G1859

Stormwater Management: Landscape Water Conservation

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This publication, part of a series addressing stormwater issues, focuses on water conservation and water runoff from landscapes and their importance to the overall issue of stormwater management.

Any discussion of water issues must address both water quality and water quantity. Using water wisely on lawns and landscapes is an important practice for homeowners in the dry prairie states where water resource depletion is a serious concern due to the growing demand for water by urban and rural populations. As populations grow, usage of water for home landscapes also grows and is putting new strains on available water resources. However, homeowners still can have beautiful landscapes that conserve water.

Regardless of whether water is supplied by a municipal water system or by a private well, it is drawn from either surface or ground water sources. Homeowners purchasing water from their town or city may limit their landscape water usage to prevent high water bills. Homeowners with private wells, however, may be tempted toward high landscape water usage since their water is "free." All homeowners must understand the greater environmental impact of high landscape water usage, the necessity to use water sparingly, and conserve ground and surface water resources for future generations.

Important questions to understand about watering a home landscape include:

- how landscape water is lost during irrigation
- how to adjust irrigation techniques based on soil type
- when is the best time of day to irrigate
- what is the best irrigation equipment to use to conserve water
- which plants can be used to create a beautiful landscape that use water more efficiently

How Is Water Lost During Irrigation?

Many common watering practices result in a large percentage of water lost to evaporation or runoff. For example:

- Water is lost as runoff when it is applied too quickly for the existing soil type or to already saturated soils.
- Runoff also occurs when water is applied to hard, impermeable surfaces, such as sidewalks, driveways, streets, or compacted soil.

Figure 1. Shallow tree rooting in an over-irrigated lawn.

- A large percentage of irrigation water is lost to evaporation if applications are made during the hottest, windiest parts of the day, especially when oscillating or impact sprinklers are used that spray water up into the air.

Water also is unavailable for plant use when it percolates below the depth of the plant's root zone because it is applied too quickly or in excess of the plants' needs.

Efficient water use involves the quantity of water used, when it is applied, how it is distributed to the lawn and garden, and how it can be conserved through techniques such as mulching and plant selection.

How Much Water to Apply

Always water landscape plantings, including lawns, thoroughly and deeply to promote the growth of deeper, more drought tolerant root systems. Frequent light and shallow, or daily water applications actually harm plants by encouraging the development of shallow, weak root systems that depend on constant surface watering. Plants with shallow root development are more vulnerable to drought, winter's extreme temperature fluctuations and wind stress *(Figure 1)*. Daily applications of water also can result in a shallow layer of constantly saturated soil, resulting in root dieback and runoff during rain events.

However, if water is applied too heavily at a single application it is forced below the depth of the plant's root system and is wasted. This happens most commonly on sandy soils.

When irrigating turfgrass, ornamental annuals and vegetables the upper 5 to 6 inches of soil should be moistened. Herbaceous perennials should be watered to a depth of 8 to 10 inches, and woody trees and shrubs to a depth of 12 to 18 inches.

Most plants, including turfgrasses, ornamental annuals and perennials, trees and shrubs, and vegetables, require 1 to 1 1/2 inches of water per week, although applications must be adjusted according to the type of plants being irrigated, the soil texture and microclimate they are growing in, and the season of the year. When irrigation is needed turfgrass applications usually are broken up into two to three weekly applications of 1/2 inch each. Woody plants and most ornamentals require 1 inch of water applied in a single, weekly application. Vegetable plants require at least 1 inch of water per week. Determine when to water by scratching the soil. If the top 1 to 2 inches of soil is dry, then the vegetable garden should be watered.

Plant water requirements are a total of any natural precipitation received, plus irrigation. Don't forget to turn off automatic irrigation systems if enough rain has been received within a week to meet plant water requirements.

When installing in-ground irrigation systems, lawn areas and landscape beds should be zoned separately due to the differing needs of each plant type. Sunny and shaded areas of the landscape also should be zoned separately. Older irrigation systems may need to be updated to separate the irrigation of lawns and landscape beds.

How to Measure Water Applications

An easy way to measure the water output of irrigation heads or sprinklers is to scatter several straight-sided cans, such as coffee, cat food or tuna cans, throughout an area 10 to 15 feet apart (but no more than 15 feet apart), then run the sprinklers or irrigation system for at least 15 minutes. Afterward use a ruler to measure the amount of water in each can. *Table I* explains how to determine the amount of water applied by an irrigation system run for 15 minutes.

Table I. Water depths obtained from the Catch-Can Test run for 15 minutes in order to determine the system's watering rate.

Can Number						*Total Water*
1	*2*	*3*	*4*	*5*	*6*	
3/8”	7/16”	5/16”	5/16”	3/8”	7/16”	36/16”

Average Depth (Inches)
Divide 36/16” by 6 cans = 6/16” or 3/8”
Average depth of water measured is 3/8” in 15 minutes.

The information in *Table II* can be used to determine the number of minutes to run an irrigation system to apply the proper amount of water. For example, assume an irrigation system applies an average of 3/8” in 15 minutes. Go to the 3/8” value to determine the time needed for the system to apply 1 inch of water. Below the 3/8” value is the number 40. This is the number of minutes the system needs to apply an average of 1 inch of water. Determine the total irrigation run time needed to achieve 1/2 inch of water per application, however, based on the area's soil type and infiltration rate several smaller applications may need to be done to achieve deep irrigation without runoff.

Also consider whether water is being applied uniformly throughout the area. If not, adjust irrigation heads as needed, or if necessary add additional sprinkler heads.

Table II. Total run time needed for a system to apply an average of 1 inch of water, after you have measured the water delivered in 15 minutes.

	Irrigation System Watering Rate										
	1/8”	*3/16”*	*1/4”*	*5/16”*	*3/8”*	*7/16”*	*1/2”*	*9/16”*	*5/8”*	*11/16”*	*3/4”*
Time (min.)	120	80	60	48	40	34	30	27	24	22	20

Adjust Water Applications According to Soil Type and Topography

Clay soils have high water holding capacity but slow water infiltration rates, usually .10 to .25 inch per hour. For this reason water should be applied slowly enough to avoid runoff, or applied in multiple light applications. Clay soils may require two or more light applications **within one day** to apply the total amount of water desired while avoiding runoff or standing water.

Loam soils have a moderate water holding capacity and an infiltration rate of .25 to .50 inch per hour. Loam soils are preferred for horticultural purposes because of these characteristics.

Sandy soils have the fastest water infiltration rates at .50 to .75 inch per hour, but low water-holding capacity. Water can be applied to sandy soils more quickly with less chance of runoff; however, any water applied beyond the water-holding capacity of the soil is lost as it moves below the plant's root zone. More frequent applications may be necessary to provide plants growing in sandy soils the continuous amounts of water needed for good growth.

Measuring Water Infiltration Rates

To measure the water infiltration rate for the soil in your landscape, cut the top and bottom out of a coffee can. Mark the inside of the can in 1 inch increments. Insert one end of the can into the soil. Be sure it goes through both turf and thatch. Check that water does not seep laterally from the can. Fill the can with water and allow time for all of it to drain into the soil. Then add water to the 2 inch mark on the can. Now measure the time for this water to sink into the soil. Divide this elapsed time by two. The number you get will be the infiltration rate for your lawn, i.e., the rate for 1 inch of water to enter your soil. Adjust your irrigation system to apply water at this rate.

Slopes require special attention when watering, because water runoff due to the pitch of the ground significantly impacts water infiltration rates. Water tends to run off before it has the chance to infiltrate into the soil unless it is applied very slowly. Soil erosion also is a common problem on slopes, particularly if a well-established groundcover is not in place to hold the soil and slow the rush of water down the slope.

If possible, aerate the slope annually to improve water infiltration and encourage root development to prevent soil erosion. Place sprinklers at the top of the slope and allow gravity to pull water down to the slope's base, but apply the water very slowly.

When to Water

The most efficient time of day to water is early morning from 4 a.m. to 10 a.m. At this time, sunlight intensity and air temperatures are low and winds usually are lower than later in the day. All this results in less water lost to evaporation. Plus, by watering in the morning plant leaves have time to dry before evening, resulting in fewer disease problems.

Avoid watering on a pre-set schedule. Light intensity, temperature, humidity levels, and wind speeds all play a role in how quickly water evaporates or is used by plants. Instead learn to recognize the signs of thirsty plants and dry soil, then water as soon as dry conditions are apparent. Plant foliage often changes color to a dull blue-green at the first sign of a water deficit. This is followed by wilting and, in the case of turfgrass, failure of leaf blades to spring back when stepped on. Landscapes often have dry spots. These areas can be useful in providing an early indication of soil moisture levels and dry conditions.

Adjust your watering schedule as the seasons change. Over-watering is common in spring and fall when summer irrigation schedules have not been adjusted to the cooler temperatures.

Watering Equipment

Many types of watering equipment are available to homeowners. All types, even conventional oscillating or impact sprinklers, should be adjusted to avoid applying water to hard, impermeable surfaces, such as driveways, sidewalks, and streets. Also consider installing a backyard rain gauge. It is a good way to measure rainfall and avoid unnecessary watering. Or consider rain harvesting, using rain barrels, to conserve and recycle water.

Drip irrigation is 90 percent efficient and a great way to provide water and prevent evaporation loss. Water is slowly applied at the soil surface (measured in gallons per hour versus gallons per minute for spray irrigation) to individual plants and is most commonly used for trees, shrubs, and landscape beds. Water is not sprayed up into the air or to large areas around plants, and narrow or oddly shaped areas can be irrigated efficiently. Drip irrigation also helps decrease foliar diseases since water is applied to the soil and not to plant leaves. Soaker hoses or "leaky pipes" are the least expensive form of drip irrigation available for home landscape plantings. They weep or drip water through the sides of the hose wall. Soaker hoses can be coiled through a landscape planting and buried under mulch. They also can be automated through the addition of a battery-operated timer/valve at the hose connection.

Single plant drip emitter systems supply water through a series of plastic pipes, carrying a low flow of water at low pressure. Pressure regulating drip emitters provide the same amount of water to all emitters along the length of a pipe. Each plant receives only the water it needs, applied at the soil surface, resulting in very little water lost to evaporation. Systems can be expanded over time and emitters can be moved along the length of the pipe as plants die or are rearranged.

Traditional in-ground irrigation systems are less water-efficient, 50 to 70 percent, when compared to drip systems. A well designed system providing a uniform application of water is important so that no dry spots occur. Ideally, spray patterns should overlap one another to assure uniform coverage. Systems often are designed with fewer spray heads to reduce costs, but poor efficiency and coverage normally result. Heads should be selected that: are adjustable in coverage to minimize unwanted overspray, spray water at a low trajectory to minimize wind evaporation and pattern distortion; are matched in precipitation rates so that consistent water application occurs throughout every zone regardless of elevation changes. In addition, be sure that the system operates at the proper pressure. Overly high pressure creates misting which significantly increases evaporation potential.

Monitor systems to ensure that water is applied evenly throughout the landscape. Install irrigation system controllers such as rain sensors that prevent sprinkler systems from turning on during and immediately after rainfall. Or use sensors that activate sprinklers only when soil moisture levels drop below a pre-set level. When considering options for system draining in freezing climates, automatic drain valves that drain pipes at every shutoff should be avoided to minimize water loss. Instead, have the system blown out with compressed air each fall. Heads at low system points also will drain water after the system shuts down. For these locations, install spray heads with check valves that seal off water loss at low pressures.

Both drip irrigation and traditional in-ground irrigation systems should be monitored on a regular basis and receive annual maintenance. Watch for low water pressure problems and soggy areas in the landscape that may indicate a broken head or damage to the water line. Replace damaged heads or clogged emitters and redirect poorly targeted spray heads. Also monitor the irrigation system over time as the landscape matures. Taller plants may eventually block or distort spray patterns, requiring adjustment of individual heads.

Mulching

Organic mulches, including hardwood chips, bark chips, shredded bark, composted leaves, and grass clippings, are useful in retaining soil moisture by reducing evaporation. Mulch also helps slow down water runoff in the landscape and garden and reduces weed growth. Apply a 2 to 3 inch layer of mulch to ornamental annual and perennial plantings and a 3 to 4 inch layer of mulch around trees and shrubs.

In high traffic areas, use porous paving materials such as brick-in-sand patios, and paver or flagstone walks, which allow water to percolate through and into the soil beneath.

For more information, refer to NebGuide G1257, *Mulches For The Home Landscape*.

Plant Selection

When selecting plants consider drought tolerance along with shape, color, and function. Choose plants with the ability to tolerate periods of drought or low rainfall. A good place to start is with native plants because they have evolved to grow in harmony with the environmental and weather extremes of the prairie states. Non-native plants also can be used in a water-conserving landscape, but make sure they are well-adapted to Nebraska's hot, humid, dry summers and cold, dry winters.

When selecting landscape plants, keep the axiom ***"right plant, right place"*** in mind. All plants should be chosen to fit the microclimates your landscape has to offer. For example, choose plants that thrive or tolerate shade to grow in the shadow of taller trees. Choose plants that grow well in full sun, for those hot, sunny areas. Don't chose a plant that looks great in a catalogue, then try to find a place for it to fit in your landscape without first considering if your landscape has the right conditions for that plant to grow well. This strategy often backfires, and even plants with great disease resistance can have problems if forced to grow in the wrong environment.

If plants with varying water requirements are used, consider grouping those with similar water requirements together in common locations so that water use and plant health can be maximized. If higher water usage plants are used, such as hybrid tea roses, group them together in one area of the landscape so they can be watered separately as needed, preventing plants with lower water requirements receiving too much water.

Selecting drought tolerant plants will reduce the need for supplemental irrigation *(Table III)*. Finally, choose plants with good disease and insect resistance. They will require less fertilizer, pesticides, and water for good growth, thus minimizing water usage and eliminating some of the common chemical sources of landscape runoff pollution.

Table III. Low Water Use Plant Varieties Recommended for Nebraska.

Trees

Acer ginnala — Amur Maple, 25 ft
Acer platanoides — Norway Maple, 50 ft
Aesculus glabra — Ohio Buckeye, 40 ft
Carya spp. — Hickory, 45 ft
Celtis occidentalis — Common Hackberry, 60 ft
Cercis canadensis — Eastern Redbud, 20 ft
Crataegus crusgalli var. *inermis* — Thornless Cockspur Hawthorn, 20 ft
Crataegus phaenopyrum — Washington Hawthorn, 25 ft
Ginkgo biloba — Ginkgo, 60 ft (male cultivars)
Gleditsia triacanthos var. *inermis* — Thornless Honeylocust, 60 ft
Gymnocladus dioicus — Kentucky Coffeetree, 60 ft
Juniperus spp. — Junipers, 25-35 ft
Koelreuteria paniculata — Golden Raintree, 30 ft
Maclura pomifera — Osage-orange, 50 ft (thornless male)
Malus cultivars — Crabapple, 15-25 ft
Phellodendron amurense — Amur Corktree, 35 ft
Picea pungens — Colorado Spruce, 50 ft
Picea glauca var. *densata* — Black Hills Spruce, 45 ft
Pinus aristata — Bristlecone Pine, 20 ft
Pinus banksiana — Jack Pine, 35-40 ft
Pinus cembroides — Pinyon Pine, 20 ft
Pinus flexilis — Limber Pine, 40 ft
Pinus ponderosa — Ponderosa Pine, 60 ft
Pinus resinosa — Red Pine, 50 ft
Pseudotsuga menziesii — Douglas Fir, 50 ft
Quercus coccinea — Scarlet Oak, 65 ft
Quercus imbricaria — Shingle Oak, 40 ft
Quercus gambelii — Gambel Oak, 20-30 ft
Quercus macrocarpa — Bur Oak, 50 ft
Quercus muehlenbergii — Chinkapin Oak, 40 ft
Quercus velutina — Black Oak, 55 ft
Quercus bicolor — Swamp White Oak, 50 ft
Robinia pseudoacacia — Black Locust, 60 ft
Syringa reticulata — Japanese Tree Lilac, 20-30 ft
Taxodium distichum — Baldcypress, 50 ft

Shrubs

Amelancher alnifolia — Saskatoon Serviceberry, 6 ft
Amorpha canescens — Leadplant, 8-20 ft
Aronia melancarpa var. *elata* — Black Chokeberry, 10 ft
Berberis × *mentorensis* — Mentor Barberry, 7 ft
Berberis thunbergii — Japanese Barberry, 7 ft
Caragana arborescens — Siberian Peashrub, 15-20 ft
Ceanothus americanus — New Jersey Tea, 3 ft
Cercocarpus montanus — Mountain Mahogany, 12 ft
Chaenomeles spp. — Flowering quince, 3-6 ft
Chrysothamnus nauseosus — Rabbit Brush, 4 ft
Cornus mas — Corneliancherry Dogwood, 20 ft
Cornus racemosa — Gray Dogwood, 12 ft
Cotinus coggygria — Smoketree, 15 ft
Hamamelis virginiana — Common Witchhazel, 15 ft
Juniperus spp. — Juniper, 10-15 ft
Kolkwitzia amabilis — Beautybush, 10 ft
Ligustrum spp. — Privet, 15-20 ft
Lonicera × *'Emerald Mound'* — Emerald Mound Honeysuckle, 2 ft
Physocarpus opulifolius — Common Ninebark, 10 ft
Pinus mugo — Mugo Pine, 5-15 ft
Potentilla fruticosa — Potentilla, 1-4 ft
Prunus besseyi — Western Sandcherry, 4 ft
Pyracantha coccinea — Scarlet Firethorn, 6 ft
Rhus spp. — Sumac, 6 ft
Ribes spp. — Currant, 3-6 ft
Rosa rugosa — Rugose Rose, 4 ft
Sambucus candensis — Elderberry, 8 ft
Shepherdia argentea — Silver buffaloberry, 6-10 ft
Spiraea spp. — Spirea, 1-5 ft
Symphoricarpos occidentalis — Western Snowberry, 3-4 ft
Symphoricarpos orbiculatus — Coralberrry, 3 ft
Syringa spp. — Lilac, 10 ft
Viburnum lantana — Wayfaringtree, 10 ft
Viburnum lentago — Nannyberry, 25 ft
Viburnum prunifolium — Blackhaw Viburnum, 15 ft
Yucca glauca — Soapweed, 3 ft
Yucca filamentosa – Adams Needle or Yucca, 3 ft

Forbs (wildflowers and perennials)

For more information refer to NebGuide G1214, *Perennials In Water-wise Landscapes*

Achillea spp. — Yarrow
Antennaria species — Pussytoes
Artemisia spp. — Artemisia
Aster novae-angliae — New England Aster
Asclepias tuberosa — Butterfly Milkweed
Baptisia spp. — False Indigo
Coreopsis spp. — Coreopsis cultivars
Dalea purpurea — Purple Prairie Clover
Echinacea purpurea — Purple Coneflower
Gaillardia species — Blanket Flower
Hemerocallis spp. — Daylily
Iris spp. — Iris species
Liatris spp. — Gayfeather
Monarda species — Beebalm
Sedum spp. — Sedum
Sempervirens spp. — Hens-N-Chickens

Ornamental Grasses

Andropogon gerardii — Big Bluestem
Bouteloua curtipendula — Sideoats Grama
Calamagrostis acutiflora — Feather Reedgrass
Eragrostis tricbodes — Sand Lovegrass
Miscanthus spp. — Eulaliagrass
Panicum virgatum — Switchgrass
Pennisetum spp. — Fountaingrass
Schizachyrium scoparium — Little Bluestem
Sorghastrum nutans — Indiangrass

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