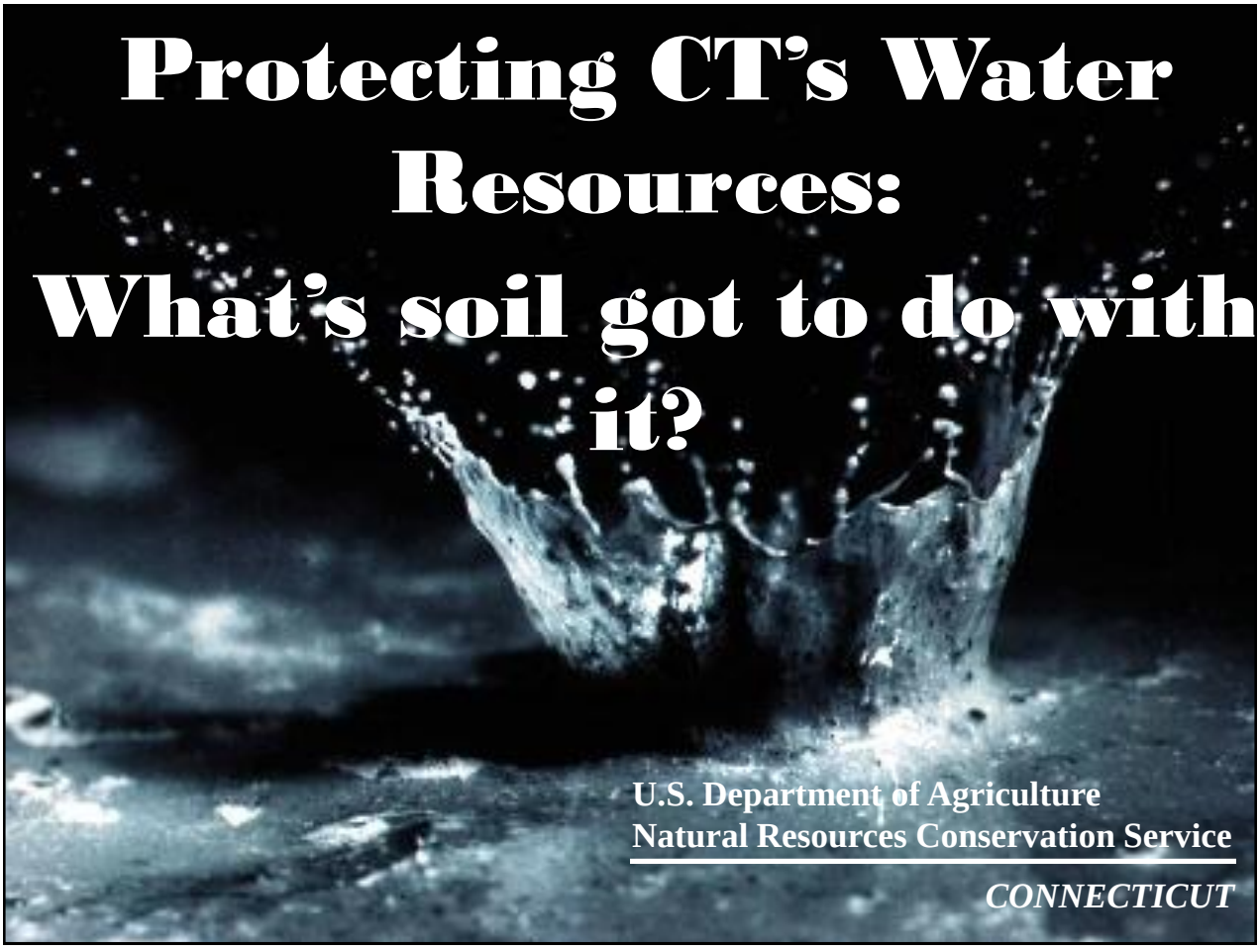
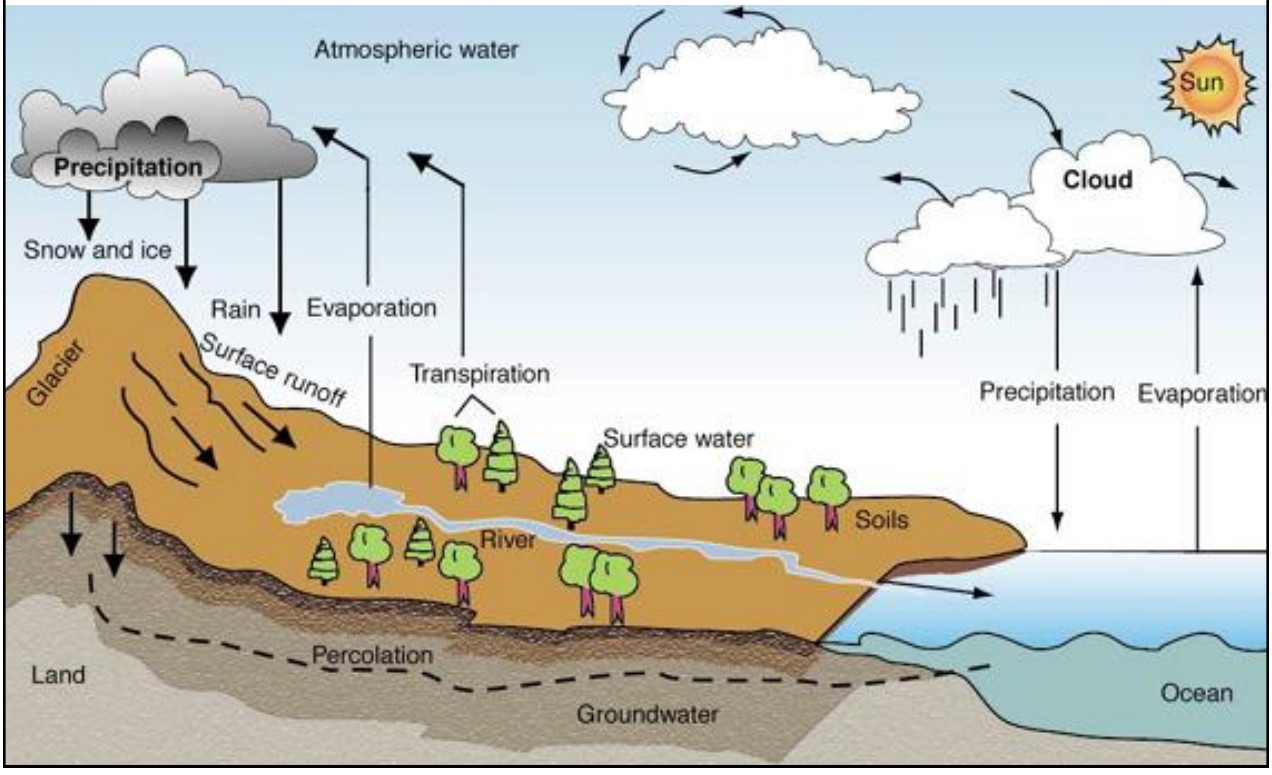
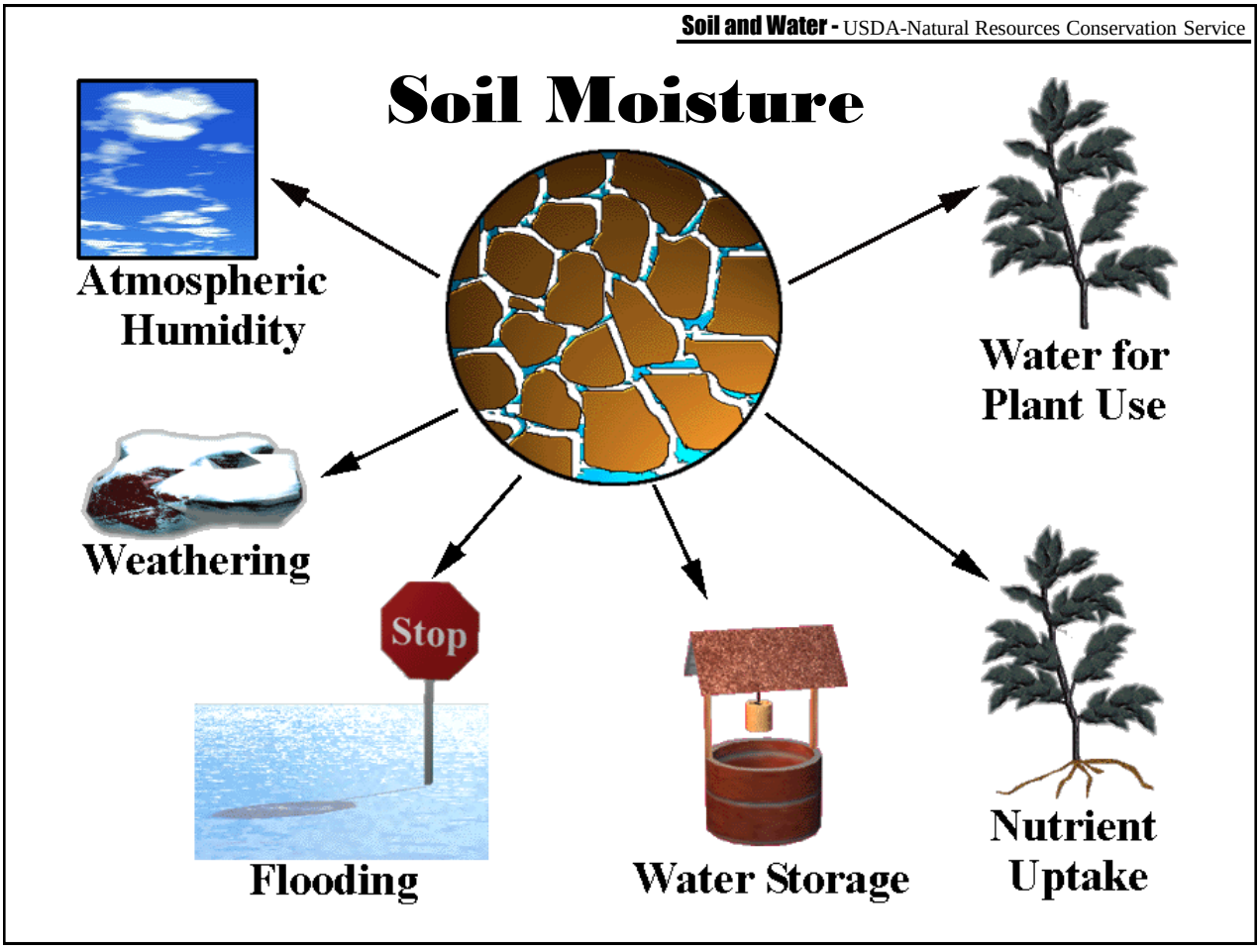

Protecting CT's Water Resources:
What's soil got to do with it?
U.S. Department of Agriculture
Natural Resources Conservation Service
CONNECTICUT

Soil and Water - USDA-Natural Resources Conservation Service

Hydrologic Cycle

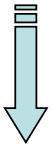



Soil Moisture
Atmospheric Humidity
Water for Plant Use
Weathering
Stop
Flooding
Water Storage
Nutrient Uptake

Annual Amounts in Connecticut

Precipitation

(averages 42 – 52 inches)

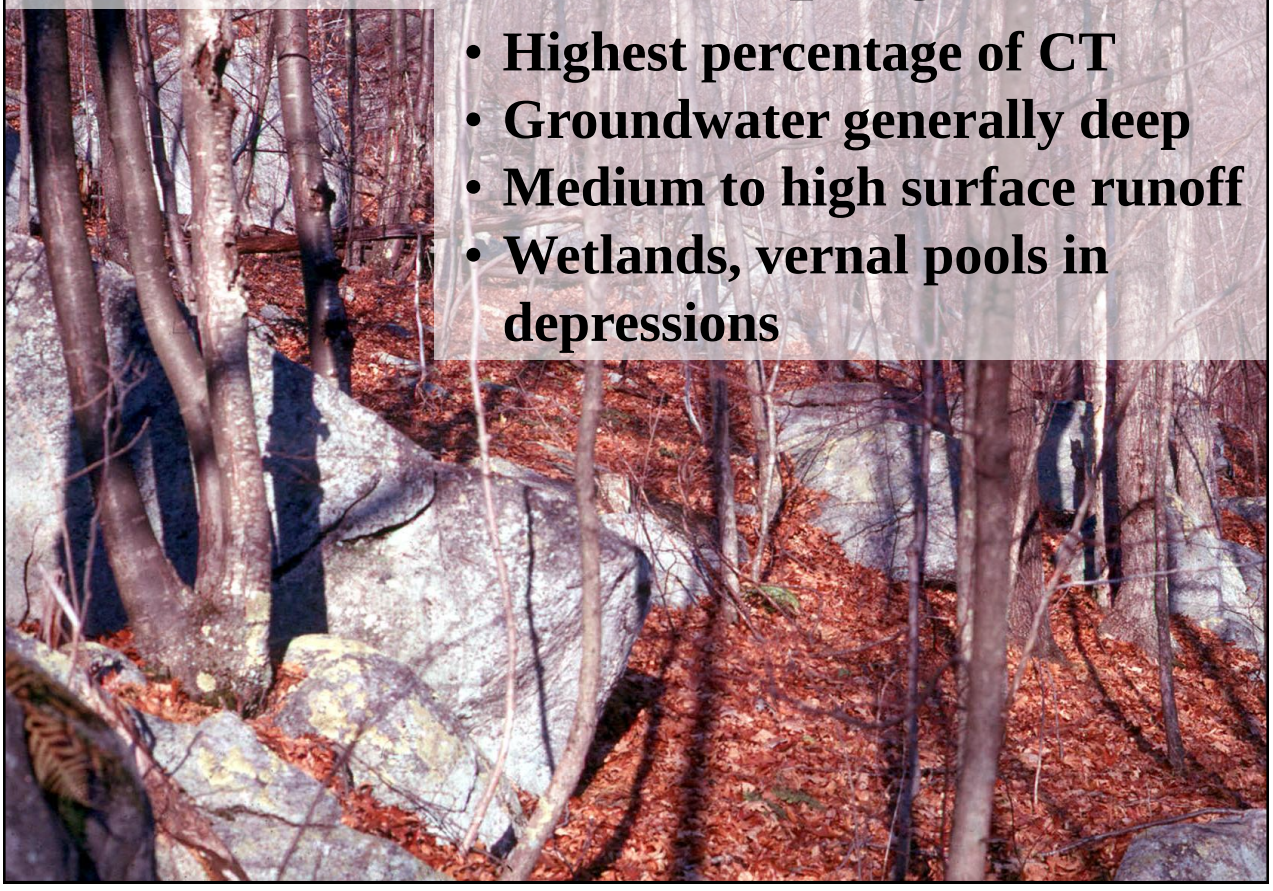


Evapotransportation: averages 22 – 24 inches

Runoff: averages 22 – 26 inches

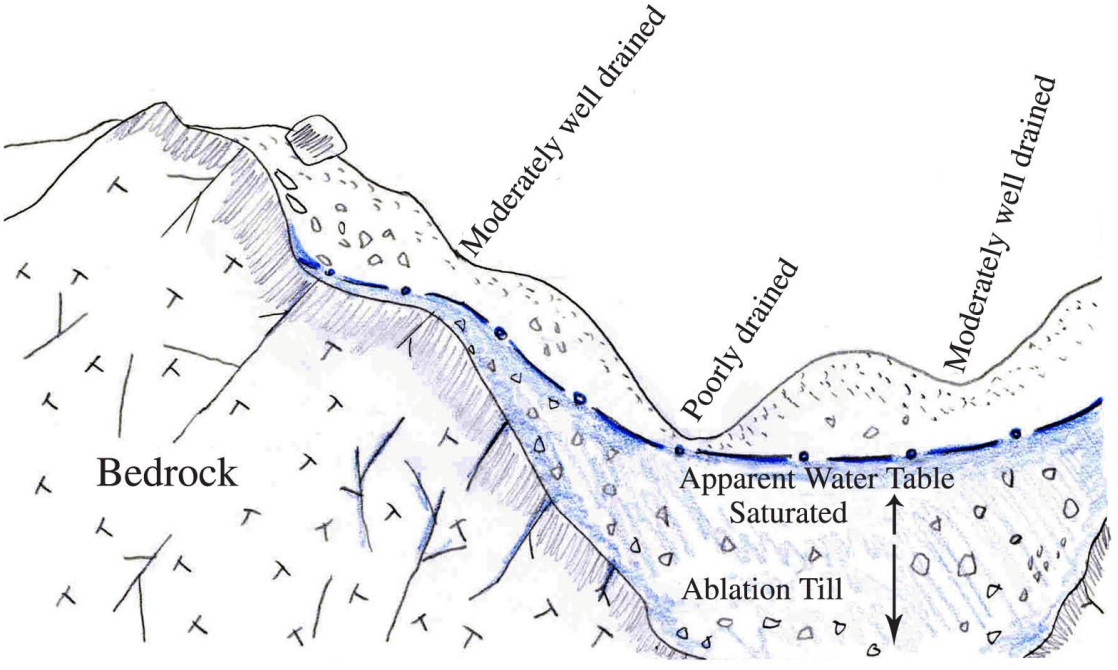
Groundwater recharge: averages 7 – 10 inches

Bedrock Controlled Supraglacial Till



- Highest percentage of CT
- Groundwater generally deep
- Medium to high surface runoff
- Wetlands, vernal pools in depressions

Hydrology in Bedrock Controlled Till



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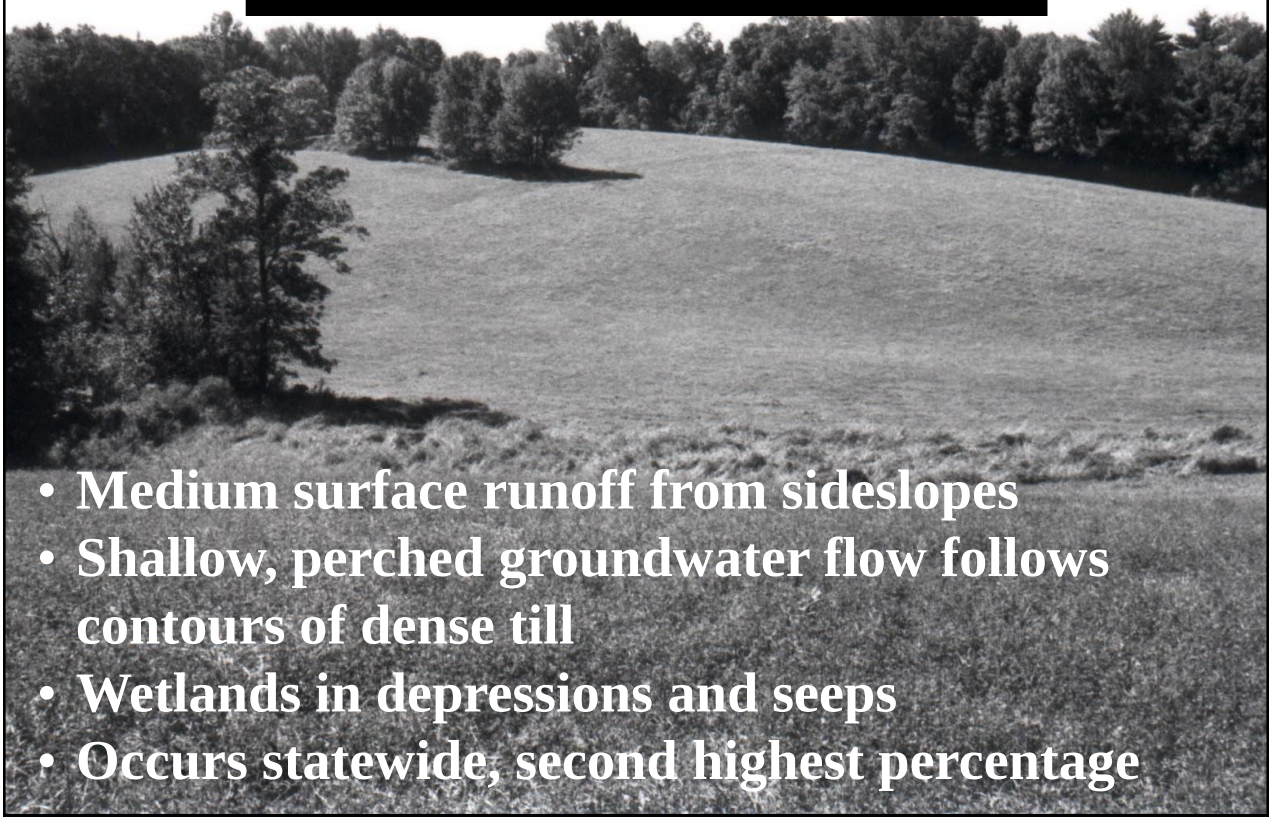
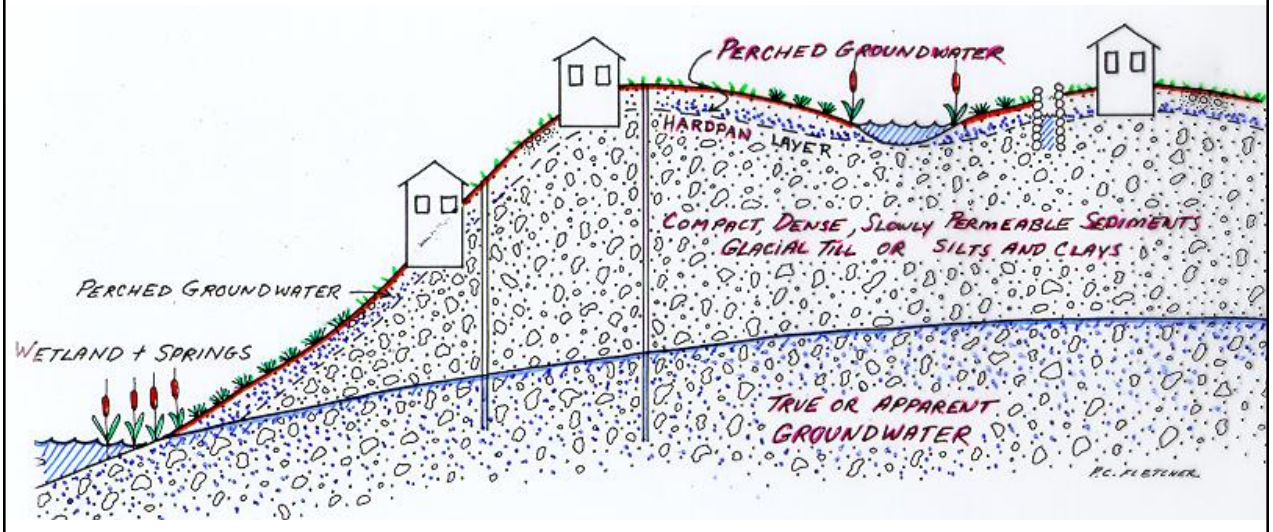
Deep Subglacial Till



- Medium surface runoff from sideslopes
- Shallow, perched groundwater flow follows contours of dense till
- Wetlands in depressions and seeps
- Occurs statewide, second highest percentage

Hydrology in Tills



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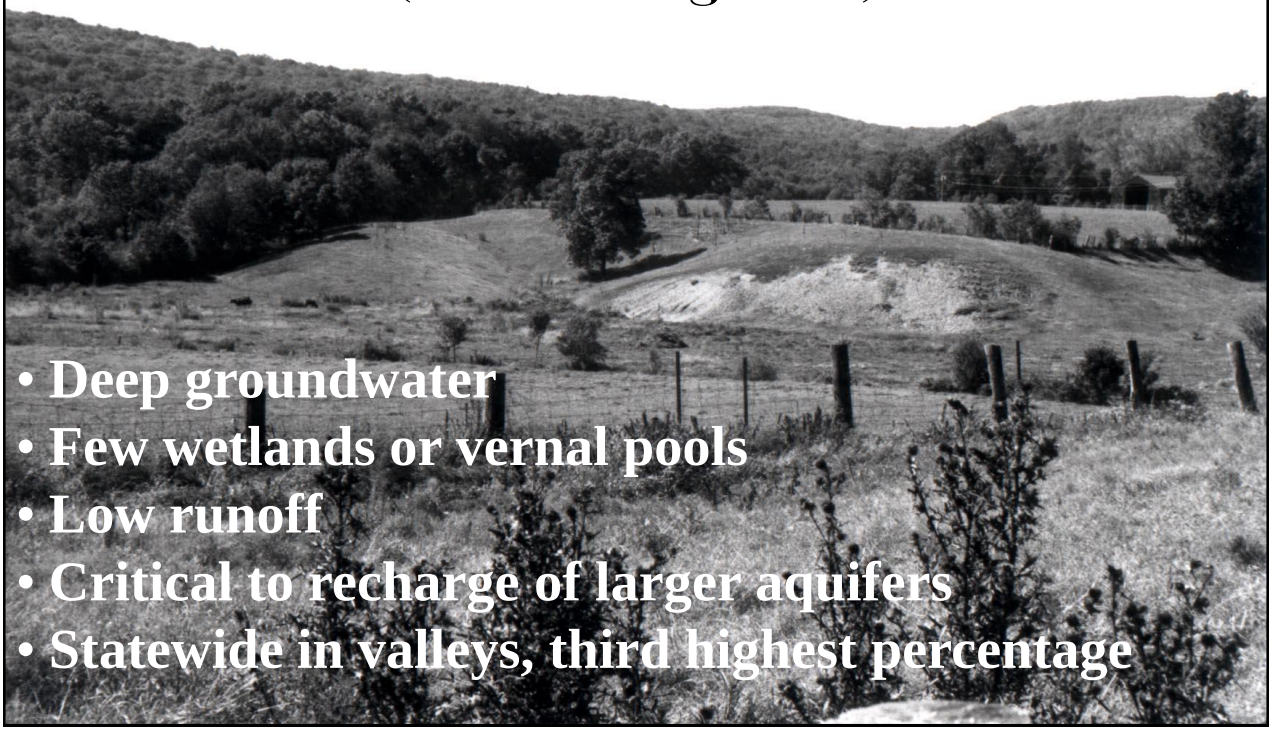
Outwash
(sand and gravel)



- Deep groundwater
- Few wetlands or vernal pools
- Low runoff
- Critical to recharge of larger aquifers
- Statewide in valleys, third highest percentage

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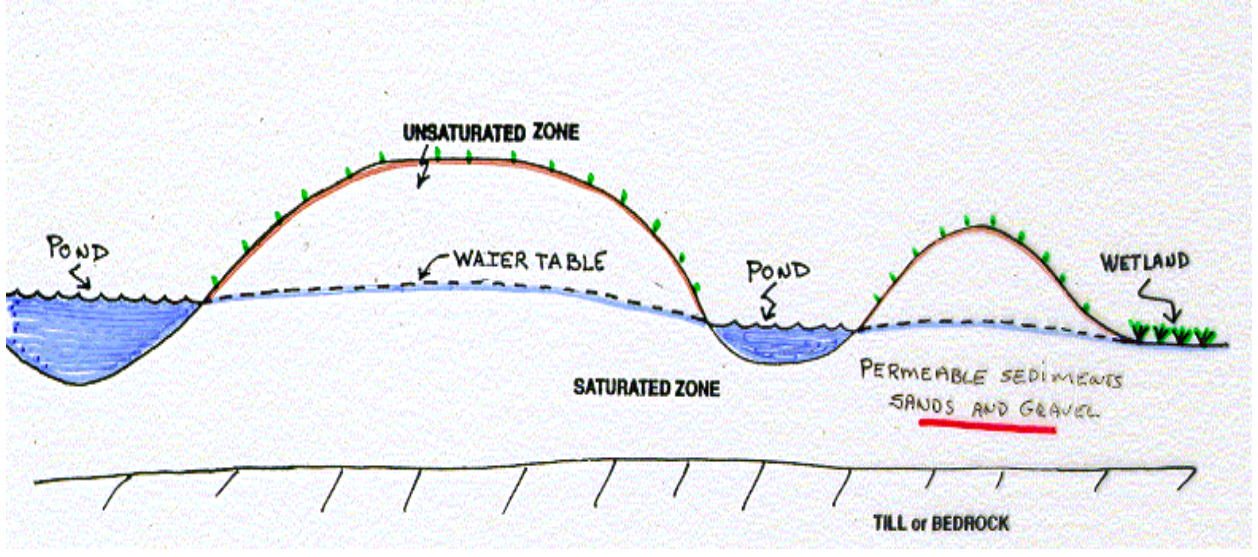
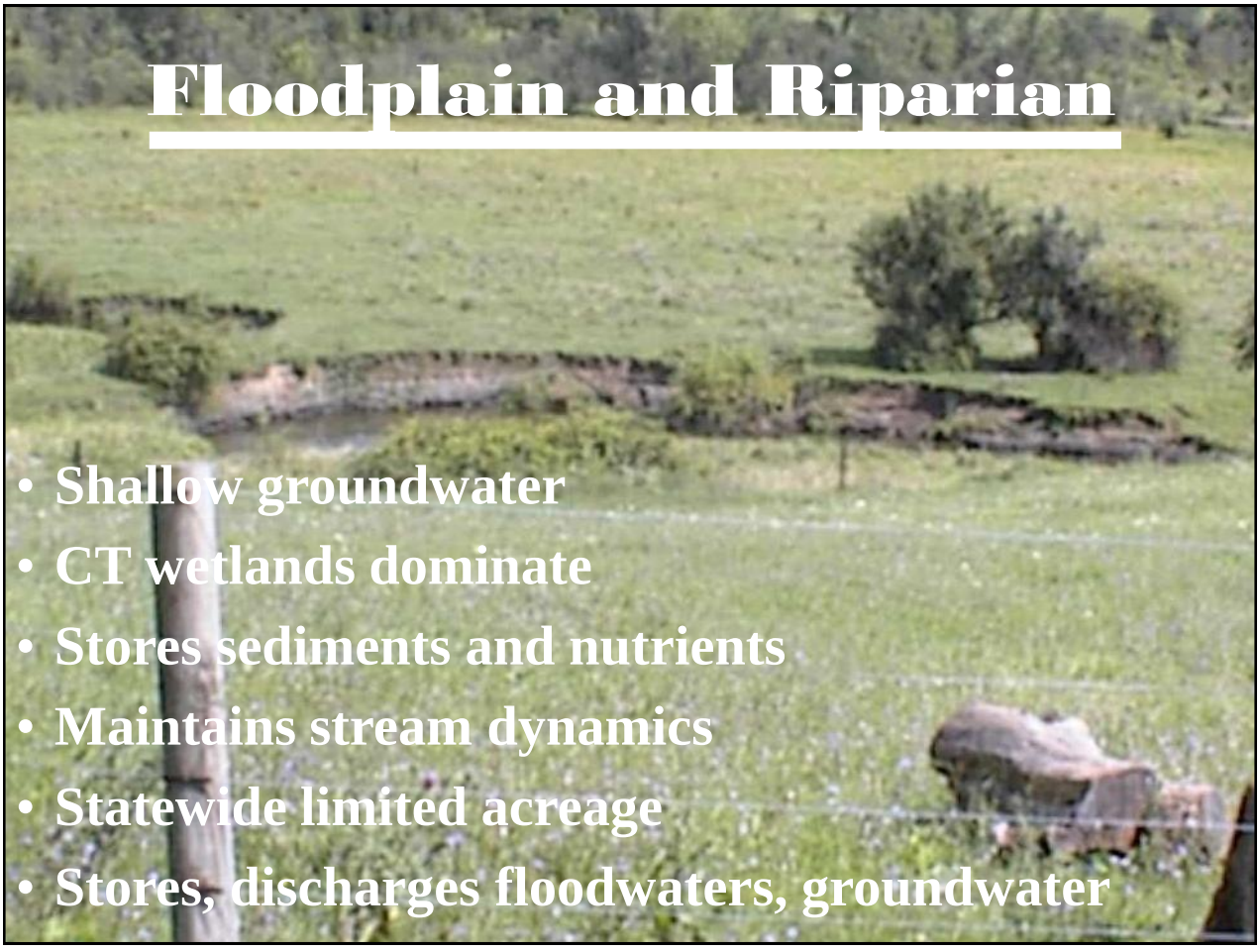
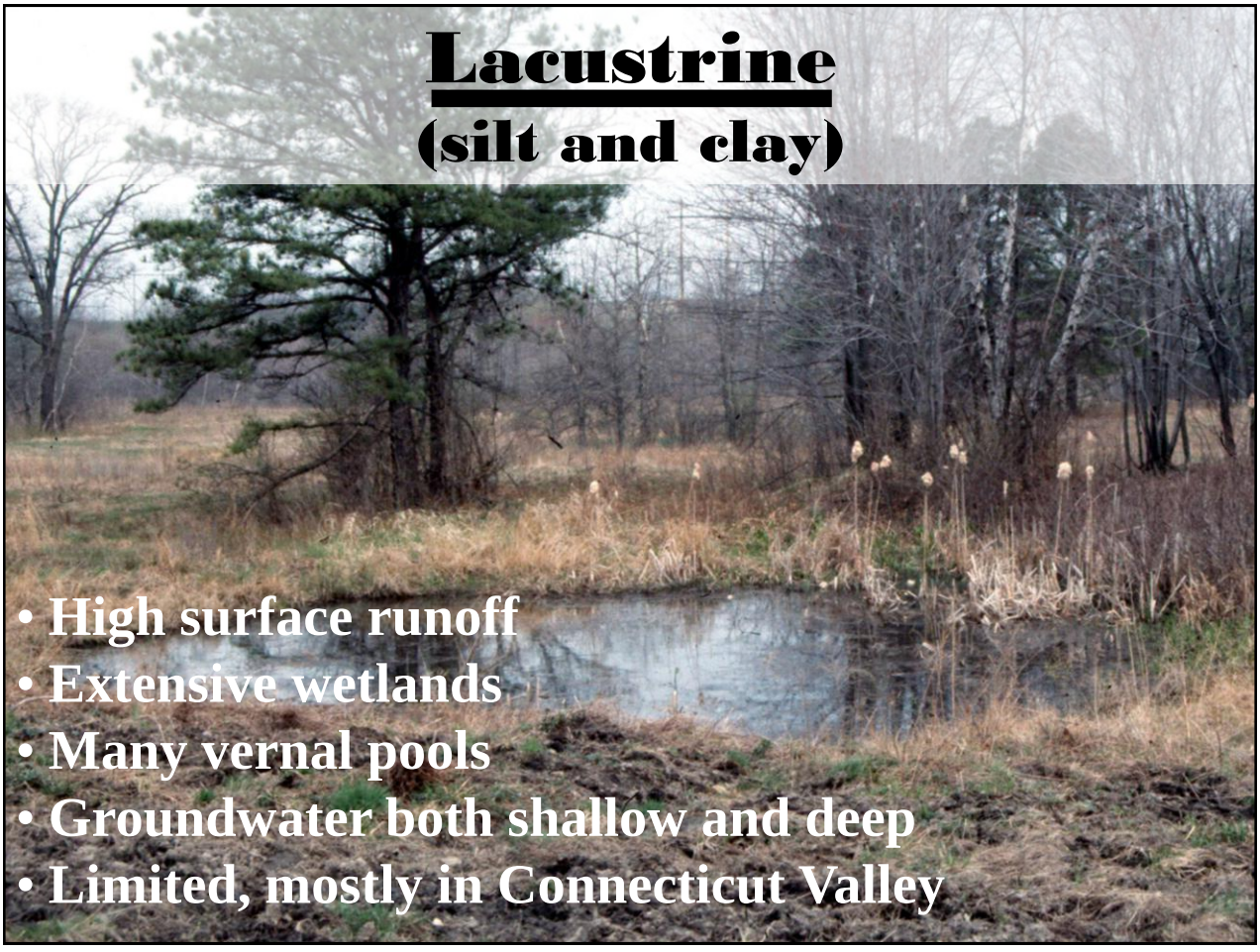
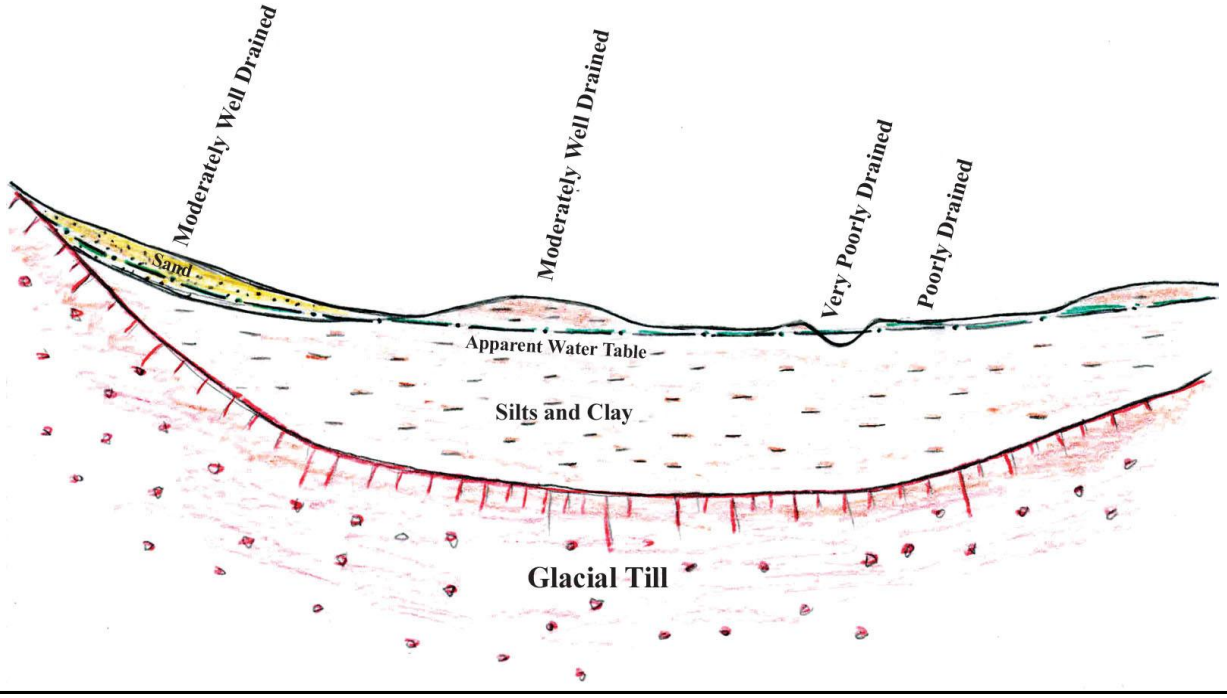
Outwash Hydrology




Floodplain and Riparian
• Shallow groundwater
• CT wetlands dominate
• Stores sediments and nutrients
• Maintains stream dynamics
• Statewide limited acreage
• Stores, discharges floodwaters, groundwater


Lacustrine
(silt and clay)
• High surface runoff
• Extensive wetlands
• Many vernal pools
• Groundwater both shallow and deep
• Limited, mostly in Connecticut Valley

Lacustrine Landscape




Other Landscapes
• Tidal marsh, estuary
• Inland swamp, bog, marsh
• Human made

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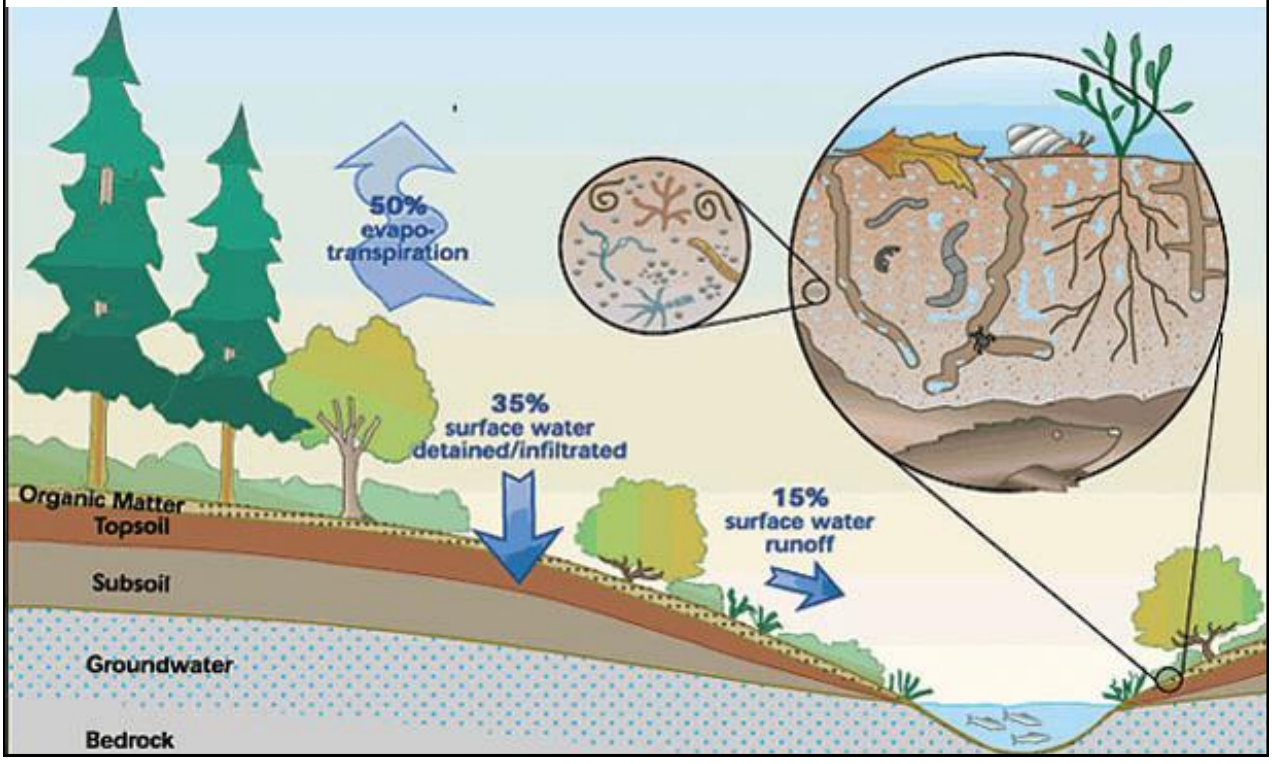
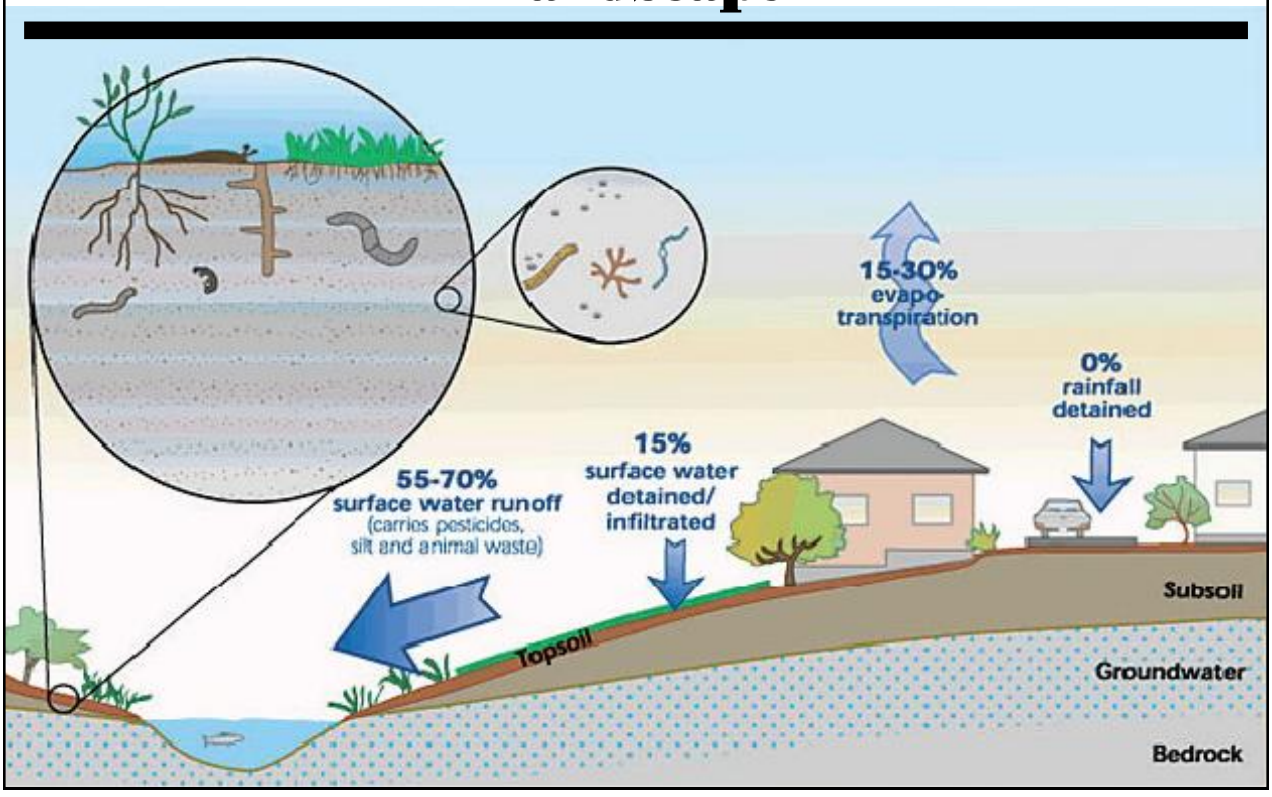
Water Movement on a Natural Landscape



Soil and Water - USDA-Natural Resources Conservation Service

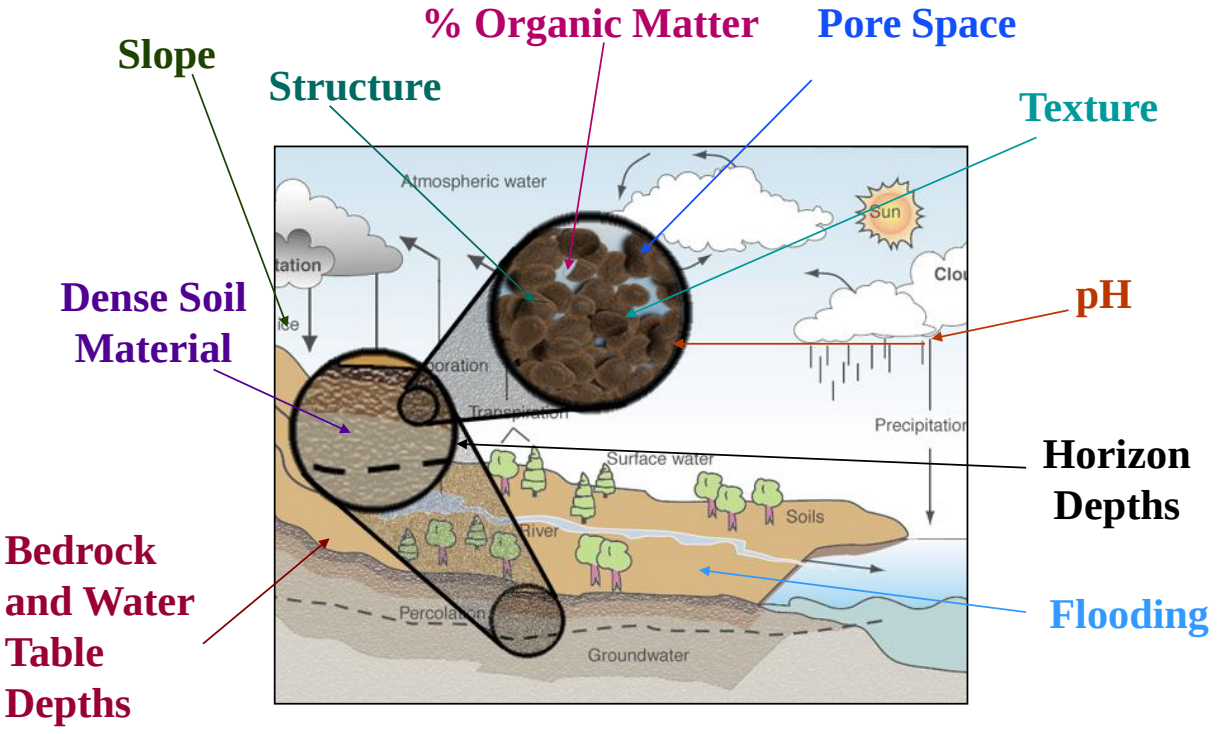
Water Movement on a Disturbed Landscape

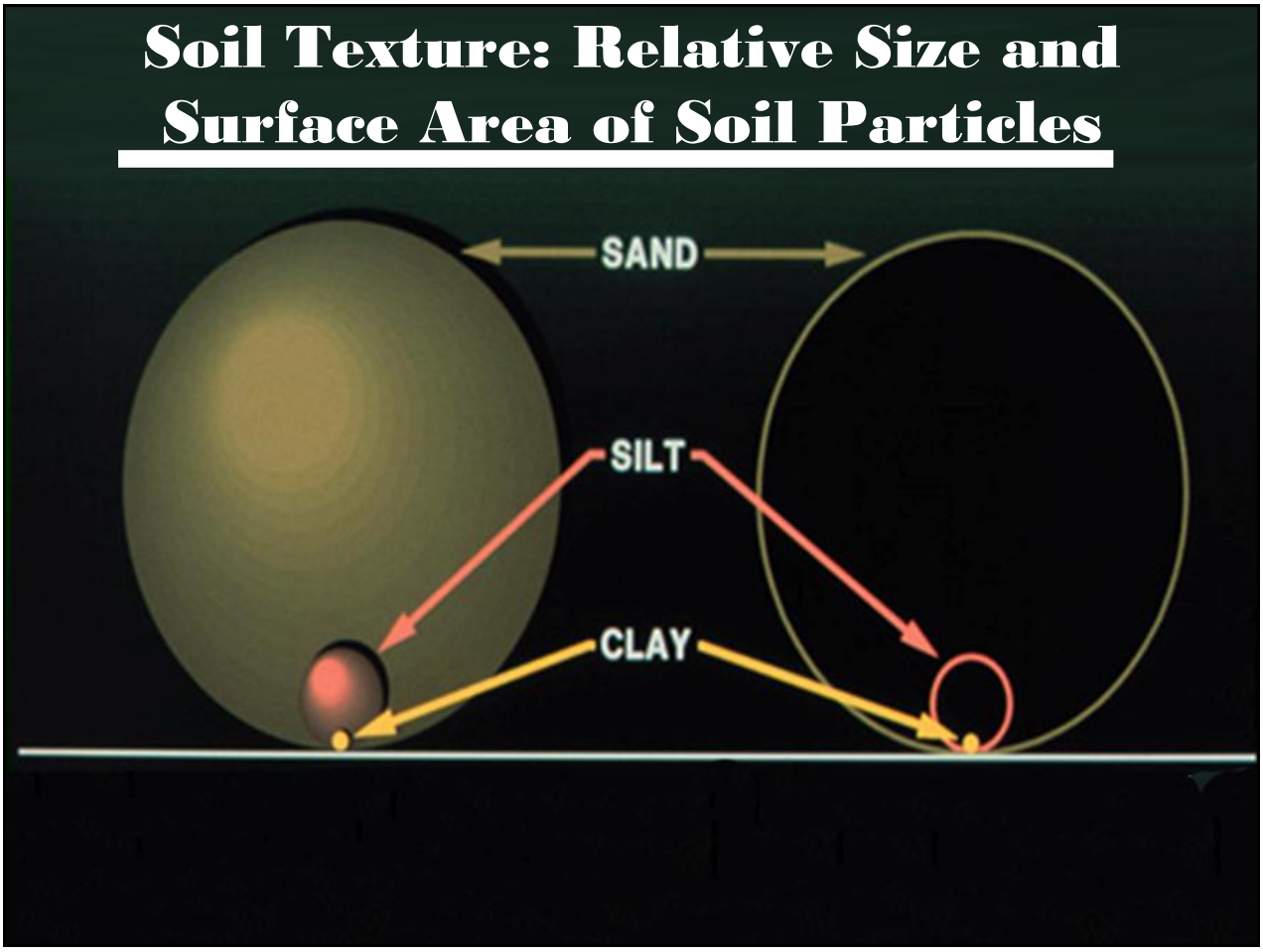


How Contaminants Move

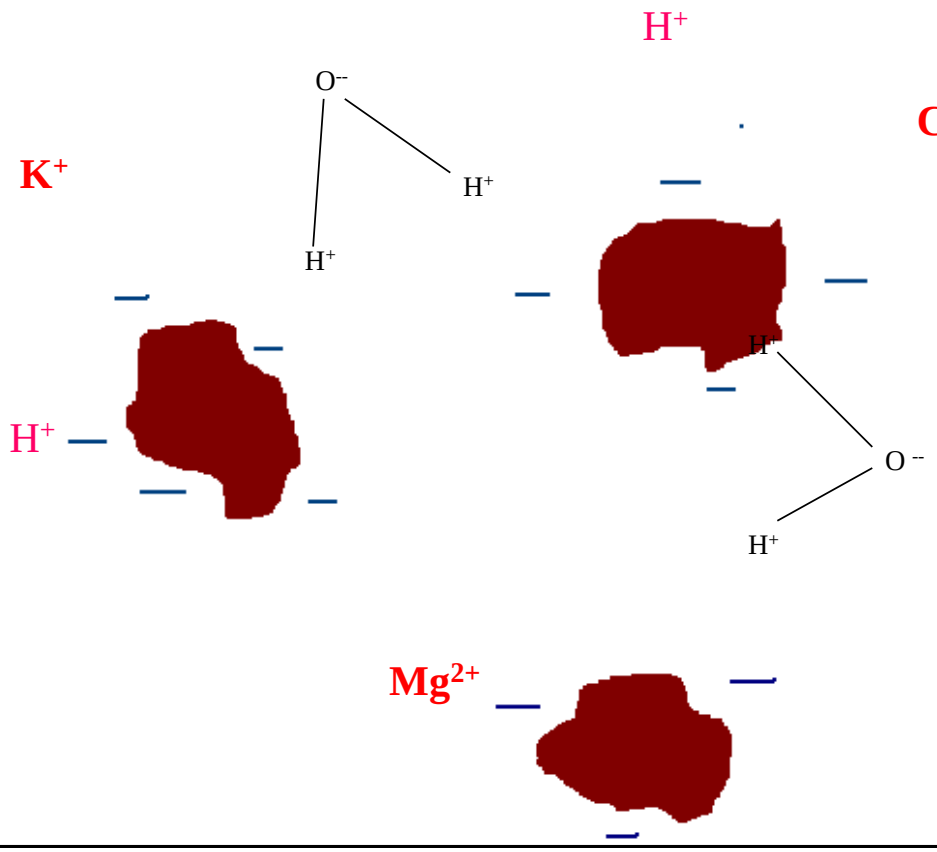
- **Runoff**
  - Dissolved contaminants in solution
  - Attached to soil particles
- **Leaching**
  - Most solids are removed on or near the surface
  - Dissolved contaminants move downward in soil water

Soil Properties That Affect Leaching and Runoff




Soil Texture: Relative Size and Surface Area of Soil Particles
SAND
SILT
CLAY

Soil Particles Have a Negative Charge



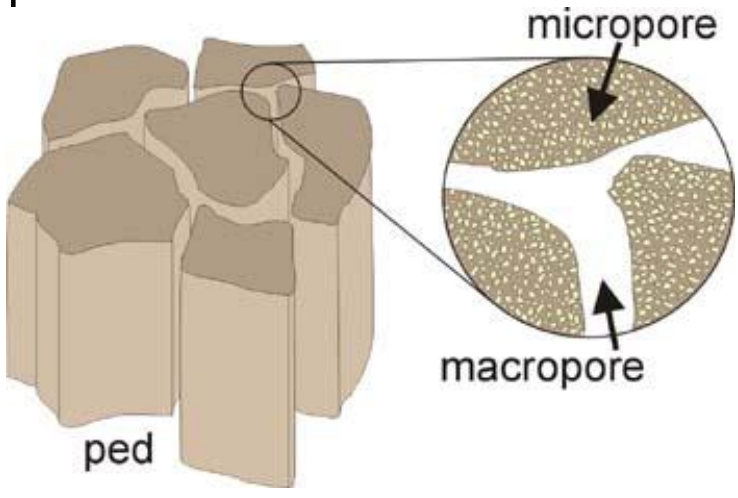
Organic Matter

- Has up to 10X more negative charge by weight than clay
- Also acts like a sponge, absorbs water
- Assists in aggregation (good soil structure)

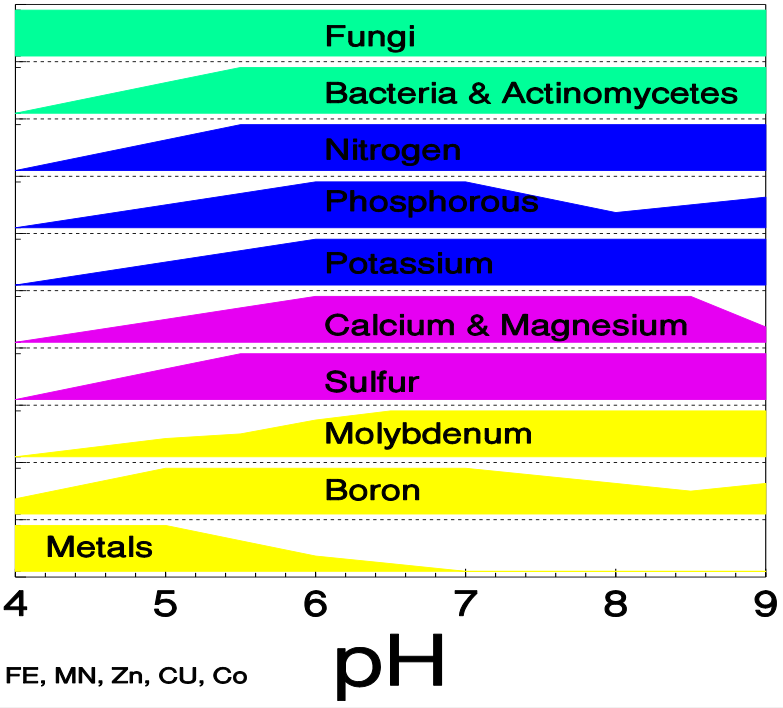
Soil Structure

- Infiltration
- Permeability
- Pore size and shape affect water movement

Micropores vs. macropores
Gravity vs. capillary action



pH Affects the Availability of Nutrients, Metals, and Microfauna



Metals = FE, MN, Zn, CU, Co

Attenuation or Filtering Capability

Soils protect ground and surface water by acting as a natural filter that:

- Captures solids
- Holds chemicals or dissolved substances on the soil particle surface
- Transforms chemicals through microbial biological processing
- Retards movement of substances
- Retains nutrients for plant uptake

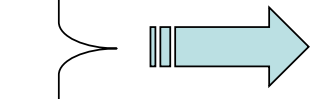
Surface Depth

Most filtering occurs in the A and B horizons, so the soil and horizon depths are important considerations.

Runoff Potential

Many of the same factors affect runoff

Texture
Structure
Organic Matter
Depth
Slope



Infiltration and Percolation vs. Runoff

Soil and Water - USDA-Natural Resources Conservation Service

Runoff : Erosion

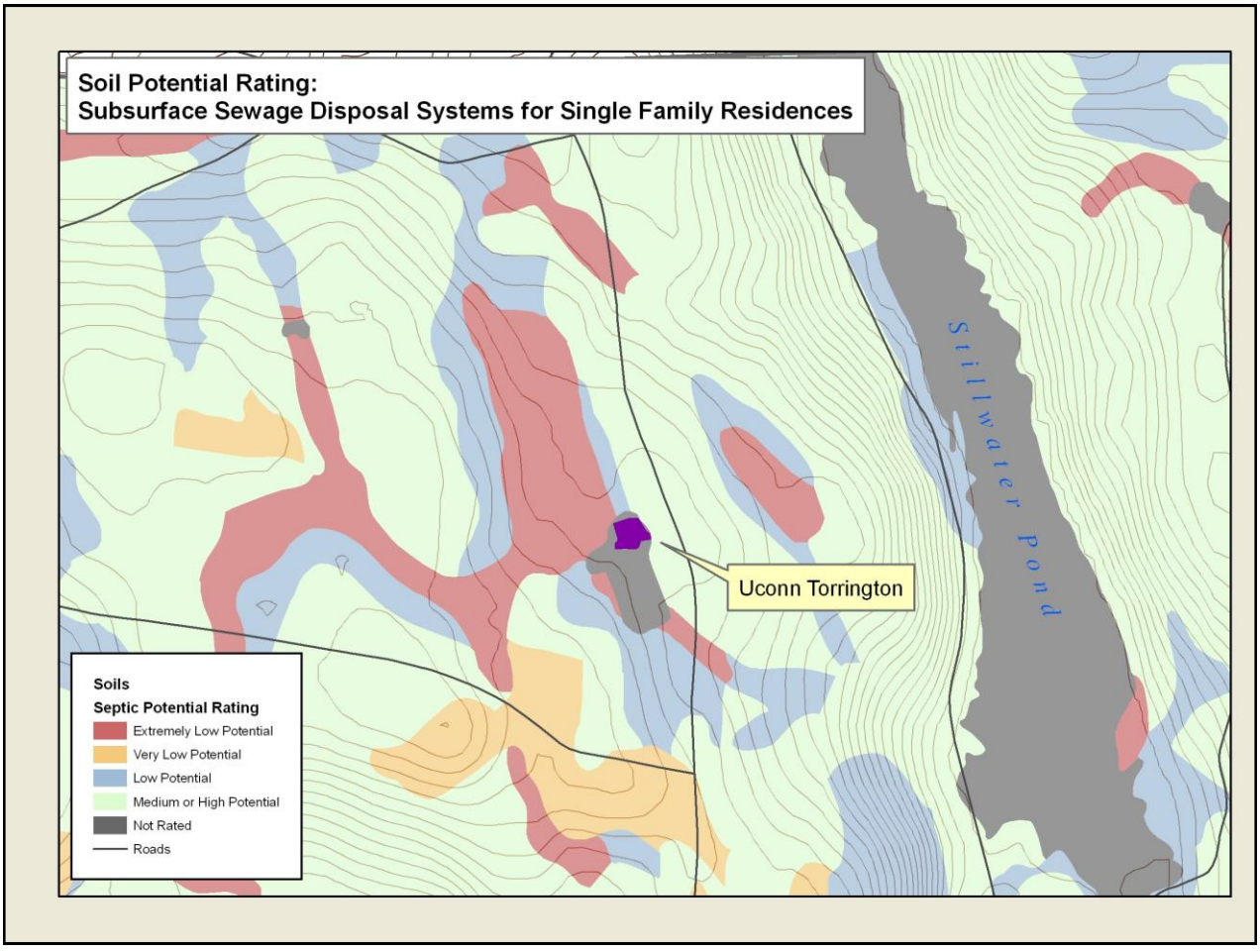
- Soils high in very fine sands and silts are the most vulnerable
- Sand particles are more difficult to move because of their size and weight
- Clay particles lump together into larger particles

Impacts of Development on Water Quality

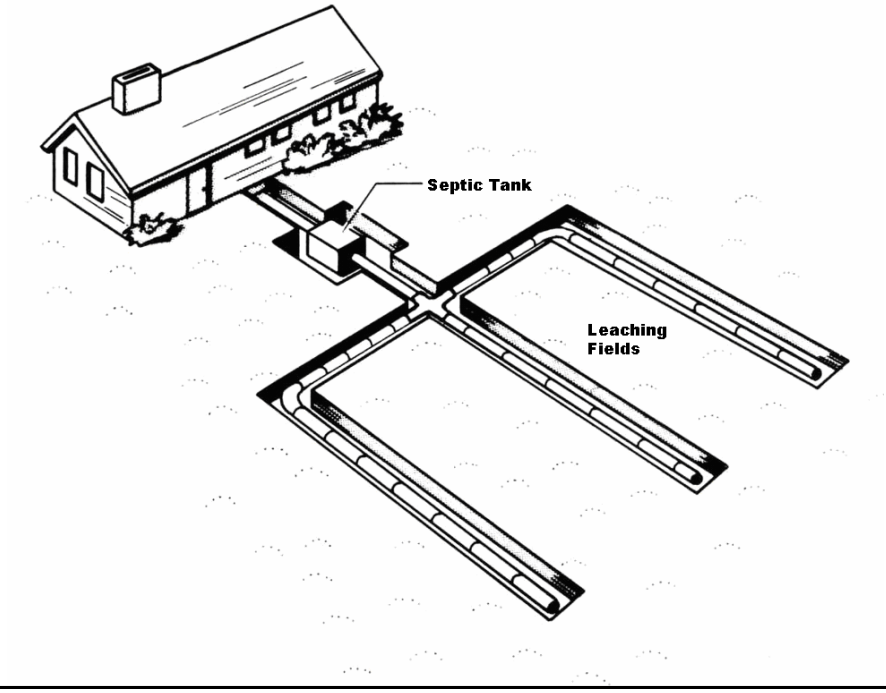
- Lawn and landscaping
- Septic / sewer
- Impervious surface
- Soil disturbance
- Changes in vegetation
- Stormwater discharge

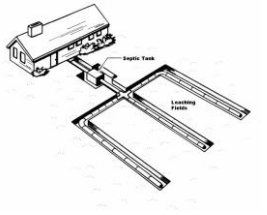
→ Increased nutrient, contaminent, sediment, and pathogen losses

→ Thermal pollution


Soil Potential Rating:
Subsurface Sewage Disposal Systems for Single Family Residences
Uconn Torrington
Stillwater Pond
Soils
Septic Potential Rating
Extremely Low Potential
Very Low Potential
Low Potential
Medium or High Potential
Not Rated
Roads

Residential Subsurface Sewage Disposal System





How the System Works

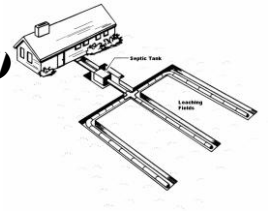
The Tank

Removes organic substances from raw wastewater, sludge settles on bottom, grease floats on top

Distribution Lines

(perforated pipes over gravel) distribute wastewater evenly on soil surface

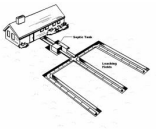
How the System Works *(continued)*



Leach Field

- Water seeps into the underlying soil
- Dissolved wastes are decomposed by microorganisms, are adsorbed on soil particles or are taken up by plants.
- Remaining wastes and water travel to groundwater

Wastewater Renovation



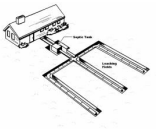
Bacteria and Viruses

A biomat is formed on the bottom and sides of the field, reducing pathogens by 99.9%. (This can sometimes get too thick and cause clogging and system failure.)

Nitrogen

10% removed in the sludge in the bottom of tank, more is removed by plants, volatilization, adsorption, and denitrification. A total of 21 – 25% of the total is removed by a conventional system.

Wastewater Renovation *(continued)*

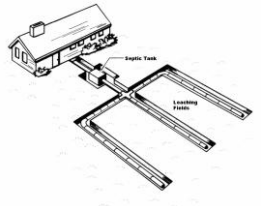


Phosphorus

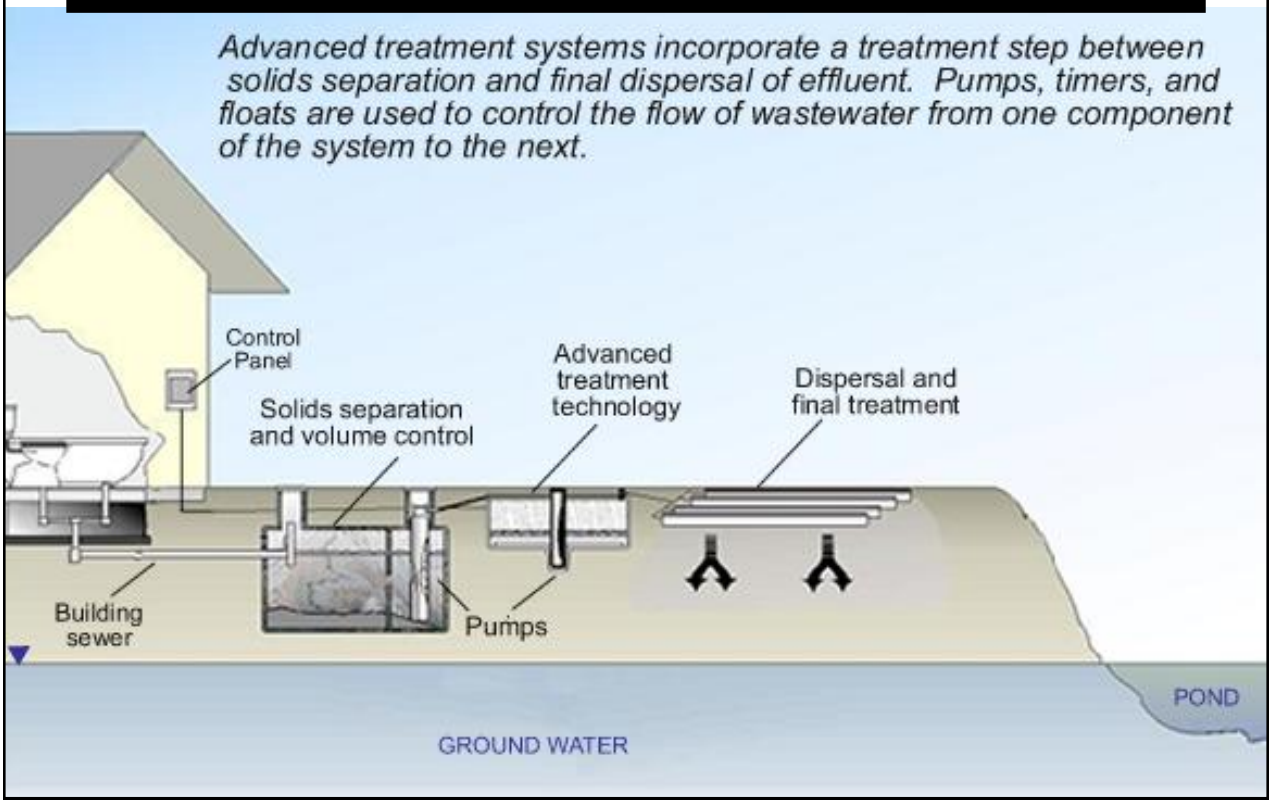
Removed in the unsaturated zone beneath a leach field by sorption onto active soil particles and plant uptake. Phosphorus transport through the soil is more likely to occur in coarse textured soils low in organic matter.

Soil/Site Considerations

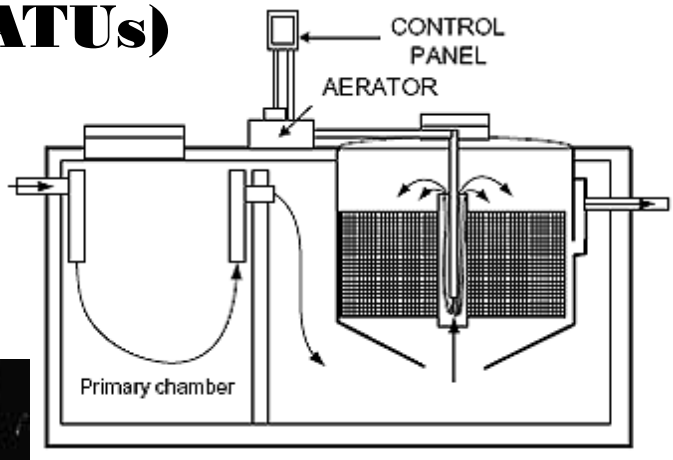
- **Vertical separation between the bottom of the drainfield and water table or bedrock.**
- **Non-flooding areas only**
- **Setbacks from wetlands, watercourses, and wells**
- **Density of systems**



Advanced Treatment Systems



Aerobic Treatment Units (ATUs)



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Media Filters

Peat, textile, and sand filters

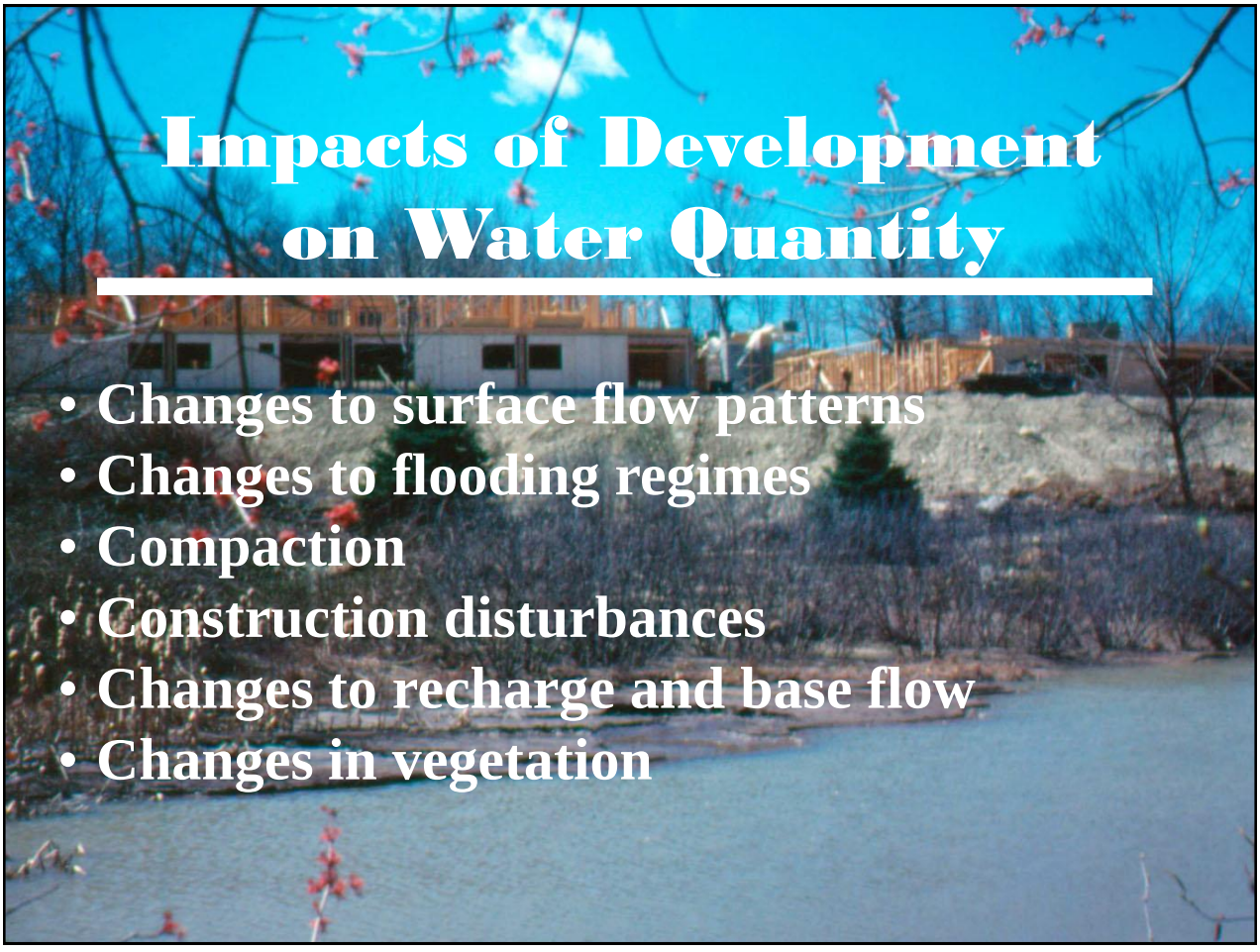
Dispersal of Effluent

- Shallow dispersal recommended because there are fewer solids and less organic matter to serve as food for bacteria
- Media filters can be configured in a bottomless fashion to serve as drain field options
- Flow of wastewater controlled with pumps, timers, etc. to prevent peak flows and high flow events from overloading system

Questions about Alternative System Status in Connecticut?

For further information:

Jennifer Perry Zmijewski
DEP Sanitary Engineer
(860) 424-3802

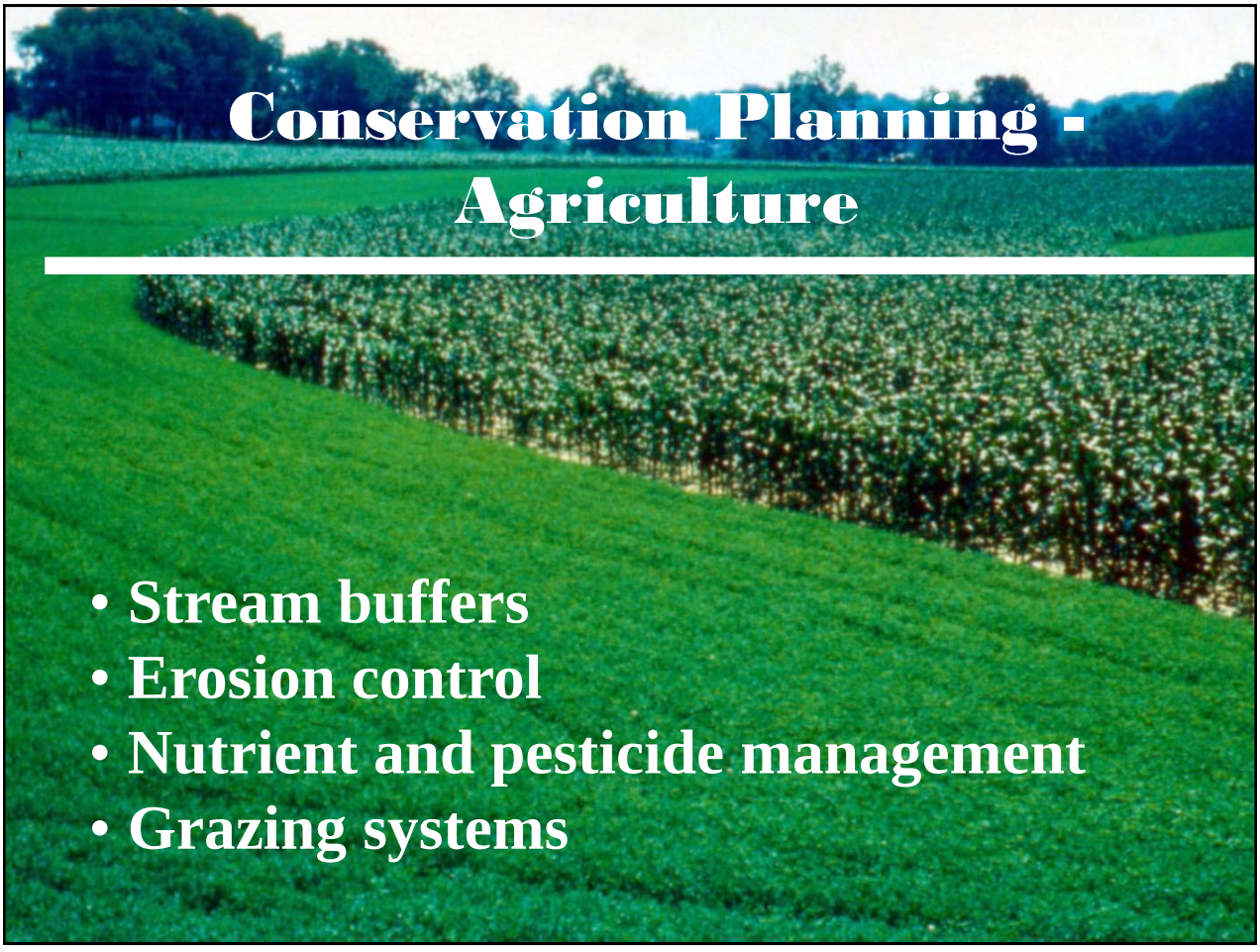

Impacts of Development on Water Quantity
• Changes to surface flow patterns
• Changes to flooding regimes
• Compaction
• Construction disturbances
• Changes to recharge and base flow
• Changes in vegetation

Best Management Practices – Developed Areas

- **Stormwater management (during and after construction)**
- **Riparian buffers**
- **Erosion control**
- **Low impact development practices**

Impacts of Agriculture on Water Quality/Quantity

- Manure, fertilizers and pesticides
- Erosion and sediment
- Pathogens
- Stream base flow
- Changes in vegetation


Conservation Planning - Agriculture
• Stream buffers
• Erosion control
• Nutrient and pesticide management
• Grazing systems

Impacts of Forest Management on Water Quality/Quantity

- Roads
- Streams
- Erosion and sediment
- Thermal pollution
- Increased runoff

NRCS Best Management Practice Standards for forestry activities are available on the Electronic Field Office Technical Guide (*e*FOTG), available on the Connecticut NRCS website

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
CONNECTICUT

FOREST TRAILS AND LANDINGS

(Acre)

CODE 655

DEFINITION

A route, travel-way or cleared area within a forest.

PURPOSE

- Provide access to forest stands for management.
- Provide access for removal and collection of forest products.
- Provide access to forested areas for recreation.
- Minimize onsite and off-site damage to resources during periods of access.

CONDITIONS WHERE PRACTICE APPLIES

On forestland.

CRITERIA

General Criteria Applicable To All Purposes

Laws and Regulations. All Federal, state, and local laws, rules, and regulations, including local inland wetland agency regulations, governing the construction and and expected users and equipment. They shall be configured to minimize adverse onsite and off-site impacts such as accelerated erosion, riparian zone degradation, stream channel and streambank damage, hydrology modification, other water resource damage, aesthetics or unacceptable damage to advance regeneration, residual growing stock, wildlife habitat, fragmentation, or restrict wildlife movement.

Timing and use of equipment will be commensurate with site and soil conditions to maintain site productivity and minimize soil erosion, displacement and compaction.

Slash, debris and vegetative material left on the site after construction will not present an unacceptable fire or pest hazard or interfere with the intended purpose.

Water bars, rolling dips, timber bridges, rock plunge pools, and other drainage measures for trails shall be of sufficient size, intervals and gradient for adequate drainage and erosion control.

Trails and landings shall be sufficiently revegetated to control erosion.

Select plants that according to federal, state


What Can You Do
to Limit Potential Impacts?
Understand how water moves over and through the landscape
Utilize soils and other natural resources information into planning for conservation and development
Plan and review on a watershed hydrologic basis
Review and update rules, regulations, and standards

Hyperlink to movie: Water Movement in Soils

West Rock
(Frederic Church, 1849)