AGENDA
CITY OF GLENWOOD SPRINGS
Planning and Zoning Commission
Special Meeting
JULY 20, 2021
Council Chambers, First Floor
101 W. 8TH STREET
6:00 PM

1 Roll Call

2 Comments from citizens appearing for items not on the agenda

3 New Items

A. Strategies for Drought Resiliency
(Joint Session with River Commission)

B. Commissioner Directed Topics

4 Commissioner Comments

5 Director Comments

6 Adjournment

Strategies for Drought Response

Glenwood Springs, CO

Water Use Restrictions Happening in the West

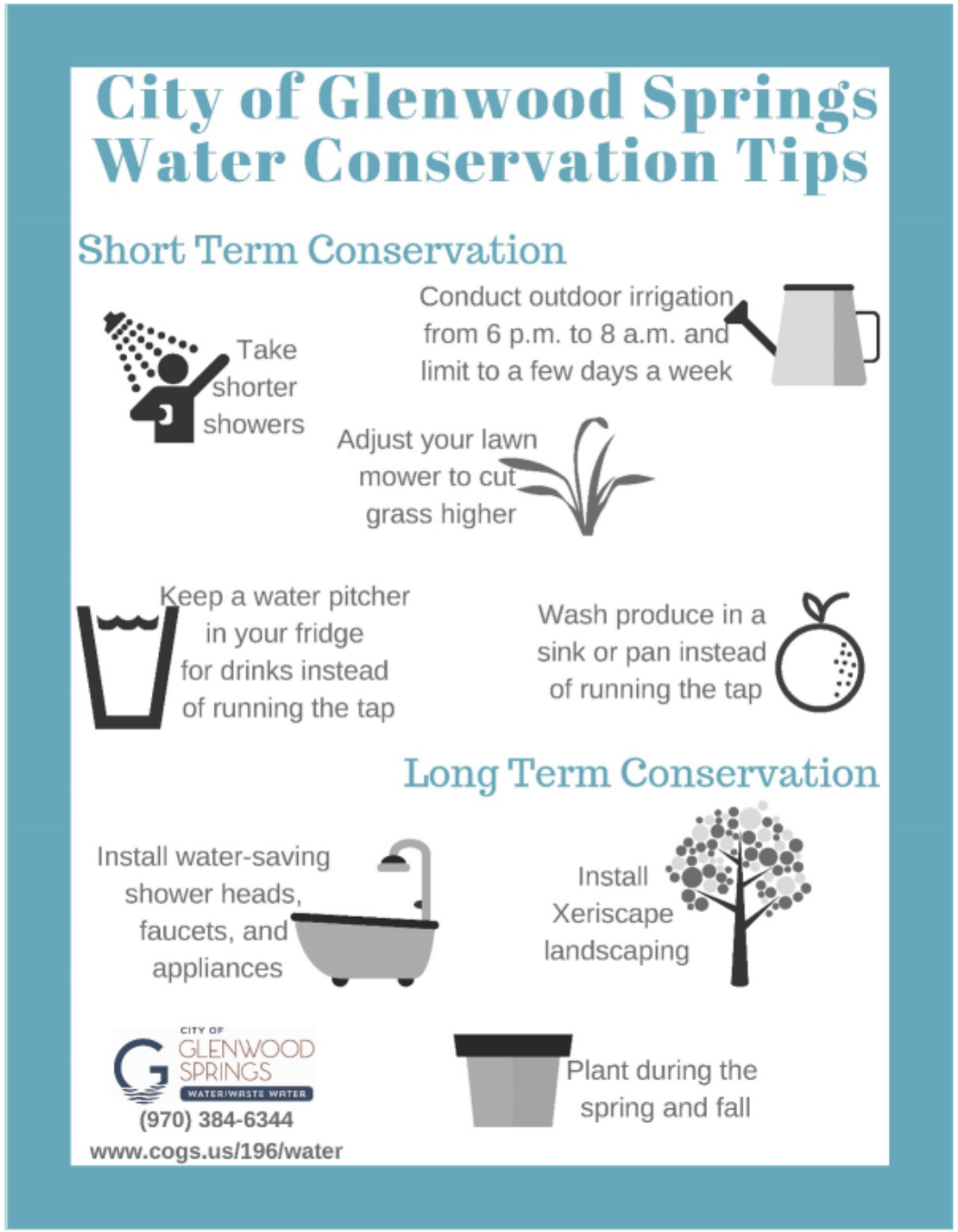
- Communities in California have moved their restrictions to spray irrigation 1 time a week and drip irrigation to only 2 days a week, with no watering on Saturday or Sunday at all.
- The use of specific schedules allows water providers to control the flow of water out of plants, regulate water tank levels and provide their code enforcement schedules to make regulation enforcement simple.
- Some water providers in the west have moved water times all the way from 8pm to 6am to make sure the heat of the day had passed, and spray irrigation would not evaporate off the grass.
- Other water providers are restricting watering to no sooner than 48 hours after measurable rainfall.
- Some water providers are water budgeting households to 74 gallons per person per day interior use only, no outside watering of any kind.

Options for Drought Response Locally

- Continue to draw water from Grizzly and No Name Creek at needed capacity without drying up the creeks.
- Install raw water line from pump station to Red Mountain Plant that can make up lack of water flows as the creeks have less water during the year.
  - 16" line for makeup water capacity.
  - ~24" line for full supply capacity, possible pump station upgrade.
- Reconnect south Glenwood irrigation to a raw water supply system to remove that load from the Cardiff tanks, increase fire storage capacity in South Glenwood and reduce processing flow needed from the water plant.
- Move other areas of the city, especially large users, to raw water supply systems for irrigation off water rights available or to be purchased.
- Expand our existing raw water irrigation systems, install reduced filter system to control turbidity within the lines to irrigation levels.

Options for Drought Response Locally (cont.)

- Review of all City water rights and how they can be utilized for raw water systems.
- Possible review of water storage options: Reservoirs, purchased storage capacity, large raw water tank.
- Review of independent water systems within the City Boundary and how they function or could function.



Water Conservation Basic Rules

- Basic water conservation rules sent out in the spring to remind people of easy water and money saving ideas.
- Discussions are planned with the Planning Commission to cut back on landscaping requirements and encourage Xeriscaping options and drip systems.
- Planting new lawns in the summer is highly wasteful for plant establishment.

Water Sources

Glenwood Springs is fortunate to have physically abundant, high quality water sources that primarily drain a pristine, protected watershed. **No Name** and **Grizzly** Creeks provide source diversity and redundancy in the primary supply with the **Roaring Fork River** as a reliable backup. The City's water rights are senior and are likely to be sufficient to meet the supply needs of the community as projected through 2050. The City continues to monitor and evaluate the communities growth and needs annually. The City's raw water system is largely gravity fed, which reduces the need for costly pumping. Only two areas of the City require pumping for treated water service.

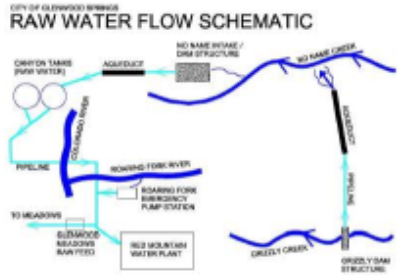


*Figure not to scale and has been reoriented for formatting purposes

Population Growth

The City is expanding slowly and anticipates growth between 1 and 2 percent per year through 2050. It is forecasted that the population of Glenwood Springs will increase from 10,581 in 2013 to approximately 14,800 by 2035 and 18,800 by 2050. This represents a 77% increase in the population, or approximately 1.6% per year.

Water Demand

The maximum annual water use in Glenwood Springs over the past 10 years was 2,357 AF (768.03 MG) in 2007, and the range of forecast future demands in the year 2050 are from 2,837 AF (924.44 MG) to a maximum of 3,541 AF (1,153.84 MG).

City of Glenwood Springs Water Conservation Program

CITY OF GLENWOOD SPRINGS WATER/WASTE WATER

USING WATER WISELY—USE IT SPARINGLY!

The City of Glenwood Springs' water supply is likely to be sufficient to meet our community's demand as projected through 2050. The City continues to monitor and evaluate the communities growth and needs annually. However, our sources are not immune to drought conditions or seasonal streamflow variability. The City is committed to conservation programs aimed at improving our system reliability, improving water efficiency, and preserving water resources for other downstream water users.

What is the City of Glenwood Springs doing to conserve our drinking water sources?

- **WATER EFFICIENCY PLANNING.** The City has developed a formal Water Efficiency Plan that outlines our short and long term conservation goals. For more information, you can download the plan from the City's website at http://www.cogs.us/DocumentCenter/View/1199.
- **PUBLIC INFORMATION AND OUTREACH.** The City of Glenwood Springs is a regional leader in source water protection and water conservation efforts. We are also committed to educating our community about our water and wastewater systems. If you are interested in touring our water or wastewater treatment facilities, please contact the water department.
- **AUTOMATED WATER METERING.** The City requires all water services connected to the system to be metered. In addition, we are working to install automated meter reading equipment throughout the entire water distribution system. Most of these new meters have the ability to detect leaks on the customer side of the water service shut off valve.
- **TIERED RATE STRUCTURE.** The City has implemented a tiered water rate structure to encourage water conservation. The current water rate structure for residential users is shown below:

Fixed Monthly Customer Service Fee	$20.88
Usage Rate	Water Rate Per 1,000 gallons
Up to 5,500 gallons	$3.59
From 5,500 gallons to 17,500 gallons	$4.77
Over 17,500 gallons	$6.34

- **LEAK DETECTION PROGRAMS.** The City has a implemented a comprehensive leak detection program aimed at identifying and locating leaks within the water distribution system. The program involves testing 25% of the system annually. Any leaks that are detected are investigated and repaired.
- **LOW WATER LANDSCAPING.** The City Parks Department has implemented many water saving devices to manage the Parks Systems including installation of rain sensors and computerized monitoring.
- **DROUGHT/WATER EMERGENCY PLANNING.** The City has developed a drought and water emergency plan that outlines actions the City takes to respond to water supply emergencies.
- **WATER-WASTING ENFORCEMENT.** The City has a "Water Wasting" Ordinance which outlines penalties for users that waste water. To report water wasting, contact the water department at 384-6344.

What Can You Do To Conserve Our Drinking Water?

Indoor Conservation Ideas

- ☑ **Check for and repair leaks.**
- ☑ **Don't use your toilet as a trash can.**
- ☑ Install a high efficiency toilet.
- ☑ Take showers instead of baths.
- ☑ Use water-saving showerheads, toilets, faucets, and high efficiency appliances such as dishwashers and washing machines.
- ☑ Keep a pitcher of water in your refrigerator instead of running the tap for cold drinks, so that every drop goes down **YOU** and not your drain.
- ☑ Wash your produce in a sink or a pan that is partially filled with water instead of running water from the tap.
- ☑ Plug the bath tub before turning the water on, and then adjust the temperature as the tub fills up.

Outdoor Conservation Ideas

- ☑ Water only when necessary and preferably in the mornings or evenings to avoid evaporation losses (up to 50%) from hot and windy weather conditions.
- ☑ Install Xeriscape landscaping.
- ☑ Encourage landscapes that maximize water efficiency.
- ☑ Plant during the spring or fall when the watering requirements are lower.
- ☑ Adjust your lawn mower to cut grass high to hold moisture.
- ☑ Use the sprinkler for larger areas of grass. Water small patches by hand to avoid waste.

Did You Know?

- It's okay to report significant water losses from broken pipes or water wasting activities Call 970-384-6344.
- Installing newer appliances is an easy way to conserve water. For example, new washing machines can save up to 20 gallons per load!
- If you time your shower to keep it under 5 minutes, you could save up to 1,000 gallons a month! That could add up to big savings on your monthly water bill.
- Leaking toilets waste a lot of water, resulting in high water bills. You can detect a leak by putting a few drops of food coloring in your toilet tank. If the color seeps into the toilet bowl, have a leak. Its easy to fix, and you could save more than 7,000 gallons a year!
- Spreading a layer of organic mulch around your outdoor plants reduces evaporation and can save hundreds of gallons of water a year.
- If you use a broom instead of a hose to clean your driveway or sidewalk, you could save up to 80 gallons every time.
- If you run your dishwasher only when its full you can save as much as 400 gallons a month!
- If you insulate your hot water lines within the house it takes less time for the water to warm up in the kitchen and bathroom and you conserve water.
- If you turn off water while brushing your teeth, you can save approximately 3 gallons per minute. That could be as much as 1,000 gallons a year!
- You can install an automatic shut-off device on your irrigation system that will stop outdoor watering after a recent rainstorm.

Contact Us

- The City of Glenwood Springs Water Department can be reached at 970-384-6344.
- View our department webpage at: www.cogs.us/water

City of Glenwood Springs Water Conservation Program

Committed to Conserving Our Community's Water Supplies!

070.040.050 Landscaping, Screening, and Fencing.

(a) *Purpose.* The purpose of this Section is to ensure that landscaping, screening, and fencing is provided to:

(1) Protect and enhance the visual appeal of Glenwood Springs;

(2) Contribute to high-quality development;

(3) Improve air quality;

(4) Buffer potentially incompatible neighboring land uses;

(5) Mitigate the environmental and visual impacts of surface parking areas; and

(6) *Protect residential and commercial property values.*

(b) *Applicability.*

(1) *New Development and Redevelopment.* These standards shall apply to all new development or redevelopment unless otherwise exempted by Paragraph (2).

(2) *Exemptions.*

a. Single- and two-family residential uses except 070.040.050(d), Streetscape Requirements, and 070.040.050(f)(2), Fence Standards.

b. Mixed-use or nonresidential uses on a lot that is less than five thousand (5,000) square feet shall be exempt from this Section.

c. Expansion of existing structures or uses by less than twenty-five (25) percent gross floor area provided that any existing compliant landscaping remains unaltered.

(c) *General Landscaping Standards.*

(1) *Minimum Landscaped Site Area.*

a. The minimum percentage of site area required to be landscaped is established for each zoning district in Section 070.020.020, Summary of Dimensional Standards.

b. Except for areas with native vegetation cover, any part of a site not used for building coverage, parking areas, driveways, sidewalks, or other site improvements shall be landscaped.

(2) *Type and Amount of Plant Material.*

a. Trees and other plant material shall be provided according to Table 040.5: Minimum Plant Material and Standards.

b. Existing landscaping may be used to satisfy the landscaping requirements, except that preservation of existing trees shall comply with Subsection 070.040.050(c)(4).

c. Artificial trees, shrubs, turf, or plants shall not be used to satisfy any of the requirements of this Section.

d. Where fractional number results, the number of trees, shrubs, or perennials shall be rounded to the next highest whole number.

Table 040.5: Minimum Plant Material and Standards		
Plant Material	Minimum Amount	Species and Size Standards
Trees	One tree per 400 square feet of site area	**Deciduous:** minimum caliper 2.5 inches (understory ornamental trees may be two-inch

	required to be landscaped in addition to those required for parking areas	caliper)
		Evergreen: (a) minimum height of six feet; (b) shall not exceed 50 percent of total required trees; (c) if provided, ten percent of evergreen trees shall have a minimum height of ten feet.
		Shrub substitution: Up to 50 percent of required trees may be substituted with shrubs (above required amount) at a rate of ten shrubs = one tree. All such shrubs shall comply with the standards in this table.
Shrubs	One shrub per 100 square feet of site area required to be landscaped in addition to those required for parking areas	(a) at least 20 percent of required shrubs shall be an evergreen species; (b) shall be a minimum of five gallons in size and shall grow to a minimum height of one foot at maturity; (c) if used for screening requirements in Subsection 070.040.050(f), shall grow to a minimum height of four feet at maturity.
Perennials	One perennial per 50 square feet of site area required to be landscaped	(a) shall be a minimum of one gallon in size; (b) shrubs (above required amount) may be substituted for perennials at a rate of one shrub = five perennials.

(3) *Location of Required Plant Material.*

a. Required trees, shrubs, and perennials shall be planted in required setbacks, parking areas, and along building foundations.

b. When planted in required setback areas or along building foundations, trees may be either uniformly spaced or placed in irregular groupings.

c. Landscaping or other obstructions within a sight distance triangle shall comply with the height restrictions in Subsection 070.020.190(c)(5), Sight Distance Triangle Requirement.

d. Trees shall be planted at least four (4) feet away from overhanging vehicles. (Figure 040-3)

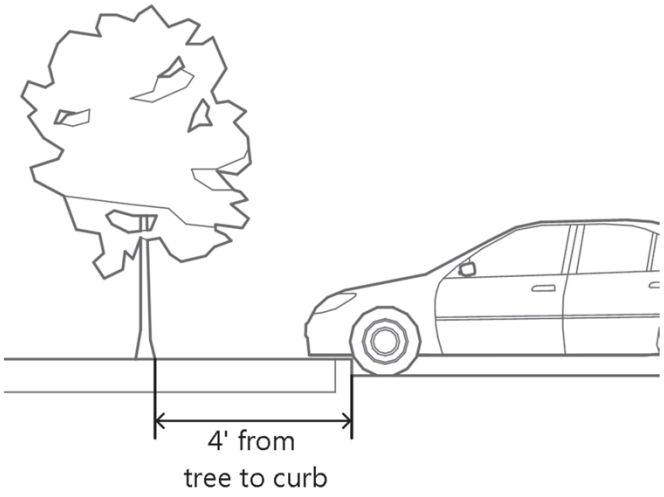


Figure 040-3: Vehicle Overhang

(4) *Credits for Tree Preservation.*

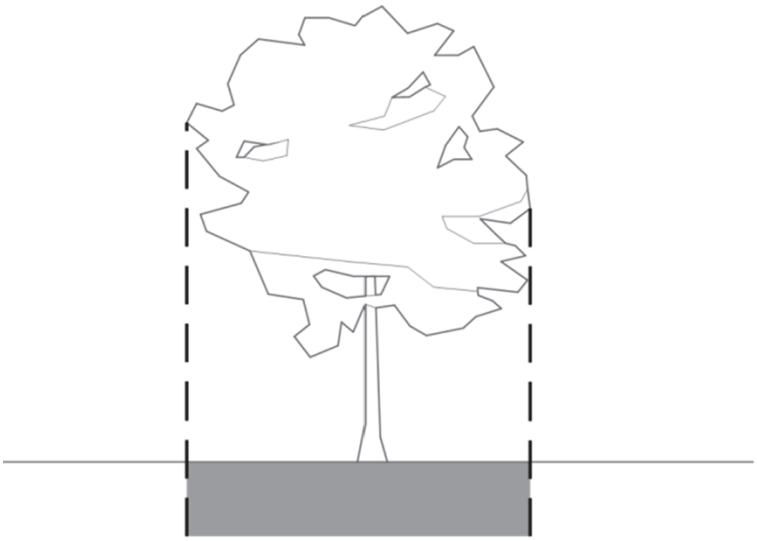


Figure 040-4: Drip Line

iii. Trees intended for preservation shall be shown on the landscape plan with caliper size and drip line noted.

(d) *Streetscape Requirements.*

(1) *Minimum Streetscape Elements.* Streetscape elements shall be provided according to Table 040.6: Minimum Streetscape Requirements.

Table 040.6: Minimum Streetscape Requirements

	Minimum Amount (Residential)	Minimum Amount (In the Downtown Core)	Minimum Amount (Other Mixed-Use and Nonresidential)	Other Standards
Street Trees	One tree per 75 feet street frontage	**Residential:** one tree per 35 feet street frontage; **Mixed-Use:** one tree per 50 feet street frontage	One tree per 50 feet street frontage	(a) trees shall meet City specifications pursuant to Article 090.040, Streets and Sidewalks; (b) evergreen trees are prohibited as street trees in the planting strip; (c) where overhead utility lines are present, select a variety of tree that, at maturity, grows no higher than the lowest utility line; (d) trees shall be spaced 30 feet apart on center unless alternative spacing is approved by the Director.
Planting Strip	Minimum five feet in width (from back edge of curb)	Minimum five feet in width (from back edge of curb); however, the Director may waive this requirement based on existing conditions along the block face provided landscape elements are used to define the edge	Minimum five feet in width (from back edge of curb)	(a) shall include a combination (at least two) of the following: trees, shrubs, grasses, native plants, drought-tolerant or low-water plants, perennials, annuals, or turf; (b) in the Downtown Core, grasses or turf may only be used

		of the property in the absence of a planting strip.		for residential or mixed-use development; (c) up to 40 percent of the planting strip may be hard surfaced with concrete, brick, composite pavers, stone, or rock-type mulch.
Amenities	None	Per Director discretion based on the needs for a particular block	None	Amenities shall be designed and installed pursuant to the streetscape manual.

(2) *Location of Street Trees.*

a. Unless otherwise permitted in this Section, street trees shall be located within the designated planting strip.

b. Where no planting strip is present or where utilities prevent trees from being planted in the designated planting strip, trees may be planted on the development parcel, in an area ranging from three (3) to seven (7) feet behind the property line nearest to the public right-of-way.

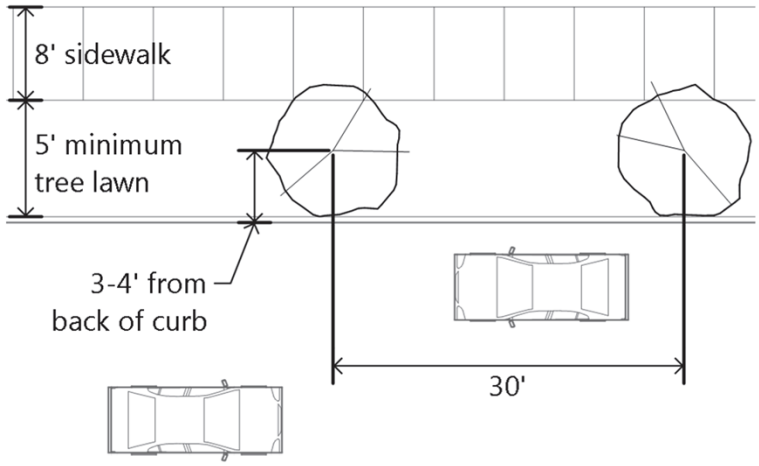


Figure 040-5: Location of Street Trees

(e) *Parking Area Landscaping.* See Subsection 070.040.060(h)(6), Parking Area Landscaping.

(f) *Screening, Fences, and Walls.*

(1) *Screening Standards.*

a. *Credits Toward Required Landscaping.* Any landscaping provided to meet screening standards will be credited towards the overall landscaping requirements enumerated in this Section.

b. *Screening Loading and Outdoor Storage Areas.* Loading and outdoor storage areas shall be screened from view of public rights-of-way and from adjacent residential land uses or districts using any one (1) or a combination of fences, walls, berms, or landscaping that is at least six (6) feet in height and provides a permanent, opaque, year-round screen.

c. *Screening Refuse Containers.*

1. *Enclosures Required.* Refuse containers shall be located within an enclosure.

2. *Location.* Refuse container enclosures shall be located at the rear of the property to the extent practicable and shall be sited to allow for easy vehicular access such that access does not require backing movements onto public rights-of-way, with the exception of alleys.

3. *Design and Materials.* Refuse container enclosures shall be of sufficient height to screen containers, but shall not exceed six (6) feet in height unless screening a refuse container taller than six (6) feet. Such enclosures shall be visually compatible with materials used on the primary building. In no case shall enclosures consist of chain link or corrugated metal. Refuse containers shall comply with the provisions set forth in Article 100.010.060 of the Municipal Code. (Figure 040-6)

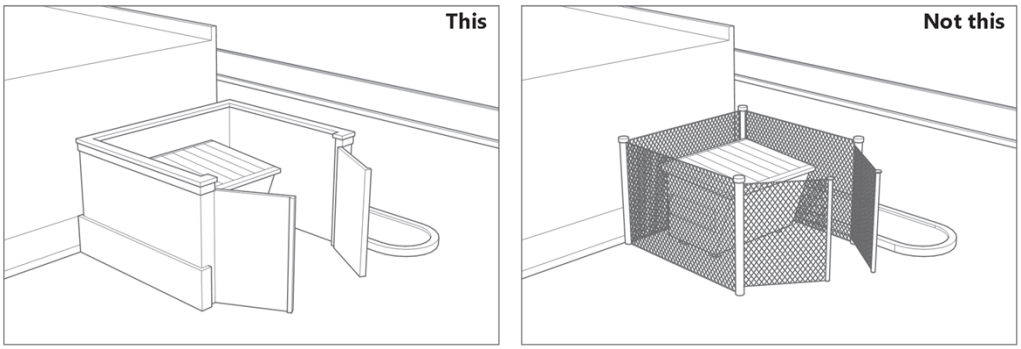


Figure 040-6: Refuse Container Enclosures

4. *Landscaping.* Landscaping shall be used to soften the appearance of the enclosure where such enclosure is located within a side yard or can be viewed from public rights-of-way.

d. *Screening Mechanical and Utility Equipment.* All mechanical and utility equipment including but not limited to air-conditioning, heating and soft water tanks, television antennas, satellite dishes, security apparatus, transformers, and electric and gas meters shall be integrated into the building design, screened from public view or enclosed in a suitable accessory structure, pursuant to the following standards:

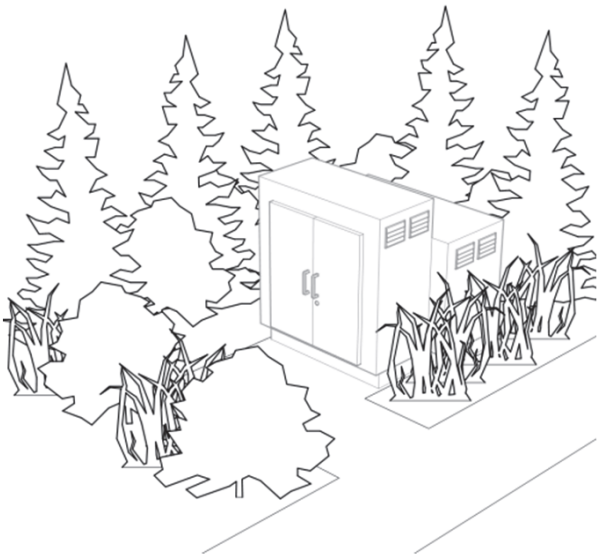


Figure 040-7: Screening Ground-Mounted Equipment

iii. Fire Hydrants.

iv. Roof-Mounted Equipment.

(2) *Fence Standards.*

(3) *Retaining Wall Standards.*

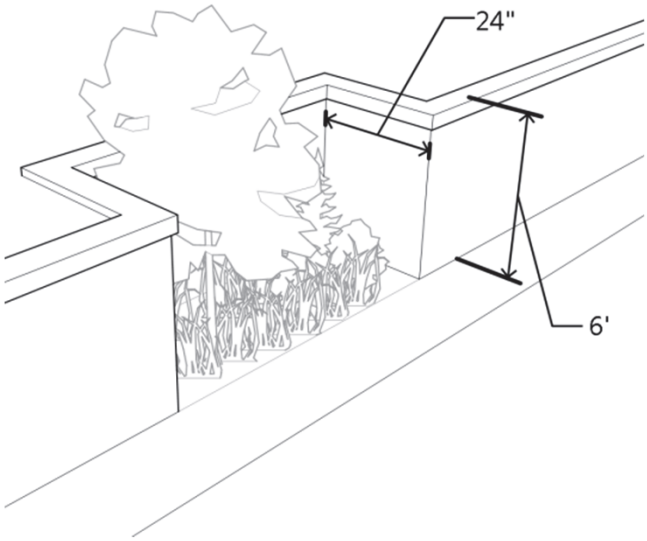


Figure 040-8: Retaining Wall Design

ii. Landscaping at a minimum shall include trees, shrubs, ornamental grasses and/or and perennials and be of sufficient quantity to add visual interest and to minimize the impact of the structure as viewed from neighboring properties or the public right-of-way. The Director may approve alternative designs to soften retaining walls to reduce the amount of water behind such walls provided the intent of this Section is met. Alternative designs shall be processed according to Subsection 070.040.050(g)(2).

5. Retaining walls shall be designed such that the structure conforms to the existing natural terrain.

6. Retaining walls shall conform to maximum height requirements when located within a sight distance triangle.

b. *Terracing Required.* The Director may allow retaining walls that exceed six (6) feet in height if they are terraced to minimize visual impacts on residents, neighboring properties, and the public realm by: (Figure 040-9)

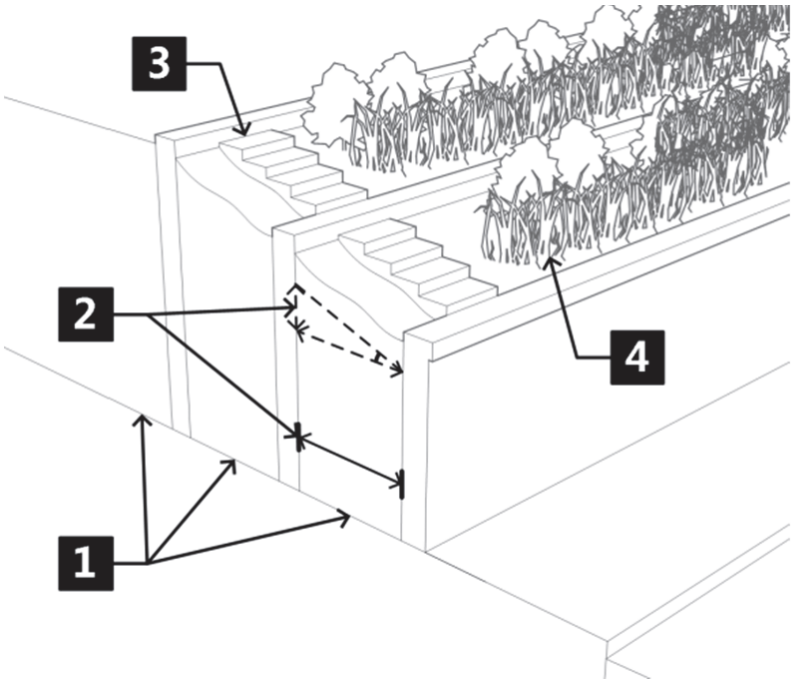


Figure 040-9: Retainign Wall Terracing

Annotations correspond with paragraph numbers in the preceding text.

c. *Materials and Color.*

d. *Landscape Buffer as an Alternative.*

(g) *Landscaping Evaluation Procedure.*

(1) *Landscape Plan.*

a. All development except for single-family detached houses and duplexes shall provide a landscape plan demonstrating compliance with the standards in this Section shall be provided in a form established by the Director.

b. Review and evaluation of the landscape plan shall be pursuant to the specific application procedure pursuant to Article 070.060: Administration and Procedures.

(2) *Alternative Compliance.*

a. For developments with severely hydrocompactive soils, especially those present around building foundations, the Director may approve landscaping and related irrigation design alternatives that meet the overall intent of this Section but that address the special characteristics of these soil types. The Director may require a statement from a licensed geotechnical engineer that specifically addresses the hydrocompactive soil issue as it relates to compliance with the requirements in this Subsection for the City to consider an alternative landscaping design.

b. For developments where other exceptional physical limitations of either existing building location or site dimensions result in impractical or impossible application of this Section, then the Director may approve landscaping, screening, fencing, and wall alternatives that meet the intent of this Section.

(h) *Installation and Maintenance.*

(1) *Timing of Installation.* The developer shall install all landscape improvements including operable irrigation systems prior to receiving a Certificate of Occupancy. This requirement may be modified by the Director if security is provided and the developer identifies an alternative timeframe for landscaping and/or irrigation system installation. The amount of security shall be based on itemized cost estimates of all landscaping and irrigation system improvements, as well as related labor costs. Itemizations shall be generated from a qualified landscape architect, irrigation system specialist, and/or a local or regional landscaping nursery or garden center.

(2) *Irrigation System Design.* Irrigation systems shall be professionally designed by a landscape architect or irrigation specialist. When available, raw water shall be utilized for irrigation. Irrigation systems shall be designed to prevent water from spraying on impervious surfaces adjacent to landscape areas, shall utilize drip irrigation where appropriate to minimize run-off from sprinklers, and shall incorporate moisture sensors to reduce water consumption.

(3) *Maintenance.* The owner of the property and his/her successors, heirs, and assigns, are responsible for the proper maintenance of the landscaped area, screening, fencing, and parking lot subject to the approved landscape plan. All landscape and parking areas shall be maintained free of trash. Landscaping shall be continuously maintained, including all necessary watering, weeding, pruning, and pest control.

(4) *Protection of Existing Vegetation.*

a. No existing live trees with a caliper size of fourteen (14) inches or greater may be removed without approval of the Director and Parks and Recreation Director.

b. Planting strips or areas, walkways, fences, hedges, or walls shall be protected from vehicles and maintenance equipment by curbs, bollards, wheel stops, or other means.

(5) *Replacement of Dead or Diseased Plant Material.* Replacement of dead or diseased plant material shall be of equivalent species or material, as specified in the approved Landscape Plan. Replacement shall occur at the time of removal or, if necessary, the next planting season. In any event, replacement shall occur within one (1) year from the time of removal.

(6) *Maintenance of Trees in Public Right-of-Way.* Trees located within the public right-of-way or on public property shall be maintained in accordance with Section 090.050.030 of the Municipal Code.

(Ord. No. 19-2018 , § 2(Exh. A), 8-2-2018; Ord. No. 3-2019 , § 2(Exh. A), 1-31-2019; Ord. No. 15-2020 , § 2(Exh. A), 7-2-2020)

Botanical name	Common name	Notes	
Deciduous Shade Trees			
Acer negundo	Box Elder	N	
Fraxinus pennsylvanica	Green Ash		L
Populus acuminata	Lanceleaf Cottonwood	N	
Populus angustifolia	Narrowleaf Cottonwood	N	
Populus balsamifera	Balsam Poplar	N	
Sorbus scopulina	Mountain Ash	N	
Ornamental Trees			
Acer glabrum	Rocky Mountain Maple	N	
Alnus incana tenuifolia	Thinleaf Alder	N	
Amelanchier canadensis	Shadblow Serviceberry	N	L
Betula occidentalis	Rocky Mountain Birch	N	
Crataegus succulenta	Western Hawthorn	N	L
Crataegus erythropoda	Cerro Hawthorn	N	
Malus "Dolgo"	Dolgo Crabapple		
Malus "Radiant"	Radiant Crabapple		
Malus "Spring Snow"	Spring Snow Crabapple		
Populus tremuloides	Quaking Aspen	N	
Prunus pensylvanica	Pin Cherry	N	L
Prunus virginiana	Chokecherry	N	L
Quercus gambelii	Gambel Oak	N	L
Evergreen: Pine, Spruce, Fir			
Picea pungens	Colorado Blue Spruce	N	
Picea engelmannii	Engelmann's Spruce	N	
Pinus aristata	Bristlecone Pine	N	L
Pinus edulis	Pinyon Pine	N	L
Pinus flexilis	Limber Pine	N	L
Pinus ponderosa	Ponderosa Pine	N	
Pseudotsuga menziesii glauca	Colorado Douglas Fir	N	
Upright Junipers			
Juniperus communis	Common Juniper	N	L
Juniperus scopulorum	Rocky Mountain Juniper	N	L
Juniperus monosperma	Oneseed Juniper	N	L
Spreading Junipers			
Juniperus horizontalis "Blue Ring"	Blue Ring Creeping Juniper		L
Juniperus horizontalis "Prince of Wales"	Prince of Wales Creeping Juniper		L
Juniperus sabina "Arcadia"	Arcadia Savin Juniper		L
Juniperus sabina "Broadmoor"	Broadmoor Savin Juniper		L
Juniperus sabina "Buffalo"	Buffalo Savin Juniper		L
Juniperus sabina "Scandia"	Scandia Savin Juniper		L
Juniperus sabina tamariscifolia	Tamarix (Tam) Juniper		L

Juniperus scopulorum "Table Top"	Table Top Rocky Mountain Juniper		L
Broadleaf Evergreens			
Arctostaphylos uva-ursii	Kinnikinnick	N	L
Cercocarpus ledifolius	Curl-Leaf Mountain Mahogany	N	L
Cercocarpus montanus	Alderleaf Mountain Mahogany	N	L
Mahonia repens	Creeping Oregon Grape	N	L
Yucca glauca	Soapweed Yucca	N	L
Shrubs			
Acer ginnala	Amur Maple		L
Acer glabrum	Rocky Mountain Maple	N	L
Amelanchier alnifolia	Saskatoon Serviceberry	N	L
Artemisia filifolia	Sand Sagebrush	N	L
Atriplex canescens	Chamiso	N	L
Chrysothamnus nauseosus	Yellow Twig Rabbit Brush	N	L
Cornus sericea	Red Osier Dogwood	N	L
Cotoneaster acutifolia	Peking Cotoneaster		L
Eunoymus alatus	Burning Bush		
Holodiscus dumosus	Mountain Spray	N	L
Potentilla sp.	Cinquefoil	N	
Prunus besseyi	Western Sand Cherry	N	L
Prunus cistena	Purpleleaf Sand Cherry		L
Prunus virginiana	Chokecherry	N	L
Physocarpus opulifolius	Common Ninebark	N	L
Quercus gambelii	Gambel Oak	N	L
Rhamnus smithii	Smith Buckthorn	N	L
Rhus glabra	Smooth Sumac	N	L
Rhus trilobata	Three Leaf Sumac	N	L
Ribes americanum	American Black Currant	N	
Ribes aurem	Golden Currant	N	
Ribes cereum	Wax Currant	N	
Ribes inerme	Whitestem Gooseberry	N	
Ribes leptanthum	Trumpet Gooseberry	N	
Rosa glauca	Red-Leaved Rose		
Rosa woodsii	Western Wild Rose	N	L
Rubus deliciosus	Rocky Mountain Raspberry	N	
Rubus ideaus	Wild Red Raspberry	N	
Salix caprea	Pussy Willow		
Salix irrorata	Bluestem Willow	N	
Shepherdia argentea	Silver Buffaloberry	N	
Symphoricarpos albus	Common Snowberry	N	
Symphoricarpos oreophilus	Mountain Snowberry	N	
Syringa vulgaris	Common Lilac		L

N—Species native to Colorado the State
L—Low water use plants (after establishment)
Refer to local nurseries for information regarding perennials and annuals that will tolerate the short mountain growing season

colorado waterwise

TECHNICAL GUIDE

GUIDEBOOK OF BEST PRACTICES

FOR MUNICIPAL WATER CONSERVATION IN COLORADO

COLORADO WATER CONSERVATION BOARD · STATE OF COLORADO · 1876 · 1937 · NIL SINE NUMINE

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WATER ENGINEERING & MANAGEMENT

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BEST PRACTICE 8: Rules and Regulations for Landscape Design and Installation and Certification of Landscape Professionals

- Programmatic and control practice
- Customer side best practice - implemented by water customers with support from water utilities
- Customer participation – action by customers required for successful implementation

Overview

The key concept of this best practice is creating landscapes that are "water smart from the start." Creating rules for new landscape and irrigation system design and installation is a relatively inexpensive way to affect landscape water use. Proper installation and maintenance are needed to create and maintain water-efficient irrigation. A second powerful tool is minimum training requirements and certification for landscape irrigation professionals. These requirements can function in concert as trained and certified professionals are in the best position to design and install water efficient landscapes and irrigation systems that meet mandated standards.

Why a Best Practice?

In Colorado, urban landscape irrigation accounts for 50 percent or more of the total annual water demand for a utility.[13] Improving the efficiency of water use on urban landscapes is perhaps the single most important urban water conservation effort than can be made in Colorado.

Colorado's population is expected to double over the next 40 years. If all new landscapes in Colorado are designed, installed and maintained with water efficiency as a priority there is tremendous potential to reduce future demands below what they might be otherwise.

Ensuring that landscapes are designed and installed with water efficiency in mind and that landscape professionals have the best available training represents a best practice for water providers.

State Planning Requirements

Colorado statute requires that all covered entities (water providers that deliver more than 2,000 acre-feet per year) file a water conservation 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. Under this statute, one of the water saving measures and programs that must be considered in a conservation plan is, "Low water use landscapes, drought-resistant vegetation, removal of phreatophytes, and efficient irrigation." [CRS 37-60-126 (4) (a) (II)].

[13] AWWA (1999), Aquacraft (2007), Davis et. al. (2009), Grabow et. al. (2009), Mayer et. al. (2009), McReady (2009), County (2008), Dukes et. al. (2008), GreenCO (2008), Guz (2008), Jakubowski et. al. (2008), Haley et. al. (2007), US BOR (2007), NCWCD (2008), Baum (2005), CSU, (2005), PMSI (2005), Bamezai (2004), Barta (2004), CWRRI (2004), MWDOC (2008, and 2004), DeOreo et. al. (1998), CSU (1994).

Applicability

This best practice is applicable to all utilities, cities, counties, and states seeking to improve the efficiency of outdoor use and increase the technical capabilities of local landscaping professionals.

Implementation

This best practice can be implemented through local ordinances and codes such as a model landscape code, green building programs, local building and plumbing codes, and the specification of training requirements. Proper jurisdiction must be determined for successful implementation and enactment may require approval of city or county government for some code provisions. This is an area where the State of Colorado could enact stricter plumbing codes and set landscape standards.

Mandating certification of landscape professionals is greatly simplified by the WaterSense Certification offered by the US EPA which accredits programs such as the Irrigation Association's training courses. An entity such as a city, county, or state can specify that all landscapes must be designed and installed by a WaterSense certified professional.

Additional landscape certification programs that may be considered are listed in Table 4-13 along with the sponsoring organization and link to access addition information.

Table 4-13: Landscape certification programs

Certification Program	Sponsoring Organization	Web Link
Licensed Landscape Architect	State of Colorado	www.dora.state.co.us/la/LAInstructions.pdf
Professional Land Care Network (PLANET)	Various programs	www.landcarenetwork.org/cms/certification/categories.html
- Landscape Industry Certified Technician (formerly CLT)	Professional Land Care Network (PLANET) and Associated Landscape Contractors of Colorado (ALCC)	www.landcarenetwork.org/cms/certification/clte.html www.alcc.com/index.php?option=com_content&view=article&id=154&Itemid=84
- Certified Landscape Professional (CLP)	Professional Land Care Network (PLANET)	www.landcarenetwork.org/cms/certification/clte.html
- Certified Turfgrass Professional	Professional Land Care Network (PLANET)	www.landcarenetwork.org/cms/certification/clte.html
Colorado Certified Nursery Professional (CCNP)	Colorado Nursery and Greenhouse Association (CNGA)	www.coloradonga.org
Certified Greenhouse Growers Program (CGG)	Colorado Nursery and Greenhouse Association (CNGA)	www.coloradonga.org
Certified Arborist	International Society of Arboriculture (ISARMC)	www.isarmc.org/pro/index.htm
Board Certified Master Arborist	International Society of Arboriculture (ISARMC)	www.isarmc.org/pro/index.htm

Certification Program	Sponsoring Organization	Web Link
Irrigation Association	Various Programs	
- Certified Irrigation Contractor (CIC)	Irrigation Association	www.irrigation.org
- Certified Water Conservation Manager – Landscape (CWCM-L)	Irrigation Association	www.irrigation.org
- Certified Irrigation Designer (CID)	Irrigation Association	www.irrigation.org
- Certified Landscape Irrigation Auditor (CLIA)	Irrigation Association	www.irrigation.org
- Certified Golf Irrigation Auditor	Irrigation Association	www.irrigation.org
- Certified Agricultural Irrigation Specialist (CAIS)	Irrigation Association	www.irrigation.org

Customer outreach is also an important component to implementing this best practice. A utility should communicate with customers about the value of quality landscape service. Customers should know who they are hiring and what their certifications and accreditations mean.

Water Savings and Other Benefits

Range of Likely Water Savings: Moderate to Significant

A 2002 study of three landscape tracts located in northeastern Colorado Springs compared water use between a traditional landscape and two landscapes developed using the principles of xeriscape. The study found water savings ranging from 22% to 63% over that of a traditional turfgrass landscape after implementing the rules and regulations set forth in the 1998 Colorado Springs Landscape Code and Design Manual. The tract developed prior to implementation of the 1998 manual applied 170% of ET to the landscape. The landscape manual was developed by following the main principles of good xeriscape design, installation, maintenance and "regulations set forth by the city, requiring additional [soil] amendments, inspections, and the submittal of landscape professional's credentials" (Schneider 2008).

There are many factors that contribute to water use and savings when considering urban landscapes. Many of the factors are behavioral (irrigation scheduling, maintenance, etc.) and education should be a component of a landscape efficiency program.

How to Determine Savings

Determining savings from new development is difficult since new demand patterns are being established and pre- versus post-analysis is not possible. Savings can be determined by comparing annual water demands on a new property against an older property or properties with comparable area, plantings, and irrigation methods.

There are no established methods for measuring the effectiveness of training and certification for landscape professionals.

Savings Assumptions and Caveats

Mandatory landscape water efficiency standards are more likely to achieve measurable savings for a community compared with voluntary programs. If programs consist of voluntary certifications (such as LEED), the number of new accounts with conservation measures in place will be significantly lower than if standards are mandated and enforced. Many voluntary green

building programs encompass much more than water conservation, and as such, buildings may qualify as green without having significantly reduced water use.

Goals and Benchmarks

Water providers seeking to ensure long range irrigation efficiency should establish a goal of having all new landscape and/or irrigation system installations and retrofits meet strict efficiency standards. Water providers should also seek mandate that local landscape professionals be trained and certified. Because of jurisdictional issues, water providers may need to work with local and/or state to enact certain code and training requirement provisions.

Other Benefits

In addition to water efficiency, well-designed and maintained landscapes also improve storm water management, provide recreation opportunities, offer habitat to local wildlife, and provide aesthetic benefits (GreenCO 2008). Additionally, proper landscape installation can reduce life-time maintenance costs.

Costs

Utility Costs

Costs for new rules fall less on utilities than on customers. However, passing ordinances costs legal fees, staff time for research and political capital. There are no exact numbers for costs of adopting ordinances, codes and rules.

Enforcement of any new rules can add to costs. However, in the case of rules involving new construction, water utilities are not solely responsible for enforcement. If water conservation standards are incorporated into the local government's building code, enforcement can be part of the building department's permitting process.

Costs associated with requiring certification of landscape professionals are similar to rules for landscape installation. Creating requirements will take staff time, some financial outlay and political will. These costs are small compared to enforcing such rules. Enforcement costs can be significant, however. One way to manage enforcement costs is to have requirements built into the building permit process. For example, the permitting process could require that only certified professionals are allowed to design landscapes. While this approach will capture new building projects, new installation of landscape on existing buildings may not be controllable through the building permitting process. This approach will not be able to control who performs maintenance of landscapes and irrigations systems.

Customer Costs

Utilities contemplating landscape installation regulations must realize that there are many stakeholders who will see both costs and benefits. There are two distinct types of customers affected by rules for new construction. Builders and residents each face different costs and savings potentials from rules for new construction. The commercial sector sees an additional disconnect in costs for green building in that building owners may bear the costs associated with green building but tenants may reap the rewards in the form of lowered utility bills.

Builders face increased costs from constructing green buildings. A study on the costs associated with LEED certification found that green building practices added 1.5% to 3% to the so-called soft costs (such as design and certification) of building a commercial building. Complete costs, from design through implementation were estimated to be 4% to 11% (Northbridge Environmental Management Consultants, 2003). The EPA calculates additional costs associated with WaterSense New Home Specifications to range from $700 to $3,000, with $300 of that allocated for turf and mulching.

Occupants of green buildings, on the other hand, will likely see savings in the form of reduced utility bills. The EPA estimates that WaterSense homes save $100 per year in utility costs over standard new homes and $200 in utility costs over a typical home.

Most of the costs for professional certification requirements will be borne by customers and contractors and not by the utility. Professionals and companies employing irrigation professionals will be faced with costs of certification. Irrigation Association certification costs range from $250 to $500 for examination fees; annual renewal fees cost between $50 and $150. Certified professionals will likely charge a higher rate for their services, meaning these costs may be passed on to customers. Requiring certification will tend to level the playing field for irrigation professionals who currently have to compete with businesses with fewer qualifications and less training.

Resources and Examples

Resources

Additional information on WaterSense – including information for utilities – can be found online at the EPA website: www.epa.gov/watersense/partners/promotional.html

Information on LEED can be found at the US Green Building Council's website: www.usgbc.org/

Utilities must identify and make available a local source of ET data. There are several sources for ET data for Colorado. Colorado ET provides links to different three ET networks around the state. www.coloradoet.org/etnetworks.html. Denver Water maintains nine weather stations in the metro area.

Northern Colorado Water Conservancy District (NCWCD) has 24 weather stations located in the northeastern part of the state, six of which are located east of Greeley. Some stations are located on turfgrass and others are in agricultural settings. The website provides daily weather summaries at each station dating as far back as 1996 for some stations. More information can be found at www.ncwcd.org/weather/weather.asp.

Colorado Agricultural Meteorological Network (CoAgMet) is a network of over seventy-two weather stations located around the state primarily in rural agricultural settings. Originally developed by plant pathology specialists at Colorado State University and the USDA's Agricultural Research Service Water Management Unit, as a means of collecting local weather data in irrigated agricultural areas, the site now provides ET data for many areas of Colorado.

Climate data is now being collected by the Colorado Climate Center at CSU and can be found at www.coagmet.com/

Examples

Model Codes – DOLA Steamboat Springs and Routt County

Colorado's Department of Local Affairs has various model building codes, including a green building program that includes rules for new landscapes. The City of Steamboat Springs, Routt County and DOLA collaborated to develop a green building program. DOLA offers the program as a working model for other communities. The program was developed to provide guidance for green building and to raise the bar on green standards. The program applies to single family, duplex and row town home construction. A green building checklist is required when applying for a building permit. The building plans will then be reviewed against the checklist. If the minimum point threshold is met, the building permit will proceed through the usual sign off process.

The checklist is organized to follow the construction process. It comprises 17 categories and a total of 321 possible points. The categories include energy, recycling and reuse, electrical, landscaping and plumbing. The landscape requirements section has a score of 27 possible points. The mandatory measures affecting water use include:

- Turfgrass must have water use requirement less than Buffalo Grass, Tall Fescue or Blue Grama.
- Installed irrigation systems must use low-flow drip or bubblers and low-flow sprinklers.

Table 4-14 shows a list of water conservation rules for landscape in the DOLA plan.

Table 4-14: Water conservation rules for landscape found in DOLA Model Green Building Program

Measure	Means of Conservation
Construct water efficient landscapes	Native species account for 75% of plants, and these must be drought-tolerant species.
Group plants by water needs (hydrozoning)	Hydrozoning matches water needs of plants located together.
Turf type	Water requirement will be less than or equal to Tall Fescue, Buffalo Grass, or Blue Grama.
No turf on hard to irrigate areas	Turf shall not be installed on areas with slope greater than 10% or on turf strips less than eight feet wide because these types of areas are hard to irrigate efficiently.
Limited turf area	Turf must be less than 33% of landscape area (for 2 points) or less than 10% of landscape area (for 3 points).
Irrigation system uses low-flow technology	System uses only low-flow drip, bubblers, or low-flow sprinklers.
Irrigation system includes rain sensor	The system includes a rain shut-off device.
Irrigation system includes a weather-based irrigation controller	The irrigation system is controlled by a weather-based irrigation controller with the idea that such controllers reduce over-watering.

The Colorado Department of Local Affairs (DOLA) has links to other green building programs in the state. Links and details on the Steamboat Springs and Routt County program can be found at: www.dola.colorado.gov/osg/modelcodes.htm#GreenBuildingProgram

Castle Rock – required training for landscape professionals

The Town of Castle Rock requires anyone designing, installing or maintaining properties within the Town to attend the Town's Landscape Registration Program and GreenCO's Best Management Practices Training and Exam. The Landscape Rules and Regulations training covers their ordinance information and also affidavits to confirm understanding of the regulations. If professionals do not attend, they cannot perform work in the Town of Castle Rock.

Sterling Ranch – conservation from the developer's point of view

Conservation is not the sole purview of water utilities – nor should it be. Developers have a major role to play in water conservation. One example of a proposed development design with strong water planning goals is Sterling Ranch. Sterling Ranch intends to be a 3,100 acre, multi-use development located in Douglas County. Building in the development is slated for 2011, but already the conservation plan is in place. The developer, Sterling Ranch LLC, states that they are, " a firm believer that new development must be planned to meet human needs while protecting natural resources so that these needs can be met into the indefinite future," (Headwaters Corp. 2009). Water planning includes several aspects, such as a water supply plan (recycled water is a major part of the water supply plan), water treatment, water demand planning and conservation.

A major conservation component enacted by Sterling Ranch is a proposal to limit landscapes to an average of 1,500 square-feet per single family detached home. This will be done through landscape water budgets. Sterling Ranch plans to have builders submit front and back yard landscape designs for approval. Sterling Ranch plans to follow up with 100% inspection of all sites. Efficient sprinklers or sub-surface drip will be standard. Narrow swaths of landscaping will be watered with subsurface or drip, in an effort to limit overspray (Headwaters Corp. 2009).

City of Westminster Landscape Regulations

Westminster City Council adopted landscape regulations with provisions for design, installation and maintenance criteria which took effect in September 2004. The landscape regulations are intended to enhance property values and the living environment while improving air and water quality and reducing heat, dust, and noise. The efficient use of water resources is an important component of the landscape regulations as well and addresses water conservation through water wise landscaping, xeriscape and irrigation design. The regulations pertain to all landscaped areas and include:

- New development
- Redevelopment (with exceptions)
- Existing development requesting modification from previously approved plans
- Non-single family detached dwellings with no Official Development Plan or waiver
- Existing single family detached dwellings with no Official Development Plan of waiver

New landscape designs or modification of existing landscapes are subject to approval and must incorporate certain irrigation and landscape design elements. They include:

- The seven principles of xeriscape
- Identification of low, moderate, and high hydrozones on landscape and irrigation plans[14]
- Water budget not to exceed 24 inches (15 gallons) per square foot/year
- Transitioning of hydrozones
- Installation of automatic irrigation systems
- Soil preparation to include rototilling and incorporation of soil amendment. Soil analysis recommended
- Mulching in all non-turf areas; organic mulch required in moderate and high hydrozones
- Plant selection and location must be appropriate for the hydrozone

Section XII of the Westminster Landscape Regulations 2004 provides considerable detail of the design and construction of the irrigation plan and installation requirements. Although not part of the Official Development Plan, the irrigation plan must be submitted for review and approval at the same time. This section reiterates many of the basic irrigation design, installation, and operating recommendations and requirements necessary for efficient operation of an irrigation system as set forth by the Irrigation Association (IA 2002).

An Evaluation of Landscape Regulations in a Planned Community in Colorado Springs

The impact of rules and regulations, designed to conserve water in the landscape, was examined in a planned community in Colorado Springs in 2002. Evaluation of water use was performed on three separate tracts of land located within a master planned community consisting of large areas of open space, including two housing communities and a business campus. Development of the community took place over a period of twenty-five years and as a result the community has created a mix of landscapes "that are representative of different regulation and design eras" (Schneider, 2008) in the three tracts of land.

Because of the similarity of characteristics of the three sites (proximity, climate, part of the same master plan), the study sites provided a much better than normal opportunity to examine the impact of various codes, regulations, and the enforcement of each on water consumption. Each tract was developed using one of three sets of codes:

1. City landscape codes, policies, and guidelines developed and enforced prior to 1998
2. City landscape codes, policies, and guidelines developed and enforced after 1998
3. Regulations required by the master plan combined with city landscape and policy guidelines developed after 1998 but without enforcement

A scoring system of water savings measures[15] was developed for the study as a way to determine the effectiveness of various conservation measures. The site that was developed prior to 1998

[14] Low hydrozones require no more than 3 gallons/SF/yr; moderate hydrozones require 10 gallons/SF/yr; high hydrozones require 18 gallons/SF/yr.

had implemented only six water savings measures at the time of the study whereas the second and third sites implemented thirty and thirty-six measures respectively during the same period. Water use varied considerably at each of the three sites; the site that was developed prior to the 1998 rules and regulations had water use that was 70% greater than that of ET for the same time period. The second site and third sites were developed using the same principles of a water efficient landscape design but showed significant variability in savings. The second site showed a savings of 63% over that of a traditional turfgrass landscape. Irrigation management decisions resulted in water use that exceeded ET by 11%; the result of manually irrigating areas that were not designed to be irrigated. Manual irrigation was applied to plants that were perceived not to be thriving as a result of improper soil preparation. When the data were normalized to control for the manual irrigation, the site showed water savings of 22% over that of a traditional landscape (Schneider, 2008).

WaterSense Certification for Landscape Professionals

In addition to the new home specifications, WaterSense also includes certification for landscape professionals. This program is analogous to the WaterSense label for products in that it provides a standard for evaluating certification programs. As part of the New Home specification, landscapes must be evaluated by a WaterSense irrigation partner. While this requirement can be waived if there are too few WaterSense irrigation partners, it presents a model of possible certification requirement. The labeling program targets three categories of landscape professionals:

- Irrigation system designers,
- Irrigation system contractor[16]
- Irrigation auditors.

Each of these professional types has similar requirements for labeling.

- Programs must have an independent oversight committee.
- Certification must require experience. In the case of auditors, the certification program must require at least one irrigation audit be performed before being certified. For irrigation system designers, certification must require at least three years of experience in the field of landscape design.
- Installation and maintenance professionals must have at least one year of experience before they can be certified.
- In order to be awarded a WaterSense label, a certification program also must have an examination component.
- Exams must be independently administered and graded.
- In order to be awarded the WaterSense label, the certification must require certification renewal including continuing education. (EPA WaterSense Program 2006, Specification for WaterSense Labeling of Certification Programs for Irrigation System Installation and Maintenance Professionals, Specification for WaterSense Labeling of Certification

[15] The scoring system gives points for implementing the principles of xeriscape, good design, efficient irrigation, and regular maintenance of the landscape and irrigation.
[16] Irrigation contractors are responsible for the installation, maintenance, and repair of the irrigation system.

Programs for Irrigation System Designers and Specification for WaterSense Labeling of Certification Programs for Irrigation System Auditors).

Specific exam topics are shown in Table 4-15.

Irrigation Association

The Irrigation Association (IA) provides several training and certification programs for landscape professionals. Association members include landscape equipment manufacturers, landscape installation and maintenance professionals, retailers and distributors. The organization's mission is to promote efficient irrigation. The certification process, including training and the composition of exams, is overseen by IA's Certification Board. Several of the IA certifications have been approved to the EPA WaterSense label. Six areas of certification are offered by the IA. These are shown in Table 4-15. Details can be found at http://irrigation.org/certification/default.aspx?pg=programs.htm&id=93.

Table 4-15: WaterSense experience and exam requirements for certification programs (EPA WaterSense 2006)

	Irrigation Installation and Maintenance Professionals	**Irrigation System Designers**	**Irrigation Auditor**
Experience required	A minimum of one year of experience installing and maintaining irrigation systems	At least three years of design experience	At least one audit performed prior to certification
Exam Topics Required	• Knowledge of system components, system design layout and equipment specifications particularly as they pertain to distribution uniformity and system efficiency • System maintenance • Soil/water/plant relationships • Precipitation rates and irrigation scheduling • Impact of site conditions on equipment choice • System hydraulics • System pumps • System pressure • Equipment commissioning • Blueprint reading and interpretation • Awareness of other aspects of good practice, such as OSHA • Electrical and plumbing codes • Knowledge of when local and state regulations supersede federal regulations. • Recent innovations and technology developments	• Design, operation, and scheduling for water efficiency • Preparation of site design reflecting site requirements • Soil/water/plant relationships • Slope and runoff • Equipment selection and specification • System hydraulics • System pumps • System pressure • Maintenance • Evaluation of available water sources • Water management (budgeting and consumption) • Awareness of other aspects of good practice, such as OSHA • Electrical and plumbing codes • Knowledge of when local and state regulations supersede federal regulations. • Recent innovations and technology developments	• Distribution uniformity • Precipitation rates and irrigation scheduling • Water pressure and impact on sprinkler performance • Auditing process • Soil/water/plant relationships • Recognition of system problems and maintenance requirements • Awareness of other aspects of good practice, such as OSHA and • Electrical and plumbing codes • Knowledge of when local and state regulations supersede federal regulations • Recent innovations and technology developments

Table 4-16: Certification types offered by the Irrigation Association (Irrigation Association 2010)

Certification Type	Overview	Requirements
CIC, Certified Irrigation Contractor	• Execute irrigation projects to meet all specifications and requirements. • Prepare installation sites, including layout, staking, excavation, boring, trenching, grading and back-filling. • Cut and join pipe, know the limitations of different piping systems and understand basic hydraulics. • Layout and install piping and water delivery components; backflow prevention components; mechanical, hydraulic and electrical irrigation controls; and other irrigation system components. • Troubleshoot and repair irrigation components and systems. • Understand good business practices; construction contracts and their legal rights and obligations; and licensing laws and codes in their state.	• Demonstrate a minimum of three years of irrigation-related experience and education. • Pass a written exam on general irrigation and specialty topics. • Agree to follow the Code of Ethics established by the IA Certification Board. • Remain in good standing by submitting 10 continuing education units and a nominal renewal fee each year.
CID, Certified Irrigation Designer	• Evaluate site conditions and determine water availability and use requirements. • Select the most effective irrigation equipment, methods and materials for the application. • Develop efficient and cost-effective irrigation designs that meet the plant or crop's watering requirements. • Prepare comprehensive plans and specifications that include construction details, equipment or materials, as well as appropriate irrigation schedules. • Ensure the installation matches the design intent. • Provide direction to the end user on system use, scheduling and maintenance.	• Evaluate site conditions and determine water availability and use requirements. • Select the most effective irrigation equipment, methods and materials for the application. • Develop efficient and cost-effective irrigation designs that meet the plant or crop's watering requirements. • Prepare comprehensive plans and specifications that include construction details, equipment or materials, as well as appropriate irrigation schedules. • Ensure the installation matches the design intent. • Provide direction to the end user on system use, scheduling and maintenance.

Certification Type	Overview	Requirements
CLWM, Certified Landscape Water Manager	• Evaluate site conditions and determine water availability and use requirements. • Have working knowledge of general irrigation theory, including hydraulics, soil-plant-water relationships, water requirements and electricity principles. • Understand irrigation equipment selection, use, restrictions and installation methods. • Identify and implement system upgrades and modifications, and manage the control system to provide the most efficient irrigation possible. • Provide direction to the end user on system use, scheduling, maintenance and water conservation.	• Demonstrate a minimum of three years of irrigation-related experience. • Be an IA certified landscape or golf irrigation auditor in good standing. • Pass a written exam on irrigation water management topics, including scheduling, efficiency, and uniformity and soil-plant-water relationships. • Agree to follow the Code of Ethics established by the IA Certification Board. • Remain in good standing by submitting 10 continuing education units and a nominal renewal fee each year.
CGIA, Certified Golf Irrigation Auditor	• Develop system testing strategies. • Identify plant materials by general groups and determine irrigation water requirements. • Take soil samples and determine soil types and root zone depths. • Observe system operations, locate irrigation zones, prepare site audit maps and visually identify broken or misaligned equipment. • Check pressure and flow rates, conduct water application distribution tests and collect data to determine irrigation uniformity and efficiency. • Estimate potential dollar and water savings.	• Demonstrate a minimum of one year of irrigation-related work experience. • Pass a written exam on the principles and practices of auditing. • Submit an independently completed audit on a green and fairway for evaluation. • Agree to follow the Code of Ethics established by the IA Certification Board. • Remain in good standing by submitting 10 continuing education units and a nominal renewal fee each year.

Certification Type	Overview	Requirements
CLIA, Certified Landscape Irrigation Auditor	• Develop system testing strategies. • Identify plant materials by general groups and determine irrigation water requirements. • Take soil samples and determine soil types and root zone depths. • Observe system operations, locate irrigation zones, prepare site audit maps and visually identify broken or misaligned equipment. • Check pressure and flow rates, conduct water application distribution tests and collect data to determine irrigation uniformity and efficiency. • Estimate potential dollar and water savings.	• Demonstrate a minimum of one year of irrigation-related work experience. • Pass a written exam on the principles and practices of auditing. • Submit an independently completed audit on one rotor and one spray area for evaluation. • Agree to follow the Code of Ethics established by the IA Certification Board. • Remain in good standing by submitting 10 continuing education units and a nominal renewal fee each year.
CAIS, Certified Agricultural Irrigation Specialist	• Understand surface irrigation methods and pressurized systems, including micro-irrigation and sprinklers. • Evaluate crops and determine water availability and use requirements. • Understand soil-plant-water relationships and how salinity affects irrigation. • Select the most effective irrigation methods and equipment for the application. • Develop efficient and cost-effective irrigation schedules that meet the crop's water requirement.	• Pass a written exam on the principles and practices of on-farm irrigation management. • Agree to follow the Code of Ethics established by the IA Certification Board. • Remain in good standing by submitting 10 continuing education units and a nominal renewal fee each year.

Colorado House Bill 10-1358

Colorado House Bill 10-1358, passed in May 2010 and taking effect in 2011, presents buyers of new homes with the chance to select water efficient appliances and fixtures up front. By integrating high-efficiency toilets, water efficient clothes washers, low flow faucets and showerheads, and water-smart landscapes into new homes at the outset, we can avoid sending precious water and money down the drain. This bill allows new home buyers to chose from several options, including:

- Low use water fixtures like toilets, faucets, and showerheads
- High efficiency washing machines that save both energy and water.
- Financed water wise landscape upgrades implemented by the builder and designed utilizing GreenCO's best management practices (GreenCO 2008) including proper landscape design, installation, irrigation technology, water budgeting and all 7-principles of Xeriscape.

More information about this new Colorado program can be found here: www.leg.state.co.us/clics/clics2010a/csl.nsf/fsbillcont/7F972C539E9610D6872576BE0079EE23?Open&file=1358_rer.pdf

California Model Water Efficient Landscape Ordinance

California's Model Water Efficient Landscape Ordinance presents a sophisticated approach to defining new landscape requirements. California law requires municipalities to adopt ordinances governing landscape conservation and this model ordinance is the approved template. There are supporting documents online, including a table of text that will need to be changed for adoption of the ordinance by other agencies. This table can be found at the California Department of Water Resources website: www.water.ca.gov/wateruseefficiency/landscapeordinance/.

Two methods of calculating a water budget for the landscape were compared for the California Model. One landscape budget was calculated using the maximum applied water allowance and was based on the amount of area landscaped, local climate (using ET) and an ET adjustment.[17] This budget functions as the design standard. The second method of calculating the landscape water budget – the estimated total water use – is calculated based on the water needs of the plants chosen as part of the landscape design and the total area irrigated. The estimated water use may not exceed the maximum water allowance. Because the California ordinance bases water need on local ET, it can be readily translated to Colorado's various local climates.

EPA WaterSense

WaterSense is a label and certification program developed by the United States Environmental Protection Agency. This label has been applied to a number of products, but WaterSense has also released a standard of efficiency for new homes. The development process included stakeholders with different perspectives. Water utilities, product manufactures, retailers and consumers were all involved in creating the WaterSense standards. Products are independently tested to earn the WaterSense label.

[17]The ET adjustment in California is 0.7 in the case of new landscape.

The EPA WaterSense specification for new homes extends beyond labeling fixtures and extends to household-wide uses of water. This standard requires WaterSense fixtures and Energy Star appliances, which are covered in Best Practice 8 but also includes landscape design and installation specifications. These specifications recommend conservation-oriented landscape design, slope management, mulching, and pool covers. Irrigation systems are not required. However, if they are installed, the systems are subject to efficiency standards.

There are two approaches for landscape design in the WaterSense requirements. The simplest approach is to limit turfgrass to 40% of the landscaped area. Alternatively, landscapes may be designed using a water budget (see Best Practice 10). The budget tool is a Microsoft Excel-based calculator that can be found at: www.epa.gov/watersense/nhspecs/water_budget_tool.html. For each hydrozone, the landscape designer enters square footage and then selects plant type and irrigation type. Zip code-based ET and rainfall data are needed and are available from the EPA website (with a hyperlink in the relevant place on the tool spreadsheet). These data comes from the International Water Management Institute and based on historic data gathered from 1961 to 1990. The calculator then determines how much water the given design will use. If it is more than the allowance calculated from the ET and rainfall, the calculator indicates that the design should change. However there is no guarantee that limiting turf will absolutely result in a certain percentage of water reduction, since people can and do over water turf, no matter how much they have in their yards.

WaterSense goes beyond landscape design and has additional standards for outdoor water use:

- Pools must be covered when not in use; water features must use re-circulated water.
- Once installed, the landscape must be evaluated by a WaterSense irrigation partner (unless there are an insufficient availability of irrigation partners).
- The system shall not have leaks, runoff or overspray.
- The lower quarter distribution uniformity shall be 65% or higher. The lower quarter distribution uniformity is, “the average water applied in the 25% of the area receiving the least amount of water divided by the average water applied,” to the total area (The Irrigation Association 2007). It measures the potential for dry patches and over-watered areas. See Best Practice 10 - landscape evaluations.
- The system shall be equipped with a rain sensor.
- Sprinklers shall not be used to water landscape other that turfgrass.
- Micro-irrigation systems shall be equipped with pressure regulators, filters and flush end assemblies.
- Schedules developed in the audit phase shall be posted at the controller.

In addition, there are several measures targeting storm water management: slopes must be vegetated and exposed soil must be covered with mulch.

In order to meet the standard, homes must be inspected by an independent contractor. It is estimated that WaterSense homes will be 20% more efficient than typical new homes. Over the course of a year, these homes are expected to save 10,000 gallons of water. (EPA WaterSense Program 2009 WaterSense Single-Family New Home Specification Supporting Statement).

Utilities looking for water savings in the residential sector can use EPA WaterSense to specify community standards for landscapes. Sixteen utilities in Colorado are WaterSense Promoting Partners. Partners are given a tool kit specific to their needs. For utilities, the kit includes materials promoting conservation.

Additional information on WaterSense – including information for utilities – can be found online at the EPA website: www.epa.gov/watersense/partners/promotional.html

LEED

LEED (Leadership in Energy and Environmental Design) is a scoring program for green building. LEED was created by the US Green Building Council, made up of public and private entities focused on promoting environmental building practices. LEED standards cover a broad range of building types and a few specific CII types such as schools and hospitals. LEED is applicable to both new and existing buildings. LEED certification is voluntary.

The LEED program is based on scoring different conservation measures across a broad range of environmental issues, of which water is only one part. Water efficiency accounts for 11 out of 110 possible points in the scoring system. Certification for LEED is based on four possible scoring levels: certified (40 to 49 points), silver (50 to 59 points), gold (60 to 79 points), and platinum (80 points or higher).

The areas of focus for LEED are:

- Energy and atmosphere
- Sustainable sites
- Materials and resources
- Indoor environmental quality
- Location and linkages (e.g. located near transit options)
- Education and awareness
- Water efficiency
- Innovation and design
- Regional priority

LEED's philosophy on water conservation is, "While saving water may be one boon of the survey, secondary benefits may not be as apparent…. Finding and stopping leaks may also prevent structural or landscape damage."

Water conservation measures for LEED 2009 (version 3) are:

- 20% reduction in water use[18]
- Innovative waste water technologies
- Water efficient landscaping

[18] This is the only required water conservation measure. Additional conservation break points are at 30%, 35%, and 40%.

- Water use reduction beyond 20%.

The Alliance for Water Efficiency has recommendations for water utility personnel who are trying to ensure that their green programs include water conservation:

- Be familiar with green building programs in your service area. This includes voluntary and mandated programs.
- Seek out other programs and governments working on sustainability issues. Guide and advise them about water conservation.
- Know about national standards that may be adopted or in place in your area. Make friends in the local government offices charged with building codes and land use.
- Be alert to "green washing," the tendency to adopt and promote practices that appear to be sustainable but have little or negative impacts on conservation. Be aware that many green building programs focus on energy conservation far more than water conservation.

(Alliance for Water Efficiency 2010)

Built Green Colorado

Built Green Colorado is one of oldest and largest green home building programs in the nation. It was started by the Home Builders Association of Metro Denver for the purpose of encouraging home builders to use technologies, products, and practices that result in homes that are better built and better for the environment.

Similar to LEED certified homes, Built Green homes must achieve a minimum amount of points awarded for incorporating certain technologies across topic areas. A detailed checklist provides the home builder with the required specifications and associated point values. The Built Green standards have also been adopted to certify homes by Build Green Utah. A selection of the Built Green Water Conservation requirements is provided below.

- Efficient hot water delivery system is designed so that water heater is within 20 pipe feet of all hot water fixtures.
- Clothes washer has ENERGY STAR label.
- Toilets are dual-flush gravity, or pressure/vacuum assist averaging 1.1 gallon per flush
- Landscape is designed based on a water budget with a maximum of 15 gallons per square foot per year.
- Efficient irrigation system incorporates hydrozones where shrubs and trees are irrigated with drip or subsurface irrigation.
- A list of drought-tolerant plants is provided to home buyers.

(Source: WRA 2009)

BEST PRACTICE 9: Water Efficient Design, Installation, and Maintenance Practices for New and Existing Landscapes

- Programmatic and customer support best practice (utility perspective)
- Customer side best practice - Implemented by water customers with support from water utilities.
- Customer participation – Action by customers required for successful implementation.

Overview

How we design, install, and maintain our landscapes and irrigation systems can greatly impact the amount of water needed to keep the plants alive and healthy. This best practice describes key considerations for maximizing water efficiency through the proper design, installation, and maintenance of new and existing landscapes and irrigation systems. The information presented here is largely based on the work of the Green Industries of Colorado (GreenCO) published in their 2008 BMP guide (GreenCO 2008).

Recent studies suggest that technology alone will not render the level of efficiency desired in urban landscapes (Mayer, et. al. 2009). Irrigation must be addressed with a systems approach that includes design, installation, and maintenance as well as the selection of plant materials and individual irrigation technologies. Education of those operating and maintaining systems should not be overlooked.

Landscape design, installation, and maintenance practices offer a non-regulatory approach to improving outdoor water use efficiency. Proper design and installation can ensure landscapes are capable of thriving on less water. Maintenance practices can help preserve and ensure conservation savings. This best practice is wide ranging and includes many commonly used everyday practices.

The *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability* (GreenCO 2008) is the fundamental companion document to this best practice. The GreenCO BMPs are richly detailed and provide tremendous detail on the methods and practices for ensuring water efficiency in Colorado landscapes. These BMPs were developed with broad stakeholder support and form the foundation for the best practices described below.

The seven basic principles of xeriscape, developed years ago by Denver Water (and others), remain the fundamental underpinning for conservation-oriented landscapes. These principles are: planning and design, soil improvement, grouping plants with similar water demands, practical turf areas, efficient irrigation, mulching, and appropriate maintenance. In the *Handbook of Water Use and Conservation*, (Vickers 2001) Amy Vickers adds one additional principal to this foundational list: selection of native and low-water-use plants.

Why a Best Practice?

In Colorado, urban landscape irrigation accounts for 50 percent or more of the total annual water demand for a utility.[19] Improving the efficiency of water use on urban landscapes is perhaps the single most important municipal water conservation effort than can be made in Colorado.

State Planning Requirements

Colorado statute requires that all covered entities (water providers that deliver more than 2,000 acre-feet per year) file a water conservation 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. Under this statute, one of the water saving measures and programs that must be considered in a conservation plan is, "Low water use landscapes, drought-resistant vegetation, removal of phreatophytes, and efficient irrigation." [CRS 37-60-126 (4)(a)(II)].

Applicability

The water efficient landscape design, installation, and maintenance practices described in this best practice apply to both utility customers and landscape professionals who are designers, installers, irrigators, and maintainers of urban landscapes. An irrigator is defined here as anyone that regularly applies utility treated potable water to a landscape through a manual or automatic irrigation delivery system.

Many of the practices and principles described in this best practice will also apply to water utilities for their own irrigation practices and to their efforts to educate and inform their customers.

Implementation

Landscape Design

Whether developing an entirely new landscape or renovating an existing yard, properly planned and designed landscapes can conserve water and protect water quality. For both the do-it-yourself project and the professionally designed landscape, key considerations for water efficient landscape design include:

- Consider site conditions including existing slope, soil, drainage, and plants
- Provide soil most appropriate to the plants
- Use of native and low-water-use plants
- Limit turf areas to those needed for practical purposes
- Group plants according to their water needs (hydrozoning)
- Use efficient irrigation systems
- Mulch over soil and around plants to reduce evaporation

[19] AWWA (1999), Aquacraft (2007), Davis et. al. (2009), Grabow et. al. (2009), Mayer et. al. (2009), McReady (2009), County (2008), Dukes et. al. (2008), GreenCO (2008), Guz (2008), Jakubowski et. al. (2008), Haley et. al. (2007), US BOR (2007), NCWCD (2008), Baum (2005), CSU, (2005), PMSI (2005), Bamezai (2004), Barta (2004), CWRRI (2004), MWDOC (2008, and 2004), DeOreo et. al. (1998), CSU (1994).

The *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability* (GreenCO 2008) includes 39 guidelines for landscape design in a detailed BMP. Key elements of this and other GreenCO BMPs are summarized into this best practice.

Site Considerations – "Consider existing grade (slope), existing plants to preserve/protect, exposure to natural (e.g., wind, sun) and human elements (e.g., pedestrian traffic), soils, availability of natural precipitation and supplemental irrigation, and drainage when designing the overall landscape." (GreenCO 2008) Groundcovers with lower water requirements are a good choice for slopes and hard-to-mow locations. Place lower-water demand plants 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.

Soil Condition – Evaluate the soil through tests and improve it, if necessary, to promote efficient water use and healthy plants (GreenCO 2008). In order to determine the proper soil amendments to use at a site, inexpensive soil tests like those conducted by the CSU Soil Testing Lab are recommended. The GreenCO BMPs offers useful guidance on soil amendments and testing. In general, the best soil amendments increase water and nutrient holding capacity while improving aeration and water infiltration which is critical to reducing water demands (Davis and Wilson 2005). 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 xeric plans have adapted well to clay soil and in fact prefer it over amended soil as long as it is not over-watered.

Plant Selection – Many plants are capable of thriving without supplemental irrigation. Reducing supplemental water requirements is fundamental to designing landscapes that are water efficient. Consider creating at least one part of the landscape that can thrive on available precipitation without additional irrigation (except during establishment and during unusually dry periods). Key resources to assist in plant selection include the *Annual and Perennial Plant Guide and Rocky Mountain Plant Guide* published by the Colorado Nursery and Greenhouse Association (www.coloradonga.org) and the X-rated gardening website maintained by the Garden Centers of Colorado (www.gardencentersofcolorado.org/xratedgardening2/) (GreenCO 2008).

Practical Turf Areas – "Limiting lawns to functional spaces devoted only to practical uses – for example, recreation and sitting areas – can significantly reduce landscape irrigation needs" (Vickers 2001). Turfgrass is often the plant with the highest water demand in a landscape, but many varieties of grass are now available including some which require less supplemental water. The CSU Turfgrass Program website (http://csuturf.colostate.edu/) offers the latest studies on the advantages and disadvantages of various grass species (GreenCO 2008).

Hydrozoning – Group plants with similar water requirements together. This practice is known as hydrozoning. The reason hydrozoning is so important is because irrigation systems should be designed to apply water evenly across each zone or area. If plants in one 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 zone.

Efficient Irrigation – Efficient irrigation means applying the minimum amount of water required for a healthy landscape with an acceptable level of appearance. Efficient irrigation practices are important for both manual and automatic irrigators although most of the literature on this subject is devoted to automatic irrigation systems. Automatic irrigation is not required for effective and efficient irrigation and numerous studies have shown that manual irrigators use significantly less water on average than automatic irrigators (Mayer et. al. 1999). However, many people prefer the convenience of an automatic system.

In order to provide efficient irrigation, **"**Properly design, install and maintain irrigation systems to ensure uniform distribution[20] and efficient delivery of water, thereby conserving water and protecting water resources" (GreenCO 2008).

The Irrigation Association (IA) has established the five fundamental best practices for irrigation systems. They are as follows:

1. Assure 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.

The GreenCO Colorado BMPs provide detailed information and additional resources on this large topic.

Mulch – Mulches are placed on the soil surface to reduce evaporation. GreenCO recommends using organic mulches to "reduce water loss through evaporation" and "to reduce soil loss due to exposure to wind and runoff and to suppress weeds and to provide a more uniform soil temperature" (GreenCO 2008). Use of mulch should be specified as part of a comprehensive water efficient landscape design.

Other benefits of mulch include:

- The reduction of weeds that compete with plants for moisture and soil nutrients
- Erosion control by allowing rainfall to be absorbed before running off
- Reducing 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

[20] Distribution uniformity is defined as the measure uniformity of irrigation water over an area (IA 2010).

It is important to select mulches that are appropriate for the hydrozone and plant type. Organic mulches break down with time and in so doing enrich the soil and improve the texture of the soil near the surface. Many plants selected for use in the landscape benefit from these characteristics of organic mulch.

Plants that have adapted to living under xeric conditions often perform better with the use of inorganic mulches. Many of these plants prefer soil without the addition of organic matter and have characteristics that enable them to thrive in poor soil with little or no irrigation. In fact the moisture retained by organic mulches can result in their early demise. The heat absorbed by inorganic mulch encourages plant growth and helps to reduce competition from weeds.

Other Design Considerations – Additional design considerations for maximizing landscape water efficiency include:

- In mountain areas in particular, wildfire hazards must be considered in any landscape design.
- Hardscapes are an often neglected element of landscape design. Hardscapes have no water requirement and as such form an important part in landscapes created to be water efficient.
- Wind can dramatically impact irrigation particularly if the sprinkler head creates a fine mist. In windy areas, sprinkler heads that produce larger drops of water should be considered.
- Water features including ponds, fountains, waterfalls, etc. are notoriously water wasteful even if designed to be re-circulating. Evaporative losses and unavoidable leaks place water features outside the boundary of good water efficient landscape design.

Landscape Installation

When installing a new landscape or replacing an existing landscape, minimize erosion and control sediment leaving the site during landscape installation, follow the landscape design plan carefully, and provide proper care of the landscape during installation (GreenCO 2008).

Sediment and erosion control practices summarized below, are detailed extensively in the *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability* (GreenCO 2008).

- Protect existing plants and trees that are not to be impacted by the installation.
- Protect drainage areas from runoff.
- Comply with applicable stormwater permit requirements.
- Phase construction to limit exposed land.
- Properly store and if necessary cover topsoil and soil amendments (i.e. not in the street).
- Take special care with planted slopes to slow water runoff.
- Properly handle, store, and dispose of all chemicals, fertilizers and pesticides.

A significant portion of the installation best practices revolve around soil preparation because proper soil preparation can substantially reduce irrigation requirements by increasing water holding capacity.

Assuming that a water efficient landscape design has been completed, the installation process involves carefully following the design plan while minimizing impacts to neighboring properties and ecosystems and maintaining the health of existing plants and trees that are not to be impacted by the installation. GreenCO has identified the following areas for consideration during landscape installation (GreenCO 2008):

- 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.
- 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.

Irrigation System Installation[21]

Each irrigation system should be installed in accordance with design specifications as well as any applicable manufacturer specifications, local code requirements, and the fundamental principles of efficient and uniform water distribution (GreenCO 2008).

The irrigation system installation best practices, summarized below, are detailed extensively in the *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability* (GreenCO 2008).

- Installation should not commence until all underground utilities are located and marked.
- Install the irrigation system in accordance with design specifications. Any alteration or deviation from the design should be approved in advance by the designer.
- The design and installation should both be completed by reputable professionals. (Please see best practice on certification of landscape professionals for additional information.)
- Ensure the water supply and pressure at the point of connection meet design criteria.
- On-the-ground reality often differs from plan drawings. Carefully review all site plans against what can be observed at the site to minimize conflicts between buildings, hardscape, plants of differing sizes, and sprinkler head placement.
- Alert the property owner and designers about unusual or unexpected site or soil conditions.
- Existing plants that do not receive supplemental irrigation may rely heavily on drainage for water to grow. Ensure that site drainage has not been altered.
- The irrigation designer (or other qualified inspector) and local authorities should perform at least one field observation during installation to ensure adherence to design specifications and local codes and to check for proper installation and function of the backflow prevention assembly, main line, pipes, valves, sprinklers, control wire, irrigation controller, and soil sensor(s) or rain shutoff device.

[21] This section of the best practice applies largely to in-ground automatic irrigation systems, although many of the same principles apply to manual irrigation systems as well.

- Furnish “as-built” record drawings to the owner of the system.
- Test the irrigation system to verify that the system meets the design criteria and delivers water uniformly in each zone.
- Create an irrigation schedule to meet the water requirements of the plants with minimal runoff. Understand that the establishment schedule will differ from normal operational schedule. Re-evaluate the irrigation schedule regularly to ensure efficiency and adequacy.
- Perform a thorough inspection of the system after installation and perform an irrigation efficiency evaluation of the site using established IA procedures after one year of operation of the new system (see Best Practice 10). Make any necessary repairs and adjustments.

Landscape Maintenance

To ensure optimum water efficiency, practice regular and appropriate maintenance for the landscape including (but not limited to): spring clean-up, mowing, aeration, pruning, weeding, mulching, fertilization and attention to the irrigation system (GreenCO 2008).

The landscape maintenance best practices, summarized below, are detailed extensively in the *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability* (GreenCO 2008).

- 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.

Irrigation System Maintenance and Operation

Automatic irrigation systems must be maintained regularly to ensure efficient performance and uniform distribution of water. In Colorado, this minimally includes a check-up in the spring when the system is turned on and a winterization before the first hard freeze. During the irrigation season, the irrigation schedule should be modified to accommodate changing plant water needs and repairs should be made as required.

The irrigation system maintenance best practices, summarized below, are detailed extensively in the *Green Industry Best Management Practices (BMPs) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability* (GreenCO 2008).

- Establish a systematic maintenance schedule for inspecting, testing and reporting on performance conditions of the irrigation system.
- Check, adjust and repair irrigation equipment on a regular basis, ideally on a weekly schedule and within 24 hours of mowing, whenever possible.
- The person mowing the property is often in the best position to identify broken or misaligned heads, overly wet areas, and other potential problems. As part of day-to-day maintenance, staff should understand the irrigation system basics and be able to recognize system problems.

- Set mower height appropriately.
- Identify irrigation system leaks and repair them promptly.
- Where applicable, post irrigation schedules, zone location map and other relevant programming information in or near each controller (or clearly identify where information is kept).
- Employ a certified landscape irrigation auditor at least once every five years to conduct a thorough and comprehensive check for efficiency of water application.
- Make adjustments whenever irrigation water falls or runs onto hard surfaces such as sidewalks, streets or driveways.
- Check for leaks. 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. In drip systems, leakage problems may be due to damaged tubing from foot traffic or gnawing by animals.
- Periodically perform a thorough inspection of the system components to verify that the components meet the original design criteria for efficient operation and uniform distribution of water.
- Verify that the water supply and pressure are as stated in the design. Differences in the sprinkler system's required design operating pressure and actual water pressure can affect distribution uniformities and operation efficiency. Time of day can affect pressure. Pressure measurements should be made at the same time of day the irrigation is likely to occur. Install pressure reducing valves (PRVs) where needed, and flow control devices on individual sprinklers to stop misting due to excessive pressure. Verify that pressure regulators are adjusted for desired operating pressure.
- Verify that the backflow prevention device is working correctly; annual testing is ideal, but not required in all areas.
- Adjust valves and flow regulators for proper pressure and flow operation. Valves must shut off tightly to prevent leakage and soggy spots, and operate without slamming open or closed to prevent pipeline and sprinkler damage from water surges.
- Install a master valve. This prevents leakage from the irrigation system when the system is not in use.
- Verify that sprinklers are properly adjusted—check the nozzle, arc, radius, level and altitude with respect to slope.
- Verify that sensors are working properly and are within their calibration specifications.
- Look for debris (e.g., rocks, sand, and dirt) lodged in sprinklers and drip emitters and watch for salt build-up around drip emitters.
- Examine filters and clean filtration elements as required.
- Test all repairs.
- Ensure that the replacement hardware used for system repairs matches the existing hardware, and is in accordance with the design.
- As plants mature, trim or remove vegetation as required to preserve system performance.
- Re-program automatic controllers (if necessary) to meet the seasonal plant needs.

Water Savings and Other Benefits

A well designed, installed, and maintained landscape and irrigation system should use substantially less water than a poorly maintained landscape and irrigation system on a similar property.

Range of Likely Water Savings: Varies

The water savings achievable from well designed, installed, and maintained landscapes and irrigation systems are not well quantified. For some landscapes the savings will be substantial, on the order of 30 – 50%, but for others there may no measurable savings achieved and in some cases water use may even increase as a result of changes made to the landscape or irrigation system.

The 2004 YARDX study of Xeriscape sponsored by Metro Water Conservation, Inc. of Denver and the U.S. Bureau of Reclamation, in partnership with nine water utilities examined water use from 1997 through 2002 and compared outdoor water use for traditional (pre-existing) and waterwise landscaping along Colorado's Front Range. The YARDX study found that water efficient landscapes could consistently obtain water savings of 30%, and up to 50%, over traditional landscaping (Medina and Gumper 2004).

The water saving benefits of implementing the recommendations of this best practice will be experienced over many years and likely cannot be accurately measured without great effort. From a water savings perspective the key is that only the necessary amount of water is applied to the landscape and over irrigation is eliminated. A recent study in California found that eliminating over irrigation in sites that had historically over irrigated would reduce outdoor use in single-family homes by about 30%, or about a 15% reduction in total use (DeOreo et. al. 2010). It is estimated that full implementation of the recommendations in this best practice resulting in the elimination of over-irrigation will result in outdoor water savings in the range of 10 – 40% (and total savings in the range of 5 – 20%) over the period of time the landscape remains in place compared with a similar poorly designed, installed, and maintained landscape.

How to Determine Savings

For existing landscapes that are upgraded and improved using the recommendations of this best practice, water savings can be measured by comparing weather-adjusted billed consumption data from pre- and post-completion time periods. For new landscapes that are designed and installed implementing the recommendations from this best practice, it may be possible to determine water savings by comparing water use against similar, neighboring sites that did not implement the recommendations of this best practice. However, this type of analysis must be carefully designed to yield reliable results.

Savings Assumptions and Caveats

Although irrigation accounts for approximately 50% of urban water use in Colorado, the extent of over irrigation and inefficient irrigation is not well understood. The 1999 *Residential End Uses of Water* study found that homes in Denver applied about 85% of the net ET requirement for turfgrass on average while homes in Boulder applied about 68% (Mayer et. al. 1999).

Water savings are achieved by eliminating over-irrigation and by reducing irrigation demands by changing plant materials and improving landscaping practices. If over-irrigation is not occurring, there is little potential to save through irrigation efficiency improvements. Although some people believe over-irrigation is rampant in Colorado, the available data and studies do not support this notion. Over-irrigation is only a problem in a relatively small percentage of properties in any utility service area. Fortunately, it is possible to identify over-irrigators using historic consumption data and a measurement (or even an estimate) of the landscape area. Using landscape area and billed consumption, the amount of water applied over the course of a year can be calculated and compared against the net ET rate (net ET) for the same time period. Sites with an irrigation application greater the net ET are the best candidates for irrigation demand reductions.

Goals and Benchmarks

A reasonable goal or benchmark for landscape irrigation can be calculated for any site in Colorado assuming climate data and the landscape area are available. The Theoretical Irrigation Requirement (TIR) for a site can be calculated using the following equation:

Theoretical Irrigation Requirement (TIR) (inches) = (ET_o x kc) – Effective Precipitation

Where:

ET_o = Gross annual ET (inches)[22]

Effective Precipitation = effective precipitation (inches) which is the useful amount of precipitation stored in the soil in a 24-hour period.

k_c = ET adjustment factor or crop/landscape coefficient (a default value of 0.8 is a recommended starting point and upper limit for a water efficient landscape. Many landscapes, particularly those featuring the principles of xeriscape and/or water wise plantings, should have a lower k_c ranging from 0.5 to 0.7.[23]

In Colorado, expect TIR values to range from 10 to 30 inches depending upon the ET_o rate, amount of precipitation and the water requirements of the plants in the landscape.

Other Benefits

In addition to water efficiency, well-designed and maintained landscapes also improve stormwater management, provide recreation opportunities, offer habitat to local wildlife, provide aesthetic benefits, and help reduce non-point source pollution through reduced runoff (GreenCO 2008). Well designed and maintained landscapes are also healthier and look better.

[22] ETo is more formally defined as "the rate of ET from a hypothetical reference crop with an assumed crop height of 0.12 m (4.72 in), a fixed surface resistance of 70 sec m^{-1} (70 sec $3.2ft^{-1}$) and an albedo of 0.23, closely resembling the ET from an extensive surface of green grass of uniform height, actively growing, well-watered, and completely shading the ground". http://edis.ifas.ufl.edu/ae256

[23] The GreenCO landscape BMPs offer an detailed information about crop coefficients in Appendix E - http://greenco.org/bmp_downloads/BMP_Manual_Appendices.pdf.

Xeriscape plants also provide drought flexibility. In times of drought and mandatory water restrictions, low-water using plants may survive better and therefore reduce replacement costs.

Costs

Utility Costs

There are no utility costs associated with customers implementing the recommendations of this best practice. Some utilities have developed programs to encourage water wise landscapes and efficient irrigation by offering classes, rebates (for turf removal or purchase of low-water requirement plants), or by providing low interest loans for water wise landscape projects. These utility programs are likely to only be cost effective in communities with expensive new water supply projects that might be avoided or delayed through conservation.

Customer Costs

Landscaping costs vary enormously depending upon what work is being done, who is doing it, and the condition of the existing landscape. A local Colorado landscape professional reviewed 18 professional xeric landscape installations that her company performed over the past three years and found tremendous variability in the per square foot costs. The cost data below is provided for informational purposes and to illustrate the possible range of customer costs associated with a professionally installed xeriscape. Please understand that prices will vary and may be more or less than those presented here.

Site Preparation

Most landscape projects require that the existing landscape be removed to make way for the new landscape to be installed. The costs for site preparation varied from $0.43/SF to $3.75/SF with most site prep work falling between $0.60/SF and $1.40/SF (Peck 2010).

Installation Costs

Installation costs depend largely upon the level of planting vs. hardscape and irrigation (i.e. no system, new system, or rehab of existing system).

Least Expensive

The least expensive installations are only plantings (no hardscape), using mostly shrubs and some sod or seeded turfgrass areas. Low cost installations do not have in-ground sprinklers and drip irrigation (if installed) is accomplished by attaching drip lines to a hose bib. An estimated cost for a basic installation such as this is approximately $4.00/SF (Peck 2010). Lower cost installations are also possible. The “Garden in a Box” program offered by Boulder’s Center for Resource Conservation in 2010 provided plant materials for under $3/SF (Woodward 2010).

Lower Mid-Range

The next tier of water efficient landscapes have more extensive shrub plantings with drip irrigation, limited turf area (less than 25% of total area) with in-ground irrigation, and some perennial flowers and ground covers (less than 20% of total area). These landscape installations often include some boulders and/or flagstone walkways or stepping stones (less than 10% of total area). Most of these landscapes were renovations of entire suburban lots,

and the costs were fairly consistent at $8 - $9.50/SF. The size of the plants installed can impact the cost and Peck explained that these installations all used 1 gallon shrubs instead of 5 gallon shrubs along with flats of perennial flowers and ground covers instead of 1 gallon plants whenever possible.

Upper Mid-Range
Landscapes that are similar to the lower mid-range but which include more hardscape and larger sized plants cost $14 - $18/SF to install.

Most Expensive
There is really no upper limit to the amount of money that can be spent on a landscape, but landscapes with extensive hardscape, large boulder placements, flagstone patios and walkways, and elaborate irrigation systems cost in range of $22 - $24/SF to install. Peck reported that installing flagstone mortared over concrete was significantly more expensive than installing dry laid flagstone.

Resources and Examples

Resources

Handbook of Water Use and Conservation, Amy Vickers, 2001, Water Plow Press, Amherst, MA

Xeriscape Plant Guide, 1999, Fulcrum and Denver Water and AWWA, Denver, CO.

Xeriscape Handbook: A How-To Guide to Natural, Resource-Wise Gardening, Gayle Weinstein, 1999, Fulcrum Publishing.

Waterwise Landscaping with Trees, Shrubs, and Vines: A Xeriscape Guide for the Rocky Mountain Region, California, and the Desert Southwest, James M Knopf (Editor), Maureen McIntyre (Illustrator), 1999, Charisma Books.

The Xeriscape Flower Gardener: A Waterwise Guide for the Rocky Mountain Region, Jim Knopf, 1991, Johnson Books.

Dry-Land Gardening: A Xeriscaping Guide for Dry-Summer, Cold-Winter Climates, Jennifer Bennett, 1998, Firefly Books.

Residential Landscape Architecture: Design Process for the Private Residence, Norman K. Booth and James E. Hiss, 1998, Prentice Hall.

Landscaping : Principles and Practices : The Residential Design Workbook, Ferrell Bridwell, 1997, Delmar Publishing.

Landscape Plants for Western Regions: An Illustrated Guide to Plants for Water Conservation, by Bob Perry, Land Design Publishing, 1992 (Out of Print – Only Available Used or Library Loan)