HEALTHY SOILS IN URBAN DEVELOPMENT

SOIL SCIENCE BASICS FOR STORMWATER BMPs

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CITY OF BLOOMINGTON UTILITIES

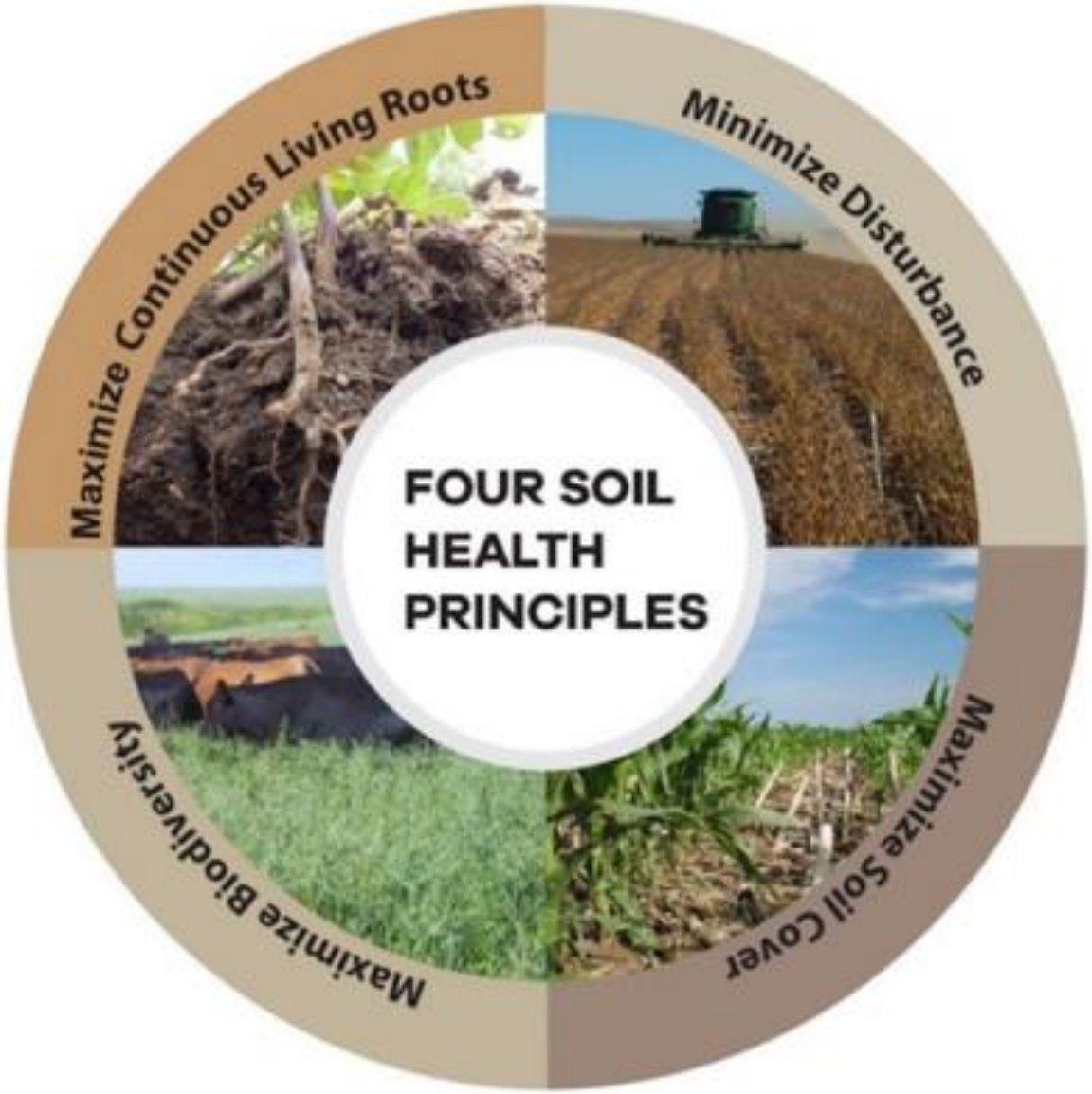
OVERVIEW

- City of Bloomington MS4 – Quick Update
- What is Soil Health?
- Soil Properties
- Soil Degradation and Erosion
- Soil Management and Stabilization
- Design and Maintenance Considerations

MS4 PROGRAM UPDATE

- CBU Engineering Website – New!
- CBU Construction Specifications 2020
- SWPPP Review Fee
- Brighten B-Town Initiative
- New Green Infrastructure Crew
- New Green Infrastructure Funding for City Projects
- City Stream Monitoring Program

WHAT IS SOIL HEALTH?



SOIL HEALTH SYSTEM

- Increasing organic matter
- Increasing water infiltration
- Improving nutrient use efficiency
- Increasing aggregate stability
- Increasing water holding capacity
- Enhancing and diversifying soil biology and habitat

Indiana Conservation Partnership, 2019

MAJOR SOIL FUNCTIONS

- Serves as media for plant growth
- Provides habitat for animals and microorganisms
- Absorbs and filters water
- Recycles nutrients and carbon
- Serves as engineering media for construction

SOIL MICROORGANISMS

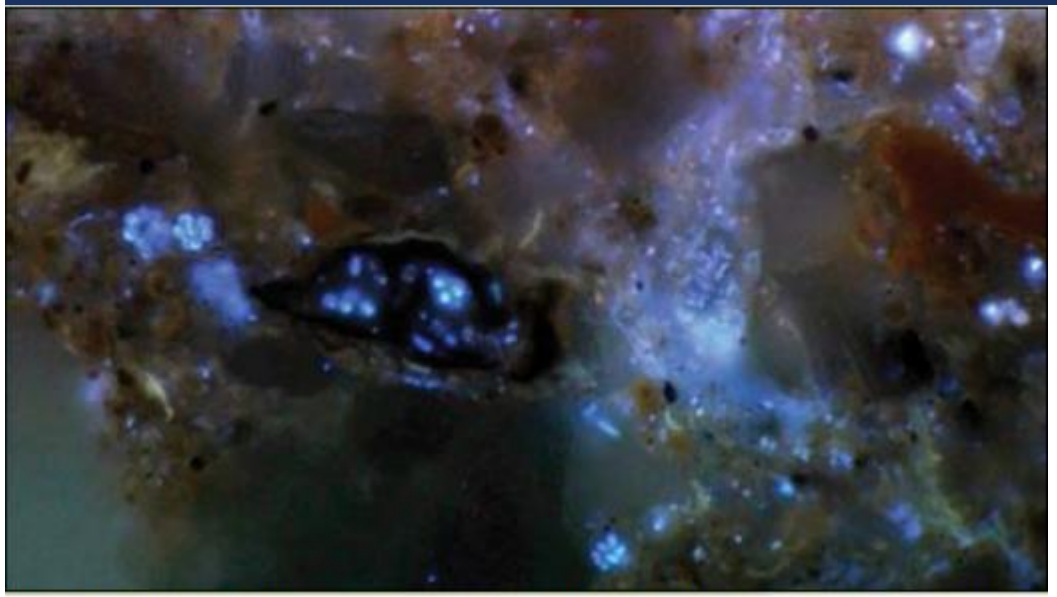


Figure 1: Colonies of soil bacteria (shown in light blue). Each bacterium is approximately one micron in size.
Source: Karl Ritz (soilquality.org.au)

- Produce gooey substances that help soil particles stick together
- Stabilize soil structure

- Bacteria and fungi
- Decompose organic matter
- Make nutrients available to other organisms

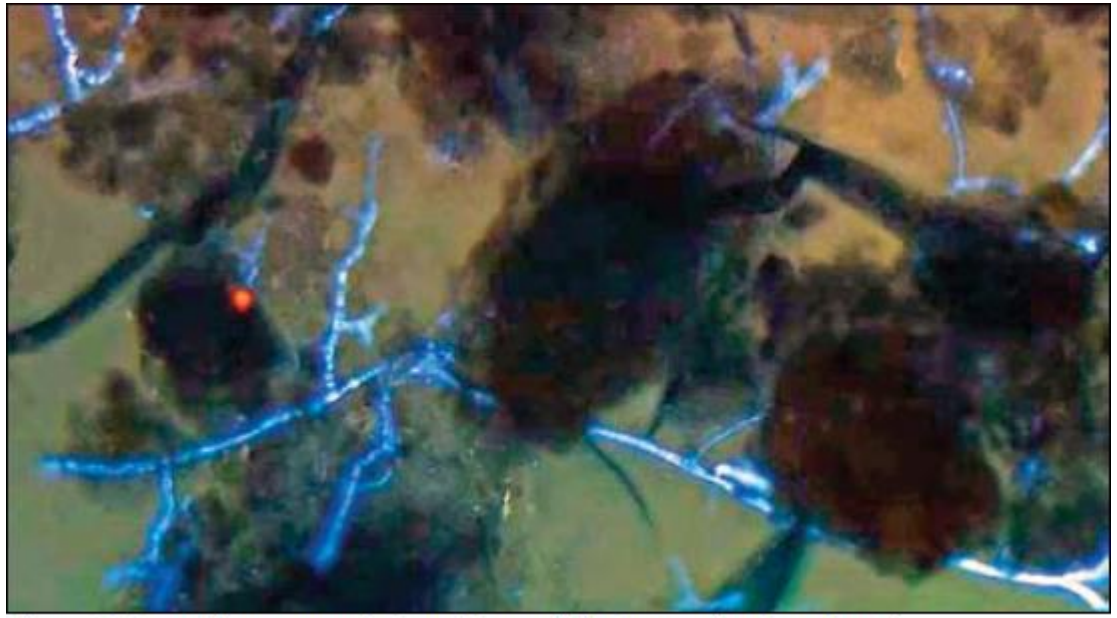
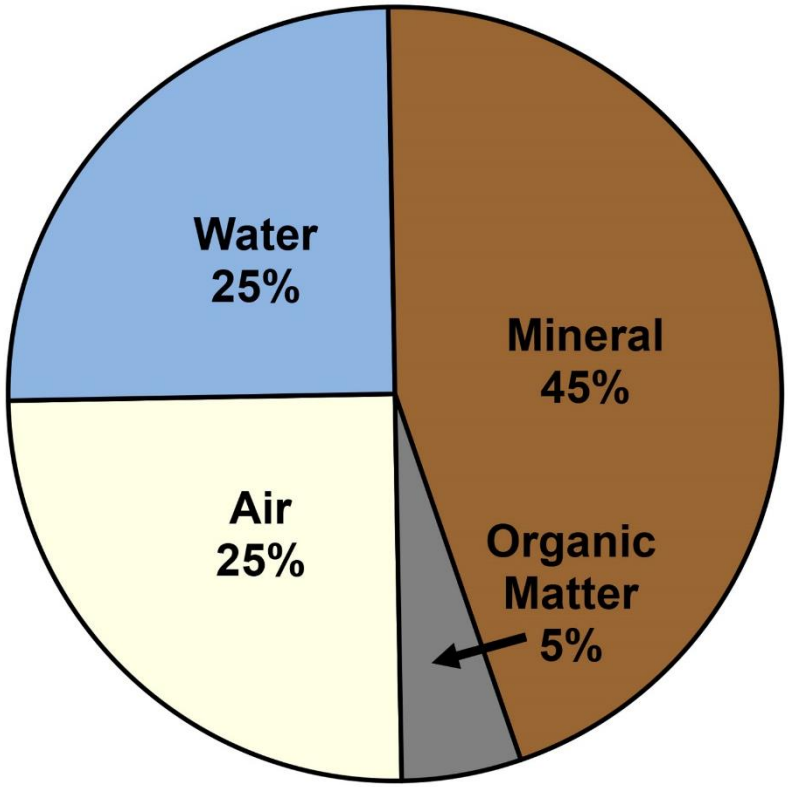
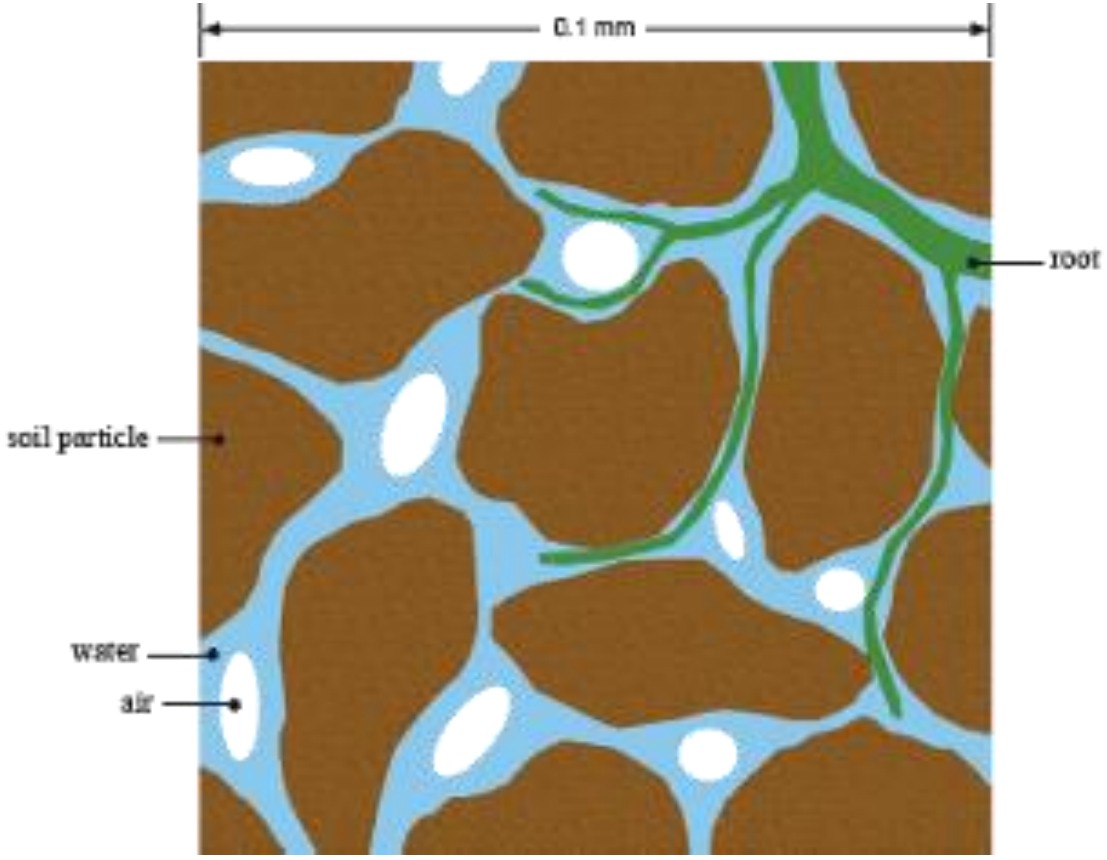


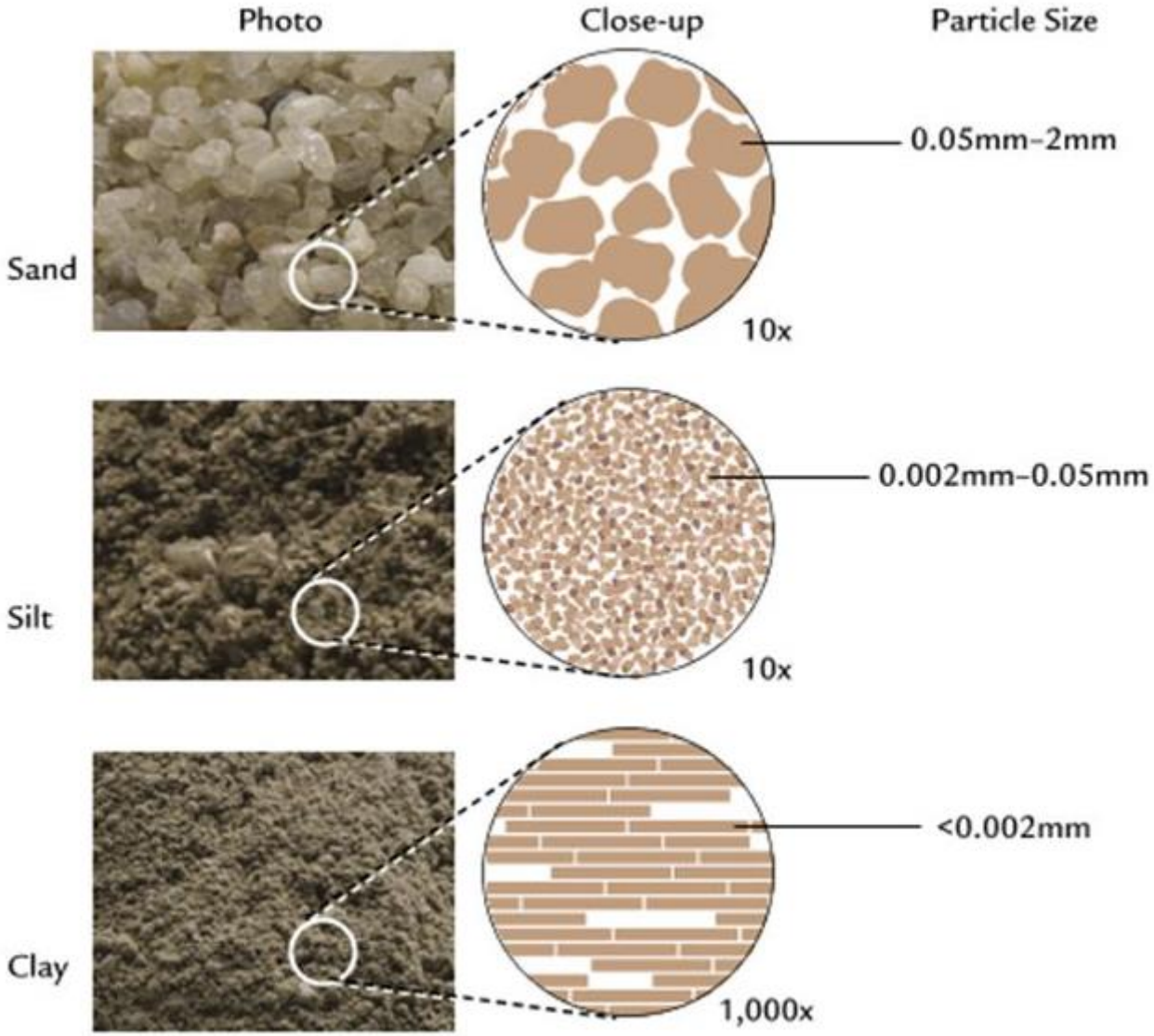
Figure 2: Fungal filaments, or hyphae, (shown in blue) extending through soil.
Source: Karl Ritz (soilquality.org.au)

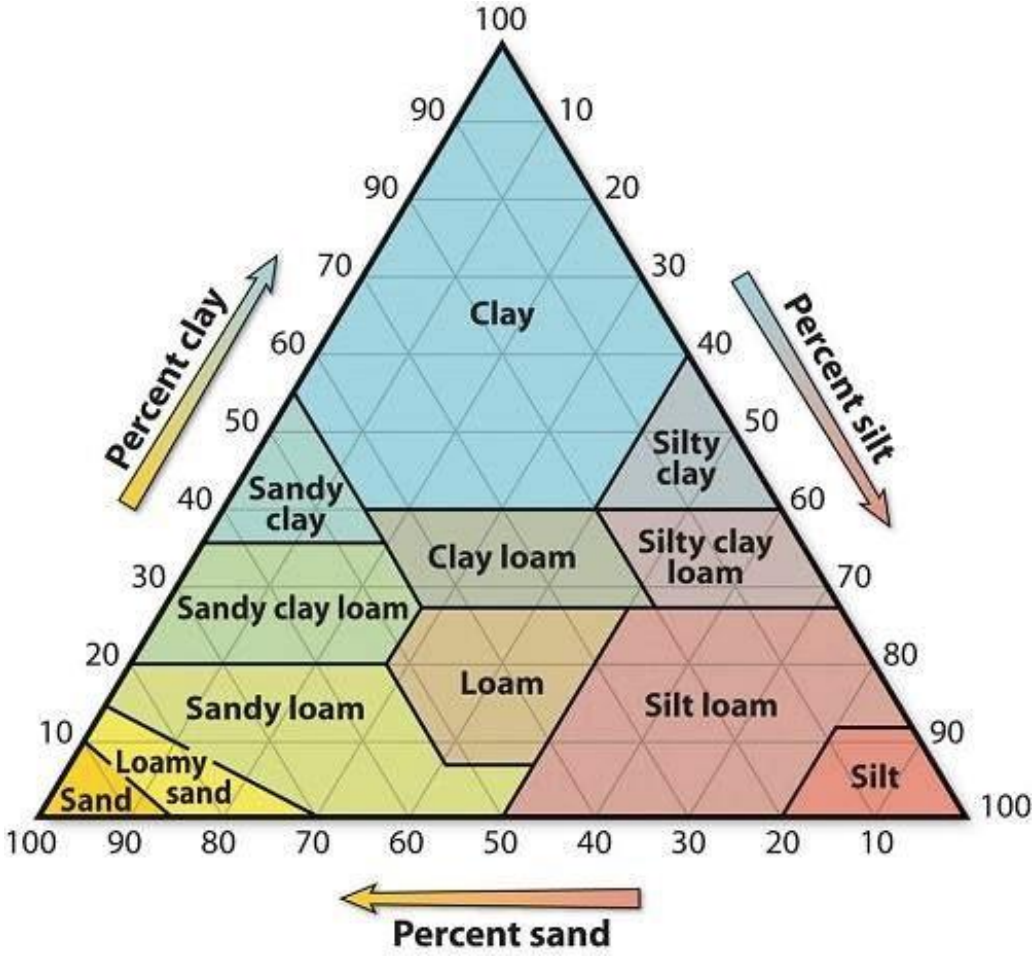
SOIL STRUCTURE AND POROSITY





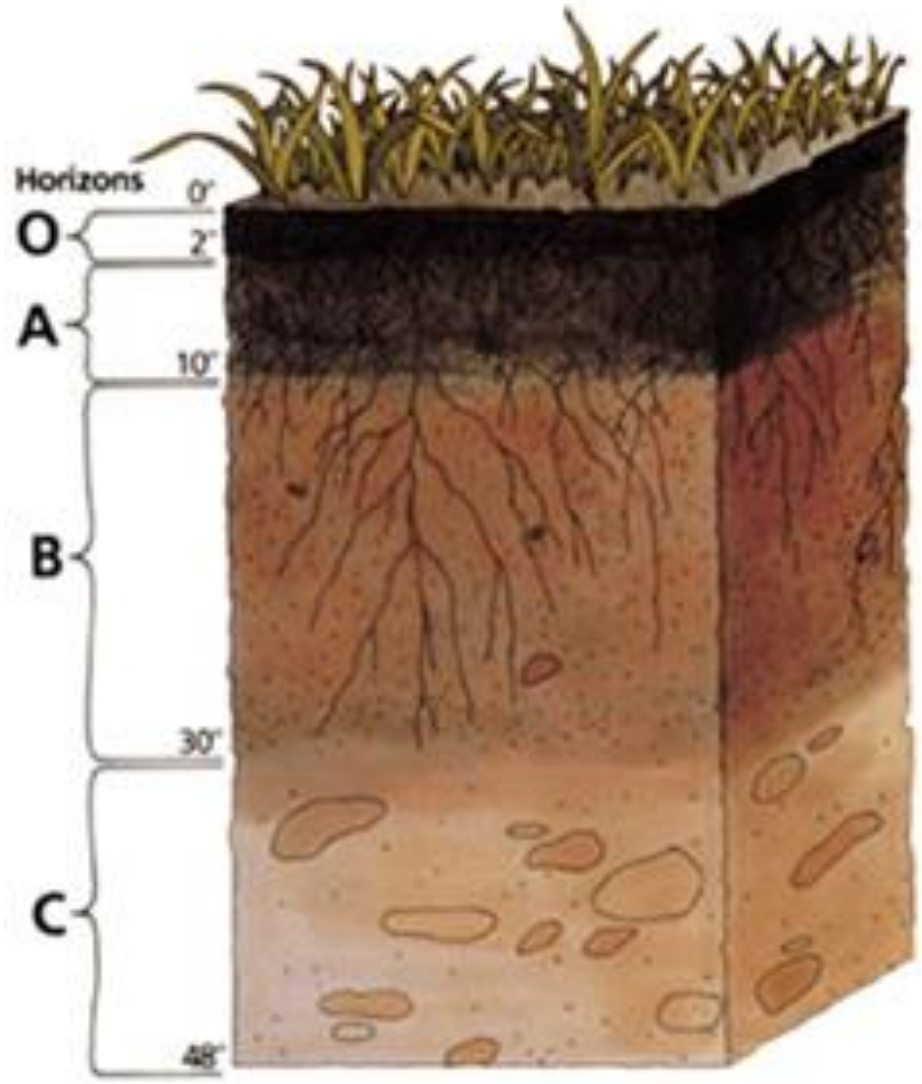
SOIL TEXTURE





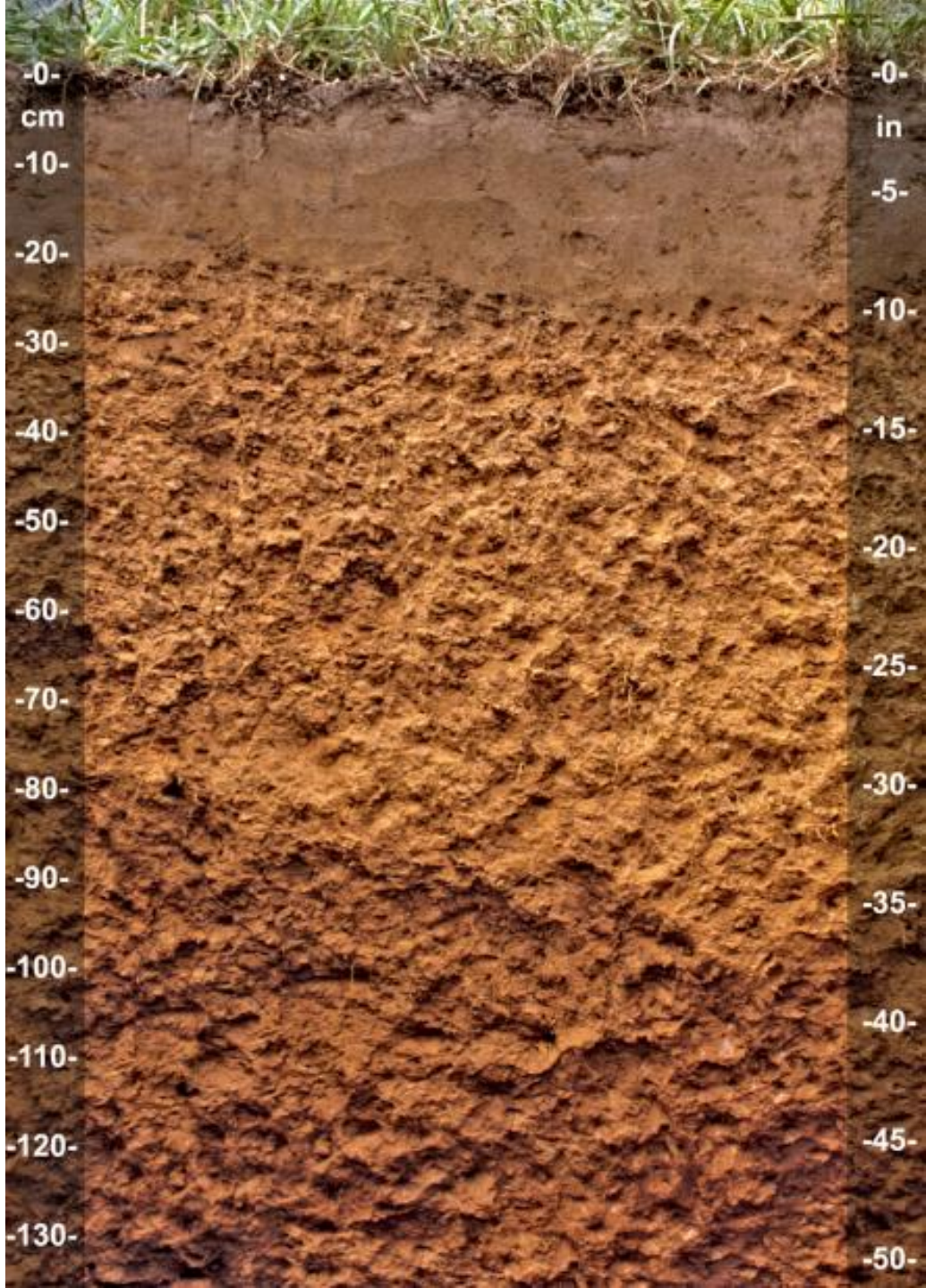
SOIL HORIZONS

- Soil profile
- Differences in soil properties (color, texture)
- Used to define soil types



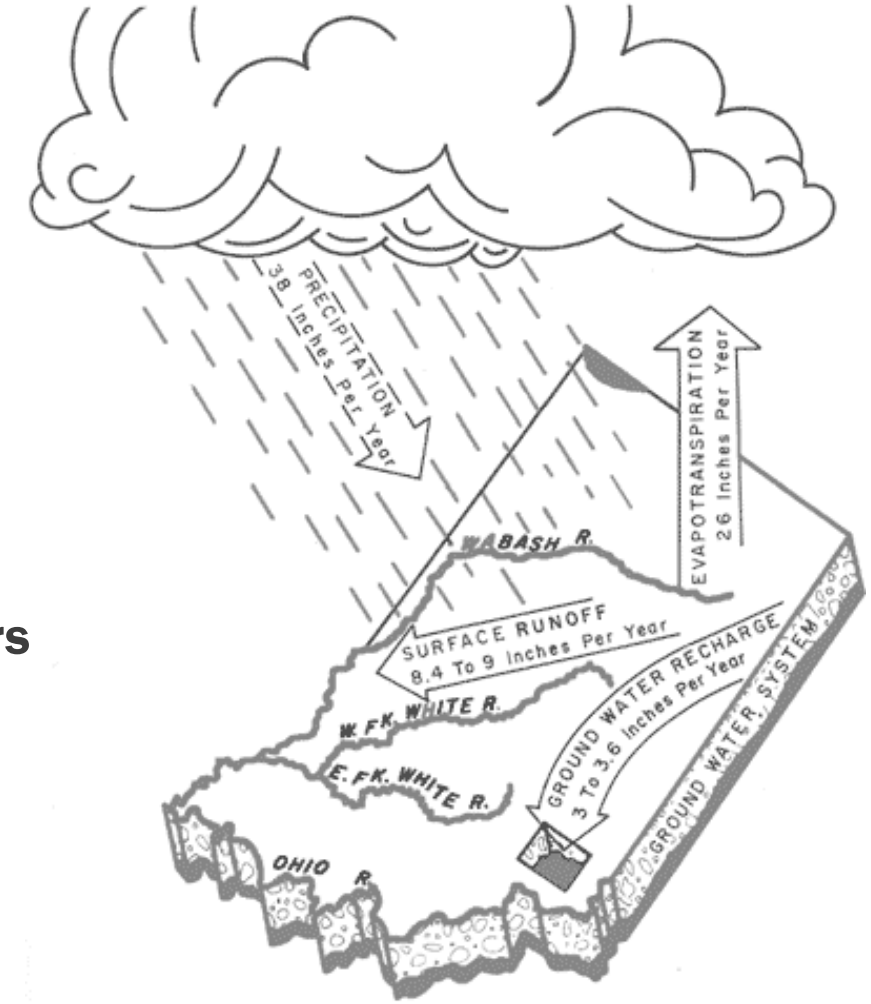
CRIDER SOILS

- Parent material is limestone
- Original vegetation was mixed hardwood forest
- Deep and well-drained, moderately permeable
- Flat and rolling terrain with 0-12% slopes
- Texture: Silt Loam (Topsoil) to Silty Clay (Subsoil)
- Few limitations for use



FACTORS AFFECTING SOIL FORMATION

- Parent Material
- Topography
- Climate
- Biological Factors
- Time



SOIL HEALTH FOR CONSTRUCTION SITES

SITE PLANNING AND DESIGN

- Soil maps
  - Help determine best place to build
  - Slope of the land surface
  - Soil biological, physical, and chemical properties
  - Potential for water runoff, drainage or storage

Search

Map Unit Legend

Monroe County, Indiana (IN105)

Monroe County, Indiana (IN105)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CrB	Crider silt loam, 2 to 6 percent slopes	1.4	2.9%
CrC	Crider silt loam, 6 to 12 percent slopes	2.4	4.9%
CtB	Crider-Urban land complex, 2 to 6 percent slopes	12.3	25.5%
CtC	Crider-Urban land complex, 6 to 12 percent slopes	31.0	64.2%
Ua	Udorthents, loamy	1.2	2.5%
Totals for Area of Interest		**48.3**	**100.0%**

Soil Map

Legend

Scale (not to scale)

SOIL DEGRADATION:

COMPACTION, EROSION, CONTAMINATION

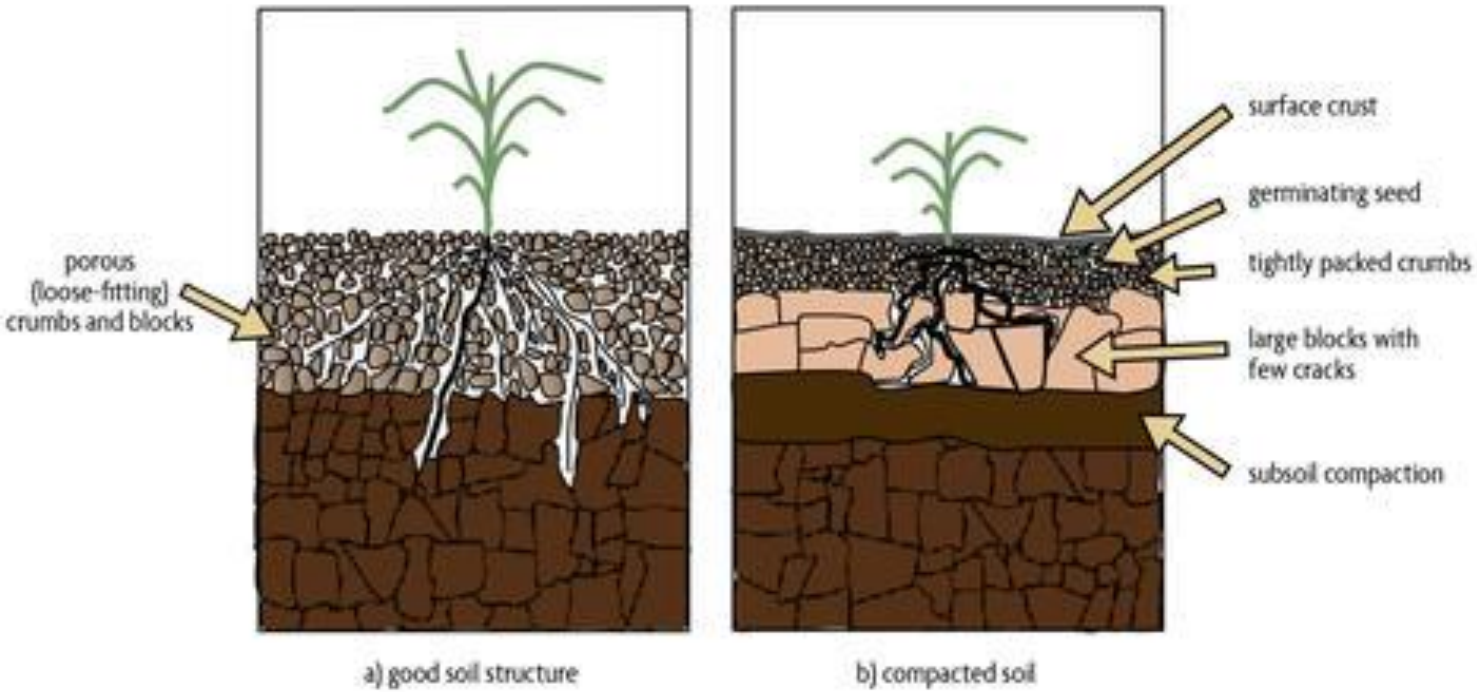
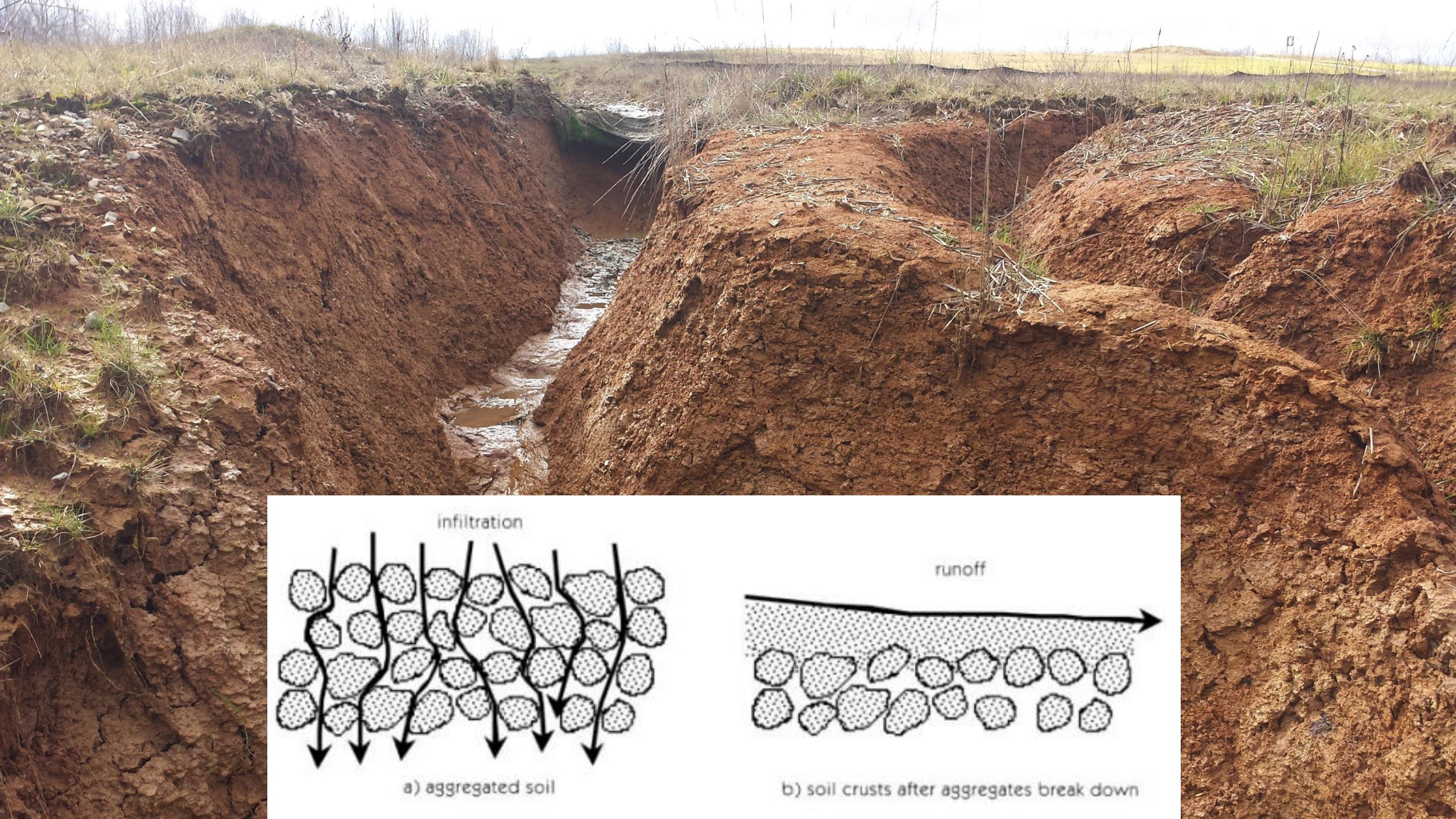


Figure 6.6. Plants growing in (a) soil with good tilth and (b) soil with all three types of compaction.


infiltration
runoff
a) aggregated soil
b) soil crusts after aggregates break down

FACTORS THAT INFLUENCE EROSION

- Soil Erodibility
- Vegetative Cover
- Topography
- Climate
- Season


OVERGRAZED PASTURE
MANAGED PASTURE
CONVENTIONAL TILLAGE
LONG TERM NO-TILL, with COVER CROPS
RUNOFF
RUNOFF
RUNOFF
RUNOFF
RUNOFF

TEMPORARY STABILIZATION

- Erosion controls can reduce sediment loss by up to 90%
- Established vegetation reduces sediment loss by 97%

TOPSOIL MANAGEMENT

- Topsoil Salvaging
  - Avoid mixing soil layers
- Topsoil Stockpiles
  - Make piles as low as possible
  - Store topsoil for short periods
  - Avoid heavy machinery on stockpiles
  - 5:1 side slopes (ideal)

“Final Stabilization” doesn’t mean it only happens at the end…

Permanent stabilization should occur throughout the course of construction

SEDIMENT CONTROLS

- For fine soils, sediment-laden discharges are unavoidable
- Length-to-width ratio at least 2:1 for increased flow path length
- Clean out when it reaches 50% capacity

Pond standpipe installation during construction

FACTORS AFFECTING RUNOFF

- Precipitation
- Watershed Area
- Ground Cover
- Soil Moisture
- Soil Permeability

SUMMARY

- Soil health – Not just for farmers!
- Soil properties – physical and biological
- Soil degradation and erosion
- Soil Management and Stabilization
- Sediment and Runoff Controls

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