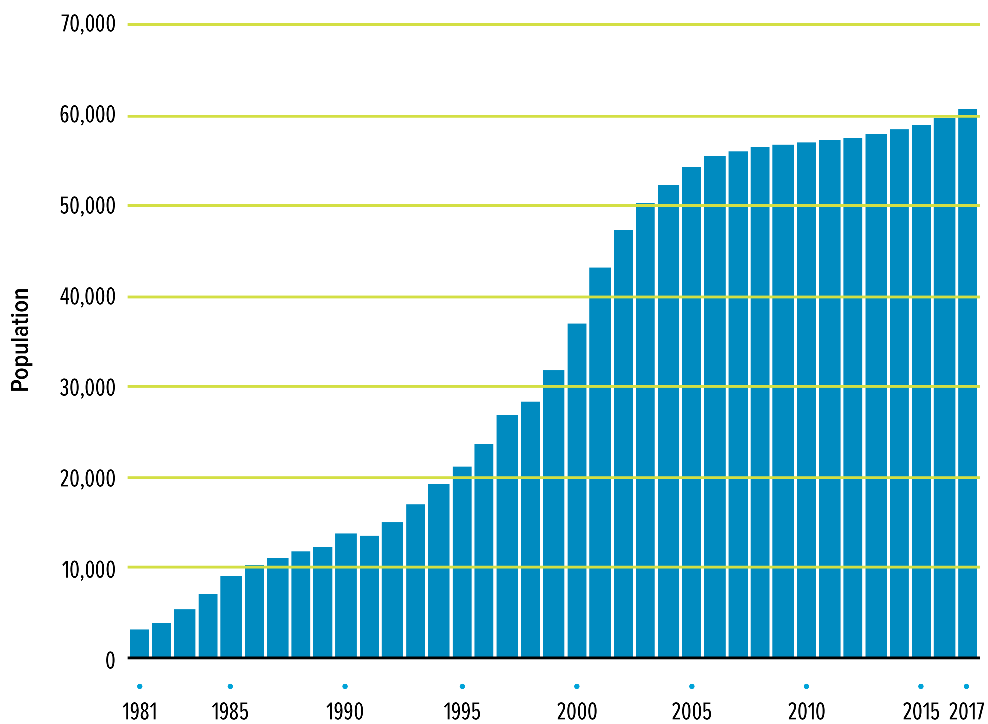
2.3 : Historical Water System Development

As noted in the description of the historic Smoky Hill Trail, ECCV is located in an area of limited and unreliable surface water supplies. The South Platte River is located many miles to the west and, at the time of District formation, ECCV did not have the financial resources to develop the water rights and infrastructure necessary to divert, store, convey, and treat surface water supplies from the South Platte. Local streams in the vicinity of ECCV have intermittent flow and are unreliable for meeting the primary water supply needs of a water district such as ECCV. As a result, at the time of District formation, water supply development initially focused on nontributary groundwater. Nontributary groundwater supplies in the Denver Basin formation were readily available, drought resistant, could be developed incrementally at a relatively low cost, and needed minimal treatment. ECCV's goal was to eventually develop renewable water supplies to supplement their existing nontributary groundwater supplies.

There was only minor growth in the District from its inception in 1962 through 1976. Growth during those years was annexed into and provided water service by the City of Aurora. Major development commenced in 1977. Figure 2-2 shows the estimated ECCV population for 1981–2017. Population in 1981 was approximately 3,100 and has steadily increased to an estimated population of approximately 60,600 in 2017. Growth rates in the early 1980s were as high as 40%. Since 1981, growth has averaged 9 percent per year.

FIGURE 2-2

ECCV Estimated Population 1981–2017



2.3.1 : Nontributary Groundwater

ECCV's existing nontributary groundwater supplies are derived from wells drilled in the Denver groundwater Basin. The Denver Basin formations underlying ECCV's service area include the Dawson, Denver, Arapahoe, and Laramie-Fox Hills formations. Figure 2-3 shows a cross-section of the Denver Basin aquifer formations.

The initial groundwater development to meet ECCV's water demands occurred within the District boundaries. Wells were drilled incrementally as development occurred. The nontributary groundwater supplies developed by ECCV require minimal treatment; therefore, ECCV does not have a central water treatment facility for treating its nontributary groundwater. Treatment to meet regulatory requirements for disinfection is completed at all sources prior to entry into the distribution system. Table 2-1 provides information on the number, location, and aquifer source of ECCV's existing nontributary groundwater wells.

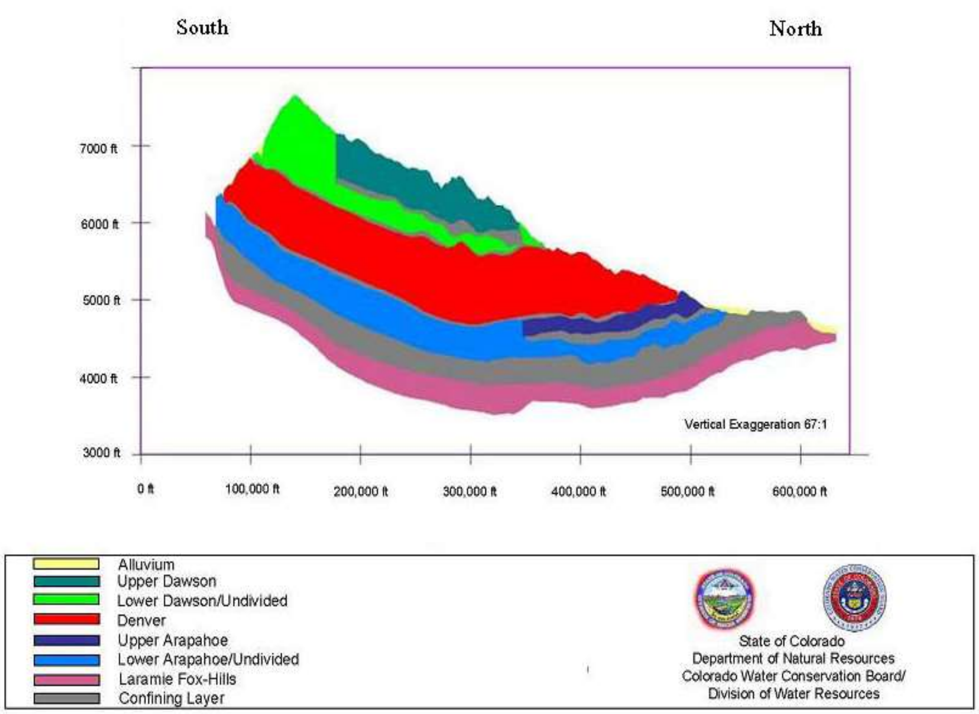


FIGURE 2-3

Denver Basin Aquifer South-North Cross Section – South Platte Basin

(Source: CWCB South Platte DSS)

ECCV's long-range water supply planning recognized that future renewable supply sources would be required to complement the existing nontributary sources and provide for long-term sustainability through aquifer storage and recovery or the development of additional renewable water supplies. As the search for renewable supplies continued, increasing water demands were met in the interim by drilling additional Denver Basin aquifer wells. Over time, ECCV did not realize the anticipated yields from the new wells as the result of a number of factors.

TABLE **2-1**

ECCV Nontributary Groundwater Supplies

Denver and Dawson basin wells are not in use.

Number of Wells in Each Aquifer				
Location	Denver/ Dawson	Arapahoe	Laramie-Fox Hills	Total
Within District	4	32	29	65
Western system	3	14	2	19
Total	**7**	**46**	**31**	**84**

2.3.2 : Two Forks Reservoir Project

The first major attempt by ECCV to develop renewable water supplies was through participation in the Denver Water Board's Two Forks Reservoir Project and System-wide Environmental Impact Statement (EIS). Two Forks Reservoir was a planned 1,100,000 acre-feet (AF) reservoir that would store water from the Colorado and South Platte River basins and provide over 100,000 AF per year of firm yield to Denver and its suburban participants. ECCV was one of the largest suburban participants in this project. ECCV's 6.05 percent participation in the Two Forks Reservoir would provide approximately 4,840 AF firm yield of renewable water supplies. The federal environmental permitting process commenced in 1982 with the suburban participants funding 80 percent of the cost of the EIS and other costs such as Denver Water Department staff time. After six years of environmental studies and over $40 million in expenditures by Denver Water Department and its suburban participants, the Army Corps of Engineers issued a final EIS and authorized a 404 permit for the construction of Two Forks Reservoir. The Environmental Protection Agency (EPA) vetoed the Two Forks Reservoir Project permit in 1989. The veto of the permit was not appealed by the Denver Water Board. As a result, ECCV was forced to seek other sources of renewable water and commenced a 15-year search for reliable sources of renewable water. ECCV began a permanent lease of 771 acre-feet per year (AFY) from Denver Water to compensate for the cancelled Two Forks Reservoir Project.

2.3.3 : State Board of Land Commissioners Wells

ECCV entered into an agreement with OAR, Inc., the predecessor to the Rangeview Metropolitan District (Rangeview), in 1983 for the lease and development of Denver Basin groundwater on nearby State Board of Land Commissioners (SBLC) Lowry Range land leased by OAR. In order to delay the need for immediate development of the SBLC wells, ECCV entered into a temporary water trade agreement with the City of Aurora. Pumping of groundwater from the SBLC wells eventually started in 1996 and was used by ECCV to provide water to the City of Aurora under the terms of the water trade agreement in exchange for water delivered from Aurora to ECCV. A total of eight wells were developed pursuant to this agreement, and ECCV built a pipeline from the SBLC wells to the ECCV treated water storage tanks on Smoky Hill Road to deliver groundwater pumped from those wells to ECCV when the wells were not being used to deliver water to Aurora.

These wells did not produce the desired yield to ECCV. This supply was intended to provide an interim water supply while long-term renewable water supplies were developed. In 2012, ECCV entered into a lease arrangement with Rangeview that, for the remainder of the original lease terms through 2032, this system would be leased back to Rangeview. As a result, this supply is no longer available to ECCV.

2.3.4 : Western Project

In 1999, ECCV entered into an agreement with the Willows Water District for the acquisition of the Willows nontributary groundwater system. This system is located near C-470 and Quebec outside and west of ECCV boundaries. The acquisition of the Willows system and construction of pumping and transmission facilities (the Western Project) provides additional potable water deliveries to ECCV to meet average and peak demands while ECCV continues to develop long-term renewable water supplies. The Western Project also provides valuable long-term drought protection backup to future renewable supplies as well as a potential aquifer storage and recovery (ASR) system that ECCV and potentially other South Metro water providers can use in the future to better manage water supplies in the Denver Basin aquifers. The acquisition of the Willows system was possible as the result of Willows entering into a treated water agreement with the Denver Water Board for service from Denver. The ECCV-Willows agreement was contingent on the Water Court approval of the transfer of the Willows nontributary groundwater rights. The Water Court approval was concluded in 2001 and ECCV received title to the Willows facilities.

ECCV constructed a 48–54 inch pipeline along a 14-mile alignment that follows C-470 and E-470 from Quebec Street to its storage tanks on Smoky Hill Road to deliver the groundwater from the Western wells to ECCV. The Western Water Project began delivering water to ECCV in May 2003. The Western Project represents a potential maximum of 3,500 AFY of nontributary groundwater supplies. The Western Booster Pump Station (WBPS) has a capacity of 14 MGD, but sustainable peak deliveries from this well field over an entire irrigation season without recharge are estimated at approximately 5 MGD. This supply was intended to provide an interim water supply while long-term renewable water supplies were developed through the Northern Water Supply Project.

In 2014, ECCV entered into an agreement with a consortium, including the Denver Water Board and the South Metro WISE Authority, which conveyed the Western Pipeline to these entities. ECCV has reserved 8 MGD capacity that will allow its continued use of the Western line. ECCV retains ownership of the wells and the WBPS.

The Quebec Street Water Treatment Plant was designed and constructed as part of the South Metro WISE project, wherein the South Metro WISE consortium purchased the Western Pipeline from ECCV. In order to achieve the water quality desired by South Metro WISE, an iron removal facility was constructed by the consortium.

The facility consists of four mixed media pressure filters with a nominal capacity of 4 MGD, with the capability to bypass a portion of the flows during high-demand periods. Iron filtration replaced orthophosphate sequestration of iron, as many of the South Metro WISE are within the Cherry Creek Basin and strict phosphate limits apply to their systems. The facility also provides chloramine disinfection to the water, replacing a free chlorine disinfection formerly applied. The facility is jointly owned by ECCV, Denver, and South Metro WISE; the facility is operated under contract by ECCV.

Water produced at the facility is introduced into the western end of the Western Pipeline, along with some purchased water from Denver Water. The total meter volume in at the western end of the line is matched by an equal volume of water drawn out of the pipeline's eastern end at the ECCV Zone 2 connection to the WISE system.

2.3.5 : Nonpotable Irrigation System

As part of ECCV's overall water management and conservation program, in 2004 the District implemented a nonpotable irrigation system. The ECCV nonpotable irrigation system pumps tributary groundwater from the Piney Creek alluvium. The nonpotable system provides an additional water supply that is derived from the reuse of ECCV potable deliveries via the capture of lawn irrigation return flows (LIRFs) from ECCV customers. These LIRFs return to the Piney Creek/Cherry Creek alluvium. The accounting for ECCV's LIRFs was decreed by Division 1 Water Court in Case No. 88CW054. As the ECCV wells have relatively junior water right priorities and are rarely in priority to pump, some of ECCV's out-of-priority alluvial well pumping is replaced (augmented) by the use of the ECCV LIRFs. The ECCV accounting for its replacement of out-of-priority well pumping for its nonpotable system is now coordinated as part of the Upper Cherry Creek Water Association (UCCWA) augmentation plan (Case No. 01CW284). The other members of UCCWA are the City of Aurora, Arapahoe County Water and Wastewater Authority, Cottonwood Water and Sanitation District, and Colorado State Parks.

The ECCV nonpotable system delivers disinfected treated nonpotable water to large irrigation customers in the southwest portion of ECCV. The system consists of three alluvial wells, a chlorination station, and a 2.3 MGD storage tank. The system currently supplies approximately 275 AFY of water. The use of the LIRFs represents a reuse of a scarce resource and reduces the demand for potable water supplies, including pumping of nonrenewable Denver Basin groundwater supplies.

ECCV is using its nonpotable system to the fullest legal extent. At times when ECCV did not have sufficient LIRFs to meet its nonpotable needs, it used LIRFs from the Upper Cherry Creek Water Users Association (UCCWUA), to which it belongs. Recently, ECCV also supplemented the nonpotable system with 10 MG diverted from the potable system at the end of the season. This is an indication that ECCV is maximizing the amount of nonpotable water delivered to its customers and at times must supplement the nonpotable system with potable supplies when there is a lack of nonpotable water. In 2017, ECCV added additional LIRF water in Case No. 12CW220. With the additional LIRF water, ECCV will reduce its use of UCCWUA LIRFs and reduce the use of potable water to supplement the nonpotable system.

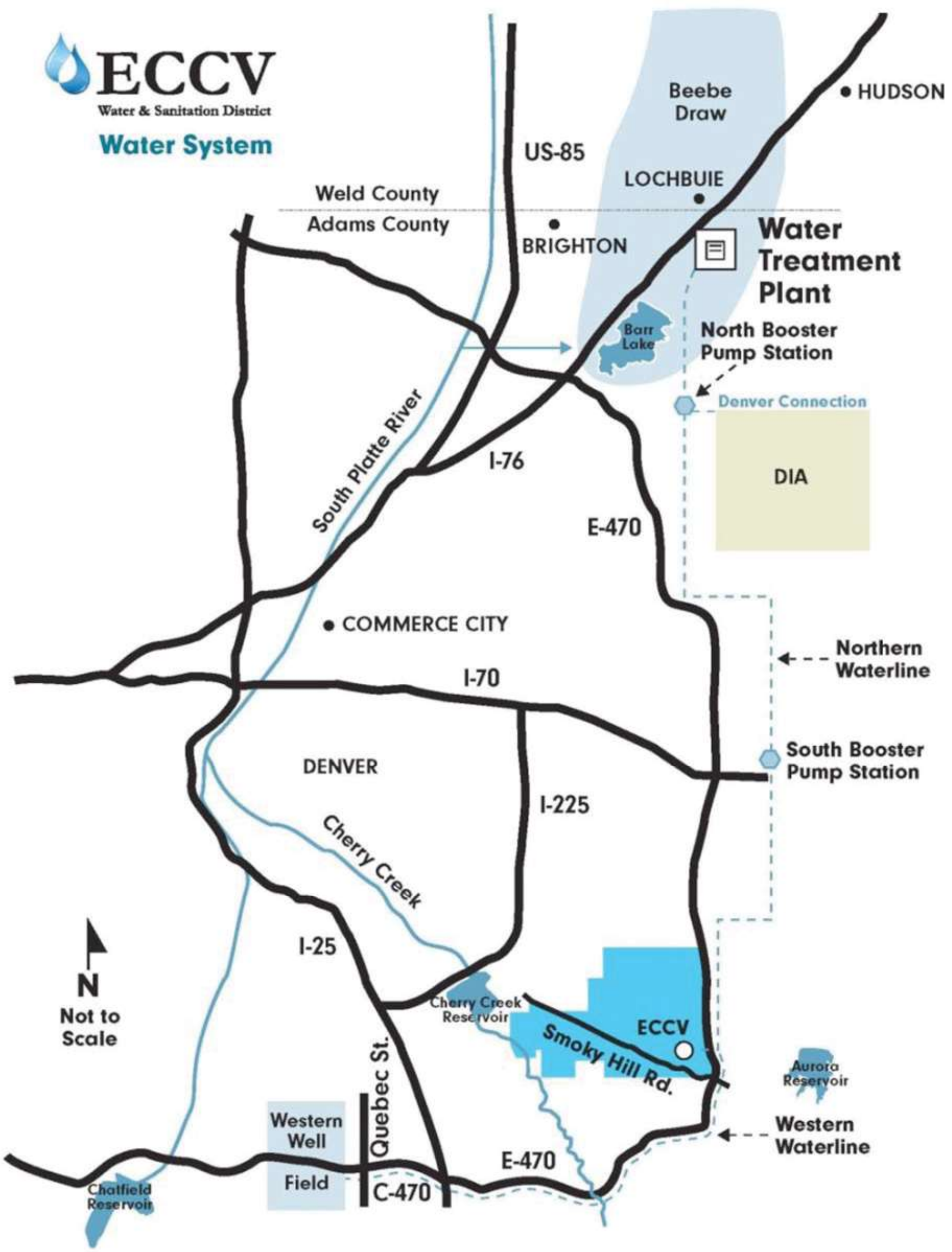


FIGURE
2-4

ECCV Northern Water Supply Project Facilities

2.3.6 : Northern Water Supply Project

ECCV is developing renewable surface water supplies through its Northern Water Supply Project, a multi-phase project to deliver surface water from the South Platte River to ECCV and reduce the reliance on Denver Basin nontributary groundwater. ECCV initiated the planning of the Northern Water Supply Project in 2003 to provide a renewable surface water source that diversifies the resources of ECCV's water supply system, offering a reliable and sustainable water supply for ECCV's customers. This project was developed in cooperation with United Water and Sanitation District and the Farmers Reservoir and Irrigation Company.

Phase I of the Northern Water Supply Project, known as H2'06, was completed in 2006 and included a contract for the eventual acquisition of approximately 6,200 AF of renewable surface water rights; the construction of six wells in the Beebe Draw alluvium approximately 2.5 miles downstream from Barr Lake; a 48 inch, 31-mile pipeline (Northern Pipeline); two pumping stations; and storage tanks to deliver potable water to ECCV, as shown in Figure 2.4. ECCV takes delivery of water pumped from the alluvial wells in the Beebe Draw and transports it to ECCV's storage tanks on the eastern edge of ECCV near Smoky Hill Road and E-470. At this location, water is blended with ECCV's other supplies and distributed to ECCV's customers. Water pumped from the Beebe Draw under the Northern Water Supply Project is fully consumptive because it is augmented under the 404/442 Decree when depletions are out of priority.

Construction of the Northern Pipeline

Successful implementation of conservation measures delayed the need for ECCV to add water treatment capacity until 2012, at which time the Northern Project Water Treatment Plant (WTP) came on line and began delivering water. Water from Northern Project WTP replaced ECCV's temporary lease agreement with Denver for an additional 1,000 AFY, which ended in 2012.

ECCV began construction of the second phase of the Northern Water Supply Project in 2010 with completion in 2012. This phase included the construction of a 10 MGD nominal capacity reverse osmosis (RO) WTP and an additional six alluvial wells below Barr Lake. At buildout capacity, the Northern Water Supply Project will be able to treat and deliver over 47 MGD of high-quality water for a total of over 50,000 AF per year. ECCV's goal is to develop sufficient renewable supplies such that its reliance on nontributary supplies is minimal. Nontributary groundwater would primarily function as a backup supply and to firm treated water deliveries to customers during drought periods, when renewable rights may be yielding less than projected. The sustainability of the nontributary groundwater as a backup supply will require the use of recharge of the Denver Basin aquifer, using renewable water sources, and employing ASR methods. The yield of ECCV's junior conditional surface water rights will be used to help ECCV achieve its renewable goals, understanding that the yield from the conditional rights will not be firm and yields may not be sustainable during extended droughts. Through ASR, the water diverted can be beneficially used and reduce reliance on nonrenewable resources. In addition, a portion of the annual water demand will be met by the nonpotable irrigation system and Denver Water–treated water deliveries. Any remaining demand not met by the Northern Water Supply Project,

Reverse Osmosis Skids

nonpotable irrigation, and Denver deliveries must be met from the in-district and Western nontributary wells.

The Northern Water Supply Project also delivers treated water to Arapahoe County Water and Wastewater Authority (ACWWA). ACWWA has other water supplies including in-district wells that are not delivered through the Northern Water Supply Project. Other potential deliveries from the Northern Water Supply Project system include members of the South Metro Water Supply Authority (SMWSA) that have acquired capacity in the Northern Pipeline but have not acquired capacity in the RO plant or the pump stations. Participating SMWSA members in the ECCV Northern Pipeline, in addition to ACWWA, include Centennial Water & Sanitation District, Cottonwood Water & Sanitation District, Inverness Water & Sanitation District, Stonegate Village Metropolitan District, and the Town of Castle Rock. These members must secure their own water supplies and treatment in order to use their capacity in the Northern Pipeline. ACWWA has acquired 2.25 MGD of capacity in the existing ECCV RO WTP and a total of 5.25 MGD of capacity in the ECCV Northern Pipeline. ACWWA is participating in a WTP expansion that will provide a total of 5.25 MGD of treatment capacity upon completion in 2020.

The Northern Water Supply Project system includes several storage reservoirs in the vicinity of the alluvial wells and along the South Platte and Cache la Poudre rivers. It also includes a portfolio of senior water rights in several ditch, reservoir, and canal companies throughout the South Platte Basin and junior water rights associated with the storage reservoirs. These water rights are used to augment pumping depletions from the Beebe Draw alluvial wells. ECCV is also currently expanding the Northern Water Supply Project pump stations and adding additional wells for supply. The booster station expansion and treatment plant expansion will increase capacity to 20 MGD firm, of which ECCV will have 14.75 MGD and ACWWA 5.25 MGD.

2.3.7 : Denver Water

In addition to nontributary groundwater and the renewable surface water supplies from the Northern Water Supply Project, ECCV has an agreement with Denver Water for 771 AFY of treated water. ECCV takes delivery of this water through a connection to its Northern Water Supply Project pipeline from Denver Water's system near Denver International Airport. Denver Water retains ownership of the return flows associated with deliveries to ECCV to the extent the water delivered by Denver is reusable.

ECCV and Denver Water have modified the agreement, allowing ECCV to take water at its Western connection, located at University and C-470. Water delivery began at that location on January 1, 2018 and will be delivered seasonally based on Denver's needs. Water is also delivered into the WISE system. See Appendix A for more information on WISE system.

2.3.8 : Reuse of ECCV Wastewater Return Flows

ECCV currently delivers approximately 4,000 AFY of wastewater to the Metro Wastewater Reclamation District (Metro) for treatment and discharge. This wastewater is currently delivered to Metro via the City of Aurora sewer interceptor system under a 1976 agreement that provides for some ability by Aurora to reuse the consumable portion of ECCV wastewater. In the future, ECCV may pursue the right to reclaim the use of all or a portion of its consumable wastewater flows currently delivered to Metro via the City of Aurora sewer system for diversion in its Northern Water Supply Project, to augment alluvial nonpotable well pumping or by other means.

2.3.9 : Timeline of ECCV Water System Development

Table 2-2 provides a timeline of the major ECCV water system development activities since the inception of the District in 1962.

TABLE **2-2** ECCV Water System Development Timeline

Year	Water System Activities/Milestones
1962	ECCV Water & Sanitation District is formed.
1976	ECCV enters into an agreement with the City of Aurora for carriage of ECCV sewer flows to Metro Wastewater Reclamation District via the City of Aurora sewer system.
1977	Development in the District accelerates, and ECCV begins a program of annually drilling additional Denver Basin wells to meet demands.
1982	ECCV and other suburban water providers enter into participation agreement with the Denver Water Board for Two Forks Project and System-wide EIS.
1983	ECCV enters into an agreement with OAR, Inc. for the development of Denver Basin wells on SBLC Lowry Range lands. This lease lasts through 2032.
1989	After a total expenditure of over $40,000,000 by Denver Water Board and suburban providers, the EPA vetoes the Two Forks Permit issued by the Army Corps of Engineers. Denver decides not to appeal the veto.
1998	ECCV identifies middle South Platte supplies as a potential water supply source and begins discussions with the Farmers Reservoir and Irrigation Company (FRICO), a Brighton-based mutual ditch company, as a possible provider of renewable water.
1999	ECCV enters into an agreement with Willows Water District that provides the supply for the ECCV Western Project. The agreement provides for the acquisition of the Willows nontributary groundwater system, subject to Water Court approval.
2002–2003	Construction of the Western Project. Western Project commences delivery of water to ECCV in 2003.

Year	Water System Activities/Milestones
2003	ECCV enters into an agreement with United Water and Sanitation District to acquire approximately 6,000 AF per year of South Platte surface water in Weld County and to develop the infrastructure to deliver it to a proposed ECCV WTP located near Brighton. The project is termed the “Northern Water Supply Project.”
2003–2004	ECCV develops a nonpotable irrigation system based on renewable alluvial groundwater pumped from the Cherry Creek Alluvium.
2005–2006	Construction of Phase One of the Northern Water Supply Project (alluvial wells, pipeline, and pump stations). Northern Water Supply Project Phase One begins delivering approximately 1,800 AFY of renewable supply in July 2006.
2008	Design and permitting begins on Phase Two of the Northern Water Supply Project.
2010–2011	Construction and development of the current phase of the Northern Water Supply Project.
2012	Completion of Phase Two – six additional production wells and a 10 MGD RO WTP.
2012	Lease of SBLC wells to Rangeview for the remainder of the original OAR lease agreement.
2013	Deliveries of water to partner agency ACWWA began in July 2013. ACWWA demands are accounted for separately and are not included in this document.
2014	WISE Agreement executed including sale of the Western line to South Metro WISE.
2014	Water Court case 10CW306 for additional five wells decreed.
2017	Design of Northern Plant and Pump Station Expansion begins.
2018	Start of Northern Plant and Pump Station Expansion construction.
2020	Anticipated completion of construction of Northern Plant and Pump Station Expansion.

2.4 : Water Sources and Yields

The existing potential annual yield and peak day projection capability of the major treated water sources for ECCV are summarized in Table 2-3. In 2006, ECCV began the Northern Water Supply Project with the H2'06 project, which produced water from the Beebe Draw with the construction of six wells, the North & South Booster Pump Stations, and the 31-mile 48-inch pipeline to the District. These original six wells were blended with leased water from Denver to achieve an acceptable TDS. In 2012, ECCV brought on line the next portion of the Northern Water Supply Project, including construction of six additional wells and construction of advanced RO treatment with capacity of 10 MGD. This will deliver high-quality renewable water at a peak flow rate of 7.8 MGD for use by ECCV customers and 2.2 MGD for use by ACWWA. An additional production of up to 0.7 MGD is achieved at the plant through a secondary recovery of RO reject water through a brine minimization process. Membrane cleaning and routine maintenance require the plant to operate at reduced capacity for a portion of each week. Routine net weekly deliveries are approximately at a rate of 8.5 to 9.5 MGD for the week.

Photo: iStockPhoto

ECCV has a permanent lease with Denver Water for 771 AFY of treated water. ECCV also has significant nontributary groundwater supplies that can meet a portion of ECCV's annual demand. These nontributary supplies are considered nonrenewable, and ECCV has estimated the production rates from its nontributary wells in the Arapahoe aquifer will decrease by 2.7 percent annually. Use of the Laramie-Fox Hills wells was minimized once the Northern Plant came on line, but the wells are being maintained in their current condition as a measure to increase redundancy in the system. ECCV is considering a project to connect the Laramie-Fox Hills wells to the nonpotable system for supplemental irrigation. These nontributary supplies are not adequate to meet the current potable demands during the summer when outdoor use increases; nontributary supplies have decreased in importance as a source of supply to the ECCV system. As a result, ECCV will continue to develop additional facilities and renewable sources to meet future water demands and replace the current nontributary sources.

TABLE **2-3**

Summary of Major Water Sources for ECCV

Water Supply Source	2017 Peak Day Capacity* (MGD)	2017 Annual Yield* (AFY)
In-District nontributary groundwater wells	8.5	7,500 (maximum with all wells operating)
Western System nontributary groundwater wells	5.2	3,500 (maximum with all wells operating)
Northern Water Supply Project Phases I and II	10.0	6,200
Denver Treated Water	3.2	771
Total	**26.9**	**17,971**

* The current peak capacity and long-term yield of the nontributary groundwater supplies will decline significantly due to the nonrenewable nature of these supplies. ECCV's long-term goal is to rely on renewable supplies to the maximum extent practicable. The current infrastructure is not capable of delivering a sustained 17,971 AF per year.

2.5 : Ability to Serve

ECCV currently relies on wells from the Denver Basin aquifers for approximately 42 percent of its water supply. ECCV has 92 wells drilled; not all are currently operational. If all the wells currently in operation are pumped simultaneously, the wells would produce approximately 20 MGD. As noted, the sustainable peak production is estimated at 13.7 MGD. If all of the nontributary wells owned or under the control of ECCV were drilled, fully operating, connected to the system, and producing the decreed amount, the aggregate yield would be approximately 17,971 AFY. However, the current ability of the system is much less.

ECCV has ongoing planning for the raw and treated water systems including water supply acquisitions, water rights applications, treatment plants, pump stations, storage tanks, and major distribution pipelines to serve ECCV. A summary of system conditions is shown in Table 2-4.

TABLE **2-4**

ECCV Summary of System Conditions

Planning questions	Yes	No	Comments
Is the system in a designated critical water supply area?	Y		The ECCV system resides above the Denver Basin Aquifer. Scientific evidence shows recent draw-down on the aquifer. This region was identified in the Statewide Water Supply Initiative as a critical water supply area.
Does the system experience frequent shortages or supply emergencies?		N	
Does the system have substantial non-revenue water?		N	
Is the system experiencing a high rate of population and/or growth?		N	
Is the system planning substantial improvements or additions?	Y		ECCV is continuing the development of its Northern Water Supply Project with substantial expansions both to satisfy demand and reduce reliance on nonrenewable water sources as well as providing source water for the District's ASR project, if permitted.
Are increases to wastewater system capacity anticipated within the planning horizon?	Y		Increases in capacity will be made to meet future growth. ECCV may pursue the right to reclaim some or all of its wastewater return flows.
Is there a need for additional drought reserves?	Y		
Are there drinking water quality issues?		N	
Is aging infrastructure in need of repair?		N	There are no significant projects needed at this time.
Are there issues with water pressure in portions of the distribution system?	Y		ECCV is in the process of identifying pressure issues within its distribution system. There are not any pressure issues related to supply.

Section 3 : Current Water Use

3.1 : Annual and Monthly Water Use by Customer Class

ECCV's customer base, as shown in Table 3-1, Figure 3-1, and Figure 3-2, consists primarily of single family residential accounts, with the remainder being school, commercial, and irrigation-only accounts. Single family residential represents 80 percent of total billed water use with potable irrigation the next largest user class at 8 percent. Nonpotable irrigation use is 4 percent and commercial and commercial-irrigation use is also at 4 percent of total annual billed water usage, respectively. School use, including irrigation, makes up 3 percent, and fire hydrant use is 1 percent.

TABLE **3-1**

Annual Water Use by Customer Class

General Class	2011–2017 Average Annual (Kgal)	Percentage of Total
Single Family Residential	2,027,123	80%
Commercial & Commercial Irrigation~	105,626	4%
School	85,386	3%
Irrigation (potable)	201,842	8%
Irrigation (nonpotable)	95,228	4%
Fire Hydrant*	13,782	1%
Total	**2,528,987**	**100%**

The District has no Industrial accounts.

~ The District has one multifamily complex that accounts for approximately 20,850 Kgals per year.

* Hydrant use is temporary construction water for mass earth work in development areas and is expected to end once the District service area is built out.

The average monthly water usage is shown in Figure 3-2. During the summer, monthly use mirrors the average annual water usage with single family residential comprising the largest demand. During the winter months of November through March, when irrigation ceases, single family residential use reduces to half; commercial and school uses also greatly decline; and potable and nonpotable irrigation uses are close to zero.

FIGURE
3-1

Percentage of Annual Water Use by Customer Class

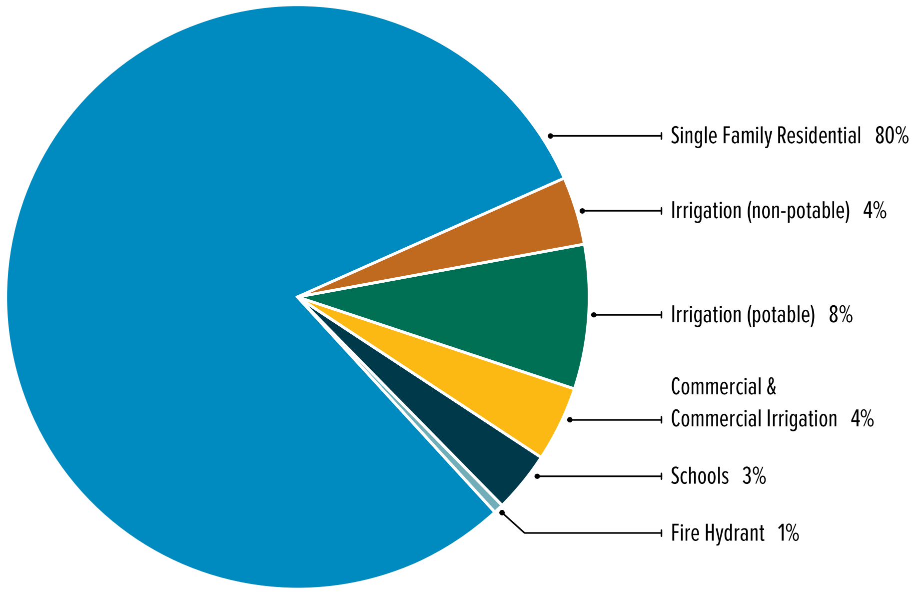
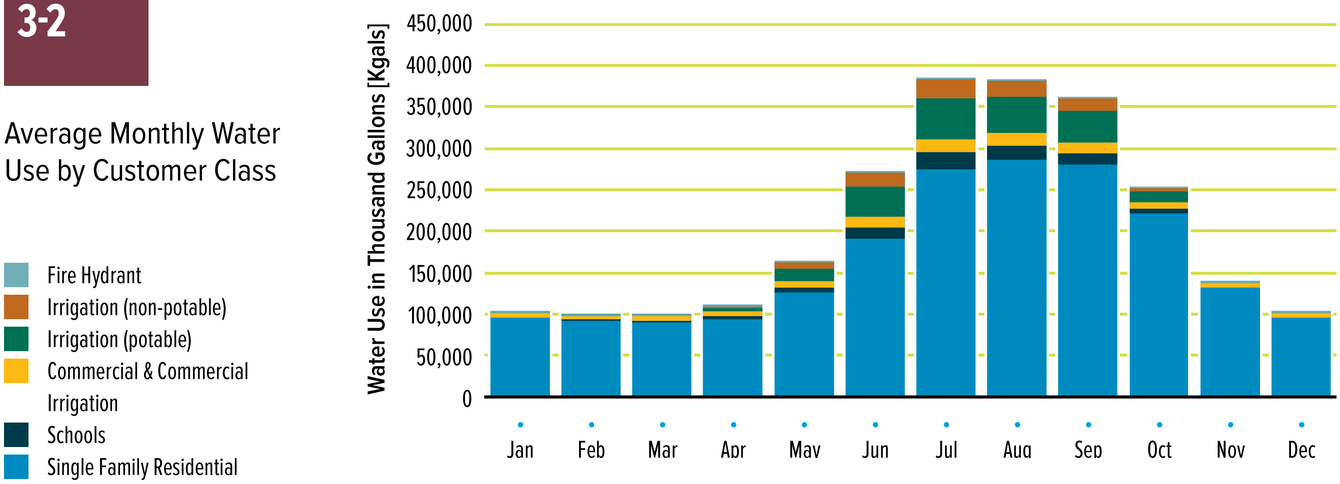


FIGURE
3-2

Average Monthly Water Use by Customer Class



3.2 : Historical Water Demand

Total annual water production for 1981–2017 is shown in Figure 3-3. Nonpotable water usage began in 2005 and is also included in the total water production shown in this figure. As seen in Figure 3-3, demand has increased an average of about 220 AF per year from approximately 600 AFY in 1981 to 8,800 AF per year of potable and nonpotable demand in recent years.

Population in the District has grown significantly since 1981. ECCV tracks the number of water customers as single family equivalents (SFEs), which is the estimated water use for a 3/4" water tap. Other water users that have larger water taps are converted to SFEs as shown in Table 3-2.

TABLE **3-2**

Single Family Equivalents by Tap Size

Tap Size (inches)	Single Family Equivalent
3/4	1
1	2
1.5	4
2	8
3	18
4	36

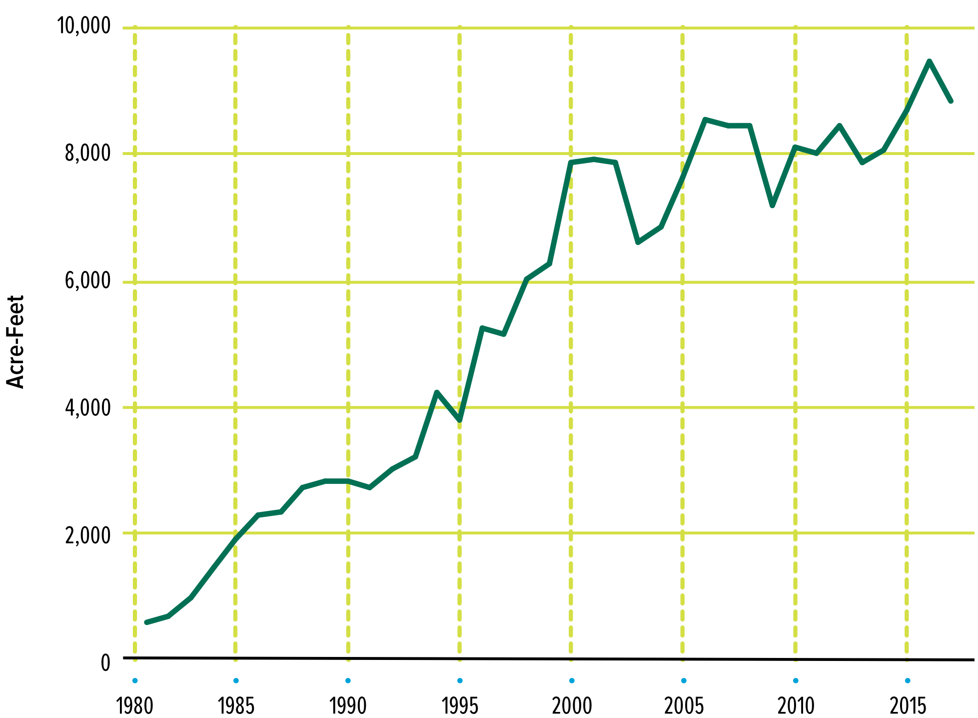


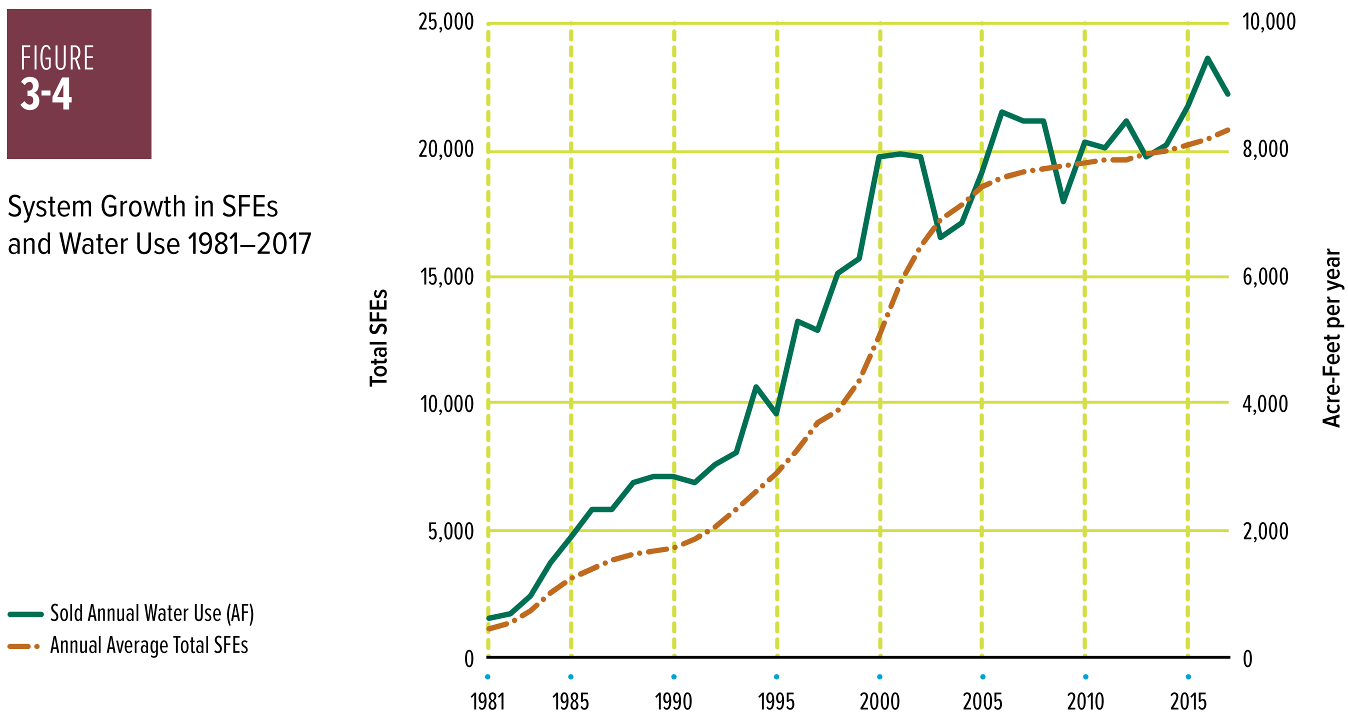
FIGURE **3-3**

Total Annual Water Billed 1981–2017 (includes ACWWA)

The growth of single family equivalents in ECCV is shown in Figure 3-4 as total SFEs in the ECCV system. Annual average water usage is also shown in the figure. The decrease in water usage after the 2002 drought can be seen in this figure. However, due to growth and climate conditions, water usage has rebounded to slightly higher levels.

FIGURE
3-4

System Growth in SFEs and Water Use 1981–2017



The additional SFEs added to the ECCV district varies from year to year. Figure 3-5 illustrates the number of SFEs added to the ECCV district each year since 1982. The number of SFEs added reached a peak in 2001 with 2,098 and declined until 2011. The SFEs added each year began to increase again in 2013 and continue to do so.

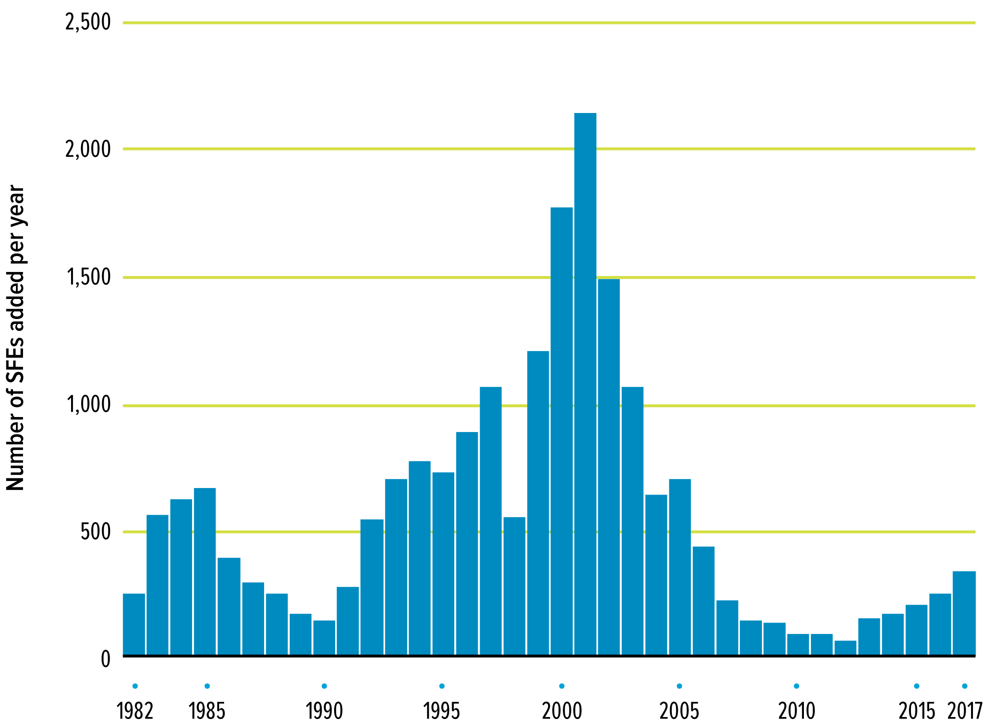


FIGURE
3-5

Number of SFEs added per year to the ECCV District

Photo: Shutterstock

3.2.1 : Historical Water Demand by Customer Class

Historical water billed by customer class has been tracked since 1998 and is shown in Table 3-3 and Figure 3-6. Billing is conducted monthly and is available electronically. As previously noted, residential water use represents approximately 80 percent of total demand, followed by potable and nonpotable irrigation. The nonpotable irrigation system became fully operational in 2005 and currently represents approximately 4 percent of total water billed. The highest annual total billed water use occurred in 2006 with a total billed water use of 8,575 AF. The highest nonpotable use occurred in 2012 with 340 AF used for nonpotable irrigation. ECCV treats water for ACWWA. ACWWA has its own water rights and accounts for this water in its own accounting.

TABLE **3-3**

ECCV-only Annual Water Billed by Customer Class

ECCV-only Annual Water Use in Acre-Feet (AF)						
Year	Commercial	Schools	Irrigation	Nonpotable Irrigation	Residential	Total
1998	159	270	429	-	4,435	5,294
1999	184	298	495	-	4,729	5,707
2000	262	410	760	-	6,097	7,528
2001	215	351	828	-	6,539	7,933
2002	263	325	790	-	6,517	7,895
2003	215	243	553	-	5,602	6,613
2004	221	244	753	-	5,643	6,861
2005	237	306	608	179	6,296	7,626
2006	287	337	634	276	7,042	8,575
2007	302	358	679	264	6,861	8,464
2008	314	361	769	285	6,741	8,471
2009	318	277	536	211	5,840	7,182
2010	302	277	623	314	6,587	8,103
2011	305	283	664	305	6,461	8,018
2012	335	619	695	340	6,751	8,439
2013	369	241	542	257	5,875	7,283
2014	433	233	529	251	5,708	7,154
2015	346	278	583	253	5,897	7,357
2016	372	224	697	324	6,543	8,159
2017	406	256	626	317	6,314	7,920

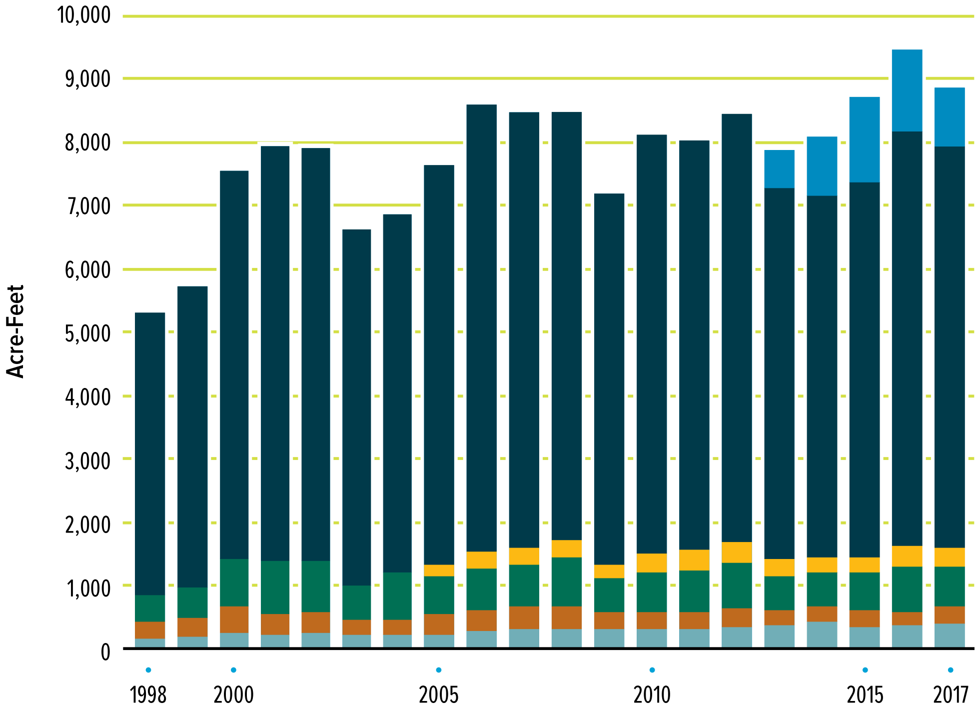


FIGURE
3-6

Annual Water Billed by Customer Class

3.2.2 : Historical Residential and Per Capita Water Use

An analysis of per capita water demand is a common measurement of water use. Average daily water demand divided by the population served provides total system gallons per capita per day (gpcd). Comparison of total system gpcd should be viewed cautiously, as the percentage of water use by nonresidential customer classes or nonpermanent residences can impact the gpcd calculation. Residential-only gpcd is calculated by dividing residential water use by the estimated population served. Single-family-only residential gpcd is also used if there is a high percentage of multifamily customers. Population, total, and residential per capita water demands have been calculated for 1998–2017 and are shown in Table 3-4. Annual population increased at double-digit rates from 1998–2002 and averaged over 2 percent growth from 2003–2008. From 2008–2015, growth slowed to just over 0.75 percent, and for 2016 and 2017 growth has started to increase, averaging 1.5 percent. Per capita water demands showed the opposite trend, with decreases in total and residential per capita water use over this same period. The 1998–2001 total gpcd averaged 164, while the 2006–2008 total gpcd averaged 135, an 18 percent decrease. For 2009–2017, total gpcd averaged 117, a 13 percent decrease from the 2006–2008 period. Similarly, for residential-only gpcd, the 1998–2001 average was 135 and the 2006–2008 average was 109, a 19 percent decrease. More recently, the 2009–2017 residential-only gpcd average was 94, a 14 percent decrease from the 2006–2008 period. Total system and residential-only gpcd are shown in Figure 3-7.

TABLE 3-4

Historical per Capita Water Use

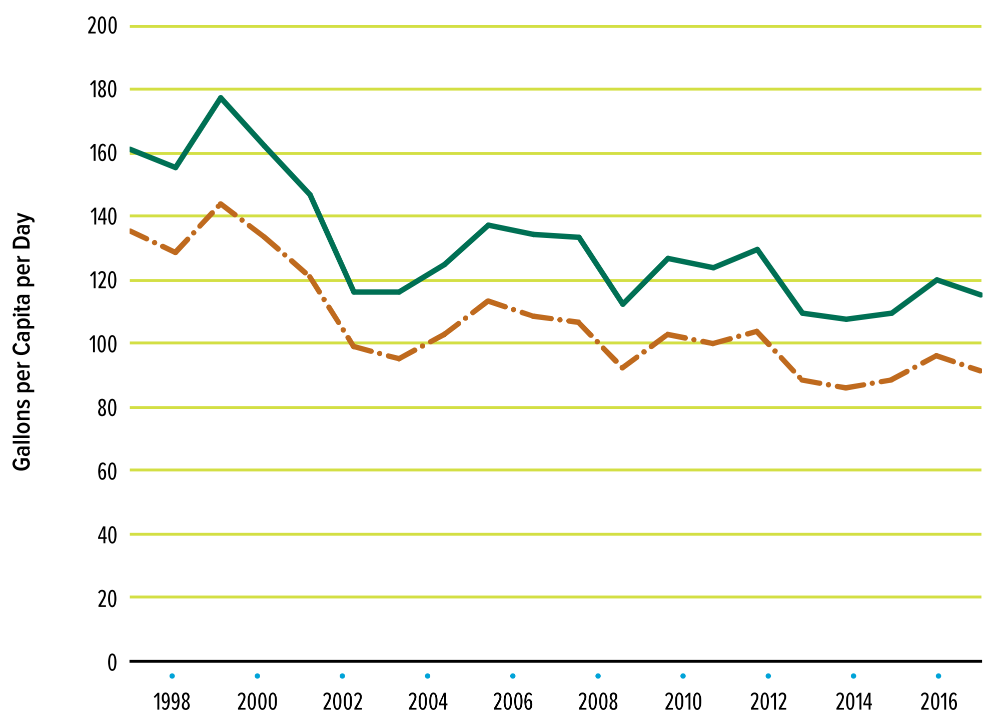
Year	Estimated Population	Estimated % Pop. Change	Residential Accounts	Total system gpcd[1]	Residential gpcd[2]
1998	29,273	–	9,206	161	135
1999	32,751	11.9%	10,299	156	129
2000	37,863	15.6%	11,907	177	144
2001	43,740	15.5%	13,755	162	133
2002	48,127	10.0%	15,134	146	121
2003	50,840	5.6%	15,987	116	98
2004	52,908	4.1%	16,638	116	95
2005	54,501	3.0%	17,139	125	103
2006	55,656	2.1%	17,502	138	113
2007	56,362	1.3%	17,724	134	109
2008	56,695	0.6%	17,829	133	106
2009	56,890	0.3%	17,890	113	92
2010	57,109	0.4%	17,959	127	103
2011	57,917	1.4%	18,213	124	100
2012	58,152	0.4%	18,287	130	104
2013	59,221	1.8%	18,623	110	89
2014	59,425	0.3%	18,687	107	86
2015	59,844	0.70%	18,819	110	88
2016	60,639	1.30%	19,069	120	96
2017	61,625	1.60%	19,379	115	91

1 Calculated as the total treated water production divided by total service population.

2 Calculated as the total residential + multifamily metered treated water demand divided by total service population.

FIGURE 3-7

Historical Total System and Residential per Capita Water Use



Total system gpcd; excludes ACWWA

Residential gpcd

3.2.3 : Historical Peak Day Water Demand

ECCV determines water treatment and delivery capacity requirements using a maximum daily use per SFE and multiplying it by a projected SFE buildout figure. Historically, ECCV has used 1.2 gallons per minute (gpm) per SFE at maximum day as its planning criteria for sizing water production and transmission infrastructure. This planning criterion includes a reasonable safety factor and allowances for firefighting and other uses.

The tracking of daily water production for the ECCV system has historically been a challenge due to the significant number (> 90) of individual wells in the ECCV water system. Historical daily water production and consumption data are incomplete for years prior to 2005 due to unavailability of data as a result of limited telemetry from individual wells. For the periods that have estimated peak day water use data, peak day water demand was highest at 1.27 gpm/SFE in 1990. By the mid-1990s, peak day demand averaged 1.0 gpm/SFE. Starting in 2002, ECCV implemented designated watering restrictions for two days per week. These restrictions were modified to three days per week in 2006. The days of the week are specified based on address. Peak day water use has averaged 0.7 gpm/SFE from 2005 to 2018. The historical maximum recorded peak day occurred in 2005 at 21.0 MGD. Data are unavailable for 1999–2004, but a greater historical peak day may have occurred during this period. Historical average daily and peak day demands are shown in Figure 3-8. Average annual daily demands have increased from 0.5 MGD in 1981 to 7.9 MGD in 2017.

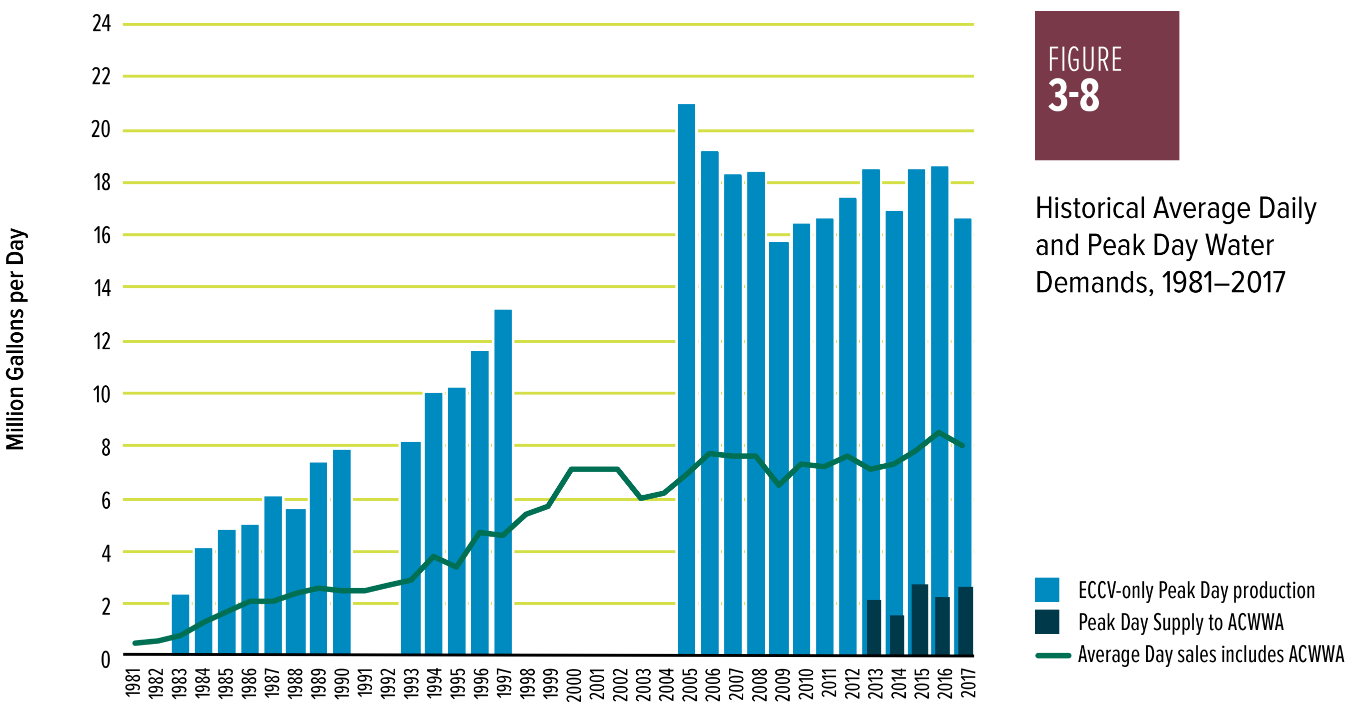


FIGURE 3-8

Historical Average Daily and Peak Day Water Demands, 1981–2017

In 2013, temporary restrictions were planned to limit residential watering days to two days per week. This is the routine drought response. However, restrictions were never implemented and were lifted due to increased precipitation. During drought conditions, commercial irrigation is limited from 48 hours of watering per week to 39 hours per week.

As noted, when planning for meeting peak day demands, appropriate safety factors should be included. The volume of treated water storage as a percentage of peak day demand is also a consideration when determining safety factors and the ability to meet peak hour demands for firefighting and other purposes.

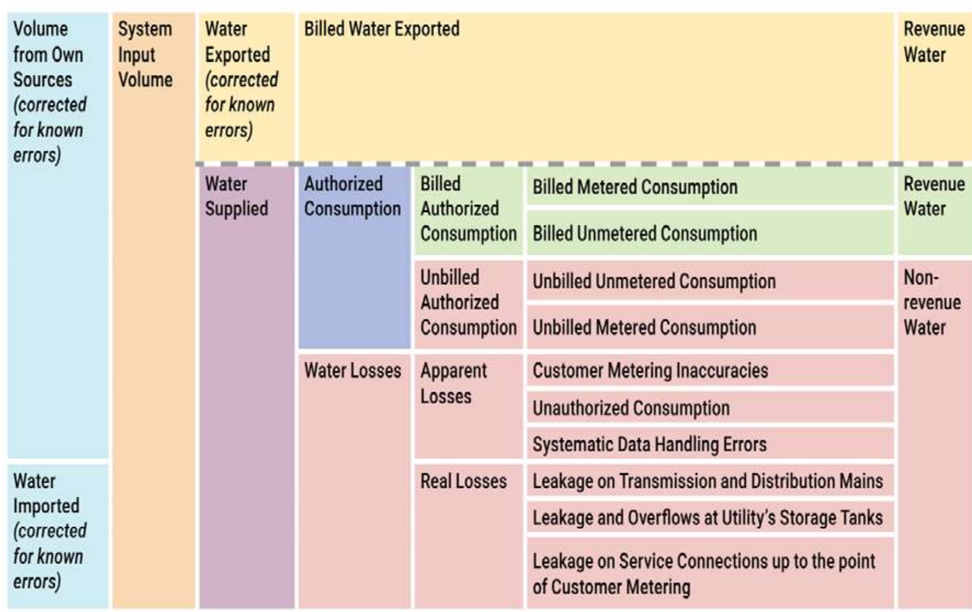
3.3 : Water Loss Accounting

The description of current water use in this Plan is meant to be consistent with the International Water Association (IWA) and American Water Works Association (AWWA) Water Balance approach, which was updated in 2012 (AWWA, 2012) to provide utilities a consistent methodology for assessing water loss. Although the full assessment of a water balance is outside the realm of this report, the terminology is consistent. The main categories discussed for ECCV are revenue (metered) and non-revenue (metered and unmetered) water, which are defined in Figure 3-9 below.

FIGURE
3-9

AWWA Water Balance Summary

(Source: AWWA White Paper, 2016)



All of ECCV water use is metered and billed. There are no customers who receive water that is not billed or charged, and all metered water use is Revenue Water as defined in the IWA/AWWA Water Balance. The non-revenue water use for the ECCV system includes:

- Unbilled, unmetered consumption (see below)
- Customer metering inaccuracies
- Data-handling error
- Leakage on mains
- Leakage on service lines
- Leakage and overflows at storage

Unbilled, unmetered consumption includes the following:

- Annual waterline and fire hydrant flushing program conducted by ECCV (estimated at 3 to 5 million gallons per year).

- Street-sweeping operations using fire hydrants to fill street-sweeping vehicles. These are local jurisdictions with street maintenance responsibilities that are separate from ECCV. They are required to have a hydrant meter, but occasionally a sweeper operator will not use the hydrant meter in violation of ECCV requirements.

- Fire department operations filling fire trucks for firefighting and training activities. These fire departments are separate from ECCV.

As noted, the tracking of total and daily water production for the ECCV system has been a challenge due to the significant number (> 90) of individual wells in the ECCV water system and the historical lack of central telemetering. Historical total water production data have not been included in the following analysis for years prior to 2005 due to unavailability of data as a result of limited telemetry from individual wells prior to 2005. In 2005, ECCV implemented a program of upgrading the SCADA reporting and meter accuracies of its approximately 90 individually metered wells. At the present time, the SCADA system is being monitored on a continuous basis as part of ECCV's Water Loss Control Program. As a result, water production and billing data for 2005–2017 are the years included in the estimate of water loss accounting. ECCV is looking at the AWWA methodology to figure out how to improve water loss audits. ECCV did register to take part in the Colorado Water Loss Initiative training.

Review of production and sales information has been conducted by ECCV annually since 2005 to determine the efficiency of the water distribution system. There are three pieces of data used to perform this evaluation: total water production; total water billed to customers; and water accounted for, but not billed. The non-revenue water is calculated by subtracting all accounted- for water (total water billed and accounted for but not billed) from the total water production. All water use in the ECCV system that is metered is billed. Industry standards consider up to 10 percent non-revenue water to be acceptable. For 2016 and 2017, non-revenue water was 4 percent and 7 percent, respectively, showing that the District's water system is consistently within an acceptable range.

A comparison of metered total water production vs. total water billed and accounted for/not billed is shown in Figure 3-10. The difference between total production and billed is non-revenue water as described above. As shown in Figure 3-11, non-revenue water ranged from a high of 13 percent in 2005 to a low of 4 percent in 2016 with a 12-year average of 7 percent. It is important to note that ECCV only implemented its water loss-accounting program in 2005 and the actual determination of non-revenue water will increase in accuracy as SCADA upgrades and individual well meter analyses are complete. The high non-revenue water in 2005 compared to subsequent years is partially attributable to the following:

- Meter accuracy testing improved in each subsequent year as the Water Loss Control Program was implemented.

- Water production accounting improved in each subsequent year as the Water Loss Control Program was implemented.

- In 2005, many production sources were estimated due to inoperable meters or data compilation. As a result, 2005 non-revenue calculation is only an estimate.

- Steps were taken to improve meter function in 2006 and 2007 and are ongoing as part of the Water Loss Control Program. This is reflected in the lower non-revenue percentages for these years compared to the two previous years.

Photo: Shutterstock

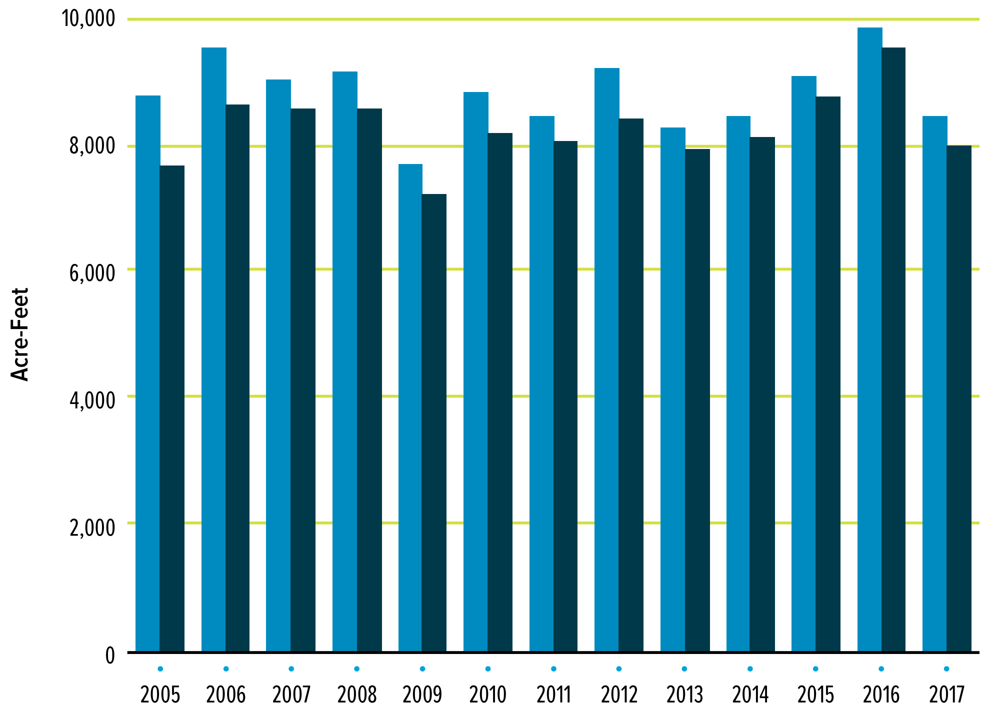


FIGURE
3-10

Total Water Production vs. Water Billed

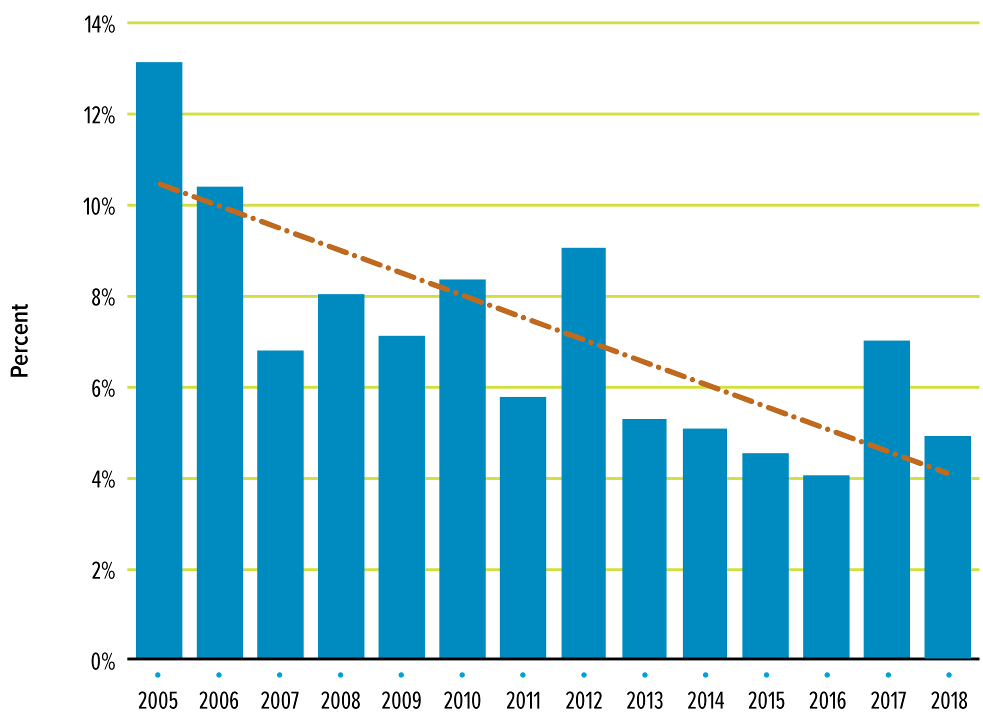


FIGURE
3-11

ECCV Non-revenue Water

Note: 2005 Non-revenue water is estimated.

If there is a reason to suspect a leak, ECCV contracts out for sonic leak detection equipment to locate leaks within the distribution system. The SCADA system is monitored continuously for any unusual changes in pressure and tank level. Leaks that are identified at the surface and located are repaired immediately. As shown in Table 3-5, 31 percent of ECCV's water lines are older than 30 years in age and 59 percent are older than 20 years. Forty-one percent of ECCV's water lines are less than 20 years old and leaks in these lines are assumed to be minimal. This is confirmed by the relatively low number of water breaks experienced annually, averaging approximately two per year.

TABLE **3-5**

Age of Construction of ECCV Waterlines

Years Constructed	Miles	Percentage	Age (years)
1970–1979	10	4%	40+
1980–1989	64	27%	30–39
1990–1999	64	28%	20–29
2000–2009	83	36%	10–19
2010–2018	12	5%	0–9
Total	**233**	**100%**	

ECCV started up its Northern Water Supply Project Treatment Plant in 2012. As a result of this additional supply and treatment capacity, ECCV has minimized usage of its Laramie-Fox Hills wells and some of the less productive Arapahoe wells. In 2016, three Arapahoe wells were re-drilled adjacent to their original locations in order to assure capacity in conformance with their decrees. In conjunction with this reduction in active wells and associated meters, SCADA telemetry upgrades are underway. This will allow ECCV to increase its accuracy in determining system losses. Several years of data after the reduction in production wells are needed to determine if non-revenue water percentages have changed. With the ECCV system being a relatively new system and with many production meters to monitor, it is anticipated that the amount of non-revenue water will continue to stay within the acceptable range of less than 10 percent. ECCV purchased 38 new magnetic flow meters for the Arapahoe wells currently in use. Ten of the purchased magnetic flow meters were installed at various sites during 2018, replacing numerous types of mechanical meters, and allowing for more accurate flow totals. Additional meters are programmed to be installed in 2019 at various well sites.

As part of the expansion of the Northern Water Supply System, all of the existing magnetic meters and those new production meters in the expansion will be converted to Ethernet protocol, and the totalizer values will be captured electronically. Ethernet protocol is also planned for the in-district supply wells, if a suitable interface between the meters and the new PLCs can be created.

Section 4 : Existing Conservation Efforts

ECCV has used water conservation and efficiency measures to manage water demands and conserve water for over 20 years. ECCV's water conservation and efficiency program offers a diverse range of programs and measures targeted at all water demand customer classes. Demand management strategies have included conservation measures designed to manage peak day demands and other measures designed to reduce total annual demands. ECCV has implemented a conservation-oriented water rate structure designed to encourage efficient use through the implementation of water budgets for irrigation accounts and tiered-rate structure for all customers. Other measures include designated watering days to manage peak and irrigation season demands, rebates on high efficiency plumbing fixtures, and a range of activities designed for irrigation use. The current program is described in this section and summarized in Table 4-4.

Photo: Shutterstock

4.1 : Operational Utility Side Measures

Integrated Resources Planning – ECCV has practiced integrated resources planning (IRP) as part of its overall water supply and demand management strategy. A least-cost analysis of demand and supply options resulted in the conclusion that water conservation and efficiency and demand management options were cost-effective and, as a result, were incorporated into future supply planning. As implemented by ECCV, the IRP approach is a comprehensive planning effort that incorporates water conservation and efficiency as key components for meeting future needs. The results of the IRP approach have resulted in savings of tens of millions of dollars to ECCV as described in Section 7.

Full Metering – All ECCV customers and associated water use is metered and billed.

Modifications to Increasing Block Rate Structure – ECCV implemented significant changes in its tiered, increasing block rate water structure in 1998 in order to promote water conservation through pricing. As experience was gleaned from the implementation of the rate structure, the rates and blocks were modified to increase the water conservation effect. An analysis of average residential lot size and irrigated area using a generalized water budget approach was used in 2003 to adjust the tiers for residential water use in order to increase the water pricing and water conservation signal to customers. The blocks for the residential rate structure since 1998 are shown in Table 4-1.

TABLE **4-1**

ECCV Residential Water Rate Tiers

Block	1998	1999	2000–mid-2002	2003–2005	2006–2018
	Monthly Water Use in 1,000 gallons				
1	0–16	0–14	0–8	0–6	0–5
2	17–32	15–28	9–20	7–20	6–20
3	> 32	> 28	> 21	21–30	21–30
4	N/A	N/A	N/A	31–40	31–40
5	N/A	N/A	N/A	> 40	> 40

Water-Use-Based Irrigation Tap Fees – All irrigation tap fees are based on irrigated area and planting materials. Existing large irrigators are allowed to add water taps at no charge (other than installation and meter cost) so they can irrigate more efficiently. This was in response to the fact that most of the older systems were undersized because the tap fees were based on meter size, and developers undersized meters to avoid additional tap fee charges.

Sustainable Water Assurance Fee (SWAF) – ECCV has developed and implemented the Northern Water Supply Project to develop renewable water supplies and reduce dependence on nontributary groundwater. In order to finance the implementation of this policy, a SWAF of $25 per month was instituted for residential customers. This additional water bill charge results in a water conservation signal to customers that has resulted in reduced water use.

Designated Watering Days – Designated watering days are in effect for all customers on a permanent basis. This program manages peak irrigation demands as well as total water use. The current program allows watering three days per week and prohibits watering between the hours of 10 a.m. and 6 p.m. Designated watering days started in 2002; watering was limited to two days per week. The number of water days was increased to three days per week in 2006 when the first phase of the Northern Water Supply Project operated. Experience has shown that the three days per week watering schedule allows water production to be paced closer to demand. Enforcement of the watering day schedules is accomplished using seasonal water conservation staff. From 2002–2006, water conservation patrols were 7 days per week. Since 2007, the patrols are typically only on the weekends.

Seasonal Planting Limits for Turf – No new sod or grass seed planting is allowed from June 1 to September 1. Exemptions have been made on a case-specific basis for buffalo grass planting and large irrigators with a short planting season such as athletic fields.

Water Waste Ordinance – ECCV adopted new rules and regulations in 2014. Specific to water conservation, the District prohibited the wasting of water and defined water waste within the service area. Failure to comply with the Conservation Plan and violations of wasting water will result in Water Waste Charges. ECCV also outlined how water restrictions, curtailments, or prohibitions upon water use may be enacted and provided details for the tiered water rate system.

4.2 : Water Loss Control Program

Annual System Water Accounting Audits – System-wide accounting audits have been conducted by ECCV annually since 2005 to determine the efficiency of the water distribution system. ECCV will continue this best practice annually as part of its normal operations. There are three pieces of data used to perform this evaluation:

1. Total water production
2. Total water billed to customers
3. Water accounted for, but not billed

The non-revenue water is calculated by subtracting all accounted-for water (total water billed and accounted for/not billed) from the total water production. The industry standards consider up to 10 percent non-revenue water to be acceptable. From 2005–2008, the average percentage of non-revenue water was 10 percent, 7.5 percent for 2007–2008, and now is 5.2 percent for 2015–2017, showing that the District's water system is consistently within an acceptable range since the SCADA upgrades. Currently, ECCV's goal is to maintain their current level of non-revenue water, not to exceed 8 percent. If the annual system water audits show an increase above 8 percent on a 36-month running average, ECCV will implement system-wide sonic leak detection covering 20 percent of the system annually.

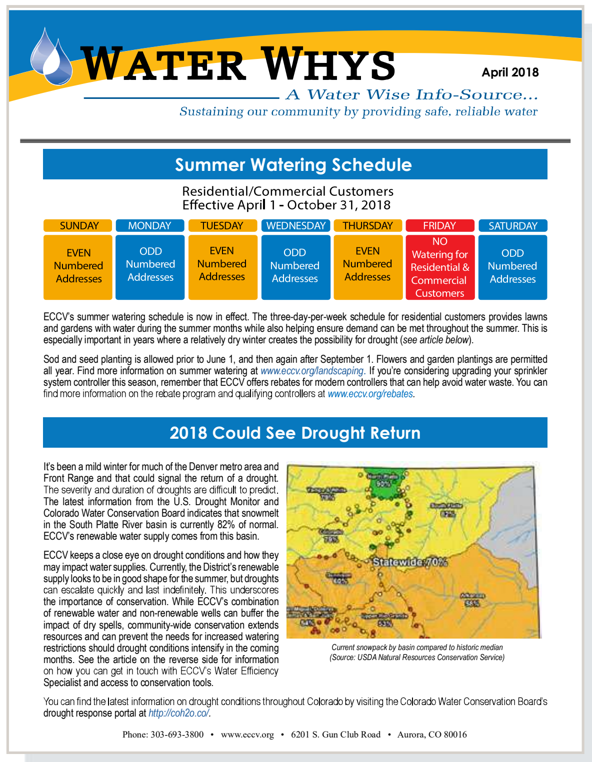
If there is a reason to suspect a leak, ECCV contracts out for sonic leak detection equipment to locate leaks within the distribution system. The SCADA system is monitored continuously for any unusual changes in pressure and tank level. As shown in Table 3-5, 31 percent of ECCV's water lines are older than 30 years in age and 59 percent are older than 20 years. Forty-one percent of ECCV's water lines are less than 20 years old and leaks are estimated to be minimal. This is confirmed by the relatively low number of water breaks experienced annually. In the past six years, ECCV has had a total of 12 water main breaks, an average of two per year.

ECCV completed its Northern Water Treatment Plant in 2012; during that year, the temporary treated water lease with Denver expired. As a result of this additional supply and treatment capacity, ECCV has become less reliant upon a number of low-yielding/poor-quality nontributary wells. In conjunction with this reduction in wells and associated meters, SCADA telemetry upgrades are ongoing. This may result in an increase in accuracy in determining system losses. Several years of data collected after the reduction in production wells are needed to determine if non-revenue water percentages have changed. With the ECCV system being a relatively new system and with the many production meters to monitor, it is anticipated that the percent of non-revenue water will continue to fall within ECCV's goal of < 8 percent. Over the recent period analyzed, non-revenue water, including leaks, has averaged 5.2 percent over a 36-month moving average ending in 2017.

4.3 : Education and Public Information

Water Efficiency Specialist – ECCV added a full-time Water Efficiency Specialist in March 2018. This staff member's sole responsibility is water conservation and efficiency efforts to increase efficiency and lower costs for customers. The Water Efficiency Specialist will review and evaluate the continuation of the rebate program in the next year. This staff member will also create programs and content to carry out the recommendations of this Plan.

Conservation Public Information Campaign – Water conservation and efficiency information is disseminated via bill inserts, brochures, and the ECCV website (http://www.eccv.org/). Water conservation and efficiency topics include information on the toilet and clothes washer rebate programs, irrigation management, Xeriscape landscaping, and other water-saving tips. Staff responds to residential and commercial customers with water use or billing questions and requests for water conservation information.



WATER WHYS

April 2018

A Water Wise Info-Source...

Sustaining our community by providing safe, reliable water

Summer Watering Schedule

Residential/Commercial Customers
Effective April 1 - October 31, 2018

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
EVEN Numbered Addresses	ODD Numbered Addresses	EVEN Numbered Addresses	ODD Numbered Addresses	EVEN Numbered Addresses	NO Watering for Residential & Commercial Customers	ODD Numbered Addresses

ECCV's summer watering schedule is now in effect. The three-day-per-week schedule for residential customers provides lawns and gardens with water during the summer months while also helping ensure demand can be met throughout the summer. This is especially important in years where a relatively dry winter creates the possibility for drought (*see article below*).

Sod and seed planting is allowed prior to June 1, and then again after September 1. Flowers and garden plantings are permitted all year. Find more information on summer watering at *www.eccv.org/landscaping*. If you're considering upgrading your sprinkler system controller this season, remember that ECCV offers rebates for modern controllers that can help avoid water waste. You can find more information on the rebate program and qualifying controllers at *www.eccv.org/rebates*.

2018 Could See Drought Return

It's been a mild winter for much of the Denver metro area and Front Range and that could signal the return of a drought. The severity and duration of droughts are difficult to predict. The latest information from the U.S. Drought Monitor and Colorado Water Conservation Board indicates that snowmelt in the South Platte River basin is currently 82% of normal. ECCV's renewable water supply comes from this basin.

ECCV keeps a close eye on drought conditions and how they may impact water supplies. Currently, the District's renewable supply looks to be in good shape for the summer, but droughts can escalate quickly and last indefinitely. This underscores the importance of conservation. While ECCV's combination of renewable water and non-renewable wells can buffer the impact of dry spells, community-wide conservation extends resources and can prevent the needs for increased watering restrictions should drought conditions intensify in the coming months. See the article on the reverse side for information on how you can get in touch with ECCV's Water Efficiency Specialist and access to conservation tools.

Current snowpack by basin compared to historic median
(Source: USDA Natural Resources Conservation Service)

You can find the latest information on drought conditions throughout Colorado by visiting the Colorado Water Conservation Board's drought response portal at *http://coh2o.co/*.

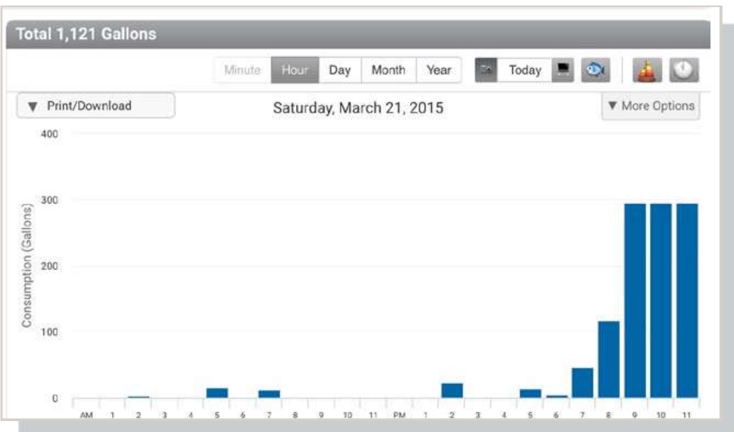
Phone: 303-693-3800 • www.eccv.org • 6201 S. Gun Club Road • Aurora, CO 80016

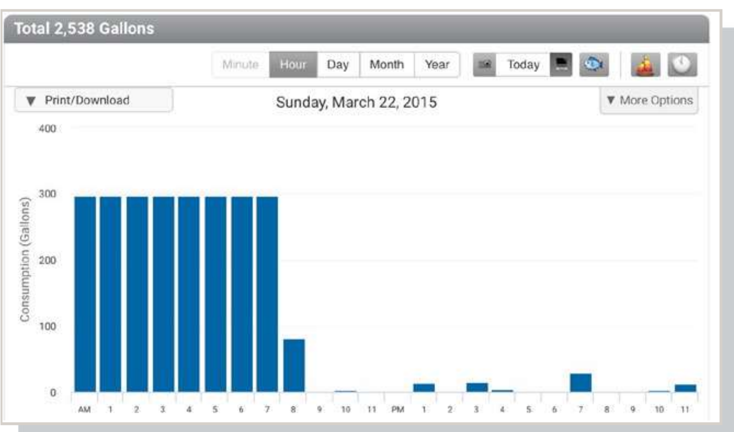
School Education Programs – Staff responds to requests for water conservation presentations to school classes. A proactive education program to visit schools with water conservation programs is under development.

Annual Large Irrigators Water Conservation Meetings – ECCV staff holds an annual meeting with Large Irrigators, including homeowners' associations (HOAs), irrigation management companies, and irrigation specialists. Every March since 2003, an annual meeting is held to review the ECCV water conservation program, including irrigation water budgets, watering schedules, water rates, and penalties. The meeting is also used to explain in detail the components of the water budget and irrigation management program, including evapotranspiration calculations, calculation of irrigated area, and establishment of water budgets.

Online Access to Water Use History – Customers have online access to their water bills and have the ability to view and compare monthly water use history. This program allows customers to adjust water use in response to past history and cost of water.

Enhanced Water Meter Data Logging – Since January 2009, as ECCV replaces water meters as part of its normal replacement program, it is installing meters with data-logging capabilities. The meter has a data profiler transmitter that allows a detailed analysis of water usage patterns. Meter readings are stored at user-programmable intervals. This is an ideal tool for addressing customer service issues such as erroneous meter readings and other billing complaints, leak detection, and water-use data for water audits. Once it is stored, the captured information can be retrieved by ECCV customer service representatives using a laptop or data collector and then graphed. A customer can view the information with ECCV customer service representatives at the customer's location and also request a paper copy.





EyeOnWater – EyeOnWater is a mobile device app available at no cost to users. EyeOnWater allows customers with compatible meters to access hourly data from their water meter on a daily basis. Various alerts and warnings can be programmed by the user to indicate issues with the account including leak detection. Initial installation of meters using this technology started in 2016, and in 2017 all commercial accounts within the District were provided with this technology. There is currently an installed base of approximately 6,400 water meters (out of approximately 20,000) that could access this information. The District is actively working to roll this technology out and encourage its use by customers. For more information about EyeOnWater and Badger Meter, see Appendix B.

4.4 : Indoor – Residential

High-Efficiency Clothes Washer and Toilet Rebates – Rebates are offered for high-efficiency (HE) EPA WaterSense ultra low-flow (ULF) toilets and HE clothes washers. The program has been in effect since 2004. Toilet rebates are for HE EPA WaterSense ULF toilets and limited to homes constructed before 1994. Each customer can receive up to two toilet rebates. The annual number of rebates is shown in Table 4-2.

TABLE **4-2**

ECCV Residential Indoor Fixture Rebates

Indoor High-Efficiency Fixture Rebates 2004–2017

Year	Washer	Toilet	Sprinkler Controllers	Actual Total	Annual Budget Total	Date Program Ended
2004	356	138	0	$58,338	$50,000	12/29/2004
2005	330	103	0	$51,188	$50,000	11/17/2005
2006	345	68	0	$49,963	$50,000	9/6/2006
2007	445	94	0	$65,000	$65,000	7/13/2007
2008	666	156	0	$98,850	$100,000	9/3/2008
2009	622	188	0	$98,213	$100,000	12/21/2009
2010	603	177	0	$93,013	$100,000	12/30/2010
2011	442	140	0	$69,250	$75,000	12/30/2011
2012	226	105	0	$38,750	$65,000	12/30/2012
2013	165	106	31	$33,001	$65,000	12/31/2013
2014	36	113	17	$16,859	$65,000	12/31/2014
2015	20	66	31	$14,764	$65,000	12/31/2015
2016	36	85	71	$18,863	$65,000	12/31/2016
2017	36	56	124	$20,914	$65,000	12/31/2017

4.5 : Outdoor Efficiency – Landscapes and Irrigation

Residential Sprinkler Controller Rebates – Smart, weather-based irrigation clocks automatically adjust an irrigation system's run-time based on historical weather data. This reduces the amount of water applied in cooler months and increases the amount during peak irrigation season. ECCV offers a 50 percent rebate of up to $100 on the installation and cost of new, qualifying irrigation sprinkler controllers. As technology improves, the program may require identification of more sophisticated controllers for rebates. ECCV may possibly work with builders on providing controllers for new neighborhoods and subdivisions.

Water Budgets for Irrigation Accounts – Water budgets for irrigation accounts were first implemented in 2005. Aerial photography and GIS were used to calculate the irrigated areas for each irrigation account. Customers were provided the opportunity to verify the calculation of irrigated areas. Monthly water budgets are established based on evapotranspiration (ET) requirements for bluegrass in the Denver area. Individual block rate structures are established for each irrigator that corresponds to blocks used for residential customers. For residential customers, irrigation is assumed to average 14,000 gallons during the peak month based on average residential lot size as calculated using GIS. The blocks for residential and irrigation water use are shown in Table 4-3.

TABLE **4-3**

ECCV Blocks for Residential and Irrigation Customers

Block	Range (gallons)	Residential Block (1,000 gallons)	Large Irrigator Block	2016 Rate (per 1,000 gallons)	2017 Rate (per 1,000 gallons)
1	0–5,000	Indoor usage	N/A	$3.60	$3.85
2	6,000–20,000	Average outdoor usage	Water budget	$5.55	$5.65
3	21,000–30,000	1.5 × average outdoor usage	1.5 × water budget	$8.50	$8.60
4	31,000–40,000	2.0 × average outdoor usage	2.0 × water budget	$11.00	$11.25
5	> 41,000	< 2.3 × average outdoor usage	< 2.3 × water budget	$12.50	$12.50

Due to potential impacts on irrigators, the water budgets were phased in over a four-year period, beginning in 2005. The following schedule illustrates how the water budgets decreased by 15 percent to 20 percent each year from 150 percent of the new allotted water budget in 2005 down to the allotted water budget by 2008:

- 2005 – Allowance of 150 percent of allotted water budget
- 2006 – Allowance of 130 percent of allotted water budget
- 2007 – Allowance of 115 percent of allotted water budget
- 2008–present – Allowance of 100 percent of allotted water budget

Irrigation System Water Conservation Requirements and Certification of Landscape Professionals – Irrigation design and water use requirements have been established as a performance standard. All irrigation system designs must be submitted for review and approval prior to the issuance of an irrigation tap for non-single family residential properties. Irrigation systems are inspected after installation. These design and usage requirements were established to conserve water. High water and maintenance expenses can be reduced when these irrigation system design requirements and performance standards are implemented and maintained. The water-reduction implementation measure requirement applies to all new irrigation systems except single family residences. The irrigation designer shall be a Certified Irrigation Designer (Commercial) as certified by The Irrigation Association or other professional with extensive experience in the design of commercial irrigation systems as determined by the District Manager.

Water-Efficient Maintenance Practices for New and Existing Landscapes – ECCV irrigation design standards require that a regular maintenance schedule shall be submitted to ensure irrigation efficiency. The maintenance schedule shall include weekly or biweekly reviews of the system. Heads will be checked for coverage and leakage, and controllers will be reprogrammed monthly or more often if necessary. A landscape irrigation audit for irrigation accounts must be performed every five years by an auditor approved by the District, and a copy of the audit shall be provided to the District.

ECCV conducts an annual review if any large irrigator went over the allotted budget and incurred penalty rates.

Weather Station for Monthly Allowance – ECCV shared the cost of a weather station with Cherry Creek School District to monitor the ET rates for a given month. The ET rate is factored into large irrigators' water budgets. If the ET rate is higher than normal, then the water budget is increased for the month, but if the ET rate is lower, then the water budget is reduced for the month. The average weather data for the prior month is compiled. The average ET rate is used to determine the water budget for billing.

ET Irrigation Controllers – A program to assist large irrigators in replacing outdated irrigation controllers with systems that can improve irrigation efficiency has been in place since 2000. If irrigation customers request financial assistance for the replacement of irrigation controllers, ECCV staff evaluates the requests on a case-specific basis to determine if there is potential for significant water savings from replacement of controllers. Several HOAs have participated in the ET irrigation controller pilot program. All irrigation controllers must have battery backup or be unaffected by a power interruption and be secured to prevent tampering. Financial assistance from ECCV to irrigators is phased over several years based on actual water use reductions achieved by the irrigators. ECCV continues to monitor the results of the program. ECCV is looking at how to approach the program and is evaluating where to focus resources.

There are no set schedules for schools due to the many activities and use of athletic fields. Schools have established water budgets, and water use must be within the budget. All of the large irrigators have the EyeOnWater Tool available to them for monitoring their accounts.

Pilot Programs of Efficient Irrigation Systems – ECCV has participated in pilot program funding of local park districts' and HOAs' use of subsurface irrigation methods to reduce evaporation losses and increase overall irrigation efficiency. Netafim subsurface drip irrigation systems were installed in several local parks and HOA irrigated areas. The Netafim system was removed from the small area within the HOA where it was installed after it did not seem to be working. This technology did not produce the anticipated results, and ECCV has not continued funding of its use at this time.

Xeriscape of ECCV Office – The District offices and maintenance facilities were constructed in 2003. A portion of the facility was landscaped using Xeriscape plantings and customers can view several Xeriscape gardens as they enter the facility.

ECCV office Xeriscape plantings

4.6 : Water Reuse Systems

Nonpotable Irrigation System – As part of ECCV's overall water management and conservation program, the District implemented reuse of legally reusable flows. This is accomplished via a nonpotable irrigation system. The ECCV nonpotable irrigation system pumps tributary groundwater from the Cherry Creek alluvium and delivers disinfected treated nonpotable water to large irrigation customers in the southwest portion of ECCV. The system currently supplies approximately 275–300 AFY of water. The use of the LIRFs represents a reuse of a scarce resource and reduces the demand for potable water supplies including pumping of non-renewable Denver Basin groundwater supplies.

4.7 : Water Savings from Previous and Existing Conservation Efforts

In the South Platte Basin Implementation Plan, the Metro Basin Roundtable set a goal to reduce system-wide per-capita water use from a baseline of 155 gallons per capita day (gpcd) in 2010 to 129 gpcd by 2050. The Metro Basin includes Denver and surrounding areas including the ECCV District. The South Platte Roundtable set a goal to reduce per capita water use from a baseline of 188 gpcd in 2010 to 146 gpcd by 2050. As discussed in Section 3.2.2, the system-wide per capita water use in the ECCV District averaged 117 gpcd from 2009–2017 and the residential-only per capita water use averaged 94 gpcd. ECCV has met its conservation goals of reducing per capita water use and is well below the goals set for the Basin to achieve by 2050. The majority of ECCV's water demand is for residential use and thus, conservation efforts have been focused on those uses. Moving forward, ECCV's task is to maintain the current level of water conservation and efficiency.

Figure 4-1 displays the decline in annual water use in AF per SFE. The decrease in annual billed AF per SFE indicates that water savings from past and current conservation measures have been significant. The average billed AF per SFE in 2011 was 0.41 AF; in 2017, it was 0.34 AF, a decrease of 18 percent. Based on the number of SFEs in 2017, the difference between 0.41 AF per SFE and 0.34 AF per SFE equals a 1,450 AF savings. Due to various factors including the phasing in and out of water conservation efforts, the initial high rate of savings and gradual savings decline of rebate programs, and the frequent updates to technology such as meters, it is not possible to allocate exact water savings to specific water conservation efforts.

FIGURE
4-1

ECCV Annual Water Use per Single Family Equivalent

Photo: Shutterstock

TABLE 4-4

ECCV Current Water Conservation Program

Water Conservation Measure	Year Implemented
Operational Utility Side Measures	
Integrated Resources Planning	2004
Full metering	1976
Modifications to increasing block-rate structure	1998
Water use based on irrigation tap fees	2001
Sustainable Water Assurance Fee	2003
Designated watering days	2002
Seasonal planting limits for turf	2002
Water waste ordinance	2014
System Water Loss Control	
Annual system water accounting audits	2005
Education and Public Information	
Water Efficiency Specialist	2018
Conservation public information campaign	2001
School education programs	2009
Annual large irrigators water conservation meetings	2005
Online access to water use history	2005
Enhanced water meter data logging	2009
EyeOnWater	2016
Indoor – Residential	
Residential clothes washer rebates	2004
Residential toilet rebates	2004
Outdoor Efficiency – Landscapes and Irrigation	
Residential sprinkler controller rebates	2013
Water budgets for irrigation accounts	2005
Irrigation system water conservation requirements and certification of landscape professionals	2001
Water-efficient maintenance practices for new and existing landscapes	2001
Weather station for monthly water budget allowance	2006
ET irrigation controllers	2000
Pilot program for efficient irrigation systems	2000
Xeriscape of ECCV office	2003
Water Reuse Systems	
Nonpotable system augmented by reusable return flow credits	2004

Section 5 : Identification and Screening of Proposed Conservation Measures

5.1 : Water Efficiency Goals

As was described in Section 4.7, ECCV has met its previous goal of per capita water use and will work to maintain the current level of water conservation and efficiency. ECCV has updated its water efficiency goals based on this level of performance. Details of ECCV's water efficiency goals and measurements for success are presented in Table 5-1.

ECCV has implemented a comprehensive water conservation program described in Section 4. Significant water use savings have been realized. As part of this Water Conservation Plan, the existing water conservation measures and additional water conservation programs and measures were evaluated. ECCV conducts internal discussions among senior staff members to identify, screen, and evaluate conservation efforts and programs. Conservation measures are screened and evaluated based on their applicability to the ECCV service area (majority residential); their proven effectiveness and reliability; and whether they fit within the conservation program budget. The District is meeting its conservation goals and does not have any areas of major conservation concern; therefore, ECCV staff have selected conservation measures that will maintain the current level of water use and help to improve water efficiency. It is important to note that as a water district, ECCV does not have land use or building permit regulatory authority. As a result, ECCV does not have the regulatory authority to require certain water conservation measures.

In July 2008, the CWCB awarded an efficiency grant to Colorado WaterWise, a water conservation non-profit group, to create a best management practices guidebook specific to Colorado. The guidebook assists water providers with the selection and implementation of effective water conservation programs and measures. The Colorado WaterWise Guidebook of Best Practices for Municipal Water Conservation in Colorado is a planning tool prepared for the purpose of improving and enhancing water efficiency in Colorado. The Best Practices Guidebook for Municipal Water Conservation in Colorado (Best Practices Guidebook) offers a detailed description of specific water conservation measures, program elements, regulations, policies, and procedures that can be implemented by Colorado water providers to help ensure reliable and sustainable water supplies for future generations.

The existing ECCV water conservation measures were evaluated and compared to the Best Practices Guidebook to determine if there were potential best practices to be considered that are not already part of the current ECCV water conservation program. The best practices are shown in Table 5-2. The Best Practices Guidebook was also used to evaluate potential additional conservation measures.

Descriptions of the existing and proposed conservation measures that were evaluated are included below. For new conservation measures that have not been fully implemented, the descriptions also include steps that will be taken for implementation, the anticipated implementation timeline, and actions necessary to implement the activity. ECCV will continue to be flexible, active, and responsive to customers' conservation needs and requests. A summary of the water conservation measures is shown in Table 5-3.

TABLE **5-1** ECCV Water Efficiency Goals

Goal Category	Goal(s)	Measurement of Success
Water Rate Structure	Maintain a fair and equitable water rate structure that promotes efficient use while maintaining sufficient revenue.	Revenue remains sufficient, per capita demands are maintained, and usage is stabilized.
Public Involvement and Education	Educate the public on the value of water. Foster a water-efficiency ethic via educational outreach and publicly available tools.	Track the number of educational outreach programs, hours spent, and estimate of number of customers reached. Survey public before the education campaign and after five years of the campaign to assess differences.
Water efficiency targets for certain customer categories	Continue to retrofit residential meters and promote the EyeOnWater program for customer self-monitoring.	Monitor billing data (water demands).
Water efficiency targets for certain customer categories	Reduce the duration of customer leaks and educate customers on detecting leaks themselves.	Monitor progress of leak detection and shortened duration through water monitoring applications.
Non-Revenue water	Continue to reduce non-revenue water and maintain level below 8 percent.	Monthly review of water produced vs. water billed. Maintain 36-month running average calculations.
Water savings for largest users	Educational outreach for high water users.	Monitor billing data (water demands).

Measure	Best Practice	Category or Sector Impacted
Full metering	BP 1	ALL
Conservation-oriented rates	BP 1	ALL
Conservation-oriented tap fees	BP 1	ALL
Integrated resource planning, goal setting, and monitoring	BP 2	Utility
Water loss control	BP 3	Utility
Water Efficiency Specialist	BP 4	ALL
Water waste ordinance	BP 5	ALL
Public information and education	BP 6	ALL
Landscape water budgets	BP 7	Outdoor irrigation
Rules and regulations for landscape design and installation	BP 8	Outdoor irrigation
Certification of landscape professionals	BP 8	Outdoor irrigation
Water-efficient design, installation, and maintenance practices for new and existing landscapes	BP 9	Outdoor irrigation
Irrigation efficiency evaluations	BP 10	Outdoor irrigation
Rules for new construction (residential and nonresidential)	BP 11	ALL
High efficiency fixtures and appliances – Residential	BP 12	Residential
High efficiency fixtures and appliances – Nonresidential	BP 12	CII
Residential water surveys and evaluations, targeted at high demand customers	BP 13	Residential
Specialized nonresidential surveys, audits, and equipment efficiency improvements	BP 14	CII

TABLE **5-2**

Water Conservation Best Practices from Guidebook

Operational Utility Side Measures

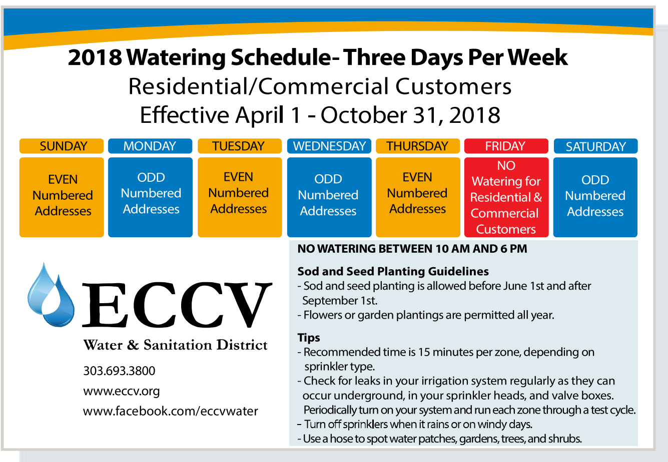
Integrated Resources Planning – This is an existing measure and will continue to be the foundation of ECCV's water supply and demand management strategy. As described in Section 7, this approach has resulted in significant infrastructure and water rights development and operation and maintenance (O&M) costs. This measure is listed as Best Practices Guidebook Best Practice **(BP #2)**.

Full Metering – All ECCV customers and associated water use will continue to be metered and billed. **(BP #1)**

Modifications to Increasing Block Rate Structure – This is an existing measure, and ECCV will continue to refine its water rate structure to promote water conservation. **(BP #1)**

Water-Use-Based Irrigation Tap Fees – This is an existing measure, and ECCV will continue to implement irrigation tap fees that are based on irrigated area and planting materials. **(BP #1)**

Sustainable Water Assurance Fee (SWAF) – ECCV will continue its program to develop renewable water supplies and reduce dependence on nontributary groundwater. ECCV will finance this with a SWAF of $25 per month, which was instituted for all residential customers. This additional water bill charge results in a water conservation signal to customers that has resulted in reduced water use. **(BP #1)**



Designated Watering Days – Designated watering days will remain in effect for all customers. This program manages the demands of peak irrigation and total water use. The continued use of patrols to enforce the program will be evaluated annually. **(BP #1)**

Seasonal Planting Limits for Turf – ECCV will continue to enforce that no new sod or grass seed planting will be allowed from June 1 to September 1. Exemptions may be made on a case-specific basis for buffalo grass planting or for specific uses such as athletic fields.

Water Waste Ordinance – ECCV adopted new rules and regulations in 2014. Specific to water conservation, the District prohibits the wasting of water and defined water waste within the service area. Failure to comply with the Conservation Plan and violations of wasting water will result in Water Waste Charges as illustrated in the ordinance. ECCV also outlined how water restrictions, curtailments, or prohibitions upon water use may be enacted and provided details for the tiered water rate system. **(BP #5)**

Residential Water Surveys and Evaluations, Targeted at High-demand Customers – ECCV has existing programs and aggressive increasing water block rates that limit the water use and minimizes high water users. At this time, additional residential water surveys and evaluations are not needed as there are few high demand users. **(BP #13)**

5.2 : Water Loss Control Program

Water Loss Control Program – System-wide audits have been conducted by the ECCV annually since 2005 to determine the efficiency of the water distribution system. Industry standards consider up to 10 percent non-revenue water to be acceptable. For 2015–2017, the non-revenue water averaged 5.2 percent.

A leak identification survey uses sonic leak detection equipment to identify leaks within a section of piping. The results of the survey would determine the amount of water that could possibly be saved. This measure would allow ECCV to prioritize and repair sections of the distribution system before a leak surfaces. ECCV understands the importance of identifying leaks within the distribution system and the water savings that can be achieved with such a water conservation measure. A system-wide leak detection program that would survey 20 percent of the system each year is estimated to cost $50,000 per year for contractor and administrative costs. The expenditure of additional funds for leak detection would reduce the financial resources for other conservation programs. ECCV has established a goal of a maximum of 8 percent non-revenue water and will implement a system-wide leak detection program if non-revenue water increases to over 8 percent on a 3-year running average. **(BP #3)**

5.3 : Education and Public Information

Water Efficiency Specialist – ECCV added a full-time Water Efficiency Specialist in March 2018. This staff member's sole responsibility is water conservation and efficiency efforts to increase efficiency and lower costs for customers. The Water Efficiency Specialist will review and evaluate the continuation of the rebate program in the next year. This staff member will also create programs and content to carry out the recommendations of this Plan. **(BP #4)**

Conservation Public Information Campaign – In addition to its existing in-house public education program, ECCV will disseminate water conservation and efficient use information. **(BP #6)**

School Education Programs – ECCV's Water Efficiency Specialist will implement school education programs. **(BP #6)**

Annual Large Irrigators Water Conservation Meetings – ECCV staff will continue to hold an annual meeting with Large Irrigators, including HOAs, irrigation management companies and irrigation specialists. The annual meeting will review the ECCV water conservation program including irrigation water budgets, watering schedules, and water rates and penalties. **(BP #6)**

Online Access to Water Use History – Customers have online access to their water bills and have the ability to view and compare monthly water use history. This program allows customers to adjust water use in response to past history and cost of water. **(BP #6)**

EyeOnWater – ECCV will expand its EyeOnWater program to all residential customers. EyeOnWater is a mobile device app available at no cost to users. EyeOnWater allows customers with compatible meters to access hourly data from their water meter on a daily basis. Various alerts and warnings can be programmed by the user to indicate various issues with the account including leak detection. Initial installation of meters using this technology started in 2016, and in 2017 all nonresidential accounts within the District were provided with this technology. There is currently an installed base of approximately 6,400 water meters (out of approximately 20,000) that could access this information. The District is actively working to expand the use of this technology by all customers through outreach and education programs. The Water Efficiency Specialist will provide education to customers on the capabilities of the EyeOnWater app and encourage customers to self-monitor water usage and look for leak detection. **(BP #6)**

Enhanced Water Meter Data Logging – ECCV will continue its meter replacement program with meters that have data logging capabilities. Beginning in 2018, all newly installed meters were equipped to be read electronically on a daily basis and allow customer access to data using the EyeOnWater app. Of the existing meters, there are approximately 13,450 residential meters that need to be upgraded to daily electronic reads with customer access. ECCV anticipates that retrofitting these meters at a rate of 1,225 per year, it will take almost 11 years to complete the update. **(BP #6)**

Xeriscape Design and Water-efficient Garden Programs – ECCV will work on the implementation of Xeriscape Design Clinics for all water providers in the SMWSA. ECCV may hold a customer Xeriscape contest and provide prizes to the winners. Customers may also get reimbursed for taking Xeriscape classes from local garden businesses. ECCV will partner with the Resource Center to host a "Garden in a Box" program for customers. The program provides a Xeriscape garden available for purchase and installation. ECCV plans to host the program for two years, after which it will evaluate the program's success and determine if it will continue the program. ECCV will also re-evaluate how to better utilize the Xeriscape garden at their offices in the future. **(BP #6)**

5.4 : Indoor – Residential

HE Clothes Washer and Toilet Rebates – ECCV will continue its toilet and clothes washer rebate program but will limit the toilet rebates to only those toilets that meet the EPA WaterSense criteria. The annual budget allocated for rebates will be evaluated annually as well as the continued inclusion of clothes washers as new efficiency requirements for clothes washers took effect in 2011; the cost-effectiveness of a rebate program for clothes washers may be diminished. **(BP #12)**

Low-flow Faucets and Showerhead Rebates – ECCV does not have current plans for a program to extend its residential indoor rebate program to low-flow faucets and showerheads as its residential indoor rebate program has been successful for toilets and clothes washers. **(BP #12)**

Rules for New Construction – ECCV, as a water district, does not have the regulatory authority to require HE plumbing fixtures or other conservation measures for new residential construction. **(BP #11)**

5.5 : Indoor – CII

High-efficiency Indoor Fixture Audits and Retrofits – ECCV has very limited commercial customers representing 4 percent of total billed water usage and no industrial customers. Within the next two years, the Water Efficiency Specialist will conduct water audits of ECCV's commercial customers. At the conclusion of this audit, ECCV will evaluate the cost-effectiveness of a CII indoor fixture retrofit program or other measures to address CII indoor usage including processes. **(BP #12)**

Rules for New Construction – Building Codes Requiring High-efficiency Fixtures and Process Equipment – ECCV, as a water district, does not have the regulatory authority to require HE plumbing fixtures or other conservation measures for new Commercial, Industrial, or Institutional construction. **(BP #11)**

Specialized Nonresidential Surveys, Audits, and Equipment Efficiency Improvements – ECCV has very limited commercial representing 4 percent of total billed water usage and no industrial customers. As a result, ECCV will not independently implement a nonresidential program. **(BP #14)**

5.6 : Outdoor Efficiency - Landscapes and Irrigation

Water Budgets for Irrigation Accounts – Water budgets for irrigation accounts will continue. Local ET data will continue to be used to establish the water budgets. **(BP #7)**

Irrigation System Water Conservation Requirements and Certification of Landscape Professionals – Irrigation design and water use requirements will continue as a performance standard. All irrigation system designs must be submitted for review and approval prior to the issuance of an irrigation tap for non-single family residential properties and inspected after installation. The irrigation designer shall be a Certified Irrigation Designer (Commercial) as certified by The Irrigation Association or other professional with extensive experience in the design of commercial irrigation systems as determined by the District Manager. **(BP #8)**

Water-efficient Maintenance Practices for New and Existing Landscapes – ECCV irrigation design standards will continue to require that a regular maintenance schedule be submitted to ensure irrigation efficiency. The maintenance schedule shall include weekly or biweekly reviews of the system. **(BP #9)**

ET Irrigation Controllers – If irrigation customers request financial assistance for the replacement of ET irrigation controllers, ECCV will evaluate the request on a case-specific basis to determine if there is potential for significant water savings from replacement of controllers. All irrigation controllers must have battery backup or be unaffected by a power interruption and be secured to prevent tampering. Financial assistance from ECCV to irrigators, if approved, will be phased over several years based on actual water use reductions achieved by the irrigators. ECCV is looking at how to approach the program and is evaluating where to focus resources. **(BP #9)**

Weather Station for Monthly Allowance – ECCV shared the cost of a weather station with Cherry Creek School District to monitor the ET rates for a given month. The ET rate is factored into large irrigators water budget. If the ET rate is higher than normal then the water budget is increased for the month, but if the ET rate is lower, then the water budget is reduced for the month. The average weather data for the prior month is compiled. The average ET rate is used to determine the water budget for billing. ECCV will continue using the weather station for water budget billing. **(BP #7)**

Efficient Irrigation Systems Program – If irrigation customers request financial assistance for the replacement of existing irrigation systems or installation of new systems with highly efficient irrigation systems, ECCV will evaluate the request on a case-specific basis to determine if there is potential for significant water savings. Efficient irrigation systems include subsurface irrigation methods to reduce evaporation losses and increase overall irrigation efficiency. The irrigation customer must show the ability to perform recommended operations and maintenance for the life of the system as a prerequisite to financial assistance from ECCV. ECCV is looking at how to approach the program and is evaluating where to focus resources. **(BP #9)**

Residential Sprinkler Controller rebates - ECCV will continue providing rebates for sprinkler controllers. ECCV offers a 50 percent rebate of up to $100 on the installation and cost of new, qualifying irrigation sprinkler controllers. As technology improves, the program may require identification of more sophisticated controllers for rebates. ECCV may possibly work with builders on providing controllers for new neighborhoods and subdivisions. **(BP #9)**

Residential Irrigation Efficiency Evaluations – In addition to the existing Efficient Irrigation Systems Program for large irrigators, ECCV will offer a pilot program for residential irrigation system assessments. ECCV plans to conduct this program for two years, after which it will evaluate the program's success and determine if it will continue the program. **(BP #10)**

Limits on Turf Landscaping for New Construction – ECCV, as a water district, does not have the regulatory authority to limit turf landscaping for new construction and does not intend to pursue this with local governments at this time.

Rebates for Turf Replacement – ECCV has evaluated a rebate program for the replacement of turf but does not intend to pursue this program at this time due to concerns with long-term savings and administration.

5.7 : Water Reuse Systems

Nonpotable Irrigation System – ECCV will continue to reuse legally available LIRFs for nonpotable irrigation. It will expand the system where it is cost-effective and supply has been determined to be sustainable. A study for a potential next phase of the nonpotable system has been completed. Expansion would require a pump station and additional piping infrastructure. Long-term lawn irrigation return flow credits may diminish due to increased irrigation efficiency, and there may be insufficient LIRFs to justify the cost of expansion.

Reuse of Consumable Effluent Return Flows – ECCV will continue to investigate the right to reclaim the use of all or a portion of its consumable wastewater flows for diversion in its Northern Water Supply Project, to augment alluvial nonpotable well pumping or by other means.

TABLE 5-3

Evaluated Water Conservation Program Activities

(Continues on next page)

Water Conservation Measure	Existing Measure to be Continued	ECCV has Regulatory Authority?	Best Practices Guidebook BP #	Retained for Continued and/or Future Implementation?
Operational Utility Side Measures				
Integrated Resources Planning	X	Yes	2	Yes
Full metering	X	Yes	1	Yes
Modifications to increasing block rate structure	X	Yes	1	Yes
Water-use-based irrigation tap fees	X	Yes	1	Yes
Sustainable Water Assurance Fee	X	Yes	1	Yes
Designated watering days	X	Yes	1	Yes
Seasonal planting limits for turf	X	Yes		Yes
Water Efficiency Specialist	X	Yes	4	Yes
Water waste ordinance	X	Yes	5	Yes
Residential water surveys and evaluations targeted at high-demand customers		Yes	13	No
Water Loss Control Program				
Water loss control program	X	Yes	3	Yes
Education and Public Information				
Conservation public information campaign	X	Yes	6	Yes
School education programs	X	Yes	6	Yes
Annual large irrigators water conservation meetings	X	Yes	6	Yes
Customer online access to water use history	X	Yes	6	Yes
Water monitors	X	Yes	6	No
EyeOnWater	X	Yes	6	Yes
Enhanced water meter data logging	X	Yes	6	Yes
Xeriscape design program	X	Yes	6	Yes
Indoor – Residential				
Residential clothes washer rebates	X	Yes	12	Yes
Residential toilet rebates	X	Yes	12	No
Residential toilet rebates for WaterSense HE only	X	Yes	12	Yes
Residential low-flow showerheads and faucets rebates		Yes	12	No
Building codes requiring HE fixtures		No	11	No

TABLE 5-3

Evaluated Water Conservation Program Activities

(Continued)

Water Conservation Measure	Existing Measure to be Continued	ECCV has Regulatory Authority?	Best Practices Guidebook BP #	Retained for Continued and/or Future Implementation?
Indoor – CII				
CII indoor audits and retrofits		Yes	12	Yes
Rules for new construction – building codes requiring HE fixtures and process equipment		No	12	No
Specialized nonresidential surveys, audits, and equipment efficiency improvements	X	Yes	14	Yes
Outdoor Efficiency - Landscapes and Irrigation				
Water budgets for residential and irrigation accounts	X	Yes	7	Yes
Irrigation system water conservation requirements and certification of landscape professionals	X	Yes	8	Yes
Water-efficient maintenance practices for new and existing landscapes	X	Yes	9	Yes
Efficient irrigation systems program	X	Yes	9	Yes
ET irrigation controllers	X	Yes	9	Yes
Weather station for monthly allowance	X	Yes	7	Yes
Residential sprinkler controller rebates	X	Yes	9	Yes
Residential irrigation efficiency assessments		Yes	10	Yes
Limits on turf landscaping for new construction		No		No
Rebates for turf replacement		Yes		No
Water Reuse Systems				
Nonpotable system augmented by reusable return flow credits	X	Yes		Yes
Recapture and reuse of reusable effluent		Yes		Yes
Recapture of reusable return flow credits for use in the Northern Water Supply Project		Yes		Yes

Section 6 : Water Demand Forecasts

ECCV conducts its own annual baseline demand forecast. The District is currently at 85 percent buildout and projects to be at 100 percent buildout within 10 years. The baseline forecast represents the historical water use of 0.6 AF per SFE. The Alliance for Water Efficiency (AWE) Conservation Tracking Tool v3.0 was used to determine plumbing code and program savings. The Water Conservation Tracking Tool is an Excel-based spreadsheet tool for evaluating the water savings, costs, and benefits of urban water conservation programs. In addition to providing users a standardized methodology for water savings and benefit-cost accounting, the tool includes a library of pre-defined, fully parameterized conservation activities from which users can construct conservation programs. Detailed information on the inputs, assumptions, and methods used in Water Conservation Tracking Tool can be found in the User Guide. Results from the AWE Conservation Tracking Tool are included in this plan.

Four demand forecasts were made using ECCV's Baseline Demand Forecast, a Climate Change Forecast for outdoor use, and the Water Conservation Tracking Tool:

1. Baseline
2. Baseline + climate change
3. Baseline + climate change + plumbing code savings
4. Baseline + climate change + plumbing code savings + existing and planned water conservation program savings

6.1 : Baseline Demand Forecast

The baseline forecast represents the ECCV demand forecast based on the historical water use of 0.6 AF per SFE. This forecast is based on SFE demands before the implementation of aggressive water conservation measures starting in 2000 and the drought of 2002. The baseline forecast includes growth in SFEs as projected by ECCV. Since ECCV is nearing buildout and remaining undeveloped land within its service area has been platted, the future land use and SFEs is known with a relatively high degree of certainty. ECCV projects that its service area will reach buildout by 2028 at 23,500 SFEs. This results in a buildout water demand of 14,100 AF per year (AFY.) This demand forecast includes an estimated 7 percent water loss but does not include the normal water supply planning safety factors. Instead, the difference between the current SFE demands with water efficiency activities and the SFE demands prior to implementation of conservation measures is incorporated as a water supply planning safety factor. The demand forecasts in Sections 6.2 through 6.4 are treated water forecasts, understanding that raw water supply requirements are greater as described in Section 7. For the purposes of this plan, demand forecasts are treated water forecasts, understanding that firm yield raw water supply requirements are significantly greater, approximately 20–30 percent.

6.2 : Baseline + Climate Change Forecast

This forecast includes the baseline demands plus additional demands for outdoor irrigation due to the impacts of climate change. Several studies on the Front Range have shown that climate change will result in a growing season that starts earlier in the spring and continues later into the fall, in addition to warmer summer temperatures. This will result in higher evapotranspiration of irrigated areas and higher outdoor irrigation requirements. These studies were summarized in McCurry 2011, and the data from the McCurry report was used to estimate the increased water demand for irrigation. The studies suggested that climate change will be in full effect by 2050, thus the change in demand due to climate change is forecasted for 2050. This additional water use was added to the Baseline demand forecast.

The buildout water demand plus climate change considerations is 14,408 AFY in 2050, an addition of 308 AFY.

6.3 : Baseline + Climate Change + Plumbing Code Savings Forecast

The Baseline + Climate Change + Plumbing Code Savings forecast includes forecasted reductions in demand that have or will occur as a result of national plumbing code efficiency standards. For example, ULF toilet requirements included in the National Energy Policy Act took effect in 1994. New efficiency requirements for clothes washers took effect in 2011. In Colorado a WaterSense law was passed in 2014 requiring that only WaterSense fixtures be available for sale. Based on this legislation, the values for plumbing code savings may be realized more quickly, and this change may be reflected in the next iteration of the plan.

The Baseline + Climate Change + Plumbing Code Savings demand forecast is approximately 13,886 AFY in 2050, a savings of 522 AFY. Due to phased adoption and ramping up of plumbing code savings, the total estimated water savings from 2018–2050 is approximately 345 AFY.

6.4 : Baseline + Climate Change + Plumbing Code Savings + Program Savings Forecast

The Baseline + Climate Change + Plumbing Code Savings + Program Savings forecast includes forecasted reductions in demand from the existing and planned water conservation program in addition to the savings projected to occur as a result of national plumbing code efficiency standards.

The existing and planned water conservation programs were included as inputs into the AWE Water Tracking Tool to estimate and forecast the water savings from the existing and planned programs. The total estimated water savings from 2018–2050 from water conservation programs is approximately 2,276 AFY. This is an additional savings of approximately 910 AF from the previous conservation plan due to the implementation of new conservation programs. By 2050, the total estimated water savings from conservation programs decrease slightly to 2,197 AFY as a result of declining savings several years after residential water conservation survey activities have ended. Water savings have been estimated for the current and new programs listed in Table 6.1. It is difficult to attribute savings to individual measures, such as select education and public information programs, as these savings are reflected in the successful implementation of other programs. As a result, the estimated water savings should be evaluated by major category rather than evaluating the efficacy of individual conservation programs. The very low average water savings attributed to the continuation of the residential HE clothes washer rebates is the result of the rebate program being on the decline. Most single family homes have already taken part in the rebate program and updated their washer to an HE model, or the home was built after 2011 and came equipped with an HE washer. There are very few residential accounts that do not already have HE washers. Commercial and industrial indoor fixture retrofits is another area of low average water savings. This is due to a limited number of newer commercial and no industrial accounts that may already have higher-efficiency indoor fixtures. ECCV may conduct indoor audits of schools and commercial users to determine the potential water savings from a program to address indoor plumbing fixtures and processes. As a result, the projected savings may change.

The loss control program at an annual cost of $50,000 per year is also estimated to result in only minor savings given the average age of transmission and distribution lines, very low frequency of water line breaks, and system losses that are well within industry standards. As described in Sections 4.2 and 5.2, system-wide leak detection will be implemented if non-revenue water exceeds 8 percent on a 36-month running average.

TABLE **6-1**

ECCV Water Conservation Activities and Savings included in AWE Tool

Program	Savings through 2028 [AF]	Average Annual Savings* [AFY]
Water Loss Control Program (System-wide Leak detection)	0.0	8.8
Large Land Irrigation Controller	23.4	7.8
Residential HE Washer, SF	68.2	29.0
Large Landscape Water Budgets	110.4	110.4
Residential HE Toilets, SF	64.9	67.8
Residential Irrigation Controller, SF	35.0	8.4
Education and Public Information	74.7	73.9
Enhanced Water Meters	433.6	558.9
Designated Water Days	681.0	711.2
Residential Increasing Block Rates	665.6	695.7
Total	**2,156.7**	**2,276.0**

* These are the average annual savings. Savings by 2050 are estimated at 2,197 AFY

Water savings from specific programs do not change linearly over time, nor do they remain constant. An educational program may result in large water savings the year that it is implemented, but water savings may decay for the next five years due to people falling back into their old routines. This results in high water savings during the first few years of implementation and slightly lower long-term average water savings.

The total of all of the ECCV water conservation programs are forecast to save an additional 2,197 AFY by 2050 for a total savings of 2,719 AFY for the plumbing code savings plus the ECCV program code savings. This represents an 18.9 percent total savings over the baseline plus climate change water demands as shown in Table 6.2.

TABLE **6-2**

ECCV Water Conservation Savings

Service Area Water Savings	Units	2050
Plumbing Code Water Savings	AF	522
Program Water Savings	AF	2,197
Total Water Savings	**AF**	**2,719**
Percentage of Baseline + Climate Change Demands	**percent**	**18.9%**

Section 7 : Impacts of Conservation Programs

The forecasted total water savings of 2,719 AFY represents significant benefits to ECCV. Figure 7-1 shows the annual water demands based on the baseline, baseline + climate change, baseline + climate change + code savings, and baseline + climate change + code savings + program savings for 2017 to 2050. Also included in this figure is the estimated current capacity of the ECCV water supply system. The current limiting factor is water production capacity.

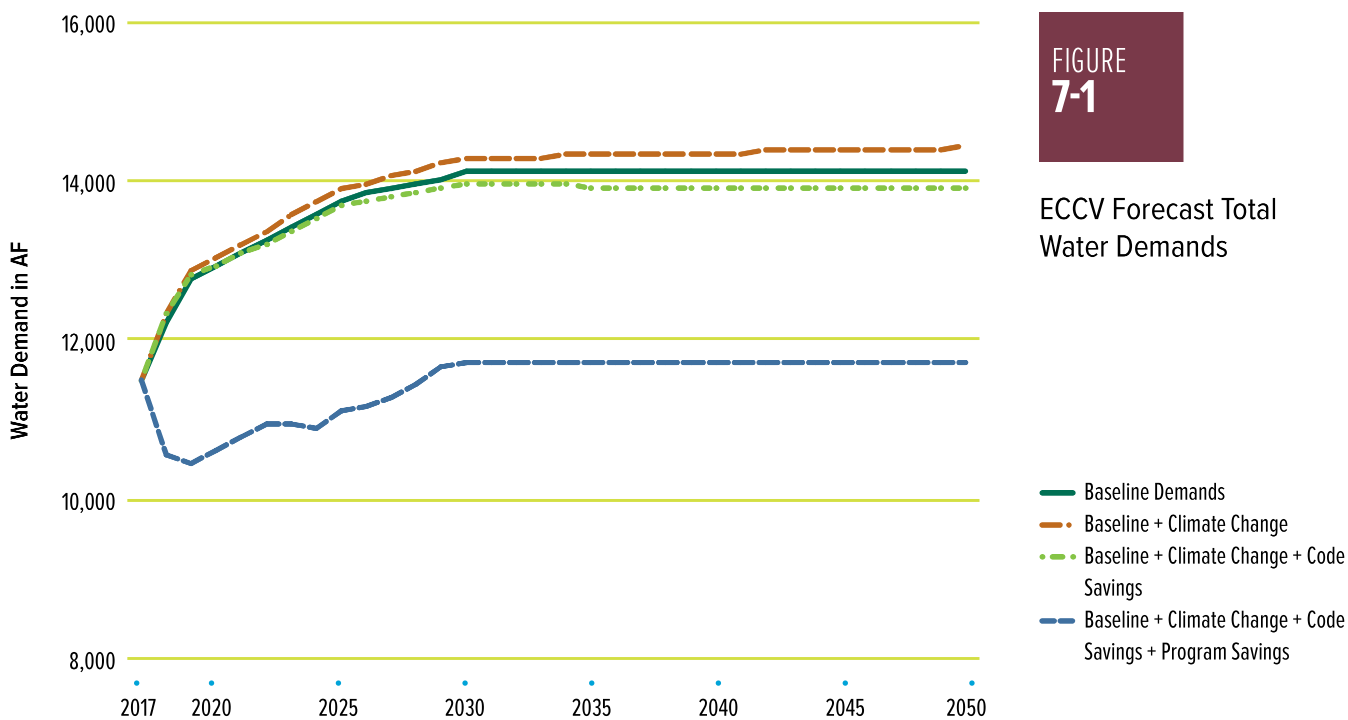


FIGURE 7-1

ECCV Forecast Total Water Demands

7.1 : Benefits and Financial Savings

The following benefits and potential financial savings in capital improvements have been identified based on the projected water savings. It has and will continue to require ongoing conservation efforts to ensure that the identified water conservation savings can be made permanent.

Raw Water Supply Development – ECCV will continue to acquire renewable water supplies to meet buildout water demand. The estimated cost for additional raw water supply development, including water rights acquisitions, Water Court transfers, diversion facilities, operational and firming storage, alluvial pretreatment, and conveyance to the ECCV Water Treatment Plant is $25,000 per acre foot. The forecast demand reduction of 2,719 AFY from the ECCV water conservation programs and plumbing codes (combined program), if permanent, represent a savings of $67.975M (based on $25,000/AF.)

Water Treatment Plant – The projected reduction in peak demands from the combined program is 9 MGD. The projected cost per MGD of additional water treatment capacity, including RO concentrate disposal through a deep injection well, is $4.4 million. This represents a total savings of $39.6M from avoided water treatment capital projects.

Installation of ECCV Deep Injection Well No. 2, 2016

Northern Pipeline and Pump Stations – The projected savings in peak demands from the combined program is 9 MGD. ECCV has already constructed the Northern Pipeline to meet its baseline peak demands. ECCV reserved approximately 24 MGD capacity for buildout demand in the Northern Pipeline and Pump Stations. If conservation programs and plumbing code savings are achieved, ECCV could have 9 MGD of additional capacity to sell. ECCV has already sold available capacity for $1.5M per MGD. The cost to develop additional pumping capacity in the ECCV North and South Booster Pump Stations is $1M per MGD. The total combined savings or additional revenue if freed capacity is sold is $22.5M.

The savings to ECCV for capital expenditures is summarized in Table 7-1. The total savings in avoided capital expenditures for raw water supply development, water treatment, and conveyance infrastructure is $130,075,000. Ongoing water conservation programs will be needed to ensure that these savings are permanent.

TABLE **7-1** ECCV Capital Expenditure Savings

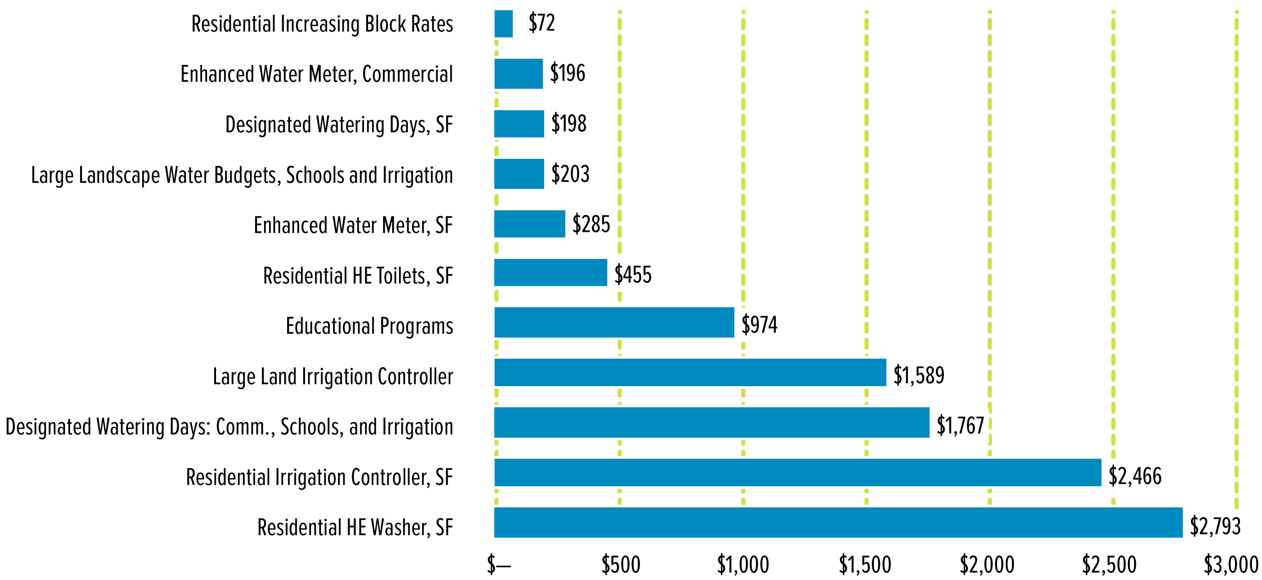
Water Development Activity	Water Demand Units	Total Water Conservation Program Forecast Demand Reductions	Estimated Unit Cost	Total Financial Savings if Demand Reductions are Permanent
Raw Water Supply Acquisition and Development	AFY	2,719	$25,000	$67,975,000
Water Treatment	MGD	9.0	$4,400,000	$39,600,000
Northern Water Line and Pump Stations	MGD	9.0	$2,500,000	$22,500,000
Total				**$130,075,000**

7.2 : Conservation Program Costs

The estimated cost to ECCV per AF saved by the program was evaluated using the AWE Tool as shown in Figure 7-2. The residential increasing block water rates, which ECCV has been implementing for over 20 years, continues to be a low-cost and effective program for water savings. The installation of enhanced water meters for commercial and residential accounts, allowing customers to self-monitor their water usage and detect leaks with the EyeOnWater app, is another cost-effective measure that ECCV began implementing in 2016. The relatively high costs for education and public information is partially attributable to the incorporation of some of the savings from education and public information to other conservation measures that are successfully implemented as a result of the education and public information programs. The high estimated cost per AF of the residential HE washer program is a result of the high administrative costs associated with the implementation of this program for a limited number of remaining residential accounts that have not yet received the rebate. Although not included in the table, the estimated loss control (system-wide leak detection) program is also a high cost program as the ECCV water transmission and distribution system is relatively young, water line breaks average two per year, and non-revenue water is well within industry standards. Water loss savings from system leaks can vary significantly, and it is questionable how much reduction ECCV may achieve given its low system loss percentage. Implementing a system-wide leak detection program is a lower priority at this time. As the system ages, water loss control may be expected to be more cost-effective. As noted, a system-wide leak detection program covering 20 percent of the system annually will be implemented if system losses average greater than 8 percent on a 36-month running average. As noted in Section 5.6, the Water Efficiency Specialist will conduct audits of all commercial users. A measure to address commercial indoor fixtures or processes will be implemented if warranted based on the results of the audits, and additional water savings will be assessed as part of the audit.

FIGURE
7-2

Conservation Programs Cost to ECCV per AF Saved



7.3 : Other Considerations

There are other considerations in addition to reduced capital project expenditures when evaluating the impacts of the water conservation program.

Reduced Nonpotable Irrigation Supply – As irrigation demands are reduced, the lawn irrigation return flow credits generated from lawn watering are also reduced. This results in less augmentation supply available to offset the ECCV nonpotable well pumping. The impacts on the nonpotable system have not been quantified for this analysis but will be monitored on an ongoing basis as part of the nonpotable irrigation accounting.

Sewer Charges – ECCV currently pays a flat monthly fee per SFE to the City of Aurora for conveyance of sewer flows to Metro Wastewater Reclamation District and treatment by Metro. ECCV charges its customers a flat monthly fee for sewer service. As a result, any decreases in sewer flows by individual users do not result in reductions in sewer charges to that customer. The estimated sewer flows are evaluated periodically by reviewing water usage data, and any reductions in indoor water usage resulting in reduced total sewer flows can result in reductions in the total sewer charge paid by ECCV to Aurora that can be passed on to customers.

Operations, Maintenance, and Replacement – Most of the ECCV O&M costs are fixed, especially for labor. The 18.9 percent forecast demand reductions will likely only result in minor savings in labor costs. The savings will primarily be realized in operations and maintenance costs such as electricity and chemicals from the reduced need to divert, treat, and pump supplies. Over the long-term, there will be fewer capital facilities to replace. The AWE Tool provided an estimate of the variable operations, maintenance, and replacement costs per AF of water treated of $589, for an annual savings of $1.6M. This is not a direct savings to ECCV as it would not treat and deliver this water without customer demand. The customers would experience an annual savings of $5.0M, assuming an average cost of saved water at $5.65 per 1,000 gallons.

Reduced Revenue – As noted, ECCV will experience less O&M and the customers will pay less in water bills. This results in a loss of potential revenue to ECCV. As long as ECCV can recover its costs for existing investment in the Northern Pipeline and Pump Stations, this loss of potential revenue should not present a problem for operations, although the ECCV fixed costs for labor will likely not be reduced. The District's water charge structure has significant flat fees which are not impacted by volumetric changes in demand which help mitigate reduced revenue due to conservation or drought.

Reduced Energy Costs – The AWE Tool was used to estimate reduced energy costs to residential customers from the replacement of existing clothes washers with HE clothes washers. The existing ECCV rebate program is proposed to continue up to a total of 7,000 rebates over the life of the program. The AWE Tool estimates that this will result in annual savings of $75,000 in electricity and $44,000 in gas charges to residential customers.

Photo: iStockPhoto

Section 8 : Implementation and Monitoring Plan

8.1 : Implementation

ECCV will continue its current water conservation programs. In addition, it will implement the new programs as previously described in Section 5 and shown in Table 8-1. This table also indicates the proposed dates of implementation.

8.2 : Ongoing Monitoring

ECCV will track the impacts of the Conservation Plan annually and will collect data monthly. Monitoring of total and billed water usage will provide information on water use and progress toward the water conservation goals. ECCV will also track system per capita water use, system peak day water use, and billed water use by customer category including treated and raw metered water use. As part of ECCV's Annual Water Efficiency Report to the CWCB, ECCV will also document meter-reading frequency; meter updates; the billing rate structure; system loss and leak detection information; conservation program incentives, staffing, costs, and education; and water waste activities. Utilities staff will continue to produce an annual report on the conservation program that includes a detailed description of plan implementation as well as the measured impacts on usage. Conservation Plan monitoring and evaluation results including lessons learned will be communicated to the ECCV Board of Directors at the annual Board Retreat, which occurs every fall.

TABLE 8-1 ECCV Implementation Plan

Water Conservation Measure	Date of Implementation if New Measure
Operational Utility Side Measures	
Integrated Resources Planning	Ongoing
Full metering	Ongoing
Modifications to increasing block rate structure	Ongoing
Water-use-based irrigation tap fees	Ongoing
Sustainable Water Assurance Fee	Ongoing
Designated watering days	Ongoing
Seasonal planting limits for turf	Ongoing
Water Efficiency Specialist	2018
Water waste ordinance	2014
Water Loss Control Program	
Water loss control program	Ongoing
Education and Public Information	
Conservation public information campaign	Ongoing
School education programs	Ongoing
Annual water conservation meetings with HOAs	Ongoing
Customer online access to water use history	Ongoing
EyeOnWater	2016
Enhanced water meter data logging	Ongoing
Xeriscape design program	2013

Water Conservation Measure	Date of Implementation if New Measure
Indoor – Residential	
Residential clothes washer rebates	Ongoing
Residential toilet rebates for WaterSense HE only	Ongoing
Indoor – CII	
CII indoor audits (and retrofits, if warranted by audits)	2013
Outdoor Efficiency – Landscapes and Irrigation	
Water budgets for residential and irrigation accounts	Ongoing
Irrigation system water conservation requirements and certification of landscape professionals	Ongoing
Water-efficient maintenance practices for new and existing landscapes	Ongoing
Efficient irrigation systems program	Ongoing
ET irrigation controllers	Ongoing
Weather station for monthly allowance	Ongoing
Residential sprinkler controller rebates	2013
Residential irrigation efficiency evaluations	2012
Water Reuse Systems	
Nonpotable system augmented by reusable return flow credits	Ongoing
Recapture and reuse of reusable effluent	See Note

Note: ECCV will continue to investigate the right to reclaim the use of all or a portion of its consumable wastewater flows for diversion in its Northern Water Supply Project to augment alluvial nonpotable well pumping or by other means.

8.3 : Compliance with State Planning Requirements

Colorado Statutes Title 37 Water and Irrigation – CWCB and Compacts 37-60-126 requires a state-approved water conservation plan for covered entities as a condition of seeking financial assistance from the CWCB. Key planning requirements of the statute include the following items:

1. Consideration of specific conservation measures and programs including (I) fixtures and appliances; (II) water-wise landscapes; (III) CII measures; (IV) water reuse systems; (V) water loss and system leakage; (VI) information and education; (VII) conservation-oriented rate structure; (VIII) technical assistance; (IX) regulatory measures; (X) incentives and rebates.
2. Role of conservation in the entity's supply planning.
3. Plan implementation, monitoring, review, and revision.
4. Future review of plan within seven years.
5. Estimated savings from previous conservation efforts as well as estimates from implementation of current plan.
6. A 60-day minimum public comment period.

As identified in Sections 5 and 8.1, all of the criteria listed in 1-5 above have been satisfied. In addition, as noted in Section 5, the measures identified in the Best Practices Guidebook were also used to guide the selection of conservation measures.

A public review of the Conservation Plan (#6) took place from May 23 to July 21, 2018. A draft version of the Plan was provided to the public on the ECCV website (**https://www.eccv.org/conservation**), and the public was invited to review the draft and provide comments or ask questions via telephone or e-mail correspondence. No comments were received.

The ECCV Water Conservation Plan was formally adopted by the ECCV Board of Directors on July 26, 2018. A copy of the Board Memo officially adopting the plan is included in Appendix C.

8.4 : Plan Refinement

ECCV will review the program and implementation for conformance with this plan annually. ECCV may adjust the programs identified in this plan as warranted due to new technology or analysis of the effectiveness of individual programs. Monitoring results will be evaluated and ECCV will determine if changes to conservation programs are needed to maintain the current level of water conservation and efficiency. Necessary modifications identified will be incorporated into plan updates. A complete review and revision of the Conservation Plan will be completed seven years after adoption.

Photo: iStockPhoto

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Addendum: Land Use

ECCV is a Colorado Title 32 special district without land use control. The City of Centennial and Arapahoe County have land use authority. ECCV coordinates with the appropriate entity for water and wastewater flows within its jurisdiction, see the map of jurisdictions within the ECCV district, Figure A-1. ECCV is evaluating land use planning and coordination with Arapahoe County and others in the future on landscaping for schools, HOAs, and other large irrigators.

ECCV's wastewater is delivered to City of Aurora interceptor sewers and transported to the Metro treatment plant at 56th & York, where it is treated and discharged to the South Platte River.

The 1976 sewer use contract between ECCV and Aurora states:

> *"The City of Aurora agrees in this connection not to oppose any overall plan of development for the District or the Service Area lying outside the City of Aurora city limits, or incremental parts thereof, devoted to residential, office, and retail commercial centers which do not exceed an overall gross density of 3.5 dwelling units per acre."*

This agreement limits the densities that ECCV can allow within the District boundaries now and would limit redevelopment in the future.

There are very few undeveloped parcels remaining within the ECCV legal boundaries. There are few to none within the City of Centennial. The bulk of the undeveloped land lies in unincorporated Arapahoe County, see Figure A-1.

- All of the Copperleaf Subdivision, with the exception of area M4 is already partially or completely through the development process. Parcel M4 is a 76-acre parcel slated for some type of regional commercial center.

- Arapahoe Park & Recreation District (APRD) owns a 168-acre parcel north of Quincy, west of E-470 slated for a regional park/ open space/recreation facility.

- Areas N (30 Acre) and O (10 Acre) are parcels sited between E-470 and Gun Club Road. They are narrow parcels, approximately 400 feet wide.

- There is a 23-acre vacant parcel located under the Buckley overflight zone, which has very restricted uses.

There is not specific guidance for irrigation of landscape for any of these parcels. Each of them presents unique challenges that will need to be addressed at the time of development.

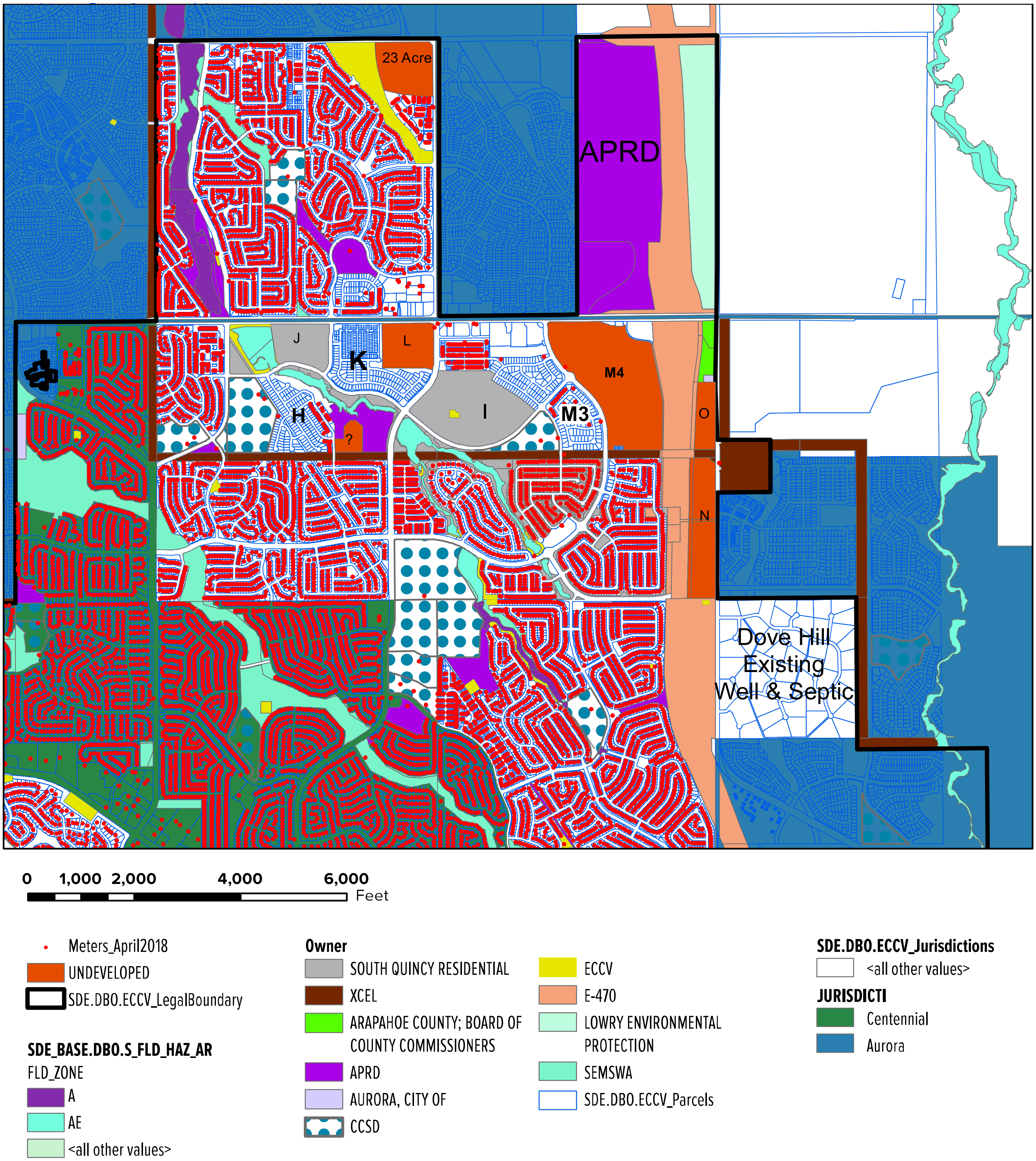
The District's service territory is about 7,900 acres; the four undeveloped parcels identified above constitute about 273 acres or 3.5% of the service territory. Some of the service territory has approved development plans which have not yet been executed.

The existing Dove Hill development lies within the District legal boundaries. This area is fully developed as an Arapahoe County large-lot, single family, well and septic project. Changes are unlikely within the planning horizon of this document.

The housing stock within ECCV is very new, varying from 1972 to current date construction, and almost all of it is single family detached. The likelihood of a Denver-style redevelopment with slot homes, etc. is very unlikely within the planning horizon of this document.

FIGURE **A-1**

Jurisdictions within the ECCV District



Appendix A : WISE System

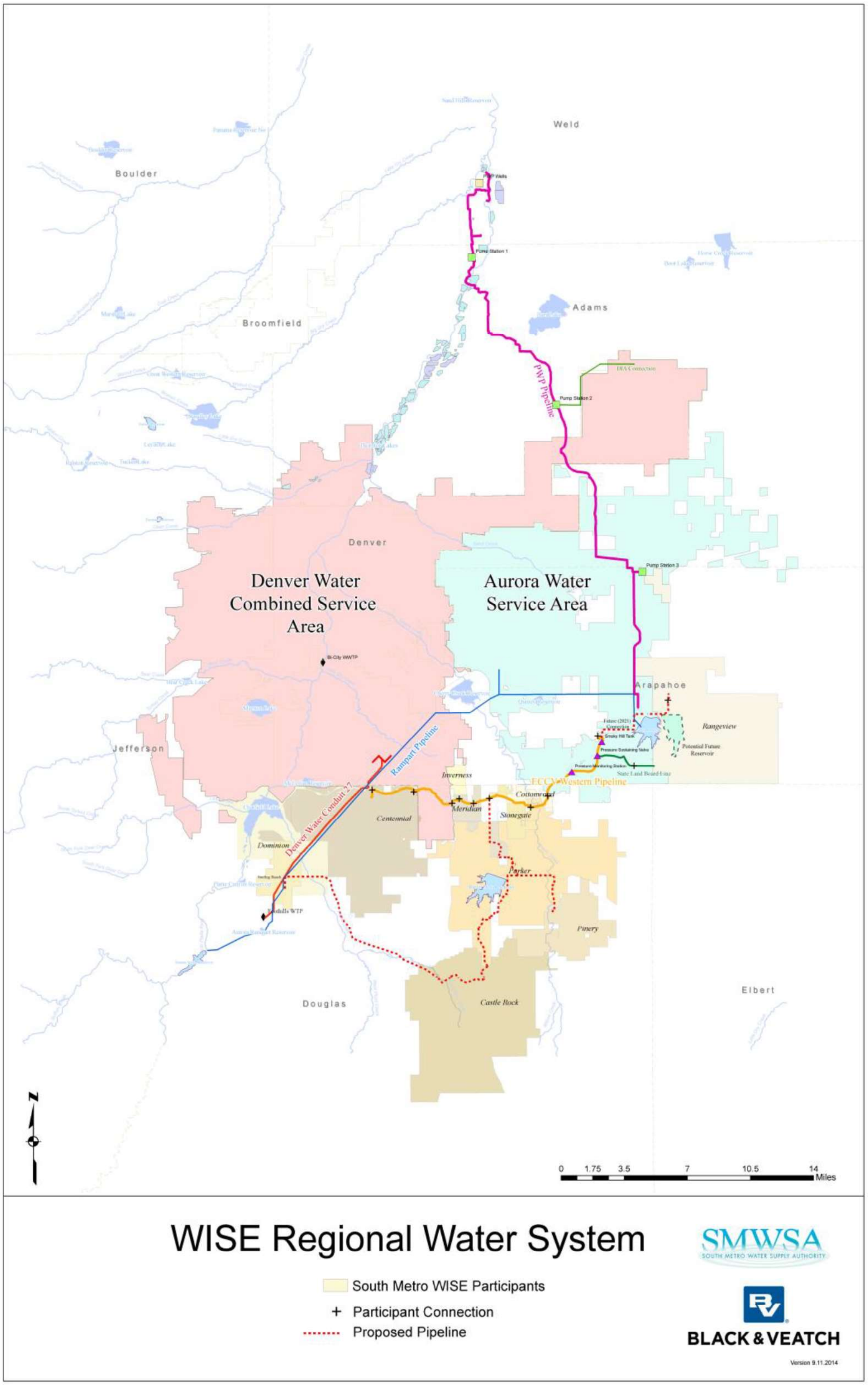
The WISE (Water Infrastructure and Supply Efficiency) Partnership

In February 2008, Aurora Water and Denver Water entered into an Intergovernmental Agreement (IGA) to investigate cooperative water supply opportunities; i.e., the sharing of water and/or infrastructure that could be mutually beneficial. In November 2008, the South Metro Water Supply Authority (SMWSA) joined the investigation through a Memorandum of Understanding (MOU). It was the expectation of the parties that the engineering investigations would lead to the development of a joint water supply project, utilizing available supplies and capacities in the parties' existing and planned water systems. The relationship between the three parties was solidified with an IGA executed in May 2009, with a final Water Delivery Agreement (WDA) defining the terms of deliveries executed in December 2013. The collective group of water suppliers are now referred to as the Water Infrastructure and Supply Efficiency (WISE) Partnership.

The backbone of WISE is Aurora's Prairie Waters Project (PWP). PWP, shown in the map below, pumps reusable water from the lower South Platte back to Aurora, where it is treated at the Binney Water Purification Facility. There are times when Aurora has available capacity in PWP and unused treatment capacity at Binney. At times, Aurora also has available reusable supplies in the lower South Platte that could be delivered to PWP.

Denver Water has an extensive water delivery system, including water it diverts from the west slope to the South Platte through the Roberts Tunnel. After Denver makes use of that water, the unconsumed portions of these flows return to the lower South Platte near PWP. These return flows are fully reusable, which, at times, Denver cannot fully use.

The SMWSA is comprised of thirteen water providers in Douglas and Arapahoe counties. The SMWSA relies heavily on non-renewable groundwater, and has been investigating developing renewable surface water supplies for a number of years. Several years of engineering study have identified opportunities to achieve efficiencies within the three systems of the Partnership through sharing and cooperative uses of infrastructure and supplies. A regional water supply project concept was developed and the necessary agreements are in place. Ten of the thirteen SMWSA members have contracted to receive water under the WISE Partnership. The ten members formed the new South Metro WISE Authority (WISE Authority) and are a signatory to the WDA, and include: Centennial Water and Sanitation District, Cottonwood Water and Sanitation District, Dominion Water and Sanitation District, Inverness Water and Sanitation District, Meridian Metropolitan District, Parker Water and Sanitation District, Pinery Water and Wastewater District, Rangeview Metropolitan District, Stonegate Village Metropolitan District, and the Town of Castle Rock.

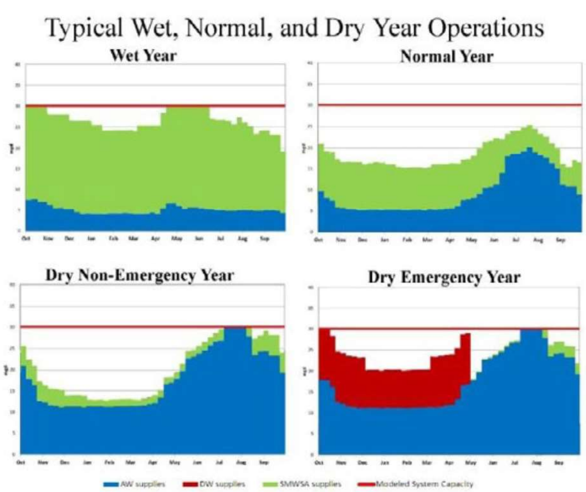

Weld
Boulder
Broomfield
Adams
PWP Pipeline
Denver
Denver Water Combined Service Area
Aurora Water Service Area
Arapahoe
Rangeview
Jefferson
Rampart Pipeline
Denver Water Conduit 27
ECCV Western Pipeline
Inverness
Centennial
Meridian
Commercial
Stonegate
Dominion
Parker
Pinery
Castle Rock
Douglas
Elbert
N
0 1.75 3.5 7 10.5 14 Miles
WISE Regional Water System
South Metro WISE Participants
Participant Connection
Proposed Pipeline
SMWSA
SOUTH METRO WATER SUPPLY AUTHORITY
BLACK & VEATCH
Version 9.11.2014

How the WISE Partnership Works

Sharing infrastructure capacity and available water supplies will provide significant benefits to all three partners. The majority of the time, supplies will be made available to South Metro from both Aurora and Denver. Aurora and Denver offered to make available 100,000 ac-ft every 10 years. Of this, the WISE Authority subscribed to 72,250 ac-ft every 10 years with an average delivery of 7,225 ac-ft/yr, and under an option agreement with Douglas County the project can grow to the full 100,000 ac-ft/10 yrs. Deliveries noted in this summary are based on the current WDA; if additional options are exercised by Douglas County, deliveries will be adjusted accordingly. Water deliveries do vary and are interruptible, with annual deliveries ranging from at or near 0 up to a maximum annual delivery of 18,063 ac-ft under the WDA. Some South Metro water providers may be able to store WISE water in the Town of Parker's Rueter-Hess Reservoir, further stretching the yield of the project. Aquifer storage and recovery (ASR) is also being investigated by South Metro as a means to firm project yield.

Denver Water will benefit by being able to utilize the project to provide up to 15,000 ac-ft/yr of backup water supply for its own needs on an infrequent basis.

Aurora will benefit by putting its PWP system to fuller use, keeping rates down for its customers.



WISE water deliveries are possible due to the manner in which the partners' water supplies and infrastructure can be utilized both seasonally and under varying hydrologic conditions. The chart to the left shows examples of how WISE could operate under a modeled wet, normal, and dry year, and in a year when Denver Water needs to use its supplies. The chart shows Denver Water using its supplies during a dry year for illustration, but Denver Water may choose to use its supplies in any type of hydrologic conditions when it needs its backup supply. The red line represents the capacity of the PWP system. The blue area represents Aurora's planned use, the red area is Denver's, and the green area represent water available to South Metro. For instance:

- *Wet Year* – Aurora would have adequate mountain supplies and not need to fully utilize PWP, Denver may also not need to take deliveries through WISE, leaving a large amount of water available to South Metro.

- Normal *year* (not wet or dry) – Aurora's use of PWP will increase, Denver might again not use the system, and significant supplies would be available to South Metro.

- *Dry year* – Aurora will rely heavily on PWP, likely using the full system capacity during the summer months. If Denver also needs to use its backup supply, there would likely be limited capacity and supply available for South Metro. However, Denver may not always choose to take water in dry years and some limited supplies and capacity may still be available to South Metro during such years.

Note that if Denver chooses to take water in wet and normal years, there will generally be sufficient supply and capacity remaining to also allow some level of WISE deliveries to South Metro. The water available to South Metro is a mix of Denver and Aurora available reusable supplies. The relative mix will vary from year to year. In wet years, it will generally be mostly Aurora supplies as Denver is not anticipated to have reusable effluent. In drier years, the supply could be mostly from Denver. In normal years, the supply will be a mix of the two sources.

WISE water will be fully treated potable water through a process of treatment and blending that will result in water that meets or exceeds all existing and anticipated drinking water standards and provides water that will be indistinguishable from Aurora's current supplies. Deliveries under all scenarios would be at a master meter connection at which water will be conveyed to individual members of South Metro.

Delivery Schedule and Implementation

Downstream of the Master Meter, the WISE Authority will invest in significant infrastructure. The WISE Authority and Denver Water purchased East Cherry Creek Valley's Western Pipeline as the transmission pipeline for WISE water deliveries. Modifications necessary to make that pipeline successfully operate the WISE project are being designed and constructed in anticipation of water deliveries starting in 2016. In addition to Western Pipeline modifications, a number of connections to the pipeline will be constructed by WISE Authority members in order to take delivery of water. Initially, 5,000 ac-ft/yr will be offered each delivery year under this plan through 2021. Deliveries exceeding 5,000 ac-ft/yr may be offered on an as-available basis. During this delivery period, additional infrastructure will be constructed by the Partnership to increase these deliveries to an average of 7,225 ac-ft/yr with a commitment to provide 72,250 ac-ft over a 10-year block period on a permanent basis.

The WISE (Water Infrastructure and Supply Efficiency) Partnership

Denver Water and Aurora Water have been providing water to more than 2/3 of the Denver Metro Area's population for over 100 years and 60 years, respectively, and the WISE Partnership can provide a much-needed reliable and sustainable water supply to the South Metro area for years to come. As indicated below, the WISE Partnership will be of mutual benefit to Aurora, Denver, and South Metro.

The WISE Partnership truly represents:

A Regional Partnership for a Sustainable Water Future

Benefits to Aurora

AURORA WATER

- Efficient utilization of the Prairie Waters Project (PWP) system
  - Offset PWP costs
  - Share in the cost of future expansion and water rights purchases
  - Protects current and future firm yield of water supply system

Benefits to Denver

DENVER WATER

- Back up supply for Denver
  - Access to unused supplies
  - May be used to replace portion of "Strategic Water Reserve"
  - New "system feed" from lower South Platte

Benefits to South Metro

SMWSA SOUTH METRO WATER SUPPLY AUTHORITY

- Greater regional cohesion
- Efficient utilization of regional infrastructure
- Provides a portion of the region's renewable water supply goal
- Reduces reliance on groundwater
- Minimizes the need to purchase agricultural water rights

Benefits to Partnership

- Connected systems and a cooperative atmosphere will provide added options and redundancy during emergencies
- A regional solution to best utilize existing water and infrastructure resources to meet future water supply needs in a regionally sustainable manner
- Reducing legal fees and water rights disputes between parties

Appendix B : EyeOnWater and Badger Meter

AMI + GIS = Multiple Benefits

With advances in the technology, more water utilities are seeing the value of integrating GIS and AMI.

By William Atkinson

Compound series meters

PHOTOS: BADGER METER

Under what circumstances does it make sense for water utilities to integrate GIS and Advanced Metering Infrastructure (AMI)? "Utilities have been integrating GIS with AMI and AMR [automatic meter reading] for years," says Joe Ball, director of marketing, Water North America for Itron. "Many utilities used their AMI/AMR deployments as a way to get accurate GIS coordinates of meter and communication module locations."

"There are several instances when it makes sense for water utilities to integrate GIS with their AMI," says Dan Pinney, global director of water marketing for Sensus. "Traditional overlays of GIS and AMI are often used for asset management, but the biggest benefit from the integration is for minimizing non-revenue water."

In addition, according to Pinney, smart water meters are excellent at alerting the utility when leaks are present. Often, though, leaks happen between the endpoints in the distribution system itself. Adding devices like pressure systems is beneficial to detect non-revenue water in the distribution system, but GIS adds an extra layer of information by geocoding where the devices are located in the system. "Being able to do this is crucial to detecting and putting a stop to non-revenue water," he says.

According to Greg Richards, marketing manager of software for Badger Meter, technology changes now allow utilities to gather more information on many of the different assets that they have deployed and need to maintain throughout their systems. "Tying GIS and AMI systems together allows utilities to incorporate management and review of the information into a single, easy-to-use platform," he says. "Gathering more GIS data within an AMI system enables advanced metering analytics to better manage their meter reading infrastructure, water distribution system, and consumption." The larger and more diverse the geographic area served, the more value a utility may find in integrating its metering data collection and mapping systems.

BENEFITS OF INTEGRATING GIS AND AMI

Besides being critical for asset management and minimizing non-revenue water, the integration of GIS and AMI is also an overall "game changer" for operations, according to Sensus's Pinney. It enables water utilities to understand their distribution system and endpoints as one cohesive system instead of simply pipes and endpoints. "When integrated, the system takes snapshots in time of particular sections of pipe," he says. "If you know that your distribution system is going through a particular area, and you're associating all locations that are fed off that pipe, then you're correlating all of that data and consistently taking snapshots in real time of particular geographic areas. This way, water coming in and out of certain pipes can be managed very quickly." The combination of GIS and AMI also allows water utilities to create new billing cycles and target particular issues of the system, rather than simply billing geographically co-located units. This enables, for example, the billing of non-paying customers at a convenient time when they are more likely to pay, such as around the first of the month when certain checks arrive, as opposed to when a meter was traditionally scheduled to be read. "Emerging technologies using GIS also allow utilities to monitor places that can be problematic, including lift stations and drought and flood areas," says Pinney. With this technology, AMI enables water utilities to deploy sensors and set alarms for potential issues, such as sewer overflow, while GIS pinpoints exactly where the issue will occur. Knowing what the problem is and where it is located before it happens can prevent significant complications.

BEACON AMA software suite

"Overall, the geospatial information that you can get from GIS can add so much insight to an AMI network that helps people do their jobs better," says John Sala, director of marketing for Neptune Technology Group. "Integrating GIS and AMI is not all just maps. One of the challenges where GIS helps is with geocoding." When a fixed network goes in, if the utility did not opt to geolocate the meters during deployment, the utility will need a way to geocode those meter locations, because, historically, meters were not something that were in the GIS database. The GIS database might go as far as the service line or the lateral, because they typically want to understand where those are located. "Our N_SIGHT systems geocode meters using ESRI ArcGIS Online, down to the premise address, so that we can place them on maps," he says. "This is the first

step, from an AMI perspective, to really be able to leverage GIS. Geolocating in the field is always best, but without at least basic geocoding, you just get a 'blob'—a coordinate of the zip code, or something like that, which is not useful at all for mapping." Once you have the coordinates for the individual meters, or minimally, the premises, you can use the geospatial information on the maps to better manage the water distribution network and make more informed decisions about information you are receiving from Neptune's system or other systems. "If you don't have geospatial information, you're kind of left in the dark, especially when something happens in the field, such as if a large C&I customer had a continuous leak, or a radio endpoint antenna gets damaged," says Sala. "You have a bunch of points of information, but you don't really know what the relationship is between them. If you have a bunch of meters that are not communicating to the host software, it is helpful to be able to see them on a map and understand the relationship to the collector(s) that the meters are 'talking' to."

Disc series meter

According to Itron's Ball, using GIS to track customer meters' locations enables utilities to improve asset management, billing route creation, service order data, operations, and more. "The utility can use commercially-available mapping applications to plot customer meter locations and make this information available to field workers, enabling them to locate assets assigned for investigation or service," he says. "The utility can also map the meter locations along with other distribution network assets, such as mains, valves, fire hydrants, storage tanks, and pump stations to visually display their complete network."

"Connecting AMI and GIS allows utilities to track and manage their assets, crews, and work orders," says Badger's Richards. Correlating the data also helps to spot trends and determine whether they exist in isolated areas or systemwide. "For instance, if a group of people call the utility to complain about the lack of water pressure, reviewing the information in a map-based presentation will assist the utility in identifying the location of a problem within the system," he says. In addition, geocoding the precise location of meters or other assets within a site improves productivity by helping crews locate them quickly, compared with simply having an address.

NEW GIS/AMI INTEGRATION TECHNOLOGIES

According to Ball, Itron's AMI solution enables the storage and use of GIS data within its systems. "We offer mapping features within several of our products to give utility users a visual presentation of meter and/or account status related to consumption, leaks, tampers, alerts, events, and communications," he says. Itron is also working with third-party vendors

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to interface AMI data collected, including GIS coordinates, into their applications, such as work order management and hydraulic models applications. This will help expand the use of AMI data within the utility. In addition, Itron's professional services team will collect GIS coordinates for all meter assets while performing the AMI system deployment at the request of the utility.

Badger Meter's most recent innovation is an end-to-end managed solution for utility management, called BEACON Advanced Metering Analytics (AMA). BEACON AMA combines the software suite with ORION AMI technology, using fixed and cellular networks to provide utilities with greater control, more information, and better customer service. The BEACON AMA cloud-based software includes a map-based application and integrates with GIS and other systems to help track utility assets and visualize the location of leaks, backflows, tampers, or other alerts that require investigation. "AMI information can feed back into GIS or work order systems to help manage maintenance crews and their priorities," says Richards.

GIS is built into Sensus smart meters and endpoints and easily integrates with the Sensus FlexNet system, which is a long-range radio network that provides a scalable and reliable communications infrastructure. "For our customers, it is simply a matter of programming the devices with GIS information, which we offer as part of standard installation," says Pinney. "For monitoring devices that are between endpoints, such as our acoustic leak monitoring, Sensus's Professional Services team can help. This team can advise water utilities on deployment, how to analyze specific data, and the most cost-effective way to deploy devices in the field."

Neptune Technology Group introduced its GIS module in late 2014. "As an AMI vendor, we use GIS-type information as part of what we do when we develop AMI solutions," says Sala. "We also use GIS information to help support our customers within our applications. The GIS component really helps us when we are working with utilities to implement AMI."

Sala shared a number of the benefits of the integration:

- **Leaks:** Various outside factors can contribute to leaks, such as water quality and pressure. So, since Neptune meters can capture leak events at 15-minute intervals, you can overlay these leak events on a GIS map to see if there are any geographic relationships. The GIS overlay can also help coordinate any inspections that will likely result to make the most effective use of the field technician's time. Kind of a one-two-punch from the GIS integration.
- **Backflow:** Neptune meters can detect backflow. "Backflow can happen for some innocuous reasons, such as in a very tight home where a water heater cycles when no one is using water, pushing some water back out of the house as a result of thermal expansion," says Sala. "That's not too important. In other cases, though, backflow can be important, such as a major line break that hasn't been reported yet, which is causing negative pressure upstream." Then, when someone opens a faucet, it can create a reverse flow of water. In addition, Neptune's radios work with acoustic leak loggers that can be installed on distribution lines. They can alert the utility of a possible distribution line leak. If these don't happen to be lined up all on the same street, you may assume these are independent, non-related, and non-important instances. However, by being connected to the GIS system, it will show the lines, laterals, and entities. If you overlay the distribution, you may find that there is an actual common line, because sometimes lines don't run down the middle of a single street. When you overlay this, the line that does connect them becomes visible, and you can see

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the geocoded meters that are having backflow events that are all on that same line. "This lets you know that you need to go out and begin looking for the leak that is causing all of those problems, before it blows a hole in the road or floods something," he says. "In other words, you want to 'roll a truck' to do repair proactively when possible, using the AMI intelligence for your preliminary investigation."

- **Redundancy:** "There are some very sophisticated GIS-based products that help make sure there is proper communication and coverage between the meters and the collectors," says Sala. "GIS and AMI integration can also reduce the need for certain collectors. You may find that certain networks are overbuilt, and certain devices are being read by four different collectors. This overlap happens a lot in some networks." The utility may also find that everything being read by a certain collector is being read by at least one other collector, and thus that collector may not even be necessary.
- **DMAs:** "We can create groups in our systems," says Sala. With meters, for example, if you want to create a DMA (district metering area), one benefit of GIS is that you can see all of the points, you can see all of the inputs or outputs, and this allows you do draw a circle or polygon around all of the devices, select them all, right-click, and say "Assign to Group DMA 1." "It is so simple," says Sala. "Doing it the traditional way, on the other hand, is extremely complex. You would have to go into a huge list to find all of the properties, and then try to find the devices associated with the properties, then go to the billing system to try to find the accounts."
- **Disaster Recovery:** "If there are a group of meters that are all grouped together in one particular area and not being "heard", those are pieces of information that can help you determine if you have a situation such as a collector that got struck by lightning," he says. If this happens, the collector may not stop working, but the antenna can be damaged or the cable may get fried, causing the antenna to gain a certain amount of impedance, causing it to reduce performance. "Now you can see that coverage hasn't gone away, but it has shrunk, which is useful information, because it will signal to you that maybe you need to check the antenna on the collector," he says.

ADDRESSING GIS/AMI INTEGRATION CHALLENGES

One challenge that can exist during a GIS and AMI integration, according to Sensus's Pinney, is inaccurate data. "You have to be sure that you're using the system the right way and understand the data it's producing," he says. "Consistent training and education help to ensure that you are using the system properly. Not only is initial training vital, but it is also important to continue to stay up-to-date on best practices for properly

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using the system."

Another challenge is lack of updated business processes for how to respond to the new data and alarms. "Previously, water utilities did not have the breadth of GIS, AMI, and sensor data," says Pinney. "As a result, the existing processes and resulting actions taken were based off limited information. Now, since so much information is available, the processes need to be updated to enable efficiency." Providers must walk through several various scenarios and determine what to do when an alarm goes off, what actions are going to be taken, and who is going to do them. According to Pinney, this challenge is outside the technology, and more in the training, business, and communication processes across the organization, ensuring that everyone understands their roles in taking advantage of the available information.

An additional challenge: "Not all AMI data may already be in the system," says Itron's Ball. "The utility may need to locate any missing assets in the field to make certain that the GIS has an accurate location." The utility needs to ensure that interfaces between AMI and GIS are created, so that entering data into the AMI system properly updates the GIS system. This is especially true for utilities that are in the process of AMI implementation. A detailed testing program will need to be developed to make sure that data integration is successful. "Once the interfaces are in place and working, the key challenge is to make sure that the processes are in place to keep the system up-to-date as work orders are processed and changes are made to the system," he says. "The most efficient utilities synchronize these systems daily."

During any software integration project, according to Badger's Richards, utilities should budget an appropriate amount of time for IT resources to make the systems work together. This task has been made easier with the release of Web-based software applications and the ability to transfer data using standard Web service application programming interfaces. "These allow data to be transferred in real time and eliminate the need for a user to initiate the data transfer process," he says.

KEYS TO SUCCESS IN GIS/AMI INTEGRATION

According to Itron's Ball, the keys to success in integrating GIS and AMI are to obtain accurate coordinates for all assets that the system is expected to manage, and have the processes in place to keep them current. To ensure that assets are properly represented in mapping, and that work orders are generated in the correct locations, the utility needs to ensure that the coordinates for each location are correct to the level of accuracy that they need. "Additionally, a utility's network is continually adding, removing, or updating assets," he says. "The GIS and AMI systems must have a process to keep these systems in sync, typically daily, as work orders are processed. This will ensure that the users of the system are viewing the most current and accurate information to perform their work." There are different levels of accuracy available. It is very important to determine which level of accuracy is desired, in order to make sure that all data is available with the necessary level of detail.

"Everyone knows the adage, 'Garbage in, garbage out,' so the first key to success is to make sure the data is accurate and that the system is robust enough to properly manage the information," says Sensus's Pinney. "Sometimes, when a system is designed a certain way, it pulls data from the last known location, which would be a significant distance away, and, as a result, creates errors or inefficiencies. There are a variety of reasons why you might be blocked from the satellites." Therefore, you need to make sure that your data and the way the system is designed is robust enough to work in any condition. From there, using a combination of GIS and AMI and a variety of sensors in a smart and analytical way is the most important key to success. "Essentially, it requires using the right tool at the right time and at the right location, and then using the analytic tools to work the data for you," he says.

"Accurate geocoding of assets and synchronization of AMI, GIS, and other systems, with one being a 'source of truth' for each piece of information, is key to system integrity and maintenance," says Badger's Richards. "Geographic data can be imported into the BEACON AMA software from other utility applications, such as the billing system or GIS via the BEACON Data Exchange interface or Web services, and AMI information can be sent back to those systems."

WHEN ANOTHER AGENCY PROVIDES THE GIS

"As regards integration of AMI and GIS, we have been working with two water utilities that have AMI," says Frank Loge, Ph.D. P.E., professor in the Department of Civil and Environmental Engineering, and Director of the Center for Water-Energy Efficiency at University of California–Davis (**http://cwee.ucdavis.edu**). "If you want to integrate GIS and AMI, you need to know the location of your AMI meters, which means you will need to get customer-identifiable information, which water utilities are reluctant to give out, but they will give it out under certain circumstances." Then, according to Loge, you need the water use for each of those AMI meters for whatever time-scale they collect it on—every 15 minutes, every hour, etc. "Then you can import that into GIS and begin to create graphics of water use," he says. "First, though, you need to aggregate the customer-identifiable information up to a level that will not allow any of the individual accounts to be identified on any of the visual images you show with GIS, such as a census block group scale or a pressure zone."

ORION cellular technology

One thing that can be useful to show, according to Loge, is, when you aggregate the AMI data on, for example, a census block basis, and look at water usage, you can determine which census blocks have higher usage than other census blocks. "This allows the water utility to decide where it should begin to target various conservation efforts," he says.

While all of this can be done with regular water meters, the one thing specific to AMI that is useful is that, by having a time series of data on a very fine resolution, if you give that data to a customer, it allows the customer to make better decisions on how they are using their water, since they can actually see their water use. "In this [California] drought, for example, some water utilities are swapping out standard water meters for AMI water meters on their higher-use customers, and then giving the information being collected by the AMI meters to those customers," says Loge. "They are finding that this helps these customers understand how they are using water and the make better-informed decisions on conservation."

GIS/AMI INTEGRATION CASE STUDY

"There is, of course, a major drought in California," says Kapil Kulkarni, marketing supervisor for Burbank, CA Water & Power, which serves about 42,000 residential customers and 6,000 commercial customers for electricity, as well as 25,000 residential and commercial water customers. "Our goal is to reduce water consumption 28% by next year, which we call the 'Million Gallon Challenge.' When total water usage is about six million gallons, that is pretty significant."

As such, the utility needed to find a way to improve water use efficiencies. "In the past, we relied on education only," says Kulkarni. "Now, though, with the drought, we are becoming more serious. We need to identify actual excess water usage, as well as leaks."

One way the utility is doing this is by restricting the amount of watering that can be done for outdoor irrigation. "First, we needed to find out when customers were watering, if they were watering too many days, if they were watering during the daytime when they were not supposed to, et cetera," says Kulkarni. "If we were able to gain access to this information, then we could send out notifications to customers that they may be subject to fines."

One tool that has been helpful to the utility has been AMI meters. "We began installing smart water meters about four years ago, and they transmit information on water usage every hour," he says. "We installed the meters because we wanted to create more operational efficiency for the utility, and also create greater engagement with the customer, so that they could have more information about their water usage." The AMI meters play a very important role in terms of providing very detailed information to the utility and the customer. For example, they are able to locate leaks on the customer side and inform them of this, such as if there is constant water usage during the night, such as a toilet leak. "We are also able to identify when customers are watering," says Kulkarni.

"Our GIS system also plays a role in this," he says. "We have a good internal GIS system that our water division uses. It allows us to see where customers are located when we find leaks that are occurring, as well as excess outdoor watering. This information then allows us to target these areas in specific for our conservation program." WE

William Atkinson *specializes in topics related to utilities and infrastructure.*

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Badger Meter

BEACON® Advanced Metering Analytics

Managed Solution

OVERVIEW

The BEACON® Advanced Metering Analytics (AMA) managed solution from Badger Meter brings a new level of utility optimizing information to light. The managed solution approach combines our intuitive BEACON AMA software suite with the proven ORION® communication technologies to give you greater visibility and control over utility management.

Configured for your utility, the BEACON AMA managed solution utilizes two-way communications—plus cellular and fixed networks—to deliver a simple, yet powerful end-to-end-solution.

Built-in infrastructure management services and a system design that keeps you in step with technology advancements, allows you to do what you do best—manage your water utility. Plus, built-in consumer engagement tools help enhance customer service, increase satisfaction and reduce costs.

SOFTWARE APPLICATIONS

BEACON Advanced Metering Analytics (AMA)

With tools beyond meter reading and network management, BEACON AMA software offers targeted Advanced Metering Analytics. BEACON AMA software puts interval meter data to work to increase efficiency in day-to-day utility operations and address demands for actionable intelligence.

- **Problem solver** – User intuitive data tools place the power of water consumption data at your fingertips, allowing you to rapidly respond to customer inquiries and quickly resolve—and even eliminate—many billing issues.
- **Customized design** – A customizable dashboard delivers information configured to user security access level in a format matched to the utility's individual requirements, providing data management integrity, security and control.
- **Works with you** – Integration with utility systems—billing, work order, inventory, Customer Relationship Management (CRM) and Geographic Information Systems (GIS)—streamlines and improves utility operations without disrupting the current utility billing interface file transfer process.
- **Find out fast** – Alert conditions can be set to monitor and notify users of system exceptions, including continuous flow, for faster leak detection.
- **Innovation at your service** – Secure, hosted platform with automatic software upgrades ensures the latest technology and features are always available.

EyeOnWater®

The BEACON AMA software suite includes informative consumer outreach tools to improve customer service consisting of the EyeOnWater consumer engagement website, smartphone mobile apps, and email or SMS text alerts, providing easy access to personal consumption data and alerts to potential leaks. With these tools, water consumers are able to view their usage activity, and gain greater understanding and control of what they use and the value you provide.

HARDWARE

The BEACON AMA managed solution is built on the proven ORION system for interval data capture and two-way communication. In a managed solution, a network analysis of the deployment area is performed to determine the optimal mix of ORION technologies to achieve system performance goals. Should the analysis recommend the inclusion of any fixed network gateways and endpoints, Badger Meter installs and maintains the gateways. The solution also employs cellular endpoints which, as they leverage the public cellular network and require no proprietary gateways to operate, dramatically reduce infrastructure requirements compared to a traditional fixed network. This speeds installations and simplifies expansion as a system evolves.

- **Hourly data** – ORION endpoints are programmed to automatically broadcast hourly meter reading and event data to the BEACON software on a daily basis. Hourly data helps identify potential customer-side leaks and other anomalies in water use, and provide the utility with a potent tool to enhance its customer service. Optionally, endpoints can be reprogrammed over the air via the network to collect data and transmit more frequently.
- **Two-way communication** – BEACON software communicates with ORION endpoints to accomplish a number of system tasks, including requesting additional information from the endpoint and synchronizing the internal endpoint clock. If needed, the ORION two-way system architecture sends upgrades to the endpoint firmware over the air via the network, utilizing the powerful BEACON AMA software suite.
- **Data integrity** – ORION endpoints utilize secure and robust encryption to ensure that data is reliably transmitted and received, that the integrity of the data is maintained, and that data cannot be captured or altered by unauthorized users.

SECURITY

BEACON AMA is ISO 27001 certified and SOC 2 examined for security, availability and confidentiality.

TECHNICAL SUPPORT AND TRAINING

Configured for the utility, the safe and secure BEACON AMA managed solution provides utilities with regular software updates, long-term support and maintenance. Comprehensive training is provided at the time of system deployment. To maintain best practices, a library of online videos and options for web-based training and support are also available. Once deployed, our technical support specialists can be contacted by phone, email and web to provide ongoing, customer-friendly support.

Additionally, Badger Meter offers extended customized training to further enhance user expertise.

TECHNICAL REQUIREMENTS

BEACON AMA

Developed as a hosted software platform, BEACON AMA is a cloud-based application accessed through a standard web browser. Internet access is required. User logins provide secure access.

BEACON AMA supported web browsers include the latest and next previous major releases of Google® Chrome, Microsoft® Edge, Mozilla® Firefox®, Microsoft® Internet Explorer® (IE 11 only); and Apple® Safari®.

EyeOnWater Consumer Engagement

The EyeOnWater consumer engagement website is a cloud-based application accessed through a standard web browser. Internet access is required. Water consumer user logins provide secure access to their information.

Supported web browsers include the latest and next previous major releases of Google® Chrome, Microsoft® Edge, Mozilla® Firefox®, Microsoft® Internet Explorer® (IE 11 only); and Apple® Safari®.

EyeOnWater smartphone applications require Android 4.1 or iOS 9.1 or later, and can be downloaded from Google Play or the Apple Store. Maximum screen density for Android smartphone applications is 640 ppi.

Making Water Visible®

www.badgermeter.com

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Appendix C : ECCV Board Official Adoption of Conservation Plan

ECCV
Water & Sanitation District

**AGENDA
MEMORANDUM**

TO:	Board of Directors	AGENDA ITEM O
FROM:	Dave Kaunisto, District Manager	
MEETING DATE:	July 26, 2018	
SUBJECT:	Consideration of Acceptance of the 2018 Water Conservation Plan	

Background: ECCV originally adopted its Water Conservation Plan (WCP) in the mid-1990's in accordance with State Statutes. The next version of the WCP was prepared in 2011 by DiNatale Water Consultants, Inc. and Kennedy/Jenks Consultants and accepted by the Board on May 26, 2011.

Statutes have changed since the adoption of the original plan, changing the required elements of WCP's, and also mandating that an updated plan be approved by the Colorado Water Conservation Board (CWCB) in order to receive state funding or loans from the CWCB or the Colorado Water Resources and Power Development Authority. The WCP must be updated and re-submitted to CWCB every seven years.

The updated 2018 WCP was prepared by DiNatale Water Consultants, Inc. The public comment period for the 2018 Water Conservation Plan is now complete. Receiving only minor internal comments, staff has finalized the plan for acceptance by the Board. After the Board's acceptance, it will be forwarded to CWCB for completion.

Staff Recommendation: Acceptance of the 2018 ECCV Water Conservation Plan, subject to minor corrections approved by the District Manager, for final submittal to the Colorado Water Conservation Board.

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Plan prepared by

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