



How to Retrofit Irrigation Systems from Lawns to Trees

Tom Bressan from
The Urban Farmer Store

New Products, Systems and Use Issues

Lawns and Trees

System and planting under new WELO Rules

Types of drought modifications

Loss of water and Soil

Drip with mulch

Sprinkler Remedies



Why convert sprinklers to drip?



- Misting and overspray often occurs in landscapes using traditional spray irrigation.
- New laws require drip on areas adjacent to property lines.
- Drip irrigation uses less water and at a slower rate eliminating runoff.
- It places water under the mulch and right at the plant.
- Many water agencies are supporting this conservation effort.

Sprinkler to Drip Conversion

- This and other Handouts available at our table. — step-by-step instructions

Sprinkler to Drip Conversion

Why convert?

Drip irrigation is the most efficient means of watering everything in your garden. A drip system can deliver water directly to the plant's root zone. Sprinkler systems tend to waste some water through run-off on slopes and unintentional spraying of pathways, sidewalks and buildings. Drip irrigation converts a high-pressure stream to a slow emission of droplets that can be placed exactly where water is needed.

Water savings result due to the precision of drip irrigation. Unlike sprays and sprinklers, there is no evaporation loss, and the amount of water each plant receives can be tailored to suit its needs. As shrubs and perennials mature and grow, they often block the distribution pattern of sprinklers and prevent water from reaching the intended spots. With drip irrigation, water is delivered to the base of each plant, avoiding interference from leaves, branches and objects.

Conversion of a sprinkler system to drip irrigation at the spray head allows us to use the existing timer, control wire, valve and lateral lines (pipes). It provides a simple way to convert spray systems to drip eliminating runoff and overspray. The unneeded sprays can be sealed off with a simple-to-install universal cap off device.

The virtues of drip extend beyond its water-efficiency. It is by far the best method of deep watering. If a plant grows on a slope, drip will maximize the amount of water available to its roots because the slow delivery of water won't run off the surface before having a chance to penetrate the soil. Moreover, sprinklers wet foliage, trunks, and flower petals, which can shorten the life and degrade the appearance of certain plants by encouraging rot.

Drip is also the preferred method of watering vegetable gardens. The original impetus for the use of drip irrigation in agriculture was not water savings but rather the greatly increased plant growth

that it encourages. Drip decreases soil compaction, keeps soil moisture close to ideal levels and reduces weed growth between rows.

Full drip conversion

One or more zones of an existing sprinkler system can be completely converted to a conventional drip system. The first step is to insert a filter and pressure regulator near the beginning of the system. The best place is often right after the control valve, and you can usually use a "Slip-Fix" expanding coupling to simplify the installation. The existing underground pipe continues to distribute the water, and saves a lot of digging.

Sprinkler heads are removed and replaced with parts, including a PVC (white plastic) fitting, and special compression adapters. Flexible, black polyethylene (PE) tubing, attached in place of the sprinkler heads, allows the use of standard drip irrigation devices to deliver water to your various plants. Add emitters, misters and micro sprays as needed. Remove and cap sprinkler heads not needed for drip. Using this method, one filter and pressure regulator can serve hundreds of emitters. Drip lines can be left on the surface, or covered by a layer of soil or mulch to become invisible.

Partial drip conversion

Alternatively, a filter and pressure regulator can be attached to a sprinkler riser and the drip system laid out from this point. The main drawback to this method is cost. If you wish to use several risers as take-off points for the drip system, you will need to purchase a filter and pressure regulator or retrofit body for each riser.

Sprinkler body retrofit

For partial conversion applications, Rain Bird provides a sprinkler body replacement, which contains a filter, and pressure regulator. Just unscrew the old sprinkler body and screw on the retrofit body.

The Agrifim CAP POP/25 caps off most spray heads, without digging! Use when converting spray head zones to drip irrigation and to cap off spray heads that are no longer necessary after plantings become established.



The Agrifim Conversion Kit features a 30PSI regulator, 150 Mesh filter, and a flow of 300gph. The unit works with all types of spray head zones. Its low profile design allows connection to the tubing at the desired grade and in provided tee or elbow configurations.

Rain Bird. Sprinkler to Drip Retrofit Body
200 gph maximum capacity per unit.



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Use what you can of existing system

- If the valve works use it for the new system.
- If the valve works from the controller then the wiring is good.
- The timer works but might be replaced with one with better features and is self adjusting.
- The existing sprinkler lines can be used when the sprinklers are removed to be the point of connection(s) for the new drip system.

Design Considerations

- If the working sprinklers are removed and replaced by a drip system will it work?
- Yes, almost without exception.
- To check add up the total gallons per minute of the removed nozzles. Multiply it by 60 to get gallons per hour and compare it to the flow of the drip system to be installed.
- If the flow is less in the new system is less the system will work.
- On grid system look up the application rate of the emitter-line system to be added often .5 to 1.0 inches per hour and compare it to the precipitation rate of the sprinkler system being removed, usually about 1.5" per hour. If so it will work.

Considerations for the transition

- Adding filtration and pressure regulation
- Removing the sprinklers
- Attaching a drip system
 - Works with point source drip systems that use individual emitters in sparsely planted landscapes.
 - Works with line source systems that have emitters built in the tubing and laid out in grid patterns for complete area watering.

What is a Pop Up Conversion Kit?



A pop up conversion kit is a quick and easy way to install a drip irrigation system without having to remove the existing system.

The Pop Up Spray head becomes the source of water for the new system.



The Pop Up Conversion kit uses the spray head location as the new point of connection that will deliver water to the rest of the system.

RainBird's Retrofit Body

- Can replace the guts on 1804 body or screw onto the fitting under an existing sprinkler.
- Capacity of 240 gallons per hour at 30 psi.
- Includes a 200 mesh filter.

RAIN BIRD



Flow: 0.5 to 4 GPM

Inlet Pressure: 15 to 70 psi (1,0 to 5,0 Bars)

Dimensions

1/2" (15/21) female-threaded inlet

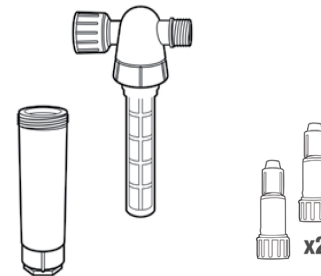
1/2" (15/21) male-threaded swivel outlet

Height: 7" (17,8 cm)

Width: 2" (5,1 cm)

Agrifim's Conversion Kit

- Replaces Pop-Up with two outputs and comes with fittings to use one or both.
- It includes necessary filtration.
- It has a 30psi output with capacity for up to 390 gallons per hour.
- The tubing adapter work with 16, 17 and 18 mm tubing.



FR2 17-710



Maximum Working Pressure	= 30 psi @ 80° F
Inlet / Outlet Size	3/4"
Housing Material	Polypropylene
Mesh	150
"O" Ring Material	Buana
Filtration Area	4 square inches
Maximum Recommended Flow	6.5 gpm

Cap Unused Sprinklers

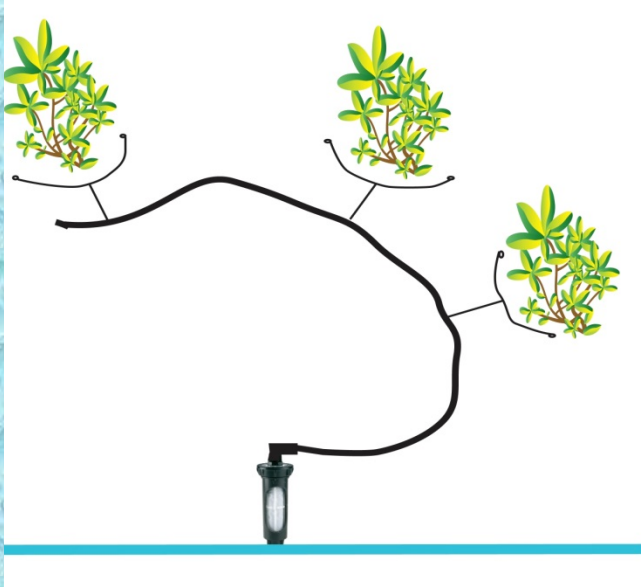
- Best to remove the sprinkler and fittings below and screw a threaded plug into the pvc pipe, or a threaded cap can be used to close off the riser just under the sprinkler.
- A universal cap-off , like the one on the right, can be used by removing the guts of the pop-up and threading on the device as shown.



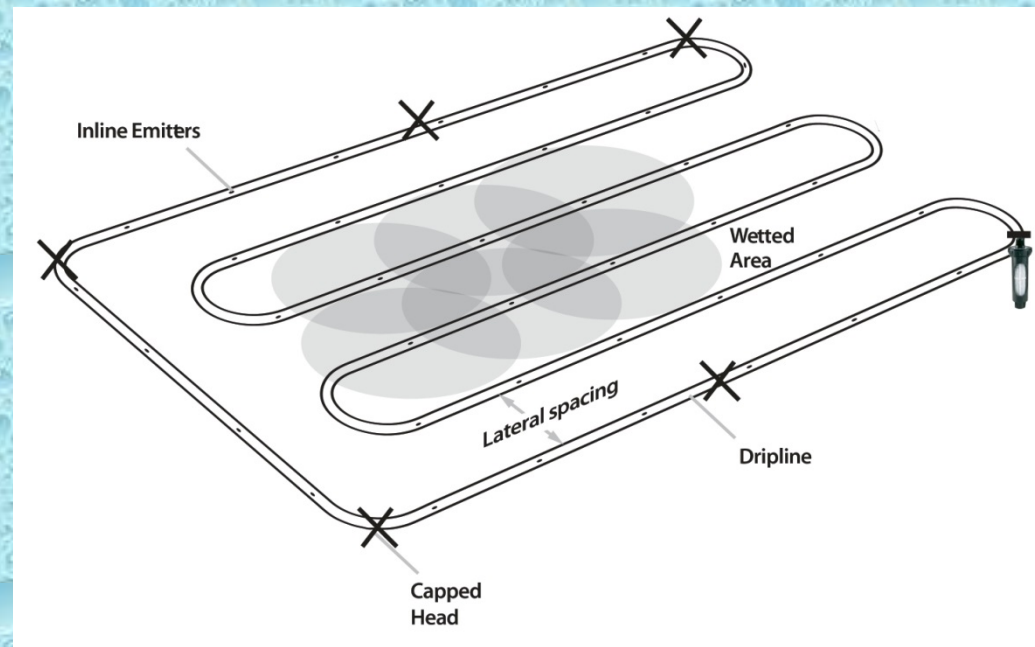
How Many Conversion Kits Are Needed?

Use one conversion kit per valve unless your drip conversion uses more than the maximum flow allowed for that device or the area is separated by hardscape like a sidewalk that tubing can't cross. The rest of the sprinklers need to be removed or capped.

Point Source Sparse



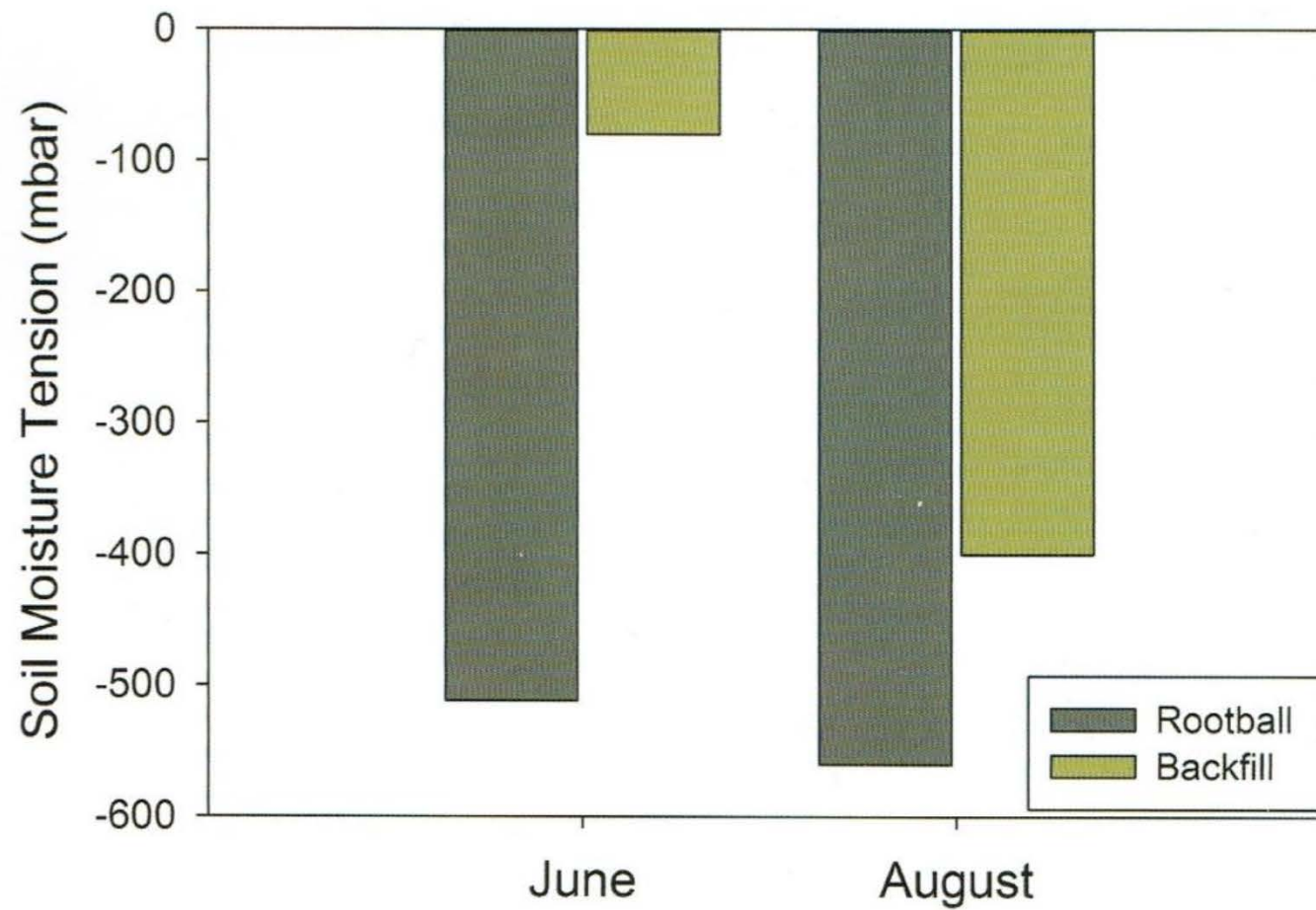
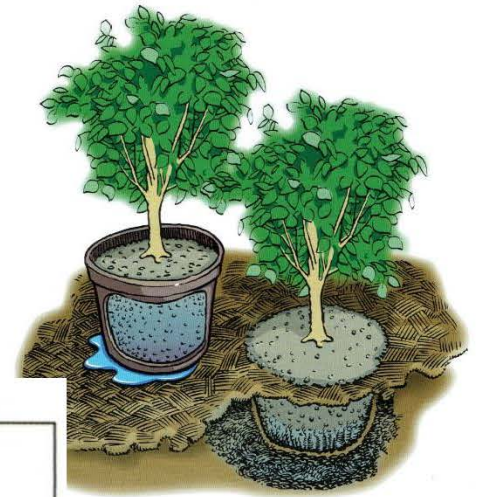
Line Source Dense Plantings



Watering Trees

- Where do we water
- How long do we water
- How often do we water
- Watering transition new to established
- By season

New trees only get water from the root ball soil



Where are the roots?

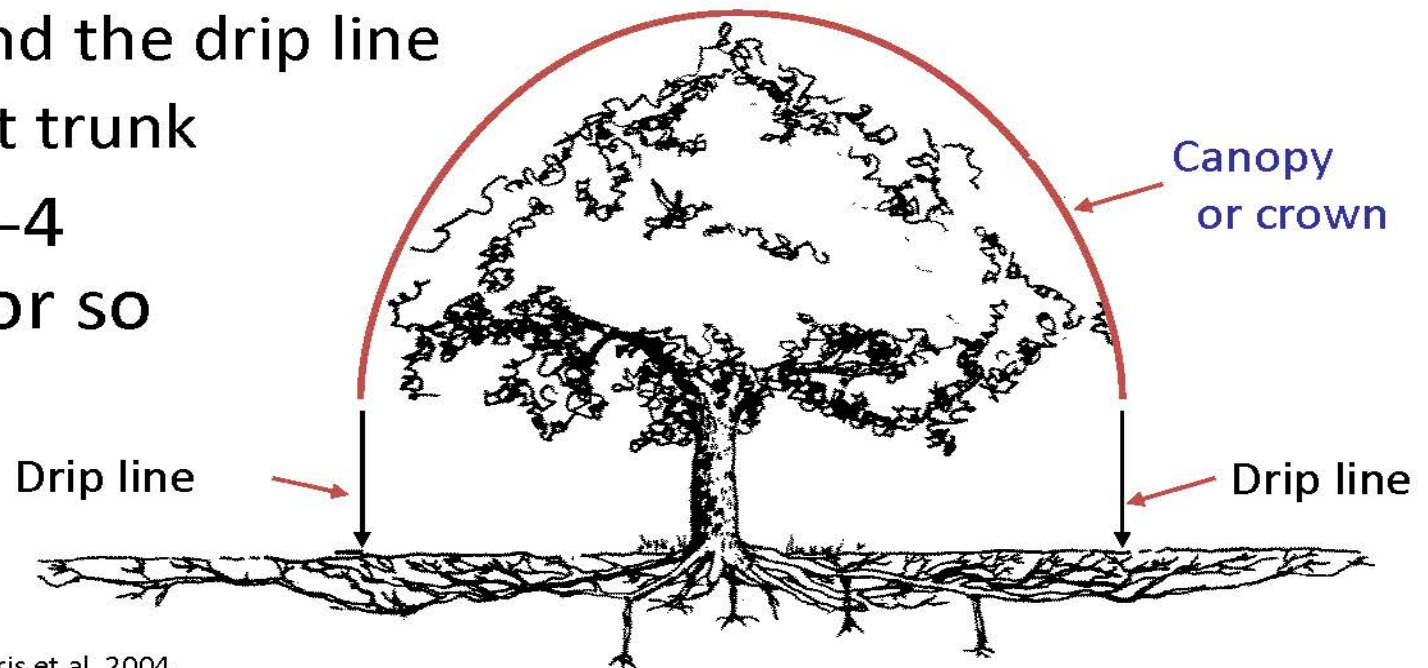
Root System of Mature Ginkgo Tree

Considered Deep Rooted



Tree Irrigation

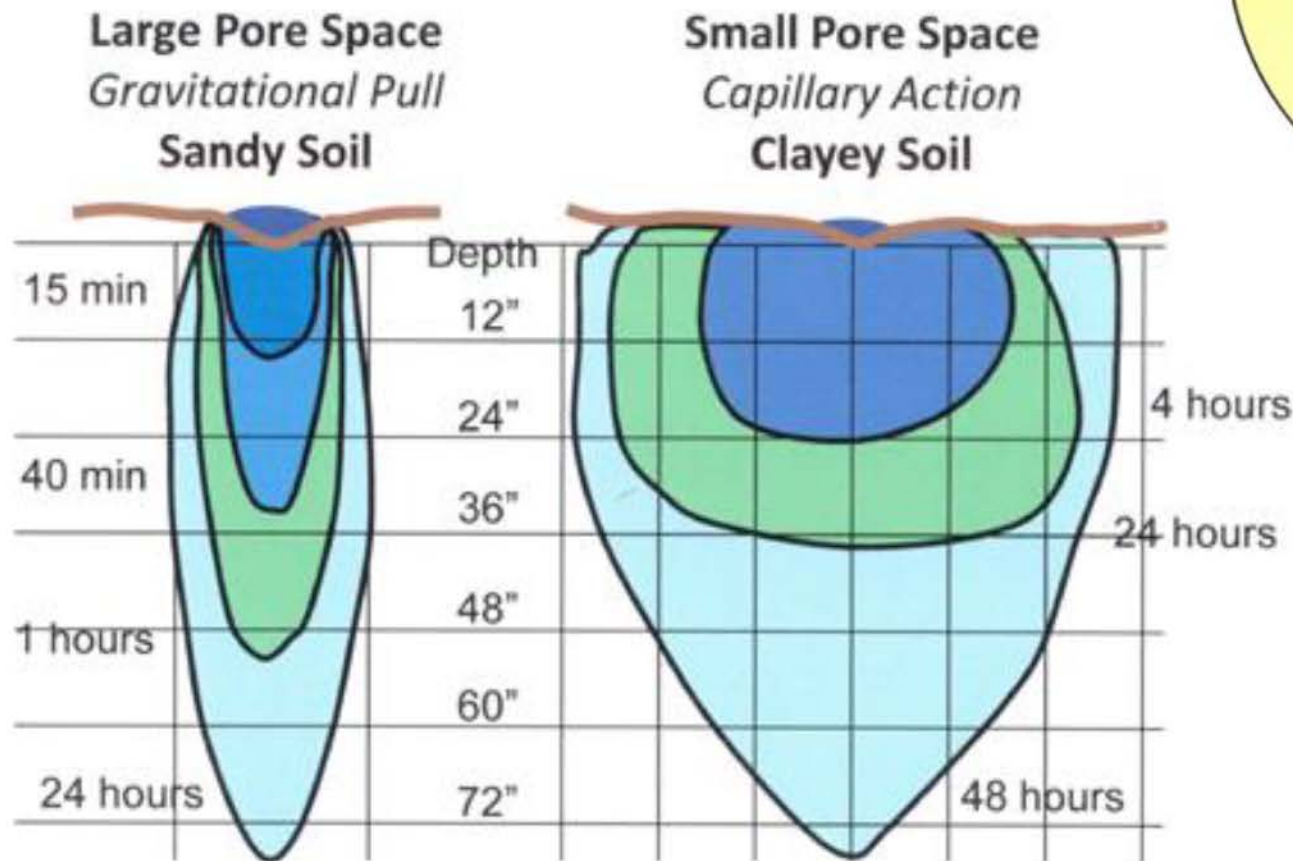
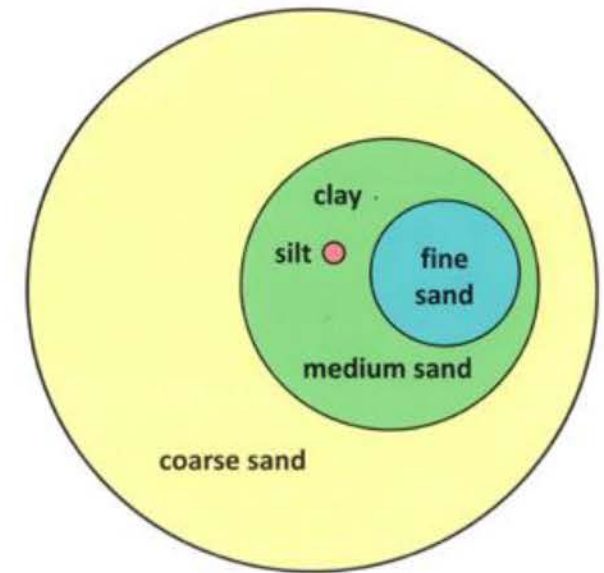
- Deep to 2 -3 feet
- Beneath the canopy
 - Beyond the drip line
 - Not at trunk
- Every 2-4 weeks or so



Graphic adapted from Harris et al. 2004

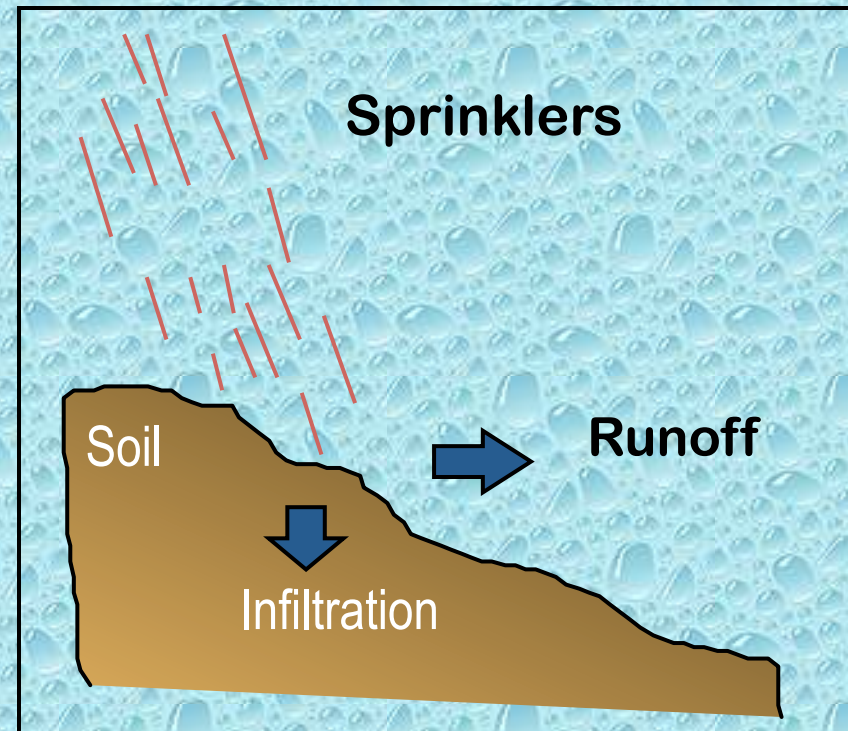


Water movement in soil: soil texture



Compare Soil Intake Rates

Coarse Sand	.75" - 1"/hr.
Fine Sand	.5" - .75"
Fine Sandy Loam	.35" - .5"
Silt Loam	.15" - .4"
Clay Loam	.1" - .2"



How fast are we watering (Precipitation Rate)

- Standard Sprinklers 1.5 to 2 inches per hour
- Toro Precision Nozzles 1 inch per hour
- Single Stream Rotors About .5 inches per hour
- Hunter MP Rotors .5 inches per hour
- Line Source Drip Grids .25 to 1 inch per hour
- Point Source Drip ?????? See chart

Understanding Application Rates

For Drip Irrigation

Application Rates of Emitter-Line Grids – This simple formula allows the precise calculation of application rates in inches per hour. Just enter the emitter rate (GPH), the spacing of the emitter-line that you are using in inches, and the spacing of the laterals in inches into the formula.

$$\text{Inches Per Hour} = \frac{231.1 \times \text{Emitter Rate (gph)}}{\text{Emitter Spacing (in inches)} \times \text{Lateral Spacing (in inches)}}$$

Application Rates of Point source Drip Systems – This formula is for systems using individual emitters. You add up the total GPH of all the emitters on the valve and enter that total along with the area watered in square feet to get your application rate in inches per hour.

$$\text{Application Rate (inches/hour)} = \frac{\text{GPH} \times 1.604}{\text{Area (square feet)}}$$

For Sprinklers

Precipitation Rates of Sprinkler Systems – Most of us rely on the precipitation rates from manufactures' catalogs. But with single stream rotors we often can use this formula to be more precise. We add up the total gpm's of the sprinklers used and calculate the square feet of the area watered. We enter those in the formula to get inches per hour.

$$\text{Precipitation Rate (inches/hour)} = \frac{\text{GPM} \times 96.3}{\text{Area (square feet)}}$$

Line Source Drip Design

- Let the manufacturer install your emitters
- Great for even coverage in an area
- Ideal for dense shrub planting
- Adjustable application rate
great uniformity in irregular areas.
- Allows for easy compliance with WELO



General Information on Emitterline Grids


Goal is to match Emitter Output, Emitter Spacing and Lateral Spacing to the soil type, plant types and slope

GENERAL GUIDELINES	TURF												SHRUB & GROUNDCOVER											
	CLAY SOIL			LOAM SOIL			SANDY SOIL			SANDY SOIL			CLAY SOIL			LOAM SOIL			SANDY SOIL		SANDY SOIL			
EMITTER FLOW	0.26 GPH			0.4 GPH			0.6 GPH			0.9 GPH			0.26 GPH			0.4 GPH			0.6 GPH		0.9 GPH			
EMITTER SPACING	18"			12"			12"			12"			18"			18"			12"		12"			
LATERAL (ROW) SPACING	18"	20"	22"	18"	20"	22"	12"	14"	16"	12"	14"	16"	18"	21"	24"	18"	21"	24"	16"	18"	20"	16"	18"	20"
BURIAL DEPTH	Bury evenly throughout the zone from 4" to 6"												On-surface or bury evenly throughout the zone to a maximum of 6"											
APPLICATION RATE (INCHES/HOUR)	0.19	0.17	0.15	0.45	0.41	0.37	0.96	0.83	0.72	1.44	1.24	1.08	0.19	0.16	0.14	0.29	0.24	0.21	0.72	0.64	0.58	1.08	0.96	0.87
TIME TO APPLY ¼" OF WATER (MINUTES)	81	90	99	33	37	41	16	18	21	10	12	14	81	94	108	53	61	70	21	23	26	14	16	17
Following these maximum spacing guidelines, emitter flow selection can be increased if desired by the designer. 0.9 GPH flow rate available for areas requiring higher infiltration rates, such as coarse sandy soils.																								

Note: 0.4, 0.6 and 0.9 GPH are nominal flow rates. Actual flow rates used in the calculations are 0.42, 0.61 and 0.92 GPH.

Techline is the leader in Linesource drip irrigation

- Copied by everyone.
- Wide selections of emitter rates and spacing.
- Allows for great uniformity at different application rates.
- Pressure compensation allows for long laterals.
- Check valves in emitters allow for in soil and under mulch installation.



TECHLINE® CV Maximum Uniformity in Subsurface and On-Surface Including Slopes

17mm DRIPLINE

APPLICATIONS

- Subsurface or on-surface installations
- Turf, shrubs, trees and flowers
- Sports turf, tennis courts, golf courses
- Slopes
- Longer lateral runs
- Curved, angular or narrow planting areas
- High traffic/high liability areas
- Areas subject to vandalism
- High wind areas
- At-grade windows
- Green walls, green roofs
- Raised planters

SPECIFICATIONS

- Broadest choice of emitter flow rates: 0.26, 0.4, 0.6 and 0.9 GPH
- Emitter spacings: 12", 18" and 24" (24" spacing available for 0.6 and 0.9 GPH only)
- Pressure compensation range: 14.5 to 58 psi (stainless steel clamps recommended above 50 psi)
- Bending radius: 7"
- Maximum recommended system pressure: 58 psi
- Minimum pressure required: 14.5 psi
- Tubing diameter: 0.66" OD, 0.56" ID, 0.050" wall
- Coil length: 100', 250', 500', 1,000'
- Recommended minimum filtration: 120 mesh
- Diaphragm made of silicon

FEATURES & BENEFITS

2 psi CHECK VALVE IN EACH EMITTER
All emitters turn on and off at the same time, maximizing balance of application. Holds back up to 4.6' of water (elevation change). No low emitter drainage, great on slopes. Delivers more precise watering.

UNIQUE PATENTED EMITTER DESIGN WITH PHYSICAL ROOT BARRIER
Offset flow path, extra large bath area and raised outlet prevent root intrusion without chemical reliance.

PRESSURE COMPENSATING
Precise and equal amounts of water are delivered over a broad pressure range.

CONTINUOUS SELF-FLUSHING EMITTER DESIGN
Flushes debris as it is detected, throughout operation, not just at the beginning or end of a cycle, ensuring uninterrupted emitter operation.



EMITTER WITH ANTI-SIPHON FEATURE
Prevents ingestion of debris into tubing caused by vacuum.

SELF-CONTAINED, ONE-PIECE DRIPLINE CONSTRUCTION
Assures reliable, easy installation.

FLEXIBLE UV RESISTANT TUBING
Adapts to any planting area shape - tubing curves at a 7" radius. For on-surface installations withstands heat and direct sun.

QUALIFIES FOR USE ON LEED PROJECTS
Contains the required quantity of post-consumer and post-industrial recycled material.

MAKES INSTALLATION QUICKER
Does not require air/vacuum relief vent or automatic flush valve for subsurface installations.



Limited Warranty for Driplines
Netafim warrants any polyethylene tubing and driplines (Techline® CV, Techline® DL, Techline® RW and Techline® EZ) sold to be free from environmental stress cracking for a period of seven (7) years from the date of original delivery.

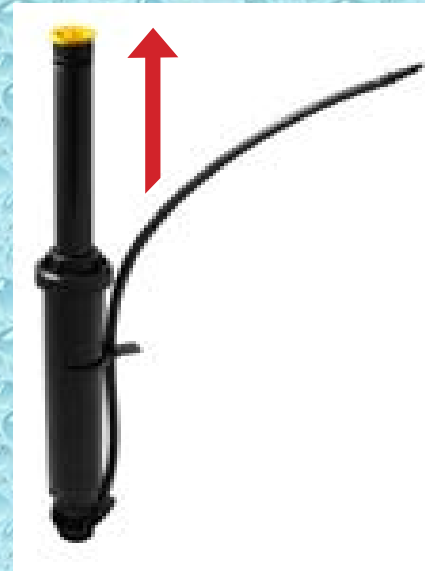
System Operation Indicator

Model

- OPERIND



System is OFF



System is ON

Low Impact Landscape Transitions

- Do not destroy the soil texture.
- Save costs of disposal.
- Great drought transitions to a new landscape.
- Swales to hold water and mulch in place.
- Go to bayfriendlycoalition.org
- Flyer on table



Lose Your Lawn: the Bay-Friendly Way

Sheet mulching is an easy way to replace your lawn

www.LoseYourLawn.org

Now is a great time to transform your conventional lawn into a Bay-Friendly garden. Sheet mulching is a technique of laying cardboard or newspaper over an existing lawn and then topping it off with layers of compost and wood mulch. The layers suppress weed growth and break down naturally – creating a vibrant ecosystem that gives you healthier soil and plants.

Sheet mulching can be done all at once or a little bit at a time. It doesn't require the use of heavy equipment or pesticides. Sheet mulching can be completed in one day, depending on the size of the area you are covering. The best time to sheet mulch is in the fall to take advantage of the rains, but it can be done any time of year. There are many different ways to sheet mulch. The following is a simple method recommended by the Bay-Friendly program:

1 PREPARE THE SITE

- **Mow or knock down tall weeds** so they lie flat.
- **Remove woody, bulky and invasive plants** such as blackberries, oxalis, horsetail, kikuyu and Bermuda grass.
- **Flag your sprinkler heads** if you plan to retrofit your sprinkler heads for drip irrigation.



Knock down weeds.

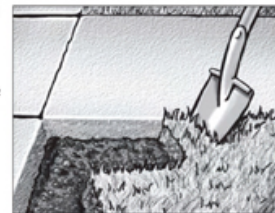


Soak the area.

Soak the area with water to start the natural process of decomposition

2 EDGING & MOUNDING FOR EROSION CONTROL

- **Edge the lawn** to avoid run-off and keep mulch from spilling onto paving. Use a flat-edged shovel to cut the lawn 8-12 inches away from the edge of the concrete. The soil should be at least 3 inches below the top of the concrete.



- **Create mounds** using the leftover soil and sod from edging, or simply sheet mulch in place. Just flip the edges over so the roots and soil face up. Don't worry if you encounter the plastic netting that came with your sod, just throw away the pieces that you see. Mounds can create visual interest in the garden by adding height and depth. Many native plants like well drained soil and thrive on mounds.



3 PLANT LARGE PLANTS

- **Install 5-gallon or larger plants** once the area has been prepared.



4 ADD A WEED BARRIER

- **Add a weed barrier** that is permeable to water and air, such as cardboard, newspaper or burlap. Recycled cardboard boxes can be found at appliance stores or bike shops. You can also buy recycled cardboard rolls. Do not use plastic or types of weed cloth which will not degrade.



CONTINUED ON OTHER SIDE...

Simple retrofits to sprinkler Systems

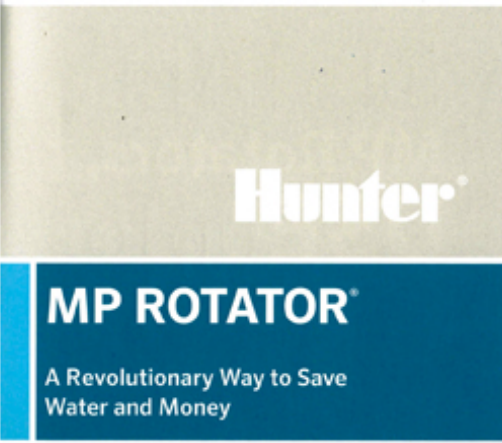
If not taking out the lawn and not mulching you might still want sprinklers.

Shut off some sprinklers where they are less needed for the trees


Put adjustable arc rotating nozzles set to areas you want covered.

Begin adjusting from a turf schedule to a tree schedule.

With lower precipitation it is easier to water deep.



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Irrigation Adjustment Guides

- We are at the apex of plan water needs
- July is Smart Irrigation Month
- Plant water needs vs. Rainfall
- This is what “New Smart Controllers” do
- Available at our table

DROUGHT CONSERVATION STRATEGY

Cut water use by up to 30% with monthly controller adjustments

San Francisco Area Rainfall vs. Plant Water Needs

Inches

Water wasted without adjustments

Water wasted without adjustments

Watering not needed (except rarely)

Start Watering

Increase Watering

Maximum Water Need

Cut back Watering

First Hard Rain STOP Watering

Watering all summer at peak July water needs wastes the amount of water shown in the shaded area on the chart. Manual monthly adjustments will reduce waste created by an on-in-spring-off-in-fall watering program, cutting landscape water consumption by up to 30%!

First program your controller for maximum July water needs for each zone using the guidelines on the reverse. Beginning in April (subject to actual weather conditions) and at the beginning of every month, adjust the water budgeting by % feature of your controller. The graph above leads to the table below of approximate water needs by month, expressed as a percent of July needs.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0%	0%	0%	45%	76%	96%	100%	85%	66%	28%	0%	0%

Older controllers may not have the features required to implement this strategy, so it may be time to upgrade to a smart self-adjusting controller that will do this automatically, every day, based on actual weather conditions. Smart controllers are easier to use, much more reliable, and can save more water than using approximate manual adjustments, and may be eligible for rebate or incentive programs from your water department.

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How to water after you have opened up the sidewalk and let the earth reappear

Pick hardy plants—Landscape with natives and other low water need plants. This will allow for less dry season watering.

Use swales—depressions in the landscape—allow for winter rain to collect and water that you apply in the dry season to stay in the bed, and does not runoff taking with it soil and mulch.

Amend heavy soils—Clay soils will not take in water as fast as it is applied. For winter rains and summer hand-watering to be more effective loosen up the soil before you start.

Install watering tubes—At any tree or large shrub you can install perforated tubes vertically to encourage downward movement of water. They come pre-made or made from drain pipe.

Buckets or manufactured watering bags—The use of moveable storage that slowly runs out is often helpful in establishing plants. Options are a bucket with drip emitters attached or more formal products.

Attaching a formal drip irrigation system—This system can be set in place and mulched over with a connection made to a hose when the area needs watering, or if possible added to a permanent system with a pipe under the sidewalk.



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Planting Areas Without Formal Irrigation

At the table

Simple Actionable Solutions

Bay-Friendly Landscaping and Gardening Coalition's Drought Action Items for California Property Managers

- The state has mandated no more than 2 days a week watering. Although challenging to the inland California lawns in mid-summer, it might help us learn how the landscape actually needs watering.
- Watering is to be done between 8pm and 10am; run drip last if having trouble with the watering window. Exceptions are only for testing and repair. The drip areas should be mulched.
- No use of water to wash sidewalks or driveways except for unsanitary conditions.
- Inspect systems for leaks and blocked sprinklers. Learn to read the water meter and the indicator of low-constant flows. Make sure site personnel know how to shut off systems in case of line breaks or valve failures.
- When finding run off in sprinkler systems, shorten run time and use repeat cycles to help put the water deeper in the ground and not down the gutter. Smarter cycling – adjusting cycling so that water can soak deeper into the root zone is essential in our heavy soils.
- Better sprinkler heads – convert to multi-stream rotating nozzles which produce less runoff, better uniformity, and better wind resistance. They offer a plug-and-play improvement that can be done immediately and give a great ROI.
- Drip conversion of planting beds where sprays are ineffective. Most of the original hardware can be reused and a layer of mulch will dress up the area, holding in the moisture while hiding the drip lines.
- Make regular adjustments in the watering schedule to meet the changes in weather. New "smart" controllers adjust daily to the factors that affect your plants' need for water.
- Irrigation systems must be off during rain and for at least 2 days afterwards. Rainfall is defined as $\frac{1}{4}$ " or more. This can be done with automatic equipment or on-site management.
- Reconsider the landscape and watering adjacent to hardscape, make changes to avoid runoff. Correct what you can and rethink the topography, the plant material and watering systems as you remodel.
- Modifications in the landscape should take into consideration the state WELO (Water Efficient Landscape Ordinance) easy to web search. Some of the basic principles:
 - Less lawn
 - Use of climate appropriate plants.
 - Drip irrigation for landscape planting.
 - Planting beds are to be mulched.
 - Automatic controllers are to be self-adjusting
 - No water allowed to run off property
 - More permeability, less sloped areas to hardscape
- If you are considering lawn conversion – do it now and enjoy immediate water savings. Converting a sprinkler zone to drip, "Bay-Friendly" recommends replacing the turf in this zone with mulch covered cardboard and drought-tolerant plants watered by drip lines. This method composts in-place enriching the soil. It can be staged so water savings is immediate, the site is dressed up with mulch and signage explaining the process, and wait for the cooler days of fall to plant the area and the winter rains to supply most of the water.
- Much of the water savings from our serious drought of the mid 70's came from the improvements in toilets. If you haven't done so it is time to replace them now.
- Check with your local water provider for advice and the availability of rebates to help you with your efforts. The State is adding to these rebates that can make lawn conversion and "smart" controller installation more affordable.
- Contact Bay-Friendly for a qualified professional.



• 111 Park Place, Suite 208 • Point Richmond, CA 94801 • www.bayfriendlycoalition.org •

Thanks

- I hope that the lecture and handouts help
- I can be reached at
tom@urbanfarmerstore.com