

Standardized Testing Methods Alternative Wastewater Systems

**Steven DeHart B.S. / REHS
January 29, 2014**





Alternative Wastewater Systems



Early Flush Toilet Design

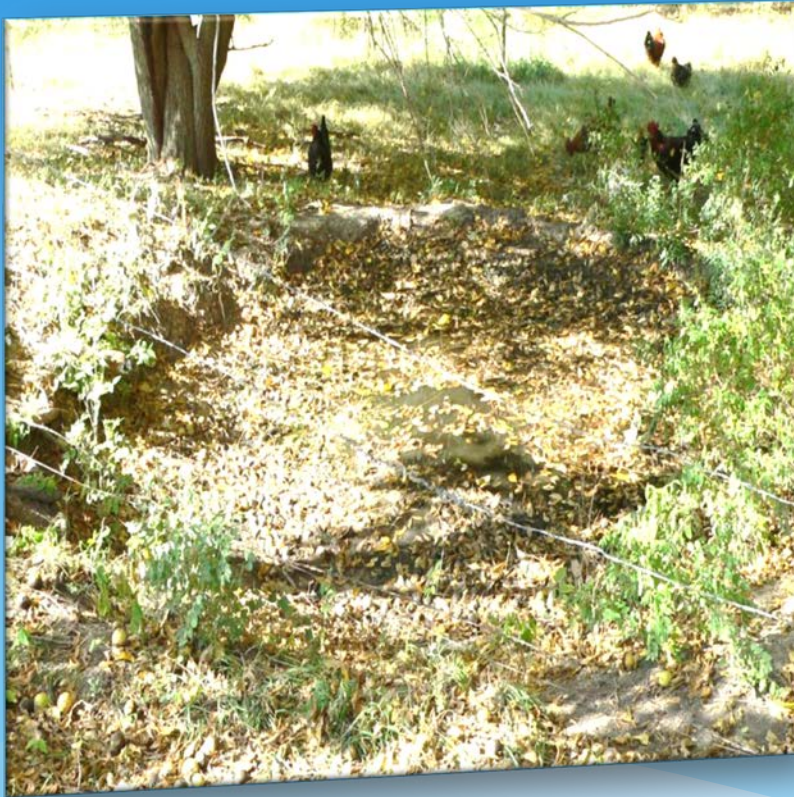
- **Alternative Wastewater systems are designed to meet the requirements for restrictive soils.**
- **Percolation values of 0 to 5 min/inch require an alternative system.**
- **Rates of 61 to 120 min/inch necessitate construction of a double lateral field, an alternative system or a lagoon.**

Riley County Alternative Treatment

- The first system was installed in 1994.
- This was an Experimental Sand Filter.



- Effluent testing requirements included sampling for Total Suspended Solids, pH, and Biochemical Oxygen Demand.



Free range chickens had been laying eggs for public consumption.

- Although required, few systems were tested.
- Compliance Rate varied from 1 to 3% during 1994 to 2009.
- Investigation revealed system failure due to the lack of regular maintenance.

Riley County Alternative Septic System



The Riley County Sanitary Code

*Riley County
Planning and Development*

Environmental Health

*Adopted
June 14, 1999*

Resolution 061499-22 & Resolution 013012-05

- The Sanitary Code was adopted in 1999.
- Homeowners were required to have their alternative systems serviced twice a year.
- Compliance rates did not change after adoption of the new code.

Factors Influencing Alternative Systems Non-Compliance

- **Designs often prevented maintenance.**
- **Contractors were not trained.**
- **Testing techniques were unreliable.**
- **A certified laboratory was not always available for time sensitive testing.**
- **Operation manuals often recommended listening for noise or smelling the system.**

Submitted Alternative System Maintenance Report

Leonard Backhoe Service, Inc.

32820 Hwy. K-18
Manhattan, KS 66502-1566
(785) 436-2860
Cell # (785) 556-2222

Date 3/18/04

Customer Pat Wyrbach
Address 3943 Wildcat Creek Rd
City Man. State Ks Zip 66503
Customer phone # _____

TERMS: Maintenance service performed on Aerobic Wastewater Treatment
Unit

UNIT # 00144 A.T.U.

DATE INSTALLED 2003

ITEMS CHECKED:

- #1 Clean filter ✓
#2 Check smell OK
#3 Check solid build-up in septic tank OK pump pump 3 yrs
#4 Check alarms OK
#5 Check chambers 3 Lines full out of 4
#6 Other comments _____

- Pat paid \$ 200 to have his system smelled twice a year to stay in compliance.

Leonard Backhoe Service, Inc.
32820 Hwy. K-18
Manhattan, KS 66502

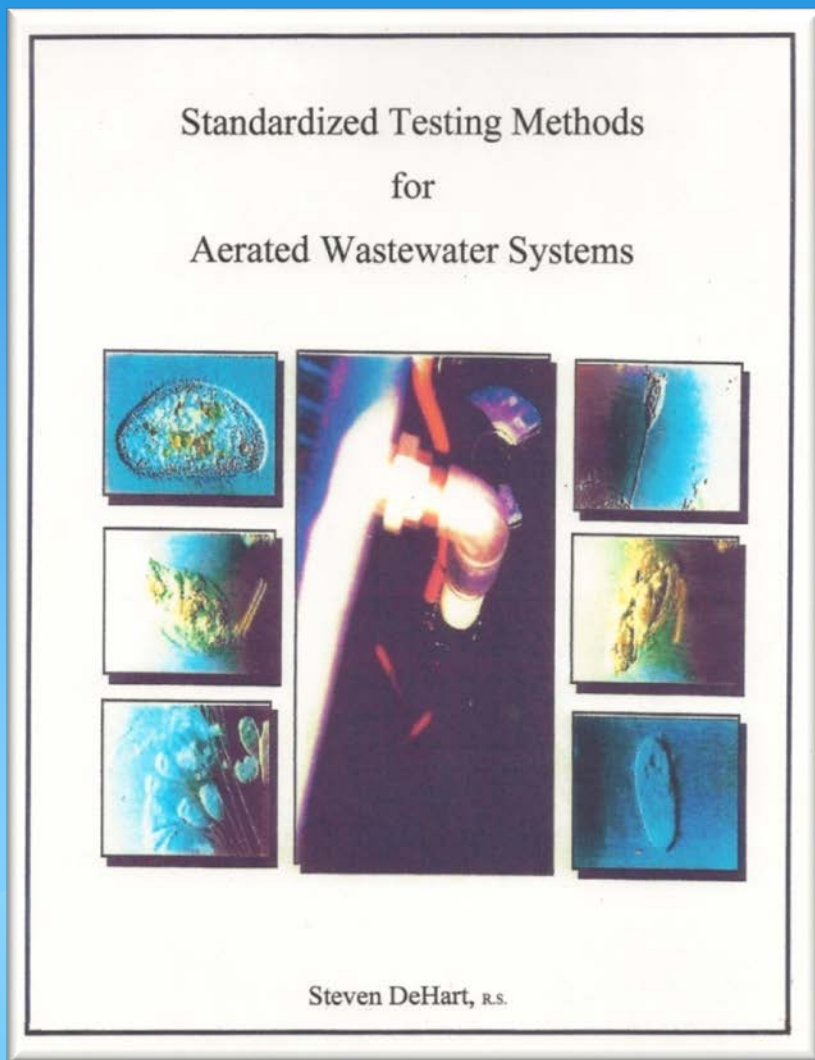
NOV 24 2008

Maintenance Check List on A.T.U.'s

Date: 11/26/08

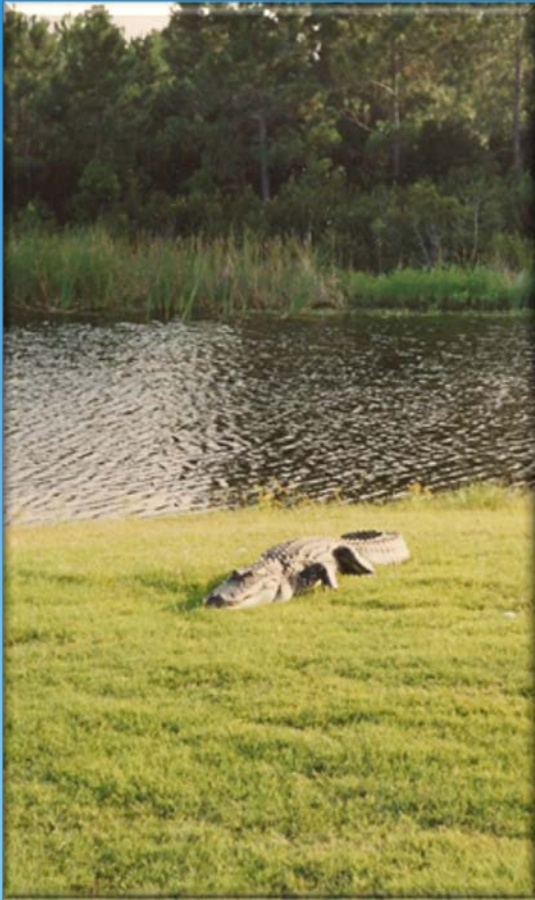
Name	<u>Pat Wyrbach</u>
Address	<u>3943 Wildcat Creek Rd</u>
Air Filter	<u>clean</u>
Check Smell	<u>OK</u>
Solid Buildup	<u>OK</u>
Check Chambers	<u>2 wet 2 dry</u>

Standardized Testing Manual



- A procedures manual was developed to provide testing methods.
- Contractors could now evaluate onsite to maintain the system's efficiency.

Special Contractors License Requirements



- **Alternative System Contractors are required to attend a special Riley County Environmental class.**
- **The class covers microbiology, testing methods, and reporting requirements.**
- **The Instructor works onsite to monitor and reinforce the new testing methods.**

Enforcement Phase

- A maintenance notice reminder was mailed in May of 2009 to each of the permitted owners.
- Those who did not respond received a **“Notice of Violation”** by certified mail.

RILEY COUNTY
PLANNING & DEVELOPMENT
June 15, 2009

Owner: Jason Born
Address: 100 South Dam Road
Manhattan, Kansas 66503

Monty R. Wedel, AICP
Director
110 Courthouse Plaza
Manhattan, Kansas 66502
Phone: 785-537-6332
Fax: 785-537-6334
E-mail: mowedel@rileycountyks.gov
Website: www.rileycountyks.gov/ehh

Notice of Violation
@ 100 South Dam Road

It has come to the attention of our office that the property listed below, which is owned and/or controlled by you is in violation of the Riley County Sanitary Code Regulations for an Alternative Wastewater System.

Section of Regulation(s): Article 3, Prohibited Practices, Section 2-3.1 b., Article 5, Section 2-5.6.2 a, b, c, & d.

Property Description: Tuttle Heights, lot 16, acres 1.6

Violation: The required Alternative Semi-Annual Inspection Report has not been filed at the Riley County Environmental Health.

Corrective Action Required:

1. A Riley County licensed alternative system wastewater contractor must inspect your wastewater system.
2. The contractor will submit a report and a signed maintenance contract to the Riley County Environmental Health within 30 days following maintenance.

You are hereby notified that you have 10 calendar days to have your alternative wastewater system inspected.

This violation must be corrected by: **June 29, 2009**

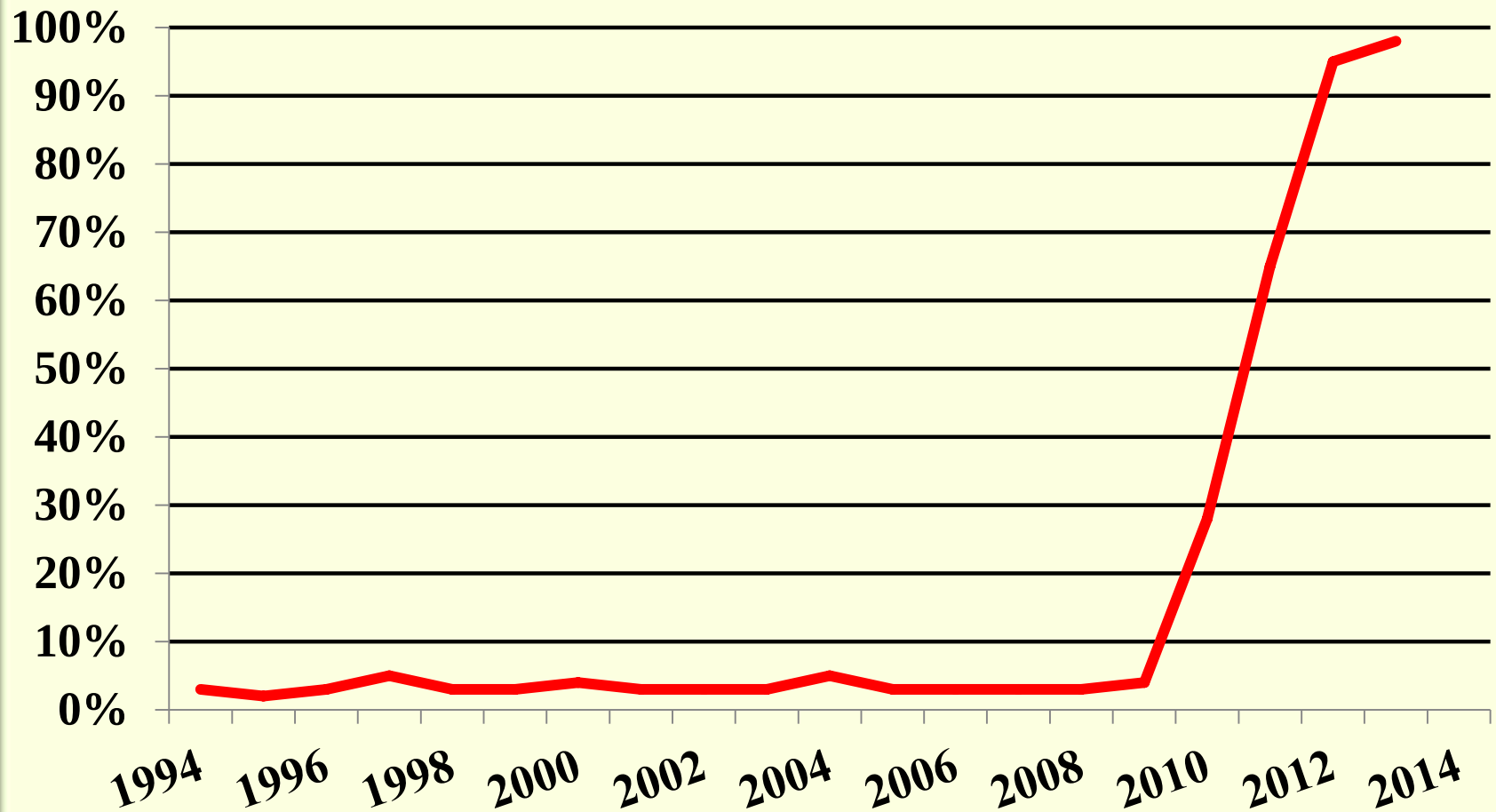
If you have any questions, please contact me at 785-537-6332.

Sincerely, *Steven DeHart*
Steven DeHart, D.S. / R.S. / REHS
Environmental Health
Riley County Environmental Health

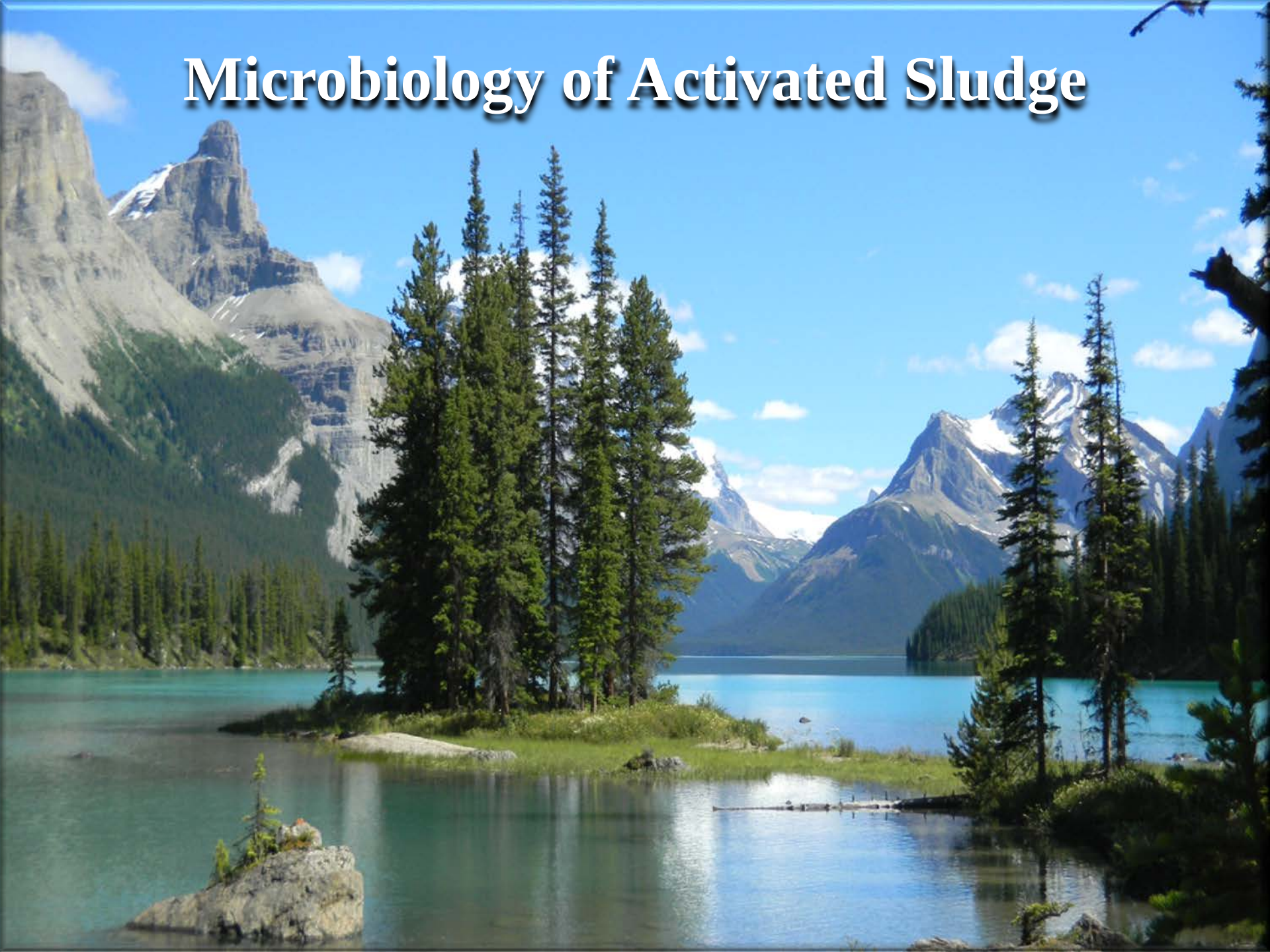
(Printed with 2009 Enforcement Files)

Riley County, Kansas

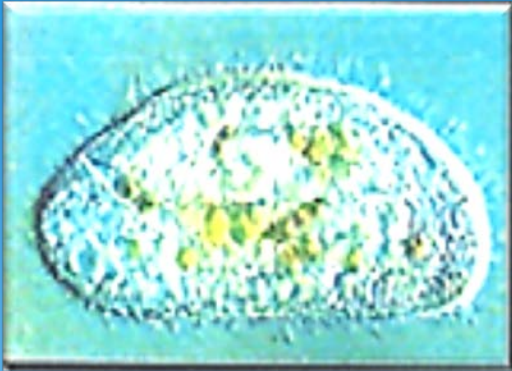
Compliance Rate for Alternative Systems



Microbiology of Activated Sludge

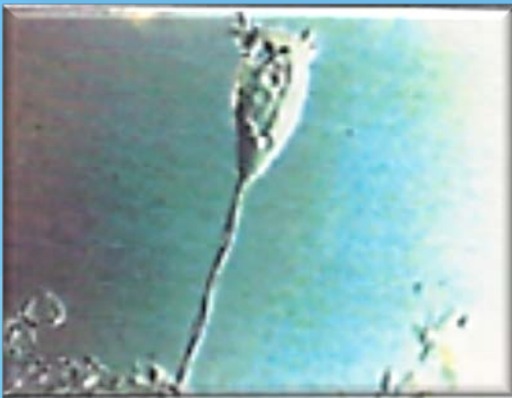


Indicator Organisms



Ciliate

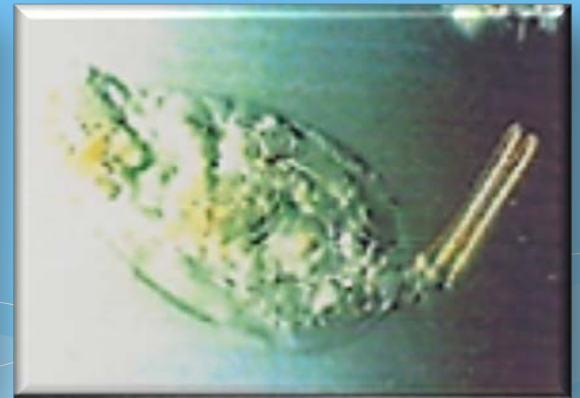
- Bacteria plus these “Bugs” make the alternative system function.
- They are indicators used to establish the “health” of the system.



Vorticella



Epistylis

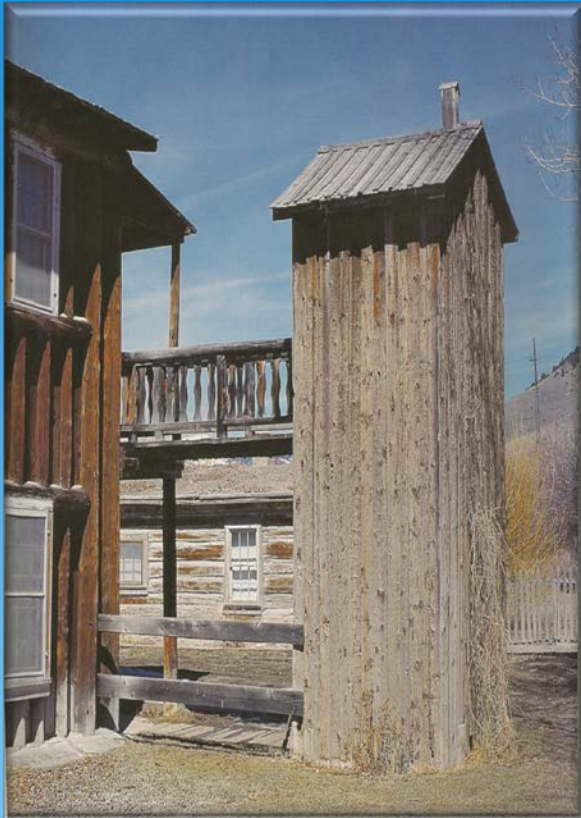


Rotifer

Activated Sludge is Diversified



- The process is a very dynamic environment.
- Approximately 65% is biodegradable organic matter.
- Once the optimum microbial population has been obtained, adding additional organisms does not decreased the effluent nutrient discharge.



- Typical domestic wastewater is approximately 200 – 240 mg/l Total Suspended Solids and BOD.
- When conditions are met, organisms will attack complex substances and reduce the compounds to simpler products until the final waste can no longer be used as a food source.

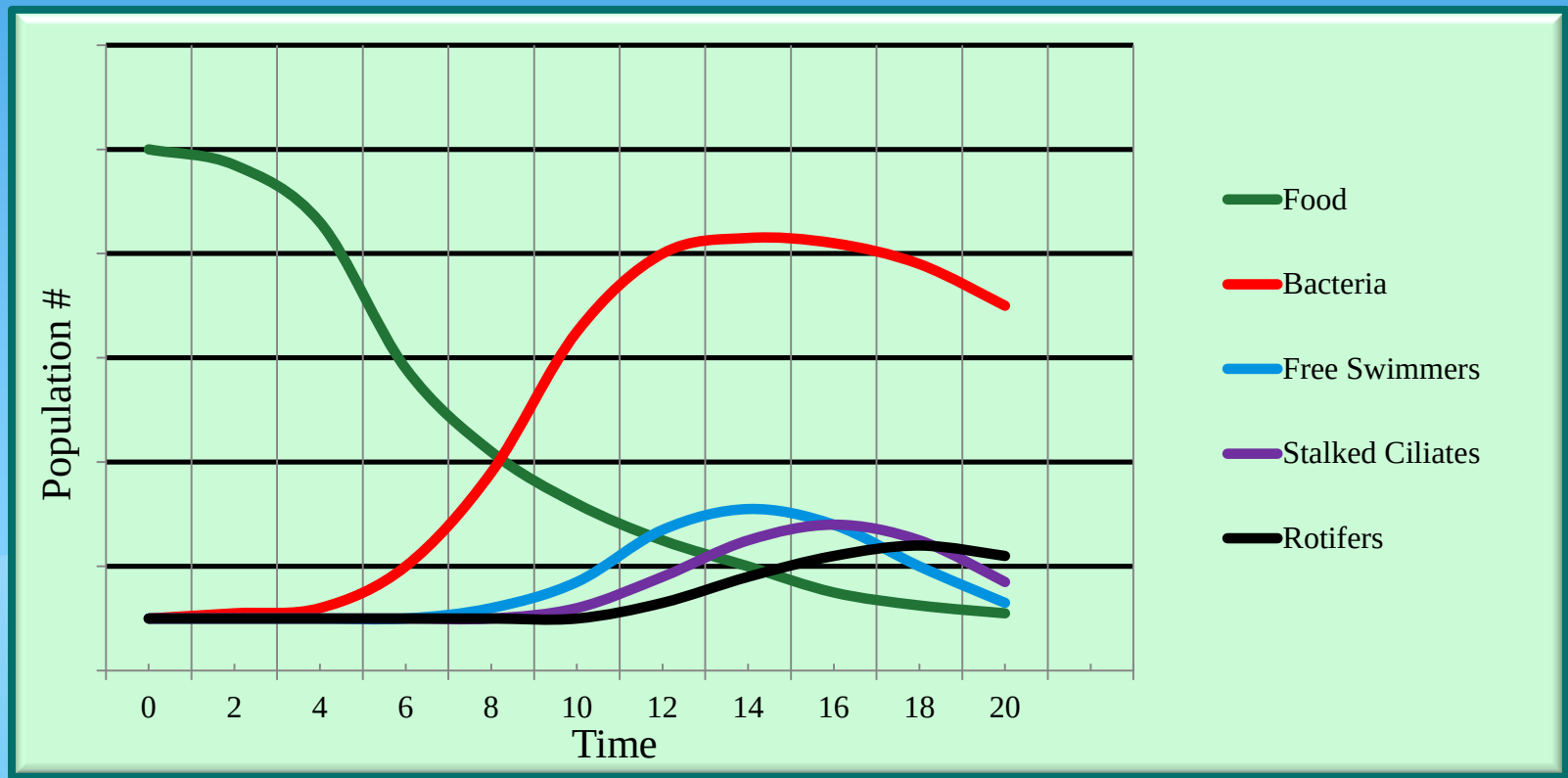
Essential Growth Factors

- **Nutrients consist of the essential building blocks that cannot be manufactured within the cell.**
- **Nitrogen, Phosphorous, Sulfur, Carbon, Potassium and Calcium are vital for survival.**
- **Iron, Nickel, Cobalt, Magnesium, Molybdenum and Copper are trace metals, also critical for cell growth.**
- **Alkalinity in the range from 200 to 300 mg/l, will buffer the treatment system from acid production.**

Optimizing Growth Factors

- **Sludge age (15 to 30 + days)**
 - It is the average length of time that the biomass stays in the system.
 - Bacteria and protozoa require sufficient time to establish themselves.
 - This can be several weeks to months depending on the organism and environmental conditions.
 - Crawling Ciliates show up after free swimmers and stabilize the particles by releasing a sticky mucus.

- A thriving ecosystem of ciliates, rotifers and other protozoans develops that aid in the process of flocculation.
- A decreasing food supply will directly limit the number of supporting microorganisms.





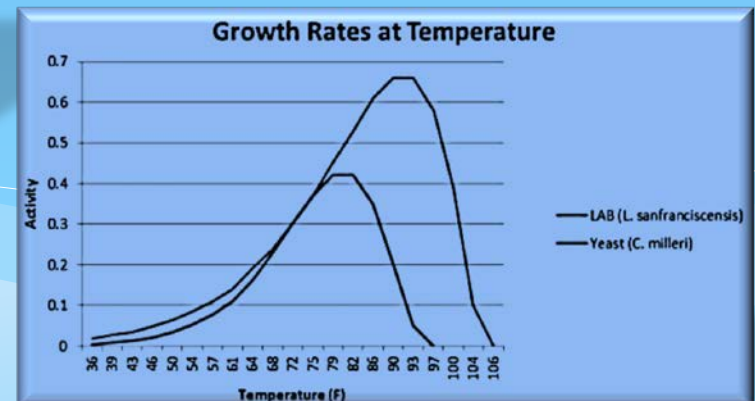
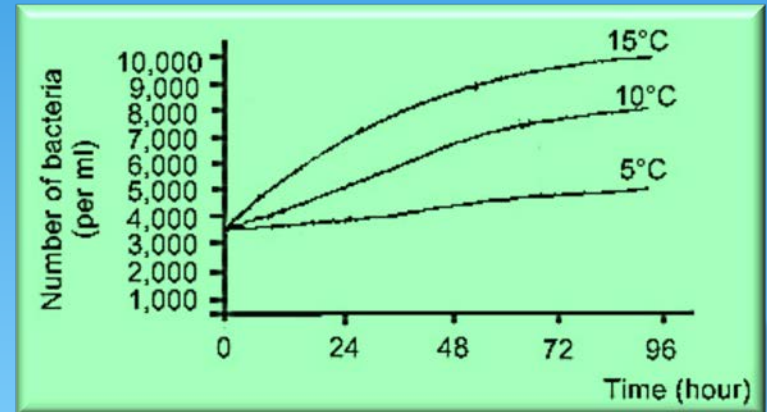
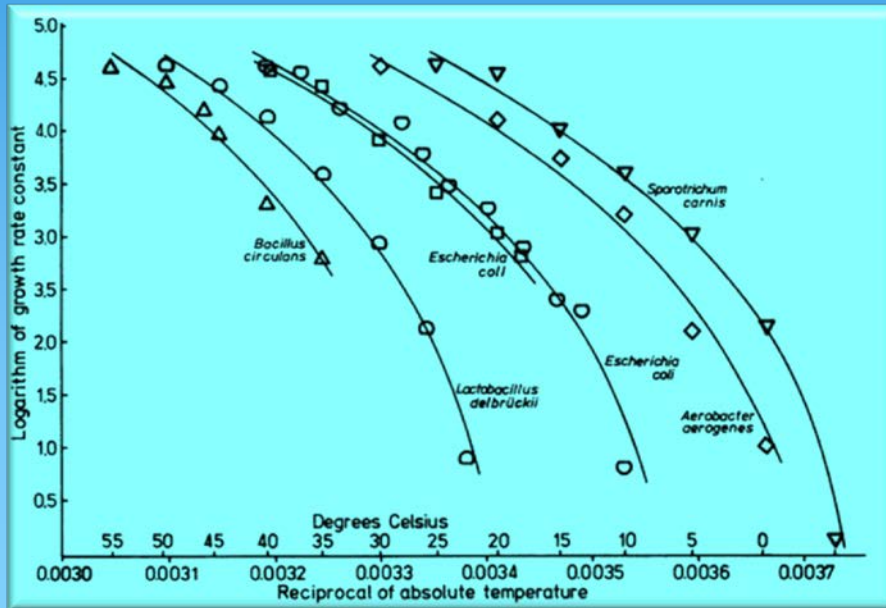
- **Bacteria in Activated Sludge have a dual role of oxidizing organic waste and providing a substrate for the settleable floc particles.**
- **The brownish floc-like material that forms, consists of 95% Bacterial growth and 5% Protozoa, Invertebrates and Parasites.**

- **During periods of low mixed liquor solids or initial start-up, a crisp white foam will form.**
- **This foam is often mistaken for detergent soap suds.**



■ Temperature (10 to 25 C)

- As temperature decreases, the bacterial reaction rates lower.
- Growth is restricted at lower temperatures.

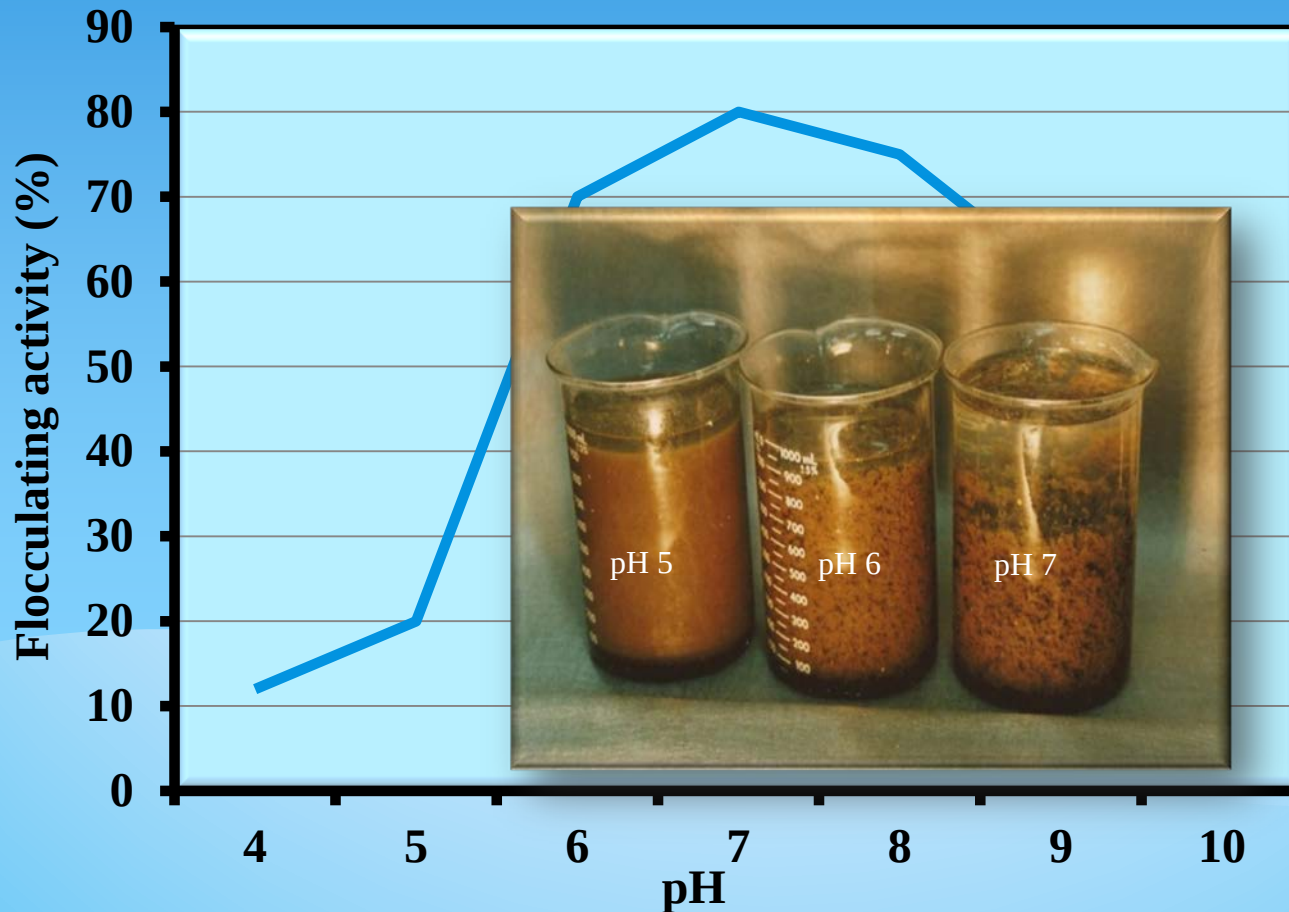


↔
Thermophiles
50C +

↔
Psychrophiles
-5 to 30C

↔
Mesophiles
20 to 40C

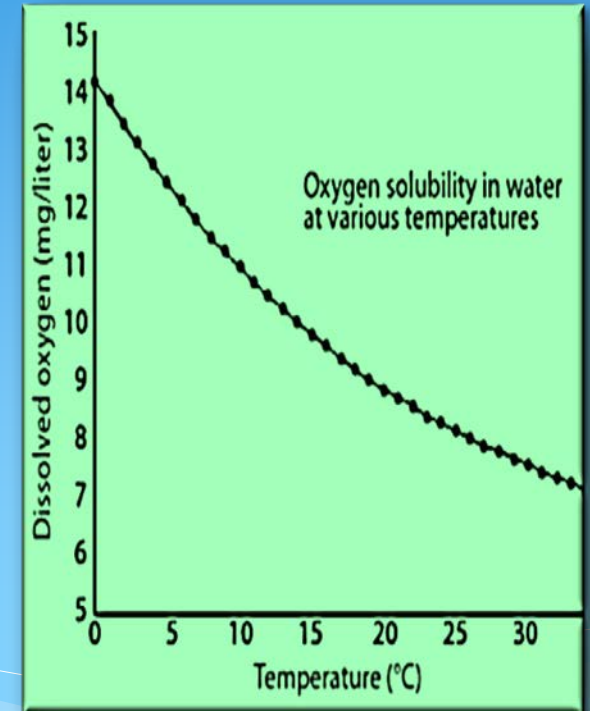
- **pH range is 6 to 10**
 - Below pH 5, the floc particles delaminate.
 - Organisms do not form a settleable floc.
 - Solids wash out.



- **Dissolved Oxygen (1.5 – 2.5 mg/l)**
 - **Efficiency of contaminant removal is based on the ability of microorganisms to compete for available food and oxygen.**
 - **Increased bacterial growth produces an accompanying elevated oxygen demand.**
 - **Oxygen levels below .5 mg/l for extended periods of time will cause a cloudy effluent and system failure.**

- Unfortunately, oxygen has limited solubility in water, thus only a finite amount of bacterial biomass can be supported in the facility.

C°	O ₂ (mg/l)	C°	O ₂ (mg/l)	C°	O ₂ (mg/l)	C°	O ₂ (mg/l)	C°	O ₂ (mg/l)
0	14.6	9	11.6	18	9.5	27	7.9	36	6.8
1	14.2	10	11.3	19	9.3	28	7.8	37	6.7
2	13.8	11	11.0	20	9.0	29	7.7	38	6.6
3	13.5	12	10.8	21	8.9	30	7.6	39	6.5
4	13.1	13	10.5	22	8.7	31	7.4	40	6.4
5	12.8	14	10.3	23	8.6	32	7.3	41	6.3
6	12.5	15	10.0	24	8.4	33	7.2	42	6.2
7	12.1	16	9.8	25	8.3	34	7.0	43	6.1
8	11.8	17	9.6	26	8.1	35	6.9	44	6.0



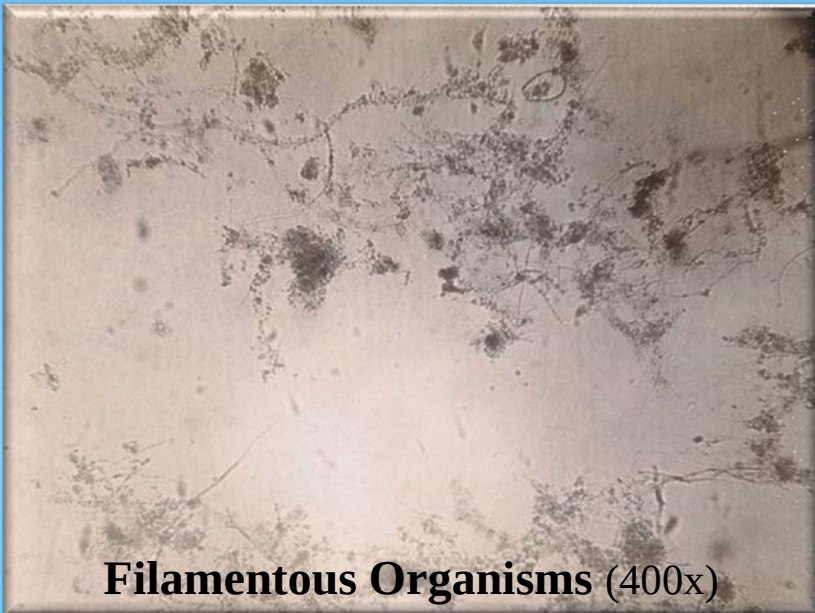
Highlighted Temperature Range (50 F to 77 F)

Effect of Lower Dissolved Oxygen



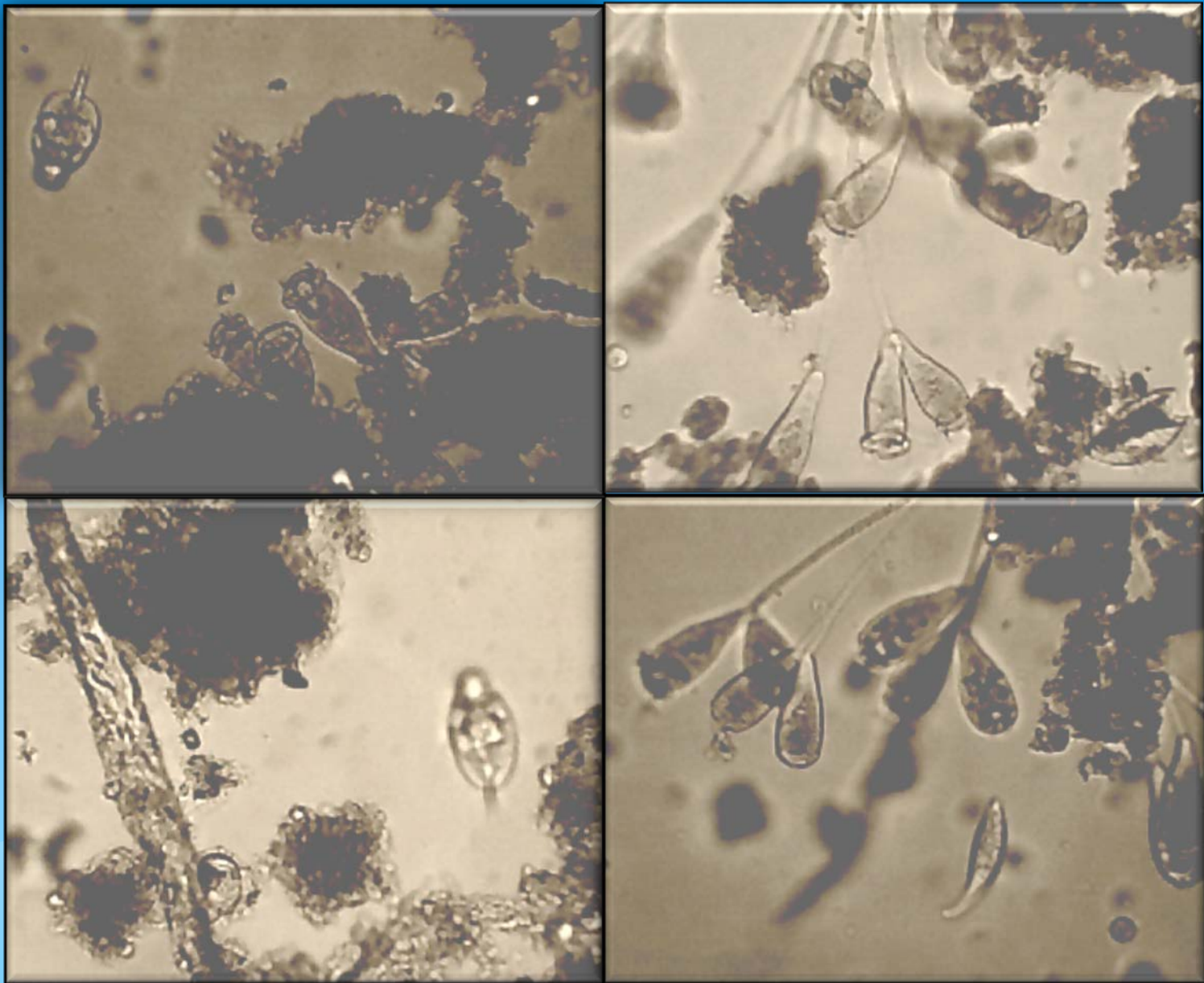
**60 minutes
(no settleability)**

- **Bulking Mixed Liquor is caused from excessive filamentous growth.**
- **This filament formation is a gradual process that is primarily caused by low Dissolve Oxygen levels.**



Filamentous Organisms (400x)

- **If the bulking condition is not rectified, excessive solids inventory will be transferred to the lateral field and may cause premature failure.**



(100 x)

Developing Testing Standards for Alternative Systems



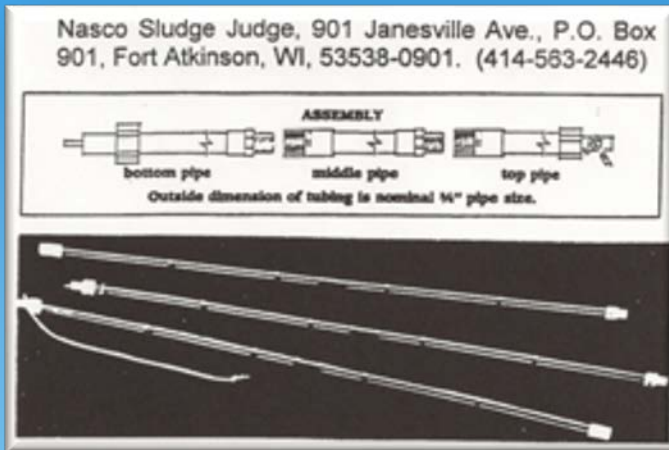
Aerated Wastewater Treatment Systems



- The goal is to discharge a high quality, clear effluent to the lateral field.
- $< 5 \text{ mg/l BOD}$
- $< 5 \text{ mg/l TSS}$

Sampling with a Sludge Judge

- Measures clarifier blanket depth
- Removes test samples from the aeration tank



Settleability Test

- Simulates the conditions in the clarifier.
- Requires a test container and a countdown timer.
- Mixed Liquor is sampled from the aeration basin.



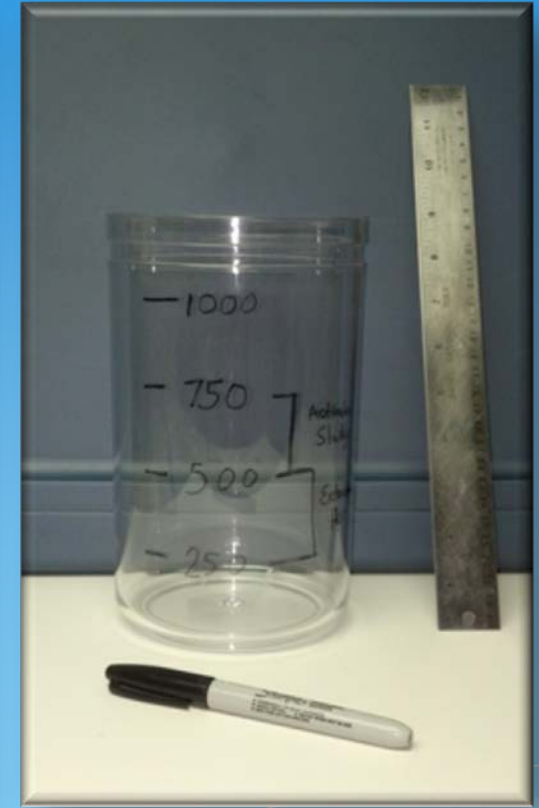
Making a Settleability Tester



Flour Canister
\$5.23

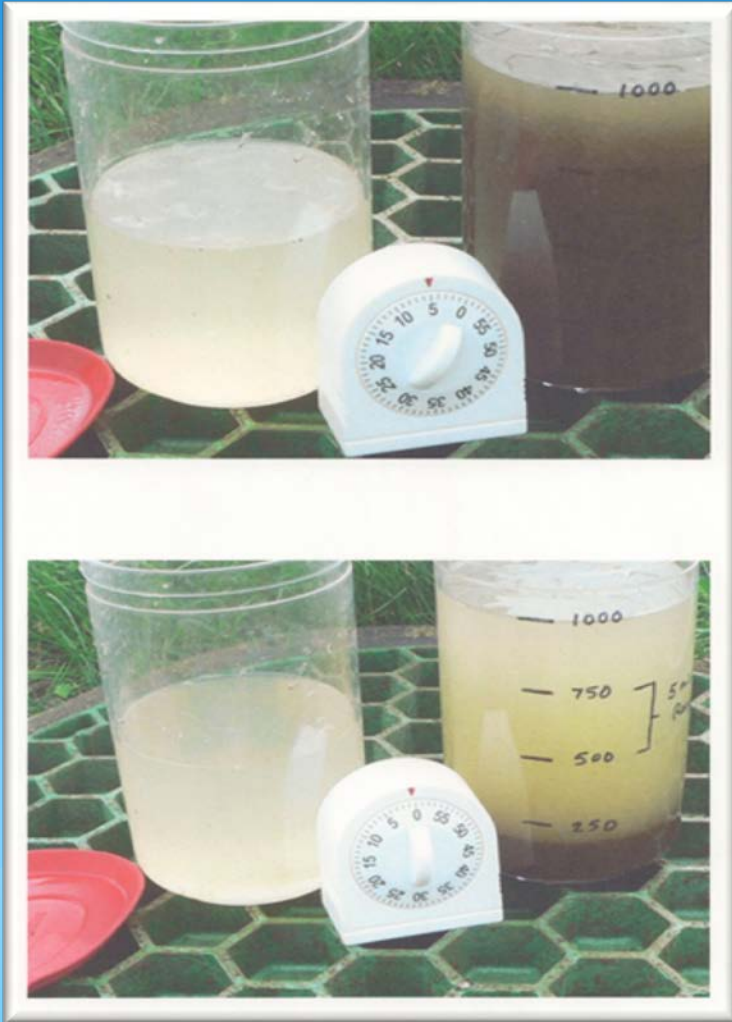


Remove the top lid
and hardware



Mark the container,
ready for use.

Conducting the 5 minute Settleability Test



- Gently mix the sample.
- Set the timer for five minutes.
- Record the level of flocculation drop.
- Extended aeration units will have a settleability between 250 and 500.

Determining Aeration Tank Pumping

- Fill one container with 100% Mixed Liquor.
- Fill the second container with a mixture of 50% Mixed Liquor and 50% Effluent.
- Mix both gently and start the 5 minute timer.



(100 % ML) (50/50 % Mixture)



(Effluent)

- **Allow to settle for 5 minutes.**
- **Observe both containers, record level readings.**
- **Determine the wasting necessary to improve performance and then pump accordingly.**



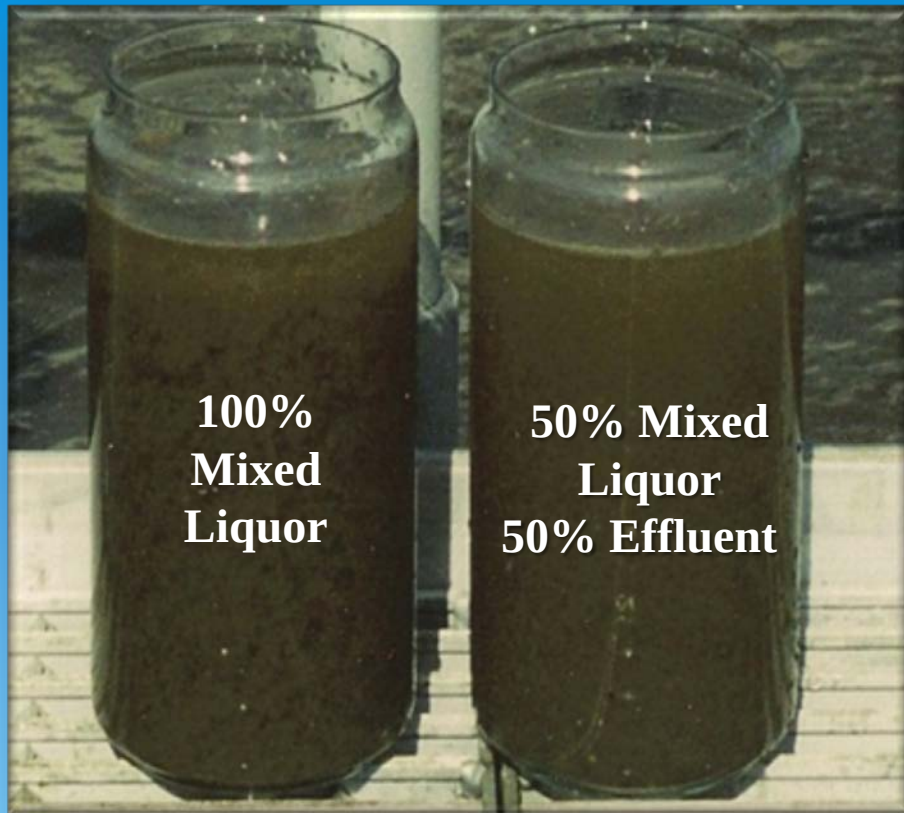
**100% Mixed Liquor
@ 5 minutes**



**50% Effluent
50% Mixed Liquor
@ 5 minutes**



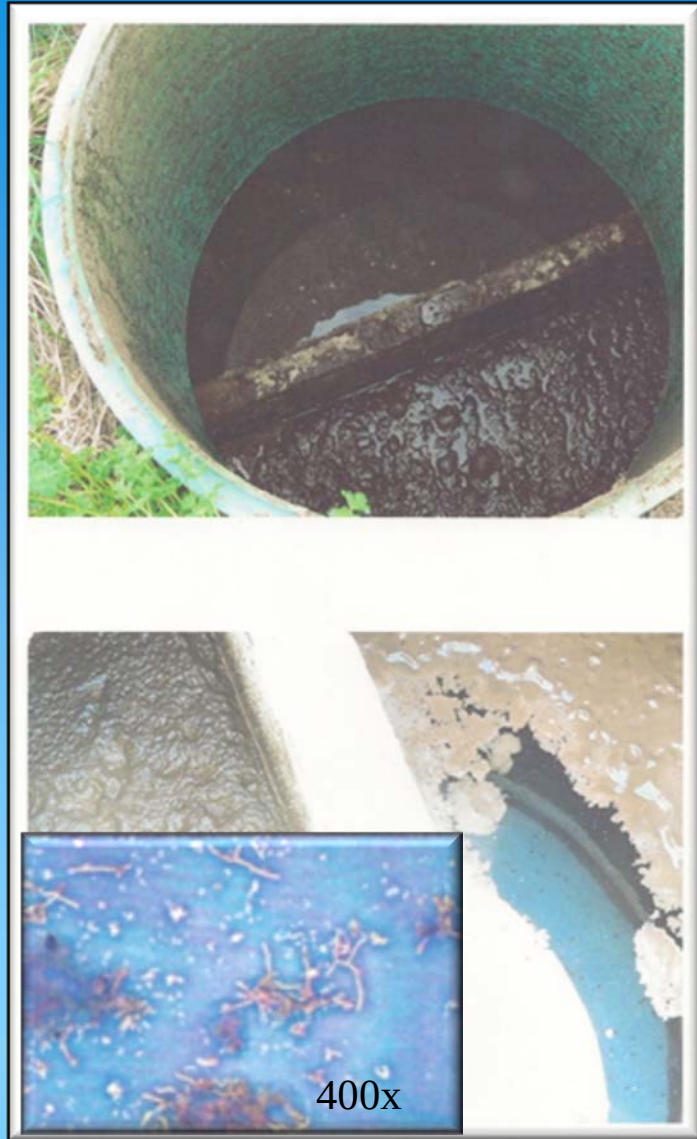
**75% Effluent
25% Mixed Liquor
@ 5 minutes**



- Pumping this tank would degrade the quality of the effluent.

- Testing Mixed Liquor from another system utilizing the 5 minute settleability test.





- Nocardia is a fungus-like organism that belongs to a group called Actinomycetes. Not quite bacteria and not quite fungus.
- They are found in the greasy, brown surface foams that form with long sludge ages.
- The organism will not cause any settleability issues.
- An important decomposer capable of digestion of lipids in the foam.

pH Testing in the Field



- pH paper provides an economical test method readily utilized in the field.

- Field meters are pocket-sized and can have three point calibration with automatic temperature compensation.



Dissolved Oxygen Testing



- Proper operation requires that the dissolved oxygen levels should be 1.5 - 2.5 mg/l.
- You can utilize a D.O. meter such as the one to the left.
- Another method is to examine a sample of the Mixed Liquor for floating Stalk Ciliate heads.

Clamp-on Amp Meter



- The amperage draw is recorded for the blower and pumps on the system.
- Voltage is checked.
- Ambient Temperature is also recorded.



Clamp-on Amp Meter and Voltage Tester



Alternative Maintenance Report

- In order to stay in compliance, this form is required semi-annually.
- A separate form is utilized for Sand and Shale filter systems.

Riley County Alternative Septic System Maintenance Report

Inspection Date #1: _____ Serviced by: _____
 Inspection Date #2: _____ Serviced by: _____
 Name: _____ Contact Number: _____
 Address: _____ Serial # _____
 _____ Permit # _____

Equipment	Yes	No	Results
Alarm(s) (Tested)			
Air Inlet Filter (Cleaned)			
Blower Amperage (amp)			
Blower Voltage (v)			
Temperature (C°)			
Biological			
5- Minute Settleability (ml)			
Aeration tank color			
Odor			
pH			
Dissolved Oxygen (mg/l)			
Sludge Judge (inches)			
Tank Requires Pumping			
Primary (settling)	Yes	No	If Yes, Then Date Pumped
Secondary (aeration)			
Lift station			
Septic System Overview			
Inspection Ports Checked	Yes	No	
Lateral Field Surfacing			
Tank Defective			
Septic System Requires Repair			

* Riley County Sanitary Code, Adopted June 14, 1999, by Resolution # 061499-22

** Alternative Septic Systems require additional maintenance every 6 months per your notarized agreement on file at the Riley County Register of Deeds.



**This alternative system
passed inspection six
months ago.**

**Livestock activity
destroyed the system.**

**Semi-annual maintenance is
the key ingredient.**





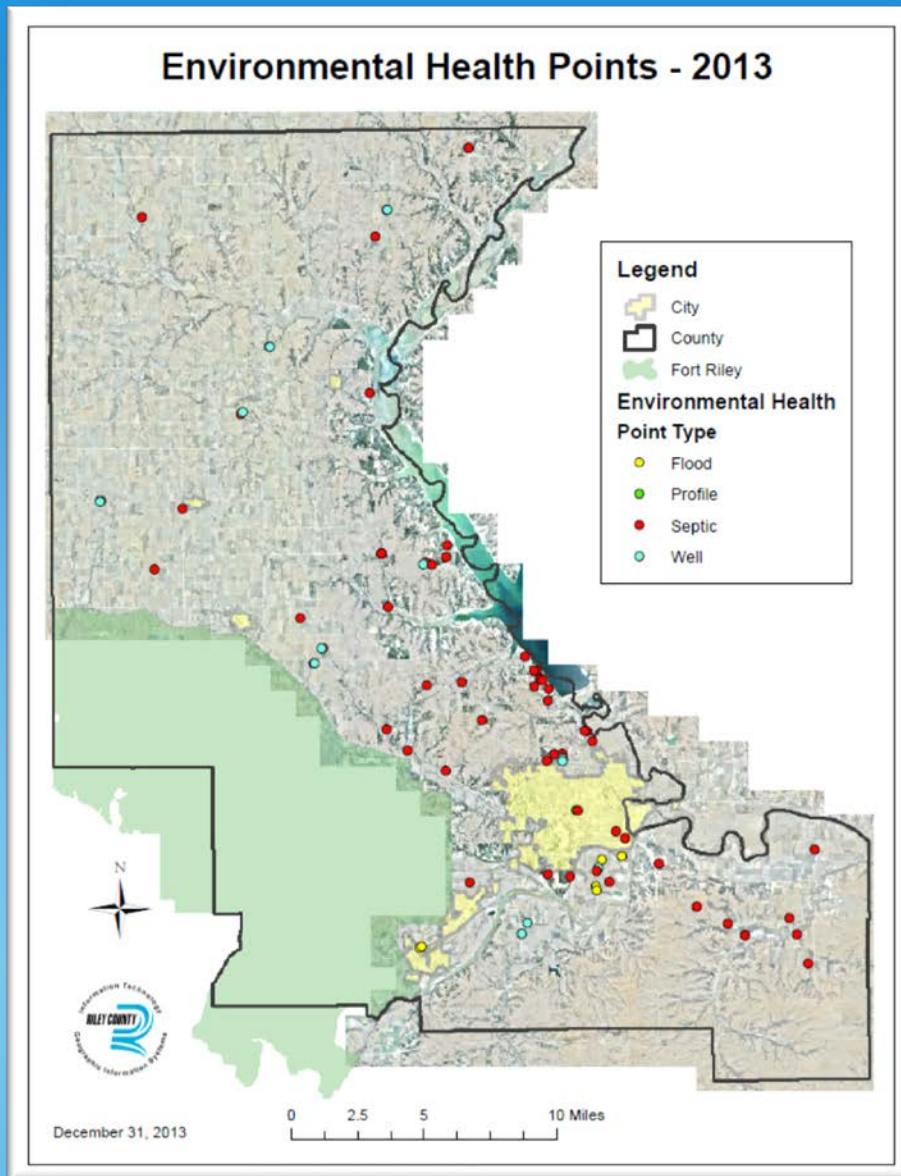
**This sand filter
was overflowing to
the ditch behind
the pump station.**

**The flush line was
filled with sludge.**



GPS in Riley County

- Septic systems and wells are now located and mapped.



Alternative Systems Applications



- Drip Irrigation
- Pre-treatment for a Standard Lagoon
- Pipe and gravel lateral fields
- Standard chamber lateral fields





Manhattan, Kansas



Treating Wastewater in the Flint Hills

- **Prairiewood Retreat and Preserve is located in the Scenic Flint Hills of Kansas.**
- **Public sewer was not available.**
- **Soil percolation exceeded 120 min./inch.**
- **A standard lagoon was proposed to handle the variable loading and peaking rates common with a resort.**
- **Owners of this premier destination wanted more than just the minimum treatment requirements.**

- **A treatment design was developed that supported their conceptual vision:**
 - **Protecting the native tall-grass prairie preserve that surrounded the retreat.**
 - **Providing exquisite environmentally low impact accommodations for their guests.**



- **An alternative wastewater system was selected that removes 95% of the loading demand before discharging to the lagoon.**
- **Today the clear and odor free lagoon looks like a pond and could be stocked with fish.**



Questions ?

Steven DeHart B.S. / REHS
Riley County Planning and Development
Environmental Health

