Don't waste another minute wasting water

bewaterwise.com®

5 Things to Know about California's Drought

1. It's one of the worst in California's history
2. Storage levels are dropping, preserve our reserves
3. Conservation is key in hot summer and fall
4. Limiting outdoor water use equals big savings
5. Do your part, go to bewaterwise.com® for water-saving tips and valuable rebates

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

WATER SAVING TIPS

Southern Californians have done a good job conserving water. But the multi-year drought has reduced our water reserve levels. More saving must be done to make sure there is water for the future. Be sure to check with your local water agency to find out about mandatory requirements that may be in place where you live.

Here are some helpful things you can do to save water:

Outdoor

- Water your yard early in the morning or later in the evening to reduce evaporation. Save up to 25 gallons a day.
- Keep mulch around plants to reduce evaporation and save hundreds of gallons a year.
- Use a broom instead of a hose to clean driveways, sidewalks and patios. You'll save 150 gallons a week.
- Fix sprinkler leaks, overspray and broken sprinkler heads. You'll save 500 gallons a month.
- Replace part of your lawn with California Friendly® plants and save thousands of gallons a month.

Indoor

- Turn off the water when you brush your teeth and shorten your showers to 5 minutes. Save up to 25 gallons a day.
- Fix leaking faucets and running toilets. Save 20 gallons a day.
- Wash only full loads of laundry and save between 15 and 50 gallons each time.
- Buy water-saving devices like high-efficiency toilets and clothes washers. These are eligible for rebates! Check bewaterwise.com®.
- Talk to your family and friends about saving water. If everyone does a little, we save a lot.

bewaterwise.com®

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

COMMERCIAL REBATE PROGRAM

SoCal Water$mart

WHY

California is facing prolonged dry conditions. Gov. Jerry Brown has declared a statewide drought and asked Californians to lower their water use by 20 percent. Your help is needed. Metropolitan has expanded its SoCal Water$mart rebate and incentive programs to make saving water more affordable for commercial customers.

WHO

Commercial, industrial and institutional customers within Metropolitan's 5,200-square-mile, six-county service area are eligible for rebates on indoor and outdoor water-saving devices. Both the water service and installation address must be located within Metropolitan's service area.

Contractors who meet specific business requirements can apply to participate in Metropolitan's Contractor Direct Rebate Program. The SoCal Water$mart Program provides screened and approved contractors with the ability to receive rebate payments directly for installations of eligible products. Contractor requirements and online enrollment information is at socalwatersmart.com under the Commercial Rebate Program option.

bewaterwise.com®

More Eligibility Information

- You must be a commercial, industrial or institutional water customer with a service and installation address located within Metropolitan's service area. Common areas in townhome, condominium, mobile home and apartment complexes are considered commercial customers, as well as landscape managed by a homeowners association.
- Refer to Metropolitan's list of qualified products for rebate eligibility.
- Facilities using recycled water may not qualify. Call 888.376.3314 to check eligibility.
- A reservation must be submitted online at socalwatersmart.com and approved prior to the purchase and installation of the device(s).
- Rebate amounts vary by participating water agency and are subject to change without notice.
- Metropolitan reserves the right to verify and inspect installation of rebated devices.
- Refer to Program Terms & Conditions at socalwatersmart.com for detailed eligibility terms and guidelines.

WHAT Products Eligible For Rebates

Measure	Base Rebate
Plumbing Fixtures	
High-Efficiency Toilets (Multi-Family)	$145/Toilet - 1.06 gallons per flush or less $100/Toilet - 1.28 gallons per flush or less
High-Efficiency Toilets (Flushometer/Tank)	$100
Ultra-Low and Zero-Water Urinals	$200
Plumbing Flow Control Valves	$5/Valve (minimum of 10)
Landscaping Equipment	
Smart Irrigation Controllers/ Central Computer Irrigation Controllers	$35/Station
Soil Moisture Sensor Systems	$35/Irrigation controller station
Rotating Nozzles for Pop-up Spray Heads	$4/Nozzle (minimum of 15)
Large Rotary Nozzles	$13/Set (minimum of 8 sets)
In-Stem Flow Regulators	$1/Regulator (minimum of 25)
Turf Removal	
Removal of Irrigated Turf	$2/square foot of irrigated turf removed and replaced with drought - tolerant plants or other approved landscape options
Food Equipment	
Connectionless Food Steamers	$485/Compartment
Air-Cooled Ice Machines	$1,000
HVAC Equipment	
Cooling Tower Conductivity Controllers	$625
Cooling Tower pH Controllers	$1,750
Medical and Dental Equipment	
Laminar Flow Restrictors	$10/Restrictor (minimum of 10)
Dry Vacuum Pumps	$125/0.5HP (up to 2HP max)

SoCal Water$mart is a region-wide program brought to you by the Metropolitan Water District of Southern California. Local water agencies may offer other incentive program opportunities. Rebates will be issued on a first-come, first-served basis until funding is exhausted.

HOW

1. Create an online account at socalwatersmart.com.
2. Submit an online rebate reservation. Funding is limited and submitting a rebate reservation does not guarantee you will receive a rebate. Rebates will be issued on a first-come, first-served basis until funding is exhausted.
3. Receive a reservation number.
4. Purchase and install the qualified device within 60 days of making the reservation.
5. Submit the final rebate application online. Be sure to submit a copy of the water bill for the property where the device is installed as well as the invoice for the device(s) that lists manufacturer name, model numbers, and price.

WHERE

Looking for more information? Go to socalwatersmart.com or call 888.376.3314.

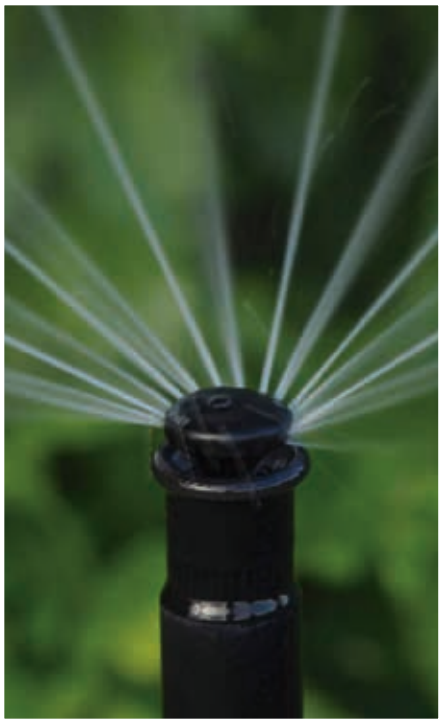
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
P.O. Box 54153
Los Angeles, CA 90054-0153
mwdh2o.com

CALIFORNIA FRIENDLY • program •

bewaterwise.com®

06.14

Choosing **rotating** sprinkler nozzles for your landscape



THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Q & A about rotating sprinkler nozzles:

Replace: *This conventional fan spray noz*

What are rotating sprinkler nozzles?

The latest innovation in sprinkler technology are nozzles that turn a standard pop-up spray head into a precision device that can save water in your landscape. In addition, water jetting from these nozzles is more resistant to wind, less likely to mist, and significantly reduces run-off onto streets and sidewalks.

How do they work?

These nozzles shoot multi-trajectory, rotating streams that apply water more slowly and uniformly than conventional sprays and heads —especially when adjusted for specific site conditions. Rotating nozzles use less water than traditional spray heads because they operate with lower precipitation rates and have greater distribution uniformity. In many cases, you can update your existing sprinkler heads with new rotary nozzles without having to replace the entire sprinkler body. Also, rotating nozzles have greater coverage.

How much does it cost?

About $6 per nozzle. Depending on where you live, you may be eligible for a rebate from your local Southern California water agency on a portion of the cost.

With this water-efficient rotating nozzle

How much water will I save?

Actual water savings will vary depending on local conditions and other factors. On average, replacing one conventional fan spray nozzle with a rotating nozzle could save up to 1,300 gallons a year.

Where can I find them?

Precision rotating sprinkler nozzles can be found at most irrigation supply stores and home and garden stores. Log on to **bewaterwise.com** to find a listing of stores and manufacturers.

bewaterwise.com

The Metropolitan Water District of Southern California

700 N. Alameda
Los Angeles, CA 90012
(800) CALL MWD
mwdh2o.com

Inefficient or poorly maintained sprinklers, like those shown below, waste water and increase pollution by sending water, fertilizer and grime into the stormwater system, and then waterways and oceans.

The Metropolitan Water District of Southern California

and

The Family of Southern California Water Agencies

700 N. Alameda St., Los Angeles, CA 90012
(800) CALL MWD
mwdh2o.com

bewaterwise.com

02/14 80m

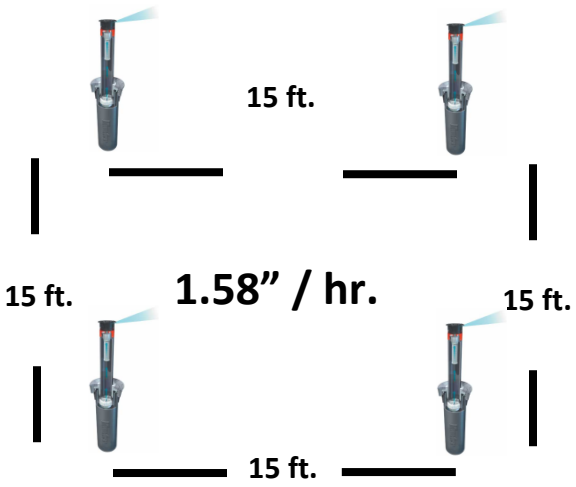
Sprinkler precipitation rates – the key to controlling irrigation runoff

Spray nozzles have a high precipitation rate that frequently results in irrigation runoff. The precipitation rate will vary with pressure and spacing. At 30 psi and spaced in a square pattern the precipitation rate is 1.58” per hour. The triangular pattern has slightly higher precipitation rates due to the tighter row spacing of 13 ft. at 1.83”

15 Series MPR

30° Trajectory

Nozzle	Pressure psi	Radius ft.	Flow GPM	Precip In/h ■	Precip In/h ▲
15F	15	11	2.60	2.07	2.39
	20	12	3.00	2.01	2.32
	25	14	3.30	1.62	1.87
	30	15	3.70	1.58	1.83
15H	15	11	1.30	2.07	2.39
	20	12	1.50	2.01	2.32
	25	14	1.65	1.62	1.87
	30	15	1.85	1.58	1.83



Verify the working water pressure at the spray nozzle to be a minimum of 30 psi. In the case of the 15 Series nozzle, any pressure less than 30 psi requires a closer spacing than 15 ft. If the sprinklers are operating at 20 - 25 psi and spaced at 15 ft there will be serious coverage (uniformity) problems. Measure water pressure as the circuit operates at the first and last sprinkler on the circuit. Verify spacing to be no greater than the radius. Sprinklers should be spaced in a square or triangular pattern with consistent spacing between heads.

Test working water pressure at the first and last sprinkler with a pressure tee and gauge.

Verify spacing between heads with a tape measure. At 30 psi spray heads should be spaced at no greater than their series, i.e 15 series at 15 ft, 12 series at 12 ft, etc.

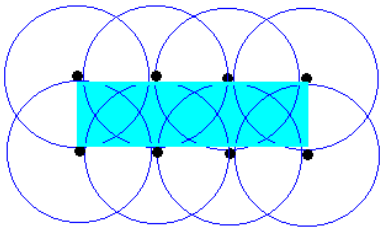
Rotor sprinklers rotate a single or multiple streams to achieve coverage. In general, the end of the stream from one sprinkler should hit right at the base of the adjacent sprinkler. The pressure requirement at the nozzle is dependent on the spacing and the nozzle installed in the sprinkler. Performance charts indicate a radius(spacing interval) that can be achieved with a particular nozzle at varying pressures. Generally, these sprinklers have a higher pressure requirement than spray nozzles. As a consequence low nozzle pressure is a common problem. Pressure, along with spacing must be verified in the field. Precipitation rate data may only be relied upon when pressure, nozzle, and spacing agree with nozzle performance data. These sprinklers have lower precipitation rates than sprays and therefore can be run for longer periods before runoff occurs.

PGP Red Standard Nozzle Performance Data

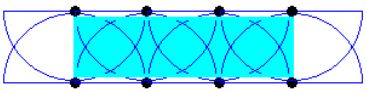
Nozzle	Pressure PSI	Radius ft.	Flow GPM	Precip in/hr ■	Precip in/hr ▲
1	30	28'	0.5	0.12	0.14
	40	29'	0.6	0.14	0.16
	50	**29'**	**0.7**	**0.16**	**0.19**
	60	30'	0.8	0.17	0.20
2	30	29'	0.7	0.16	0.19
	40	30'	0.8	0.17	0.20
	50	**30'**	**0.9**	**0.19**	**0.22**
	60	31'	1.0	0.20	0.23
3	30	30'	0.9	0.19	0.22
	40	31'	1.0	0.20	0.23
	50	**31'**	**1.2**	**0.24**	**0.28**
	60	32'	1.3	0.24	0.28
4	30	32'	1.2	0.23	0.26
	40	33'	1.4	0.25	0.29
	50	**34'**	**1.6**	**0.27**	**0.31**
	60	34'	1.8	0.30	0.35
5	30	34'	1.6	0.27	0.31
	40	36'	1.8	0.27	0.31
	50	**38'**	**2.0**	**0.27**	**0.31**
	60	38'	2.2	0.29	0.34
6	30	34'	2.0	0.33	0.38
	40	36'	2.4	0.36	0.41
	50	**38'**	**2.7**	**0.36**	**0.42**
	60	38'	2.9	0.39	0.45

These charts represent precipitation rates at half circle or 180 degree setting. For full circle operation divide the chart values by 2!

38 ft. square spacing



#5 noz. - 2.0 gpm @ 50 psi at 360 deg precipitation rate = 0.135" / hr



#5 noz - 2.0 gpm @50 psi at 180 deg (half circle) precipitation rate = 0.27" / hr.

The pitot tube and pressure gauge are used to measure nozzle pressure which is evaluated against nozzle performance charts

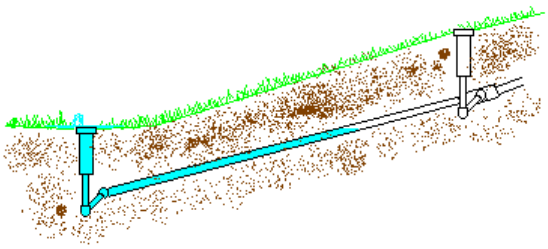
Suggested maximum run times on clay soil before runoff occurs
(on flat surfaces)
infiltration rate - 0.10" / hr

spray	spray	spray	rotors	rotors	rotors	rotors	rotor
1.6" / hr	1.8" / hr	2" / hr	0.25"/hr	0.35" / hr	0.45"/hr	0.55"/hr	0.65"/hr
4 min	4 min	4 min	24 min	17 min	13 min	11 min	9 min

Suggested maximum run times on clay loam soil before runoff occurs
(on flat surfaces)
infiltration rate - 0.16" / hr

spray	spray	spray	rotors	rotors	rotors	rotors	rotor
1.6" / hr	1.8" / hr	2" / hr	0.25"/hr	0.35" / hr	0.45"/hr	0.55"/hr	0.65"/hr
6 min	5 min	4 min	38 min	27 min	21 min	17 min	14 min

Low head drainage occurs in lateral sprinkler piping after the irrigation valve has shut down. When heavy clay soils are being irrigated, multiple cycles (usually 6-8) must occur every day that irrigation takes place. This necessary cycling process introduces the problem of low head drainage. This problem may be resolved with addition of check valves which may be retrofitted into the base of spray head bodies.



It is not unusual to find irrigation valves with spray and rotor type sprinklers plumbed together. This is never acceptable and should be corrected because of the different precipitation rates of the two types!

While low pressure at spray nozzles is frequently encountered, it is not unusual to find spray systems with excessive pressure. When pressure exceeds 45 psi, the sprinkler body should have a pressure regulating feature. This feature, like the anti-drain check valve, may be retrofitted into an existing spray body without digging up the sprinkler When sprinkler inlet pressures exceed 75 psi a regulator must be installed at the valve or backflow prevention device location.

Spray heads operating at 90 psi. This problem was corrected with the addition of a regulator feature on the valve.

Internal pressure regulating device is designed for inlet pressures between 45 and 75 psi

Same circuit operating at 30 psi!

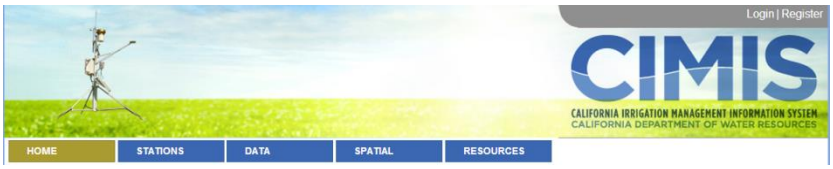
Managing the Irrigation Controller in a Drought

The amount of irrigation water applied to the landscape varies with the type of plant material and the precipitation rate of the sprinklers. The environmental factors that drive plant water use are temperature, wind, solar radiation, humidity, and ground temperature and collectively they generate a number known as Evapotranspiration (ET). These factors are nearly impossible for the landscape manager to evaluate in the field. The State of California manages a network of computerized weather stations linked to a free website in a program known as CIMIS (California Irrigation Management Information System). There are nearly 200 of these stations throughout the state. They provide the landscape manager with a number that represents the inches of water plants generally need in a month, week, or day. The number available from the local weather station is known as ET_O or reference ET. There are many regions of the state that lack a local weather station. In these instances tables are available providing monthly averages in the Water Efficient Landscape Ordinance (WELO) which is also available on line.

Average ETo Values by Station

Stn Id	Stn Name	CIMIS Region	Jan (in)	Feb (in)	Mar (in)	Apr (in)	May (in)	Jun (in)	Jul (in)	Aug (in)	Sep (in)	Oct (in)	Nov (in)	Dec (in)
159	Monrovia	LAB	2.10	2.41	3.72	4.31	5.24	5.7	6.61	6.26	4.86	3.39	2.39	1.93

http://wwwcimis.water.ca.gov/



http://ucanr.edu/sites/WUCOLS/

Water Efficient Landscape Ordinance (WELO)
http://www.water.ca.gov/wateruseefficiency/landscapeordinance/

Every plant has a different water requirement relative to ET_O based upon the landscape coefficient or K_L. The primary factor that drives that landscape coefficient is the species factor. Our biggest concern in the drought is the water requirement for turfgrass as it consumes the bulk of the landscape water. The plant water requirement ET_L is obtained for any period by multiplying the ET_O x K_L. In a traditional year cool season turfgrass such as fescue, Kentucky Bluegrass, or rye have a species factor of 70 percent or 0.70. In a drought we reduce this species factor and in turn the landscape coefficient (K_L) to 60 percent or 0.60. This follows guidelines developed by turfgrass experts at the University of California at Davis and Riverside.

July ET_L in a traditional year – ET_O (6.61") x K_L (0.70 for cs turf) = 4.63" / month

July ET_L in a drought year – ET_O (6.61") x K_L (0.60 for cs turf) = 3.97" / month

The water savings associated with this recommendation will save 0.65" in the peak month of July which is a 14% reduction in water use!

The development of an irrigation schedule is based on the average daily ET_L. In the month of July we have a ET_L of 3.97". The objective is to establish an average daily ET_L which in this case is 0.128" per day (3.97" / 31 = 0.128"). The replacement for every 3rd day watering for turf in a typical July is 0.38 inches (3 x 0.128). If we were watering on a flat clay surface the infiltration rate or maximum intake rate of the soil is 0.08 inches per hour. It would be necessary to have 5 cycles or start times (5 x 0.08 = 0.40). Since most programs have only 4 start times, it will be necessary to utilize two programs to have an adequate number of start times on clay soils.

Daily ET_L	Sun	Mon	Tue	Wed	Thur	Fri	Sat
	0.128"	0.128"	0.128"	0.128"	0.128"	0.128"	0.128"
			Water Tue a.m. replace 0.38"		Water Thur a.m. replace 0.26"		Water Sat a.m. replace 0.26"

On Tuesday the turf water requirement is 0.38". Regardless of the type of sprinkler, the soil infiltration or intake rate of 0.08" for clay (in this case) dictates the maximum amount of water applied to be 0.08" before runoff. Some sprinklers such as rotors and drip apply water more slowly and can have longer run times. Spray type sprinklers have a much higher precipitation rate so their run times to reach runoff are shorter. The sprinkler does not dictate the number of repeats rather it is the soil type! So the number of cycles required is 5 (0.38 /0.08 = 4.75) We may have to use 2 programs here because of the limitations of start times available per program on most controllers.

WATERING SCHEDULE FORM EXAMPLE

		PROGRAM A	PROGRAM B	PROGRAM C
DAY OF THE WEEK		M (T) W T F S S	M (T) W T F S S	M T W T F S S
ODD/ EVEN or INTERVAL				
PROGRAM START TIMES	1	12:30 am	11:00 pm	
	2	2:00 am		
	3	3:30 am		
	4	5:00 am		
STATION	LOCATION	STATION RUN TIME	STATION RUN TIME	STATION RUN TIME
1				

The next step in scheduling is to determine the run time in minutes required for Tuesday. We use a simple run time formula RT = ET_L (turf water requirement) / PR (precipitation rate) x 60 (constant). In this example the sprinkler is a 15 ft spray spaced square at 30 psi with a precipitation rate of 1.58" / hr. Recall the Tuesday ET_L so the run time is as follows ET_L (0.3842) / PR (1.58) x 60 = 15 minutes. The number is divisible by 5. On Program A we'll water 3 minutes per cycle x 4 starts = 12 minutes. If we water 3 minutes on program B we would be watering 15 minutes.

(plant water requirement)

$$RT = \frac{ET_L}{PR} \times 60$$

(constant)

(precipitation rate)

WATERING SCHEDULE FORM EXAMPLE

		PROGRAM A	PROGRAM B	PROGRAM C
DAY OF THE WEEK		M (T) W T F S S	M (T) W T F S S	M T W T F S S
ODD/ EVEN or INTERVAL				
PROGRAM START TIMES		12:30 am	11:00 pm	
		2:00 am		
		3:30 am		
		5:00 am		
STATION	LOCATION	STATION RUN TIME	STATION RUN TIME	STATION RUN TIME
1		3 min.	3 min.	

(3 min. x 4 starts = 12 min.) (3 min. x 1 start = 3 min.)
12 min. + 3 min. = 15 min.)

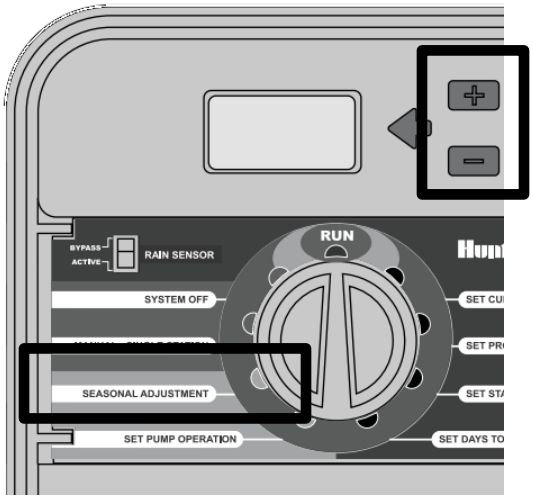
We've completed the schedule for station 1 for the spray heads on the turf for Tuesday. The irrigation water that we had to apply (0.3842") requires 5 repeats and utilized the capabilities of both the A and B programs. The water requirement for Tuesday morning replaces 3 days of turf water use or 0.3842 inches of water). On the majority of controllers in the field there are only three programs. We'll use the final program, program C, for station 1 on Thursday and Saturday. The amount of water required on Thursday and Saturday replaces two days of turf water use or 0.26 (0.256). The run time for program C (Thursday and Saturday) is RT = ET_L / PR x 60 (0.26 / 1.58 x 60) = 10 min. The 10 min run time cannot be split. Two five minute cycle would produce 10 minutes total but with runoff. There is also a problem with 11 minutes so the only option is 12 minutes or four 3 minute cycles. This is the problem dealing with high precipitation rate spray type sprinklers. We would prefer to water 10 minutes total but the controller can only do 9 minutes or 12 minutes.

WATERING SCHEDULE FORM EXAMPLE

		PROGRAM A	PROGRAM B	PROGRAM C
DAY OF THE WEEK		M (T) W T F S S	M (T) W T F S S	M T W (T) F (S) S
ODD/ EVEN or INTERVAL				
PROGRAM START TIMES	1	12:30 am	11:00 pm	12:30 am
	2	2:00 am		2:00 am
	3	3:30 am		3:30 am
	4	5:00 am		5:00 am
STATION	LOCATION	STATION RUN TIME	STATION RUN TIME	STATION RUN TIME
1		3 min.	3 min.	3 min.

(3 min. x 4 starts = 12 min.) (3 min. x 1 start = 3 min.)
12 min. + 3 min. = 15 min.)
(3 min. x 4 starts = 12 min.)

One important feature of more modern controllers is the percentage or seasonal adjust key or +/- key. It allows adjustment of an entire program by percentages. Heavy clay soils and spray heads render this a meaningless feature. Imagine that there is a 3 minute run time that needs a 10% reduction. The controller times in 1 minute increments so the % key only works for 33% changes (3 minutes reduced to 2 minutes is a 33% change). The only options we have with these short run times is to eliminate a start time or decrease a run time. This is exactly why rotors, with their lower precipitation rates, and longer run times are a better option than sprays. If the rotor station was set for four 10 minute cycles a 90% adjust would reduce the run time to 9 minutes!



Ultimately we need to be very creative in dealing with drought conditions where reduced watering days may be imposed by cities or water agencies. There are many limitations to controller programming when this occurs and they are acutely felt during a drought. Another serious limitation in the more arid regions of the state is the limitation of the water meter to apply water in two days that would normally be applied in 3 to 7 days per week!

Irrigation Schedule — Monrovia, CA - CIMIS Sta. 159

Pop Up Spray Heads / Cool Season Turf

Cool Season Turf with a K_T species factor (maximum stress) 0.60

DU_{LQ}	0.56	
PR Rate	1.58	inches / hr.
RTM	1.36	

Every other day watering — Every 3rd day watering

		Monrovia ET_O Avg Monthly	Monrovia ET_O Avg. daily	Monrovia CS Turf Req't daily	Lower Bndry. Run Time min.	Upper Bndry. Run Time min.	Lower Bndry. Run Time min.	Upper Bndry. Run Time min.
31	Mar	3.72	0.1200	0.0720	5	7	8	11
30	Apr	4.31	0.1437	0.0862	7	9	10	13
31	May	5.24	0.1690	0.1014	8	10	12	16
30	Jun	5.76	0.1920	0.1152	9	12	13	18
31	Jul	6.61	0.2132	0.1279	10	13	15	20
31	Aug	6.26	0.2019	0.1212	9	13	14	19
30	Sep	4.86	0.1620	0.0972	7	10	11	15
31	Oct	3.39	0.1094	0.0656	5	7	7	10
		40.15						

MP Rotators / Cool Season Turf

Cool Season Turf with a K_T species factor (maximum stress) 0.60

DU_{LQ}	0.72	
PR Rate	0.43	inches / hr.
RTM	1.2	

Every other day watering — Every 3rd day watering

		Monrovia ET_O Avg Monthly	Monrovia ET_O Avg. daily	Monrovia CS Turf Req't daily	Lower Bndry. Run Time min.	Upper Bndry. Run Time min.	Lower Bndry. Run Time min.	Upper Bndry. Run Time min.
31	Mar	3.72	0.1200	0.0720	20	24	30	36
30	Apr	4.31	0.1437	0.0862	24	29	36	43
31	May	5.24	0.1690	0.1014	28	34	42	51
30	Jun	5.76	0.1920	0.1152	32	39	48	58
31	Jul	6.61	0.2132	0.1279	36	43	54	64
31	Aug	6.26	0.2019	0.1212	34	41	51	61
30	Sep	4.86	0.1620	0.0972	27	33	41	49
31	Oct	3.39	0.1094	0.0656	18	22	27	33

MAXIMUM CYCLE LENGTH (IN MINUTES) TO AVOID RUNOFF ON CLAY SOILS		
SPRAYS	4 MINUTES	(15 FT SQUARE SPACING)
ROTORS	14 MINUTES	(0.43" / HR PRECIP RATE)
LINE SOURCE DRIP	4 MINUTES	(0.9 GPH - 12" X 12" SPACING)

Drip / Line Source - 0.9 GPH - 12" x 12" spacing

Ornamental Shrubs with a species factor K_P (max stress) 0.40

DU_{LQ}	0.9	
PR Rate	1.42	inches / hr.
RTM	1.06	

		Monrovia ET_O Avg Monthly	Monrovia ET_O Avg. daily	Monrovia Orn. Shrub Req't daily	Lower Bndry. Run Time min.	Upper Bndry. Run Time min.	Every other day watering: Lower Bndry. Run Time min.	Every other day watering: Upper Bndry. Run Time min.
31	Mar	3.72	0.1200	0.0480	NA	NA	6	6
30	Apr	4.31	0.1437	0.0575	NA	NA	7	8
31	May	5.24	0.1690	0.0676	NA	NA	9	9
30	Jun	5.76	0.1920	0.0768	NA	NA	10	10
31	Jul	6.61	0.2132	0.0853	NA	NA	11	11
31	Aug	6.26	0.2019	0.0808	NA	NA	10	11
30	Sep	4.86	0.1620	0.0648	NA	NA	8	9
31	Oct	3.39	0.1094	0.0437	NA	NA	6	6

Drip / Point Source - random spacing - 0.25" / hr. PR

Ornamental Shrubs with a species factor K_P (max stress) 0.40

DU_{LQ}	0.9	
PR Rate	0.25	inches / hr.
RTM	1.06	

		Monrovia ET_O Avg Monthly	Monrovia ET_O Avg. daily	Monrovia Orn. Shrub Req't daily	Lower Bndry. Run Time min.	Upper Bndry. Run Time min.	Every other day watering: Lower Bndry. Run Time min.	Every other day watering: Upper Bndry. Run Time min.
31	Mar	3.72	0.1200	0.0480	NA	NA	35	37
30	Apr	4.31	0.1437	0.0575	NA	NA	41	44
31	May	5.24	0.1690	0.0676	NA	NA	49	52
30	Jun	5.76	0.1920	0.0768	NA	NA	55	59
31	Jul	6.61	0.2132	0.0853	NA	NA	61	65
31	Aug	6.26	0.2019	0.0808	NA	NA	58	62
30	Sep	4.86	0.1620	0.0648	NA	NA	47	49
31	Oct	3.39	0.1094	0.0437	NA	NA	31	33

EWING

9850 E. Rush St	*S. El Monte*	*(626) 350.9530*	*Rigo Lopez*
21101 Superior St	*Chatsworth*	*(818) 882.9530*	*Armando Sanchez*
433 Borrego Ct	*San Dimas*	*(909) 599.0515*	*Ricardo Hernandez*
4552 Colorado Blvd	*Glendale*	*(818) 551.9550*	*Jack Tauvaga*
2327 Federal Blvd	*West L.A.*	*(310) 479.9533*	*Robert Romo*

* lower boundary represents a water time that assumes a high uniformity of application DU_{LQ}

* upper boundary increases run time to account for normal sprinkler uniformity deficiencies

Precipitation Rate Tables - Low Volume/Drip-Micro Irrigation

Point Source Emiiters or Micro Spray

(METER FLOW)

AREA IN SQUARE FEET(CANOPY AREA)

CFM	GPM	50	75	100	125	150	175	200	225	250	275	300	325	350	375	400	425	450	475	500	525	550	575	600	625	650	675	700
0.03	**0.25**	0.48	0.32	0.24	0.19	0.16	0.14	0.12	0.11	0.10	0.09	0.08																
0.07	**0.50**	0.96	0.64	0.48	0.39	0.32	0.28	0.24	0.21	0.19	0.18	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.08					
0.10	**0.75**	1.44	0.96	0.72	0.58	0.48	0.41	0.36	0.32	0.29	0.26	0.24	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.10
0.13	**1.00**	1.93	1.28	0.96	0.77	0.64	0.55	0.48	0.43	0.39	0.35	0.32	0.30	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.18	0.18	0.17	0.16	0.15	0.15	0.14	0.14
0.17	**1.25**	2.41	1.61	1.20	0.96	0.80	0.69	0.60	0.54	0.48	0.44	0.40	0.37	0.34	0.32	0.30	0.28	0.27	0.25	0.24	0.23	0.22	0.21	0.20	0.19	0.19	0.18	0.17
0.20	**1.50**	2.89	1.93	1.44	1.16	0.96	0.83	0.72	0.64	0.58	0.53	0.48	0.44	0.41	0.39	0.36	0.34	0.32	0.30	0.29	0.28	0.26	0.25	0.24	0.23	0.22	0.21	0.21
0.23	**1.75**	3.37	2.25	1.69	1.35	1.12	0.96	0.84	0.75	0.67	0.61	0.56	0.52	0.48	0.45	0.42	0.40	0.37	0.35	0.34	0.32	0.31	0.29	0.28	0.27	0.26	0.25	0.24
0.27	**2.00**	3.85	2.57	1.93	1.54	1.28	1.10	0.96	0.86	0.77	0.70	0.64	0.59	0.55	0.51	0.48	0.45	0.43	0.41	0.39	0.37	0.35	0.33	0.32	0.31	0.30	0.29	0.28
0.30	**2.25**	4.33	2.89	2.17	1.73	1.44	1.24	1.08	0.96	0.87	0.79	0.72	0.67	0.62	0.58	0.54	0.51	0.48	0.46	0.43	0.41	0.39	0.38	0.36	0.35	0.33	0.32	0.31
0.33	**2.50**	4.82	3.21	2.41	1.93	1.61	1.38	1.20	1.07	0.96	0.88	0.80	0.74	0.69	0.64	0.60	0.57	0.54	0.51	0.48	0.46	0.44	0.42	0.40	0.39	0.37	0.36	0.34
0.37	**2.75**	5.30	3.53	2.65	2.12	1.77	1.51	1.32	1.18	1.06	0.96	0.88	0.81	0.76	0.71	0.66	0.62	0.59	0.56	0.53	0.50	0.48	0.46	0.44	0.42	0.41	0.39	0.38
0.40	**3.00**	5.78	3.85	2.89	2.31	1.93	1.65	1.44	1.28	1.16	1.05	0.96	0.89	0.83	0.77	0.72	0.68	0.64	0.61	0.58	0.55	0.53	0.50	0.48	0.46	0.44	0.43	0.41
0.43	**3.25**	6.26	4.17	3.13	2.50	2.09	1.79	1.56	1.39	1.25	1.14	1.04	0.96	0.89	0.83	0.78	0.74	0.70	0.66	0.63	0.60	0.57	0.54	0.52	0.50	0.48	0.46	0.45
0.47	**3.50**	6.74	4.49	3.37	2.70	2.25	1.93	1.69	1.50	1.35	1.23	1.12	1.04	0.96	0.90	0.84	0.79	0.75	0.71	0.67	0.64	0.61	0.59	0.56	0.54	0.52	0.50	0.48
0.50	**3.75**	7.22	4.82	3.61	2.89	2.41	2.06	1.81	1.61	1.44	1.31	1.20	1.11	1.03	0.96	0.90	0.85	0.80	0.76	0.72	0.69	0.66	0.63	0.60	0.58	0.56	0.54	0.52
0.53	**4.00**	7.70	5.14	3.85	3.08	2.57	2.20	1.93	1.71	1.54	1.40	1.28	1.19	1.10	1.03	0.96	0.91	0.86	0.81	0.77	0.73	0.70	0.67	0.64	0.62	0.59	0.57	0.55
0.57	**4.25**	8.19	5.46	4.09	3.27	2.73	2.34	2.05	1.82	1.64	1.49	1.36	1.26	1.17	1.09	1.02	0.96	0.91	0.86	0.82	0.78	0.74	0.71	0.68	0.65	0.63	0.61	0.58
0.60	**4.50**	8.67	5.78	4.33	3.47	2.89	2.48	2.17	1.93	1.73	1.58	1.44	1.33	1.24	1.16	1.08	1.02	0.96	0.91	0.87	0.83	0.79	0.75	0.72	0.69	0.67	0.64	0.62
0.64	**4.75**	9.15	6.10	4.57	3.66	3.05	2.61	2.29	2.03	1.83	1.66	1.52	1.41	1.31	1.22	1.14	1.08	1.02	0.96	0.91	0.87	0.83	0.80	0.76	0.73	0.70	0.68	0.65
0.67	**5.00**	9.63	6.42	4.82	3.85	3.21	2.75	2.41	2.14	1.93	1.75	1.61	1.48	1.38	1.28	1.20	1.13	1.07	1.01	0.96	0.92	0.88	0.84	0.80	0.77	0.74	0.71	0.69

** Obtain flow to the area by reading water meter. Calculate canopy area using Ewing's "16 point" measuring system for irregularly shaped areas.*

In-Line Drip Tubing Flow Precipitation Rates (Netafim)

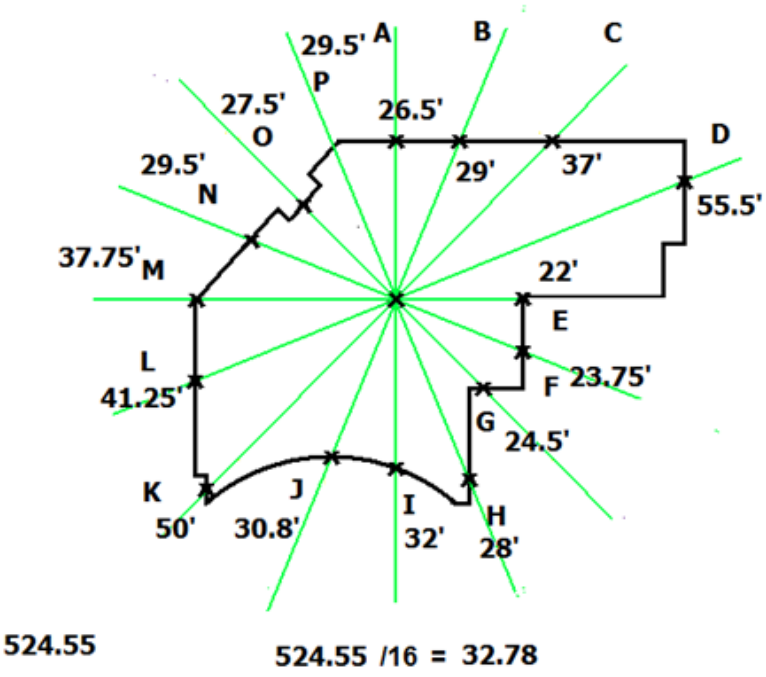
GENERAL GUIDELINES	TURF												SHRUB & GROUNDCOVER											
	CLAY SOIL			LOAM SOIL			SANDY SOIL			COARSE SOIL			CLAY SOIL			LOAM SOIL			SANDY SOIL			COARSE SOIL		
EMITTER FLOW	0.26 GPH			0.4 GPH			0.6 GPH			0.9 GPH			0.26 GPH			0.4 GPH			0.6 GPH			0.9 GPH		
EMITTER SPACING	18"			12"			12"			12"			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.

Measuring irregularly shaped drip zone canopy

When the geometry of an area is complex, the area can be measured by treating it as a circle. The formula for the area of a circle is Pi (3.14) x radius (squared) = A. We can determine the average radius of any shape by measuring the distance from near the center to the perimeter 16 times using a 100 foot tape. We then total these measurements and divide by 16 to obtain the average.

In the field use a fabricated 2 x 2 plywood sheet with a hole in the center for a screwdriver and place this sheet near the approximate center of the area to be measured. Create 16 permanent radii from the center at 22.5 degree increments on the plywood sheet. Use these as a guide and measure to the perimeter.



A	26.5'
B	29'
C	37'
D	55.5'
E	22'
F	23.75'
G	24.5'
H	28'
I	32'
J	30.8'
K	50'
L	41.25'
M	37.75'
N	29.5'
O	27.5'
P	29.5'

Figure 1- Measuring an irregularly shaped landscape area

For simplicity of calculation inches are converted to a decimal equivalent. A conversion chart for inches to decimal equivalent may be found on the right side of the table on the reverse side of this page.

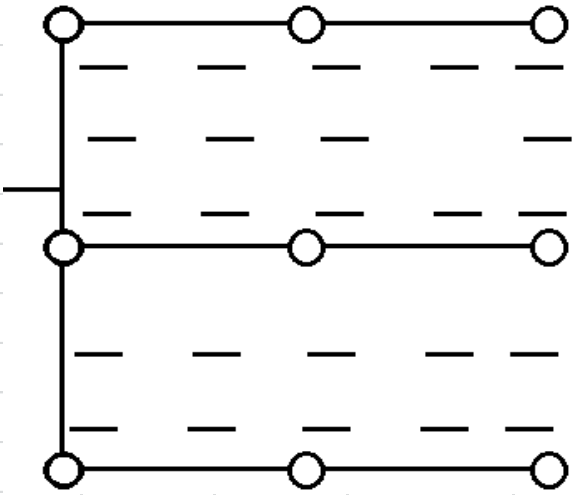
This shape has a total of 524.55 feet. The average radius is therefore 32.78 (524.5/16). Find the average radius on the reverse table. We have to interpolate to determine that the area is 3,346 sq. ft

Conversion Chart - Average Radius to Square Feet (16 radii minimum)							
Avergage Radius (feet)	Area (square feet)	Avergage Radius (feet)	Area (square feet)	Avergage Radius (feet)	Area (square feet)	Avergage Radius (feet)	Area (square feet)
10.00	314	22.00	1,521	43.00	5,809	66.50	13,893
10.25	330	22.50	1,590	43.50	5,945	66.00	13,685
10.50	346	22.75	1,626	44.00	6,082	66.50	13,893
10.75	363	23.00	1,662	44.50	6,221	67.00	14,103
11.00	380	23.25	1,698	45.00	6,362	67.50	14,314
11.25	398	23.50	1,735	45.50	6,504	68.00	14,527
11.50	415	23.75	1,772	46.00	6,648	68.50	14,741
11.75	434	24.00	1,810	46.50	6,793	69.00	14,957
12.00	452	24.25	1,847	47.00	6,940	69.50	15,175
12.25	471	24.50	1,886	47.50	7,088	70.00	15,394
12.50	491	24.75	1,924	48.00	7,238	70.50	15,615
12.75	511	25.00	1,963	48.50	7,390	71.00	15,837
13.00	531	25.50	2,043	49.00	7,543	71.50	16,061
13.25	552	26.00	2,124	49.50	7,698	72.00	16,286
13.50	573	26.50	2,206	50.00	7,854	72.50	16,513
13.75	594	27.00	2,290	50.50	8,012	73.00	16,742
14.00	616	27.50	2,376	51.00	8,171	73.50	16,972
14.25	638	28.00	2,463	51.50	8,332	74.00	17,203
14.50	661	28.50	2,552	52.00	8,495	74.50	17,437
14.75	683	29.00	2,642	52.50	8,659	75.00	17,671
15.00	707	29.50	2,734	53.00	8,825	75.50	17,908
15.25	731	30.00	2,827	53.50	8,992	76.00	18,146
15.50	755	30.50	2,922	54.00	9,161	76.50	18,385
15.75	779	31.00	3,019	54.50	9,331	77.00	18,627
16.00	804	31.50	3,117	55.00	9,503	77.50	18,869
16.25	830	32.00	3,217	55.50	9,677	78.00	19,113
16.50	855	32.50	3,318	56.00	9,852	78.50	19,359
16.75	881	33.00	3,421	56.50	10,029	79.00	19,607
17.00	908	33.50	3,526	57.00	10,207	79.50	19,856
17.25	935	34.00	3,632	57.50	10,387	80.00	20,106
17.50	962	34.50	3,739	58.00	10,568		
18.00	1,018	35.00	3,848	58.50	10,751	Decimal Equival.	
18.25	1,046	35.50	3,959	59.00	10,936	inches	decimal
18.50	1,075	36.00	4,072	59.50	11,122		
18.75	1,104	36.50	4,185	60.00	11,310	1	0.08
19.00	1,134	37.00	4,301	60.50	11,499	2	0.17
19.25	1,164	37.50	4,418	61.00	11,690	3	0.25
19.50	1,195	38.00	4,536	61.50	11,882	4	0.33
19.75	1,225	38.50	4,657	62.00	12,076	5	0.42
20.00	1,257	39.00	4,778	62.50	12,272	6	0.50
20.25	1,288	39.50	4,902	63.00	12,469	7	0.58
20.50	1,320	40.00	5,027	63.50	12,668	8	0.67
20.75	1,353	40.50	5,153	64.00	12,868	9	0.75
21.00	1,385	41.00	5,281	64.50	13,070	10	0.83
21.25	1,419	41.50	5,411	65.00	13,273	11	0.92
21.50	1,452	42.00	5,542	65.50	13,478		
21.75	1,486	42.50	5,675	66.00	13,685	c. 2009 Ewing Irrigation Produ	

Once the canopy area of a specific drip irrigation zone has been measured, the flow to the zone must be obtained by operating the zone from the irrigation controller. Proceed to the water meter and observe the flow to the zone as the station is running. Allow a couple of minutes for the tubing to fill and come to full pressure before reading flow at the meter. Proceed to the precipitation rate chart and derive the
precipitation rate by matching area in square feet to meter flow in cubic feet per minute (CFM)

Also insure that there is adequate pressure to the last (and or highest) elevation emitter in the zone. Minimum psi for pressure compensating emitters is 10 psi and for drip line 15 psi.

Spray Circuit - Audit Run Time (4 minutes)



psi

gpm

cfm

Driest 6 catches

Total

Avg.

psi (total divided by 6)

DU_{LQ} dry 6

avg of 24

Total of 24 catch readings

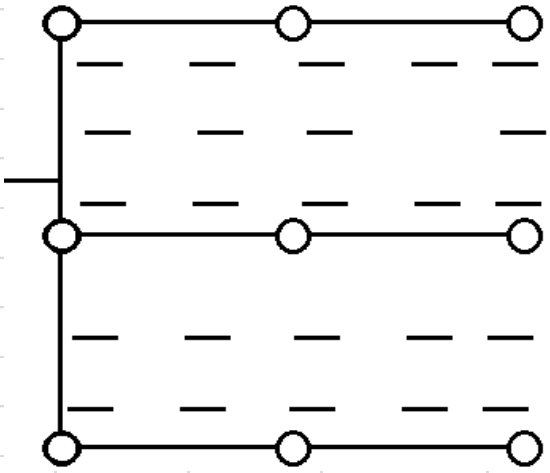
avg.(total divided by 24)

DU_{LQ}

PR $= \frac{3.66 \times V_{avg}}{t_r \times 16.5}$

PR

Rotating Stream Circuit - Audit Run Time (10 minutes)



psi

gpm

cfm

Driest 6 catches

Total

Avg.

psi (total divided by 6)

DU_{LQ} dry 6

avg of 24

Total of 24 catch readings

avg.(total divided by 24)

DU_{LQ}

PR $= \frac{3.66 \times V_{avg}}{t_r \times 16.5}$

PR

Estimating Irregularly shaped Areas

Measurement	
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	
M	
N	
O	
P	
TOTAL	
AVG/16	
SQ. FT	
METER	
FLOW	
CFM	
PR Rate	

EMITTER FLOW (TIME TO FILL 2" CAP)		
EMITTER TYPE	**GPH**	**FILL TIME**
POINT SOURCE	**2.00**	**56 SECONDS**
POINT SOURCE	**1.00**	**1 MIN 52 SECONDS**
LINE SOURCE	**0.92**	**2 MIN 2 SECONDS**
LINE SOURCE	**0.61**	**3 MIN 4 SECONDS**
POINT SOURCE	**0.50**	**3 MIN 45 SECONDS**
LINE SOURCE	**0.42**	**4 MIN 26 SECONDS**

The Water Meter – A Drought Management Tool

The water meter is an important management tool during the drought. As a landscape professional you can provide a very important service for your customers by monitoring their water use. If you are performing landscape maintenance at a site, then you are visiting it on a weekly basis and it will take just a few minutes to provide this service. Your primary objective in this regard is to look for leaks. Open the valve meter box when you arrive for maintenance and watch the meter for a few moments. There is a low flow indicator on the meter. If the meter is not dedicated to the landscape there may be a flow of potable to the residence or building. Try to check for leaks when no one is present in the building. If the irrigation system is off and no one is home the low flow indicator should not be moving. Observe it for a few seconds to see if it is turning. It may not be turning, but there still may be a leak. Note the position of the needle and the reading on the total flow which looks like a car's odometer. Check this before you leave the site to see if there has been any flow during your maintenance period. Calculate the flow of the leak per hour and multiply by 8,760 (hours per year to determine the amount of water loss per year.

At each maintenance visit check the low flow indicator and the position of the needle and total flow to determine if there is a slow leak. Take a digital image with your phone camera to document any leaks as well as the meter number. This is a great low cost service that you can provide to your customers during the drought!

The water meter is usually located between the curb and the backflow prevention device. Most commercial sites have dedicated landscape meters but this is not always the case. Meters record water volume in gallons or cubic feet, but most water agencies provide meters that record in cubic feet. A cubic foot of water is 7.48 gallons and is a 12"x12"x12" cube. Customers are billed in what is known as ccf's or hundred cubic foot units of 748 gallons.

Each full revolution of the dial on commercial meters (1 ½" and larger) represents a flow of ten cubic feet or 74.8 gallons

Each full revolution of the dial on a residential meter (5/8", 3,4" and 1") represents a flow of one cubic foot or 7.48 gallons

The water meter limits the amount of water that can be delivered to the site. Most irrigation systems were designed with the expectation that they would apply water anywhere from three to seven days per week. Take the system that in non-drought years was able to water six days per week and nine hours per day in the month of July. This is a total watering time of 3,240 minutes (6 x 9 x 60). Let's assume this is a 2" meter providing 50 gallons per minute. Under these conditions the meter could provide up to 162,000 gallons per week. (This 50 gpm flow is an average as some stations such as drip have far less flow and others such as large turf rotors have more)

Now, transition to a drought where watering is allowed two days per week for a maximum of thirty hours per week. The amount of water that could be delivered to the site would be 90,000 gallons (1,800 minutes x 50 = 90,000. Given this shortfall it is likely the site manager will have to set priorities on landscape watering and it is possible that some areas of the landscape may not survive. Invest the landscape water in large trees and shrubs which have the greatest value in the landscape!

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

REBATES FOR WATER EFFICIENCY UPGRADES

SoCal Water$mart

bewaterwise.com®

SoCal Water$mart COMMERCIAL PROGRAM

Plumbing Fixtures	Base Rebate
High-Efficiency Toilets (Multi-Family)	$145/Toilet - 1.06 gallons per flush or less $100/Toilet - 1.28 gallons per flush or less
High-Efficiency Toilets (Flushometer/Tank)	$100
Ultra-Low and Zero-Water Urinals	$200
Plumbing Flow Control Valves	$5/Valve (minimum of 10)

Landscaping Equipment	
Smart Irrigation Controllers/ Central Computer Irrigation Controllers	$35/Station
Soil Moisture Sensor Systems	$35/Irrigation controller station
Rotating Nozzles for Pop-up Spray Heads	$4/Nozzle (minimum of 15)
Large Rotary Nozzles	$13/Set (minimum of 8 sets)
In-Stem Flow Regulators	$1/Regulator (minimum of 25)

Turf Removal	
Removal of Irrigated Turf	$2/square foot of irrigated turf removed and replaced with drought-tolerant plants or other approved landscape options

Food Equipment	
Connectionless Food Steamers	$485/Compartment
Air-Cooled Ice Machines	$1,000

HVAC Equipment	
Cooling Tower Conductivity Controllers	$625
Cooling Tower pH Controllers	$1,750

Medical and Dental Equipment	
Laminar Flow Restrictors	$10/Restrictor (minimum of 10)
Dry Vacuum Pumps	$125/0.5HP (up to 2HP max)

SoCal Water$mart RESIDENTIAL PROGRAM

Indoor Fixtures	Base Rebate
High-Efficiency Toilets (Tank-Type)	$100
High-Efficiency Clothes Washers	$85

Landscaping Equipment	
Smart Irrigation Controllers	$80/Controller for less than one acre $35/Station for areas larger than one acre
Soil Moisture Sensor Systems	$80/Controller for less than one acre $35/Station for areas larger than one acre
Rain Barrels	$75
Rotating Nozzles for Pop-up Spray Heads	$4/Nozzle (minimum of 15)

Turf Removal	
Removal of Irrigated Turf	$2/square foot of irrigated turf removed and replaced with drought-tolerant plants or other approved landscape options

SoCal Water$mart PUBLIC AGENCY PROGRAM

Landscaping Equipment	Base Rebate
Smart Irrigation Controllers/ Central Computer Irrigation Controllers	$55/Station
Soil Moisture Sensor Systems	$55/Station
Large Rotary Nozzles	$13/Set (minimum of 8 sets)
Rotating Nozzles for Pop-up Spray Heads	$6 each (minimum of 15)

SoCal Water$mart FITNESS CENTER PROGRAM

Equipment	Base Rebate
High-Efficiency Toilets (Tank or Flushometer)	$300
Ultra-Low or Zero-Water Urinals	$500

SoCal Water$mart is a region-wide program brought to you by the Metropolitan Water District of Southern California. Local water agencies may offer other incentive program opportunities. Rebates will be issued on a first-come, first-served basis until funding is exhausted.

More Information

Log on to socalwatersmart.com for eligibility terms and application guidelines or call 888.376.3314.

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