

FIRST DISTRICT HEALTH UNIT
Regional Public Health Agency

Troubleshooting Septic Tanks



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ORGANIC MATTER → **BACTERIA**

CO₂
CH₄
H₂S
NH₃


GASES + HUMUS

Septic tank should smell "septic" when you open the lid

Anaerobic Digestion

Anaerobic Microbes

- Anaerobic bacteria grow in absence of free oxygen, O₂
- Most anaerobic organisms are bacteria
- Anaerobic treatment processes split oxygen bound,
 - Ex. SO₄: →H₂S, NO₃ → N₂
- Common condition in:
 - Septic tanks,
 - Processing tanks,
 - Constructed wetlands
 - Other saturated environments



Anaerobes Cont'd

- They are not able to get as much energy from their food
- Advantages:
 - Microbes that do not require oxygen are able to live in places where aerobes cannot survive,
 - human gut,
 - any other places where oxygen is in low supply (SEPTIC TANK)
 - For pathogenic microbes is a HUGE advantage
 - allows anaerobic pathogens to cause disease in areas of the body and environment that are not exposed to oxygen

Locating the Tank

- Downhill from house
- Locate roof stack
- Impression
- Different shade of grass
- Landscaping



Locating Tools - Prototek

- AR-1 - "Ardy"**
 - Nonmetallic lines
 - Analog receiver locates tanks and nonmetallic lines
 - Flushable Transmitters
 - ~\$650
- FR-1 - Ferris**
 - Cast iron & nonmetallic
 - Locates in cast iron and nonmetallic lines
 - \$750



www.prototek.net
800.541.9123

Locating Toils - Camera

- Probe
- Small diameter access
- Manhole access





Tough to Check



Evaluate Conditions

- Odors
- Secure caps
- Secure lids
- Accessibility
- Depth



Conditions at the Tanks

Problems: Could make system a public safety issue



Settling



Tank Access

- At-grade
 - Recommend secondary constraint?
- Buried
 - Recommend risers to grade?



Evaluate Risers

-  STAINS


Current Operating Level

- Above the outlet elevation
 - Effluent screen plugged
 - Soil treatment plugged
 - Pump broke
 - Alarm?




Current Operating Condition

- Below the outlet elevation
 - Leaking
 - Pumped recently



Baffles and Screens

- Plugging indicates use issues or construction problems
- Designed to only let water in clear zone to pass
- Indicates system upsets
- Need to have proper slope and drop




Is it Plugged?



Blocked Baffle




Indication of Problems



Effluent Screens

- Placed in outlet of septic tank for additional filtration
- Remove solids
- Requires periodic cleaning
- The need for frequent cleaning is an indication of overloading



Checking from the Surface



Operation Test


- Flush all toilets once and run all fixtures to determine that they flow into treatment tank
- Introduce water into the system at the rate of 3-4 gpm (this is the flow of one spigot fully opened) for 20-30 minutes
- Observe level of water in septic tank

Water Meter




Checking Sludge and Scum

- Use sampling probe (Sludge Judge, Dip Stick, etc)
- Should be three distinct layers if functioning properly
- Need to maintain 2 day HDT between solids layers




Sludge Levels

- Indicates amount of settling in tank
- Heavy accumulation means excess inputs (garbage disposal?)
- Color should be black = anaerobic
- Yellow or brown can indicated chemical usage



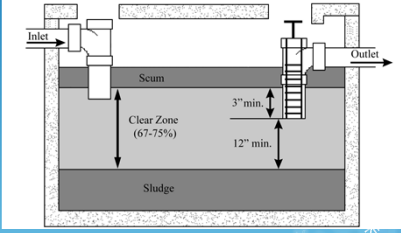
Scum in Tank

- Heavy accumulation could be from:
 - Fat, oils and grease
 - excessive paper product usage
 - Color should be noted




When to Pump the Tank?

- 25 - 33 % of working volume of tank
- High risk pump more often



Pump Through the Manhole

- Tanks shall ONLY be pumped from/through the manhole/access port of each tank or tank compartment



Observe

- Lid
- Walls
- Listen for running water
 - Inlet
 - Outlet
 - Sides



Tanks Must be Watertight



- Exfiltration could release untreated sewage deep in the soil
- Infiltration may occur
 - Disrupt settling
 - Overload drainfield or downstream components



Possible Points of Leakage

- Weep holes at the base of the tank
- Mid-seam joint
- Inlet/outlet pipe penetrations
- Top-seam joint
- Tank top/access riser joint
- Access riser/lid joint
- Any damaged, improperly-formed location or area where material is too thin

Problems - Roots



- Structural
- Back-up
- Leaks

Leak at Mid-Seam



Tank Structural Condition

- Check for:
 - Rebar exposed
 - Corrosion




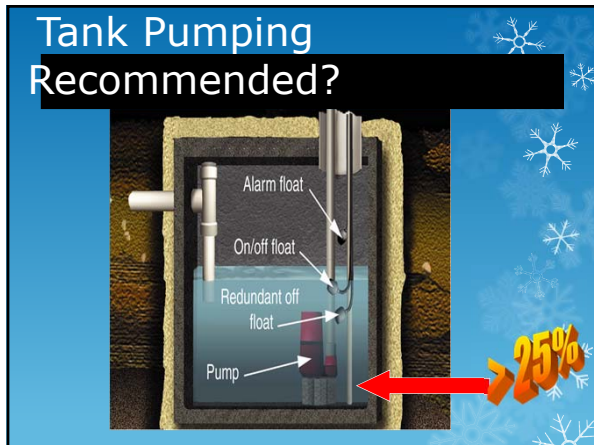
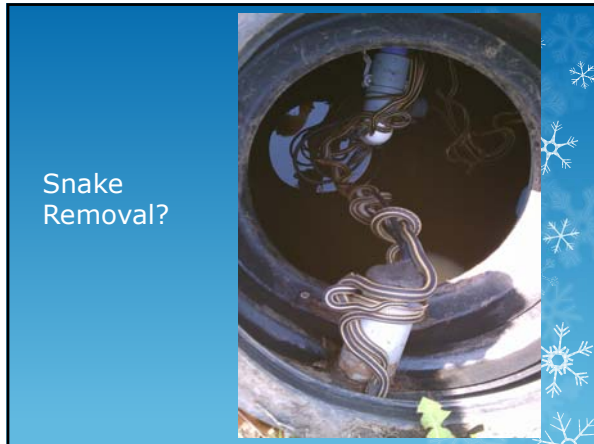
Corrosion in the Tank

- High sulfur levels in water
- Hydrogen sulfide produced in septic tank
- Lack of venting
 - Tank
 - Piping
 - Plumbing



What Wrong with this Tank?

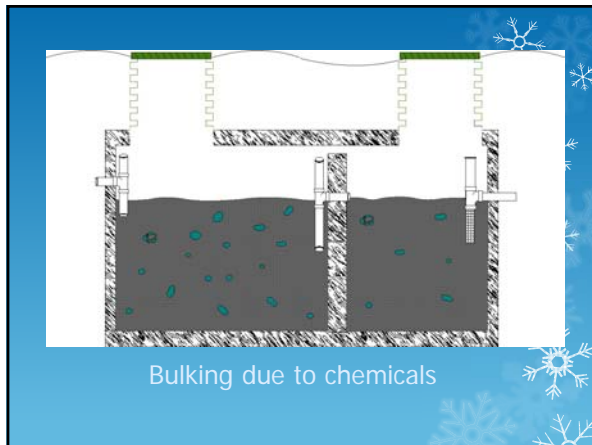
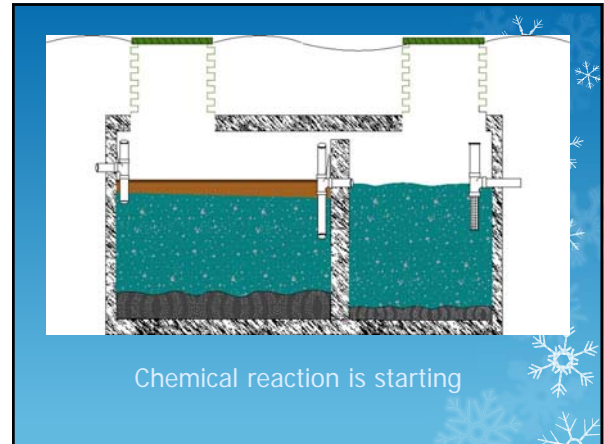
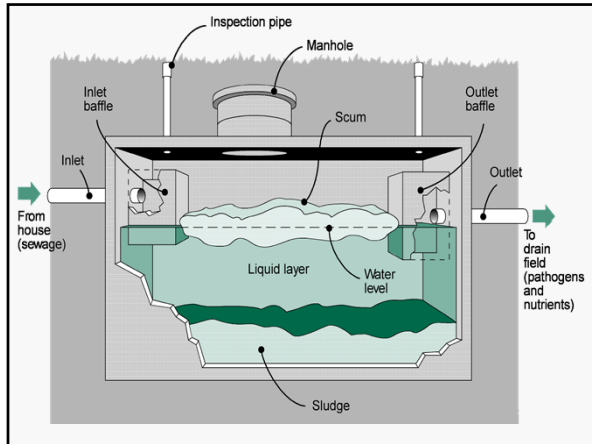




- ### Process of Troubleshooting Tanks
- Identify that septic tank does not look normal
 - Off look or smell to tank?
 - Tank not have three distinct layers?
 - Sludge or scum too thick
 - Effluent filter plugging up routinely?
 - Interview owner/user of system
 - Use issues
 - Homeowner/troubleshooting survey
 - Antibacterials
 - Medicines
 - Cleaners

- ### Factors That Influence Anaerobic Digestion
- pH
 - Chemicals
 - Temperature
 - Highly variable flow patterns
 - Pharmaceuticals
 - Heavy inputs
 - Lack of tank maintenance
-

- ### Troubleshooting Septic Tank
- Determine last date of tank pumping
 - Determine amount of sludge and scum
 - Get profile of tank layers
 - Get lab analysis to determine how "sick" the tank is
 - BOD and TSS
 - FOG only if commercial or a lot of FOG visible
-



Tank Start-up with New Systems

Run in the first 1-3 months

- Toxic tank
- Cleaning Chemicals
- Construction Chemicals
- Other Outcomes
 - First time on septic- Education on use
 - Understanding the need for maintenance

Leaks & Clean Water into Tanks

- Leaks
 - In home
 - Drips
 - A 1/2 gallon per minute leak results in 700 gpd!
 - In system
 - Leaks into tank/risers
- Extras
 - Footing drains
 - Sump pumps
 - Roof leaders
 - Treated water
 - Pools
 - Hot tubs
 - Water treatment devices
 - Water softener
 - Iron filter
 - Reverse osmosis, etc

Mixing of Tank

- Reasons
 - Leaks/clean water
 - Peak use
 - Multiple shower heads
 - Cleaning day
 - Entertaining
 - Pumping to tank
 - Elevation difference
 - Upstairs laundry or large bath tub
- Solutions
 - Control usage
 - Increased tank capacity
 - Effluent filter
 - Controlling loading
 - Timer control

Extra Water and Waste Producers

- Garbage disposal including many dishwashers
 - More food
 - More water
 - Slower to breakdown
 - Slower to settle
- Grinder pumps in the basement
- Jacuzzis




Monitoring

- Sampling
 - Timing –after busy weekend
 - Mature tank
- Location
 - Average – Pump tank
 - Outlet baffle of last tank
- Test
 - Sludge and scum
 - BOD
 - TSS
 - FOG
 - Temperature
- Cost ~ \$100 for BOD/TSS/FOG
- Time



Venting

- Vents by septic tanks may be required
- No adequate way to vent back through plumbing stack
- Release hydrogen sulfide and methane naturally produced in septic tank



Odors in Yard

- Can get caught under roof overhangs
- Wind patterns can limit odor traveling away from home
 - Valleys, forested areas, low areas, etc
- Vent on home can be extended
- Carbon filters can be added on end
 - Be careful of blockage
 - Last 1-5 years





Outdoor Odor Problems

- Odors near septic tank
 - Manholes and riser secure?
 - Cover with soil or mulch
 - Seal with weather stripping
 - Sick septic tank?
 - Excessive chemical use in tank or lack of maintenance can effect odor
 - Pump tanks, reduce chemical usage




Odors Continued

- Odors near pump tank
 - Tank lid secure
 - Electrical conduit sealed?
- Odors near soil treatment units
 - Surfacing effluent
 - Vent pipe open



Odors in House?

- Dry traps
- Bad seal on grinder/ejector pump in home
- Blocked plumbing stack
- Improper venting
- Sewage back-ups



Septic System Additives

- Not been proven to be beneficial to system performance
- Not recommended
- Potential to break up particles that are settled at the bottom and make them suspended
- Potential solids loading to downstream components



What are we adding to our water? Expensive urine?

COUNTERTHINK

EXPENSIVE URINE

PROZAC : \$143	QUALITY MULTIVITAMIN : \$28
LIVITOX : \$129	SUPERFOOD SUPPLEMENT : \$45
BLOODREN : \$83	MEDICINAL HERBS : \$75
VASOTEC : \$64	FRESH PRODUCE DAILY : \$225
PLENDIL : \$85	AGED GARLIC EXTRACT : \$13
CHEMOTHERAPY : \$1,350	OMEGRANATE JUICE : \$60
\$1,854 PER MONTH	\$446 PER MONTH

CONCEPT- MIKE ADAMS ART- DAN BERGER www.NATURALNEWS.COM

Pharmaceuticals and Personal Care Products (PPCPs)


- Many pharmaceuticals and other chemicals have been introduced and new chemicals are introduced into the environment every year
- The environmental fate and impact of most of these chemicals are not fully understood, especially at low levels of concentrations
- Many of these new & old chemicals are not routinely monitored or assessed

PPCPs continued

- Including a wide suite of human prescribed drugs (e.g., antidepressants, blood pressure)
 - Over-the-counter medications (e.g., ibuprofen), bactericides (e.g., triclosan), sunscreens, synthetic musks
- 10% to 70% of medications and vitamins pass through the body and are excreted through urine
- Veterinary medicines such as antimicrobials, antibiotics, anti-fungals, growth promoters and hormones

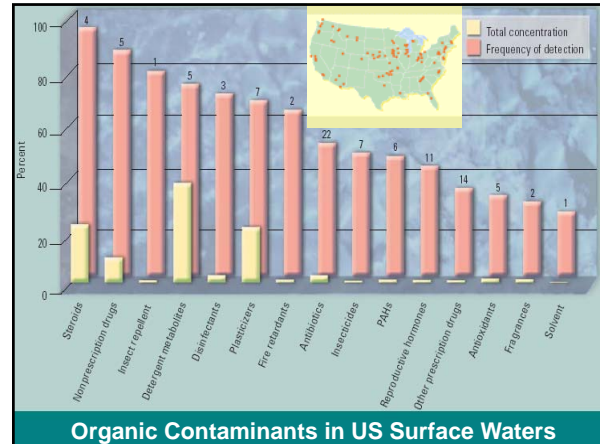
How Widespread is the Problem?

Endocrine disrupting compounds and other pharmaceuticals observed in streams and wastewater treatment plant discharges in the US, Europe, & Asia



Surface Water Study

- Sampled downstream of urban areas, intense livestock areas, WWTPs
- Sampled for 95 WW chemicals
- 139 streams across US from 30 states
- Found in 80% of samples
- 82 of 95 found



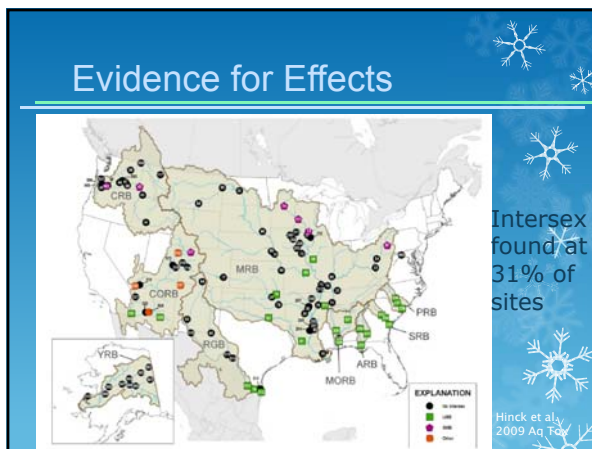
Drinking Water Study

- 19 utilities serving 138 million people
- 2006-07
- 55 chemicals – found 11 most frequently

Survey of 19 US Drinking Water Utilities

- Atenolol - betablocker
- Atrazine - herbicide
- Carbamazepine - anticonvulsant
- Estrone - hormone
- Gemfibrozil - antilipidemic
- Meprobamate - antianxiety
- Naproxen - anti-inflammatory
- Phenytoin - anticonvulsant
- Sulfamethoxazole - antibiotic
- TCEP - flame retardant
- Trimethoprim - antibiotic

Benotti et al. ES&T 2009



Potential Sources of PPCPs

- Combined Sewage Overflow with direct discharge of raw sewage
- Confined Animal Feeding Operations,
- Municipal landfills leaching,
- Waste Treatment Plants, large to small
- Sewage discharge from cruise ships (millions of passengers per year)

....and where do they come from?

- Personal care products
- Detergents
- Industrial discharge
- Residential wastewater
- Agriculture






General Issues, The Dirty Dozen & Safer Alternatives

Microbes Minimal Requirements

- Temperature must be life-sustaining
- Steady supply of food to maintain stable microbial population
- pH needs to be controlled
- Limited biocides

Cleaning Products

- Problems
 - Sanitizing
 - pH impacts
- Antibacterial
- Raises owner awareness
- They have **cumulative** effects on system performance

Cleaning Product Labels

- **DANGER:** Means the chemical will kill the bacteria, and its use should be minimized or eliminated
- **WARNING:** Means limited use should have a minimal impact on the system
- **CAUTION:** Typically means the product will have little effect

1. Liquid Fabric Softeners



- Petroleum based
- Often contain quats
- Adds additional salts to the water used on laundry
- Should not be used
- Emulsification of tank
- Recommendations:
 - Add a 1/2 cup of baking soda
 - Drier balls
 - Add a cup of vinegar
 - Anti-static - aluminum foil ball technique

2. Bath and Body Oils

- Increases oil and grease
- If usage is great, may need more maintenance
- If levels get high enough can create toxic environment for microbes
- Recommendation: Limit usage



3. Drain Cleaners

- Toxic drain cleaners can impact ability to properly treat wastewater
- Affect bacteria activity
- Recommendation: Use a plunger, metal snake, or remove and clean trap



4. Toilet Cleaners

- Most are toxic, harsh cleaners
- Read the labels
- Automatic cleaners
 - Not recommended
 - Continual impact causes long-term problems
- Recommendation: Sprinkle on baking soda or Bon Ami, then scrub with a toilet brush
 - Bon Ami is non-scouring, biodegradable, nontoxic and hypoallergenic



5. Spray Shower Cleaners

- By spraying or at the push of a button the shower cleaner will spray a cleaning mist, and remove soap scum, mildew and other buildup from your shower walls
- Daily dose of sanitizer and emulsifier
- Recommendation: Sprinkle baking soda on a damp sponge or add 4 Tbs. baking soda to 1 qt. warm water or use Bon Ami



6. Degreasers

- At home, limit use of dishwashing soaps
- In a restaurant, should be avoided
- Recommendations:
 - Use distilled vinegar
 - Make a baking soda paste to cut grease



7. Quaternary Ammonia

- Typically known as "Quats"
 - Many individual chemicals
 - Present in thousands of end-use formulations, many of which are blends of various Quats
 - Varying levels, some are worse than others
- Common uses include disinfectants, surfactants, fabric softeners, antistatic agents, and wood preservation

Quats in Wastewater



- Exponential increase in use
 - 1993 - Jack in the Box e coli incident; Four children die and many more became sick in Western states
 - Quat use in sanitation subsequently became more prevalent
- Problems
 - Attitude of more is better
 - Shock use on weekends during low flow conditions
 - Spills or dumping

More About Quats

- Compounds are very stable and hard to break, so has long lasting biocidal effect
- Certain quats will biodegrade
 - Biodegradation poor under anaerobic conditions
 - Biodegradability of QACs under aerobic conditions
 - 90% removal cited in literature
- Toxic/Inhibitory to Nitrifying Bacteria - in concentrations < 2 mg/l

Testing Quats



- Test strips: Hydrion, LaMotte, EM Quant
- Hach has a low range test kit for levels up to 5 ppm
- Potentiometric titration most accurate; ASTM Method D5806-95 for Quats used as disinfectants

Quat Alternatives

- In home disinfectant - Use borax: 1/2 cup in a gallon of water; deodorizes also
- Commercial sanitizing is done by either a chemical or with high temperature
 - Chlorine
 - 165 degrees F

9. Prescriptions Drugs

- Average American fills 12 prescriptions each year
- On average, people age 45 and older say they take four prescription medications daily

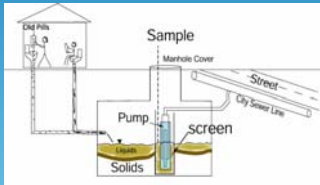


Prescription Drugs and Antibiotics

- Can kill microbes living in system
 - Won't discriminate against organisms living in the system
- Additional treatment components may be necessary
- Increase maintenance

Antibiotics and Similar Meds

- Antibiotics are not selective in which bacteria are killed
- While antibiotics help a patient by killing harmful bacteria, the medicine often kills good bacteria also
- Recommendations: Use them only when needed, dispose of unused ones properly (Do NOT flush)



National Drug Take-Back Day



- According to a press release from The US Department of Justice in May, the fourth national drug take-back day (last spring) collected a record 276 tons of prescription drugs

10. Antibacterial Soap and Products

- Antibacterial ingredients have been added
- These chemicals kill bacteria and microbes but are **NO** more effective at deactivating viruses than any other kind of soap or detergent, and they also kill nonpathogenic bacteria
- Antibacterial soap affects biology of tank
- Liquid soaps tend to be overused
- Use is promoting the developing of "super" bugs

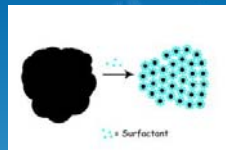


11. Powdered Laundry Detergent

- Dry detergent may have fillers or extenders that clog the drain field
- Less expensive dry laundry detergents actually contain montmorillonite clay which is used as a sealant as a form of filler
- This clogs the drain field as well as sodium and other extenders found in powdered detergents



12. Surfactants



- In many soaps/cleaners
- Surfactants are found in almost every laundry detergent because they help separate the body soil or oily stains from the fabric
- Two types
 - natural or oleochemical surfactants derived from plant oils such as palm or coconut oil.
 - synthetic or petrochemical surfactants are derived from crude oil
- Recommendation: Choose natural one with a zero phosphate content

Surfactant Affects

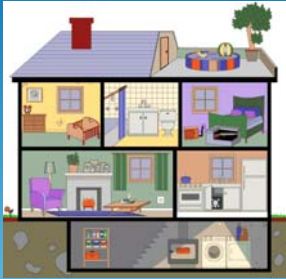
Concentration (mg/L)	Potential Effects
≥ 1.0	Risk of long-term accumulation of surfactants in soil, leading to decreased hydraulic conductivity and increased water repellence
10	Inhibition of hydrolysis, leading to greater accumulation of solids in anaerobic sewage treatment systems
30	Direct degradation of soil structure and decrease in hydraulic conductivity

Example from 6 Adult Care Facilities in MN

Site	Anionic Surfactants mg/L
A.	2.0
B.	0.76
C.	3.8
D.	8.6
E.	1.5
F.	3.4
G. Control Site	2.7

13. Paint and other remodeling debris
- Flushing household chemicals, gasoline, oil, pesticides, antifreeze and paint can stress or destroy the biological treatment taking place in the system or might contaminate surface or ground water
 - Unused products should be dropped off at hazardous waste clean up centers
 - Clean paint brushes outside rather than in the sink


Home Management tips



- Typical water use
- Room-by-room:
 - Bathrooms
 - Laundry
 - Kitchen
 - Other water using devices

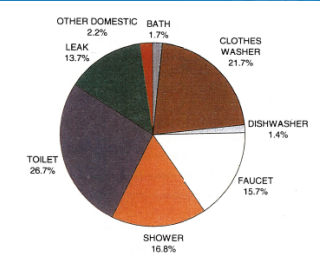
Typical Water Use

- 50-80 gallons/person/day
- Annual estimates of use
 - Per person per year = 28,000 gal
 - Typical home ~ 3 persons = 82,000 gal/yr
 - 250 homes in a township = 20 million gallons/year



Where Does it Come From?


- Water use:
 - Bathroom = 60%
 - Toilet = 27%
 - Bathing = 19%
 - Faucets = 8%
 - Laundry = 22%
 - Kitchen = 10%
 - Leaks = 14%



Mayer, et al. Residential End Uses of Water. 1999.


Toilet - 27%

- Limit flushes
- Replace old toilets
- Low flow – High quality
- Leaking problems
 - Gaskets & "running"
 - Dye test kits



What Should go in the Bowl

- Single ply toilet paper because it breaks down in the septic system faster and better than higher ply count toilet paper
- Human waste
- Nothing else!





Septic Safe?

- Even if items are marked as "septic safe" do not flush them
- For example, some wipes, toilet bowl cleaners and cat litter may be labeled this way
- In many instances it means they will flush


Bathing – 19%

- Leaks
- Low flow
- Short showers use less water (unless you have multiple shower heads)
- Limit:
 - Cleaners
 - Anti-bacterial soaps
 - Shaving cream, bath oils



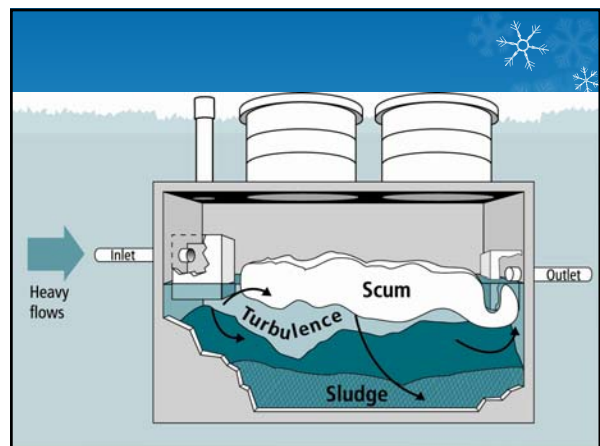
Laundry – 22%

- ▶ Install front loading machines
 - 65% less water
 - 12 – 20 gallons
 - Less electricity to dry clothes
- ▶ Spread out loads
 - think even
 - throughout week
 - throughout day
- ▶ Limit bleach use
- ▶ Use low water level setting for small loads




Laundry Continued

- Add a washing machine lint filter:
 - Washing clothing releases a lot of lint much of which is inorganic
 - Options:
 - Simple screen/pantyhose on discharge line
 - Purchase a "Septic Protector"






Soap

- ▶ Use high quality
- ▶ Use the minimal amount needed
- ▶ Liquid
 - Filler is typically water
- ▶ Limit
 - Detergents w/ bleach
 - Bleach
- ▶ Do **NOT** use liquid fabric softeners as they are petroleum based emulsifiers



Kitchen – 10%



Dishwashing

- Scrape plates in garbage/compost
- **Dishwasher:**
 - Full loads
 - Detergents
 - Use No/Low Phosphorus
 - New gels – less filler
 - Scrape plates
- **Sink:**
 - Rinsing
 - Leaks
 - Fats and Oils are solid waste!



Garbage Disposal

- **Problems:**
 - Adds more solids
 - Undigested food
 - Chopped into small pieces
 - More water
- **Recommendation/requirements**
 - Don't install one
 - Don't use it if you have one




General Cleaning Recommendations

- Use non-chlorine, non-ammonia, non-antibacterial, non-toxic and bio-degradable cleaning products.
- Most all-natural cleaners are septic safe
- When it comes to chemicals, it's a good idea to remember that if you only feel safe wearing gloves when you handle them, then it's a good bet that you won't want to put these items down your drain.

Replace Ammonia Based Cleaners

- **Recommendations:**
 - For surfaces, sprinkle baking soda on a damp sponge
 - For windows, use a solution of 2 Tbs. (30 mL) white vinegar to 1 qt. (1 L) water
 - Place the mixture into the spray bottle



How do we deal with these issues?


Potential Solutions

- Education
 - Eliminate as many of the issues as possible
- Management
 - More management may be needed
- Secondary treatment
 - Treatment breaks down many components




Shock load

- One time addition over a day or a few weeks
- Example - house goes on antibiotics
- Recommendation:
 - Monitor - Wait and see if it comes back
 - Clean out and start over



Short term usage

- ~ <1 year
- Example: Chemotherapy
- Recommendation
 - Monitor tank
 - Holding tank if very upset
 - Manage more frequently



Long Term Usage

- Example: Long term prescription drug use
- Recommendations:
 - Monitor
 - More maintenance needed?
 - Remediation?
 - Design in advanced treatment?



Questions, Discussion Items?

