Objective

To give a clear understanding of the basic concepts of wastewater treatment including wastewater composition, treatment in the tank, pollutants in wastewater, effluent characteristics and advanced treatment units
Onsite Sewage Treatment and Disposal Systems

Advantages and Importance of Onsite Systems

- Simple and effective
- Minimal moving parts
- Less disruptive to the environment to install and maintain
- Provide wastewater treatment to areas where otherwise it would not be available
- A source of groundwater recharge
- Lower cost compared to central sewer
“Public health and environmental protection officials now acknowledge that onsite systems are **not just temporary installations** that will be replaced eventually by centralized sewage treatment services, but **permanent approaches** to treating wastewater for release and reuse in the environment”. (USEPA, 1997)

“Onsite systems are recognized as potentially viable, low-cost, long-term, decentralized approaches to wastewater treatment if they are **planned, designed, installed, operated, and maintained properly**”. (USEPA, 1997)
Florida’s Onsite Wastewater Treatment Systems

- **2.67 million** septic systems*
- **8.8 million** housing units**
- > **30%** served by septic systems
- > **465 million gallons per day** of flow
  (based on 2.51 persons per household and 69.3 gallons per day/person)

*FL Dept of Health, **2008 US Census
Topics in OSTDS Design

- Wastewater Composition
- Pre-treatment
- Wastewater Disposal

Body Wastes from the average person

- 1.25 L (0.33 gallons) urine per day
- 0.25 Kg (0.55 LB.) feces per day

from Guttormsen, 1978
Human Body Wastes
(Total volume ~ 1.5 L per day)

**DRY SOLIDS 150 g made of**

- Organic material 118 g
- Nitrogen 16 g
- Phosphorus 2 g
- Other 14 g

*includes salts and trace elements from Guttormsen, 1978*

---

Human Body Wastes
*organics*

- Organic material - anaerobic bacteria
- $10^{12}$ bacteria **per gram** of feces
- 1,000,000,000,000 or 1 trillion

*from Guttormsen, 1978*
In Florida

For residences the volume of wastewater is calculated as 50% blackwater and 50% graywater.

Modified after Siegrist, 1977

### Segregation of Household Wastewater

#### Table 3-3: Residential water use by fixture or appliance

<table>
<thead>
<tr>
<th>Fixture/Use</th>
<th>Gallons/Person Day Average</th>
<th>Gallons/Person Day Range</th>
<th>% Total: Average Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet</td>
<td>3.5</td>
<td>2.0-3.0</td>
<td>18.5</td>
</tr>
<tr>
<td>Shower</td>
<td>14.9-18.6</td>
<td>11.8-20.2</td>
<td></td>
</tr>
<tr>
<td>Bath</td>
<td>1.2</td>
<td>0.5-1.9</td>
<td></td>
</tr>
<tr>
<td>Clothes washer</td>
<td>0.37</td>
<td>0.30-0.42</td>
<td></td>
</tr>
<tr>
<td>Dishwasher</td>
<td>10.0, 9.3-9.6</td>
<td>12.0-17.1</td>
<td></td>
</tr>
<tr>
<td>Faucets</td>
<td>4.4</td>
<td>4.5-8.6</td>
<td></td>
</tr>
<tr>
<td>Leaks</td>
<td>NA</td>
<td>9.5</td>
<td></td>
</tr>
<tr>
<td>Other Domestic</td>
<td>NA</td>
<td>0.9-4.0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>NA</td>
<td>69.3</td>
<td></td>
</tr>
</tbody>
</table>

1. Results from average rainfalls at 798 homes in 12 metropolitan areas. Homes surveyed were served by public water supplies, which operate at higher pressures than private water supplies. Leakage rates might be lower for homes on private water supplies.
2. Results are averages over range. Range is the lowest to highest average for 12 metropolitan areas.
3. GPH/person/day times 0.0033 min = gallons per minute. Numbers in use per person per day.

Source: Mayer et al., 1999.
Figure 3.2. Indoor water use percentage, including leakage, for 1,168 data logged homes

* gpcd = gallons per capita (person) per day
Source: Mayer et al. 1999.

Table 3.8. Residential wastewater pollutant contributions by source

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Garbage disposal (gpcd)</th>
<th>Toilet (gpcd)</th>
<th>Bathing, sinks, appliances (gpcd)</th>
<th>Approximate total (gpcd)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD₅</td>
<td>mean</td>
<td>18.0</td>
<td>16.7</td>
<td>28.5</td>
</tr>
<tr>
<td></td>
<td>range</td>
<td>10.9-30.9</td>
<td>6.9-23.6</td>
<td>24.5-38.8</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>(28%)</td>
<td>(28%)</td>
<td>(46%)</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>mean</td>
<td>26.5</td>
<td>27.0</td>
<td>17.2</td>
</tr>
<tr>
<td></td>
<td>range</td>
<td>15.8-43.6</td>
<td>12.5-36.5</td>
<td>10.8-22.6</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>(37%)</td>
<td>(38%)</td>
<td>(24%)</td>
</tr>
<tr>
<td>Total nitrogen</td>
<td>mean</td>
<td>0.6</td>
<td>8.7</td>
<td>1.9</td>
</tr>
<tr>
<td></td>
<td>range</td>
<td>0.2-0.9</td>
<td>4.1-16.8</td>
<td>1.1-2.0</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>(5%)</td>
<td>(78%)</td>
<td>(17%)</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>mean</td>
<td>0.1</td>
<td>1.5</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>range</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>% of total</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

* Adapted from USEPA, 1992.
* Means and ranges for BOD, TSS, and TN are reported in Bennett and Linstedt, 1975; Laak, 1975; Lignman et al., 1974; Olson et al., 1968; and Siegel et al., 1976.
* Grams per capita (person) per day.
* The use of low-phosphate detergents in recent years has lowered the TP concentrations since early literature studies; therefore, Sodell (1991) was used for TP data.
The test measures the amount of dissolved oxygen organisms need to degrade wastes in wastewater. Also referred to as CBOD5. (Carbonaceous Biochemical Oxygen Demand).

A portion of wastewater that has resisted settling, that is retained when passed through a filter. Also indicates wastewater clarity. Can clog the soil absorption system.

There are 3 forms of nitrogen that are commonly measured: ammonia (NH4), nitrates (NO3) and nitrites (NO2). Total Nitrogen is the sum of total Kjeldahl nitrogen (organic and reduced nitrogen), ammonia and nitrate-nitrite. (TKN)

Occurs in wastewater bound to oxygen to form phosphates. Phosphates are classified as orthophosphates, polyphosphates and organic phosphates.

Used as indicator organism for the presence of pathogens and used to determine if wastewater has been adequately treated.

The combination of fats, oils, and greases and other related constituents in wastewater. Excessive FOG can clog systems, create odors and increase BOD.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Reduction in pollutant loading (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total suspended solids</td>
<td>25–40</td>
</tr>
<tr>
<td>Biochemical oxygen demand</td>
<td>20–28</td>
</tr>
<tr>
<td>Total nitrogen</td>
<td>3.6</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>1.7</td>
</tr>
<tr>
<td>Fats, oils, and grease</td>
<td>60–70</td>
</tr>
</tbody>
</table>

### Residential Influent Wastewater Concentrations (part 1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemical Oxygen Demand (BOD)</td>
<td>420 mg/l</td>
</tr>
<tr>
<td>Total Solids (TS)</td>
<td>1028 mg/l</td>
</tr>
<tr>
<td>Total Suspended Solids (TSS)</td>
<td>232 mg/l</td>
</tr>
<tr>
<td>Total Organic Carbon (TOC)</td>
<td>183 mg/l</td>
</tr>
<tr>
<td>Dissolved Organic Carbon (DOC)</td>
<td>110 mg/l</td>
</tr>
</tbody>
</table>

*Source: WERF, 2009*

### Residential Influent Wastewater Concentrations (part 2, nutrients)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Nitrogen</td>
<td>60 mg/l</td>
</tr>
<tr>
<td>Organic N</td>
<td>43 mg/l</td>
</tr>
<tr>
<td>Ammonia (NH₃)</td>
<td>14 mg/l</td>
</tr>
<tr>
<td>Nitrate N (NO₃⁻)</td>
<td>1.9 mg/l</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>10.4 mg-P/L</td>
</tr>
</tbody>
</table>

*Source: WERF, 2009*
Residential **Influent** Wastewater Concentrations (*part 3, microbes*)

<table>
<thead>
<tr>
<th>Type</th>
<th>Organism</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total bacteria</td>
<td>$1 \times 10^8/100\text{ml}$</td>
<td></td>
</tr>
<tr>
<td>Total coliform</td>
<td>$2 \times 10^6/100\text{ml}$</td>
<td></td>
</tr>
<tr>
<td>Fecal coliform</td>
<td>$3 \times 10^4/100\text{ml}$</td>
<td></td>
</tr>
<tr>
<td>Fecal streptococci</td>
<td>$3 \times 10^4/100\text{ml}$</td>
<td></td>
</tr>
<tr>
<td>Enteric virus</td>
<td>32-7000 PFU/L</td>
<td></td>
</tr>
</tbody>
</table>

Source: Canter & Knox 1985

Waterborne Pathogens found in Human Waste and Associated Diseases

<table>
<thead>
<tr>
<th>Type</th>
<th>Organism</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td><em>Escherichia coli</em> (enteropathogenic)</td>
<td>Gastroenteritis</td>
</tr>
<tr>
<td></td>
<td><em>Legionella pneumophila</em></td>
<td>Legionellosis</td>
</tr>
<tr>
<td></td>
<td><em>Leptospira</em></td>
<td>Leptospirosis</td>
</tr>
<tr>
<td></td>
<td><em>Salmonella typhii</em></td>
<td>Typhoid Fever</td>
</tr>
<tr>
<td></td>
<td><em>Salmonella</em></td>
<td>Salmonellosis</td>
</tr>
<tr>
<td></td>
<td><em>Shigella</em></td>
<td>Shigellosis</td>
</tr>
<tr>
<td></td>
<td><em>Vibrio cholera</em></td>
<td>Cholera</td>
</tr>
<tr>
<td></td>
<td><em>Yersinia enterolitica</em></td>
<td>Yersinosis</td>
</tr>
</tbody>
</table>

Source: USEPA, 1999
### Waterborne Pathogens found in Human Waste and Associated Diseases

<table>
<thead>
<tr>
<th>Type</th>
<th>Organism</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protozoans</td>
<td><em>Balantidium coli</em></td>
<td>Balantidiasis</td>
</tr>
<tr>
<td></td>
<td><em>Cryptosporidium</em></td>
<td>Cryptosporidiosis</td>
</tr>
<tr>
<td></td>
<td><em>Entamoeba histolytica</em></td>
<td>Amoebic dysentery</td>
</tr>
<tr>
<td></td>
<td><em>Giardia lambia</em></td>
<td>Giardiasis</td>
</tr>
<tr>
<td></td>
<td><em>Naegleria fowleri</em></td>
<td>Amoebic Meningoencephalitis</td>
</tr>
</tbody>
</table>

Source: USEPA, 1999

### Waterborne Pathogens found in Human Waste and Associated Diseases

<table>
<thead>
<tr>
<th>Type</th>
<th>Organism</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viruses</td>
<td><em>Adenovirus</em> (31 types)</td>
<td>Conjunctivitis</td>
</tr>
<tr>
<td></td>
<td><em>Enterovirus</em> (67 types)</td>
<td>Gastroenteritis</td>
</tr>
<tr>
<td></td>
<td><em>Hepatitis A</em></td>
<td>Infectious hepatitis</td>
</tr>
<tr>
<td></td>
<td><em>Noroviruses</em></td>
<td>Gastroenteritis</td>
</tr>
<tr>
<td></td>
<td><em>Reovirus</em></td>
<td>Gastroenteritis</td>
</tr>
<tr>
<td></td>
<td><em>Rotavirus</em></td>
<td>Gastroenteritis</td>
</tr>
</tbody>
</table>

Source: USEPA, 1999
Forms of viral hepatitis - exposure routes

- Hepatitis A
- Hepatitis B
- Hepatitis C
- Delta- Hepatitis
- Hepatitis E

IN: Benenson, 1990

- SewAge (fecal-oral)
- Blood-borne
- Transfusions
- Blood & plasma
- Contaminated water (fecal-oral)

Pathogen Content of Gray water surprisingly high...

Possible sources are:
- sputum & vomitus - bathroom sink
- contaminated garments - clothes washer
- normal skin flora (rectal area) - shower/ bath

Source: Plews, 1977
Typical Septic Tank effluent bacterial count (mean#/100 ml)

- Total bact. \(3.4 \times 10^8\)
- Total colif. \(3.4 \times 10^6\)
- Fecal colif. \(4.2 \times 10^5\)
- Fecal strep. \(4.0 \times 10^4\)
- \(Pseudomonas\) \(8.6 \times 10^3\)

Siegrist, 1977
Univ. of Wisconsin, 1978

Bacterial Characteristics of Gray Water

<table>
<thead>
<tr>
<th>EVENT</th>
<th>ORGANISM</th>
<th>Mean(#100 ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bath/Shower</td>
<td>Fecal strep.</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>Fecal colif.</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>Total colif.</td>
<td>1,100</td>
</tr>
<tr>
<td>Clothes Wash</td>
<td>Fecal strep.</td>
<td>210</td>
</tr>
<tr>
<td></td>
<td>Fecal colif.</td>
<td>1,400</td>
</tr>
<tr>
<td></td>
<td>Total colif.</td>
<td>18,000</td>
</tr>
<tr>
<td>Clothes Rinse</td>
<td>Fecal strep.</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Fecal colif.</td>
<td>320</td>
</tr>
<tr>
<td></td>
<td>Total colif.</td>
<td>5,300</td>
</tr>
</tbody>
</table>
Nitrogen

- septic tank effluent 27 – 119 mg-N/L (60 mg-N/L median)*
- Very little removal in tank*
- **as much as 10 - 50% removed in drainfield** (based on soil permeability) *
- each person generates 9 lbs./year**
- need to determine risks of nitrogen build up in groundwater

* Water Environment Research Foundation (WERF), Project Number 04-DEC-1, Influent Constituent Characteristics of the Modern Waste Stream from Single Sources, 2009

** Wekiva Study Florida, Feb 2006 by D. L. Anderson et al, the researchers determined that the average amount of nitrogen in untreated domestic sewage contributed by each person in a home was 11.2 grams per person per day or around 22 pounds per year per each household of 2.5 people.

Total Nitrogen in Effluent

- ~ 45 mg-N/L SEPTIC TANK
- ~ 40 mg-N/L AEROBIC UNIT

Source: 1993 Florida OSTDS Study
### Nitrogen

<table>
<thead>
<tr>
<th></th>
<th>Nitrogen Primarily in the form of:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic Tank Effluent</td>
<td>Ammonia ($\text{NH}_3$)</td>
</tr>
<tr>
<td>Aerobic Treatment Unit Effluent</td>
<td>Nitrate N ($\text{NO}_3^-$)</td>
</tr>
</tbody>
</table>

### Nitrate

- Not Retained In Soil
- Moves With Groundwater
- Created By Unsaturated Soils and Aerobic Treatment Units
High concentrations of nitrate (greater than 10 mg/L) can cause **METHEMOGLOBINEMIA** or "**Blue Baby Syndrome**" a disease in infants that reduces the blood's ability to carry oxygen.

- **MCL for N is 10 mg/l** – EPA Groundwater Standard
- Septic tanks are ineffective in removing nitrogen.
- Nitrogen contamination of ground water below infiltrative fields has been documented by many investigators.

Source: EPA, 2002

---

**Limiting Nitrate Effects**

- **Control System Density**
- Maximum Sewage Flow Applied Per Acre
- Reduce Amount Of Nitrogen In Effluent
Phosphorus

- Sources: soaps & detergents (lowered), feces
- Average person generates 3 lb./yr
- 5-20% retention in tank
- Plant uptake in root zone
- Soils with organic content will absorb P
- 85 – 95% removed as measured in the vadose zone (aerated or unsaturated zone below the drainfield)
- Chemical precipitation, ion exchange canisters
- Fate: lake and tropical marine degradation

Source: EPA, 2002

Volatile Organic Compounds (VOCs)

- Sources: cleansers, dyes, solvents used in home, pesticides, organic chemicals
- Removal efficiency: high in coarse aggregate drainfield material (presumably vaporize into air voids)
- Most prevalent toxic organics in wastewater: toluene, xylenes, acetone.

Source: EPA, 2002
Volatile Organic Compounds (VOCs)

- Concentrations in septic tank effluent 9-75 micrograms/L
- Toluene found in all effluent samples
- Chloroform & methylene chloride found in some effluent samples
- No positive samples immediately beneath drain fields

Source: Florida’s OSTDS Research Project

Pretreatment

- Occurs in treatment tanks
- Septic tanks - provide primary treatment
- Aerobic units - provide secondary treatment
Functions of a Septic Tank

- Sedimentation in scum & sludge layers
- Storage of layers
- Digestion of solids without oxygen
Sedimentation Function

- quiescent conditions
- settleable solids sink to bottom - sludge
- floatables rise to form scum layer
- remove / reduce particles suspended in wastewater
- partition tanks (baffled) or tanks in series prevent short circuiting

Storage Function

- Adequate volume
- Scum and sludge stored without disturbing other functions
- Protects drainfield absorption area
Digestion Function

- Without oxygen (anaerobic)
- Reduce organic molecules to soluble compounds and gases
- Gas bubbles produced in sludge rise to surface and seed the clear zone
- Can interfere with sedimentation
- Reason for compartmentalized tanks and outlet and filter devices

Anaerobic Digestion

The purpose of the anaerobic process is to convert sludge to end products of liquids and gases while producing as little biomass as possible

- **Hydrolysis** – large polymers broken down by enzymes
- **Fermentation** – Volatile fatty acids are also produced along with carbon dioxide and hydrogen
- **Acetogenesis** – breakdown of volatile acids to acetate and hydrogen
- **Methanogenesis** – Acetate, formaldehyde, hydrogen and carbon dioxide are converted to methane and water
Indigestible materials to avoid:

- coffee grounds
- cooking fats & grease
- wet strength towels
- disposable diapers
- cigarette butts
- plastics
- kitty litter

What is in Septic Tank Effluent?

- oxygen-demanding substances
- disease-causing agents
- small suspended particles
- nutrients and other dissolved substances
- 99.9% water
Septic Tank Effluent Characteristics

- Remove nearly all the settleable solids
- Fats, greases & floating debris removed
- Can vary widely in characteristics
- Can vary from day to day in same tank, depending on usage, season and climate

Septic Tank Effluent

<table>
<thead>
<tr>
<th>Influent RAW (mg/l)</th>
<th>Effluent (STE) (mg/l)</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBOD&lt;sub&gt;5&lt;/sub&gt;</td>
<td>420</td>
<td>216</td>
</tr>
<tr>
<td>TSS</td>
<td>232</td>
<td>61</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>10.4</td>
<td>9.8</td>
</tr>
</tbody>
</table>

Source: WERF, 2009
Closer to the Soil Surface…

- more biological activity
- stimulation natural microbes & macro-organisms
- greater oxygen concentration
- shorter distance for oxygen to diffuse to biomat

Biomat

- Clogging mat, zone, or bio-crust
- Highly effective in removing bacteria and pathogens
- Acts as an active biological site for treatment
- Large portion of BOD removed
- Adsorption, filtration and purification
- Predation of sewage microbes by naturally-occurring soil microbes

Biomat: The layer of biological growth and inorganic residue that develops at the wastewater-soil interface and extends up to about 1 inch into the soil matrix. The biomat controls the rate at which pretreated wastewater moves through the infiltrative surface/zone.
Table 3-17. Examples of soil infiltration system performance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Applied concentration in milligrams per liter</th>
<th>Percent removal</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{BOD}_5$</td>
<td>130–150</td>
<td>90–98</td>
<td>Siegrist et al., 1986 U. Wisconsin, 1978</td>
</tr>
<tr>
<td>Total nitrogen</td>
<td>45–55</td>
<td>10–40</td>
<td>Reineau 1977 Sikora et al., 1976</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>8–12</td>
<td>85–95</td>
<td>Sikora et al., 1976</td>
</tr>
<tr>
<td>Fecal coliforms</td>
<td>NA$^*$</td>
<td>99–99.99</td>
<td>Gerba, 1975</td>
</tr>
</tbody>
</table>

* Fecal coliforms are typically measured in other units, e.g., colony-forming units per 100 milliliters.

Source: Adapted from USEPA, 1992.

---

Conventional vs. Advanced OSTDS

- Conventional
  - Septic Tank and Drainfield

- Advanced
  - Aerobic Treatment Unit (ATU)
  - Performance Based Treatment System (PBTS)
A sewage treatment unit which introduces air into sewage
- Treatment provided by bacteria adapted to presence of dissolved oxygen

Aerobic vs. Anaerobic Bacteria
- Get more energy out of same amount of food
- Reproduce faster when conditions favorable
- Greater proportion of food consumed goes into cell mass
### Aerobic Unit Effluent

Meets National Secondary Standards – NSF Standard 40

<table>
<thead>
<tr>
<th></th>
<th>Conventional STE</th>
<th>ATU NSF 40 STE Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{BOD}_5$</td>
<td>216 mg/L</td>
<td>25 mg/L</td>
</tr>
<tr>
<td>$\text{TSS}$</td>
<td>61 mg/L</td>
<td>30 mg/L</td>
</tr>
<tr>
<td>Microbe Reduction</td>
<td>loaded</td>
<td>99.9% (not disinfection)</td>
</tr>
</tbody>
</table>

### Steps in Aerobic Treatment

- **Pretreatment** - using septic tank, trash trap or primary settling compartment *(manufacturer specifications/NSF certification)*
- **Aeration** - two types
  - suspended growth - floating in liquid
  - attached growth - attach to surface trickling filter or rotating disks examples
Pretreatment Tank
- Prior to ATU
- Trash Tank
- Built in
- Separate Tank

Suspended Growth

Attached Growth
### Aerobic Treatment Unit

<table>
<thead>
<tr>
<th>Incentives/Advantages</th>
<th>Disincentives/Addn. requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Much higher treatment (greater reduction in BOD and TSS)</td>
<td>• Operating expense</td>
</tr>
<tr>
<td>• Can extend drainfield life</td>
<td>• Requires electricity</td>
</tr>
<tr>
<td>• Reduced drainfield</td>
<td>• More frequent routine maintenance</td>
</tr>
<tr>
<td>• Replacement system in areas with chronic failing septic tanks</td>
<td>• Subject to upsets under heavy loads</td>
</tr>
<tr>
<td></td>
<td>• Less resilient to long periods of no use (starvation)</td>
</tr>
</tbody>
</table>

In addition, an operating permit and annual inspection by CHD required.

### Performance Based Treatment System (PBTS)

- Engineer Design
- Comparison/Differences to ATU’s
- Reduction in Sewage Strength and Nutrients
- Increased Lot Flows
- Reduction in Set backs
- Greater Reduction in Drainfield size than ATU
- Operating Permits
- Maintenance
- Monitoring and Sampling
- CHD Inspection - Annually
Performance Based Treatment System (PBTS)

- a specialized onsite sewage treatment and disposal system designed by a professional engineer with a background in wastewater engineering, licensed in the state of Florida, using appropriate application of sound engineering principles to achieve specified levels of **CBOD5** (carbonaceous biochemical oxygen demand), **TSS** (total suspended solids), **TN** (total nitrogen), **TP** (total phosphorus), and **fecal coliform** found in domestic sewage waste, to a specific and measurable established performance standard. This term also includes innovative systems. 

*Chapter 64E-6.025(10), Florida Administrative Code*
Additional Reference Materials

- EPA Design Manual – Onsite Wastewater Treatment and Disposal Systems, October 1980
  EPA/625/1-80-012
  http://www.epa.gov/nrmrl/pubs/625180012/625180012total.pdf

- EPA – Onsite Wastewater Treatment Systems Manual, February 2002
  EPA/625/R-00/008
  http://www.epa.gov/nrmrl/pubs/625r00008/html/625R00008.htm

- Florida Department of Health, Onsite Sewage Programs
  http://www.myfloridaeh.com/ostds/index.html

- Water Environment Research Foundation (WERF), Project Number 04-DEC-1,
  Influent Constituent Characteristics of the Modern Waste Stream from Single Sources, 2009
  http://www.werf.org/