Wastewater Treatment

Wastewater Treatment

- Purpose:

  To manage water discharged from homes, businesses, and industries to reduce the threat of water pollution.

Wastewater Treatment

- Pre-treatment
- Preliminary treatment
- Primary treatment
- Secondary treatment
- Sludge (biosolids) disposal

Wastewater Treatment

- Pre-treatment
  - Occurs in business or industry prior to discharge
  - Prevention of toxic chemicals or excess nutrients being discharged in wastewater

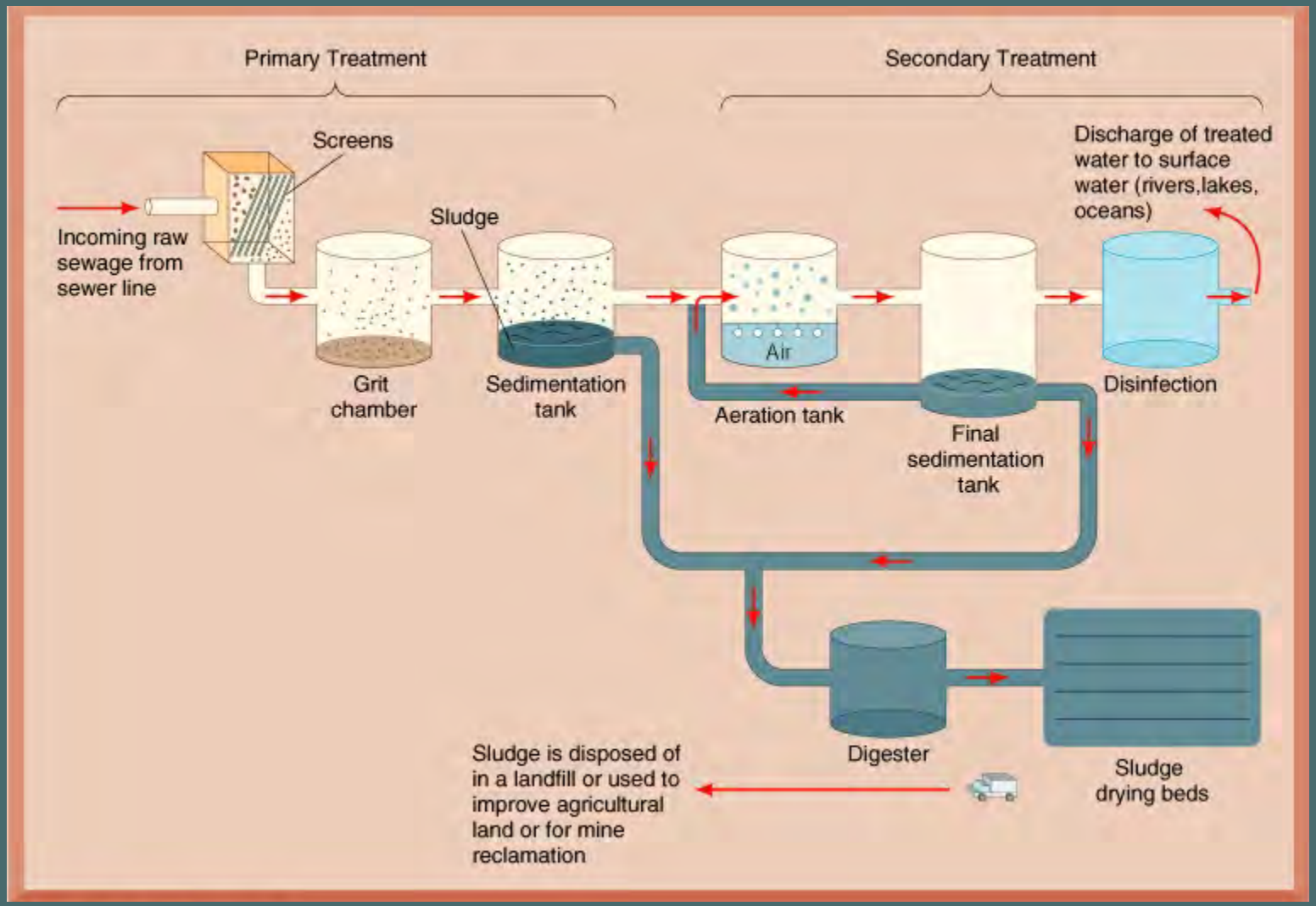
Wastewater Treatment

- Water discharged from homes, businesses, and industry enters sanitary sewers
- Water from rainwater on streets enters storm water sewers
- Combined sewers carry both sanitary wastes and storm water

Wastewater Treatment

- Water moves toward the wastewater plant primarily by gravity flow
- Lift stations pump water from low lying areas over hills

Wastewater Treatment



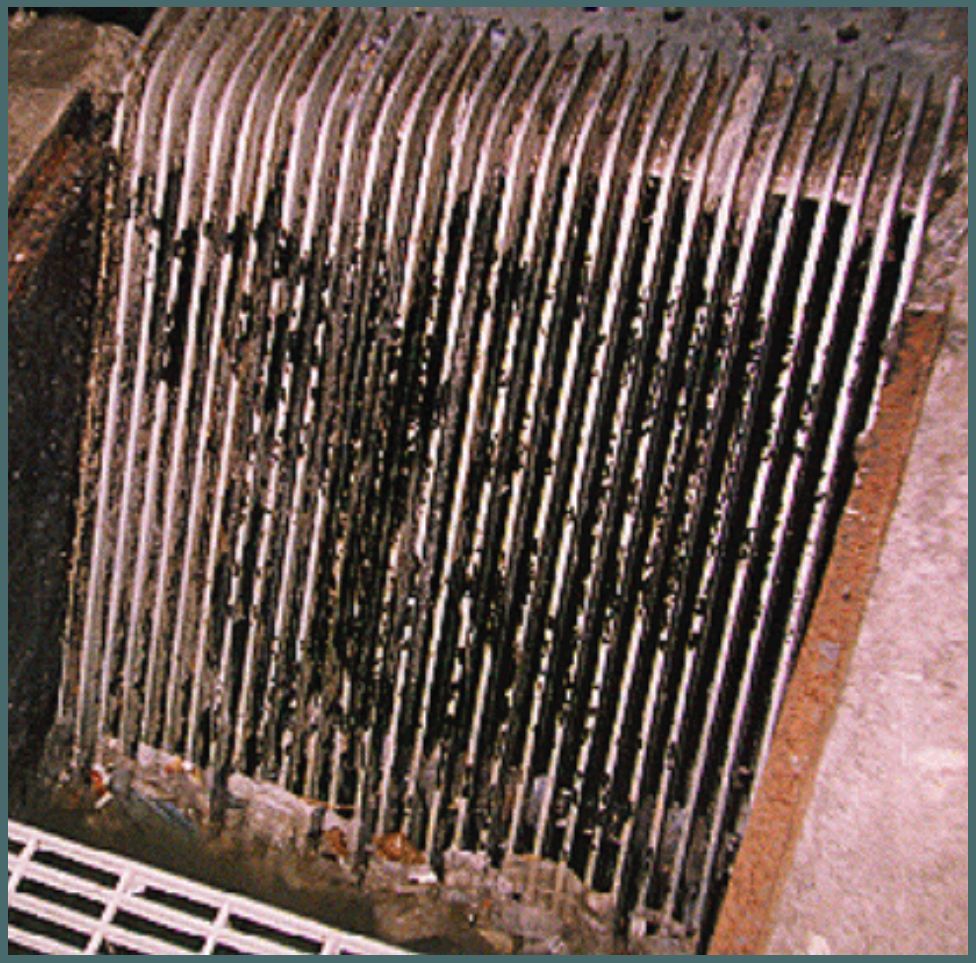
Wastewater Treatment

- Preliminary Treatment
  - removes large objects and non-degradable materials
  - protects pumps and equipment from damage
  - bar screen and grit chamber

Wastewater Treatment

- Bar Screen

  - catches large objects that have gotten into sewer system such as bricks, bottles, pieces of wood, etc.



Wastewater Treatment

- Grit Chamber

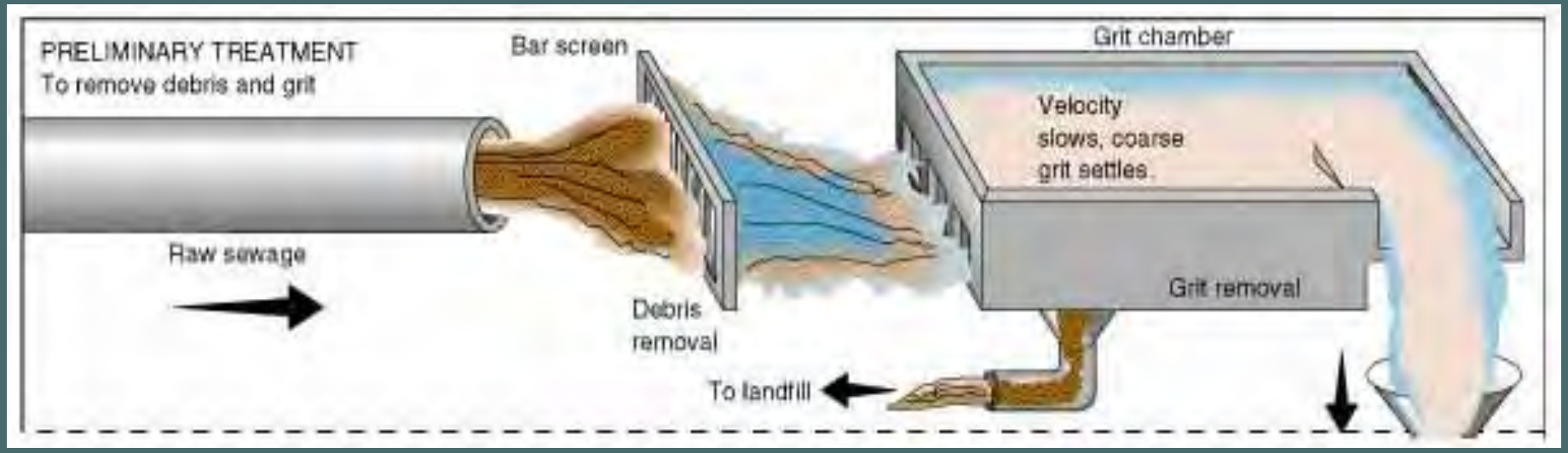
  - removes rocks, gravel, broken glass, etc.

- Mesh Screen

  - removes diapers, combs, towels, plastic bags, syringes, etc.

Wastewater Treatment

- Preliminary Treatment



Wastewater Treatment

- Measurement and sampling at the inlet structure

  - a flow meter continuously records the volume of water entering the treatment plant

  - water samples are taken for determination of suspended solids and B.O.D.

Wastewater Treatment

- Suspended Solids – the quantity of solid materials floating in the water column

- B.O.D. = Biochemical Oxygen Demand

  - a measure of the amount of oxygen required to aerobically decompose organic matter in the water

Wastewater Treatment

- Measurements of Suspended Solids and B.O.D. indicate the effectiveness of treatment processes

- Both Suspended Solids and B.O.D. decrease as water moves through the wastewater treatment processes

Wastewater Treatment

- Primary Treatment

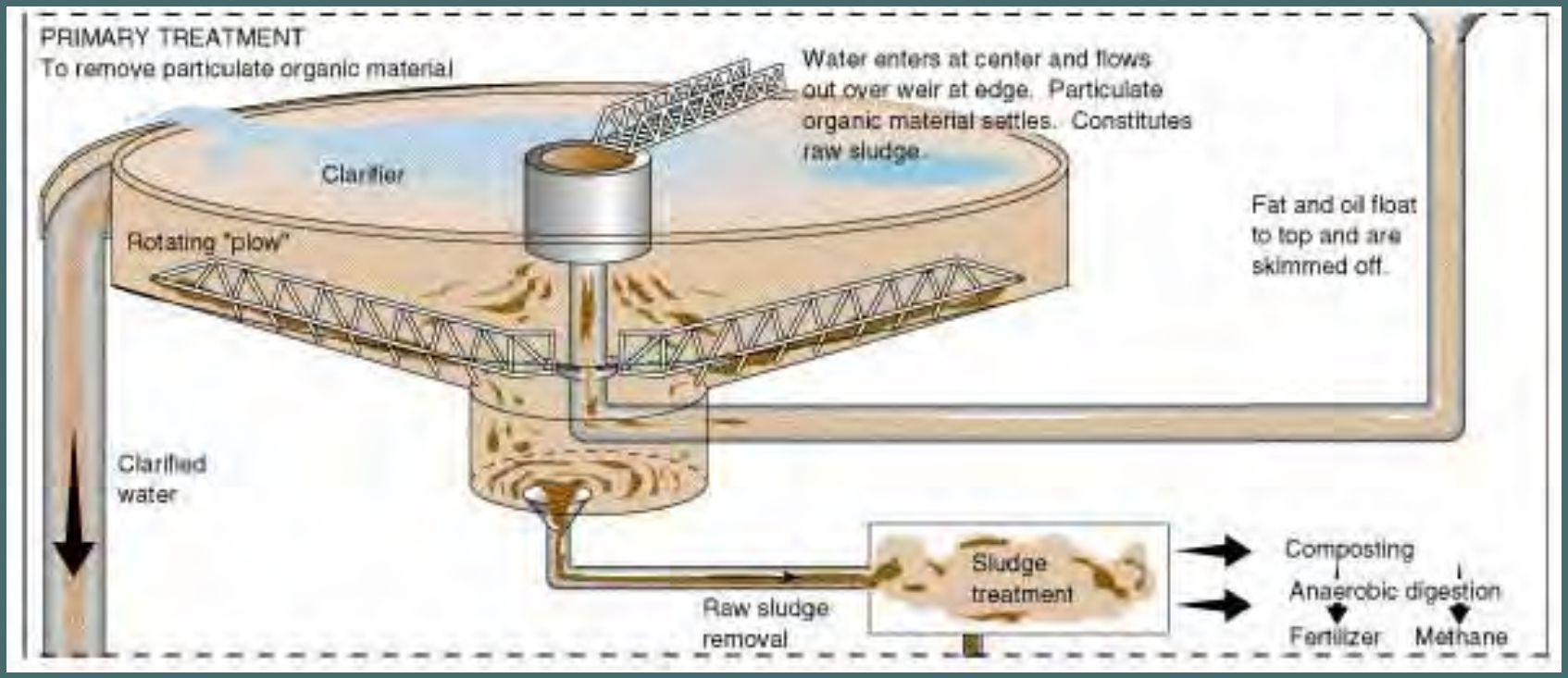
  -- a physical process

  -- wastewater flow is slowed down and suspended solids settle to the bottom by gravity

  -- the material that settles is called sludge or biosolids

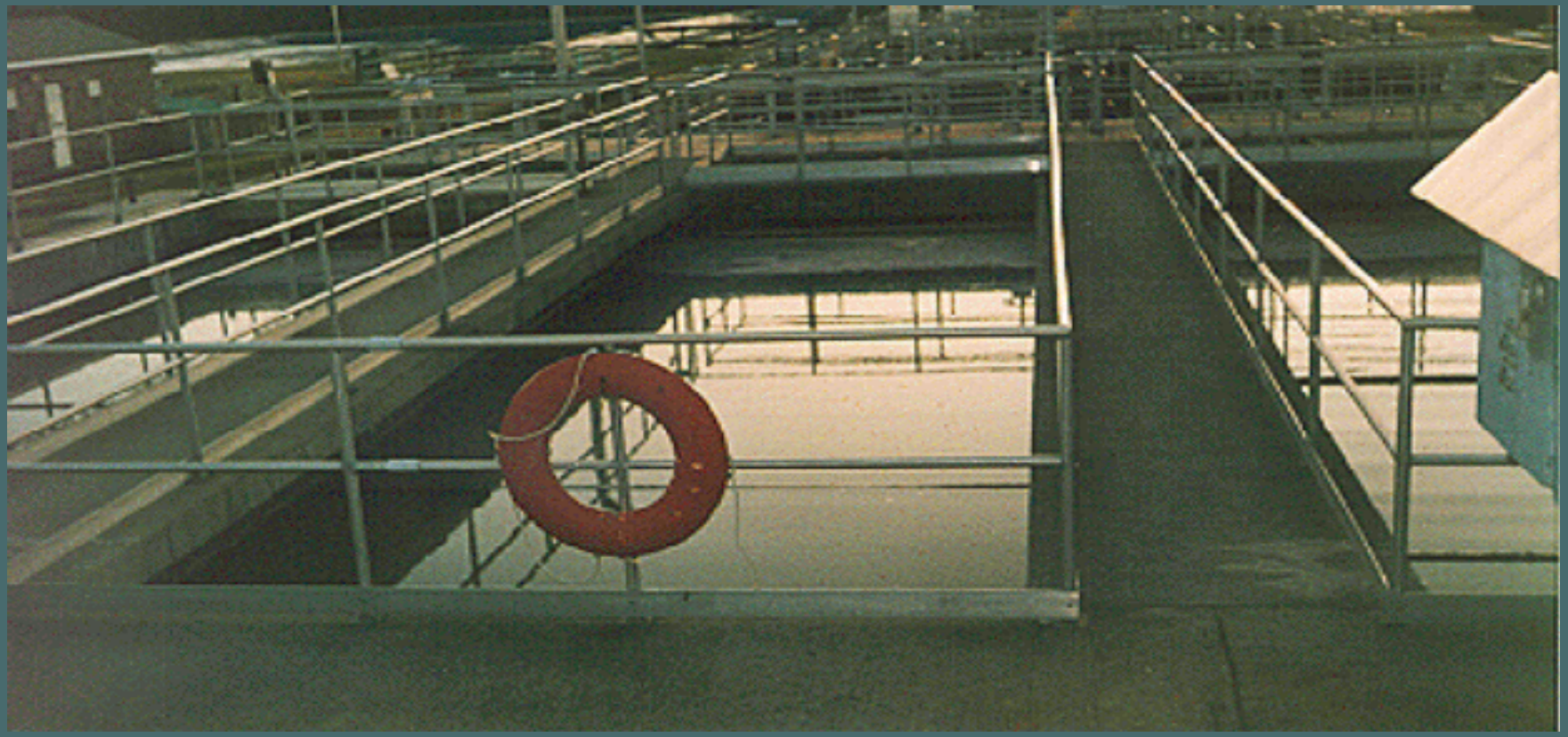
Wastewater Treatment

- Primary Treatment



Wastewater Treatment

- Primary Treatment



Wastewater Treatment

- Primary Treatment

Wastewater Treatment

- Sludge from the primary sedimentation tanks is pumped to the sludge thickener.

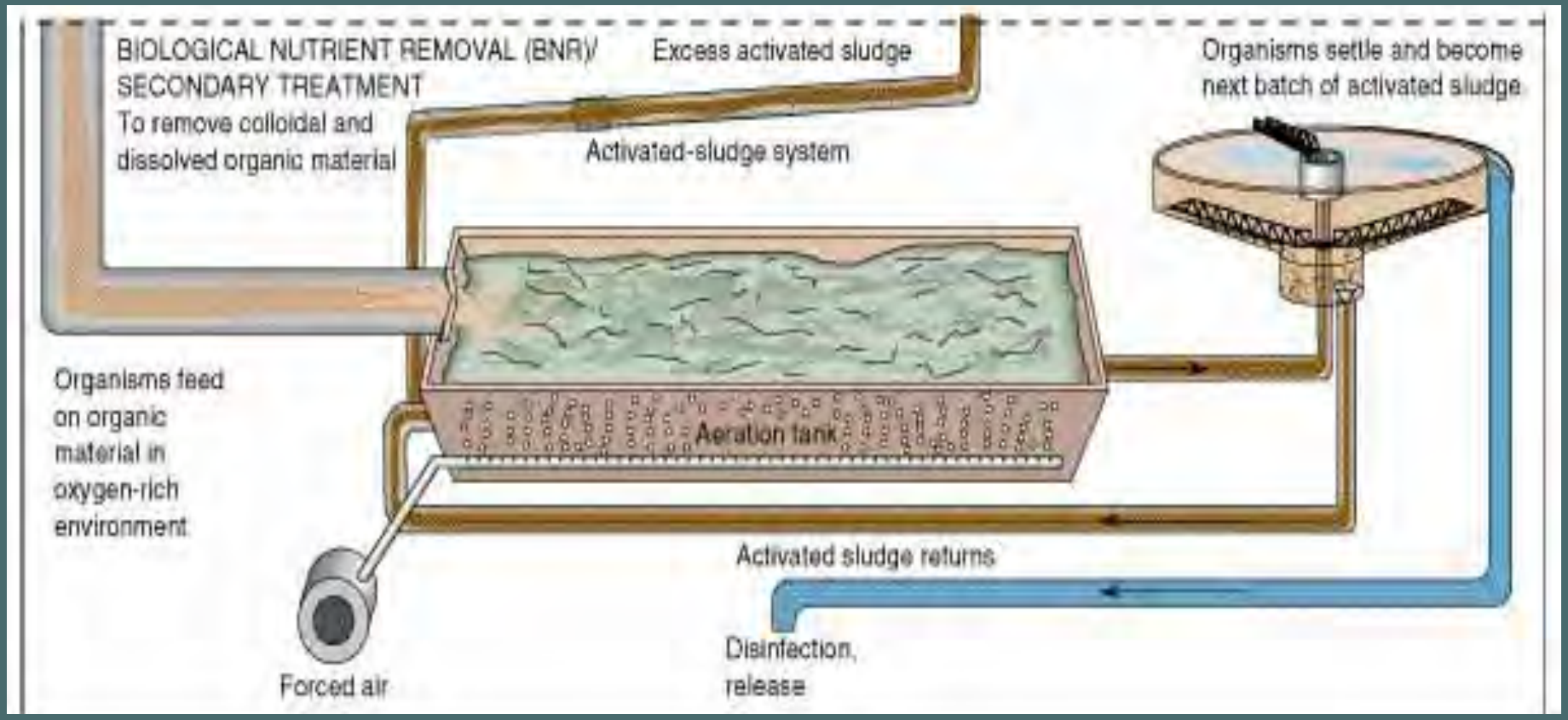
  - more settling occurs to concentrate the sludge prior to disposal

Wastewater Treatment

- Primary treatment reduces the suspended solids and the B.O.D. of the wastewater.
- From the primary treatment tanks water is pumped to the trickling filter for secondary treatment.
- Secondary treatment will further reduce the suspended solids and B.O.D. of the wastewater.

Wastewater Treatment

❖Secondary Treatment



Wastewater Treatment

❖Secondary Treatment

❖Secondary treatment is a biological process

❖Utilizes bacteria and algae to metabolize organic matter in the wastewater

❖In Cape Girardeau secondary treatment occurs on the trickling filter

Wastewater Treatment

❖Secondary Treatment

❖ the trickling filter does not “filter” the water

❖ water runs over a plastic media and organisms clinging to the media remove organic matter from the water

Wastewater Treatment

- From secondary treatment on the trickling filter water flows to the final clarifiers for further removal of sludge.
- The final clarifiers are another set of primary sedimentation tanks.
- From the final clarifiers the water is discharged back to the Mississippi River.

Wastewater Treatment

- The final clarifiers remove additional sludge and further reduce suspended solids and B.O.D.

Wastewater Treatment

- Disposal of Sludge or Biosolids

-- the sludge undergoes lime stabilization (pH is raised by addition of lime) to kill potential pathogens

-- the stabilized sludge is land applied by injection into agricultural fields

Wastewater Treatment

- Disposal of Sludge or Biosolids

-- in the past, Cape Girardeau disposed of the sludge by landfill or incineration

-- landfill disposal discontinued to the threat of leachate

-- incineration discontinued because of the ineffectiveness and cost

Wastewater Treatment

- The final part of the field trip tour will be in the treatment plant lab.

Wastewater Treatment

- The wastewater plant lab conducts a number of measurements and tests on the water.

suspended solids
B.O.D.
pH
temperature
nitrogen
phosphorus

Wastewater Treatment

- In addition to test performed at the wastewater lab, an off-site contract lab performs additional tests

heavy metals priority pollutants

W.E.T (Whole Effluent Toxicity) tests

Wastewater Treatment

- Governmental Agencies monitor wastewater treatment plants

U.S. Environmental Protection Agency

Missouri Department of Natural Resources

Septic System Maintenance Scheduling

by
Bob Schultheis, Extension Agricultural Engineering Specialist

OUTREACH & EXTENSION
UNIVERSITY OF MISSOURI
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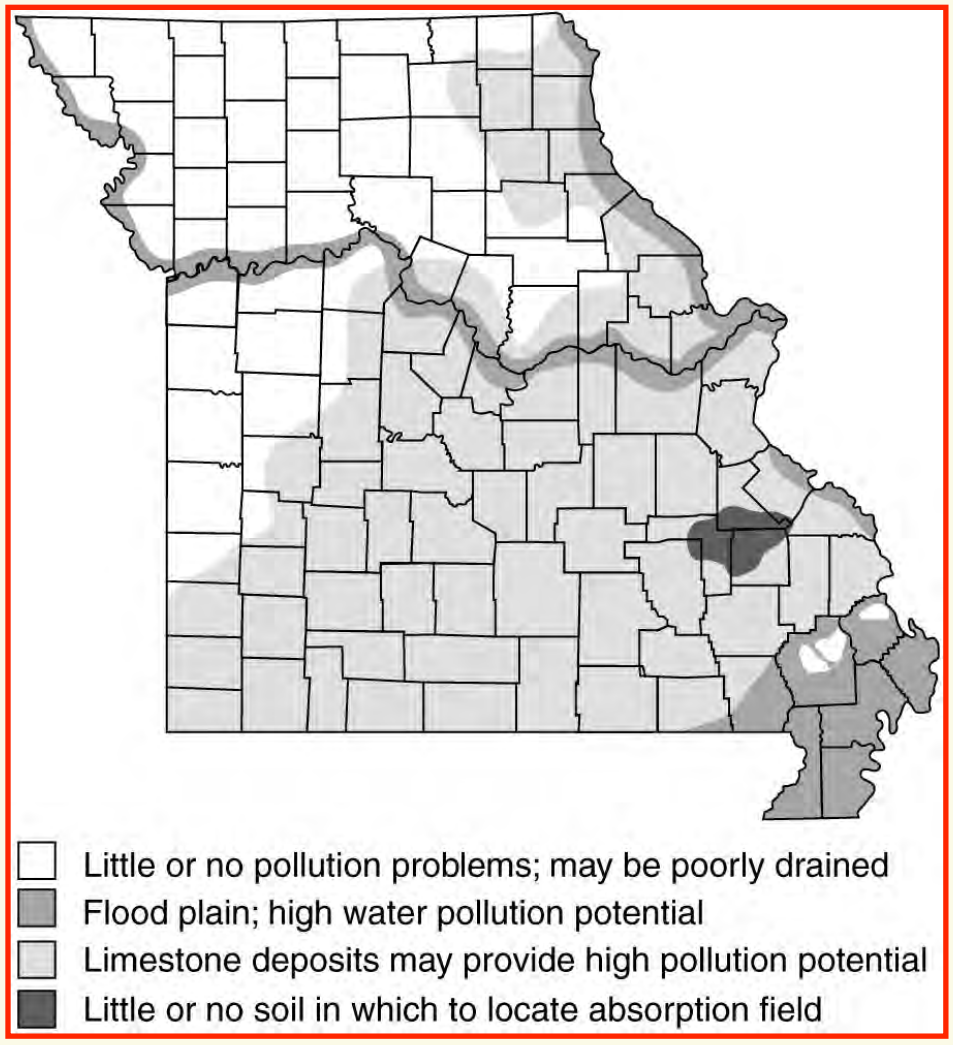
Clues to Septic System Failure 1

Clues to Septic System Failure 2

6. More septage pumped from septic tank than it is designed to hold.
7. Alarm flashing or beeping
8. Weed & algae buildup in nearby lakes & ponds
9. Presence of bacteria &/or nitrates in water well
10. Increase in infections or illnesses

Pollution Risk Areas



8-min. video from University of Minnesota

VIDEO - Keys to a Good System

- ✓ **Treatment** - takes care of the *problem*
  - Solids, BOD, Pathogens, Nutrients
- ✓ **Management** - takes care of the *system*
  - Operation = how you use it
  - Monitoring = checking for proper operation
  - Maintenance = actual pumping
  - Mitigation = fixing it if it breaks

A Common Question….

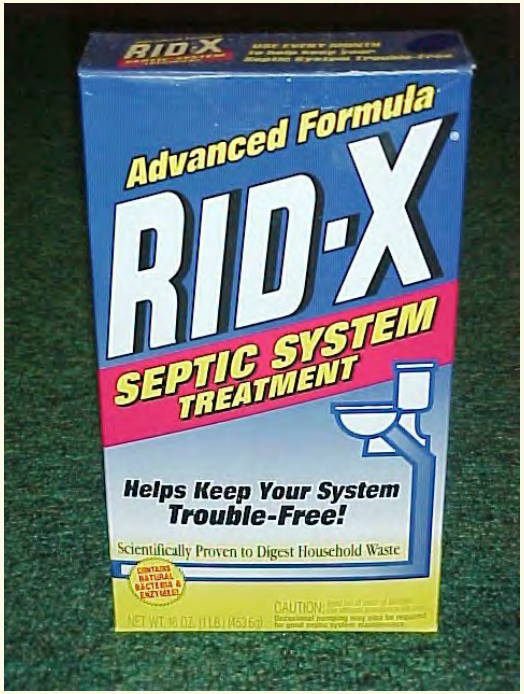
Isn't there something I can put in the septic tank to make the bacteria work better?

Three Types of Septic Tank Additives [1]

- ✓ **Organic solvents**
  - Effective in degreasing internal house piping
  - Strongly linked to groundwater contamination from absorption field
- ✓ **Inorganic chemicals**
  - Acids, bases, flocculants
  - Can destroy septic tank action through corrosion, sludge bulking, disruption of biological activity

Three Types of Septic Tank Additives 2

- ✓ **Biological**
  - Unlikely to pollute groundwater
  - Will a few million bacteria help the billions already in the tank?
  - Additives likely to be killed, too, if tank is toxic.
  - Tank will recover on its own in 30-60 hours.



The Additive Answer….

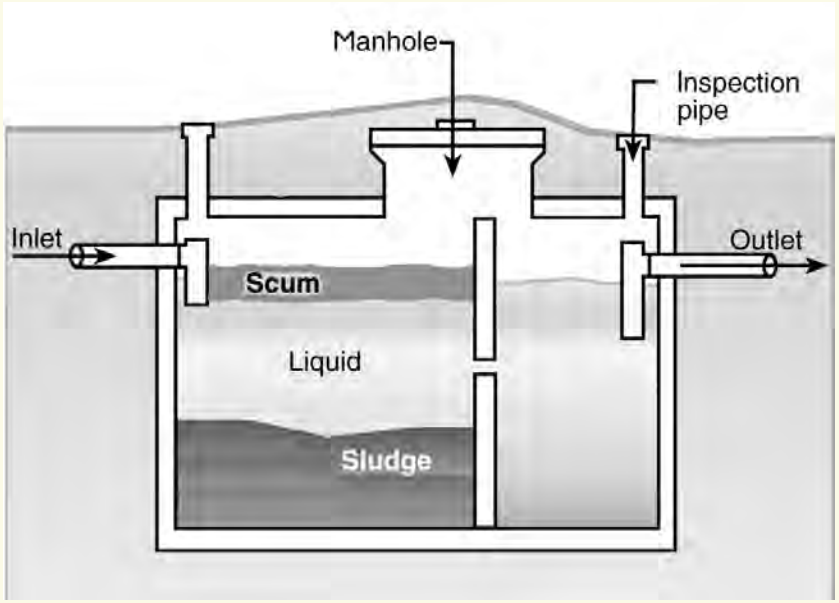
Septic Tank / Absorption Field Systems

Functions of Septic Tank 1

- ✓ Separate the solids from the liquids.
- ✓ Anaerobically digest *a portion* of the organic material.
- ✓ Trap grease & floatable solids to prevent them from leaving the tank.

Functions of Septic Tank 2

- ✓ Give 48-hour liquid detention time.
- ✓ Store solids in the tank until they can be removed.
- ✓ Not expected to remove pathogens or nutrients.



Septic Tank Pumping 1

- **Frequency is based on:**
  - Number & ages of people in the home
  - Amount of wastewater generated
    - **Water use habits of occupants**
    - **Types of plumbing fixtures (shower heads, hot tubs, leaky toilets & faucets, etc.)**
  - Volume of solids in the wastewater
    - **Garbage grinders greatly increase solids**
    - **Disposal habits of occupants (toilet as trash can)**

Garbage Grinders Increase Solids in Septic Tank

Tank Pumping Frequency

Tank Size (gallons)	Household Size (no. of people) 2	3	4	5
	Pumping Frequency (years)			
500	2.6	1.5	1.0	0.7
750	4.2	2.6	1.8	1.3
1000	5.9	3.7	2.6	2.0
1250	7.5	4.8	3.4	2.6
1500	9.1	5.9	4.2	3.3

NOTE: Pumping frequency may increase by 50% if garbage grinder is used.
Source: MU Guide WQ401

Six Steps to Tank Cleaning

1. Hire a pumping contractor.
2. Locate the system.
3. Uncover the access holes.
4. Flush the toilets.
5. Measure the scum & sludge levels.
6. Clean the septic tank.

Hire a Pumping Contractor

- ✓Tank must be pumped if repairs are made to sewage system
- ✓Land apply septage per DNR (EPA 503) regulations (See MU Guides WQ422 & WQ426)

Locate the System 1

1. Measure where sewer pipe goes through foundation wall of dwelling.

Locate the System 2

2. Look for septic tank 2-3 ft. deep in yard 10-15 ft. from house.
   a. Probe insulated metal rod in damp soil
   b. Metal detector
   c. $20 radioactive "detector ball" & meter
   d. "Water-witching" wires

Locate the System 3

3. Look for absorption field
   a. Usually downhill from septic tank (unless pumped)
   b. Soggy spot in dry yard
   c. Slight depression or mound
   d. Grass greener or grows poorly
   e. Probe insulated metal rod in soil to find gravel
   f. “Water-witching” wires

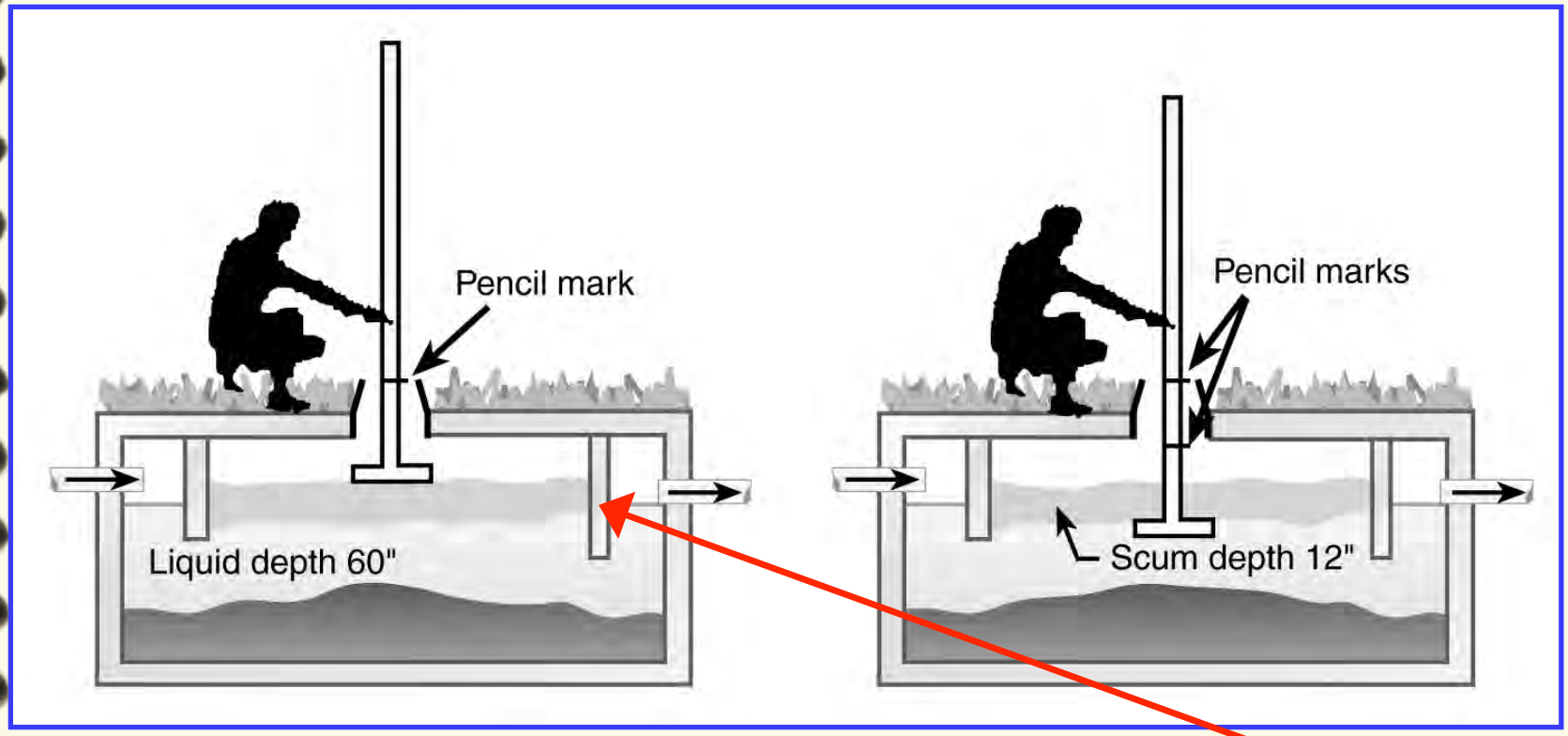
Uncover Access Hole

- ✓ If missing, add manhole & inspection pipe risers flush with ground surface.

Flush the Toilets

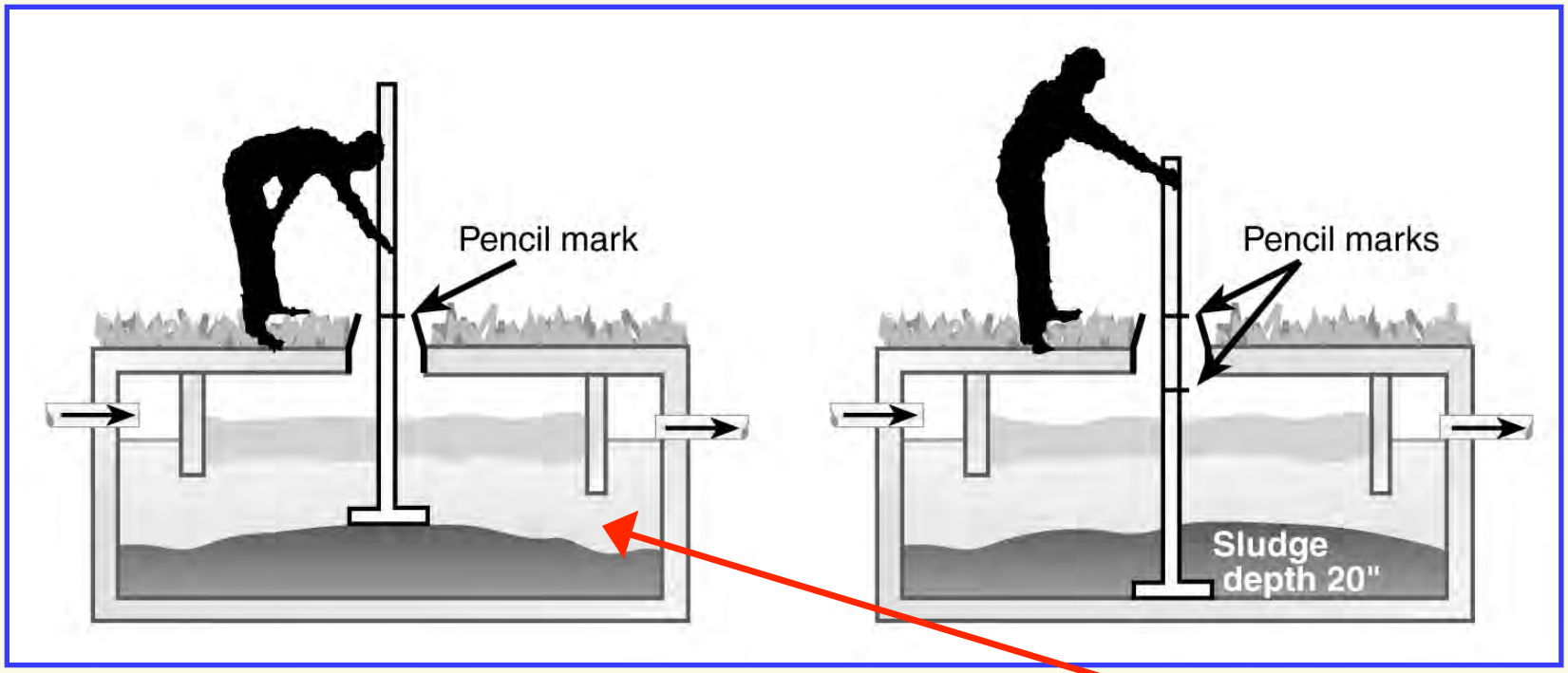
- ✓ This confirms proper operation of the plumbing system.

Checking Scum Level



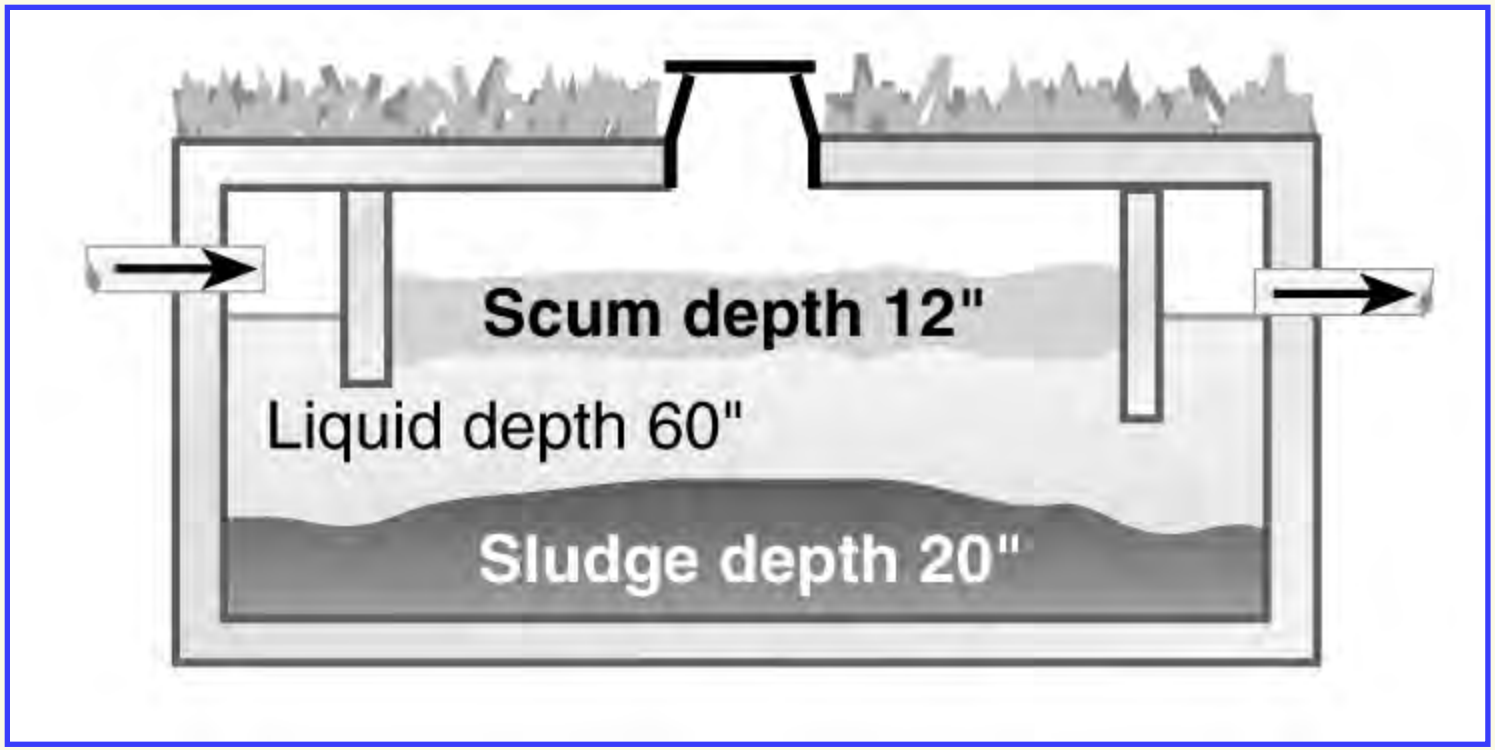
Pump tank when scum is < 3” above outlet baffle or > 12” thick.

Checking Sludge Level



Pump tank when sludge is < 12” below outlet baffle or if scum + sludge is > half the liquid depth

Tank Pumping Example



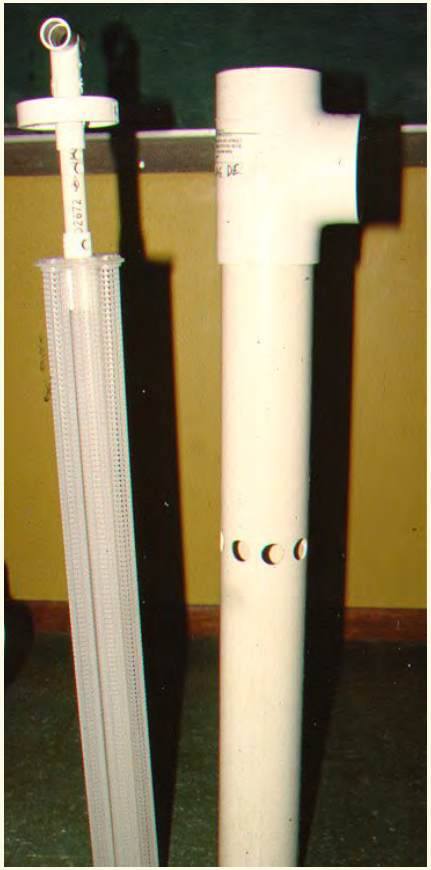
12” scum + 20” sludge = 32” total
32” is > half of 60” liquid depth

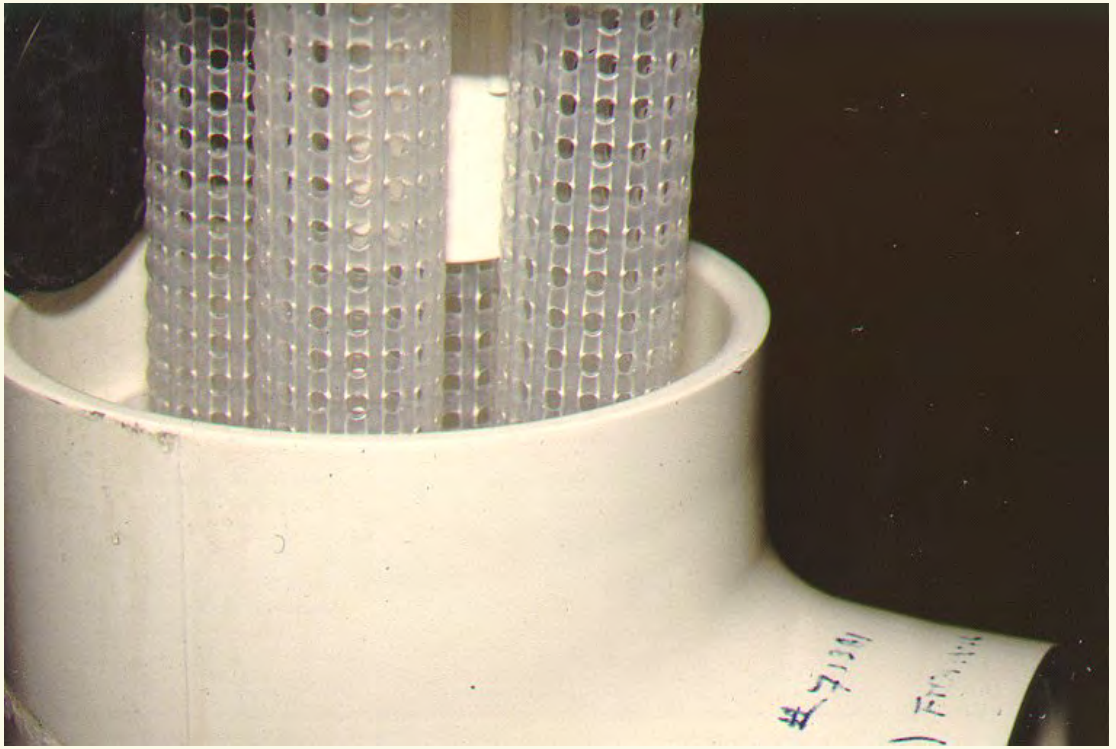
TANK NEEDS PUMPING

Cleaning the Septic Tank

- ✓ Pump tank empty
- ✓ Pump only from manhole, not from inspection ports
- ✓ Check tank baffles or tees for damage
- ✓ Clean or replace the outlet filter

Septic Tank Outlet Filter 1a





Septic Tank Outlet Filters 1b

Outlet Filter - Cleaning

Pumps, Alarms & Valves

- ✓ Pumps & motors
  - Regularly check for proper operation.
  - Replace if weak or faulty.
- ✓ Alarms on pumps & filters
  - Attend to immediately.
- ✓ Distribution box flow valves
  - Readjust as needed

D-Box Flow Regulators

- ✓ Must be accessible for adjustment

Absorption Field Care

- ✓ Mow, but do not fertilize or water turf grasses over the absorption field.
- ✓ Keep heavy vehicles (cars, tractors, RVs, etc.) off of tanks & absorption field.
- ✓ Maintain stands of appropriate plants on constructed wetland sites.

Aerated Septic Tanks

Aerated Septic Tanks

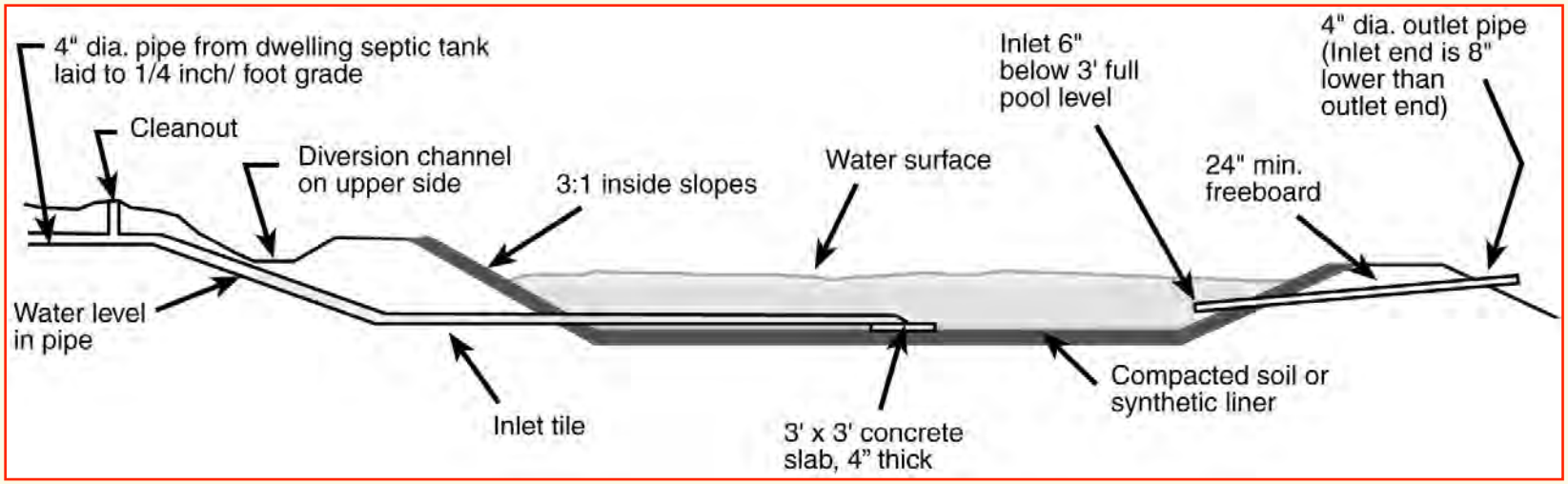
- ✓ Oxygen added to improve effluent quality (still needs 2nd treatment)
- ✓ Detergents, disinfectants & vacations can easily upset operation.
- ✓ Requires uniform sewage loading (no slugs)
- ✓ Mech. parts need monthly maintenance.
- ✓ Pump tank every 8-12 months.

Aerobic Sewage Lagoons

Functions of a Lagoon

- ✓ Provide primary or secondary treatment of wastewater from home
- ✓ Aerobically digest *a portion* of the organic material.
- ✓ Shallow depth = aerobic bacteria
- ✓ Bacteria + waste = CO_2
- ✓ CO_2 + sunlight = algae + O_2
- ✓ Surface area + wind = odor dispersion

Aerobic Sewage Lagoon [1]



Section View

Sizing the Lagoon

Based on 440 sq.ft. per bedroom, 3’ water depth, 2’ freeboard, 3:1 inside slope

BdRm	Water Area Sq.Ft.	Round (in feet) PD	BD	ID	OD	Square (in feet) PL	BL	IL	OL
1-2	900	34	16	46	54	30	12	42	50
3	1320	41	23	53	61	37	19	49	57
4	1760	47	29	59	67	42	24	54	62
5	2200	53	35	65	73	47	29	59	67

Lagoon Maintenance

- ✓ Expect “musky odor” in the spring.
- ✓ “Rescue” an undersized lagoon by adding a septic tank ahead of it.
- ✓ Trim grass/weeds/trees around lagoon to improve air flow & sunshine.
- ✓ Control excess aquatic weeds other than algae. (See MU Guide G4856)
- ✓ Fence out children & animals.
- ✓ Keep lagoon overflow on your property.

Does the Lagoon Leak?

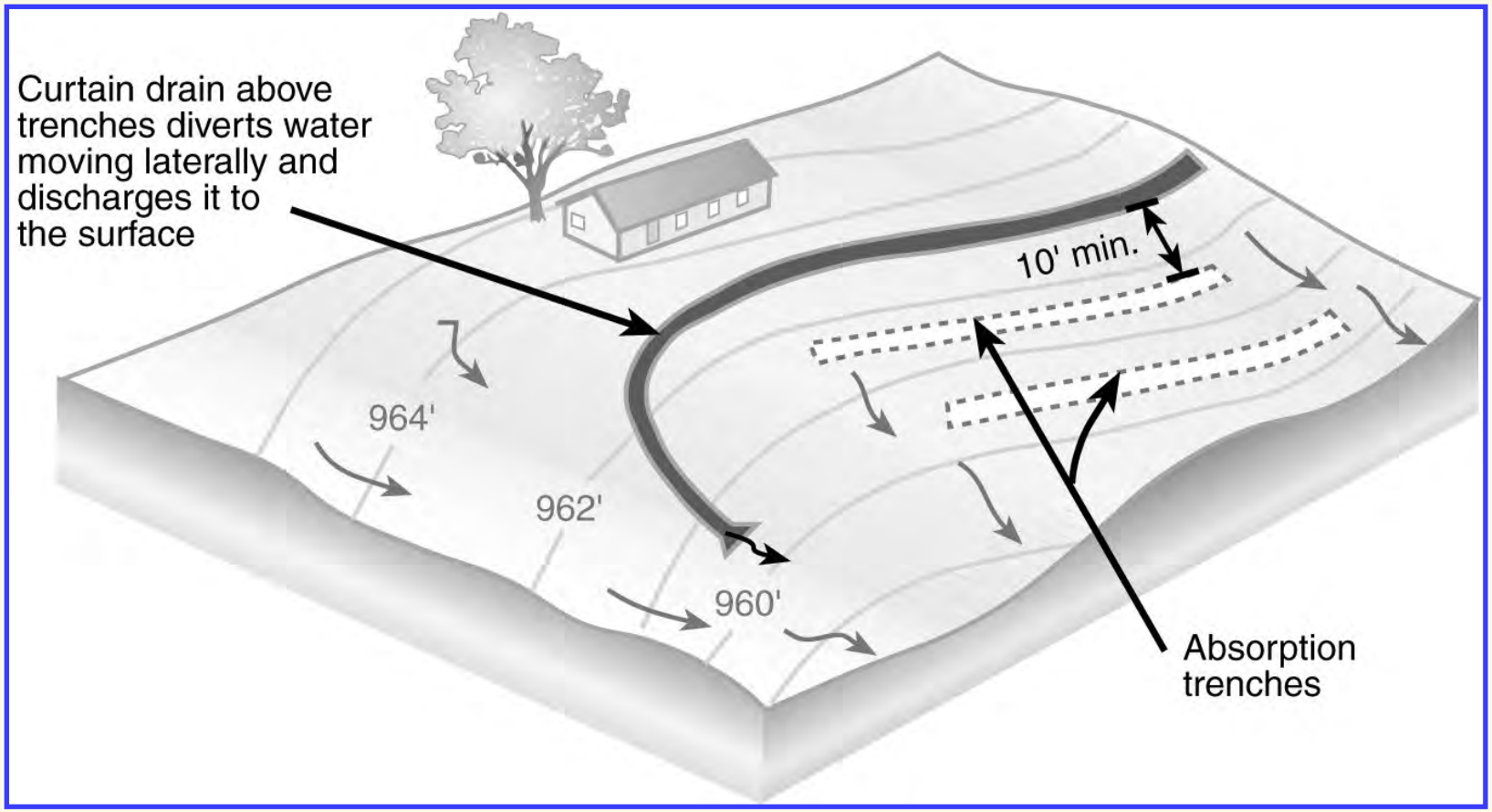
- ✓3BR home = 360 GPD = 1050 sq.ft. lagoon **(49’ x 49’ to top inside of berm)**
- ✓1” rain/acre = 1,500 gallons on lagoon **(27,154 gal./in. x 3,249 sq.ft. / 43,560 sq.ft./ac.)**
- ✓Webster County historical weather:
  - **Rainfall = 41”/year**
  - **Evaporation = 40”/year (0.25”/day in summer)**
- ✓360 GPD adds 0.55”/day to lagoon
  120 GPD adds 0.18”/day

More Management Tips

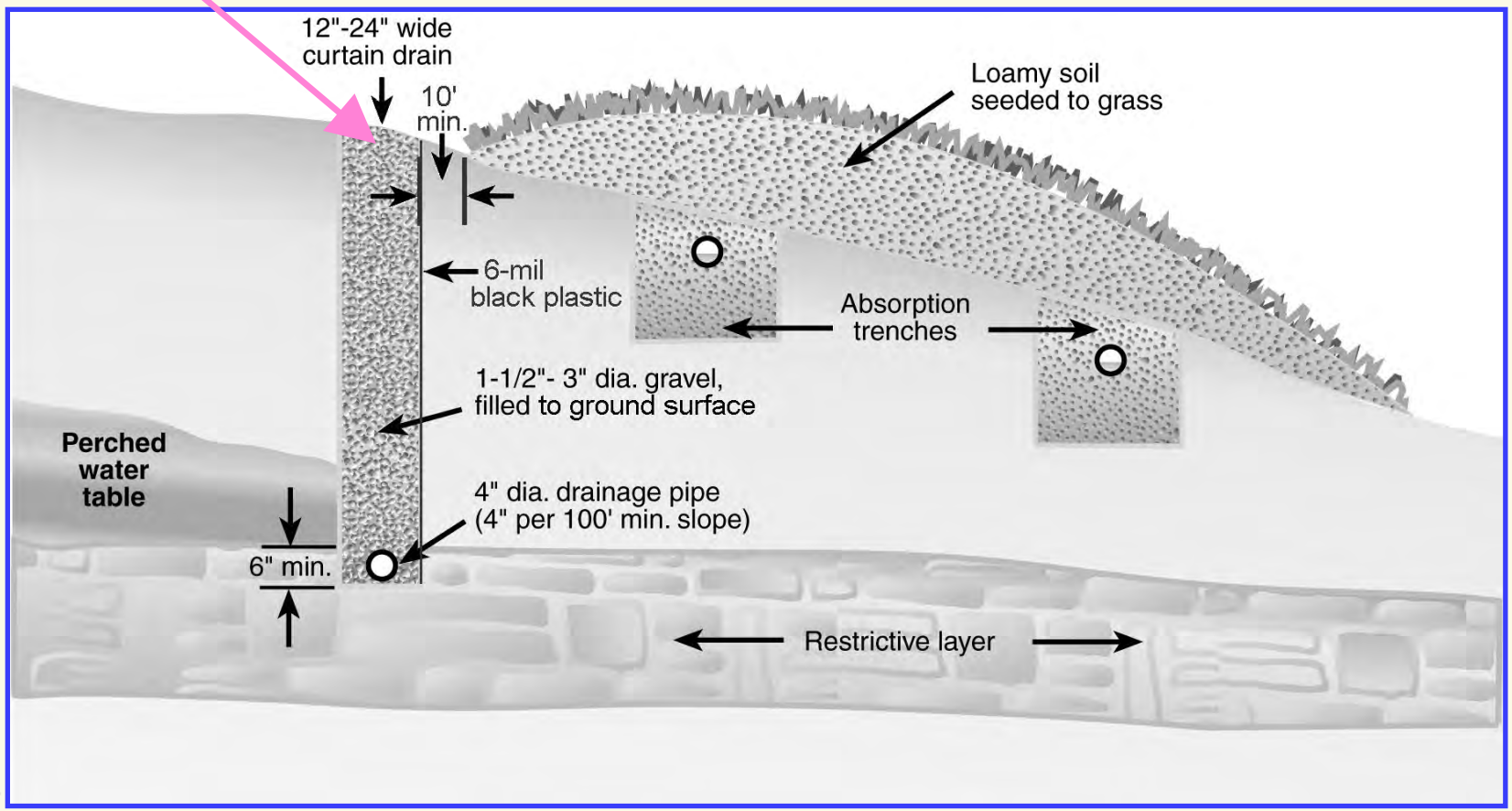
Our Best Advice on Septic Tank Management [1]

- ✓ Install the trenches shallow (<18” deep)
- ✓ Monitor sludge & scum levels annually.
- ✓ Have the tank pumped every 2-5 years.
- ✓ Divert roof downspouts away from absorption field.
- ✓ Use interceptor drains to keep subsurface water away.

Interceptor (Curtain) Drains [1]



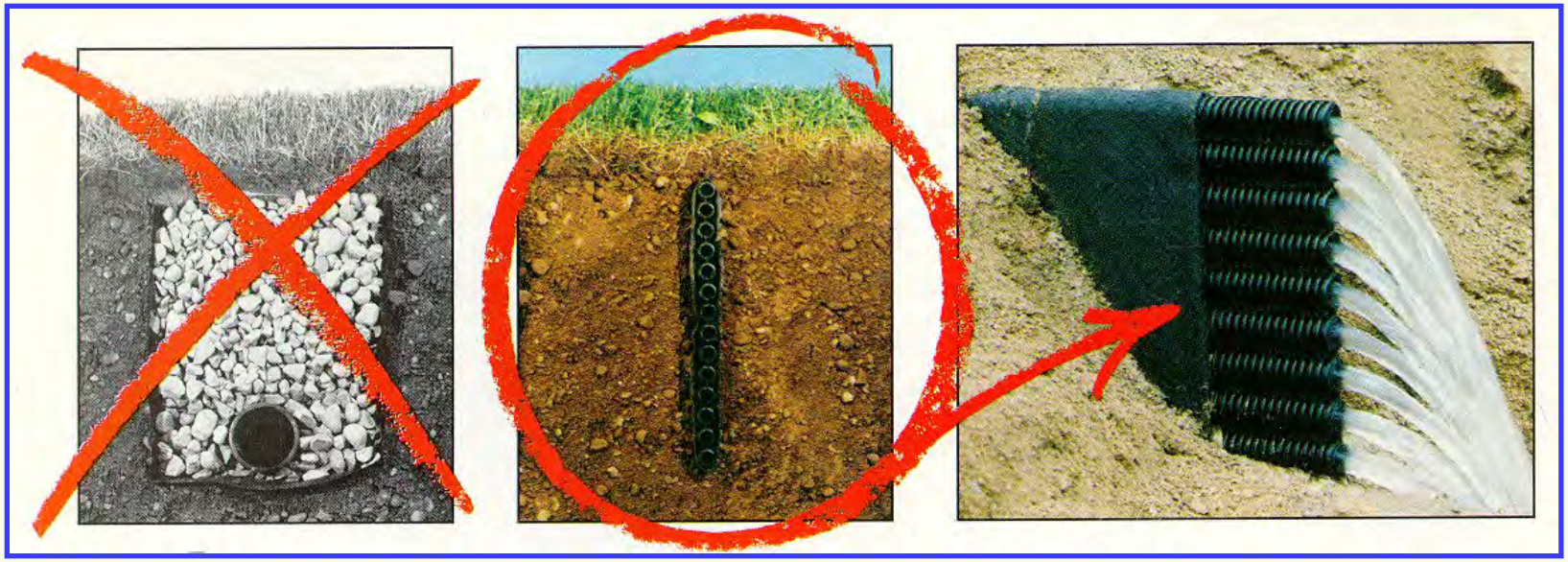
Interceptor (Curtain) Drains 2



Interceptor (Curtain) Drains 3

- ✓ Locate trenches 10-15 ft. uphill from absorption field
- ✓ Trench 12”-24” wide; cut 6” into restrictive layer
- ✓ Use 4” perforated PVC drain pipe (no corrugated tubing in coils)
- ✓ Slope pipe 1/16” per foot (6” per 100 ft.)
- ✓ Drain or pump to daylight & screen pipe ends

A Plastic Alternative



Varicore Technologies, Inc.
Toll-free: 800-978-8007
Fax: 320-978-6607
Website: http://www.varicore.com/

Our Best Advice on Septic Tank Management 2

- ✓ Space laundry loads throughout the week to reduce water overloading.
- ✓ Save money on tank additives for a more productive use.
- ✓ Flush only toilet tissue that dissolves easily (jar test)
- ✓ Implement water conservation measures.

Water Conservation Measures (Indoors) 1

a. Repair faucet & toilet leaks.
b. Install toilet dams on older units.
c. Avoid unnecessary toilet flushing.
d. Take short showers instead of baths.
   (8-10 gallons vs. 30-50 gallons)
e. Use low-flow shower head.
   (50% less water, with more velocity)

Water Conservation Measures (Indoors) 2

f. Turn off shower when shampooing or soaping.

g. Run only full loads in dishwasher & clothes washer (20-50 gallons/cycle)

h. Install faucet aerators (50% less water)

i. Turn off faucet when shaving, brushing teeth, handwashing dishes.

j. Limit use of the hot tub/spa/Jacuzzi.

Water Conservation - Dishwasher (full)

Water Conservation - Clothes Washer (full)

Water Conservation - Faucets (off when not using)

Summary & Long-Term Solutions

Long-Term Solutions to Avoid Septic System Failure [1]

1. Inspect & maintain septic tank.
2. Select "secondary treatment" system suited to soil type.
3. Use sealed septic tank of proper size. (1000-gal. minimum)
4. Increase size of absorption field & use distribution box.
   (Avoid 8' x 8' x 8' gravel hole)

Long-Term Solutions to Avoid Septic System Failure 2

5. Increase vertical separation distance from confining soil/rock layers.
6. Lay lateral lines level on the hill contour. (100' maximum length each)
7. Dig & backfill trenches properly. (Work soil only when crumbly)
8. Use enough rock in the trenches.

Long-Term Solutions to Avoid Septic System Failure 3

9. Dosing is better than gravity-flow.
10. Use interceptor drains on periodically-saturated soils.
11. Redirect surface water away from absorption field.
12. Use water conservation measures
13. Keep grease, fats & hazardous chemicals out of septic system.

Long-Term Solutions to Avoid Septic System Failure 4

14. Plant "greenbelt" between absorption field & shoreline.
15. Connect to community sewage system if available.
16. Participate in community "cluster" sewer system (pump to treatment site).

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Karst Topography & Soils

for

Master Naturalist Training

February 3, 2014

Joplin, MO

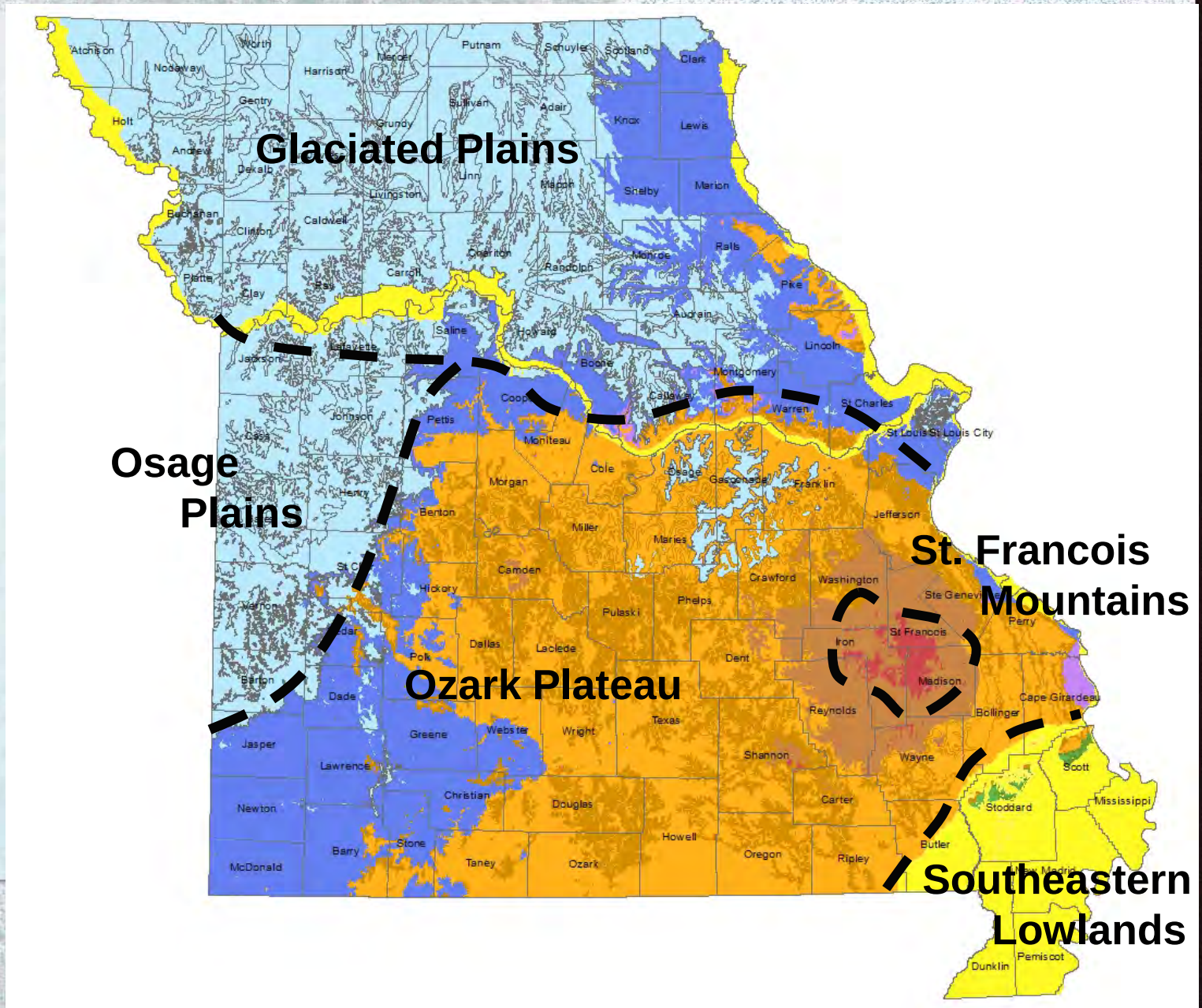
by

Bob Schultheis

Natural Resource Engineering Specialist

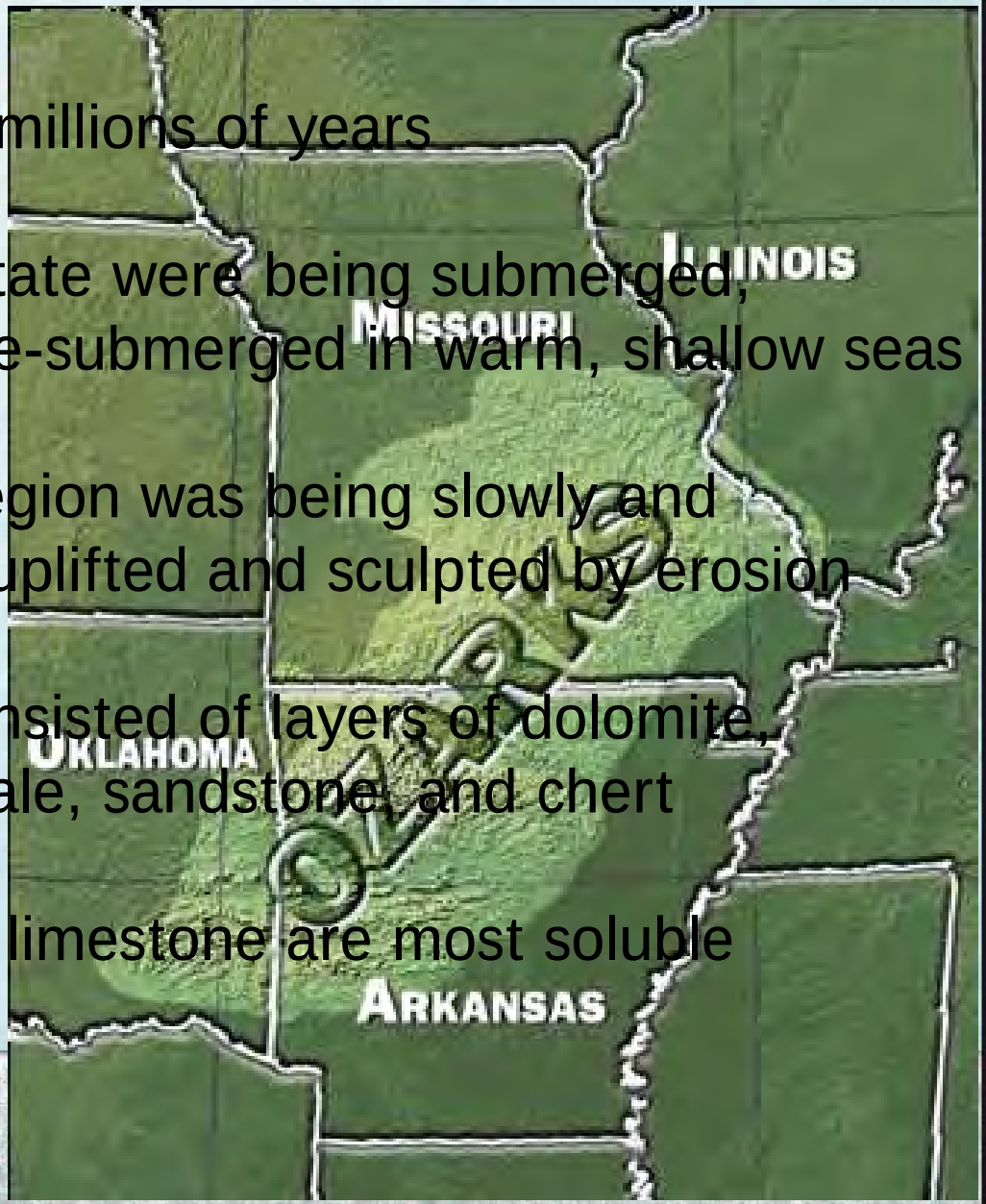
UNIVERSITY OF MISSOURI Extension

5 Major Geologic Regions In Missouri



How the Ozarks Was Formed

- Created over millions of years
- Parts of the state were being submerged, uplifted and re-submerged in warm, shallow seas
- The Ozarks region was being slowly and continuously uplifted and sculpted by erosion
- Sediments consisted of layers of dolomite, limestone, shale, sandstone, and chert
- Dolomite and limestone are most soluble



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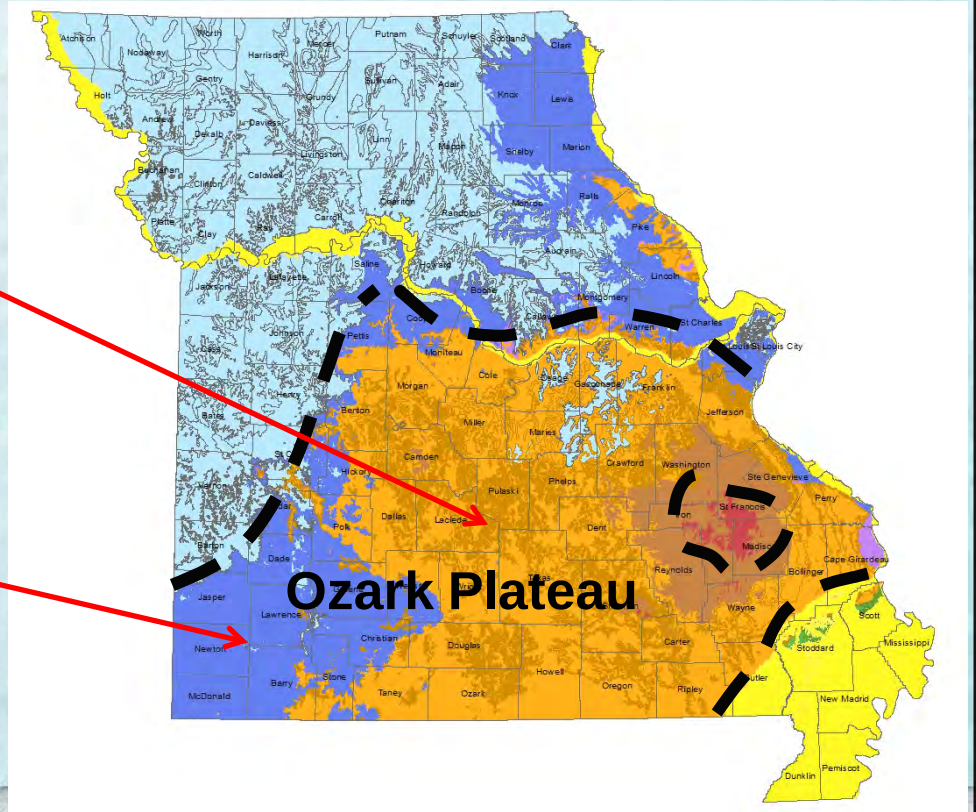
Typical Geology of the Ozark Plateau

- Includes the Salem Plateau & Springfield Plateau
- Underlain by highly permeable limestone and dolomite bedrock (karst)
- Large amounts of groundwater

Ordovician-age carbonates = 440-480 myo

Mississippian-age limestones = 320-360 myo



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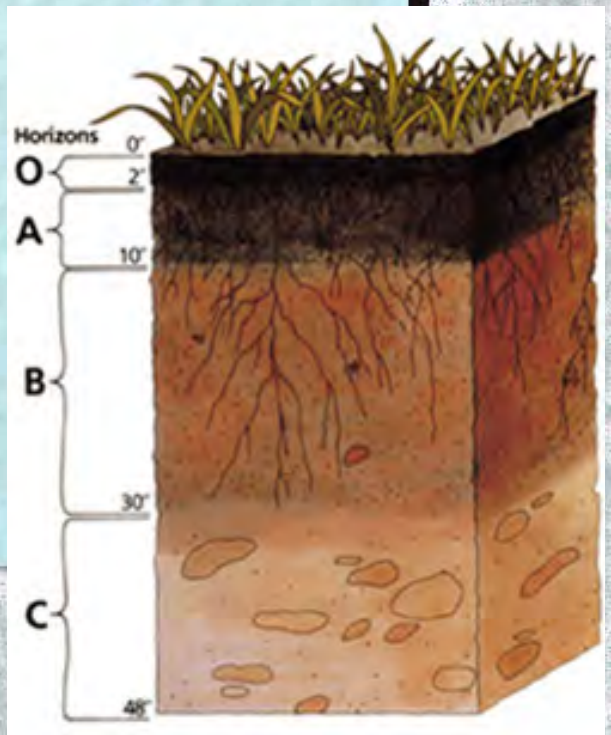
Typical Geology of the Ozark Plateau

- Soils are highly weathered; can be extremely gravelly
- Composed of highly-permeable cherty silty clay residuum
- Vary in depth from 0 feet to >50 feet and are poor quality
- High Iron (Fe) and Aluminum (Al) content
- Because the soils are highly permeable, there is a short retention time; therefore minimal natural filtration of pollutants



Why Do Soils Become Acidic Over Time?

- Parent material - sandstone or shale is more acidic than limestone
- Higher precipitation leaches more of alkaline elements like Ca & Mg, leaving acidic elements such as H, Mn and Al
- Decomposition of organic matter
- Nitrogen fertilization
- Crop grown
- Flooding
- Acid rain can also acidify the soil

What is Karst ?

- Created as groundwater dissolves soluble rock such as limestone or dolomite
- A landscape characterized by the presence of:
  - caves
  - springs
  - sinkholes
  - losing streams

Features of Karst – Limestone

A sedimentary rock composed of calcium carbonate; a rock of marine origin derived from the lime mud and ooze that accumulated on calm, shallow sea floors.

How Does Karst Form?

H_20 (rainwater) + CO_2 (carbon dioxide)

=

H_2CO_3

(weak carbonic acid)

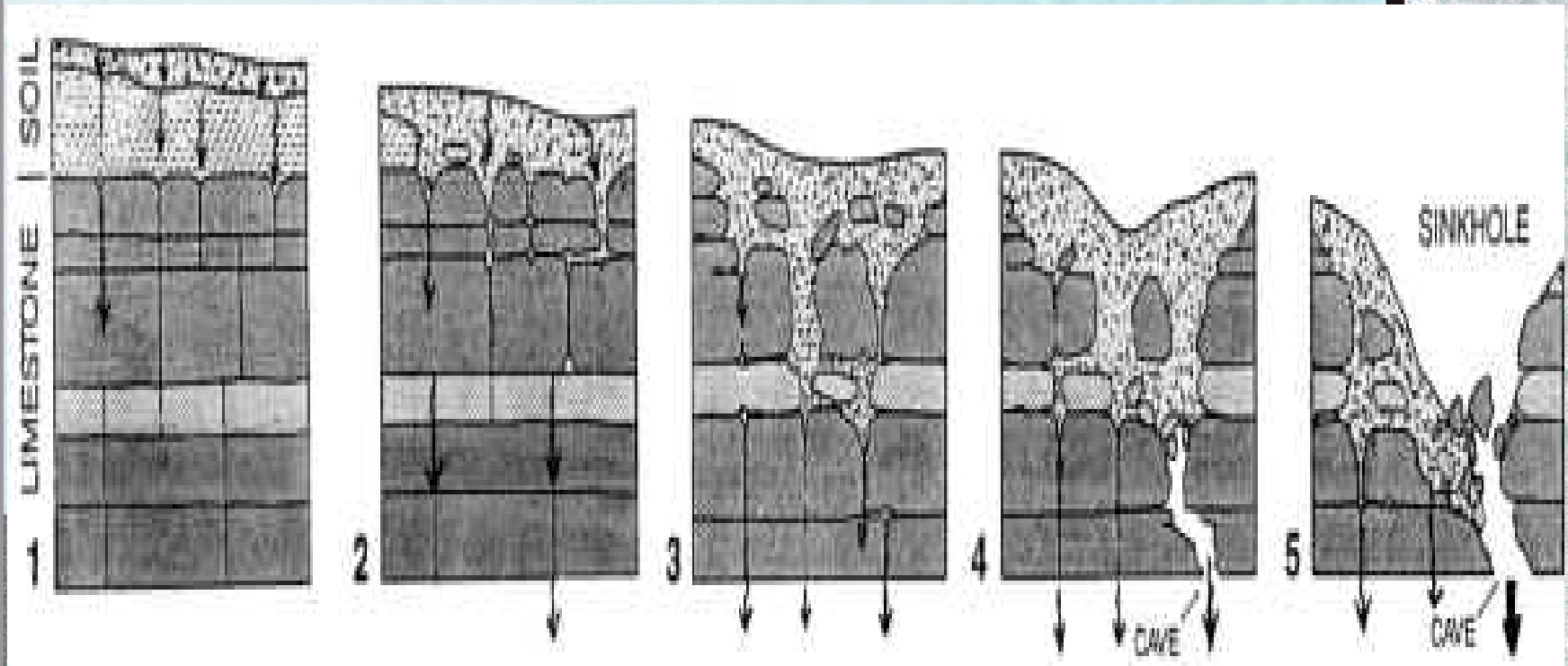
$CaCO_3$ (limestone) + H_2CO_3

=

Ca + CO_2 + H_2O (groundwater)

Basic Solution Weathering Process

- Small fractures in the bedrock allow water to migrate downward. Remember, during this process water is a weak carbonic acid.
- The fractures continue to grow and enlarge, ultimately resulting in the development of underground drainage systems.




Solution
Channel

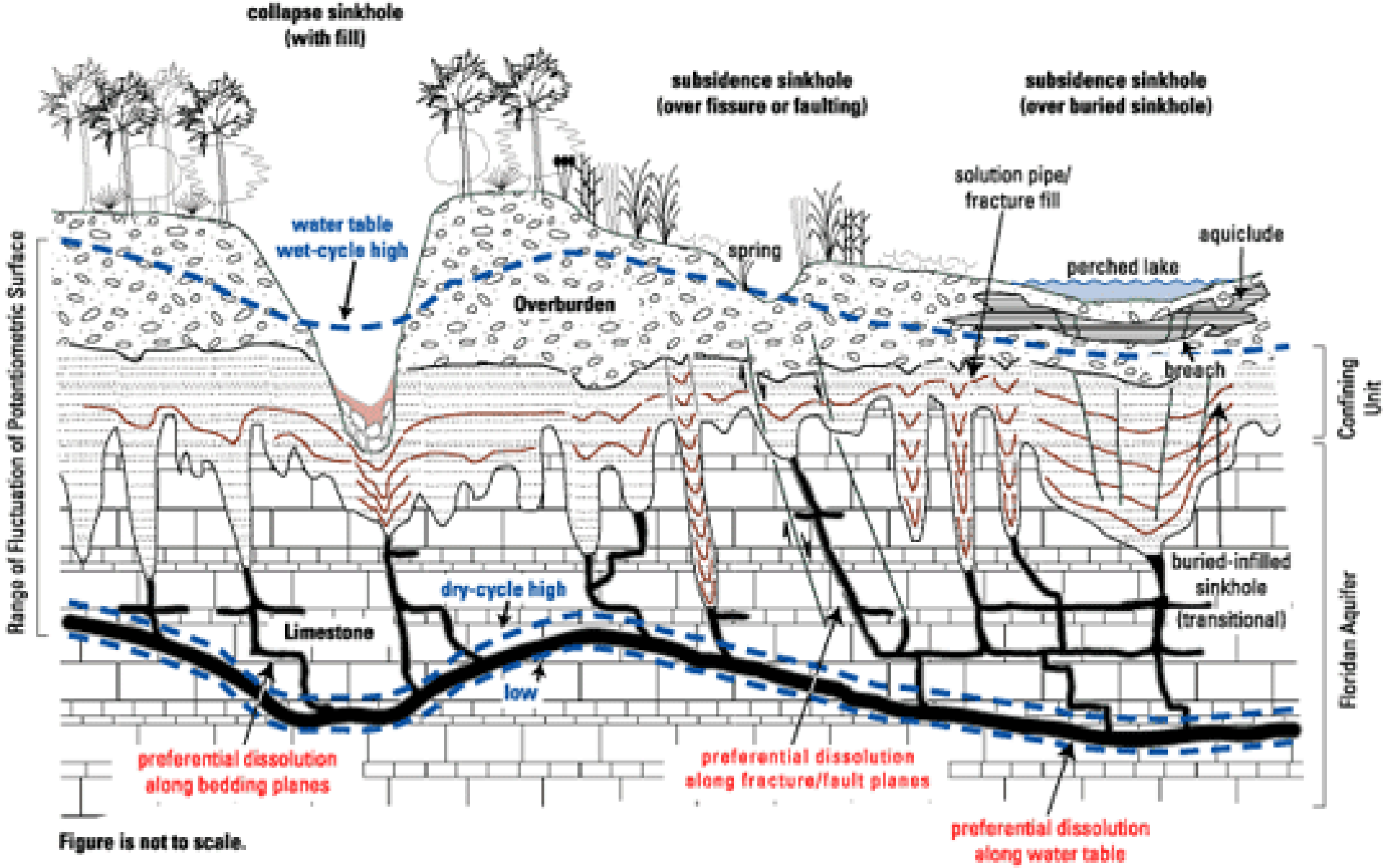
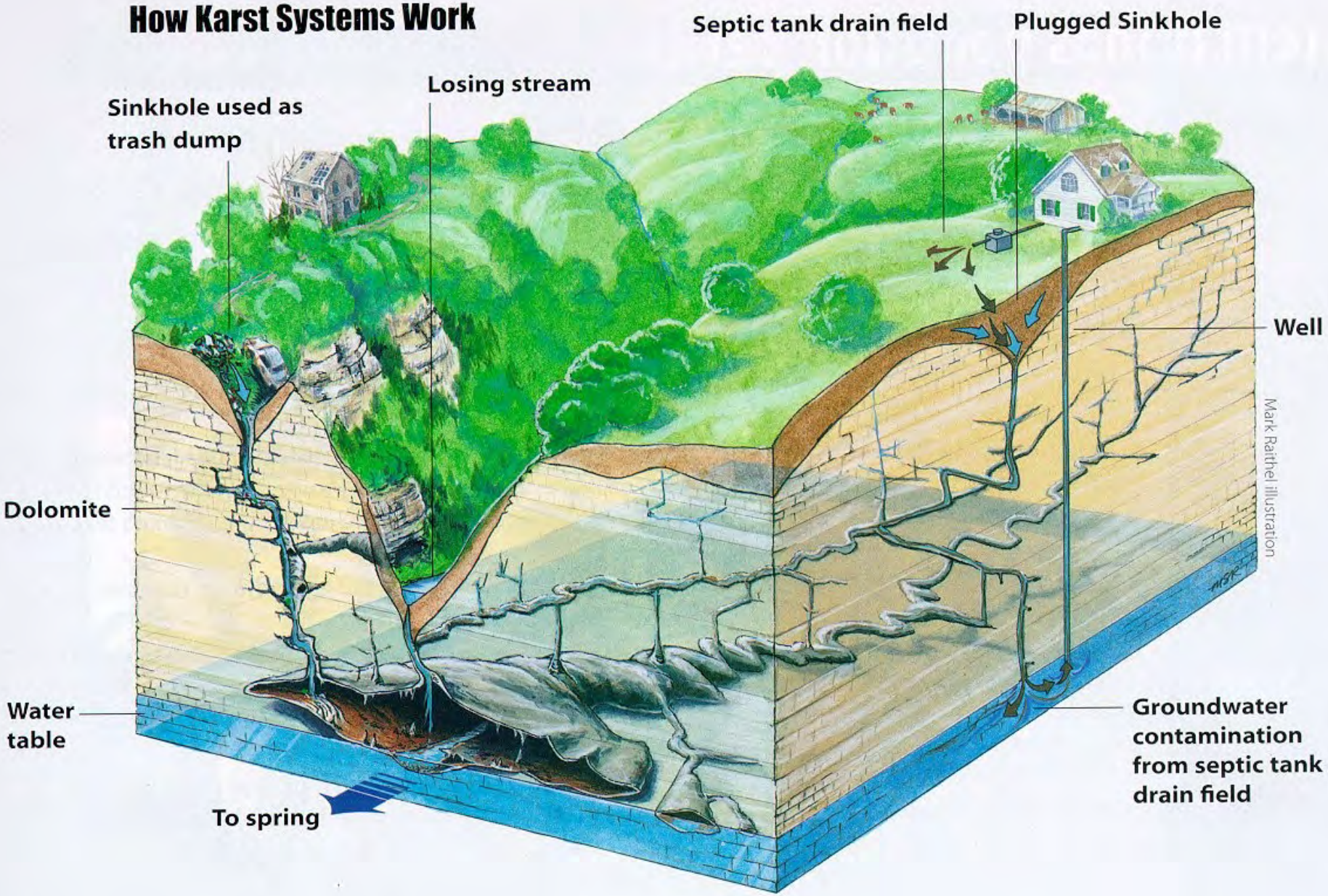


Figure is not to scale.

How Karst Systems Work



Karst Map of the U.S.

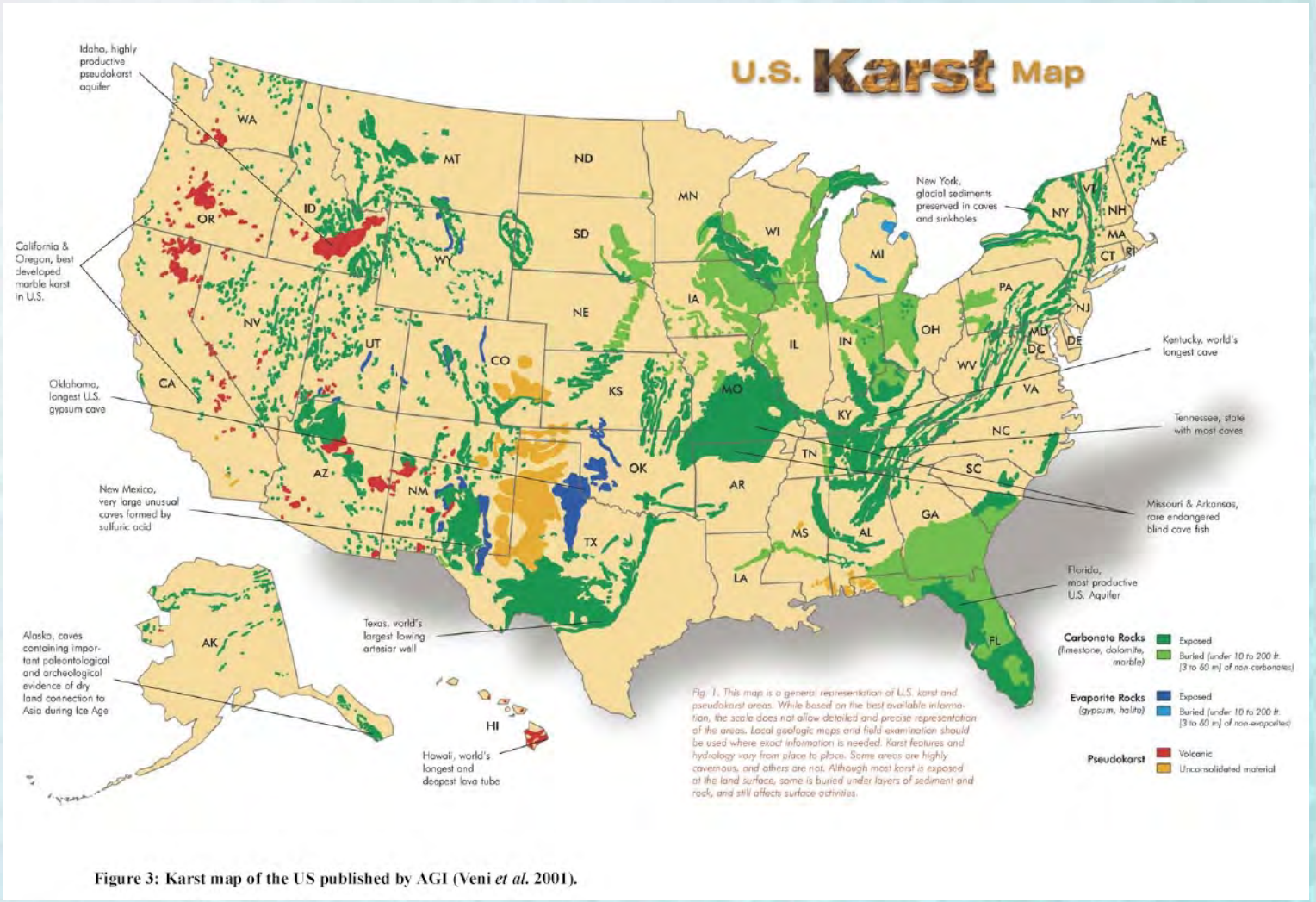


Fig. 1. This map is a general representation of U.S. karst and pseudokarst areas. While based on the best available information, the scale does not allow detailed and precise representation of the areas. Local geologic maps and field examination should be used where exact information is needed. Karst features and hydrology vary from place to place. Some areas are highly cavernous, and others are not. Although most karst is exposed at the land surface, some is buried under layers of sediment and rock, and still affects surface activities.

Figure 3: Karst map of the US published by AGI (Veni *et al.* 2001).

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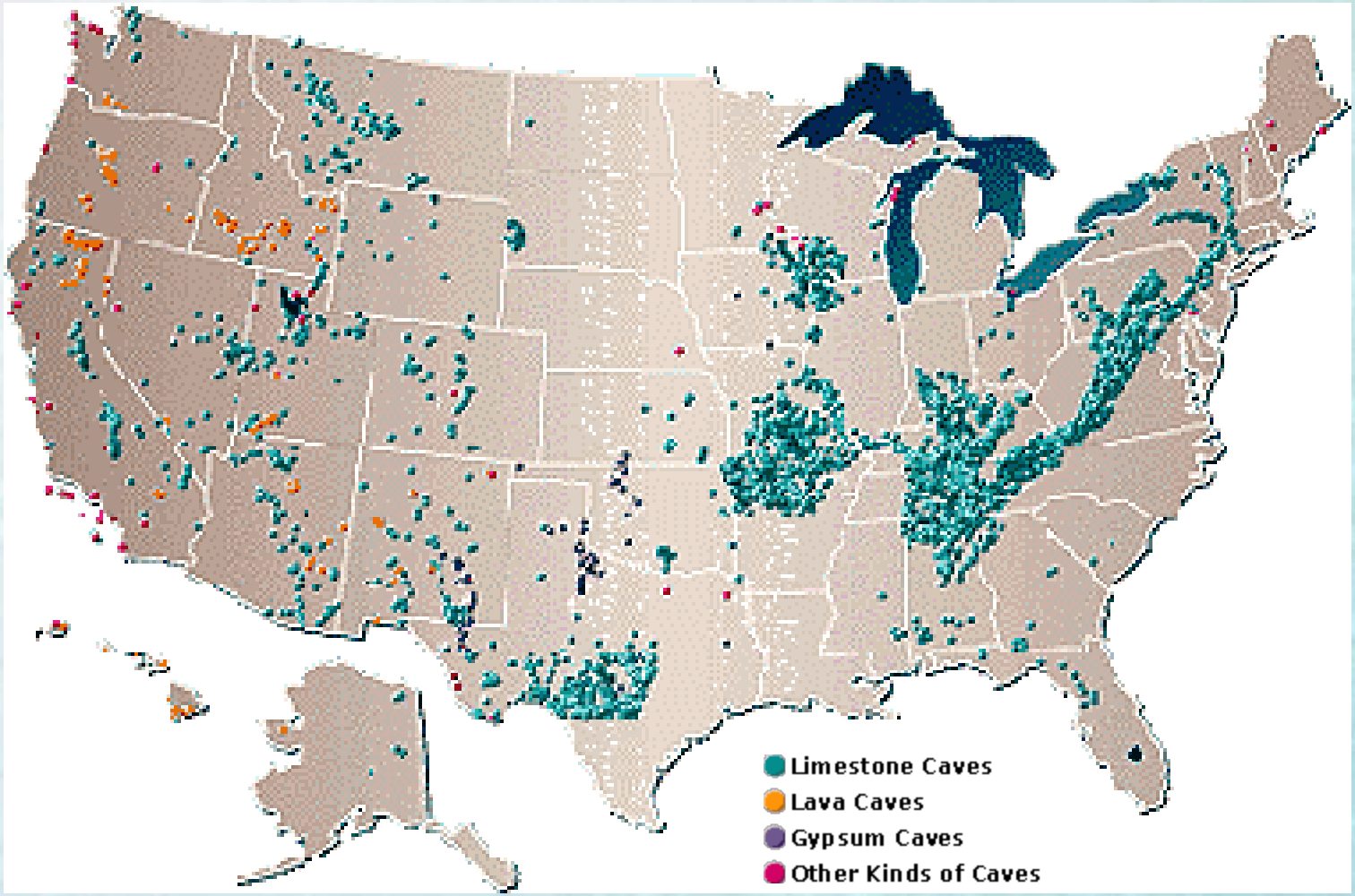
Features of Karst - Caves

A natural cavity beneath the earth's surface. Caves are formed when slightly acidic water combines with limestone or dolomitic rock, and dissolves the rock, creating a cavity.

Where are U.S. Caves ?



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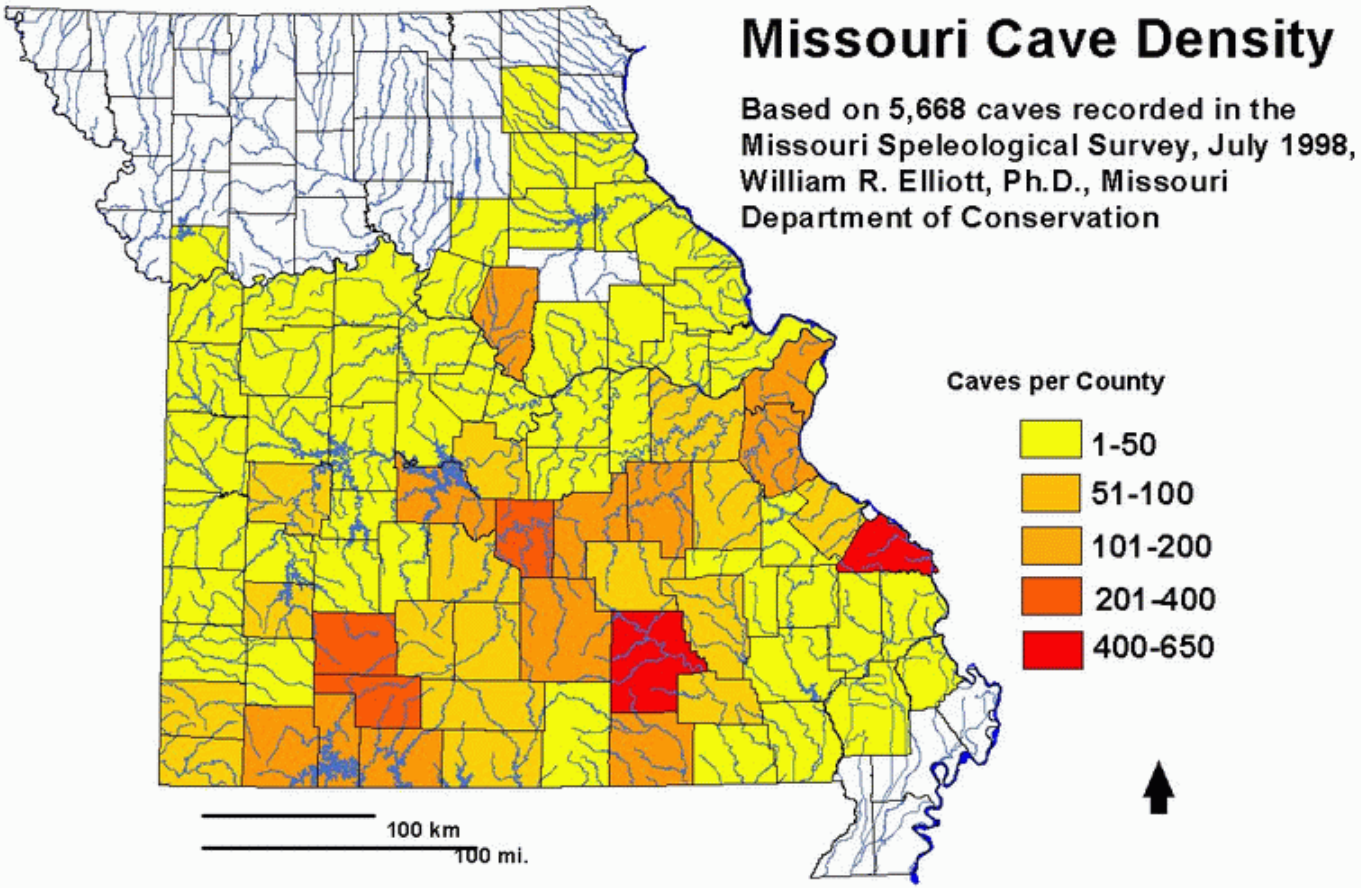
Where are Missouri Caves ?



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Missouri Caves

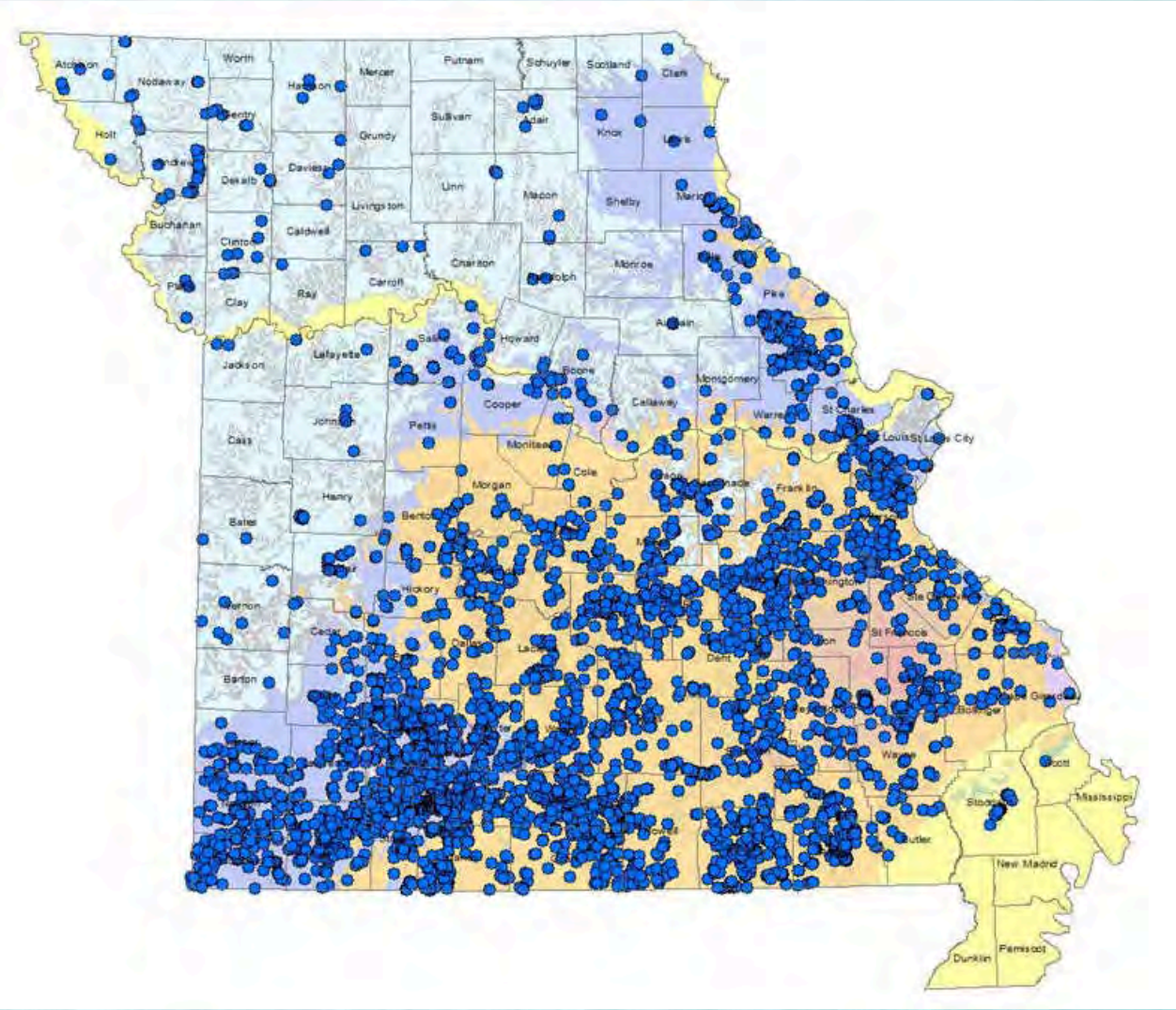
- 6,300+ caves recorded as of 2009
  - Perry 656
  - Shannon 535
  - Greene 360
  - Pulaski 350
  - Stone 283
  - Christian 220
  - Crawford 205
  - Texas 178

Photo credit: www.ozarkhighlandsgrotto.org

Features of Karst - Springs

A natural discharge of water from a rock or soil to the surface

Where are the Springs ?



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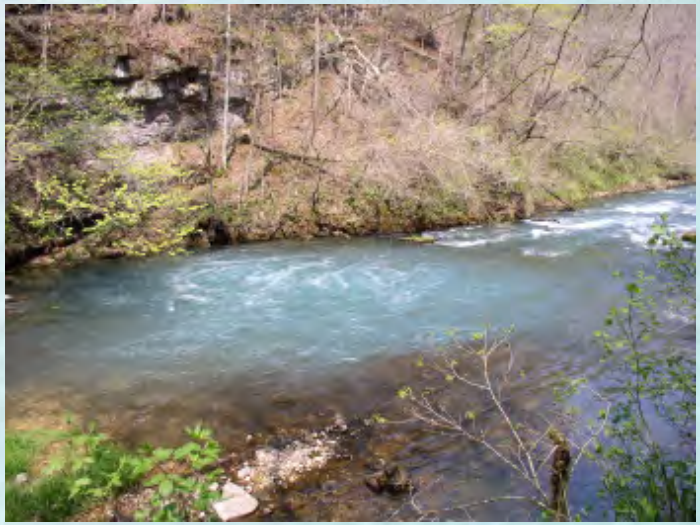
Large Springs of Missouri

Big Spring, Carter County, 289 MGD



Greer Spring, Oregon County, 222 MGD

Bennett Spring, Dallas County, 114 MGD

Source: www.dnr.mo.gov/env/wrc/springsandcaves.htm

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Features of Karst - Sinkholes

- Natural depression in the ground surface formed by the dissolution and collapse in soluble rock
- Ranging in diameter from a few feet to more than 3,000 feet

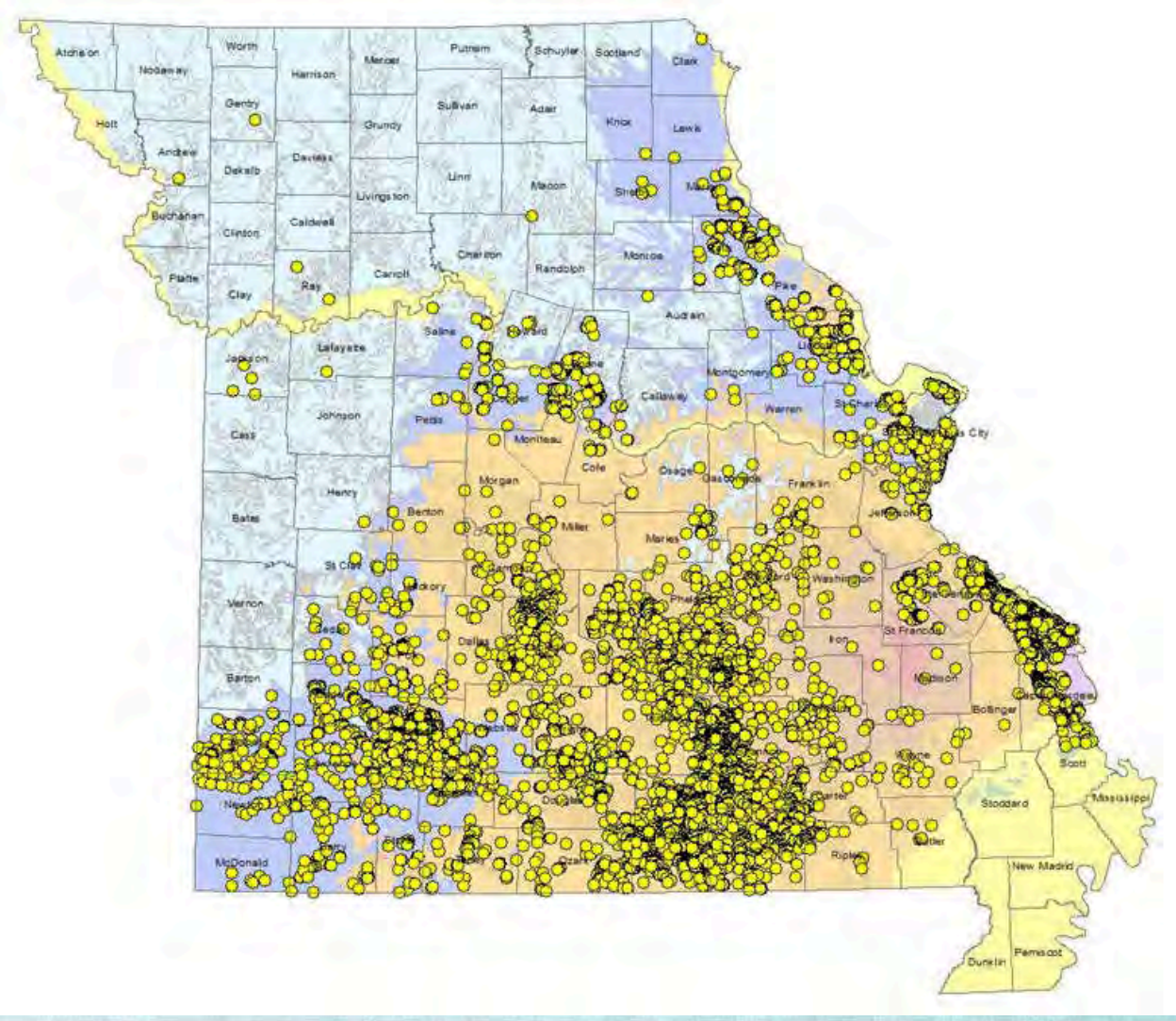
Sinkhole near Edgar Springs in Phelps County

Source: www.dnr.mo.gov/env/wrc/springsandcaves.htm

Features of Karst - Sinkholes

- Depths range from barely discernible to the eye and not represented on topographic maps to hundreds of feet deep
- Drainage is subterranean
- They are direct funnels to the underground

Where are the Sinkholes ?



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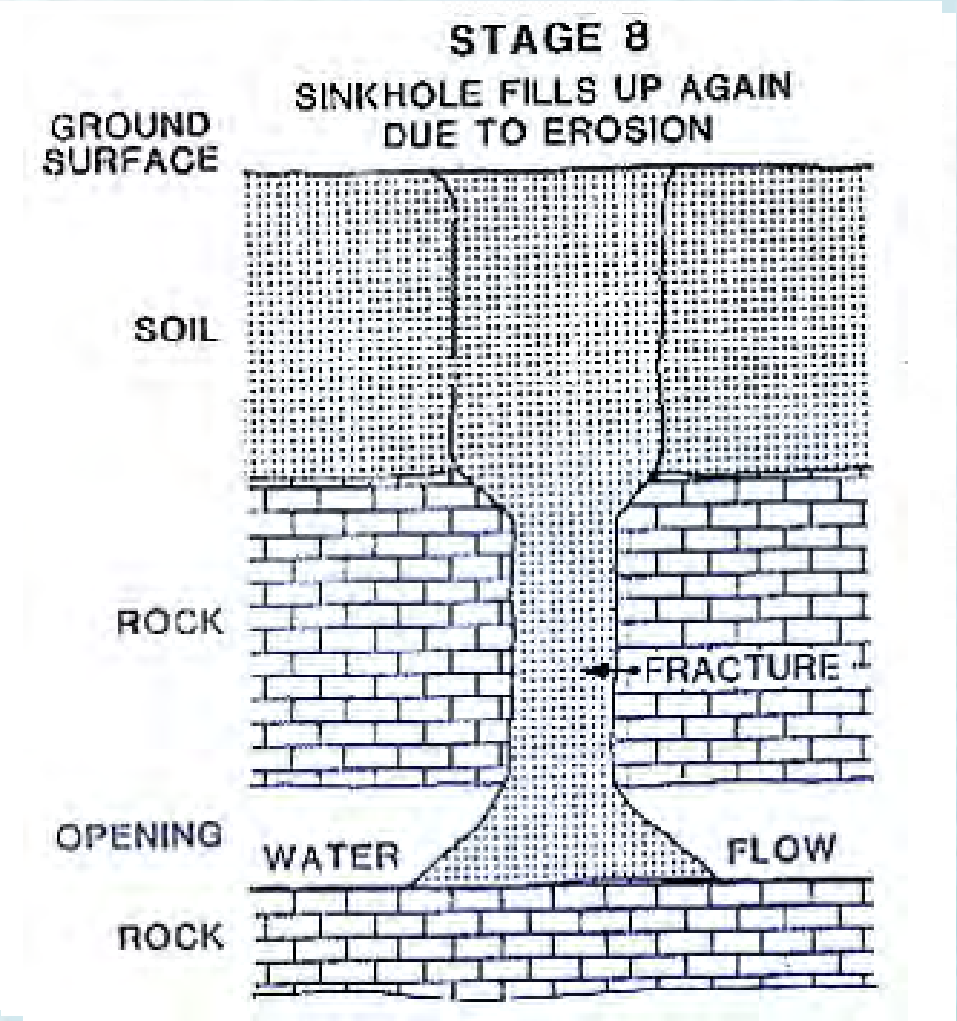
How Sinkholes Form



Source: dnr.mo.gov/geology/geosrv/envgeo/sinkholes.htm

Sinkholes Take Many Shapes

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2004 Berg Sinkhole Collapse, Barry County
This sinkhole developed in one day!

Sinkholes are Funnels to Underground

Sinkhole in residential development on SE corner of
Kansas Expressway and Walnut Lawn, Springfield, MO

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Sinkholes are Funnels to Underground

Trash disposed in Laclede County sinkhole. Dye tracing shows this sinkhole provides recharge to Ha Ha Tonka Spring

Source: www.dnr.mo.gov/env/wrc/springsandcaves.htm

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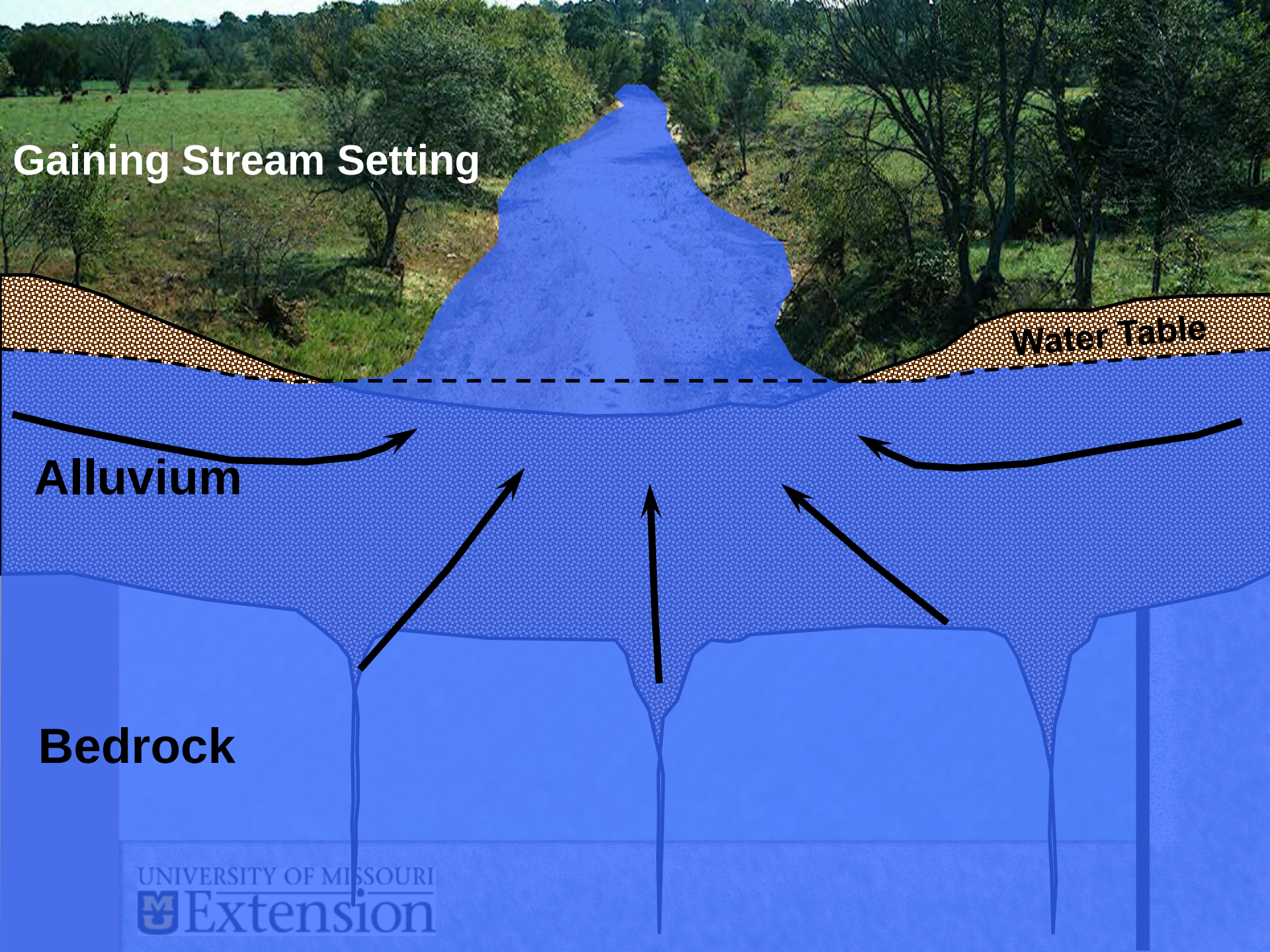
Features of Karst – Losing Streams

- A stream that loses a significant part of its normal runoff into bedrock openings beneath the streambed

Goodwin Hollow, Laclede Co.

On Missouri Highway 5 north of Lebanon, MO, this losing stream drains more than 72 square miles. Water lost underground provides recharge to Bennett, Sweet Blue and Ha Ha Tonka Springs.

Source: www.dnr.mo.gov/env/wrc/springsandcaves.htm


Gaining Stream Setting
Water Table
Alluvium
Bedrock
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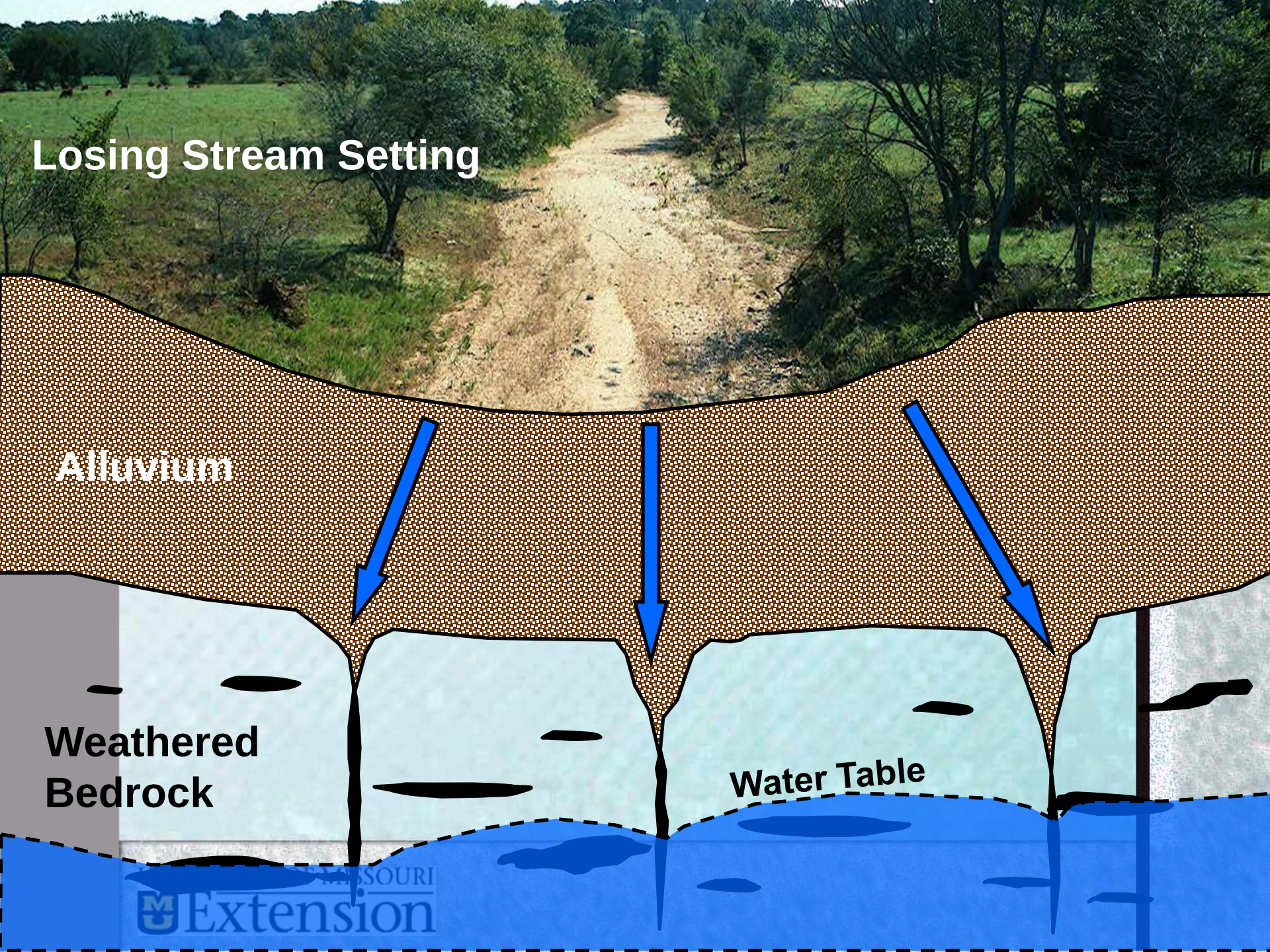
Losing Stream Setting
Alluvium
Weathered
Bedrock
Water Table
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Typical Losing Streams


North Cobb Creek, Laclede County


McDonald County


Taney County


Laclede County

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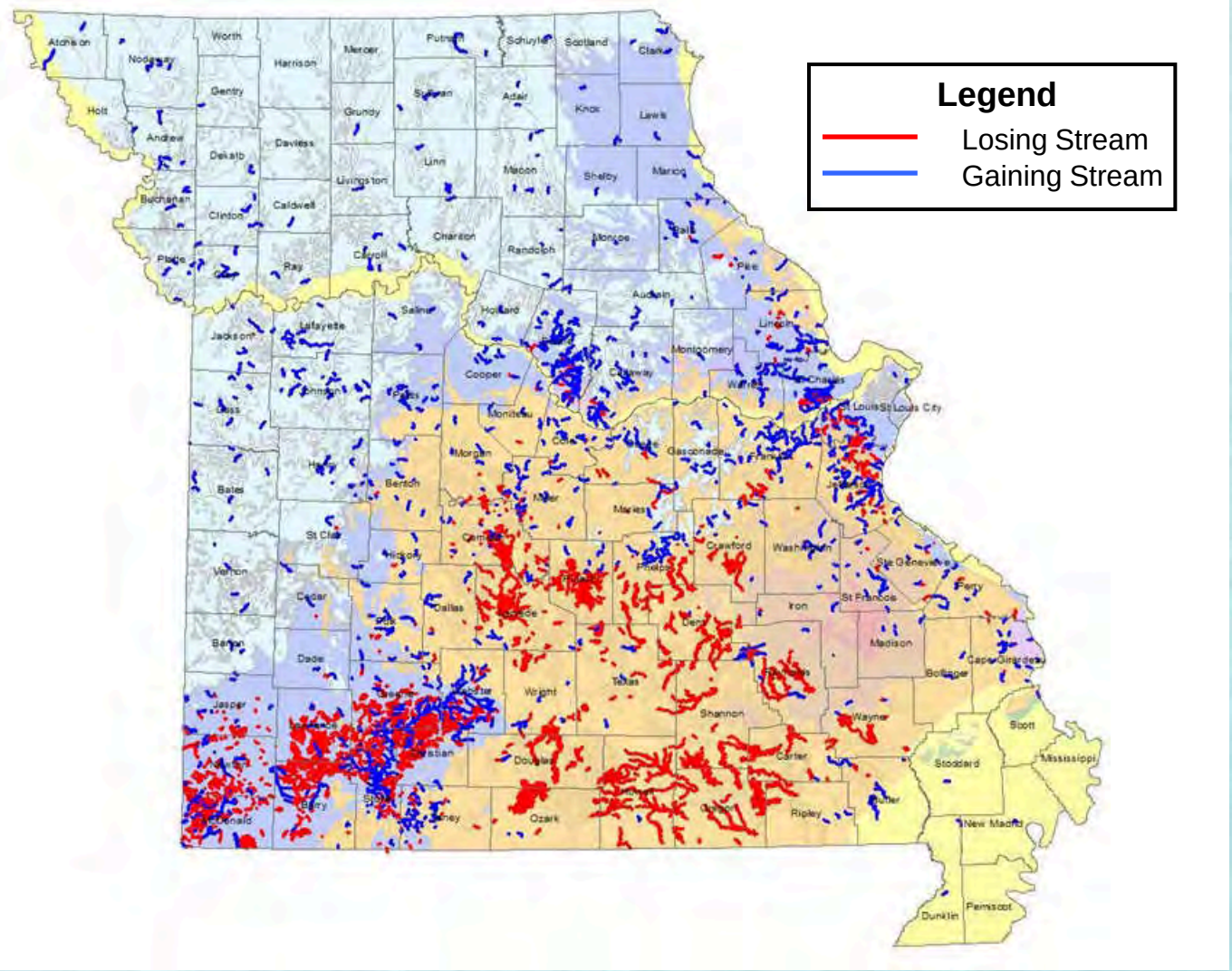
Schluersburg Karst Chasm

St. Charles County

July 2000
Completely filled
with coarse gravel

January 2000
237 feet long,
30 feet deep,
5 to 10 feet wide

Where are Losing & Gaining Streams?



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Tracking Groundwater Flow

Fluorescein dye

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Tracking Groundwater Flow

Rhodamine dye

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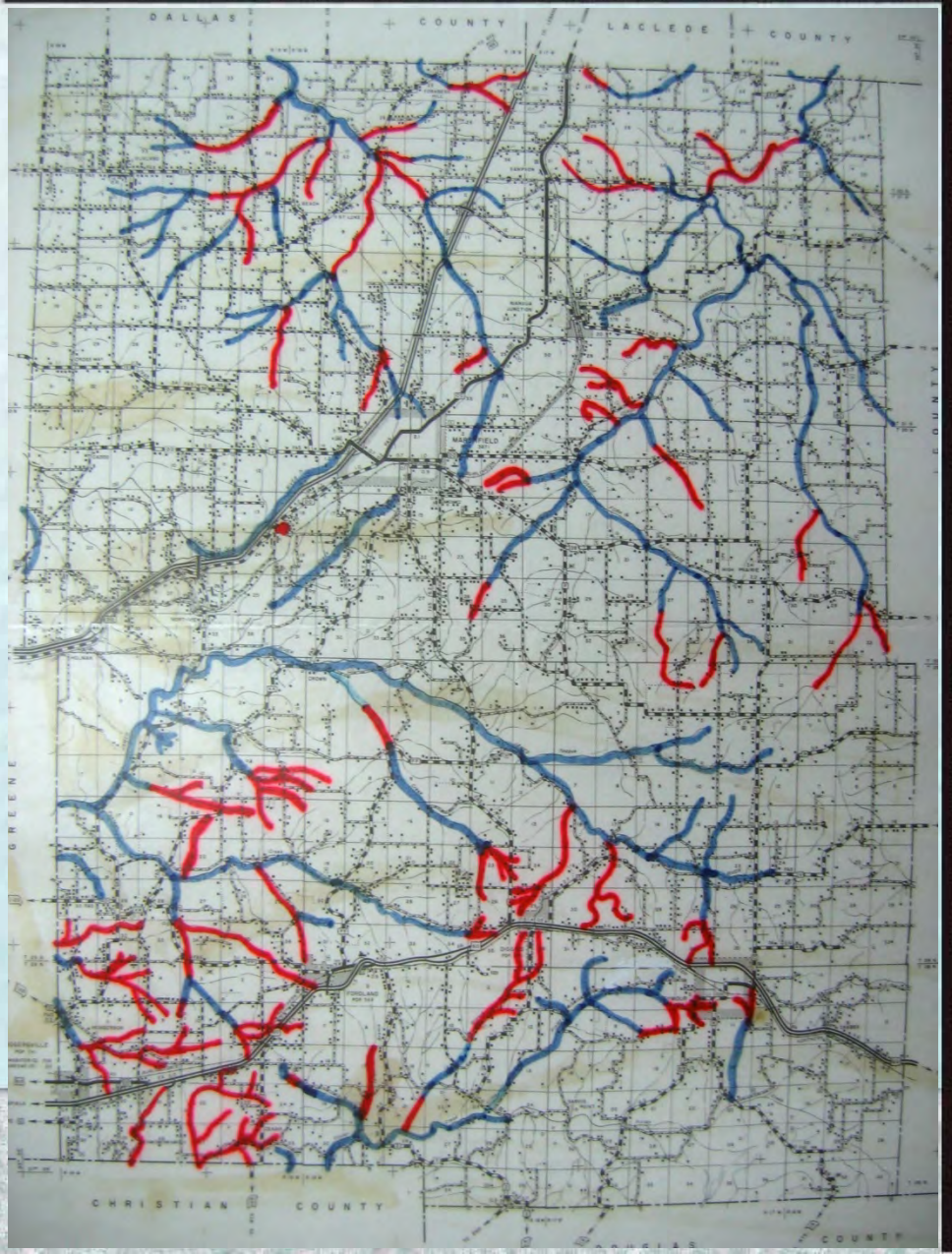
Losing Streams of Webster County

Gaining streams show in blue

Losing streams shown in red



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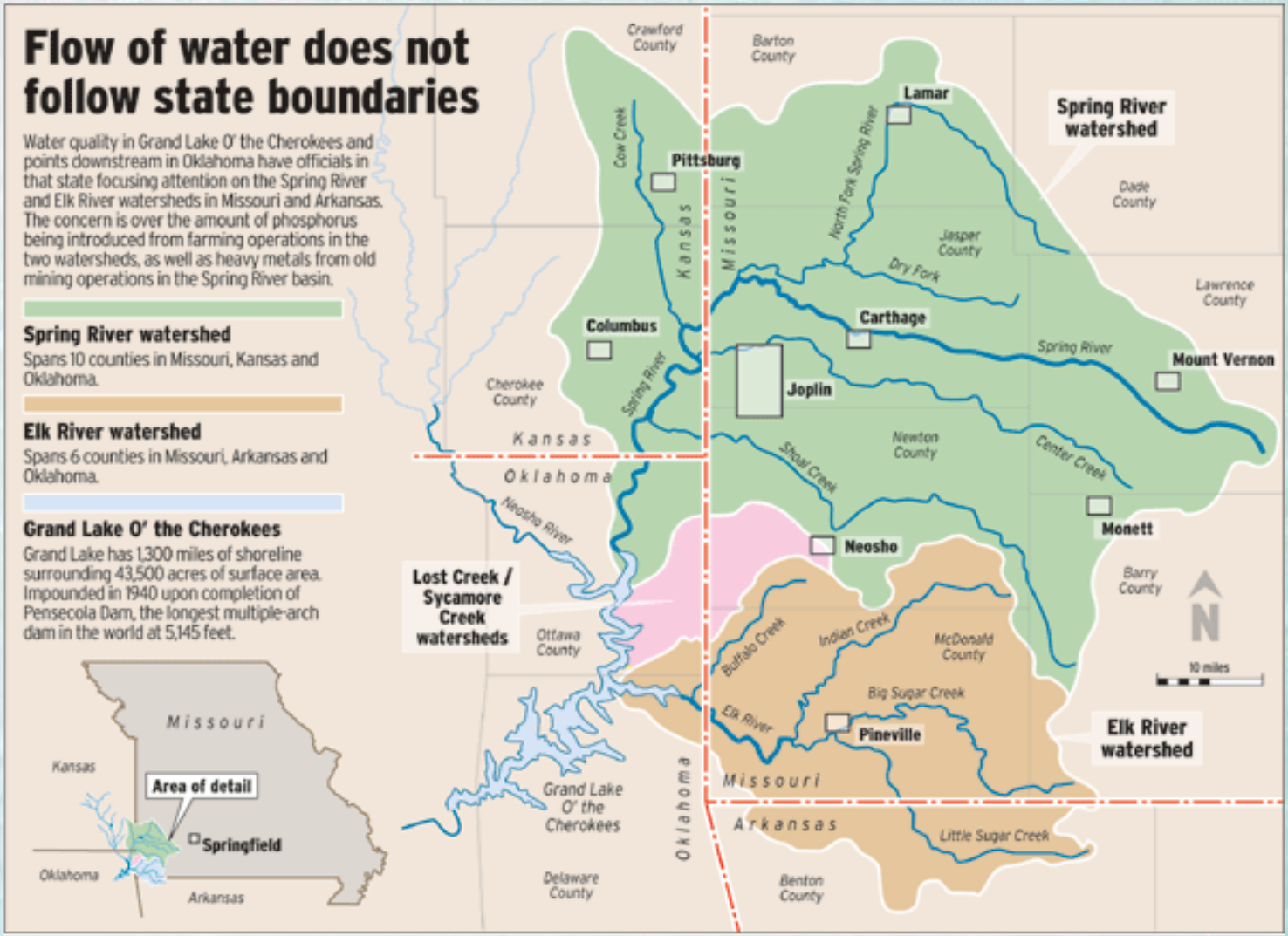

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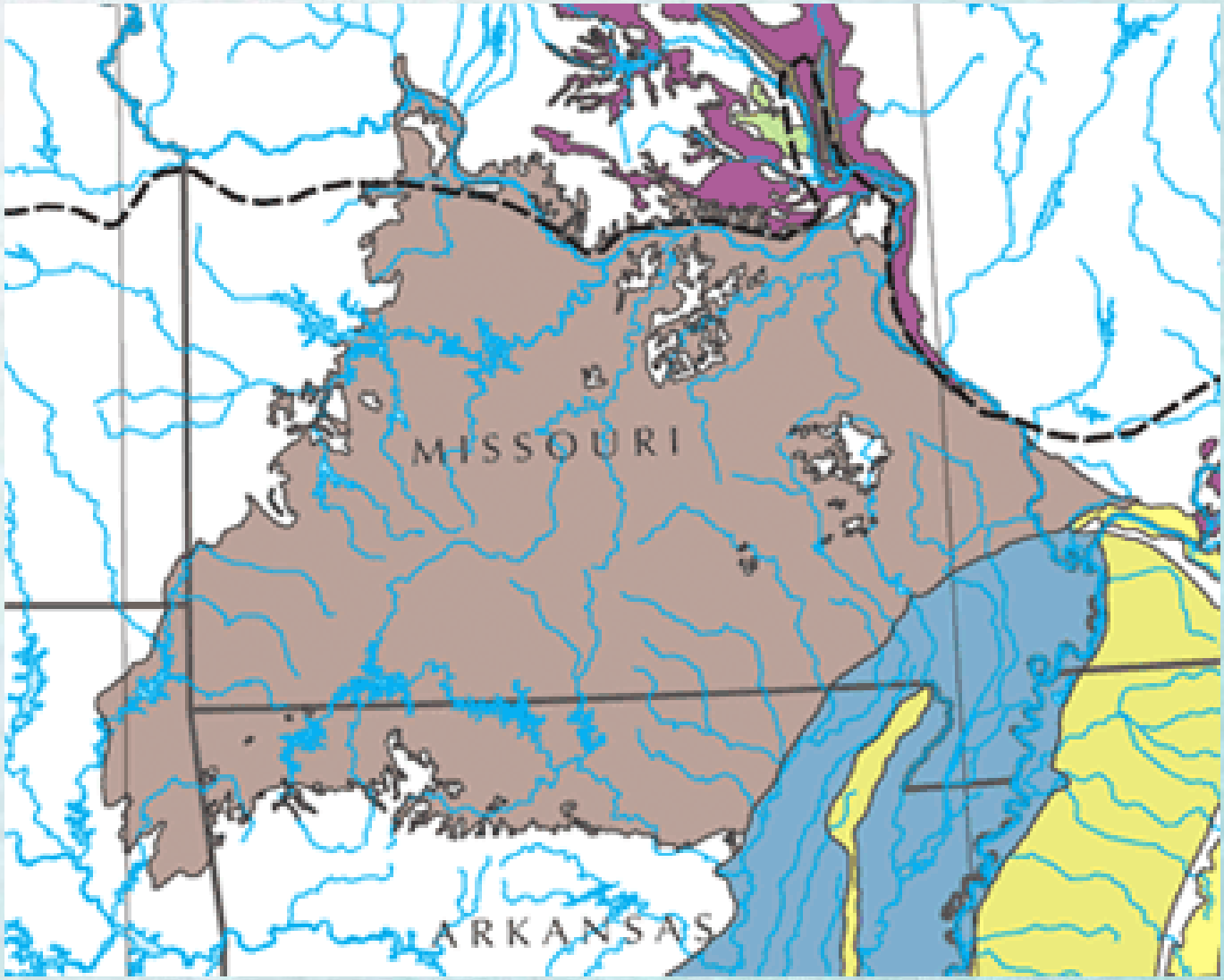
Ozarks Plateau Aquifer System



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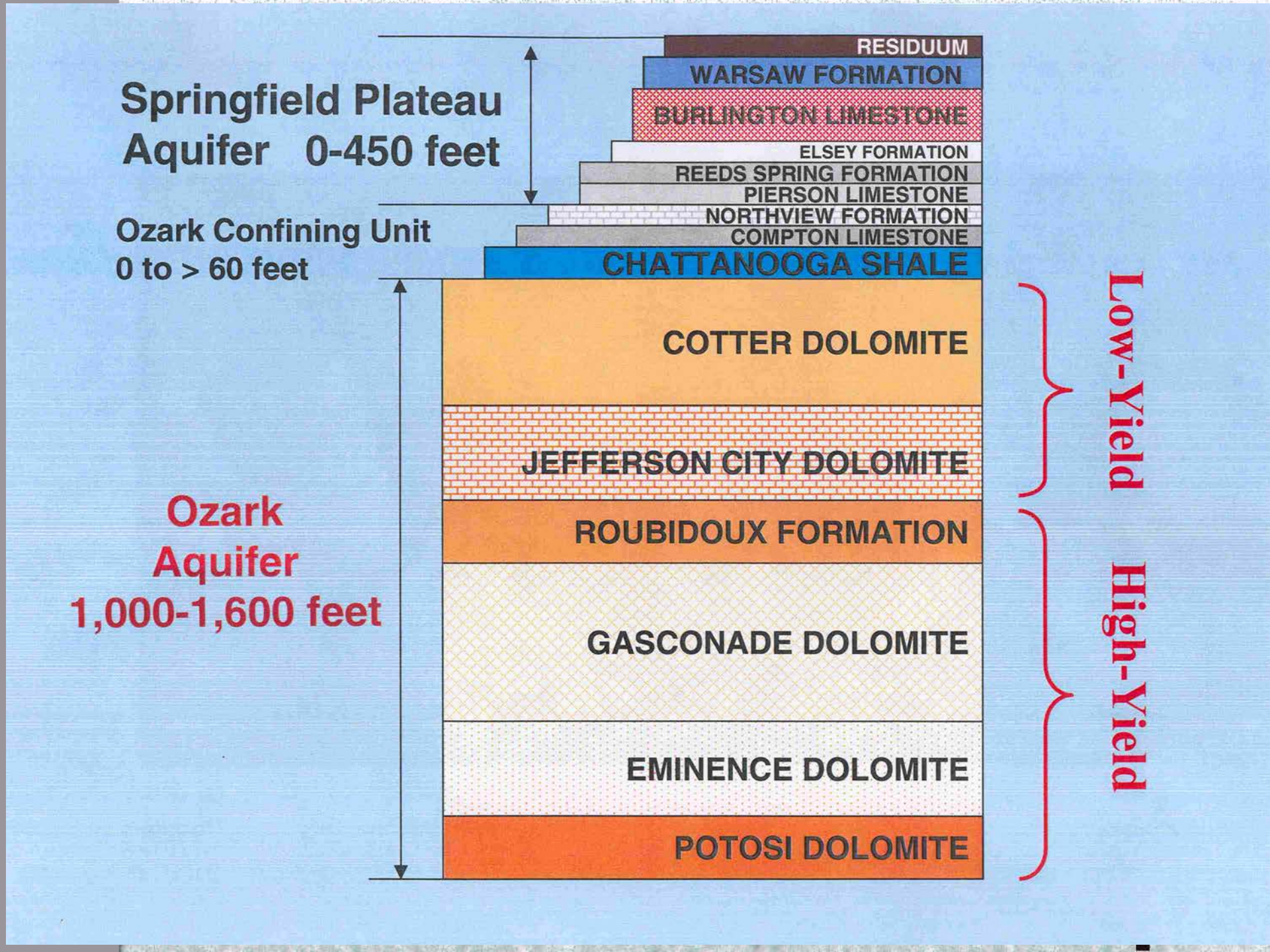
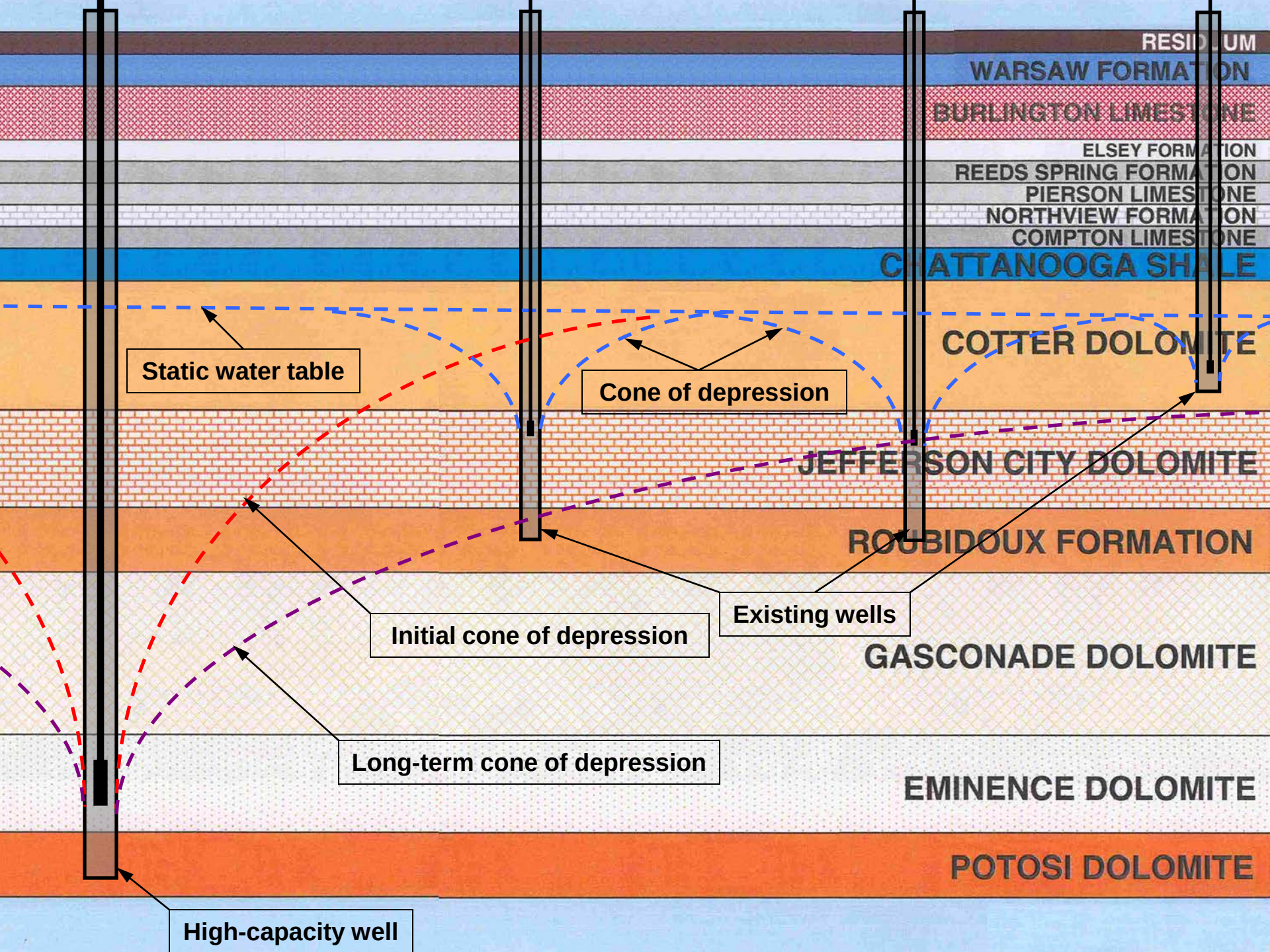

Springfield Plateau Aquifer 0-450 feet
Ozark Confining Unit 0 to > 60 feet
Ozark Aquifer 1,000-1,600 feet
RESIDUUM
WARSAW FORMATION
BURLINGTON LIMESTONE
ELSEY FORMATION
REEDS SPRING FORMATION
PIERSON LIMESTONE
NORTHVIEW FORMATION
COMPTON LIMESTONE
CHATTANOOGA SHALE
COTTER DOLOMITE
JEFFERSON CITY DOLOMITE
ROUBIDOUX FORMATION
GASCONADE DOLOMITE
EMINENCE DOLOMITE
POTOSI DOLOMITE
Low-Yield
High-Yield


RESIDUUM
WARSAW FORMATION
BURLINGTON LIMESTONE
ELSEY FORMATION
REEDS SPRING FORMATION
PIERSON LIMESTONE
NORTHVIEW FORMATION
COMPTON LIMESTONE
CHATTANOOGA SHALE
COTTER DOLOMITE
JEFFERSON CITY DOLOMITE
ROUBIDOUX FORMATION
GASCONADE DOLOMITE
EMINENCE DOLOMITE
POTOSI DOLOMITE
Static water table
Cone of depression
Initial cone of depression
Existing wells
Long-term cone of depression
High-capacity well

Environmental Issues and Impacts

- Water quality degradation
  - Excessive nutrients may reach springs, streams and rivers through groundwater drainage.
  - Nutrients promote algae and aquatic plant growth which can impair water transparency and aquatic life.
  - Household chemicals, oils and cleaning products can also release toxins into the environment.

Algae Bloom on Lake

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Health/Social Issues and Impacts

- Contamination of drinking water by diseases and invasive parasites
  - Cholera
  - Typhoid
  - Salmonella
  - Shigella
  - Staphylococcus
  - Dysentery
  - Hepatitis A, B, C
  - Polio
  - Viral Gastroenteritis
  - Cryptosporidiosis
  - Giardiasis
  - Worms (flat, tape, round, hook)

Current cases in the Ozarks

Health/Social Issues and Impacts

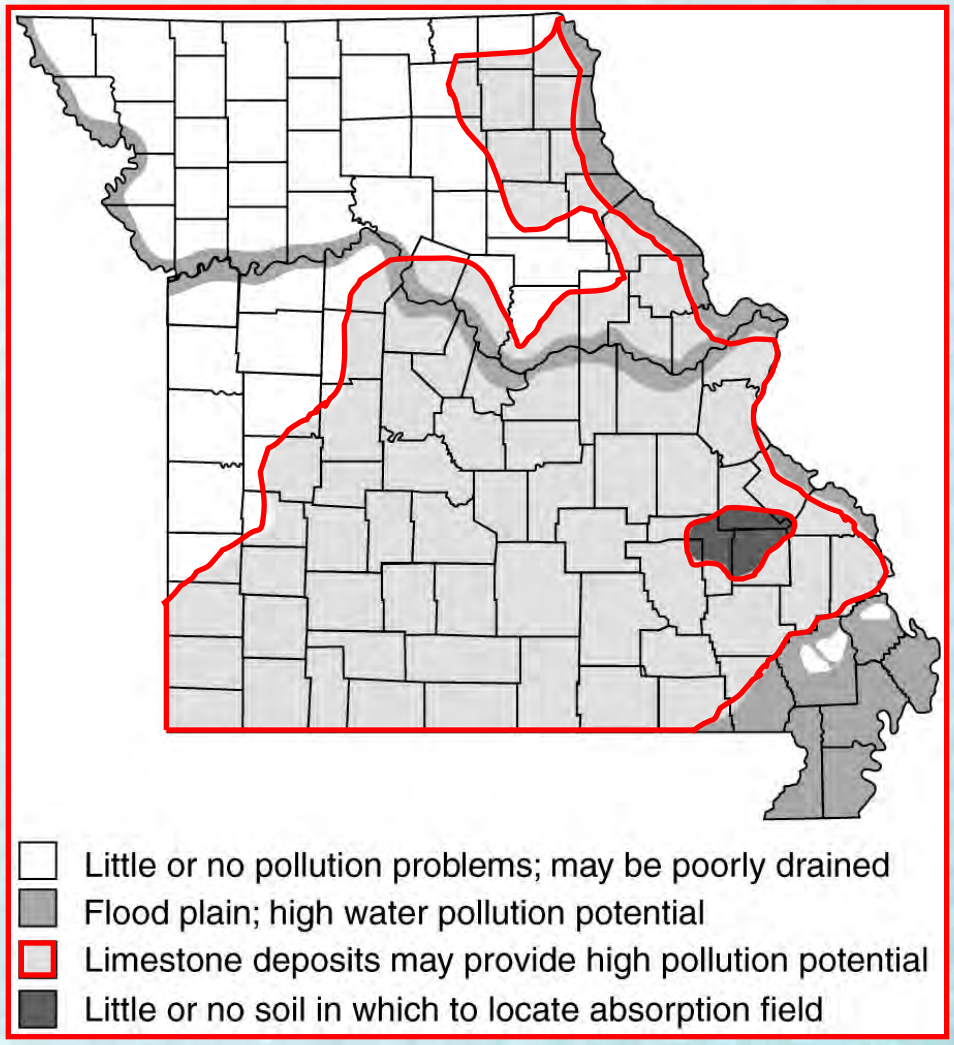
- Quality of life
  - Aesthetic (scenic environment)
  - Economic (tourism)
  - Recreation (fishing, boating, swimming)
  - Safety

Aerial photo of 1999 algae bloom in the James River arm of Table Rock Lake (Missouri DNR photo)

Environmental “Hot Spots”

- Failing septic systems
- Abandoned wells
- Livestock lagoons
- On-farm solid waste disposal
- On-farm fuel storage areas
- Hazardous materials disposal
- On-farm pesticide & fertilizer storage areas
- Former methamphetamine labs

Failing Septic Systems



Septic System Soil Selection Matrix

Soil Dispersal System	Severe Soil Rating (See County Soil Survey Book for Soil Ratings)				
	Shallow to Bedrock	Rapidly Permeable	Slowly Permeable	Water Table	Steep Slope
Soil-Absorption (Gravity)	No	No	No	No	Yes
Shallow-Placed (Gravity)	Maybe	Maybe	No	Maybe	Maybe
Sand-Lined Trenches (Gravity)	No	Yes	No	No	Yes
Aerobic Lagoon	No	No	Yes	Maybe	No
Low-Pressure Pipe (LPP)	Maybe	Maybe	Maybe	Maybe	Yes
Drip Irrigation	Yes	Yes	Yes	Maybe	Yes
Mound	Maybe	Yes	No	Yes	No

= Soils not suitable for sewage system

= Soils possibly suitable for sewage system

= Soils acceptable for sewage system

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Abandoned Wells

- MoDNR estimates that Missouri has more than 150,000 abandoned wells (1 well per 80 acres)
- State law requires that abandoned wells be properly plugged. This can be done by the landowner or by a professional.
- Why plug an abandoned well?
  - Reduces health risk
  - Reduces liability
  - Reduces chance of environmental contamination to groundwater

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Abandoned Wells

- Plugging is responsibility of landowner
- Plugged wells must be registered with MoDNR
- Typical cost = $300 to $1000
- See:
  - *Eliminating an Unnecessary Risk: Abandoned Wells & Cisterns* www.dnr.mo.gov/pubs/pub2281.pdf
  - *Casing Depth Request Form* www.dnr.mo.gov/forms/780-1426-f.pdf
  - *Abandonment Registration Record* www.dnr.mo.gov/forms/780-1603-f.pdf

Livestock Lagoons

- If not in use but was a permitted lagoon, owner must follow DNR regulations to properly close or abandon the lagoon.
- DNR land disturbance permit is required if 1+ acre(s) affected (Phase II Stormwater Rules).
- Lagoons can create environmental & liability problems, or can be a selling point if they can be rejuvenated as a pond or lake.
- See:
  - *Guide to Animal Feeding Operations* www.dnr.mo.gov/pubs/pub915.pdf

On-farm Solid Waste Disposal

Three main ways of trash disposal

1. Burning
2. Ditch or ravine
3. Have it hauled off by professional company

On-farm Solid Waste Disposal

- If a burn area, what is effect on property value?
  - Household trash only
  - *Facts on Open Burning under Missouri Regulations* www.dnr.mo.gov/pubs/pub2047.pdf
- If a ditch or ravine, what are cleanup procedures?
- If buried, dump must be listed with county recorder's office & becomes part of the property's legal description
  - *Report Illegal Dumping* www.dnr.mo.gov/env/swmp/dumping/enf_instruct.htm
  - *Management of Scrap Tires* www.dnr.mo.gov/pubs/pub2056.pdf
- Recommend to recycle, reuse or haul away

On-farm Fuel Storage Areas

- Fuel storage tanks and other areas must be reviewed to determine if they might create an environmental problem that will reduce the land value.

- See:
  - *Assessing Risk of Petroleum Product Storage* extension.missouri.edu/p/WQ654

Hazardous Materials Disposal

- Farm or household hazardous materials disposal areas may be a point of environmental concern that will affect property values.
- Paints, adhesives, cleaners, pesticides and many day-to-day materials are classified as hazardous materials and the area where they are disposed of must be treated accordingly.
- See:
  - *Assessing Risk from Hazardous Waste Management* extension.missouri.edu/p/WQ655
  - *Hazardous Waste in Missouri* www.dnr.mo.gov/pubs/pub919.pdf

On-farm Pesticide & Fertilizer Storage and Handling Areas

- Review areas for human health & environmental concerns where pesticides and/or fertilizer were stored, mixed or disposed
- See:
  - *Assessing Risk from Fertilizer Storage and Handling*
    extension.missouri.edu/p/WQ653

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Former Methamphetamine Labs

- Contact local law enforcement agency
- Ask for contractor name who removed materials
- Be sure buildings are aired out properly
- See:
  - *Methamphetamine Awareness*
    www.justice.gov/archive/olp/methawareness
    www.methproject.org
  - *Cleaning Up Former Methamphetamine Labs*
    health.mo.gov/atoz/pdf/MethLabCleanup Guidelines.pdf

For More Information

- DNR Division of Environmental Quality
  www.dnr.mo.gov/env
- Missouri Ozarks
  www.dnr.mo.gov/pubs/pub655.pdf
- What You Should Know Before You Build
  www.dnr.mo.gov/pubs/pub484.pdf
- Water Protection Resources
  extension.missouri.edu/webster/water.aspx
- University of Missouri Guidesheets
  extension.missouri.edu/publications

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Questions??

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Natural Resource Engineering Specialist
Webster County Extension Center
800 S. Marshall St.
Marshfield, MO 65706
Voice: 417-859-2044
Fax: 417-468-2086
E-mail: schultheisr@missouri.edu
Web: extension.missouri.edu/webster

Program Complaint Information

To file a program complaint you may contact any of the following:

University of Missouri

- MU Extension AA/EEO Office
  109 F. Whitten Hall, Columbia, MO 65211
- MU Human Resources Office
  130 Heinkel Bldg, Columbia, MO 65211

USDA

- Office of Civil Rights, Director
  Room 326-W, Whitten Building
  14th and Independence Ave., SW
  Washington, DC 20250-9410

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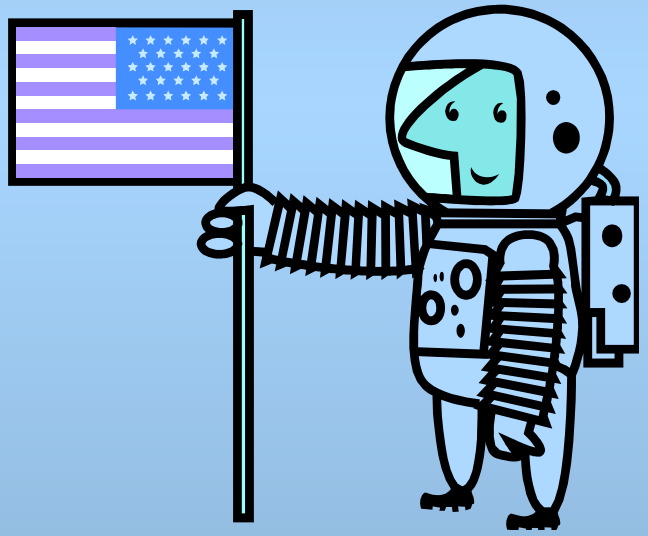
Persuasive Strategies

Claim

State your argument.



Example: I am going to try to convince you that chocolate is a healthy snack.

Big Names

Important people or experts can make your argument seem more convincing.

Example: Former U.S. president Bill Clinton thinks that junk food should be taken out of vending machines.

Logos

Facts, numbers, and information can be very convincing.

Example: A Snickers bar has 280 calories and 30 grams of sugar. That's not very healthy.

Pathos

Getting people to feel happy, sad, or angry can help your argument.

Example: Your donation might just get this puppy off the street and into a good home.

Ethos

If people believe and trust in you, you're more likely to persuade them.

Example: Believe me! I've been there before. I'm just like you.

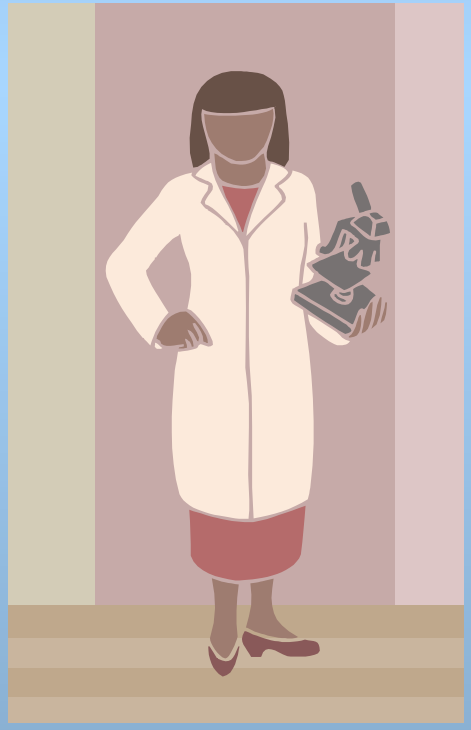
Kairos

Try to convince your audience that this issue is so important they must act now.

Example: This is a one-time offer. You can't get this price after today.

Research

Using reliable research can help your argument seem convincing.



Example: A recent study found that students who watch TV during the week don't do as well in school.