

# Colorado WaterWise Best Practices Guidebook

colorado  
waterwise



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# Preface

On behalf of Colorado WaterWise, we are pleased to present you with this updated Guidebook of Best Practices for Municipal Water Conservation in Colorado. Colorado WaterWise, the voice of Colorado's water conservation community, was formed in 2000 to promote and facilitate the efficient use of water in Colorado. Colorado WaterWise represents the Colorado water conservation community. We connect stakeholders that are invested in water efficiency in the State of Colorado in order to foster innovation and dissemination of education and technology.

This Best Practices Guidebook was inspired by an emerging need statewide for water providers large and small to plan for and implement impactful water conservation programs, to comply with Colorado's water conservation and management legislation, and to educate and inform water professionals and citizens across the state.

The Best Practices Guidebook was developed through a stakeholder process that allowed for input from local water providers, state agencies, the private sector, water conservancy districts, local non-profits, consultants, members of academia, and more.

We often hear that, "water is our most precious natural resource." It is Colorado WaterWise's sincere hope that this Best Practices Guidebook will not only help to fill the need for a technical resource, but also provide value in the challenge of meeting our state's water needs.

Our sincere thanks go to the Colorado Water Conservation Board and the Colorado River District for providing a generous grant to fund development of this updated Best Practices Guidebook and for their dedicated support for this project.

***Brad Brady and Alyssa Quinn***  
***2023 Co-Chairs***  
***Colorado WaterWise***





# INTRODUCTION

As population growth and climate change strains Colorado's limited water resources, new supplies are more difficult to develop and water providers must rely more heavily on demand management programs to stretch supply portfolios. There are many ways to conserve water and reduce demand that have been tried over the years. Experience in developing and implementing water conservation programs over the past decades has resulted in an extensive body of knowledge in Colorado and across the United States. This knowledge, combined with experience, research, and analysis has resulted in the development of best practices, which includes water planning, management, and efficiency measures and policies designed to deliver proven water savings and improved water management.

The Colorado WaterWise *Guidebook of Best Practices for Municipal Water Conservation in Colorado, 2<sup>nd</sup> Edition* was prepared for the purpose of improving and enhancing water conservation and efficiency in Colorado. Although tailored for Colorado water providers, the *Best Practices Guidebook for Municipal Water Conservation in Colorado* (*Best Practices Guidebook* for short) offers a detailed description of specific water conservation measures, program elements, regulations, policies, and procedures that can be implemented by water providers across North America to help ensure reliable and sustainable water supplies for future generations.

Colorado WaterWise (CWW) envisions that this *Best Practices Guidebook* will be used by water professionals including water providers, local governments, consultants, building managers, design engineers, irrigation professionals, and others to help select the most sensible and cost-effective water conservation measures and programs to implement. Water providers can use best practices to understand state laws and regulations and to guide in the selection of water conservation program measures to include in their conservation plans. Landscape and development professionals may use the *Best Practices Guidebook* to determine the most sensible water efficiency practices to implement in new construction and retrofit projects. Others may find the *Best Practices Guidebook* a useful tool to increase water efficiency in their local community.

## Water Conservation and Efficiency

This Guidebook is designed to promote water conservation and efficiency. The Colorado Water Plan provides definitions for these related terms (CWCB, 2023):

**Water conservation** is the minimization of water loss or waste. The goal of water conservation is to use only the amount of water necessary to complete a task or meet a need. Water conservation can be achieved through policies, programs, and practices designed to encourage the use of less water.

**Water efficiency** refers to strategies or technologies that facilitate using less water to accomplish an activity. Low-flow toilets and showerheads are examples of technologies that increase water efficiency. Water efficiency improvements are typically accomplished via engineered products or solutions.

## What is a Best Practice?

Best practices (BPs) are water planning, management, and efficiency measures and policies designed to deliver proven water savings and improved water management. Implementing best practices helps achieve and optimize water efficiency from existing water users and ensure new water users are water efficient from the start.

The water conservation best practices described in this guidebook were developed specifically for communities in Colorado. Each best practice was prepared to help water providers and municipal water consumers reduce water use and operate with maximum efficiency.

# What's Included in the Guidebook?

The *Best Practices Guidebook* includes detailed information on best practices in the following seven areas:



**Planning and  
Implementation**



**Rates and Charges**



**Measurement  
and Data**



**Development and  
Codes**



**Education and  
Communication**



**Indoor Water Use**



**Outdoor Water Use**

Each Best Practice area is structured similarly with a clear definition that describes the practice, its subcomponents, implementation techniques, scope, potential water savings, water savings estimating procedures, cost effectiveness considerations, resources for more information, and references. For each, the information is summarized into the following sections:

- Summary of major benefits
- Regulatory requirements
- Key best practice concepts
- Costs, benefits, and water savings
- Examples and case studies
- Resources



## How Were the Best Practices in this Guidebook Selected?

The Second Edition of the *Guidebook of Best Practices for Municipal Water Conservation in Colorado* keeps much of the content from the original 2010 Guidebook but includes a significant reorganization.

The Second Edition was informed by six stakeholder meetings held throughout 2022 and 2023 to gather ideas, information, and input. The robust and successful stakeholder outreach effort included more than 400 participants in both in-person and online meetings. In-person meetings were held in Westminster and Glenwood Springs and four online meetings were held. One stakeholder meeting was specifically focused on outdoor water use and landscape efficiency.

The project team collected and organized the input from the stakeholder and included as much information as possible in the final guidebook.

The entire project was supervised and reviewed by Colorado WaterWise, the Colorado Water Conservation Board (CWCB), and the Colorado River District.

## Changes Since the Last Guidebook

Remarkable progress has been made to improve water efficiency and conservation in Colorado since the first *Best Practices Guidebook* was published in 2010.

## Climate Change Drives Change

Driving all these important and impactful changes has been climate change and, in particular, the crisis on the Colorado River. Demand has long outpaced the Colorado River's supplies and flows are projected to continue dwindling — reduced by increased temperatures and dry soils that drink up critical runoff as climate change fuels the long-term drying of the region.

One way that Colorado has responded to climate change and the changing conditions on the Colorado River is by strengthening water planning and increasing municipal water efficiency. Since the first *Best Practices Guidebook* was published in 2010, the State of Colorado and water and government professionals across the State have:

- Released two state water plans;
- Improved data reporting;
- Adopted best practices for water loss control and educated providers about these practices;
- Mandated that only water efficient fixtures be sold; and
- Funded turf replacement and limited non-functional turf.

It has been a remarkable period of progress for urban water efficiency in Colorado.

The following section provides a summary of the most significant policy and planning changes in Colorado since the last edition of the *Best Practices Guidebook* was published in 2010.

## Colorado Water Plan [2015] and Colorado Water Plan Update [2023]

The Colorado Water Plan provides a framework for helping Colorado meet its water challenges through collaborative action around water development and water conservation. The Water Plan is a grassroots effort and relies on the Colorado water community to identify and implement basin-specific and/or statewide water projects that provide multiple benefits to the state's diverse water users.

The [2015 Colorado Water Plan](#) was Colorado's first water plan, and was developed to serve as the state's framework for solutions to the state's water challenges. It helped establish widespread support for multi-beneficial water projects and was foundational in establishing the Water Plan Grants Program.

The [2019 Technical Update to the Water Plan](#) provided updated data and demand projections to inform the Colorado Water Plan, as well as provide tools and data for the Basin Roundtables.

The [2023 Colorado Water Plan](#) was the first update to the Colorado Water Plan and builds off the original plan's successes and collaboration.

In addition to the State Plan, in 2022 the eight [Basin Implementation Plans](#) (BIPs) were updated to identify local water goals and projects and align with State objectives.

## Water Data Reporting Under HB 1051

In 2010, the Colorado General Assembly adopted [HB10-1051](#) which requires covered entities to [report](#), on an annual basis, water use and conservation data to be used for statewide water supply planning. Previously, there had been no formal way for the CWCB to regularly and reliably understand and track municipal water use in Colorado.

The bill directed the CWCB to adopt guidelines regarding the reporting of water use and conservation data by covered entities and to begin collecting data annually. For the first time, Colorado began collecting water use data in a systematic way from providers across the state. The first few years of data reported under this provision were used to help prepare the Colorado Water Plan Update.

## Water Loss Control and Water Loss Reporting

In 2018, the Colorado Water Conservation Board launched a comprehensive program of training and technical assistance in water loss control for urban water systems across Colorado. This program, known as the [Colorado Water Loss Initiative](#), supports a strategic objective from the Colorado Water Plan – to support water management activities for all water providers. The initiative is structured and funded for the largest 165 water systems, though smaller systems may be considered if space is available. The focus of the program is on the American Water Works Association (AWWA) M36 water audit, the free AWWA Water Audit Software, and water audit validation methodology.

The program included training sessions spread out over a multi-year period, beginning in spring 2019. Based on the success of this effort, in 2024, the Colorado Water Conservation Board will begin requiring water providers to submit their completed M36 water audit as part of state data reporting requirements. Audit validation is not required, but highly recommended. This not only helps track water loss, but it also offers CWCB a more reliable and uniform data set of municipal water demands.

## Integration of Water and Land Use Planning

Since 2010, there has been a concerted effort to connect and integrate land use and water planning in Colorado. There is now a requirement to include this integration as part of water provider water efficiency planning.

The Department of Local Affairs (DOLA) and CWCB jointly-funded a Water and Land Use Planner position to lead and educate water providers and planners across the state. [New resources for land use and water planning integration](#) were developed through the CWCB and a collaborative water and land use planning alliance began meeting quarterly. Additionally, [Sonoran Institute's Growing Water Smart Program](#), which helps communities, land use authorities, and water providers integrate land use and water planning into decision making and solutions, has trained professionals servicing 65% of Colorado's residents to craft action plans to integrate water and land use planning.

## Colorado Becomes a WaterSense State

In 2019, Colorado became a “WaterSense state” when the legislature passed [HB 19-1231](#) which requires that some standard plumbing fixtures sold in Colorado, such as toilet, shower heads, and faucets, be EPA WaterSense certified. This action ensures that most fixtures sold and installed in Colorado are water efficient, including those installed in new buildings.

EPA created [WaterSense](#) in 2006 as a voluntary program to label products that are at least 20% more water efficient and perform as well as or better than standard models. WaterSense labels toilets, bathroom faucets and faucet accessories, flushing urinals, showerheads, new homes, and more.

## Turf Replacement and Non-Functional Turf

Starting in 2022, the Colorado legislature began funding a grant program to remove and replace high-water-use turf across the state. This program was expanded by the legislature in 2024. In 2023 and 2024, the Colorado legislature passed legislation imposing limits on “non-functional” turf in new development areas ([SB24-005](#)).

In this legislation, functional turf is defined as *“turf that is located in a recreational use area or other space that is regularly used for civic, community or recreational purposes, which may include playgrounds; sports fields; picnic grounds; amphitheaters; portions of parks; and playing areas of golf courses, such as driving ranges, chipping and putting greens, tee boxes, greens, fairways, and roughs.”*

Non-functional turf is defined as turf *“that is not functional turf”* and includes turf *“located in a street right-of-way, parking lot, median or transportation corridor.”* Adoption will necessitate code updates for non-residential landscapes across the state that must be implemented by January 1, 2026.





# Planning and Implementation



Water efficiency plans, sometimes called water conservation plans, serve as roadmaps for establishing successful water conservation programs that meet the goals of the water provider and the needs of its customers. Regardless of a water provider's size, water efficiency plans provide guidance for action, promote and improve utilization of resources, and facilitate development of water saving goals. Water efficiency plans should be the first step in developing any water conservation program.

That said, even the best laid plans require implementation resources to garner the desired impact. Dedicating resources, both staff and funding, is an essential component of successful plan implementation. The Planning and Implementation Best Practice provides a framework for establishing and executing well-made water efficiency plans, as well as outlining how to integrate water conservation into other plans and processes to achieve maximum impact.







This best practice area summarizes the regulatory requirements, key concepts, and costs and benefits for the following best practices:

- Developing effective **water efficiency plans** to serve as a roadmap to guide conservation efforts.
- Integrating water into **other relevant plans and services.**
- Executing the **dedicated coordination of a water conservation program** to support successful water efficiency program implementation.

## State Water Efficiency Plan Requirements

✓	Indoor: fixtures and appliances
✓	Outdoor: waterwise landscapes, efficient irrigation
✓	Non-residential: water efficient industrial and commercial processes
✓	Water reuse systems: utility or building scale
✓	Water loss control
✓	Information and public education
✓	Conservation oriented rate structure and billing system
✓	Regulatory measures designed to encourage water conservation

## Major Benefits

Category	Definition
 <p><b>Water Savings</b></p>	Water efficiency plans are the first step for any successful water conservation program. They establish water saving goals and define the programs and implementation approaches necessary to achieve those goals.
 <p><b>Economic Cost Savings</b></p>	Water efficiency plans help prioritize water provider resources by identifying the most cost-effective profile of programs and strategies to achieve goals. Water saving programs implemented from the plan can reduce bills for participating customers.
 <p><b>Education</b></p>	Water efficiency plans should include customer education programs. Coordinating with other plans and relevant services can help educate service providers and community leaders about water topics.
 <p><b>Community/Social</b></p>	Dedicated coordination of a water efficiency program can promote relationship building and collaboration across various organizations and services. In turn, this helps cultivate a shared sense of water stewardship and increases overall program success.
 <p><b>Environmental</b></p>	Water efficiency plans can include programs that promote co-benefits, like waterwise landscapes. Integrating with other plans and service providers can also support the identification of other environmental co-benefits.
 <p><b>Climate</b></p>	Water efficiency plans can include programs that promote efficient water use in both wet and dry years. Less water use in drought years can increase a community's drought resilience. The reduction of water use will also decrease treatment needs, decreasing the amount of greenhouse gases emitted through water treatment and possible through distribution.

## Best Practice Area Key Takeaways

Key takeaways from each best practice include:

- **Water efficiency plans are essential for effective water efficiency programs** and should outline customer needs and available resources to meet those needs.
- **Every water efficiency plan should:**
  - Include components of the seven Best Practice Areas outlined in this document.
  - Be action-oriented.
  - Optimize available resources.
  - Provide effective guidance.
  - Include goals, metrics, and data for accountability.
  - Meet State requirements (see: [cwcb.colorado.gov/public-information/technical-tools/municipal-water-efficiency-plan-guidance-document](http://cwcb.colorado.gov/public-information/technical-tools/municipal-water-efficiency-plan-guidance-document)).
- Integration with other plans **enables a broader spectrum of influence and benefits** water efficiency can have across organizations and communities. It also can serve a tool to **break down silos among departments** by fostering communication and relationship building.
- Dedicated coordination of a water conservation program is **essential for program success and requires supporting resources**.
- Even if there are inadequate resources for dedicated staff, **every program should include a leader or champion, with dedicated back-up support**.
- Coordination **must be action-oriented and include metrics and data for accountability**.

## Water Efficiency Plans

Water efficiency plans (WEP) are essential to develop effective programs that enhance water efficiency while working within available resources for implementation and the needs of customers. While the state requires all water providers that sell over 2,000 acre-feet of water annually to have a water efficiency plan, **it is a best practice for all water providers to have a water efficiency plan (WEP)** regardless of size. Comprehensive water efficiency plans include components from the seven Best Practice areas described throughout this document, are action-oriented, optimize available resources, provide effective guidance, and include a means of accountability for accomplishing desired results.

“

*An effective water conservation program often has a strong education component, incentives to drive innovation, right pricing to facilitate efficient water use, and regulatory components to create water efficient development as well as to reduce water waste.*

*- The Colorado Water Plan*

”

## Regulatory Requirements

The Water Conservation Act of 2004 ([HB 04-1365](#)) requires all covered entities (retail water providers that sell 2,000 acre-feet annually) to have a State approved water efficiency plan (HB04-1365, 2004). While not a requirement, it is beneficial for water providers selling less than 2,000 acre-feet to have a water efficiency plan. State-approved water efficiency plans are necessary to receive State grants and loans. State-approved water efficiency plans must be updated at a minimum of every seven years, and must include CWCB “essential” items called out in the CWCB water efficiency planning guidance documents: [Municipal Water Efficiency Guidance Document](#) (CWCB, 2012) and [Best Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts](#) (Castle A. , 2019).

## Key Concepts

Water efficiency planning is evolving in Colorado. Competition for and the cost of water continues to increase. When these considerations are coupled with the uncertainties of a warming climate, conservation is an important piece in addressing future water needs. Water efficiency plans are interplaying more frequently with other local governmental services (e.g., land use planning) and climate resilience and equity are increasingly integrated into WEPs.

There are already myriad resources to support water providers in developing modern, effective, and implementable water efficiency plans.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- State Water Efficiency Plan Resources
- National Water Efficiency Planning Resources

### State Water Efficiency Plan Resources

There are a variety of guidance documents and manuals on water efficiency planning.

Colorado’s WEP guidance documents lay out the requirements necessary for State-approved plans, including the 2018 requirement to include integrated water and land use planning into all WEPs. The three primary resources from the Colorado Water Conservation Board include:

- [Municipal Water Efficiency Guidance Document](#)
- [Best Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts](#)
- [Sample Municipal Water Efficiency Plan](#)

### City of Greeley Water Efficiency Plan

The [City of Greeley’s 2022 Water Efficiency Plan](#) incorporated a triple bottom line approach to water conservation. The plan includes the following five core values for water conservation:

- Drive water conservation through innovation and technology.
- Provide excellent customer service.
- Continue and build on Greeley’s water conservation history.
- Commit to sustainability and environmental stewardship.
- Fulfill future customer needs and changing values.

(City of Greeley, 2022)



Collectively, these documents detail five steps to water efficiency planning, and provide an overview on how to integrate water efficiency and land use planning (CWCB, 2012):

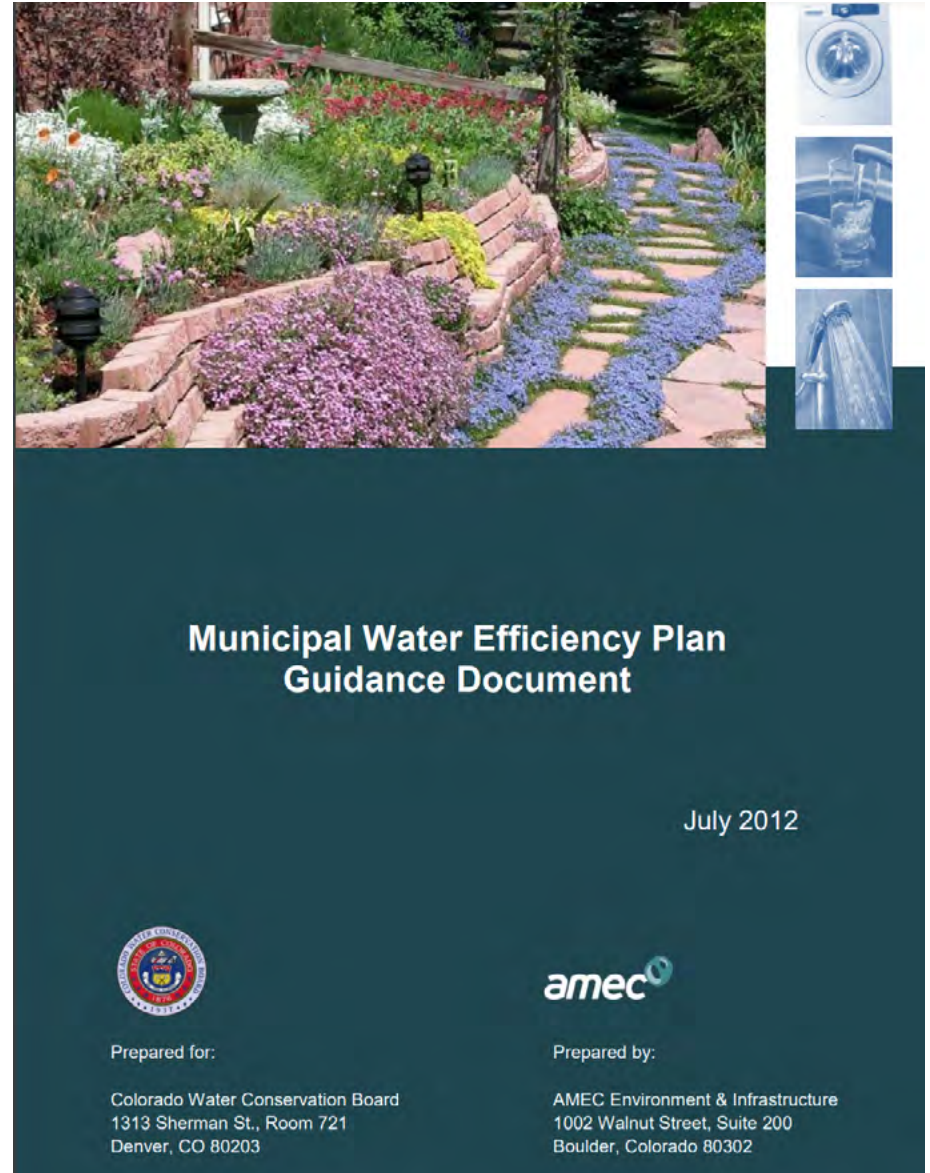
1. Profile of existing water supply.
2. Profile of water demands and historical demand management.
3. Integrated planning and water efficiency benefits and goals.
4. Selection of water efficiency activities.
5. Implementation and monitoring plan.

**All water efficiency plans, regardless of if they are required by the State, should include these five elements, and follow the State's guidance document.**

### Recommendations for Developing Water Efficiency Plans

When developing water efficiency plans, water providers should:

- ✓ Ensure water efficiency plans meet State requirements for approval.
- ✓ Know the customer base and what will be effective in producing water savings.
- ✓ Capture the "low hanging fruit" that will yield the greatest results. This will vary for each provider (e.g., targeting high water users or fixing leaky pipes and proper metering).
- ✓ Capitalize on opportunities for collaborating and leveraging resources.
- ✓ Involve a variety of staff and departments. Water plays a role in many functions of a municipality (e.g., billing, land use planning, infrastructure, communications, etc.).
- ✓ Think holistically and incorporate One Water concepts (e.g., land use planning, climate resilience, disadvantaged communities, environmental and health benefits, etc.).
- ✓ Make the plan actionable with a realistic implementation strategy and focused goals that encourage accountability.



## Municipal Water Efficiency Plan Guidance Document

July 2012



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Boulder, Colorado 80302

*Municipal Water Efficiency Plan Guidance Document*

### **National Water Efficiency Planning Resources**

In addition to Colorado Water Conservation Board's resources, the EPA and AWWA have manuals on water efficiency planning. Specifically, the AWWA/ANSI G480-20 standard can support water providers to develop water efficiency plans. This standard provides guidance on both supply side measures upstream of customer meters (e.g., distribution system management) and demand side measures (e.g., customer billing and education) that should be included in water efficiency plans/programs.

Specific AWWA measures are:

- Dedicated staff for conservation initiative (point of contact)
- Conservation and efficiency planning
- Integrated resources planning
- Water shortage or drought plan
- Public information and education
- Water waste ordinance
- Universal metering and source water metering practices
- Nonpromotional water rate
- Monthly billing based on metered use
- Clear definition of water use units in gallons or liters
- Landscape efficiency program
- Water loss control program (AWWA, 2020)

In addition to these key elements, the second edition of the AWWA M52 Water Conservation Programs manual identifies key considerations to ensure plans are implementable (AWWA, 2017).

- Establish clear lines of communication for staff and management.
- Hire or assign staff to coordinate selected measures.
- Obtain necessary funding for selected measures.
- Consider teaming with neighboring water providers and utilities to capitalize on economies of scale.
- Actively market the measures to potential participants.
- Involve elected officials in the launching of each measure.
- Measure and share the success of each measure.
- Evaluate the cost-effectiveness of each measure.

### **Regional Water Efficiency Plans**

Multiple entities have collaborated to develop regional water efficiency plans. Existing relationships and collaborative efforts have played a role in the success of these regional plans. Some of these include:

- [City of Steamboat Springs](#) and Mount Werner Water and Sanitation District (City of Steamboat Springs and Mount Werner Water and Sanitation District, 2020)
- [Roaring Fork Watershed Regional Water Efficiency Plan](#) (includes five water providers and five additional stakeholders) (ELEMENT Water Consulting & WaterDM , 2015)
- [Blue River Watershed Regional Water Efficiency Plan](#) (includes five water providers) (High Country Conservation Center, 2018).

## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Water Provider Perspective:</b> The costs to develop a water efficiency plan vary depending on the content, detail, and level of technical analysis applied. Water efficiency plans are both developed by water provider staff and hired consultants. The cost to develop a plan can range between \$30,000 - \$100,000 depending on the level of consultant support and outreach/engagement process. State grant money is available through the <a href="#">Colorado Water Plan conservation and land use planning grant pool</a> (CWCB, 2024). Entities that provide over 2,000 acre-feet of water are required to update the plan every seven years. Additional funds are also required to implement water conservation strategies outlined in the water efficiency plan.</p> <p>Importantly, Colorado WaterWise's <a href="#">2020 State of Water Conservation</a> in Colorado survey found that 58% of 155 respondents have no dedicated conservation program budget to implement water conservation programs. Despite so many lacking dedicated implementation budgets, 54% reported having water conservation goals, highlighting a major gap to implementing water conservation across Colorado (Volckens &amp; Denwood, 2022). In addition to funds to complete the water efficiency plan, dedicated staffing resources are needed to create and/or oversee the plan's completion (see Dedicated Coordination of a Water Conservation Program section).</p>	<p><b>Water Provider Perspective:</b> Developing a water efficiency plan is the first step for any organization tackling water conservation. The water efficiency planning process provides a forum to identify comprehensive goals for the water efficiency program including the amount of targeted future water savings, actionable guidelines to achieve these goals through compatible and effective water efficiency measures, and a means to foster accountability. In turn, these details can support staff in communicating with leadership and provide the costs and/or justification necessary to inform decision-making about additional staff and financial resources necessary to implement a water efficiency program.</p> <p>Additionally, planning allows organizations to identify comprehensive goals for the water efficiency program including the amount of targeted future water savings, actionable guidelines to achieve these goals through compatible and effective water efficiency measures, and a means to foster accountability across multiple departments and staff. The public process required for State approved plans also provides a forum to educate customers and stakeholders about water efficiency. Public outreach can be implemented in a manner to foster community cohesiveness and dialogue around water.</p>
<p><b>Customer Perspective:</b> There are no direct customer costs associated with the creation of a water efficiency plan.</p>	<p><b>Customer Perspective:</b> Water efficiency plans indirectly benefit customers, by ensuring customers live in communities that are taking steps to responsibly manage and protect the water resources that provide safe, reliable drinking water to all residents and businesses.</p>
<b>Water Savings Assumptions</b>	
<p>State approved water efficiency plans must provide estimated water savings for existing water efficiency measures and projected water savings for selected measures to be implemented over the planning horizon. There is not a standardized approach for estimating these savings in Colorado and saving estimates cannot be reasonably made for some measures (e.g., public education) given the complexity of factors that influence customer behavior. The Resources section provides a list of resources providers may use to develop their water saving estimates.</p>	

## Integration with Other Relevant Plans and Services

Water plays into many facets of governmental services including water resources, public works, land use planning, parks, billing and finance, public communications, and more. Consequently, policy and measures to achieve water savings often involve coordination of staff and stakeholders across the water provider and other relevant local government service departments.

**The execution of a water efficiency program and overall quality of a water efficiency plan can be enhanced by applying a One Water ethic to the planning process.** This entails including input from a diverse collection of water provider and local government staff upfront in the planning process and ensuring that the WEP is coordinated with other planning efforts throughout the water provider and relevant local government(s). The following sections summarize these planning efforts and how they connect to water conservation.

### What is One Water?

One Water is a movement, a shift in thinking, and the future of how we manage our water resources with practical and bold ideas coming together in a collaborative way. The Water Research Foundation defines One Water as “an integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, meeting both community and ecosystem needs” (Colorado Water Plan).

## Regulatory Requirements

While a best practice, there are no regulatory requirements that dictate water efficiency plans be explicitly integrated with other relevant plans and services. That said, all State approved water efficiency plans are required to evaluate best practices for implementing water conservation through land use measures ([SB15-008](#)), which includes integration with land use planning and staff. Additionally, while not required, [HB20-1095](#) outlines what local governments need include if they choose to add a “water supply element” to comprehensive/local master planning. Note that C.R.S. [§31-23-206 Master Plan](#) and [§30-28-106 Adoption of Master Plan](#) describe the regulation for county master/comprehensive planning for Colorado municipalities and counties. See the Development and Codes Best Practice Area for additional information about local master/comprehensive plans.

## Key Concepts

The integration of water conservation planning and program implementation with other governmental services enables a broader spectrum of influence water efficiency can have at the community and municipal operational levels. Ultimately, this integration enhances the many benefits associated with water efficiency. Often water efficiency is housed in one department and there is a need to break down silos among different departments by fostering communication and relationship building. This requires leadership support, resources, and fortitude to enable successful collaboration.

Additionally, many of these services are not only dispersed among departments, but also among various local jurisdictional entities. Many water providers are separate organizations from their local government. This means that there are different roles and jurisdictions that are important to understand for coordination and planning. Table 1 captures some of these key roles and how they differ. While these intersections are conceptually reasonable, integrating water efficiency across operational management and staff levels is dynamic and complex. This increases the complexity and level of effort necessary to integrate water efficiency planning and implementation of water efficiency programs. In areas where the water provider and the local government are the same entity, some of these roles may overlap. These are identified with an “\*” in Table 1.

Table 1. Intersection of Water Efficiency and Other Local Governmental Services

Community Services	Water Provider Examples	Local Government Examples
<b>Leadership and Decision Making</b>	<ul style="list-style-type: none"> <li>Board of Directors</li> <li>Utilities Commission</li> </ul>	<ul style="list-style-type: none"> <li>City Council</li> <li>Board of County Commissioners</li> <li>Planning and Zoning Commission</li> </ul>
<b>Land Use Planning</b>	<ul style="list-style-type: none"> <li>Development application referrals</li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive Plans</li> <li>Neighborhood Plans</li> <li>Annexations*</li> <li>Development Review*</li> </ul>

Community Services	Water Provider Examples	Local Government Examples
<b>Sustainability Services</b>	<ul style="list-style-type: none"> <li>• Energy management</li> </ul>	<ul style="list-style-type: none"> <li>• Emissions Reduction Goals*</li> <li>• Climate Adaptation Strategies*</li> <li>• Affordable Housing Development</li> <li>• Economic Development</li> <li>• Social Equity Programs*</li> </ul>
<b>Water Resources Management</b>	<ul style="list-style-type: none"> <li>• Water Supply Plans</li> <li>• Water Efficiency Plans</li> <li>• Water Treatment and Delivery</li> <li>• Water Shortage or Drought Plan</li> </ul>	
<b>Hazard Mitigation</b>	<ul style="list-style-type: none"> <li>• Emergency Preparedness and Response*</li> </ul>	<ul style="list-style-type: none"> <li>• Wildfire Mitigation</li> <li>• Emergency Response*</li> </ul>
<b>Capital Improvements</b>	<ul style="list-style-type: none"> <li>• Infrastructure Master Plans</li> <li>• Improvement Projects</li> </ul>	<ul style="list-style-type: none"> <li>• Infrastructure Master Plans*</li> <li>• Improvement Projects*</li> <li>• Right of Way Coordination*</li> </ul>
<b>Water Billing</b>	<ul style="list-style-type: none"> <li>• Water Rates</li> <li>• Water Development Fees</li> </ul>	<ul style="list-style-type: none"> <li>• Assistance Programs*</li> </ul>
<b>Communications</b>	<ul style="list-style-type: none"> <li>• Water conservation programs and practices*</li> <li>• System notifications *</li> </ul>	<ul style="list-style-type: none"> <li>• Hazard response*</li> </ul>
<b>Parks and Recreation</b>	<ul style="list-style-type: none"> <li>• Water delivery *</li> </ul>	<ul style="list-style-type: none"> <li>• Water use*</li> </ul>

To support implementation of this best practice, the following key concepts are covered in the sections below:

- Water Supply and Integrated Water Resources Planning
- Capital and Project Planning
- Land Use Planning
- Sustainability and Climate Action Planning
- Water Shortage and Drought Planning
- State and Regional Planning

### **Water Supply and Integrated Water Resources Planning**

“Integrated water resources planning” and “supply planning” are terms used by water providers to describe the assessment of existing and future water demands in relation to available water supplies. The scope, effort, and depth of quantitative analysis invested in these planning efforts depends on a variety of factors (e.g., size of the water provider, resource availability, projected population growth, reliability of supplies, etc.).

As the cost of water and limitations on available new supplies continues to increase in some areas of the State, **water efficiency is becoming an increasingly important factor when evaluating future water supply and demand options.** The AWWA/ANSI [G480](#) Water Conservation Standard Checklist includes a specific line item (4.2.3) for including water conservation in integrated resources planning. It recommends:

1. “Where appropriate, include water made available through conservation as part of the supply portfolio when conducting supply and demand forecasting analyses” and
2. “Treat conservation equally to other water supply options” (AWWA, 2020).

The level in which Colorado water providers’ demand projections incorporate water saving trends and future water conservation targets is at the discretion of the water provider; however, **best practice is for water supply planning efforts to consider the potential future water and cost savings associated with water efficiency measures.** There are a number of significant long-term benefits from integration, including cost savings that can be achieved through investing in upfront water saving measures to reduce long-term demand projections relative to acquiring additional water supplies. The amount of costs savings and other water efficiency benefits varies on a case-by-case basis.

## Fort Collins Utilities: Water Supply and Integrated Water Resources Planning

In 2023, Fort Collins Utilities began to develop a water demand model to inform the update of their water efficiency plan. The water demand model will eventually be used to update water demand projections for water supply planning purposes. The model will facilitate the development and evaluation of scenarios that incorporate various types of indoor and outdoor water efficiency measures, water restrictions, and future development and land use changes.

### Capital Investment and Project Planning

Water efficiency measures that lower water demand can delay the need for water treatment and delivery infrastructure and reduce the size of the infrastructure (e.g., water treatment plants, pipelines, pumps, etc.), yielding cost savings. Conversely, water efficiency measures may call for infrastructure upgrades and capital improvement investments such as the repair of leaky distribution systems or an upgrade in water metering. **Capital investments and capital improvement project planning should consider water efficiency programs and accompanying projected water demands to ensure that the investment, capital improvement projects, and timing are aligned with municipal water conservation objectives and outcomes.**

### Land Use Planning

The Colorado Water Plan highlights the increasing importance of integrated water and land use planning:

*“Historically, land use and water planning decisions have been made in a disconnected manner. Land planners (Planning Commissions, City Councils, and County Commissioners) make decisions about future developments that rely on water. Meanwhile, water planners often project supplies and demands in separate and disconnected analyses from land planners. Land use patterns have a strong influence on water demand. Subsequently, communities that implement a thoughtful land use and water planning nexus can more easily plan for and regulate future growth while providing adequate water supplies. As Colorado grows, integrated land use and water planning must be considered the minimum standard for moving forward. Integrated land use and water planning can be a tool for protecting community water supplies, meeting future water demand, protecting water*

*quality and riparian corridors, and/ or establishing the appropriate location, pace, intensity, and sustainability of development” (CWCB, 2023).*

The increasing focus on integrating water and land use has led to the development of myriad resources, guidance documents, and technical support programs available to water providers and local governments. For example, DOLA provides technical assistance on connecting water and land use planning with dedicated staff. The Sonoran Institute’s [Growing WaterSmart Program](#) provides training for municipalities on how they can integrate land use and water planning (Sonoran Institute, 2023). To summarize best practices related to the integration of water and land use planning, there are two major areas for focused integration: (1) integration of land use considerations into water plans, and (2) integration of water considerations into land use plans.

- **Integration of Land Use Considerations into Water Plans:** All State-approved water efficiency plans are required to evaluate best practices for implementing water conservation through land use measures (SB 15-008). CWCB provides a guidance document specifically addressing how land use planning may be integrated: [Best Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts](#) (Castle & Rugland, 2019). It includes a checklist of best practices to consider, across the categories of foundational water and land use planning activities, incentives and technical assistance, conservation-oriented tap rates, regulations and land use planning code, and educational activities.



- **Integration of Water Considerations into Land Use Plans:** The comprehensive plan (or master plan) provides the land use policy framework for regulatory tools like zoning, subdivision regulations, annexations, and other policies. A comprehensive plan promotes the community’s vision, goals, objectives, and policies, establishes a process for orderly growth and development, addresses both current and long-term needs, and provides for a balance between the natural and built environment (DOLA, 2023). A step in the integration of water and land use planning is to include water in the comprehensive plan by 1) creating a formal mechanism for cross-fertilization in the long-range planning process and/or 2) incorporating a water element into the comprehensive plan.

While not required, all comprehensive or master plans that contain a water supply element must include water conservation policies determined by the local government ([HB 20-1095](#)). Best practice is for all Colorado comprehensive plans to contain a water element that includes water conservation policies and to formalize coordination between the local government and water provider(s) in the land use planning process.

See the Development and Codes Best Practice for details related to integrating water efficiency and conservation considerations into development processes and land use regulations, including zoning, subdivision, and landscape codes.

### Land Use and Water Primer and Planning Alliance

A three-part Land Use and Water Primer, developed by staff from Colorado’s Department of Local Affairs’ Community Development Office and the Colorado Water Conservation Board’s Water Supply Planning Section, provides resources and information about how Colorado’s local governments typically engage in water and land use planning efforts. Land Use and Water Primer | Division of Local Government ([colorado.gov](#))

The Water and Land Use Planning Alliance, an informal group convened by DOLA and CWCB, meets regularly to help elevate water and land use integration. This group includes by State agencies, local governments, advocacy organization, research organization, and other interested parties (DOLA, 2024).

### Integrated Water and Land Use Planning at Sterling Ranch

Sterling Ranch is a master planned community in Douglas County that is at the forefront of incorporating water efficiency into land use planning, using about half as much water as other municipalities in the Denver Metro and Douglas County areas. Sterling Ranch is the first community in the State where each new home is equipped with a dual indoor and outdoor meter system to better assist residents in lowering water use. All outdoor irrigation meters are also equipped with smart irrigation controllers, alerting customers of leaks and weather changes. Sterling Ranch partners with Denver Botanic Gardens to develop landscape codes that leverage step climate planting that thrives in our arid climate, reducing water demands for outdoor irrigation without impacting the aesthetic value of the community (Sterling Ranch, 2023).



## Sustainability and Climate Action Planning

Many Colorado communities are engaging in sustainability and/or climate action planning to enhance their triple bottom line (i.e., economic, environmental, equity) outcomes, reduce greenhouse gas emissions, and adapt to a changing climate. These plans are multi-disciplinary in nature and help local governments identify needs and prioritize investments around policy, programs, projects, and partnerships.

Resource efficiency, especially related to water and energy, is a common topic in sustainability and climate action plans. These plans provide excellent opportunities to elevate, reinforce, and monitor existing water efficiency and conservation goals; they may also establish new water-related goals and tracking mechanisms. **Best practice for sustainability plans in Colorado is to collaborate with water providers on establishing water conservation goals, metrics for measuring water conservation progress, and prioritization of water conservation and efficiency strategies, ideally in alignment with adopted water efficiency plans.**

In addition to water conservation-related goals and strategies, many climate action plans address the water energy nexus as a fundamental concept in addressing greenhouse gas emissions. There is strong linkages between water and energy where producing, transporting, treating, and heating water requires energy, and consequently can contribute to greenhouse gas emissions. Conversely, water can be used to produce hydroelectricity. **The reduction of water use through water efficient measures can reduce energy consumption needed for treatment and delivery and therefore help to reduce greenhouse gas emissions.** Furthermore, water efficiency measures can also contribute to developing sustainable municipal communities that are resilient to the impacts of climate change. For example, the installation of native, low-water use landscaping, can contribute to the health of urban watersheds that are more resilient to the impacts of intensified droughts induced by climate change. **Best practice for climate action plans in Colorado include addressing the water energy nexus and identifying water-related risks and vulnerabilities associated with climate change.**

“  
*The importance of municipal conservation and efficiency continues to grow as Colorado’s population increases and climate change increases uncertainty in water supplies.*  
- The Colorado Water Plan  
”

## The City of Lafayette: Water and Climate Action Planning

The City of Lafayette is updating its 2021 Sustainability Plan to a Climate Action Plan in 2024. The Sustainability Plan focused on reducing greenhouse gas emissions through addressing energy consumption (buildings), energy production, and solid waste. The Climate Action Plan will expand these categories to also include water, natural environment, transportation, etc. (Lafayette, 2023).

## Water Shortage and Drought Planning

The goal of water shortage and drought planning is to reduce customer water use during water shortages. A common example of a drought planning strategy is water restrictions. Compared to a water efficiency plan, which includes long-term strategies that increase water efficiency over time, drought plans include short-term solutions to reduce water use because of a reduction in the available water supply. While the objectives are different there is overlap, and staff that are involved with the implementation and messaging of water efficiency are commonly involved in water shortage/drought response and communication. As a result, there are **often efficiencies in coordinating water efficiency and drought planning.** Examples of ways water efficiency planning can support drought planning, and vice versa, include:

- Leveraging a water efficiency program’s established channels of communication (e.g., program contact lists or customer water portals) can help make drought communication easier and ensure all customers are aware of restrictions and requirements.
- Landscape choices that promote low-water use and drought tolerant plants increase a community’s drought resiliency and decrease plant mortality in times of drought or water restrictions. This decreases the impacts from drought and a community’s recovery costs.

## Colorado Water Conservation Board: Drought Planning Resources

CWCB provides a number of resources for water providers to help plan and develop drought responses. More information can be found at: [cwcb.colorado.gov/drought](https://cwcb.colorado.gov/drought).



- Water budgets can be a powerful tool in a drought by helping water providers identify customers who are overusing and/or designing restrictions based on a reduction in a customer's water budgets as opposed to more traditional approaches like days of the week. See the Water Budgets best practice for additional information.
- Droughts and water shortages often increase public awareness about the value of water. In turn, political will to invest in water and efficiency measures can increase during drought periods. This can provide an opportunity to further invest in water efficiency.

“

*Drought Management Planning is planning for the conditions under which a drought-induced water supply shortage occurs and specifies the actions that should be taken in response. Planning may include the development of mitigation actions to lessen drought impacts.*

*- Colorado Water Conservation Board*

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### Town of Erie: Integrated Water Shortage and Water Efficiency Planning

In 2021, the Town of Erie leveraged these synergies by updating its Drought and Water Shortage Plan and its Water Efficiency Plan at the same time with a diverse group of town staff representing various governmental services (e.g., public works, communications, finance, parks, etc.). This fostered collaborative discussion around water and communication among staff that do not normally interact on a regular basis. More information can be found at: [www.erieco.gov/1054/Water-Plans](http://www.erieco.gov/1054/Water-Plans).

### State and Regional Water Planning

In Colorado, statewide and regional water planning is more formalized than land use planning, which is conducted primarily at the local government level (though regional land use plans do exist in some areas of the state). At the statewide level, Colorado's Water Plan "provides a framework for helping Colorado meet its water challenges through collaborative action around water development and water conservation" (CWCB, 2023).

Regional water planning is formalized through [Basin Roundtables](#). These nine entities facilitate discussion on regional water management issues and are responsible for preparing [Basin Implementation Plans \(BIP\)](#). The BIPs show how each basin plans to meet its future water and environmental needs.

[House Bill 1051](#) requires that entities supplying over 2,000 acre-feet annually report annual report water usage data to the State. These data help to assist the regional BIP and State water planning efforts in understanding current water usage, the impacts of water conservation and efficiency, and making more accurate forecasts of future water use. See the Measurement and Data section for additional information on data and data tracking.

Water efficiency plans help inform the Colorado Water Plan and Basing Implementation Plans. Water efficiency plans also help inform other local or regional water and/or land use planning efforts. For example, as of early 2024, El Paso County has completed a water master plan and Arapahoe and Larimer counties are developing county water master plans to supplement the county comprehensive plans. **Emerging best practices in this space are to involve both water providers and land use authorities in regional land use and water planning efforts to improve coordination and collaboration around conservation opportunities.**

## Costs, Benefits, and Water Savings

<i>Costs</i>		<i>Benefits</i>	
<b>Water Provider Perspective:</b> Costs are variable. The initial short-term investment to integrate water efficiency into other planning efforts and functions of municipal government can help streamline operations in the long-term, yielding cost benefits. Like all plans, additional staffing resources are also needed to coordinate plan integration and create and/or oversee alignment.		<b>Water Provider Perspective:</b> Integration with other relevant plans and services allows organizations to take a comprehensive approach to water management, while also addressing sustainability, reducing the carbon footprint, and improving climate resiliency. By incorporating water efficiency practices into other plans and services, increased communication and relationships at a staff level will allow organizations to cohesively respond to natural hazards (e.g., drought or water shortage). It also creates efficiencies and enhances the ability for organizations to proactively integrate water efficiency into the land use planning prior to development, as well as align communications and messaging for staff and customer bases. This provides opportunities to enhance equity since a diversity of stakeholders can be involved in the up-front planning process.	
<b>Customer Perspective:</b> There are no direct customer costs associated with integrating water efficiency plans for relevant plans and services.		<b>Customer Perspective:</b> Water efficiency plans indirectly benefit customers, by ensuring customers live in communities that are taking steps to responsibly manage and protect the water resources that provide safe, reliable drinking water to all residents and businesses.	
<i>Water Savings Assumptions</i>			
While the success of water conservation efforts and associated savings can be increased through the coordination of multiple municipal departments and functions, the amount of water savings achieved is difficult to quantify.			

## Dedicated Coordination of a Water Conservation Program

A plan alone does not save water. Successful implementation of a water efficiency plan and program requires a thought-out and strategic effort that likely will require coordination across multiple departments and, potentially, external organizations. Successful water conservation programs will generate leadership support for resources necessary to implement programs, while building on action-oriented implementation approach. However, to achieve this it is important there is an established and centralized approach to program coordination that leverages partnerships in and outside the organization. The following sections focus on these key aspects, in addition to staff and financial resources, necessary to execute a well-run and effective conservation program.

### Water Conservation vs. Water Efficiency

The terms “water conservation” and “water efficiency” are often used interchangeably. While both help people reduce their water use, they mean different things for how water savings are achieved. Water conservation focuses on water reduction or “doing more with less.” Water efficiency focuses on only using the amount of water needed to complete a specific task or “using the least amount of water necessary to get the job done.” For example, only running the dishwasher when it is full is an example of water conservation, while using an ENERGY STAR rated dishwasher that uses less water is an example of water efficiency. Both are important elements of any water conservation/efficiency program, and as a result both are used throughout this guidebook and water providers.23).

## Regulatory Requirements

There are no regulatory requirements that dictate the dedicated coordination of a water conservation program; however, this best practice should be incorporated into every water conservation program.

## Key Concepts

Colorado WaterWise’s 2020 survey on the [State of Water Conservation in Colorado](#) found that of 155 respondents across Colorado 23% do not have dedicated conservation staff, 52% have 1 – 3 dedicated conservation staff (Volckens & Denwood, 2022). Dedicated staff and financial resources play a critical role in the development and execution of water conservation programs.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Dedicated Water Conservation Staff
- Partnerships for Implementation

### Dedicated Water Conservation Staff

Successful water conservation programs intersect many aspects of municipal services and therefore require well executed central coordination. “Dedicated staff for conservation initiative (point of contact)” is included in the [G480-20](#) standard checklist for water conservation and efficiency program operations and is often considered essential for water providers aiming to reduce water demand (AWWA, 2020). For larger water providers, this **coordination often includes a full-time water conservation coordinator** with supporting staff and/or contractors. Smaller providers may not have the resources for a full-time employee, however, **every water provider should at least have an assigned staff member responsible for conservation coordination, even if that person may also have other responsibilities.**

Fundamental responsibilities of a dedicated water conservation coordinator include:

- Supporting and managing the development of a water conservation plan.
- Overseeing implementation of the conservation plan including data tracking and coordination in and outside of the organization.
- Improving customer understanding of conservation through outreach and education.

Full time water conservation coordinators may be housed in a variety of departments including, public works, water resources, sustainability services, or communications. Job titles also may vary from “water conservation coordinator.” Other job title examples include sustainability coordinator, water efficiency specialist, or water efficiency analyst. While the name may have less significance, the department and seniority of the position influences the types of connections and decisions the employee will be able to make. For example, if housed in the water resource department it will be easier to draw connections to water resource management. Additionally, successful conservation programs require political capital and financial support, staff, and training sources. If staff does not have decision making authority for resource allocation, program effectiveness may be diminished.

## Water Efficiency Plan Implementation Funding Support

A variety of State and Federal funding opportunities exist to support water efficiency planning and implementation support.

- Bureau of Reclamation WaterSMART Grants: [www.usbr.gov/watersmart/](http://www.usbr.gov/watersmart/)
- CWCB Colorado Water Plan Grants: [cwcb.colorado.gov/funding/colorado-water-plan-grants](http://cwcb.colorado.gov/funding/colorado-water-plan-grants)
- CWCB Turf Replacement Program: [cwcb.colorado.gov/turf](http://cwcb.colorado.gov/turf)
- Colorado River District Community Funding Partnership: [www.coloradoriverdistrict.org/community-funding-partnership/](http://www.coloradoriverdistrict.org/community-funding-partnership/)

WaterNow Alliance provides resources and technical support to water providers navigating these opportunities. More information can be found at: [waternow.org/](http://waternow.org/).

## Partnerships for Implementation

**Partnerships with outside organizations optimize available resources to further elevate municipal water conservation.** This best practice is particularly important for resource limited organizations who may not have staff to implement programs or complete outreach. Partner organizations for water conservation programs include:

- Conservation oriented non-profit organizations and contractors (e.g., Resource Central).
- Energy utilities looking to decrease hot water use, and in turn, promote water efficiency (e.g., Platte River Power Authority's Efficiency Works program).
- County sustainability and water programs (e.g., Larimer County Conservation Corps).
- Teaming opportunities with other water providers on messaging and/or other measures.
- Opportunities offered through regional leadership (e.g. Northern Water's water efficiency programs).
- Regional water conservation plan with other entities (e.g., [Blue River Watershed Regional Water Efficiency Plan](#)).
- Trainings like Sonoran Institute's [Growing Water Smart Program](#).
- Universities (e.g., Colorado State University Water Center).

Water efficiency measures provide co-benefits beyond saving water. For instance, the installation of well-maintained waterwise landscapes provides environmental, community health, water quality, and climate resiliency benefits and the reduction of indoor water use and reduce energy necessary to heat water. Identifying co-benefits can also open new opportunities for collaboration which can further promote the measure.

## Collaborative Water Conservation Outreach in the Yampa Valley

The Yampa Valley Sustainability Council has partnered with the City of Steamboat Springs, Mount Werner Water and Sanitation District and the Craig-Scheckman Family Foundation to conduct water conservation outreach, including waterwise landscaping in the Yampa Valley (Yampa Valley Sustainability Council, 2023).



# Case Study

## DEDICATED COORDINATION OF A WATER CONSERVATION PROGRAM | GREELEY, CO

The City of Greeley uses a triple-bottom-line approach to guide the implementation of their water efficiency program: prosperity, water conservation management, and community. Every year, the City of Greeley undergoes a comprehensive review of their water efficiency program to assess program performance and to adjust course for the upcoming year. To guide this evaluation process, Greeley developed a scorecard with performance indicators for each triple-bottom-line category. Each water efficiency program component is grouped into one or more triple-bottom-line categories. Greeley staff then undergo a two-day review process to score each program component using the relevant performance indicators. Water savings are estimated for all triple-bottom-line categories to further quantify performance.



In addition to this assessment, Greeley participated in [WaterNow Alliance's Project Accelerator](#) program in 2020. Through the Project Accelerator program, WaterNow Alliance and Western Resource Advocates worked with Greeley to evaluate the city's water efficiency program portfolio. This assessment included research, interviews with city staff and officials, quantitative analyses, and a customer survey. A GIS study identified geographic and demographic gaps where Greeley's program was underserving key community segments.

In response to this assessment, Greeley hired a bilingual staff member to lead engagement with underserved communities. Greeley is engaging underserved residents through a community workshop and a survey to determine how to best reach these communities through targeted messaging and outreach. Program(s) that foster sustainability within the underserved communities, such as tree plantings and waterwise gardens that promote temperature cooling, are a focal point for future program(s) (Egenhoff, 2024).

## Costs, Benefits, and Water Savings

### Costs

**Water Provider Perspective:** Costs to implement a conservation program are highly variable and depend on many factors including the goals of the program, program design, number of staff dedicated to implementing the program, etc. Typically, larger water providers have a dedicated water conservation program budget with dedicated staff member(s) to implement the program. Smaller water providers typically have less available resources and may rely on a staff employee for program implementation who also has other dedicated responsibilities outside of water conservation. Budgets also depend on other factors such as political priorities, cost of water, and the status of water infrastructure.

From a staffing perspective, Colorado WaterWise's 2020 survey on the [State of Water Conservation in Colorado](#) found that of 155 respondents across Colorado 23% do not have dedicated conservation staff, 52% have 1 – 3 dedicated conservation staff (Volckens & Denwood, 2022). The survey also found that when water providers lack dedicated staff the two most commonly implemented programs are water loss audits and efficiency-oriented rate structures.

**Customer Perspective:** There are no direct customer costs associated with the administration of a water conservation program.

### Benefits

**Water Provider Perspective:** It will be challenging for any organization to successfully implement water conservation programs and plans, without a coordinated water conservation program. Having dedicated staff implementing water conservation programs and plans is the ideal scenario. However, if that isn't feasible, incorporating water conservation management into existing positions' job duties and/or having a staff champion is key to program success. Having dedicated coordination will optimize available resources and ensure water savings targets are met.

**Customer Perspective:** Dedicated coordination of a water conservation program indirectly benefits customers, by ensuring customers live in communities that are taking steps to responsibly manage and protect the water resources that provide safe, reliable drinking water to all residents and businesses.

### Water Savings Assumptions

The water savings achieved through the implementation of a water conservation program is highly variable and depends on many factors including the goals of the program, program design, customer base, and allocation of resources.

# Resources

## General

- Colorado Basin Roundtables: <https://cwcb.colorado.gov/about-us/basin-roundtables>
- Colorado WaterWise: <https://coloradowaterwise.org/>
- CWCB Water Plan Grants: <https://cwcb.colorado.gov/funding/colorado-water-plan-grants>
- Northern Water and Water Efficiency: <https://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use>
- Resource Central: <https://resourcecentral.org/>

## Water Efficiency Plans

- Alliance for Water Efficiency Water Conservation Tracking Tool: <https://www.allianceforwaterefficiency.org/resources/topic/water-conservation-tracking-tool>
- Amy Vickers Handbook of Water Use and Conservation: <https://www.waterplowpress.com/>
- City of Steamboat Springs and Mount Werner Water and Sanitation District Regional Water Efficiency Plan: <https://co-steamboatsprings.civicplus.com/251/Water-Conservation>
- Colorado WaterWise Yield and Reliability Demonstrated in Xeriscape: [https://www.coloradowaterwise.org/resources/Documents/Library/YARDX\\_Report.pdf](https://www.coloradowaterwise.org/resources/Documents/Library/YARDX_Report.pdf)
- Colorado WaterWise: <https://coloradowaterwise.org/>
- CWCB Colorado Water Loss Initiative: <https://www.coloradowaterloss.org/>
- CWCB Municipal Water Efficiency Guidance Document: <https://cwcb.colorado.gov/public-information/technical-tools/municipal-water-efficiency-plan-guidance-document>
- CWCB Sample Municipal Water Efficiency Plan: <https://cwcb.colorado.gov/public-information/technical-tools/municipal-water-efficiency-plan-guidance-document>
- CWCB Turf Replacement Program: <https://engagecwcb.org/cwcb-turf-replacement-program>
- DNR Best Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts: <https://dnrweblink.state.co.us/cwcbsearch/ElectronicFile.aspx?docid=208193&dbid=0>
- DNR Colorado Minimum Water Planning Guidelines: <https://dnrweblink.state.co.us/cwcb/0/edoc/210759/GuidelinesEvalWCPlansMay2016.pdf>

- EPA Water Conservation Plan Guidelines: <https://www.epa.gov/watersense/water-conservation-plan-guidelines>
- EPA WaterSense: <https://www.epa.gov/watersense>
- Northern Water Garden in the Box Irrigation Recommendation Cooperative Project with Resource Central: [https://www.northernwater.org/getattachment/4642c97f-937d-4e24-a8a0-d8e840c90b35/Garden\\_in\\_a\\_Box\\_Irrigation\\_Recommendations](https://www.northernwater.org/getattachment/4642c97f-937d-4e24-a8a0-d8e840c90b35/Garden_in_a_Box_Irrigation_Recommendations)
- Northern Water Landscape Conversion Water Savings Calculator: <https://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/fact-sheets-and-tools>
- Roaring Fork Watershed Regional Water Efficiency Plan: [https://roaringfork.org/media/1567/wep\\_rfregional\\_plan\\_20150812.pdf](https://roaringfork.org/media/1567/wep_rfregional_plan_20150812.pdf)
- Water Research Foundation Residential End Uses of Water, Version 2: <https://www.waterrf.org/research/projects/residential-end-uses-water-version-2>

## Integration with Other Relevant Plans and Services

- AWWA Forecasting Urban Water Demand 2<sup>nd</sup> Edition: <https://engage.awwa.org/PersonifyEbusiness/Bookstore/Product-Details/productId/6395>
- AWWA M50 Water Resources Planning 3<sup>rd</sup> Edition: <https://engage.awwa.org/PersonifyEbusiness/Bookstore/Product-Details/productId/63491393>
- AWWA Manual M60 Drought Preparedness and Response, 2<sup>nd</sup> Edition: <https://www.awwa.org/portals/0/files/publications/documents/m60lookinside.pdf>
- AWWA The Green Utility: A Practical Guide to Sustainability: <https://engage.awwa.org/PersonifyEbusiness/Bookstore/Product-Details/productId/20673>
- Colorado Basin Implementation Plans: <https://cwcb.colorado.gov/colorado-water-plan/basin-implementation-plans>
- Colorado Department of Local Affairs Land Use and Water Primer: <https://dlg.colorado.gov/land-use-and-water-primer>
- Colorado Department of Local Affairs Water and Land Use Integration for Local Governments: <https://dlg.colorado.gov/water-and-land-use-integration>
- Colorado Drought Management Guidance Document: <https://cwcb.colorado.gov/drought-assistance>
- Colorado Water Plan: <https://cwcb.colorado.gov/colorado-water-plan>
- Conservation and Demand Management through Land Use Planning Efforts: <https://dnrweblink.state.co.us/cwcbsearch/ElectronicFile.aspx?docid=208193&dbid=0>

- CWCB Drought Overview: <https://cwcb.colorado.gov/drought>
- EPA Climate Resilience Evaluation and Awareness (CREAT) Risk Assessment Application for Water Utilities <https://www.epa.gov/crwu/climate-resilience-evaluation-and-awareness-tool-creat-risk-assessment-application-water>
- EPA Drought Response and Recovery for Water Utilities: <https://www.epa.gov/waterutilityresponse/drought-response-and-recovery-water-utilities>
- Lincoln Institute of Land Policy Incorporating Water into Comprehensive Planning: <https://www.lincolnst.edu/incorporating-water-comprehensive-planning>
- Sonoran Institute Growing Water Smart Growing Water Smart Workshops: <https://sonoraninstitute.org/card/gws/>
- Town of Erie Integrated Water Planning: <https://www.erieco.gov/1054/Water-Plans>
- Urban Land Institute Water Wise Strategies for Drought-Resilient Development: <https://knowledge.uli.org/-/media/files/research-reports/2022/uli-waterwise-final-report.pdf>
- Western Resource Advocates Integrating Water Efficiency into Land Use Planning in the Interior West: A Guidebook to Local Planners: <https://westernresourceadvocates.org/publications/integrating-water-efficiency-into-land-use-planning/>
- Western Resource Advocates State of Water and Land Use Planning Integration: Learning from Colorado Communities: <https://westernresourceadvocates.org/publications/the-state-of-water-and-land-use-planning-integration-learning-from-colorado-communities/>

## Dedicated Coordination of a Water Conservation Program

- AWWA M52 Water Conservation Programs: A Planning Manual 2<sup>nd</sup> Edition: <https://engage.awwa.org/PersonifyEbusiness/Bookstore/Product-Details/productId/61841578>
- AWWA/ANSI G480-20 Water Conservation and Efficiency Program Operation and Management: <https://engage.awwa.org/PersonifyEbusiness/Bookstore/Product-Details/productId/86216893>
- Blue River Watershed Regional Water Efficiency: <https://highcountryconservation.org/water/how-to-conserve/>
- Colorado WaterWise State of Water Conservation in Colorado: <https://coloradowaterwise.org/The-State-of-Water-Conservation-in-Colorado>
- CWCB HB 1051 Reporting Portal: <https://cwcb.colorado.gov/hb1051-reporting-tool>
- WaterNow Alliance's Project Accelerator: <https://waternow.org/our-work/our-work-projects/project-accelerator/>
- Yampa Valley Sustainability Council: <https://yvsc.org/water-conservation/>





# Rates and Fees









Water providers charge new customers when they join the water system and charge existing customers for the water they use. A water provider's rate and fee structure can serve multiple purposes. Rates and fees collected from new and existing customers cover water provider expenses associated with providing high quality water infrastructure and services. However, the rates and fee structures can also impact water affordability and incentivize – or disincentivize – water efficiency. The Rates and Charges Best Practice Area highlights the importance of establishing water system development rates and water usage fees that cover water provider's expenses, reflect the value of conserving water, and maintain affordability for a resource essential to life.

This best practice area summarizes the regulatory requirements, key concepts, and costs and benefits for the following best practices:

- Establishing **conservation-oriented tap or connection fees** (commonly known as “system development charges” or “tap fees”) to encourage water-efficient development from the start.
- Establishing a **conservation-oriented water rate structure** to encourage the efficient use of water by customers.

State Water Efficiency Plan Requirements	
	Indoor: fixtures and appliances
	Outdoor: waterwise landscapes, efficient irrigation
	Non-residential: water efficient industrial and commercial processes
	Water reuse systems: utility or building scale
	Water loss control
	Information and public education
✓	Conservation oriented rate structure and billing system
✓	Regulatory measures designed to encourage water conservation

## Major Benefits

Category	Definition
 <p><b>Water Savings</b></p>	<p>Conservation-oriented tap fees provide a financial incentive for developers and builders to use water efficient techniques. Water efficient new buildings and landscapes can use 30-45% less water compared to standard building and landscaping practices (Chesnutt, et al., 2018; DeOreo W. , Mayer, Dziegielewski, &amp; Kiefer, 2016; Mayer P. , DeOreo, Towler, &amp; Lewis, 2003). Conservation oriented rate structures provide a financial incentive for customers to use water efficiently. Water budget-based rate structures can reduce water demands by 10-30% (Mayer P. , DeOreo, Chesnutt, &amp; Summers, 2008).</p>
 <p><b>Economic Cost Savings</b></p>	<p>Rates and fees that lead to more efficient water use can reduce or delay the need for costly water supply and/or infrastructure development.</p>
 <p><b>Education</b></p>	<p>Water bills and water rates are two of the most prevalent education tools available to water providers. The amount a water provider charges for water use communicates the value of water, and bills can serve as a visual reminder for customers to use less water.</p>
 <p><b>Community/ Social</b></p>	<p>Rate and fee structures can simultaneously promote conservation and affordability by keeping prices low for essential water use, while charging higher rates for discretionary water use.</p>
 <p><b>Environmental</b></p>	<p>Rate and fee structures that improve water efficiency, or reduce total water demands, increase water availability for other beneficial uses.</p>
 <p><b>Climate</b></p>	<p>Rate and fee structures that improve water efficiency may decrease treatment needs, decreasing the amount of greenhouse gases emitted through water treatment or distribution.</p>

## Best Practice Area Key Takeaways

Key takeaways for each best practice include:

- **Conservation Oriented Tap or Connection Fees**
  - **Conservation-oriented tap fees base** part of the connection charge on the anticipated demand at the site.
  - **Developers respond to the price incentive.** When developers confront tap fees based on anticipated water use, they recognize the incentive to build smaller homes on smaller lots and to install conserving fixtures and landscapes to pay a lower connection fee.
  - **Be smart from the start.** Incentivizing conservation, through the prospect of reduced tap fees, is an effective method for reducing future water use on the property.
- **Conservation-Oriented Water Rate Structure**
  - **Colorado has implemented tiered rates.** Almost all water providers in Colorado have implemented the best practice of having a conservation-oriented rate structure.
  - **Water budget-based rates are effective and popular.** A growing number of Colorado providers are implementing water budget-based rates which are considered the most advanced and effective rate structure form.
  - **Tiered rates and avoidance of fixed charges are most equitable.** In Colorado, the focus of conservation-oriented rates is on tiered, inclining block rate structures and most water providers already use this form which is most equitable. Avoiding overreliance on fixed charges may be a newer concept for Colorado water suppliers and is something everyone should consider when implementing rate updates.
  - **Considerations when selecting and designing a rate structure:**
    - Size blocks appropriately.
    - Make block price differential meaningful.
    - High fixed service charges ensure water provider revenue but are less equitable and weaken intended conservation effects.
    - Billing cycles and the ability to track water use influence customer rate response.

## Conservation Oriented Tap or Connection Fees

An important goal of water conservation programs is to ensure that new buildings and new customers added to a water system are efficient from the start. Tap or connection fees (“tap fees”), as described in this best practice, are implemented by the water providers or water planning agencies and apply to new customers joining the water system who are seeking a new connection(s) and, sometimes, with certain types of redevelopment.

Traditional tap fees base system connection charges on the size of the water meter – which may be a reasonable approach if peak demand is the only consideration. Conservation-oriented tap fees base part of the connection charge on the anticipated demand at the site. When developers confront tap fees based on anticipated water use, they recognize the incentive to build smaller homes on smaller lots and to install conserving fixtures and landscapes to pay a lower connection fee. As a result, **tap fees should be developed based on anticipated water use of a new building or development to the extent possible.** A fee based on anticipated water use provides an incentive for the new building(s) and landscape to be as water efficient as possible from the start.

### Peak vs. Annual Water Demand

**Peak water demand** is typically the maximum volume of water delivered to the system in a single day. Peak water demand is important when designing water treatment and delivery systems and sizing water meters.

**Annual water demand** is the total volume of water delivered throughout an entire year. Annual water demand is important for water resource and water conservation planning.

After development is approved and occupancy occurs, it is the water provider’s rates and policies that primarily influence conservation and efficient use of water (see Conservation-Oriented Water Rate Structure). For Colorado providers, most of whom already utilize inclining block rate structures, tap fees based on the amount of water the development will need, and other techniques that incentivize lower water use, may offer the greatest potential for future additional savings (Castle & Rugland, 2019).

The following sections summarize the key concepts related to conservation-oriented tap fees and how to implement a conservation-oriented structure.

## Regulatory Requirements

Colorado Revised Statutes (C.R.S.) establish the legal options available to local governments and other community organizations to allow them to raise revenues for funding improvements to water systems through fees (DOLA, 2023).

In Colorado, **a water provider or governing board needs a “rational reason” for collecting the rate, setting the amount of the rate, and for using the chosen rate setting methods** (DOLA, 2023). Usually, a cost-of-service study, conducted by a qualified professional rate consultant, establishes the rational reason for collecting a specific connection fee or rate. To challenge water rates, a legal challenger must prove that the rates or rate setting methods do not have a rational relationship to a legitimate government purpose (DOLA, 2023).

## Key Concepts

Incentivizing conservation through the prospect of reduced tap fees is an effective method for reducing future water use on the property (Castle & Rugland, 2019). Many providers have two fundamental components to the tap fee structure:

- Water resources charge
- System development charge

The water resources charge is based on the anticipated annual volume of use. The system development charge is based on the size of the water meter plus additional costs associated with bringing water to the site. When developing conservation-oriented tap fees, water providers typically focus on the **water resource charge** component, however there are other important considerations for conservation-oriented tap fees.

To support implementation of the best practice, the following key concepts are addressed in the section below:

- Implementation of Conservation Oriented Tap Fees

## Implementation of Conservation Oriented Tap Fees

Tap fees, as described in this best practice, are implemented by the water providers or water planning agencies. Tap fees apply to new customers joining the water system. Depending on the type of project, they may also apply to customers who are going through a redevelopment process.

To incentivize efficiency, tap fees can be developed based on anticipated water use in the new or redeveloped building or landscape. The more water that will be used, the higher the tap fee which discourages water-inefficient development (Rugland, 2022). A tap fee based on anticipated water use provides an incentive for the new building(s) and landscape(s) to be as water efficient as possible from the start, to receive a lower connection charge.

Reducing tap fees for lower future consumption incentivizes the inclusion of conserving fixtures and landscapes from the very beginning. They can also be designed to reduce demand on a given site by incentivizing smaller lot sizes and denser housing stock. Linking tap fees to a water budget can help ensure that the demands projected when tap fees are paid are actually observed over time (see the Water Budgets Best Practice Area for additional information).

Coordination between water providers and land use planners in the land use planning and development approval processes can ensure that everyone is aware of the water impacts of the proposed development and of the potential to reduce tap fees and ultimate costs to consumers through adjustments to the development proposal (Castle & Rugland, 2019).

### Western Resource Advocates: Conservation Oriented Tap Fee Resources

In 2018, Western Resource Advocates and Raftelis' published a [guidebook](#) on Conservation Oriented Tap Fees that summarizes additional details and considerations for water providers exploring conservation-oriented tap fees and includes five additional case studies. The guidebook is being updated, and a new version is expected to be published in 2024. More information can be found at: [westernresourceadvocates.org/publications](https://westernresourceadvocates.org/publications).




### What if Water Use is Higher Than Expected?

What happens if a customer is given a lower tap fee, but then, for whatever reason, uses more water on an annual basis than was paid for via the tap fee? How are the financial interests of the water provider and other customers on the system protected? The potential for overuse does exist and this is an issue that water providers must think about and plan for in advance. There are several options.

The easiest approach is the “do nothing” option – let water rates take care of it. Water use in excess of an agreed upon tap fee volume, is still bought and paid for by water users through volumetric rates. Depending on the level of excess, no action may be warranted or needed. For small volumes of excess use, it could be assumed that the volumetric rates are sufficient for recovering enough additional revenue. This could also be true for larger volumes of excess use, depending on the water provider rate structure.

When the volume of excess use is regular and more significant – in the order of twice as high as expected or more – then water rates alone may not be sufficient. In some cases where water use exceeds expected amounts, the water provider bills the customer for the additional component of the tap fee, based on the actual volume of use. Frequently the developer that originally negotiated the water use and paid the tap fee is no longer involved and it is the property owner or account holder that becomes responsible for the additional tap fee assessment.

For example, in the City of Greeley, if water use in a new commercial, mixed use, or multi-family building (greater than 4 units) exceeds its service commitment in any calendar year, the owner will be required to pay a raw water surcharge for the volume of water exceeding the service commitment. Furthermore, if water use exceeds the service commitment in any two consecutive years, a property owner will be required to purchase additional water through a cash-in-lieu payment to the city.



# Case Study

## CONSERVATION-ORIENTED FEES | GREELEY, CO

The City of Greeley has a multi-part tap fee structure that encourages developers to incorporate efficiency from the start. In Greeley, tap fees are charged for all new water connections and may also be charged for modifications to existing connections.

There are four components to the Greeley tap fee that must be satisfied for all new taps:

- Water meter
- Cash-in-lieu of raw water
- Water plant investment fee
- Sewer plant investment fee

A separate tap is required for each single-family detached and attached unit and for each multi-family and non-residential building. Buildings with mixed residential and commercial uses require separate taps for the residential and non-residential components of the building. Importantly, all landscaping requires a separate irrigation tap, except residential buildings of four units or fewer.

### **Water Meter and Tap Sizing**

In Greeley, the water meter charge is based on the meter size selected for the development. Residential single-family detached and attached houses normally have a ¾" tap and water meter. Multi-family and non-residential water taps and meters are sized based on the water use, which is determined by the number of fixtures, types of appliances, and other water demands.

### **Cash-in-Lieu of Raw Water**

Historically, the City of Greeley required developers to dedicate raw water rights to the City when a new development joined the system, however now the City accepts Cash-in-Lieu fees if the developer does not have enough acceptable raw water or raw water credits associated with the existing taps on the property being developed.

The amount of raw water or Cash-in-Lieu fees due depends on a customer's service commitment, or annual expected volume of water use. This provides an incentive for developers or builders to reduce the water requirement. For residential single-family detached and attached homes, the service commitment is standardized based on the type of residential unit. For non-residential projects, service commitment is calculated based on the type of business, the square footage of the business area, and the square footage and type of landscaping. Including the landscaping square footage and landscape type provides an incentive for developers or builders to install waterwise landscaping.

Greeley records the service commitments with the Weld County Clerk and Recorder. If water use in a non-residential, mixed use, or multi-family building (greater than 4 units) exceeds its service commitment in a calendar year, the owner will be required to pay a raw water surcharge for the volume of water exceeding the service commitment. This surcharge is waived in the first calendar year of water service to acknowledge the additional water required to establish healthy landscapes. If water use in a non-residential, mixed use, or multi-family building exceeds its service commitment in any two consecutive years, the owner will be required to purchase additional water through a Cash-in-Lieu payment.

## Water Plant Investment Fee

In Greeley, the water plant investment fee (PIF) is charged based on the size of the water tap. For a dedicated landscaping water tap, a reduced PIF will be owed if at least 75% of the landscape is xeriscape and the tap is 1" in diameter or smaller. This provides a significant incentive for waterwise landscaping. If the landscaping does not meet Greeley's 75% threshold of waterwise landscaping, then the full PIF is owed. The sewer plant investment fee is charged based on the size of the domestic water tap.

## Conservation Oriented Tap Fees for Single-Family – Little Thompson Water District

The Little Thompson Water District, which serves about 250 square miles located in Boulder, Larimer and Weld Counties, has a conservation-oriented tap fee structure for single family customers. Little Thompson's tap fee includes five separate single-family residential categories starting with micro-homes of less than 1,000 square feet and no outdoor use; and going up through urban homes on lots smaller than 9,000 square feet; and finishing with Estate homes. Even in the Estate home category, there are turf limits. Estate Taps are generally appropriate for lots larger than 17,000 sf in size, and suggested outdoor use is limited to approximately 13,000 sf of turf or less.

In 2024 the smallest single-family tap available in the Little Thompson Water District cost \$41,300 and the largest, an estate tap, cost \$191,700. This difference of more than \$150,000 reduces the cost of building smaller, denser single-family neighborhoods and recognizes the additional costs associated with serving large homes on large lots.

More information here: <https://littlenthompsonwd.colorado.gov/about-rates-and-charges>.



## Costs, Benefits, and Water Savings

<i>Costs</i>	<i>Benefits</i>
<p><b>Water Provider Perspective:</b> Implementing a new tap fee structure usually requires significant research and planning to ensure that the fees will cover all necessary costs and are equitable for both new and existing customers. A cost of service study often accompanies implementation of a new tap fee structure. The cost of implementing a conservation-oriented tap fee structure is difficult to predict and will vary depending upon the current structure and the significance of the changes proposed. Additionally, conservation-oriented fee structures that are based on anticipated water use may require more staff time and/or staff with specific expertise than other systems based just on information like tap size.</p>	<p><b>Water Provider Perspective:</b> A conservation-oriented tap fee structure provides incentive for customers to join the water system at a better level of water efficiency and can result in 30 – 45% less water use than in comparable buildings and landscapes constructed without concern for water efficiency (Chesnutt, et al., 2018; DeOreo W. , Mayer, Dziegielewski, &amp; Kiefer, 2016; Mayer P. , DeOreo, Towler, &amp; Lewis, 2003). From the water provider perspective, this helps slow the growth of demand in the water system and can result in reduced capital expenditure over time. In addition tap fee structures that encourage waterwise plantings improve community resilience, especially during drought. In turn, this leads to less landscapes being abandoned and helps maintain a healthy community in wet and dry years.</p>
<p><b>Customer Perspective:</b> When it comes to tap fees, there are two customer perspectives to consider. First, there is the original purchaser of the tap, usually a developer. Second, there are the future occupants of the property.</p> <p>Reducing tap fees in exchange for installation of high-efficiency fixtures and waterwise landscapes from the beginning is a cost savings for the developer and future residents who will pay lower water bills every month assuming they do not overwater and pay surcharges. This policy lowers the overall cost of development for builders that include waterwise components. This policy results in greater affordability for water-efficient homes and lower water bills over time.</p>	<p><b>Customer Perspective:</b> The initial customer associated with tap fees is usually a developer. Conservation-oriented tap fees result in lower connection charges for developers who commit to installing water efficient fixtures and waterwise landscaping during the construction process. This also results in lower water bills for eventual customers than they would have received with a less water efficient property. The actual cost savings to the customer are determined by the specific tap fee structure and water rate structure in place.</p>
<i>Water Savings Assumptions</i>	
<p>Water savings from conservation-oriented connection fees are determined by comparing the actual water use of a property versus the hypothetical volume that would have been used if water efficiency measures and/or waterwise landscape had not been installed. Buildings with water efficient fixtures, appliances, and waterwise landscaping can use 30% - 45% less water (Chesnutt, et al., 2018; DeOreo W. , Mayer, Dziegielewski, &amp; Kiefer, 2016; Mayer P. , DeOreo, Towler, &amp; Lewis, 2003).</p>	

# Conservation-Oriented Water Rate Structure

## What is a Conservation-Oriented Rate Structure?

In a conservation-oriented rate structure, the cost of water increases as the level of use increases to send a price signal and promote water conservation. Almost all water providers in Colorado have implemented the best practice of having a conservation-oriented rate structure.

Some water providers have implemented water budget-based rates, which is a more complex form of water conservation-oriented rates, including:

- Boulder
- Greeley
- Castle Rock
- Centennial Water and Sanitation District

How a water provider bills its customers for water affects revenue and demand. The rate structure impacts both the water provider and customer directly. Revenues to the water provider are determined via the rate structure as are fees paid by all customers (Colorado WaterWise and Aquacraft, Inc., 2010). **Rate structures and water bills** are both key for sending conservation signals and communicating with customers.

Specifically, conservation-oriented rate structures serve two fundamental purposes:

- Theoretically, conservation-oriented rates can link excess water use to the cost for new supplies which provides a **strong price signal to the customer** and, in turn, **can promote water conservation**.
- Practically, conservation rates allow the water provider to **maintain revenue stability even as they encourage conservation** by recovering capital costs from heavy users.

Almost all water providers in Colorado have implemented the best practice of having a conservation-oriented rate structure including Aspen, Aurora, Boulder, Castle Rock, Centennial, Colorado Springs, Denver Water, Durango, Fort Collins Utilities, Glenwood Springs, Grand Junction, Greeley, Longmont, Pueblo, and many others.

Equally as important as the rate structure are **how** customers are billed. How a water provider bills its customers for water impacts revenue and demand.

Additionally, regular water bills are the most direct way in which water providers communicate with customers. **Monthly billing is a best practice** in Colorado and beyond, and customers should have easy access to view their bills, water use, and more.

## Regulatory Requirements

Colorado Revised Statutes (C.R.S.) establish the legal options available to local governments and other community organizations to allow them to raise revenues for funding improvements to water systems through rates (DOLA, 2023).

C.R.S. require that all covered entities (water providers that deliver more than 2,000 acre-feet per year) file a water efficiency plan with the Colorado Water Conservation Board (CWCB). Entities that do not have an approved plan on file are not eligible to receive grant funding from the State. The statute defines several measures and programs that must be considered for inclusion in a conservation plan. One of these measures is, “Water rate structures and billing systems designed to encourage water use efficiency in a fiscally responsible manner” [C.R.S. §37-60-126 (4)(a)(VII)]. The statute goes on to state, “The department of local affairs may provide technical assistance to covered entities that are local governments to implement water billing systems that show customer water usage and that implement tiered billing systems.”

Finally, C.R.S. require **all water systems with at least 600 taps must install meters** (Colorado Revised Statutes, 1997; C.R.S. §37-97-103). A metered system makes it easier to bill customers for their demand on the system.





## Key Concepts

Water rates are a tool that water providers use to achieve multiple fundamental objectives, including:

- **Revenue generation:** to generate sufficient revenue to pay prudent costs.
- **Fiscal sustainability:** to support sustainable water service delivery.
- **Resource efficiency:** to avoid consumptive or productive waste.
- **Affordability and equity:** to ensure access to clean, reliable drinking water to all customers.

Revenue generation and fiscal sustainability are a water provider's primary and most straightforward objectives. Water providers must recover the costs incurred to provide reliable water, pay for operations, and fund needed system improvements. Rate structures should be designed to cover these costs and provide sufficient annual revenue at a level determined by the water provider.

In addition to these two fundamental objectives, water rates are also a powerful tool to help ensure the efficient use of finite water resources. Prices that reflect costs help ensure prudent use of resources. Rates should signal the additional costs of extra production, treatment, and delivery, thus providing the basis for matching consumptive decisions with production costs. In addition, water providers should incorporate affordability considerations to ensure an equitable rate structure design.

Setting rates for a water provider or sewer utility should be a process of allocating expenses (operations, maintenance, debt service, repair/replacement, capital improvements, etc.) to customer classes (residential, commercial, industrial, etc.). In this process, it is often helpful to separate recurring and/or predictable fixed costs, from variable costs that may result from annual usage variations, unexpected repairs, etc. (Woodcock, Giardina, & Cristiano, 2017).

Done successfully, **water conservation-oriented rate structures can help water providers achieve all these objectives.** There are however a variety of approaches and considerations to conservation-oriented rates.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Types of conservation-oriented rates structures
- Selecting and designing a conservation rate structure
- Affordability and equity considerations

## Types of Conservation-oriented Rate Structures

Traditional ratemaking for water providers involves three discrete, logical steps:

- Step 1: Identify costs and water agency revenue requirements.
- Step 2: Allocate costs to types of water usage.
- Step 3: Design rates for each type of water usage to recover costs from customers (Beecher & Mann, 1991; Raftelis, 2005; Mayer P., DeOreo, Chesnutt, & Summers).

Steps 1 and 2 combined accounts for the cost of service analysis portion of the rate process and will not be discussed further in this Best practice. Step 3 is where the rate structure is selected, and the actual rates and charges set. There are three primary varieties of conservation-oriented rate structure:

- **Increasing block rates:** With increasing block rates, higher prices are charged as consumption increases as shown in Figure 1. Block sizes are fixed for each customer class. For example, a residential customer might pay \$3.00 per 1,000 gallons (kgal) for the first 5 kgal each month, \$5.50 per kgal for any usage between 5 and 15 kgal, and \$8 per kgal for any usage above 15 kgal. Colorado water providers implementing increasing block rates include Denver Water, Fort Collins Utilities, Colorado Springs Utilities, City of Glenwood Springs, City of Grand Junction, City of Pueblo, and many others. This is the most popular rate structure form in Colorado.

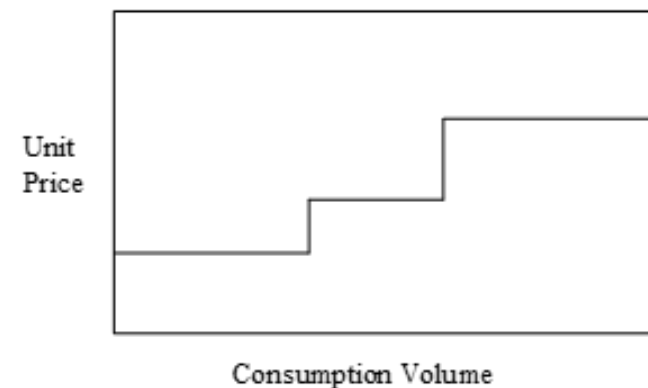


Figure 1. Increasing block rate structure

- **Water budget-based, individualized rates:** Water budget-based rates (sometimes called individualized rates) are a variation of increasing block rates where the block size is defined by an empirical determination of efficient use for each customer using customer specific characteristics such as irrigable area, lot size, home size, estimated household use, and sometimes landscape type (Figure 2). Colorado water providers implementing water budget-based rates include Centennial Water and Sanitation District, Town of Castle Rock, City of Greeley, and City of Boulder.

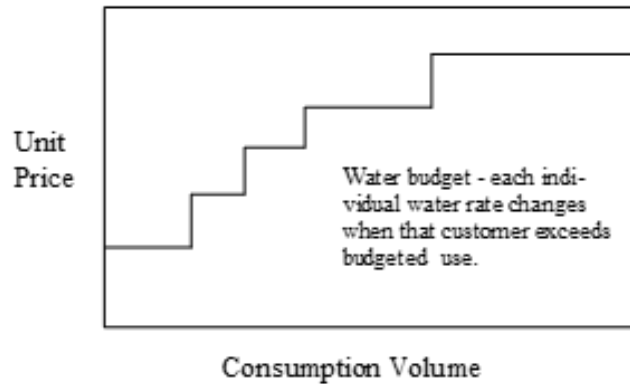


Figure 2. Water budget-based, individual rates

- **Seasonal rates:** With seasonal rates, higher prices are charged during periods of scarcity (typically summer and fall to more efficiently allocate water in times of shortage and to encourage reduced demand) as shown in Figure 3. Denver Water, Town of Castle Rock, Colorado Springs, Fort Collins Utilities, City of Monte Vista, and Durango are examples of water providers that have incorporated some element of seasonal rates into their increasing block rate structures.



Figure 3. Seasonal rate structure

### Alliance for Water Efficiency: Adopting an Efficiency-Oriented Rate Structure

The [Alliance for Water Efficiency's Financing Sustainable Water initiative](#) developed useful guidance for water utilities considering a new rate structure (Alliance for Water Efficiency, 2014). Key recommendations include:

- **Embrace uncertainty:** Analysis of rate design must represent the future as a set of possibilities rather than a single line and should decision makers about probabilities and consequences of risk.
- **Understand efficiency objectives at the outset:** Be clear about water provider objectives when designing and communicating rates, explain who is impacted and how, and make a clear distinction between the long-term and the short-term impacts.
- **Customers must understand:** The success of efficiency-oriented rates relies on incentives and a customer's ability to make changes in usage. Rate design must be focused on giving customers enough control to make decisions that benefit them while simultaneously achieving water provider objectives. Monthly billing provides signals to customers in a time frame that allows them to make changes in consumption patterns quickly.
- **Rate structures are unique:** A single rate structure may not work for all water providers or even all classes of service. A high uniform rate may provide the same desired price signal as an increasing tiered rate that varies across customer classes. It is important to consider a variety of factors when selecting a rate structure, including priority objectives, service area characteristics, and customer values and demographics.
- **Consider affordability:** Rate design should include an in-depth evaluation of affordability. AWE's Sales Forecasting and Rate model provides a Affordability index to help water provider's understand the impacts of rates on certain customer segments.

# Case Study

## INCREASING BLOCK RATE STRUCTURE | GLENWOOD SPRINGS, CO

Glenwood Springs bills customers on a monthly basis using a three-tier increasing block rate structure. This rate structure has been in place since January 2000. The city's rate structure provides for 5,500 gallons of water use per month in Tier 1 and an additional 12,000 gallons of water per month in Tier 2. All monthly usage greater than 17,500 gallons is billed at the Tier 3 rate as shown in Table 2. Separate rate structures apply to bulk water purchases and raw water customers.

Table 2. Glenwood Springs treated water rates and rate structure, 2023

Rate Tier	2023 Water Rate
Tier 1 – up to 5,500 gallons/month	\$3.77 per 1,000 gallons
Tier 2 – from 5,501 – 17,500 gallons/month	\$5.01 per 1,000 gallons
Tier 3 – over 17,500 gallons/month	\$6.66 per 1,000 gallons
Fixed monthly service fee	\$21.92 per month

In this rate structure, Tier 2 represents a 33% increase over Tier 1 and Tier 3 represents a 33% increase over Tier 2. The rates themselves are set based on the cost-of-service requirements of the city.

The city utilizes a computerized billing system and the Badger Orion AMI system. This system enables frequent remote interrogation of water meters. The city takes advantage of this capability to help identify leaks and abnormal usage across the community. The AMI implementation and meter replacement project was completed over several years.



## Selecting and Designing a Rate Structure

Most of the literature on selecting and designing rates focuses on revenue requirements and cost of service evaluation. The following are important considerations related to water efficiency (Colorado WaterWise and Aquacraft, Inc., 2010).

- **Engage the public:** Typically, there is a structured public process where water provider customers, including citizens and businesses, can have direct input into the selection and development of the rate structure. All water providers should take into consideration key stakeholders and the public processes before making changes to any rate structure.
- **Billing software:** Water providers must consider billing system software and ensure it can accommodate any rate structure selected. While modern billing system software can accommodate most rate structure designs, sometimes a water provider's existing billing systems must be updated or changed all together depending on their functionality and age.
- **Size blocks appropriately:** Increasing block rate structures will not achieve desired conservation results if the blocks are not properly sized (i.e. if the blocks are too large). For residential customers, the **size of block 1 should be based on an efficient level of monthly (or bimonthly) indoor use.** Reasonable block sizes range from 3 to 8 kgal per month. The smaller the block size, the more potent the conservation price signal. The beauty of water-budget-based rates is that the blocks sizes are tailored to each customer in the system. When sizing blocks for an increasing block rate structure (without water budgets) it is more difficult to send a fair and effective conservation price signal for individual customers.
- **Make block price differential meaningful:** Many increasing block rate structures have very small differences in rate between each block. For example, a rate structure that charges \$3.20 per kgal in block 1 and \$3.45 per kgal in block 2 will not send much of a price signal to customers since the difference in rate is so small as to be trivial. A rate structure such as the one in this example is little improvement (from a conservation standpoint) over a uniform rate. Setting the block rates is a complicated process that, by necessity, must include a cost-of-service analysis, but it should be possible to **make the block price differentials significant enough to send a meaningful price signal to customers when their usage moves them into a higher rate block.** One measure of a meaningful price signal is a positive slope in the average price curve. The steeper the positive slope, the stronger the price signal. The average price curve should be examined for any rate structure under consideration.

With a water budget-based system, where blocks are sized based on customer-specific information, it is possible to employ more dramatic block price differentials in a more equitable manner since water use over the budgets is charged at marginal rates, or penalty rates for excess use, as specified in the water waste ordinance. Marginal rates are based on the cost of the most expensive water in the system, and penalty rates are fines for excess use, and are not linked to costs directly. Some water providers use revenue from high tiers to fund conservation programs efforts directed at the customers who use water in the high tiers. The issue of revenue stability must also be carefully considered when setting differential block prices.

- **High fixed service charges ensure water provider revenue, but are less equitable and weaken intended conservation effects:** Water providers that set a high fixed service charge each billing period will generally have a more stable revenue stream, however if more money is collected via fixed charges, **less can be collected via the variable rate – the most equitable method** of recovering costs while advancing affordability (Cooley, Shimabuku, & DeMyers, 2022). Additionally, **fixed service charges can offset the conservation incentives** of increasing rates (Michaelson, et. al. 1998).
- **Billing cycles and the ability to track water use influence customer rate response:** Customers should be provided regular information on how much water they use as well as some context for understanding the relative efficiency of their usage through comparisons with historic use and established benchmarks (what they could or should be using). **Monthly billing is a best practice in Colorado and beyond.** Providing customers easy access to their account and consumption information via regular billing, smart meters with remote readers, web portals, or home leak detection devices like will better encourage conservation behavior (WRA 2004). Monthly billing with understandable billing documents that clearly show the volume consumed and, if possible, comparisons with previous usage and usage by other similar customers is ideal.

### What are Fixed and Variable Fees?

Many water providers use a combination of a **fixed fee (base)** and a **variable fee (volume)** for their water rate structure. Fixed charges generally include the price the customer pays as a base charge to help cover costs for maintaining existing infrastructure and repaying loans and bonds used to build that infrastructure. More information can be found at: [www.epa.gov/watersense/understanding-your-water-bill#](http://www.epa.gov/watersense/understanding-your-water-bill#)

## Affordability and Equity Considerations

### Resources for Water Affordability

While not a focus of this best practice guidebook, there are a number of resources to support water providers in designing equitable rates, including resources from NRDC ([Water Affordability Advocacy Toolkit](#)) and AWWA ([What Constitutes Accurate Pricing of Water?](#)).

From a water conservation lens, programs that help customers reduce their water use, and in turn save money on their water bills, are essential. See the **Indoor Water Use** and **Outdoor Water Use** Best Practice Areas for additional information and equity considerations.

Water is fundamental to life and is an essential social and community benefit. Water efficiency helps keep the cost of water service as low as possible by limiting the amount of new water supply that must be acquired to meet demands. As the cost for water and wastewater services increases, ensuring the equitable provision and affordability of these services for all customers is an important consideration. Providers should consider both total revenue needs, and how that revenue is generated amongst ratepayers of different income levels.

In Colorado, most water providers associate conservation-oriented rates with a tiered, increasing block rate structure (Figure 1). Assuming rates are set appropriately, this an increasing block rate structure is considered to be the most equitable (Cooley, Shimabuku, & DeMyers, 2022). That said, **avoiding overreliance on fixed charges** may be a newer concept for Colorado water suppliers, however is something everyone should consider when implementing rate updates.

Even when taking these considerations into account, more equitable rate structures by themselves cannot ensure that rates are affordable for all low-income households. While not a focus in this *Best Practices Guidebook*, this is where lifeline rates and other forms of financial assistance may enter the picture. Additionally, a well-designed rate structure can help address affordability challenges by reducing the number of customers that require assistance from means-tested programs in the first place.



# Case Study


## CITY OF WESTMINSTER, CO

The City of Westminster has long been a leader in the utilization of volumetric and flow rate-based tap fee structures. In Westminster there are two components of the connection fee:

- Water resources fee
- Water infrastructure fee

The Water Infrastructure Fee is set to recover an equitable portion of the value of the city's infrastructure required to meet the demand of the new customer. Infrastructure tap fees are calculated based on fixture count and resulting meter size, which is the best determination of projected peak demand on the infrastructure system.

The Water Resources Fee is set to recover the value of the city's water supplies developed to meet the demand of the new customer. Water resources are calculated in terms of Service Commitments (SC). One SC is equal to 140,000 gallons of annual use. Multiples of service commitments are purchased based on a projected volume of use.



# Case Study

## WATER BUDGET-BASED AND SEASONAL RATE STRUCTURE | CASTLE ROCK, CO

In 2009, Castle Rock Water implemented a unique increasing block rate structure, with tiers based on an indoor and outdoor water budget. Tier 1 only encompasses indoor water use, at a relatively low rate to acknowledge the value of indoor water use as essential to life. The indoor water budget for each customer is based on the average winter monthly consumption (AWMC) use at the site (i.e. the average of monthly consumption between Nov. – Feb.). Tier 2 accommodates water use that exceeds 100% of expected indoor use and up to 100% of expected outdoor use. Water use in this range is charged at more than double the rate for Tier 1 water use, providing a clear signal of the importance of outdoor water conservation. The outdoor water budget is based on the landscape area at the property and adjusted if residents participate in Castle Rock’s turf replacement program. In addition, customers receive a flat monthly service charge based on the size of the meter (Table 4). The 2023 residential water rates for Castle Rock are shown in Table 3, the flat monthly service charge in Table 4 and the non-residential water rates are shown in Table 5.

Table 3. Town of Castle Rock residential water rates, 2023

Tier	Irrigation Season, 4/1 - 10/31 <i>Cost per 1,000 gallons</i>	Winter Season, 11/1 - 3/31
Tier 1 (Up to 100% of AMWC)	\$2.95	\$2.95
Tier 2 (>100% of AMWC and up to 100% of outdoor budget)	\$6.00	N/A
Tier 3 (Above AMWC + outdoor budget)	\$8.95	\$6.00
Surcharge > 40kgals	\$8.95	\$8.95

AMWC = average monthly winter consumption

Table 4. Town of Castle Rock water monthly service charges, 2023

Meter Size	Monthly Charge
5/8 x 3/4"	\$9.97
3/4"	\$9.97
1"	\$14.34
1.5"	\$19.63
2"	\$27.17
3"	\$43.66
4"	\$98.36
6"	\$153.89

Table 5. Town of Castle Rock non-residential water rates, 2023

Category and Block	Irrigation Season, 4/1 - 10/31 <i>Cost per 1,000 gallons</i>	Winter Season, 11/1 - 3/31
<b>Greenbelt (Irrigation)</b>		
Tier 1 (up to 100% of AWMC)	N/A	N/A
Tier 2 (up to 100% of outdoor budget)	\$8.21	N/A
Tier 3 (Above outdoor budget)	\$12.31	\$12.31
<b>Multi-Family (Indoor use only)</b>		
Tier 1 (Up to 100% of AMWC)	\$2.95	\$2.95
Tier 2 (Irrigation)	N/A	N/A
Tier 3 (Excess)	\$3.87	\$3.87
<b>Multi-Family with irrigation</b>		
Tier 1 (Up to 100% of AMWC)	\$2.95	\$2.95
Tier 2 (Irrigation)	\$5.09	N/A
Tier 3 (Excess)	\$7.61	\$5.09
<b>Commercial (Indoor use only)</b>		
Tier 1 (Up to 100% of AMWC)	\$2.95	\$2.95
Tier 2 (Irrigation)	N/A	N/A
Tier 3 (Excess)	\$4.12	\$4.12
<b>Commercial with irrigation</b>		
Tier 1 (Up to 100% of AMWC)	\$2.95	\$2.95
Tier 2 (Irrigation)	\$5.15	N/A
Tier 3 (Excess)	\$7.70	\$5.15

AMWC = average monthly winter consumption.

## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Water Provider Perspective:</b> Creating a conservation-oriented tap fee structure may require dollars in the form of a rate fee study. From a staffing perspective, once created, a conservation-oriented tap fee structure likely does not require an increase in staff resources, however it may require modifications or changes to billing systems which can be costly and significant to change.</p>	<p><b>Water Provider Perspective:</b> A well-designed conservation-oriented rate structure accomplishes several key societal goals: stable and sufficient revenue for the community water system; a fair and effective price signal that encourages conservation and ensures that those who use more water and thus place a higher cost burden on the system pay their fair share; a mechanism for providing useful feedback to customers about their water demand patterns.</p>
<p><b>Customer Perspective:</b> When a conservation-oriented rate structure is implemented, customers with lower water use will likely see their monthly bill decline, but high demand customers may experience a significant increase in water costs. This is exactly the intent of a conservation-oriented rate structure – to charge higher rates for higher use with the goal of incentivizing customers to adopt more water efficient behaviors and to install more efficient fixtures and appliances. Customer costs will, of course, vary depending upon the rate structure implemented and all the factors that go into determining the monthly bill for each specific customer.</p>	<p><b>Customer Perspective:</b> In a conservation-oriented rate structure, customers that use less water will have a lower water bill. This gives customers more control of their water bills and creates a signal if they are using more water.</p>
<b>Water Savings Assumptions</b>	
<p>Water savings from a change in rate structure can be measured by comparing demands before and after implementation of the rate structure. Ideally at least one full year of data after the rate structure has gone into effect should be obtained, but comparisons of monthly demands can be made. Corrections for differences in climate, population, and possible other factors should be considered.</p> <p>The rate structure directly impacts how much a customer pays each month for water and wastewater service and consequently may influence people to try and use less water in some circumstances. When customers use more water they pay more for the water they use. However, because the water bill only arrives once a month the linkage between higher consumption and rates is not always obvious. Additional information, such as comparisons with previous consumption, neighboring properties, or established benchmarks (what a customer could or should be using) provides useful context. Research has shown that customers frequently respond to comparisons which show their consumption to be different from their neighbors or the social norm (Beckwith, 2009). See the Measurement and Data Best Practice for additional information.</p>	

### What Elements and Costs are Associated with Implementing a New Rate Structure?

1. Cost of service study that often precedes implementation of a new rate structure.
2. Customer information and billing system – is new billing software and/or hardware required to implement the proposed rate structure? Can the current billing system be adapted to incorporate proposed changes?
3. Data requirements – is additional data required to establish the new rate structure? Water budget-based rate structures can have significant one-time data development costs, although many water providers have found the data necessary to establish water budgets is cheaply (or freely) available from already existing geographic information systems (GIS) coverage and/or county property tax assessor records.
4. Customer information – customers must be informed and educated about upcoming changes to water rates, charges, and rate structures. Water providers should budget staff time and money for the important task of informing customers about any changes to the rate structure.



# Resources

## General

- AWWA What Constitutes Accurate Pricing of Water: <https://www.awwa.org/Resources-Tools/Resource-Topics/Affordability>
- Colorado Rural Water Association: <http://www.crwa.net/>
- CWCB Water Supply Planning: <https://dnrweblink.state.co.us/cwcb/0/doc/201967/Electronic.aspx>
- Department of Local Affairs (DOLA): <https://cdola.colorado.gov/office-of-rental-assistance/contractor-resources/schedules>
- Environmental Finance Center Network: <https://efcnetwork.org/>
- Innovative Finance: An Overview of DC Water and Sewer Authority's Environmental Impact Bond: <https://dnrweblink.state.co.us/cwcb/0/doc/201960/Electronic.aspx>
- NRDC Water Affordability Advocacy Toolkit: <https://www.nrdc.org/resources/water-affordability-advocacy-toolkit>
- Rural Community Assistance Corporation: <https://www.rcac.org/>

## Tap or Connection Fees

- Alliance for Water Efficiency Review of Connection Fees and Service Charges by Meter Size: <https://www.iapmo.org/media/25939/awe-meter-size-connection-fee-research.pdf>
- Western Resource Advocates Guide to Designing Conservation-Oriented Water System Development Charges: [https://westernresourceadvocates.org/wp-content/uploads/2019/06/WRA-Guide-to-Conservation-Oriented-SDCs\\_web.pdf](https://westernresourceadvocates.org/wp-content/uploads/2019/06/WRA-Guide-to-Conservation-Oriented-SDCs_web.pdf)

## Conservation-Oriented Water Rate Structure

- Alliance for Water Efficiency Financing Sustainable Water: Rates, Revenue, Resources: <https://dnrweblink.state.co.us/cwcb/0/doc/201963/Electronic.aspx>
- Alliance for Water Efficiency Sales Forecasting and Rate Model: <https://dnrweblink.state.co.us/cwcb/0/doc/201957/Electronic.aspx>
- Econics Waterworth Financing Tool: <https://dnrweblink.state.co.us/cwcb/0/doc/201966/Electronic.aspx>
- EPA Understand Your Water Bill: <https://www.epa.gov/watersense/understanding-your-water-bill>
- Financing Sustainable Water Challenges in Rate Design: <https://dnrweblink.state.co.us/cwcb/0/doc/201958/Electronic.aspx>



# Measurement and Data



The cliché is true; we cannot manage what we do not measure and track. Collecting water use data, and using that data to make informed decisions, is a fundamental water conservation practice that supports system-wide water efficiency for water providers and customers. For instance, providers can use water meter data to analyze water use by customer type, set efficiency benchmarks, and prioritize outreach to high-use customers.

However, to make the greatest impact, water data must be collected, managed, and communicated in a way that is easily understood – both by the provider and the customer. The Measurement and Data Best Practice Area addresses data collection, maintenance, analysis, and sharing.

This best practice area summarizes the regulatory requirements, key concepts, and costs and benefits for the following best practices:

- **Metering** and measuring water use to inform decision-making.
- Establishing **water loss control** practices to ensure a water provider's distribution and billing system prevents unnecessary and, sometimes costly, water loss.
- Establishing **water budgets** to support water efficiency through water benchmarking.
- Leveraging **data and data management** to ensure residents and businesses have easy access to view and understand their water use through customer portals.

## State Water Efficiency Plan Requirements

Indoor: fixtures and appliances

Outdoor: waterwise landscapes, efficient irrigation

Non-residential: water efficient industrial and commercial processes

Water reuse systems: utility or building scale





✓ Water loss control



✓ Information and public education

✓ Conservation oriented rate structure and billing system

✓ Regulatory measures designed to encourage water conservation

## Major Benefits

Category	Definition
 <p><b>Water Savings</b></p>	<p>Compared to unmetered water use, metered water use can reduce average customer water use by 15-30% (Hanke &amp; Flack, 1968; Mayer, et al., 2004; Tanverakul &amp; Lee, 2015).</p> <p>A systematic approach to reducing non-revenue water loss can result in substantial system wide water savings. Water budgets inform water users about their overall efficiency and are a proven tool for reducing excessive use.</p>
 <p><b>Economic Cost Savings</b></p>	<p>Metering water use allows a water provider to more accurately measure and bill for water use and to recoup the actual cost of purchasing, treating, and providing water to customers.</p> <p>Reducing non-revenue water loss can result in substantial financial savings. Water budgets can help customers reduce excessive use and realize cost savings. Understand water use with data is essential to measuring and realizing financial savings.</p>
 <p><b>Education</b></p>	<p>Metering water use and communicating water use through customer portals allows water providers to educate customers on their water use to help them take action to reduce use.</p> <p>An annual non-revenue water audit is a useful educational tool for the utility itself to help understand demand and system losses. Water budgets are a powerful education tool to inform water users if their use is efficient or not.</p>
 <p><b>Community/ Social</b></p>	<p>Metering ensures that all customers are responsible for the water they use, providing equity and accountability.</p> <p>Water loss control provides stewardship and accountability in provider operations and sets a positive example for customers. Water budgets help assure that the right amount of water is allocated and used based on legitimate need. Collecting and maintaining and communicating data for understanding and managing water demand is an important community benefit.</p>

 <p><b>Environmental</b></p>	<p>Water savings associated with metering, the reduction of non-revenue water loss, and the use of water budgets increases water availability for other beneficial uses.</p>
 <p><b>Climate</b></p>	<p>Water savings associated with metering, the reduction of non-revenue water loss, and the use of water budgets may decrease treatment needs, decreasing the amount of greenhouse gases emitted through water treatment or distribution.</p>

## Best Practice Area Key Takeaways

Key takeaways for each best practice include:

- **Metering**
  - **Water meters are fundamental to water provider function.** Metering is required under Colorado Revised Statutes 37-97-103 “Water Metering Act.”
  - **Measuring use and billing customers for what they use is fundamental to all water conservation efforts.** Meters enable billing and provide essential information on consumption.
  - **Meters must be regularly tested, maintained, and replaced.** A meter in the field should last 15 years and new electronic meters offer battery life that exceeds 10 years.
  - **Monthly meter reading is a best practice.** Bi-monthly or quarterly billing is not frequent enough to provide useful, actionable information to customers. Monthly meter reads, or advanced metering infrastructure, is necessary for customers to be able to track and understand their use.
- **Water Loss Control**
  - **AWWA’s M36 method is the best practice.** The American Water Works Association water loss methodology (detailed in the M36 manual) is considered the industry standard. The annual water audit is completed using a free Excel spreadsheet developed by industry experts and available here: [www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control/Free-Water-Audit-Software](http://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control/Free-Water-Audit-Software).
  - **The Colorado Water Loss Initiative offers training and support in water loss control.** Funded by the CWCB, this program provides comprehensive training and technical assistance for urban water systems across Colorado. More information can be found here: [www.coloradowaterloss.org/](http://www.coloradowaterloss.org/).

- **An annual water audit is mandatory.** Auditing a water distribution system for real and apparent losses and evaluating the costs of those losses are the foundation of water loss control. Starting in 2024, all covered entities in Colorado must annually submit a completed M36 water audit to the CWCB. Every water provider should conduct an annual water audit and some water providers implement the audit process even more frequently.
- **Water audit validation should be a goal.** Validation refers to the process of examining water loss audit inputs to consider the water audit's accuracy and document the sources of uncertainty. Level 1 Validation seeks to:
  - Confirm the accurate application of M36 water audit methodology and terminology to the specific situation of the water supplier.
  - Identify evident inaccuracies and correct inaccuracies.
  - Verify the consistent selection of correct data validity grades.
- **Water Budgets**
  - **Water budgets are a powerful information and management tool.** Water providers use water budgets as a way of informing water users about the efficiency of their water use. In Colorado, water budgets are frequently linked with an inclining block rate to create a customized rate structure that strongly incentivizes efficient use.
  - **Water budgets are a powerful drought enforcement tool.** The water budget can inform all customers on a regular basis of the required use reductions. The water budget associated with a monthly bill can show each customer how much water they are allocated during a drought response.
  - **Residential indoor water budgets can be calculated using three factors:**
    - The number of people in the household
    - The average amount of water an efficient person uses daily (usually 40– 50 gallons per capita per day)
    - The number of days in the billing cycle
  - **Landscape water budgets can be calculated using two factors:**
    - The landscape size or irrigable area (usually in square feet)
    - The water requirement of the plants in that landscape which is often represented by the evapotranspiration (ET) rate
- **Options are available for estimating landscape or irrigable area:**
  - Tax assessor records of lot size, building area, and permeable area
  - Pervious and impervious area measurements from storm water programs
  - Geospatial analysis
  - Physical measurements and sampling
- **Data and Data Management**
  - **Water demand, water use data, and associated customer information data are essential.** Providing customers with access to information on their water use empowers them to make rational decisions about water management and efficiency.
  - **Data enables water providers to target conservation programming.** Targeting water conservation initiatives at the customers who have the greatest savings potential ensures water providers maximize impact.
  - **Essential water use data include:**
    - Production and delivery – entire system
    - Monthly consumption – by customer and customer category
    - Water budget vs. actual consumption
    - Efficiency program and participation
  - **Classifying non-residential customers is valuable.** To understand the diversity and complexity of non-residential water use, it is necessary to classify and categorize these customers so that their water use can be understood and compared.
  - **Customer information portals can provide timely, actionable information.** Advanced metering with daily or hourly reads offers the potential of rapid leak detection and abnormal use alerts. To achieve this potential, water providers must obtain electronic contact information for their customers including mobile phone and email. Customer participation is essential to the success of a portal.

# Metering

The cliché is true, we cannot manage what we do not measure. **Measuring use and billing customers for what they use is fundamental to all water conservation efforts.** Numerous studies have documented the conserving impacts of metering (Hanke & Flack, 1968; Mayer, et al., 2004; Tanverakul & Lee, 2015).

Meters enable water providers to bill customers based on their actual consumption and provide customers with direct feedback on their water use. Customers who pay for the metered volume of water also consume less water. Likewise, submetering also provides valuable information for customers about their water use. Smart meters, which report data at daily or even hourly intervals, can help detect leaks and enhance customer's ability to manage their water use.

## Regulatory Requirements

Under the Water Metering Act, Colorado Revised Statutes (C.R.S.) require all water systems with at least 600 taps to install meters (Colorado Revised Statutes, 1997; C.R.S. §37-97-103). The Water Metering Act includes the following key provisions:

- “Every water service supplier providing water in this state shall provide a metered water delivery and billing service to its customers.”
- “Billing of such water services based on the metered service shall begin no later than ninety days from the date of the installation of the meter.”

## Key Concepts

Universal metering is implemented by water providers and water planning agencies by requiring installation of a water meter on the service line(s) of every water customer to measure all water use on the site. It is a fundamental best practice that supports all water conservation activities. While metering is universally accepted as a best practice, there are nuances to metering that take into consideration how often meters are tested and replaced, how meters are read, and when to separate meters via code.

To support implementation of this best practice, the following Key Concept is addressed in the section below:

- Implementation of Metering

## Implementation of Metering

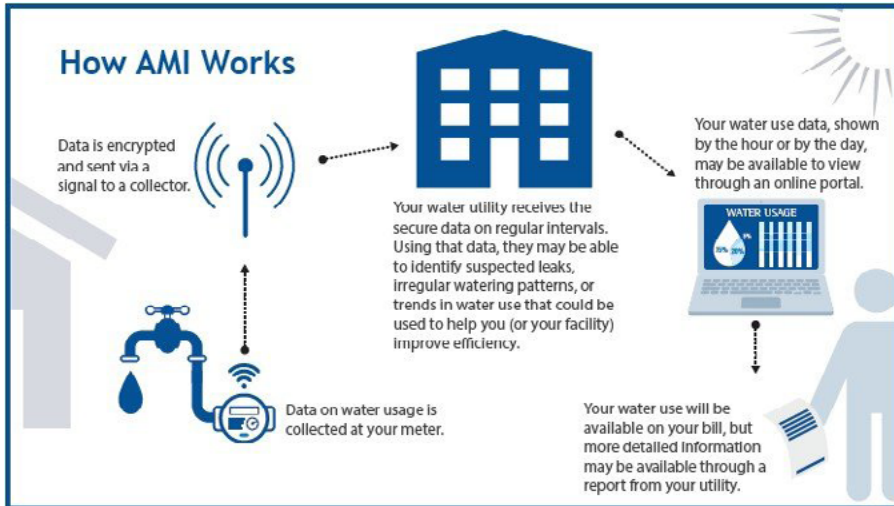
Selecting, installing, testing, and maintaining water meters is standard water provider practice that has been implemented in some form since the earliest days of public water supply in Egypt, China, Babylon, and Rome. Those seeking to learn more about the specifics of meters and metering should refer to the [AWWA Manual of Water Supply Practice M6 – Water Meters – Selection, Installation, Testing and Maintenance](#) (AWWA, 2012).

Water meters are read and maintained on a regular schedule by the water provider to ensure accuracy. Meters are read in one of two ways: by people or by machine.

- People read:
  - Manually by a meter reader.
  - Manually by a touch pad or tick.
  - Mobile or drive-by automatic meter reading (AMR).
- Machine read:
  - Advanced Metering Infrastructure (AMI) with fixed network communications operated by the water provider or using cellular, wifi or another existing network.

How meters are read has varying staff and cost implications. **Automated Meter Reading (AMR)** allows water providers to read meters simply by walking or driving by, eliminating the need for staff to individually read every meter. Unlike AMR, **Advanced Meter Infrastructure (AMI)** does not require any staff to read and, as a result, can provide more real-time and granular data. **This can support water conservation in a variety of ways by providing better insight into customers' water use, allowing for leak detection, streamlining billing,** and more (see Indoor Water Use for more information).





Source: (EPA, 2024)

### Indoor and Outdoor Metering

Separate meters (indoor and outdoor) are often required for large landscapes, multifamily, and commercial properties.

**This is considered a best practice because dual metering provides much more useful information than a single master meter.**

Metering landscape water use separately allows for a clear understanding of the efficiency of water use on the landscape.

No matter how meters are read, **meters must be regularly tested, maintained, and replaced.** Sometimes meters fail and stop registering, even as water is still passing through. A meter in the field should last 15 years and new electronic meters offer battery life that exceeds 10 years. Older mechanical meters tend to lose accuracy. For most meter types, underreporting (particularly at low flows) is more common than over-reporting. While this can benefit the customer, it does pose a risk to the water provider who could under collect needed revenue and highlights the importance of having a meter replacement program and Water Loss Control.



## Costs, Benefits, and Water Savings

### Costs

**Water Provider Perspective:** Meters are part of a water provider's infrastructure and costs for installing, maintaining, repairing, and replacing meters are usually part of annual budgets which are in turn funded through water sales to customers. Water meters themselves range in cost from under \$100 to thousands of dollars depending upon the size, type, and quality of the meter. Electronic meters are generally more expensive than mechanical meters. Fixed-infrastructure AMI requires more up-front investment. Additionally, from a staffing perspective, the type of meter also has different staffing implications depending on if meters must be read manually or not.

**Customer Perspective:** Meter purchase and installation costs are not directly billed to customers except in rare circumstances. Developers typically pay the meter costs as part of the tap/connection fee (see the Rates and Charges Best Practice Area for additional information). From the customer perspective, the most significant impact of metering is that they are accountable to pay for the measured amount of water used. If a more expensive metering system is selected by the water utility, it is ultimately the customers who will pay for the difference through the water rates and fees.

### Benefits

**Water Provider Perspective:** Metering ensures that all customers are responsible for the water they use, providing equity and accountability. Numerous studies have documented the conserving impacts of metering. Meters enable water providers to bill customers based on their actual consumption and provide customers with direct feedback on their water use. Likewise, submetering also provides valuable information to customers about their water use. Smart meters, which report data at daily or even hourly intervals, can help detect leaks and enhance customer's ability to manage their water use.

Since all customers in Colorado who are part of a water provider with 600 connections or more are supposed to be metered, much of the initial water savings from metering has already been achieved. Additional water savings could be available through customer leak detection using AMI. There may also be potential savings from individually metering apartments and condo units, provided the installation costs do not outweigh the benefits for some water providers.

**Customer Perspective:** Metering provides customers with essential information about the amount of water used each billing period. This helps customers to make rational water use behavioral decisions and may encourage efficiency upgrades.

For many multi-family and commercial properties, water bills are paid by someone separate from the property itself such as an accountant or remote manager. The water bill contains essential information for understanding and managing water use and water costs. Without a bill or a way to access consumption data, the people who use water on the site are not provided with any information about their consumption patterns or the cost of that consumption.

This water use information gap is a situation that water providers and customers alike are seeking to overcome through water provider information portals and flow monitoring products like Flume that offer real-time information on water use.

### Water Savings Assumptions

Studies on the impacts of metering have found significant water savings for metered customers versus unmetered customers. Since metering in Colorado is required by statute, these savings may have been fully realized already. Typical water savings achieved through metering are in the range of 10 – 40% reduction in residential demand with more recent studies showing a 15% reduction (Cooley, Phurisamban, & Gleick, 2019; Hanke & Flack, 1968; Hanke S. , 1970; Flechas, 1980; Mayer, et al., 2004; Olmstead & Stavis, 2009; Porges, 1957; Tanverakul & Lee, 2015). Savings can only be realized if customer meters are read and billed regularly and appropriately. Separate metering and billing of irrigation accounts and multi-family apartments have also been shown to be an effective conservation measure resulting in measurable water savings.

# Water Loss Control

Water loss control is the practice of system auditing, loss tracking, infrastructure maintenance, leak detection and leak repair for water providers. Leak detection and repair are familiar water agency practices, but true water loss control is more pragmatic than simply finding and fixing leaks. **The American Water Works Association water loss methodology** (detailed in the M36 manual and described in this best practice) **is considered the industry standard and best practice** (Kunkel & Association, 2016).

Auditing a water distribution system for real and apparent losses and evaluating the costs of those losses is the foundation of water loss control. **Real losses** are actual physical losses of water due to leaks or other problems with the system. **Apparent losses** are due to meter inaccuracy, unauthorized consumption, and data handling errors. Cost and benefit considerations drive implementation actions in the recommended methodology, described in detail in the AWWA M36 Manual. Every water provider should conduct an annual water audit (this is the recommended frequency), however some water providers choose to implement the audit process more frequently.

## Regulatory Requirements

Colorado requires water loss reporting to the Colorado Water Conservation Board (CWCB) annually using the [AWWA M36 reporting methodology](#).

The Colorado Revised Statutes (C.R.S) requires that all covered entities (water providers that deliver more than 2,000 acre-feet per year) file a water efficiency plan with CWCB every seven years. Entities that do not have an approved plan on file are not eligible to receive grant funding from the State. The statute defines several measures and programs that must be considered for inclusion in a conservation plan. One of these measures is “Distribution system leak identification and repair” [C.R.S. §37-60-126 (4)(a)(V)].

In 2010, the Colorado General Assembly adopted [HB10-1051](#) which requires covered entities to report water use and conservation data on an annual basis, to be used for statewide water supply planning. Data from an annual water loss audit is now included as part of this reporting requirement. In August 2018, the CWCB launched the Colorado Water Loss Initiative, a comprehensive program using the American Water Works Association (AWWA) M36 water loss methodology for training and providing technical assistance for urban water systems across Colorado. This program is part of a strategic objective from the Colorado Water Plan – to support water management activities for all water providers.

The focus of the program has been on the AWWA M36 water audit, the free AWWA Water Audit Software, and associated water audit validation methods. The AWWA M36 water audit methodology is the industry-standard best practice in North America to support informed decision making for water loss control and revenue recovery. Cost-effective water loss management reduces cost and increases revenue, serving the water provider’s bottom line and the rate-payer alike.

Building on the momentum developed through the Colorado Water Loss Initiative, in November 2023, the Board of Directors of the CWCB voted to require annual water loss reporting in Colorado. Starting in June 2024, data reporting to the state under HB10-1051 was modified to require mandatory water loss reporting using the AWWA M36 water audit reporting methodology.

## Key Concepts

Water loss control covers all efforts for water providers to reduce water waste throughout their distribution system. When done successfully, water loss control provides stewardship and accountability in provider operations and sets a positive example for customers. Additionally, water loss control gives water providers the potential to conserve a significant volume of treated water by reducing real losses and to increase revenue by reducing apparent losses. **Water loss control is a cost-effective water conservation practice that should be implemented by all providers in Colorado.**

To support implementation of this best practice, the following Key Concept is addressed in the section below:

- Utility System Audit

### Fundamental Resources

Resources to support water provider system audits include:

- American Water Works Association (2016) Water Audits and Loss Control Program: Manual of Water Supply Practices (M36). Available for purchase from [www.awwa.org](http://www.awwa.org).
- Free Microsoft Excel-based water audit and loss control evaluation software developed by the AWWA Water Loss Control Committee. Free download available from [www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control/Free-Water-Audit-Software](http://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control/Free-Water-Audit-Software)
- Free support and resources from the Colorado Water Loss Initiative: [www.coloradowaterloss.org/](http://www.coloradowaterloss.org/)



## Utility System Audit

Water loss control programs are undertaken by utility staff and their designated contractors with little or no involvement from customers.

There are two fundamental steps when conducting a utility water system audit using the AWWA M36 methodology: (1) the water audit; and (2) The water balance.

The **water audit** typically traces the flow of water from the site of withdrawal or treatment, through the water distribution system, and into customer properties. The **water balance** summarizes the components and provides accountability, as all water placed into a distribution system should, in theory, equal all water taken out of the distribution system.

The combination of the system water audit and the water balance provide a variety of useful measures of utility water loss. Of particular interest to water agencies is the ability to quantify the costs of real and apparent water losses and to use this information to improve the bottom line. Traditional water loss accounting focused on the percentage of unaccounted water. Under the 2009 M36 methodology, the term “unaccounted water” is eliminated. Key water loss performance metrics include:

- Apparent losses per service connection per day
- Real losses per service connection per day
- Real losses per length of main per day
- Unavoidable real losses
- Non-revenue water as a percentage by volume of water supplied
- Non-revenue water as a percentage by cost of operating system
- Annual cost of apparent losses
- Annual cost of real losses

Table 6 shows the key components of the water balance and water loss accounting in the M36 methodology. The shaded area represents water losses. Developing a utility water audit using the M36 methodology involves developing measurements or estimates of all the values shown in Table 6. Water providers first implementing this methodology are encouraged to start with a desktop audit where existing data and estimates are used as inputs to the water balance. This process is called the “top-down” audit. The “bottom-up” approach involves replacing estimated values with actual measurements and generally takes planning and effort of several years for a utility to fully implement. Both the top-down and bottom-up approaches are made much easier with the free software which automatically performs the required water balance calculations.



Table 6: Water balance for water loss audit accounting from AWWA 2009

Water From Own Sources (corrected for known errors)	System Input Volume	Water Exported	Authorized Consumption	Billed Authorized Consumption	Billed Water Exported	Revenue Water	
		Water Supplied			Water Losses		Billed Metered Consumption
							Billed Unmetered Consumption
				Unbilled Authorized Consumption		Unbilled Metered Consumption	Non-revenue Water
		Real Losses		Apparent Losses	Unbilled Unmetered Consumption		
					Unauthorized Consumption		
Customer Metering Inaccuracies							
Water Imported					Systematic Data Handling Errors		
					Leakage on Transmission and Distribution Mains		
					Leakage and Overflows at Utility's Storage Tanks		
					Leakage on Service Connections Up to Point of Customer Metering		


Note: All data in volume for the period of reference, typically one year.

Essential implementation steps are detailed in Table 7. AWWA's water audits and loss control stresses information collection and data analyses. A key point in the audit process is valuing apparent losses at the prevailing retail rate. By valuing apparent losses this way, corrective actions become much more cost effective. As with any action, cost considerations are important. The AWWA water loss control audit places significant emphasis on assessing costs and benefits before setting water loss reduction targets. However, there are potential barriers to even beginning a water loss audit. Staff time and availability are probably the first barriers to confront. Data availability and limitations of data validity are also critical barriers during the initial phase of the audit process.

Apparent losses due to meter inaccuracies result in under collection of potential revenue and is inequitable in that some customers pay for less water than they actually use. The practice of right sizing meters in new accounts and in old accounts where use patterns have changed is as important as maintaining and replacing old meters. For instance, consider a site that was originally a restaurant but has been replaced by a retail shop. If equipped with a 2" meter when a 3/4" meter would suffice, there is a risk of underreporting consumption. Compound meters can be used on some multi-family residential accounts to ensure higher accuracy and full accounting during low consumption periods.

Table 7. Key water audit implementation steps

Water Audit Step	Brief Description
1. Collect distribution system information	Includes infrastructure, financial, and operational data. Most information should be readily available to a utility.
2. Measure water supplied to the distribution system	Identifies how much water enters the distribution system and where it originates.
3. Quantify billed authorized consumption	Identifies the amount of water delivered to customers that have accounts in the customer billing system.
4. Calculate non-revenue water	Identifies the amount of water remaining after billed authorized consumption is deducted.
5. Quantify unbilled authorized consumption	Includes unmetered fire hydrant use, flushing, street cleaning, etc.
6. Quantify water losses	Water losses are made up of apparent and real losses.
7. Quantify apparent losses	Comprised of customer meter inaccuracy, systematic data-handling errors, and unauthorized consumption.
8. Quantify real losses	In the "top-down" approach, this is calculated total water loss minus apparent losses. In "bottom-up" approach, physical measurements improve the measurement of real losses.
9. Assign costs of apparent and real losses	Apparent losses should be valued at the prevailing retail rate charged to customers. Real losses are typically valued the same as the variable production costs to treat and deliver water.
10. Calculate performance indicators	This task (along with many others) is done automatically through the free AWWA software.



# Case Study

## COLORADO WATER LOSS INITIATIVE | CWCB

The Colorado Water Conservation Board (CWCB) provides a comprehensive program of training and technical assistance for water providers across Colorado. This program is known as the [Colorado Water Loss Initiative \(CWLI\)](#) and supports a strategic objective from the Colorado Water Plan – to support water management activities for all water providers. The focus of the program is on the AWWA M36 water audit, the free AWWA Water Audit Software, and the basic audit validation methodology. The AWWA Water Audit Software is the industry standard tool for quantifying water loss and non-revenue water.

Phase 1 of the CWLI program took place from 2018 – 2020, introducing the American Water Works Association (AWWA) M36 methodology and the AWWA Free Water Audit Software.

Phase 2 of the CWLI is currently available to all water providers and offers water loss training and technical assistance at two different entry points. Phase 2 will continue through 2024.

**Learner Track:** Water providers that partially participated in Phase 1 or are brand new to the program enter a new learner track with the opportunity to move into the advanced program track.

**Advanced Track:** Water providers that fully completed Phase 1 may continue an advanced track with training and direct technical assistance. Technical assistance opportunities include supply input meter testing, billing data analysis and prorating, customer meter test design and result analysis, real loss component analysis, or leak detection.

The CWLI and the M36 methodology are for systems of all sizes, and small systems are encouraged to participate. Approximately 85% of the Phase 1 participants said they spent 40 hours or less throughout the two-year program on efforts outside of the CWLI workshops (e.g., data gathering, internal team meetings) and 93% said that their experience in the Phase 1 will drive them to continue using the AWWA M36 methodology and Free Water Audit Software annually moving forward.

## Costs, Benefits, and Water Savings

<i>Costs</i>	<i>Benefits</i>
<p><b>Water Provider Perspective:</b> Utility costs for water loss control vary. Initial implementation of the AWWA water loss audit methodology using the free software costs little more than staff time. Taking this step enables a utility to make sensible decisions about how best to allocate resources to water loss reduction. In some cases, the first steps may involve improving the data used to calibrate the water loss accounting.</p> <p>The financial accounting elements included as part of the AWWA water loss auditing tool provide powerful decision support tools for water providers. The software examines real and apparent losses and associated costs and water values. This analysis provides clear information on how real and apparent water losses impact a utility's bottom line. For example, apparent losses from underreporting meters are valued at the retail rate of water. Installing meters on unmetered accounts may represent a major water loss control activity that, in the long run, generates revenue for the utility.</p> <p>On the other hand, efforts to correct some types of loss will be expensive. For example, if a utility finds major infrastructural repairs are needed, costs can be quite large. In all cases, cost-effective analysis should guide decision making. The <a href="#">CWCB's Colorado Water Loss Initiative</a> offers grants and loans for implementation of water loss control programs and measures.</p>	<p><b>Water Provider Perspective:</b> Successfully done water loss control provides stewardship and accountability in provider operations and sets a positive example for customers. Additionally, water loss control gives water providers the potential to conserve significant volumes of treated water by reducing real losses and to increase revenue by reducing apparent losses.</p>
<p><b>Customer Perspective:</b> Utility customers do not have direct costs associated with water loss control. However, if large loss problems exist, customers will ultimately bear costs related to repair and replacement of infrastructure.</p>	<p><b>Customer Perspective:</b> While there are not direct benefits to customers, water loss control indirectly benefits customers through proper management of water provider systems.</p>

## Water Savings Assumptions

Water savings from water loss management programs depend entirely on the ongoing level of loss. It should be the goal of all water providers to limit real and apparent losses to economically efficient levels. Water losses vary significantly from system to system. Typically, systems with older pipes and/or higher pressure have greater real losses while systems with old, over-sized water meters and/or poor accounting practices have greater apparent losses. For many water providers in Colorado, implementing the [AWWA M36 water loss audit methodology](#) may reveal that greater financial benefits can be achieved from improved accuracy in metering than by repairing or replacing water mains.

**Estimating savings with AWWA M36 Water Loss Methodology:** Economic levels of real and apparent water loss can be determined by utilizing the free AWWA water audit software. Understanding the parameters that influence loss can help an agency better understand the potential cost and water savings from various water loss control measures. Water loss from leakage is highly dependent on system pressure, length of mains, number of connections, and location of customer meter on service lines as well as infrastructure material and age. **AWWA's 1996 benchmark of 10% unaccounted for water is no longer applicable and measuring only unaccounted water is no longer considered an industry standard approach (AWWA 1996, 2009, 2016). The industry standard is to implement the AWWA M36 water loss methodology with validation.**

### Water Audit Validation

*Water audit validation refers to the process of examining water loss audit inputs to consider the water audit's accuracy and document the sources of uncertainty. Level 1 Validation is a process of reviewing a water supplier's M36 water loss audit inputs.*

*Level 1 Validation seeks to:*

- *Confirm the accurate application of M36 water audit methodology and terminology to the specific situation of the water supplier.*
- *Identify evident inaccuracies and correct inaccuracies.*
- *Verify the consistent selection of correct data validity grades.*

The financial metrics incorporated into the AWWA M36 methodology and the free water audit software may prove to be the most valuable component for water agencies. Financial indicators are based on user-entered variable production costs and water retail costs. The software automatically calculates costs of real and apparent losses. Using these results, agencies can make rational cost-benefit decisions on prioritizing water loss control. Many water providers who have implemented this methodology are surprised to learn that the cost of their apparent losses is more significant (financially) than the cost of their real losses. In Philadelphia, PA, for example, when a water audit was conducted the apparent losses were valued at \$34.5 million and the real losses at \$4.2 million (Kunkel & Association, 2016).

**Savings Assumptions and Caveats:** The free Excel-based software calculated values are accompanied by a clear explanation showing how each calculation was made (as opposed to having the calculations performed in hidden cells or macros). This show-your-work approach allows the user to quickly understand the methodology for computing given values.

The AWWA software provides a built-in assessment of the data used to calculate water loss. Because collecting valid data is an essential part of the water audit process, low data validation scores prioritize actions for improving data in water loss control.

Depending on the corrective action water loss control, the lifespan of savings will vary. Water providers should understand that water loss control is an ongoing activity. Ideally, a system audit should be conducted annually.

**Goals and Benchmarks:** At this time there are no established state or national standards for water loss using the M36 methodology, but this is rapidly evolving as more and more validated audits are prepared. One goal for water providers should be to regularly have their water audit validated using the approaches described in the M36 manual. Additionally, local agencies have in-house goals and benchmarks for water loss and non-revenue water.

## Water Savings Assumptions Continued

Water loss control measures can be expensive and sometimes cost more than the value of the water being lost. The cost benefit analysis component of the water audit process can help guide agencies in setting reasonable water loss control goals.

In most cases a cost-benefit ratio greater than 1.0 is desired for implementation of a conservation measure.

Additional benefits of water loss control include:

- Reduced road repair by decreasing frequency of main breaks via pressure management.
- Improved utility water and cost accounting.
- Improved water meter testing and evaluation.
- Establishes the utility as a good actor and leader in the cause of water efficiency.

### Water Budgets Explained

*The City of Greeley defines a residential water budget as “the amount of water you need during any particular billing period, based on your family size, on the irrigable (area where plants can grow) square footage of your yard, and real-time weather conditions” (Water Budget).*

*In Greeley, the indoor portion of the water budget is 45 gallons per person per day. The outdoor proportion reflects moderate (as opposed to high) water use on lawns.*

[greeleygov.com/services/ws/water-budget](http://greeleygov.com/services/ws/water-budget)

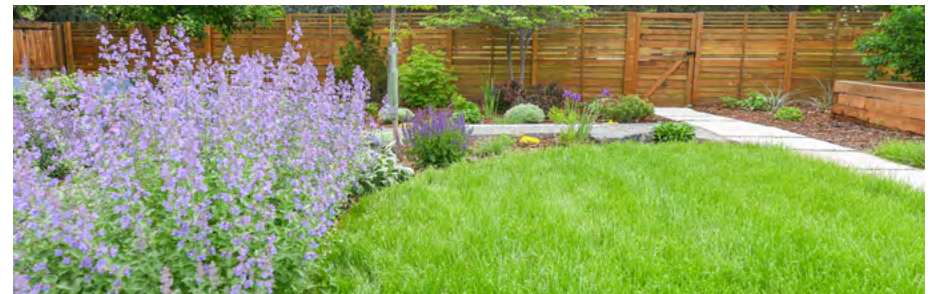
## Water Budgets

A water budget is the monthly or annual volume of water, based on efficient use, needed by a water customer based on the specific characteristics of the site and building. Water providers use **water budgets as a way of informing water users about the efficiency of their water use**. Water budgets can be used simply to inform without any connection to a water rate structure. In Colorado, water budgets are frequently linked with an inclining block rate to create a customized rate structure that strongly incentivizes efficient use (see the Rates and Fees Best Practice Area for additional information).

Water budgets are a powerful conservation tool for addressing residential indoor, non-residential indoor, and landscape water use and encouraging efficiency. A water budget can compare actual metered consumption against the legitimate water needs of the customer based on type of building, occupancy, landscape area, plant materials, climate conditions, and more.

Many water customers are unaware if they are using water efficiently or grossly over-using indoors or outdoors. A water budget provides a reasonable target level of water use that is customized for each customer. Water budgets help water users better understand their consumption patterns and make sound decisions about how to best manage water use, particularly outdoor irrigation. Water budgets provide water providers with a powerful tool for identifying which customers are using water efficiently and which are not and provide a way to directly program resources to those that could reduce most with efficiency improvements.

**Water budgets can be incorporated into a water provider’s rate structure** as has been done in Greeley, Castle Rock, Centennial Water and Sanitation District, and Boulder, but **they are also useful** in their own right outside of a rate structure **as a tool for assessing water use**. Informational water budgets are used by Denver Water, Aurora, Aspen, Colorado Springs, Durango, and many other Colorado providers.



## Regulatory Requirements

There are no specific requirements for water budgets in Colorado. Colorado Revised Statutes (C.R.S.) requires that all covered entities (water providers that deliver more than 2,000 acre-feet per year) file a water efficiency plan with the Colorado Water Conservation Board (CWCB). Entities that do not have an approved plan on file are not eligible to receive grant funding from the State. While not requiring a water budget, the statute defines several measures and programs that are related to water budgets. One of these measures is, "Low-water use landscapes... and efficient irrigation," [C.R.S. §37-60-126 (4) (a) (II)]. Another water conservation measure to be considered is "Water rate structures and billing systems designed to encourage water use efficiency in a fiscally responsible manner," [C.R.S. §37-60-126 (4) (a) (VII)].

## Key Concepts

Information is power. Water budgets provide essential information to help customers manage their water use by answering questions like:

- How much water was used?
- How much water was required?
- What is the efficiency of use at this site?

Water budgets can be created for residential and non-residential customers, as well as for landscapes. The complexity and approach vary depending on the customer type and information available. Additionally, how a water provider approaches creating water budgets will likely be different if they are used to inform a water provider rate structure or being used for educational purposes.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Indoor Water Budget – Residential
- Outdoor Water Budget – Non-residential
- Landscape Water Budget
- Other Water Budget Considerations

### US EPA Water Budget Tool

The US EPA has developed an online water budget tool and a water budget data finder to assist customers and water providers in the task of developing and understanding water budgets.

The WaterSense Water Budget Tool can be used to comply with [the WaterSense New Home Specification \(PDF\)](#) or to ensure a measure of efficiency and regional suitability for the amount of water applied to a landscape based on local climate data. While the tool is not a requirement under Version 2.0 of the Homes Specification, it may still be useful in helping to design water-efficient landscapes. [www.epa.gov/watersense/water-budget-tool](http://www.epa.gov/watersense/water-budget-tool)

The EPA developed the Water Budget Data Finder to help water professionals determine peak watering month and the appropriate evapotranspiration and rainfall values for a specific United States zip code. [www.epa.gov/watersense/water-budget-data-finder](http://www.epa.gov/watersense/water-budget-data-finder).

### Indoor Water Budget – Residential

For residential customers (single or multi-family) the indoor water budget can be set based on an efficient level of indoor use for an average customer **or** it can be customized based on the number of residents and/or days in the billing cycle.

A basic indoor residential water budget is calculated using three factors:

- The number of people in the household
- The average amount of water an efficient person uses daily, usually 40-50 gallons per capita per day (gpcd)
- The number of days in the billing cycle

For example, a family of 3 people using an average of 40 gpcd would use 3,600 gallons per month over 30 days (3 people\*40 gpcd\*30 days = 3,600 gallons per month). The same family using an average of 50 gpcd would use approximately 4,500 gallons per month (3 people\*50 gpcd\*30 days = 4,500 gallons per month).

Alternatively, water providers often set the indoor residential water budget at a fixed amount such as 5,000 gallons per month and then offer exceptions for large families and households.

More information on non-residential indoor water use can be found in the Indoor Water Use Best Practice Area.



### Indoor Water Budget – Non-Residential

Setting an indoor water budget for non-residential customers is challenging due to the wide variation in water use. Several basic approaches have been utilized by water providers:

- **Average historic use:** For existing non-residential customers, a typical approach to setting an indoor water budget is to use an average of past months. The advantage of this approach is that it is relatively simple to implement, and the budget is useful for identifying use that is outside of the historic range. The disadvantage of this approach is that it is not based on empirical efficiency and rewards historic inefficient use with a higher budget allocation. There is an additional challenge if indoor and outdoor use must be disaggregated. The City of Boulder uses historical average as one available method for setting non-residential water budgets.
- **Meter size:** Centennial Water and Sanitation District sets non-residential water budgets based on the meter size and an analysis of water use by meter size. The larger the meter, the larger the monthly water budget. This approach works well for new customers and for customers where little is known about the organization or business using water. This approach does not allow for differentiation based on type of customer or volume of water use.
- **Industry-standard methodology:** Some water providers, including the Eastern Municipal Utility District in southern California, based indoor water budgets for non-residential customers on industry-standard methodology, which considers factors such as the type of business, historical average use, and other factors. This approach may or may not really differ from the average historical use method, depending upon the implementation. A number of Colorado utilities including the City of Westminster, City of Greeley, and Fort Collins Utilities have collected data on non-residential customers to use for this purpose (see Table 18 in the Indoor Water Use Best Practice Area).

More information on non-residential indoor water use can be found in the Indoor Water Use Best Practice Area.

### Landscape Water Budget

The concept of a water budget originated in agriculture and the calculation of a landscape water budget is well understood and usually based on data and measurements. Developing landscape water budgets is a process that has been successfully accomplished by water providers both small and large. A landscape water budget is typically calculated from two fundamental parameters (Mayer P., DeOreo, Chesnutt, & Summers, 2008):

- The landscape size or irrigable area (usually in square feet).
- The water requirement of the plants in that landscape which is often represented by the evapotranspiration (ET) rate.

A simple landscape water budget can be calculated using the following equation:

$$\text{Water budget (gal)} = \text{Area (sq. ft.)} \times \text{ET (inches)} \times 0.0833 \text{ (ft/inch)} \times 7.48 \text{ (gal/cubic foot)},$$

or simplified to

$$\text{Water budget (gal)} = \text{Area (sq. ft.)} \times \text{ET (inches)} \times 0.623 \text{ (gal/inch/cubic foot)}$$

For example:

- Area (sq. ft.): 10,000
- ET (inches): 28 inches/year (full annual ET rate for turfgrass)
- Water Budget:  $(10,000 \text{ sq. ft.}) \times (28 \text{ inches}) \times (0.0833 \text{ ft/inch}) \times (7.48 \text{ gal/cubic foot}) = 174,463 \text{ gallons (174 kgals)}$

To determine a reasonable landscape water budget for the diverse landscapes served by a Colorado water provider, an ET adjustment factor of between 0.4 and 0.7 can be used. This factor simply reduces the overall allocation to between 40% and 70% of a full bluegrass allotment to account for plants with lower water demands.

Building on the previous example:

- Area (sq. ft.): 10,000
- ET (inches): 28 inches/year (full annual ET rate for turfgrass)
- ET Adjustment: 70% (waterwise landscape than only needs 70% of turfgrass rate)
- Water Budget:  $(10,000 \text{ sq. ft.}) \times (28 \text{ inches}) \times (0.70) \times (0.0833 \text{ ft/inch}) \times (7.48 \text{ gal/cubic foot}) = 122,124 \text{ gallons (122 kgals)}$

## Evapotranspiration (ET) and Data

Evapotranspiration (ET) is the water that is lost from soil via evaporation and plants via transpiration. The rate of ET is dependent on a variety of factors such as temperature, wind, solar radiation, soil moisture, and more. It is important for setting water budgets because it represents the volume of water lost by a plant, and therefore informs the amount of supplemental water that must be provided from irrigation.

While 28 inches/year is a good standard ET value for turfgrass, it will vary from year to year and location to location due to changes in the factors listed. To be more specific, there are a variety of approaches to calculate ET including the FAO Panman-Monteith or Blaney-Criddle method.

Alternatively, there are a couple of public sources that provide pre-calculated ET including the Colorado Agricultural Meteorological Network (CoAgMet, [coagmet.colostate.edu/](http://coagmet.colostate.edu/)) and Northern Water Conservancy District ([www.northernwater.org/our-data](http://www.northernwater.org/our-data)).

## Land Cover Data For the Front Range from DRCOG

Front range water providers may be able to utilize land cover data sets developed by the Denver Regional Council of Governments (DRCOG). A pilot land use land cover endeavor was undertaken by the DRCOG, the Babbitt Center for Land and Water Policy, and the Conservation Innovation Center in 2019. During this pilot, 1,000 square miles of the Denver region were classified at 1-meter resolution using high-resolution imagery acquired as part of the 2018 Denver Regional Aerial Photography Project. In March 2021, DRCOG received a Water Plan Grant from the Colorado Water Conservation Board, as well as contributions from nine local partners, to create a similar deliverable covering the entire 6,000 square mile region and using 2020 imagery. This project was completed in April of 2022.

For some water providers, developing individual measurements of the landscape area for each water customer is a challenge. For landscape water budgets, there are several available options:

- **Option 1 – Tax assessor records:** A cost-effective method for estimating the landscape or irrigable area at a site or a group of sites involves utilizing county property tax assessor records. These records typically provide information on lot size and, on occasion, include measurements of the building footprint. Establishing a connection between tax assessor records and water provider billing accounts can often be achieved using a parcel ID or a similar identifier, or through address matching. Tax assessor records typically only provide the total lot size area, so under this method estimated measurements of impermeable areas (roofs, pavements, etc.) must be made. Since tax assessor records often include information about the buildings at each site including number of floors, total square footage, and presence of a garage or other accessory buildings, these data can also be used to estimate impermeable areas.
- **Option 2 – Existing impervious area measurements from storm water programs:** Colorado water providers that have calculated pervious and impervious area as part of a storm water management program may already have the data necessary to establish basic landscape water budgets. Since landscape water budgets are based on the irrigable (or pervious) area at a site, the storm water data by itself or in concert with tax assessor records may be sufficient to make the necessary calculations. Water providers seeking a low-cost methodology for establishing landscape water budgets should consider this approach first as much of the work may already have been done on a site by site basis.
- **Option 3 – Geospatial analysis:** Landscape water budgets are often calculated using a water provider's geographical information system (GIS), aerial imagery, and data from local weather stations. High resolution GIS data (usually 12 inches or less) with linkage to the water provider billing database allows for the irrigated area of each customer to be determined with reasonable accuracy as shown in Figure 4. Many water providers have high-resolution aerial imagery available. Water providers can also reach out to partner with their land use authorities or local government agencies, who may have high-resolution aerial imagery for other purposes. The analysis does not need to be as detailed as shown in Figure 4 and could be limited to something as simple as permeable and non-permeable area.



Figure 4. Landscape area calculation using geospatial analysis of aerial imagery

- **Option 6 – Landscape plan:** As the State continues to focus on the connection between land use and water planning, more land use authorities are requiring water budgets as part of their landscape regulations. If a water provider’s land use authority requires details on hydrozone areas or plant water requirements, information can be leveraged to create water budgets and/or a land use authority can simply require a water budget as part of the landscape plan. These details and more are discussed in greater depth in the Development and Codes Best Practice Area.

**Communicating with Large Irrigators**

For large irrigators, an informational water budget is only effective when the information is shared by the part of the organization paying the bill as well as the landscape manager. For example, with a condominium’s homeowners association, the board, the property manager, and the landscape company all need feedback from the bill. Creating financial feedback for overwatering can prompt the parties responsible for finances to share information with on-the-ground landscapers.

- **Option 4 – Physical measurement:** Hiring a survey crew to physically measure the landscape area at selected sites and/or leverage data from irrigation assessment programs is also an option (see the Outdoor Water Use Best Practice Area for more information on irrigation assessment programs). This is a reasonable option for a small water provider or limited scale water budget program but may not be practical when seeking to develop water budgets for an entire service area.
- **Option 5 – Sampling:** Water providers with a reasonably homogeneous customer base can measure (via GIS or physical measurement) the irrigable area at a carefully selected sample of sites in the service area. This allows for a ratio between pervious and impervious areas to be established for each site in the sample. Once the range of areas is better understood, landscape area classifications can be created and each property in the service area can be placed into the appropriate category – usually based on tax assessed lot size. All sites within a category would have the same water budget each month. Centennial Water and Sanitation District in Douglas County used this method for establishing landscape water budgets for their budget-based rate structure. Based on the sampling effort, Centennial assumes 45% of the total lot size is irrigable.

### Other Water Budget Considerations

Apart from calculating water budgets, it is important to consider the **timeframe** for the budget, as well as if an **appeals process** based on if the water budgets are being tied to **a rate structure vs. informational purposes**.


- **Timeframe:** Water budgets can be set on an annual, quarterly, bimonthly, or monthly basis. To adjust landscape water budgets, the ET factor in the equation must correspond with the desired time period (e.g.,  $ET_{July}$  could be used to establish a water budget for the month of July). In Colorado, the irrigation season is usually only six or seven months long, so water landscape budget updates need only be provided for half the year – from April through October.

If connecting water to rate structure, the budget must be based on the water provider billing period. This may require adjusting ET rates to correspond with billing periods with differing start and end dates (a meter may be read on the 22<sup>nd</sup> of the month, for example). When implementing informational water budgets, different time periods can be considered; however, **monthly budgets provide regular feedback and are usually the best option**.

Monthly budgets provide an opportunity to make changes to irrigation schedules or system improvements to adapt to water budget allotments and then to learn if these changes have had the desired effect. Annual budgets are far less immediate and informational, unless tied to the rate structure, and are unlikely to stimulate efficiency improvements.

- **Appeals process:** If water budgets are used as the basis for billing and are linked to the water rate structure, then inaccuracies can hit end users in their pocketbook and an appeals process is required. As a result, **it is important to have an appeals process that allows the customer to submit information in support of a revised water budget**, typically enlarging the budget from what was established by the water provider. Since customers are usually more knowledgeable about their building and landscape than anyone else, reasonable appeals are usually accepted. If water budgets are used for informational purposes only, then an appeals process is likely unnecessary.





# Case Study

## ESTABLISHING INDOOR AND OUTDOOR WATER BUDGETS | GREELEY, CO

Leaders at the City of Greeley saw the severe drought of early 2000s as a wakeup call, which galvanized the community to improve water efficiency and management. Implementing a water budget-based rate structure was a key component of this effort and Greeley achieved this through a well thought-out, phased approach that informed and prepared the community.

In 2011, Greeley implemented a pilot program to provide an informational water budget (e.g., for information only and not tied to rates) to a small group of single-family residential customers. Greeley used on-bill graphics to show customers how they were performing compared to their water budget, and encouraged users to remain within their budget. Even with no financial incentive to remain within budget, the campaign proved successful. In 2013, the city provided informational water budgets to all single-family customers through their water bill.

To further incentivize single-family customers, Greeley took the next step, connecting the water budget to their rate structure. Under this new rate structure, customers are charged a higher rate for using water in exceedance of their budget. In 2016, Greeley began marketing and education on the new water budget-based rates and in 2017 the water budget-based rate structure went live. Then in 2020, Greeley evaluated the budgets and rates and adjusted them to make the budget more reflective of use.

### Indoor Budget

The Greeley single-family residential indoor water budget is based on the number of people in each household, with a default of three people. Households with more than three people can update their information and water budget on the city's website. Each household is allocated 45 gallons per person per day. Under Greeley's system, the minimum monthly indoor water budget is 4,050 gallons (3 people x 45 gpcd x 30 days).

### Outdoor Budget

The Greeley single-family outdoor water budget is based on:

- Real-time Greeley weather.
- Measured total irrigable area which is defined as the total area that could be landscaped, including any rights-of-way the customer is responsible for maintaining. It does not include the roof of the house, patios, driveways, or other hardscapes. Greeley allows customers to verify and update irrigable area with an online water budget map.

Customers are provided outdoor water budgets beginning April 15 and ending on October 31. The budget is adjusted each month to increase when the weather is hot and dry and decrease when the weather is cool and wet.

## Costs, Benefits, and Water Savings

### Costs

**Water Provider Perspective:** Water providers will face financial costs in the form of staff or contractor time needed to develop and implement water budgets. Billing systems may need to be upgraded to accommodate water budgets. Geographical information systems (GIS) can greatly enable establishment of water budgets on a system-wide scale, but GIS is not a requirement for creating landscape water budgets. Other less expensive methods have been used and water providers that have already calculated pervious and impervious areas as part of a stormwater management program can re-use that same information to establish landscape water budgets. Data-savvy water providers may find that they can create basic landscape water budgets using existing data which can reduce costs substantially. However, agencies that do not have existing data resources may need to make a more significant investment to establish accurate water budgets.

**Customer Perspective:** There are no direct customer costs associated with implementing water budgets, but customers do finance the programs through water bill payments as with all water provider functions and programs.

### Benefits

**Water Provider Perspective:** Water budgets have proven to be a useful tool for shortage response including responding to drought conditions. In times of shortages, water budgets allow a water provider to identify excess use quickly and easily and even penalize it if necessary. Water budgets establish an empirical and quantifiable limit to the amount of water that a customer is entitled to use at a given price from a given tap. Water budgets have the potential to protect the utility from overuse and to protect the customer from having their water allocated to other uses or micromanaged by the utility (Mayer P., DeOreo, Chesnutt, & Summers, 2008).

During a drought, water budgets have the potential to assist water providers in more fairly and effectively apportioning demand reductions among customers with different needs and among different customer classes since the reference point for reductions is based on the water required by each customer in normal times. Historically, when customers are asked to reduce their use from the previous year, justified complaints arise from customers who are already conserving, and don't have as much room for additional curtailments. Research on drought response from the Alliance for Water Efficiency found that water providers that combined their water budgets with a surcharge on excess use achieved the highest level of water savings (Alliance for Water Efficiency, 2020).

Another way that water budgets aid with drought plan implementation is in the enforcement of mandatory demand curtailment. A simple query can inform the water provider each billing period which customers have complied with drought restrictions and remained within budget, and which have not. If necessary, additional penalties and enforcement could be implemented. This is a highly reliable system. Unlike the "water cop" approach where customers are ticketed if they happen to be observed violating the drought restrictions or turned in by a neighbor, a water budget drought enforcement program automatically identifies every customer who is not complying, enabling fair and uniform enforcement. A water budget provides a regular and automatic check on which customers are in or out of compliance with drought response (Mayer P., DeOreo, Chesnutt, & Summers, 2008).

**Customer Perspective:** Water budgets are tailored to the customer, providing customers with more accurate signals if they are over or under using water that are based on their actual water use. Additionally, they allow water providers to administer water restrictions more equitably.

## Water Savings Assumptions

The savings achievable from water budgets are largely based on the level of excess use that occurred prior to implementation of the program. Customers who have historically over-irrigated or have inefficient fixtures have significant potential for savings, while those who are already efficient will have little potential to reduce.

Water budgets, particularly when linked with an increasing block rate structure, have led to significant reductions in water use in Colorado. After implementing budget-based rates, the Centennial Water and Sanitation District reported a 25% reduction in demand vs. their previous inclining block rate structure. This overall reduction can be tied to landscape reductions. Irvine Ranch Water District found that irrigation levels dropped substantially when landscape water budgets were used as part of the rate structure (Mayer P., DeOreo, Chesnutt, & Summers, 2008).

Water savings from water budgets cannot be assumed, but rather, should be measured and verified. Adjusting for differences in weather during the pre- and post-implementation period and accounting for other changes at the site not related to the water budget will yield more accurate results.

## Water Budgets During a Drought

Water budgets can help with drought plan enforcement and communication. The water budget can inform all customers on a regular basis of the required use reductions. The water budget associated with a monthly bill can show each customer how much water they are allocated during the drought. Drought allocations can be developed well before the drought occurs.

## Data and Data Management

To effectively manage customer water demand, water use data and associated customer information data are essential. Data, however, are only useful if **water providers have systems in place to store and manage water efficiency data and communicate usage data to customers through portals and applications.** Providing customers with access to information on their water use empowers them to make rational decisions about water management and efficiency.

Targeting water conservation initiatives at the customers who have the greatest potential to save (i.e., to the least efficient users in a customer class) can be the most effective way to guarantee water savings, but water providers often have precious little information about their customers, particularly in the diverse non-residential category (see the Indoor Water Use Best Practice Area for additional information on targeting).

**A best practice is to collect and maintain basic classification information on each customer** served by a water provider as it greatly enables targeting efforts and conservation program design. Coupling an understanding of who customers are with measured consumption (metered billing) provides powerful tools for water providers seeking to improve efficiency.

Important customer information also extends beyond categorization. **Accurate contact information, such as emails, is also critical customer information when communicating water savings suggestions** to high water users. Geographic information systems (GIS) are another important element of customer information that can aid in identifying inefficient water use.

## Regulatory Requirements

In 2010, the Colorado General Assembly adopted [HB10-1051](#) which requires covered entities (retail water providers who sell 2,000 acre feet or more of water annually) to report, water use and conservation data on an annual basis, to be used for statewide water supply planning. The bill directed the Colorado Water Conservation Board (CWCB) to adopt guidelines regarding the reporting of water use and conservation data by covered entities, and to report to the legislature regarding the success and progress of the guidelines.

**The CWCB has developed an [online portal](#) for reporting required data.**

**The deadline is June 30 for submission of the prior calendar year data.**

Data have been collected annually through this process for 10 years. These data were used to inform the Colorado Water Plan, but the complexity and detail required for reporting is prompting requests for changes to the HB10-51 data reporting in the coming years.

## Key Concepts

To be effective, water providers should take a comprehensive approach to data and data management that considers data storage and access, as well as how to leverage the data in analyses to support water conservation.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Customer Information Portals
- Demand Tracking

### **Customer Information Portals**

A customer portal is a web-based, customer-facing system that **enables water providers to interact with and serve their customers – while also empowering customers to serve themselves.** Customer portals for water providers give customers with a secure means to access and manage their account information, as well as payment and consumption data.

Timely consumption data, provided in context, can help water customers understand their water use and whether it is efficient or not. Advanced metering with daily or hourly reads offers the potential of rapid leak detection and abnormal use alerts (see Metering best practice). AWWA's 2022 guidebook for practitioners highlights the following as some of the top ways customer information portals can help promote water conservation (Akesson, Hahn, Kacha, Leavell, & Ong, 2022):

- **Improved water monitoring:** Not only do customer portals provide water providers with access to data, but they also empower customers to serve themselves. This can be especially helpful for water providers that do not have extensive resources to support water conservation.
- **Leak and high-water use alerts:** Most customer portals can automatically notify customers of high-water use and/or leak alerts, allowing customers to respond in near real time, save water, and avoid costly property damage.
- **Improved understanding of pricing tiers:** As water providers move to more complex and tiered water rates, customer portals create more transparency around water use and help customers more easily navigate rate structures without having to wait for a water bill.
- **Personalized communication:** Based on water use patterns, many customer information portals will customize recommendations for specific customers. This more tailored approach connects customers with the water conservation programs that are most applicable and impactful.
- **Entertaining way to save water:** Customer informational portals are often more interactive than traditional customer engagement, allowing users to click through graphs, informational videos, and more.
- **New customer touchpoint:** Customer portals are dynamic and allow water providers to try new educational strategies and communication techniques.

To achieve this potential, water providers must obtain electronic contact **information for their customers including mobile phone and email, as well as permission to use electronic contact information for communications.** Customer participation is essential to the success of a portal.



## Customer Information Portal Examples

The City of Westminster has implemented a portal with the provider Smart Energy Water ([www.sew.ai/](http://www.sew.ai/)). Westminster's portal offers residents and customers the ability to monitor water consumption and receive emergency leak alerts via email. They can also compare past water consumption, pay their water bill, and learn about water efficiency programs (Figure 5).

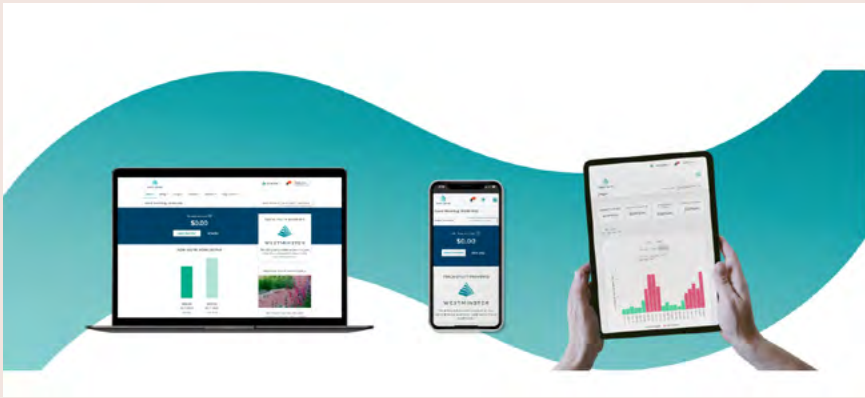


Figure 5. City of Westminster's Westy Water online customer portal

Other customer portal products that have been implemented in Colorado include:

- Badger's EyeOnWater® Consumer Engagement [www.badgermeter.com/products/analytics-software/eyeonwater-consumer-engagement/](http://www.badgermeter.com/products/analytics-software/eyeonwater-consumer-engagement/) (e.g., City of Greeley).
- Vertex One (formerly WaterSmart): [www.vertexone.net/](http://www.vertexone.net/) (e.g., Eagle River Water and Sanitation District and Fort Collins Utilities).

## Demand Tracking

### Alliance for Water Efficiency Water Conservation Tracking Tool

The Alliance for Water Efficiency Water Conservation Tracking Tool is an Excel-based spreadsheet tool for evaluating the water savings, costs, and benefits of urban water conservation programs and for projecting future water demands. In addition to providing users a standardized methodology for water savings and benefit-cost accounting, the tool includes a library of 50 pre-defined, fully parameterized conservation activities from which users can construct conservation programs. This resource is available free to all members of the Alliance. Learn more here: [www.allianceforwaterefficiency.org/resources/topic/water-conservation-tracking-tool](http://www.allianceforwaterefficiency.org/resources/topic/water-conservation-tracking-tool)

Water efficiency professionals must regularly track water demand to understand changes in use and to prepare water efficiency plan updates. Demand tracking can be as simple as a spreadsheet that is updated at least annually or could be part of a data information system or customer information system (see Customer Information Portals). Regardless of the delivery and complexity, understanding trends in water demand at the system level and at the customer class level improves water efficiency program outcomes.

**A declining trend in per capita water use is a strong indicator of the success of water conservation programs and policies across the board, but water use fluctuates from year to year and progress is often incremental.** Sometimes annual water use in a community changes because of weather or economic conditions that are completely outside of the influence of a water conservation program. It is therefore important to evaluate water use in the context of other factors like total annual precipitation or major events (e.g., water shortage or pandemics).

## Non-residential Customer Classification

While many water providers already have basic customer classification information that distinguish between residential and non-residential customers, many are missing more granular data to distinguish between commercial, industrial, and municipal water users. To understand the diversity and complexity of non-residential water use, it is necessary to classify and categorize these customers so that their water use can be understood and compared. More information on how to classify, and benchmark, non-residential customers can be found in the Targeting Users Best Practice.

Additionally, **the impact of water efficiency programs is much broader than demand reductions alone.** Water efficiency is an important water provider function and a demonstration to the community of the value of water. It is therefore important to also track participation metrics (e.g., number of customers who participate in programs) to quantify non-water saving benefits.

To understand water use and the impact of water efficiency measures over time, the following metrics are useful to track:

- **Total system production and demand** at a daily, monthly, and annual timestep
- **Peak demand** at a maximum hour, day, week, and monthly timestep
- **Use by customer category** split into the following categories:
  - Residential Users
    - Single-family
    - Indoor/non-seasonal
    - Outdoor/Seasonal
  - Multi-Family
    - Indoor/non-seasonal
    - Outdoor/seasonal
  - Non-Residential Users
    - All available categories (this may include irrigation only water users depending on the water provider's customer categories)
      - Indoor/non-seasonal
      - Outdoor/Seasonal

- **Non-Revenue water** at an annual or, as necessary, monthly time step (see Water Loss Control)
- **Weather data** including precipitation and average annual temperature
- **Efficiency program data** including:
  - Programs implemented.
  - Number of devices, rebates, participants, etc.
  - Water budget vs. actual data.
  - New policies or efficiency measures implemented.
  - Trends in gallons per capita per day broken out into total, residential, and non-residential categories.

## Growing Water Smart Metrics Guidebook: Measuring Progress Toward Integrating Water and Land Use Planning

Integrating water and land use planning is a top priority for the State of Colorado. Now a required component of all water efficiency plans, more and more water providers and communities are working together to think about land use planning and water efficiency together. However, as more entities explore this topic, what metrics or data can be leveraged to understand if efforts are successful? Published in 2020, The Sonoran Institute's Growing Water Smart Metrics Report outlines common metrics and data needed to answer this question. More information and the guidebook can be found at: [sonoraninstitute.org/resource/growing-water-smart-metrics-report](https://sonoraninstitute.org/resource/growing-water-smart-metrics-report).

## Costs, Benefits, and Water Savings

<i>Costs</i>	<i>Benefits</i>
<p><b>Water Provider Perspective:</b> Customer information portals are usually implemented with a “software as a service” contract from a provider. The cost is often based on the size of the water provider. As a result, implementing a customer portal is a recurring, high-cost, annual expense for a water provider. On the flip side, while demand tracking requires time, it is a low-cost activity that most water providers can implement on their own. Resources like the Alliance for Water Efficiency Tracking Tool are also available to help.</p>	<p><b>Water Provider Perspective:</b> A customer portal can serve multiple purposes across the organization. A customer portal with an alert system is a good way for water providers to communicate vital information about water use, billing, water quality, emergency outages, and other relevant issues directly with customers. Account level electronic communication with customers is increasingly seen as a core water provider function. Additionally, understanding trends in water demand at the system level and at the customer class level improves water efficiency program outcomes and long-term decision making and is a fundamental best practice for all water providers.</p>
<p><b>Customer Perspective:</b> There are no direct costs to the customer.</p>	<p><b>Customer Perspective:</b> A customer portal and with an alert system is a tremendous benefit to customers, offering them actionable, prompt information on water use and billing and connecting customers with their water provider. Without a portal, customers have limited ability to understand their water use and receive alerts about leaks and/or abnormal use. While demand tracking does not directly benefit customers, overtime it can help provide the best possible service to customers.</p>
<i>Water Savings Assumptions</i>	
<p>The customer categorization and information effort is not a water saver by itself, but represents a fundamental improvement in management that benefits a program over the long term. The ability to identify similar customers and to compare their water demands against each other and established benchmarks gives water providers with a powerful targeting tool for directing limited program resources to the customers who have the most potential to conserve. Water providers that have a better understanding of who their customers, and the nature of their water needs are better able to provide a high level of service. As water providers evolve and adapt to the inevitable changes and challenges of the future, customer level information helps meet the water needs of an ever-changing customer base.</p>	

# Resources

## General

- Alliance for Water Efficiency Tracking Tool: <https://www.allianceforwaterefficiency.org/resources/topic/water-conservation-tracking-tool>
- Sonoran Institute Growing Water Smart Metrics Report: <https://sonoraninstitute.org/resource/growing-water-smart-metrics-report/>
- Metering
- AWWA Manual of Water Supply Practice M6 Water Meters – Selection, Installation, Testing and Maintenance: <https://engage.awwa.org/PersonifyEbusiness/Bookstore/Product-Details/productId/28471>

## Water Loss Control

- AWWA Free Water Audit Software: <https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control/Free-Water-Audit-Software>
- AWWA Water Audits and Loss Control Program: Manual of Water Supply Practices (M36): <https://engage.awwa.org/PersonifyEbusiness/>
- Colorado Water Loss Initiative: <https://www.coloradowaterloss.org/>
- Water Research Foundation Level 1 Water Audit Validation: <https://www.waterrf.org/research/projects/level-1-water-audit-validation>

## Water Budgets

- City of Greeley Water Budgets: <https://greeleygov.com/services/ws/water-budget>
- Colorado Agricultural Meteorological Network ET Calculator: <https://coagmet.colostate.edu/>
- Northern Water Conservancy District ET Calculator: <https://www.northernwater.org/our-data>
- US EPA Water Budget Data Finder: <https://www.epa.gov/watersense/water-budget-data-finder>
- US EPA Water Budget Tool: <https://www.epa.gov/watersense/water-budget-tool>
- US EPA WaterSense New Home Specification: <https://www.epa.gov/sites/production/files/2017-01/documents/ws-homes-spec.pdf>

## Data and Data Management

- Badger Meter EyeOnWater® Consumer Engagement: <https://www.badgermeter.com/products/analytics-software/eyeonwater-consumer-engagement/>
- Smart Energy Water Customer Experience Platforms: <https://www.sew.ai/>
- Vertex One Customer Software Solutions: <https://www.vertexone.net/>



# Development and Codes



Ensuring all new buildings and landscapes are water efficient when they join the water system, and that water efficiency is automatically incorporated into redevelopment, are fundamental conservation opportunities. Codes and regulations play an important role in determining the water efficiency of new development and redevelopment. In many communities, codes and regulations are established and enforced by an entity separate from the water provider (e.g., municipality, county government, etc.). The Development and Codes Best Practice Area is intended to provide water providers with information to effectively understand and interact with community codes, regulations, and processes related to land use and community development. To the extent possible, it is a best practice for water providers to collaborate with land use planners when the land use entity is undertaking a code revision process that could significantly reduce water demand in new and/or redevelopment.

This best practice area summarizes the regulatory requirements, key concepts, and costs and benefits for the following best practices:

- Understanding how **development regulations**, such as zoning, subdivision, and landscape ordinances, shape water use and conservation at the site, neighborhood, and community levels.
- Understanding how **building regulations**, including building and plumbing codes, impact indoor water use and conservation.
- Understanding how **other codes and ordinances**, such as water conservation ordinances, nuisance ordinances, and homeowners' association (HOA) codes and covenants, regulate the use of water and water conservation and efficiency practices.







## Colorado Growing Water Smart Guidebook

Growing Water Smart, a program of the Sonoran Institute and the Babbitt Center for Land and Water Policy, produced the [Colorado Growing Water Smart Guidebook](#). The guidebook “provides resources related to collaborative and holistic water resource management and land use planning so that communities can shift their focus from supply-to demand-side management, from growth to an emphasis on holistic watershed health, and from siloed governance to an integrated water and land use planning paradigm” (Sonoran Institute and Babbitt Center for Land and Water Policy, 2023).

## State Water Efficiency Plan Requirements

	Indoor: fixtures and appliances
✓	Outdoor: waterwise landscapes, efficient irrigation
	Non-residential: water efficient industrial and commercial processes
	Water reuse systems: utility or building scale
	Water loss control
	Information and public education
	Conservation oriented rate structure and billing system
✓	Regulatory measures designed to encourage water conservation

## Major Benefits

Category	Definition
 <b>Water Savings</b>	Lot sizes, landscape standards, and other development and construction regulations influence how much water is needed, and therefore how much is ultimately used or conserved.
 <b>Economic Cost Savings</b>	<p>Developers can save money on tap fees and water supply requirements by incorporating water efficiency and conservation practices early in the development process.</p> <p>Customers may have lower bills when water conserving practices (e.g., landscapes, fixtures, etc.) are integrated into developments from the start. Water providers may reduce or delay the need for costly water supply and/or infrastructure development by coordinating with developers.</p>
 <b>Education</b>	Codes and regulations serve as an educational tool to inform developers and the community at-large about what their standards are for development and how water is to be used.
 <b>Community/Social</b>	Codes and regulations set the minimum requirements and the rules for how water should be planned, developed, and used for community benefit.
 <b>Environmental</b>	Codes and regulations that address development practices for water conservation and efficiency, as well as the use of water, can also provide environmental benefits such as water quality and ecosystem health.
 <b>Climate</b>	Codes and regulations that address development practices for water conservation and efficiency, as well as the use of water, can also provide climate benefits such as drought resilience, urban heat island mitigation, and greenhouse gas emissions reduction through reduced energy use for water treatment or distribution.

## Key Takeaways

- Codes regulating indoor water use (e.g., Plumbing Code) are more standardized in Colorado than codes regulating outdoor water use (e.g., zoning ordinances, landscape standards); water providers need to work closely with communities on development regulations that shape outdoor water use.
- Development and building codes are helpful to address water use and efficiency associated with new construction and redevelopment; additional tools and incentives are often needed to address water use and conservation for existing development (see the Outdoor Water Use and Indoor Water Use best practices for additional information).
- **Development Regulations**
  - Land use and development regulations shape water use and conservation significantly. Integrating conservation and efficiency into new development layout and design is simpler than retrofitting existing development.
- **Other Codes and Ordinances**
  - Communities may adopt other codes and ordinances to regulate water use, but close coordination with water providers is essential for these regulations to be effective and enforceable.

## Development Regulations

Local governments regulate development activities through a variety of actions. At the macro scale, they adopt master plans and zoning ordinances, which define how people can use land (e.g., residential, commercial, industrial) and where. See the Planning and Implementation best practice for additional information about community master plans (i.e., comprehensive plans).

At the micro scale, subdivision and site planning regulations set more detailed standards for property layout and design. They specify how infrastructure improvements like water and sewage — but also roads, sidewalk, and other key improvements – will make the land what we recognize as neighborhoods and blocks. Sometimes there is a unified development code that integrates zoning, subdivision regulations, and other development specifications. Other times, these regulations are separately adopted and managed.

Adopted development regulations vary by jurisdiction and legal authority. Historically, water professionals have not always been involved in the creation or updating of local land use or development regulations. However, **best practice is for community planners to work closely with water providers when updating development regulations.** Working together can help minimize the water demand impacts of development by integrating water conservation and efficiency considerations into development regulations.

The following sections summarize the key intersections between development regulations and water conservation, while providing guidance on how water professionals can interpret, or even inform, development regulations in a manner that is beneficial to both the community and water provider(s).

## Regulatory Requirements

Jurisdiction for regulating development frequently falls outside of the water provider. However, understanding how water interacts with regulations at the state, county, and municipal level can help water providers be informed about key opportunities for collaboration and where they may be asked to inform and/or align with key components of development regulations.

### State of Colorado

In Colorado, local government regulation of land use is authorized by the Colorado Revised Statutes (C.R.S.) [§29-20 Part 1 - Local Government Land Use Control Enabling Act](#). This enabling legislation establishes the authority of local governments to plan for and regulate the use of land.

C.R.S. [§29-20 Part 3 – Adequate Water Supply](#) identifies adequacy of water for new developments as a matter of statewide concern. The regulations within this section specify the role of local governments in reviewing and determining the adequacy of water supply.

### Development Code Template for Colorado Counties and Cities

Colorado's Department of Local Affairs (DOLA) provides model codes for communities to use as a template that communities can tailor and refine to reflect local priorities. The codes cover zoning, subdivision, and other development standards, among other topics. The code templates are being updated in 2023-24 and will be available at: [dlg.colorado.gov/land-use](http://dlg.colorado.gov/land-use).

### Colorado Counties

C.R.S. [§30-28 Part 1 - County Planning](#) establishes the regulations for county planning authorities and processes, including [§30-28-106 Adoption of Master Plan – Contents](#), which describes the duty of a county or regional planning commission to adopt a county master plan, and the limits of applicability of such plan on incorporated municipalities. Requirements for county master plans include “the general location and extent of an adequate and suitable supply of water” among other requirements. If the master plan includes a water supply element, §30-28-106 states:

*The supply element must include water conservation policies to be determined by the county, which may include goals specified in the state water plan adopted pursuant to section 37-60-106.3 and may include policies to implement water conservation and other state water plan goals as a condition of development approvals, including subdivisions, planned unit developments, special use permits, and zoning changes. A county with a master plan that includes a water supply element shall ensure that its master plan includes water conservation policies at the first amending of the master plan that occurs after September 14, 2020, but in no case later than July 1, 2025.*

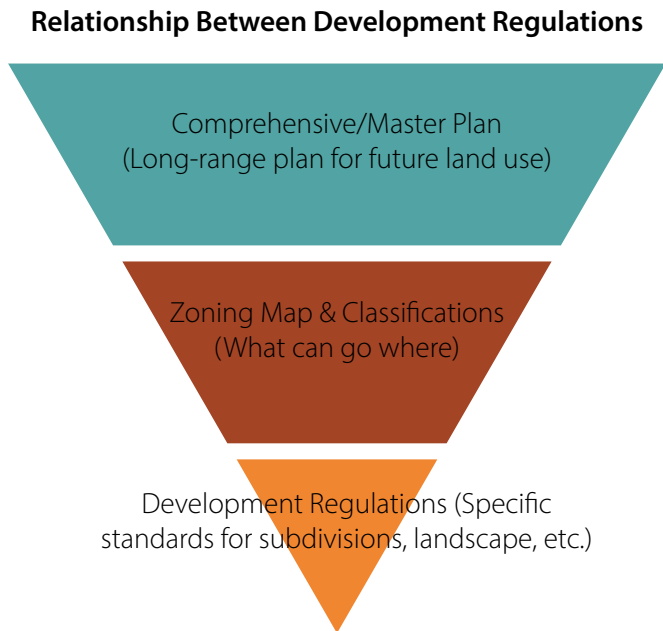
C.R.S. [§30-28-111 Zoning Plan](#) allows counties to adopt a zoning plan and to regulate the location, height, bulk, and size of buildings and other structures, the percentage of lot which may be occupied, the size of lots and open spaces, the density and distribution of population, and the location and use of buildings and structures, among other items.

Similarly, C.R.S. [§30-28-133 Subdivision Regulations](#) establishes the requirement for every county planning commission to adopt and enforce regulations for the subdivision of land.

### Colorado Municipalities

For municipalities, C.R.S. [§31-23-206 Master Plan](#) establishes the duty of a municipal planning commission to adopt a master plan for the physical development of the community as an advisory document to guide land use decisions. As with county master plans, if the municipal master plan includes a water supply element, it must include water conservation policies. The requirement to have water conservation policies in an amended master plan by no later than July 1, 2025 also applies to municipal master plans.

Like the regulations for counties, C.R.S. [§31-23-211 Zoning](#) and [§31-23-214 Subdivision Regulation](#) establish authorities and regulations related to municipal zoning and subdivision.



## Key Concepts

The difference between zoning, subdivision, and site planning regulations can be confusing to those unfamiliar with the terms. Think of zoning as the broad-brush strokes needed to outline a painting, and subdivision regulations as the first layer of detail, and site planning regulations (such as landscape standards) as the fine-tuned brush that fills in the final details.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Zoning and Subdivision
- Landscape Standards

### Zoning and Subdivision

Zoning is the regulatory assignment of broad areas into general “districts.” Each zoning district type dictates the types of land uses that are permitted, and the intensity of development allowed (i.e., number of dwelling units, percent of lot that can be developed, etc.). Subdivision regulations set the standards for how parcels of land are divided into lots and guide the overall layout of lots and infrastructure to be developed.

Key opportunities for water providers to advance water conservation through zoning and subdivision include:

- **Permitted uses:** Most zoning ordinances list the land uses that are permitted in each zone district. Water providers talk about uses in reference to customer type (e.g., residential, commercial and industrial, etc.); permitted uses in zoning ordinances are usually more specific/detailed (e.g., residential uses such as single-family residential, commercial uses such as office, car wash, etc.).

Permitted uses have different water demands, and water providers should familiarize themselves with the range of permitted uses. It is helpful for planners and developers to know about the water-related requirements and water conservation opportunities associated with each permitted use. Water providers can provide this type of information in their comments when they receive development review proposals, such as new development or change of use applications, for review. Furthermore, adoption of water conservation standards for permitted water-intensive uses could help reduce connection fees (e.g., water recycling requirements for car washes).



Local governments and water providers could consider restricting the development of uses with high/very high water demand, and/or modifying the review processes for water-intensive uses to include additional review standards or approval criteria.

- **Approval processes:** Review and approval processes vary by proposed use and zoning district. Some uses are allowed automatically, without any special review processes – this is known as a “use by right” or “as of right use.” Other uses must be approved on a case-by-case basis. These “conditional” uses are often only approved if they meet use-specific standards. By getting involved in drafting or updating zoning regulations, water providers have an opportunity to help inform both the approval processes and the specific standards associated with land uses, especially for high-water uses such as car washes, breweries, or those with large turf areas.
- **Development density/intensity:** Zoning regulations frequently prescribe allowable density (i.e., number of dwelling units and lot sizes), and intensity (i.e., setbacks, building heights, and floor area ratio (FAR)). FAR is the measurement a building’s total floor area in relation to the size of the parcel on which it is located. Decisions around uses, density, and development standards are multi-faceted and take into account myriad community values and goals (e.g., housing affordability, transportation and open space accessibility, etc.). Water use and development intensity are closely related, but it is overly simplistic to say that water use decreases with increased density/intensity or vice versa. Factors such as the number and type of dwelling units, other land uses, and total landscaped area and type will drive total water demand. Water providers can help identify opportunities for both water conservation and water efficiency for all development densities and intensities.

### Standards for High Water Uses

Aurora Water’s Car Wash Standards (an appendix to the 2024 Water, Sewer, and Storm Drainage Standards) complement the City of Aurora’s zoning requirements, and provide additional specificity related to the development of car washes. They include requirements for a water recycling system that recycles not less than 75% of the water being used.

Similarly, Aurora Water’s Large Water Users Guide provides criteria for evaluating allowable commercial and industrial flow rates for proposed uses, and establishes levels of volumetric use and non-recoverable water use that are not allowed.

### Residential Density and Total Water Demand

A [study](#) by the [Decision Center for a Desert City](#) (DCDC) at Arizona State University analyzed the quantifiable impact of increasing residential density on total water demand in the Denver Regional Council of Governments (DRCOG) service area.

The results “showed that “increasing residential density and reducing landscaping irrigation reduces water demand over conventional development... primarily because at higher densities there is less landscaping per household” (Keystone Policy Center, 2018).

- **Overlay zoning:** Some zoning districts layer on top of others to establish additional standards applicable to a specific community feature or geographic area. For example, many communities designate flood hazard overlay zones for areas that are within floodplains. Overlay zones that are applicable to water conservation and efficiency include water conservation/supply and wildfire hazard overlays. Water conservation/supply overlay zones can be designated where water resources are known to be scarce and include elevated standards related to water conservation and efficiency that are required for development.

Wildfire hazard overlays designate areas that are at risk for wildfire and specify elevated standards for firewise practices (e.g., allowed building materials, landscaping, and subdivision access). In wildfire prone areas, special attention must be given to the type and maintenance of landscaping so that it doesn’t increase wildfire risk. Water providers should be involved in informing the areas designated as conservation overlays, as well as with shaping the specific water and landscaping-related standards in all applicable overlay zones.

### Water Supply Overlay Districts

Douglas County, Colorado’s Zoning Resolution (DCZR) establishes the [Water Supply Overlay District](#). The intent of the overlay district is to “ensure that development in all areas of Douglas County provides for a water supply that is sufficient in terms of quantity, quality, and dependability” (Douglas County, 2017). The overlay district is divided into 4 zones that are accompanied by distinct water-related standards for each area.

- **Planned unit developments:** A zoning tool that provides local governments flexibility to negotiate the details of large projects with developers is called Planned Unit Development (PUD). In these developments, large areas are rezoned as PUDs, which then provides flexibility in planning the area, including the mix of uses and other development components, such as design, layout, and amenities. Through the negotiation process, or by establishing clear approval criteria for PUDs, local governments can elevate water conservation and efficiency standards for the development. For example, an approval requirement for PUDs may include landscaping standards related to the amount of turf allowed. Similarly, developers can propose enhanced water conservation or efficiency measures that could increase the likelihood of approval. Water providers should be involved in the review and negotiation process for PUDs to ensure that water conservation and efficiency measures are incorporated. Note that overlays may be used in combination with PUDs, or the PUD may incorporate overlay district considerations, depending on the nature of the development proposal and resource conservation needs.
- **Cluster development:** Another commonly used zoning and subdivision tool is cluster development, which focuses development on a portion of a larger plot of land, with the remaining land dedicated as open space or similar. Cluster development facilitates a more compact development footprint in terms of lot sizes, infrastructure needs, and potentially total landscaped area, which can present water conservation opportunities. When reviewing proposals for cluster developments, water providers should be looking at and recommending water conservation opportunities for both the developed lots and the remaining open space or residual land.

Note that overlay zones may be used in combination with cluster development, especially in areas where there are sensitive resources to be protected or conserved. Similarly, PUDs may incorporate characteristics of cluster development by focusing development in a specific area.

### Planned Unit Developments

The City of Centennial, Colorado's PUD Zoning is a flexible tool that can be applied to proposed developments under a unified plan that may not correspond exactly with the requirements of other zoning districts. Development proposals requesting PUD zoning must meet or exceed the following minimum requirements (City of Centennial, 2023):

1. Provides above-average open space and recreational amenities.
2. Incorporates creative and superior quality and design aesthetics that exceeds the city's current design standards or other land use regulations set forth in the Land Development Code.
3. Provides a greater efficiency in layout and provision of roads, utilities and other infrastructure.
4. Implements the Comprehensive Plan or an adopted Sub-Area Plan, or supports the implementation of such plans.
5. For nonresidential development, adds new and unique tenants or employment opportunities to the city.

By using PUD zoning, a developer may have the flexibility to propose a development concept that elevates and integrates water efficiency and conservation, beyond the code's minimum standards. For example, PUD requirements could include elevated standards for landscape materials, water conservation, and/or prohibition of water-intensive uses such as fountains or pools. Note that PUDs require additional staff time to review and administer (beyond standard zoning) and should be used judiciously.

### Landscape Standards

Landscape regulations establish the standards for the amount and type of landscape required with development projects, addressing topics such as street trees, common areas, parking areas, setback and buffer areas, and even residential yards in some communities. Landscape standards also address topics ranging from plant materials and use of turf, to irrigation and soil amendment practices, and even considerations for wildfire prone areas. Because outdoor water use is shaped significantly by landscape water needs and applications, there are many opportunities to integrate conservation and efficiency measures into landscape standards and water provider/community landscape regulation coordination, including:

- **Landscape plans:** Requirements for landscape plans vary by community and development type. It is most common for landscape plans to be required for non-residential, multi-family, redevelopment, and residential development proposals (especially for common areas) as part of the site plan review process. Some communities require landscape plans to be prepared for changes in use (e.g., change from home to office, bank to restaurant, etc.), and others even require them for single-family properties. Note that when adding or revising requirements for landscape plan, local governments and water providers must ensure adequate staff capacity to process increased volumes of reviews.

Landscaping standards may be embedded into a municipal or county development code as a long, detailed list of requirements, or by reference to a separately maintained design manual with detailed standards. Communities may require landscape plans to be prepared by a certified landscape architect or similar professional credential to ensure quality of design and regionally appropriate landscape materials. Best practices for landscape plans in the development review processes include providing developers with a detailed list of requirements to be included on the landscape plan and providing clear, regionally appropriate standards to inform landscape plan design.

For communities with sufficient staff resources and/or large development proposals, best practice is to require water use estimates on landscape plans and set maximum limits on the amount of water allowed (i.e., Water Budgets). Landscape water budgets need to be closely coordinated between the community and the water provider to ensure that the review, approval, inspection, and maintenance processes align with regulatory requirements.

For communities with limited staff resources and/or smaller development proposals, best practice is to establish basic landscape standards (e.g., turf and/or high water use plant limitations, approved plant list) for all development projects.

Water providers should be familiar with community landscape plan standards and submittal requirements and should be reviewing development proposals for consistency with those standards from a water use and conservation perspective. Water providers should also be involved in the process to update any requirements for when landscape plans are needed, to ensure alignment with any changes needed to tap sizes or types.

- **Plant materials:** Landscape regulations should address the types of plant materials desired, as well as those that are discouraged and/or prohibited. Some communities develop and provide detailed plant lists within their codes; most provide references to other manuals/lists/resources for ease of update and maintenance.

It is important for approved or recommended plant materials to be regionally appropriate. Best practice is for approved plant lists to be organized by water needs, so that landscape plans can be designed for water efficiency, grouping plants according to water, soil, and sun

needs (i.e., “hydrozones”). Water providers should be aware of any locally adopted plant guides/resources, aligning and reference those resources in their development review comments and customer educational materials (e.g., websites).

### Hydrozone Program Landscape Plan Requirements and Plant List

The City of Loveland’s optional Hydrozone Program has [specific requirements](#), including landscape plan details such as organization of plant areas into hydrozones and the location and size of the dedicated irrigation meter. The program leverages the city’s [Plant List](#), which includes information about the water usage per plant type.

### Cool-Season Grass Limitations

The City of Aurora, Colorado’s [Unified Development Ordinance Section 4.7.3 General Landscaping Standards](#) limit the use of cool-season grass sod, seed and seed mixtures that contain cool-season grass species, to no more than 33% of the site’s total landscaped areas, and require that areas consisting of high-water using species of cool-season grasses (such as Kentucky bluegrass) are contiguous. These standards apply to all development areas except playfields .

- **Turf standards:** Cool season turf, like Kentucky bluegrass, can be an appropriate landscaping material in areas that need to serve a beneficial function such as sport fields, gathering areas at parks and cemeteries, pet relief and play, and similar. Nonfunctional turf is commonly irrigated, ornamental turf that does not serve a beneficial use, such as turf in street medians, parking lots, or large non-recreational open space areas.

Standards regulating turf differ by community and water provider. Approaches for regulating turf include but are not limited to establishing maximum areas for turf (as a percentage of total landscape area or total square footage), defining maximum average water use for turf and/or landscape areas, specifying contiguity requirements for turf areas, and prohibiting the use of nonfunctional turf. Best practice is for communities to be clear about the differences between functional and non-functional turf, and to provide specific standards to limit the use of non-functional turf. Water providers should be involved with the establishment or revision of any landscape standards related to turf, with attention given to appropriate fee and rate structures for both functional and nonfunctional turf areas.

### Limitations on New Turf

A [2022 Memorandum of Understanding \(MOU\) by and among Colorado River Basin Municipal and Public Water Providers](#) commits to implementing limitations on new turf and introducing a program to reduce the quantity of non-functional turfgrass by 30% (Colorado River Basin Municipal and Public Water Providers, 2022).

### Prohibit Landscaping Practices for Water Conservation

Colorado recently passed SB24-005, a bill that takes effect on and after January 1, 2026 and “prohibits local governments from allowing the installation, planting, or placement of nonfunctional turf, artificial turf, or invasive plant species on commercial, institutional, or industrial property, or corridor common interest community property, or a street right-of-way, parking lot, median, or transportation corridor.”

It also “prohibits the department of personnel from allowing the installation, planting, or placement of nonfunctional turf, artificial turf, or invasive plant species as part of a project for the construction or renovation of a state facility, which project commences on or after January 1, 2025.”

The bill defines functional turf as:

*Turf that is located in a recreational use area or other space that is regularly used for civic, community, or recreational purposes, which may include playgrounds; sports fields; picnic grounds; amphitheaters; portions of parks; and the playing areas of golf courses, such as driving ranges, chipping and putting greens, tee boxes, greens, fairways, and roughs.*

California and Nevada have passed similar nonfunctional turf legislation.

### Landscaping Regulations and Homeowners Associations

Per C.R.S. § 37-60-126, “Any section of a restrictive covenant that prohibits or limits xeriscape, prohibits or limits the installation or use of drought-tolerant vegetative landscapes, or requires cultivated vegetation to consist exclusively or primarily of turfgrass is hereby declared contrary to public policy and, on that basis, that section of the covenant shall be unenforceable.” This means that community associations in Colorado are not allowed to prevent residents from incorporating xeriscaping and drought-tolerant plants in their landscaping. This restriction should be reinforced in landscaping standards and other water-related codes and ordinances.

In addition to this restriction, Colorado’s SB23-178 requires single family (not townhome or apartment) homeowners associations to pre-approve at least three water saving landscaping designs for homeowners.

- **Irrigation standards:** Similar to general landscaping standards, requirements for irrigation plans and system design vary by community. In general, best practice is to require plans for irrigation systems with landscape plans, ensure review of those plans, and then inspect systems in accordance with plans once installed. Irrigation plans should specify efficient irrigation systems which may include smart controllers, irrigation shut off valves, master valve and flow sensors, rain and soil moisture sensors, and efficient emitters (drip vs spray) (Northwest Colorado Council of Governments, 2020). The irrigation plan should be aligned with hydrozones and other site and plant material characteristics and designed in accordance with any water budget requirements. Requiring landscapes that do not require irrigation should be avoided as it can be challenging to successfully establish and maintain landscapes without some water, especially in dry years. Furthermore, irrigation is essential for tree health.

In Colorado, all sprinkler, all sprinkler spray head bodies must be WaterSense certified and require pressure reducing elements within the spray head body to reduce water pressure and control waste due to excessive water pressure.. Local governments and water providers may require submetering or separate outdoor (irrigation) meters, and this practice is recommended to help with monitoring of water use. Communities and water providers may adopt standards that go into detail about irrigation schedule requirements, though these standards often reside in other parts of a municipal or county code (not a development code) and apply to all development, not just new development (see Other Codes and Ordinances).

- **Soil standards:** Landscaping regulations often include standards related to soil amendments and quality. Soil amendments include organic materials and minerals, like compost and lime, that can be used to adjust soil composition and acidity (Eppig, 2022). Healthy soil amended with organic matter such as compost and other nutrients helps plants retain moisture and resist evaporation (Eppig, 2022). Landscaping regulations or guidelines may specify the types of soil amendment and preparations needed, and the type and quality of soil used. Landscaping codes can encourage and require new developments to use water conserving soil types and practices (such as clay, shredded bark, or vermiculite) (Western Resource Advocates, 2018). Best practice is to require soil testing to determine soil quality and composition and adopt standards for soil amendment and quality for new development. Water providers will likely have minimal role in reviewing or adopting soil amendment or quality standards but should be aware that these standards can be a helpful conservation tool.
- **Firewise standards:** Development codes in Colorado increasingly include standards related to wildfire. In fire prone areas, landscape standards should be developed to provide defense against wildfire, also known as defensible space. Best practices for defensible space frequently align with best practices for water efficient landscaping, including: requirements for and review of landscape and irrigation plans; use of low-growing, native plants and hydrozones; requiring efficient and automated irrigation systems, and ensuring regular landscape and irrigation system maintenance.

### Water Efficient Landscaping Standards

The [City of Aspen's Water Efficient Landscaping Standards](#) are adopted and incorporated by reference in the [Municipal Code](#). These standards apply to all "landscaping, grading, installing or disturbing hardscapes, additions to structures, etc. that has a disturbance area greater than 1,000 square feet and greater than 25% of the entire lot or parcel" and "all building permits that trigger a "substantial remodel," defined as the increase by 50% or more in the water using capacity of new waster using devices or fixtures installed on a property..." (City of Aspen, 2022).



# Case Study

## LANDSCAPE REGULATION UPDATES | BROOMFIELD, CO

In Broomfield, 60-70% of the annual water supply is applied to outdoor uses, and much of this water is used to irrigate high-water use turfgrass (City and County of Broomfield, 2023). In the face of a hotter and drier future, installing landscapes with lower water demands and efficient irrigation systems in new development and redevelopment is one of the community's biggest opportunities to improve water supply resilience (City and County of Broomfield, 2023).

As part of Western Resource Advocates and WaterNow Alliance's [Project Accelerator Program](#), in October 2023, the [City and County of Broomfield](#) adopted new landscape requirements for new development and redevelopment. The new regulations took effect on January 1, 2024, and apply to:

- All new construction, including residential and non-residential;
- All construction projects that cumulatively increase the gross floor area of the property by 65% or more;

- Any total redevelopment of a parcel that includes demolition and new construction;
- Construction of parking lots containing 10 or more spaces; or
- Expansion of an existing parking lot by more than either 10 spaces or 50% of the existing parking lot area, whichever is greater (City and County of Broomfield, 2023).

While the previous code included some provisions for water-efficient landscapes, the code still allowed for up to 60% of residential lots to use turfgrass, lacked requirements for waterwise plant species, and included references to out-of-date irrigation technology. Importantly, the previous landscaping code was only applicable to residential development. The new regulations serve to modernize the previous code and to further reduce per acre outdoor water use in new development and redevelopment.

The new code limits cool season turfgrass to a maximum of 30% for residential coverage and states that any included cool season grass must be a hybridized lower water use turfgrass like Dogtuff or Tahoma. The code also includes new standards for commercial and industrial development, among others.



Figure 6. An example of a single-family residential lot that includes the proposed maximum coverage of cool-season turfgrass threshold with drought-tolerant landscaping

## Specific standards include:

- **General Landscaping Standards**

- All development subject to the requirements shall include a variety of waterwise plant materials.
- Planting cool-season turfgrass in lieu of drought-tolerant vegetation to meet the minimum landscape lot coverage is prohibited.
- The removal of waterwise plant material to convert the area back to cool-season turfgrass is prohibited.
- Soil amendments are required.
- A minimum of 75% of all annuals and trees, and 100% of shrubs, perennials, groundcovers, and ornamental grasses are required to be selected from a plant list contained in the Landscape Reference Manual.
- Non-living materials such as stone, masonry and steel (used for edging) may not comprise more than 25% of the landscaped area.

- **Single-Family Detached Residential Development Standards**

- Properties that meet the development threshold requirements (new development greater than a 65% expansion of an existing home, or a full demolition of the existing structure with new construction).
- Landscape requirements apply to front and visible side yards, only.
- Minimum of 75% of the front yard and side yards visible from a public street.
- Turfgrass cannot exceed 30% of the area that is required to be landscaped.
- Included turfgrass must be a hybridized lower water use turfgrass like Dogtuff or Tahoma.
- Irrigation systems installed must meet EPA WaterSense certification requirements.

- **Non-Residential, Multi-Family, Single-Family Attached, and Mobile Home Park Development Standards**

- Properties meeting the development threshold requirements (new development greater than a 65% expansion of an existing building, or a full demolition of the existing structure with new construction).
- Irrigation systems installed must meet EPA WaterSense certification requirements.
- The landscape plan must adhere to waterwise principles.
- Cool-season turfgrass established at a maximum of 30% coverage.
- Included cool-season turfgrass must be a hybridized lower water use turfgrass like Dogtuff or Tahoma.
- Parking Lot Landscape Requirements.
- Minimum materials (size, quantity) and placement requirements.
- Solar panels may be installed in lieu of parking lot islands, provided used as canopies over parking stalls.
- Turfgrass and artificial turf is prohibited within the interior of the parking lot.



## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Local Government Perspective:</b> Establishing or revising development regulations can be a time consuming and costly endeavor for local governments. In addition to staff time to draft and engage stakeholders and community leaders in the review and adoption process, other costs for local government in developing or revising regulations can include consulting resources for code language, process, design, and legal support. After development regulations are adopted, costs for local government shift to investing in staff time or consultant resources for reviewing all development applications against the adopted standards and ensuring inspection and compliance after construction.</p>	<p><b>Local Government Perspective:</b> Water conservation and efficiency focused development regulations rarely provide financial benefits to local government because of the staff time needed to review development proposals against those standards and then enforce them. However, financial benefits are rarely the sole reason for local governments to adopt and enforce development regulations. Other benefits include community aesthetics and safety, environmental stewardship, community resilience, economic development, and supporting water provider and customer savings.</p>
<p><b>Water Provider Perspective:</b> Water providers may play a supporting role in developing or reviewing new or revised development regulations, and so the costs associated with those processes will vary. Once development regulations are established, costs to water providers are largely the investment of staff time to review and comment on development proposals, in alignment with adopted development and water provider standards. In some cases, the utility may also be responsible for ongoing monitoring of water use, especially as it relates to landscape and irrigation plans that use a water budget approach.</p>	<p><b>Water Provider Perspective:</b> The greater the community's peak demand, the more capacity a system requires for storage, conveyance infrastructure, and treatment. Reducing peak demand can extend existing infrastructure capacity, preventing the need for costly investments in upgrades or expansion (Northwest Colorado Council of Governments, 2020). Development regulations that elevate water conservation and efficiency can also help protect a water provider's long-term supply. Additionally, "smart from the start" development can help prevent the need for costly retrofit projects to make existing properties or buildings more efficient.</p>
<p><b>Customer Perspective:</b> The initial customer associated with development codes is the developer. Typically, the developer will bear the costs of preparing and finalizing plans that adhere to local development regulations. The final customer is the building/property user, and the costs associated with adhering to the development regulations are frequently incorporated into the sale or lease price, or sometimes through property tax or association dues. Costs associated with maintenance according to the standards are the responsibility of the property owner or lessee.</p>	<p><b>Customer Perspective:</b> Development regulations help ensure that properties are designed and developed with conservation and efficiency in mind, helping to reduce water use and associated fees.</p>

### Water Savings Assumptions

Water savings associated with development regulations are difficult to quantify because inherently, new development results in a net increase in total water use. Communities that update development regulations to elevate water conservation and efficiency considerations would need to compare actual water use data for similar subdivisions or development types built before and after the regulations to quantitatively evaluate the true impact of development regulations on water use. In the absence of comparing actual water use data, best practice for estimating water savings for updated development regulations is to use a constant baseline for indoor water use for each dwelling unit, and then comparing the estimated outdoor water use for the development proposal under older regulations (e.g., bluegrass) against estimated outdoor water use for a development proposal adhering to the updated regulations (e.g., low-water plantings).

The [Alliance for Water Efficiency's Water Conservation Tracking](#) tool is a helpful resource for estimating water savings, costs, and benefits related to landscaping codes for new development (Alliance for Water Efficiency, 2021)



# Building Regulations

While development regulations shape land and site development, building regulations shape the construction and inspection of buildings and structures. And just as adherence with development regulations are typically overseen by community planning and zoning staff, adherence with building regulations typically falls under the purview of building officials and inspectors.

In Colorado, local governments have authority to adopt building regulations that encompass a variety of regulations related to construction, energy, plumbing, and more. Many communities model their codes from a suite of international and/or national code products, adopting amendments to tailor these codes to local conditions.

The following sections address water efficiency and conservation considerations associated with building regulations:

- Building Code
- Plumbing Code
- Graywater
- Reclaimed Water Regulations
- Rainwater Collection

## Regulatory Requirements

The regulatory requirements for this best practice are detailed as part of the key concepts.

## Key Concepts

Across Colorado, most communities require a building permit for building improvements such as new construction, expansion, alteration, repair, and even moving and demolition. The permit process is designed to ensure compliance with adopted regulations, which are intended to protect safety, health, and welfare of building occupants.

To support implementation of this best practice, the following key concepts are summarized in the sections below:

- Building Code
- Plumbing Code
- Graywater
- Reclaimed Water
- Rainwater Collection

### Evaporative Cooling Towers

In 2023, Southern Nevada Water Authority, which serves Clark County, Nevada, approved a ban on evaporative cooling in new commercial buildings. Evaporative cooling systems are the second-largest water consumers in the County, behind outdoor irrigation. In addition to the ban on new systems, the Authority also provides an incentive program to encourage voluntary switch from evaporative cooling to air conditioning systems (Saegert, 2023).

### Building Code

In Colorado, counties and municipalities are authorized to adopt building and associated codes, under C.R.S. [§30-28 Part 2 - Building Codes](#) and [§31-15 Part 6 - Building and Fire Regulations](#).

Colorado does not have a statewide building code. Instead, building codes are adopted and enforced by local governments. When updating any building code, Colorado jurisdictions are required to adopt and enforce one of the three most recent versions of the International Energy Conservation Code (IECC). The IECC is part of a suite of codes, commonly referred to as "I-Codes," which are written to be adopted together, and are released every three years (e.g., 2018, 2021, etc.). Best practice is to align adoption of codes (e.g., building, energy, and plumbing code) to the same year to avoid conflicts. Topics that relate to water conservation in a building code include permit requirements, maintenance, inspections, the required number of plumbing fixtures, and more.

### Plumbing Code

In Colorado, C.R.S. [§12-105-106 Colorado Plumbing Code](#) establishes the Colorado Plumbing Code as the minimum standards for installation, alteration, and repair of plumbing equipment and systems. Local government can adopt amendments to this code, if such amendments are equal to or exceed the Colorado Plumbing Code minimum requirements.

As of 2023, the adopted Colorado minimum plumbing code is the [2018 International Plumbing Code \(IPC\)](#), [2018 International Fuel Gas Code \(IFGC\)](#) and the plumbing chapters of the [2018 International Residential Code \(IRC\)](#).

### Maximum Flow Rates and Consumption for Plumbing Fixtures

The City of Fort Collins amended the Colorado Plumbing Code to establish maximum water consumption flow rates and quantities for all plumbing fixtures. Under the EPA WaterSense® label, residential water closets have a maximum flow rate of 1.28 gallons per flush; whereas the City of Fort Collins standard for a residential water closet is 1.1 gallons per flush cycle (City of Fort Collins, 2023).

The [Uniform Plumbing Code](#) (UPC) is an alternative to ICC's International Plumbing Code, and was last updated in 2024. Communities looking to go beyond the Colorado Plumbing Code may adopt all or parts of the UPC in their local regulations.

### Shortened Plumbing Design

Because there is less water flowing with low-flow fixtures, modifications to plumbing design steepness (i.e., shortened plumbing design) can help reduce blockages. This design is more important in non-residential settings where there may not be a lot of water use outside of a bathroom/ only during certain times of the day. The Water Efficiency and Sanitation Standard for the Built Environment is a leading resource for standards related to safe and efficient water use in buildings.

C.R.S. [§6-7.5 Water and Energy Efficiency Standards](#) regulate the efficiency standards for products sold in Colorado, as a matter of public interest. Regulated products include faucets, flushometer-valve water closets, spray sprinkler bodies, and water coolers, among others. Some communities choose to adopt even more stringent standards related to maximum flow rates and consumption for plumbing fixtures and fittings.

### Graywater

Graywater is a portion of water used in a residential, commercial, or industrial building that may be collected after the first use and put to a second beneficial on-site use (State of Colorado Department of Public Health and Environment, 2016). Graywater strategies support water conservation by beneficially reusing water from sinks, showers, bathtubs, and laundry systems for toilet flushing, cooling, or outdoor irrigation. Use of water in Colorado must comply with Colorado water rights and water quality regulations. To allow graywater use, local jurisdictions must adopt a greywater control program that meets the requirements of Colorado Department of Public Health and Environment's (CDPHE) [Regulation 86](#).

[Regulation 86](#) outlines seven categories for graywater use. Requirements vary depending on the graywater source(s) and end use. Communities can permit all or a combination of categories based on local needs and opportunities. For water users that rely on municipal water supplies, the Colorado Division of Water Resources does not regulate the reuse of graywater within the municipal system and does not consider it a water rights conflict if water reuse or re-circulation as a part of residential, commercial, or industrial operations, and that reuse or recirculation takes place within the confines

of that operation. See this administrative position from the Division of Water Resources for additional information: [dnrweblink.state.co.us/dwr/ElectronicFile.aspx?docid=3576582&dbid=0](http://dnrweblink.state.co.us/dwr/ElectronicFile.aspx?docid=3576582&dbid=0).

Some water providers take a more judicious approach to graywater and water reuse considerations in the context of their water rights portfolios. As a result, is important that water providers coordinate with local jurisdictions that are working to adopt a graywater control program. For more information on graywater system applications and water savings potential see the Indoor Water Use Best Practice Area. Note that in 2023, CDPHE gathered stakeholder feedback to inform an update to Regulation 86. To find the most up to date information on Regulation 86 visit: [cdphe.colorado.gov/water-quality/clean-water/reg-86-graywater-control](http://cdphe.colorado.gov/water-quality/clean-water/reg-86-graywater-control).

### Graywater Ordinance

A new development in Castle Rock, CO is piloting graywater systems for about 30 homes. The systems take water from showers and baths and repurposes it in toilets. The systems add an estimated \$5,000 cost to each home and are forecasted to save approximately 20% of indoor water use (McKibbin, 2022).

The Town of Castle Rock adopted a greywater ordinance in 2019, in accordance with State of Colorado regulations ([4.05.010 – Graywater Systems](#)). Castle Rock Water is the local agency responsible for oversight and implementation.

## Reclaimed Water

Reclaimed water is treated wastewater that receives “limited” secondary treatment. Reclaimed water is distributed through separate distribution systems with purple pipes. Reclaimed water systems support water conservation by lessening the demand for potable water.

### Reclaimed Water

The City of Westminster, CO’s reclaimed water system serves 121 sites, and more than 1,100 irrigated acres, including parks, golf courses, schools, and common areas. Reclaimed water is treated in accordance with State of Colorado regulations, and is delivered through separate, “purple” pipes that are separate from the city’s drinking water system (Reclaimed Water in Westminster, n.d.).

CDPHE [Regulation 84](#) specifies how reclaimed water can be used. Currently in Colorado, reclaimed water can be used for irrigation, as well as limited industrial and commercial applications. Reclaimed water can only be delivered by water providers with existing, reusable water rights. Water providers that use reclaimed water should ensure that the local jurisdiction’s building and plumbing code address construction and other standards for reclaimed water systems, consistent with State of Colorado regulations. For more information on reclaimed water applications and water savings potential see the Outdoor Water Use Best Practice Area.

## Rainwater Collection

Rainwater collection supports water conservation by reducing the need for portable and reuse water. C.R.S. [§37-96.5 Rooftop Precipitation Collection](#) establishes the regulations for rainwater collection in Colorado, and declares that the use of a rain barrel does not constitute a water right. These regulations allow for the collection of precipitation from a residential rooftop (4 or fewer units), provided that the collected precipitation is used for outdoor purposes on the residential property which the precipitation is collected. The regulations allow for collection of precipitation in up to two rain barrels, with a combined storage capacity of no more than 110 gallons.

Many rainwater collection systems are installed after construction and are therefore not frequently included in building or plumbing code regulations or inspections. Building code regulations can encourage roof and gutter design to support rainwater collection in accordance with State of Colorado regulations. For more information on rainwater collection and water savings potential see the Outdoor Water Use Best Practice Area.



Figure 7. Reclaimed water system in Westminster, Colorado

## Costs, Benefits, and Water Savings

<b>Costs</b>	<b>Benefits</b>
<p><b>Local Government Perspective:</b> Establishing and updating building regulations can be a time consuming and costly endeavor for local governments. In addition to staff time to draft and engage stakeholders and community leaders in the review and adoption process, other costs for local government in developing or revising regulations can include consulting resources for code language, process, design, and legal support. After building and plumbing regulations are adopted, costs for local government shift to investing in staff time or consultant resources for educating contractors, reviewing all development applications against the adopted standards, and ensuring inspection and compliance after construction.</p>	<p><b>Local Government Perspective:</b> Water conservation and efficiency focused building regulations rarely provide financial benefits to local government because of the staff time needed to review permit applications against those standards and then enforce them. However, financial benefits are rarely the sole reason for local governments to adopt and enforce building regulations. Other benefits include health and safety, environmental stewardship, community resilience, economic development, and supporting water provider and customer savings.</p>
<p><b>Water Provider Perspective:</b> Water providers may play a supporting role in developing or reviewing new or revised building regulations, and so the costs associated with those processes will vary. Once building regulations are established, costs to water providers are largely the investment of staff time to review and comment on permit applications, in alignment with adopted water provider standards and approval processes.</p>	<p><b>Water Provider Perspective:</b> The greater the community’s peak demand, the more capacity a system requires for storage, conveyance infrastructure and treatment. Reducing peak demand can extend existing infrastructure capacity, preventing the need for costly investments in upgrades or expansion (Northwest Colorado Council of Governments, 2020). Building regulations that elevate water conservation and efficiency can also help protect the water provider’s long-term supply. Additionally, “smart from the start” development can help prevent the need for costly retrofit projects to make existing properties or buildings more efficient.</p>
<p><b>Customer Perspective:</b> The initial “customer” associated with building codes is the developer or builder. Typically, the developer or builder will bear the costs of preparing plans and constructing the development in accordance with local building regulations. The final “customer” is the building/property user, and the costs associated with adhering to the building regulations are frequently incorporated into the sale or lease price, or sometimes through property tax or association dues. Costs associated with maintenance according to the standards are the responsibility of the property owner or lessee.</p>	<p><b>Customer Perspective:</b> Building regulations help ensure that properties are designed and developed with conservation and efficiency in mind, helping to reduce water use and associated fees.</p>

### Water Savings Assumptions

Estimating the water savings from building code or plumbing code updates is difficult and requires detailed comparison of previous code requirements compared to updated requirements – this may be best addressed at the individual building and fixture levels.

See the Indoor Water Use best practice for water saving information related to specific plumbing fixtures. The [Alliance for Water Efficiency’s Water Conservation Tracking Tool](#) is also a helpful resource for estimating water savings, costs, and benefits related to landscaping codes for new development (Alliance for Water Efficiency, 2021).

## Other Codes and Ordinances

Beyond the development and building codes that regulate development processes and construction, communities often adopt additional water-related ordinances and regulations in other parts of their municipal and county codes. These can range from voluntary certifications and opportunities to be eligible for incentives, to ordinances that regulate the use or misuse of water.

The following other codes and ordinances are addressed in this section:

- “Green” Rating Systems, Incentive Programs and Labels
- Water Conservation Ordinances

## Regulatory Requirements

There are no regulatory requirements for other codes and ordinances.

## Key Concepts

Communities shape the use of properties and the management of resources by promoting and incentivizing practices that they want to see more of (e.g., green building certifications), adopting ordinances that influence desired behaviors (e.g., water conservation), and establishing rules and procedures for limiting and enforcing undesirable behaviors (e.g., wasting water). Together, the other codes and ordinances described in this section support development and building regulations by providing additional regulatory tools and options for communities and water providers to address water conservation and efficiency.

To support implementation of the best practice, the following key concepts are addressed in the sections below:

- “Green” Certifications Programs, and Labels
- Water Conservation ordinances

### Net Zero/Water Neutral Growth Policies

Net zero or water-neutral growth policies involve offsetting the projected water demand of new development with water efficiency measures to eliminate the impact on water use and service area demands. The Alliance for Water Efficiency’s Net Blue: Supporting Water-Neutral Growth initiative provides case studies, a model ordinance, calculation template, and community outreach materials to communities interested in adapting this model locally.

### Water Efficient New Home Construction Incentive Program

The City of Thornton, CO, piloted a three-tier program to incentivize water-efficient new home construction. Tier 1 required EPA WaterSense certified smart irrigation controllers, MP rotators, and 0.8 gallon per flush toilets for a \$500 credit. Tier 2 included all Tier 1 requirements plus a maximum 25% turf for a \$1000 credit. Tier 3 included Tier 1 and 2 requirements plus graywater and hot water recirculating systems for a \$2000 credit. The city allocated \$25,000 for Tier 1 incentives in 2019, and the participating 50 new homes saved approximately 430,000 gallons of water. Estimated water savings from the Tier 1 and 2 incentives were 9-14% (Tier 3 savings were not determined) (WaterNow Alliance, 2023).

### “Green” Certifications, Programs and Labels

In addition to the adopted codes that communities use to regulate all development activities, some communities also adopt voluntary “green building” rating systems, incentive programs, and/or labels that are managed themselves or by other organizations (e.g., Leadership in Energy and Environmental Design (LEED) certification, International Green Construction Code (IgCC®), EPA WaterSense Labeled Homes, etc.) to guide development projects.

In most cases, these “green” certifications, standards, or programs are used to quality development projects for incentives such as expedited reviews or financial assistance, such as fee reductions or rebates. In some circumstances, communities adopt “green” certifications (e.g., LEED) as the minimum code standards, but this is rare, since it can be complicated for developers to demonstrate third party certification in a manner that also aligns with local approvals and incentive timelines. Exceptions include standards for the construction of public facilities (requirements for LEED certification of public facilities are common), and instances where the “green requirements” are negotiated into approval of a PUD or similar development agreement (e.g., metropolitan district approvals).

Water providers should coordinate with local jurisdictions on any certifications, programs, or label (mandatory or voluntary) to ensure alignment of review processes, fees/incentives, and standards. For example, while development proposals that incorporate “green” features such as urban agriculture, community gardens, green roofs, and/or graywater or reclaimed water systems may be desirable to the community overall, these proposals may take more time to review, which could be incongruent with an incentive that promises expedited application review times. Similarly, financial incentives for “green” development need to be examined in the context of the water provider’s costs and fee structures and rates.

### Water Conservation Ordinances

Colorado communities do not have a standard approach for regulating water conservation. This is due to myriad factors, including but not limited to jurisdictional authority, code format and organization, relationship with water provider(s), and monitoring and enforcement considerations. Some of the most common ways that communities regulate water conservation include:

- **Conservation ordinances:** These ordinances are most frequently found as part of a community’s development regulations, but sometimes are found in other sections of a county or municipal code (e.g., health and safety, nuisances, utility services). Conservation ordinances establish the general standards and expectations related to water use and conservation (indoor and/or outdoor), and may apply to new development, all development, and/or public properties. Water conservation ordinances are helpful in promoting water conservation and efficiency but need to be closely coordinated with water providers to be meaningful and enforceable.

#### Model Water Conservation Ordinance

The [Northwest Colorado Council of Governments’ Water Savings Resource Guide and Model Provisions for the Colorado Headwaters Region](#) includes model provisions for outdoor water efficiency that could be included in a Water Conservation Ordinance. The code provisions address topics ranging from plant materials, irrigation efficiency, seasonal and time of day irrigation restrictions, day of week restrictions, water features, rainwater harvesting, water waste and fugitive water, restrictive covenants, emergency water restrictions, and violations and enforcement (Northwest Colorado Council of Governments, 2020).

- **Water waste ordinances:** These ordinances may be a part of a more comprehensive conservation ordinance or stand alone as separate regulations. Typically, water waste ordinances apply to all properties (not just new development) and address standards and practices related to outdoor irrigation, including prohibited activities (e.g., allowing irrigation to pool or run off) and maintenance expectations (e.g., leak repair). Water waste ordinances are an important regulatory tool to have in place in the event a water provider has to enact water restrictions due to drought or other conditions.

Water waste ordinances should align with other community and water provider policies and procedures for property/system maintenance and nuisance violations, or the water waste ordinances should provide detail about how they will be monitored and enforced. Additionally, water provider water restrictions should align with water waste ordinance provisions and processes. Water providers may be asked to provide water data to inform whether a violation is occurring; water providers may also have the technology to alert customers about potential water waste issues (e.g., leaks) before a formal violation occurs. See the Measurement and Data Best Practice Area for additional information.

#### Enforcing Water Waste

Communities enforce conservation and water waste ordinances in different ways. For example, the City of Aurora describes water waste as “excessive runoff, pooling water in landscape or hard surfaces and spraying onto hard surfaces (sidewalks, driveways, gutters, streets or alleys).” The city prohibits watering between 10 am and 6 pm from May 1 to September 30. New sod, seed, and irrigation systems require a permit (Watering Times, 2024). The city provides a phone number and [online form](#) for residents to report water wasting concerns. Persons out of compliance are issued a warning on their first violation. If they are out of compliance again within the same 12-month period they will receive a fine between a \$125 - \$2,000, outlined in [Sec. 138 – 190](#) of Aurora’s Municipal Code.

- **Irrigation scheduling ordinances:** These ordinances (i.e., water use/ watering restrictions, sprinkler limitation ordinance) can be related to conservation, water shortage, and/or water waste ordinances or they may stand alone. They specify rules for outdoor irrigation, either when triggered by an event (e.g., drought), or all the time, and address

topics such as season, day of week, time of day, and/or time limits for irrigation. In addition to prescribing the desired irrigation parameters, effective irrigation scheduling ordinances define the purpose of the ordinance, applicability (which properties and water supplies it applies to), triggering conditions (e.g., drought tiers or thresholds), notification, penalties, enforcement. In many cases a drought response or sprinkler limitation ordinance is designed to support implementation of a drought management or drought response plan. See Integration with Other Relevant Plans and Services for additional information.

Enforcement of irrigation scheduling ordinances can be challenging, in situations where communities do not have real-time water use data (e.g., AMI data), and especially when the water provider and land use authority are separate entities. When the water provider and land use authority are part of the same organization, or when the water authority adopts the ordinance, water use data can inform enforcement, and penalties frequently come in the form of fees and/or surcharges on a water bill. See the Measurement and Data section for additional information.

When the water provider and land use authority are separate entities, and a community adopts an irrigation scheduling ordinance, the ordinance is frequently enforced via community nuisance codes. Community nuisance enforcement can be labor-intensive and often involves inspections, hotlines, or webforms for reporting violations, notifications, and fines.

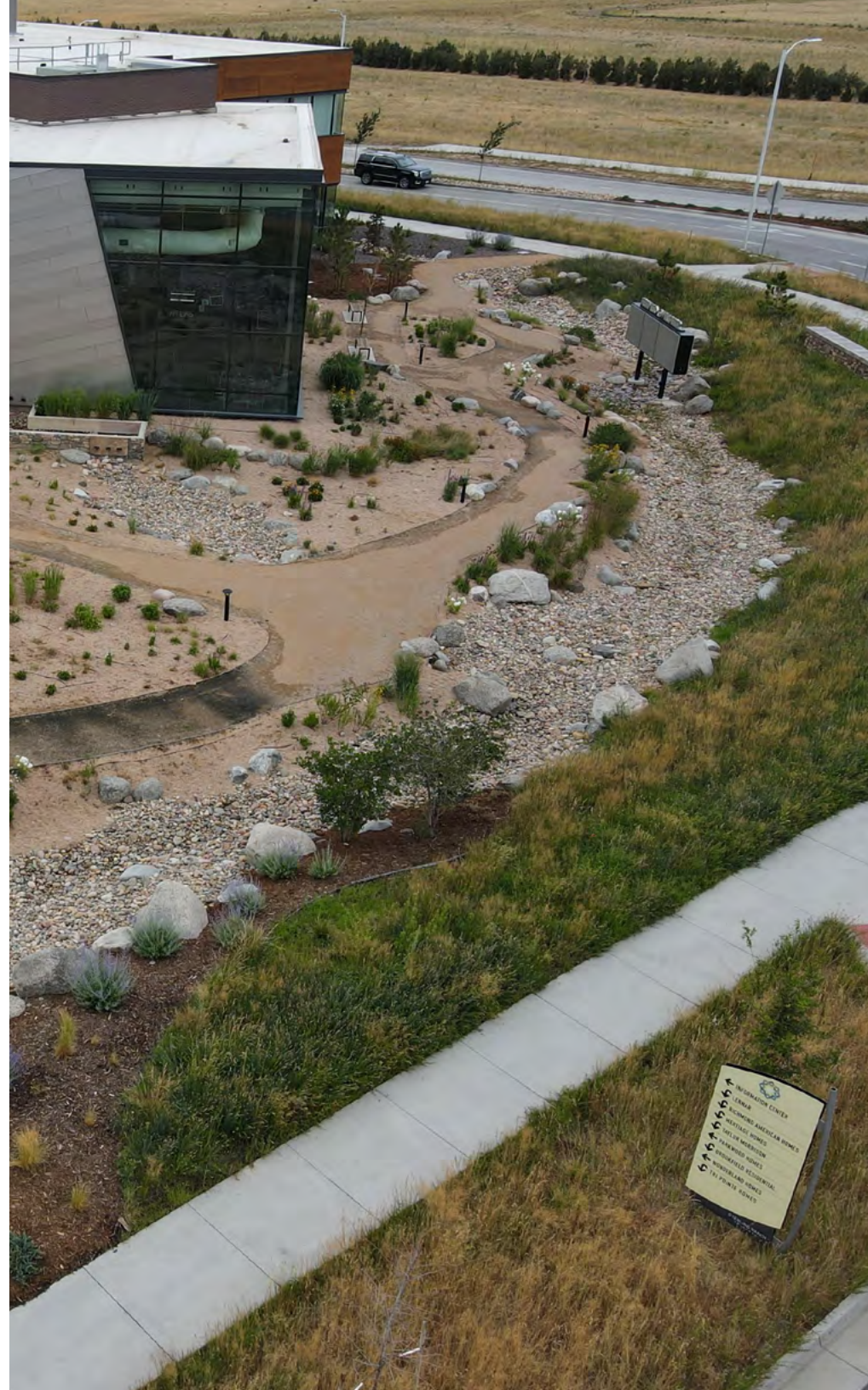
### Watering Restrictions

Since 2013, the City of Lafayette, Colorado has enacted a permanent water conservation ordinance that prohibits watering outdoor landscaping between 10 a.m. and 6 p.m. except for those watering by hand with a hose that is equipped with an automatic shut-off valve and for city-owned facilities (e.g., golf course, high traffic parks, athletic fields).

In 2022, the ordinance was amended to:

- Limit outdoor irrigation to a maximum of three days per week
- Prohibit overrun of water onto any area not covered by vegetation (e.g., sidewalks, curbs, driveways, streets, other paved areas)
- Prohibit washing of paved areas such as driveways with a hose

These provisions apply to all publicly and privately owned property within the city, as well as land outside of the city that is served by the municipal water system. Enforcement can include the issuance of warnings, municipal court summons and complaints, and administrative citations (City of Lafayette, Colorado, 2024).



## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Local Government Perspective:</b> While it may be relatively straightforward to adopt green building and water conservation ordinances, monitoring and enforcing such ordinances can be a time consuming practice for local governments. After initial inspections and/or certifications, few local governments have the resources or technology to proactively monitor properties – most take a reactive approach to enforcement, responding to complaints received or interfering only when there is an obvious violation.</p>	<p><b>Local Government Perspective:</b> Benefits of green certifications/labels to local governments include economic development, community image/reputation, health and safety, environmental stewardship and resource conservation, and supporting water provider and customer savings. Similarly, water conservation ordinances support environmental stewardship and resource conservation, support water provider and customer savings, and help ensure that a community publicly “walks the talk” as it relates to prioritizing water efficiency and conservation.</p>
<p><b>Water Provider Perspective:</b> Water providers may have the data and technology to support enforcement of water conservation ordinances, but usually making this information available to local jurisdictions will be an added cost to water providers, not a financial benefit, unless the water conservation ordinance is tied to an excess water use surcharge for customers or similar financial mechanism. Depending on the partnership with a water provider’s local government, staff time may also be required to enforce or monitor ordinances.</p>	<p><b>Water Provider Perspective:</b> The greater the community’s peak demand, the more capacity a system requires for storage, conveyance infrastructure and treatment. Reducing peak demand can extend existing infrastructure capacity, preventing the need for costly investments in upgrades or expansion (Northwest Colorado Council of Governments, 2020). Ordinances that require water conservation and efficiency can also help protect the</p>
<p><b>Customer Perspective:</b> Green certifications and irrigation systems designed to adhere with water conservation ordinances may cost slightly more upfront than developments that do not achieve such standards, but those initial costs will frequently have a positive return on investment through reduced operations costs. Violations to water conservation ordinances usually come in the form of fees or excess water use surcharges.</p>	<p><b>Customer Perspective:</b> Green certifications and water conservation ordinances benefit customers by helping reduce excess water use, and therefore water-related costs.</p>

### Water Savings Assumptions

Water savings for green certifications/labels will vary. For example, WaterSense Labeled Homes must be at least 30% more water-efficient than typical new construction and can save around 44,000 gallons per year per household (EPA, 2024). On the non-residential side, a study conducted by the U.S. Green Building Council (USGBC) found that LEED certified buildings can use roughly 15% less water than non-LEED certified buildings (USGBC, 2018).

Estimating water savings from water conservation ordinances is challenging. While water savings will be difficult to untangle, tracking other metrics like the number of waste water or irrigation schedule ordinance offenders can help implementers evaluate the level of impact. Additionally, while estimating water savings in non-drought conditions is challenging, if, in a mandatory water shortage, water conservation ordinances and water restrictions have been found to reduce water demand by up to 30% (Northwest Colorado Council of Governments, 2020).



# Resources

## General

- Colorado Department of Local Affairs Water and Land Use Integration for Local Governments: <https://dlg.colorado.gov/water-and-land-use-integration>
- Colorado Department of Natural Resources Best Practices for Implementing Water Conservation and Demand Management through Land Use Planning Efforts: <https://dnrweblink.state.co.us/cwcbsearch/ElectronicFile.aspx?docid=208193&dbid=0>
- Lincoln Institute Incorporating Water into Comprehensive Planning: <https://www.lincolninst.edu/incorporating-water-comprehensive-planning>
- Sonoran Institute Colorado Growing Water Smart Guidebook: <https://resilientwest.org/2018/cogws-guidebook/>
- Sonoran Institute Colorado Growing Water Smart Self-Assessment: <https://resilientwest.org/2018/growing-water-smart-self-assessment/>
- Sonoran Institute Growing Water Smart Metrics Report: <https://sonoraninstitute.org/resource/growing-water-smart-metrics-report/>

## Development Regulations

- Alliance for Water Efficiency Landscape, Irrigation, and Outdoor Water Use Resources: <https://www.allianceforwaterefficiency.org/resources/outdoor>
- City and County of Broomfield Water Wise Landscape Requirements: <https://www.broomfieldvoice.com/landscape-code-rewrite>
- City of Aspen Water Efficient Landscaping Code Standards: [https://library.municode.com/co/aspen/codes/municipal\\_code?nodet=TIT25UT\\_CH25.30WAEFLAST\\_S25.30.020ADASWAEFLAST](https://library.municode.com/co/aspen/codes/municipal_code?nodet=TIT25UT_CH25.30WAEFLAST_S25.30.020ADASWAEFLAST)
- City of Loveland Hydrozone Program Requirements: <https://www.lovelandwaterandpower.org/home/showpublisheddocument/52508/637430368874270000>
- Colorado Department of Local Affairs Model Codes: <https://dlg.colorado.gov/land-use>
- Colorado State University (CSU) Low-water Native Plants for Colorado Gardens: Mountains 7,500' and Above: <https://extension.colostate.edu/docs/pubs/native/Mountains.pdf>
- CSU Colorado Native Plant Master Program: <http://conativeplantmaster.colostate.edu/>

- CSU Extension List of Native Low-water Grasses for Eagle County: [http://www.greenco.org/images/downloadables/Colorado\\_Recommended\\_Plant\\_List.xls](http://www.greenco.org/images/downloadables/Colorado_Recommended_Plant_List.xls)
- Denver Water Water Wise Handbook: [https://www.denverwater.org/sites/default/files/2017-05/Water\\_Wise\\_Landscape\\_Handbook.pdf](https://www.denverwater.org/sites/default/files/2017-05/Water_Wise_Landscape_Handbook.pdf)
- EPA WaterSense What to Plant: <https://www.epa.gov/watersense/what-plant>
- GreenCo Crop Coefficient Plant List: [http://www.greenco.org/images/downloadables/Colorado\\_Recommended\\_Plant\\_List.xls](http://www.greenco.org/images/downloadables/Colorado_Recommended_Plant_List.xls)
- Northern Water Plant List: <https://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/fact-sheets-and-tools>
- POLARIS: <https://polaris.erams.com/docs/?token=RfIGPc7sNQ>
- South Metro Water Supply Authority's Model Landscape and Irrigation Criteria: [https://southmetrowater.org/application/files/1915/7894/2140/FINAL\\_SMWSA\\_ModelLandscapeOrdinance\\_2017-1.pdf](https://southmetrowater.org/application/files/1915/7894/2140/FINAL_SMWSA_ModelLandscapeOrdinance_2017-1.pdf)

## Building Regulations

- Uniform Plumbing Code: <https://www.iapmo.org/publications/read-uniform-codes-online/>
- Water Efficiency and Sanitation Standard for the Built Environment: <https://epubs.iapmo.org/2020/WESstand/>
- Other Codes and Ordinances
- Alliance for Water Efficiency Green Building Resources: <https://www.allianceforwaterefficiency.org/resources/green-building>
- CDPHE Regulation 86 Greywater Control: <https://cdphe.colorado.gov/water-quality/clean-water/reg-86-graywater-control>
- EPA WaterSense Homes: <https://www.epa.gov/watersense/homes-specification>
- U.S. Green Building Council LEED rating system: <https://www.usgbc.org/leed>



# Education and Communication



Water education is an investment in the future. While education and communication don't save water by themselves, raising awareness about conservation and water use is fundamental to getting people take water-saving actions (Vickers, 2001).

Impactful education campaigns effectively communicate the value of water, deliver timely and useful information to target audiences, and provide consistent and persistent messages.







The Education and Communication Best Practice Area provides guidance to help water professionals build campaigns that foster a sense of water stewardship amongst water provider customers.

This best practice area summarizes the regulatory requirements, key concepts, and costs and benefits for the following best practice.

- Designing and delivering effective **education and communication** campaigns

State Water Efficiency Plan Requirements	
	Indoor: fixtures and appliances
	Outdoor: waterwise landscapes, efficient irrigation
	Non-residential: water efficient industrial and commercial processes
	Water reuse systems: utility or building scale
	Water loss control
✓	Information and public education
	Conservation oriented rate structure and billing system
	Regulatory measures designed to encourage water conservation

## Major Benefits

Category	Definition
 <b>Water Savings</b>	Education can cultivate water stewardship and provide customers with the motivation and tools for saving water.
 <b>Economic Cost Savings</b>	Connecting customers with information about water saving opportunities (including conservation measures and leak abatement) can reduce bills for customers.
 <b>Education</b>	Education campaigns can raise awareness about the value of water, the importance of water conservation, and strategies and opportunities to conserve water.
 <b>Community/ Social</b>	Education can cultivate a greater sense of water stewardship in the community.
 <b>Environmental</b>	Education campaigns can help customers understand the full water cycle and the importance of conserving water to ensure enough remains to support healthy ecosystems. By reducing the amount of water we send down our drains every day, we can also cut down on the total amount of wastewater that we have to treat, and we can support properly functioning waste treatment systems. This is how conserving water in our homes helps to protect local water quality.
 <b>Climate</b>	Education campaigns can help customers understand the role of energy, and related greenhouse gas emissions, used in the treatment and distribution of water. Education campaigns can also help customers understand the co-benefits of well designed, water conserving landscapes, including drought resilience and urban heat island mitigation.

## Best Practice Area Key Takeaways

- **Education and outreach are linked with all other best practices.** An element of public information and education is required in nearly all other best practices.
- **Timely, useful, consistent, and persistent messaging is essential.** Effectively communicating the value of water, delivering timely information that reaches all water users, and providing consistent and persistent messages help ensure success.
- **Water education is an investment in the future.** Public information is the mortar that holds together all other program elements.
- **Awareness leads to action.** Raising awareness about water and water use efficiency is fundamental to getting people to take the next step and doing something practical that saves water directly.
- **Traditional communication channels are losing impact.** Water providers have the ability to communicate directly with traditional bill inserts and direct mail. However, as water billing becomes more and more electronic these approaches are less impactful.
- **Customized, electronic communication with customers is the future.** Water providers are rapidly gaining the ability to communicate and educate through online customer portals with alert capabilities and customized on-bill information delivered electronically.
- **Establishing and maintaining electronic contact information is essential.** Water providers must do the work of collecting and maintaining email and mobile phone numbers.

## Education and Communication

Water conservation programs cannot hope to succeed without a public information and education component. Sometimes public information by itself comprises a water provider's entire water conservation program, but for most agencies it is the mortar that holds together all other program elements. Creating awareness about conservation and water usage is essential in encouraging individuals to move beyond awareness and take practical steps that directly contribute to water conservation. For any water conservation program it is **best practice to effectively communicate the value of water, deliver timely and useful information that reaches all water users, and provide consistent and persistent messages to all customers.**

## Regulatory Requirements

The Colorado Revised Statutes (C.R.S.) require that all covered entities (water providers that deliver more than 2,000 acre-feet per year) file a water efficiency plan with the Colorado Water Conservation Board (CWCB). Entities that do not have an approved plan on file are not eligible to receive grant funding from the State. The statute defines several measures and programs that must be considered for inclusion in a conservation plan. One of these measures is, the "Dissemination of information regarding water use efficiency measures, including by public education, customer water use audits, and water saving demonstrations" (Colorado Revised Statutes, 2022) [C.R.S. §37-60-126 (4)(a)(VI)].

## Key Concepts

### Key Elements of Education and Outreach

- |  |   |
|--|---|
| <ul style="list-style-type: none"><li>• School education programs (K-12)</li><li>• Bill stuffers</li><li>• Newsletters</li><li>• Media relations</li><li>• Direct mail and marketing collateral</li><li>• Advertising campaigns (newspaper, radio, TV, web, billboards, theater slides, bus signs, etc.)</li></ul> | <ul style="list-style-type: none"><li>• Informational and educational websites</li><li>• Social media (Facebook, X - formerly called Twitter, etc.)</li><li>• Water festivals and public events</li><li>• Informational billing (customer feedback on water use patterns and leaks)</li></ul> |
|--|---|

Water conservation education and communication is a fundamental best practice. Public information and education about water conservation and water supply applies to all water providers and ideally impacts all customers. A wide variety of educational curriculum, social marketing tools, and public outreach programs may prove effective. While small water providers may not have sufficient staff or budget to implement elaborate campaigns, the fundamental principles apply to all providers.

While it does not save water by itself; it connects customers with water saving programs, increases water literacy throughout the community, and helps build trust between water providers and customers. Water providers have a variety of education and communication tools to pull from when communicating with customers.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Outreach campaign design and social marketing
- Direct communication (e.g., communication through customer portals, on-bill information, bill stuffers, radio, TV, and social media)
- School education (e.g., water education curriculum, water festivals, partner non-profit organizations)

### City of Fort Collins – Shift Your Water



Shift Your Water is a Fort Collins-based marketing campaign focused on getting customers to adjust their irrigation schedule with the changing seasons and to shut systems off in the winter. [www.fcgov.com/utilities/shiftyourwater](http://www.fcgov.com/utilities/shiftyourwater)

# Case Study

## WESTERN COLORADO CHILDREN'S WATER FESTIVAL | GRAND JUNCTION, CO

The [Western Colorado Children's Water Festival](#) has grown to be recognized as the largest of its kind in the State of Colorado. Each year, the festival brings fifth-graders together from across the Grand Valley of Grand Junction, to educate and expose them to a broad range of water-related topics and to demonstrate the vital significance of water to life, and more specifically, to life in Colorado (Western Colorado Water Festival, 2023).

Presentations are tailored to the fifth-grade learning level, with plenty of opportunity for interactive, hands-on learning. Festival organizers work closely with school districts, private schools, and home schools to match the festival experience with their water curriculum.

In the past, key festival presentations have oriented students to water-related career opportunities, water rights, water in the human body, water conservation, water pollution, water safety, water species, water treatment, water's impact on Colorado industries, and much more. For many students, the festival gives them the opportunity to interact closely with professionals and get exposure to careers in the water industry.



Figure 8. Western Colorado Water Festival

## Outreach Campaign Design and Social Marketing

There is a wide variety of informational and educational efforts and programs that water providers can offer to their customers. All of these efforts can generally be classified as **social marketing** which is defined as: **“The process of communicating with the public in an effort to change people’s behaviors for the benefit of an individual, group, or community”** (Silva, Pape, Szoc, & Mayer, 2010).

The Water Research Foundation studied customer behavior and effective communication and developed a set of six recommendations for a water outreach campaign (Silva, Pape, Szoc, & Mayer, 2010). While budget constraints often set limits on the scope and breadth of an outreach campaign, thinking strategically can help an organization make the most with limited funds. **Applying the principles and recommendations in this checklist (to the extent possible) will improve the effectiveness of a water education and information program.**

- 1. Use a strategic communications approach:** Develop a sound approach based on clear, consistent, timely and strategic communications to deliver the right message to the right audience through the right channels at the right time. A strategic communication approach requires a thorough understanding of the current situation. What are the barriers that prevent the target audience from acting upon a specific behavior? How are audiences receiving information and which messages might most compel them to action?
- 2. Define campaign objectives:** Set objectives and define the target audience. Will the campaign try and reach the entire population served or a subset of customers? Without a clear understanding of what is to be achieved and who needs to be reached, the campaign will not be focused and results may be fragmented and weak. The objectives directly determine the best strategy to take and the audience to target. Identifying distinctive objectives allows the development of activities, which target specific audiences to fulfill individual goals. For instance, some campaign activities may need to be tailored for different audiences. As an example, the “place” where messages and activities are delivered will be different for homeowners than for business owners. Defined objectives will facilitate an easier examination of the general return on investment for each audience. Monitoring and evaluating achievements over time will inform which media channel best fulfilled the goals.

- 3. Know your audience:** To successfully engage with people and motivate action and change, you must know your audience:
  - What do they know?
  - What stage of change are they in?
  - What do they like? What interests them? What motivates them?
  - What are their specific challenges and barriers to change?

In Colorado, many people have a high level of awareness about water conservation practices and make a concerted attempt to integrate water conservation practices into everyday life. Others are new to Colorado or may come from places with different attitudes and concepts about water use. A good approach to improve understanding of your audience is through survey research or focus groups. This helps develop messages aimed at overcoming informational or attitudinal barriers. There are important reasons to conserve water including saving money, improving water quality, drought, and environmental protection that may stimulate people to action. It’s important that messages be based on data and facts and focused on realistic actions and water savings.

- 4. Understand current perceptions:** Many consumers believe they are already conserving as much water as they can and then a drought comes. Events like droughts (and floods) can be powerful motivators to further water efficiency and management activities. In Colorado, outdoor water efficiency is the primary focus of many programs, because that is where the highest level of use is.
- 5. Carefully consider communications channels:** Using multiple communications channels can be effective in disseminating water information to consumers (e.g., bill inserts, radio spots, website, and social media). Coordinate messaging and maintain consistency. Past research found that water supply managers are considered to be the most credible source for water management information. This is an important advantage, particularly during a drought.
- 6. Evaluate performance:** What did the campaign achieve? The levels of evaluation are frequently divided into three basic types: process, outcome, and impact evaluation. Examples of an impact evaluation include tracking the number of customers reached, the number of clicks or engagements, or the number of participants.

## Direct Communication

### The Importance of Electronic Contact Information

Collecting and maintaining electronic contact information including email address and mobile phone number is essential to the success of future communication efforts.

Water providers can start by establishing a process to collect electronic contact information from all customers. This should include obtaining necessary permissions to use this information to contact customers directly.

Direct communication to customers includes communication through channels like customer portals, on-bill information, bill inserts, radio, TV, and social media and are tools to implement strategic outreach campaigns (see Outreach Campaign Design).

**Water providers must regularly communicate with their customers with traditional bill inserts and direct mail**, however as water billing becomes more and more electronic these approaches are less impactful. Today, water providers are rapidly gaining the ability to communicate and educate through online customer portals with alert capabilities and customized on-bill information delivered electronically. **Prioritizing these electronic direct communication opportunities is a best practice and important for water conservation program success.** Essential to the success of electronic communication efforts is the task of establishing and maintaining electronic communication with water provider customers (see Measurement and Data Best Practice Area).

An example that combines direct communication and landscape water budgets is Denver Water's Outdoor Water Use Report (Figure 9). Denver Water developed simple outdoor water efficiency targets based on landscape area (from GIS) and an annual requirement of 12 gallons per square foot. Communication is sent monthly to customers and offers a smiley face for those who stay below their budget.



Figure 9. Denver Water outdoor water use reports, based on 12 gallons per square foot

## School Education

In addition to direct communications with customers, water providers and non-profits often partner with local school districts to fund and obtain water curriculum for students and to organize water festivals. These strategies are important for building water literacy and reaching all members of a water provider's service area. Details on each are summarized below:

- **Water education curriculum:** Several organizations offer school curriculum (typically K-8 or K-12) and materials focused on water supply and water efficiency. Since developing curriculum can be expensive, it is almost always cheaper to use an existing program such as [My H2O](#) (Boulder and St. Vrain Valley School districts), [Project WET](#) (Project WET Foundation, Bozeman, MT), or [Meter Hero](#) (high school level curriculum). A number of states and regions offer free water conservation curriculum to local schools. The Texas Water Development Board created their own water education curriculum called "[Water IQ](#)", which includes a section on water efficiency, for use in Texas schools.
- **Water festivals:** Water festivals are held regularly across Colorado to educate students about water in fun, interactive environments that offer alternative learning opportunities including structured learning stations and exhibits where students engage in hands-on water activities and investigations. The [Western Colorado Children's Water Festival](#) is held annually at the Las Colonias Park and Amphitheater in Grand Junction and offers presentations and exhibits structured to the fifth-grade learning level. The [Operation Water Festival](#) has been held annually for nearly 30 years at the University of Colorado, Boulder campus. Each year around 1,200 students from Boulder Valley School District are invited to participate in a day filled with educational and interactive water presentations. Students discover how drinking water is treated, learn how to protect and conserve water, and experience the history, geology, geography and science of water. The goal of water festivals is for participating students to leave the festival empowered in their role as water stewards by connecting them to real-world issues and encouraging them to learn more.
- **Nonprofit water organizations:** Local nonprofit organizations focused on water are often valuable partners in water education and water festivals. These partnerships can highlight local watershed issues including why water efficiency matters. Nonprofits that frequently partner on water education include: [Boulder Watershed Collective](#), [Roaring Fork Conservancy](#), [Eagle River Watershed Council](#), [Arkansas River Collective](#), and [Blue River Watershed Group](#). Local groups can

expand specific education goals and can offer resources about water quality and quantity. The [Eagle River Watershed Council](#) in Eagle County is an example of an organization partnering with schools and the Eagle County Water Conservation District. Together they built a program and [website promoting waterwise landscaping](#) in the region to support landowners and HOAs in reducing landscaping water use to reduce the impact on our natural water resources and to save property owners money as the cost of providing water service increases.

### Colorado Statewide Water Education Action Plan (SWEAP)

In 2019, Colorado's Statewide Water Education Action Plan (SWEAP) was released, setting a common agenda for improving public awareness and engagement regarding water issues statewide. The goal of SWEAP is to create coordinated, well-funded, and impactful education, outreach, and public engagement achieving measurable outcomes by 2025. The project kicked off with the Water 2022 public awareness campaign launched by Governor Polis. More information and additional resources can be found at: [www.cowateredplan.org/.](http://www.cowateredplan.org/)





# Case Study

## “USE ONLY WHAT YOU NEED” CAMPAIGN | DENVER WATER

Adapted from Ann Baker, Denver Water Communications and Marketing (Denver Water, 2023).

Maybe it was the time a giant toilet ran across Mile High Stadium to a stunned crowd, getting tackled by a security guard as the scoreboard blared: Stop Running Toilets. Or maybe it was when professional landscapers and horticulture professors wrote disgruntled letters about billboards and radio spots that joked, “Grass is Dumb.”



Figure 10. Use Only What You Need campaign example

At some point from 2006-2016, Denver Water’s signature orange box asking customers to Use Only What You Need became advertising legend in the metro area, winning countless awards, prompting dozens of requests to buy the rights for the campaign, and even eliciting interest for use on specialty license plates. The campaign came to a close in 2016, making way for a more broad-range message that will go beyond conservation and focus on other issues, including water quality, recreation and long-range planning, among others.

The Use Only What You Need campaign began in 2006, just as the region was recovering from a debilitating drought. Denver’s Board of Water Commissioners challenged customers to reduce their use 22% by the end of 2016, a massive undertaking that required an attack on several fronts, through audits, rebates, rates and, of course, advertising.

“

*We had to cut through the clutter,” McGuire- Collier said. “The drought had gotten our customers’ attention, and we had to strike while they were watching.*

”



Figure 11. Use Only What You Need campaign example

So every year, Use Only What You Need set out to shock Denver Water customers. (Almost) naked people walked through crowds with an orange sandwich board that read: Use Only What You Need. A taxi stripped down to just what was needed to be street legal — basically headlights, tires and a steering wheel — appeared at community events with the same simple, but prudent, message.

It was modern, often outrageous, and sparked a conversation throughout the city. It also worked. **During the campaign, customers reduced their water use by more than 20%, despite a 15% population increase.**



Figure 12. Use Only What You Need campaign example

“Use Only What You Need made people think twice about their water use,” said Jeff Tejral, Denver Water manager of water efficiency. “The culture has since changed and water use has changed,” Tejral said. “We need to capture that success and move forward.”

“

*Now the push will be to create a two-way dialogue with customers all year long, instead of only during irrigation season. It’ll help people see Denver Water as experts while teaching them about what their water provider has to offer, said Kathie Dudas, Denver Water’s marketing manager.*

”

## Costs, Benefits, and Water Savings

### Costs

**Water Provider Perspective:** Costs for the water provider will vary depending on the type of outreach and education. All activities will require staff time for administration. Additional considerations for common activities are summarized below:

- **School curriculum:** The costs for school curriculum can be paid by the water provider or shared with the school district, but free and low-cost curriculum exist. Cost should not be a barrier to implementation in Colorado. Programs like [MeterHero](#), geared at high school students may cost about \$20 - \$25 per student. Grant funding for education and outreach efforts may be available from the CWCB and/or the Colorado River District.
- **Public outreach:** Public outreach programs in Colorado have ranged from \$500 to \$1,000,000 per year. Cost depends on the type of program and the level of implementation. An annual outreach program budget between \$15,000 (small agency with fewer than 5,000 connections) and \$75,000 (up to 25,000 connections) should be sufficient to implement a basic print media and bill stuffer campaign. A larger budget will be required to implement a customer portal or a mixed media program with web, billboards, and radio spots.
- **Television:** Television is probably the most expensive media both in terms of production and placement. In Colorado, the only advertising campaign sufficiently funded to even consider commercial television opportunities was Denver Water's 2006 – 2016 "Use Only What You Need" campaign. Public access channels offer the possibility of low-cost television spots, but viewership is often limited. Free TV coverage is occasionally possible. Some television and radio stations will air well-produced public service announcements for civic causes such as water conservation at significantly reduced or no cost. If a radio or television campaign is desired this is another angle to explore.
- **Water festivals:** The cost for producing water festivals is usually shared among many organizers. Water Festivals such as the Western Colorado Children's Water Festival are often sponsored by multiple water providers, businesses, educational institutions, and more.

### Benefits

**Water Provider Perspective:** Water education and outreach campaigns provide benefits including:

- Educating young people about water, water supply, and efficiency.
- Alerting customers to leakage or higher than expected water use.
- Increasing participation in all water provider programs.
- Informing customers about different program offerings.
- Educating customers about water conservation methods and the importance of conservation.
- Framing the provider as a wise steward of essential water resources.
- Framing the provider as a knowledgeable source of information about water use and conservation.

## Costs

**Customer Perspective:** There are no direct customer costs associated with customer education programs.

## Benefits

**Customer Perspective:** Information and education are a direct benefit to customers. Knowledge and information on efficient water use practices helps customers make informed decisions and allow people to take advantage of available opportunities for water savings.

## Water Savings Assumptions

Water providers should not rely on any water savings from a public outreach campaign alone. While it is possible that a campaign will stimulate customers to more swiftly adopt conservation practices, it is more realistic to take a longer view of program impacts. Conservation outreach programs help establish a culture of wise water stewardship, which over time results in behavior change and effective action such as replacing inefficient fixtures and appliances. Conservation marketing efforts may also increase participation levels in other sponsored programs such as landscape assessments or rebates.

Don't determine the success of a water public outreach campaign based exclusively on measured changes in water use. Instead, focus on the campaign activities themselves. For example, did the advertising effectively reach the intended audience members? How many customers were reached?

The impact of conservation education and outreach campaigns can be measured over time through survey research. It is also important to keep track of other metrics such as participation. Changes in overall water use should also be tracked but it is nearly impossible to credit water savings to an education and outreach program alone, except perhaps during a drought where customer response is mandated.

# Case Study

## “LIVE LIKE YOU LOVE IT” CAMPAIGN | COLORADO WATERWISE

In 2014, Colorado WaterWise launched the Live Like You Love It® campaign: a statewide, public education campaign designed to cultivate good stewards of an essential natural resource. There have been other attempts to develop a statewide Colorado water social marketing campaign such as the Water'22 campaign, but none with the success or longevity of Live Like You Love It.

One of the central and unique factors of the campaign is its emphasis on the real emotional connection Coloradans have to water. It encourages Coloradans to learn about water issues, to voice opinions to elected officials, and to take action to support water conservation and improve water quality statewide through water management and planning.

The Live Like You Love It campaign is intended to augment local water efficiency programs, while providing a unified message. Over the first 10 years of the campaign, Colorado WaterWise developed a library of co-brandable campaign materials with engaging graphics and vital messages. Available materials include ADA compliant fact sheets, ads, banners, social media resources and more. All materials are available in English and Spanish and are free to all members of Colorado WaterWise and updated each year. Colorado WaterWise has also produced an outreach guide to help water providers and other organizations leverage these resources. Learn more on the campaign's website, [www.lovecoloradowater.org](http://www.lovecoloradowater.org).

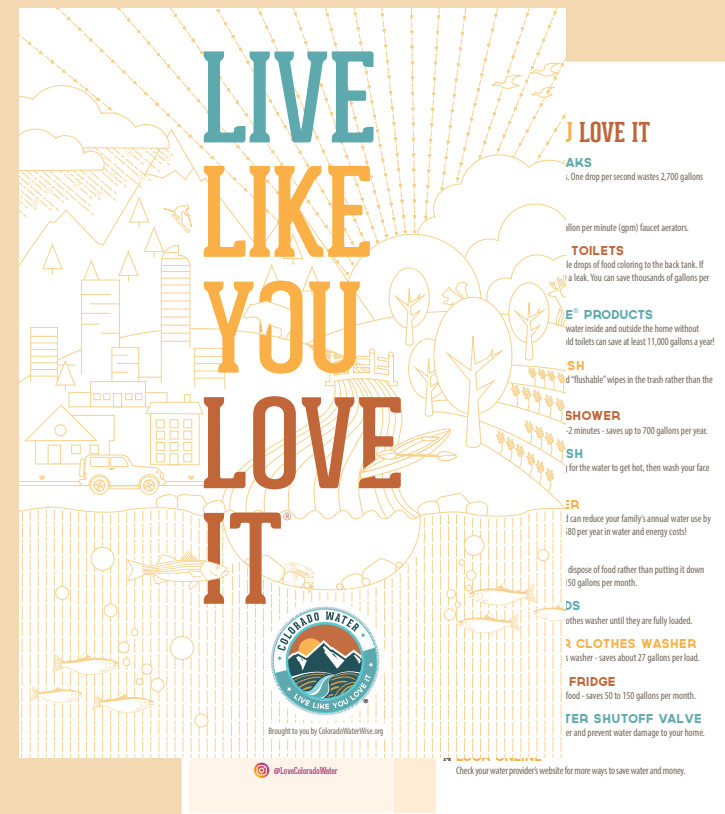


Figure 13. Indoor conservation fact sheet

# Resources

## Education and Communication

- Arkansas River Watershed Collaborative: <https://www.arkcollaborative.org/>
- Beyond Lawn: <https://beyondlawn.org/>
- Blue River Watershed Group: <https://www.blueriverwatershed.org/>
- Boulder Watershed Collective: <https://www.boulderwatershedcollective.com/>
- City of Boulder Operation Water Festival: <https://bouldercolorado.gov/news/operation-water-festival>
- City of Fort Collins Shift Your Water: <https://www.fcgov.com/utilities/shiftyourwater>
- Colorado Statewide Water Education Action Plan: <https://www.cowateredplan.org/>
- Colorado WaterWise: Live Like You Love It: <https://lovecoloradowater.org/>
- Community Based Social Marketing: <https://cbsm.com/about>
- Denver Water Outdoor Water Use Report: <https://www.denverwater.org/residential/rebates-and-conservation-tips/outdoor-water-use-report>
- Denver Water Use Only What You Need History: <https://www.denverwater.org/about-us/history/use-only-what-you-need>
- Eagle River Watershed Council: <https://erwc.org/>
- Roaring Fork Conservancy: <https://roaringfork.org/>
- Stem Hero Curriculum Meter Hero: <https://meterhero.com/>
- Thornton Water: <https://www.thorntonwater.com/h2overhaul/>
- University of Colorado: My H2O Curriculum Guide: [https://instaar.colorado.edu/uploads/content-pages/Explore%20Our%20Science/MyH2O\\_teachers\\_curriculum\\_guide\\_and\\_kit.pdf](https://instaar.colorado.edu/uploads/content-pages/Explore%20Our%20Science/MyH2O_teachers_curriculum_guide_and_kit.pdf)
- Water Education Colorado: <https://www.watereducationcolorado.org/>
- Water Education Foundation Project WET Curriculum: <https://www.watereducation.org/general-information/project-wet-guide>
- Western Colorado Children's Water Festival: <https://www.wcwaterfestival.org/>





# Indoor Water Use



Indoor water use comprises roughly 50% of residential use. Non-residential indoor water use varies by business type. Despite this diversity, non-residential indoor strategies have incredible water savings potential with annual program savings estimates ranging between 500,000 and 730 million gallons a year (Dziegielewski B. , 2016). Ensuring both residential and non-residential customers have high-efficiency fixtures is a fundamental component of indoor water conservation; however, when it comes to indoor efficiency opportunities, not all customers are the same. For example, as technology has advanced over time, so has the efficiency of fixtures in newer development. An effective indoor water use conservation program will adapt offerings to align resources with sectors and customers most in need of improvements but who have historically been overlooked in water conservation programs.







In addition to fixture efficiency, another key indoor best practice is helping customers identify and address leaks can help reduce unnecessary water waste. A simple toilet leak can waste up to 10,000 gallons a year. The Indoor Water Use Best Practice Area provides recommendations for developing effective programs that help customers improve indoor water efficiency and reduce water waste from leaks.

This best practice area summarizes the regulatory requirements, key concepts, and costs and benefits for the following best practices:

- **Targeting users** with indoor efficiency programs based on their specific needs, to increase program effectiveness, especially if resources are limited.
- Establishing **residential indoor efficiency** programs that support the installation of higher efficiency fixtures.
- Establishing **non-residential indoor efficiency** programs that address the diversity of indoor water efficiency and conservation opportunities.
- Establishing strategies to support **customer leak detection** to reduce water waste.

State Water Efficiency Plan Requirements	
✓	Indoor: fixtures and appliances
	Outdoor: waterwise landscapes, efficient irrigation
✓	Non-residential: water efficient industrial and commercial processes
	Water reuse systems: utility or building scale
✓	Water loss control
	Information and public education
	Conservation oriented rate structure and billing system
	Regulatory measures designed to encourage water conservation

## Major Benefits

Category	Definition
 <b>Water Savings</b>	Fixture retrofits and indoor strategies save water and reduce water use.
 <b>Economic Cost Savings</b>	Indoor water savings can reduce or delay the need for costly water supply and/or infrastructure development.  Customers who participate in indoor water programs may realize cost savings on their water bills.
 <b>Education</b>	Targeting users allows water providers to educate customers more effectively.  Customer leak detection programs can empower customers to identify and eliminate leaks.
 <b>Community/Social</b>	Indoor water use best practices are some of the most important for supporting low-income customers, who primarily use water indoors.
 <b>Environmental</b>	Reductions in indoor water use increase water availability for other beneficial uses.
 <b>Climate</b>	Reductions in indoor water use reduce greenhouse gas emissions for the treatment of water and wastewater, and the distribution of water.

## Best Practice Key Takeaways

Key takeaways for each best practice include:

- **Targeting Users**
  - **Strategically targeting high water users** is key for maximizing impact and success in the indoor sector. Identifying high-indoor water users can help resources go to customers with the highest potential for savings.
  - **Indoor programs are essential for developing equitable water conservation programs.** Low-income customers' predominant end uses are indoors. Indoor programs should be designed to support customers in replacing outdated and inefficient equipment.
- **Residential Indoor Efficiency**
  - It is critical to **ensure programs encourage installation of equipment that goes beyond current minimum plumbing standards.**
  - Compared to rebates, **direct installation programs** are the best practice for supporting indoor water efficiency in residential settings.
- **Non-residential Indoor Efficiency**
  - Non-residential water use is extremely variable. The first step and best practice for the non-residential sector is to **classify all non-residential customers by use type (e.g., office, hospital, etc.).**
  - **Non-residential water assessments should be paired with rebate programs** to maximize program impact and success.
  - When resources are available, **custom water rebates** create more flexibility to support non-residential water customers.



## Targeting Users

For many water providers, indoor water use makes up roughly 50% of overall water use. While most indoor water use is considered non-consumptive in Colorado (e.g., it is treated and returned to a water source with minimal loss), saving water indoors allows for water to be put to other beneficial uses and, therefore, remains a best practice for water conservation programs. Unlike outdoor programs, however, the adoption of regulations promotes efficient fixture installation through natural replacement. The question becomes: how can entities maximize their water conservation impact in the indoor sector?

While not a water conservation practice by itself, targeting programs to high water users or entities with older fixtures can increase program effectiveness, especially if resources are limited. By directing funds or time to the high-water users, programs are more likely to have a larger impact and make conservation efforts more cost effective. Targeting also plays a role in equitable program delivery by ensuring low-income or underserved populations, where decreasing indoor water use continues to be particularly important, have access to programs that help save water and reduce costs.

## Regulatory Requirements

**Plumbing code** and **fixture standards** play a critical role in determining the efficiency of indoor water fixtures and can help water providers target users based on the age of their home. Residential and non-residential fixture standards have changed over time (Table 8 and Table 9). In addition changes from the Energy Policy Act, enacted in 1994, Colorado became a “WaterSense State” in 2016 ([SB14-103](#)). As a result, all bathroom faucets, showerheads, tank-toilets, and urinals sold in any retail store after January 1, 2016 must be watersense certified. This information can help water providers target customers based on the age of their homes (e.g., homes built prior to 1994 may be more likely to have toilets that use 3.5 gallons per flush (gpf) or more).

Table 8. Common residential fixture standards through time

Fixture	Pre-1994	1994 – 2016	Post 2016
Relevant Legislation		1992 Energy Policy Act, enacted in 1994	2014 Colorado WaterSense State, enacted in 2016
Tank Type Toilet	3.5 gpf or more	1.6 gpf	1.28 gpf
Showerhead	3.0 gpm or more	2.5 gpm	2.0 gpm
Bathroom Aerator (for private use)	-	2.2 gpm	1.5 gpm
Kitchen Aerator	-	2.2 gpm	-

Table 9. Common non-residential fixture standards through time

Fixture	Pre-1994	1994 – 2016	Post 2016
Relevant Legislation		1992 Energy Policy Act, enacted in 1994	2014 Colorado WaterSense State, enacted in 2016
Tank Type Toilet	3.5 gpf or more	1.6 gpf	1.28 gpf
Urinals	1.5 gpf	1.0 gpf	0.5 gpf
Showerhead	3.0 gpm or more	2.5 gpm	2.0 gpm
Flushvalve Toilet	-	1.6 gpf	-
Bathroom Aerator	-	2.2 gpm	-
Kitchen Aerator	-	2.2 gpm	-

## Key Concepts

While not a water conservation practice by itself, targeting programs to high water users or entities with older fixtures can increase program effectiveness, especially if resources are limited. By directing funds or time to the high-water users, programs are more likely to have a larger impact and make conservation efforts more cost effective. Targeting also plays a role in equitable program delivery by ensuring low-income or underserved populations, where decreasing indoor water use continues to be particularly important, have access to programs that help save water and reduce costs.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- High-water Users
- Building Characteristics
- Low-income

### High-water Users

In any program, targeting the highest water users for education or to promote programs is a good strategy. How to target depends on data availability and the amount of time staff can dedicate to the effort. Two options – one a lower-level effort and one a higher effort – for identifying customers that could be used in targeted outreach include:

- **Low level of effort - Top Quartile:** High demand customers can be identified as the top quartile of water users in a specific sector (e.g., residential, multifamily, or commercial) on an annual or seasonal basis. If the goal is to target high indoor users, look at winter months when customers will not be irrigating. For example, water conservation program offerings could be sent to the top 25% of residential users based on the highest water users in January, February, and March.
- **Higher level of effort - Winter Quarter Average (WQA):** If one meter serves a building/house and the irrigation system, indoor use may need to be estimated. To separate indoor versus outdoor use, entities can calculate a customer's winter quarter average (WQA) as a proxy for indoor water use. As a rule of thumb, identifying the top 10 – 25% of customers based on their WQA targets high indoor water users. Using multiple years of water use data, and discounting drought years can improve data used for targeting. WQA is also often used to calculate wastewater fees, so a water provider may already have a mechanism for calculating. For this approach, if separate irrigation meters are not

required for non-residential customers, it is important to consider cooling towers, or other indoor processes that may increase summer use, when estimating indoor water use. See the Non-residential Indoor section for additional information.

### Winter Quarter Average (WQA)

Winter quarter average is a common methodology for estimating indoor use when there is one meter that provides water for both indoor and outdoor uses (e.g., most residential customers, some non-residential customers). To estimate the portion of water used indoors, winter month water use (e.g., Jan, Feb, and Dec) when a customer would not be irrigating, can be averaged. It can then be assumed that this average is the indoor base in the summer months, and that anything over this average is used for outdoor purposes. WQA is often used to calculate wastewater fees, so a water provider may already be performing this calculation on a per customer basis.

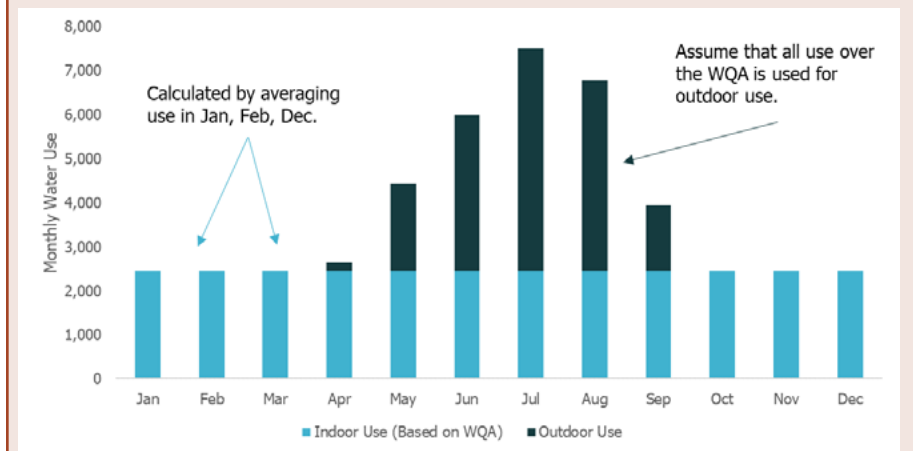


Figure 14. Example of how to calculate winter quarter average (WQA)

## Building Characteristics

While sometimes related to high water users, another strategy for targeting customers is based on a building's characteristics. Older homes and certain businesses may be more likely to have outdated equipment. Additionally, for non-residential customers targeting by business type can help customize opportunities depending on the processes that are likely to be on site.

- **Residential building characteristic considerations:** Federal toilet regulations changed in 1994. Multifamily properties and homes built prior to 1994 may have toilets that use 3.5 gallons per flush or more. With Colorado becoming a WaterSense State in 2016, natural replacement of high efficient toilets that use 1.28 gallons per flush or less, as well as efficient showerhead and aerators is happening via natural replacement (see Building Regulations for additional information). Anecdotally, some hypothesize that the sweet-spot for targeting are homes built in the 1980s and early 1990s, because older homes are more likely to have already replaced older fixtures.
- **Non-residential building characteristic considerations:** Like residential homes, older non-residential businesses are likely to have older fixtures (pre-1994). Additionally, because water use in the non-residential sector can vary so widely (e.g., office building water use vs. hotel water use) knowing business types can be very helpful. Some of the most commonly targeted non-residential customers include municipal and government buildings, schools/colleges, office buildings, restaurants, and hotels (Dziegielewski B. , 2016). For a more specific list, the [California Water Efficiency Partnership](#) and a coalition of water providers developed a set of 19 non-residential water user categories for water providers. This is an excellent starting point for Colorado water providers interested in classifying their non-residential customers to consider.

## California Non-residential Water Use Classifications

1. Water Recreation (e.g., public pools / water parks)
2. Recreation, non-water (e.g., athletic facilities, entertainment facilities, parks / cemeteries, golf course)
3. Food/Beverage (e.g., full service, fast food)
4. Laundry (e.g., laundromats, commercial / industrial laundries)
5. Lodging (e.g., hospitality, retirement homes)
6. Healthcare (e.g., hospitals, medical offices, medical and laboratory equipment and processes)
7. Offices
8. Public Services (e.g., government, prisons and correctional facilities)
9. Sales (e.g., retail, shopping centers / malls, grocery stores and food markets)
10. Services (e.g., auto, personal)
11. Religious Buildings
12. Education
13. Vehicle Wash
14. Industrial, non-manufacturing (e.g., temperature-controlled warehouses, non-temperature controlled warehouses)
15. Manufacturing (e.g., aerospace, metal finishing industries; plating, printed circuit boards, metal finishing; food processing, beverage manufacturing; high-tech industry (server facility / data center); petroleum refining, chemical industries; pharmaceutical, biotech; power plants)
16. Utility
17. Mixed Use Commercial (e.g., strip malls, shopping centers, commercial spaces that are subject to frequent changes of tenants with different water use profiles to meet their corresponding business needs)
18. Dedicated Irrigation Meter
19. Others (cannot be adequately categorized into the above categories)

Table 10. Data sources for classifying customers

Data Source	Description	Common Attributes	Considerations
<b>County Assessor Property Tax Data</b>	County Assessors are responsible for “discovering, listing, classifying, and valuing all property in a county in accordance with state laws.” As a result many County’s have datasets with valuable information on build dates, square footage, business type, etc. The type of data and format varies by County.	<ul style="list-style-type: none"> <li>• Year Built</li> <li>• Year Remodel</li> <li>• Total Square Feet</li> <li>• Property Type</li> <li>• Business Type</li> </ul>	<p>When using assessor’s data, it is important to understand how up to date the assessor’s data is, as well as how it compares to meter locations.</p> <p>Merging assessor’s data with water provider data can be difficult, especially for multifamily properties, as well as irrigation meters.</p>
<b>North American Industry Classification Systems (NAICS) codes</b>	NAICS is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy.	<p>Sector (first three digits), subsector (next 4 digits), NAICS Industries (5-digits)</p> <p>Example:</p> <p>44111: Motor Vehicle and Parts Dealers, Automobile Dealers, New Car Dealers</p>	Because NAICS has multiple levels, with varying detail, it is important to determine which level to use in categorizing. There are 20 sectors, 96 subsectors, and 306 industry groups.
<b>Standard Industrial Classification (SIC) codes</b>	SICs codes comprise of a four-digit classification. NAICS codes officially replaced SICs codes in 1997; however, some entities still use SIC codes today.	<p>Major sector (first two digits), Subsector (third digit), Business specialization (last digit)</p> <p>Example:</p> <p>3672: Electronic and Other Equipment, Electronic, Component and Accessories, Printed Circuit Boards</p>	NAICS officially replaced SICs codes in 1997. As a best practice, use of NAICS codes is recommended, not SIC codes.
<b>Reonomy Data</b>	Complete database of both property owners and tenants, regardless of who is the water provider customer.	<ul style="list-style-type: none"> <li>• Property Records by Address or Owner</li> <li>• Tenant Records</li> </ul>	Reonomy data can be valuable if a community has a high percentage of renters, however Reonomy data is not free.

## Non-residential Water Benchmarking

**Requiring or encouraging entities to benchmark water use can help water providers identify high water users and encourage more efficient practices for those users.** Currently, there are no regulatory requirements to support water benchmarking. However, related regulatory requirements have emerged in the energy sector. [House Bill 21-1286](#) created the [Colorado Building Performance Program](#) and established energy building benchmarking and performance standards. Under the Colorado Building Performance Program, all owners of commercial, multifamily, and public buildings 50,000 square feet or larger must benchmark their building's energy use and meet building performance targets defined by the state.

While House Bill 21-1286 only requires energy benchmarking, some communities have recognized the parallel benefits of requiring water benchmarking. The City of Fort Collins is one of the few entities that also requires water use be reported and benchmarked via their [Building Energy and Water Scoring municipal code](#). Reporting is required annually, and results are published via [Building Energy and Water Scoring](#) interactive map. For more information on metering and benchmarking, see the Measurement and Data best practice area.

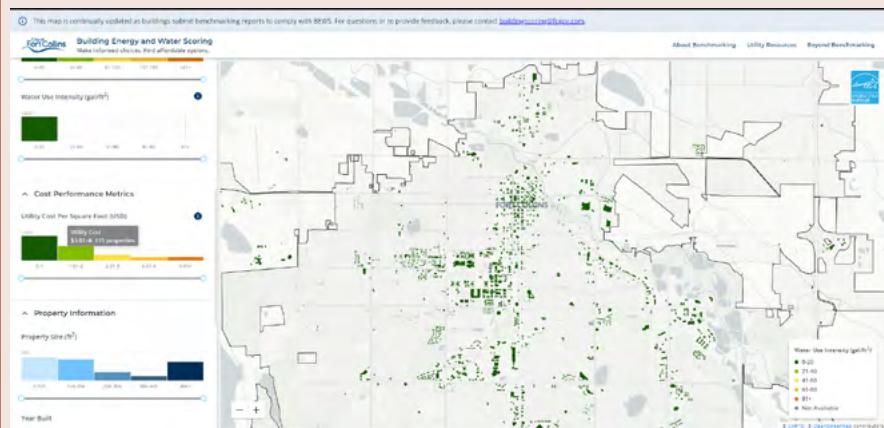


Figure 15. Fort Collins Utilities building energy and water scoring map

## Low-income

As water costs rise, affordability and water conservation programs that support low-income customers are important. For this sector, indoor water conservation programs are particularly important because outdoor use tends to be very minimal. Low-income households are also more likely to have inefficient plumbing but are also less likely to spend disposable income on retrofits (NRDC, 2022). They also may face additional barriers to participation if they rent or reside in a mobile home community.

In Colorado, a 2017 study found that 372 of 1,249 Colorado's census tracts were at "high-risk" or "at-risk of a water affordability crisis" (Mack & Wrase, 2017). Some of the regions identified in the study included Denver, Pueblo, Colorado Springs, and Alamosa, as well as many communities on the eastern plains.

To reach these customers, entities need to be able to identify their low-income customers, renters, and mobile home communities. The definition of "low-income" however varies by organization. The EPA considers drinking water affordable if water costs do not exceed 2.5% and wastewater costs do not exceed 2% of an area's median household income (MHI) (AWWA, 2013). Table 11 summarizes "low-income" definitions that are used across the state to determine program eligibility and/or identify low-income customers.

## Median Household Income (MHI)

Median Household Income (MHI) is a common metric used to evaluate a community's economic health. While the definition can vary depending on agencies, the metric is usually calculated by combining the gross income, before taxes, of all members of a household over a certain age (commonly 15 years old). The Colorado State Demography Office summarizes the most recent Census data MHI for counties across Colorado. More information at: [demography.dola.colorado.gov/](https://demography.dola.colorado.gov/).

Table 11. Low-income definitions

Source	Definition
<b>Colorado Low-income Energy Assistance Program (LEAP)</b>	<p>If a customer’s income is up to 60% of the state median income level, a customer may qualify for heating assistance through LEAP. The state median income level used for the 2022-23 LEAP season was released by the U.S. Department of Health and Human Services in July 2022. The amount of the energy assistance benefit varies depending on a variety of factors, including the primary heating fuel costs and income.</p> <p>In determining a customer’s maximum gross monthly income, household refers to all people living in a household and for whom the customer is financially responsible (Colorado Department of Human Services, 2023).</p>
<b>Colorado Affordable Residential Energy Program (CARE)</b>	<p>A household is at or below <u>80% of the area’s median income</u>.</p> <p>If anyone in the home participates in one of the following assistance programs, a home automatically qualifies (with proof of benefit):</p> <ul style="list-style-type: none"> <li>• Aid to the Blind (AB)</li> <li>• Aid to the Needy Disabled (AND)</li> <li>• Supplemental Nutrition Assistance Program (SNAP)</li> <li>• Old Age Pension (OAP)</li> <li>• Section 8 Housing</li> <li>• Women, Infants, and Children (WIC)</li> <li>• Temporary Aid to Needy Families (TANF)</li> <li>• LEAP (Utility Bill Assistance)</li> <li>• (Energy Outreach Colorado , 2023)</li> </ul>
<b>Colorado Revised Statutes Title 39. Taxation</b>	<p>“Low-income household” means an individual or family whose total income is no greater than 30% of the area median income.</p>
<b>Colorado EnviroScreen</b>	<p>Environmental justice mapping tool based on demographics information and environmental factors like pollution, environmental exposures, environmental vulnerability, and climate burden. A higher “EnviroScreen score” indicates an area is at greater risk of being affected by environmental health injustice.</p>

### Water Affordability Advocacy Toolkit

NRDC’s Water Affordability Advocacy toolkit is a resource for water conservation professionals to address gaps and promote equitable water access throughout the communities they work in. To learn more visit: [www.nrdc.org/resources/water-affordability-advocacy-toolkit](http://www.nrdc.org/resources/water-affordability-advocacy-toolkit).

When determining low-income qualifying criteria, it may be beneficial to explore and adopt definitions from other established organizations. Additionally, once defined it is important to be strategic and thoughtful on how programs are designed to reach these customers. These details are discussed in greater detail in the Residential Indoor section.

### Justice40 Data

Justice40 data highlights disadvantage communities by Census tract. Communities are highlighted as disadvantaged if they:

1. Are at or above the threshold for one or more environmental, climate or other burden.
2. Are at or above the threshold for an associated socioeconomic burden.
3. A census track is completely surrounded by disadvantage communities and is at or above 50<sup>th</sup> percentile for low-income.

Indicators Justice40 data consider include: climate change, energy, health, housing, legacy pollution, transportation, workforce development, and water/wastewater. To be identified as disadvantage in the water/wastewater category the community is at or above the 90<sup>th</sup> percentile for leaking underground storage tanks and release of toxic wastewater discharge and or at the 65<sup>th</sup> percentile for low-income. More information can be found at: [www.whitehouse.gov/environmentaljustice/justice40/](http://www.whitehouse.gov/environmentaljustice/justice40/).

## Costs, Benefits, and Water Savings

<i>Costs</i>		<i>Benefits</i>	
<b>Water Provider Perspective:</b> Outside of staff time to update targets there are no costs to the water provider unless additional data are purchased to help with targeting. Fortunately, most data are freely available.		<b>Water Provider Perspective:</b> While targeting takes time, and does not immediately yield any water savings, it can improve program efficiency and help maximize staff time especially when limited staff resources are available.	
<b>Customer Perspective:</b> There are no direct customer costs associated with targeting water users.		<b>Customer Perspective:</b> If used for outreach or to promote specific programs, a customer may receive information that is more applicable to them. However, overall, there are no direct benefits to a customer.	
<i>Water Savings Assumptions</i>			
Targeting is not a water saving strategy by itself; however, it hopefully will connect customers with the highest need or water savings potential to strategies that will help them save water. These strategies are discussed in the Residential Indoor and Non-residential Indoor sections.			

# Residential Indoor Efficiency

For residential properties, roughly 50% of household water is used indoors (Waskom & Neibauer, 2014). The top five indoor residential water uses are:

1. Toilets
2. Showers
3. Clothes washing
4. Faucet
5. Leaks

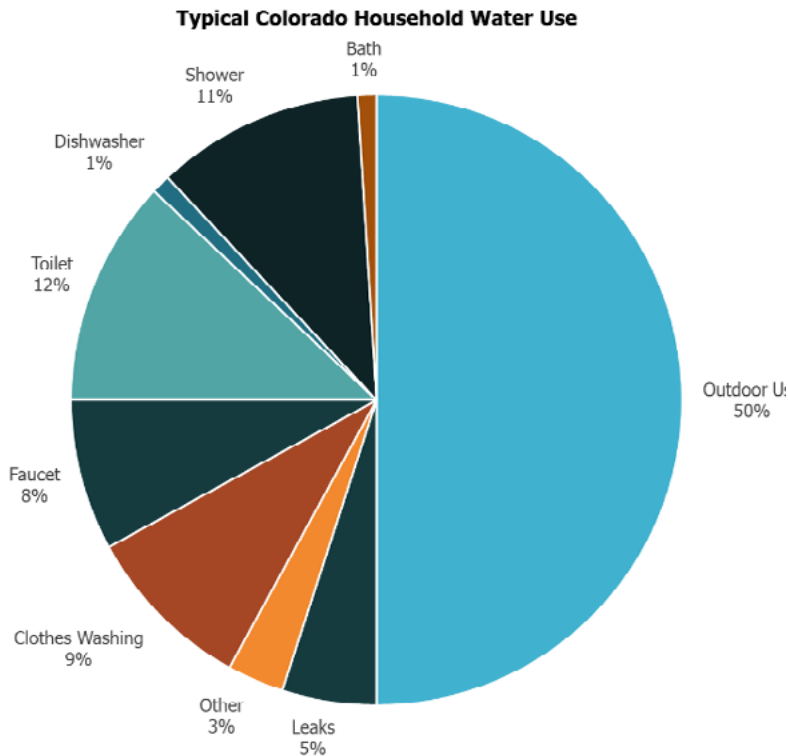


Figure 16. Typical Colorado household water use  
Source: (Waskom & Neibauer, 2014)

## Gallons Per Capita Per Day (GPCD)

Gallons per capita per day (GPCD) is a common water efficiency metric that is calculated by taking the total annual treated demand and dividing it by the total population and then by 365 (days). While it is not a perfect metric, because total treated demand includes non-residential customers that aren't represented in the total population, it is a common metric used among water providers to track water use in relation to population growth over time.

Over the past thirty years, improvements in fixture efficiency, regulation, as well as water conservation programs, have had a noticeable impact on residential indoor water use. The 1999, residential end use study reported that average indoor gallons per capita per day (GPCD) of 69.3 (Water Research Foundation, 1999). The 2016 residential end use study reported indoor GPCD to be 58.6, a 15% reduction in 17 years (DeOreo W. B., Mayer, Dziegielewski, & Kiefer, 2016). Flume, which collects and reports on indoor water use data across the United States, reported an indoor GPCD in 2021 of 46.5. This is a 32% reduction from 1999 and 20% reduction from 2016. A lot of this reduction is likely due to natural replacement of fixtures. In designing residential strategies, it is important to consider the natural replacement of low-efficiency fixtures and how/if rebate, or other programs are needed to help accelerate installation.

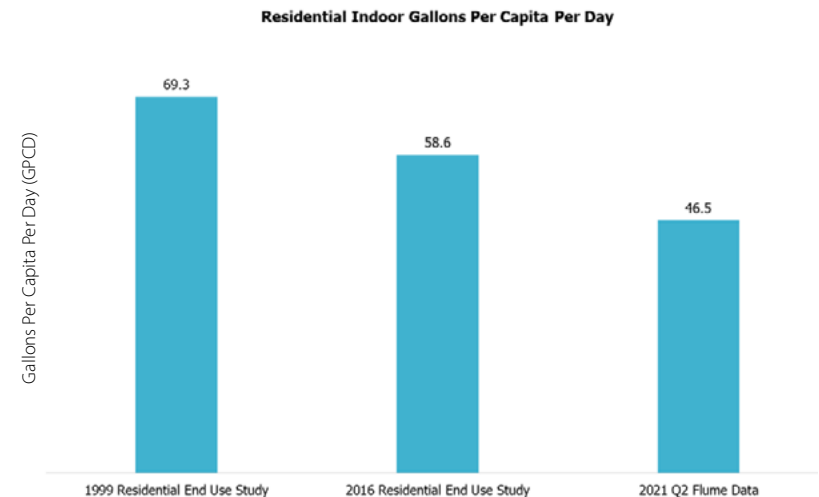


Figure 17. Residential indoor gallons per capita per day trend  
Source: (Flume & Mayer, 2022)



## Regulatory Requirements

**Plumbing code** and **fixture standards** play a critical role in determining the efficiency of indoor water fixtures. Water providers should be aware of the current minimum standards to **ensure programs encourage installation of equipment that goes beyond current minimum standards** (Table 12). See the Development and Codes Best Practice Area for more information on plumbing codes.

In 2016, [Senate Bill 14-103](#) established Colorado as a WaterSense State. In residential settings, this means that **Colorado's efficiency standards are higher than the federal standards for toilets, showerheads, and residential bathrooms aerators** (Table 12). Other fixtures, such as dishwashers and clothes washers, must adhere to federal standards. See the Water Savings Assumptions section for a complete list of federal standards and how they have changed over time. In Colorado, communities are permitted to adopt standards that exceed both the federal or state standards.

Table 12. Common residential fixture standards through time

Fixture	Pre-1994	1994 – 2016	Post 2016
<b>Relevant Legislation</b>		1992 Energy Policy Act, enacted in 2014	2014 Colorado WaterSense State, enacted in 2016
<b>Tank Type Toilet</b>	3.5 gpf or more	1.6 gpf	1.28 gpf
<b>Showerhead</b>	3.0 gpm or more	2.5 gpm	2.0 gpm
<b>Bathroom Aerator (for private use)</b>	-	2.2 gpm	1.5 gpm
<b>Kitchen Aerator</b>	-	2.2 gpm	-

When designing indoor programs, it is also important to be aware that currently the **Internal Revenue Service (IRS) considers receipts over \$600 to be taxable income unless there is a policy detailing the receipt as being tax exempt**. While energy rebates have been tax exempt since 1992, the IRS does not have a specific policy regarding water efficiency rebates. As a result, some water providers require 1099s for rebates over \$600. This can be a significant disincentive for customers to participate in rebate programs.

## Key Concepts

For residential properties, roughly 50% of household water is used indoors (Waskom & Neibauer, 2014). A best practice to improve water efficiency in indoor residential end uses is via programs that encourage installation of efficiency equipment. For water providers this is either via rebates or direct installation programs. When designing these programs, however, it is important to consider how plumbing fixture minimums dictate what equipment to rebate/replace, equity considerations to promote installation, and how programs will be administered.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Rebate Programs
- Home Assessment and Direct Installation Programs

### Rebate Programs

Rebate programs are common water conservation programs for promoting indoor water efficiency. Once set up, these programs are fairly easy to administer, especially if the water provider partners with another organization, such as the energy utility or other non-profits. Table 13 summarizes steps and considerations when designing a rebate program.

#### Water Conservation Rebate Tax

Currently, the Internal Revenue Service (IRS) considers receipts over \$600 to be taxable income unless there is a policy detailing the receipt as being tax exempt. While energy rebates have been tax exempt since 1992, the IRS does not have a specific policy regarding water efficiency rebates. As a result, some water providers require 1099s for rebates over \$600. Understandably, this can be a large disincentive to participate in programs.

Until federal law is clarified on this issue, water providers have options. Water providers should consider the reasons that rebate payments are or are not taxable under current law. Additionally, water providers can also explore alternative structures for rebate programs that navigate the taxability question (e.g., bill credits vs cash rebates or supporting direct install programs). More information about non-taxability of rebates can be found [here](#).

In addition, a large group of organizations including Alliance for Water Efficiency, WaterNow Alliance, and the Western Urban Water Coalition continue advocating to clarify this part of the tax code for water customers and water providers across the country. More information can be found [here](#).

Table 13. Considerations for residential rebate programs

Program Component		Considerations
<b>Equipment</b>	What equipment to include in the program?	Equipment availability and cost
<b>Efficiency Criteria</b>	What is the efficiency level targeted by the incentive program?	Ensure criteria goes beyond Colorado WaterSense state standards.
<b>Incentive Amount</b>	What is the amount of incentive offered?	Installation and post-installation costs
<b>Incentive Recipient</b>	Who is the program's target participant?	Renters vs. Homeowners  Residential vs. Non-residential Customers  New development vs. existing customers
<b>Form of Incentive</b>	What form of incentive is being offered?	Bill credit vs. check
<b>Eligibility Requirements</b>	Are there any eligibility criteria to participate in the program?	Renter vs. Water Provider Account Holder  Rebates only available for equipment of a certain flow volume
<b>Recycling Components</b>	Does the program include a recycling component?	Require voucher that verifies toilet has been recycled to receive rebates (e.g., <a href="#">Fort Collins Utilities</a> )

Historically rebate programs included more indoor fixtures such as dishwashers and clothes washers. As the standards for these types of equipment have become more efficient, most water providers have stopped providing rebates. Today, if pursuing a rebate program, **the best practice is to only rebate ultra-high efficiency toilets and smart home water monitors.**

Table 14 summarizes common eligibility requirements for toilet rebates. Water providers should only provide rebates for toilets that go beyond the Colorado WaterSense standards of 1.28 gallons per flush (gpf). This means most water providers have an eligibility requirement of 1.1 gpf, however some have moved to only rebating ultra-high efficiency toilets that use 0.8 gpf or less to have higher water savings. Importantly more water providers are also starting to **require both a flow volume requirement and a MaP rating**. MaP ratings quantify the amount of waste that can be flushed by a toilet. The higher the MaP rating, the more effective the toilet. Adding a MaP score to rebate criteria can be helpful to ensure customers are installing both efficient *and* effective toilets and, therefore, is considered a best practice.

Some water providers are also starting to rebate smart home water monitor devices. These are easy to attach devices that allow customers to monitor water use for different end uses and are particularly helpful for identifying and resolving leaks. See the Leaks section for more information.

Table 14. Residential rebate program equipment

Equipment	Common Efficiency Criteria	Typical Rebate Amount
<b>Tank Toilet</b>	WaterSense Certified toilet that uses 1.1 gpf or less and has a MaP rating of 600 or above.	\$75 - \$150
<b>Smart Home Water Monitor</b>	Must connect to Wi-Fi, detect leaks, break down water use by individual appliance and fixture.	\$40 - \$50

### MaP Testing for Toilets

MaP Testing is an independent test to determine how much waste can be flushed down a toilet with one flush. Specifically, a MaP score represents the volume of solid waste (measured with soybean paste and toilet paper) that a particular toilet can flush and remove completely with a single flush. Toilets are tested as they come on the market, and on their website, MaP maintains a list of makes, models, and performance scores. MaP score ranges include:

- Highly Recommend: 1,000 – 6,000 grams
- Recommend: 600 – 350 grams
- Acceptable: 350 – 250 grams
- No recommended: 250 – 0 grams

More information can be found at: [map-testing.com/](http://map-testing.com/).

### Toilet Incentives: Are they worth it?

Toilet technology has come a long way and with Colorado becoming a WaterSense state in 2016 the question becomes: are toilet rebate or installation programs still worth it or has the State of Colorado reached market saturation? A 2017 study by the Alliance for Water Efficiency and Plumbing Manufactures International estimates that 21% of toilets in homes are in-efficient. While incentive programs help, it is likely all toilets that use 1.6 gpf or more will be replaced with a 1.28 gallon per flush toilet via natural replacement by 2032 (assuming a 4% annual replacement rate). While toilet replacement programs may be harder to administer than in the past, they can still help promote toilet installation and may lead to more 1.1 or 0.8 gpf toilets being installed vs. the 1.28 (Koeller, 2017). Additionally, there are still gaps in particular sectors, especially low-income where residents rent or are less likely to spend extra income on installing high-efficient equipment. As a result, there are still applications that make sense for toilet promotion, especially if a water provider wants to accelerate natural replacement and/or promote ultra-high efficient models that use 1.1 gallons per flush or less.

Once developed, rebate programs are easy to administer, especially if rebates are provided as credits on water bills. Partnering with others, such as the area's Energy Provider, can also be a strategy to reduce administrative costs and time requirements.

### How to Provide Water Efficiency Services to Renters

Providing services to renters can be a challenge, as they are often not the water account holder and/or they may not have permission to make updates to their rental property. Some water providers are tackling this problem by partnering with energy organizations, such as [Energy Outreach Colorado's Healthy Homes Program](#) or the [Weatherization Assistance Program](#), who already have processes set up to get permission from renters to receive direct installations or updates. Others have "Landlord Release and Liability Waivers" which allow the water provider to enter a rental property and complete the work.

### Home Assessment and Direct Installation Programs

**Historically home assessments and direct installation programs were not always linked. However, combining the two strategies is a best practice that maximizes resources and results in more water savings.** As a result, many are shifting away from rebates to direct install programs.

In home assessment and direct install programs, the water provider, or a contractor, provides an assessment of water fixtures in a home and then completes direct installation of high efficiency equipment for any inefficient fixtures. While more expensive and time intensive to administer than rebate programs, direct installation programs have become popular and provide many benefits, especially to build trust and provide education and support for low-income customers.

For the home assessment component, the water provider or contractor should review all water-using equipment for leaks. Additionally flow measurements should be taken for aerators, toilets, and showerheads to identify if they can be replaced with more efficient models. If available, inefficient showerheads, aerators, and toilets should be replaced with high efficient models. Similar to rebate programs, any installed equipment should go beyond Colorado WaterSense state requirements. While there is some overlap with rebate program considerations, Table 15 summarizes program considerations for designing programs.

Table 15. Consideration for residential direct installation program

Program Component	Considerations	
<b>Home Assessment</b>	What to review during the assessment? What fixtures to measure? How?	Liability waivers to complete the installation.
<b>Equipment Available for Direct Installation</b>	What equipment to include in the program?	Showerheads and aerators are relatively low-cost direct install options. While more expensive, toilets are also a common offering that result in more water savings.

Program Component		Considerations
<b>Efficiency Criteria</b>	What is the efficiency level targeted by the direct install program?	Ensure criteria goes beyond Colorado WaterSense state standards. Consider equipment be requiring WaterSense labeled and or have a certain MaP rating.
<b>Implementor and Potential Partners</b>	Who will install the equipment? Are there any partners?	Training staff to install equipment will cut down on costs and can build trust between the community and water provider, however it requires more time compared to hiring a contractor to complete the work. Partners and local community based organizations can help cut down on costs. Work with or training interns or college students can provide an additional workforce development benefit.
<b>Incentive Recipient</b>	Who is the program's target participant?	Renters and/or Homeowners Low-income customers Language considerations to complete the assessment
<b>Eligibility Requirements</b>	Are there any eligibility criteria to participate in the program?	Renter and/or Water Account Holder Installation only completed for equipment of a certain flow volume
<b>Recycling Components</b>	Does the program include a recycling component?	Recycle old toilet or equipment (e.g., <a href="#">Fort Collins Utilities</a> )

### Equity Considerations

Traditional water conservation programs have created barriers for low-income households. Specifically, participation for low-income customers is limited by:

- **Program design:** Traditional rebate programs require money upfront to participate and reimbursement is often delayed and not in full. This program model is often not realistic for lower income customers, who do not have the disposable income to spend on high-efficient equipment.
- **Eligibility:** To participate in water conservation programs often a customer must be the water account holder. This can prevent renters or mobile home residents from participating.
- **Trust:** Cultural differences and lack of trust create barriers to low-income customers. Lack of resources and information in other languages and a history of being left out of planning and efficiency programs, can make participation in opportunities less likely.

**Direct installation programs can be a solution for many of the challenges, by providing a low-to no cost installation of efficient equipment.** Working with property managers to get permission and/or working with partner organizations like the Colorado Energy Office can help engage renters. Finally, providing resources in multiple languages, conducting assessments in Spanish, and reaching out to low-income communities can help engage customers and build trust.

### WaterSense Labeled Products

A WaterSense labeled product has been independently certified to meet the EPA's standards for water efficiency and performance. Fixtures with this label are at least 20% more water efficient than standard fixtures (EPA, 2024). Requiring equipment to be WaterSense labeled is a common best practice in both residential and non-residential water conservation programs.



# Case Study

## MANUFACTURED HOUSING (MOBILE HOMES) | COLORADO SPRINGS, CO

In 2022 there were 96,234 manufactured homes, sometimes called mobile homes, in Colorado. Of these, 44% (42,343) were built prior to 1980, meaning there may be significant opportunities to increase the efficiencies of fixtures in these homes.

Manufactured home communities have been largely left out of water conservation program design and support. While many water providers recognize the importance of supporting water conservation in manufactured home communities, there are several barriers that can make it difficult to deliver effective programs. Manufactured home communities are usually master metered and, as a result, it can be challenging to understand water use and identify savings opportunities on a per-home basis. Additionally, some manufactured home communities are managed by a property manager. In these cases, a water provider must work directly with the property manager or get permission from the property manager to work with residents, which can require substantial relationship building.

Colorado WaterWise Best Practices Guidebook

Even when connecting directly with residents, water providers may need to take time to build up trust or be prepared to address concerns beyond conservation. A 2022 survey of 800 manufactured home residents found 95% do not trust the tap water in their home and almost 75% do not drink the tap water in their home as a result (Protegete, 2022). That said, 85% identified that they support and are interested in local government and water providers providing financial incentives for water efficient fixtures and landscapes (Protegete, 2022).

During the 2023 legislative session, [HB23-1257](#) passed, requiring the State to develop a water testing program by July 2024. All of Colorado's manufactured home communities must be tested by July 1, 2028. The bill outlines standards for testing, as well as actions to take if a manufactured home community is out of compliance. Colorado Springs Utilities has started to tackle manufactured home water use by offering free direct installation of high-efficiency equipment and leak detection services to manufactured home communities. Partnering with a local plumber and Energy Resource Center, Colorado Springs worked with Highland Home Mobile Home Park in 2022. Highland Home Mobile Home Park was built in 1945. With 98 units on-site, the community averaged just under 1,000,000 gallons of water per year. The community is deemed affordable housing by the City of Colorado Springs and the majority of residents' primary language is Spanish.

It took multiple visits to reach the Property Manager of Highland Mobile Home Parks. Once a relationship was built, Colorado Springs leveraged a weekly resident meeting to inform residents about the opportunity. Of the 98 units, 30 signed up for an assessment. A translator was hired to schedule and conduct the assessment with the residents. During the assessment fixtures were replaced, and leaks were identified. Of the units assessed, 30% had a leak. The majority of leaks were in the bathroom. Anecdotally, many residents were interested in submetering to better understand their use and be charged individually. Leak resolution and direct installation of equipment was estimated to save over 2 million gallons of water. The program cost roughly \$16,000 to administer.



Source: Colorado Springs Utilities

# GRAYWATER SYSTEMS | COLORADO

Graywater is water that is collected from bathroom and laundry sinks, bathtubs, showers, and laundry machines and put to a second use (e.g., subsurface irrigation or toilet/urinal flushing). Graywater does not include water from toilets, urinals, kitchen sinks, dishwashers, or non-laundry utility sinks. To allow graywater use in Colorado, local jurisdictions must adopt a graywater control program that meets all requirements outlined in Regulation 86 (State of Colorado Department of Public Health and Environment, Water Quality Control Commission). See the Development and Codes Best Practice Area for more information on adopting a graywater control program.

Currently, there are two kinds of graywater systems allowed in Colorado:

- 1. Subsurface irrigation:** Sub-surface irrigation systems take water from graywater sources, moves the graywater through a coarse filter, and then pumps the water into underground irrigation systems to protect users' health and safety. A common application of a subsurface irrigation system is a laundry to landscape system. Due to the underground piping, retrofitting can be expensive, and they are most common in a new development setting. This may change with technology advancements and future adjustments to the Regulation 86 requirements.
- 2. Toilet and urinal flushing:** Toilet and urinal flushing systems take water from graywater sources, moves the graywater through a coarse filter and disinfection process, and then replumbs the water to a toilet or urinal. Due to the graywater system equipment cost and size it is usually not cost effective to retrofit homes or facilities with graywater systems, and therefore their application currently makes the most sense in new developments. This may change with technology advancements and future adjustments to the Regulation 86 requirements.

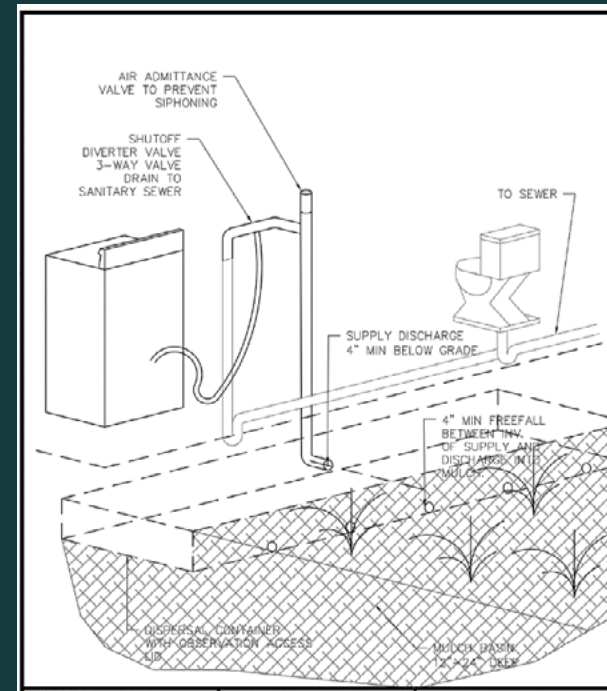


Figure 18. Laundry to landscape graywater system



Figure 19. Toilet graywater system

Despite being permitted since June 2015, there has not been a lot of uptake in graywater systems. Table 16 summarizes some of the Colorado communities who have adopted a graywater control program.

Table 16. Communities in Colorado that have adopted graywater regulations

Community	Year	Systems Permitted	Uptake
Denver City & County	2016	All	Roughly 3 homes
Town of Castle Rock	2018	All	Roughly 30 homes
Pitkin County	2018	All	0
City of Golden	2020	Residential laundry to landscape	0
City of Broomfield	2021	All	0
City of Fort Collins	2022	Toilet and urinal flushing	0

It is assumed that the lack of uptake is partially due to cost and low return on investment. As part of their adoption, the City of Fort Collins estimated graywater costs, water savings and return on investment for a toilet and urinal flushing system (Table 17).

Table 17. Toilet flushing graywater system impact

	Average upfront cost to customer or developer	Average annual maintenance costs	Average annual water savings	Average annual 2022 water bill savings	Return on Investment
Single-family with 4 residents	\$4,500	\$36	10,000 – 20,000 gallons	\$69 - \$138	33 – 65 years
Multifamily with 100 residents	\$90,000	\$500	230,000 – 500,000 gallons	\$1,388 - \$3,017	30 – 65 years

*Assumptions:*

- The maintenance costs for the graywater measures are very rough estimates and may likely be too low.
- All utility bill savings and ROI are based on the 2022 Fort Collins Utilities water and wastewater rates and do not include maintenance costs.
- For reference, a single-family home in the Fort Collins Utilities service area with four residents is estimated to use an average of 130,000 gallons per year.

The graywater values assume the system is in a new construction setting. It is far more costly to retrofit existing structures than to incorporate a system into new construction. The existing limited data suggest more interest will take place in new development.

While water savings increase with larger properties, so do costs, making the payback periods long.

## Costs, Benefits, and Water Savings

### Costs

**Water Provider Perspective:** Rebate programs are less expensive than home assessment and direct installation programs. They also require less staff time to administer. On the flip side, direct installation programs allow water providers to build trust and rapport with customers. Budgets for either may range between \$10,000 and \$50,000. Costs the water provider must consider include any software or program for processing the rebates, as well as the rebates themselves. While arguably more effective for achieving water savings, home assessment and direct installation programs are more expensive for water providers to administer. The water provider must pay for a contractor, staff, or train interns/college students to complete the home assessment and direct installation. Additionally, depending on the program design, the water provider may cover some or all the costs for the equipment.

**Customer Perspective:** For rebate programs, the customer covers the difference between the cost of the equipment and the amount of the rebate. Alternatively, depending on program design, direct installation programs will likely be a low or no-cost service for the customer.

### Benefits

**Water Provider Perspective:** Both rebate and direct installation programs reduce indoor water demand, however they accommodate different customer preferences. For some customers, rebates are easier to navigate however for others direct installation reduces barriers to participating. Once designed, rebate programs are easy to administer. While they take more time to administer, home assessment and direct installation programs guarantee savings. They can also help water providers target sectors that need the most support in reducing their water use. Supporting replacement with high-efficient water fixtures can reduce indoor water demand by 30% (Neibauer & Waskom, 2014).

**Customer Perspective:** Installation of water-efficient equipment will result in water savings, reducing costs for the customer. Direct installation programs are also easy for the customer and guarantee savings that will result in lower water bills. This is especially important for low-income customers who need access to low or no cost options for water efficiency upgrades.

### Water Savings Assumptions

Supporting replacement with high-efficient water fixtures can reduce indoor water demand by 30% (Neibauer & Waskom, 2014). With the correct information, estimating water savings from fixture replacement is relatively straightforward. See the Indoor Water Savings Tables for common assumptions, methodology, and water saving estimates for toilets, showerheads, and aerators (EPA, 2017).

### Resources for Program Development and Financing

In addition to water provider revenue sources, there are a variety of resources available to water providers to support program development and financing. Some of these include:

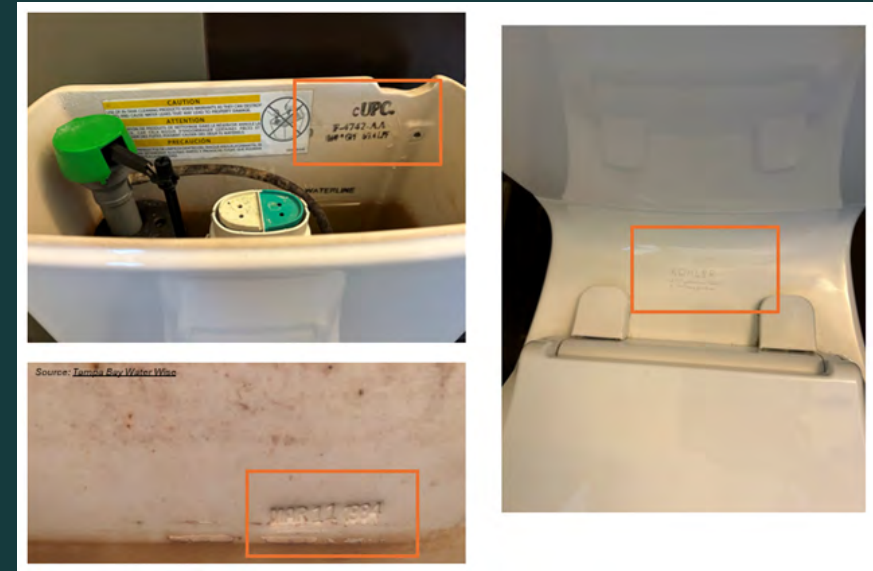
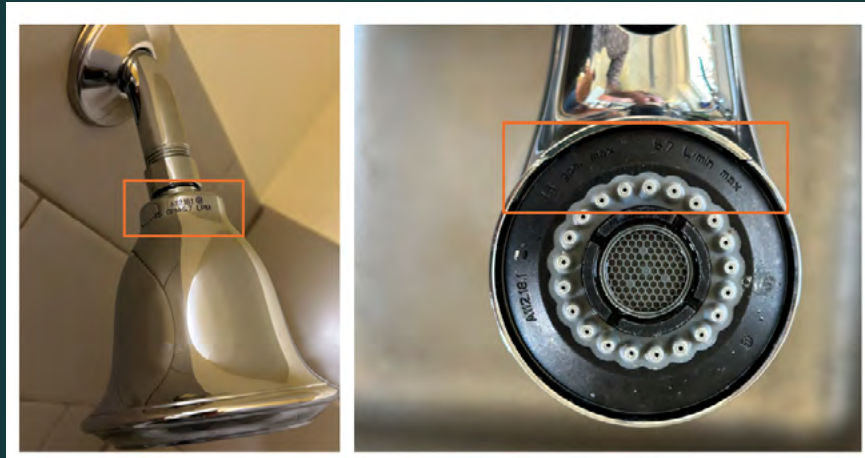
- Bureau of Reclamation WaterSMART Grants: [www.usbr.gov/watersmart/weeg/](http://www.usbr.gov/watersmart/weeg/)
- Colorado Water Plan Grants: [cwc.colorado.gov/funding/colorado-water-plan-grants](http://cwc.colorado.gov/funding/colorado-water-plan-grants)
- WaterNow Project Accelerator: [waternow.org/our-work/our-work-projects/project-accelerator/](http://waternow.org/our-work/our-work-projects/project-accelerator/)

WaterNow's Resilience Toolkit and the Colorado Water Center provide summaries of these and other resources.



# IDENTIFYING FLOW RATES

For toilets, sinks, and showerheads flow rates can often be found stamped onto a piece of equipment. If a flow rate cannot be identified, a flow bag can be used to estimate water use for showerheads and sinks.



If a flow rate is not easily identifiable on a toilet look for the manufactured date, which will always be stamped on the inside of the tank or lid. This date can be compared to historic flow standards to estimate toilet volume. For example, if a toilet's date is stamped "1992" it can be assumed the toilet uses 3.5 gpf because that was the minimum standard during that time. See Regulatory Requirements section for minimum flow rates through time).



The non-residential sector is the second largest consumer of water use in the United States, accounting for 17% of water withdrawals (EPA, 2023). In the municipal environment, non-residential demand can account for 20 – 40% of total annual water use (Vickers, 2001). The non-residential sector has great opportunity, with potential water savings for non-residential water users range from 15 – 50% which have gone largely unrealized (Dziegielewski B. e., 2000). While water conservation programs are fairly common, non-residential programs and strategies are more limited. AWWA's 2016 survey on non-residential water efficiency programs found that less than 20% of water providers have dedicated non-residential programs despite the large opportunity for water savings in the sector (Dziegielewski B. , 2016).

This is partially because water use is highly variable in the non-residential sector. As a result, designing programs is a challenge. For example, office buildings use water very differently than hotels or industrial processes. Figure 20 provides water end uses for a variety non-residential facilities.

Even though water use varies across the non-residential sector, there are important commonalities such as toilets, urinals, faucets, showers, and outdoor irrigation. Water providers do not need to focus exclusively on specific and expensive industrial and commercial equipment and process water reductions; water savings can frequently be achieved through domestic fixture replacement and landscape transformation.

**Terminology Check: Commercial, Industrial, and Institutional (CII) Water Use**

Commercial, industrial, and institutional (CII) is another common term for non-residential customers, sometimes also called ICI. While definitions vary slightly by organization, typically the breakdown of each of these categories is:

- **Commercial:** private facilities that provide a service or are distributing a product (e.g., offices, hotels, restaurants).
- **Industrial:** factory or processing facilities.
- **Institutional:** higher education, government buildings.

Figure 1-1. End Uses of Water in Various Types of Commercial and Institutional Facilities

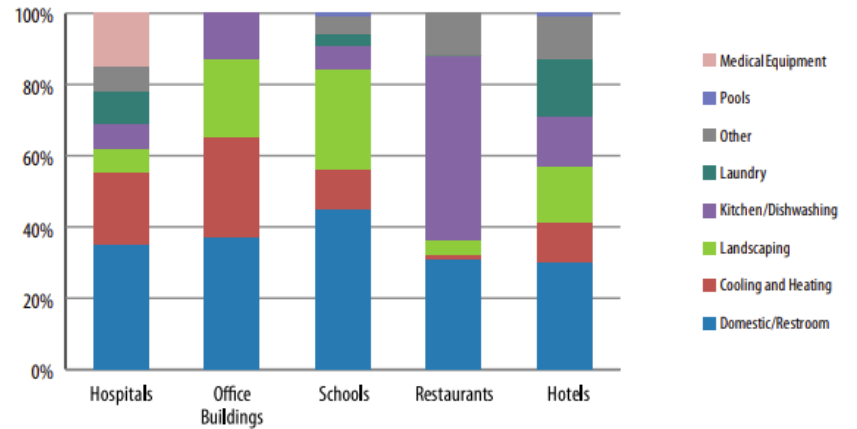


Figure 20. Percent breakdown of end uses in non-residential settings  
Source: (EPA, 2023)

Discussed in the Targeting Users section, the **first step and best practice for the non-residential sector is to identify non-residential customers.** After customers have been classified, **benchmarks can be assigned to identify high users, as well as connect customers with programs like water assessments and rebate programs.**

Table 18 summarizes business specific water use benchmarks. Importantly, some of these examples are from entities that use water benchmarks for their water supply requirement or system development fee. While related, water demand does not always equate to water supply. As a result, when interpreting these values, entities should consider if values are being used for water supply requirements or not.

Table 18. Non-residential water use benchmarks (gal/sq ft)

Use	<u>City of Greeley</u>	<u>Fort Collins Utilities</u>	<u>Westminster</u>	<u>EPA Portfolio Manager</u>	<u>University of Florida</u>	<u>Santa Fe New Mexico</u>	<u>CWW - Brendle Group (Low Range)</u>	<u>CWW - Brendle Group (Upper Range)</u>	<u>WRF (Low Range)</u>	<u>WRF (High Range)</u>	<u>Austin</u>	<u>Boston</u>	<u>New York</u>	<u>Washington DC</u>	<u>Philadelphia</u>	<u>Minneapolis</u>	<u>Australia</u>
<b>Auto Service and Retail</b>	12	8	21.7														
<b>Childcare</b>	47	28	60														
<b>Church/Places of Worship</b>	5	10	31.5	7	15										11		
<b>Grocery Store</b>	20	25	38.5	24	95	36			25	64							
<b>Gas Station without Car Wash</b>	93	44	242														
<b>Hospital</b>	21		59.97	51	31						58				68		
<b>Hotel/Motel</b>				54	85		79	165	60	115	72	55	71	55	100		
<b>Medical Office</b>	25	33	35.7	19	34	49							33		35		
<b>Office</b>	14	7	8	13	20	26			9	15		12	13	15	17	11	25
<b>Recreation with Pool</b>	122		148.8														
<b>Recreation without Pool</b>	25	36	55														
<b>Restaurant</b>	188	145	200		221		173	211	130	330	215						
<b>Retail</b>	16	5	29	5	32	20							10		16		
<b>K-12 Schools</b>	11	11	12.4	10	20		12	19	8	16			7	10	13		
<b>Warehouse</b>																	

Once targeting is complete, water providers should explore the following strategies, to tackle water conservation in the non-residential sector:

- **Non-residential water assessments:** Water assessments analyze facility water use to identify efficiency opportunities. Because water use varies and is more complicated in the non-residential sector, they are an important step for tackling water efficiency in business settings.
- **Non-residential rebates:** Following a water assessment, water providers can connect customers with rebate opportunities to promote installation of efficient equipment. Because water efficient strategies are less prescriptive in the non-residential sector, some water providers offer custom rebate options that are based on a project’s water savings. This approach allows for more flexibility and the opportunity for businesses to implement strategies that make sense to their operations.
- **Business specific strategies and technologies:** Outside of rebates and assessments, there are certain strategies to help target water efficiency by sector or technology. For example, cooling towers can be one of the largest water end uses. Understanding these opportunities can help water conservation professionals tailor opportunities for specific industries.

## Regulatory Requirements

**Plumbing code** and **fixture standards** play a critical role in determining the efficiency of indoor water fixtures. Water providers should be aware of the current minimum standards to **ensure programs encourage installation of equipment that goes beyond current standards**. See the Development and Codes Best Practice Area for more information on plumbing codes.

In 2016, [Senate Bill 14-103](#) established Colorado as a WaterSense State. In non-residential settings, this means that **Colorado’s efficiency standards are higher than the federal standards for urinals, tank-type toilets, and showerheads**. Other fixtures, such as bathroom faucets in public spaces and flush valve toilets, are not covered under the bill and must adhere to federal standards (Table 19). See the Appendix for a complete list of federal standards and how they have changed over time.

Table 19. Common non-residential fixture standards through time

Fixture	Pre-1994	1994 – 2016	Post 2016
Relevant Legislation		1992 Energy Policy Act, enacted in 2014	2014 Colorado WaterSense State, enacted in 2016
Tank Type Toilet	3.5 gpf or more	1.6 gpf	1.28 gpf
Urinals	1.5 gpf	1.0 gpf	0.5 gpf
Showerhead	3.0 gpm or more	2.5 gpm	2.0 gpm
Flushvalve Toilet	-	1.6 gpf	-
Bathroom Aerator	-	2.2 gpm	-
Kitchen Aerator	-	2.2 gpm	-

Because equipment can be so variable, many organizations **leverage ENERGY STAR and WaterSense certifications to identify high-efficiency equipment**.

### ENERGY STAR Certifications

Administered by the EPA, ENERGY STAR® is a government system for identifying energy and water efficient equipment. The blue ENERGY STAR label is a way to identify water efficiency equipment (ENERGY STAR, 2024). Many water providers require fixtures be ENERGY STAR certified to qualify for rebates.



WaterSense at Work provides a suite of best management practices for non-residential customers. For more information visit: [www.epa.gov/watersense/best-management-practices](http://www.epa.gov/watersense/best-management-practices).

## Key Concepts

Non-residential water use is highly variable. While there is carry over from the Residential Best Practice topics, successful non-residential programs will consider business specific strategies and opportunities that are built on via water assessments and rebates.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Business Specific Strategies and Technologies
- Non-Residential Water Assessments
- Non-Residential Rebates

### Business Specific Strategies and Technologies

As discussed, non-residential water use varies widely. Targeting non-residential customers by business type can ensure that businesses are connected to the correct strategies, increasing program effectiveness. How a water provider chooses to target will depend on the breakdown of their customers. See the Targeting Users section for additional details on how to target by sector. **Table 20 summarizes other common best practice strategies for improving water efficiency by business type.**

Table 20. Strategies by business type

Business Sector	Strategies
Hotels	Like multifamily properties, hotels present an opportunity to install large numbers of high efficiency toilets, aerators, and showerheads. As a result, targeting hotels can be a good non-residential program strategy.
Schools	Partnering or working with schools is another interesting strategy. High numbers of sinks and bathrooms create easy wins for installing high-efficient equipment. Additionally, partnering with a school district or student to complete installations or track water use can create educational opportunities that can increase water literacy and water conservation education.
Campuses and Public Institutions	Many large campuses or public institutions have their own water conservation plans and goals. Partnering with these agencies can be an easy way to promote water provider water conservation goals, while also supporting the non-residential sector.

Restaurant	<ul style="list-style-type: none"> <li>• <b>Pre-rinse spray valves (PRSV):</b> Used to wash dishes before they go into a dishwashing machine, PRSVs are one of the most cost-efficient and easiest ways for restaurants to save water. Currently, all PRSVs must use 1.6 gpm per flow or less. Water efficient PRSVs use 1.2 gpm or less. Spraying water at a higher pressure than the high water use models, water efficient PRSVs can save close to 30,000 gallons of water a year and only cost \$75 - \$100 to install (Alliance for Water Efficiency, 2017). PRSVs are also easy to install and can be incorporated into a non-residential water assessments program as a direct install option.</li> <li>• <b>Dipper wells:</b> Common in cafes, juice shops, and ice cream parlors, cold-water dipper wells can run continuously, with flow rates as high as 1 gallon per minute (gpm). This can equate to between 260,000 – 520,000 gallons of water used annually. Installation of a flow restrictor on the main valve, so the well doesn't run continuously, is a low-cost option that can reduce water use by 90% (Alliance for Water Efficiency, 2017).</li> <li>• <b>Food thaw:</b> It is estimated that 52% of water consumed in restaurants is used for kitchen/ dishwashing (EPA, 2012). Of this a large portion can be used to defrost foods. Defrosting food ahead of time, or using technology that recirculates water can be a larger water saver.</li> </ul>
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In addition to business specific strategies, there are unique technologies and processes in the non-residential sector. Some of the most common, that can result in the largest water savings include:

- Cooling towers
- Laundry
- Car washes

## Cooling Towers

Cooling towers can be the largest indoor water end uses in non-residential facilities, accounting for 40% or more of a building's water demand (Alliance for Water Efficiency, 2021). Cooling towers remove heat from a building through an evaporative cooling process and are commonly found in non-residential settings that have a high cooling needs such as data centers or hospitals. Cooling towers cool by dissipating heat via evaporation. Water will leave a cooling tower system in one of four ways:

- 1. Evaporation:** Cooling towers evaporate water as the primary way to transfer heat from the cooling tower system to the environment. **Evaporation is not typically targeted for water conservation because it controls the cooling process** (EPA, 2012).
- 2. Drift:** Small quantity of water carried from the tower as mist or small droplets. The volume of drift is small compared to evaporation and blowdown. **Baffles and drift eliminators can reduce drift** to less than 0.005% of the cooling tower flow rate, making the drift impact negligible (EPA, 2012).
- 3. Blowdown:** As water evaporates, dissolved solids (e.g., calcium, magnesium, chloride, silica) remain in the recirculating water. If the concentration of these solids gets too high, they can cause scale and corrosion. This is controlled by removing a portion of the highly concentrated water through "bleeding" or "blowdown" and replacing it with make-up water that has a lower concentration of dissolved solids. **Controlling the amount of blowdown needed provides the largest water conservation opportunity in cooling towers** (EPA, 2012)
- 4. Leaks or overflows:** While a properly operated cooling tower system should not have leaks or overflows, they are a possibility. **Requiring an overflow alarm and frequently checking for leaks help minimize the impact of leaks and overflows.**

### Southern Nevada Water Authority Evaporative Cooling Restrictions

In 2022, Southern Nevada Water Authority issued a moratorium on the installation of evaporative cooling devices in new commercial and industrial buildings in the Las Vegas Valley. Evaporative cooling is estimated to be the second largest consumptive use of water in the area, consuming roughly 10% of Southern Nevada's Colorado River allocation annually. In 2023, the water authority offered up to 50% cash back to replace cooling tower or swamp coolers with dry-cooled systems with no limit (Southern Nevada Water Authority, 2023).

In terms of water conservation, the top water conservation opportunities for cooling towers include:

- Maximize cycles of concentration:** The cycles of concentration is the ratio of the total dissolved solids (TDS) or conductivity in the blowdown water compared to TDS in the make-up water. The higher the cycles of concentration the more water efficient the cooling tower (Figure 21). Ideally, cooling towers should be managed to operate at 5 cycles of concentration or more, however if local make-up water has high TDS it may only be possible to achieve 3 – 4 cycles of concentration. In such cases another benchmark for cooling towers is to set the TDS/conductivity controller at a minimum of 1500  $\mu$ s.

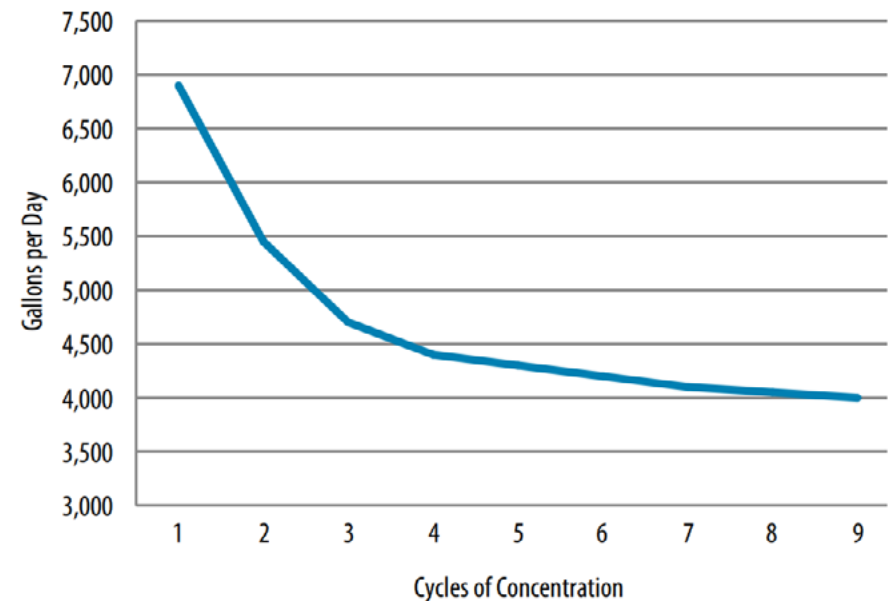


Figure 21. Cooling tower water usage at different Cycle of Concentration for a 100-ton tower (EPA, 2012)

- Submetering:** To help calculate the cycle of concentration, submeters should be placed on both the make-up and blowdown water. These should be checked regularly and monitored for changes in performance.
- Conductivity meter:** To help check the cycles of concentration, conductivity meters should be installed on both the make-up and blowdown water. If conductivity meters can't be installed a handheld meter can be used. Ratios between the make-up and blow-down

conductivity should be roughly equal to the cycles of concentration. If they are not the same, check the tower for leaks.

- **System monitoring and management:** A regular maintenance and cleaning schedule should be in-place to check for leaks, high areas of corrosion, or other factors that may be decreasing cooling tower performance.

## Laundry

Within the non-residential sector laundry facilities vary widely. Many use residential equipment, however, some have larger laundry facilities or coin-operated machines. Generally, larger laundry facilities are found in hotels, hospitals, nursing homes, prisons, and universities.

- **Residential clothes washers:** Residential washers are washers that are commonly found in homes. They can either be top-loading or front-loading, however front-loading is more efficient. **The water conservation best practice for residential washers (sized up to 8 cubic feet), is to install an ENERGY STAR certified model (EPA, 2023).**
- **Multi-load or large washers.** Sometimes called coin or card operated, multi-load washers are similar to residential washers; however, there are usually multiple together. They are commonly found in hotels, laundromats, and multi-family complexes. Historically, multi-load washers have been top-loading; however, with technology advancements more efficient, front-loading options are coming on the market. **The current water conservation best practice is to install models that use no more than 4 gallons per cycle per cubic foot of capacity. If large volumes of water are being processed, consider replacing with a tunnel washer.**
- **Wash extractors:** Washer extractors are much larger versions of multi-load washers, typically ranging between 300 – 800 pounds of laundry. They are commonly found in hotels, nursing homes, and universities. If possible, it is a best practice to choose machines with built-in water recycling capabilities that can store rinse water from previous load for us in the next load. **Water use should be less than 2.5 gallons of water per pound. If large volumes of water are being processed, consider replacing with a tunnel washer.**
- **Tunnel washers:** Tunnel washers are large-volume washers that have multiple chambers for the various laundry processes (e.g., soaking, washing, rinsing). While they are most costly, **tunnel washers are more water efficient** than multi-load or wash extractors because water moves throughout the system, reducing the water used by 30 – 60%.

- **Ozone systems:** Ozone systems can be installed on all commercial laundry machines. Ozone systems generate ozone, which is injected into the ash to disinfect and whiten. Ozone significantly decreases the hot water needs, providing significant energy savings in addition to water savings. It also decreases detergent costs. Water savings are estimated to be between 10 - 25%; however, savings vary depending on operating costs and processes (EPA, 2023).

## Car Washes

Car washes have increased their water efficiency dramatically and automated car washes can be more efficient than washing a car at home. To understand water conservation opportunities in car washes, it is important to understand the differences between the three types of non-residential car washes:

1. **Self-serve or manual:** Self-serve or manual car washes are typically non-automatic. Users wash the car themselves with a wand/sprayer. The average self-serve car wash uses 17-18 gallons per car (Southwest Car Association).
2. **Conveyor or express:** Conveyor or express car washes are automatic, and the car moves through the wash on a belt. The equipment itself does not move. The average conveyor car wash uses 30 – 40 gallon per car (Southwest Car Association).
3. **In-bay automatic:** In-bay car washes are automatic, however the car does not move. The equipment moves around the car. In-bay car washes use more water than conveyor or express car washes.

Water saving opportunities vary depending on the type of car wash. According to the WaterSense at Work (EPA, 2023) and the Southwest Car Association (Southwest Car Association), water conservation best practices for each type include:

- **Self-serve or manual systems**
  - Limit nozzle flow rate to 3 gallons per minute or less
  - Install check valves to prevent backflow
  - If towels ringers are installed, use a positive shut off valve
  - Replace nozzles annually
- **Conveyor or express**
  - Limit water consumption to 35 gallons per vehicle
  - Install check valves where possible to prevent backflow
  - Have no visible water leaks
    - If reverse osmosis water is used for spot-free rinse water, capture reject water and reuse in water cycles.

- **In-Bay automatic**
  - Limit water consumption to 40 gallons per vehicle
  - Limit water consumption during the rock panel/undercarriage cycle to 12 gallons per vehicle
  - Install check valves where possible to prevent backflow
  - Install laser sensors to evaluate length of vehicle being washed and adjust washing procedure to length of vehicle
  - Have no visible water leaks
  - If reverse osmosis water is used for spot-free rinse water, capture reject water and reuse in water cycles.

### Denver Water Car Wash Certification Program

Denver Water partnered with the [Southwest Car Wash Association](#) to create a [car wash certification program](#). All car washes that meet the Southwest Car Wash Association's Conservation Alliance Program requirements receive a certification from Denver Water and are authorized to operate during all stages of drought response.

### Non-Residential Water Assessments

In the non-residential sector **water assessments should be the first step to identify water savings opportunities for an individual customer.**

Depending on the resources available, water assessments can vary in detail and scope will also vary depending on business type. Generally, any assessment has four main phases:

1. **Data collection:** Prior to visiting the facility, preliminary facility and water use and cost data should be gathered. Data should be reviewed prior to a site visit. Data to collect includes:
  - Facility information
    - Building year built
    - Facility square footage
    - Irrigation square footage
    - If the building is leased vs. owned
    - If water using equipment is leased vs. owned (e.g., commercial dishwasher, ice machine, etc.)
  - Utility information
    - Utility providers (water, wastewater, natural gas, electricity)
    - 3 – 5 years of water use monthly data
    - 3 - 5 years of monthly water and wastewater cost information

- Operations information
  - Number of employees (annual or daily)
  - Days open per year
  - Hours of operation
  - Number of full-time equivalent employees
  - Number of employees working in the building on a typical day
  - Number of visitors/customers/students in the building on a typical day

2. **Site visit:** During the site visit all water-using fixtures should be reviewed. Flow rates can be measured using flow bags and/or pictures of equipment specs can be taken for equipment that doesn't have measurable flow rates (e.g., commercial dishwashers). During the site visit, any questions that came up during the data collection phase can also be discussed. Additionally, like in the residential sector, sometimes direct installation is offered in this phase for water efficient equipment like aerators, showerheads, and/or pre-rinse spray valves. It is recommended that **all water assessments should offer direct installation as an option to increase water savings impact.**
3. **Analysis:** After the site visit, an inventory of all water using equipment should be created and compared to the historic water use data. Ideally, the operating data (e.g., number of employees, operating hours), and fixture water use information can be combined to create water balance by end-use. Water conservation opportunities should be included in the analysis with clear connections to possible rebates. **Return-on-investment (ROI) calculations for these opportunities should consider the water and wastewater savings, as well as any energy savings from heated water.** If available, water use can also be benchmarked to other similar facilities to create an efficiency metric (Table 18).
4. **Report:** After the analysis is complete, a final report should be drafted that summarizes the data, fixture information, water conservation opportunities, and return on investment. This should be sent to the customer with the opportunity to discuss or clarify any questions or concerns. Ideally, the report also links the customer to rebates or other incentive options to help complete the recommendations (see Non-residential rebates).



More details on assessment approaches can be found in the following resources:

- [The City Energy Project Water Audit Guidance for Commercial Buildings](#)
- [Department of Energy Water Evaluation Tools](#)
- [Better Building Partnerships Guidance 5.2 Undertaking a Water Audit](#)

Colorado Spring Utilities Commercial Assessments	Northern Water Commercial Assessments
Colorado Spring Utilities offers water non-residential assessments at no cost to all business customers. During the assessment staff reviews toilets, bathroom fixtures, kitchen equipment, clothes washers, cooling towers, and water-cooled equipment to measure efficiency (Colorado Springs Utilities, 2023).	Northern Water offers free non-residential assessments. After a review of past water use and a walkthrough of the facility, participants receive a detailed report summarizing recommendations and next steps. In 2021, nine assessments were performed which resulted in 800,000 gallons of water savings through direct installation and 3.1 million gallons of identified savings (Northern Water, 2024).

### Non-residential Rebates

**Given the high water savings potential and generally untapped opportunity, non-residential rebate programs are a best practice.**

Many considerations for a non-residential rebate program are like those of a residential rebate program, however administrative costs and time requirements are likely to be higher given the scale of the projects and variety of equipment being installed (Table 21). Table 22 outlines common non-residential rebates and associated criteria.

High-Efficiency Toilets in Non-Residential Settings
Toilet performance is dependent on two aspects: flushing performance and drainline carry. Unlike residential settings which have smaller pipes, steeper slopes, and more supplemental flow, installing high efficiency, or ultra high-efficiency, toilets in some non-residential settings may not be applicable in settings with long drainlines and little supplemental water flows outside of toilet use (e.g., office buildings) (Gauley & Koeller, 2009). Understanding these nuances is important for successful toilet installation in non-residential settings.

Table 21. Considerations for non-residential rebate programs

Program Component		Considerations
Custom vs. prescriptive fixture rebates	Does the water provider want to offer a customer non-residential rebate, prescriptive rebates, or some combination of both?	Custom rebate programs allow for more project flexibility, however, they take more staff time to administer.  Prescriptive fixture rebates are easier to administer but are not applicable for water saving processes.
Efficiency Criteria	What is the efficiency level targeted by the incentive program?	Ensure criteria goes beyond Colorado WaterSense state standards. Consider leverage WaterSense and ENERGY STAR certifications to help identify efficiency equipment.
Incentive Amount	What is the amount of incentive offered?	Incentive limitations (i.e., cap projects at certain percent of project costs)
Incentive Recipient	Who is the program's target participant?	Renters vs. Homeowners  Residential vs. Non-residential Customers
Form of Incentive	What form of incentive is being offered?	Bill credit vs. check
Eligibility Requirements	Are there any eligibility criteria to participate in the program?	Buisness types (i.e., industrial vs. commercial customers)  Require inspection or verification to receive rebate
Recycling Components	Does the program include a recycling component?	Require voucher that verifies toilet has been recycled to receive rebates (e.g., <a href="#">Fort Collins Utilities</a> )

Table 22. Common non-residential rebates

Equipment	Common efficiency criteria	Typical Rebate Amount in 2024
Tank Toilet	WaterSense Certified toilet that uses 1.1 gpf or less and has a MaP rating of 600 or above.	\$75 - \$150
Flushvalve Toilet	WaterSense Certified flushvalve toilet that uses 1.28 gpf or less and has a MaP rating of 600 or above.	\$75 - \$150
Urinal	0.5 gpf or less	\$75 - \$150
Pre-rinse Spray Valve	1.28 gallons per minute or less	\$50
Sub-meter rebate	<p>Installation in individual dwelling units in a multifamily building or individual commercial spaces in a commercial complex.</p> <p>Installation to track individual processes (e.g., irrigation, industrial process, cooling towers) in a commercial settings.</p>	\$40 - \$50
Other Commercial Equipment (e.g., Dishwashers)	ENERGY STAR Certified	Variable

**For water providers with more staffing resources, moving to custom rebate programs, instead of prescriptive rebates for certain fixtures, may be a good option.** In custom rebate models, the total amount rebated is project specific and usually is based on the total water saved. This provides a water provider more flexibility in rebating unique processes that may not fall into a specific rebated category. Time to administer a custom rebate is higher, as it usually requires estimating or measuring water use data to issue the rebate. Examples of custom rebates include:

**Sub-meters in Non-residential and Multifamily Settings**

In many non-residential or multifamily settings one meter will serve multiple businesses or residences. As a result, it can be hard to track water use and, in turn, identify water efficiency opportunities. As sub-meter technology advances, easy to install, strap on sub-meters allow water providers and customers to get more granular data quickly. Costing as little as \$350, sub-meters can be a cost-effective solution to addressing water use in master meter situations.

If exploring sub-meter options, it is important to know pipe size, as well as pipe material, as products are usually only compatible in certain settings. Additionally, most require WiFi and a small monthly fee to access data via a portal.

Table 23: Non-residential custom rebate approaches

Entity	Typical Rebate Amount in 2024	Considerations
<a href="#">Southern Nevada Water Authority Water Efficient Technologies Program</a>	Consumptive-use: \$45 per 1,000 gallons saved Non-consumptive use: \$15 per 1,000 gallons saved	Rebate is capped at 50% of the project cost.  The project must be "sustained for a minimum of 10 years."
<a href="#">Fort Collins Utilities</a>	\$10 per 1,000 gallons of water saved	Rebate is capped at 50% of the project cost.
<a href="#">Colorado Springs Utilities</a>	Up to \$50,000; total amount is based on the project	Installed equipment is verified and inspected

#### Colorado Commercial Property Assessed Clean Energy (C-PACE)

If a building resides in a participating County, Colorado C-Pace allows property owners to finance up to 100% of water efficiency, energy efficiency, and renewable energy efficiency projects. Private capital providers offer financing at competitive rates with repayment terms of up to 25 years. In 2023, 39 of Colorado's 64 counties were participating, and 12 more were in-discussion. More information, and participating counties, can be found at [copace.com](http://copace.com).



## Costs

**Water Provider Perspective:** Non-residential programs are generally more expensive and require more staff time than residential programs due to their size and complexity. The main costs associated with non-residential water assessments are staff time to conduct the assessment. If direct installation of equipment is completed during the assessment, there may be additional cost to acquire the fixtures. If a custom rebate model is used, processing will take more time. Additionally, the water provider must consider any software or program costs for processing the rebates, as well as the cost for rebates themselves.

**Customer Perspective:** Non-residential assessments are a no cost opportunity for a customer to learn more about their water use. If a customer participates in a rebate program, the customer must pay for the portion of the equipment that rebate does not cover, in addition to their own time to submit and apply for the rebate.

## Benefits

**Water Provider Perspective:** While they do not save water by themselves, non-residential assessments help water provider's understand non-residential end uses and tailor recommendations for specific customers. Pairing a non-residential water assessment program with a rebate program can ensure customers receive the support they need to know what types of equipment to install to save water. Non-residential water rebate programs help customers save water, in turn helping the water provider reach its water savings goals. AWWA's Commercial and Institutional End Use study found CII programs can save between 500,000 and 730 million gallons a year (Dziegielewski B. , 2016). In this study, programs with larger savings were geared towards customers with high water using processes.

**Customer Perspective:** Assessments present a free opportunity for a customer to better understand their water end uses and processes. Rebates also help customers install water efficient equipment, which will result in water and reduce long-term costs for customers.

## Water Savings Assumptions

AWWA's Commercial and Institutional End Use study found that water provider's non-residential programs can save between 500,000 and 730 million gallons of water per year (Dziegielewski B., 2016). Programs with larger savings were geared towards customers with high water using processes. Looking at the different components of the non-residential opportunities, non-residential water assessments do not by themselves save water, however when paired with a rebate program they can help non-residential understand what equipment to install and the costs.

See the Residential Water Savings Assumptions and the Indoor Water Savings Tables for information on how to calculate toilet, showerhead, bathroom aerator, and kitchen aerator water savings. Additional non-residential water savings specific calculations or resources are included on the next page.

### End-Use Assumptions

Non-residential end use assumptions vary by business sector. While outdated, East Bay Municipal Utility District's Details of Commercial and Industrial Assumptions, by end use provides a good starting point for estimating non-residential use assumptions (EBMUD, 2000).

Table 24. Non-residential toilet end use water assumptions

Business Type	Flush per Day			Number per Day (1,000)		
	Employee	Visitor	Other	Employee	Visitor	Other
Office	2.6	0.33	-	3,788	3,788	-
Schools	1.95	0.86	1.95	1,289	2,199	5,952
Restaurants	2.6	0.34	-	891	11,150	-
Retail	2.6	0.13	-	1,421	10,512	-
Hospital	2.6	1	4	428	95	-
Hotels	2.6	-	4	182	-	47
Laundries	2.6	-	-	44	-	255

Table 25. Non-residential urinal end use water assumptions

Business Type	Flush per Day			Number per Day (1,000)		
	Employee	Visitor	Other	Employee	Visitor	Other
Office	1.25	0.17	-	3,788	3,788	-
Schools	0.94	0.31	0.94	1,289	2,199	5,952
Restaurants	1.25	0.17	-	891	11,150	-
Retail	1.25	0.07	-	1,421	10,512	-
Hospital	1.25	-	-	428	95	-
Hotels	1.25	-	-	182	-	47
Laundries	1.25	-	-	44	-	255

Table 26. Non-residential hand washing end use water assumption

<b>Faucet Run Time</b>	0.11 minutes per flush
------------------------	------------------------

When possible, it is always more accurate to use a businesses actual employee and visitor numbers to estimate water savings (see non-residential water assessments for more information).

### Flushometer-Valve Toilets

Unlike tank toilets, flushvalve toilets rely on a diaphragm, water piping, and pressure changes to remove waste (Figure 22). Unlike tank toilets, where flow volumes will usually be printed inside the tank, the following equation can be used to estimate flushvalve toilet volumes:

$$\text{Gallons Per Flush} = \text{Time to Flush} \times 0.42 \text{ (EPA, 2023)}$$

Flushometer-valve or flushvalve toilets are tankless toilets commonly found in non-residential settings (Figure 23). Once the gallons per flush has been estimated the methodology outlined in Residential Toilet Water Savings section can be applied.



Figure 22. WaterSense labeled tank type toilet (Source: EPA)

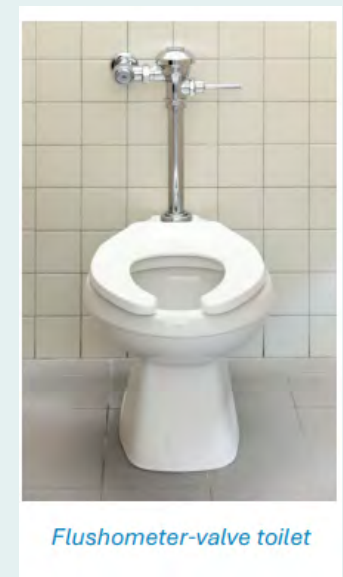


Figure 23. Flushometer-valve toilet (Source: EPA)

## Customer Leak Detection

Customers are usually responsible for addressing leaks that occur after the meter, while water providers are responsible for leaks that occur before the meter (Figure 24). For more information on leaks in water provider distribution systems see the Measurement and Data Best Practice.

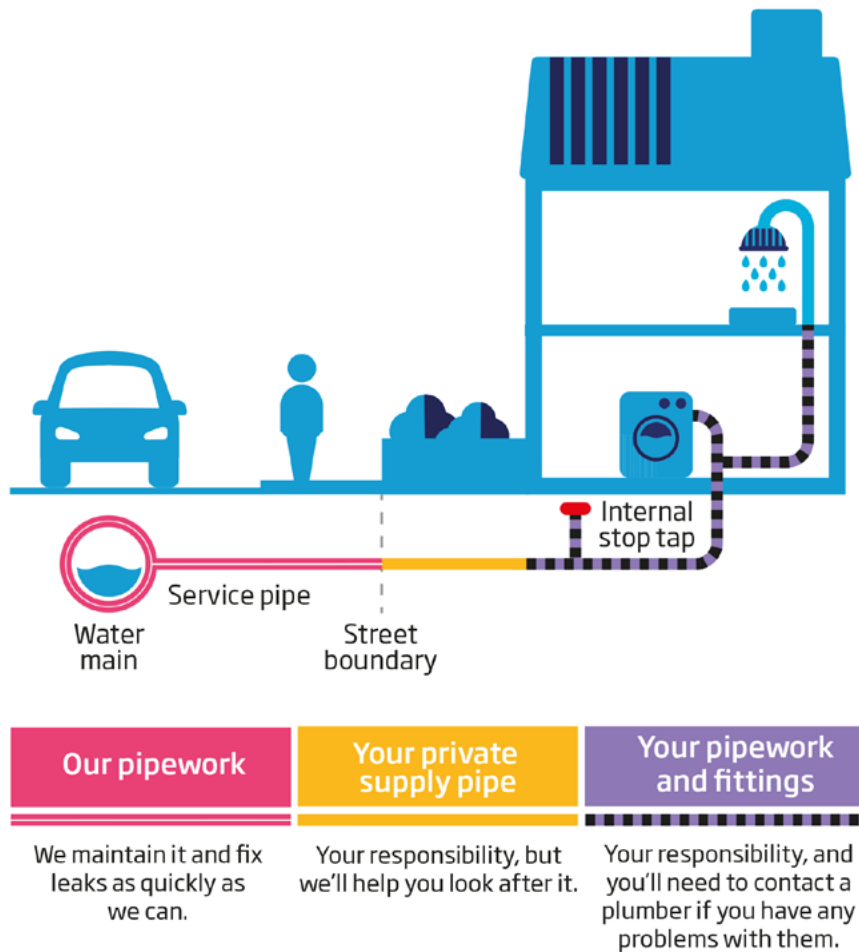


Figure 24. *Diagram of who is responsible for leaks*

While it is the responsibility of the customer, water providers can support customers with tools to minimize leaks. In the United States roughly 10% of homes have leaks that add up to almost 10,000 gallons of water waste per household per year (EPA, 2023). Detecting leaks in non-residential settings can be trickier, as some businesses operate 24/7 making it hard to identify if water use is a leak or standard practice.

Strategies to help water providers address leaks include:

- 1. Dye Tabs:** Putting dye tabs in a toilet's tank can help identify leaks. If dyed water appears in the bowl, it is an indicator that there is a leak between the bowl and tank.
- 2. Sub-metering:** As meters get more sophisticated, leak notifications can be sent in near-real time. Helping water users respond and resolve leaks faster.
- 3. AMI Portals and Notifications:** Like sub-metered data, water providers with AMI data and portals, can leverage leak notifications that can be sent in near-real time. Helping water users respond and resolve leaks faster.

## Regulatory Requirements

Many water providers have **water waste ordinances** that ensure efficient leak resolution. See the Development and Codes Best Practice Area for additional information.

## Key Concepts

Leak detection strategies range from simple (e.g., dye tabs) to more expensive and complicated (e.g., sub-metering and automatic leak notifications). In any case the goal is to help customers identify and quickly fix leaks to prevent unnecessary water waste.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Dye Tabs
- Smart Home-Water Monitoring Devices
- AMI Portals and Notifications

### **Dye Tabs**

Dye tabs are an inexpensive leak detection tool that many water providers give out for free. Dye tabs can be dropped in the toilet's tank. If dyed water appears in the bowl, it is an indicator that there is a leak between the bowl and tank. While sub-meter data and AMI portals are more effective tools, **dye tabs are an easy and affordable offering for customers.**

### **Smart Home-Water Monitoring Devices**

For water providers without AMI, Smart Home Water Monitoring Devices can help customers quickly identify and resolve leaks. Costing around \$250, smart home water monitoring devices allow customers to have access to real time data, immediately receive notifications if a leak occurs, and understand water use by fixture type. Most can easily be installed by a homeowner in less than 10-minutes. As this technology advances, **some water providers are offering rebates to promote their installation.** See the Rebate Programs section for additional information.

### **AMI Portals and Notifications**

With AMI data and portals becoming more common, water providers can now frequently enable leak alerts for customers. Usually sent via automated letter, email, or text, these alerts notify customers quickly, increasing leak resolution, water savings, and decreasing the likelihood of costly water damage. Leak alerts are often the most popular feature in an AMI portal (Akesson, Hahn, Kacha, Leavell, & Ong, 2022). Additionally, once set up, leak alerts yield significant savings without requiring a lot of staff time.

Considerations for water providers setting up leak alerts include:

- **Opt-in vs. opt-out:** Water providers will likely have the option to have customers opt-in, where a customer must proactively enroll themselves to receive leak alerts, or opt-out, where a customer is automatically enrolled and has the option of opting out of leak alerts. If palatable, an opt-out approach will increase the effectiveness and reduce the number of long-lasting water leaks.
- **Leak notification recipients:** Leak alerts can be sent to residential, multifamily, irrigation, or non-residential customers. Currently, most leak alerts are sent only to residential customers, however more water providers are starting to explore irrigation and multifamily leak notifications. Non-residential leak notifications continue to be a challenge since some business processes require continuous water use.

- **Leak flow rate threshold:** A leak alert requires a minimum volume requirement to trigger an alert, usually set in gallons per hour. The volume requirement will be partially dependent on meter resolution. Thresholds will also differ depending on the sector (e.g., residential vs. multifamily). Recent examples from AWE's AMI evaluation found water providers set residential thresholds between 5 and 7.5 gallons per hour (Alliance for Water Efficiency, 2023).
- **Minimum time threshold:** A leak alert also requires a threshold for the minimum time the continuous water use must occur before a leak alert is sent, usually set in hours. Recent examples from AWE's AMI evaluation found water providers set thresholds between 72 and 120 hours (Alliance for Water Efficiency, 2023).
- **Notice frequency:** How frequently leak notifications are sent (e.g., every day, once a month, etc). Timing may depend on the type of notification (e.g., email, text, or letter).



## Costs, Benefits, and Water Savings

<i>Costs</i>	<i>Benefits</i>
<p><b>Water Provider Perspective:</b> Leak reduction strategies vary widely in cost, however none require a lot of staff time unless a water provider is interested in pro-active leak resolution or enforcement (see Other Codes and Ordinances). Dye tabs are a low-cost option for water providers. Costing roughly \$0.35 per packet, they can be an easy giveaway item to help customers identify leaks. Smart Home Water Monitors are a more expensive solution, as the utility will have to cover the cost of any rebates, as well as staff to administer and process the rebates (see Rebate Programs). Finally, AMI portals with leak notification capabilities are the most expensive option, however, they have numerous benefits. See the Measurement and Data Best Practice for more information.</p>	<p><b>Water Provider Perspective:</b> Supporting customers in eliminating unnecessary water waste is an important strategy for all water providers. Dye tabs are a low-cost option water providers can offer to support customer leak identification. While more expensive than dye tabs, supporting installation of smart home water monitoring devices, via rebates or other programs, can help customers identify all types leaks, while also providing customers more frequent access to data. They are also cheaper than AMI. That said, when available AMI portals and notifications are a very effective way to notify all customers of leaks. Assuming the process is automated, once set up it requires little staff time to administer and can yield significant savings. Unfortunately, unlike Smart Home Water Monitoring Device, there can be a delay (24 – 72 hours) in sending leak notifications depending on the AMI system.</p>
<p><b>Customer Perspective:</b> Dye tabs are no cost to low-cost tool for customers to identify toilet leaks. If not provided for free from the water provider, dye tabs cost between 0.35 - \$5. Smart home water monitoring devices cost between \$250 - \$350 dollars, however rebates can lower this cost. With smart home water monitoring devices, there can be a small ongoing cost to access the data, however this cost varies by product and many of the most popular products are completely free. AMI meters and portals are completely free to the customer.</p>	<p><b>Customer Perspective:</b> Of all the leak identifying tools, smart home water monitoring devices may be the most beneficial for customers without AMI data. Not only do they help with real-time leak identification, but they also have a myriad of other benefits to help customers understand their water use. In comparison, AMI Portals and Notifications offer customers a no-cost solution to support leak identification and data access. While sometimes slightly delayed (24 – 72 hours), AMI portals and notifications offer customers a much more granular insight into their water data compared to their water bills.</p>
<b>Water Savings Assumptions</b>	
<p>Leak notification have been found to save water providers between 25 and 165 million gallons a year, however greater savings are achieved when alerts are sent quickly and there is not a lag time between when the notification is sent and received by the customer (Alliance for Water Efficiency, 2023).</p>	



# Indoor Water Savings Tables

## Fixture Water Saving Tables

This section includes tables for common assumptions, methodology, and water saving estimates for toilets, showerheads, and aerators (EPA, 2017). These values will change depending on the equipment being replaced and installed. Additionally, variables can be adjusted depending on a water provider's characteristic.

### Toilet Water Savings

Table 27. Toilet water savings

Variable	Example
Flow rate of original toilet	3.5 gpf
Flow rate of toilet being installed	0.8 gpf
Duration Assumption	N/A
Daily Use Assumption	5 flush per person per day
Number of Occupants Per Household	2.5 <sup>2</sup>
Days in the Year	365
Annual Water Savings Equation	$[(\text{Original Flow Rate}) - (\text{New Flow Rate})] * \text{Daily Use Assumptions} * \text{Number of Occupants Per Household} * 365 = \text{gallons saved per year}$
Example	$[(3.5\text{gpf}) - (0.8\text{gpf})] * (5 \text{ flushes/person}) * 2.5 \text{ people/house} * 365 \text{ days/year} = 12,319 \text{ gallons saved per household per year}$
Expected Life of Savings (Years)	25

<sup>1</sup>Values will vary depending on flow volumes of showerhead being replaced or installed. <sup>2</sup>Colorado's 2017 – 2021 average persons per household. For a more accurate estimate look up a city or county average persons per household using the most recent [US Census Data](#).

### Showerhead Water Savings

Table 28. Showerhead water savings

Variable	Example
Flow rate of original showerhead	2.5 gallons per minute (gpm) <sup>1</sup>
Flow rate of showerhead being replaced	1.5 gpm <sup>1</sup>
Duration Assumption	8 minutes per shower
Daily Use Assumption	0.7 showers per person per day
Number of Occupants Per Household	2.5 <sup>2</sup>
Days in the Year	365
Annual Water Savings Equation	$[(\text{Original Flow Rate}) - (\text{New Flow Rate})] * \text{Duration Assumption} * \text{Daily Use Assumptions} * \text{Number of Occupants Per Household} * 365 = \text{gallons saved per year}$
Example	$[(2.5\text{gpm}) - (1.5\text{gpm})] * (8 \text{ min/shower}) * (0.7 \text{ showers/day/person}) (2.5 \text{ people/house}) * (365 \text{ days/year}) = 5,110 \text{ gallons saved per household per year}^1$
Expected Life of Savings (Years)	10

<sup>1</sup>Values will vary depending on flow volumes of showerhead being replaced or installed. <sup>2</sup>Colorado's 2017 – 2021 average persons per household. For a more accurate estimate look up a city or county average persons per household using the most recent [US Census Data](#).

### Bathroom Aerator Water Savings

Table 29. Bathroom aerator water savings

Variable	Example
Flow rate of original aerator	2.2 gallons per minute (gpm) <sup>1</sup>
Flow rate of aerator being replaced	0.5 gpm <sup>1</sup>
Duration Assumption	1 minute
Daily Use Assumption	N/A
Number of Occupants Per Household	2.5 <sup>2</sup>
Days in the Year	365
Annual Water Savings Equation	$[(\text{Original Flow Rate}) - (\text{New Flow Rate})] * \text{Duration Assumption} * \text{Number of Occupants Per Household} * 365 = \text{gallons saved per year}$
Example	$[(2.2\text{gpm}) - (0.5\text{gpm})] * 1\text{min} * 2.5\text{people/house} * 365 = \mathbf{1,551\text{ gallons saved per household per year}^1}$
Expected Life of Savings (Years)	10

<sup>1</sup>Values will vary depending on flow volumes of showerhead being replaced or installed.

<sup>2</sup>Colorado's 2017 – 2021 average persons per household. For a more accurate estimate look up a city or county average persons per household using the most recent [US Census Data](#).

### Kitchen Aerator Water Savings

Table 30. Kitchen aerator water savings

Variable	Example
Flow rate of original aerator	2.2 gallons per minute (gpm) <sup>1</sup>
Flow rate of aerator being replaced	1.5 gpm <sup>1</sup>
Duration Assumption	10 minutes
Daily Use Assumption	N/A
Number of Occupants Per Household	N/A
Days in the Year	365
Annual Water Savings Equation	$[(\text{Original Flow Rate}) - (\text{New Flow Rate})] * \text{Duration Assumption} * 365 = \text{gallons saved per year}$
Example	$[(2.2\text{gpm}) - (1.5\text{gpm})] * 10\text{min} * 365 = \mathbf{2,555\text{ gallons saved per household per year}^1}$
Expected Life of Savings (Years)	10

<sup>1</sup>Values will vary depending on flow volumes of showerhead being replaced or installed.

<sup>2</sup>Colorado's 2017 – 2021 average persons per household. For a more accurate estimate look up a city or county average persons per household using the most recent [US Census Data](#).

## Pre-rinse Spray Valve

Table 31. Pre-rinse spray valve

Variable	Example
Flow rate of pre-rinse spray valve	1.6 gpm
Flow rate of pre-rinse spray valve being installed	0.65 gpm
Average daily use time	200 minutes <sup>1</sup>
Day of facility operation per year	360
Annual Water Savings	[(Original flow rate)-(New Flow Rate)]*Average Daily Use Time*Days of Facility Operation Per Year=gallons saved per year
Example	[(1.6gpm)-(0.65gpm)]*(200 min)*360 days/year = <b>75,920 gallons saved per year</b>

<sup>1</sup>Value may vary. Source: EPA's WaterSense program. March 31, 2011. Pre-Rinse Spray Valves Field Study Report. Page 22. [www.epa.gov/sites/default/files/2017-02/documents/ws-background-prsv-field-study-report.pdf](http://www.epa.gov/sites/default/files/2017-02/documents/ws-background-prsv-field-study-report.pdf).

## Cooling Towers

Alliance for Water Efficiency's Cooling Tower Estimate Model and Guide: [www.allianceforwaterefficiency.org/resources/topic/CTEM](http://www.allianceforwaterefficiency.org/resources/topic/CTEM).

## Non-Residential Minimum Flow Standards

The tables below summarize non-residential minimum flow standards as of January 1, 2024. To look up the most recent flow-standards see:

- [Section 432 of the Energy Independence Security Act](#)
- [Code of Federal Regulations 10 CFR 430 – Energy Conservation Program for Consumer Products](#)
  - [Subpart C – Energy and Water Conservation Standards](#) (e.g., faucets, showerheads, water closets, urinals, residential dishwashers, residential clothes washers). Note if State standards have precedence over any federal standards.
- [Code of Federal Regulations 10 CFR 431 – Energy Efficiency Program for Certain Commercial and Industrial Equipment](#)
  - [Subpart H. Automatic Commercial Ice Makers](#)
  - [Subpart I. Commercial Clothes Washers](#)
  - [Subpart O. Commercial Prerinse Spray Valves](#)
- [EnergyStar Key Product Criteria](#)

Table 32. 2023 Federal dishwasher standards

	Current Minimum Standard	Implementation Date
Standard size dishwasher	Will not exceed 5 gallons per cycle	May 30, 2013
Compact size dishwasher	Will not exceed 3.5 gallons per cycle	May 30, 2013
EnergyStar standard size dishwasher	Will not exceed 3.5 gallons per cycle	January 29, 2016
EnergyStar, compact size dishwasher	Will not exceed 3.1 gallons per cycle	January 29, 2016

Section: [10 CFR 430.32\(f\)](#); ENERGY STAR Key Product Criteria: [www.energystar.gov/products/appliances/dishwashers/key\\_product\\_criteria](http://www.energystar.gov/products/appliances/dishwashers/key_product_criteria)

Table 33. 2023 Federal clothes washer specifications

	Current Minimum Standard	Implementation Date
Top loading, Compact (less than 1.6 ft <sup>3</sup> capacity)	12 gal/cycle/cu.ft.	January 1, 2018
Top loading, Standard Clothes Washer (1.6 ft <sup>3</sup> or greater capacity)	6.5 gal/cycle/cu.ft.	January 1, 2018
Front-loading, Compact Clothes Washer (less than 1.6 ft <sup>3</sup> capacity)	8.3 gal/cycle/cu.ft.	January 1, 2018
Front-loading, Standard Clothes Washer (1.6 ft <sup>3</sup> or greater capacity)	4.7 gal/cycle/cu.ft.	January 1, 2018

Clothes Washer Source: [10 CFR 430.32\(g\)](#)

Table 34. 2023 ENERGY STAR clothes washer key product criteria

Product Type	Current Criteria Levels (as of April 22, 2021)
ENERGY STAR Residential Clothes Washers, Front-loading (> 2.5 cu-ft)	IMEF ≥ 2.76 IWF ≤ 3.2
ENERGY STAR Residential Clothes Washers, Top-loading (> 2.5 cu-ft)	IMEF ≥ 2.06 IWF ≤ 4.3
ENERGY STAR Residential Clothes Washers (≤ 2.5 cu-ft)	IMEF ≥ 2.07 IWF ≤ 4.2
ENERGY STAR Commercial Clothes Washers	MEFJ2 ≥ 2.20 IWF ≤ 4.0
ENERGY STAR Combination All-in-One Washer-Dryer	Meets IMEF, IWF and the current ENERGY STAR requirements for clothes dryers (except the time requirements) for the closest product type

Table 35. 2023 Federal pre-rinse spray valves specifications

Product class (spray force in ounce-force, ozf)	Flow rate (gallons per minute, gpm)
Product Class 1 (≤5.0 ozf)	1.00
Product Class 2 (>5.0 ozf and ≤8.0 ozf)	1.20
Product Class 3 (>8.0 ozf)	1.28

Section: 10 CFR 431.266; Integrated Water Factor, IWF, is the water performance metric for ENERGY STAR certified residential clothes washers as of March 7, 2015 and ENERGY STAR certified commercial clothes washers as of February 5, 2018. It allows the comparison of clothes washer water consumption independent of clothes washer capacity. Manufacturers must submit their water consumption factors with their ENERGY STAR certified residential clothes washers (Energy Star, 2024).

Source: [www.energystar.gov/products/appliances/clothes\\_washers/key\\_product\\_criteria](http://www.energystar.gov/products/appliances/clothes_washers/key_product_criteria)

Table 36. 2023 Federal minimum standards for ice machines

Equipment type	Type of cooling	Harvest rate lb ice/24 hours	Maximum condenser water use <sup>1</sup> gal/100 lb ice
Ice-Making Head	Water	<500	200–0.022H.
Ice-Making Head	Water	≥500 and <1,436	200–0.022H.
Ice-Making Head	Water	≥1,436	200–0.022H.
Ice-Making Head	Air	<450	Not Applicable
Ice-Making Head	Air	≥450	Not Applicable.
Remote Condensing (but not remote compressor)	Air	<1,000	Not Applicable.
Remote Condensing (but not remote compressor)	Air	≥1,000	Not Applicable.
Remote Condensing and Remote Compressor	Air	<934	Not Applicable.
Remote Condensing (but not remote compressor)	Air	≥934	Not Applicable.
Self-Contained	Water	<200	191–0.0315H.
Self-Contained	Water	≥200	191–0.0315H.
Self-Contained	Air	<175	Not Applicable.
Self-Contained	Air	≥175	Not Applicable.

<sup>1</sup> Water use is for the condenser only and does not include potable water used to make ice. Section: [10 CFR 431.136](https://www.ecfr.gov/current/title-10/chapter-IV/subchapter-B/part-431/subpart-136); ENERGY STAR Key Product Criteria: [www.energystar.gov/products/commercial\\_food\\_service\\_equipment/commercial\\_ice\\_makers/key\\_product\\_criteria](https://www.energystar.gov/products/commercial_food_service_equipment/commercial_ice_makers/key_product_criteria)

# Resources

## Targeting Users

- City of Fort Collins Building Energy and Water Scoring Municipal Code: [https://library.municode.com/co/Fort\\_Collins/codes/municipal\\_code?nodetid=CH12HEEN\\_ARTXIBUENWASC](https://library.municode.com/co/Fort_Collins/codes/municipal_code?nodetid=CH12HEEN_ARTXIBUENWASC)
- NRDC's Water Affordability Advocacy Toolkit: <https://www.nrdc.org/resources/water-affordability-advocacy-toolkit>
- Colorado State Demography Office: <https://demography.dola.colorado.gov/>
- Justice40 Initiative: <https://www.whitehouse.gov/environmentaljustice/justice40/>

## Residential Indoor

- Alliance for Water Efficiency Water Conservation Rebates Remain Taxable: <https://www.allianceforwaterefficiency.org/resources/legislative-watch/legislation-introduced-make-water-conservation-rebates-tax-free>
- City of Fort Collins Toilet Recycling Program: <https://www.fcgov.com/utilities/residential/conserves/water-efficiency/toilet-rebates/toilet-recycling>
- Colorado Energy Office Weatherization Assistance Program: <https://energyoffice.colorado.gov/weatherization-assistance/weatherization-faqs>
- Energy Outreach Colorado Healthy Homes Program: <https://www.energyoutreach.org/healthy-homes/>
- MaP Toilet Testing: <https://map-testing.com/>
- Reducing Residential Water Use in the Santa Clarita Valley: [https://publicexchange.usc.edu/wp-content/uploads/2023/10/SCV-Water-Research-and-Messaging-Brief\\_rev7.13.23.pdf](https://publicexchange.usc.edu/wp-content/uploads/2023/10/SCV-Water-Research-and-Messaging-Brief_rev7.13.23.pdf)

## Non-Residential Indoor

- Alliance for Water Efficiency Commercial Kitchen Guide: <https://www.allianceforwaterefficiency.org/impact/our-work/commercial-kitchens-guide>
- Alliance for Water Efficiency Cooling Technology Resources: <https://www.allianceforwaterefficiency.org/resources/topic/cooling-technology-study-resources>

- Better Building Partnerships Guidance 5.2 Undertaking a Water Audit: <https://www.betterbuildingspartnership.co.uk/responsible-property-management-toolkit/water/gn-52-undertaking-water-audit>
- Better Buildings Upgrading Commercial Laundry Facilities: <https://betterbuildingssolutioncenter.energy.gov/toolkits/upgrading-commercial-laundry-facilities>
- City of Colorado Springs Custom Commercial Rebate Program: <https://www.csu.org/pages/customrebatewater.aspx>
- City of Fort Collins Custom Rebates for HOAs, Multifamily, and Commercial: <https://www.fcgov.com/utilities/business/improve-efficiency/rebates-incentives/water-efficiency/custom-rebates>
- City Project Water Audit Guidance for Commercial Buildings: [https://www.cityenergyproject.org/wp-content/uploads/2019/05/City\\_Energy\\_Project\\_Resource\\_Library\\_Water\\_Audit\\_Guidance\\_For\\_Commercial\\_Buildings.pdf](https://www.cityenergyproject.org/wp-content/uploads/2019/05/City_Energy_Project_Resource_Library_Water_Audit_Guidance_For_Commercial_Buildings.pdf)
- Colorado C-PACE Financing: <https://copace.com/counties-government/counties-government-how-it-works/>
- Department of Energy Water Evaluation Tools: <https://www.energy.gov/femp/articles/water-evaluation-tools>
- EPA Water Efficiency Management Guide Mechanical Systems: <https://www.epa.gov/sites/default/files/2017-12/documents/ws-commercialbuildings-waterscore-mechanical-systems-guide.pdf>
- EPA WaterSense Commercial Buildings Best Management Practices: <https://www.epa.gov/watersense/best-management-practices>
- New York City Environmental Protection Agency Restaurant Managers Guide to Water Efficiency: <https://www.nyc.gov/assets/dep/downloads/pdf/water/drinking-water/restaurant-managers-guide-to-water-efficiency.pdf>
- Southern Nevada Water Authority Water Efficient Technologies Program for Businesses: <https://www.snwa.com/rebates/business-rebates/index.html>
- Southwest Carwash Association: <https://swcarwash.org/>
- The City Energy Project Water Audit Guidance for Commercial Buildings: [https://www.cityenergyproject.org/wp-content/uploads/2019/05/City\\_Energy\\_Project\\_Resource\\_Library\\_Water\\_Audit\\_Guidance\\_For\\_Commercial\\_Buildings.pdf](https://www.cityenergyproject.org/wp-content/uploads/2019/05/City_Energy_Project_Resource_Library_Water_Audit_Guidance_For_Commercial_Buildings.pdf)
- The Water Conservancy Commercial Laundries: <https://www.smartwatermark.org/smartwateradvice/saving-water-business/non-residential-laundries/>
- U.S. Green Building Council Cooling Tower Water Use Qualifications for LEED certification: <https://www.usgbc.org/credits/data-centers-existing-buildings/v4-draft/wec3>

## Leaks

- Alliance for Water Efficiency Smart Practices to Save Water: An Evaluation of AMI-enabled Proactive Leak Notification Programs: <https://www.allianceforwaterefficiency.org/impact/our-work/smart-practices-save-water-evaluation-ami-enabled-proactive-leak-notification>
- AWWA Increasing Consumer Benefits & Engagement in AMI-based Conservation Programs: A Guidebook for Practitioners: [https://www.awwa.org/Portals/0/AWWA/ETS/Resources/Technical%20Reports/ami\\_guidebook\\_feb\\_2022.pdf?utm\\_medium=print&utm\\_source=handout&utm\\_campaign=driver\\_topics&utm\\_content=pubs&utm\\_term=driver\\_flyers](https://www.awwa.org/Portals/0/AWWA/ETS/Resources/Technical%20Reports/ami_guidebook_feb_2022.pdf?utm_medium=print&utm_source=handout&utm_campaign=driver_topics&utm_content=pubs&utm_term=driver_flyers)





# Outdoor Water Use



In Colorado, about 40% of municipal and industrial water use is accounted for through outdoor water use (WEco, 2016). While strides have been made to improve outdoor water efficiency, there is still a significant amount of waste and additional water savings that may be achieved via waterwise landscapes. In addition to significant water-saving potential, healthy landscapes provide important environmental benefits, increase property values, and improve quality of life.

The Outdoor Water Use Best Practice Area is at the intersection of multiple professional fields that are rapidly evolving (e.g., water resources, landscaping, horticultural science). The information provided in this section serves as an introduction to foundational principles and presents current conditions at the time of writing. This best practice area summarizes the regulatory requirements, key concepts, and costs and benefits for the following best practices:







- Supporting **Waterwise Basics** in all plant selection, landscape planning, and design.
- Ensuring **Landscape Design, Installation, and Maintenance** that is water efficient.
- Supporting **Efficient Irrigation** that accounts for waterwise plant selection and landscape design.
- Developing **Landscape Transformation Programs** that help customers install waterwise and efficient landscapes.

- **Elevating the Landscaping Industry** to create a workforce that has the tools and knowledge to successfully design, install, and maintain waterwise landscapes.
- Other **Outdoor Water Uses** and considerations, including urban agriculture and pool water efficiency.

State Water Efficiency Plan Requirements	
	Indoor: fixtures and appliances
✓	Outdoor: waterwise landscapes, efficient irrigation
	Non-residential: water efficient industrial and commercial processes
	Water reuse systems: utility or building scale
	Water loss control
✓	Information and public education
	Conservation oriented rate structure and billing system
	Regulatory measures designed to encourage water conservation



## Major Benefits

Category	Definition
 <b>Water Savings</b>	Outdoor water use can represent 50% of total residential water use. Water efficiency landscapes can use 30-50% less water than traditional Kentucky bluegrass.
 <b>Economic Cost Savings</b>	More efficient outdoor water use can reduce peak demands during the irrigation season which can allow water providers to reduce or delay the need for costly water supply and/or infrastructure development.
 <b>Education</b>	Waterwise landscapes provide opportunity to increase awareness and promote responsible stewardship of water.
 <b>Community/Social</b>	Waterwise landscapes add an element of beautification and increase property value. A 5% investment in landscaping can raise the value of a home by 15% – a net 150% return on your investment (Johnson, 2017). Well-designed landscapes can promote physical activity and reduce stress.
 <b>Environmental</b>	Well-maintained waterwise landscapes can support soil health, reduce stormwater runoff and improve water quality, enhance biodiversity, improve air quality, and reduce heat island effect.
 <b>Climate</b>	Waterwise landscapes can support drought resilience and mitigate urban heat island impacts. Native landscapes specifically mitigate the loss of pollinator habitat to climate change.

## Key Takeaways

Key takeaways for each best practice include:

- **Waterwise Basics**
  - Waterwise plant selection **is an essential best practice that incorporates healthy native and low-water use plants that are climate appropriate** for a water provider's region.
  - For waterwise landscapes, **high water demand turfgrass should be limited to functional purpose(s)**.
  - All waterwise landscapes must **consider the benefits and maintenance of trees**.
- **Landscape Design, Installation, and Maintenance**
  - Landscape design, installation, and maintenance are **equally as important as plant selection for achieving water savings**.
  - Landscape design, installation, and maintenance must take into account factors like **sun exposure, soil conditions, use, and applicable landscape standards**.
- **Irrigation Efficiency**
  - Like landscape design, **irrigation design, installation, operations, and maintenance play critical roles in saving water and must be considered at the beginning of the process**.
  - Irrigation efficiency is a **specialized field that requires professional expertise and homeowner education**.
- **Landscape Transformation Programs**
  - There is **significant momentum across the state** for landscape transformation programs.
  - When designing programs, **it is important to consider the differences between small- and large-scale landscape transformation projects**.
  - **Maintenance plans** are critical for long-term success.
- **Elevating the Landscaping Practice**
  - **Additional training and resources are needed** to increase the number of certified landscape professionals familiar with waterwise landscapes and efficient irrigation.
  - In developing additional training and resources, it is critical to **partner with the industry to understand needs and provide adequate support**.
  - It is important to **connect customers with certified landscape professionals** to “close the loop.”

## Waterwise Basics

Traditional outdoor urban landscapes consist of high-water demand turfgrass that requires a substantial amount of irrigation during the summer and is not well suited for Colorado's arid climate. While this is still a common practice, more communities are adopting landscape regulations for new development and turf conversion programs that **support the best practice of establishing waterwise landscapes** (see Development and Codes Best Practice Area and Landscape Design, Installation and Maintenance Best Practice).

Waterwise landscaping encompasses the same general principles of xeriscaping (Table 37), and also includes the following components:

- Climate-appropriate landscape design and efficient irrigation technologies.
- Healthy native and low-water use plants that are compatible with arid climates.
- High water demand turfgrass is limited to areas that serve functional purpose(s) (e.g., athletic fields).
- Well maintained to retain landscape health and efficient irrigation.
- Incorporates the benefits and maintenance of trees, where appropriate.

“

*Waterwise landscape is a plant and water management practice that is functional, attractive, and emphasizes using plants that have lower supplemental water needs, such as native and drought-tolerant plants. Beyond plant type, the landscape and irrigation system are designed, installed, and maintained using practices that reduce water demand such as drip irrigation, applying mulch, improving the soil with compost, and grouping plants with similar watering needs together.*

*- Western Resource Advocates and WaterNow Alliance*

”

Table 37. Principles of xeriscape (waterwise landscapes)

Principle	Description
Planning and design	Consider site conditions including existing slope, soil, drainage and plants
Soil improvement	Provide soil most appropriate to the plants
Hydrozoning	Group plants according to their water needs
Practical turf areas	Limit turf areas to those needed for practical/essential purposes
Efficient irrigation	Eliminate water waste and use efficient irrigation systems/practices
Mulching and appropriate maintenance	Apply appropriate maintenance practices to maintain health of landscaping
Native and low-water use plants	Selection of native and low-water use plants

There are many different landscape types that may be included in waterwise landscaping. The following sections summarize each and how they can be incorporated into waterwise landscapes.

### The History of Xeriscape Landscapes

The concept of lower water use landscapes was introduced in the 1980s by Denver Water, through the seven principles of Xeriscape. While these seven principles still generally serve as foundational principles for low-water use landscapes, the term xeriscape has become less favorable for public messaging. In many cases, the term xeriscape has been interpreted by the public to mean “zero-scape” which has manifested as large spans of landscaping rock with “zero” or very little vegetation. While irrigation is no longer needed, such landscapes negate the the valuable diverse benefits associated with healthy, waterwise landscapes and are not the desired landscape at a broader community level.



## Low-Water Use Plantings

Low-water use plantings encompass a broad range of plants, trees, shrubs, ornamental bunch grasses, wildflowers, and other warm-season and native grasses that play an important role in waterwise landscapes. They provide many ecosystem benefits and are conducive for Colorado's arid climate. Low-water-use vegetation also use far less water than traditional high-water demand turf and it is a **best practice to promote installation of these low-water use plantings in development codes and/or turf replacement programs.**

Some low-water-use plants require very little to no supplemental irrigation while others, may require an annual nine gallons per square foot, half of what is generally needed for traditional high-water demand turf at 18 gallons per square foot. Across the industry, there is different terminology for low-water use plants. While all achieve the best practice's goal of reducing water use through promotion of waterwise landscapes, it is helpful to be aware of each and understand their differences:

- **Xeric plants:** evolved with drought and continue to flower, set seed and generally thrive in arid conditions (Northwest Council of Governments, 2020).
- **Drought-tolerant and drought-resistant plants:** adaptive to drought conditions through survival mechanisms such as defoliating or going dormant. Drought-tolerant plants are those that can survive a short-term drought while drought-resistant refers to the adaptation response (Northwest Council of Governments, 2020).
- **Native plants:** often defined as species present in America preceding European settlement, evolved based on regional climates (e.g., desert, alpine ranges, etc.). Not all native plants are necessarily xeric as demonstrated by some native species being threatened by climate change. (Northwest Council of Governments, 2020). Native can be a confusing term where it has different meanings within different contexts and social settings. Some providers choose to not use the word native because it can mean different things and instead use alternative terminology.
- **Climate-appropriate plants:** vegetation that generally thrives in a specific climatic setting. While "climate setting" can be defined in a variety of different ways, the USDA publishes a Plant Hardiness Zone Map, which can help identify plants that will do well in Colorado's climate (Figure 25). Importantly these maps are only updated every 10 years and are based on the lowest temperatures. As a result, it is a

best practice to couple map information, with data provided by local nurseries and local Extension offices. More information can be found at: [planthardiness.ars.usda.gov/](http://planthardiness.ars.usda.gov/) and [extension.colostate.edu/field-offices/](http://extension.colostate.edu/field-offices/).

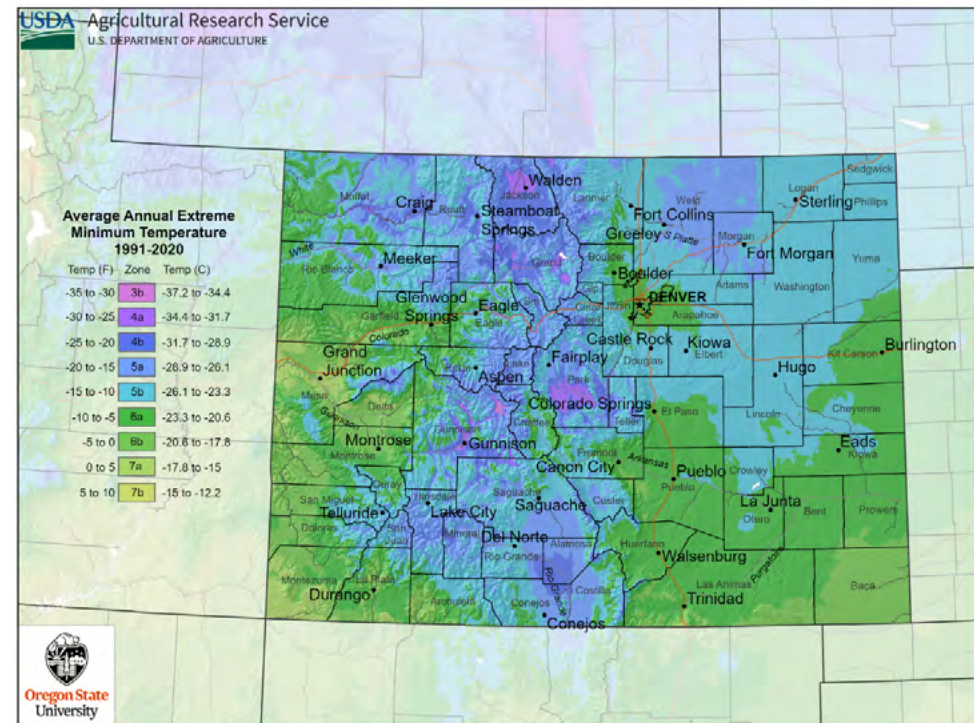


Figure 25. USDA Plant Hardiness Zone Map

In addition to these examples, there are numerous plant lists and demonstration gardens throughout the state to help water providers and the general public identify waterwise plants that are applicable for their area. Some, but certainly not all, of these resources are summarized in Table 38.

Table 38. Low-water use plant lists and demonstration gardens

Low-water Use Plant List Resources	
<b>Colorado State University (CSU) Plant Master</b>	Through CSU's extension office there are numerous resources, including <a href="#">Colorado's Plant Database</a> . More information can be found at: <a href="http://conativeplantmaster.colostate.edu/">conativeplantmaster.colostate.edu/</a> .
<b>Plant Select</b>	Plant Select is a non-profit collaboration among Colorado State University, the Denver Botanic Gardens, and horticulturalists. The organization supports plant design that succeeds in high plains and intramountainous regions. Plant Select plants do well with less water, are habitat-friendly, and non-invasive. A list of Plant Select Plants and more information can be found at: <a href="http://plantselect.org/plants/our-plants/">plantselect.org/plants/our-plants/</a> .
<b>Colorado Native and Water Wise Grass Guide for Installation and Maintenance</b>	A group of over fifty Colorado landscape and water professionals have designed a guide, specifically focusing on native and waterwise grasses. More information can be found at: <a href="http://coloradonativegrass.org/">coloradonativegrass.org/</a> .
Low-water Use Demonstration Gardens	
<b>Northern Water</b>	Northern Water's Conservation Campus and Gardens provide education on plant, irrigation, and waterwise landscapes. Garden visitors will see eight different types of landscapes, all of which use less water than traditional turfgrass. More information on the gardens can be found at: <a href="http://www.northernwater.org/ConservationGardens">www.northernwater.org/ConservationGardens</a> .
<b>Denver Botanic Gardens</b>	The Denver Botanic Gardens includes a variety of different gardens, include the "Roads Water-Smart Garden."The Gardens also has a <a href="#">Plant Finder</a> , which allows users to search for any plant found in the gardens. More information can be found at: <a href="http://www.botanicgardens.org/">www.botanicgardens.org/</a> .

Low-water Use Demonstration Gardens	
<b>Betty Ford Alpine Gardens</b>	The Betty Ford Alpine Gardens holds the National Collocation of Colorado's Alpine Flora. In addition to providing education on alpine plants, the Gardens develops a collection of plants and seeds to help propagate waterwise plants throughout alpine communities. More information can be found at: <a href="http://bettyfordalpinegardens.org/">bettyfordalpinegardens.org/</a>

Low-water Native Plants for Colorado Mountain Gardens
In partnership with Colorado State University Extension, Denver Botanic Gardens, the High Plains Environmental Center and more, the Colorado Native Plant Society published a list of native plants for mountain communities situated at 7,500 feet and above. The resource includes a plant list, with information on water use, sun exposure and plant size, as well as sample landscape designs. More information can be found at: <a href="http://extension.colostate.edu/docs/pubs/native/Mountains.pdf">extension.colostate.edu/docs/pubs/native/Mountains.pdf</a> .

### Turfgrass

Different grass species have different water requirements which can provide some water savings. Additionally, certain grass species are more drought tolerant than others. **Waterwise landscaping promotes limiting the use of high-water using turfgrasses only to functional uses (e.g., athletic fields) and promoting waterwise grasses in other areas where grass may be more appropriate than waterwise plants or shrubs (e.g., large unused HOA areas).**

To understand what turfgrass is applicable in what location, it is important to understand the differences between grasses. Grasses are grouped into two categories – cool and warm season. Differences between the two are summarized in Table 39:

- **Cool-season turfgrass:** Cool-season grasses are naturally green in the spring and fall (e.g., their respective growth season). Without supplemental irrigation, they will go dormant and brown in the summers. Cool-season grasses can tolerate some shade and many varieties can withstand high amounts of foot traffic. They are more adapted to higher altitudes and long winters. Common examples of cool-seasonal grass are Kentucky bluegrass and Fescue.

- **Warm-season turfgrass:** Warm-season grasses growth season (e.g., when they will be green) is the late spring and summer. Warm-season grasses are very intolerant of shade, and some are not tolerant of foot traffic. Common examples of warm-season grasses are Bermudagrass or Buffalograss.

Table 39. Turfgrass irrigation water requirements

Location	Irrigation Season	Annual Irrigation Requirement Cool Season Grass, Gal/Sq. Ft. (2017 – 2021 Average)	Average Annual Irrigation Requirement Warm Season Grass, Gal/Sq. Ft. (2017 – 2021 Average)
Cheyenne, WY	May – Oct	15	10
Colorado Springs, CO	May – Oct	16	10
Denver, CO	May – Oct	19	14

(Moravec, 2022)

Despite having a higher water use, cool season grasses, such as Kentucky bluegrass, are the most common in Colorado, especially in urban areas. This is likely due to their drought tolerance and tolerance of high foot traffic. New non-native grass species, such as Tahoma 31, are being explored as alternatives to high water using cool season grasses. These grasses demonstrate similar qualities to cool season robust turfgrass (e.g., can tolerate high foot traffic) yet require less water and may be waterwise alternatives to higher water use turfgrasses in the future. **If turf is in an active or functional area, it is best practice to use a drought tolerant cool-season grass that is tolerant of high foot traffic.**

In other areas, **such as large unused HOA common spaces, native and low-water use grass species** such as buffalo grass, blue grama grass, and mixtures of prairie grass species **may be applicable**. These species provide aesthetic appeal that require little to no irrigation once established. The [Colorado Native and Water Wise Grass Guide For Installation and Maintenance](#) provides extensive information on the installation and maintenance of these grasses at a commercial scale (Colorado Native Grass, 2024).

## Trees

The urban tree canopy provides many benefits to the environment and communities, including:

- **Mitigation of urban heat island effect:** Trees provide shade and cooling which reduces energy necessary to cool urban homes and structures. A 2022 USGS study showed that replacing 25% of impervious surface with urban trees in a 60 square meter area can reduce daytime local air temperatures by almost 1 degree Celsius (Ibsen, 2022).
- **Carbon sequestration and air quality:** Trees reduce greenhouse gases and pollution. Denver’s tree canopy alone provides the city with air quality benefits in excess of \$1.7 million (Johnson, 2017).
- **Urban ecosystem benefits:** Trees provide food and shelter for wildlife.
- **Erosion benefits:** Trees stabilize soils, which can help with runoff and improve soil and water quality.
- **Stormwater benefits:** Trees intercept and absorb rain, which reduces runoff and improves water quality.
- **Community aesthetic benefits:** Trees provide visual amenities in urban communities.
- **Economic benefits:** Trees increase resale value of properties. Large street trees can add 3% to 15% value to a home and appreciate over time (Johnson, 2017).
- **Quality of life:** Trees provide human health benefits such as reduction in stress levels.



However, in Colorado, irrigation is necessary to establish trees and maintain a healthy urban tree canopy. As a result, when installing waterwise landscapes, that require less irrigation, it is **essential to consider the water needs of trees to ensure healthy establishment and survival**. Supplemental irrigation for trees with higher water demands than their surrounding waterwise landscape may be needed. Additionally, severe drought restrictions that reduce or eliminate irrigation and turf conversion programs should be designed to preserve the health of trees. Additionally, resources like Colorado State University's [Front Range Tree Recommendation List](#) can help communities identify trees that are most applicable for their region.

### Tree Equity

Trees have a long list of environmental benefits; however, in many communities “a tree equity gap” exists, with more affluent neighborhoods having older and more mature trees. [The Park People](#) work with Denver communities to plant trees for a healthy resilient future. Their flagship program, Denver Digs Trees, provides over 1,000 free and low-cost trees to residents within Denver annually, focusing on 28 low-income, low-canopy neighborhoods (Denver Foundation, 2021).

### Hardscapes

Hardscapes are patios, decks, walkways, or the “hard” landscape materials that are incorporated into any landscape design. Hardscapes often provide key functional elements to a landscaping plan and are **important features in a waterwise landscape by accentuating aesthetics and providing important social benefits** (e.g., patio). While hardscapes do not require irrigation, pressure washing is sometimes applied for maintenance purposes, and they can also contribute to the heat island effect. To mitigate these impacts, **best practice is to ensure any hardscaping incorporated into waterwise landscaping is permeable to allow-water to pass through** (Figure 26).



Figure 26. Permeable sidewalk design

### Artificial turf

Artificial turf is an alternative option to natural turf and is comprised of plastic that attempts to replicate the look, feel, and function of an athletic field or natural grass lawn. It is seen by some as a viable option in reducing outdoor water use. While artificial turf does not require irrigation, it does require periodic cleaning and, therefore, does require water. From a functional perspective, artificial turf may also be considered an alternative hardscape for specific applications that have high human traffic and provide an aesthetic appeal.

However, **the broad application of artificial turf does not support healthy landscapes and watersheds and, therefore, is not considered a best practice, even though it has a lower water requirement than natural turf**. Artificial turf contributes to the heat island effect, by elevating ambient air temperature and harms soil health. It also contains harmful chemicals, including PFAS, that when exposed to heat and light, can mobilize. Microplastic contamination is also of concern where the plastic turfgrasses can break off and migrate into the environment. The average life span of plastic turf is ten years and when disposed of, takes up valuable landfill space (Benjamin, 2022). Additionally, cost comparisons with natural grass conclude that artificial turf is more costly in the long term (Western Resource Advocates and WaterNow Alliance, 2022).



## Firewise Landscapes in Colorado

Fire is a natural part of Colorado's environment. The suppression of fire, coupled with a warming climate, has exacerbated the negative impacts of wildfire on human development in both forested and grassland areas. As the wildfire threat to residential landscapes has grown, the popularity of firewise, sometimes called firescape, landscapes have also grown.

Firewise landscape practices entail three primary zones around a structure to defend against wildfire and include the following general landscaping principles (Northwest Council of Governments, 2020):

- Plant low growing, naturally occurring, and non-resinous plants.
- Regularly maintain landscapes and irrigation systems. This includes mowing grasses, and cutting back of shrubs when dormant to limit fuel.
- Incorporate open areas and buffers that include permeable hardscaping such as rock pathways or pebble mulch around groups of plants.
- Plant high hydrozone plants, with highest water use, adjacent to structures.
- Use efficient automatic irrigation systems in the case of fire.

In 2023, the City of Lafayette began to install a [demonstration garden at its Fire Station #1](#) that is designed to be one of Colorado's most extensive firewise and waterwise demonstration gardens.

Northern Water is also partnering with Norris Design and community stakeholders to develop six landscape templates for neighborhoods impacted by the December 2021 Marshall Fire that destroyed 1,084 homes in Louisville, Superior and Boulder County. Homeowners will be able to use these templates at their own properties as they rebuild. Each template will be designed with the following objectives: sustainable water use, low flammability and pollinator-friendly design, and consideration of costs for installation and maintenance (Northern Water, 2023). Additional information on firewise landscapes can be found in the Landscape Standards section.





## Costs, Benefits, and Water Savings

### Costs

**Water Provider Perspective:** While most water providers are not bearing the costs unless completing work on their own properties, landscape type and plant selection are important cost considerations for customers. Water providers should understand these costs in order to adequately support customers in the promotion of waterwise landscapes via rebates or other educational programs. These opportunities should consider both the installation and long-term maintenance costs for homeowners.

**Customer Perspective:** Costs for installation and maintenance of waterwise landscapes vary significantly on a site-by-site basis. Northern Water's average cost from 2019-2023 for large property landscapes ranged between \$0.06 to \$23 per square foot. Turf conversions that consisted of converting high-water demand turf to low-water demand native turf were less per square foot than conversions to waterwise gardens. The cost include plant material and installation, but they do not include design (Northern Water, 2024). Customers must also consider costs for changing irrigation systems, as well as the ongoing maintenance and weed reduction costs, which can be higher than costs associated with a turf-grass landscape that only requires mowing.

### Benefits

**Water Provider Perspective:** First and foremost, waterwise landscapes and plant selection are a water saving opportunity for water providers. Waterwise basics also provide other co-benefits including reduced stormwater runoff, increased community resiliency, and increased pollinator habitat.

**Customer Perspective:** Waterwise landscapes are an important and worthwhile investment toward a sustainable future. Well-maintained healthy waterwise landscapes provide numerous environmental, economic, quality of life, and community educational benefits including:

- Support for the local economy.
- Support for healthy soils.
- Enhance biodiversity, provide native habitat, increase pollinators
- Add elements of beautification and increase property values by up to 15% (Johnson, 2017).
- Improve physical and mental health through natural landscapes, promote physical activity, and provide stress reduction through gardening.
- Represent the natural arid climate conditions within Colorado and bring social awareness around water being a limited and valuable resource.

### Water Savings Assumptions

Water savings achieved through waterwise landscapes vary widely. Savings depend on a variety of factors including:

- Local climate
- Prior levels of irrigation on the previous landscape
- Irrigation design and installation
- Current plantings
- Size of the designated area
- Quality of installation and maintenance

Data required to calculate water savings includes:

- Evapotranspiration for the type of vegetation and location
- The amount of water used by the plant
- The amount of supplemental water needed after subtracting natural precipitation
- The amount of irrigation water that needs to be applied considering irrigation efficiency

The details of these calculations are beyond the scope of this document; however, there are numerous resources available on this topic including:

- Northern Water's Landscape Conversion Water Savings Calculator: [www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/fact-sheets-and-tools](http://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/fact-sheets-and-tools)
- Alliance for Water Efficiency's Water Conservation Tracking Tool: [www.allianceforwaterefficiency.org/resources/topic/water-conservation-tracking-tool](http://www.allianceforwaterefficiency.org/resources/topic/water-conservation-tracking-tool)

High level estimates of savings that may be achieved through turf conversions are discussed in the Landscape Transformation Programs section.

## Landscape Design, Installation and Maintenance

The design, installation, and maintenance of landscapes play an important role for both water efficiency and maintaining the health and aesthetic appeal of the landscape. How landscapes are installed and maintained can greatly impact the amount of water needed to keep vegetation alive and healthy.

This best practice describes **key considerations for maximizing water efficiency through the proper design, installation, and maintenance of new and existing landscaping.**

### Regulatory Requirements

Under [C.R.S. §37-60-126\(4\)\(a\)\(III\)](#) one of the water-saving measures and programs that must be considered in a water efficiency plan is “[...]low water use landscapes, drought-resistant vegetation, removal of phreatophytes, and efficient irrigation.”

[HB 19-1231](#). All sprinkler bodies sold in Colorado are required to be WaterSense certified, which can reduce water use by 20% or more when irrigation system pressure exceeds 60 psi.

[HB19-1050](#) passed in 2019, establishes the right of unit owners in HOAs to use water efficient landscaping, and specifies that HOAs cannot require a homeowner to install cool-season turfgrass.

[HB 21-1229](#), passed in 2021, prohibits HOAs from banning xeriscape, among other protections for property owners interested in installing energy efficient and other sustainable technologies.



[HB22-1151](#), passed in 2022, authorizes state funded Turf Replacement Program for turf replacement projects throughout Colorado. HB22-1151 directs CWCB to develop a voluntary statewide grant program that matches local turf replacement program funding.

### Key Concepts

While step one of a waterwise landscape is plant selection (see Waterwise Plant Selection), proper landscape design, installation, and maintenance are equally, if not more, important for water conservation and efficiency. While this document introduces each of these topics and some key considerations, it is not intended as a manual on landscape design. Additional resources to support more comprehensive landscape design, installation, and maintenance can be found in the Resources section.

To support implementation of this best practice, the following key concepts are addressed in this section:

- Design Considerations
- Landscape Installation
- Landscape Maintenance

### Design Considerations

A landscape that is not designed properly will not save water. **When initiating or supporting customers with landscape projects, key considerations to maximize water savings include:**

- **Slope:** Groundcovers with lower water requirements are a good choice for slopes and hard-to-mow locations. It is recommended that lower-water demand plants be placed at the tops of slopes and higher-demand plants at the bottom, in lower-lying drainage areas, near downspouts or in the shade of other plants.
- **Existing plants to preserve/protect:** If any existing plants or trees are being incorporated into the landscape design, it is important to consider their location, age, and irrigation requirements to ensure they will continue to grow in their new landscape.
- **Exposure to natural elements (e.g., wind, sun):** Certain plants or turf are better equipped for different environments. Local considerations such as sunlight requirements, deer resistance, and size all influence where a certain plant will be successful.
- **Exposure to human elements (e.g., pedestrian traffic):** Certain plants or turf are better equipped to handle high foot traffic. Thinking about how a landscape will be used can ensure that the right plant is in the right place.

- **Soil conditions:** Proper soil conditions can significantly contribute to landscape health and save water. Soil releases nitrogen from organic matter without the addition of fertilizers. It also plays a role in supporting water savings as the aeration of soils results in deeper roots, improved drainage, and better infiltration of precipitation. Landscape designs should consider the type of existing soil and any soil amendments that may be needed to ensure vegetative health and water efficiency. In Colorado, there are many areas that have very rocky or porous, sandy soils and amendments can be useful in these soils. Another option is to select plants that thrive in sandy soils. Colorado is also known for its heavy clay soils with poor aeration which are found in many urban areas. Adding water to clay soils can cause oxygen starvation in the root zone. Clay soils can limit the growth of some plants, but many native and low-water use plants have adapted well to clay soil and some prefer it over amended soil if it is not over-watered.
- **Stormwater considerations:** When designing landscapes, especially larger landscapes, it is important to consider the stormwater implications of the design. This includes drainage of the overall landscape and where to place certain landscaping materials (e.g., mulch).
- **Hydrozoning:** Hydrozoning or grouping plants according to their water needs promotes water efficiency. Irrigation systems should be designed to apply water evenly across each zone or area. If plants in the same zone have different water requirements, the irrigation system must be adjusted to meet the needs of the highest water use plant in the zone, thus delivering more water than is necessary to meet the needs of the rest of the zone.
- **Applicable landscape standards:** All new development and some redevelopment will need to meet applicable landscape standards. This is often a surprise and can delay projects or add additional costs if not considered upfront. See Development and Codes Best Practice Area for additional information.

Specific waterwise design templates that take all these considerations into account are available from a number sources, including, but not limited to:

- Denver Botanic Garden: [www.botanicgardens.org/our-impact/sustainable-landscape-services](http://www.botanicgardens.org/our-impact/sustainable-landscape-services)
- Northern Water: [www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/landscape-templates](http://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/landscape-templates)
- Resource Central: [resourcecentral.org/](http://resourcecentral.org/)

Additional information and resources can be found in the Resources section.

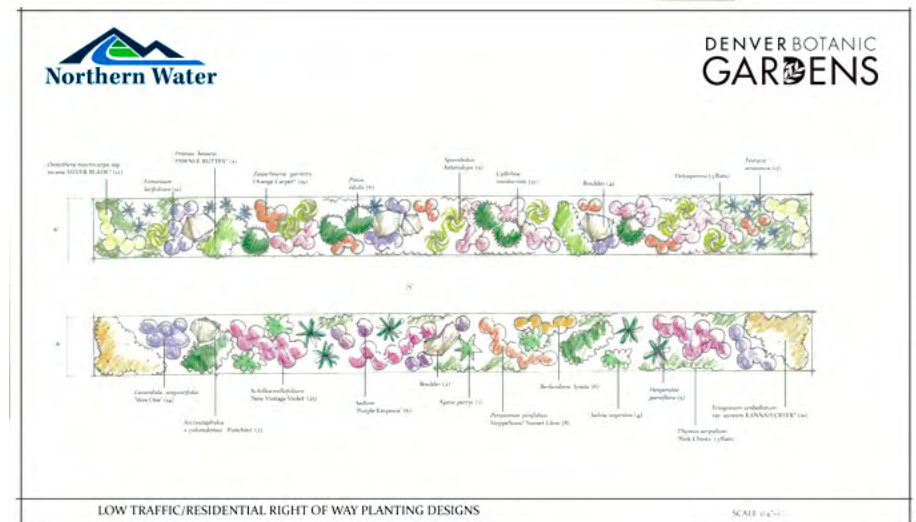


Figure 27: Example waterwise design

### Colorado State University Soil Water Plant Laboratory

To develop specific soil quality standards, consult with local specialists, such as your local Colorado State University extension office, on what is most appropriate for the community's soil characteristics. Proper soil amendments increase water and nutrient holding capacity while improving aeration and water infiltration which is critical to reducing water demands. More information at: [extension.colostate.edu/contact-us/](http://extension.colostate.edu/contact-us/) and [agsci.colostate.edu/soiltestinglab/](http://agsci.colostate.edu/soiltestinglab/)

## Landscape Installation

Once plants are selected and the landscape has been designed, it is time for installation. **The installation process should follow the landscape design plan and minimize impacts to neighboring properties and ecosystems, while maintaining the health of existing plants and trees.** Some key considerations for installation include:

- **Protect drainage areas from runoff:** This includes complying with any applicable stormwater permit requirements, phasing construction to limit land exposure, properly storing and topsoil or soil amendments, and taking care with planted slopes to slow water.
- **Understand soil conditions and implement any applicable improvements:** Proper soil preparation can substantially reduce irrigation requirements by increasing water-holding capacity. Soils may be evaluated through tests and improved, if necessary, to promote efficient water use and healthy plants (GreenCO, 2008). Additional best practices to improve soil health include (Northwest Council of Governments, 2020):
  - Perform soil analysis to determine what amendments and fertilizer may be necessary
  - Properly amend soil as needed and till to a depth of 4 to 6 inches
  - Remove rocks, debris, clumps
  - Enhance soil with compost based on a documented metric: number of inches, cubic inches per square foot or percentage of volume
  - Till soil to 6-inch depths
- **Mulch to reduce unnecessary evaporation:** Mulch should be specified as part of a comprehensive water efficient landscape design. GreenCO recommends using organic mulches to “reduce water loss through evaporation” and “reduce soil loss due to exposure to wind and runoff and to suppress weeds and provide a more uniform soil temperature.” There are different philosophies on the quantity of mulch used and on whether using organic and wood mulch versus alternative inorganic mulch materials. The Denver Botanic Gardens recommends a “squeegee” rock or crushed granite. Other benefits of mulch include:

- Reduction of weeds that compete with plants for moisture and soil nutrients
  - Erosion control by allowing rainfall to be absorbed before running off
  - Reduced soil compaction from rainfall and overhead irrigation
  - Regulation of soil temperatures and reduction of damage to plants from freezing and thawing of the root zone
  - Delineation of hydrozones
- **Other considerations:** GreenCO has identified the following areas for consideration during landscape installation including (GreenCO, 2008):
    - Sow seeds at proper time of year and mulch seeded areas adequately to retain moisture.
    - Maintain health of plants in containers prior to planting in the ground.
    - Irrigate adequately and appropriately during the establishment period. Length of establishment varies with different plants.
    - Conduct regular, routine inspections of new plantings and attend to any detected problems as soon as possible.

### Denver Botanic Gardens Sustainable Landscape Services

The Denver Botanic Gardens offers landscape design services for municipalities and community projects ranging from garden/landscape design to installation and maintenance support. Support extends throughout the Intermountain Western United States where successful design and establishment can be unique. More information can be found at: [www.botanicgardens.org/our-impact/sustainable-landscape-services](http://www.botanicgardens.org/our-impact/sustainable-landscape-services).

## **Maintenance**

Sound installation and maintenance are critical to the longevity and success of all landscapes. **Maintenance practices help preserve water savings after initial installation and establishment.** Routine maintenance best practices to ensure water savings include, but are not limited to:

- Remove dead or dying plants and all weeds that compete with healthy plants for available water. Clean up plant litter and remove weeds before they go to seed.
- Replace or replenish mulch in areas where it has deteriorated.
- Aerate turf in the spring and in the fall, if needed, to eliminate compaction and improve the turf's ability to take up moisture, nutrients, and air.
- Maintain the irrigation system to ensure it is irrigating efficiently without water waste.
- Adjust irrigation as plants mature to ensure the right plants are receiving the right amount of water.
- Weed at appropriate intervals to maintain health of the landscape.

In addition to the list above, there are standard best practices for management of traditional turfgrass. Additionally, there are many products (aerators, fertilizers, pesticides, turfgrass seed) readily available at home retail stores and nurseries that support long-term landscape success.



## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Water Provider Perspective:</b> While most water providers are not bearing the costs of landscape design, installation and maintenance, unless completing work on their own properties, all are major costs for customers. That said, water providers often fund turf replacement programs that cover the costs for planning, installation, and sometimes maintenance. It is important that water providers understand these costs in order to adequately support customers in the installation and long-term success of waterwise landscapes.</p>	<p><b>Water Provider Perspective:</b> First and foremost, well designed, maintained, and installed landscapes are a water saving opportunity for water providers. These landscapes can also provide other co-benefits including reduced stormwater runoff, increased community resiliency, and increased pollinator habitat.</p>
<p><b>Customer Perspective:</b> Design, installation, and maintenance costs will vary depending on the type of landscaping work, landscaping features, who is completing the work, and the condition of the existing landscape. Key project costs generally include landscape design, site preparation, and installation. Maintenance costs following the landscape installation are also critical to consider. Maintenance for waterwise landscapes can be more complex than for traditional turfgrass and often requires weeding, which is more time-intensive than mowing. Annual costs, excluding the cost of water, for a 500 square foot bluegrass lawn is estimated to be \$160/year (BBC Research and Consulting, 2024). In comparison, native grass landscapes are estimated to cost \$60/year and low-water use plants are estimated to cost \$90/year. From 2019 – 2023, Northern Water’s landscape for large properties ranged from \$0.06 to \$23.00 per square foot. Turf conversions that consisted of converting high-water demand turf to low-water demand native turf were less per square foot than conversions to waterwise gardens. These costs only included installation and did not include the landscaping design (Nowels, 2024).</p>	<p><b>Customer Perspective:</b> Well designed, maintained, and installed landscapes provide numerous environmental, economic, quality of life, and community educational benefits. Done well, turf replacement programs can:</p> <ul style="list-style-type: none"> <li>• Support the local economy.</li> <li>• Support healthy soils.</li> <li>• Enhance biodiversity, provide native habitat, increase pollinators</li> <li>• Add elements of beautification and increase property values by up to 15% (Johnson, 2017).</li> <li>• Improve physical and mental health through natural landscapes, promote physical activity, and provide stress reduction through gardening.</li> <li>• Represent the natural arid climate conditions within Colorado and bring social awareness around water being a limited and valuable resource.</li> <li>• Improve drought resiliency.</li> </ul>
<h3>Water Savings Assumptions</h3>	
<p>A well designed, installed, and maintained landscape should use substantially less water than a poorly maintained irrigation system; however, water savings are not well quantified and there can be a lot of variability. For some, savings will be substantial, on the order of 30 – 50%, but for others there may no measurable savings (Colorado WaterWise and Aquacraft, Inc., 2010). Water providers can navigate this issue by making adjustment to water savings estimates given site-specific information or assume the design, installation and maintenance are performed to the recommended practices without adjustments.</p> <p>Water providers can also help ensure high water savings by:</p> <ul style="list-style-type: none"> <li>• Providing educational resources and support to customers to ensure landscapes are well designed.</li> <li>• Couple landscape design with irrigation system upgrades (see the Efficient Irrigation Best Practice).</li> <li>• Ensure every landscape has a corresponding maintenance plan to ensure long-term success of the landscape.</li> <li>• Connecting customers with trained and certified landscape professionals (see Elevating the Landscaping Industry).</li> </ul>	

## Efficient Irrigation

Efficient irrigators apply the minimum amount of water required for a healthy landscape with an acceptable level of appearance. It is about knowing how much water plants need and how often to water to meet those needs.

While efficient irrigation practices are important for both manual and automatic irrigators, most of the literature is devoted to automatic irrigation systems. Numerous studies have shown that manual irrigators use significantly less water on average than automatic irrigators (Colorado WaterWise and Aquacraft, Inc., 2010). As a result, **this best practice focuses on automatic irrigation, introducing the basic concepts of irrigation equipment, design, operations, and maintenance.**

### Regulatory Requirements

Under [C.R.S. §37-60-126\(4\)\(a\)\(III\)](#) one of the water-saving measures and programs that must be considered in a water efficiency plan is “[l]ow water use landscapes, drought-resistant vegetation, removal of phreatophytes, and efficient irrigation.”

[HB 19-1231](#). All sprinkler bodies sold in Colorado are required to be WaterSense certified, which can reduce water use by 20% or more when irrigation system pressure exceeds 60 psi.

[HB19-1050](#) passed in 2019, establishes the right of unit owners in HOAs to use water efficient landscaping, and specifies that HOAs cannot require a homeowner to install cool-season turfgrass.

[HB21-1229](#), passed in 2021, prohibits HOAs from banning xeriscape, among other protections for property owners interested in installing energy efficient and other sustainable technologies.

[HB23-178](#), passed in 2023, requires HOAs to allow up to 80% drought tolerant plants in a homeowner’s landscape and to select at least 3 preapproved waterwise landscape design templates for unit owners to select from. It’s recommended that HOAs double check to ensure their bylaws are updated to comply with these new allowances for waterwise landscaping.

[HB22-1151](#), passed in 2022, authorizes state funded Turf Replacement Program for turf replacement projects throughout Colorado. HB22-1151 directs CWCB to develop a voluntary statewide grant program that matches local turf replacement program funding.

## Key Concepts

This best practice describes key considerations for maximizing irrigation water, with a focus on irrigation systems and their components. According to GreenCO’s 2008 best practice guide, the five fundamental practices for irrigation systems are:

1. Ensure the overall quality of the irrigation system
2. Design the irrigation system for uniform distribution and efficient management of water
3. Install the irrigation system according to the design criteria
4. Maintain the irrigation system to adhere to the design criteria, for optimum performance
5. Manage the irrigation system according to changing plant water requirements

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Irrigation Design and Installation
- Irrigation Water Saving Technologies
- Irrigation Scheduling
- Irrigation Maintenance
- Irrigation Assessments

Additionally, while not the focus of this best practice, water budgets are also often leveraged as a key tool to identify irrigation needs and measure efficiency (see the Water Budgets Best Practice Area for additional information).

“  
*The best irrigation efficiency is achieved when most of the water that is applied to the landscapes by irrigation systems is used by the plants being irrigated. It is the result of appropriate design, installation, operation, and maintenance of the system.*  
”  
*The Irrigation Association (Colorado WaterWise and Aquacraft, Inc., 2010)*

## Irrigation System Design and Installation

The design and installation of irrigation systems impact the amount of water required to keep the plants alive and healthy, while also not overirrigating and wasting water.

Successfully designed irrigation systems should avoid runoff, low-head drainage, overspray and other conditions where water flows onto adjacent property and non-irrigated impermeable surfaces such as sidewalks and roads. To the average homeowner, however, the design and installation of irrigation systems can be intimidating, as it requires a specialized level of professional expertise and knowledge. Professional irrigation contractors are often needed to install irrigation systems on residential and larger community properties.

### Hydrozones

To conserve water, plants with similar soil, sun, and water requirements should be planted together in what is commonly called a hydrozone. Grouping plants into hydrozones ensures that the irrigation systems are designed in a way that meets plant needs – preventing overwatering for plants that need less water, and underwatering for plants that need more water. Common hydrozones include:

- Routine irrigation zones
- Reduced irrigation zones
- Limited irrigation zones
- Non-irrigated zones

Hydrozones can also be used to create water budgets. See the Water Budgets best practice for additional information.

Well-designed and installed irrigation systems take into consideration the following site conditions:

- Soil type and infiltration rate
- Plant type(s) and spatial distribution
- Microclimates (e.g. shaded vs sunny areas), site grading/slope(s)
- Exposure to wind and sun, size of irrigated area
- Available flow and pressure
- Water quality
- Historical evapotranspiration and annual rainfall
- Construction budget
- Manufacturer specifications
- Local code requirements

There are three primary irrigation methods (Northwest Council of Governments, 2020).

- **Drip irrigation:** low-pressure, low-flow-rate irrigation (0.5 to 2 gph) that delivers water directly to the root zone of plants via irrigation tubes, drippers, bubblers, and soakers. The water is delivered slowly over a longer period which helps penetrate the soil and reduces runoff and evaporation. Drip irrigation is also referred to as low-flow, trickle, and microirrigation. **Drip is the most efficient irrigation method**, achieving up to a 90% efficiency rating with little evapotranspiration (Figure 28).
- **Microspray irrigation:** low-pressure, low-flow irrigation (0.5 - 5 gph) that uses small sprinklers, sprayers, or jets to spray water short distances to irrigate plants just above the ground surface. Microspray has an efficiency rating ranging from 70 to 90% (Figure 29).
- **Overhead irrigation:** higher pressure that omits streams of water through the air to plants (e.g., sprinkler). Water efficiency ratings range between 50 – 75%. Overhead spray is less efficient because of greater atmospheric evaporative losses (more exposure to the air) and susceptibility to losses from windy conditions (Figure 30).

**Colorado requires that all sprinkler bodies sold in the state be WaterSense certified.** Any exceptions must include an integral pressure regulator and meet the water efficiency and performance criteria and other requirements of that specification ([HB 19-1231](#)).



Figure 28. Example of drip irrigation





Figure 29. Example of microspray

If using overhead irrigation, there are a variety of overhead sprinkler bodies/heads on the market. Using the appropriate type of sprinkler head per application and size of irrigation space can increase irrigation efficiency:

- **Spray sprinkler heads:** use the most amount of water and are best for shorter distances under 15 inches. They are fixed, where they do not move as they spray.
- **Rotor sprinkler heads:** spray the longest distance and are best for larger areas. They rotate with one, single-stream, and can move from side to side.
- **High-efficiency rotary nozzles:** use the least amount of water at one time but emit a higher volume per water droplet that better irrigates grass and reduces evaporation. They are best for medium-sized areas and move like an oscillating fan with a fixed point that sprays the same pattern over and over again.

**The type or irrigation equipment used depends on the landscape.** Overhead irrigation is used for turf and native grasses. Unless the area is very large it is **best practice to irrigate small-to-medium sized turf areas with high-efficiency rotary nozzles.** While not very common in Colorado, another efficient option for turf areas is sub-surface drip.

Drip and microspray are used for flowers, bushes, and vegetable gardens. When possible, it is **more efficient to use drip irrigation as opposed to microspray** irrigation.



Figure 30. Types of overhead spray irrigation heads: spray head and rotary nozzle

It is also critical **that all irrigation designs take into consideration tree watering requirements.** Trees that do not receive water from overhead spray turf irrigation should be irrigated with microspray or drip. Newly established trees need to be irrigated around the base of the trunk while irrigation for established larger trees should be applied to the zone between the trunk and outer edge of the tree canopy.

## Irrigation Water Saving Technologies

In addition to irrigation methods, there are a variety of devices and equipment available to improve irrigation efficiency. Table 40 lists the common devices and equipment applied. Water estimates for each of these are variable, depending on pressure, application, climate, and other site-specific conditions. High level estimates for some of these are available through the [Alliance for Water Efficiency Water Conservation Tracking Tool](#).

Table 40. Devices and equipment for irrigation efficiency

Device/Equipment	Description
Smart controllers - Weather-based irrigation controllers	Adjusts irrigation schedule based on local weather and landscape conditions (rainfall, plant type, soil type, site exposure, sprinkler type). Connected to sensor array or online sources of weather data. WaterSense labeled products available. Residents and customers using smart controllers must be trained, otherwise water use may actually increase, especially if not paired with a rain sensor.
Central control systems	For large common areas, playing fields, golf courses, etc.
Smart controllers - Soil moisture-based irrigation controller	Measures soil moisture and tailors irrigation schedule accordingly. WaterSense labeled products available.
Pressure regulators	Pressure regulation plays a key role in efficient irrigation. Distribution system water pressure can exceed the optimal pressure for sprinkler nozzle application, which can result in excessive flow rates, misting, fogging, and uneven coverage. Installing pressure regulators rated for higher pressures can reduce water waste associated with higher pressures.
Spray sprinkler bodies	Installing sprinklers rated for higher pressures can reduce water waste associated with higher pressures. Provides pressure regulation which can reduce water waste by providing a constant flow and delivery rate at the sprinkler nozzle. WaterSense labeled products available.
Soil moisture meter	Monitors the water levels in soil
Soil moisture sensor	Detects moisture levels in root zone and signals the controller if irrigation cycles may be omitted

Device/Equipment	Description
Rain gauge	Measures rainfall to better understand precipitation and adjust irrigation accordingly.
Rain sensors on controllers	Detects recent rainfall and signals the controller if irrigation cycles may be omitted
Water saving hose nozzles	Spray nozzles attached to hoses to reduce the flow rate of a “normal” hose while increasing water pressure for a powerful spray.
Lawn and garden hose timer	Shuts off irrigation via a garden hose automatically once the watering cycle completes
Anti-drain check valves	Prevents water loss from sprinklers or emitters at low spots in the irrigation system
High wind shutoff devices	Shuts off spray irrigation systems under high winds
Drip conversion kits	Used to convert less efficient spray zones to more efficient drip irrigation zones

There are a variety of actions water providers can take to better incorporate water saving technologies into irrigation, which include:

- Installing devices on water provider and/or city owned properties.
- Requiring water efficient devices in landscape code for new and redevelopment (see Development Regulations).
- Providing incentives via rebates and/or specialty discounts .
- Providing giveaways at special events.
- Educating customers on the benefits and how to use efficient equipment and devices .

## Irrigation Efficient Devices and Equipment

Numerous Colorado providers promote a range of irrigation efficient devices and equipment through giveaways, rebates, and direct installs. Examples of these programs include:

- **Eagle River Water and Sanitation District** (ERWSD) requires that hoses must have water saving shut-off nozzles to prevent free running water. They also provide irrigation efficiency bundles where customers receive a 25% rebate up to \$1,500 for upgrading irrigation equipment based on water audit recommendations that are conducted by ERWSD staff.
- **Efficiency Works**, a collaboration with Estes Park Power and Communications, City of Fort Collins Utilities, City of Longmont Power and Communications, Loveland Water and Power, the Platte River Power Authority to provide rebates and discounts through an online store for a variety of indoor and outdoor water devices.
- Aurora Water has been offering smart controller rebates since 2016 at \$200 a rebate (2023 rebate amount). About 90% of their rebate program in 2023 were smart controllers, where they provided about 300 controllers (York, 2023).
- **Resource Central** partners with water providers to offer free smart controllers and rain sensors, including installation, setup, and a tutorial.

**Whether via giveaways, incentives, or direct installation, education on how the technology improves irrigation and efficiency and why efficiency is equally important for program success and water savings** (see Operations and Irrigation Scheduling).

### *Irrigation Scheduling*

Irrigation operations and scheduling addresses the frequency (how often) and duration (how long) water is applied to each irrigation zone within the landscape. Proper operation of the irrigation system reduces water use by ensuring that the landscape receives the appropriate amount of water when it is needed. To properly schedule irrigation, it is necessary to consider the following factors to determine the appropriate application rates and frequencies such as:

- **Sprinkler and drip system application rates:** Sprinkler heads and drip systems apply water at different rates. For example, drip emitters can

use anywhere from 0.5 – 6 gallons per hour depending on the product. It is important to know the application rate of the irrigation equipment to ensure it aligns with plant water needs.

- **Soil characteristics and slopes:** Applied irrigation rates should not exceed soil infiltration rates to prevent unnecessary runoff. This can be managed through **cycle and soak techniques**, where irrigation cycles are broken into two or more-cycles with a wait/rest time in between cycles to allow the water to infiltrate into the soil. Some water providers promote this technique by setting time limits for irrigation zone watering (e.g., no zone can operate for longer than 8 minutes).
- **Plant water requirements based on evapotranspiration and adjusted seasonally:** Landscape irrigation is intended to supplement rainfall. Plant water requirements may change day-to-day depending on levels of precipitation, temperature, whether it's early in the irrigation or during the peak demand of the irrigation season, etc. As a result, **irrigation schedules should be adjusted throughout the irrigation season.** Water requirements also change throughout a plant's life cycle. Plants typically require more water during establishment (1 – 3 years) and less as they mature, trees may require more water as they mature and grow. In addition to adjusting irrigation schedules during the irrigation season, **irrigation schedules should also be reviewed at the beginning of each irrigation season and updated accordingly.** Water providers should educate customers to set operation and irrigation schedules.
- **Irrigation technology:** There are many water conserving devices that can assist with efficiently irrigating landscapes (see Irrigation Water Saving Technologies). **Homeowners and operators should know how to use these devices to optimize water saving potential.**
- **Local government regulations:** This may include voluntary or mandatory day-of-week watering restrictions where limiting turf watering to 1-3 days per week or time-of-day watering restrictions (e.g., irrigation prohibited from 9AM to 6PM). Restrictions are often applied during water shortages and some providers now implement on a permanent basis. This can be useful in regulating peak-flow, however, it is inconclusive on water saving potential. A study conducted in Colorado's Front Range on watering restrictions concluded voluntary standards have little impact (even when implemented under drought conditions), however, mandatory restrictions reduced outdoor watering demand by 30% (Kenney, 2004). Other perspectives suggest that overwatering occurs with day-of-week watering restrictions, where people overestimate the amount of water needed for their landscapes. See the Development Regulations Best Practice for additional information.



### Irrigation Schedule Education and Regulations

Water providers take several approaches to help customers set their irrigation schedules – some educational and some regulatory.

Fort Collins Utilities provides a daily watering guide that is updated based on weather data during the irrigation season. Users can access this guide through Fort Collins' website. They also email notices to customers who have participated in other water efficient programs with the week's estimated water needs (City of Lafayette, Colorado, 2024).

Colorado Spring Utilities has the following six waterwise rules. Customers who do not follow the rules can be fined \$100 (Colorado Springs Utilities, 2024).

1. You may water up to three days a week (Sunday to Saturday). You choose the days.
2. From May 1 to Oct. 15, water before 10 a.m. or after 6 p.m. to reduce evaporation.
3. Don't let water pool on hard surfaces or flow down gutters.
4. Repair leaking sprinkler systems within 10 days.
5. Use a shut-off nozzle when washing anything with a hose.
6. Clean hard surfaces (such as driveways, sidewalks and patios) with water only if there is a public health and safety concern.

Aurora Water's management plan provides detailed instructions on how outdoor water uses (e.g., turf lawns, annuals, car washing, etc.) may be irrigated/used under normal conditions and under drier conditions. The water management plan is enforced by year-round staff that patrol the service area. Aurora Water has a phone number and online reporting function enabling customers to report water-wasting violations. In 2023, 2,381 infractions were reported, 708 warnings were issued, and 13 customers were fined (York, 2023).

## Irrigation Maintenance

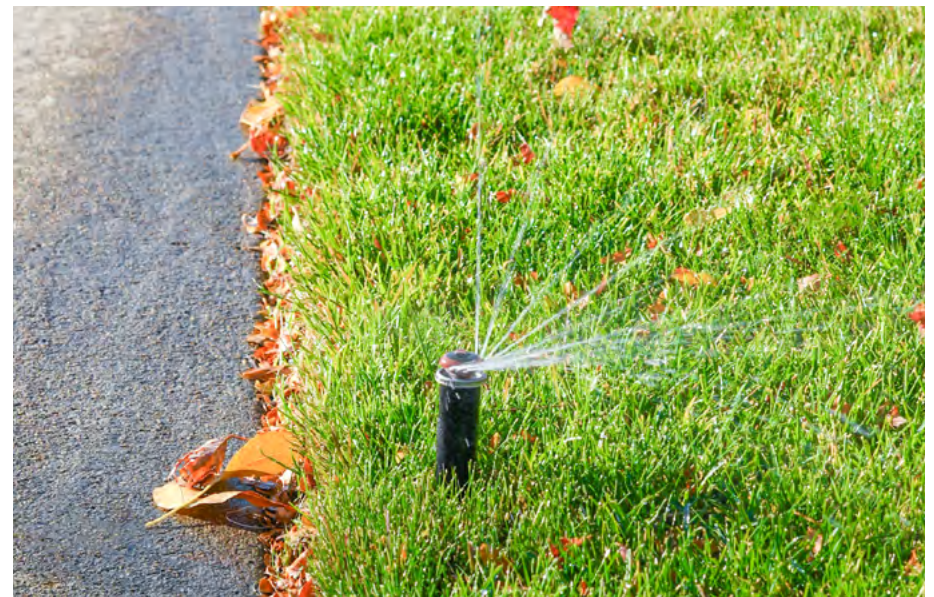
Automatic irrigation systems must be maintained regularly to ensure efficient performance and uniform distribution of water. Outdoor leaks are a common occurrence but can be detected earlier through regular maintenance. In Colorado, this includes (at a minimum) a check-up in the spring when the system is turned on and a winterization before the first hard freeze (see the Indoor Water Use Best Practice Area for additional information on leak identification). During the irrigation season, repairs should also be made when needed.

GreenCO's best practices in irrigation system maintenance are summarized below (GreenCO, 2008):

- **Establish a systematic maintenance schedule** for inspecting, testing, and reporting on performance conditions of the irrigation system.
- **Adjust irrigation systems whenever irrigation water falls or runs onto hard surfaces** such as sidewalks, streets, or driveways. Signs of leakage include overgrown or particularly green turf areas, soggy areas around spray heads and above ground hoses, jammed spray heads, and torn hoses.
- **Periodically (weekly or monthly) perform an inspection** of the system components to verify that the components meet the original design criteria for efficient operation and uniform distribution of water.
- **Ensure replacement hardware matches the existing hardware and is in accordance with the design.** Aftermarket replacement nozzles may not match original parts well enough to preserve distribution uniformity and the precipitation rate. Conduct a performance audit every three to five years to ensure that the system is working efficiently and with the desired precipitation rate specifications.
- **Trim or remove vegetation as required to preserve system performance.** Add additional sprinklers or other hardware as required to compensate for blocked spray patterns or changes in the irrigation needs of the landscape.
- **Establish a winterization protocol and a corresponding process for system activation in the spring.** Winterization primarily consists of removing all the water from the irrigation system and equipment to prevent cracked pipes, broken sprinklers, and other problems.
- **Update and retrofit existing irrigation systems with new water-saving technology.**

Water providers can incorporate these best practices by:

- **Enforcing a water waste ordinance** that prevents wasteful irrigation system losses such as unrepaired leaks and the irrigation of hard impervious surfaces (sidewalks and roads). See Other Codes and Ordinances Best Practice for additional information.
- **Educating customers** on the importance of maintaining their irrigation systems. See Education and Communication for additional information.
- **Incorporating routine maintenance of irrigation systems** on water provider owned property.
- **Require irrigation system maintenance in landscape code.** See Development Regulations for additional information.
- **Develop customer specific water budgets.** See Water Budgets for additional information.
- **Report high water use to customers** via high use or leak notifications. See Data and Data Management for additional information.
- **Requiring irrigation system maintenance or assessment** as part of Turf Conversion Programs. See Landscape Transformation Programs for additional information.



## Irrigation Assessments

Irrigation assessments, historically called irrigation audits, are a method to determine how well the irrigation system is working and to identify opportunities for improve efficiency. Many water providers have offered irrigation assessments to help customers reduce irrigation water use.

However, **while irrigation assessments can be an important tool, they do not guarantee water savings** unless the customer receiving the assessment is using water inefficiently prior to the assessment *and* implements the recommendations to achieve water savings. In fact, for deficit irrigators, that use less water than a landscape requires, water assessments may actually increase water use. For example, AWWA's 2016 Residential End Use Study found that out of 838 residential customers, 72% of them water less what than their landscape theoretically requires (DeOreo W. B., Mayer, Dziegielewski, & Kiefer, 2016). As a result, it is **best practice to target irrigation assessments to inefficient outdoor water users and ensure irrigation assessments connect customers to water savings programs like rebates or turf replacement programs**. Water providers implementing irrigation assessments should consider the following:

- **Strategically identify customers:** Irrigation assessments can be voluntary, for those that are interested in lowering their water use, or mandatory. Targeting customers with unusually high seasonal demand and/or older irrigation systems can be effective in identifying the most inefficient customers with the greatest water savings potential and lowers the risk of providing assessments to customers who may not need the irrigation assessment (see Targeting Users). Tracking billing data and developing water budgets are also useful tools in identifying customers that are over-irrigating (see Water Budgets).
- **Couple with other programs:** Irrigation assessments can be useful to educate large water users and individual homeowners on irrigation efficiency. Pairing irrigation assessments with other programs, such as rebate programs, turf conversions, and educational outreach, can be an effective way to manage costs and optimize benefits where the programs can work together to reinforce progress and ensure water savings.
- **Messaging – audit vs. assessment:** Irrigation assessments have historically been referred to as irrigation audits. Many water providers are moving away from audit and using alternative language such as assessment to avoid the association with punitive audit processes like tax audits.

- **Return on investment (ROI):** Including a ROI analysis with the efficiency evaluation can help customers better understand the long-term benefits and savings associated with implementing assessment recommendations. Unlike the installation of indoor fixtures, water savings are not permanent due to factors like weather. The extent to which savings continue is dependent on the motivation of the customer to maintain the irrigation system and, if available, stay within a water budget (Colorado WaterWise and Aquacraft, Inc., 2010). Unless the customer has incentives to maintain savings, savings may diminish over time as the irrigation system ages and the cost of repairing the system increases.

### Irrigation Assessment Examples

Numerous water providers across Colorado offer irrigation assessments. Examples include Fort Collins Utilities, Aurora Water, Greeley, Eagle River Water and Sanitation District, and the City of Aspen. Many of these are coupled with outdoor rebate incentives to help customers improve their irrigation efficiency.

Additionally, some waters providers partner with Resource Central's Slow the Flow program ([resourcecentral.org/sprinklers/](http://resourcecentral.org/sprinklers/)). Slow the Flow provides sprinkler evaluations to residential customers, HOAs and commercial properties. Evaluations are provided by trained water assessors and customers are provided with an appropriate irrigation schedule individualized for their landscape and their irrigation system along with a detailed report intended to improve the efficiency of the system and increase longevity of the system. Participants also receive the Colorado Sprinkler Guide, a free e-newsletter with tips and advice every two weeks throughout the irrigation season (mid-May to October).

Water providers who partner with Resource Central to offer Slow the Flow assessments receive an impact analysis with weather normalized water savings based on participant's water use data.

## SUPPLEMENTAL IRRIGATION

The Best Practice Guidebook focuses on potable irrigation, however, there are additional and supplemental sources of non-potable water that may be used for irrigation. This includes reuse, raw water, rain barrels, and rainwater harvesting. While using an alternative source of water supply for irrigation does not always result in significant water savings, alternative sources of supply have numerous other benefits such as decreased treatment costs. As a result, these strategies are not the primary focus of this document, however each are summarized:

- **Reuse:** Irrigating with reuse water is a common practice that can extend a water provider's water supplies. In Colorado, reclaimed water may be reused for non-potable purposes if it is legally reusable based on the water provider's water rights. There are two types of non-potable reuse, indirect or direct reuse. For indirect reuse, treated reclaimed water is not directly used for irrigation, but rather serves as an augmentation/replacement supply for the diversion of an alternative physical source of non-potable supply that is used for irrigation. This is a common water rights accounting procedure that is approved in water court. In contrast, direct non-potable reuse entails the direct reuse of the reclaimed water treated to non-potable irrigation water quality standards. Direct non-potable reuse must meet Colorado Department of Public Health and Environmental (CDPHE) regulations. The GreenCO BMP Manual provides a set of guidelines to follow if considering reuse. Experts in Colorado water rights and in reclaimed water use should be consulted if the water provider wants to further evaluate reuse as an option. The Colorado Water Quality Control Commission (WQCC) adopted new regulations authorizing and guiding water providers on the implementation of direct potable reuse in 2022 (Code of Colorado Regulations). This entails the treatment of reclaimed water to potable drinking water standards for reuse. As of the writing of this document, several water providers are investigating this as an option, however, have not officially started the CDPHE permitting process.



- **Raw water:** Irrigation using non-potable raw water is also a common practice throughout Colorado. While this practice does not necessarily save water, it can reduce the amount of potable supplies necessary to meet a water provider's water demands and can also save energy and operational costs by reducing water treatment needs. The water quality should be tested to ensure it is suitable for irrigation purposes and the design of the distribution and irrigation system should properly adhere to applicable standards and regulations, including the ability to flush sediment. Additionally, efforts should be employed to use the raw water efficiently. At a minimum, this should entail the ability to measure diversions and irrigation application, address leakages in the distribution system, and employ water efficient installation and operation procedures. Water efficiency with raw water systems can be challenging where raw water irrigation has historically occurred using older less efficient ditch systems. Water providers often have no control over these systems and must collaborate with the ditch companies and owners of the raw water systems to incentivize efficiency.
- **Rainwater harvesting and rain barrels:** Rainwater harvesting refers to the interception of stormwater runoff and using it for beneficial use. This typically entails the collection of rainwater from rooftops, concrete patios, driveways and other impervious surfaces. Within Colorado, the use of rainwater is subject to Colorado water law which historically prohibited rainwater harvesting unless a water right was in place specifically allowing this use. HB16-1005 authorized the use of rain barrels at single-family and multi-family homes (with four or fewer residents) for a combined storage of two rain barrels that do not exceed 110 gallons. SB09-089 also authorized the collection of rainwater with a Rooftop Precipitation Collection System Permit for rural residents that qualify for "exempt" wells, although the beneficial use of collected rainwater is limited to uses under the well permit. Users that qualify under both HB16-1005 and SB09-089 may collect 110 gallons and then collect additional water, if they meet the restrictions of both laws (Colorado State University Extension, 2016). Rain barrels provide a modest amount of water savings if the rainwater that is collected is applied to beneficial use and reduces the amount of water that would have been applied using water provider delivered water. Typically, this is most effective for residents that are committed to managing this additional rainwater supply. That said, rain barrels also increase customer awareness on water efficiency and can serve as a "gateway" to additional water efficient practices. The Colorado Stormwater Center provides foundational information on rain barrels and has provided past trainings (DOLA, 2023).
- **Rainwater harvesting pilot projects:** Colorado House Bill 09-1129 and amended House Bill 15-1016 allows Pilot Projects for the beneficial use of captured precipitation in new real estate development, authorizing the investigation of employing rainwater harvesting at a much larger scale. This legislation requires 100% replacement of precipitation captured out-of-priority, thereby requiring water users to find an equal amount of replacement water in like time and place. Entities have the option of using Regional Factors, as defined by House Bill 15-1016, to provide an estimate of pre-development consumptive use. These factors can be incorporated into a Substitute Water Supply Plan until a pilot project is conducted to obtain an augmentation plan for permanent operation (DWR, 2024). All pilot projects must be in new residential or mixed-use development of date of this document, one pilot study in Colorado has been conducted by Dominion Water and Sanitation District, the wholesale water provider for Sterling Ranch in Douglas County. Dominion Water and Sanitation District is currently in the process of designing their rainwater harvesting system and completing the legal process (Colorado revised Statutes, 2022).





## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Water Provider Perspective:</b> Provider costs to increase outdoor irrigation efficiency will be related to improving irrigation efficiency on their own properties or rebate programs. Costs for updating irrigation efficiency on their own properties will depend on the project. Rebate programs costs will also vary significantly depending on the specific measures applied and the extent of the program. Additionally, providers must consider time and material costs to administer a rebate program. Rebates for water efficient irrigation equipment vary from \$2.00 to \$3.00 for a high-efficiency irrigation head, to up to \$300 for a weather based smart irrigation controller. See the Indoor Best Practice for additional information on structuring a rebate program.</p>	<p><b>Water Provider Perspective:</b> When it comes to waterwise landscapes, efficient irrigation systems are just as important as plant selection or landscape design. Without a well-run and efficient irrigation system, many waterwise landscapes will not save water. While counterintuitive, irrigation systems are also important tools for keeping trees alive and protecting landscape components during times of drought. Additionally, reductions in outdoor water demand can reduce peak demands in the summer, which can provide long-term savings and a reduced need for infrastructure capital investments.</p>
<p><b>Customer Perspective:</b> Customers upgrading their irrigation systems must consider labor and equipment costs. While individual heads and drip conversion kits are relatively inexpensive (a few dollars for an irrigation head and roughly \$25 for a drip conversion kit), some pieces of irrigation equipment like irrigation controllers, pressure reducing valves, and rain sensors are more expensive. Additionally, while many homeowners retrofit irrigation systems themselves, if a contractor is completing the work, or in large landscape settings, there are additional labor costs.</p>	<p><b>Customer Perspective:</b> Customers with efficient irrigation systems will save water, reducing their water bills. Well-functioning irrigation systems will also reduce waste, contribute to healthy landscape appearance, and increase property values.</p>
Water Savings Assumptions	
<p>A well designed, installed, and maintained irrigation system should use substantially less water than a poorly maintained irrigation system. However, the achievable water savings are not well quantified and there is a lot of variability in savings. For some savings will be substantial, ranging in savings from 18% – 50%, but for others there may no measurable savings (Northwest Council of Governments, 2020). A study in California found that eliminating over irrigation would <b>reduce outdoor use in single-family homes by about 30%</b> (DeOreo et al., 2016). The City of Greeley found that residential customers <b>used 13% less water following their irrigation assessments</b> (City of Greeley, 2024). The key assumption in these savings estimates is that the customers are <i>overirrigating</i>. <b>Many customers are “deficit irrigators” and water less than their landscape needs.</b> For example, the 2016 Residential End Use Study found that out of 838 residential customers, 72% of them water less what than their landscape theoretically requires (DeOreo et al., 2016). <b>Irrigation assessments or retrofits in these scenarios may actually increase water use.</b></p>	

## Landscape Transformation Programs

In Colorado, outdoor water use accounts for 38% of municipal water demand each year (Western Resource Advocates and WaterNow Alliance, 2022). A high portion of this goes to irrigating high water using turfgrass. In 2023 it was estimated that there is approximately 100,000 acres of irrigated turfgrass in Colorado (BBC Research and Consulting, 2023). Potentially 25% of the total estimated turfgrass is considered “non-functional.” Removal of this non-functional turf has the potential to save between 10,000 and 20,000 acre feet a year (BBC Research and Consulting, 2023).

### The History of Turfgrass

Historically traditional Colorado urban landscapes have consisted of cool season turfgrass (e.g., Kentucky bluegrass) that require substantial irrigation in the summer to remain green. These lush green lawns are part of the Western cultural norm, dating back to 18th century England. At the beginning of the 18th century, Europeans modeled the aesthetic of landscape paintings with their expansive, verdant meadows, resulting in vast, sprawling lawns at wealthy palaces and manor homes in England and France. George Washington’s home, Mount Vernon, mimicked this with a lush green rolling lawn. Following the Second World War, lawns, which were previously reserved for the wealthy, were a selling feature for the large-scale tract housing communities. Turfgrass lawns are still perceived as a symbol of success and economic status (Alliance for Water Efficiency, 2018).

**Landscape transformation programs are a fundamental best practice that can help customers transition from high-water use landscapes to waterwise landscapes.** Making this transition, however, is no easy task. There are systemic challenges in transitioning Colorado’s traditional turfgrass landscapes to waterwise landscapes at a broad scale. This transformation requires the establishment of predominantly waterwise landscapes on new development and the conversion of turfgrass to waterwise landscapes on existing development.

This section introduces solutions to these challenges and discusses implementation of turf conversion projects on large-property level (e.g., HOAs and municipal properties) and at the smaller property homeowner level. Additional, information on integrating waterwise landscapes in new and redevelopment via codes and regulations can be found in the Development Regulations Best Practice.



## Non-functional Turf Limitations

Currently, there is extensive State and local effort to reduce high-water using “non-functional” turfgrass in our urban communities by promoting/ requiring low-water use plantings and less water intensive grass species. Limitations on nonfunctional turf are under consideration in Colorado as part of the 2024 legislative session. A summary of the [draft bill](#) is provided below.

*On and after January 1, 2025, the bill prohibits local governments and unit owners’ associations of common interest communities from allowing the installation, planting, or placement of nonfunctional turf, artificial turf, or invasive plant species on commercial, institutional, or industrial property or a transportation corridor. The bill also prohibits the department of personnel from allowing the installation, planting, or placement of nonfunctional turf, artificial turf, or invasive plant species as part of a project for the construction or renovation of a state facility, which project commences on or after January 1, 2025.*

## Regulatory Requirements

Under [C.R.S. §37-60-126\(4\)\(a\)\(II\)](#) one of the water-saving measures and programs that must be considered in a water efficiency plan is “[l]ow water use landscapes, drought-resistant vegetation, removal of phreatophytes, and efficient irrigation.”

[HB 19-1231](#). All sprinkler bodies sold in Colorado are required to be WaterSense certified, which can reduce water use by 20% or more when irrigation system pressure exceeds 60 psi.

[HB19-1050](#) passed in 2019, establishes the right of unit owners in HOAs to use water efficient landscaping, and specifies that HOAs cannot require a homeowner to install cool-season turfgrass.

[House Bill 21-1229](#), passed in 2021, prohibits HOAs from banning xeriscape, among other protections for property owners interested in installing energy efficient and other sustainable technologies.

[HB23-178](#), passed in 2023 requires HOAs to allow up to 80% drought tolerant plants in a homeowner’s landscape and to select at least 3 preapproved waterwise landscape design templates for unit owners to select from. It’s recommended that HOAs double check to ensure their bylaws are updated to comply with these new allowances for waterwise landscaping.

[HB22-1151](#), passed in 2022, authorizes state funded Turf Replacement Program for turf replacement projects throughout Colorado. HB22-1151 directs CWCB to develop a voluntary statewide grant program that matches local turf replacement program funding.

## Key Concepts

As the competition and cost of water continues to increase, coupled with the impacts and uncertainty of a warming climate, there has been an increase in political capital and State financial support to transition non-essential turfgrass landscapes to waterwise landscapes. While regulation can be more cost effective than turfgrass conversions (it is generally more expensive to remove existing turf than to initially just install waterwise landscape), changes to landscape code and new construction regulations are generally limited to new development and redevelopment projects (BBC Research and Consulting, 2023). Water providers across Colorado are responding to this by dedicating more resources and programming to turf conversion programs. However, supporting customers with turf conversion transition is not an easy task. Landscape transformation requires subject matter expertise, resources, and time. Considerations will differ for small vs. large landscapes and depending on where a water provider is located in the State.

To support implementation of this best practice, the following key concepts are addressed in the sections below:

- Fundamental Considerations for All Landscape Transformation Programs
- Program Design for Single-family Residential Landscapes
- Program Design for Large Landscapes

## Colorado River Basin Water Provider Commitment to Turf Reduction

In 2022, Denver Water, Aurora Water, Pueblo Water, and other large Western water providers in the Colorado River Basin signed a [memorandum of understanding](#) calling for a 30% reduction in “non-functional turf” with replacement of drought and climate resilient landscaping (Colorado River Basin Municipal and Public Water Providers, 2022).

## ***Fundamental Considerations for All Landscape Transformation Programs***

Where a water provider is designing a program for single-family or large landscapes, understanding the general challenges with landscape transformation and how to address them is useful in formulating regulations and effective programs that promote waterwise landscape on new and existing property. **The following challenges and solution-oriented approaches should be considered in the development of any type of turf conversion programs:**

- **Cultural shift:** The adoption of waterwise landscapes at a large scale requires a cultural shift from lush green lawns as the symbol of “what looks good” to climate appropriate waterwise landscapes, that are more representative of the native natural landscapes in Colorado. This cultural shift must occur at many levels including within the State and local governments; in the land use planning, developer, and landscape communities; and in the public. Solutions that leverage available resources and produce quality transformation projects can help perception shift from a mono-culture turfgrass landscape to a beautification of Colorado environments using waterwise landscapes.
- **Supply chain limitations:** Waterwise landscapes require native plants and low-water use vegetation. The supply chain, however, is not currently developed to handle large demands of these plants and there are limitations on their availability. Solutions that facilitate connections with the plant suppliers, linking demand to available supply, can help this economic systemic supply chain issue.
- **Cost to implement:** Costs to convert turf to waterwise landscapes can vary significantly, however, the largest costs usually occur at the landscape installation phase. Due to the cost of water compared to the cost of water, it can currently take years to redeem cost savings through lower water use and potential maintenance savings. Solutions that couple cost incentives with education on water stewardship and the co-benefits of waterwise landscapes (e.g., climate resiliency and ecological) can help projects be more feasible.
- **Knowledge about waterwise landscapes and turf conversions:** While the installation and management of turf is relatively established, installation and maintenance of waterwise landscapes is newer to the public and landscape industry. As a result, there are educational gaps among the public and landscape industry on how to install and care for low-water use landscapes. Additional complexity is added by the unique climate/geography and site-specific factors accompanying each project. For example, design, installation, and plant consideration needs vary across the State. Solutions that provide educational resources about waterwise landscapes are needed at the local and regional scale.
- **Shortage of trained professionals:** There is a need for additional professionals in the landscape industry to acquire the knowledge base and trained employees for installation and maintenance of waterwise landscapes. This is discussed in-depth in Elevating the Landscaping Industry. Solutions that support training and connect customers with trained landscape professionals can create incentives for the landscape industry to adopt waterwise landscaping practices at a broader scale.
- **Project longevity:** Waterwise landscapes need to remain healthy and look good for the public to eventually adopt the new aesthetic. The prevention of overwatering waterwise landscapes is also critical for achieving desired saving water. However, the maintenance of waterwise landscapes requires different knowledge and skillsets than the maintenance of traditional turf lawns. Solutions that educate and emphasize the importance of maintenance are critical in developing successful long-term projects that can contribute to society’s view of waterwise landscapes.

## Approaches to Turf Conversion Programs

Water providers take a variety of different approaches when designing turf conversion programs. The following bullets highlight summarize a few examples:

- **Southern Nevada Water Authority (SNWA):** SNWA's "cash for grass" program is one of the national leaders in non-essential turf conversions in the Las Vegas area. SNWSA records the projects and area of turf converted through a comprehensive geospatial database. More information at [www.snwa.com/rebates/wsl/index.html#:~:text=Whether%20you%20do%20it%20yourself%20or%20hire%20a,per%20property%2C%20per%20fiscal%20year%20%28July%201-June%2030%29](http://www.snwa.com/rebates/wsl/index.html#:~:text=Whether%20you%20do%20it%20yourself%20or%20hire%20a,per%20property%2C%20per%20fiscal%20year%20%28July%201-June%2030%29).
- **Aurora Water's Grass Replacement Incentive Program:** offers optional free waterwise landscape designs to customers for turf conversions, providing about 200 designs in 2023 (York, 2023). More information at [www.auroragov.org/cms/One.aspx?portalId=16242704&pageId=16534576](http://www.auroragov.org/cms/One.aspx?portalId=16242704&pageId=16534576).
- **Loveland Water and Power's Hydrozone Program:** focuses on new and existing customers with a dedicated irrigation meter, where the customer can receive a reduced water rights payment. The required waterwise design must include clusters of plants with similar water requirements that show at least a 25% reduction from the 3 AF/year requirement for Kentucky bluegrass. Conversions must meet their assigned budget or receive an annual surcharge. More information at [www.lovelandwaterandpower.org/city-government/departments/water-and-power/the-hydrozone-program](http://www.lovelandwaterandpower.org/city-government/departments/water-and-power/the-hydrozone-program).
- **Fort Collins Utilities Xeriscape Incentive Program:** offers a xeriscape design booklet with a variety of designs and plants lists for customers and supporting examples and template for irrigation system plans, water plans, and plant lists. Post project on-site inspections are required before a rebate is received. More information at [fcgov.com/xip](http://fcgov.com/xip).

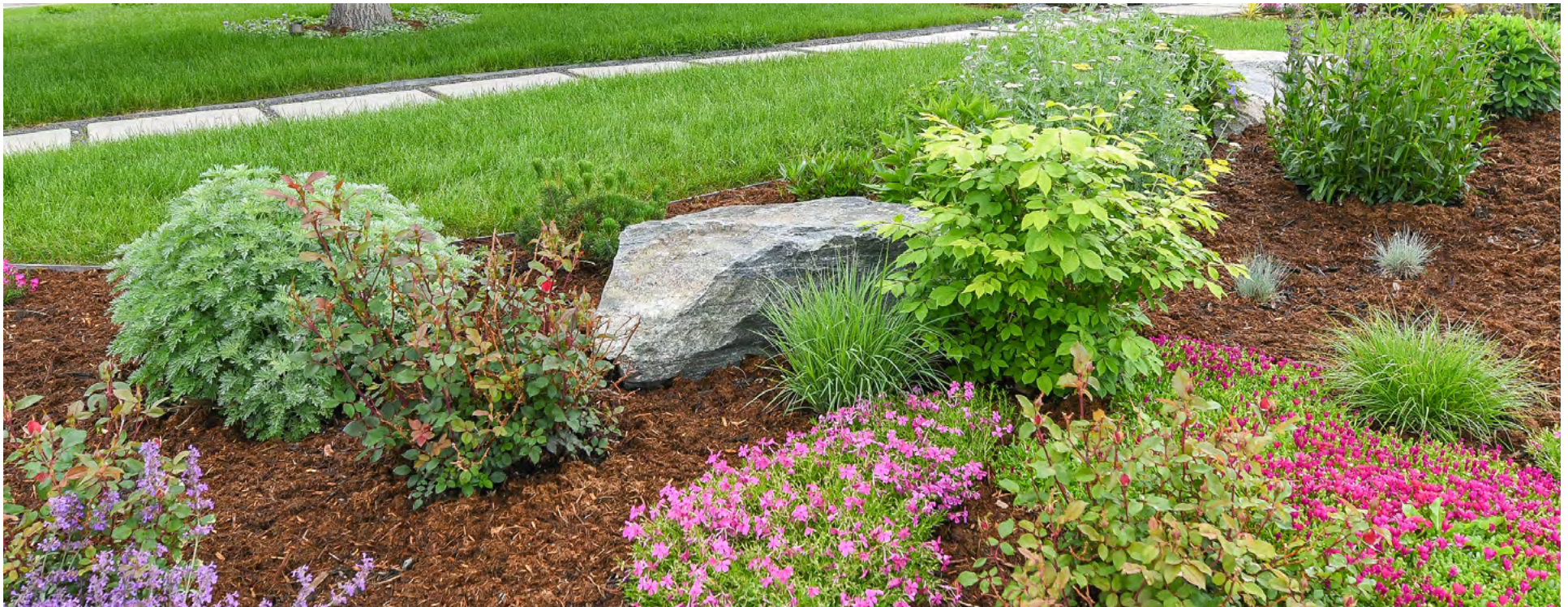


Table 41 further summarizes these challenges, solution approaches and lists a variety of solution-oriented options that may be employed by water providers and local governments.

Table 41. Landscape conversion challenges and solutions

Challenge	Solution Approach	Solution-Oriented Options
Cultural shift and political capital	Leverage available resources and produce quality projects to fuel the transformation	<ul style="list-style-type: none"> <li>• Leverage available State and federal funding sources (e.g., grants)</li> <li>• Install well maintained turf conversion projects that are aesthetically pleasing and bring inspiration</li> <li>• Develop projects on highly visible community properties</li> <li>• Lead by example by completing conversion projects on water provider property</li> <li>• Promote co-benefits of turf conversion projects (e.g., water savings, climate resiliency, ecosystem, and community benefits)</li> <li>• Encourage/require posting of educational and promotional signage on conversion projects</li> <li>• Work with non-profits and the private sector to promote conversion projects</li> <li>• Develop inspirational emotional connection through public outreach</li> <li>• Provide consistent messaging</li> </ul>
Supply chain	Facilitate connections with plant suppliers, connecting demand to available supply	<ul style="list-style-type: none"> <li>• Develop policies and programs that help properly address supply chain issues</li> <li>• Partner with big-box stores to promote low-water use, pollinator friendly, and climate appropriate plants</li> <li>• Take advantage of waterwise plant surpluses that can occur in the fall and other times of the year outside of the high demand in the spring</li> <li>• Collaborate and partner with local supply chain players in addressing local supply-chain hurdles</li> <li>• Build in customer convenience in turf conversion programs, where the customer can easily access waterwise plants</li> <li>• Connect with the professional landscape community to understand and address hurdles</li> </ul>
Cost to implement	Couple cost incentives with education	<ul style="list-style-type: none"> <li>• Develop cost incentive programs (e.g., turf conversion rebates)</li> <li>• Leverage State and federal funding for turf conversion programs</li> <li>• Leverage non-profits and other entities that provide turf-conversion resources (e.g., Resource Central, Northern Water)</li> <li>• Pool multiple money sources to fund turf conversion projects</li> <li>• Adopt water rates and tap fees that incentivize waterwise landscapes</li> <li>• When applicable, require internal city departments to pay for water (e.g., Parks)</li> <li>• Highlight the importance of water stewardship and long-term co-benefits of waterwise landscapes (ecosystem benefits) with cost incentive programs</li> </ul>

Challenge	Solution Approach	Solution-Oriented Options
Knowledge on waterwise landscapes and turf conversions	Promote educational resources on waterwise landscapes at a local and regional scale	<ul style="list-style-type: none"> <li>• Know the experts in your area that have expertise in waterwise landscapes</li> <li>• Connect customers to appropriate local plant lists and resources on waterwise landscapes</li> <li>• Make education convenient and accessible to the customer</li> <li>• Provide explanations on discrepancies in landscape best practices as the waterwise horticulture science continues to evolve</li> <li>• Promote leading native and low-water use grass mixes conducive to specific local areas</li> <li>• Incorporate education on all phases of conversion projects (e.g., design, installation, and maintenance)</li> <li>• Leverage partnership opportunities to educate and promote conversions</li> </ul>
Shortage of trained professionals	Support training and connect customers with trained landscape professionals	<ul style="list-style-type: none"> <li>• Host and/or support irrigation efficiency and waterwise landscape trainings for landscape professionals</li> <li>• Utilize certified landscapers with demonstrated knowledge on design, installation, and maintenance</li> <li>• Promote and/or require certified trained landscape professionals on turf conversion and waterwise installation projects</li> <li>• Provide customers lists of local certified landscape professionals</li> </ul>
Project longevity	Educate and emphasize the importance of maintenance	<ul style="list-style-type: none"> <li>• Ensure the irrigation system is retrofitted and maintained along with the landscape to ensure water savings are achieved</li> <li>• Incorporate long-term maintenance into landscape conversion programs (e.g., require maintenance plans)</li> <li>• Ensure maintenance is a component of educational programs and professional landscape trainings</li> <li>• Budget appropriately for maintenance on waterwise projects</li> <li>• Use volunteers to maintain land (e.g., City of Boulder uses their Parks and Recreation team and volunteers to maintain waterwise landscapes)</li> </ul>

In addition to the challenges, **there are other secondary factors that should be considered with all turf conversion programs including equity considerations, irrigation of trees, and impacts on green spaces and other public spaces.** Specifically, water providers should:

- **Quantify the amount of turf and/or non-essential turf in the community:** This includes creating feasible short and long-term targets for area of turf converted, as well as method to track total area of turf converted to demonstrate success and accountability at the programmatic level.
- **Incorporate One-Water concepts into program design:** This includes co-benefits like climate resiliency, and developing program that target underserved and disadvantaged communities. For example, while the net outcome may actually increase water there are numerous community benefits to installing waterwise landscape at properties that previously had no landscaping.
- **Account for tree irrigation:** If removing turf around established trees, ensure that trees will have adequate irrigation post project.
- **Identify the function and utility landscape:** Prior to completing projects understand the landscape's intended purpose. This is especially important for public spaces. For example, is the area used as a playing field? Is establishing more pollinator habitats a priority? The answers to these questions will influence design, installation, and maintenance plans.

#### **Aurora Water: Income Qualified Turf Conversion Replacement Program**

In 2023, Aurora Water received \$40,000 through the State's Turf Replacement Program to bolster their income qualified turf replacement program. This program includes the design and full installation of landscapes for low-income qualified households using Aurora selected contractors. Aurora Water installs an average of ten income qualified waterwise landscapes annually (York, 2023).





### **Program Design for Single-family Residential Landscapes**

Turf conversion on single-family residential properties has been a best practice in Colorado for decades. While this practice has been relatively slow to evolve, C.R.S. [§37-60-135 State Turf Replacement Program](#)'s establishment of dedicated State funding for turf conversions, increases in the cost of water, Colorado River issues, climate change and the water conservation community have accelerated this process in recent years.

Turf conversions on small residential properties face many of the same challenges experienced by large landscape conversions. However, outreach for these programs focuses on the general residential public and the scale of the projects, funding sources, and how the project is to be installed vary significantly. While some homeowners have the option of hiring a professional landscaper to design and install the project, many homeowners elect to do the project themselves. This requires a significant amount of education on behalf of the homeowner. As a result, **water providers should develop homeowner specific education designed for single-family properties.**

Key considerations in addition to those outlined in Table 38 include:

- **Cost and available funding:** While turf conversions are a property investment, upfront costs for the turf conversion can be a deterrent even with the financial benefits of reduced water bills over time. Turf conversion rebates coupled with education on the co-benefits of conversions (e.g., ecosystem benefits in addition to water savings) can help further drive incentives to perform the project.
- **Conversion of irrigation system:** Planting waterwise plants does not alone save water. Converting irrigation systems is equally important. For many homeowners this can be an overlooked step. It is important that water providers provide resources and tools that help customers convert their irrigation systems to achieve desired water savings. See the Efficient Irrigation best practice for additional information.
- **Education and technical assistance:** Individual homeowners may not have the experience or expertise to complete projects themselves. This includes the retrofit/installation of the irrigation system, plant selection, and soil amending. Easily accessible and digestible educational resources can empower the homeowner and improve the success of the project. Water providers should incorporate educational materials as part of the rebate program design.
- **Education on maintenance:** Waterwise landscapes require different maintenance practices (e.g., drip irrigation system maintenance and weeding). Water providers should provide educational material to

ensure long-time success of the landscape. If pairing a landscape program with a [irrigation assessment program](#), this educational component can be included in the assessment.

- **Selecting waterwise plants:** Many customers do not know what plants to select or where to find them. Easily accessible plant lists along with information on where to find waterwise plants can be purchased is an important program component. See the Waterwise Landscapes and Selection of Landscape Types Best Practice for additional information.
- **Connecting Homeowners to certified landscape professionals:** For homeowners who do not want to complete the work themselves, it is important that they are connected with educated and trained landscapers who are familiar with waterwise landscapes. See the Elevating the Landscaping Industry Best Practice for additional information.

#### **Resource Central's Lawn Replacement Program**

Resource Central, in partnership with participating water providers, offers its Lawn Replacement Program, where customers apply for discounted lawn removal (only \$1 per square foot) and up to 300 square feet of discounted waterwise garden kits. Customers can apply without a discount for lawn removal service and pay \$2.50 per square foot (2023 rate). Anyone can purchase a Garden In A Box kit and some may receive a discount courtesy of their water provider or municipality. Garden In A Box kits are professionally designed gardens consisting of native and low-water use, quart-sized plantings that also include seasonal maintenance suggestions, plant-by-number maps, and watering schedule recommendations. This is a popular program along the Front Range and Resource Central is expanding its program to the Western Slope in 2024. More information can be found at: [resourcecentral.org/lawn/](https://resourcecentral.org/lawn/).

### Program Design for Large Landscapes

Large scale turf conversions include transformations at non-residential properties, as well as large landscapes commonly associated with Homeowners Associations (HOAs). **Compared to single-family residential turf conversions, large scale turf conversions are more cost effective. On the flip side they require significantly more resources and expertise to be successful due to their scale.** As a result, water providers should be strategic in implementing large scale turf conversion programs. While there are many lessons learned from single-family residential programs, **water providers should develop programs and educational material that is specific to large landscapes.** Key considerations include:

- **Cost and available funding:** Large landscape conversion can be costly. From 2019 – 2023 the cost for Northern Water’s water-efficiency landscape grant projects ranged between \$0.06 to \$23 per square foot. Projects where high-water demand turf was converted to low-water demand native turf, cost less per square foot than conversions to waterwise plants and gardens. These costs did not include any landscaping design, which is another added expense (Nowles, 2024). Luckily there are funding sources available to help water providers and customers tackle these projects. For example, water providers are eligible to receive funding via the State’s [Turf Replacement Program](#). That said, resources are in high demand and there is typically more interest in these projects than available financial resources.
- **Partner with local planning departments:** Large scale properties may need to apply for a landscape plan amendment through the local planning department. This can take time, be costly, and require expertise for navigating the planning process. Before starting a program or completing any project work, it is important to work with the Planning department to understand requirements and potentially partner on a streamlined process for turf conversion projects. See the Development Regulations Best Practice for additional information.
- **Consider stormwater impacts:** Depending on the project there may be stormwater impacts. If not already captured by the local planning process, ensure large property turf conversions are reviewed by stormwater expert to mitigate any stormwater impacts.
- **Provide Technical Assistance:** Large scale conversion projects can be complex. Water providers and/or the customer project lead must understand local requirements, and irrigation and landscaping considerations for projects to be successful (see Waterwise Landscapes

and Selection of Landscape Types, Landscape Design, Installation and Maintenance, and Efficient Irrigation Best Practices for additional information).

- **Conversion of irrigation system:** Planting waterwise plants does not alone save water. Converting irrigation systems is equally important. For large landscapes this may be more complex due to a greater number of irrigation zones and components. Understanding a property’s current irrigation design, and what needs to change, is a key first step to and large-landscape transformation project. See the Efficient Irrigation Best Practices for additional information.
- **Require maintenance plans:** Project success does not end after installation. Maintenance plans that outline irrigation requirements and schedules, re-planting approach if/when plants die, and weeding practices are essential. Maintenance plans should be required at the beginning of any project plan to ensure a healthy and aesthetically pleasing landscape well into the future.
- **Relationship building and consistent messaging:** Unlike single-family residential projects, in large landscape projects property managers, landscape contractors, and/or HOA boards may all be involved in the project. This means there will likely be multiple points of contact. Knowing the “inside champions”, key board members, and property managers can significantly help in generating the buy-in to implement a successful project. Additionally ensuring there is consistent messaging across all stakeholder is key to project success and instilling customer confidence. One example message is, “turf conversions projects can serve as a long-term investment opportunity.”

#### Northern Water Collaborative Water Efficient Landscape Grants

Northern Water offers a Collaborative Water-Efficient Landscape Grant program for commercial-scale landscape projects that target water savings and ecosystem services. The program provides a 1:1 match for turf conversions that exceed 1,000 square feet, details specific landscaping requirements, and requires project design drawings, estimated water savings, a five-year maintenance plan, and post-project reporting requirements (Nowels, 2024). More information can be found at: [www.northernwater.org/grants/](http://www.northernwater.org/grants/).

- **Education to promote incentives:** As discussed, large landscape projects can be expensive. Additionally, water efficiency is not always a high priority for certain HOAs, property owners, or property managers. As a result, many annual budgets do not include sufficient, or any, funding for water efficiency projects. Educating businesses and HOAs on the benefits of transformation projects, and any available resources, can make projects more feasible.
- **Establish clear end goals:** Make project priorities clear from the start. For example, is the singular goal to save water? Or are there other priorities like increasing pollinator habitat? Are there any areas functional turf areas that should be preserved? Answering these questions will help with design and ensure the end product meets the property's needs. Encouraging customers to partner with a certified landscape professional can help properties navigate these questions and establish clear goals. See the Elevating the Landscaping Practice for more information.
- **Institutional knowledge:** Collecting and maintaining project successes and failures is important to continue to develop lasting expertise that will improve turf conversion practices now and into the future.

### Denver Water Large Scale Turf Conversion Projects

Denver Water is focusing on large scale properties to initially meet the 30% turf reduction commitment signed in 2002 through the [Memorandum of Understanding by and among Colorado River Basin Municipal and Public Water Providers](#) (Colorado River Basin Municipal and Public Water Providers, 2022). They are also offering a smaller number of lawn replacement discounts to residential customers through Resource Central in 2024.

### Engaging HOAs in Turf Conversion

There are over 10,000 HOAs in Colorado that provide housing for over 2.6 million people. This is approximately 45% of the State's population (Western Colorado Water Festival, 2023). Historically, the majority of HOA landscaping has consisted of turfgrass where there are large areas of turf in HOA medians, common areas, and entryways that provide no functional, physical or recreational function. HOAs are also unique in that they play a strong role in community landscapes by requiring residents to adhere to certain community landscaping standards. Conversions on these publicly visible properties can provide significant water savings while supporting cultural shifts away from the green turfgrass lawn (Western Colorado Water Festival, 2023).

Despite this large potential, shifting HOAs away from traditional turf landscapes is a challenge. In addition to cultural resistance to waterwise landscapes, there are usually multiple stakeholders who influence decisions (e.g., landscape contractor, property manager, HOA board). Knowing who to engage with and how is a challenge.

Luckily, C.R.S. § [37-60-126](#) states that community associations in Colorado are not allowed to prevent residents from incorporating xeriscaping and drought-tolerant plants in their landscaping. In addition to this restriction, Colorado's SB23-178 requires single family (not town home or apartment) homeowners associations to pre-approve at least three water saving landscaping designs for homeowners.

Outreach to HOAs may include both the support and promotion of turfgrass conversions while also addressing the HOA's bylaws, providing technical assistance on how they can adjust their bylaws to promote waterwise landscapes and incorporate the requirements specified in C.R.S. § [37-60-126](#) and SB23-178.

## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Water Provider Perspective:</b> Costs for the water providers to implement landscape transformation programs vary depending on the size of the program and type of incentive. In 2022 east slope water provider incentives varied from \$0.75 per square foot to \$2.00 per square foot (Western Resource Advocates and WaterNow Alliance, 2022). West slope rebates are in a similar range, with Eagle River Water and Sanitation District offering \$2.00 per square foot in 2023 and Mount Warner Water Sanitation District offering \$1.00 per square foot in 2023 (Best, 2023). In addition to the hard costs of the rebate incentives, there are staff time implications to administer programs. Depending on the size of the program, this may be equivalent to a full time employee’s job.</p> <p>Many providers can receive support for Landscape Transformation Programs via <a href="#">HB22-1151</a> which established a statewide Turf Replacement Program. Additional ways water providers can increase funds for turf replacement programs include: operating cash, federal grants like the <a href="#">Bureau of Reclamation’s WaterSmart Grant</a>, revenue collected from fines, financing options (e.g. capital markets through municipal bonds, state revolving fund) (Western Resource Advocates and WaterNow Alliance, 2022).</p>	<p><b>Water Provider Perspective:</b> First and foremost, turf replacement programs are a water saving opportunity for water providers. Turf replacement programs can provide other co-benefits including reduced stormwater runoff, increased community resiliency, and increased pollinator habitat. They also support the cultural shift from turfgrass to waterwise landscapes, especially when done well on highly visible properties, and bring social awareness around water being a limited and valuable resource.</p>
<p><b>Customer Perspective:</b> Potential costs for customers completing a turf conversion project include:</p> <ul style="list-style-type: none"><li>• Design.</li><li>• Lawn removal and disposal.</li><li>• Plants.</li><li>• Irrigation system upgrades.</li><li>• Labor to install and change the irrigation system.</li></ul> <p>Actual costs will vary depending on the size and scale of the project. Costs to homeowners who complete the work themselves vary from \$2.83 to \$4.63 per square foot low-water use plant projects and \$0.28 to \$3.19 for native grass projects (BBC Research and Consulting, 2024). For reference, in 2023 Resource Central’s turf replacement program charged customers \$2.50 per square foot of turf removed. This amount was reduced to \$1.00 per square foot, up to a subsidized cap, for customers who resided in water service areas participating in the program. From 2019 – 2023 Northern Water’s landscape for large properties ranged from \$0.06 to \$23.00 per square foot. Turf conversions that consisted of converting high-water demand turf to low-water demand native turf were less per square foot than conversions to waterwise gardens. These costs did not include the landscaping design (Nowels, 2024).</p>	<p><b>Customer Perspective:</b> Turf conversions that result in well maintained healthy waterwise landscapes provide numerous environmental, economic, quality of life, and community educational benefits. Done well, turf replacement programs can:</p> <ul style="list-style-type: none"><li>• Support the local economy.</li><li>• Support healthy soils.</li><li>• Enhance biodiversity, provide native habitat, increase pollinators.</li><li>• Add elements of beautification and increase property values by up to 15% (Johnson, 2017).</li><li>• Improve physical and mental health through natural landscapes, promote physical activity, and provide stress reduction through gardening.</li><li>• Represent the natural arid climate conditions within Colorado and bring social awareness around water being a limited and valuable resource.</li><li>• Improve drought resiliency.</li></ul>

## Water Savings Assumptions

Estimated water savings achieved through turf conversions ranges from 30 to 50% (Western Resource Advocates and WaterNow Alliance, 2022) (Medina et al., 2004). Most recently, water savings in Colorado are estimated to be 12 gal per square foot converted (BBC Research and Consulting, 2024). Savings vary due to a variety of factors including:

- local climate.
- prior levels of irrigation on the landscape that was there before.
- irrigation design and installation.
- current plantings.
- size of the project.
- quality of installation and maintenance.

Colorado Springs Utilities' Business Turf to Native Grass Conversion Incentive, a non-residential program, reports an approximate 30% – 50% reduction in outdoor water use since 2013. Castle Rock Water's ColoradoScape program, a residential program, reports a 19% reduction in outdoor water use (Western Resource Advocates and WaterNow Alliance, 2022). Due to the variability, there is a need for additional studies on the actual water savings from turf replacement in Colorado.

For an individual project, data required to calculate water savings include:

- evapotranspiration for the type of vegetation and location.
- the estimated amount of water used by the current and future plants.
- the amount of supplemental water needed after subtracting natural precipitation.
- the amount of irrigation water that needs to be applied considering irrigation efficiency.

The details of these calculations are beyond the scope of this document; however, there are resources available on this topic including, but not limited to:

- EPA Water Budget Tool: [www.epa.gov/watersense/water-budget-tool](http://www.epa.gov/watersense/water-budget-tool)
  - Northern Water Landscape Conversion Water Savings Calculator: [www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/fact-sheets-and-tools](http://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/fact-sheets-and-tools)
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## Elevating the Landscaping Industry

The landscaping industry plays a critical role in achieving outdoor irrigation efficiency and supporting more waterwise landscapes throughout Colorado. The landscape industry employs more than 43,000 people, contributes more than \$2 billion to Colorado's economy, and employs an ethnically and socioeconomically diverse work force with a broad spectrum of expertise in horticulture practices including irrigation, design, soils, installation, and maintenance (GreenCO and ALCC, 2021).

The landscape industry is currently predominantly set up to support the installation and maintenance of traditional turfgrass landscapes. However, as outdoor water efficiency technologies and landscape transitions start to be more common, new skills and training in the industry are needed to meet this growing demand. The following sections summarize key opportunities to support this transition and ensure that Colorado is prepared to support water efficiency irrigation and landscape practices.

### Regulatory Requirements

Under [C.R.S. §37-60-126\(4\)\(a\)\(III\)](#) one of the water-saving measures and programs that must be considered in a water efficiency plan is “[l]ow water use landscapes, drought-resistant vegetation, removal of phreatophytes, and efficient irrigation.”

[HB 19-1231](#). All sprinkler bodies sold in Colorado are required to be WaterSense certified, which can reduce water use by 20% or more when irrigation system pressure exceeds 60 psi.

[HB19-1050](#) passed in 2019, establishes the right of unit owners in HOAs to use water efficient landscaping, and specifies that HOAs cannot require a homeowner to install cool-season turfgrass.

[House Bill 21-1229](#), passed in 2021, prohibits HOAs from banning xeriscape, among other protections for property owners interested in installing energy efficient and other sustainable technologies.

[HB23-178](#), passed in 2023 requires HOAs to allow up to 80% drought tolerant plants in a homeowner's landscape and to select at least 3 preapproved waterwise landscape design templates for unit owners to select from. It's recommended that HOAs double check to ensure their bylaws are updated to comply with these new allowances for waterwise landscaping.

[HB22-1151](#), passed in 2022, authorizes state funded Turf Replacement Program for turf replacement projects throughout Colorado. HB22-1151 directs CWCB to develop a voluntary statewide grant program that matches local turf replacement program funding.

### Key Concepts

There are a variety of ways to support the landscape industry in transitioning from a traditional high water use turfgrass driven economy to a more diversified setting where waterwise landscapes are present and irrigation efficiency is held to a higher standard. This includes partnering with the landscape industry to provide effective trainings that support water conservation objectives and finding ways to promote certified landscapers and educate customers.

To support implementation, the following key concepts are addressed in the sections below:

- Certified Landscape Trainings
- Promotion of Certified Landscapers

### Certified Landscape Trainings

There are a variety of training courses available that teach waterwise irrigation and landscape practices. Table 42 summarizes some of the most common offered in Colorado. As water providers continue to support and improve existing trainings, **efforts should be made to ensure trainings resonate with the local landscaping industry and meets the needs of those taking the trainings.** Specifically, water providers should:

- Provide trainings and resources in other languages.
- Make trainings affordable and/or provide subsidized trainings.
- Host trainings outside of the irrigation season.

Partner with the landscaping community to ensure content and training are meeting the goals and desired outcomes of both the water provider and landscaping professionals.

Table 42. Summary of certified landscape trainings

Certification Program	Description	Entity Hosting Training	Required by Code for Landscape Installation	Required to Receive Rebates /Participate in Program
<a href="#">Qualified Water Efficient Landscaper (QWEL)</a>	EPA WaterSense certification - installation and maintenance of waterwise landscapes and irrigation systems, and specifically includes certification around how to conduct a third party irrigation audit	Castle Rock, Centennial WSD in partnership with South Metro Water Supply Authority  Summit County and Eagle County Partnership	Castle Rock Aspen Greeley	
<a href="#">Irrigation Association (IA)</a>	National EPA WaterSense professional certification - provides different levels of training and examinations for landscape/irrigation professionals like the Certified Irrigation Technician and the Certified Landscape Irrigation Auditor (not as tailored to local conditions)	Northern Water	Aspen Greeley	Fort Collins Northern Water
<a href="#">National Association of Landscape Professionals (NALP)</a>	National training that offers following 3-levels of training through its Landscape Industry Certified Exterior Technician Certification: Maintenance Technician, Installation Technician, or Irrigation Technician			Fort Collins
<a href="#">Associated Landscape Contractors of Colorado (ALCC) Sustainable Landscape Management Initiative</a>	Offers manual detailing sustainable landscape practices and a training class	Northern and CPS Distributor locations (limited to ALCC members). Members that pass are added to trained professional list on ALCC's website.		

Certification Program	Description	Entity Hosting Training	Required by Code for Landscape Installation	Required to Receive Rebates /Participate in Program
<a href="#">Green Gardener's Group (G3) Watershed Wise Landscape Professional Certification</a>	EPA WaterSense program that qualifies conservation, water quality and landscape professionals to evaluate irrigation systems and factor rainwater use efficiency into outdoor water efficiency analysis (more of a holistic One-Water approach)	Offered by Northern Water in the past		
<a href="#">GreenCO</a>	Offers BMP landscape manual tailored to Colorado's climate.	Curriculum available via GreenCO's via website. Landscapers can register to be tested on the GreenCO BMP Guide and then put on BMP Seal of Knowledge list.		

### Landscape Certification Reimbursement

To help promote certification, many water providers offer subsidies or reimbursement for landscape professionals to receive a certification. For example, [Greeley Water Conservation](#) will reimburse landscape and irrigation professionals 100% the cost of all training registration, class materials, and testing fees at the member level of accredited industry associations for qualifying certifications. Passing exam results or issued certificates are required for all incentives, and reimbursement is subject to availability of funds.



### **Promotion of Certified Landscape Professionals**

While certification is important, **ensuring customers are aware and working with certified landscape professionals is equally important.**

To ensure customers are working with certified landscape professionals, some water providers require all developers and contractors work with certified landscape professionals for any landscape installation. Others require customers to use a certified landscape professional to receive rebates. Many simply take an educational approach; promoting certified contractors via websites or lists but not requiring a certification to complete work or receive a rebate. Table 33 summarizes local approaches across Colorado.

When considering whether to require certifications for landscapers, municipalities should consider the equity implications, availability of certified landscapers in the region, if there are any incentive alternatives that may also produce results, and staff time/costs to implement and support any requirements.

#### **Statewide Landscape Certification Program**

Some states, like Texas and California, have statewide landscape certification programs. In Colorado there has been dialogue on the possibility of developing a Statewide landscaper certification program; however, at the time of this document's publication additional dialogue and policy is needed before such a certification is possible. Additional details can be found in Western Resource Advocates' publication: [westernresourceadvocates.org/publications/exploring-policy-options-for-expanding-landscape-irrigation-professional-certification-in-colorado/](http://westernresourceadvocates.org/publications/exploring-policy-options-for-expanding-landscape-irrigation-professional-certification-in-colorado/)

#### **Promoting Certified Landscape Professionals**

There are a variety of national and local resources water providers and their customers can use to find certified landscape professionals. The EPA WaterSense "Find a Pro" portal provides a list of certified landscapers, and questions customers can ask professionals to assess their skills ([lookforwatersense.epa.gov/pros/](http://lookforwatersense.epa.gov/pros/)). Northern Water refers to this portal in their training and certification fact sheet. Northern Water also requires that contractors supporting their grant funded landscape program be certified through approved training programs ([www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/grants](http://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/grants)). The Yampa Valley Sustainability Council provides a Yampascaping Professionals Guide that lists landscapers professionals vested in waterwise design and landscaping ([yvsc.org/water-conservation/](http://yvsc.org/water-conservation/)).



## Costs, Benefits, and Water Savings

Costs	Benefits
<p><b>Water Provider Perspective:</b> Potential costs for water providers to support landscaper certification programs include the cost to host and advertise the program, costs for the landscaper to take the program, and costs for the customer to hire a certified landscaper. Some water providers will partially or fully subsidize all these costs. Costs will be higher if the water provider is hosting and subsidizing certification costs, versus just subsidizing certification costs. For reference, in 2023 Northern Water’s average cost to host trainings with outside organizations is \$3,500 per training (Northern Water, 2024).</p>	<p><b>Water Provider Perspective:</b> As the demand and need for waterwise landscapes increases it is critical there are trained professionals to support the installation of new and transition of existing landscapes. This applies to both landscape decisions and irrigation systems. Water providers alone, however, cannot make these changes. By partnering with landscape professionals, the entire industry can be better equipped to install and maintain waterwise landscapes. In turn this will:</p> <ul style="list-style-type: none"> <li>• Increase success of turf conversions and installation of new waterwise landscapes.</li> <li>• Provide customers with support to make informed decisions.</li> <li>• Support the local economy.</li> <li>• Diversify the landscaping industry in the direction of meeting increasing demand for waterwise landscapes.</li> <li>• Foster collaboration with the landscaping industry.</li> <li>• Promote water efficient irrigation systems.</li> </ul>
<p><b>Customer Perspective:</b> Landscapers must pay to be certified. Cost varies by program, however in 2023 certifications provided by Northern Water ranged from \$60 to \$120 (Northern Water, 2024).</p>	<p><b>Customer Perspective:</b> Water provider promotion of certified landscape professionals provides an incentive for landscape professionals to be certified. In addition, it helps customers know which professionals are familiar with waterwise landscape installation, improves the overall quality of the landscape product, and better assures water efficiency.</p>

### Water Savings Assumptions

While direct water savings cannot be quantified from training and certifications, trainings and utilization of certified landscapers provides a significant contribution to the design, installation and maintenance of healthy waterwise landscapes. Although not quantifiable, proper design, installation and maintenance are key pieces to create reductions in outdoor water use on Colorado’s landscapes over time.

**City of Aspen Qualified Water Efficient Landscaper Program (QWEL)**

The City of Aspen is a Professional Certifying Organization (PCO) for the Qualified Water Efficiency Landscaper Program (QWEL). The city created QWEL to support their [Water Efficient Landscape Standards](#). Each year the city hosts landscaper trainings to support the renovation and installation of new waterwise landscapes. A list of landscapers who have the certification are published on the city’s website. More information can be found at: [www.aspen.gov/1195/Qualified-Water-Efficient-Landscaper-Pro](http://www.aspen.gov/1195/Qualified-Water-Efficient-Landscaper-Pro).

## Other Outdoor Water Uses and Considerations

While a small percentage of water provider's outdoor water use in Colorado, is applied to other outdoor water uses such as swimming pools or urban agriculture, understanding these uses, is important for developing a well-rounded water conservation program. Additionally, while not currently widely adopted in Colorado other considerations, like Green Infrastructure, can increase water conservation impact while promoting other co-benefits like decreased run off.

To support implementation of this best practice, the following key concepts are reviewed:

- Swimming Pools
- Urban Agriculture
- Green Infrastructure

### Swimming Pools

While not as common in Colorado as other states in the west, swimming pools can be a large outdoor water user. Average daily outdoor water uses in homes with and without a swimming pool in 2023, western US. **Households with a pool use about 59,000 gallons per year more (more than twice) than homes without a pool** (Flume, 2024).

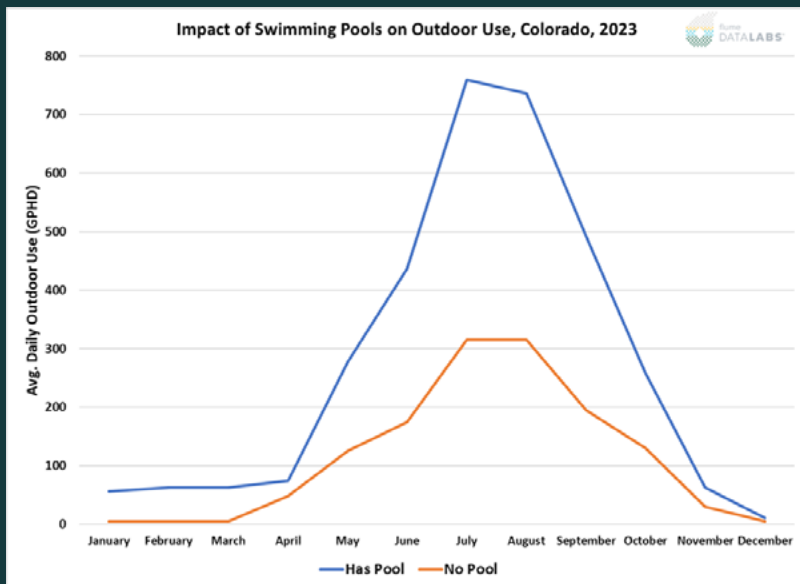


Figure 31. Average daily water use (gallons per household per day) in homes with and without a swimming pool. Colorado WaterWise Best Practices Guidebook

Leaks, splashing and evaporative losses from pools and hot-tubs also contribute to water losses. **Practices to avoid such losses include** (EPA, 2022):

- Lining in-ground pools and hot-tubs with impermeable material.
- Sizing pools for appropriate use to prevent splashing.
- Covering pools when not in use.
- Keeping pool temperatures lower, when appropriate, to reduce evaporation.

### Swimming Pool Regulations

While not yet commonly adopted in Colorado, Eagle River Water and Sanitation District regulations limits swimming pools to filling once per year, unless draining for repairs if necessary (District, 2023). Other areas of the country, where outdoor swimming pools are common, are taking a more aggressive approach to pool use regulations. The Southern Nevada Water Authority passed a resolution in 2022, limiting the surface area of new pools to 600-square-feet. While the average size limit of pools in Southern Nevada is 475 square feet, this resolution prevents the construction of large-scale water intensive residential pools (Southern Nevada Water Authority, 2024).

### Smart Approved WaterMark

Starting in 2024, products that can't be WaterSense certified, but are water efficient, can now receive a Smart Approved WaterMark from the Water Conservancy. To receive the Smart Approved WaterMark products are independently assessed by the Water Conservancy's panel. Common products include pool covers, mulch, and waterless urinals. More information can be found at: [www.smartwatermark.org/](http://www.smartwatermark.org/).



## Pressure Washing

Outdoor pressure washing of sidewalks, cars, and buildings is another common outdoor water use. Outdoor pressure washing is one of the first uses that may be restricted during drought and water shortage conditions and should be minimized when possible. Water providers may institute permanent mandatory restrictions or educate customers on other wasteful nature of these practices.

## Urban Agriculture

“

*Urban agriculture includes the cultivation, processing, and distribution of agricultural products in urban and suburban areas. Community gardens, rooftop farms, hydroponic, aeroponic, and aquaponic facilities, and vertical production are all examples of urban agriculture.*

*United States Department of Agriculture (USDA, 2024).*

”

Currently there is not a statewide formal or statutory definition of urban agriculture. The definition is often dictated by local policy and is specific to community context (e.g., zoning, soil suitability, land and water availability, etc.). Urban agriculture provides social, ecological, and economic benefits, including improved community cohesion, appealing aesthetics, local food sources, reduced urban heat island effect, educational opportunities, reduced greenhouse gas emissions from transporting food, and more. The water efficiency and conservation opportunities of urban agriculture must be considered in the context of the landscape or land uses that urban agriculture is replacing, the design and management of the land and irrigation system, and the types of agriculture products produced. **Several studies have shown that well designed and managed urban gardens can use less water than traditional turfgrass.** A 2015 Denver Water and Denver Urban Gardens study tracked water use at a community garden showing a 40% water savings relative to traditional turfgrass (WaterNow Alliance, 2022).

## Green Infrastructure

Green infrastructure filters and absorbs stormwater, supporting natural vegetation. It provides many stormwater, water quality, environmental, and visual appeal benefits. Such infrastructure includes rain gardens, bio-swales, and planter boxes. **Green infrastructure can reduce outdoor water demands by harnessing rainwater as a natural source of irrigation; however, to be successful, rain sensors must also be included to ensure irrigation systems do not turn on when green infrastructure receives adequate water from natural rainfall.** To date, green infrastructure has not been widely applied at a large scale for water efficiency purposes in Colorado. That said, it can be considered as a gateway to increasing awareness about water and promoting other water efficiency practices.

## Colorado Stormwater Center

The Colorado Stormwater Center has implemented numerous residential rain garden projects in Front Range communities, including rain gardens that have served as an alternative to turf conversion projects. Additional information, on projects, planting layouts, and installation can be found on their website: [stormwatercenter.colostate.edu/research-portfolio/rain-garden-installation/](http://stormwatercenter.colostate.edu/research-portfolio/rain-garden-installation/).



# Resources

## General

- Aquacarft, INC Residential End Uses of Water Version 2: <https://www.waterrf.org/research/projects/residential-end-uses-water-version-2>
- Green Industries of Colorado (GreenCO) Best Management Practices: <http://www.greenco.org/best-management-practices.html>
- YARDX Yield and Reliability Demonstrated in Xeriscape: [https://www.coloradowaterwise.org/resources/Documents/Library/YARDX\\_Report.pdf](https://www.coloradowaterwise.org/resources/Documents/Library/YARDX_Report.pdf)

## Waterwise Plant Selection

- Alliance for Water Efficiency Non-functional Turf 2023 Summary of Programs and Policies: [https://www.allianceforwaterefficiency.org/sites/default/files/assets/NFT%202023%20Summary%20of%20Programs%20and%20Policies%20Final%20Report\\_0.pdf](https://www.allianceforwaterefficiency.org/sites/default/files/assets/NFT%202023%20Summary%20of%20Programs%20and%20Policies%20Final%20Report_0.pdf)
- Aurora Water Wise Garden: <https://www.auroragov.org/cms/One.aspx?portalId=16242704&pageId=16599762>
- Colorado Springs Utilities Waterwise Landscaping: <https://www.csu.org/Pages/WaterWiseBasics.aspx>
- Colorado Native and Water Wise Grass Guide: <https://coloradonativegrass.org/>
- Colorado Nursery and Greenhouse Association: <https://www.coloradonga.org/publications>
- Colorado State University Extension: <https://extension.colostate.edu/garden/>
- Colorado State University Colorado Native Plant Master Program: <https://conativeplantmaster.colostate.edu/>
- Denver Water Xeriscape Resources: <https://www.denverwater.org/residential/rebates-and-conservation-tips/remodel-your-yard/xeriscape-resources>
- EPA WaterSense Outdoors: <https://www.epa.gov/watersense/outdoors>
- Front Range Tree Recommendation List: <https://extension.colostate.edu/docs/pubs/garden/treereclist.pdf>
- Low-Water Native Plants for Colorado Gardens Mountains 7,500 Feet and Above: <https://extension.colostate.edu/docs/pubs/native/Mountains.pdf>
- Northern Water Landscape Conversion Water Savings Calculator:

<https://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/fact-sheets-and-tools>

- Plant Select: <https://plantselect.org/>
- Resource Central: <https://resourcecentral.org/>
- Utah LocalScape: <https://localscapes.com/>
- WaterWise Yards: <https://waterwiseyards.org/>

## Landscape Design, Installation, and Maintenance

- American Society of Landscape Architects: <https://www.asla.org/>
- Association of Professional Landscape Designers: <https://www.apld.org/>
- Associated Landscape Contractors of Colorado: [https://www.alcc.com/index.php?option=com\\_jevents&task=icalrepeat.detail&evid=16&Itemid=116&year=2018&month=12&day=17&title=denver-chapter-holiday-party&uid=74b3312c12ed38673492dcfe575c525a](https://www.alcc.com/index.php?option=com_jevents&task=icalrepeat.detail&evid=16&Itemid=116&year=2018&month=12&day=17&title=denver-chapter-holiday-party&uid=74b3312c12ed38673492dcfe575c525a)
- Colorado State University Soil, Water and Plant Testing Laboratory: <https://agsci.colostate.edu/soiltestinglab/>
- Denver Botanic Gardens Sustainable Landscape services: <https://www.botanicgardens.org/our-impact/sustainable-landscape-services>
- Irrigation Association: <https://www.irrigation.org/>
- National Association of Landscape Professionals: <https://www.landscapeprofessionals.org/>
- Northern Water Landscape Templates: <https://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/landscape-templates>

## Efficient Irrigation

- Colorado State University Colorado Climate Center: [https://climate.colostate.edu/data\\_access\\_new.html](https://climate.colostate.edu/data_access_new.html)
- Colorado Stormwater Center: <http://stormwatercenter.colostate.edu/resources/rain-barrels/>
- EPA WaterSense Products: <https://www.epa.gov/watersense/watersense-products>
- Irrigation Association Landscape Irrigation Best Management Practices: <https://www.irrigation.org/IA/Resources/Best-Management-Practices/Landscape-Irrigation-BMPs/IA/Advocacy/Landscape-Irrigation-BMPs.aspx?hkey=cb207d5f-a03a-4064-a718-800a76d1c3bc>
- Rainwater, Storm Water & Graywater: <https://dwr.colorado.gov/services/water-administration/rainwater-storm-water-graywater>

## Landscape Transformation Programs

- Alliance for Water Efficiency Landscape Transformation: Assessment of Water Utility Programs and Market Readiness Evaluation: <https://www.allianceforwaterefficiency.org/impact/our-work/landscape-transformation-assessment-water-utility-programs-and-market-readiness>
- BBC Research & Consulting Exploratory Analysis of Potential Water Savings, Costs and Benefits of Turf Replacement in Colorado: <https://dnrweblink.state.co.us/CWCB/0/edoc/219024/Compiled%20Final%20BBC%20Turf%20Replacement%20Report%2001042023.pdf?searchid=92806f56-2448-4481-b1f4-7f09ab594e1c>
- EPA Water Budget Tool: <https://www.epa.gov/watersense/water-budget-tool>
- Northern Water Garden in a Box Irrigation Recommendation Cooperative Project with Resource Central: [https://www.northernwater.org/getattachment/4642c97f-937d-4e24-a8a0-d8e840c90b35/Garden\\_in\\_a\\_Box\\_Irrigation\\_Recommendations](https://www.northernwater.org/getattachment/4642c97f-937d-4e24-a8a0-d8e840c90b35/Garden_in_a_Box_Irrigation_Recommendations)
- Resource Central Roadmap for a Waterwise HOA: <https://www.dropbox.com/s/dcluchuevwr8699/Resource%20Central%20HOA%20Road%20Map.pdf?e=1&dl=0>
- Western Resource Advocates and WaterNow Alliance: [https://westernresourceadvocates.org/wp-content/uploads/2022/08/2022\\_0803\\_UtilityTurfReplacement\\_Final.pdf](https://westernresourceadvocates.org/wp-content/uploads/2022/08/2022_0803_UtilityTurfReplacement_Final.pdf)
- Water Resource Advocates and WaterNow Alliance Turf Conversion Database: [https://tapin.waternow.org/turf-conversion-database/?mc\\_cid=cd1cb22627&mc\\_eid=9bd81caee6](https://tapin.waternow.org/turf-conversion-database/?mc_cid=cd1cb22627&mc_eid=9bd81caee6)

## Elevating the Landscaping Practice

- Green Gardens Group Watershed Wise Landscape Professional Certification: <https://www.greengardensgroup.com/watershed-wise-landscape-training/wwlt-professional-certification/>
- Northern Water Trainings and Events: <https://www.northernwater.org/what-we-do/protect-the-environment/efficient-water-use/trainings-and-events>
- Qualified Water Efficiency Landscape (QWEL): <https://www.qwel.net/about>



# REFLECTIONS

One of the ways Colorado has responded to climate change and the changing conditions on the Colorado River is by strengthening water planning and increasing municipal water efficiency across the state. Since the first Colorado WaterWise Guidebook of Best Practices for Municipal Water Conservation was published in 2010, Colorado has released two state water plans, improved utility data reporting, adopted best practices for water loss control, educated providers about water loss control practices, mandated that only water efficient fixtures be sold, and funded turf removal and landscape transformation. It has been a remarkable period of progress in urban water efficiency in Colorado.

This second edition of Best Practice guidebook reflects the impressive changes over the past decades and looks forward to the rapidly changing regulatory environment in Colorado. The web version of this Best Practice guidebook will be updated as required in the coming years with new information and case studies. The Best Practice guidebook is available at [www.coloradowaterwise.org](http://www.coloradowaterwise.org).

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Grant funding for water conservation and efficiency planning and implementation from the Colorado Water Conservation Board, the Colorado River District, Northern Water, and others has made a huge difference in Colorado over the past 25 years. From utility water efficiency plans to water loss control training to research on water use and water savings, grant funding has literally transformed the landscape in Colorado. The return on investment is immense and municipal efficiency has helped Colorado grow and stretch supplies farther and more affordably.

Continued grant funding into the future will be important as new regulations force changes in areas like landscape water use which require new understanding and new tools for implementation and measurement.



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