Module 2

Basic Stormwater Principles

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

Module 2 Contents

2a. Overview

2b. Effects Of Landuse On The Hydrologic Cycle

2c. Impact Of Stormwater Runoff On Stream Channels And Flooding

2d. Karst Areas

2e. Summary

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Module 2a.

Overview

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Inspectors and SWM

Construction
&
Development

Water Quality
& Quantity

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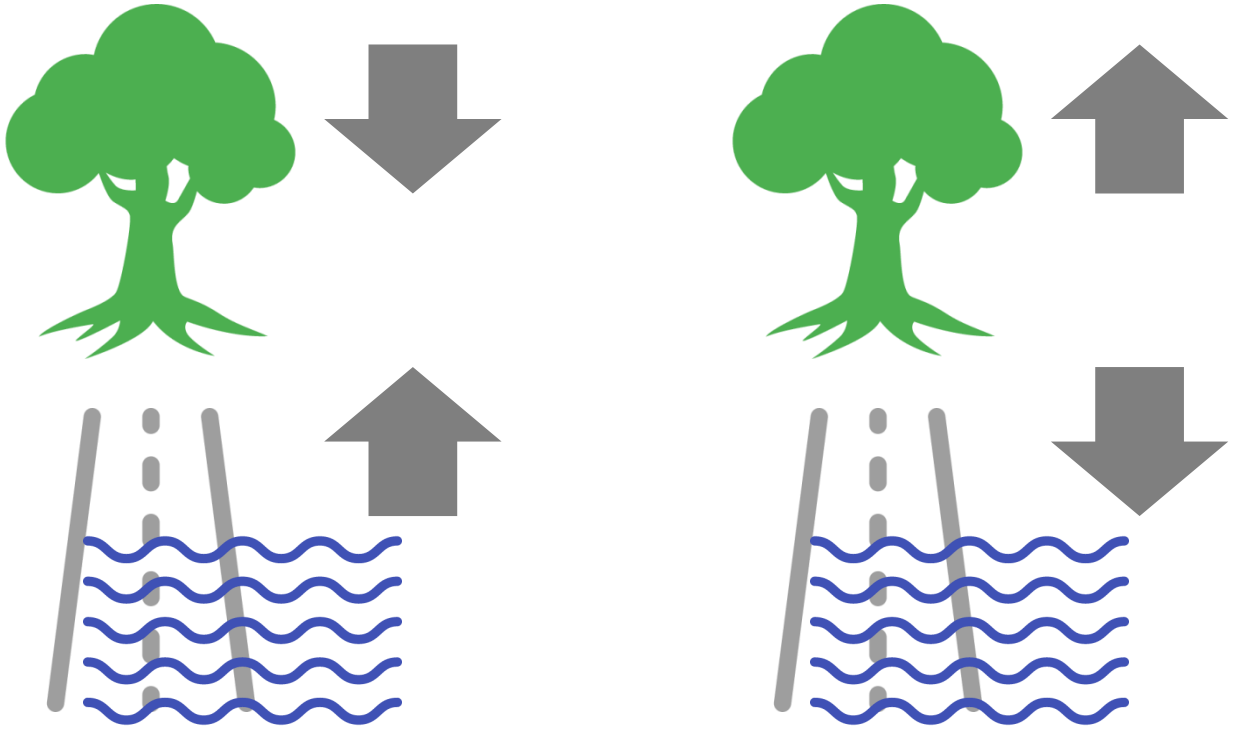
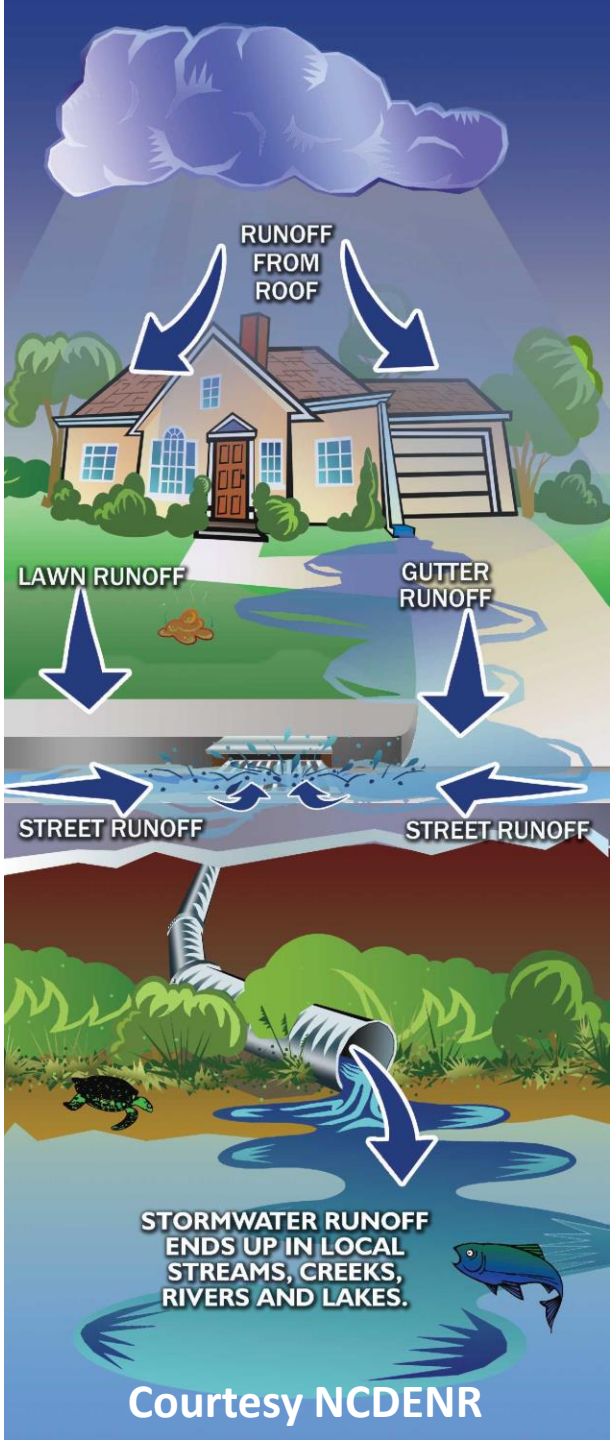
Inspectors and SWM



Conventional Development **VSMP**

Stormwater Runoff

- **Precipitation exceeds the capacity of the ground to absorb water**
- **Picks up:**
  - Sediment
  - Trash
  - Oil
  - Fertilizers
  - Other pollutants



VSMP TECHNICAL CRITERIA

- ***Water quality*** for the protection of state waters from the pollutants that are carried off a developed site in stormwater runoff; and
- ***Water quantity*** for the protection of state waters from channel erosion and flooding that can result from an increase in the volume and flow of stormwater runoff that leaves a developed site.

Environmental Site Design

- Mimic natural runoff characteristics
- Minimize impacts of development on water quality and quantity

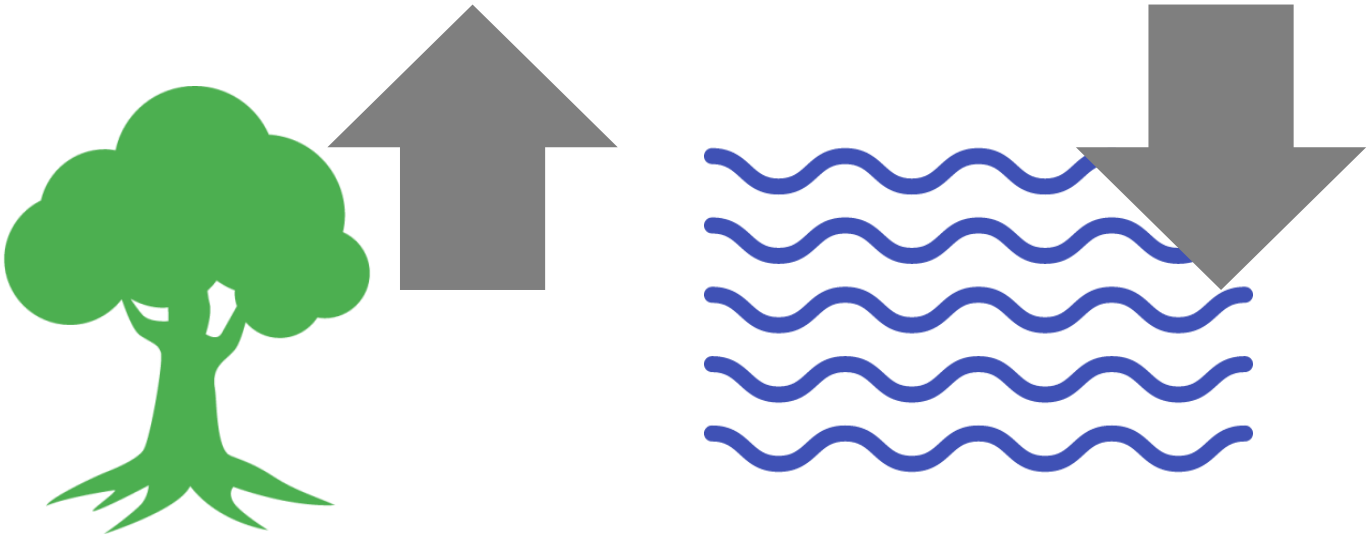
Environmental Site Design

- Promotes:
  - Conserving natural features and resources
  - Minimizing impervious surfaces
  - Slowing down runoff to maintain discharge timing and increase infiltration and evapotranspiration
  - Non-structural practices or innovative technologies

Best Management Practices (BMPs)

- Reduce stormwater runoff and/or
- Remove pollutants from stormwater

Summary



Summary

- Minimize land cover changes
- Use Environmental Site Design
  - Enhances natural functions of resources
  - Reduces runoff leaving the site

Module 2b.

Effects of Landuse on the Hydrologic Cycle

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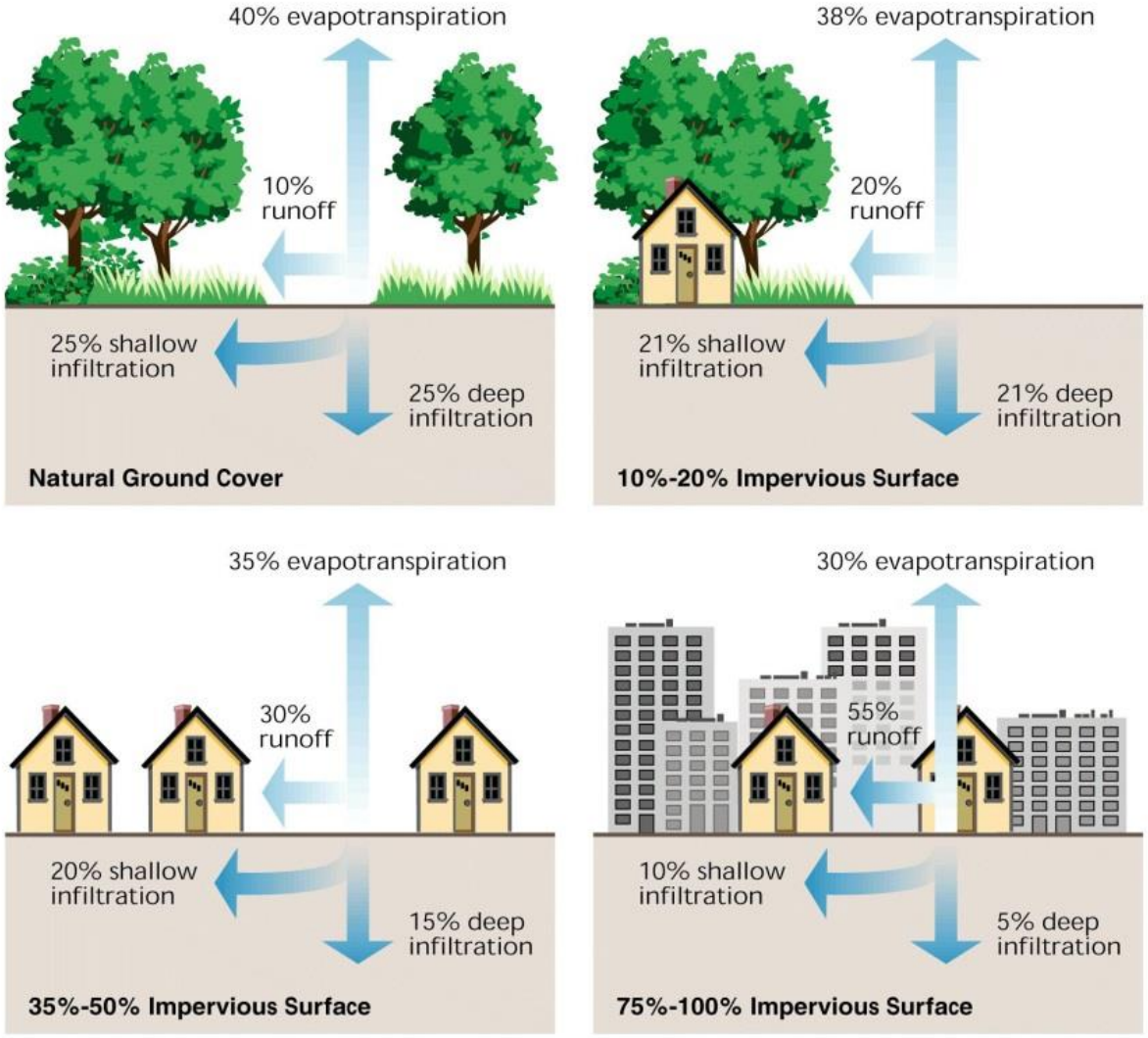
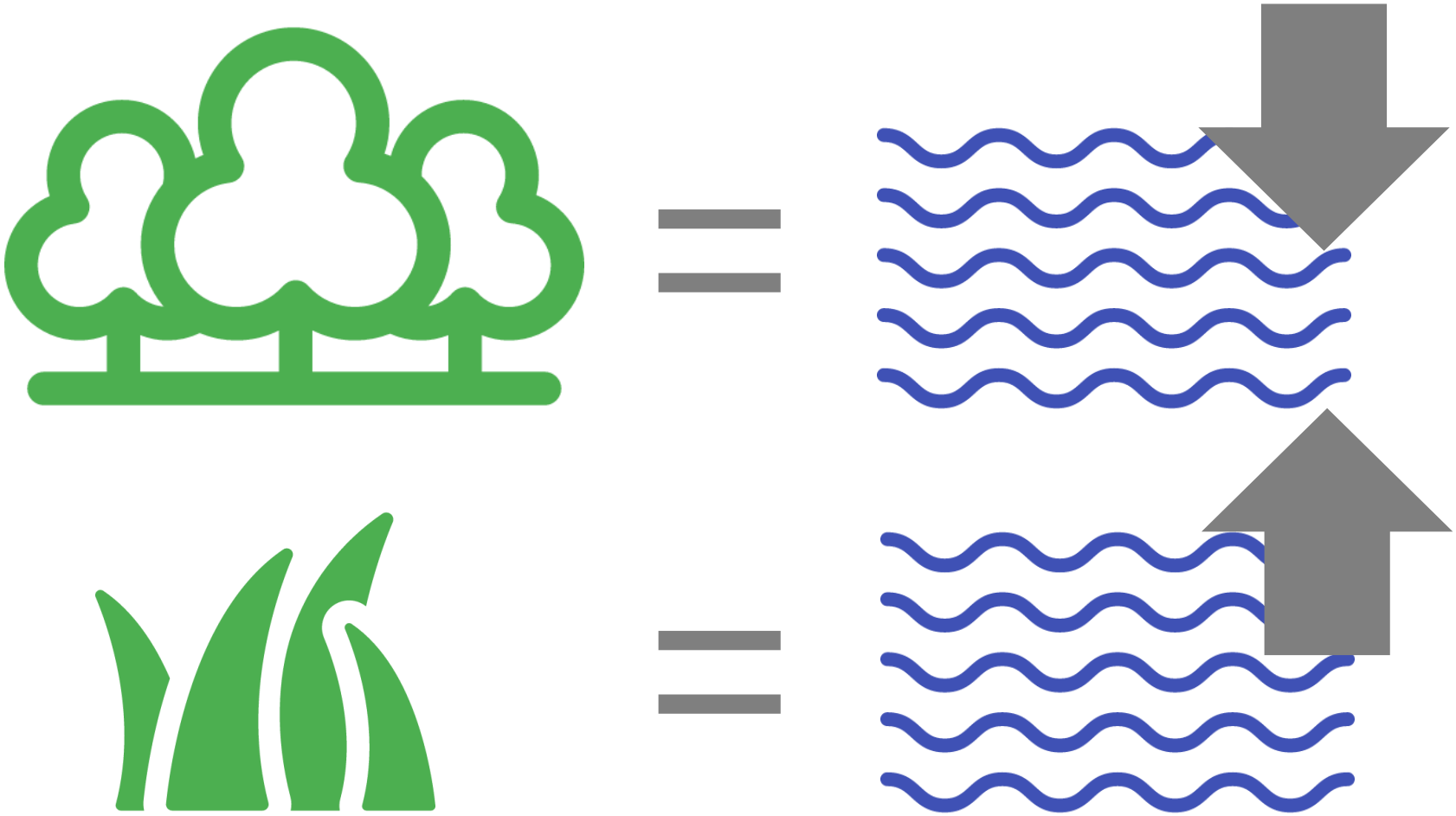
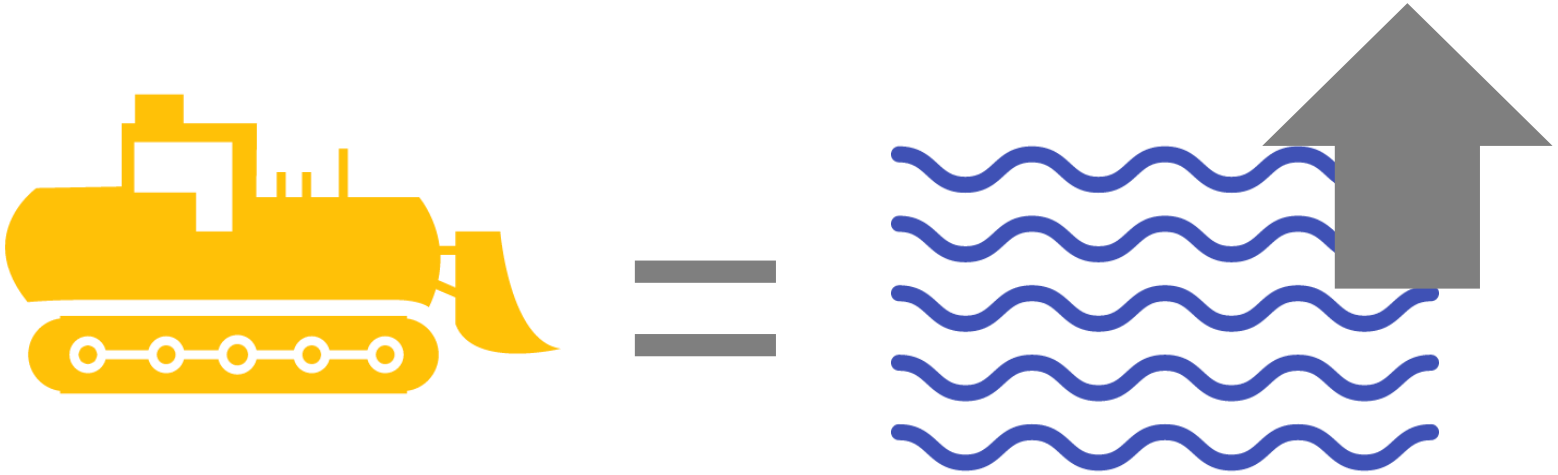
Loss of Environmental Processes

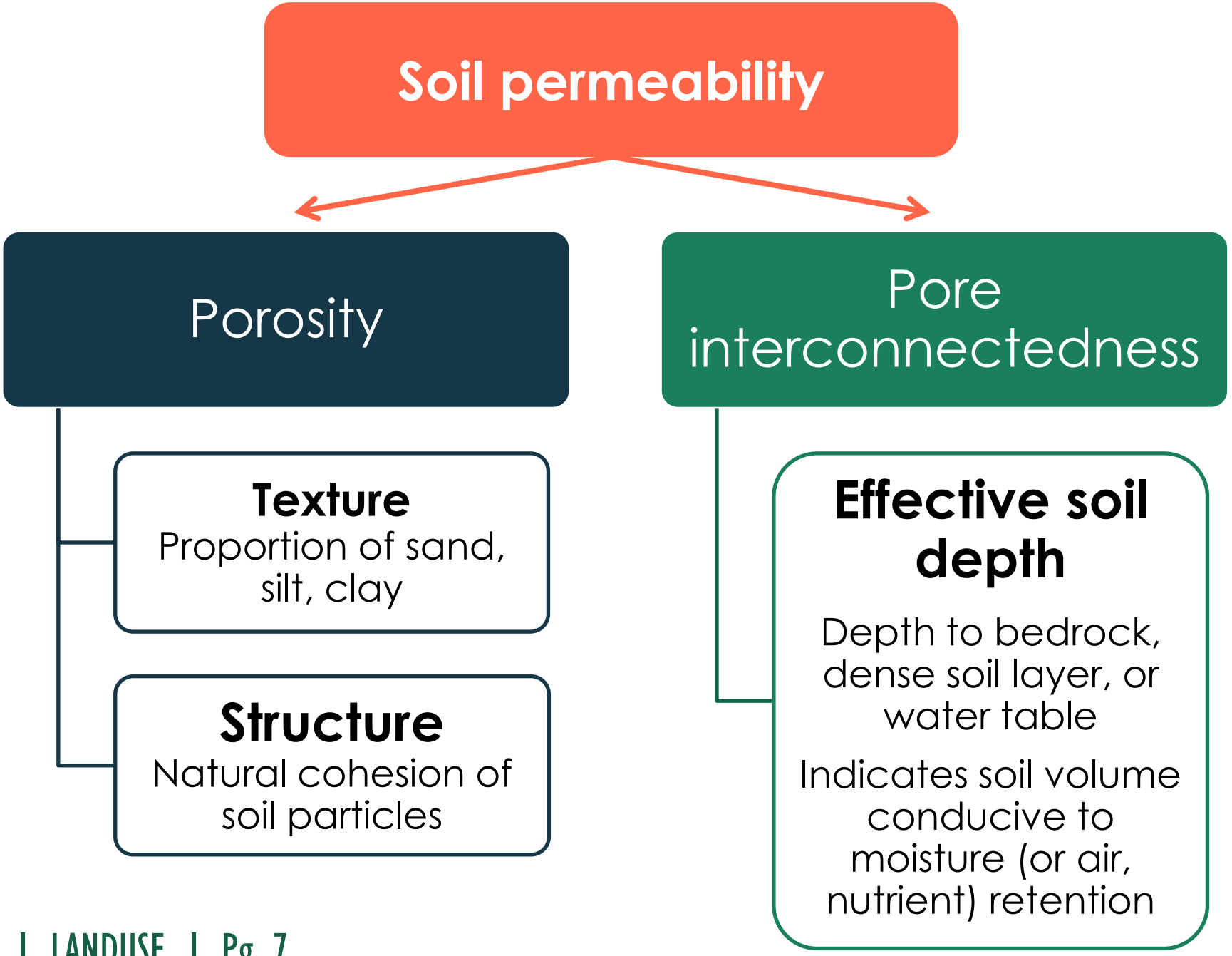


Reduced Evapotranspiration and infiltration from loss of vegetation



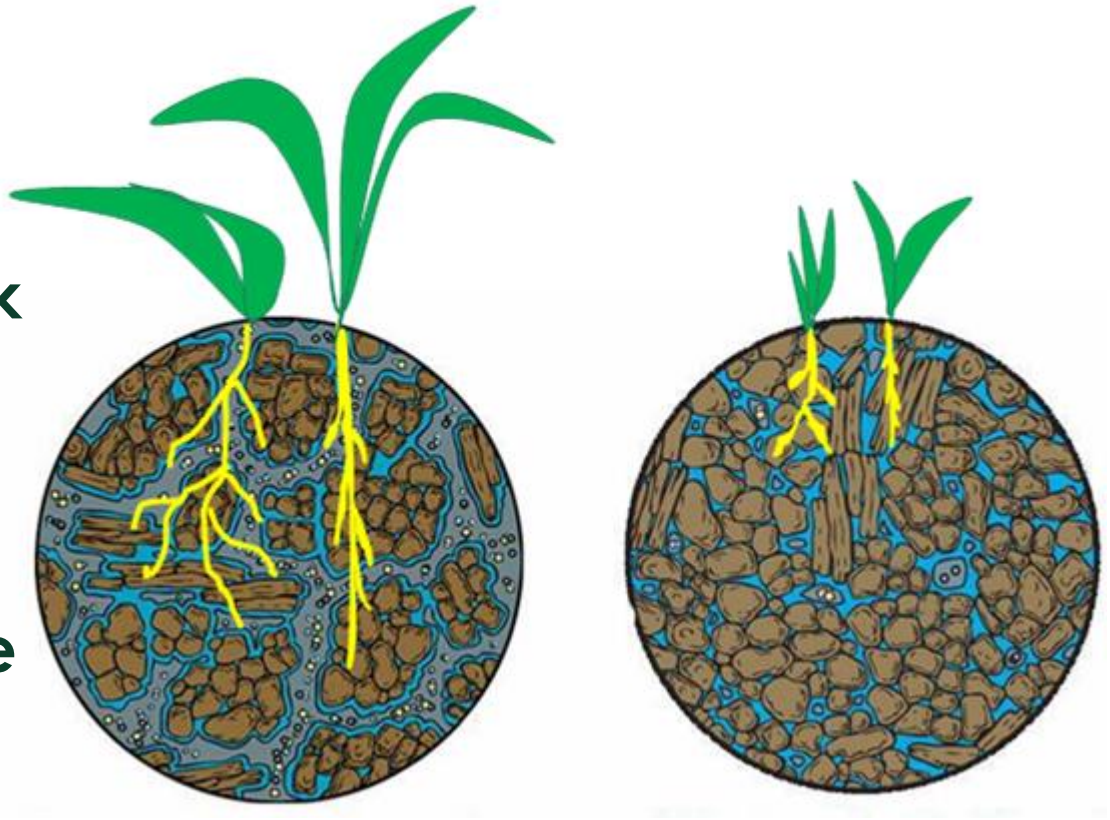
Reduced Infiltration from Removal of Topsoil and Compaction of Subsoil




Soil permeability
Porosity
Pore interconnectedness
Texture
Proportion of sand, silt, clay
Structure
Natural cohesion of soil particles
Effective soil depth
Depth to bedrock, dense soil layer, or water table
Indicates soil volume conducive to moisture (or air, nutrient) retention

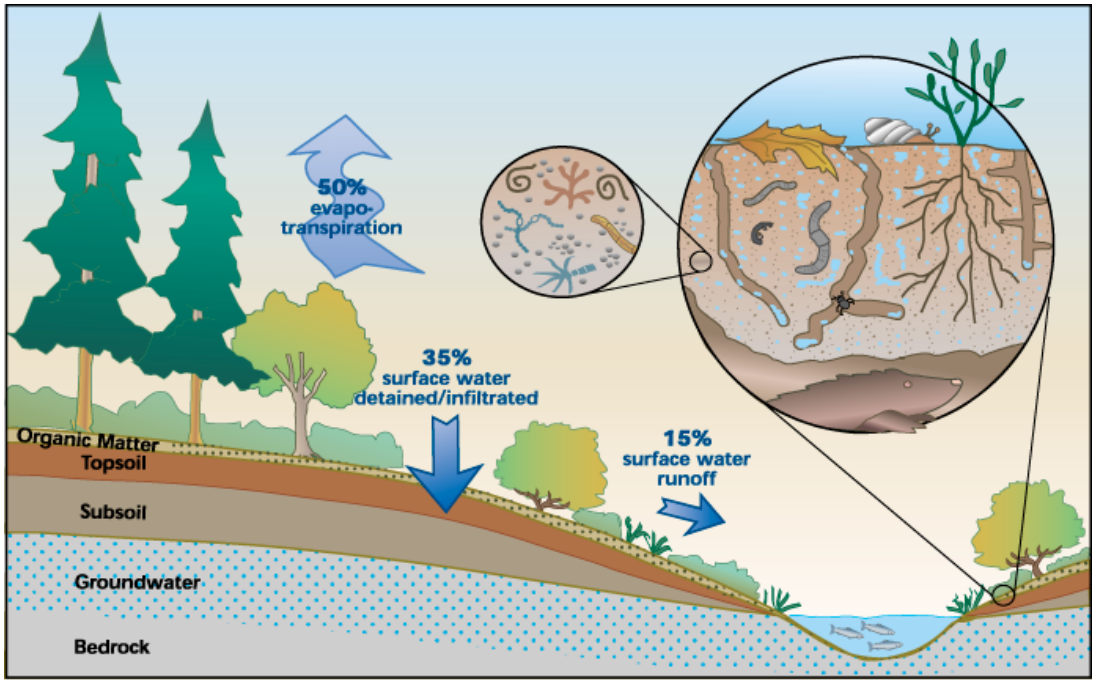
Soil Basics

Lower bulk density
Lower Weight
More pore space



Higher bulk density
Higher Weight
Less pore space

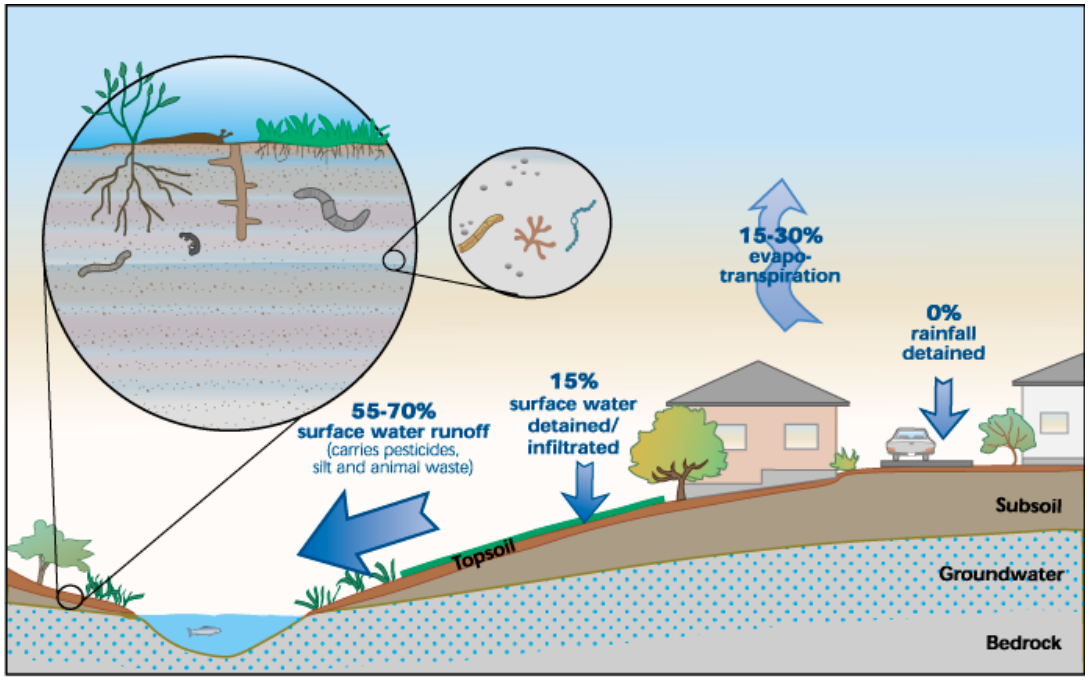
Before land disturbing activity



- Thick topsoil, organic matter
- Soil structure and texture intact
- Good soil porosity (enhanced by biological channels – plant roots, soil organisms)

Permeable soils = Very little surface runoff

After land disturbing activity

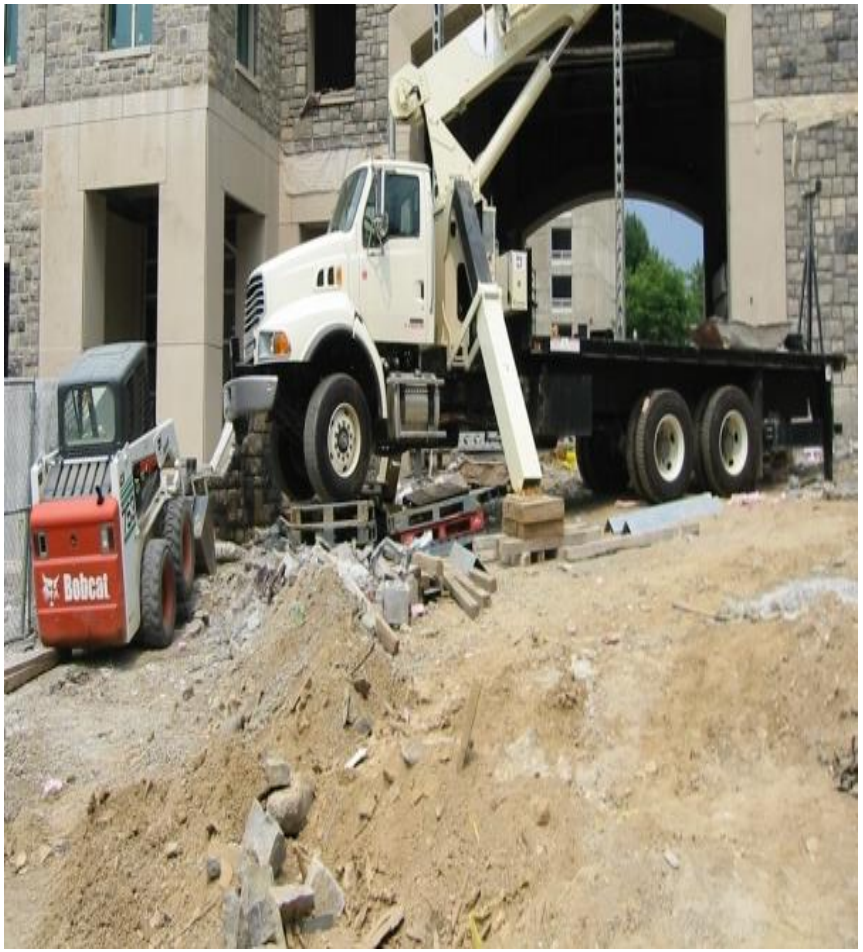


- Soil structure lost (compacted)
- Thin topsoil (if any)
- Organic matter often lost
- Soil porosity and permeability decrease

Compacted soils = More surface runoff

You should know

- Construction equipment can cause such profound soil compaction (topsoil and subsoil) that the soil's bulk density can approach that of concrete and as a result, come functionally impervious



Consider also:

Table 2-2

USDA-NRCS Estimates of Annual Groundwater Recharge Rates, Based on Soil Type

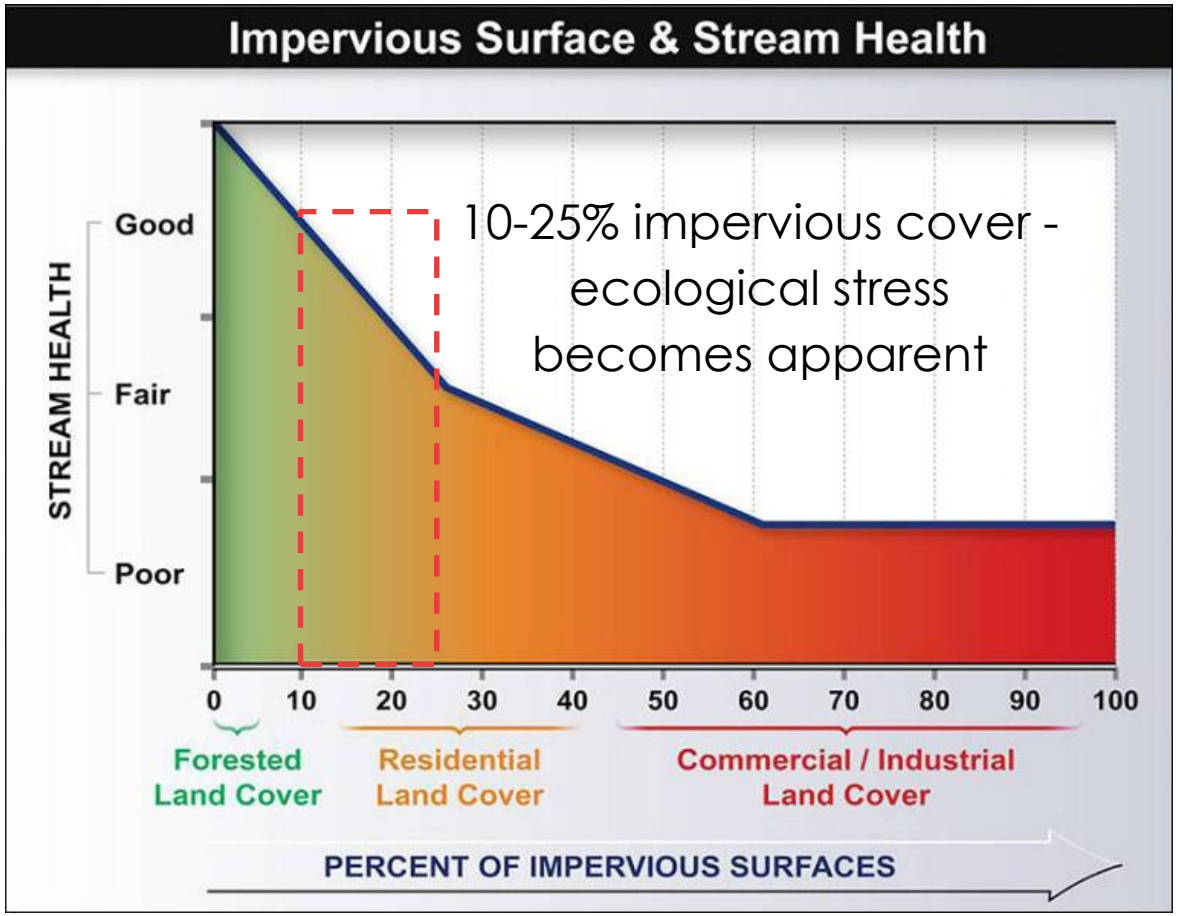
Hydrologic Soil Group (HSG)	Recharge Rate
Hydrologic Soil Group A	18 inches/year
Hydrologic Soil Group B	12 inches/year
Hydrologic Soil Group C	6 inches/year
Hydrologic Soil Group D	3 inches/year

NOTE: Average annual rainfall varies from approximately 42 - 48 inches across Virginia

Reduced Groundwater Recharge and Reduced Stream Base Flows

Reduced Infiltration from Built or Traditional Drainage Systems

Declining Watershed Health from Increased Imperviousness



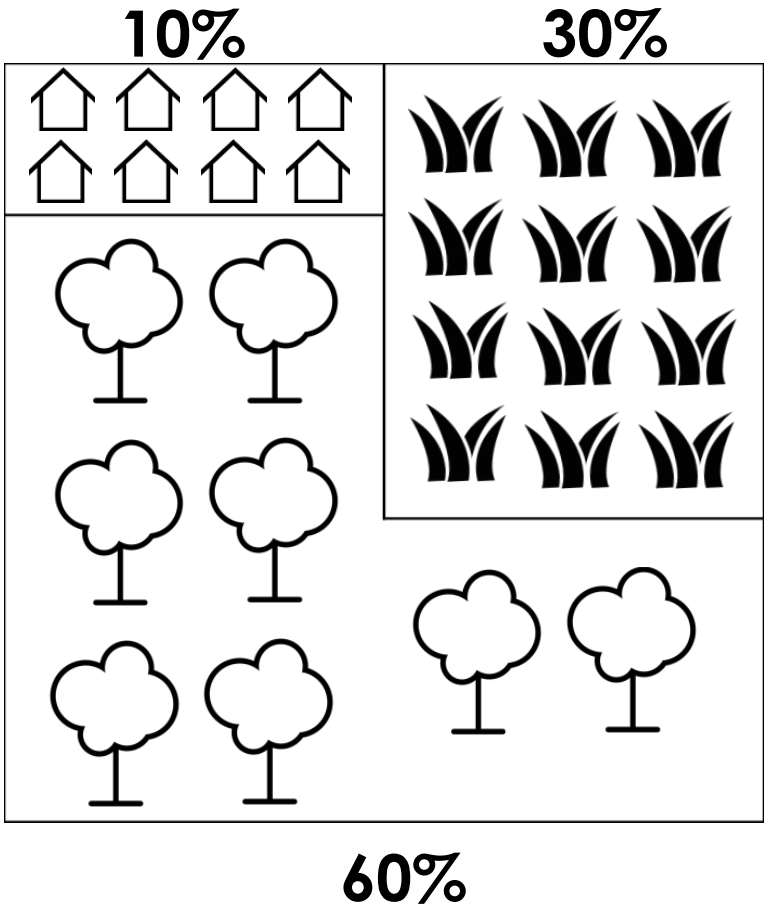
Declining Watershed Health from Increased Imperviousness

Table 2-3

Typical Site Impervious Coverage of Land Uses in the Northeast U.S.

Land Use	% Impervious Cover
Commercial and Business District	65-100
Industrial	70-80
High Density Residential	45-60
Medium Density Residential	35-45
Low Density Residential	20-40
Open (Natural Areas)	0-10

Landuse and the Runoff Reduction Method



Module 2c.

Impact of Stormwater Runoff on Stream Channels and Flooding

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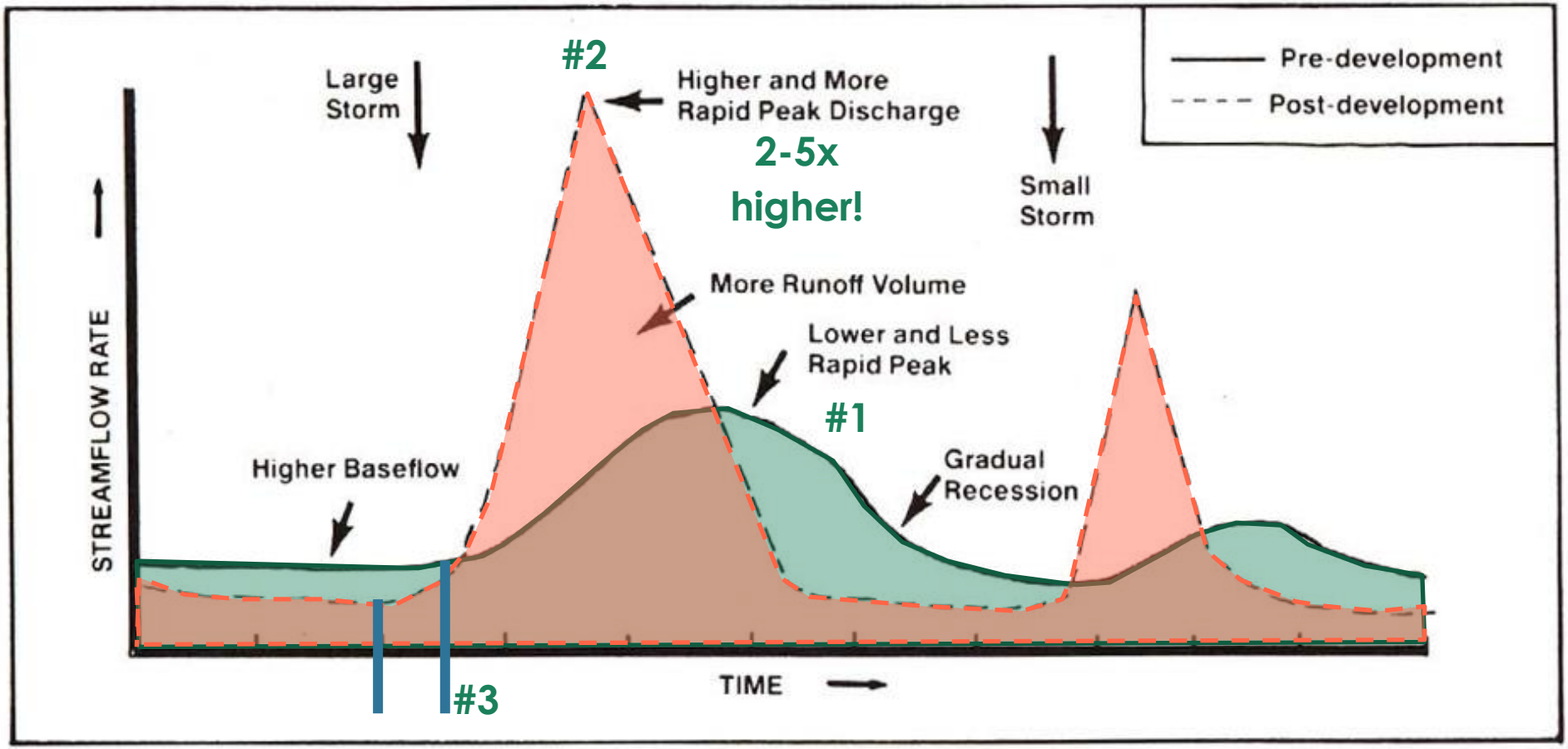
Impact of Stormwater Runoff on Stream Channels and Flooding

- The Part II B water quantity criteria address channel and flood protection because as stormwater runoff increases, there is a direct impact on stream channels and flooding

Impacts on Stream Channels and Flooding



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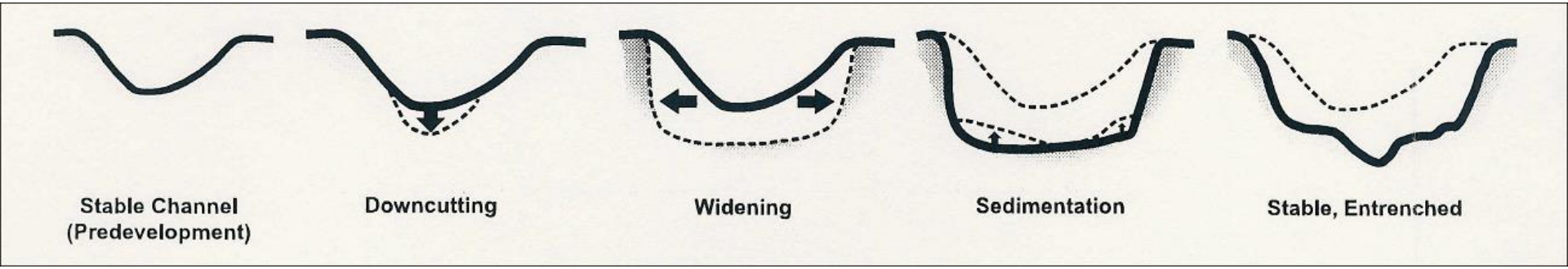
Changes to a Stream

- Greater volumes of runoff occuring more often and at higher flow rates, even in small storms can create:



Landuse and Part II B Quantity

- Maintain after-development runoff rate of flow and characteristics that replicate, as nearly as practicable, the existing pre-development site characteristics
- Make improvements where channel erosion and/or flooding already occur

Module 2d.

Karst Areas

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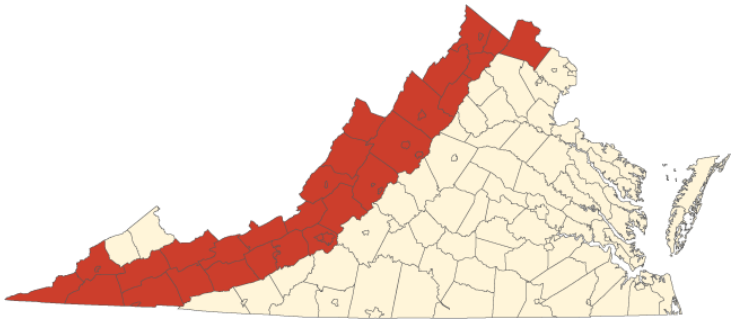
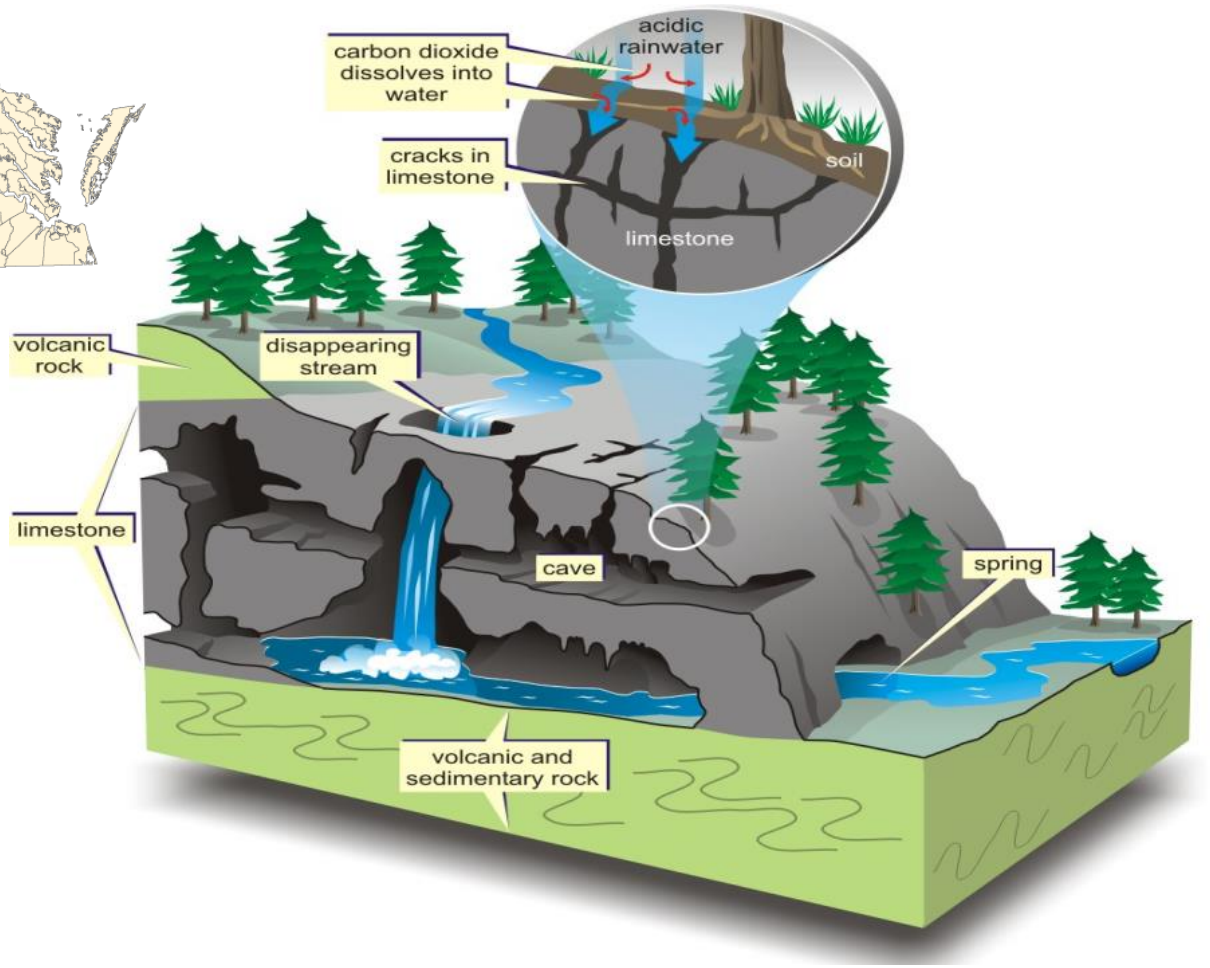
Karst Areas





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Module 2e.

Summary

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SUMMARY OF POTENTIAL PROBLEMS WITH STORMWATER RUNOFF

- High Stormwater Volume and Velocity
  - More impervious surfaces lead to less ground infiltration, more higher energy runoff
  - Increased stream volumes and flow rates, flooding, more erosion

SUMMARY OF POTENTIAL PROBLEMS WITH STORMWATER RUNOFF

- Pollutants in Stormwater Runoff
  - Pollutants transported untreated to our waterways (nutrients, sediments, toxics, litter, debris, etc.)

SUMMARY OF POTENTIAL PROBLEMS WITH STORMWATER RUNOFF

- Ecological Impacts
  - Altered or lost habitats (aquatic, riparian)
  - Reduced species richness and diversity
  - Shift in ecological balance (aquatic food sources, opportunistic species)

SUMMARY OF POTENTIAL PROBLEMS WITH STORMWATER RUNOFF

- Loss of Beneficial Uses
  - Reduction in desirable fish species
  - Shellfish contamination
  - Contamination of drinking water sources
  - Contamination of swimming beaches
  - Loss of recreation and aesthetic value of state waters

Summary

- Water quality
  - Protect waterways from pollutants
- Water quantity
  - Protect channels from erosion
  - Protect channels from flooding

Summary

- The criteria can be accomplished by reducing the volume of stormwater runoff that leaves a site through the use of Environmental Site Design and DEQ approved BMPs rather than just conventional stormwater facilities for water quantity compliance

Summary

- Critical role in meeting water quality and quantity goals!
  - Are plans being properly implemented?
  - Is maintenance occurring?

Questions?