BMP's for Water Use &Conservation

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Water is so much a part of our lives, we take it for granted

- We need water!
  - Drinking
  - Bathing
  - Washing
  - Countless other purposes
  - We can no longer take a plentiful supply of clean water for granted

Water Conservation

- Water Use Efficiency
- Alternate Sources of Water
- Water Consumption
- Water Quality
- Water Management

Irrigation Sources

- Public Water Supply
  - Outside Faucet approx 6.0 gpm
  - Irrigation system on main water supply line 10-20 gpm
- Wells for irrigation 5- 1,500 gpm
- Re-use water 3- 1000 gpm
- Ponds & Creeks
- Rain water; storage; availability


On-site sewage treatment for Irrigation. Called Re-Use Water.

Setback requirements for Re-Use Water

- Potable Water Supplies 100 ft.
- Non-potable water supplies 10 ft
- Rock outcrops and sinkholes 50 ft
- Occupied Dwellings 100 ft.
- Property lines 100 ft.

- 9VAC25-740-10 Re-Use Regs. VaDEQ


Private Irrigation Wells
DRILLING

Creeks & Streams

Dairy Holding Ponds

Marsh Ponds

Ponds in Pastures

Water Quality & Nutrient Content

- Public Water Quality
  - NO3 < 5.0 ppm
  - P2O5 < 1.0 ppm
- Well Water

  Consider Water Quality on all irrigation sources Account for all nutrient sources
  - NO3 1.0- 30 ppm
  - P2O5 1.0-5.0 ppm
  - Coliform Bacteria
- Ponds & Creeks
  - NO3 1.0 + ppm
  - P2O5 1.0-50 ppm
  - Sediment, bacteria, algae other quality issues
- Reuse Water
  - NO3 5.0-30+ ppm
  - P2O5 1.0-100+ ppm
  - Metals
- Rain Water
  - Availability, quality (algae, zinc, copper etc.)

Agronomic Concerns

- Water- Is there enough? No!
  - Climate change effects
  - Demand vs Availability **Intelligence community (ODNI) predicts that water demand will out strip water available by 40 percent by 2040**

  Salinity levels
  - One of the most important considerations
    - Normally measured as electrical conductivity or Total Dissolved Solids
    - Occur in elemental Ions naturally found in water
    - Ions retained in dissolved form after a separation process (water treatment)
    - Plants differ in their sensitivity to salts
      - Most turfgrasses can tolerate 200-800 mg/l soluble salts

Agronomic Concerns

- Many landscape plants are more sensitive to high salt levels
- Sodium, Chloride, and Boron
  - Specific ions may affect water quality
    - Sodium may cause dispersion of soil aggregates and create sealing of pore spaces, a major issue with Golf Courses

Sodium Adsorption Ratio- measures the ratio of sodium to other ions to evaluate the potential effects of irrigation water on soil structure. An SAR >13 is trouble

Agronomic Concerns

- Sodium can also be toxic to plants through root uptake and by accumulation in plant leaves
- Boron and Chlorine are necessary micronutrients but can cause toxicity issues at low levels
  - 1-2 mg/l Boron will cause burn on ornamental plants such as crape myrtles and azalea

Agronomic Concerns

- Chlorides can be toxic to Chinese Privet if water levels reach 100 mg/l
- Total suspended Solids- May clog irrigation systems and can fill soil pore spaces reducing drainage
- Free Chlorine used for disinfection can damage plants if higher than 5 mg/l
- High Bicarbonate and carbonate levels can clog sprinkler systems and cause white lime deposits on leaves

Agronomic Concerns

- Heavy Metals can be of concern and highly toxic at very low levels.
- Cadmium, molybdenum, nickel, and zinc are typically bound to the solids found in the re-use water and are not normally found in high enough concentrations to be a water quality problem

Permits Required

- Virginia Department of Environmental Quality requires a Groundwater Withdrawal Permit in all aquifers east of I-95 if Well water withdrawal is more than 300,000 gal/month
- Surface Water Withdrawal permit for all pumping of 300,000 /month from any stream, creek, or “lake” for all areas of Va.

Water Withdrawal Reporting

- DEQ requires all other withdrawals of 300,00 or more per month be reported on a quarterly basis, including ponds.

- i.e.: If 15 acre inches or more are applied as irrigation per year and you irrigate more than 7.3 acres, you may need a permit.

Water Balance

What info do we need to determine how much water is being applied?

EXAMPLE

- Flow rate in gallons per day = 1000
- Number of days per year water (or wastewater) is used/generated 365
- 27,154 gallons per acre inch
- Acres applied 1.5

Water Balance Example

EXAMPLE

$$\frac{\text{1000 gal/day X 365 days/yr = 365,000 gal / yr}}{\text{27,154 gal/acre in.}} = 13.44 \text{ ac.in/yr.}$$

$$\frac{\text{13.44 ac in/yr applied}}{\text{1.5 acres}} = 8.96 \text{ inches of water applied per year}$$

Nutrient Balance Example

- Water analysis

Organic N	5.0 mg/l
NH3	1.0 mg/l
NO3	30.0 mg/l
P	4.0 mg/l
K	1.5 mg/l
Cl	250.1 mg/l

Calculations for Nutrients found in Water

Pounds per acre = $\frac{\text{(concentration mg/l)(flow MGD)(8.34)(days per year)}}{\text{acres applied}}$

Total N applied lb/acre = $\frac{36.0 \times 0.001 \times 8.34 \times 365}{1.51 \text{ acres}}$ = 72.57 lb/acre

Total N per 1000 sq/ft = $\frac{72.57}{43.5}$ = 1.67 lb N /1000 sq ft.

Hydraulic Loading & Soil Types

- Infiltration Rates based upon Soil Texture

Soil Texture	Infiltration in/hr
Sand	.75-1.0
Fine sand	.50-.75
Sandy Loam	.35-.50
Silt loam	.25-.40
Clay loam	.10-.30

Everything in Balance?

Water Wise Landscape

- Practices Good Soil Management
- Makes Good Use of Mulch
- Puts the Right Plant in the Right Place
- Is Designed for Low Input Irrigation
- Uses Efficient Irrigation Methods

Not Water Wise Irrigation


Definitely Not Water Wise !
A great example of how NOT to irrigate a nursery

Everything is Relative

- Total Residential Water Use ave. 215 gal/day
  - Toilet 8%
  - Laundry 6%
  - Shower 5%
  - Faucets 5%
  - Leaks 4-30% (Average leakage in US 4%)
  - Baths, dishwater & misc. 2%
- Total 30%
- Outdoor uses 70% (47% effective landscape usage, **23% Wasted landscape water usage)**

Landscaping Alert! Areas to Watch

- Erosion
- Runoff
- Rain Forecast
- Method of Fertilization
- Pesticide Use
- Irrigation Timing

Irrigation Tips

- Irrigation should not exceed infiltration the results are Runoff
- Research indicates that maintaining soil moisture in a narrow range just below field capacity (65-90 % of available soil moisture), maximizes turf response, called Deficit Irrigation.
- Do not move available water past root zone; i.e. 1/3 the irrigation time for sands that is required for clay loams.

Best Management Practices for Maximum Water Use Efficiency

- Irrigation Management
- Irrigation frequency is varied with environmental and climatic factors. Less frequent irrigation is needed when the roots of turf are deep. More frequent irrigation is needed when roots are shallow (young turf or sod).
- Water is not applied too quickly to avoid runoff from sloped sites, from where turf thatch has accumulated or where there are compacted soils.
- A healthy durable turf that withstands minor drought is achieved by irrigating thoroughly, but as infrequently as possible. A sure sign that turf will benefit from irrigation is a wilted appearance.

Factors that Affect Turfgrass Water Use.

- Growth rate
- Climatic conditions
- Length of growing season
- Soil type
- Turf-grass species & cultivar
- Rainfall
- Intensity of culture
- Available soil moisture

ET Rates for Common Turfgrasses

Species	Range of ET inches/week
Fescue	2.0-3.5
Ryegrass	1.8-3.1
Bermuda	1.0-2.2
Zoysia	1.3-2.1
Bent	1.3-2.7

USDA-ARS

Maximum Irrigation Application Rates for Different Soils

Soil characteristics	Cover	Bare
Clay	0.30	0.15
Silty clay loam	0.40	0.25
Loam	0.50	0.30
Silt loam; fine sandy loam	0.60	0.40
Loamy sand- sandy loam	0.90	0.60

Rate Reduction for Slope	
6-8%	20%
9-12 %	40%

From Table 8-8 Standards & Criteria

Wilted grass

Summary of Physiology

- Under summer conditions, warm-season grasses can conserve water by closing stomates while maintaining photosynthesis. This gives them a distinct advantage over cool season grasses.
- But…..it doesn't mean that they won't experience drought stress or express symptoms

When is Irrigation Season?

- When is turf actively growing?
  - Warm Season Grass vs. Cool Season Grass
    - Available Soil Water — Field Capacity – Wilting Point
    - Field Capacity — Water held in micro-pores of soil. Gravitational water has moved out.
    - Wilting Point — Water held in soil is no longer available to plants

How to measure Soil Moisture

- Tensiometer

  Good at measuring field capacity, but will break tension before reaching wilting point.

- Electrical Resistance

  Measure electrical resistance

  Gypsum Blocks

  related to soil water

  Feel

  Accuracy?

  Accounting Approach

  Software

Irrigation Scheduling

- **Deficit irrigation** (replacing less than full ET) is a successful management practice
- Tall fescue can be successfully maintained at 80% of ET
- Bermuda/Zoysia can be irrigated at 65% of ET

Irrigation Uniformity Critical to Saving Water

Best Turfgrass Management Practices

- Avoid excess levels of N. High N levels can increase water demand by as much as 41% over those lower in fertility.
- Tune up irrigation system- conduct an audit.
- Use Rain Sensors & Moisture sensors in the soil to over ride irrigation scheduling. Irrigate to supplement rain fall ONLY!
- Practice deficit irrigation. Know how much is being applied
- If turf goes dormant, let it stay there! Do not stop and start and stop again.
- Improve soil to increase rooting depth.
- Water at the most efficient time of day (10 pm to 8am, Early Morning) to eliminate volitization losses
- Conditions may result in the need for more than one irrigation period per 24 hrs. Use site specific watering (e.g. hand watering)

Things to Remember

- Runoff is a growing problem
- Erodes Precious Soil
- Carries Pollutants
- Causes Flooding
- Water Quality
  - The Challenge is Crystal Clear!

Thank you !

- Trufgrass info provided by NC State Turfgrass Institute
- Infiltration rates furnished by USDA- Agricultural Research Service
- Nutrient Sources by DCR Standards & Criteria and Virginia Tech
- Irrigation Uniformity by Florida State University