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Irrigation Tech II

HYDRAULIC TROUBLESHOOTING

How much water & pressure is needed?

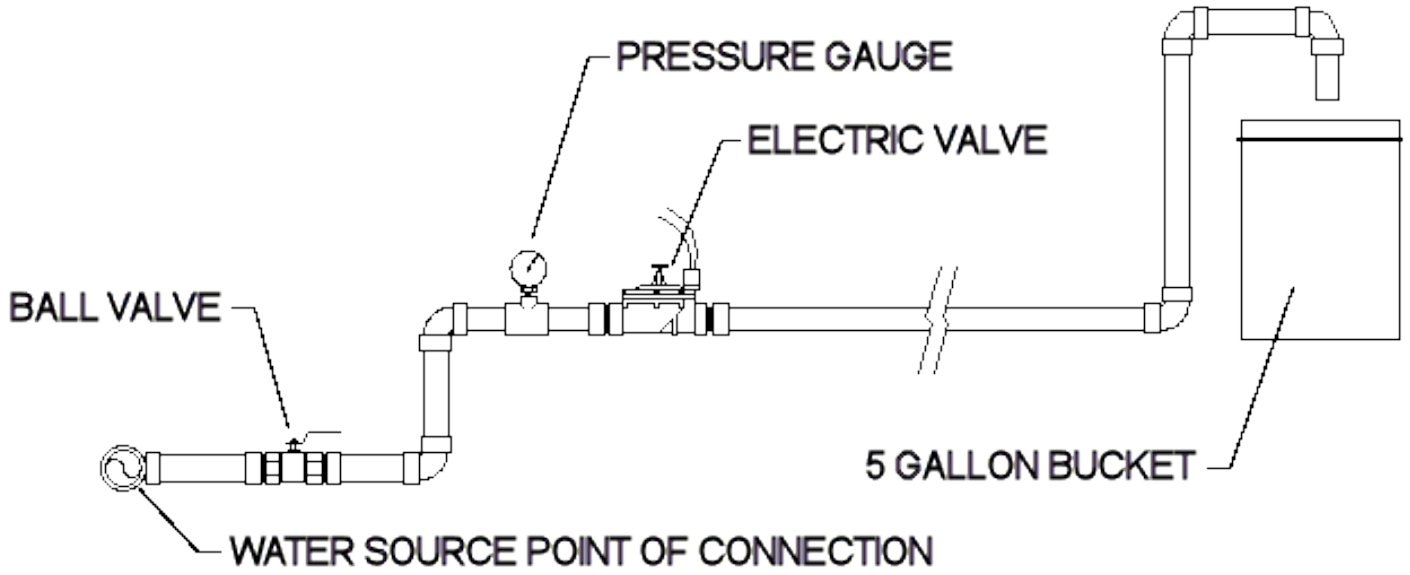
PGP® ULTRA / I-20 / PRB BLUE STANDARD NOZZLE PERFORMANCE DATA

Nozzle	Pressure PSI	Radius ft.	Flow GPM	Precip in/hr ■	Precip in/hr ▲
1.5 ● Blue	25	29	1.2	0.27	0.32
	35	31	1.4	0.28	0.32
	45	**31**	**1.5**	**0.30**	**0.35**
	55	32	1.8	0.34	0.39
	65	32	1.9	0.36	0.41
2.0 ● Blue	25	33	1.4	0.25	0.29
	35	33	1.7	0.30	0.35
	45	**34**	**2.0**	**0.33**	**0.38**
	55	34	2.1	0.35	0.40
	65	32	2.3	0.43	0.50
2.5 ● Blue	25	33	1.7	0.30	0.35
	35	35	2.1	0.33	0.38
	45	**35**	**2.5**	**0.39**	**0.45**
	55	35	2.6	0.41	0.47
	65	35	2.9	0.46	0.53
	25	35	2.2	0.35	0.40

PGP ULTRA / I-20 / PRB GRAY LOW ANGLE NOZZLE PERFORMANCE DATA

Nozzle	Pressure PSI	Radius ft.	Flow GPM	Precip in/hr ■	Precip in/hr ▲
2.0 LA ● Gray	30	25	1.6	0.49	0.57
	40	27	1.9	0.50	0.58
	50	**28**	**2.1**	**0.52**	**0.60**
	60	30	2.3	0.49	0.57
2.5 LA ● Gray	30	27	2.1	0.55	0.64
	40	30	2.5	0.53	0.62
	50	**33**	**2.8**	**0.49**	**0.57**
	60	35	3.0	0.47	0.54
3.5 LA ● Gray	30	29	2.8	0.64	0.74
	40	32	3.1	0.58	0.67
	50	**35**	**3.5**	**0.55**	**0.64**
	60	37	3.8	0.53	0.62
4.5 LA ● Gray	30	29	3.4	0.78	0.90
	40	32	3.9	0.73	0.85
	50	**35**	**4.4**	**0.69**	**0.80**
	60	37	4.7	0.66	0.76

Water Flow



http://www.irrigationtutorials.com

Water Pressure

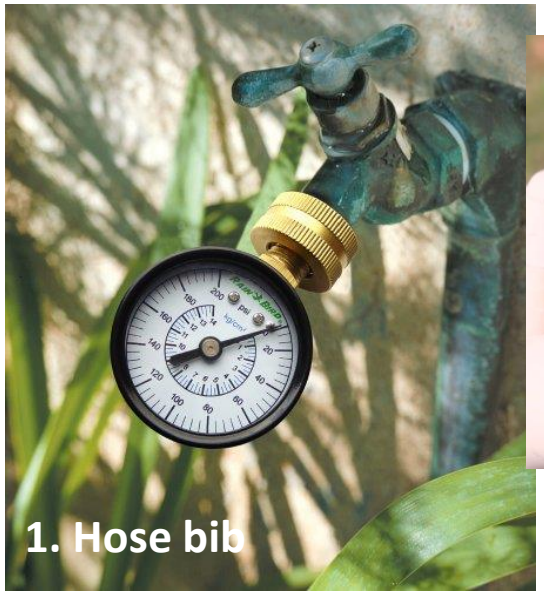
Pressure is the force that moves water through a pipe

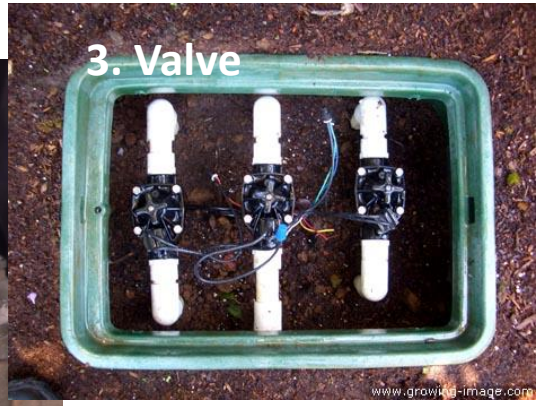
- Created by a pump
  - A pump creates pressure by pushing the water into a closed container (pipe) or a container with limited openings (pipe with sprinkler nozzles or drip emitters) so it is contained under a force.
  - Pressure changes in a system by friction losses or by elevation changes.
- Created by gravity

.433psi loss/gain per foot of elevation change

Pipe size is a factor only in that the water velocity is faster for a given flow rate for smaller pipe diameters. Remember that friction loss is greater for high water velocities.

How do you check pressure?





Troubleshooting Pressure

Video may be found at

https://www.youtube.com/watch?v=gfPuUVWWzUE

Water Flow

Flow is a function of water velocity and the pipe cross-sectional area.

Q = 7.48 x V x A

- **Q** = quantity of water flow given in gallons per minute (gpm)
- **V** = velocity of water given in feet per minute (fpm). Charts may use feet per second (fps).
- **A** = cross-sectional area of the pipe given in square feet (sq ft)

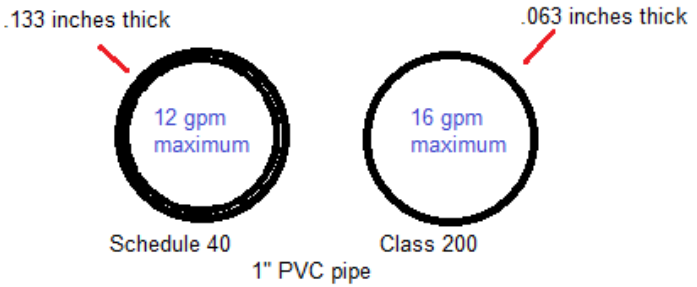
*There are **7.48 gallons of water in a cubic foot.***

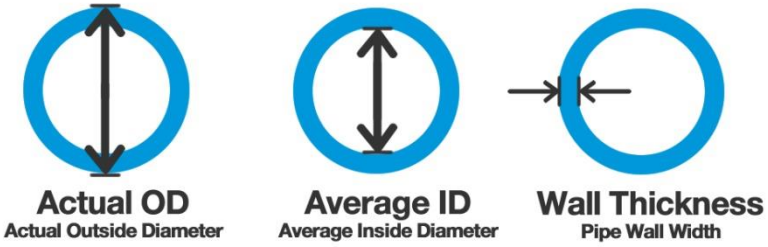
The flow rate in the pipeline must total the water demand needed to operate the sprinkler nozzles or drip emitters.

Pipe Cross-Sectional Area

- One inch pipe - it is a nominal one inch; the true inside diameter usually is not 1 inch
  - Schedule 40 PVC pipe, the inside diameter is actually 1.029”
  - Outside diameters are kept constant so pipe fittings will fit
  - **Higher pressure rated pipes will have thicker walls and smaller inside diameters.**

Schedule 40 vs Class 200





Pipe Sizing

Irrigation Association Friction Loss Chart 2008

CLASS 200 PVC IPS PLASTIC PIPE

ASTM D-2241 (1120,1220) SDR 21 C=150

PSI Loss Per 100 Feet of Pipe

Nominal Size	Class 315 1/2"		3/4"		1"		1 1/4"		1 1/2"		2"		2 1/2"		3"		4"		6"	
Avg. ID	0.696		0.910		1.169		1.482		1.700		2.129		2.581		3.146		4.046		5.955	
Pipe OD	0.840		1.050		1.315		1.660		1.900		2.375		2.875		3.500		4.500		6.625	
Avg.Wall	0.072		0.070		0.073		0.089		0.100		0.123		0.147		0.177		0.227		0.335	
Min. Wall	0.062		0.060		0.063		0.079		0.090		0.113		0.137		0.167		0.214		0.316	
Flow GPM	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS	Velocity FPS	PSI LOSS
1	0.84	0.25	0.49	0.07	0.30	0.02	0.19	0.01	0.14	0.00										
2	1.68	0.90	0.99	0.24	0.60	0.07	0.37	0.02	0.28	0.01	0.18	0.00								
3	2.53	1.90	1.48	0.52	0.90	0.15	0.56	0.05	0.42	0.02	0.27	0.01								
4	3.37	3.24	1.97	0.88	1.19	0.26	0.74	0.08	0.56	0.04	0.36	0.01	0.24	0.01						
5	4.21	4.89	2.46	1.33	1.49	0.39	0.93	0.12	0.71	0.06	0.45	0.02	0.31	0.01						
6	5.05	6.86	2.96	1.86	1.79	0.55	1.11	0.17	0.85	0.09	0.54	0.03	0.37	0.01	0.25	0.00				
7	5.90	9.12	3.45	2.47	2.09	0.73	1.30	0.23	0.99	0.12	0.63	0.04	0.43	0.02	0.29	0.01				
8	6.74	11.68	3.94	3.17	2.39	0.94	1.49	0.30	1.13	0.15	0.72	0.05	0.49	0.02	0.33	0.01				
9	7.58	14.53	4.43	3.94	2.69	1.17	1.67	0.37	1.27	0.19	0.81	0.06	0.55	0.02	0.37	0.01				
10	8.42	17.66	4.93	4.79	2.99	1.42	1.86	0.45	1.41	0.23	0.90	0.08	0.61	0.03	0.41	0.01				
12	10.11	24.75	5.91	6.71	3.58	1.98	2.23	0.63	1.69	0.32	1.08	0.11	0.73	0.04	0.49	0.02				
14	11.79	32.93	6.90	8.93	4.18	2.64	2.60	0.83	1.98	0.43	1.26	0.14	0.86	0.06	0.58	0.02				
16	13.48	42.16	7.88	11.44	4.78	3.38	2.97	1.07	2.26	0.55	1.44	0.18	0.98	0.07	0.66	0.03	0.40	0.01		
18	15.16	52.44	8.87	14.23	5.37	4.21	3.34	1.33	2.54	0.68	1.62	0.23	1.10	0.09	0.74	0.03	0.45	0.01		
20			9.85	17.29	5.97	5.11	3.72	1.61	2.82	0.83	1.80	0.28	1.22	0.11	0.82	0.04	0.50	0.01		
22			10.84	20.63	6.57	6.10	4.09	1.92	3.11	0.99	1.98	0.33	1.35	0.13	0.91	0.05	0.55	0.01		
24			11.82	24.24	7.17	7.17	4.46	2.26	3.39	1.16	2.16	0.39	1.47	0.15	0.99	0.06	0.60	0.02		
26			12.81	28.11	7.76	8.31	4.83	2.62	3.67	1.34	2.34	0.45	1.59	0.18	1.07	0.07	0.65	0.02		
28			13.80	32.25	8.36	9.53	5.20	3.01	3.95	1.54	2.52	0.52	1.71	0.20	1.15	0.08	0.70	0.02		
30			14.78	36.64	8.96	10.83	5.57	3.41	4.24	1.75	2.70	0.59	1.84	0.23	1.24	0.09	0.75	0.03		
32					9.55	12.21	5.94	3.85	4.52	1.97	2.88	0.66	1.96	0.26	1.32	0.10	0.80	0.03	0.37	0.00
34					10.15	13.66	6.32	4.31	4.80	2.21	3.06	0.74	2.08	0.29	1.40	0.11	0.85	0.03	0.39	0.00
36					10.75	15.18	6.69	4.79	5.08	2.45	3.24	0.82	2.20	0.32	1.48	0.12	0.90	0.04	0.41	0.01
38					11.35	16.78	7.06	5.29	5.36	2.71	3.42	0.91	2.33	0.36	1.57	0.14	0.95	0.04	0.44	0.01
40					11.94	18.45	7.43	5.82	5.65	2.98	3.60	1.00	2.45	0.39	1.65	0.15	1.00	0.04	0.46	0.01
42					12.54	20.20	7.80	6.37	5.93	3.27	3.78	1.09	2.57	0.43	1.73	0.16	1.05	0.05	0.48	0.01

Friction Loss

As water moves through a pipe, there is friction loss, which is a function of the surface roughness of inside pipe walls, the diameter of the pipe, the velocity of the water, and the number of path restrictions along the way.

- Proper selection of pipe size is needed to ensure that the pipe:
  - is large enough to safely carry the quantity of water
  - has a reasonable friction loss so the operating pressure is largely preserved
  - is economical for the water flow

Friction Loss

Irrigation Association Friction Loss Chart 2008

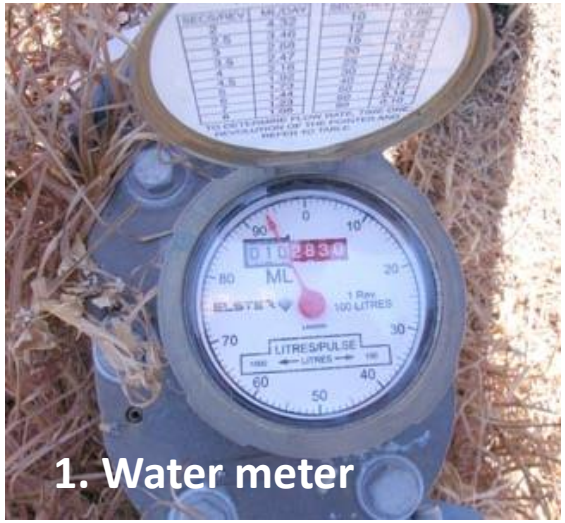
CLASS 200 PVC IPS PLASTIC PIPE

ASTM D-2241 (1120,1220) SDR 21 C=150

PSI Loss Per 100 Feet of Pipe

Nominal Size	Class 315 1/2"		3/4"		1"		1 1/4"		1 1/2"		2"		2 1/2"		3"		4"		6"	
Avg. ID	0.696		0.910		1.169		1.482		1.700		2.129		2.581		3.146		4.046		5.955	
Pipe OD	0.840		1.050		1.315		1.660		1.900		2.375		2.875		3.500		4.500		6.625	
Avg.Wall	0.072		0.070		0.073		0.089		0.100		0.123		0.147		0.177		0.227		0.335	
Min. Wall	0.062		0.060		0.063		0.079		0.090		0.113		0.137		0.167		0.214		0.316	
Flow	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI
GPM	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS
1	0.84	0.25	0.49	0.07	0.30	0.02	0.19	0.01	0.14	0.00										
2	1.68	0.90	0.99	0.24	0.60	0.07	0.37	0.02	0.28	0.01	0.18	0.00								
3	2.53	1.90	1.48	0.52	0.90	0.15	0.56	0.05	0.42	0.02	0.27	0.01								
4	3.37	3.24	1.97	0.88	1.19	0.26	0.74	0.08	0.56	0.04	0.36	0.01	0.24	0.01						
5	4.21	4.89	2.46	1.33	1.49	0.39	0.93	0.12	0.71	0.06	0.45	0.02	0.31	0.01						
6	5.05	6.86	2.96	1.86	1.79	0.55	1.11	0.17	0.85	0.09	0.54	0.03	0.37	0.01	0.25	0.00				
7	5.90	9.12	3.45	2.47	2.09	0.73	1.30	0.23	0.99	0.12	0.63	0.04	0.43	0.02	0.29	0.01				
8	6.74	11.68	3.94	3.17	2.39	0.94	1.49	0.30	1.13	0.15	0.72	0.05	0.49	0.02	0.33	0.01				
9	7.58	14.53	4.43	3.94	2.69	1.17	1.67	0.37	1.27	0.19	0.81	0.06	0.55	0.02	0.37	0.01				
10	8.42	17.66	4.93	4.79	2.99	1.42	1.86	0.45	1.41	0.23	0.90	0.08	0.61	0.03	0.41	0.01				
12	10.11	24.75	5.91	6.71	3.58	1.98	2.23	0.63	1.69	0.32	1.08	0.11	0.73	0.04	0.49	0.02				
14	11.79	32.93	6.90	8.93	4.18	2.64	2.60	0.83	1.98	0.43	1.26	0.14	0.86	0.06	0.58	0.02				
16	13.48	42.16	7.88	11.44	4.78	3.38	2.97	1.07	2.26	0.55	1.44	0.18	0.98	0.07	0.66	0.03	0.40	0.01		
18	15.16	52.44	8.87	14.23	5.37	4.21	3.34	1.33	2.54	0.68	1.62	0.23	1.10	0.09	0.74	0.03	0.45	0.01		
20			9.85	17.29	5.97	5.11	3.72	1.61	2.82	0.83	1.80	0.28	1.22	0.11	0.82	0.04	0.50	0.01		
22			10.84	20.63	6.57	6.10	4.09	1.92	3.11	0.99	1.98	0.33	1.35	0.13	0.91	0.05	0.55	0.01		
24			11.82	24.24	7.17	7.17	4.46	2.26	3.39	1.16	2.16	0.39	1.47	0.15	0.99	0.06	0.60	0.02		
26			12.81	28.11	7.76	8.31	4.83	2.62	3.67	1.34	2.34	0.45	1.59	0.18	1.07	0.07	0.65	0.02		
28			13.80	32.25	8.36	9.53	5.20	3.01	3.95	1.54	2.52	0.52	1.71	0.20	1.15	0.08	0.70	0.02		
30			14.78	36.64	8.96	10.83	5.57	3.41	4.24	1.75	2.70	0.59	1.84	0.23	1.24	0.09	0.75	0.03		
32					9.55	12.21	5.94	3.85	4.52	1.97	2.88	0.66	1.96	0.26	1.32	0.10	0.80	0.03	0.37	0.00
34					10.15	13.66	6.32	4.31	4.80	2.21	3.06	0.74	2.08	0.29	1.40	0.11	0.85	0.03	0.39	0.00
36					10.75	15.18	6.69	4.79	5.08	2.45	3.24	0.82	2.20	0.32	1.48	0.12	0.90	0.04	0.41	0.01
38					11.35	16.78	7.06	5.29	5.36	2.71	3.42	0.91	2.33	0.36	1.57	0.14	0.95	0.04	0.44	0.01
40					11.94	18.45	7.43	5.82	5.65	2.98	3.60	1.00	2.45	0.39	1.65	0.15	1.00	0.04	0.46	0.01
42					12.54	20.20	7.80	6.37	5.93	3.27	3.78	1.09	2.57	0.43	1.73	0.16	1.05	0.05	0.48	0.01

Where friction loss occurs



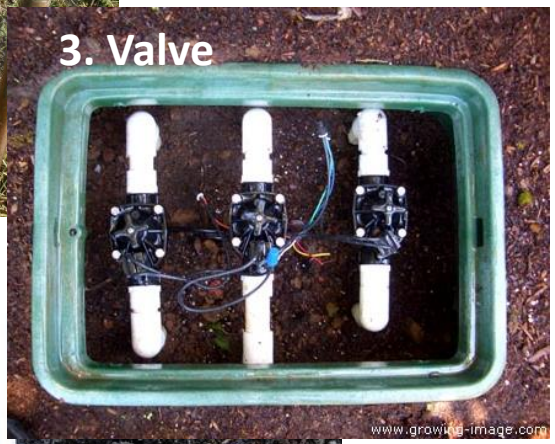


Table of Approximate Pressure Losses for Pipe Fittings

Listed in Equivalent Feet of Pipe

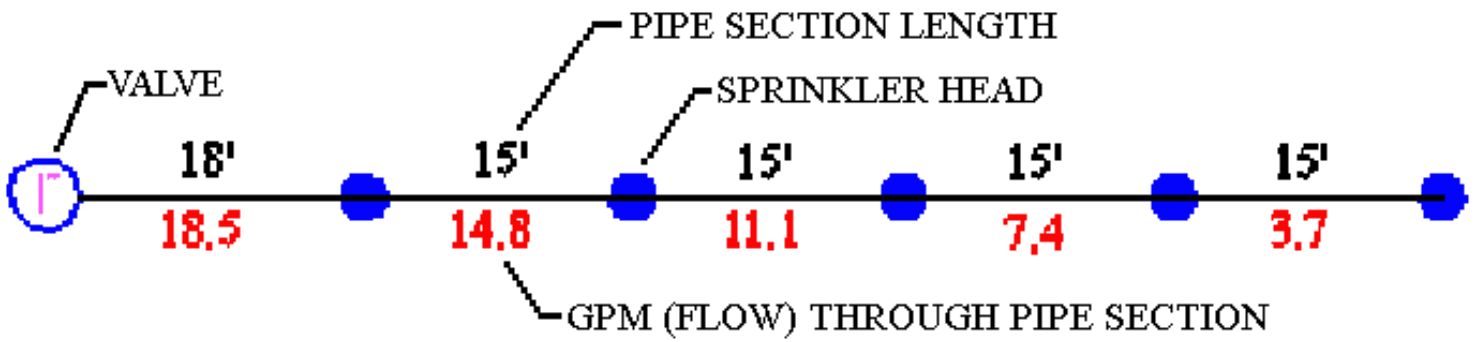
Plastic IPS or Copper Fitting Type	½"	¾"	1"	1¼"	1½"	2"	2½"	3"	4"	6"	8"
Coupling	1.5	2.5	3.0	3.0	4.0	6.0	7.0	8.0	11.0	18.0	24.0
Run of St. Tee	2.5	3.0	4.0	5.0	6.0	8.0	9.0	11.0	15.0	21.0	28.0
Tee, Side Outlet	7.0	9.0	12.0	15.0	18.0	24.0	30.0	36.0	45.0	70.0	90.0
Tee, Run Reduced ½"	3.5	4.5	6.0	8.0	9.0	11.0	14.0	17.0	24.0	34.0	45.0
Elbow, 90°	3.5	4.5	6.0	8.0	9.0	11.0	14.0	17.0	24.0	34.0	45.0
Elbow, 34°	1.5	2.0	3.0	3.5	4.0	5.0	7.0	8.0	10.0	16.0	20.0

Pressure Loss Through Water Meters

Pressure Loss: psi
Nominal Size

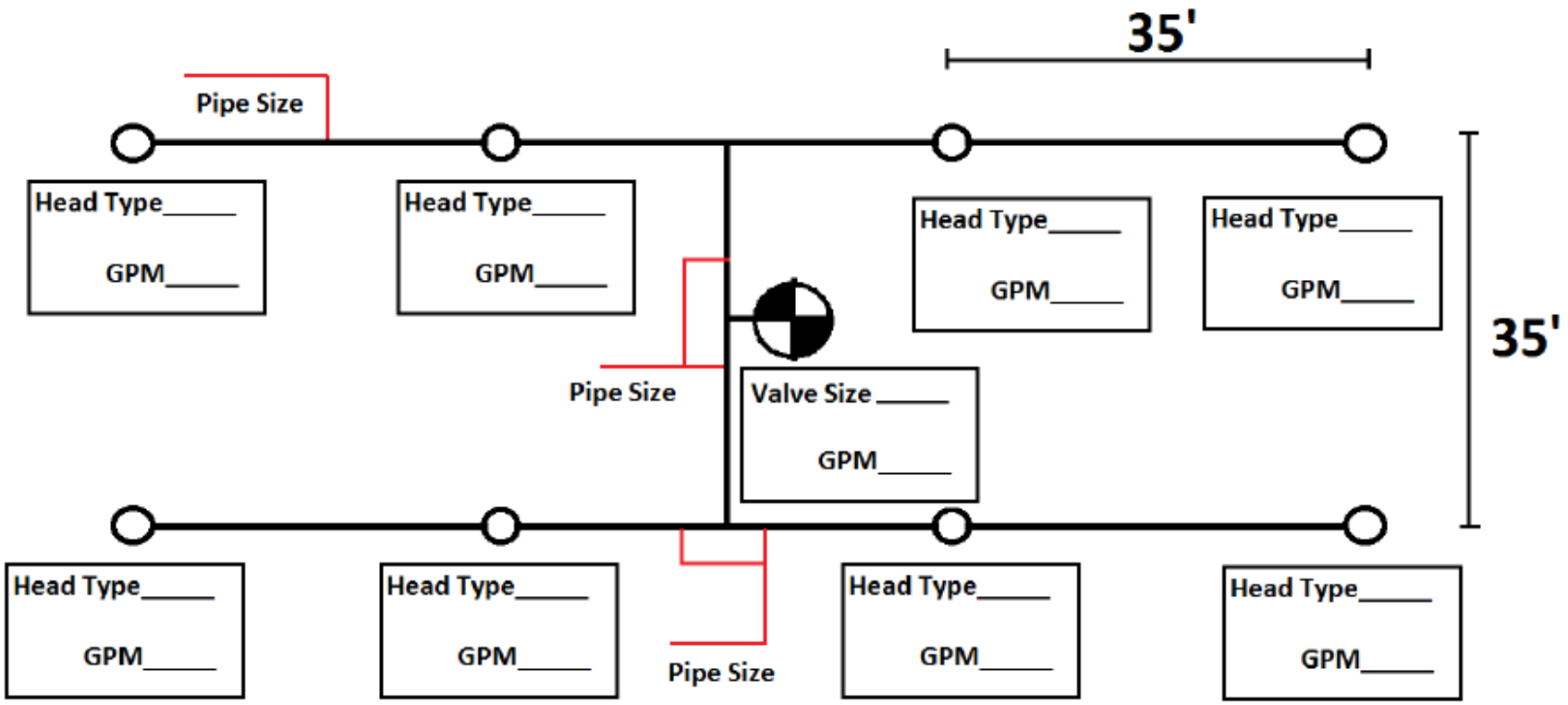
Flow gpm	5/8"	3/4"	1"	1 1/2"	2"	3"	4"
1	0.2	0.1					
2	0.3	0.2					
3	0.4	0.3					
4	0.6	0.5	0.1				
5	0.9	0.6	0.2				
6	1.3	0.7	0.3				
7	1.8	0.8	0.4				
8	2.3	1.0	0.5				
9	3.0	1.3	0.6				
10	3.7	1.6	0.7				
11	4.4	1.9	0.8				
12	5.1	2.2	0.9				
13	6.1	2.6	1.0				
14	7.2	3.1	1.1				
15	8.3	3.6	1.2				
16	9.4	4.1	1.4	0.4			
17	10.7	4.6	1.6	0.5			
18	12.0	5.2	1.8	0.6			
19	13.4	5.8	2.0	0.7			
20	15.0	6.5	2.2	0.8			
22		7.9	2.8	1.0			
24		9.5	3.4	1.2			
26		11.2	4.0	1.4			
28		13.0	4.6	1.6			
30		15.0	5.3	1.8			
32			6.0	2.1	0.8		

Irrigation Hydraulics



Irrigation Hydraulics

- How do we calculate our water needs?



Let's take another look at our provided resources… page 37

Water Velocity

Within a given pipe, the flow rate increases as the velocity increases.

Velocity

Irrigation Association Friction Loss Chart 2008

CLASS 200 PVC IPS PLASTIC PIPE

ASTM D-2241 (1120,1220) SDR 21 C=150

PSI Loss Per 100 Feet of Pipe

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Avg. ID	0.696		0.910		1.169		1.482		1.700		2.129		2.581		3.146		4.046		5.955	
Pipe OD	0.840		1.050		1.315		1.660		1.900		2.375		2.875		3.500		4.500		6.625	
Avg.Wall	0.072		0.070		0.073		0.089		0.100		0.123		0.147		0.177		0.227		0.335	
Min. Wall	0.062		0.060		0.063		0.079		0.090		0.113		0.137		0.167		0.214		0.316	
Flow	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI	Velocity	PSI
GPM	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS	FPS	LOSS
1	0.84	0.25	0.49	0.07	0.30	0.02	0.19	0.01	0.14	0.00										
2	1.68	0.90	0.99	0.24	0.60	0.07	0.37	0.02	0.28	0.01	0.18	0.00								
3	2.53	1.90	1.48	0.52	0.90	0.15	0.56	0.05	0.42	0.02	0.27	0.01								
4	3.37	3.24	1.97	0.88	1.19	0.26	0.74	0.08	0.56	0.04	0.36	0.01	0.24	0.01						
5	4.21	4.89	2.46	1.33	1.49	0.39	0.93	0.12	0.71	0.06	0.45	0.02	0.31	0.01						
6	5.05	6.86	2.96	1.86	1.79	0.55	1.11	0.17	0.85	0.09	0.54	0.03	0.37	0.01	0.25	0.00				
7	5.90	9.12	3.45	2.47	2.09	0.73	1.30	0.23	0.99	0.12	0.63	0.04	0.43	0.02	0.29	0.01				
8	6.74	11.68	3.94	3.17	2.39	0.94	1.49	0.30	1.13	0.15	0.72	0.05	0.49	0.02	0.33	0.01				
9	7.58	14.53	4.43	3.94	2.69	1.17	1.67	0.37	1.27	0.19	0.81	0.06	0.55	0.02	0.37	0.01				
10	8.42	17.66	4.93	4.79	2.99	1.42	1.86	0.45	1.41	0.23	0.90	0.08	0.61	0.03	0.41	0.01				
12	10.11	24.75	5.91	6.71	3.58	1.98	2.23	0.63	1.69	0.32	1.08	0.11	0.73	0.04	0.49	0.02				
14	11.79	32.93	6.90	8.93	4.18	2.64	2.60	0.83	1.98	0.43	1.26	0.14	0.86	0.06	0.58	0.02				
16	13.48	42.16	7.88	11.44	4.78	3.38	2.97	1.07	2.26	0.55	1.44	0.18	0.98	0.07	0.66	0.03	0.40	0.01		
18	15.16	52.44	8.87	14.23	5.37	4.21	3.34	1.33	2.54	0.68	1.62	0.23	1.10	0.09	0.74	0.03	0.45	0.01		
20			9.85	17.29	5.97	5.11	3.72	1.61	2.82	0.83	1.80	0.28	1.22	0.11	0.82	0.04	0.50	0.01		
22			10.84	20.63	6.57	6.10	4.09	1.92	3.11	0.99	1.98	0.33	1.35	0.13	0.91	0.05	0.55	0.01		
24			11.82	24.24	7.17	7.17	4.46	2.26	3.39	1.16	2.16	0.39	1.47	0.15	0.99	0.06	0.60	0.02		
26			12.81	28.11	7.76	8.31	4.83	2.62	3.67	1.34	2.34	0.45	1.59	0.18	1.07	0.07	0.65	0.02		
28			13.80	32.25	8.36	9.53	5.20	3.01	3.95	1.54	2.52	0.52	1.71	0.20	1.15	0.08	0.70	0.02		
30			14.78	36.64	8.96	10.83	5.57	3.41	4.24	1.75	2.70	0.59	1.84	0.23	1.24	0.09	0.75	0.03		
32					9.55	12.21	5.94	3.85	4.52	1.97	2.88	0.66	1.96	0.26	1.32	0.10	0.80	0.03	0.37	0.00
34					10.15	13.66	6.32	4.31	4.80	2.21	3.06	0.74	2.08	0.29	1.40	0.11	0.85	0.03	0.39	0.00
36					10.75	15.18	6.69	4.79	5.08	2.45	3.24	0.82	2.20	0.32	1.48	0.12	0.90	0.04	0.41	0.01
38					11.35	16.78	7.06	5.29	5.36	2.71	3.42	0.91	2.33	0.36	1.57	0.14	0.95	0.04	0.44	0.01
40					11.94	18.45	7.43	5.82	5.65	2.98	3.60	1.00	2.45	0.39	1.65	0.15	1.00	0.04	0.46	0.01
42					12.54	20.20	7.80	6.37	5.93	3.27	3.78	1.09	2.57	0.43	1.73	0.16	1.05	0.05	0.48	0.01

Distribution Uniformity (DU)

- The DU is a measurement of uniformity, expressed as a percentage, comparing the driest 25% or 50% of the areas to the average PR.
    - Note: the low half of the 50% DU will usually compare with the value calculated using CU
- A perfectly uniform application is represented by a DU of 100%. A less uniform application is represented by a lower percentage.

Precipitation Rate (PR)

- The PR is the average rate in inches per hour, at which water is being applied to the area covered by a specific sprinkler layout.

- PR is a function of the total sprinkler discharge applied to the area between the sprinklers.

Falcon 6504 Nozzle Performance

Pressure bar	Nozzle	Radius ft.	Flow gpm	Precip in/h ■	Precip in/h ▲
50	● 4	41	3.7	0.42	0.49
	● 6	49	5.5	0.44	0.51
	● 8	51	7.4	0.55	0.63
	● 10	53	9.1	0.62	0.72
	● 12	55	11.0	0.70	0.81
	● 14	59	12.7	0.70	0.81
	● 16	61	14.3	0.74	0.85
	● 18	59	15.4	0.85	0.98
60	● 4	41	4.0	0.46	0.53
	● 6	47	6.0	0.52	0.60
	● 8	51	8.2	0.61	0.70
	● 10	55	10.0	0.64	0.73
	● 12	57	12.2	0.72	0.83
	● 14	61	14.0	0.72	0.84
	● 16	63	15.7	0.76	0.88
	● 18	63	17.1	0.83	0.96

NOZZLES

PRECISION DISTRIBUTION CONTROL™ ADJUSTABLE NOZZLES PERFORMANCE DATA

		12A ● Green — 12' radius, Adjustable from 0° to 360°, Trajectory: 28°				15A ● Black — 15' radius, Adjustable from 0° to 360°, Trajectory: 28°			
Arc	Pressure PSI	Radius ft.	Flow GPM	Precip in/hr ■	Precip in/hr ▲	Radius ft.	Flow GPM	Precip in/hr ■	Precip in/hr ▲
45°	20	11	0.25	1.59	1.84	14	0.39	1.51	1.75
	25	12	0.28	1.60	1.85	15	0.43	1.57	1.82
	30	**12**	**0.32**	**1.68**	**1.95**	**15**	**0.47**	**1.59**	**1.84**
	35	13	0.37	1.80	2.08	16	0.52	1.55	1.79
	40	13	0.42	1.91	2.21	17	0.57	1.60	1.85
90°	20	11	0.50	1.59	1.84	14	0.77	1.51	1.75
	25	12	0.55	1.60	1.85	15	0.86	1.57	1.82
	30	**12**	**0.63**	**1.68**	**1.95**	**15**	**0.93**	**1.59**	**1.84**
	35	13	0.73	1.80	2.08	16	1.03	1.55	1.79
	40	13	0.84	1.91	2.21	17	1.13	1.60	1.85
120°	20	11	0.67	1.59	1.84	14	1.03	1.51	1.75
	25	12	0.73	1.60	1.85	15	1.15	1.57	1.82
	30	**12**	**0.84**	**1.68**	**1.95**	**15**	**1.24**	**1.59**	**1.84**
	35	13	0.97	1.80	2.08	16	1.37	1.55	1.79
	40	13	1.12	1.91	2.21	17	1.51	1.60	1.85
180°	20	11	1.00	1.59	1.84	14	1.54	1.51	1.75
	25	12	1.10	1.60	1.85	15	1.72	1.57	1.82
	30	**12**	**1.26**	**1.68**	**1.95**	**15**	**1.86**	**1.59**	**1.84**
	35	13	1.46	1.80	2.08	16	2.06	1.55	1.79
	40	13	1.68	1.91	2.21	17	2.26	1.60	1.85
240°	20	11	1.33	1.59	1.84	14	2.05	1.51	1.75
	25	12	1.47	1.60	1.85	15	2.29	1.57	1.82
	30	**12**	**1.68**	**1.68**	**1.95**	**15**	**2.48**	**1.59**	**1.84**
	35	13	1.95	1.80	2.08	16	2.75	1.55	1.79
	40	13	2.24	1.91	2.21	17	3.01	1.60	1.85

Calculating Precipitation Rates

- Use this formula to calculate PR:

$$\frac{96.3 \times GPM}{S \times L} = IPH$$

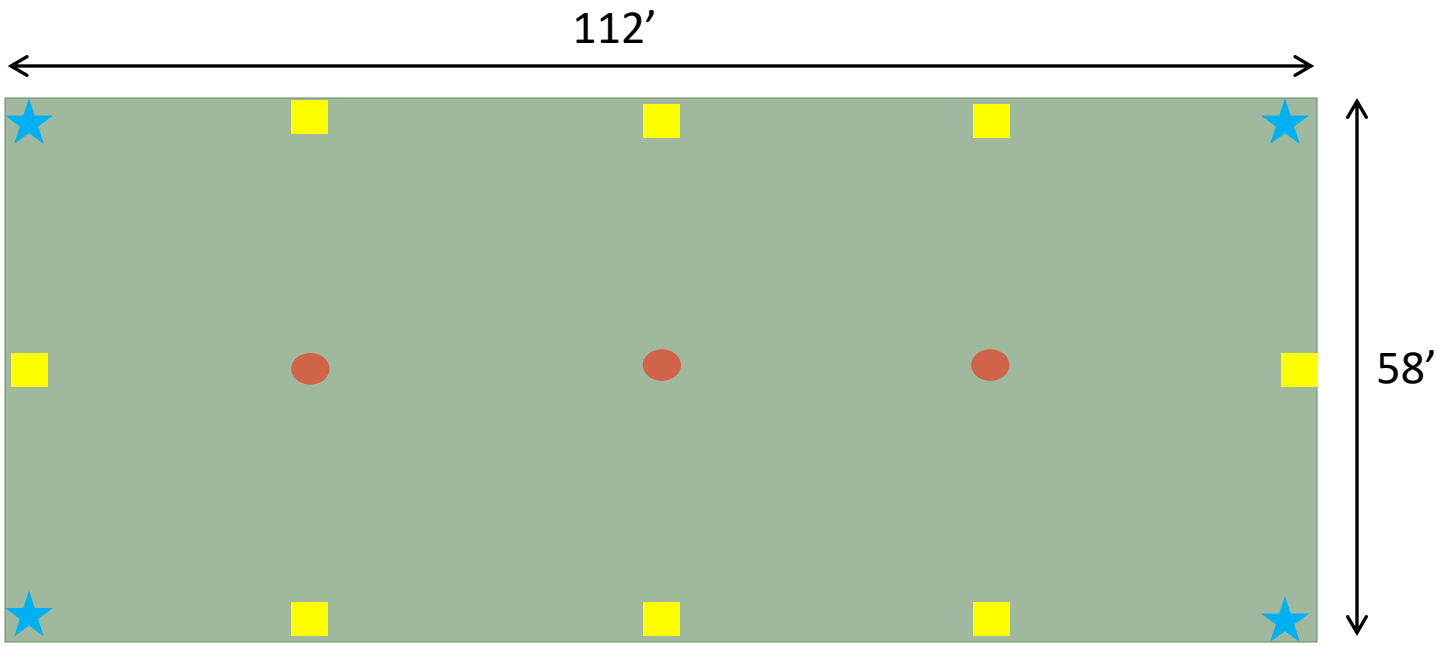
- **96.3** = a constant
- **GPM** = gallons per minutes applied to the target area by all sprinklers in patterns
- **S**= distance in feet of the sprinklers on a row
- **L**= distance in feet between sprinklers in a row
- **IPH**= average inches per hour

Calculating Precipitation Rates

Calculating the PR for the sprinkler layout using the following information:

Operating pressure: 45 psi

★ 90°- 1.4 GPM ■ 180°- 2.9 GPM ● 360°- 5.5 GPM

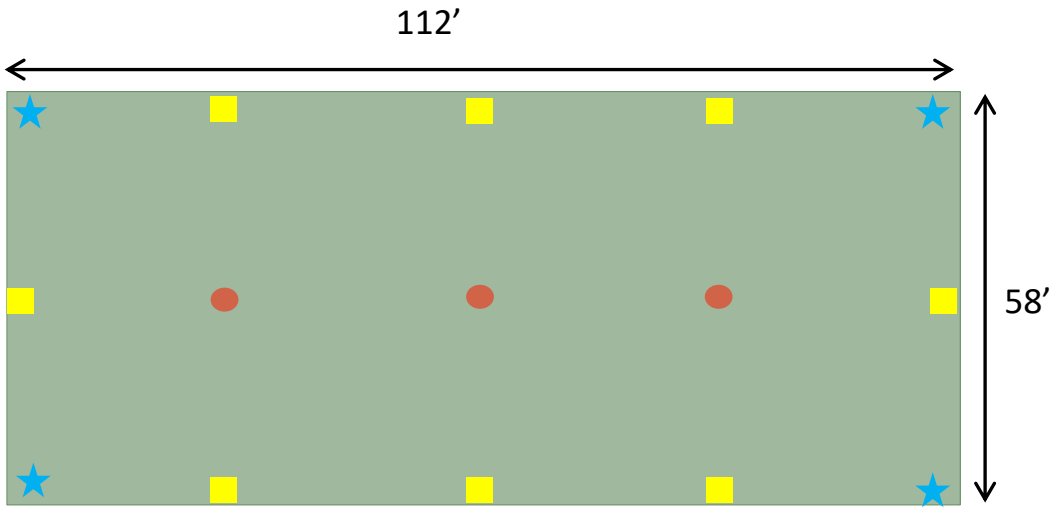


Calculating Precipitation Rates

Calculating the PR for the sprinkler layout using the following information:

Operating pressure: 45 psi

90°- 1.4 GPM 180°- 2.9 GPM 360°- 5.5 GPM



$$\frac{96.3 \times 45.3 \text{ GPM}}{112' \times 58'} = \frac{4362.4}{6496}$$

$$\frac{96.3 \times \text{GPM}}{S \times L} = \text{IPH}$$

= 0.67” per hour (PR)

Matched Precipitation Rates

- Matched Precipitation Rates (MPR)
  - Sprinklers which apply water at the same rate per hour no matter the arc or coverage (matched gpm flow rates to arc coverage)
  - Spray heads have fixed arcs and are matched for you
  - Rotors offer a choice of nozzles for you to match to the designed arc pattern

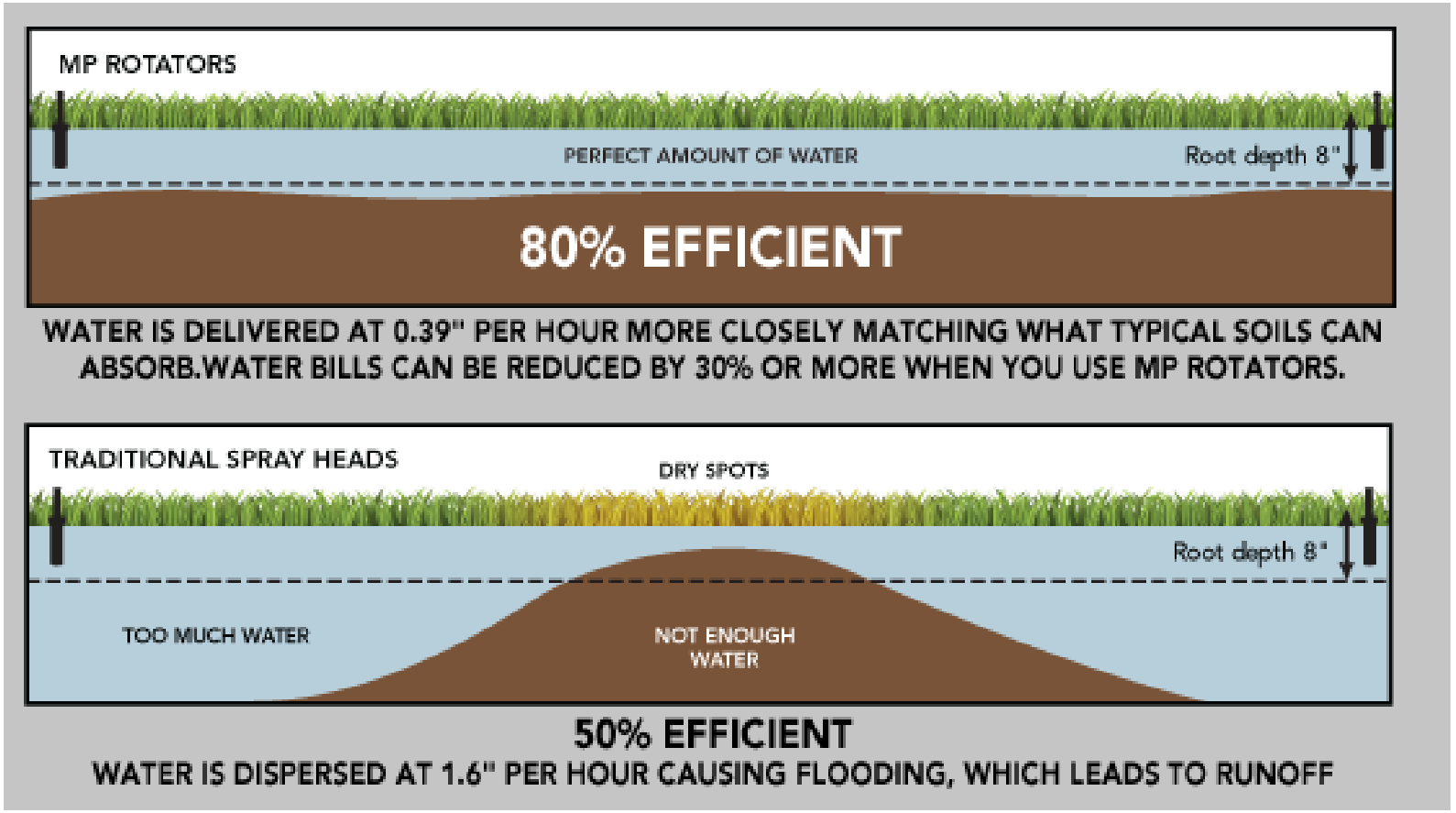
MP Rotators

MP ROTATOR PERFORMANCE DATA

		MP1000 Radius: 8' to 15' Adjustable Arc and Full-Circle ● Maroon: 90° to 210° ● Lt. Blue: 210° to 270° ● Olive: 360°					MP2000 Radius: 13' to 21' Adjustable Arc and Full-Circle ● Black: 90° to 210° ● Green: 210° to 270° ● Red: 360°					MP3000 Radius: 22' to 30' Adjustable Arc and Full-Circle ● Blue: 90° to 210° ● Yellow: 210° to 270° ● Gray: 360°				
Arc	Pressure PSI	Radius ft.	Flow GPM	Flow GPH	Precip in/hr ■	Precip in/hr ▲	Radius ft.	Flow GPM	Flow GPH	Precip in/hr ■	Precip in/hr ▲	Radius ft.	Flow GPM	Flow GPH	Precip in/hr ■	Precip in/hr ▲
90°	25	--	--	--	--	--	17	0.34	20.4	0.45	0.52	25	0.71	42.6	0.44	0.51
	30	12	0.17	10.2	0.45	0.52	18	0.38	22.8	0.45	0.52	27	0.76	45.6	0.40	0.46
	35	13	0.19	11.4	0.43	0.50	19	0.40	24.0	0.43	0.49	28	0.82	49.2	0.40	0.46
	40	**14**	**0.21**	**12.6**	**0.41**	**0.48**	**20**	**0.43**	**25.8**	**0.41**	**0.48**	**30**	**0.86**	**51.6**	**0.37**	**0.42**
	45	14	0.23	13.8	0.45	0.52	21	0.46	27.6	0.40	0.46	30	0.90	54.0	0.39	0.44
	50	15	0.25	15.0	0.43	0.49	21	0.47	28.2	0.41	0.47	30	0.95	57.0	0.41	0.47
	55	15	0.27	16.2	0.46	0.53	21	0.48	28.8	0.42	0.48	30	1.01	60.6	0.43	0.50
180°	25	--	--	--	--	--	16	0.6	36.0	0.45	0.52	25	1.44	86.4	0.44	0.51
	30	12	0.34	20.4	0.45	0.52	17	0.64	38.4	0.43	0.49	27	1.58	94.8	0.42	0.48
	35	13	0.38	22.8	0.43	0.50	18	0.71	42.6	0.42	0.49	28	1.70	102.0	0.42	0.48
	40	**14**	**0.42**	**25.2**	**0.41**	**0.48**	**19**	**0.77**	**46.2**	**0.41**	**0.47**	**30**	**1.82**	**109.2**	**0.39**	**0.45**
	45	14	0.44	26.4	0.43	0.50	20	0.85	51.0	0.41	0.47	30	1.93	115.8	0.41	0.48
	50	15	0.50	30.0	0.43	0.49	21	0.91	54.6	0.40	0.46	30	2.04	122.4	0.44	0.50
	55	15	0.51	30.6	0.44	0.50	21	0.95	57.0	0.41	0.48	30	2.13	127.8	0.46	0.53

Matched Precipitation Rates

MP ROTATORS DISTRIBUTE WATER EVENLY AND UNIFORMLY



http://www.hunterindustries.com

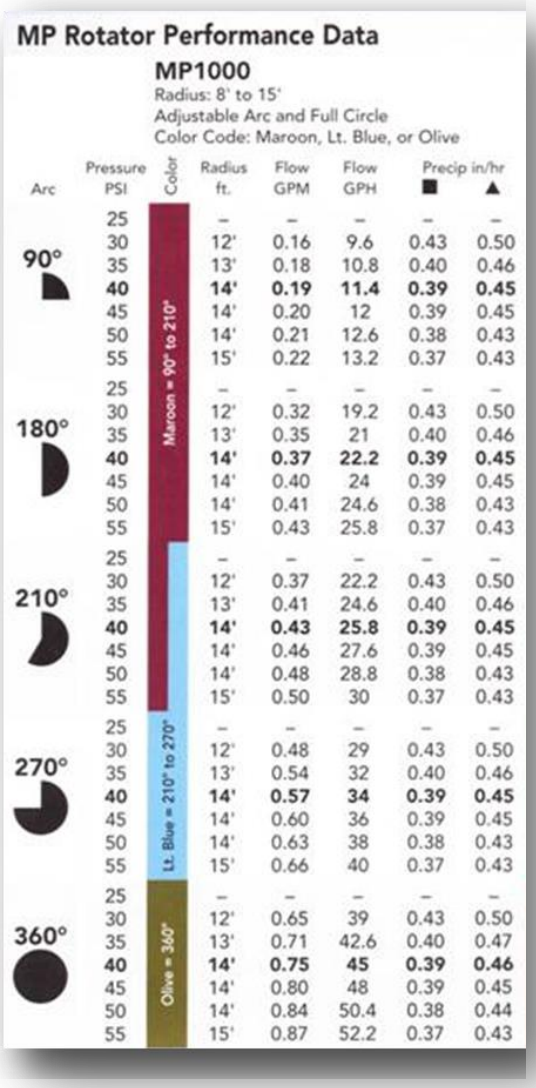
What was used in the past

vs

What’s available now

Selecting Sprinklers & Spacing Ranges

- Sprinkler performance charts contain:
- PSI
  - Sprinkler operating pressure
- Radius
  - Distance from the sprinkler to the edge of the throw (feet)
- GPM
  - Flow rate of the sprinkler with difference size orifices
- Precipitation Rate
  - Delivery rate based on arc & spacing



MP Rotator Performance Data

MP1000
Radius: 8' to 15'
Adjustable Arc and Full Circle
Color Code: Maroon, Lt. Blue, or Olive

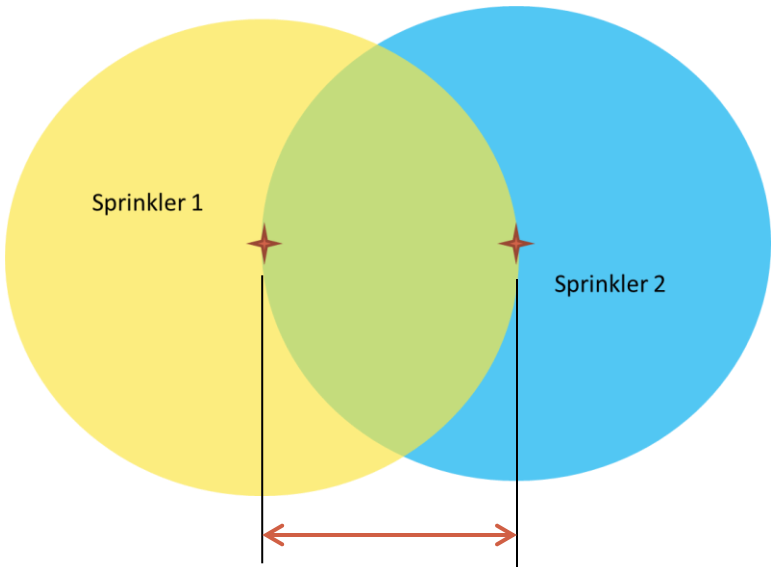
Arc	Pressure PSI	Color	Radius ft.	Flow GPM	Flow GPH	Precip in/hr ■	Precip in/hr ▲
90°	25	Maroon = 90° to 210°	–	–	–	–	–
	30		12'	0.16	9.6	0.43	0.50
	35		13'	0.18	10.8	0.40	0.46
	40		**14'**	**0.19**	**11.4**	**0.39**	**0.45**
	45		14'	0.20	12	0.39	0.45
	50		14'	0.21	12.6	0.38	0.43
	55		15'	0.22	13.2	0.37	0.43
180°	25		–	–	–	–	–
	30		12'	0.32	19.2	0.43	0.50
	35		13'	0.35	21	0.40	0.46
	40		**14'**	**0.37**	**22.2**	**0.39**	**0.45**
	45		14'	0.40	24	0.39	0.45
	50		14'	0.41	24.6	0.38	0.43
	55		15'	0.43	25.8	0.37	0.43
210°	25		–	–	–	–	–
	30		12'	0.37	22.2	0.43	0.50
	35		13'	0.41	24.6	0.40	0.46
	40		**14'**	**0.43**	**25.8**	**0.39**	**0.45**
	45		14'	0.46	27.6	0.39	0.45
	50		14'	0.48	28.8	0.38	0.43
	55		15'	0.50	30	0.37	0.43
270°	25	Lt. Blue = 210° to 270°	–	–	–	–	–
	30		12'	0.48	29	0.43	0.50
	35		13'	0.54	32	0.40	0.46
	40		**14'**	**0.57**	**34**	**0.39**	**0.45**
	45		14'	0.60	36	0.39	0.45
	50		14'	0.63	38	0.38	0.43
	55		15'	0.66	40	0.37	0.43
360°	25	Olive = 360°	–	–	–	–	–
	30		12'	0.65	39	0.43	0.50
	35		13'	0.71	42.6	0.40	0.47
	40		**14'**	**0.75**	**45**	**0.39**	**0.46**
	45		14'	0.80	48	0.39	0.45
	50		14'	0.84	50.4	0.38	0.44
	55		15'	0.87	52.2	0.37	0.43

Good Spacing

Not-so-Good Spacing

What are options for correcting this issue after install?

Sprinklers & Spacing Ranges

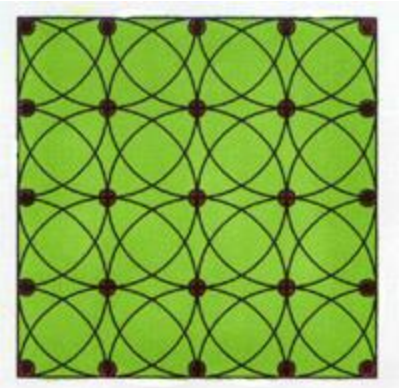


50% Spacing
(head-to-head)

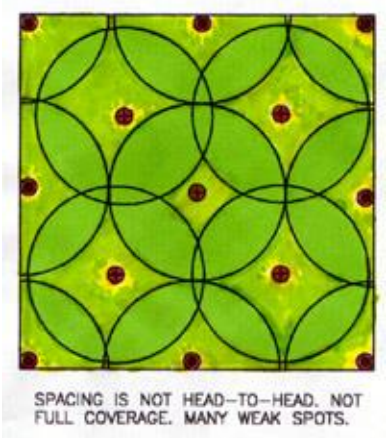
- Sprinklers are designed to provide uniform distribution of water only if overlapping coverage is provided
- A single sprinkler, when tested with catch cans, delivers most of its water close-in to the sprinkler and less and less as the distance away from the sprinkler increases
- When overlapped, the weak area of coverage from one sprinkler is supplemented by the surrounding sprinklers

Sprinklers & Spacing Ranges

- The most common sprinkler spacing range and in most cases the most efficient, is head-to-head spacing:
  - Sprinklers spaced at their expected radii or 50% of the sprinkler's diameter.
- The sprinkler radius shown in the manufacturer's catalog is measured in a zero wind test building. For windy areas, closer spacing is required to maintain head-to-head spacing (49% of diameter or closer)
- The 2 most common types of sprinkler spacing patterns are square (top) and triangular (bottom)

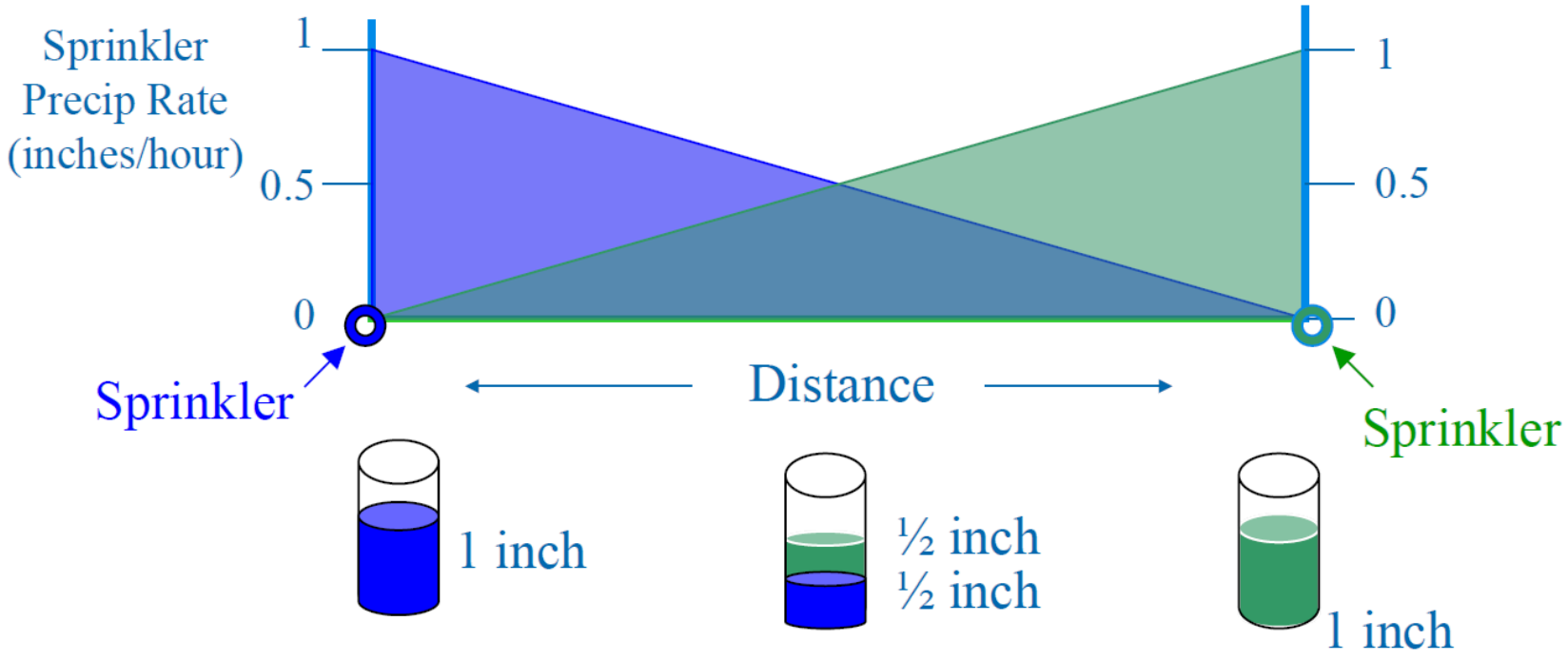


FULL COVERAGE: HEAD–TO–HEAD SPACING. SPRAY FROM EACH HEAD TOUCHES THE NEXT SPRINKLER OVER ENTIRE AREA.

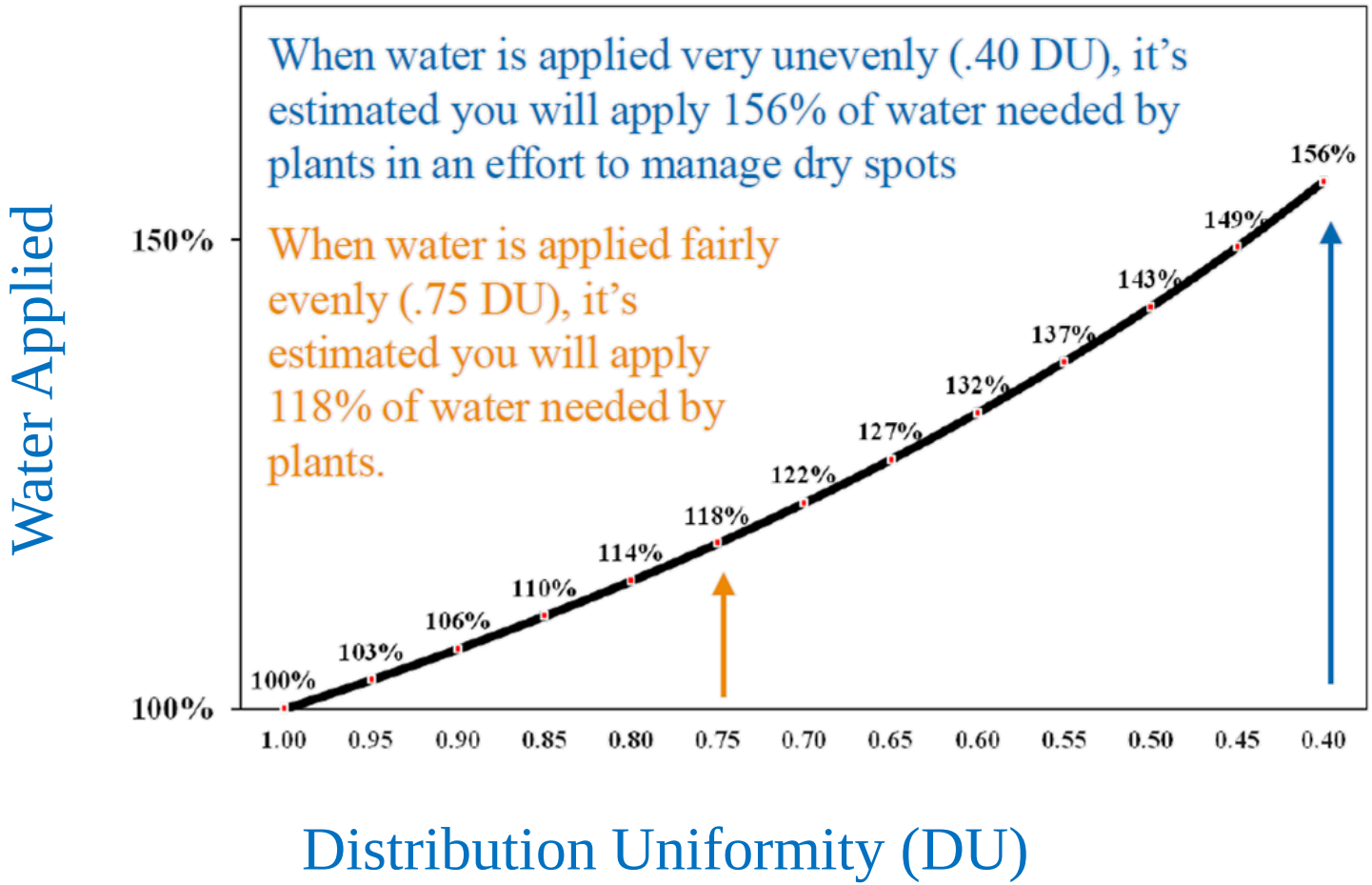


SPACING IS NOT HEAD–TO–HEAD. NOT FULL COVERAGE. MANY WEAK SPOTS.

Distribution Uniformity when head-to-head coverage



Scheduling Multiplier



Solutions

- Pressure compensating emitters
- Pressure compensating bubblers
- Pressure compensating rotors
- Pressure regulation (drip manifold)
- Pressure regulation (valve)
- Pressure regulation (backflow)
- Pressure regulation (house)
- Controller that learns, monitors and reacts to flow
- High efficiency nozzles
- Booster pump

Solutions

- Pump running at 92 psi
- At the heads the pressure was 70-72 psi
- Changed out the heads from PGP to I-20's
- Reduced the pressure at the head to 45-50 psi
- Increased droplet size and distance for each of the heads

Water Hammer

- Closing a valve quickly can cause a surge of pressure or **water hammer** in pipes that are filled quickly with high-velocity water. It can occur when flow reverses direction and goes back against a stopped pump.

- To prevent water hammer that might damage the pipes, limit water velocities to a maximum of 5 ft/sec (360 to 420 ft/min).

Water Hammer

Video may be found at:

https://www.youtube.com/watch?v=ujNGaQKap98

WATER SMART SITE CHECKLIST

EWING

Customer: _____ **Site:** _____

Inspected by: _____ **Date:** _____ **Phone Number:** _____

DISCUSSION

Walk the site to identify landscape and water concerns.

- ☐ Yes ☐ No Is the customer concerned about cost of water?
- ☐ Yes ☐ No Is the customer concerned about landscape quality?
- ☐ Yes ☐ No Is the customer concerned about ecological impact?
- ☐ Yes ☐ No Is the customer willing to change watering habits to improve the landscape concerns?

CONTROLLER

Identify controller location and type and number of valves: _____

- ☐ Yes ☐ No Irrigation schedule needs seasonal adjustment
- ☐ Yes ☐ No Map of property or list of zones is not available in controller enclosure to identify site
- ☐ Yes ☐ No Sensors need to be installed. Which: ☐ Rain ☐ Freeze ☐ Soil Moisture
- ☐ Yes ☐ No Is it time to replace the controller with a smart controller?

VALVES

Locate and identify.

- ☐ Yes ☐ No Valve installed improperly
- ☐ Yes ☐ No Does not turn on or off completely when using a bleed pin (or solenoid) to test diaphragm
- ☐ Yes ☐ No Flow setting for zone needs to be adjusted
- ☐ Yes ☐ No Solenoid wires and wire connectors appear loose, corroded, or absent
- ☐ Yes ☐ No Leaks or breaks are visible at threaded connections
- ☐ Yes ☐ No Ball valves, slip fixes or other devices installed improperly or are leaking
- ☐ Yes ☐ No Cannot operate all valves manually

SPRINKLERS/ZONES

- ☐ Yes ☐ No Spacing of sprinklers too close or too far for plant material and sprinkler type
- ☐ Yes ☐ No Mixed nozzle types on same zone
- ☐ Yes ☐ No Mixed plant types on same zone
- ☐ Yes ☐ No Misting or other signs of improper pressure
- ☐ Yes ☐ No Extremely dry spots and wet spots in the same zone
- ☐ Yes ☐ No Leaking or broken heads visible
- ☐ Yes ☐ No Clogged or missing nozzles visible
- ☐ Yes ☐ No Water blocked by overgrown plant material, sunken sprinkler bodies, etc.
- ☐ Yes ☐ No Erosion or drainage problems visually apparent

Other/Notes:

_____

_____

If **YES** is checked for any of the items above, these are opportunities to tune up your irrigation system to reduce water waste and improve landscape health!

OPPORTUNITIES TO SAVE WATER:

- ☐ Fix all leaks and breaks in sprinklers, pipes, and valves.
- ☐ Replace poor nozzles with high efficiency nozzles.
- ☐ Install pressure regulated sprinkler bodies or valves.
- ☐ Install a rain, freeze, or soil moisture sensor on the controller.
- ☐ Install check valves on all sloped areas.
- ☐ Adjust flow settings on valves.
- ☐ Upgrade to a smart controller.

A **BIG** Thank You

Contributors:

- Doug Donahue, Ewing
- Paul Tammelleo, Irritrol
- Shannon Scott, AAA Landscape
- Pat Johnston, Horizon
- Brian Whitcher, Toro
- Jeff Gilbert, University of Arizona