GARDENING SERIES
Colorado MASTER GARDENER

Irrigation Management: Irrigation Audit

no. 7.759

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To complete the irrigation audit, you will need the following items:

- 6, identical straight-sided, flat bottom cans or cups (do not use tuna or other short cans);
- Watch;
- Ruler;
- Colored flags to mark sprinkler heads by zone;
- Calculator; and
- Screwdriver or soil probe.

Why Do an Irrigation Audit?

For most residents, attention to irrigation efficiency has the greatest potential for water conservation. In the typical home yard, extra attention to irrigation system design, maintenance, and management will reduce water use by 20 percent to 70 percent; 40 percent being average.

The purpose of an irrigation audit is to evaluate the irrigation system design, maintenance, and management. It will identify areas where adjustments will make a minor or major impact on water conservation and lawn quality. Run times for each sprinkler zone will be calculated based on the precipitation rate of each zone. This audit primarily focuses on lawn areas.

The audit is only a tool to help the gardener identify where the system is working adequately and where adjustments need to be made. Actual water conservation will come as findings are incorporated.

Step 1 – Water Normally the Day Before the Audit

Step 2 – Visually Evaluate the Lawn

1. How does the lawn look?
   - ❑ Green (high input lawn)
   - ❑ Green (moderate input lawn)
   - ❑ Green (low input lawn)
   - ❑ Dry spots: _____ percent of lawn
   - ❑ Dry/Dormant
   - ❑ Thick
   - ❑ Thin
   - ❑ Weedy
   - ❑ Weed free
   - ❑ Few weeds
2. Soil conditions
   1. Stick a screwdriver in the ground to get a sense about soil compaction. The ease or difficulty at which the screwdriver can be pushed into a moist soil gives a grasp of soil compaction.
   2. If possible, use a soil probe to get a sense on soil texture, compaction, soil layers, rooting depth, and thatch layer. Note: On compacted or rocky soil, it may be impossible to push a soil probe into the soil. On extremely compacted soils, it may even be impossible to push a screwdriver into the soil.

   • Soil compaction
   - ❑ Little to no compaction (screwdriver/probe readily goes in)
   - ❑ Moderate compaction (screwdriver/probe hard to push in)
   - ❑ Severe compaction (screwdriver/probe extremely difficult to impossible to push in)
   - ❑ Aeration needed to increase infiltration

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Putting Knowledge to Work

- Soil texture
  - ❑ Coarse texture (sandy)
  - ❑ Moderate texture (loamy)
  - ❑ Fine texture (clayey)
- Soil profile
  - ❑ Changes in soil texture evident
  - ❑ Hardpan layer
  - ❑ Evidence of drainage problems (such as surface pooling)
- Thatch layer
  - ❑ Less than 1/2 inch
  - ❑ Greater than 1/2 inch
  - ❑ Aeration needed to manage thatch

3. Current irrigation pattern
   - The lawn is typically watered _____ (days) for _____ minutes
   - During the typical June/July weather, the lawn can go _____ days between irrigation before getting dry.
     – Multiply the number of days (maximum) between summer irrigations by 0.20 to estimate the water holding capacity for the soil and rooting depth at this site. This is the maximum amount of water to apply per irrigation.
     – _____ days x 0.20 inches = _____ inches per irrigation (maximum)
4. Run-off potential
   - ❑ Low potential
   - ❑ High potential (use *soak and cycle* application)
   - ❑ Due to slope
   - ❑ Due to soil conditions (compaction and/or clayey soil)
   - ❑ Due to thatch

Step 3 – Visually Evaluate Flowerbeds, Shrub Areas, and Other Non-Lawn Areas.

1. Is area mulched?
   - ❑ 3-4" wood/bark chips (best for weed control)
   - ❑ 1-2" wood/bark chips
   - ❑ Rock mulch
   - ❑ Other mulch
   - ❑ No mulch
   - ❑ Mulch OK
   - ❑ More mulch needed
   - ❑ Mulch not desirable for site
2. Are plants grouped and irrigated by hydrozoning?
   - ❑ Yes
   - ❑ No
   - ❑ Not applicable to site
   - ❑ Unknown
3. Soil conditions
   1. Stick a screwdriver in the ground to get a sense about soil compaction.
   2. If possible, use a soil probe to get a sense on soil texture, compaction, soil layers, and rooting depth.
      - Soil compaction
        - ❑ Little to no compaction
        - ❑ Moderate compaction
        - ❑ Severe compaction
      - Soil texture
        - ❑ Coarse texture (sandy)
        - ❑ Moderate texture (loamy)
        - ❑ Fine texture (clayey)

- Soil profile
  - ❑ Changes in soil texture evident
  - ❑ Hardpan layer
  - ❑ Evidence of drainage problems

4. What is the current irrigation pattern?:
   - The garden is typically watered _____ (days) for ___ minutes.
   - Is there evidence of water problems?
     - ❑ Moss or mildews
     - ❑ Iron chlorosis
     - ❑ Overly-wet soil conditions
     - ❑ Standing water
     - ❑ Overly dry condition

Step 4 – Current Controller Settings

Record current settings from the controller including watering days, start time(s) and run times. Precipitation rates and inches applied may be calculated in later.

Controller currently set for _____ (month).

Table 3. Step 4 – Current Setting and Inches Applied.

Zone	Zone Identity	Watering day(s)	Start time	Run time	Precipitation Rate	Inches Applied
1						
2						
3						
4						
5						
6						

Step 5 – Identify and Evaluate Irrigation Zones

For details, refer to fact sheet 7.755, *Water-Wise Gardening: Watering Efficiently*.

1. Using a different color flag for each zone, flag the sprinkler heads. (Sprinklers may need to be turned on to find and identify sprinkler heads by zone.)
2. Evaluate the following:

Concept	**OK** – Concept incorporated	**Minor** – Benefits received with minor adjustments or implementation	**Major** – Benefits received with major adjustments or implementation	**Not applicable** to site
Irrigation Zones				
1. Lawn zones separate from flower and shrub bed zones				
2. Lawn areas zoned by irrigation demand (i.e., high input, moderate input, and low input areas on separate irrigation zones)				

3. Zone by exposure (i.e., extreme exposures, full sun, partial shade, full shade, and slopes on separate irrigation zones)				
4. Drip, micro-sprays, or bubblers used in flowerbeds, shrub beds, small fruits, and vegetable gardens				
Design criteria for even water distribution				
5. Sprinklers "line-out" along edge of nonirrigated areas				
6. Check heads for uniformity in kind				
7. Design avoids irrigating small, irregular shaped areas (generally areas less than 10 feet wide)				
8. Rain shut-off sensor or manually turn off water in rainy weather				

Step 6 – Evaluate Sprinkler Performance for Adjustments

For details, refer to the following fact sheets:

- Fact sheet 7.755, *Water-Wise Gardening: Watering Efficiently*
- Fact sheet 7.756, *Irrigation Management: Types of Sprinklers*

1. Turn on sprinklers and evaluate performance as outlined below, repeating steps for each zone.
2. If the lawn has dry spots, compare the amount of water received in cans placed on the dry spot to cans in the green areas during the process.

Sprinkler Performance Evaluation

A. Design criteria for even water distribution.

1. Evaluate head to head coverage – Does the water from each head reach neighboring heads?

Zone	1	2	3	4	5	6
Yes = OK						
No = adjustments needed*						

* In some situations adjusting heads or changing nozzles may correct the problem. In other situations, the system design may need to be upgraded for water conservation.

2. Are sprinkler heads arranged in triangle and square patterns, avoiding pentagon patterns?

Zone	1	2	3	4	5	6
Yes = OK						
No = adjustments needed*						

*The system design may need to be up-graded for water conservation.

3. Is there a mist cloud around sprinkler heads?

Zone	1	2	3	4	5	6
No = OK						
Yes = adjustments needed*						

* A mist cloud indicates excessive pressure. Lower pressure to conserve water. In some situations this may involve installation of an in-line pressure regulator.

B. Maintenance criteria for uniform sprinkler delivery

1. For each head does the delivery angle need adjustments (to avoid spraying the sidewalk, driveway, or other areas outside the zone)?

Zone	1	2	3	4	5	6
No = OK						
Yes = adjustments needed						
Identify heads needing adjustments						

2. Do heads need adjustment to vertical (straight up and down)?

Zone	1	2	3	4	5	6
No = OK						
Yes = adjustments needed*						
Identify heads needing adjustments						

* Heads off vertical will distort the delivery pattern. Adjust to vertical to conserve water.

3. Height – Is nozzle releasing water above grass height?

Zone	1	2	3	4	5	6
Yes = OK						
No = adjustments needed*						
Identify heads needing adjustments						

* When water doesn't clear grass height, distribution pattern may be distorted. Raise head.

4. Worn heads – Look at the fan created by the water spray for each head. Is it uniform around the arc?

Zone	1	2	3	4	5	6
Yes = OK						
No = adjustments needed*						
Identify heads needing adjustments						

* Replace worn nozzles to improve distribution pattern.

5. Replace leaky valves – In the irrigation valve, the rubber diaphragm that actually turns water on and off ages over time. Valves that don't shut-off completely need the diaphragm or entire valve replaced.

Zone	1	2	3	4	5	6
Valve not leaking = OK						
Valve leaking = needing replacement						

Evaluate Dry Spots

If the zone has a dry spot, place some cans (depending on size) on the dry spot and on the green areas. Compare the amount of water received in each can.

Zone	1	2	3	4	5	6
No dry spots						
Dry spot(s) receiving less water than the green areas[1]						
Dry spot(s) receiving similar amounts of water as green areas[2]						

[1]When the amount of water received in dry area cans is significantly less than the green area cans, poor water distribution is a primary contributor. Evaluate irrigation design and maintenance issue.

[2]When the amount of water received in both the green area cans and dry area cans is similar, the problem is not directly related to sprinkler performance. Evaluate other growth factors, including soil compaction, thatch, run-off, insect or disease problems, etc.

Step 7 – Perform Precipitation Rate (Catch Can) Test

For details, refer to the following fact sheet:

- Fact sheet 7.757, *Irrigation Management: Converting Inches to Minutes*

1. Perform a precipitation rate test (catch can test) for each zone. Record the precipitation rates in Table 1, Step 8 (page 8).

Precipitation Rate (Catch Can) Test

To do the calculations you will need six identical, straight-sided, flat bottom, cans or coffee mugs such as soup cans, fruit or vegetable cans, or coffee cans. (Do not use short cans like tuna cans as they are too shallow and water may splash out.) You will need a ruler, a watch, a pen, and paper to record your findings.

Steps

1. Place six identical, straight-sided, flat bottom cans or coffee mugs randomly around the area between sprinkler heads in the zone.
2. Turn on the sprinklers for exactly 10 minutes.
3. Pour all the water into one can.
4. With a ruler, measure the depth of the water in the can. This is your precipitation rate in inches per hour.
5. Write down the rate for each zone in Table 1, Step 8, (page 8).
6. Repeat steps 1 through 5 for each irrigation zone.

Step 8 – Calculate System Run Times for Each Zone

For details, refer to the following fact sheets:

- 7.755, *Water-Wise Gardening: Watering Efficiently;*
- 7.757, *Irrigation Management: Converting Inches to Minutes;* and
- 7.758, *Irrigation Management: Methods to Schedule Irrigation.*

Considerations

Soak and Cycle – Most clayey and compacted soils can't absorb water as quickly as sprinklers apply it. Many clayey soils, typical of the Front Range, absorb about ¼ inch of water per hour. Therefore, the most effective watering schedule on these soils would be to set each zone to deliver no more than ¼ inch per cycle with multiple cycles. For example, if the lawn is to have ½ inch of water, set the controller to apply ¼ inch and an hour later apply the second ¼ inch. If the lawn was to have ¾ inch, set the controller to apply ¼ inch per cycle with 3 cycles.

Soak and cycle is particularly helpful on slopes to avoid wasteful surface runoff.

If the amount of water in some containers is significantly more or less than others, it indicates that the system is poorly designed or the head(s) are malfunctioning.

Zone		1	2	3	4	5	6
No Need for "Soak and Cycle"	No						
	Yes						

Watering time – Water between 9 p.m. and 9 a.m. (However, not just at 4 to 6 a.m. Many communities experience peak water use from 4 to 6 a.m. as many sprinklers come on.)

Irrigation start time: _____

Water deeply and infrequently to encourage deep rooting. Lawns can be effectively watered with frequent light irrigations or infrequent heavy watering. Heavy infrequent irrigation, to the extent allowed by the soil and rooting depth, has the advantage that it encourages deeper rooting, giving the lawn more resilience to hot, dry, windy weather and helps drought out shallow rooted weeds.

Maximum amount of water to apply per irrigation is _____ inches (see Step 2). Additional amounts would leach below the rooting zone.

Irrigation Schedule – Now that you have the precipitation rates for each zone, calculate the run time for each zone based on the checked irrigation scheduling option.

- ❑ Observational method – Activate system when lawn shows water stress (color change to grayish-blue and foot prints show a hour after walking on it.)
- ❑ Adjust for season – Historical ET method
  - Water every _____ day
  - Water on _____
- ❑ Real-Time ET – Fixed Day Method
  - Water every _____ day
  - Water on _____
- ❑ Real-Time ET – Fixed Amount Method
  - Amount per irrigation _____ inches

Table 1. Step 8 – Irrigation schedule by zone.

Zone			April*	May	June	July	Aug.	Sept.	Oct.
	Inches of water per week (Historical ET)		0.9"	1.1"	1.4"	1.5"	1.2"	0.9"	0.6"
	Watering days								
	Start time								
1	Precipitation rate _____ "/hr	Inches to apply							
		Run time							
2	Precipitation rate _____ "/hr	Inches to apply							
		Run time							
3	Precipitation rate _____ "/hr	Inches to apply							
		Run time							
4	Precipitation rate _____ "/hr	Inches to apply							
		Run time							
5	Precipitation rate _____ "/hr	Inches to apply							
		Run time							
6	Precipitation rate _____ "/hr	Inches to apply							
		Run time							

* Typically, irrigation starts in May

Step 9 – Set Controller Based on Precipitation Rates and Management Options

Set controller based on information calculated in Step 8, Table 1.

Step 10 – Compare New Controller Setting to Previous Controller Settings (Optional)

Calculate water application from the original controller setting (Table: Step 4).

Compare application rates to the new setting. What is the percent change in delivery?

Step 11 – Summary

The audit is only a tool to help the gardener identify where the system is working adequately and where adjustments need to be made. Actual water conservation comes as findings are incorporated.

When irrigation is done at night, it is easy to miss adjustments and system problems. Periodically turn on the system to evaluate performance.

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