Subsurface Drip Irrigation for Sports Turf

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Subirrigation

Reasons for not gaining market acceptance:

- Lack of urgency to conserve water
- Cost
- Considered to be “unproven” technology, resistance to change
- Technology predominantly for tees and greens (how much water can you conserve on 6 to 8 acres (2.5 to 3.5 ha) when 100 acres (40 ha) are irrigated?)
- Performance questionable on sloping design

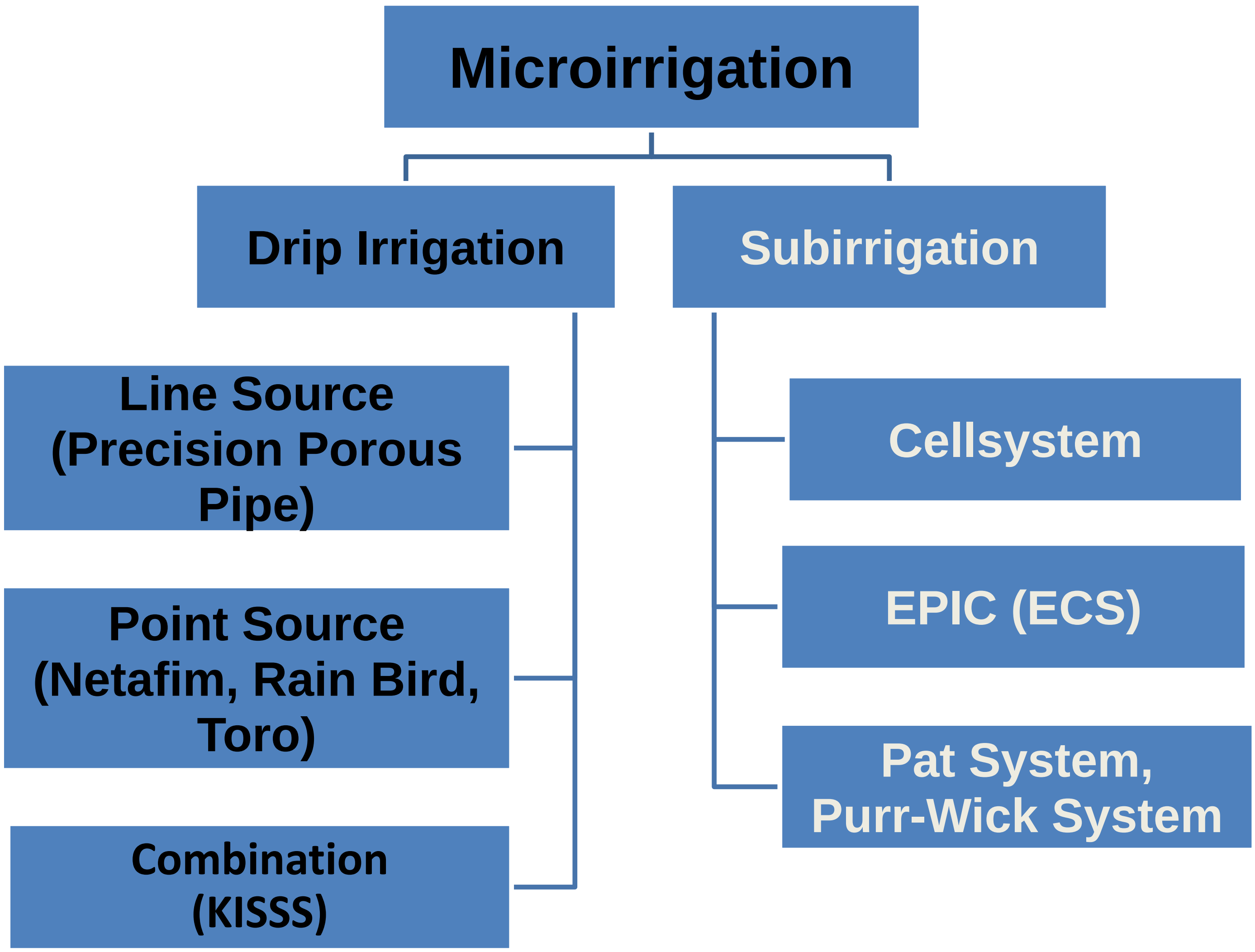
Alternative Irrigation Methods

<u>Goals:</u>

- ✓ Ensure player safety
- ✓ Maintain (increase) turf quality
- ✓ Increase irrigation efficiency through improved water distribution
- ✓ Eliminate human exposure to irrigation water

Subsurface Irrigation

- Extensively used in agriculture
- Slow to reach acceptance in turf


Microirrigation
Drip Irrigation
Subirrigation
Line Source (Precision Porous Pipe)
Point Source (Netafim, Rain Bird, Toro)
Combination (KISSS)
Cellsystem
EPIC (ECS)
Pat System, Purr-Wick System

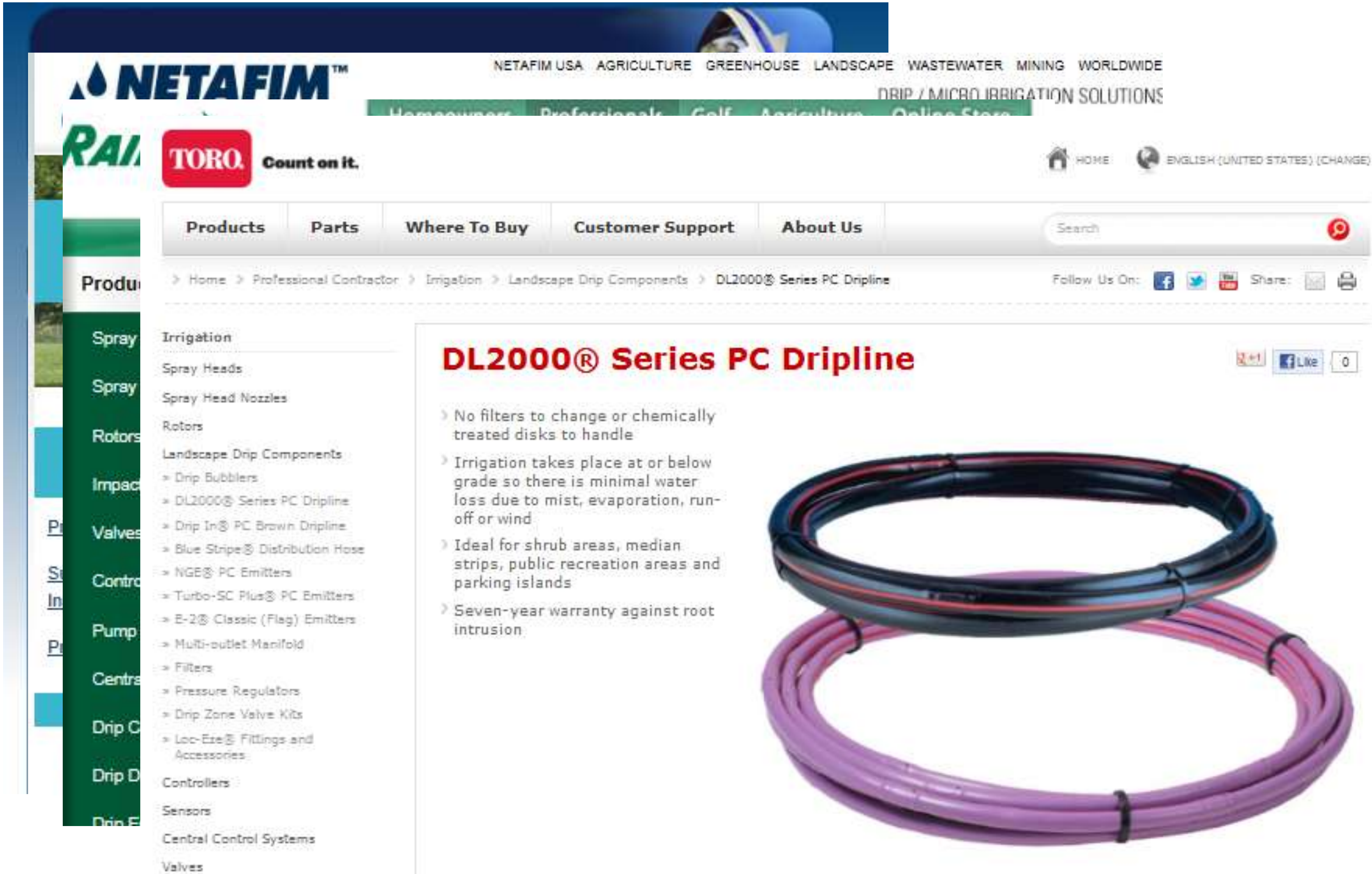
For all the naysayers …




The natural progression of a sprinkler system

Problems

Problems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TORO Count on it.
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» Blue Stripe® Distribution Hose
» NGE® PC Emitters
» Turbo-SC Plus® PC Emitters
» E-2® Classic (Flag) Emitters
» Multi-outlet Manifold
» Filters
» Pressure Regulators
» Drip Zone Valve Kits
» Loc-Eze® Fittings and Accessories
Controllers
Sensors
Central Control Systems
Valves
DL2000® Series PC Dripline
No filters to change or chemically treated disks to handle
Irrigation takes place at or below grade so there is minimal water loss due to mist, evaporation, run-off or wind
Ideal for shrub areas, median strips, public recreation areas and parking islands
Seven-year warranty against root intrusion

SUBSURFACE DRIP IRRIGATION (SDI)

Wetting pattern

Wider (spacing) and deeper (placement) in finer soils

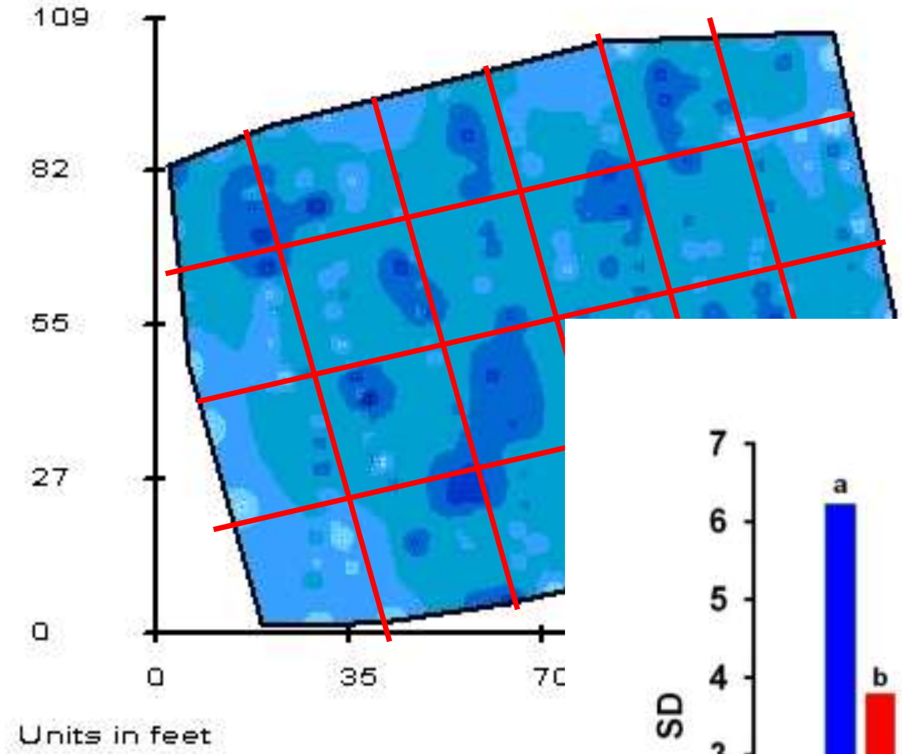
(Perceived) Challenges (1)

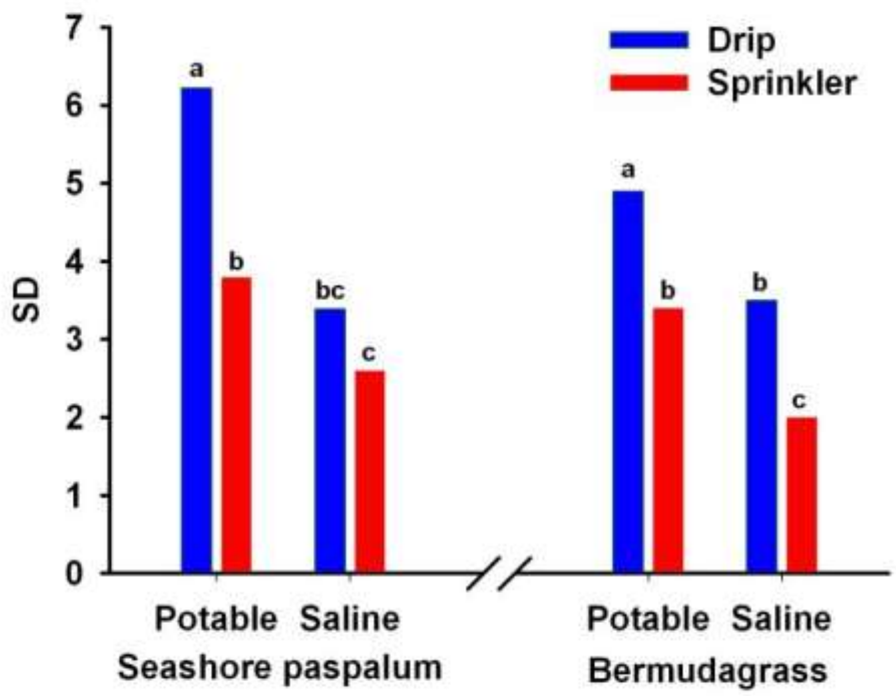
Planning / Installation	
Spacing / Depth	Water supply / Soil type / Grass
Lateral lengths (zoning)	Manufacturer Emitter spec (Label)
Root intrusion	Emitter design / Herbicide
Emitter clogging	Filtration

(Perceived) Challenges (2)

Establishment / Maintenance	
Establishment from seed	Proper timing
Establishment from sod	Proper timing
Granular fertilization	Maintain soil moisture
Salt build up / leaching	Grass selection / below drip lines
Aerification	n.a./drip line depth/ root zone selection

Irrigation Uniformity





Irrigation Uniformity

- Sprinkler irrigation (DU > 0.75) resulted in more uniform soil moisture distribution (lower standard deviation values) when compared to drip irrigation on 13 out of 18 sampling dates.
- Water quality affected moisture uniformity on 15 out of 18 sampling dates. Saline irrigated plots had soil moisture distributed more uniformly than potable irrigated plots.

Performance / Longevity

No reduction in quality when turfgrasses were irrigated with potable water from a subsurface drip system over several years

- Schiavon, M., B. Leinauer, E. Sevostianova, M. Serena, and B. Maier. 2011. Warm-season turfgrass quality, spring green-up, and fall color retention under drip irrigation. Online. Applied Turfgrass Science doi:10.1094/ATS-2011-0422-01-RS.
- Schiavon, M., B. Leinauer, E. Sevostianova, and F. Rimi. 2010. Cool-season turfgrass performance under drip irrigation in an arid climate. Proceedings 2nd European Turfgrass Society Conference:188-190.
- Leinauer, B. and D. Devitt. IN PRESS. Irrigation science and technology. *In* B. Horgan, J. Stier, S. Bonos (eds.) Turfgrass Monograph. ASA, CSSA, and SSSA, Madison WI.

Establishment of Warm and Cool-Season Grasses under Subsurface Drip and Sprinkler Irrigation

	Warm Season	Cool Season
Species	Bermudagrass ‘Princess 77’ Seashore paspalum ‘Sea Spray’	Tall fescue ‘Justice’ Kentucky bluegrass ‘Barduke’
Seeding	Mar and Jun 2008 and 2009	Sep 2009 and Oct 2010
Irrigation	Toro DL2000 MP Rotator / Toro Precision™ Series 100% ETo	Membrane covered drip system (KISSS America) Toro Precision™ Series 120% ETo
Water Quality	Potable Saline (1800 ppm, SAR 4.0)	

Subsurface Drip Irrigation

Toro DL2000

KISSS (Kapillary Irrigation Subsurface System)

October 15th

March seeded, saline and drip irrigated bermudagrass

June seeded, saline and drip irrigated seashore paspalum


Summary

- Early planting will establish warm season grasses quickly and successfully
- Saline water can be used in combination with sprinkler and subsurface drip irrigation for establishment (both seed and sod)
- Warm season grasses establish best under drip irrigation when seeded or sodded early

Schiavon, M., B. Leinauer, M. Serena, R. Sallenave, and B. Maier. 2012. Bermudagrass and Seashore Paspalum Establishment from Seed Using Differing Irrigation Methods and Water Qualities. Agron. J. 104: 706 – 714.

Summary (contd.)

- CS establishment was successful for both years
- Spacing between drip lines needs to be carefully evaluated
- Salinity problems may arise for CS grasses if subsurface drip is used with saline water

Schiavon, M., B. Leinauer, M. Serena, R. Sallenave, and B. Maier. 2013. Establishing tall fescue and Kentucky bluegrass using subsurface irrigation and saline water. Agron. J. 105:183-190.

Bermudagrass NTEP
variety trial
Subsurface drip irrigated
with saline water

Summer 2009

November 2009

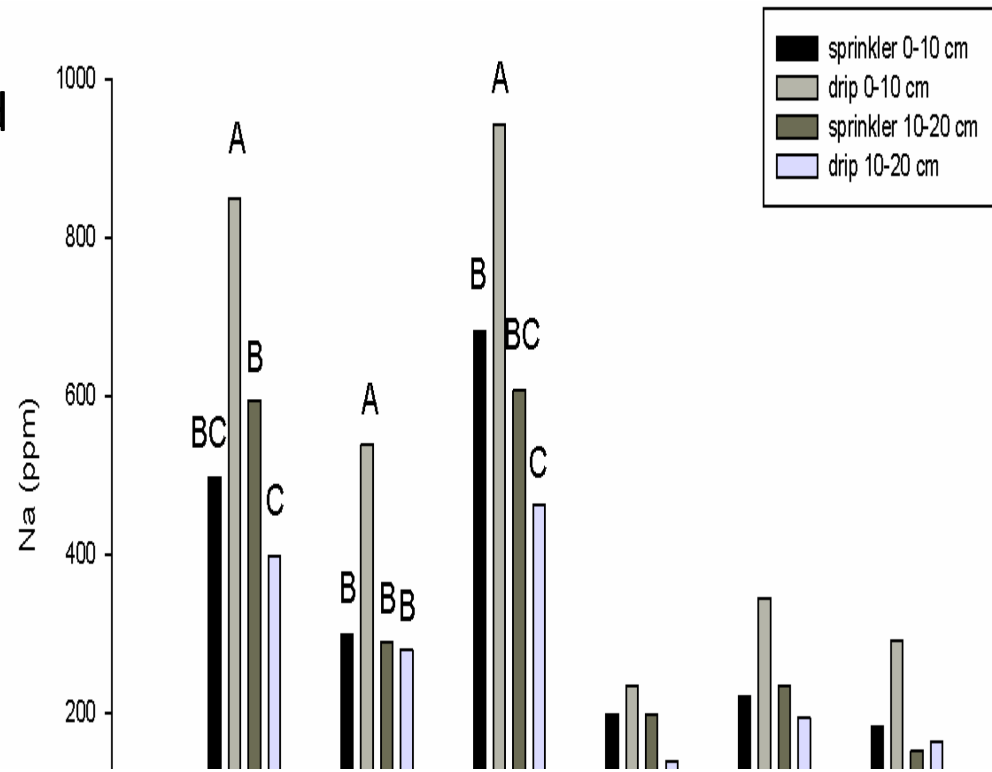
Drip irrigation with saline water

Subsurface or Sprinkler?

Results

<u>Cool season grasses</u>

- Changes in soil EC, Na content, and SAR reflected seasonal changes in irrigation and natural precipitation
- Greatest EC and Na values were reached in June of 2006 on drip irrigated plots at depths of 0 – 10 cm
- Only tall fescue maintained acceptable quality when irrigated with saline water
- More than one stressor affected quality



Sevostianova et al., 2011. Soil Salinity and Quality of Sprinkler and Drip Irrigated Cool-Season Turfgrasses. <u>Agronomy Journal 103</u>: 1503-1513

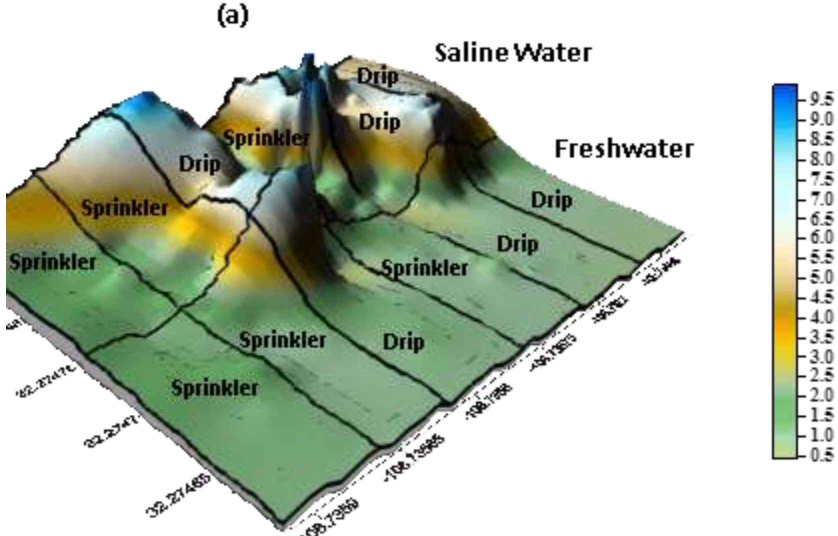
Results

<u>Warm season grasses</u>

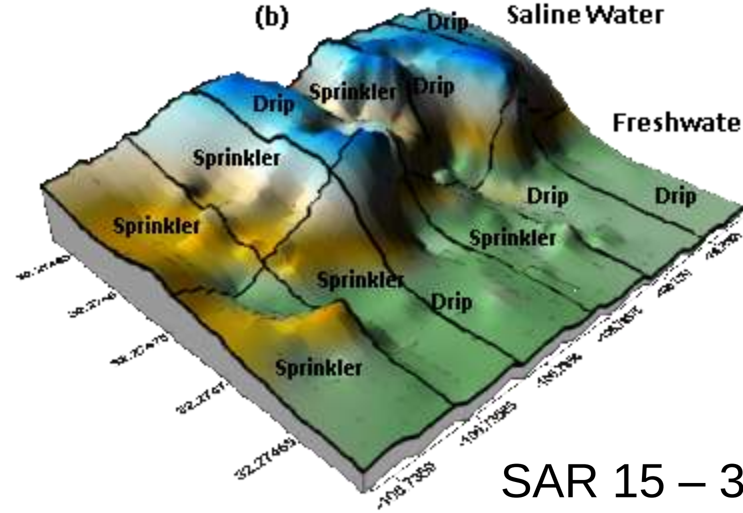
- EC, Na, or SAR did not affect turf quality
- Turf quality:

  Seashore paspalum > Princess 77, Riviera
- Drip irrigation resulted in earlier green-up than sprinkler irrigation but had no effect on summer quality or fall color retention

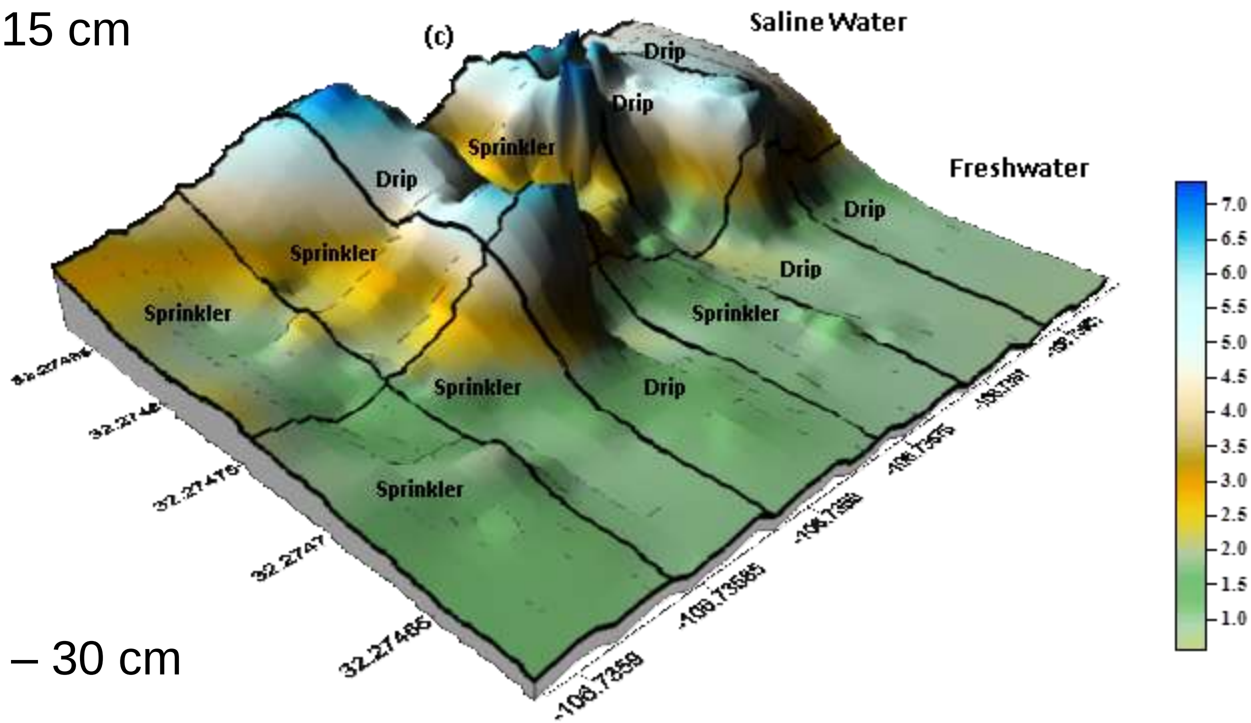
Sevostianova et al., 2011. Soil Salinity and Quality of Sprinkler and Drip Irrigated Warm-Season Turfgrasses. <u>Agronomy Journal 103</u>: 1773-1784



SAR 0 – 15 cm



SAR 15 – 30 cm



SAR 0 – 30 cm

Ganjegunte et al., UNDER REVIEW

Fertilization

Courtesy Google Earth

Conclusions

1) Subsurface drip irrigation can be used to irrigate turf efficiently
2) also in combination with saline water
3) is a viable alternative to traditional sprinkler systems if installed, monitored, and maintained properly

Installation

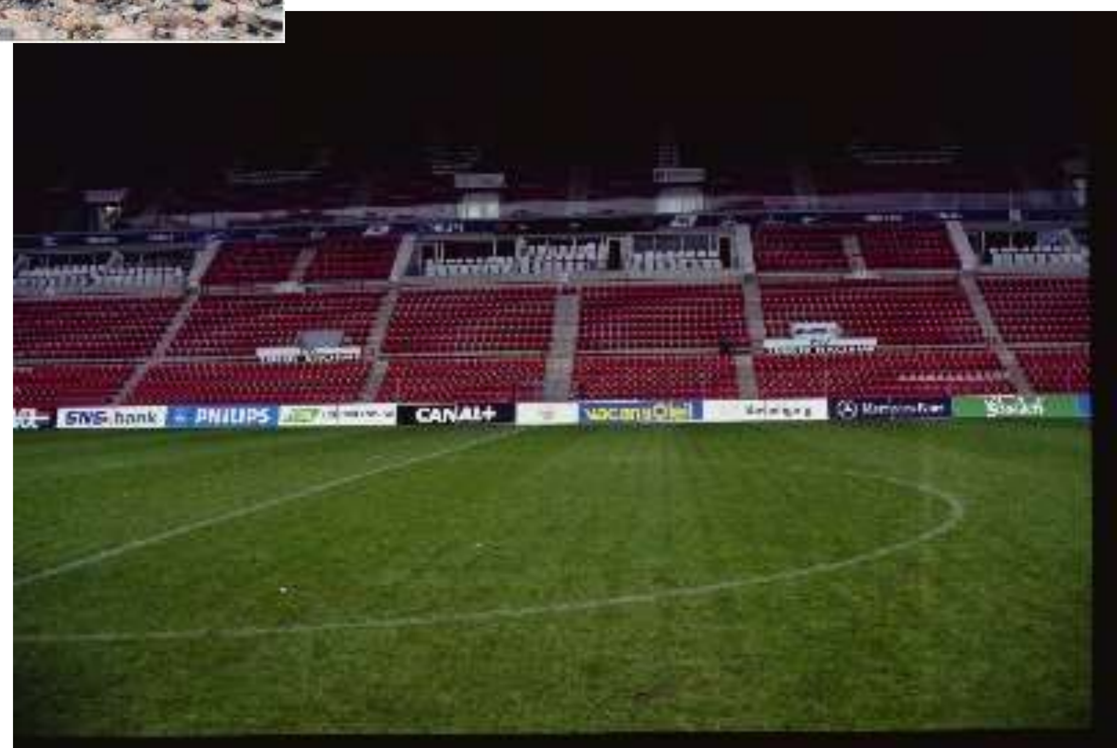
Parking Lot Project

Filtration

Maintenance + Operation

Success Stories

Athletic Fields



Athletic Fields

Rio Rancho – The Vision

Coaches Requirements

- Do it right
- Best playing surface – no artificial turf
- No sprinkler heads in playing areas
- Low mowing height
- Environmental and player friendly

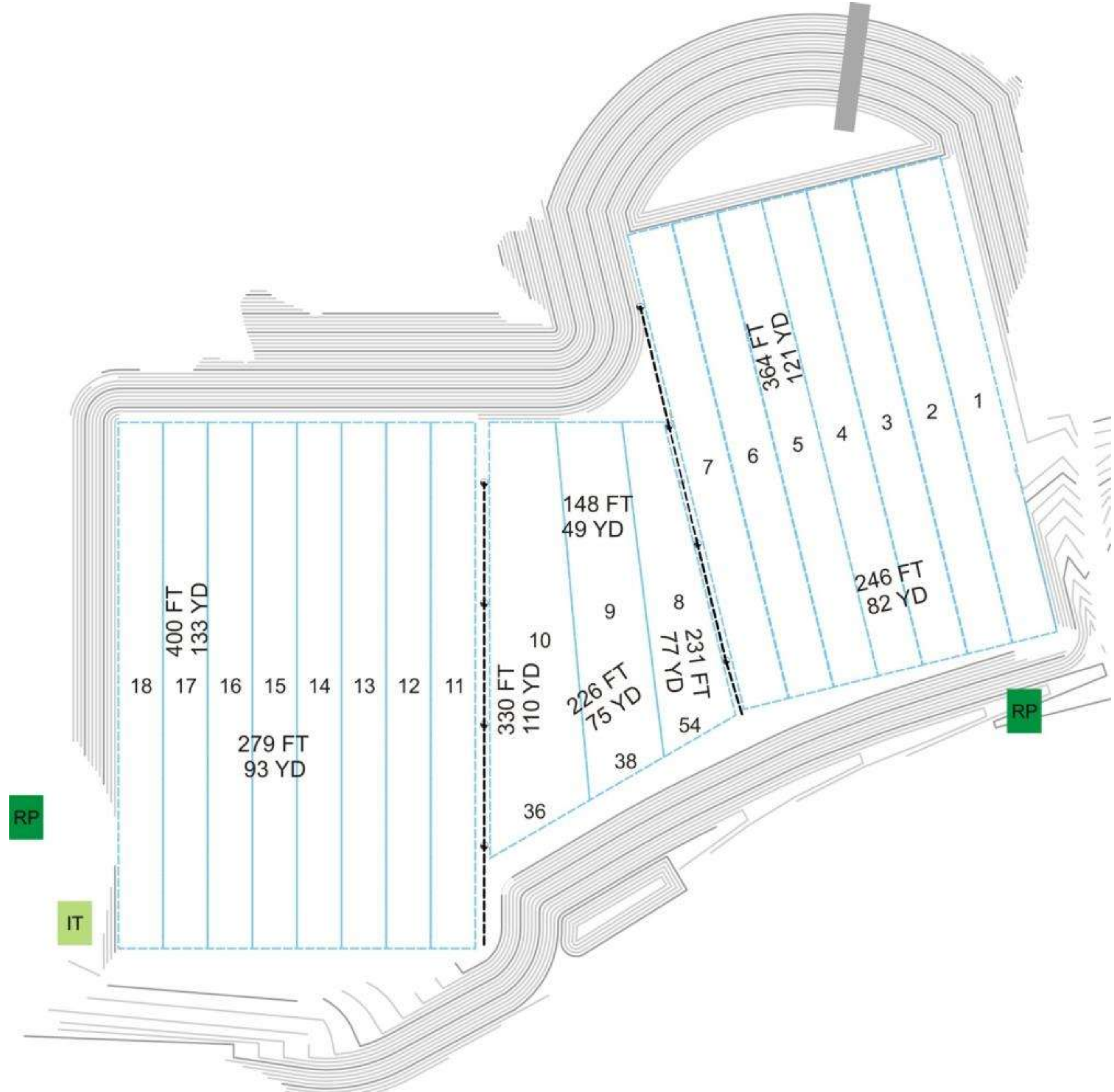
Options Considered

Rehbein Environmental Solutions
EPIC System

Drip Line
Netafim or Toro DL2000

Decisions

- Drip line due to lower initial cost
- ‘Riviera’ bermudagrass – Drought tolerant, cold tolerant, low mowing height, salt tolerant, seeded
- Infrastructure for future improvements (conduit for future lighting, accommodate future reclaimed water connection)
- Balanced grading plan (no import or export of soil)



364 FT
121 YD
1
2
3
4
5
6
7
148 FT
49 YD
246 FT
82 YD
400 FT
133 YD
8
9
10
231 FT
77 YD
18
17
16
15
14
13
12
11
330 FT
110 YD
226 FT
75 YD
RP
54
279 FT
93 YD
38
36
RP
IT

Germination and growth from 7/1/08 to 11/2/08 (Partial first growing season)


Fertilization

System Design

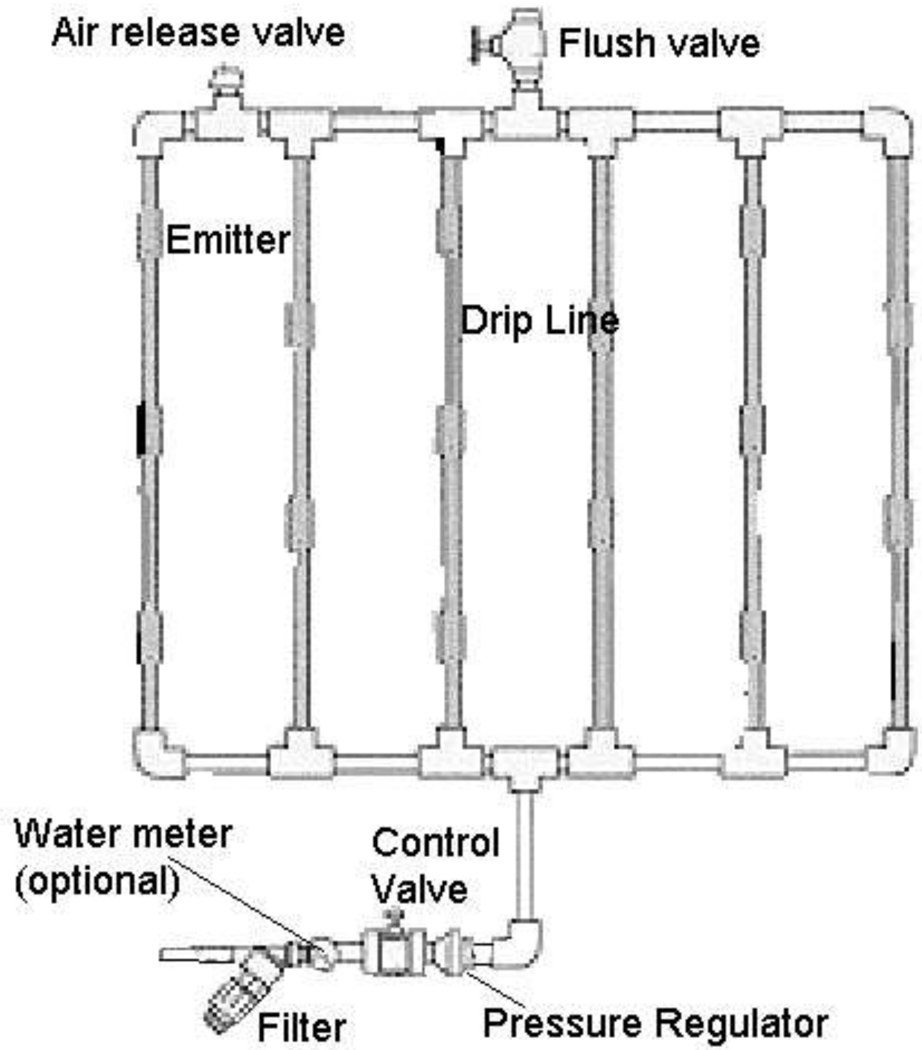
Information

1. Water quality
2. Pressure
   - preferably between 15 and 30 psi
3. Flow rate & pressure
   - important to determine maximum lateral length of drip lines

SUBSURFACE DRIP IRRIGATION (SDI)

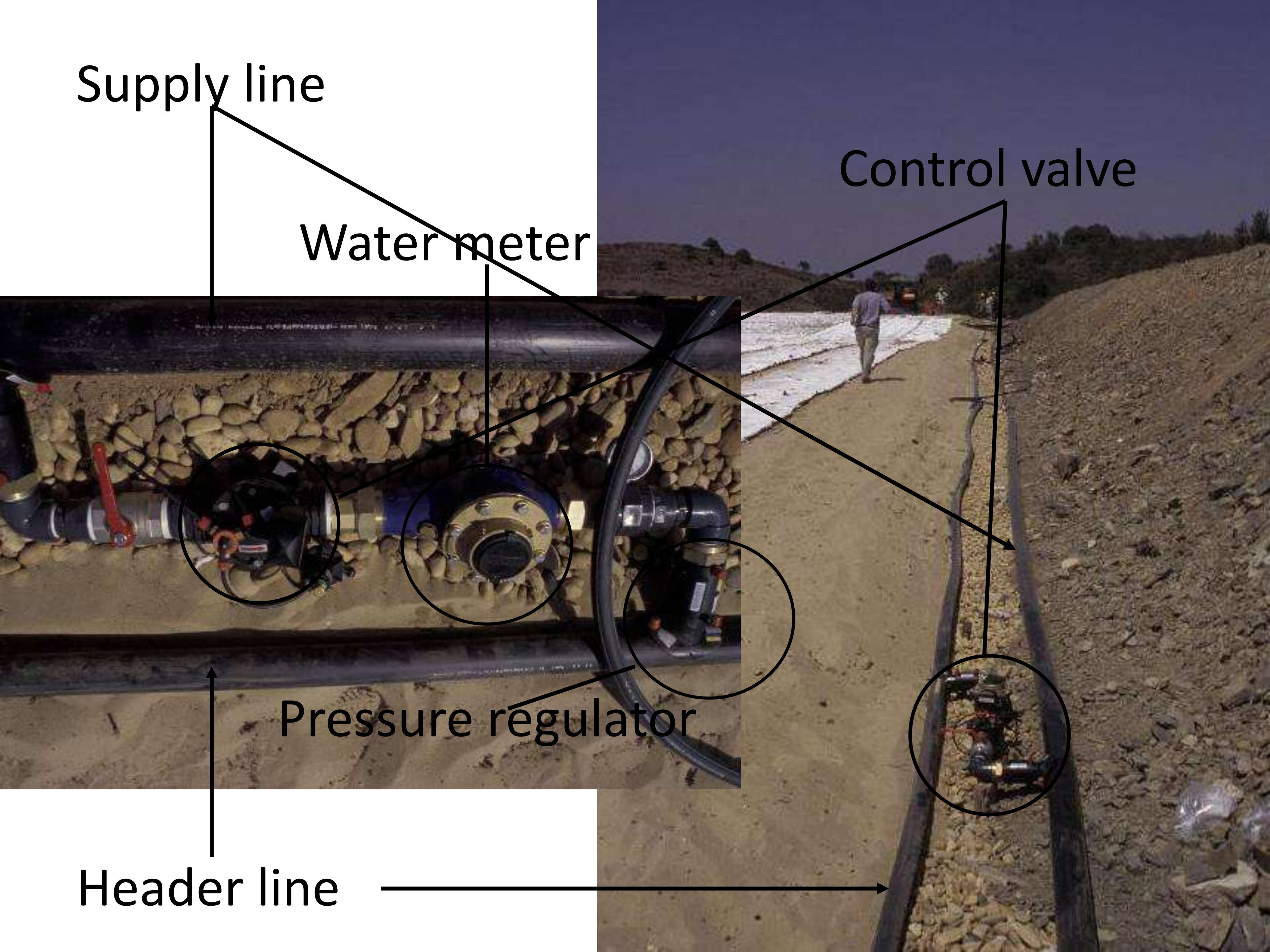
<u>Typical design:</u>

- 4” (10 cm) depth
- 1’ (30 cm) spacing



Toro, 2000

SUBSURFACE DRIP IRRIGATION (SDI)


Supply line
Control valve
Water meter
Pressure regulator
Header line

System Design

Calculation of maximum lateral length:

- Supply flow rate S_f: 20 gpm
- Emitter flow rate E_f: 0.5 / 0.9 gph
- Emitter spacing E_s: 12" / 18" / 24"

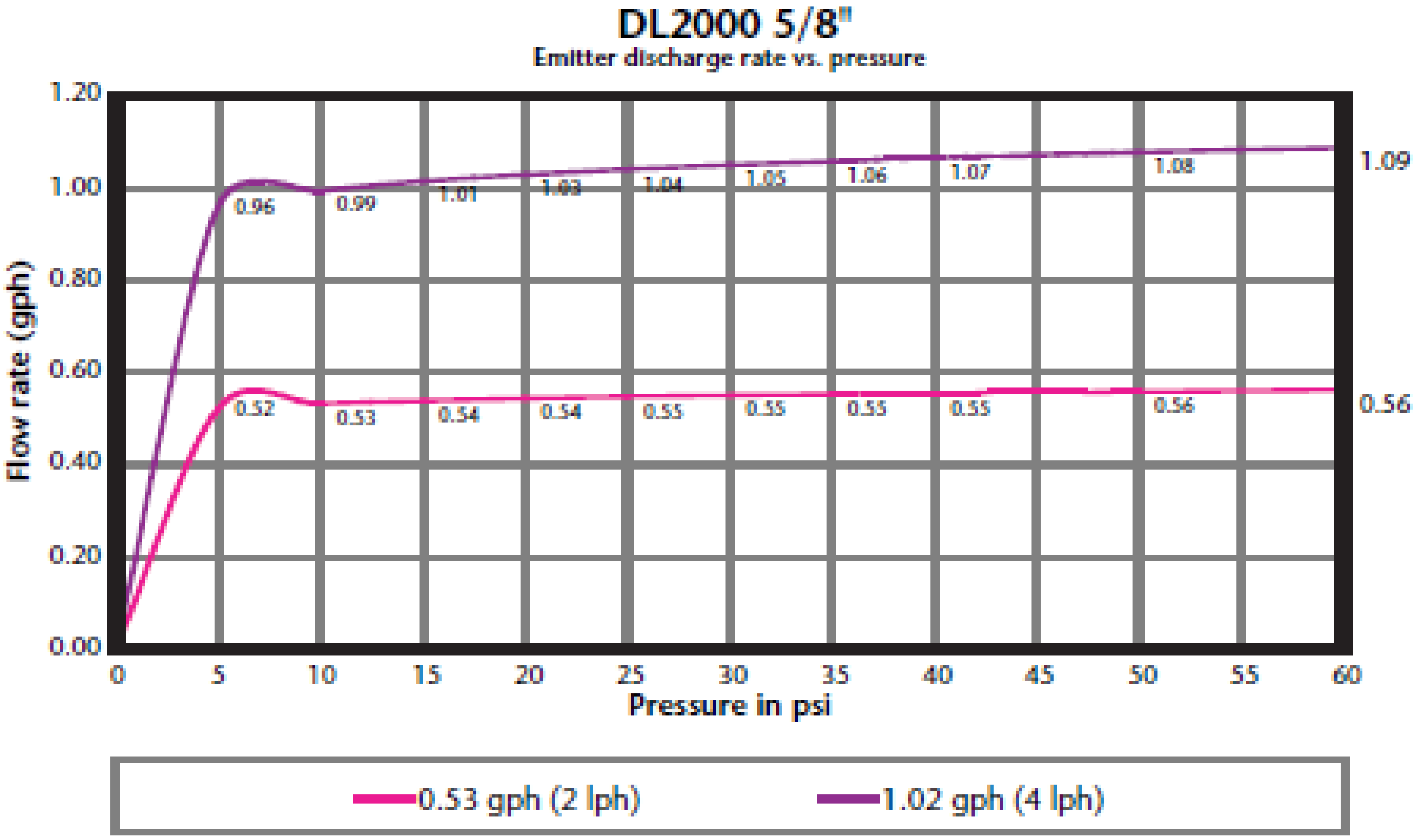
$$MLL = \frac{S_f(gph)}{E_f(gph)} \bullet E_s(ft) = \frac{20 \bullet 60gph}{0.5gph} \bullet 1ft = 2400ft$$

Installation

Length of Run Charts

5/8" (0.620" ID / 0.710" OD)			Inlet pressure vs. Max length of run in Feet			
part number	flow rate	emitter spacing	15 psi	25 psi	30 psi	40 psi
RPG212	.53 gph	12"	250'	360'	400'	460'
RPG218	.53 gph	18"	350'	515'	565'	650'
RPG224	.53 gph	24"	450'	650'	720'	825'
RPG412	1.0 gph	12"	160'	240'	260'	300'
RPG418	1.0 gph	18"	240'	340'	375'	430'
RPG424	1.0 gph	24"	300'	425'	475'	540'

Emitter



DL2000 5/8"
Emitter discharge rate vs. pressure
Flow rate (gph)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0
5
10
15
20
25
30
35
40
45
50
55
60
Pressure in psi
0.96
0.99
1.01
1.03
1.04
1.05
1.06
1.07
1.08
1.09
0.52
0.53
0.54
0.54
0.55
0.55
0.55
0.55
0.56
0.56
0.53 gph (2 lph)
1.02 gph (4 lph)

Summary Dos

+ Do it right the first time (don't use lowest bidder)
+ Use experienced contractor and a product that is specified for turf
+ Design (zoning) should follow soil test
+ Turtle back design
+ ONE filtration system for the entire system (preferably sand filter)
+ Grounds manager needs to be involved
+ Automatic AND manual flush valve for each zone
+ Fertilizer injection system

Summary Don’ts

- Cut-rate installations
  (you get what you pay for)
- Cross connections
- Crowning
- One filter for each zone (valve)