WATER QUANTITY, QUALITY AND LAW

Water Quantity
- Florida has abundant rainfall
- Florida has significant surface water features
- Florida has very good water bearing formations
- Florida has significant surface evaporation and evapotranspiration
- Florida has an ever growing population

Water Contaminates
- Sediments
- Biologics
- C
- N
- Organic Agrochemicals
- P based Organics
- P
- N base Organics
- Antibiotics
- Synthetic Hormones
Water Quality
- Drinking Water Quality
  - Drinking Water Standards
- Environmental Water Quality
  - Point Discharges – NPDES
  - Non-point Discharges (Agriculture) – TMDLs & BMPs
- Agricultural Use Water Quality
- Irrigation Water Quality

Drinking Water Standards
- Clean Water Act (1972) PL 92-500 – 33 USC
  - EPA
  - FDEP
  - FDH
  - FDA
  - FDACS

Environmental Water Quality
- Clean Water Act (1972) PL 92-500 – 33 USC
  - EPA
  - USACE
  - USDA / NRCS
  - USGS / BLM / BLR
  - FDEP
  - FDACS
  - FWMDs
  - FDH
Common Irrigation Water Quality Problems

- Physical (grit),
- Biological (bacteria and algae),
- Chemical (scale)

Water Sources

The type of emitter plugging problems usually varies with the source of the irrigation water.

Two major categories:
- surface
- groundwater

Each of these water sources produce specific plugging characteristics.

Surface Water

- Larger organisms such as moss, fish, snail, seeds, and other organic debris that must be adequately filtered before the water enters the irrigation system.
- Algal and bacterial growth are major problems
Groundwater

- Chemical precipitation
  - This precipitation is more common in water from deep wells than from shallow wells (less than 100 ft). On the other hand, shallow wells may produce plugging problems associated with bacteria.

Physical

- Particles of sand, rocks, and suspended debris that are too large to pass through the openings of emitters.
  - Clay-sized particles will **NOT** clog the system. However, if clay flocculates and forms aggregates it may be a problem.

Biological

- Algae or algal residues
  - Presence of iron and hydrogen sulfide provides a favorable environment for bacterial growth, resulting in slime buildup
Iron Bacteria

- Iron bacteria create a slime that can form aggregates called ochre, which may combine with other materials in the microirrigation tubing and cause emitter plugging. Ochre deposits and associated slime are usually red, yellow, or tan.

Sulfur Bacteria

- The slime is a yellow to white stringy deposit formed by the oxidation of hydrogen sulfide. Hydrogen sulfide (H₂S) can be recognized by the rotten egg odor.

Chemical

- Chemical plugging usually results from precipitation of one or more of the following minerals:
  - Calcium,
  - Magnesium,
  - Iron and
  - Manganese
Calcium Carbonates

- Precipitation of calcium carbonates is temperature and pH dependent.
- An increase in either pH or temperature reduces the solubility of calcium in water, and results in precipitation of the mineral.
- When groundwater is pumped to the surface and discharged through a microirrigation system, the temperature, pressure, and pH of the water often changes.

Iron

- When exposed to air, soluble ferrous bicarbonate oxidizes to the insoluble or colloidal ferric hydroid and precipitates. The result is commonly referred to as 'red water,' which is sometimes encountered in farm irrigation wells.

Manganese

- Manganese will sometimes accompany iron, but usually in lower concentrations.
**pH Effects**

- Hydrogen sulfide, which is often present in shallow wells, minimizes the precipitation of calcium carbonate (CaCO₃) because of its acidity.
- Precipitation problems generally do not occur when hard water, which contains large amounts of hydrogen sulfide, is used for irrigation.

**Fertigation**

- Fertigation, which is the application of plant nutrients through an irrigation system, may contribute to emitter plugging.

**Test**

1. Cover and place the mixture in a dark environment for 12 hours.
2. Add drops of the liquid fertilizer to a sample of the irrigation water so that the concentration is equivalent to the diluted fertilizer that would be flowing in the irrigation system.
3. Direct a light beam at the bottom of the sample container to determine if precipitates have formed. If no apparent precipitation has occurred, the fertilizer source will normally be safe to use in that specific water source.
Two Basic Approaches

1. removing the potential source of plugging from the water before it enters the irrigation system
2. treating the water to prevent or control chemical and biological processes from occurring

Prevention of Emitter Plugging

- method of filtering the irrigation water
- means of injecting chemicals into the water supply
- settling basin to allow aeration and the removal of solids
- equipment for flushing the system

Water Quality Analysis

- A water quality analysis often lists electrical conductivity in milimhos per centimeter (mmho/cm) or ds/m (decisiemens) one ds/m is equal to 1 mmho/cm. These values can be converted to parts per million (ppm) dissolved solids, by multiplying mmho/cm by 0.64. For example, if the electric conductivity meter reads 1000 mmho/cm, then dissolved solids can be estimated as 640 ppm.
### Plugging Hazard Based on Concentration

<table>
<thead>
<tr>
<th>Factor</th>
<th>Slight</th>
<th>Moderate</th>
<th>Severe</th>
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<tbody>
<tr>
<td>Physical</td>
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<td></td>
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<tr>
<td>Suspended</td>
<td>&lt; 50</td>
<td>50 to 100</td>
<td>&gt; 100</td>
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<td>Solids (filterable)</td>
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<tr>
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<tr>
<td>pH</td>
<td>&lt; 7.0</td>
<td>7.0 to 7.5</td>
<td>&gt; 7.5</td>
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<tr>
<td>Dissolved Solids</td>
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<td>500 to 2000</td>
<td>&gt; 2000</td>
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<tr>
<td>Manganese</td>
<td>&lt; 0.1</td>
<td>0.1 to 1.5</td>
<td>&gt; 1.5</td>
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<tr>
<td>Iron</td>
<td>&lt; 0.5</td>
<td>0.5 to 2.0</td>
<td>&gt; 2.0</td>
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<tr>
<td>Hydrogen sulfide</td>
<td>&lt; 0.5</td>
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<tr>
<td>Hardness*</td>
<td>&lt; 150</td>
<td>150 to 300</td>
<td>&gt; 300</td>
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<tr>
<td>Biological</td>
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<tr>
<td>Bacteria (population)</td>
<td>&lt; 10,000</td>
<td></td>
<td>&gt; 50,000</td>
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<tr>
<td></td>
<td>10,000 to 50,000</td>
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</table>

*Hardness as ppm CaCO3

Source: [WBD](Modified from Nakayama & Bucks, 1986)

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### Hardness

Hardness = \((2.5 \cdot \text{Ca}) + (4.1 \cdot \text{Mg})\)

\[
\text{Ca (meq/L) } \cdot 20 = \text{Ca (ppm)},
\]

\[
\text{Mg (meq/L) } \cdot 12 = \text{Mg (ppm)}.
\]

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### Water Law

- **Doctrine of Appropriation**
  - Western States – First Come, First Serve Approach
- **Doctrine of Riparian Use**
  - Eastern States – English "Access and Reasonableness of Use" System
- **Florida Water Law**
  - "Regulated" Riparian Doctrine
Florida’s Water Management Districts

Each district is controlled by a governing board of nine district residents appointed by the governor for four years. The boards have authority over:

- consumptive use permitting,
- artificial aquifer recharge,
- management and storage of surface waters,
- use of district works or land,
- and the construction and repair of water wells.

A watershed or basin is a catchment area that discharges to a single point.

Large river basins or watersheds are typically composed of several watersheds.