MWDOC – Fountain Valley Irrigation Workshop – June 23, 2016

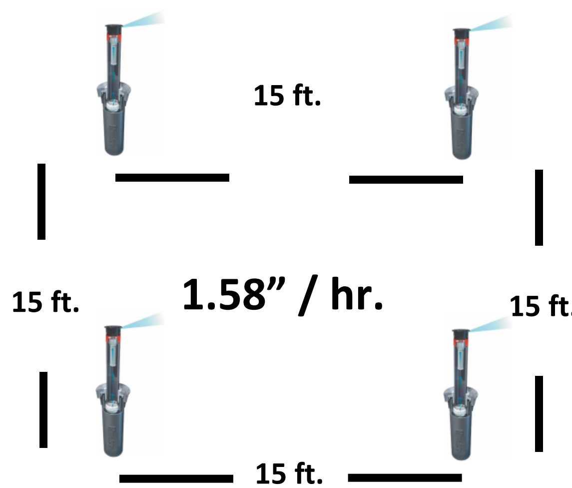
Sprinkler precipitation rates – the key to controlling irrigation runoff

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.

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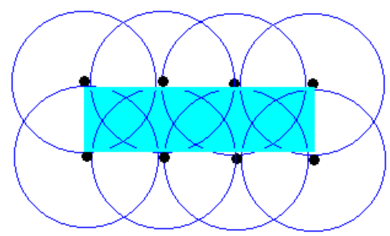
Rotor sprinklers rotate a single or multiple streams to achieve coverage. In general, the end of the stream from one sprinkler should hit right at the base of the adjacent sprinkler. The pressure requirement at the nozzle is dependent on the spacing and the nozzle installed in the sprinkler. Performance 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

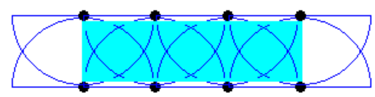
Nozzle	Pressure PSI	Radius ft.	Flow GPM	Precip in/hr ■	▲
1	30	28'	0.5	0.12	0.14
	40	29'	0.6	0.14	0.16
	50	**29'**	**0.7**	**0.16**	**0.19**
	60	30'	0.8	0.17	0.20
2	30	29'	0.7	0.16	0.19
	40	30'	0.8	0.17	0.20
	50	**30'**	**0.9**	**0.19**	**0.22**
	60	31'	1.0	0.20	0.23
3	30	30'	0.9	0.19	0.22
	40	31'	1.0	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

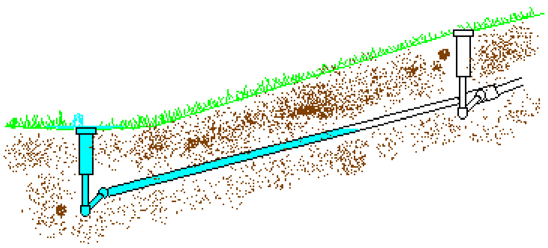
Suggested maximum run times on clay soil before runoff occurs (on flat surfaces) infiltration rate - 0.10" / hr

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

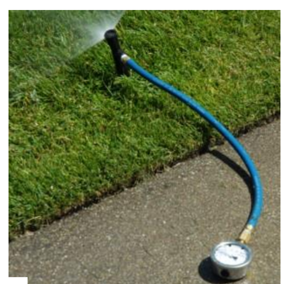
Low head drainage occurs in lateral sprinkler piping after the irrigation valve has shut down. When heavy clay soils are being irrigated, multiple cycles (usually 6-8) must occur every day that irrigation takes place. This necessary cycling process introduces the problem of low head drainage. This problem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

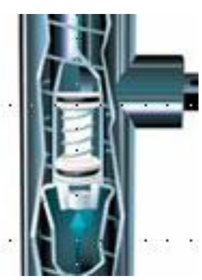


It is not unusual to find irrigation valves with spray and rotor type sprinklers plumbed together. This is never acceptable and should be corrected because of the different precipitation rates of the two types!

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

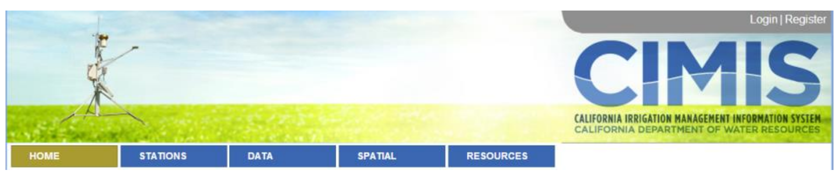
The amount of irrigation water applied to the landscape varies with the type of plant material and the precipitation rate of the sprinklers. The environmental factors that drive plant water use are temperature, wind, solar radiation, humidity, and ground temperature and collectively they generate a number 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.

Rendered in ENGLISH Units.
Printed on Wednesday, April 08, 2015

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)	Total (in)
75	Irvine	SCV	2.37	2.55	3.62	4.77	5.18	5.58	6.36	6.17	4.76	3.59	2.61	2.12	49.68

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



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

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

Irrigation & Landscape Supply

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 (6.36") x K_L (0.70 for cs turf) = 4.45" / month

July ET_L in a drought year – ET_O (6.36") x K_L (0.60 for cs turf) = 3.82" / month

The water savings associated with this recommendation will save 0.63" 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 (plant water requirement) In the month of July, in Irvine, we have an ET_L of 3.82". The objective is to establish an average daily ET_L which in this case is 0.123" per day (3.82" / 31 = 0.123"). The replacement for every 4th day watering for turf on Sunday in a typical July is 0.48 inches (4 x 0.12). If we were watering on a flat clay surface the infiltration rate or maximum intake rate of the soil before runoff is 0.08 inches per hour. It would be necessary to have 6 cycles or start times (6 x 0.08 = 0.48"). Since most programs have only 4 start times, it will be necessary to utilize two programs (B & C) to have an adequate number of start times on this watering day to avoid runoff.

Daily ET_L	Sun 0.12	Mon 0.12	Tue 0.12	Wed 0.12	Thur 0.12	Fri 0.12	Sat 0.12
JULY	Water Sun replace 4 days 0.48"			Water Wed replace 3 days 0.36"			

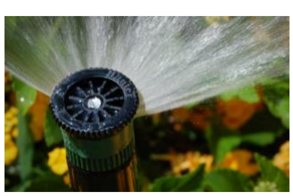
On Wednesday the turf water requirement is 0.36" (3 days replacement). Regardless of the type of sprinkler, the soil infiltration or intake rate of 0.08" for clay (in this case) dictates the maximum amount of water applied to be 0.08" before runoff. Some sprinklers such as rotors and drip apply water 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 (0.36 /0.08 = 4.5 so we round up to 5). The dilemma is that we have already planned to use programs B & C for Sunday irrigation and we only have the A program with 4 starts left for Wednesday!

		PROGRAM A	PROGRAM B	PROGRAM C
DAY OF THE WEEK		MO TU **WE** TH FR SA SU	MO TU WE TH FR SA SU	MO TU WE TH FR SA SU
INTERVAL (Choose 1 to 31 days)				
PROGRAM START TIMES	1	10:30 p.m.		
	2	11:30 p.m.		
	3	1:30 a.m.		
	4	2:30 a.m.		
STATION	LOCATION	STATION RUN TIME	STATION RUN TIME	STATION RUN TIME
1	*Front Lawn - Sprays*			
2				

The next step in scheduling is to determine the run time in minutes required for Wednesday. 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 Wednesday ET_L so the run time is as follows ET_L (0.36) / PR (1.58) x 60 = 14 minutes (13.67). The problem is that the number is not divisible by 4 cycles, so we'll round up to a number that can be divided by 4 which is 16. On Program A we'll water 4 minutes per cycle x 4 starts = 16 minutes.

		PROGRAM A	PROGRAM B	PROGRAM C
DAY OF THE WEEK		MO TU **WE** TH FR SA SU	MO TU WE TH FR SA SU	MO TU WE TH FR SA SU
INTERVAL (Choose 1 to 31 days)				
PROGRAM START TIMES	1	10:30 p.m.		
	2	11:30 p.m.		
	3	1:30 a.m.		
	4	2:30 a.m.		
STATION	LOCATION	STATION RUN TIME	STATION RUN TIME	STATION RUN TIME
1	*Front Lawn - Sprays*	*4 minutes*		
2				

(4 x 4 min = 16 minutes)



(plant water requirement) **(constant)**

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

(precipitation rate)

We've completed the schedule for station 1 for the spray heads on the turf for Wednesday. The irrigation water that we had to apply (0.36") requires 4 repeats and utilizes the A program.

The water requirement for Wednesday replaces 3 days of turf water use or 0.36 inches of water. Since the water requirement is different on Sunday,0.48"(4 day replacement), as opposed to 0.36" on Wednesday, we'll have a different run time so a different program is required. The intake rate is 0.08" per hour and the goal is 0.48 inches so we will need 6 cycles (0.48"/0.08 = 6.) as previously determined. Since the controller has only 4 starts per program it will be necessary to utilize 2 programs (B and C). The run time for Sunday is RT = ET_L / PR x 60 (0.48/ 1.58 x 60) = 18 min. It is not possible to divide this into even cycles as 18 is not divisible into six equal parts. The solution is to water different times on the programs. On the B program there will be 4 start times with 4 min cycles to achieve 16 minutes of total run time. The C program will have 2 start times with 1 minute cycles to achieve 2 minutes of total run time. The total Sunday run time will be 16 min on B and 2 min on C.

Since we utilized programs A, B, and C and 10 start times for the turf stations, the drip and shrub stations will have to water on the same days and start times as the lawns. Under such extreme programming requirements it makes sense to replace the controller with a smart controller that has "cycle/soak" capabilities.

		PROGRAM A	PROGRAM B	PROGRAM C
DAY OF THE WEEK		MO TU **WE** TH FR SA SU	MO TU WE TH FR SA **SU**	MO TU WE TH FR SA **SU**
INTERVAL (Choose 1 to 31 days)				
PROGRAM START TIMES	1	10:30 p.m.	10:30 p.m.	3:30 a.m.
	2	11:30 p.m.	11:30 p.m.	4:30 a.m.
	3	1:30 a.m.	1:30 a.m.	
	4	2:30 a.m.	2:30 a.m.	
STATION	LOCATION	STATION RUN TIME	STATION RUN TIME	STATION RUN TIME
1	*Front Lawn - Sprays*	*4 minutes*	*4 minutes*	*1 minutes*
2				
		(4 x 4 min = 16 minutes)	*(4 x 4 min = 16 minutes)*	*(2x 1 min = 2 minutes)*

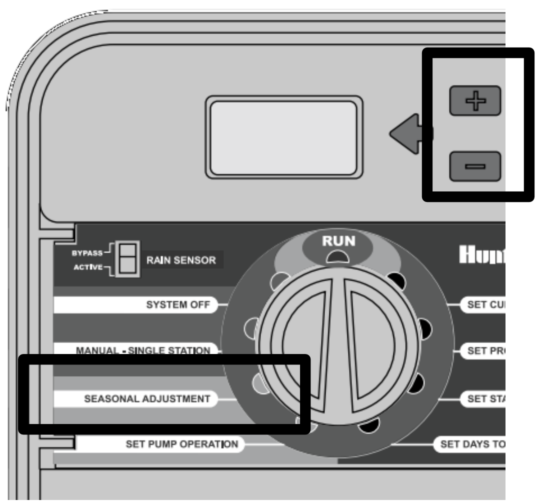
(18 minutes total run time on Sunday)

The previous special program addresses the water needs of the plant material on the designated day schedule of two days per week. Some water purveyor's may already have landscape water conservation programs in place that allow watering three times per week which would require a controller with fewer start times and programs

The previous schedule is what is known as a "lower boundary" of watering time which does not reflect typical spray irrigation systems which have problems with uniform coverage and often have poor distribution uniformity

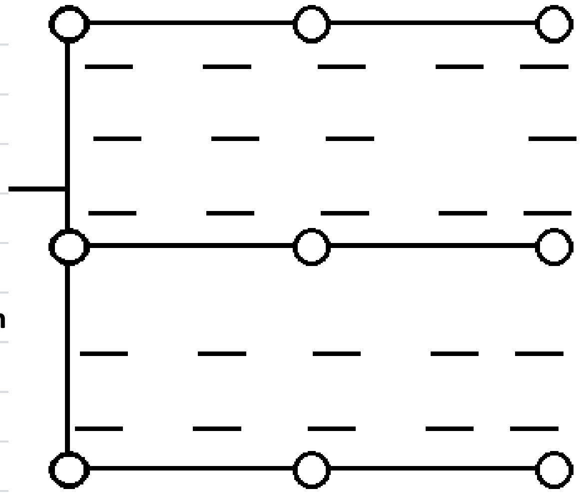
A landscape water audit would reveal the distribution uniformity DU_{LQ} of the system and once this is known we can develop a scheduling or system multiplier. The spray system we audited for this example had a DU_{LO} of 56 percent or 0.56. A scheduling or run time multiplier indicates how much we will have to increase the lower boundary run times to deliver adequate water to the drier parts of the irrigation circuit. The run time or scheduling multiplier for 56 percent is 1.36. The Wednesday run time on the lower boundary was 13.67 , which due to cycling had to be increased to 16 minutes because it can be broken into four equal cycles. The original 14 minute run time would be increased 1.36 times to compensate for poor uniformity which is 19 minutes. The upper boundary of run time for Tuesday is 4 cycles of 5 minutes. Since 5 minutes is the maximum we would like to run to avoid runoff on clay we will observe for runoff problems.

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 three days that would normally be applied in 4 to 7 days per week!

Spray Circuit - Audit Run Time (4 minutes)



psi: ____

gpm: ____

cfm: ____

Driest 6 catches: ____ ____ ____ ____ ____ ____

Total: ____

Avg. (total divided by 6): ____

psi: ____

Total of 24 catch readings: ____

avg.(total divided by 24): ____

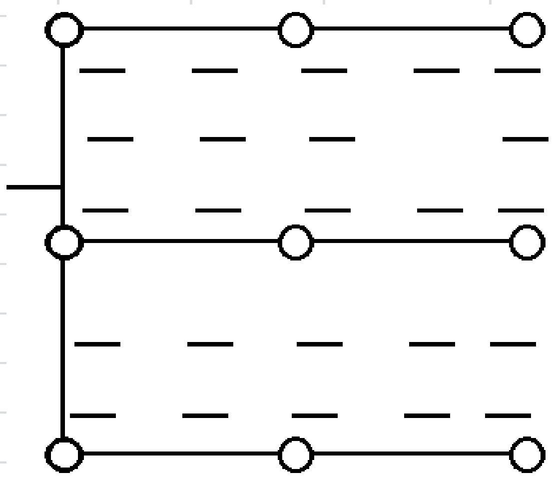
DU_{LQ} = dry 6 / avg of 24

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. (total divided by 6): ____

psi: ____

Total of 24 catch readings: ____

avg.(total divided by 24): ____

DU_{LQ} = dry 6 / avg of 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 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.

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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!

Irrigation Schedule — Santa Ana, CA *(watering 2x per week)*

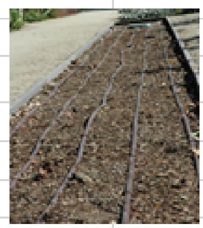
(Schedule based on CIMIS station 75, Irvine, CA)

Drip- Point source or line source - 0.25" / hr. PR

Ornamental Shrubs with a WUCOLS High Water use class. **0.80**

DU$_{LQ}$	0.9		Every 4th day watering	Every 3rd day watering
PR Rate	0.25	inches / hr.		
RTM	1.06			

		#75 ET$_O$ Avg Monthly	#75 ET$_O$ Avg. daily	#75 Ornam 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	3.62	0.1168	0.0934	90	95	67	71
30	Apr	4.77	0.1590	0.1272	122	129	92	97
31	May	5.18	0.1671	0.1337	128	136	96	102
30	Jun	5.58	0.1860	0.1488	143	151	107	114
31	Jul	6.36	0.2052	0.1641	158	167	118	125
31	Aug	6.17	0.1990	0.1592	153	162	115	122
30	Sep	4.76	0.1587	0.1269	122	129	91	97
31	Oct	3.59	0.1158	0.0926	89	94	67	71
		40.03						



Drip- Point source or line source - 0.25" / hr. PR

Ornament. Shrubs with a WUCOLS Moderate water use class **0.50**

DU$_{LQ}$	0.9		Every 4th day watering	Every 3rd day watering
PR Rate	0.25	inches / hr.		
RTM	1.06			

		#75 ET$_O$ Avg Monthly	#75 ET$_O$ Avg. daily	#75 Ornam 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	3.62	0.1168	0.0584	56	59	42	45
30	Apr	4.77	0.1590	0.0795	76	81	57	61
31	May	5.18	0.1671	0.0835	80	85	60	64
30	Jun	5.58	0.1860	0.0930	89	95	67	71
31	Jul	6.36	0.2052	0.1026	98	104	74	78
31	Aug	6.17	0.1990	0.0995	96	101	72	76
30	Sep	4.76	0.1587	0.0793	76	81	57	61
31	Oct	3.59	0.1158	0.0579	56	59	42	44
		40.03						

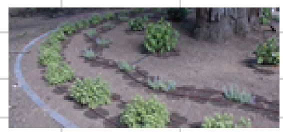
Max run time on flat clay soils before runoff

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)
POINT SOURCE DRIP	24 MINUTES	(0.25" PER HOUR)

Drip- Point source or line source - 0.25" / hr. PR

Ornamental Shrubs with a WUCOLS Low water use class. **0.20**

DU_{LQ}	0.9			Every 4th day			Every 3rd day	
PR Rate	0.25	inches / hr.		watering			watering	
RTM	1.06							
	#75	#75	#75	Lower	Upper		Lower	Upper
	ET_O	ET_O	Ornam	Bndry.	Bndry.		Bndry.	Bndry.
	Avg	Avg.	Req't	Run Time	Run Time		Run Time	Run Time
	Monthly	daily	daily	min.	min.		min.	min.
31 Mar	3.62	0.1168	0.0234	22	24		17	18
30 Apr	4.77	0.1590	0.0318	31	32		23	24
31 May	5.18	0.1671	0.0334	32	34		24	26
30 Jun	5.58	0.1860	0.0372	36	38		27	28
31 Jul	6.36	0.2052	0.0410	39	42		30	31
31 Aug	6.17	0.1990	0.0398	38	41		29	30
30 Sep	4.76	0.1587	0.0317	30	32		23	24
31 Oct	3.59	0.1158	0.0232	22	24		17	18
	40.03							



Drip- Point source or line source - 0.25" / hr. PR

Ornamental Shrubs with a WUCOLS Ow water use class. **0.10**

DU_{LQ}	0.9			Every 4th day			Every 3rd day	
PR Rate	0.25	inches / hr.		watering			watering	
RTM	1.06							
	#75	#75	#75	Lower	Upper		Lower	Upper
	ET_O	ET_O	Ornam	Bndry.	Bndry.		Bndry.	Bndry.
	Avg	Avg.	Req't	Run Time	Run Time		Run Time	Run Time
	Monthly	daily	daily	min.	min.		min.	min.
31 Mar	3.62	0.1168	0.0117	11	12		8	9
30 Apr	4.77	0.1590	0.0159	15	16		11	12
31 May	5.18	0.1671	0.0167	16	17		12	13
30 Jun	5.58	0.1860	0.0186	18	19		13	14
31 Jul	6.36	0.2052	0.0205	20	21		15	16
31 Aug	6.17	0.1990	0.0199	19	20		14	15
30 Sep	4.76	0.1587	0.0159	15	16		11	12
31 Oct	3.59	0.1158	0.0116	11	12		8	9

EWING

1813 N. National St.	Anaheim, CA 92801-1016	714.447.9530
11601 Seaboard Cir.	Stanton, CA 90680-3427	714.898.9530
23941 McWhorter Way	Lake Forest, CA 92630-6396	949.470.1000
1270 Puerta Del Sol	San Clemente, CA 92673-6310	949.366.1085
302 E. Stevens Ave	Santa Ana, CA 92707.5717	714.432.7205

* 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

Irrigation Schedule — Santa Ana, CA

EWING

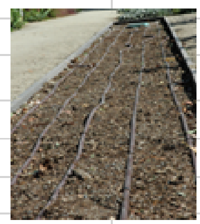
(Schedule based on CIMIS station 75, Irvine, CA)

Drip- Point source or line source - 0.25" / hr. PR

Ornamental Shrubs with a WUCOLS High Water use class. 0.80

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

		#75 ETo Avg Monthly	#75 ETo Avg. daily	#75 Ornam Req't daily	Every 4th day watering: Lower Bndry. Run Time min.	Every 4th day watering: Upper Bndry. Run Time min.	Every 3rd day watering: Lower Bndry. Run Time min.	Every 3rd day watering: Upper Bndry. Run Time min.
31	Mar	3.62	0.1168	0.0934	90	95	67	71
30	Apr	4.77	0.1590	0.1272	122	129	92	97
31	May	5.18	0.1671	0.1337	128	136	96	102
30	Jun	5.58	0.1860	0.1488	143	151	107	114
31	Jul	6.36	0.2052	0.1641	158	167	118	125
31	Aug	6.17	0.1990	0.1592	153	162	115	122
30	Sep	4.76	0.1587	0.1269	122	129	91	97
31	Oct	3.59	0.1158	0.0926	89	94	67	71
		40.03						



Drip- Point source or line source - 0.25" / hr. PR

Ornament. Shrubs with a WUCOLS Moderate water use class 0.50

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

		#75 ETo Avg Monthly	#75 ETo Avg. daily	#75 Ornam Req't daily	Every 4th day watering: Lower Bndry. Run Time min.	Every 4th day watering: Upper Bndry. Run Time min.	Every 3rd day watering: Lower Bndry. Run Time min.	Every 3rd day watering: Upper Bndry. Run Time min.
31	Mar	3.62	0.1168	0.0584	56	59	42	45
30	Apr	4.77	0.1590	0.0795	76	81	57	61
31	May	5.18	0.1671	0.0835	80	85	60	64
30	Jun	5.58	0.1860	0.0930	89	95	67	71
31	Jul	6.36	0.2052	0.1026	98	104	74	78
31	Aug	6.17	0.1990	0.0995	96	101	72	76
30	Sep	4.76	0.1587	0.0793	76	81	57	61
31	Oct	3.59	0.1158	0.0579	56	59	42	44
		40.03						

Max run time on flat clay soils before runoff

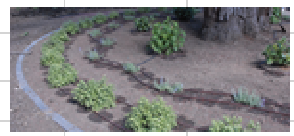
SPRAYS	4 MINUTES	(15 FT SQUARE SPACING)
ROTORS	14 MINUTES	(0.43" / HR PRECIP RATE)
LINE SOURCE DRIP	4 MINUTES	(0.9 GPH - 12" X 12" SPACING)
POINT SOURCE DRIP	24 MINUTES	(0.25" PER HOUR)

Drip- Point source or line source - 0.25" / hr. PR

Ornamental Shrubs with a WUCOLS Low water use class. 0.20

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

		#75 ETo Avg Monthly	#75 ETo Avg. daily	#75 Ornam Req't daily	Every 4th day watering: Lower Bndry. Run Time min.	Every 4th day watering: Upper Bndry. Run Time min.	Every 3rd day watering: Lower Bndry. Run Time min.	Every 3rd day watering: Upper Bndry. Run Time min.
31	Mar	3.62	0.1168	0.0234	22	24	17	18
30	Apr	4.77	0.1590	0.0318	31	32	23	24
31	May	5.18	0.1671	0.0334	32	34	24	26
30	Jun	5.58	0.1860	0.0372	36	38	27	28
31	Jul	6.36	0.2052	0.0410	39	42	30	31
31	Aug	6.17	0.1990	0.0398	38	41	29	30
30	Sep	4.76	0.1587	0.0317	30	32	23	24
31	Oct	3.59	0.1158	0.0232	22	24	17	18
		40.03						



Drip- Point source or line source - 0.25" / hr. PR

Ornamental Shrubs with a WUCOLS Very low water use class 0.10

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

		#75 ETo Avg Monthly	#75 ETo Avg. daily	#75 Ornam Req't daily	Every 4th day watering: Lower Bndry. Run Time min.	Every 4th day watering: Upper Bndry. Run Time min.	Every 3rd day watering: Lower Bndry. Run Time min.	Every 3rd day watering: Upper Bndry. Run Time min.
31	Mar	3.62	0.1168	0.0117	11	12	8	9
30	Apr	4.77	0.1590	0.0159	15	16	11	12
31	May	5.18	0.1671	0.0167	16	17	12	13
30	Jun	5.58	0.1860	0.0186	18	19	13	14
31	Jul	6.36	0.2052	0.0205	20	21	15	16
31	Aug	6.17	0.1990	0.0199	19	20	14	15
30	Sep	4.76	0.1587	0.0159	15	16	11	12
31	Oct	3.59	0.1158	0.0116	11	12	8	9

EWING

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* 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