The Center for
ReSource Conservation
Water Division

2010 Annual Report

City of Louisville

January 2011

CENTER FOR ReSource CONSERVATION

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About the Center for ReSource Conservation

Founded in 1976, the Center for ReSource Conservation (CRC) is a Boulder-based 501(c)3 non-profit organization which empowers our community to conserve natural resources. Each year, the CRC empowers more than 30,000 individuals to live a more sustainable life through educational programs and services designed to help members of our community conserve water and energy and minimize waste.

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I. Executive Summary

The Center for ReSource Conservation's (CRC) Water Division coordinates a suite of programs designed to help people irrigate efficiently and implement water-wise landscaping. The WaterWise Landscape Seminars and Slow the Flow Colorado Irrigation Inspection Program offers unique educational experiences that helps break down many of the barriers associated with conserving and using water in a more efficient way.

WaterWise Landscape Seminars

The WaterWise Landscape Seminar Week helps to educate Louisville area residents about landscaping practices that promote water conservation. From April 7th to 17th, 2010, the CRC offered ten seminars; one sponsored by Louisville and nine sponsored by neighboring communities. A total of 15 people attended the seminar in Louisville. A total of 413 people attended one of the ten seminars at an average of just over 40 people per seminar.

Slow the Flow Colorado Irrigation Inspection Program

The annual report presents the data collected during each of these programs. This data includes technical sprinkler efficiency information, participant information, water conservation features, and watering practice survey results. The report strives to present the data in a clear and understandable format, provide appropriate context, and summarize important trends. It occasionally makes recommendations, but ultimately allows the reader to decide what actions to take next.

Each inspection provides customized, pragmatic advice and one-on-one education for homeowners or property managers. Inspections are free to customers of participating water providers who sign up voluntarily through the CRC. In 2010, the CRC performed 114 inspections on residential properties in the in the City of Louisville service area.

The Steps of an Irrigation Inspection

During an inspection, a trained CRC auditor visits the property and performs the following steps:

1. Gather Participant Data
2. Visual Inspection
3. Catch Cup Tests
4. Pressure Readings
5. Soil and Root Depth Tests
6. Landscape Measurements
7. Determine a Watering Schedule
8. Share Test Results and Recommendations With Participant

Property Information

For residential properties, CRC auditors documented the irrigable landscape size, number of residents, age of the property and sprinkler system and how long people had lived in their homes. Residential properties had a median irrigable landscape size of 3,182 square feet and an average of 2.88 residents. The median house was built in 1989, and the median sprinkler system was installed in 1992. Residents had lived in their houses for a median of ten years.

CRC auditors surveyed residents and property managers about the water conservation features present on their property. The most common outdoor features were some xeric areas and drip systems, which were present in 55 percent and 61 percent of properties respectively. A significantly higher percentage of large properties had conservation features than did residential properties.

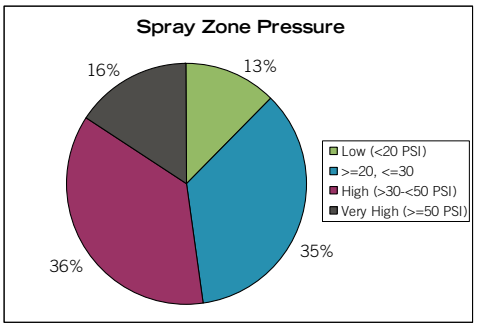
Clay was the most common soil type observed in Louisville in 98 percent of properties, while two percent had soil with a makeup primarily of loam, and zero percent with sand. To avoid runoff and water waste from irrigating clay soils inappropriately, the CRC suggests using a watering technique called 'cycle and soak' irrigation. In 2010, 19 percent of participants were using this technique before their inspection. The CRC recommends that cities should continue to educate their residents about cycle and soak irrigation for clay soils.

Sprinkler System Information

During the catch cup test portion of each inspection, auditors calculate a measure of sprinkler system efficiency called distribution uniformity (DU). DU is a measure of how evenly a system waters, and directly affects and how much water is applied to the lawn. It is measured in percentage, and the CRC considers a DU value of over 70 percent as acceptable. Only 23 percent of zones tested had acceptable DU values. DU values were significantly higher for rotor zones than for spray zones.

Sprinkler Heads 101

There are two basic types of sprinkler heads: **spray heads** and **rotor heads**. Spray heads water in a fixed pattern when the system is turned on. Rotor heads water in a rotating pattern as they spray, usually covering a larger area.



Rotor zones had significantly fewer and less severe pressure problems than spray zones. Over 50 percent of all spray zones had high pressure, and 16 percent had extremely high pressure. None of the rotor zones had problems with high pressure. This could be due to the fact that the designed pressure for rotor heads is significantly higher than that of spray heads. High pressure causes a significant amount of water loss to evaporation and wind.

The most common problems found on properties were

- Overspray
- Low heads
- Improper Pressure
- Tilted heads
- Poor head spacing

CRC auditors found overspray on 94 percent of all properties and low or tilted heads on over 75 percent of them. Overspray is both a waste of water and a significant source of nonpoint source pollution. Large properties had a much higher frequency and severity of these types of problems occurring than residential properties did.

High pressure and overspray onto a street

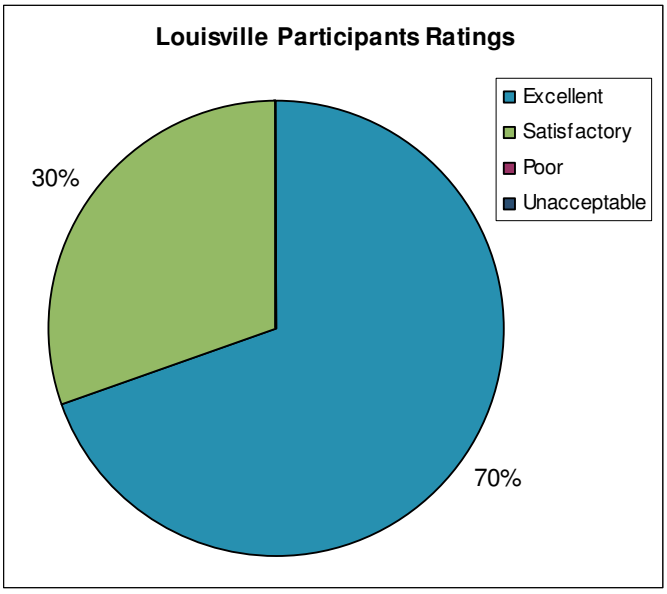
Based upon the results of the inspection, CRC auditors would recommend a watering schedule to program participants. In the annual report, the CRC compares the recommended schedule with the schedule in place before the inspection. Most residential participants were watering their spray zones for more time than the CRC recommends and their rotor zones for somewhat less time than the CRC recommends.

Different Watering Times for Spray and Rotor Zones

Spray heads and rotor heads emit water at different rates, and need to be programmed to water for different amounts of time; The CRC found that on average, spray zones should be watered for 60 percent of the length of time of a rotor zone. The CRC found people understand that this difference exists, but are not aware of its extent.

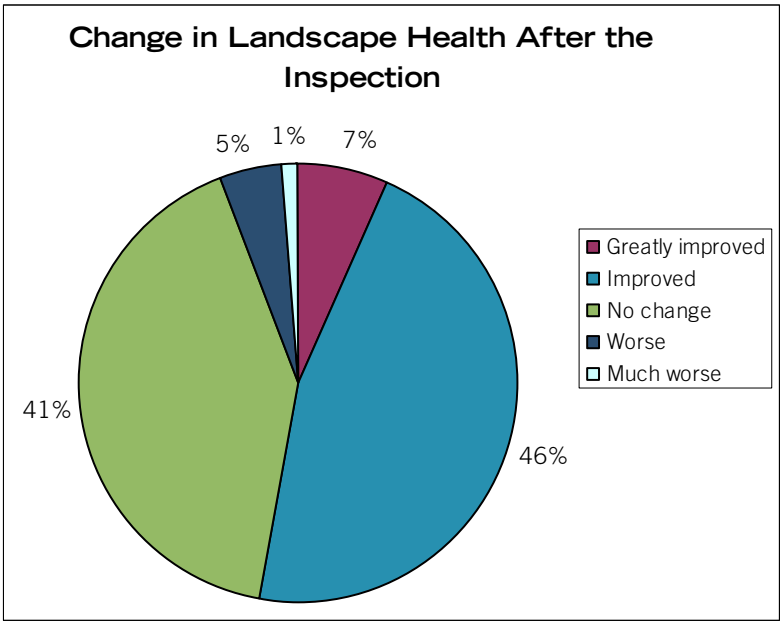
Evaluations and Program Effectiveness

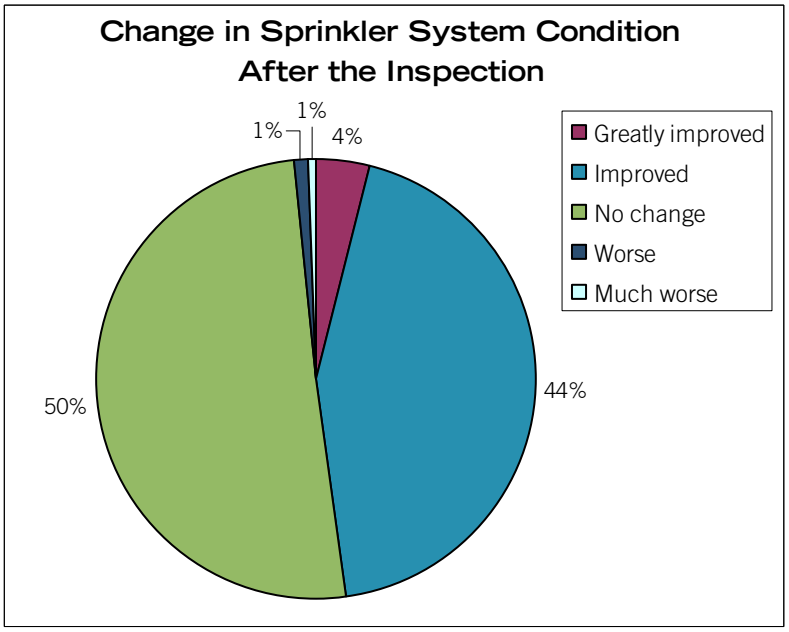
In 2010, program participant evaluations were very positive. The CRC received 17 responses from Louisville participants, a 24 percent response rate. Over 90 percent of participants from the City of Louisville rated the program as either excellent or satisfactory; 50 percent rated the program excellent and 44 percent rated it satisfactory.



Slow the Flow In-dept Survey of Audit Customers

In November of 2010 the CRC sent a follow-up survey to the Slow the Flow participants from 2007 to 2010. The goal of this survey was to see the long term effects of the program on landscape health, watering practices, and system efficiency and maintenance after an audit. The CRC asked what improvements people had made based on the results of their inspections and 93 percent of participants made at least one change after they received a Slow the Flow audit. The most common problem fixed was an inefficient watering schedule. Over 50 percent of homeowners felt that the health of their landscape had improved as a result of their inspection.





The CRC inquired about the health of both the landscape and the sprinkler system following the inspection as well as how often homeowners self inspect their systems. Over 50 percent of participants felt their landscape had improved following the inspection and 48 percent of people felt that the health of their sprinkler system had improved. The CRC found that 55 percent of people saw a decrease in their water usage following their inspection.

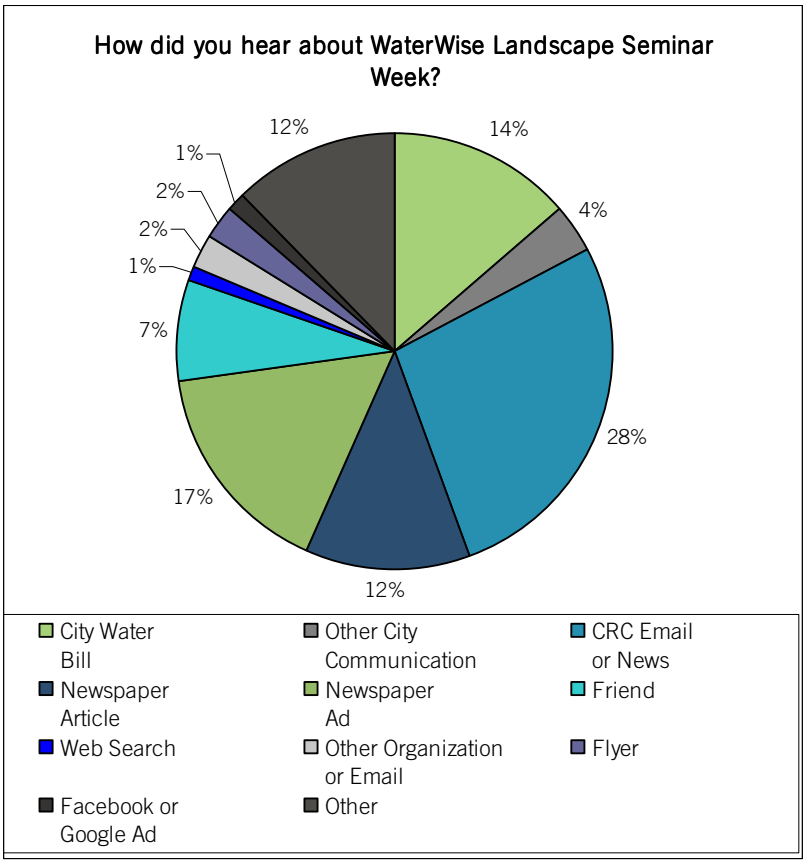
Partner Utilities
Aurora Water
Castle Pines Metropolitan District
Castle Pines North Metropolitan District
Centennial Water & Sanitation District
City of Boulder
City of Golden
City of Lafayette
City of Longmont
Cit of Louisville
City of Northglenn
City of Thornton
City of Westminster
Left Hand Water District
Parker Water and Sanitation District
South Adams County Water and Sanitation
Town of Castle Rock
Town of Superior

II. WaterWise Landscape Seminar Week

The WaterWise Landscape Seminar Week helps educate Louisville area residents about landscaping practices and technologies that promote water conservation. From April 7th to 17th, 2010, the CRC offered ten seminars; one was sponsored by the City of Louisville and nine were sponsored by neighboring communities. Across the ten seminars the total attendance was 413, an average of 40 people per seminar.

Date	Seminar	Speaker	Location	Attendance
Wednesday, April 7th	Learning the Basics	Ray Daugherty	Thornton	60
Monday, April 12th	Introduction to Xeriscaping	Curtis Manning	Boulder	58
Tuesday, April 13th	Drip Irrigation	Ron Boyd	Longmont	23
Tuesday, April 13th	Tricks of Xeriscaping	Mikl Brawner	Boulder	52
Wednesday, April 14th	Renovating an Existing Landscape with Xeriscape	Bill Melvin	Lafayette	39
Wednesday, April 14th	Permaculture	Zia Parker	Boulder	26
Thursday, April 15th	Edible Xeriscape	Alison Peck	Lafayette	31
Thursday, April 15th	Introduction to Xeriscape	Julie Hauser	Louisville	15
Saturday, April 17th	Xeriscaping on a Budget	Jim Knopf	Longmont	28
Saturday, April 17th	WaterWise Landscape Renovation	Alison Peck	Westminster	81
			Total	413

Evaluations of the seminars were generally very positive. The CRC emailed an evaluation to all seminar participants for whom it had email address. The CRC email survey received a 22 percent response rate for the seminar evaluations. Participants heard about the seminars in a variety of ways. The largest percentage of people heard about the seminars through a CRC email. City water bills and newspaper articles were also among the most successful ways of getting the word out.



Center for ReSource Conservation Evaluation Results

Seminar Title and Evaluation (Scale of 1-5 with 1 being not helpful and 5 being very helpful)	Number of Reponses	How useful did you find the content of this seminar?	How would you rate your knowledge of water-wise landscaping before attending this seminar?	How would you rate your knowledge of water-wise landscaping after attending this seminar?	How satisfactory was the presentation of the seminar material?	How would you rate this seminar over all?
Introduction to Xeriscaping	9	3.67	1.89	3.3	4.11	4.22
Introduction to Xeriscaping	6	4.8	2.2	3.6	4.6	4.8
Drip Irrigation	4	4.5	2.25	3.25	4.25	4.25
Tricks of Xeriscaping	11	4.78	2.44	3.78	4.56	4.67
Renovating an Existing Landscape with Xeriscape	9	3.67	3	NA	3.67	4
Permaculture	2	2.5	3.5	3.5	2.5	2.5
Edible Xeriscape	7	3.83	3.17	3.5	4.17	4.17
Introduction to Xeriscape	3	4.67	1.33	3	4.67	4.67
Xeriscaping on a Budget	4	4	2	3.25	3.25	3.5
WaterWise Landscape Renovation	7	4.14	3	3.14	4.33	4.71
Total and Weighted Average	62	4.13	2.5	3.42	4.13	4.3

Most participants found the seminars to be very educational. The CRC asked participants to rate their knowledge of WaterWise landscaping both prior to and following the seminar. The average participant rated themselves a 2.5 before the seminar (Scale of 1-5 with 1 being novice and 5 being expert). After the two hour class, participants felt their knowledge had increased to 3.42.

The CRC asked participants for suggestions for future seminars, and received the following suggestions:

Most frequently suggested:

- Xeriscaping: plants, materials, and planning (7)
- Permaculture (4)
- Composting for Beginners (4)
- Rain and Grey Water Uses (2)

Other suggestions:

- Drip System Installation and Management

- Project Assistance for Like-minded Gardeners
- Edible Xeric Plants

Below is a small selection of comments from the seminar evaluations:

"I strongly believe in the importance of conserving and protecting all our resources."

"Practical advice that a non-skilled person can apply that would make a difference."

"The speaker was clearly an expert in her field, and could provide specific advice. I got lots of tips on exactly what plants grow well in our climate."

The speaker was so genuine and seemed enthusiastic to share some of his findings on the subject of xeriscape that he's acquired in the last 25 years. His extensive understanding about water and the systems in place to handle, albeit incorrectly, is invaluable."

"It was great. I really appreciate the facilitators' vast knowledge and the professionalism of all the speakers."

"The speaker delivered the material with a sense of humor, excellent knowledge of the subject, and added tips from her own experience in gardening design and practice. I also liked that she provided an organic gardening perspective."

"Very knowledgeable and well prepared speaker. She is extremely experienced in her field and is always great to listen to."

"Loved the slides -- how very colorful a xeric garden can be."

"Lots of great ideas--I'm a totally beginner, so I learned a lot of things to consider when thinking about xeriscaping."

III. Slow the Flow Colorado

a.) Background

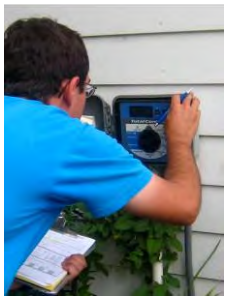
Slow the Flow Colorado is an irrigation inspection program run by the Center for ReSource Conservation which educates people about how to water more efficiently with their sprinkler systems. In an inspection, a trained auditor goes to a residential or large property, performs a thorough inspection of the sprinkler system, and spends time educating homeowners or property managers about what to fix on their sprinkler system and how to water more efficiently.

Slow the Flow Colorado is modeled after a program developed by the Utah State University Cooperative Extension called Slow the Flow Save H20. In 2003, the City of Boulder ran Slow the Flow Colorado as a pilot program. In 2004, the CRC started operating the program, performing 428 residential and 51 large property inspections for five water providers. The program has grown steadily since then. In 2010, the CRC performed 1713 residential and 58 large property inspections for 17 water providers.

The steps of an irrigation inspection

1. Gather participant data

At the beginning of the inspection, the auditor meets with the participant. The goal of this time is to gather relevant information. The participant's are often asked what their goals are for the inspection and what they hope to get out of it. Auditors also survey the participants about indoor and outdoor water conservation features and record property information, such as the current watering schedule.



Recording the current watering schedule

2. Visual Inspection

The auditor visually inspects the sprinkler zones while they operate. Auditors inspect all zones on residential properties and up to 50 zones on large properties in order to reduce the waitlist and allow the program to reach more participants.

The auditor requests participants to accompany them during the inspection. The auditor identifies the head type (rotor, spray or drip) on each zone, notes damaged or malfunctioning heads, and identifies and troubleshoots other system problems. The participant is strongly encouraged to participate and take notes during the visual inspection.

Auditor visually inspecting system

3. Catch Cup Tests

A catch cup test measures the distribution uniformity (DU) and precipitation rate of each zone. Distribution uniformity is a measure of how evenly the system waters, which affects the amount of water required to keep the landscape healthy. Slow the Flow auditors use the lower quartile method to calculate DU. Precipitation rate is the amount of water emitted by the system in a given amount of time, and helps determine an appropriate watering schedule for that zone. Auditors generally test two areas on residential properties and between four and ten areas on large properties. Due to the different characteristics of rotors and sprays, auditors try to conduct at least one catch cup test on a rotor zone area, and at least one on a spray zone area.

Catch cups on a side strip

To perform a catch cup test, the auditor distributes a series of standardized and graduated cups in a grid pattern across the areas being tested. The auditor then turns on the system for a given period of time (five or ten minutes depending on the head type), turns it off, and measures the amount of water in each cup. From these measurements, the auditor calculates the distribution uniformity and precipitation rate for the area.

4. Pressure Readings

The auditor takes dynamic pressure readings for each zone they perform a catch cup test. On spray zones, the auditor removes the nozzle and attaches a pressure-T, then turns the zone on. On rotor zones, the auditor inserts a pitot tube, attached to a pressure gauge, into the running stream of water spraying from a head. The auditor also uses pressure measurements as a means of troubleshooting suspected problems, such as leaks. For a more detailed discussion of pressure, see the system pressure section below.

Pressure-T attached to spray head

5. Soil and Root Depth Tests

On each zone tested, the auditor collects a soil core sample, using a soil probe, to determine the soil type and root depth. Soil types are evaluated as clay, loam, or sand and are used to help determine a watering schedule. Root depths are measured in inches. Often, the hard clay soils of the Front Range prevent the soil probe from reaching the bottom of the roots. In those cases, the auditor determines the soil type and tells the participant that their root depths are at least as deep as the soil probe measured.

Auditor using soil probe

6. Landscape Measurements

During residential inspections, the auditor measures the square footage of a property's irrigable landscape. Landscape measurements are later compared with participant water records to determine how much water was being applied to the landscape. Landscape measurements are split between two categories: turf and non-turf. For these results, please see the watering practices section below.

Auditor taking landscape measurement

7. Determine Watering Schedule

Using the precipitation rate and soil type from earlier tests, the auditor compiles a chart to determine a watering schedule for each of the areas tested. Watering schedules are based on a historical evapotranspiration rate of 27 inches per year in the Denver metro area. For a detailed discussion of how watering schedules are calculated, please see the watering schedule section below.

Auditor doing calculations

8. Share Test Results and Recommendations

After completing all tests and calculations, the auditor shares the results with the participants. For residential properties, the auditor discusses the results with the homeowner and leaves several worksheets and resources detailing the findings and recommendations. If necessary, the auditor will show the homeowner, how to program their control clock. For large properties, the auditor compiles a more formal written report, which is sent to the property manager. Auditors also recommend a variety of resources to the participant, including Colorado State University Extension's gardening factsheets and Master Gardener program. An example of the form a homeowner receives is included as an Appendix to this report. A sample large audit report is attached as appendix D.

Auditor explaining findings to homeowners

b.) Results

The CRC tested 114 residential properties in 2010, for the City of Louisville.

Property Information

Houses had an average of 2.91 residents in the summer and 2.85 residents in the winter. The median house was built in 1989, and the median sprinkler system was installed in 1992. Residents had lived in their homes for a median of ten years.

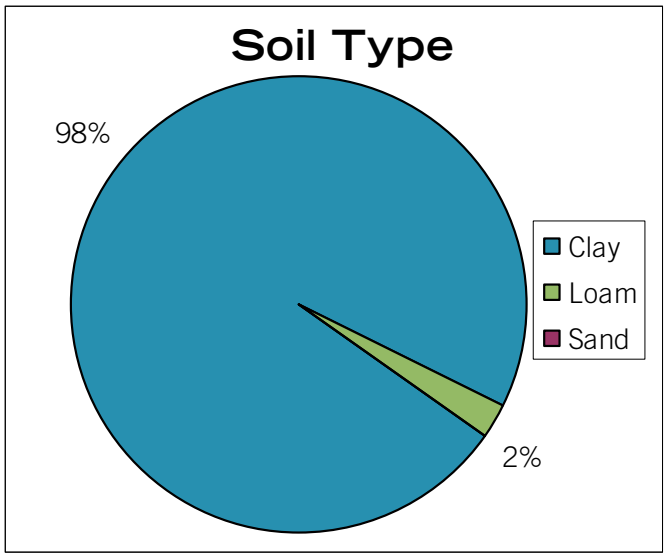
Landscape Size

CRC auditors measured irrigable landscape sizes on residential properties using measuring wheels at the time of each inspection. The median residence had approximately 2,273 square feet of turf and 829 square feet of non-turf.

Residential Landscape Size (sq. ft.)			
	Turf	Shrub	Total
Median	2273	829	3182
Mean	2558	1160	3670

Soil Type and Root Depths

CRC auditors took soil core samples of each zone for which they did efficiency tests – generally two zones for residential properties and four to ten zones for large properties. Soil types were tested using the "feel method" and categorized as clay, loam, or sand.



Why does clay soil matter?

A large majority of participants have clay soils, so it is important to understand how to efficiently irrigate that this soil type. Clay soils benefit from a watering technique called '**cycle and soak**' irrigation to prevent runoff. Clay absorbs water very slowly, but most sprinkler systems have high precipitation rates that rapidly apply water. As a result, sprinklers often apply more water than the soil can absorb in a given amount of time. The water then runs off, often into the gutter

Soil Type	
Clay	98%
Loam	2%
Sand	0%

CRC auditors also measured root depths in each zone for which they did efficiency tests using a soil probe. However, the hard clay soil of most zones often prevented the probe from reaching the bottom of grass roots, and most root depth readings were shallower than the actual root depths. Because of this issue, root depths are not presented here. CRC auditors do educate homeowners about the importance of deep roots for drought tolerance and disease prevention.

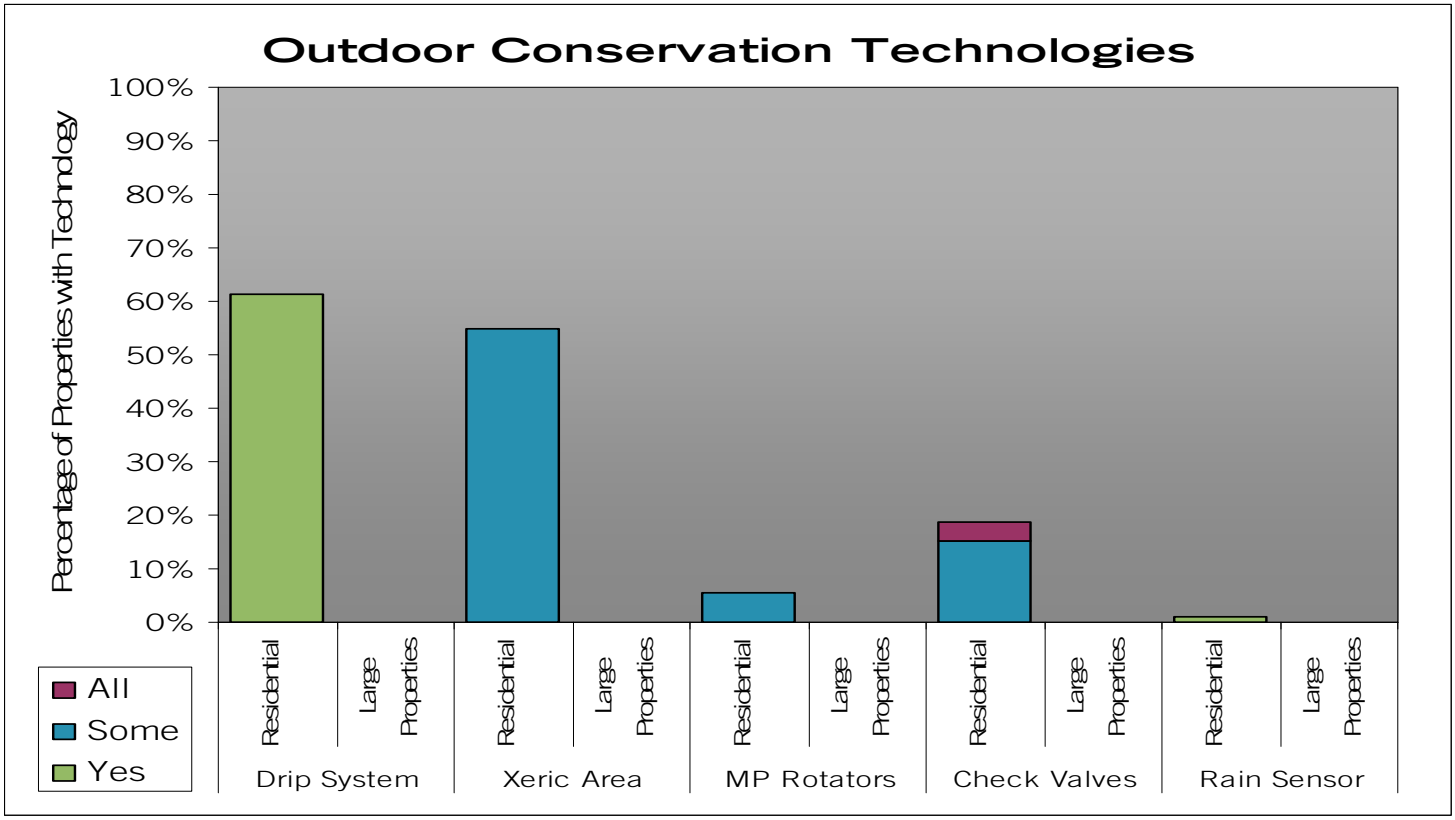
To allow the water to soak into clay soils the CRC recommends three short watering cycles. Instead of watering for 21 minutes for the average spray zone, the CRC recommends watering for three cycles of seven minutes, with an hour in between each cycle. Such cycles are easy to set with most control clocks using the multiple start times function.

Cycling saves a significant amount of water that would otherwise be lost to runoff. It also helps encourage deeper root depth which promotes healthier lawns and reduces nonpoint source pollution from runoff.

Water Conservation Features: Outdoor and Indoor

Outdoor Conservation Features

The CRC looked at six outdoor features that help conserve water. CRC auditors asked both homeowners and property managers if they had a given conservation feature and looked for that feature during the audit. The CRC evaluated outdoor conservation features for residential and large properties. Individual features are explained below the results section.



Outdoor Conservation Technologies			
Drip System		Yes	No
All Properties		61%	39%
Xeric Area	All	Some	None
All Properties	0%	55%	45%
MP Rotators	All	Some	None
All Properties	0%	6%	94%
Check Valves	All	Some	None
All Properties	4%	15%	81%
ET or Soil Moisture Sensor		Yes	No
All Properties		0%	100%
Rain Sensor		Yes	No
All Properties		1%	99%

Some of the differences in the prevalence of outdoor conservation features may be explained by how well-known each of these features are to the participant groups. Drip systems and the idea of 'xeriscape' or 'xeric' are reasonably well-known terms and ideas. Specific technologies like MP rotators and ET sensors are somewhat less well known to the general public and the CRC saw fewer of them this summer than drip systems and xeric areas. The CRC also noticed an increase in the amount of rain sensors on large properties as well as a significant increase in MP Rotators. As this technology becomes better know in the landscape community, we expect to see an increase of properties installing them.

Features Surveyed

Drip System: Drip irrigation is a type of low-flow irrigation that is an efficient and effective way to irrigate many non-turf areas. A system usually includes a timer, filter, pipes, drip emitters, and sometimes micro-sprayers. Standard drip systems work well for most non-turf areas, especially flower and food gardens. Standard drip systems are not a good way to irrigate turf, but some sub-surface drip systems can irrigate turf. CRC auditors looked at whether or not there was a drip system on the property, regardless of its size.

Xeric Area: A xeric area is an area of a landscape planted with low or zero water plants. There are many stunning flower gardens that are xeric, and xeric areas are a key element of Xeriscape design principles. CRC auditors looked at whether a property had no xeric areas, some xeric areas, or all xeric areas. Since Slow the Flow is designed for people with sprinkler systems that water grass, our results may have under-sampled houses with all xeric areas.

MP Rotators: MP Rotators are a newer type of sprinkler head that keep matched precipitation rates as each head's arc and radius are adjusted. They save water in two ways: they water more evenly (and generally result in a higher DU) than most sprinkler heads, and they have lower precipitation rates than most spray heads do, making it easier to avoid runoff. CRC auditors looked at whether a property had no MP rotators, some MP rotators, or all MP rotators. MP rotators can be easily retrofitted onto many spray zones by exchanging nozzles.

Check Valves: Check valves are valves on sprinkler heads that prevent water in system pipes from draining out of the heads once the system has been turned off. They save water by allowing this water to be used for the next watering, instead of draining out of the lowest elevation head. They also reduce runoff, as the water from inside the sprinkler system stays there. CRC auditors looked at whether a property had check valves on none of the heads, some of the heads, or all of the heads.

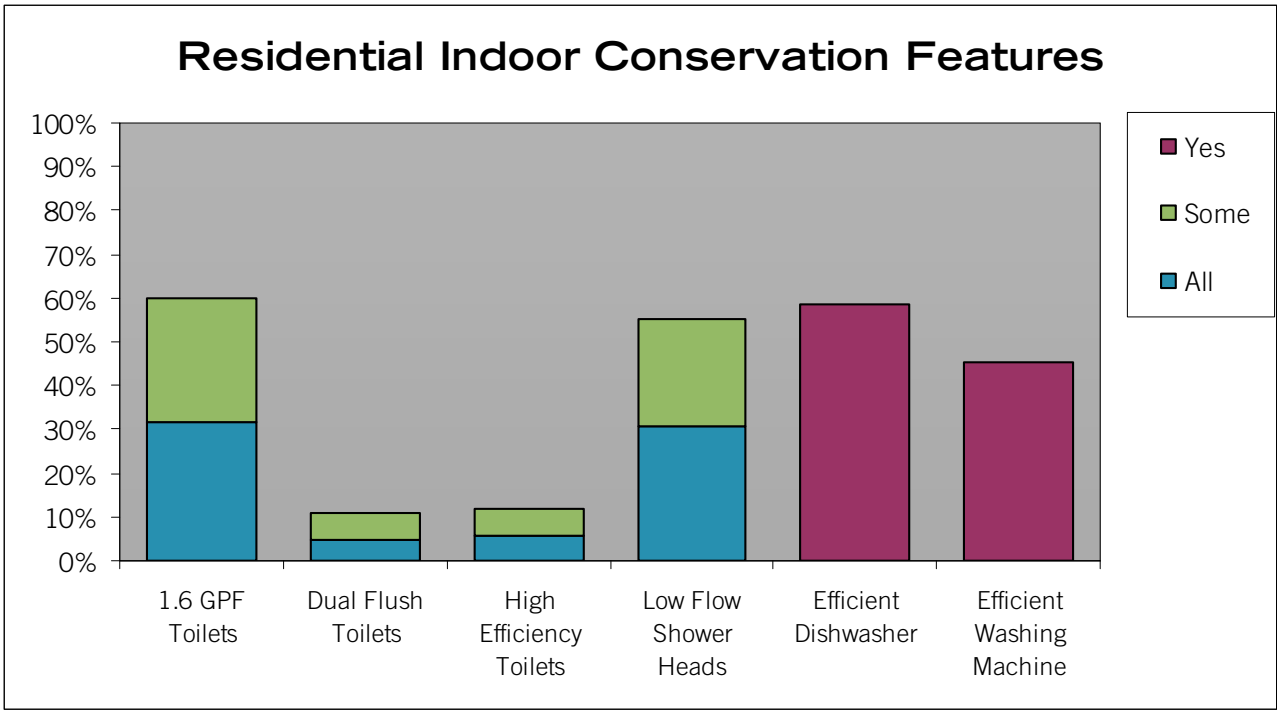
Evapotranspiration Controller or Soil Moisture Sensor (abbreviated as ET/Soil Moisture Sensor on tables): These control clocks coordinate watering times and duration with either evapotranspiration data from a weather station or the moisture level in the soil. When used properly, this can be the most efficient way to set a watering schedule as plants get exactly the amount of water that they need when they need it. CRC auditors looked at whether or not a property had either an evapotranspiration controller or a soil moisture sensor.

Rain Sensor: A rain sensor is a device that shuts off or delays a sprinkler system's operation if it is raining or has recently rained. They generally measure the amount of rain that fall and delay watering an appropriate amount of time based on that amount. When used properly, they avoid having a sprinkler system run if it is raining or has recently rained a significant amount. CRC auditors looked at whether or not a property had a rain sensor installed and in use.

Indoor Conservation Features

The CRC analyzed six features that aid in indoor water conservation for residences. The CRC did not assess indoor features for large properties because of the varying nature of that property type. CRC auditors asked residents whether they had each of the features; due to time and safety constraints, auditors did not verify residents' responses. It was clear from CRC interactions with participants that a large amount of confusion about what the different features are still exists among residential homeowners. Because of this, the data may be vulnerable to confusion from participants about what exact features they have. Features are explained below the results section.

Results



Indoor Conservation Technologies				
	All	Some	None	Don't Know
1.6 Gallon Toilets	32%	28%	37%	3%
Dual Flush Toilets	5%	6%	87%	2%
High Efficiency Toilets	6%	6%	83%	6%
Low Flow Shower Heads	31%	24%	34%	11%
		Yes	No	Don't Know
Efficient Dishwasher		59%	34%	7%
Efficient Washing Machine		45%	35%	19%

Overall, people are familiar with 1.6 gallon toilets, and efficient dishwashers. There are a significant amount of people (2-11 percent) who do not know what kind of fixtures they have. The confusion around indoor fixtures provides an opportunity for education on indoor water conservation.

Toilets: There are many types of toilets that use different amounts of water. Before the early 1990s, most toilets used between three and a half and seven gallons of water per flush (gpf). The Energy Policy Act of 1992 mandated that all toilet fixtures installed from 1994 onwards use at most 1.6 gpf. Since 1992, two more efficient toilet types have emerged. Dual flush toilets use different amounts of water depending upon the strength of flush needed and high efficiency toilets (HETs) use 20 percent less water than the mandated 1.6 gpf toilets.

CRC auditors asked residents whether they had all, some, or none of the three toilet categories: standard 1.6 gpf toilets, dual flush toilets, and HETs. Many residents may have confused HETs with standard 1.6 gpf toilets, and the numbers for HET toilets should be viewed with caution.

Low Flow Shower Heads: The Energy Policy Act of 1992 also mandates that shower heads installed after 1994 use two and a half gallons per minute of water or less at a pressure of 80 psi. The CRC refers to these shower heads as 'low flow.' As well as saving water, low flow shower heads save significant amounts of energy as less water needs to be heated up.

Efficient Washing Machines: Some washing machines use less water than others. The EPA's Energy Star program requires that washing machines must have a water factor (water consumption per cubic foot of washer space) below a certain level in order to achieve Energy Star certification. CRC auditors asked customers whether or not their washing machine was 'efficient.'

Efficient Dishwasher: Some dishwashers use less water than others. The EPA's Energy Star program rates dishwashers based on their energy consumption; however, this calculation includes an indirect measure of hot water consumption. CRC auditors asked customers whether or not their dishwasher was 'efficient.'

Sprinkler System Information

CRC auditors performed efficiency tests on a total of 204 zones in 2010. Of those, 133 efficiency tests were performed on spray zones, and 71 on rotor zones.

Zones Tested			
	Total Zones	Spray Zones	Rotor Zones
All Properties	204	133	71

Distribution Uniformity (DU)

CRC auditors tested the distribution uniformity of all or part of each zone using the lower-quartile method. Distribution uniformity is a measure of how evenly an irrigation system waters the property. It is reported as a percentage, from zero to 100 percent. The Irrigation Association considers a DU value of over 70 percent as acceptable for rotor zones, and one of over 55 percent as acceptable for spray zones. However, for the purposes of this analysis, the CRC holds both

head types accountable to the higher standard of 70 percent DU and only considers zones acceptable if they meet that level. The CRC considers values between 40 percent and 70 percent as substandard, and less than 40 percent as unacceptable.
Many factors influence distribution uniformity values. The original design and installation of the system – head choice spacing, placement, system pressure and maintenance (fixing broken or tilted heads), nozzle choice, and head replacement choices are the major factors that affect DU.

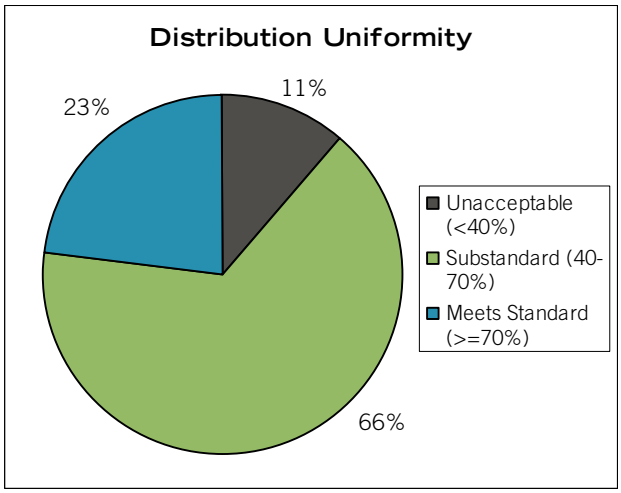
There are a few principles that will help keep distribution uniformity high. The system should be designed with head-to-head spacing: the spray from one sprinkler head reach the base of the next head. The sprinkler heads and nozzles in the system should be as uniform as possible; different brands and models of heads and nozzles have different spray patterns, and similar spray patterns yield high DU values. The system should operate at pressures within the head manufacturer's recommended range. Finally, the system should be regularly maintained and inspected, and problems should be fixed.

Distribution uniformity values do affect peoples watering schedules and watering times. If a zone has a low DU value, some sections will get much more water than others. A watering schedule that waters the correct amount for the zones as a whole will not provide enough water for zones with a low DU, resulting in brown grass. When this happens the homeowner or irrigation manager will usually increase the watering time for that zone to give the brown area enough water. This results in all of the other parts of the zone being over-watered, and the area getting the least water will have just enough. In short, people tend to apply water based on the needs of the driest part of the landscape.


Dry patch due to uneven distribution

Many areas are over-watered because of this problem. The CRC instructs its auditors not to give a watering schedule in cases when the DU value is less than 40 percent, as the CRC schedule would leave brown spots on the lawn. However, CRC auditors usually have concrete suggestions on how to improve low DU values.

Exactly what a homeowner or property manager should do to improve a low DU value depends on the source of the problem. A low DU value often occurs because of maintenance problems, such as sunken or tilted heads. In those cases, the problem can be fixed by simply raising and straightening the heads. Sometimes, incorrect nozzles or non-uniform heads cause the problem, and can be fixed by replacing incorrect parts. Occasionally, the problem stems from poor system design and the auditor will recommend a system redesign.



Distribution Uniformity Statistics			
All Properties	All Zones	Spray Zones	Rotor Zones
Median	60%	59%	63%
Mean	59%	56%	63%
Range	22-95%	7-89%	34-89%

Distribution Uniformity			
All Properties	Unacceptable (<40%)	Substandard (40-70%)	Meets Standard (>=70%)
Spray	14%	68%	19%
Rotor	7%	62%	31%
Total	11%	66%	23%

Rotor zones tend to have significantly higher DU values than spray zones across all property types.

In 2009 the Irrigation Association recommended that DU be reported in a decimal (ex: .70 vs 70 percent). After reviewing the recommendation with partner utilities, the CRC decided to continue representing the DU in a percentage so that it is better understood by homeowners.

System Pressure

In each of the zones tested, CRC auditors measured the operating pressure of one or more of the sprinkler heads. On rotor zones, pressure was tested by inserting a pitot tube into the main stream of water coming out of the head. For spray heads the auditors use a pressure-T, shown to the right. The sprinkler nozzle is removed, the T is attached and the nozzle is screwed back on. This allows for water to continue spraying out of the head, therefore keeping the system operating as normal and not artificially elevating the pressure by blocking one of the heads.

Methods used by auditors to test pressure work well for most sprinklers, but in some instances the CRC was unable to test the pressure due to incompatible pressure gauge attachments with certain types of sprinklers. For those zones, auditors could not manually test pressure, but did make visual observations about pressure levels.

Sprinkler heads are designed to operate within a given range of pressures. Most spray heads are designed to operate between 20 and 30 pounds per square inch (psi), and most rotor heads are designed to operate between 25 and 80 psi.

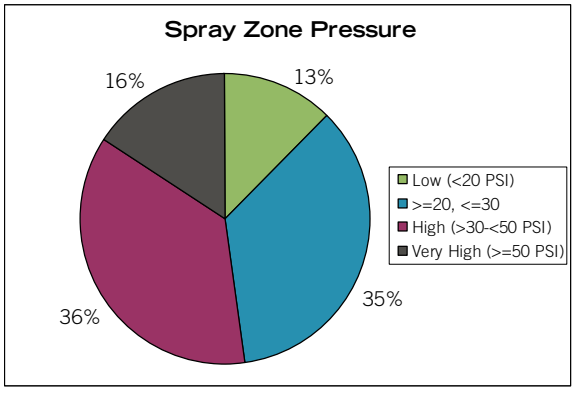
The actual pressure at which heads operate depends on several factors and is often very different from the designed operating pressure. Factors that influence operating pressure include the pressure of the line coming into the system, the presence of pressure regulators, the design and number of heads on the zone, the amount of water that each head emits, and any leaks that are present on the zone.

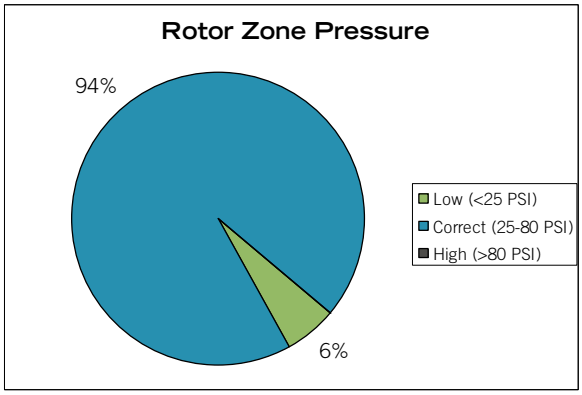
Several problems arise when operating pressure is different from design pressure. Operating pressure that is too high results in wasted water, potential overspray, and increased system wear. When pressure (especially on spray zones) is too high, the water droplets often spray out in a fine mist; as the mist hangs in the air, it evaporates and can be blown away by the wind. Exact evaporation rates depend on temperature, humidity, and wind. According to industry representatives, the amount lost can be significant.

High pressure problems can often be fixed fairly easily. Depending on the extent of the problem one of three approaches can be used. For small problems, pressure regulating stems can be utilized on individual heads. For more systematic issues, pressure reducers can be installed on specific zones or ultimately on an entire sprinkler system.

While high pressure causes water waste and unnecessary system wear, low pressure mostly impacts coverage and distribution uniformity. When pressure on a head is below the design pressure, the head may not operate as intended. The coverage pattern can be different than designed, the head may not spray as far as it was intended to, or in extreme cases heads may not pop up at all. Extremely low pressures are often a warning sign of leaks on a zone.

Low pressure problems are harder to fix than high pressure problems are. If the low pressure is caused by a leak, repairing the leak usually fixes the problem. If the problem is not caused by a leak, zones can be split so that each zone contains fewer heads, or the system can be redesigned in a similar manner, perhaps using a different type of head that requires lower pressure to operate. Sometimes running the system at a time when other water users in the neighborhood are not can raise the pressure.





Spray Zone Pressure (%)				
	Low (<20 PSI)	Correct (>=20, <=30)	High (>30-<50 PSI)	Very High (>=50 PSI)
All Properties	13%	35%	36%	16%

Rotor Zone Pressure (%)			
	Low (<25 PSI)	Correct (25-80 PSI)	High (>80 PSI)
All Properties	6%	94%	0%

Spray Zone Pressure Statistics (PSI)	
	Residential
Median	32.0
Mean	33.8
Range	9-72

Rotor Zone Pressure Statistics (PSI)	
	Residential
Median	37.0
Mean	37.9
Range	10-65

Spray pressures were above design specifications, with an average of 33.8 psi well outside the recommended 20-30 psi range, and 16 percent of spray zones had very high pressures of over 50 psi. Rotor pressures averaged 37 psi, within a 10-64 psi range. Rotor heads have a much broader range of acceptable pressure than spray heads, and the proper pressure depends on the make and model of the head.

Precipitation Rates

As part of the catch-cup test in which auditors calculate a zone's distribution uniformity, CRC auditors also calculate the precipitation rate for that zone. A zone's precipitation rate is the amount of water that falls on a given point in the zone over a certain period of time, usually expressed in inches per hour. Precipitation rates are less of a measure of the efficiency of a sprinkler system than distribution uniformity and pressure, and are used more often to calculate watering schedule.

The CRC's watering schedule, which will be explained in-depth below, recommends applying half an inch of water during each watering of bluegrass. By dividing 0.5 inches by the precipitation rate, an auditor or homeowner can determine how long it takes to apply half an inch of water. For example, if the precipitation rate was one inch per hour, it would take half an hour to apply 0.5 inches of water to the grass. CRC auditors use this information in their calculations when recommending a watering schedule.

Lower precipitation rates tend to result in less run off and therefore decrease the amount of wasted water. The Front Range's clay soils absorb water very slowly. When water is applied at a high rate, much of that water begins to run off after a few minutes. Residents and property managers can remedy the problem by using 'cycle and soak' scheduling techniques, described on page 24.

Spray Zone Precipitation Rates (Inches/Hour)	
	All Properties
Median	1.30
Mean	1.35
Range	0.3-3.9

Rotor Zone Precipitation Rates (Inches/Hour)	
	All Properties
Median	0.73
Mean	0.72
Range	0.2-2

Watering Schedules

CRC auditors recommend a watering schedule at each audit, which is based on an average historical evapotranspiration rate of 27 inches per year in the Denver area. It recommends applying half an inch of water at each watering, and watering one to three days per week, depending on the month and severity of temperatures. Exact watering times depend on soil type and precipitation rate.

CRC auditors use the following two charts in their watering schedule recommendations. It is worth noting that, as discussed in the soil type section above, CRC auditors recommend cycle and soak irrigation in nearly every schedule.

How Often to Water		
Month	Days per week	Minutes depend on Precipitation Rate
April	Spring	
May	1.5	
June	2	
July	2*	
August	2*	
September	1	

*In July and August, days per week can increase to three times in a non-drought year.

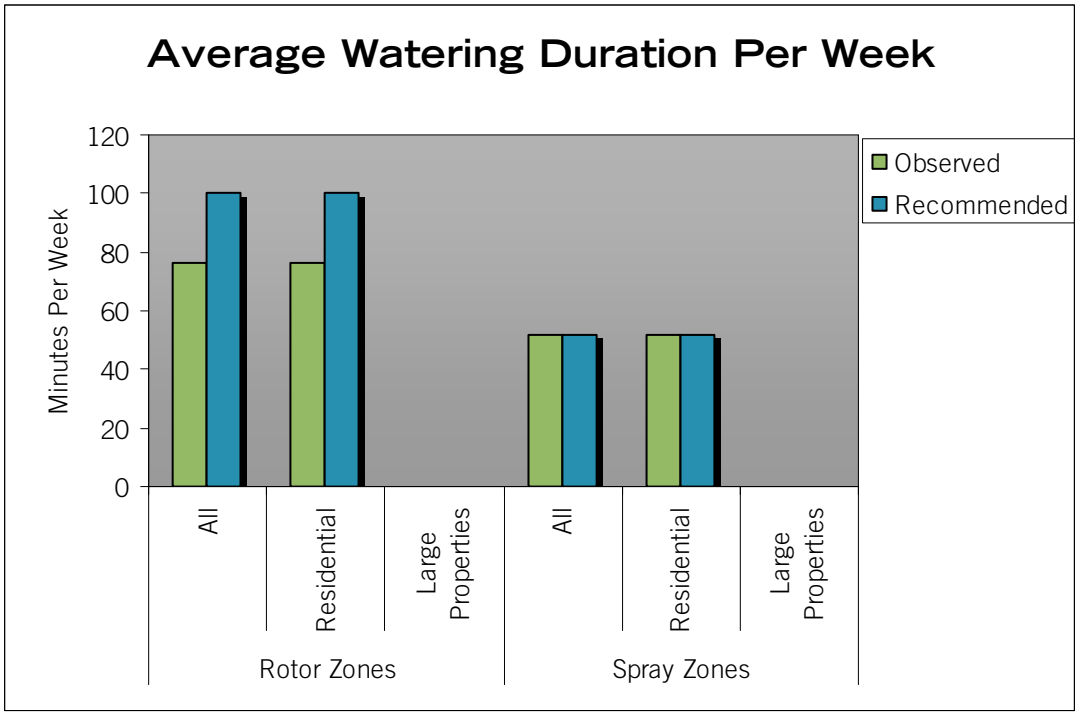
In some cases, a homeowner has been under-watering their lawn, but is happy with its state. In those cases, CRC auditors often recommend the homeowner keep watering with the current schedule, but implement cycle and soak irrigation if necessary.

How Long to Water
Based on Soil Texture

Time Required To apply 1/2 Inch of Water

Precipitation Rate (Inches Per Hour)	Clay Soils (Cycles) x Minutes	Loam Soils (Cycles) x minutes	Sandy Soils minutes
4.0	(3) 3	(2) 4	8
3.5	(3) 3	(2) 5	9
3.0	(3) 3	(2) 5	10
2.5	(3) 4	(2) 5	12
2.0	(3) 5	(2) 7	15
1.5	(3) 7	20	20
1.4	(3) 7	21	22
1.3	(3) 8	23	24
1.2	(3) 8	25	25
1.1	(3) 9	27	27
1.0	(3) 10	30	30
0.9	(3) 12	33	35
0.8	(3) 14	37	40
0.7	(3) 15	43	45
0.6	(3) 17	50	50
0.5	(3) 20	60	60
0.4	(3) 25	75	75
0.3	(2) 50	100	100
0.2	(2) 75	150	150

The CRC recommends that homeowners and property managers ease into watering schedules, especially if they have been over-watering. Plants can adapt to a range of water amounts, but they do not react well to sudden changes in water. CRC auditors often recommend people switch to cycle and soak irrigation immediately and then ease into a new watering schedule over a period of a few weeks to a month.



Based on the above graph, two trends appear from this data. First, rotor zones are watered for less than the recommended time. Second, spray zones are watered for the recommended amount of time.

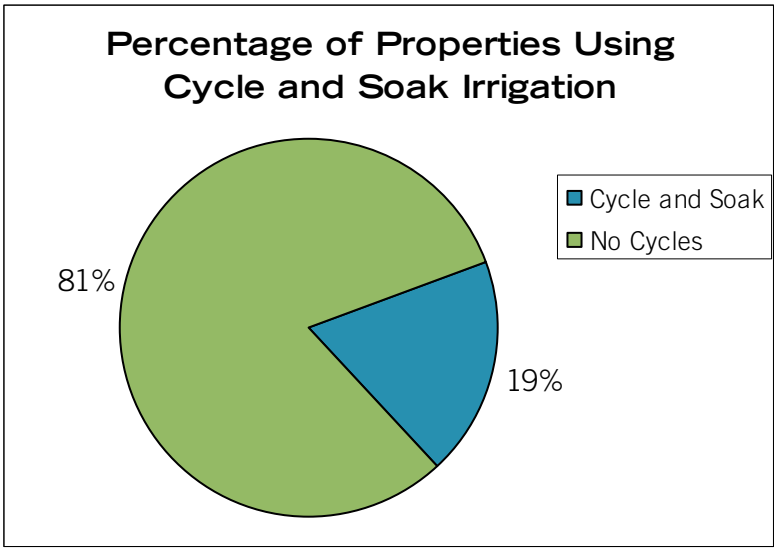
Rotor zones usually have lower precipitation rates, therefore they should be watered for longer than spray zones. It appears that most participants recognize this, and water their rotor zones for longer than spray zones. Residential participants, especially, may not be aware of the magnitude of the difference between appropriate spray and rotor zone watering times.

Average Watering Duration (minutes per week)		
Rotor Zones	**Observed**	**Recommended**
All Properties	76	100
Spray Zones	**Observed**	**Recommended**
All Properties	52	52

Cycle and Soak Irrigation

As mentioned previously, cycle and soak is an important irrigation scheduling technique for clay soils. Since the vast majority of soils in the Front Range are clay, CRC auditors recommend cycle and soak in nearly every inspection.

Auditors looked at whether participants were implementing cycle and soak irrigation, and how many cycles participants used if they were using this technique. Properties were classified as using cycle and soak irrigation if they were watering in two or more cycles. Many properties were using cycles separated by much more than one hour (half in the morning and half at night, for example). Such techniques are not ideal, as they do not include the deep watering benefits of correct cycle and soak techniques. They are, however, significantly better than no cycles at all.



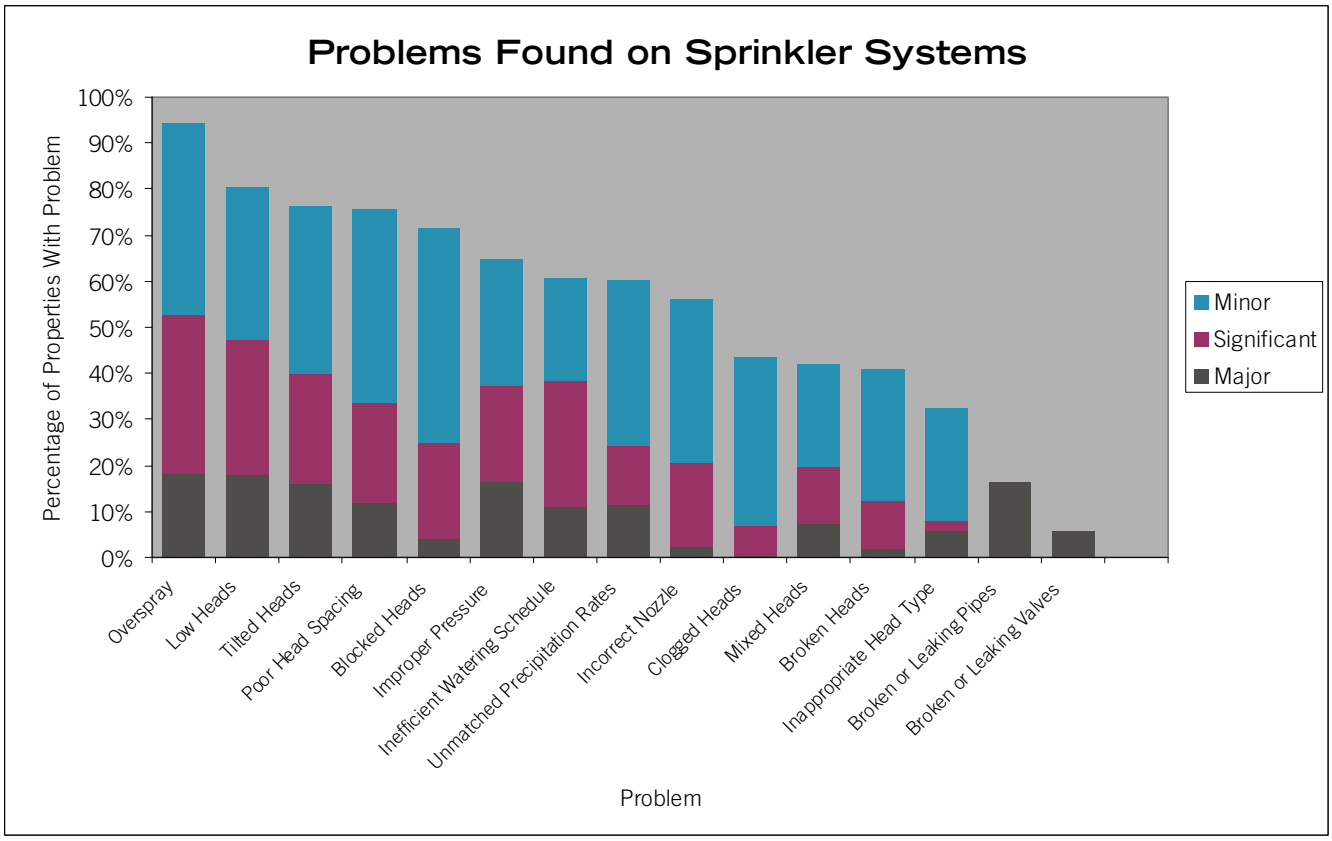
Percentage of Properties Using Cycle and Soak Irrigation	
All Properties	19%

"Many properties were using cycles separated by much more than one hour... such techniques are not ideal."

Many properties did not use cycle and soak irrigation. Anecdotal evidence from CRC auditors suggests that people are not aware of cycle and soak irrigation; once the concept is explained people tend to embrace it. Cycle and soak irrigation is an ideal target for an education campaign because of its substantial benefits, which include: reductions in water waste and non-point pollution, healthier landscapes, and ease of implementation. There is a significant amount of large properties that use the cycle and soak method. This is probably due to cycling becoming better known and an industry standard.

Problems Found on Sprinkler Systems

CRC auditors tracked the types and severity of problems found during inspections. Auditors classified 15 of the most common problems with the scale of none, minor (less than 20 percent of the property), significant (20-50 percent of the property), and major (more than 50 percent of the property). Broken or leaking pipes and valves were rated as either yes (there was a break or a leak), or no.



Problems Found - All Properties				
	Major	Significant	Minor	None
Overspray	18%	34%	42%	6%
Low Heads	18%	29%	33%	19%
Poor Head Spacing	12%	22%	42%	24%
Tilted Heads	16%	24%	36%	24%
Blocked Heads	4%	21%	47%	29%
Improper Pressure	17%	21%	27%	35%
Unmatched Precipitation Rates	11%	13%	36%	39%
Broken Heads	2%	10%	29%	40%
Inefficient Watering Schedule	11%	28%	22%	44%
Incorrect Nozzle	2%	18%	35%	56%
Clogged Heads	0%	6%	37%	58%
Mixed Heads	7%	13%	22%	59%
Inappropriate Head Type	6%	2%	24%	68%

Leaks	Yes	No
Broken or Leaking Pipes	17%	83%
Broken or Leaking Valves	6%	94%

The problems examined by the CRC can be split into two categories: maintenance and design. There is some overlap between the two categories, but overspray, low heads, tilted heads, inefficient watering schedule, blocked heads, clogged heads, broken heads, and both types of leaks are generally considered maintenance problems. Improper pressure, poor head spacing, incorrect nozzles, unmatched precipitation rates, mixed heads, and inappropriate head type are considered design problems.

Overspray was the most common problem, found on over 94 percent of all properties. Overspray problems can often be fixed by changing nozzles to ones with more appropriate or adjustable arcs. More serious overspray problems sometimes require replacing heads or redesigning a zone.

Inefficient watering schedules are often fixed during an inspection.

Low heads, tilted heads, and blocked heads can be fixed with regular system maintenance. All three problems are easy to spot by doing a visual inspection of the sprinkler system while it is turned on. They can be fixed by a do-it-yourself oriented homeowner or by a professional sprinkler company.

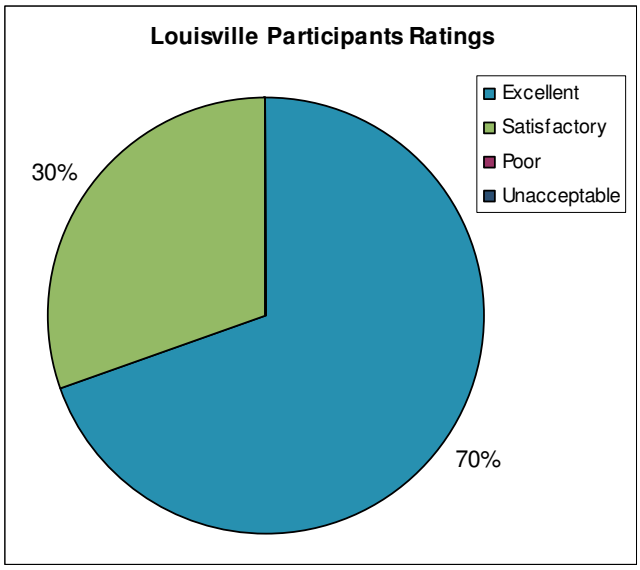
Pressure problems were generally more significant than other problems – if a property had a pressure problem, it was usually a significant or major problem. Pressure problems are usually systematic and affect an entire zone, an entire class of zones, or an entire property.

The final and perhaps most important point from this data is that large properties had significantly more problems than residential properties. All of the problems surveyed were more common and more significant on large properties than on residential properties.

c.) Evaluations

The CRC asked program participants to evaluate the Slow the Flow program. Most program participants were emailed a link to an online evaluation or given a paper evaluation if they did not have an email address. The CRC received 46 responses from Louisville participants, a 41 percent response rate.

When asked "*How would you rate your irrigation inspection?*" 70 percent of participants rated it excellent, and 30 percent rated it satisfactory.



When asked "*Did the auditor display the knowledge and skills necessary to perform the inspection effectively*?" 100 percent of responders answered yes.

In an attempt to tease out themes from evaluation comments, the CRC staff made word clouds of the responses to three open ended questions in the evaluation. A word cloud is an image reflecting the prominence of different words in a set of text. Words that occur more often are large in the image. The CRC would like to thank the website www.wordle.net for this service.

These word clouds are for the evaluations received for the entire Slow the Flow Colorado Program in 2010. The CRC found evaluation themes are similar across cities.

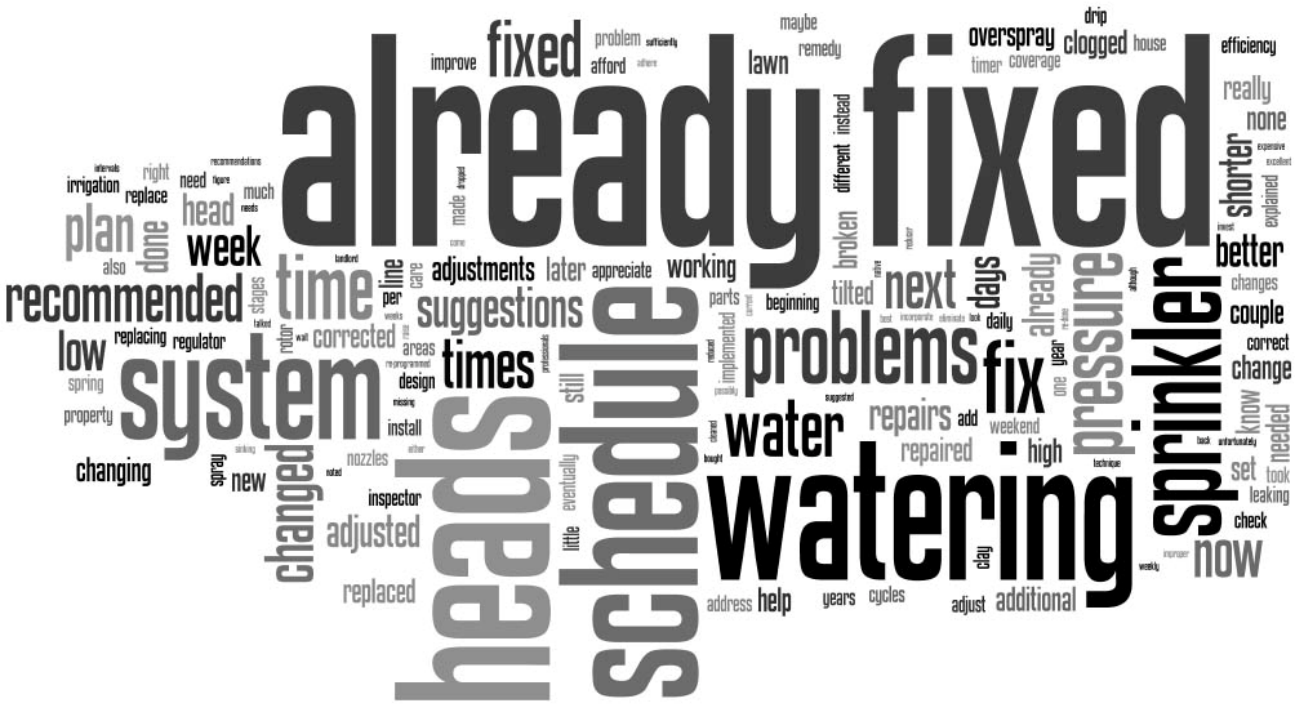
How would you rate your inspection?

People were impressed by how thorough the inspection was, and thought the auditors were knowledgeable. They received a lot of information, and they thought the inspection was professional, good, great, and helpful.

What was most useful about the inspection? What did you learn?

By far, the most common theme was what people learned about their watering schedules; the most common words were “water,” “schedule,” and “cycles.” People also learned about their system and sprinkler heads.

Which problems found with your irrigation system do you plan on fixing, if any?



What information would you have liked to receive that was not covered?

Evaluation Comments:

Below is a small selection of comments from the evaluations.

"The employee was very courteous and explained everything in terms that I could understand, even though I had no previous sprinkler knowledge"

"I want to thank your organization for providing this invaluable and free service. I felt so much better about the watering program I was using and the suggestions that were made. [The auditor] was a great person to work with. He took time to explain the details of his inspection and the paperwork he left with me so that my plant life will do well in the future !!"

"Excellent service. Our grass looks better with less water using your schedule."

"Was really happy with the whole thing and have recommended it to all the neighbors."

"We appreciate this service immensely!"

"[The auditor] did an awesome job! He explained in plain English what he was doing, what the problems were, and what I needed to do to fix them. Great job!"

"[The auditor] was extremely knowledgeable and patient in explaining issues with the system. I didn't know much about my system. [The auditor] showed mw how to set up the cycles on the system properly and broke down how easy it is to change sprinkler heads where there are wrong ones installed. Thank you for your kindness and help!"

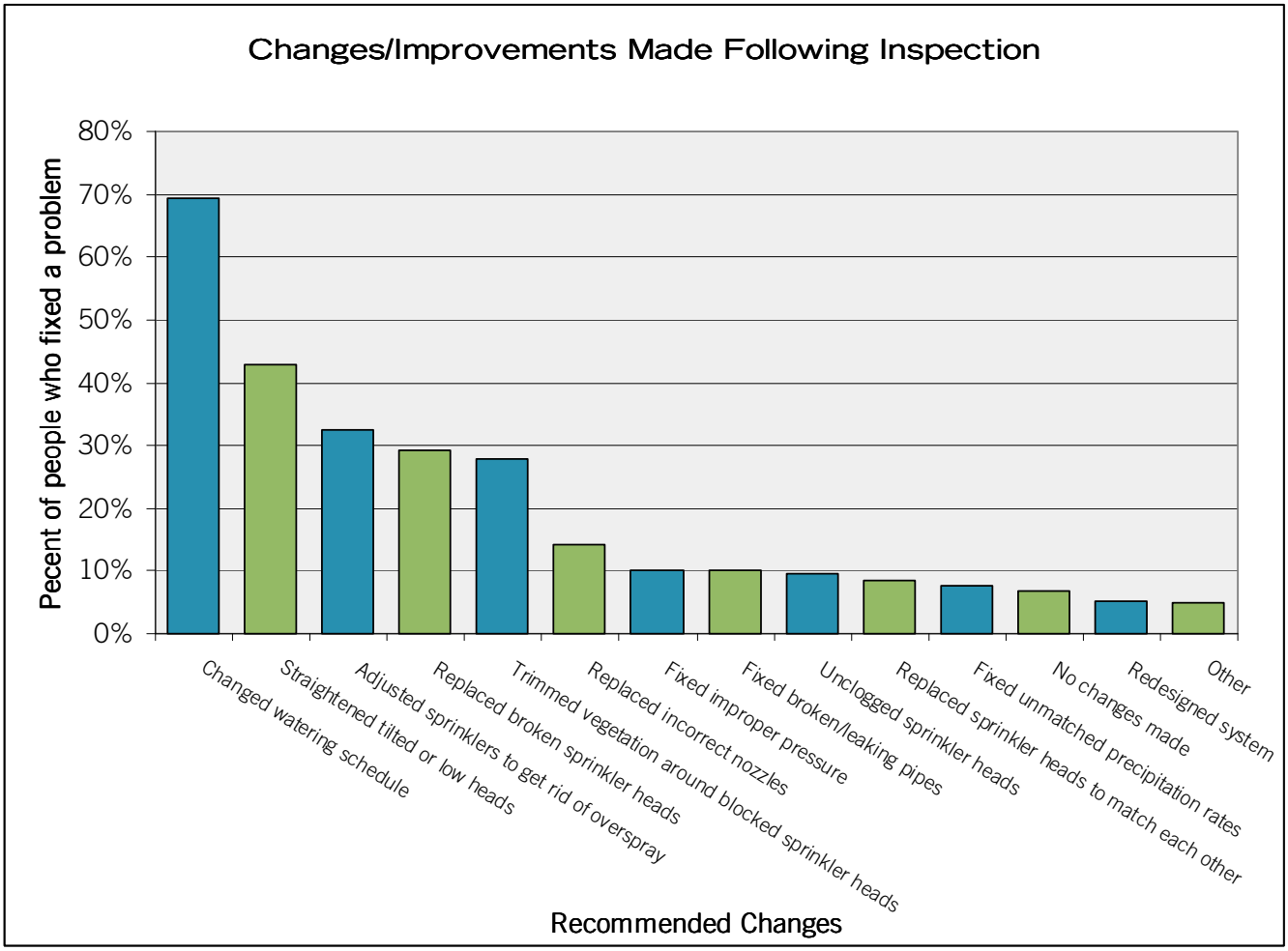
"The Slow the Flow program is a good program and [the auditor] is an excellent representative of the program. She was on-time, personable, and knowledgeable. I will sign up for an irrigation inspection next year. I have already spoken to my immediate neighbors about the program, and hopefully some will sign up for inspections this year or next. I did not expect the level of professionalism I received."

d.) Slow the Flow In-depth Survey of Audit Customers

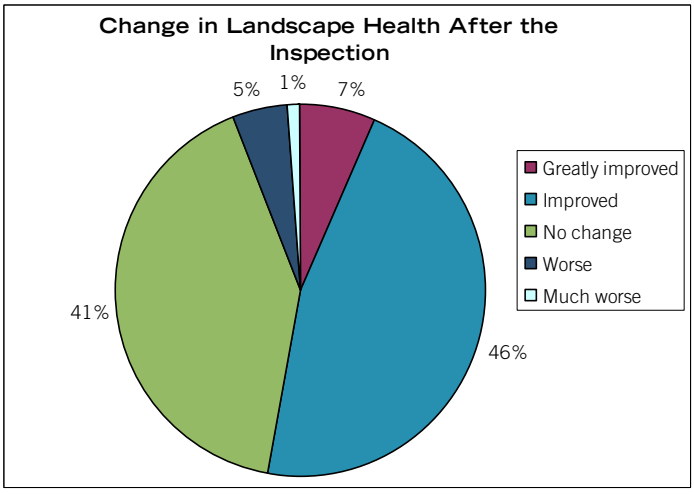
In November of 2010 the CRC sent a follow-up survey to Slow the Flow participants from 2007 to 2010. The goal of this survey was to see the long-term effects of the program on landscape health, watering practices, and system efficiency and maintenance in the years following an audit.

Landscape Information

The CRC asked what improvements people had made based on the results of their inspections and 93 percent of participants made at least one change after they received a Slow the Flow audit. Over 60 percent of participants changed their watering schedule based on recommendations. While 42 percent of homeowners raised and straightened heads and 32 percent adjusted sprinkler heads to get rid of overspray. The problems fixed are in line with the most common problems identified each year by the CRC auditors.



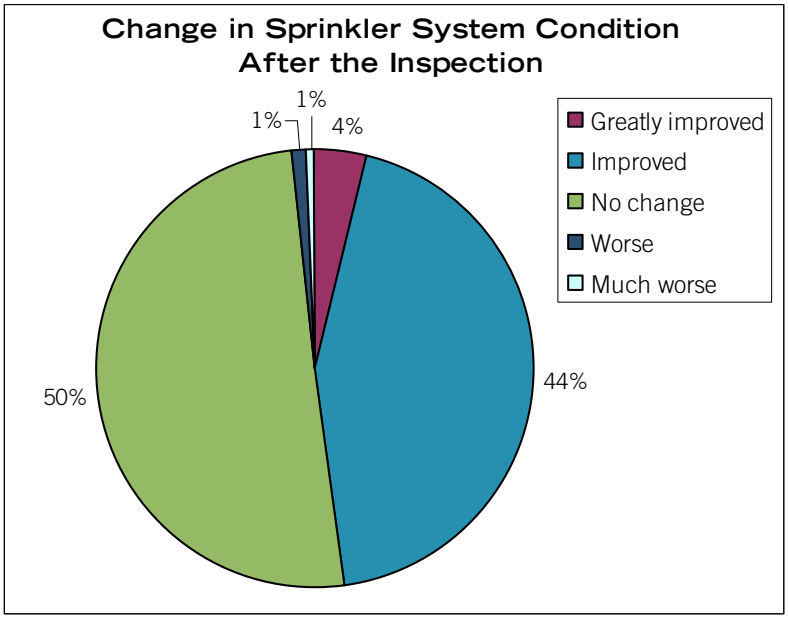
When asked how the health of their landscape had changed since the inspection seven percent, or around 30 people, said their landscape had greatly improved. The majority of people were split between 46 percent seeing some improvement and 41percent seeing no change.



"This definitely helped. I have a greener lawn and use less water. That was my goal."

Sprinkler System Health

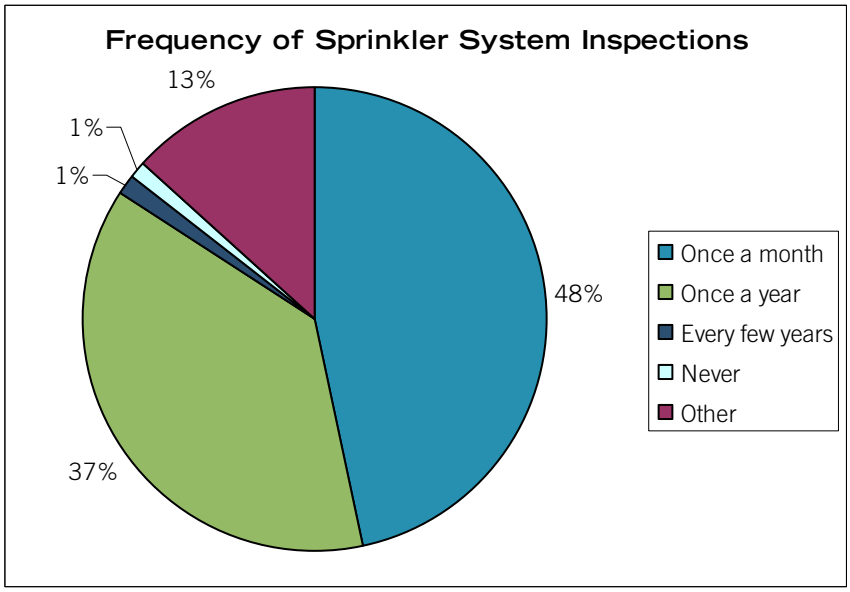
The CRC asked homeowners how the condition of sprinkler system has changed after the inspection. Almost half of all respondents felt that their sprinkler system had improved since their inspection and seven percent felt it had greatly improved. Although many people felt that there was no change, this number could be skewed slightly by participants from 2010 who have yet to make changes to their system. This was apparent in the comments for this question, where participants said they would know more next year.



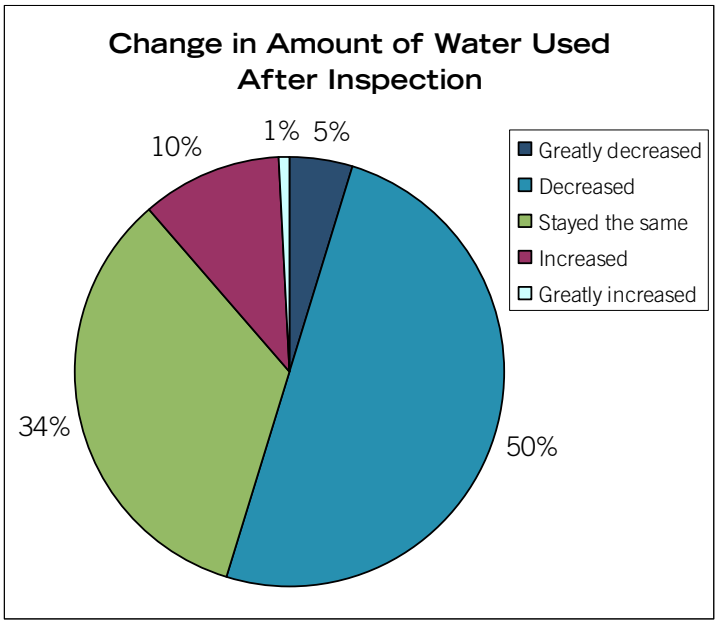
"We understand what we're trying to achieve and when things come up that initiate change, we change them in the way we discussed at the audit."

Frequency of Maintenance

The CRC recommends to homeowners that they do frequent visual inspections to ensure a healthy sprinkler system. When asked how often they check their system for problems 48 percent of homeowners said they check their system at least once a month, while 37 percent check it yearly. In the comments a few recurring themes were that homeowners looked at their system at the beginning and end of the summer, or they have their landscaper look at the system once a year or more.



Watering Practices

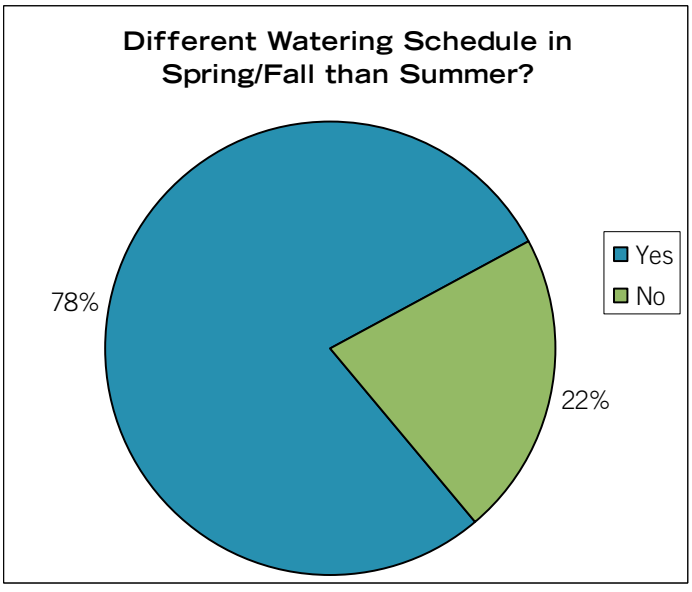


When asked about their watering practices following the audit five percent of people found that they were using a great deal less water, 50 percent found that their water use had decreased, and 34 percent found no change. Eleven percent of people felt their watering increased after the audit. Each year there is a small number of homes that are under-watering prior to the audit. Our schedule is based on evapotranspiration numbers so if a person is watering below ET our schedule may be higher than their current watering practices.

"Absolutely, I water less, use less water and pay less. And my lawn looked great all summer."

One important part of the CRC's recommended watering schedule is adjusting watering times seasonally. Therefore, one of the questions participants were asked was if they did in fact change their watering time in the spring and fall, when the water needs of grass are not as high. The CRC asked for details on how people seasonally adjust their system and the responses were extremely varied. Some people used the seasonal adjust feature on the clock; others reprogrammed the clock based on the season, while others watered fewer days out of the week.

"From the table I was given, I adjust my watering to the time of year and how much water is required to maintain a healthy lawn throughout the year."



Below are sample responses from open-ended questions:

What was the most useful thing you remember learning at the inspection? What has stuck with you?

"To water less frequently, but longer to achieve greater depth."

"How to best use water to reduce waste."

"Fixing sprinkler heads should improve water coverage."

"We water more effectively for the lawn. That has saved water and money."

"Look at ways to save water....eliminating waste!"

"My percentage of efficiency was very low, but with a few changes I was able to double it."

"We do walk our sprinkler system now 1 time per month to ensure all is working as designed. also important to have the correct pressure so the heads work as designed."

"The fact that the soil needs time to absorb the water before giving it more. I went from a soaking system to a short burst three times in a row for each station and that worked beautifully!"

"Less water time per cycle, more frequent cycles to let water soak in and not run off"

"By watering less frequently than I was, I encouraged deeper grass roots and yes, it has promoted a healthier lawn that needs less water."

"The major change was adjusting the watering times so our clay soil could absorb better. The lawn is greener with the same amount of water."

What questions do you still have?

"None had great inspector."

"What rebates can I receive for changes made in my sprinkler? Considering Toro Precision Sprays as well as other water saving methods. Are there adjustable (VAN) precision sprays?"

"I'd like to get information on fertilizing my yard and how to do it with little environmental impact however keep my grass green and limit weeds."

"None. The inspection was very helpful, especially in prompting us to assess our whole approach to water usage."

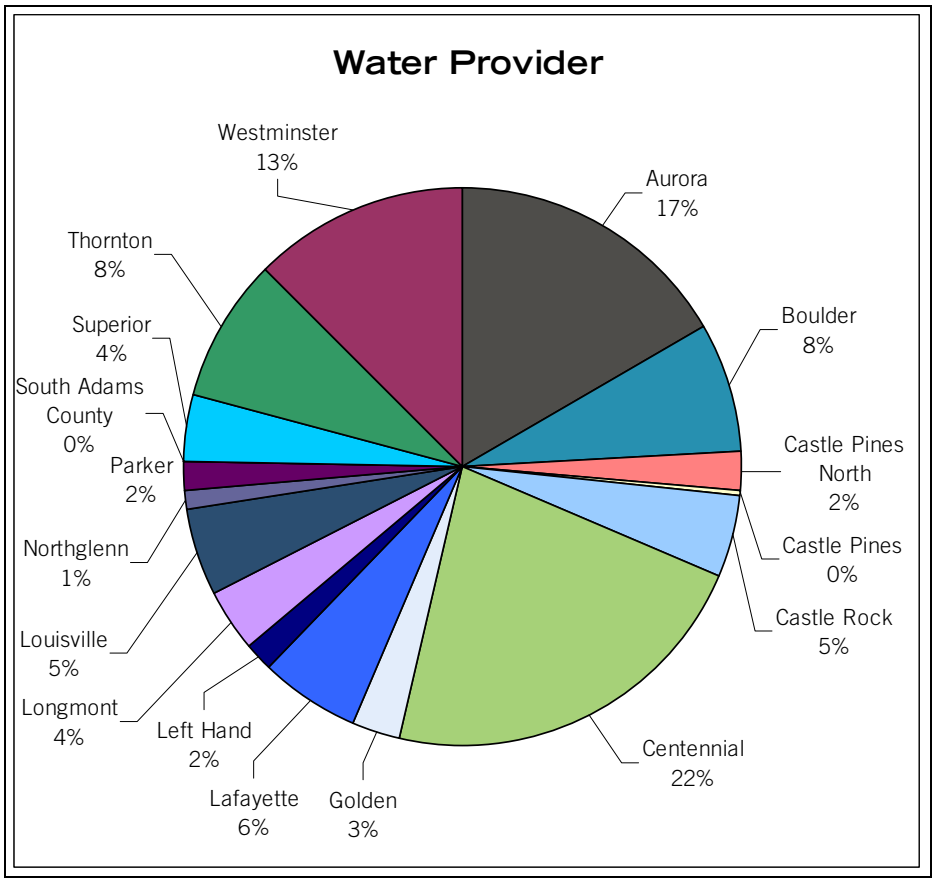
"Still trying to learn the best way to water in Colorado - we have lived here 5 years and the dryness is amazing"

"I wanted to raise some heads but when I got a sprinkler guy out he said I would be wasting his time and my money to do so. I wish you could follow this up with some classes on how to do some of this stuff on our own."

"Knowing bluegrass isn't indigenous to the area and how much water it requires, I'd like more information on supplementing or changing to something less water intensive"

Participant Information

The CRC sent the survey to 2,464 previous Slow the Flow participants with valid email addresses and received 469 responses, a 19 percent response rate. The city breakdown of the survey responses is as follows:



Appendix A: Homeowner Form

CENTER FOR ReSource CONSERVATION

SLOW the FLOW COLORADO

2639 Spruce St.
Boulder, CO. 80302
303.999.3820

What is an Irrigation Inspection?
A landscape irrigation inspection is a series of tests performed on your watering system to determine your system efficiency. This includes how much water your system puts out (precipitation rate), the soil type, which affects infiltration rate, the evenness (distribution uniformity or efficiency) of the water application and the system pressure.

Tune Up Your System
You can tune up your system by fixing the maintenance problems identified in a visual inspection. Turn the system on at least once a month and watch each zone run for a minute or so to make sure the system is working properly. Check for broken, tilted, clogged, or blocked heads and make any needed repairs. Take the time to adjust sprinklers that are not covering the desired area and learn how to change your timer.

Fixing Something? Choose a Certified Contractor
There are no statewide training or certification requirements or irrigation contractors in Colorado, although some cities have certification requirements. However, there are several organizations that provide optional certification programs, and the CRC strongly recommends using a certified contactor. For more information, please see the 'Finding a Landscaper or Contractor' section at the end of this packet.

Soil Type and Slope
Many times irrigation systems apply water faster than the soil can absorb. It is important to know your soil type and adjust your watering to minimize run-off. Slope and thatch also affect run-off.
*Soil Type*_____, *Slope* _____

Precipitation Rate
Precipitation rate (PR) is a measure of how many inches of water per hour your irrigation system is applying. Different head types have different precipitation rates. The precipitation rate determines how long you need to run your sprinklers.
Your precipitation rate is _____*in./hour in spray zones and,* _____*in./hour in rotor zones.*

Distribution Uniformity
The distribution uniformity (DU) is a measurement of an irrigation system's ability to apply water uniformly over the surface of a landscape. Since the amount of water put out by an irrigation system is not completely uniform, some parts of the landscape will receive more water than others. Minor adjustments to most systems can improve distribution uniformity and green up the dry spots.
Your Distribution Uniformity is _____ ***% Spray*** _____ ***% Rotor***.

Water Pressure
Most sprinkler heads apply water most efficiently at a water pressure between 20 and 30 PSI (pounds per square inch) for spray heads and 25-80 PSI for rotor heads. Sprinklers can't cover the desired area if the pressure is either too low or too high. If your pressure is low, try watering when less people are watering or modify your system so there are fewer sprinklers on each valve. High pressure causes misting and wears out your sprinklers faster. If your pressure is high, pressure regulating heads or a pressure regulator can be installed to lower pressure, minimize misting, and maximize irrigation efficiency.
Your Sprinkler head pressure is fixed _____*psi., rotor:*_____*psi.*

Root Depth
For a healthy lawn, roots should be 6 to 12 inches deep. This is accomplished by deep infrequent watering that greatly enhances your lawns ability to withstand extreme temperatures and increased intervals between watering.
Your root system is about _____ *inches deep.*

Evapotranspiration
Evapotranspiration (ET) is one of the most important things to consider when scheduling run times for your irrigation system. ET is the amount of water a plants loses to evaporation and transpiration and is the amount of water needed for the

27 inches of water per year. If the weather is significantly hotter and drier or cooler and wetter than average, you may need to adjust your watering schedule.

Landscape Size and Water Usage

Your landscape has approximately _____ square feet of turf and _____ square feet of non-turf areas. Turf uses an average of 27 inches of water per year in the Denver area, and the *average* shrub bed in Colorado uses roughly 18 inches of water per year. With an efficient irrigation system, it should take roughly _____ gallons of water each year to water your landscape.

Irrigation Scheduling

The following schedule has been completed based upon your soil type, and precipitation rate as well as the historical ET rate (described above). It is meant to serve as a **guide** --- keep an eye on your lawn and make adjustments as needed. Make sure to apply seasonal adjustments while the sprinkler system is in operation.

Cycling

Watering in short cycles, or 'cycling' is important in heavy clay soils, on slopes, or when sprinklers have a high precipitation rate. Run through all zones at one-half or one-third the total time needed (see 'Cycles' on the watering schedule) then re-run the zones again by adding additional start times. This will help prevent puddling and runoff.

Recommended Watering Schedule

This schedule can be used as a GUIDE during non-restrictive years. This schedule is based on the areas of your landscape that tests were performed on. Zones that have the same head types and have other similar features can use the recommended schedule as a base starting point. Adjustments for varying microclimates, such as sun exposure, will have to be made accordingly.

SPRAY ZONES TESTED:
Current Minutes Per Week: _____ Recommended Minutes Per Week: _____

Month	Times/week	Cycles	Minutes	Total Minutes per watering	Total Minutes per week
May	1.5				
June-August	2				
September	1				

ROTOR ZONES TESTED:
Current Minutes Per Week: _____ Recommended Minutes Per Week: _____

Month	Times/week	Cycles	Minutes	Total Minutes per watering	Total Minutes per week
May	1.5				
June-August	2				
September	1				

This program is brought to you through the Center for ReSource Conservation and the following water providers:

Appendix B: Evaluation Form

Irrigation Inspection Evaluation

Dear Customer,

Thank you for your participation in the Slow the Flow Colorado Irrigation Inspection program. The Center for ReSource Conservation (CRC) strives for high quality customer service. The CRC is asking for your input to help improve the Irrigation Inspection program. Your comments are important to us. We would appreciate any feedback, positive or negative. Please answer the questions below and return the questionnaire in the enclosed envelope. If you have any questions or comments that you would prefer to discuss on the phone, please feel free to contact us at (303) 441-3278 ext. 17

Thank you,
Slow the Flow Colorado

_____

1. What city do you live in?_____

2. How would you rate your Irrigation Inspection?

☐ Excellent ☐ Satisfactory ☐ Poor ☐ Unacceptable

Please Explain_____
_____

3. Did the inspector display the knowledge and skills necessary to perform the inspection effectively? ☐ Yes ☐ No

Please explain _____
_____

4. What problems, if any, were found with your irrigation system?

☐ Broken Sprinkler Heads ☐ Tilted Sprinkler Heads ☐ Low Sprinkler Heads
☐ Blocked Sprinkler Heads ☐ Clogged Sprinkler Heads ☐ Broken/ Leaking Pipes
☐ Broken/Leaking Valve ☐ Improper Pressure ☐ Overspray
☐ Incorrect Nozzle (spray distance and pattern) ☐ Unmatched Precipitation Rates
☐ Mixed Heads (Rotors & Spray on same zone) ☐ Poor Design (wrong head spacing)
☐ Inappropriate Sprinkler Head Type for Area ☐ Inefficient watering schedule
☐ Other: Please Explain_____

5. Which of the above problems found with your irrigation system do you plan on fixing, if any? _____
_____
_____
_____

6. What was most useful about the inspection? What did you learn?

_____
_____
_____

7. What information would you have liked to receive that was not covered?_____

_____
_____
_____

Additional Comments:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

May we contact you about the quality of your irrigation inspection?
□ Yes □ No
If you replied yes, please fill out the following information:

Name_____ Phone #_____
Address_____

Inspector: