This presentation premiered at WaterSmart Innovations

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Green Code Implications for Irrigation Manufacturers and Others

The Intelligent Use of Water.™

LEADERSHIP • EDUCATION • PARTNERSHIPS • PRODUCTS

Which irrigation elements should be the focus of Green Codes?

- Precipitation Rate (The rate at which water is applied to the landscape)
- Distribution Uniformity (A measure of how evenly water is applied to the landscape)
- Sprinkler Type Selection (Sprays, Rotors, Drip, Sub-surface, etc.)
- Scheduling (Time of Day, Day of Week, Irrigation interval, Length of Operation, etc.)
- Operating Pressure (Water pressure delivered to the emission device)

Panelists

Kelly Kopp

Associate Professor

Department of Plants, Soil and Climate
Utah State University

Panelists

Brent Mecham

Industry Development Director

Irrigation Association

Panelists

Brian Vinchesi

Design Engineer

Irrigation Consulting, Inc.

Panelists

Dr. David Zoldoske

Director

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California State University – Fresno

Executive Director

Water Resources and Policy Initiatives
California State University System

Panelists

Ron Wolfarth

Marketing Manager

Rain Bird Corporation
Contractor Division

What Does a Manufacturer Want in Standards & Codes?

- Vibrant Industry
  - Efficient Landscape Irrigation Water Use is key to a vibrant, sustainable industry
- Rational
  - Contribute to achieving efficient irrigation
- Consistent over Time
  - Remain the same over a reasonable product life to justify large investments in a relatively small market – constantly changing requirements will discourage investment
- Promote Innovation
  - Focus on the end result desired
  - Not prescriptive, which stifles innovation

What Does it Appear Water Suppliers Want in Standards & Codes?

- Lower Water Use
  - Forestall investments in infrastructure and new water source development
  - Not focused on landscape quality and its environmental benefits
- Ease of Administration
  - Easy to mandate, inspect and enforce
  - Easy to justify financial investment in rebate programs
- Reliability of Results
  - Must be as reliable as investments in infrastructure and new water source development
  - Similar to past successes (like low flow shower heads)

Current Debate

Precipitation Rate versus Uniformity

- Lower Precipitation Rate

Pros

- Similar to Low Flow Shower Heads, so familiar to Water Suppliers
- Benefits from high resistance to change of customer behavior (will irrigate for same length of time)
- Easy to communicate and makes sense to customers
- Easy to mandate and inspect
- Easy to retrofit, low expertise needed
- Relatively inexpensive

Cons

- Lower precipitation rate sprinklers tend to have lower uniformity (not all agree)
- Another ingrained customer behavior is to fix ‘brown spots’ with more water
- May not reduce water use due to the above factors
- Landscape quality may decline

Current Debate

Precipitation Rate versus Uniformity

- Uniformity of Application (Assume higher precipitation rate)

Pros

- Allows lowest water use with highest landscape quality
- Higher precipitation rates (if needed) are easily addressed with proper scheduling
- Uniformity is more robust with higher precipitation rates (more close-in water, better wind resistance due to larger water droplet sizes)

Cons

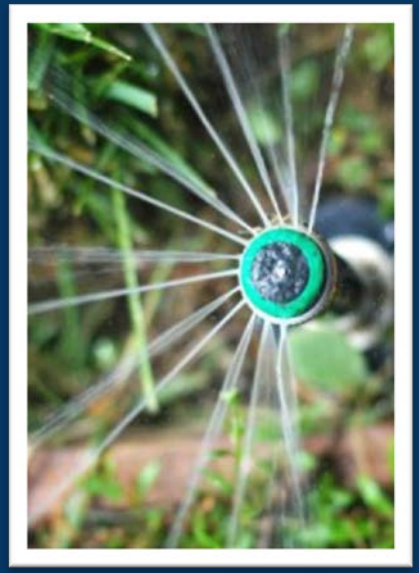
- Requires higher design, installation and maintenance expertise to achieve
- More complex requirements to communicate
- More difficult to inspect and enforce
- Expensive to retrofit
- No analogous indoor experience to increase confidence in reliability of results

Current Debate

Precipitation Rate versus Uniformity

- Recommendation
  - Favor focus on uniformity over precipitation rate if a choice is required
  - Allows the lowest water use with the highest landscape quality

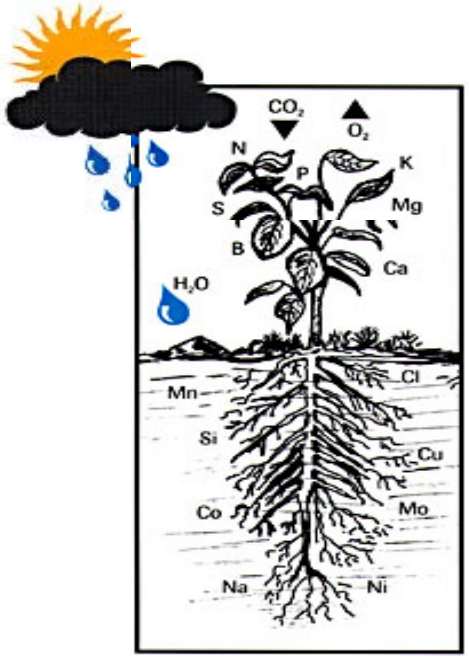
GREEN CODE IMPLICATIONS FOR MANUFACTURERS…..AND PLANTS



Kelly Kopp
Department of Plants, Soils & Climate
Utah State University

Plants need water

- Species-specific
- Transporting nutrients
- Controlling growth
- Photosynthesis



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Plant water use

- Evaporation from soil surface (E)
- Transpiration rate of the plants (T)
- Cultural practices for the plants
  - Mowing/pruning
  - Fertilization
  - Irrigation

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Factors affecting water uptake

- Soil temperature
- Aeration of soil
- Concentration of soil solution
- Health of roots
- Type of plant
- *Available water*

Irrigation frequency

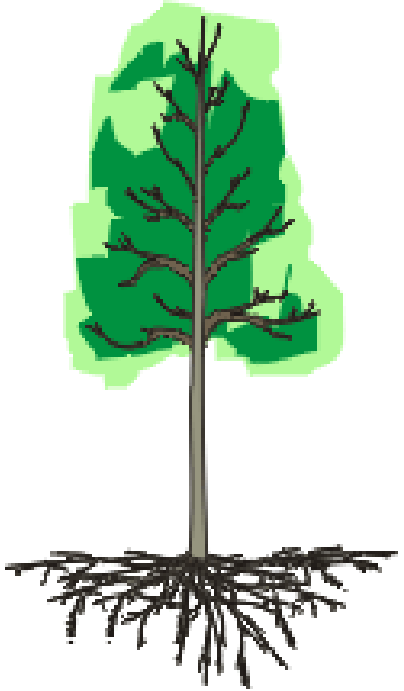
- Moisture stored in the soil
- Ground water table
- Effective Precipitation
- *Sprinkler uniformity and*

Water balance

- Water moves into the soil (in/hr)
  - Soil type and slope
- Water is stored in the soil (in/in), aka available water (AW)
  - Soil type and depth of roots
- Plants use the water (in/day or week)
  - Plant type, leaf canopy, growth stage, weather, available water

Plant irrigation efficiency

- Water moves into soil
- Water stays in root zone
- Uniformity of application across root zone
- Sufficient water quality



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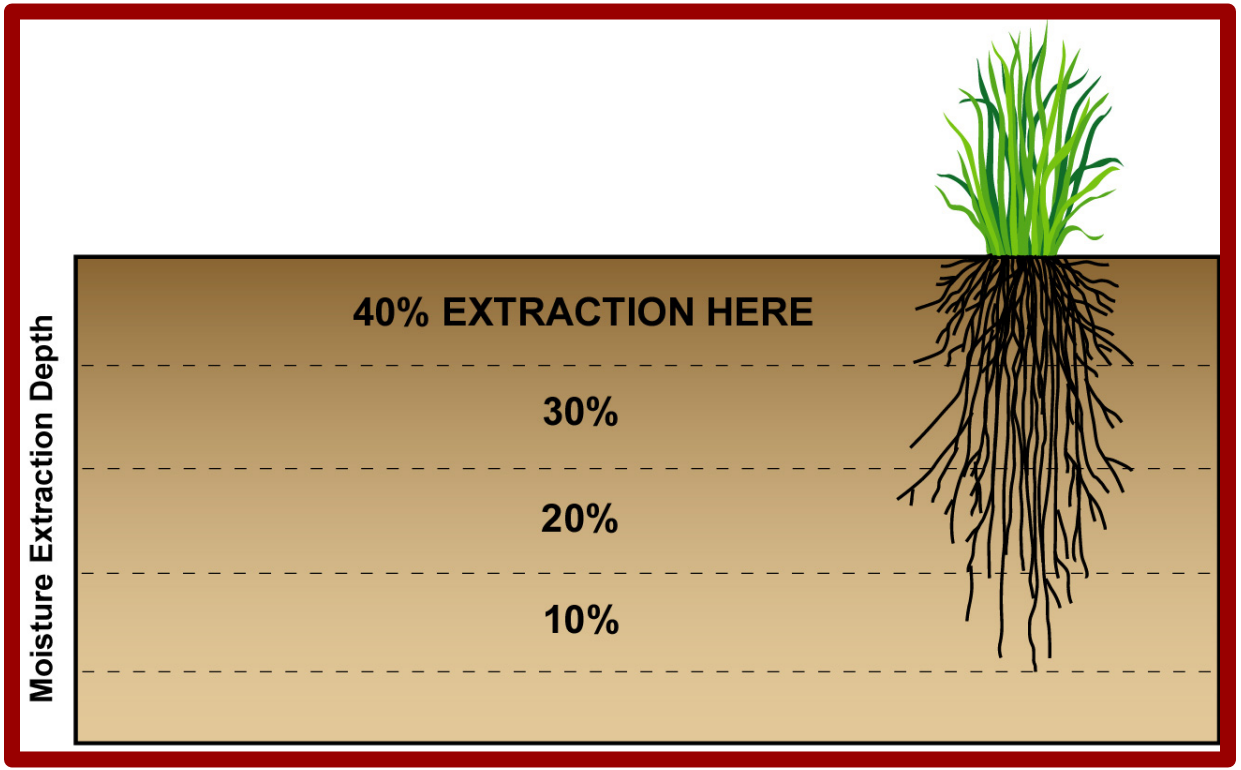
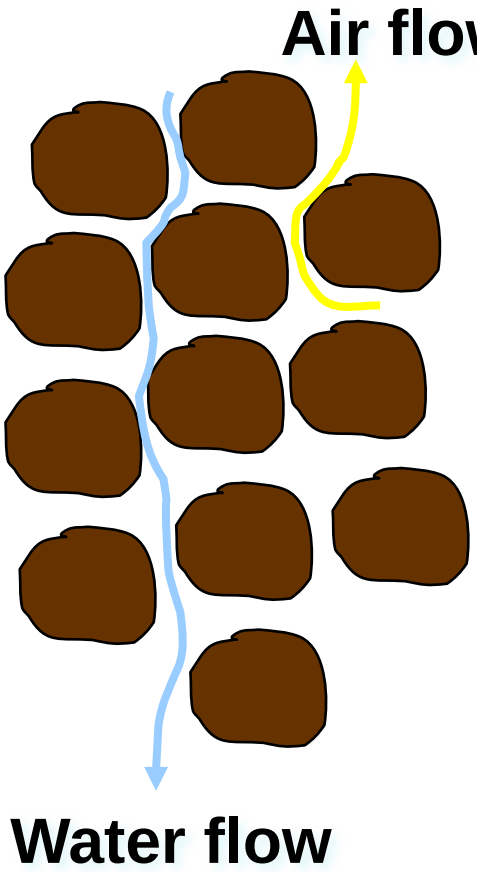
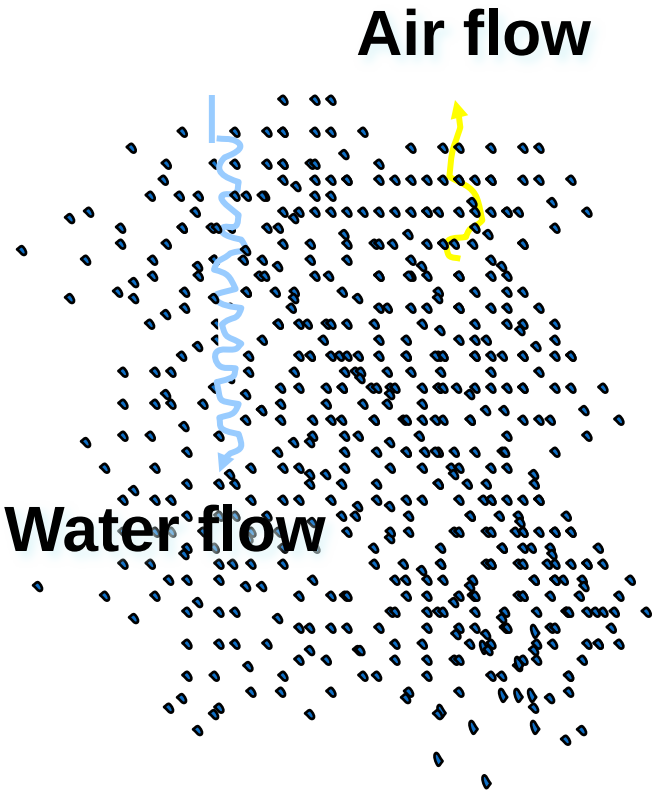
Water movement

- Within the soil
  - Texture dependent
- From soil to plant
  - Root uptake
- From the soil
  - Plant uptake
  - Percolation
  - Evaporation
  - Runoff

Plant water uptake







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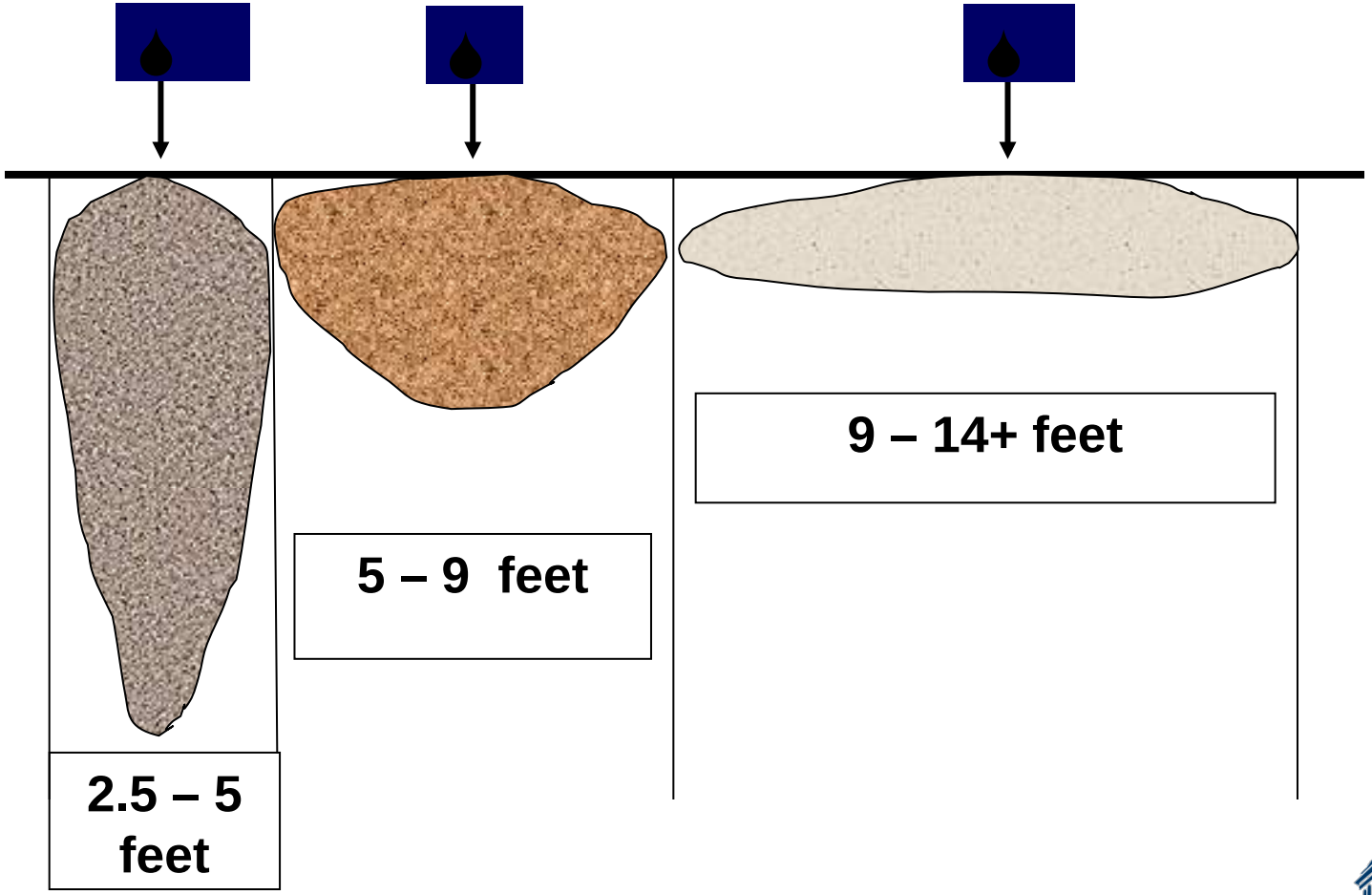
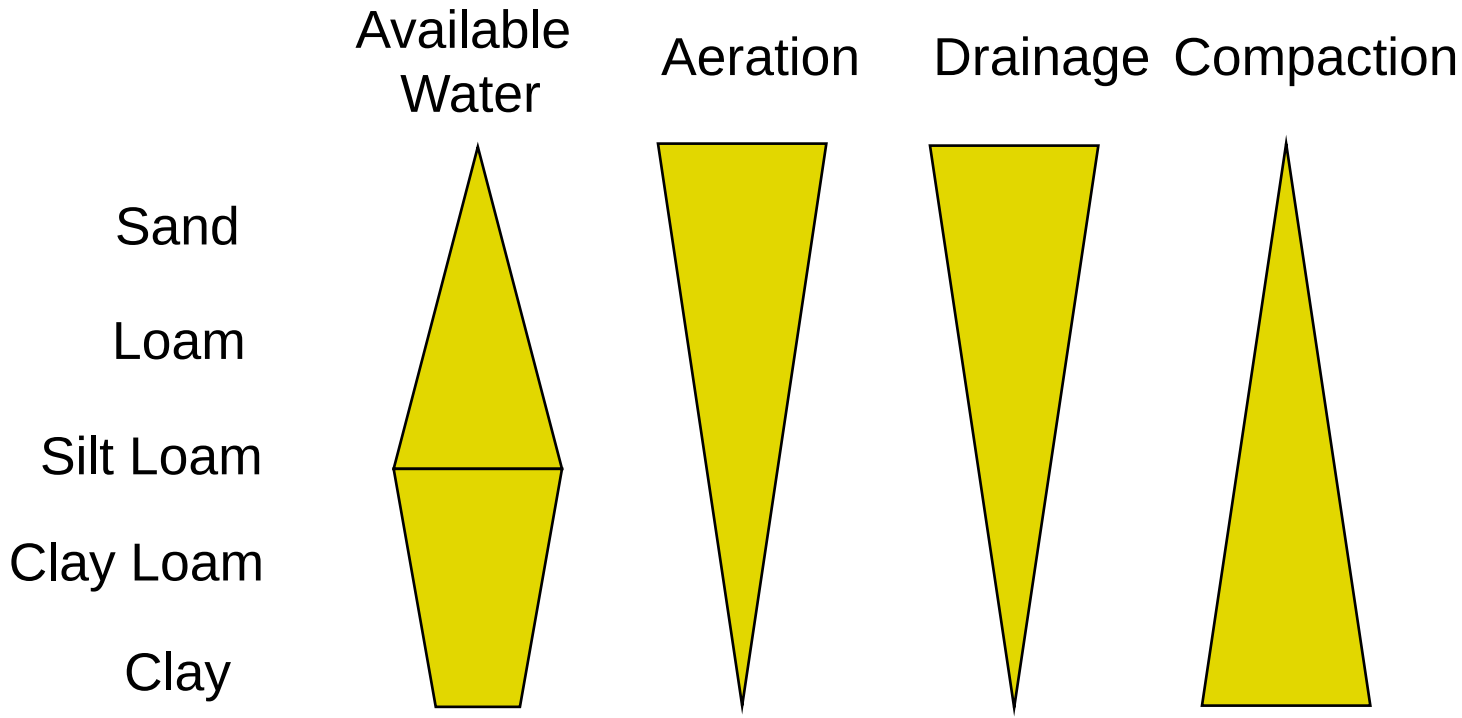

9 – 14+ feet
5 – 9 feet
2.5 – 5 feet

Effects of texture on soil physical properties



Soil water holding capacity and infiltration

Soil Texture	Available Water (in/in)	Infiltration Rate (in/hr)	MAD*
Clay	0.17	0.10	30
Silty Clay	0.17	0.15	40
Clay Loam	0.18	0.20	40
Loam	0.17	0.35	50
Sandy Loam	0.12	0.40	50
Loamy Sand	0.08	0.50	50
Sand	0.06	0.60	60
MAD-Maximum Allowed Depletion			

Water movement

- Within the soil
  - Texture dependent
- From soil to plant
  - Root uptake
- From the soil
  - Plant uptake
  - Percolation
  - Evaporation
  - Runoff

Irrigation losses

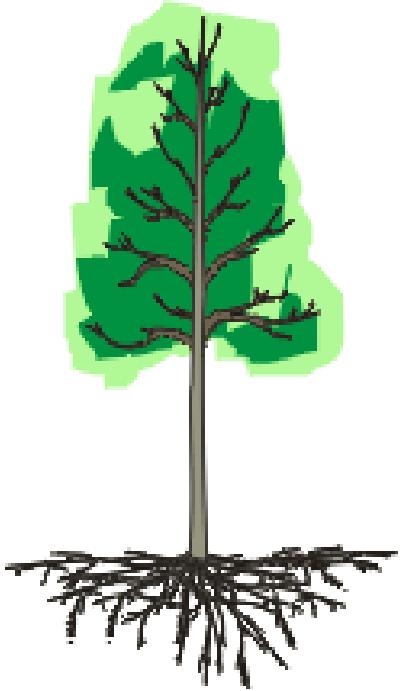
- Spray drift and evaporation losses
- Deep percolation
- Distribution uniformity (not)
- Runoff

Engineered solutions to “loss”

- Low-volume drip or micro-spray
- Pressure regulation
- Low-angle nozzles
- Irrigation scheduling
- Efficient design
- Heads/nozzles that emit large water drops

Plant irrigation efficiency

- Water moves into soil
- Water stays in root zone
- Uniformity of application across root zone
- Sufficient water quality



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Green Initiatives and Irrigation

Brent Mecham

Irrigation Association

Industry Development Director

WaterSmart Innovations 2012

- Why green initiatives?
- Programs that lead to sustainable use of resources.
- Focus on energy, water and sometimes air.

Green Initiatives

- Voluntary green initiatives
  - LEED, GBI
  - EPA WaterSense
  - Sustainable Sites
- Mandatory green codes and standards
  - Green building codes – IgCC, IAPMO GS
  - Ordinances MWELO (AB1881)
  - Executive Order 13514
  - Standards - ASHRAE 189.1, NGBS 2012

Best Practices

- *Turf and Landscape Irrigation Best Management Practices (2002, 2005, 2010)*
  - Design, Installation, Maintenance & Management
- Frequently referenced as the “how to” document for efficient irrigation.

Approaches

- Performance: No runoff or no overspray
  - Allows for maximum options to accomplish the desired result for an individual site
  - Harder to inspect
- Prescriptive: Maximum precipitation rate is 1.00 in./hr or drip irrigation for all non turf areas.
  - Eliminates options for site specific situations
  - Easier to inspect

Prescriptive

- Codes with prescriptive language override best practices, products and technologies.

Example Codes:	D/C	Max. PR (in/hr)	Slope PR (in/hr)	Min. DU	Drip	SMART Controller
IgCC	yes		0.50	0.65	yes	yes
IAPMO	yes	1.00	0.75		yes	yes
MWELO			0.75			yes
EPA WS	yes		Micro	0.65	yes	yes
EO 13514	yes				yes	

D/C =competent designer, contractor to do work

Solution

- Proper equipment selection for site
  - Design, installation and maintenance
- Proper irrigation management
  - Scheduling to apply the right amount of water
  - Scheduling options to minimize water waste
    - Cycle and soak versus maximum precipitation rate
    - Utilize proven technologies
- Accountability

Presentation on

Irrigation System Precipitation Rates: A Designer's Perspective

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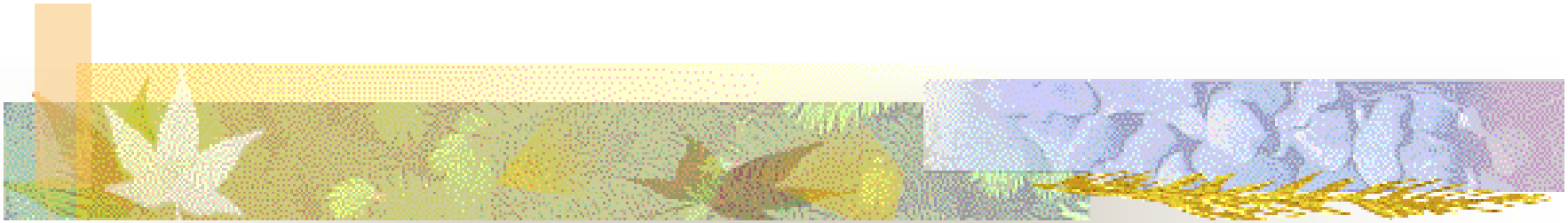

Brian E. Vinchesi, Chair

Irrigation Association SWAT Committee

IA Standards and Codes Committee

Principal, Irrigation Consulting, Inc.

Pepperell, Massachusetts

Sprinkler Selection

- Precipitation rate is incidental to the sprinkler spacing and nozzling at the beginning of the design
- Uniformity and proper irrigation spacing are important considerations
  - Head to head coverage
  - Pop up height
  - Operating pressure

Soils

- Soil type may influence precipitation rate in certain situations, but since most new landscapes are a new soil not always a consideration
- Heavy soils may require a different precipitation rate
- Sloped areas may require a lower precipitation rate

y

Operating Pressure

- Operating pressures need to be as recommended by the manufacturer at the bottom of the sprinkler
- Proper operating pressure provides for the proper droplet sizes and their distribution
- Proper operating pressure is critical to good uniformity
- Proper pressure is essential to precipitation rates being accurate as most are assumed, not calculated

Scheduling

- Precise precipitation rates and high uniformity provide for better scheduling
- Diverse precipitation rates on the same irrigation system are more difficult to manage
- Contractors have a tendency to categorize precipitation rates based by run times
- Precipitation rates can effect water windows
- Precipitation rates can and should be managed with cycle and soak

Scheduling

- Lower precipitation rates provide for more incremental timing, for example if you need to put down 0.30 inches the time for various precipitation rates is as follows:
  - 1.54 inches/hour 12 minutes
  - 0.80 inches/hour 23 minutes
  - 0.55 inches hour 33 minutes
  - 0.33 inches/hour 55 minutes
  - 0.20 inches/hour 90 minutes

Drip Irrigation

- More specific application
- Not necessarily more efficient
- Precipitation rates are not low
  - 0.6 gph at 12 inches and 12 inches = 0.96 in./hr
  - 0.6 gph at 12 inches and 18 inches = 0.64 in./hr
  - 0.9 gph at 12 inches and 12 inches = 1.44 in./hr
  - 0.9 gph at 12 inches and 18 inches = 0.96 in./hr

(line-source drip tubing set in a grid pattern)

Conclusions

- In most cases precipitation rate will be incidental to the design
- Uniformity and pressure considerations are more important
- Precipitation rates need to be considered on heavy soils and sloped areas
- Very low precipitation rates can lengthen the water window
- Drip irrigation precipitation rates are also high

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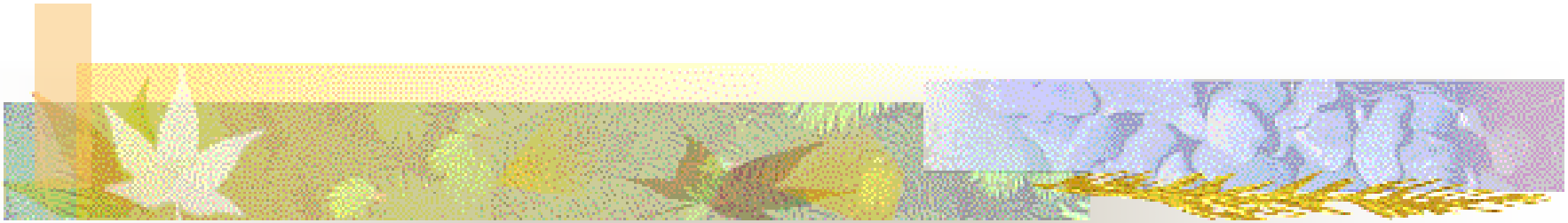
Questions?

Thank You!

Presentation on

Irrigation Water Use Efficiency: What is Really Important?

WaterSmart innovations 2012



David F. Zoldoske, Director
Center for Irrigation Technology
California State University, Fresno

Priority Issues for Achieving High Water Use Efficiency: (*hint- this may require an irrigation professional*)

- Proper site evaluation
- Proper irrigation system design
- Proper irrigation equipment selection
- Proper irrigation system installation
- Proper irrigation system management
- Proper irrigation system maintenance

Priority Issues for Achieving High Water Use Efficiency: (*additional product features may be warrented*)

- Sprinkler/sprayhead may require check valve
- Sprinkler/sprayhead may require pressure regulation
- Adjustable arc and/or pattern may be desired
- Pop-up height should be adequate for the landscape

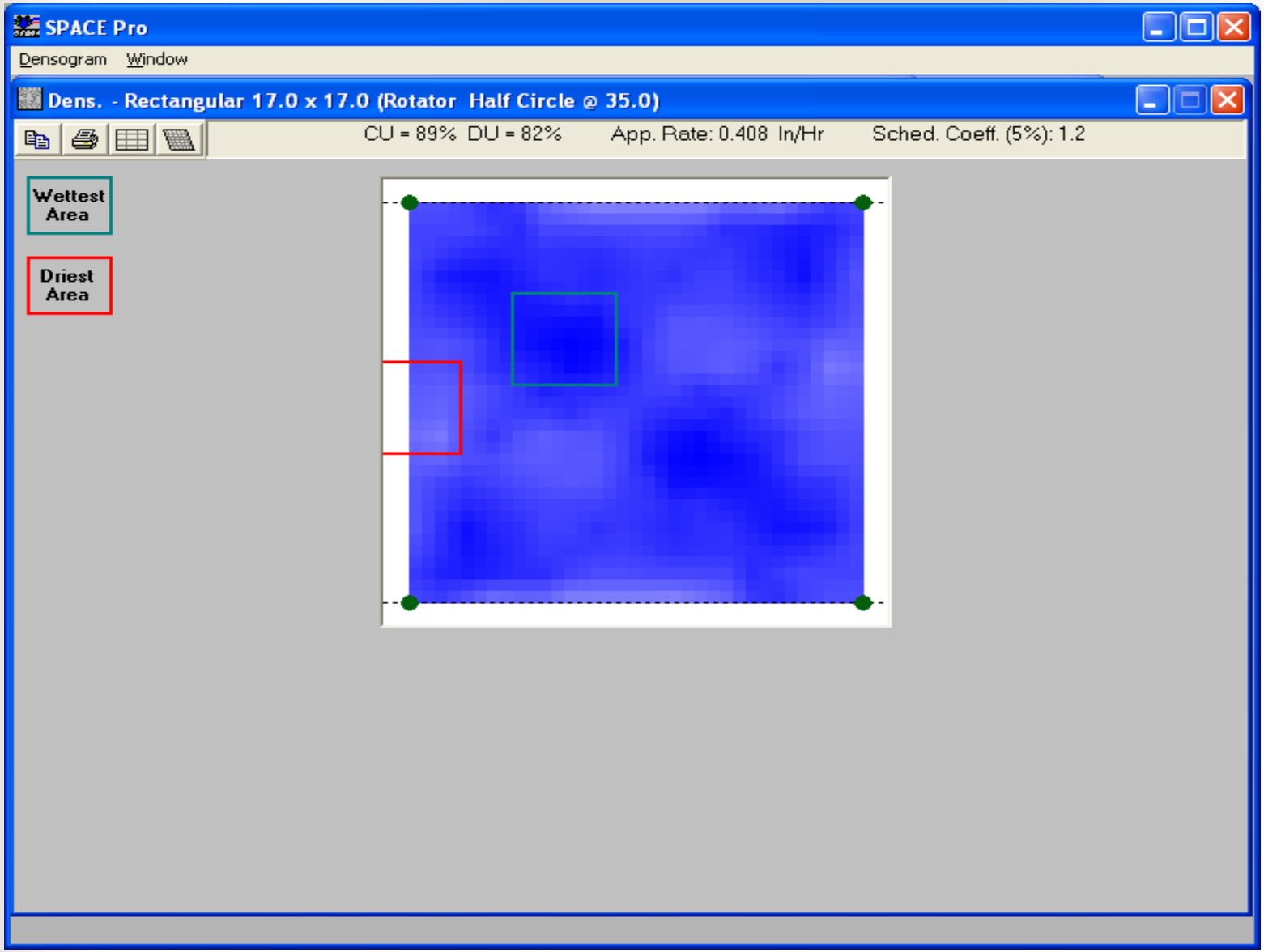
Distribution Uniformity (DU) is NOT a function of application rate, however

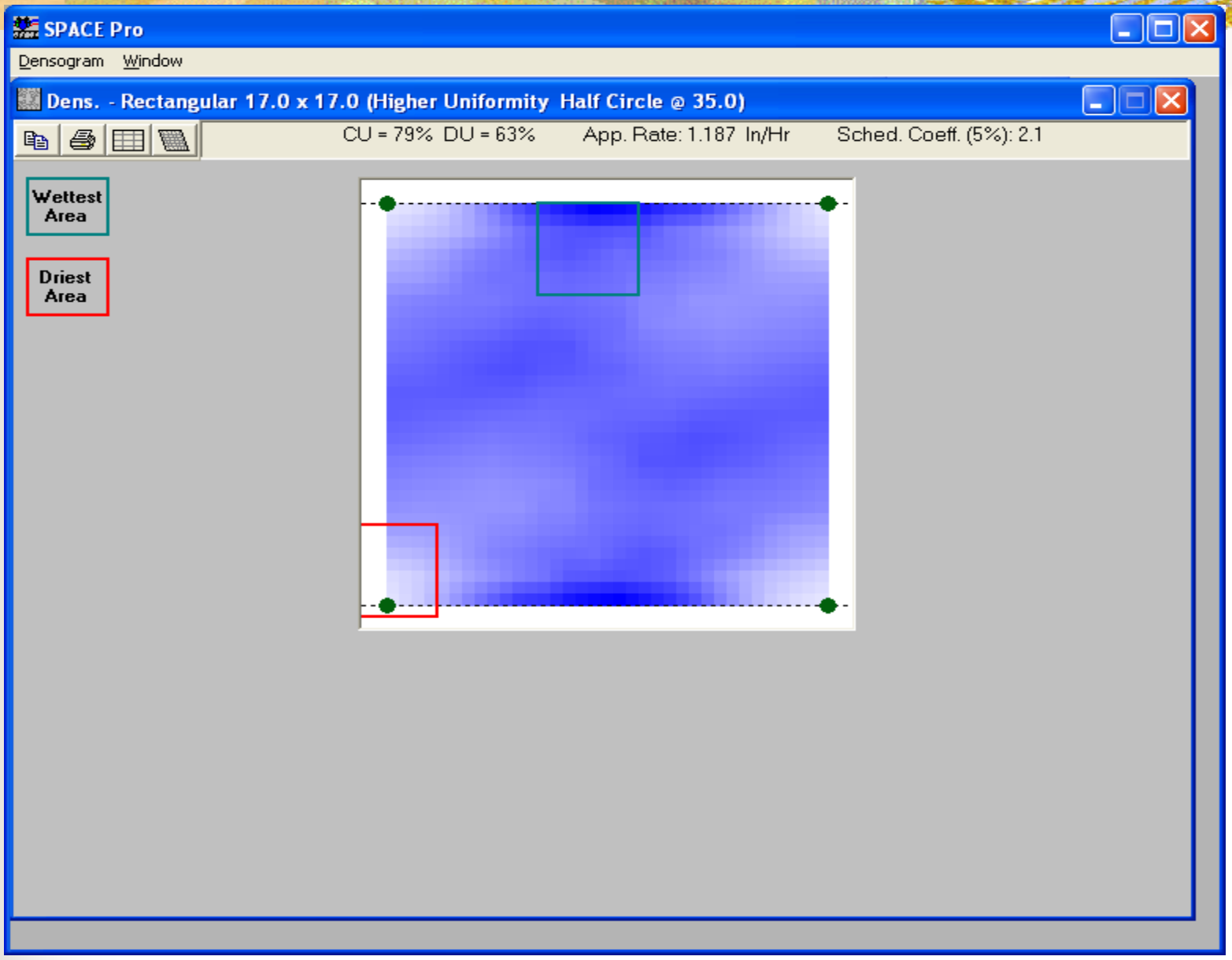
- Site conditions may dictate irrigation runtimes
- Run-off must be properly managed
- Landscape design affects emission device selection
- Local wind conditions may affect DU
- Droplet size and trajectory angle can be important

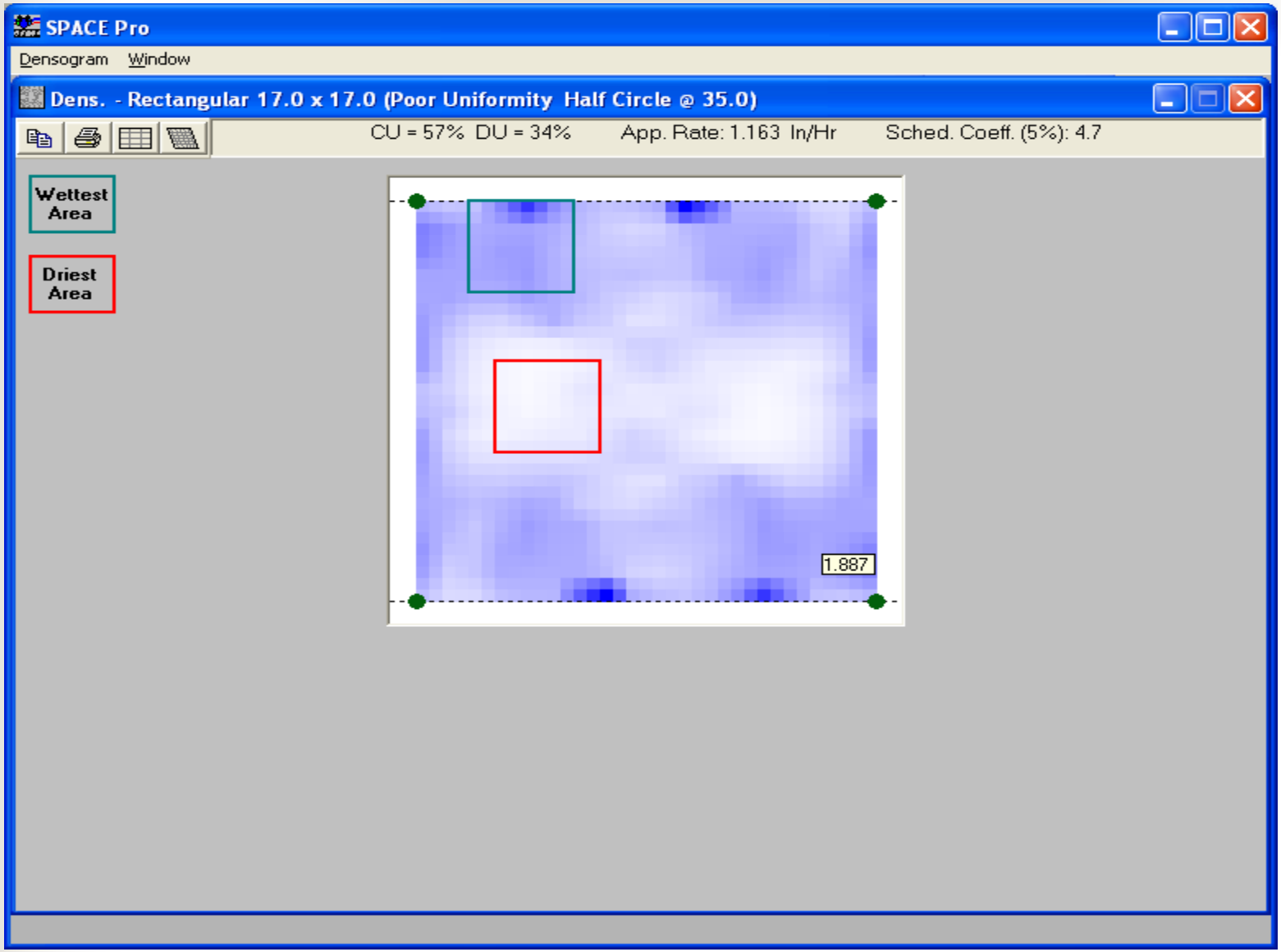
Sprinkler/Sprayhead Pattern and Spacing establish DU

(same spacing/different head will give various DU's)

- Design and installation should match (*pressure & spacing*)
- Understand changes to DU when substituting heads/nozzles (*not all the same*)
- Suggest conducting an audit at system start-up
- Provide proper system maintenance
- Conduct future system audits as needed

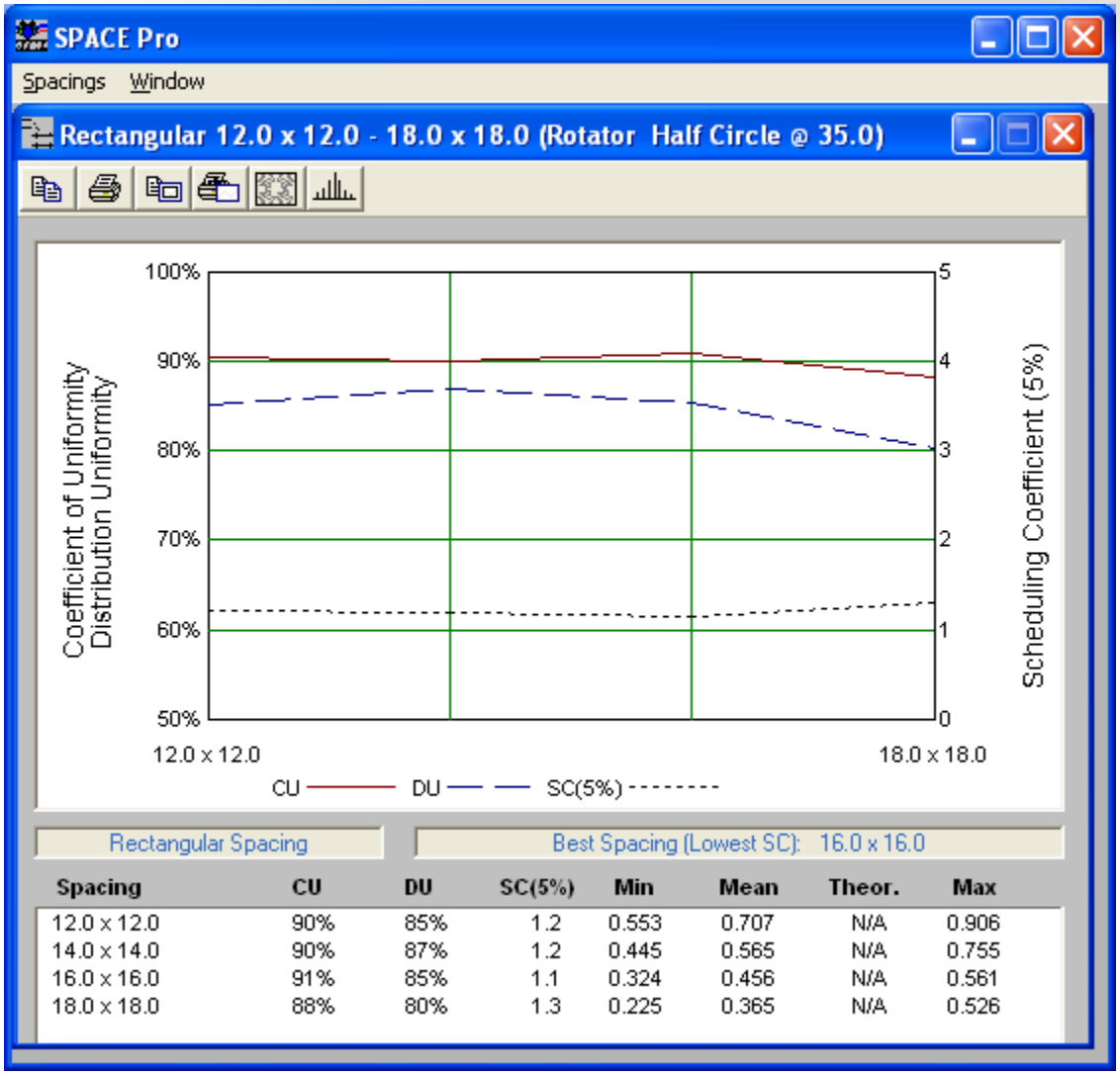

SPACE Pro
Densogram Window
Dens. - Rectangular 17.0 x 17.0 (Rotator Half Circle @ 35.0)
CU = 89% DU = 82% App. Rate: 0.408 In/Hr Sched. Coeff. (5%): 1.2
Wettest Area
Driest Area


SPACE Pro
Densogram Window
Dens. - Rectangular 17.0 x 17.0 (Higher Uniformity Half Circle @ 35.0)
CU = 79% DU = 63% App. Rate: 1.187 In/Hr Sched. Coeff. (5%): 2.1
Wettest Area
Driest Area


SPACE Pro
Densogram Window
Dens. - Rectangular 17.0 x 17.0 (Poor Uniformity Half Circle @ 35.0)
CU = 57% DU = 34% App. Rate: 1.163 In/Hr Sched. Coeff. (5%): 4.7
Wettest Area
Driest Area
1.887

Sprinkler/Sprayhead Pattern and Spacing DU Vary Widely *(some patterns are more forgiving)*

- Some heads provide “high DU” over a large range of spacings
- Some heads provide “high DU” at *selected* spacings
- Some heads *never* achieve acceptable DU’S
- Important to know which products to use in any given situation


SPACE Pro
Spacings Window
Rectangular 12.0 x 12.0 - 18.0 x 18.0 (Rotator Half Circle @ 35.0)
100%
90%
80%
70%
60%
50%
Coefficient of Uniformity
Distribution Uniformity
5
4
3
2
1
0
Scheduling Coefficient (5%)
12.0 x 12.0
18.0 x 18.0
CU
DU
SC(5%)
Rectangular Spacing
Best Spacing (Lowest SC): 16.0 x 16.0
Spacing CU DU SC(5%) Min Mean Theor. Max
12.0 x 12.0 90% 85% 1.2 0.553 0.707 N/A 0.906
14.0 x 14.0 90% 87% 1.2 0.445 0.565 N/A 0.755
16.0 x 16.0 91% 85% 1.1 0.324 0.456 N/A 0.561
18.0 x 18.0 88% 80% 1.3 0.225 0.365 N/A 0.526

Sprinkler/Sprayhead Pattern and Spacing DU Vary Widely *(some patterns are more forgiving)*

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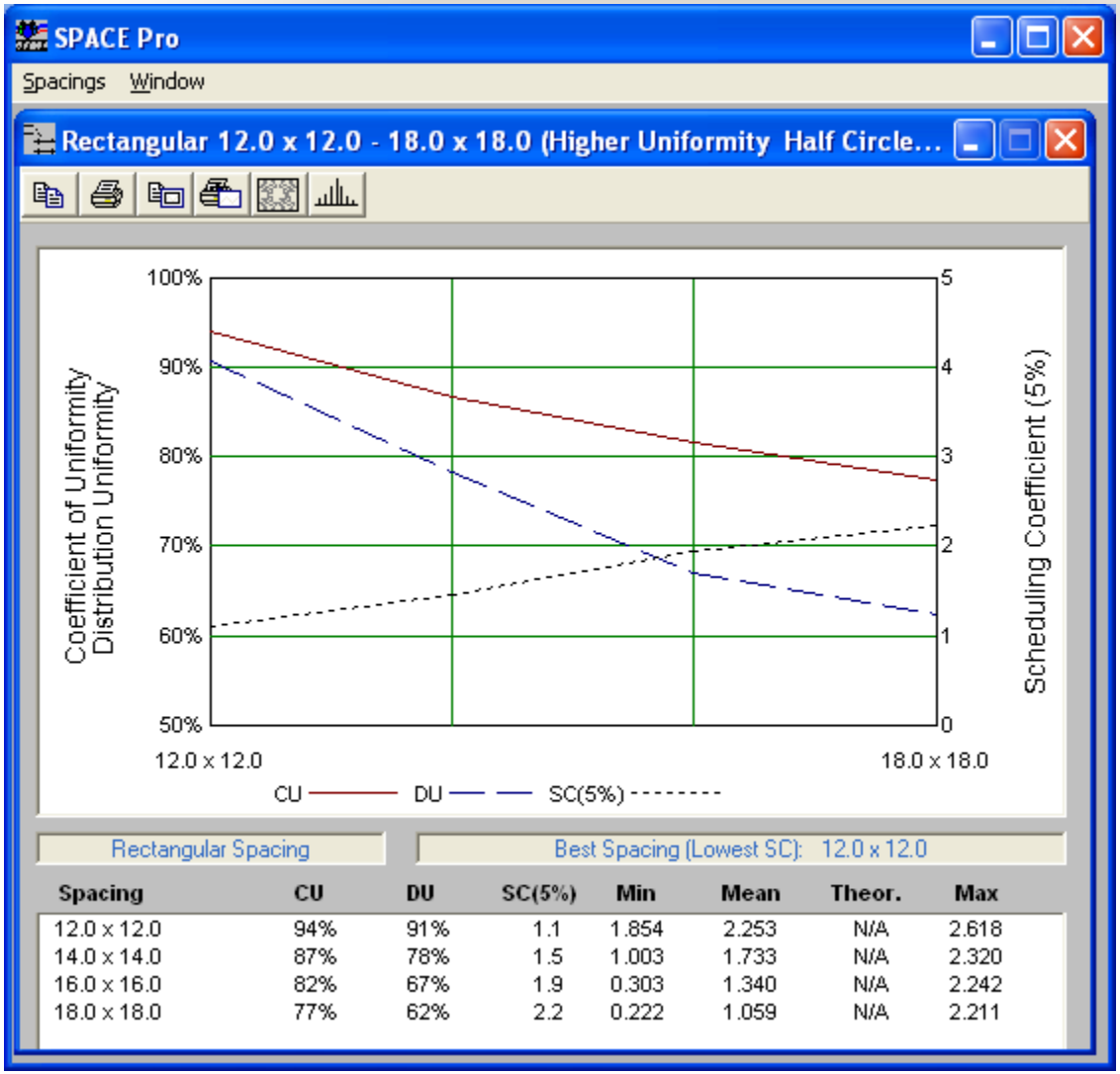

Spacing	CU	DU	SC(5%)	Min	Mean	Theor.	Max
12.0 x 12.0	94%	91%	1.1	1.854	2.253	N/A	2.618
14.0 x 14.0	87%	78%	1.5	1.003	1.733	N/A	2.320
16.0 x 16.0	82%	67%	1.9	0.303	1.340	N/A	2.242
18.0 x 18.0	77%	62%	2.2	0.222	1.059	N/A	2.211

Sprinkler/Sprayhead Pattern and Spacing DU Vary Widely *(some patterns are more forgiving)*

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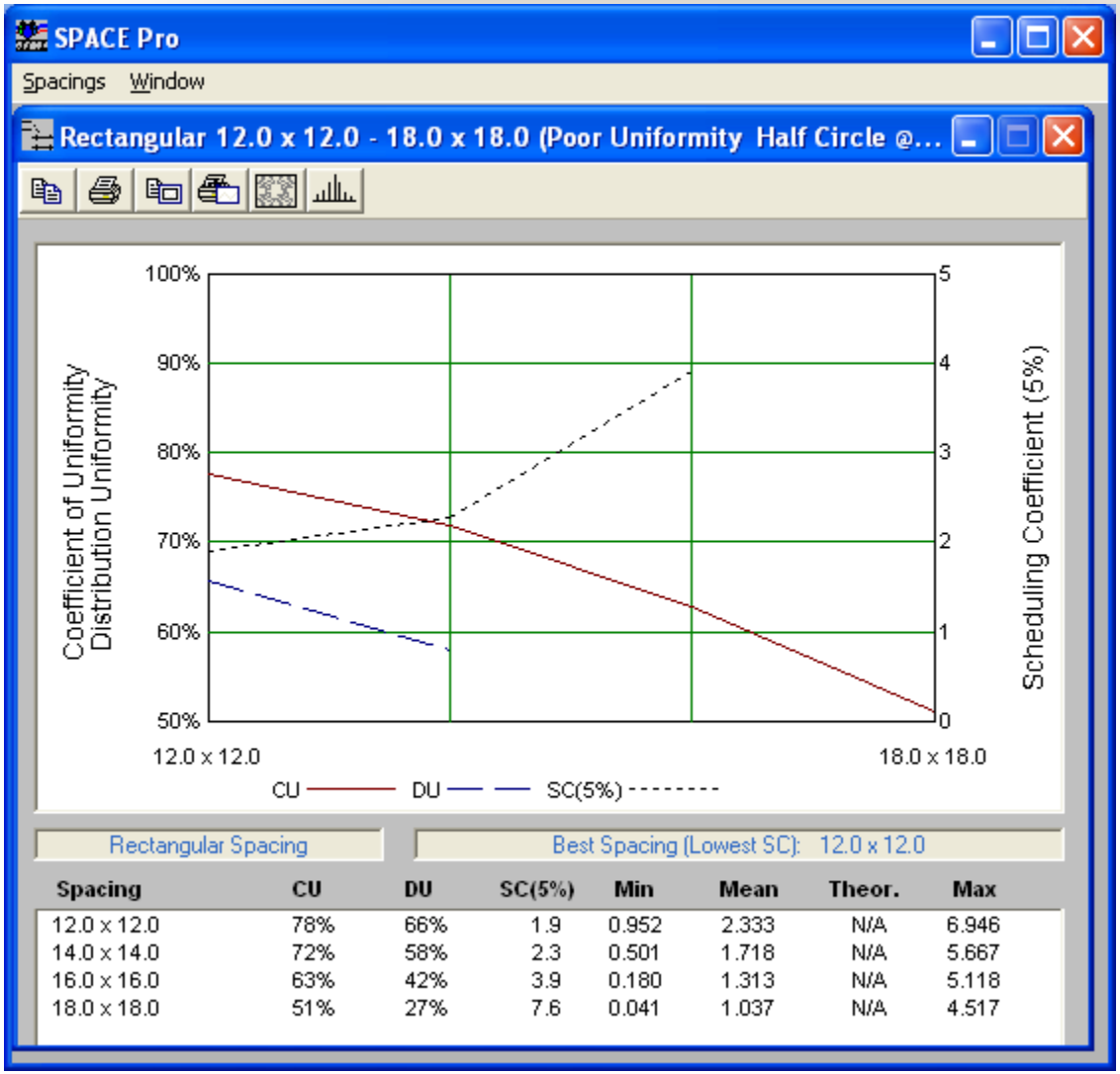
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Rectangular 12.0 x 12.0 - 18.0 x 18.0 (Poor Uniformity Half Circle @...
100%
90%
80%
70%
60%
50%
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4
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0
Coefficient of Uniformity
Distribution Uniformity
Scheduling Coefficient (5%)
12.0 x 12.0
18.0 x 18.0
CU
DU
SC(5%)
Rectangular Spacing
Best Spacing (Lowest SC): 12.0 x 12.0
Spacing CU DU SC(5%) Min Mean Theor. Max
12.0 x 12.0 78% 66% 1.9 0.952 2.333 N/A 6.946
14.0 x 14.0 72% 58% 2.3 0.501 1.718 N/A 5.667
16.0 x 16.0 63% 42% 3.9 0.180 1.313 N/A 5.118
18.0 x 18.0 51% 27% 7.6 0.041 1.037 N/A 4.517

Conclusions

- Irrigation systems require professional designs
- Application rate is a consideration, but NOT necessarily a determination of product selection
- Properly designed, installed and managed irrigation systems will perform well without run-off
- It is always desirable to keep the “tool box” full

Questions?

Thank You!