

# Water Movement Below Surface

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- Groundwater issues
  - Recharge areas
  - Inorganic pollutants
- Soil trafficability
  - Location of roads and skid trails
  - Operating seasons



Abandoned wells are most common source of ground water pollution, not surface applied chemicals.

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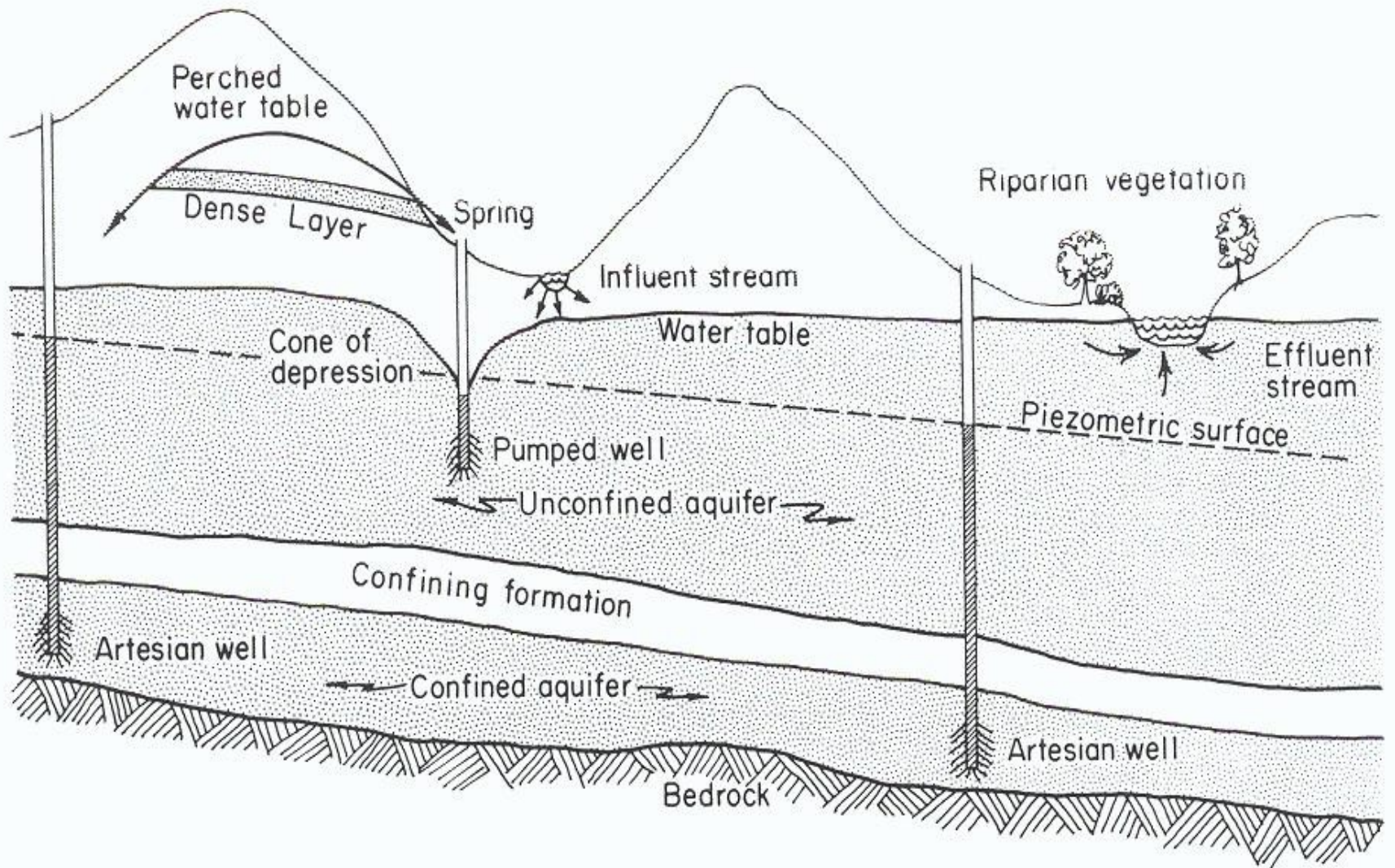
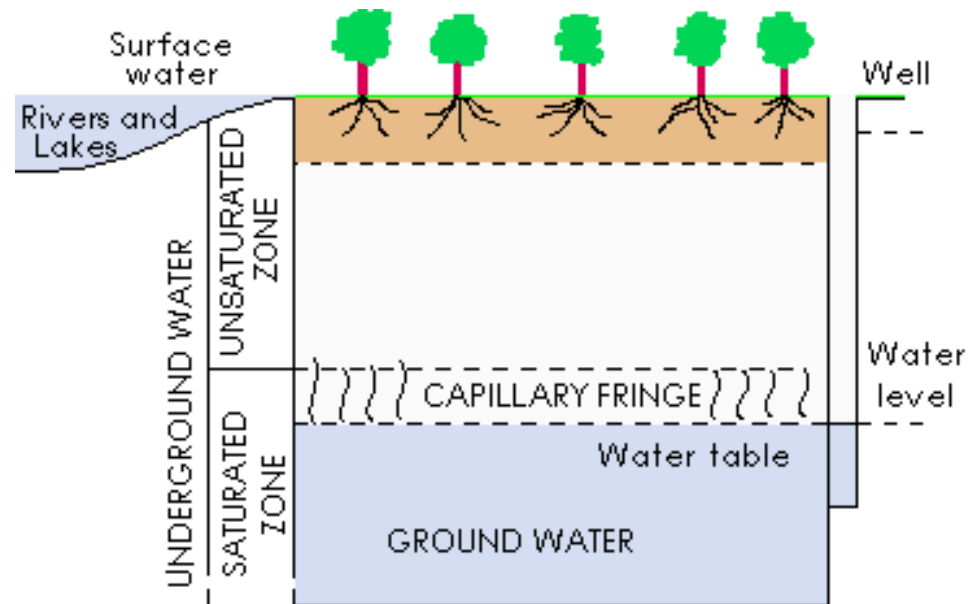


Fig 5-5. Nomenclature and characteristics of ground water. The diagram is for definition of terms, not to illustrate typical ground water conditions.

# Subsurface Water

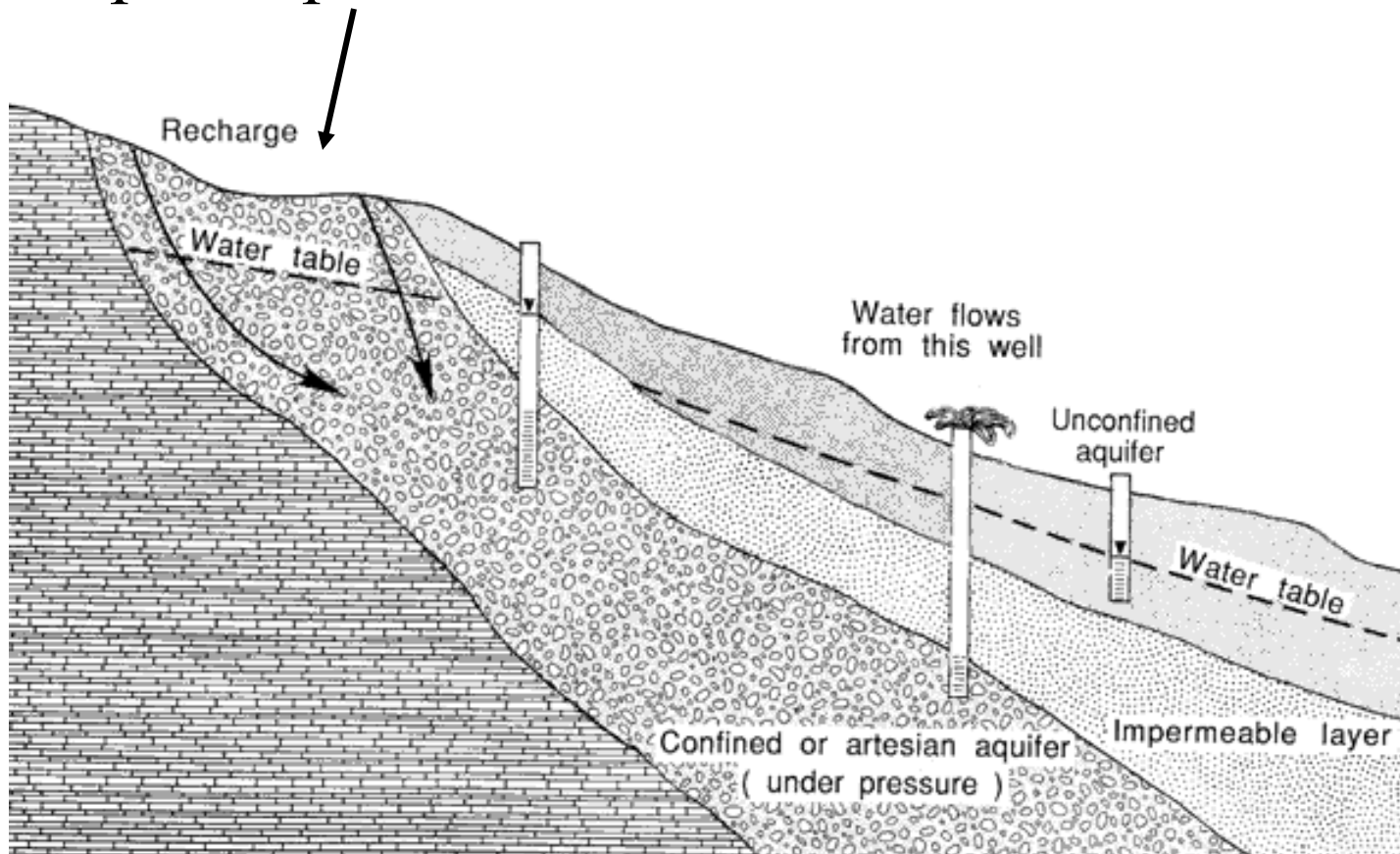
- Soil water
  - 75% precipitation in temperate climates enters surface of soil and becomes,
    - Soil moisture – in unsaturated soil, or
    - Ground water – in saturated soil and rock



# Groundwater Issues

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- Groundwater recharge zones should receive special protection



# Regolith

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The loose, incoherent mantle of rock fragments, soil, blown sand, alluvium, etc, which rests upon solid rock, i.e. bedrock. Some authors also include volcanic ash, glacial drift and peat under this heading



BC  
coastal  
forest  
and  
typical  
soil  
profile



# Structure of Regolith

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- Zone of aeration (soil moisture)
  - Root systems of most plants is limited to this zone because oxygen needed for root growth and function
  - **Solum** – part of regolith that serves as medium for plant growth
- Zone of saturation (ground water)
- Water table separates these two zones



BC  
floodplain  
and  
associated  
soil  
profile



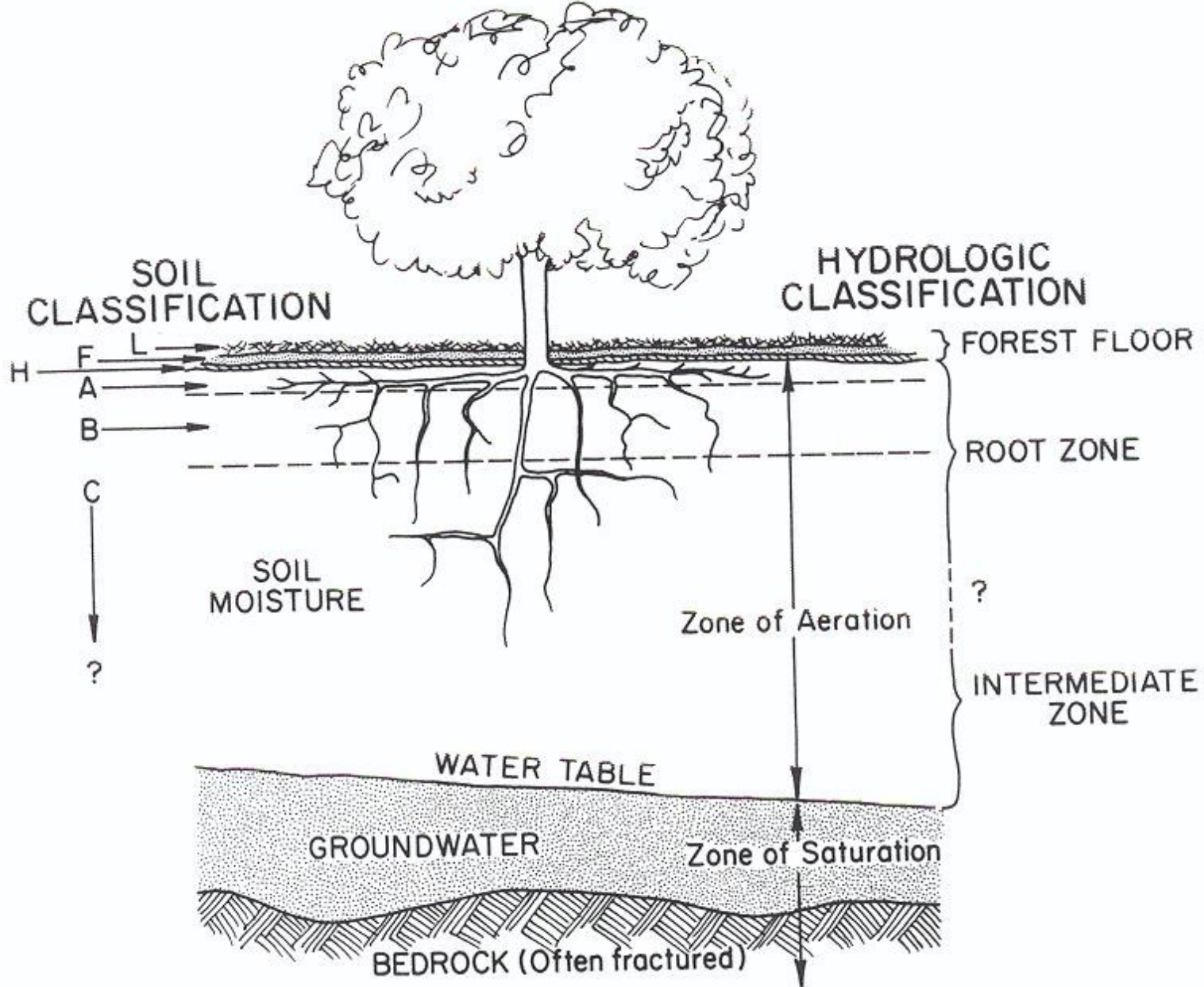
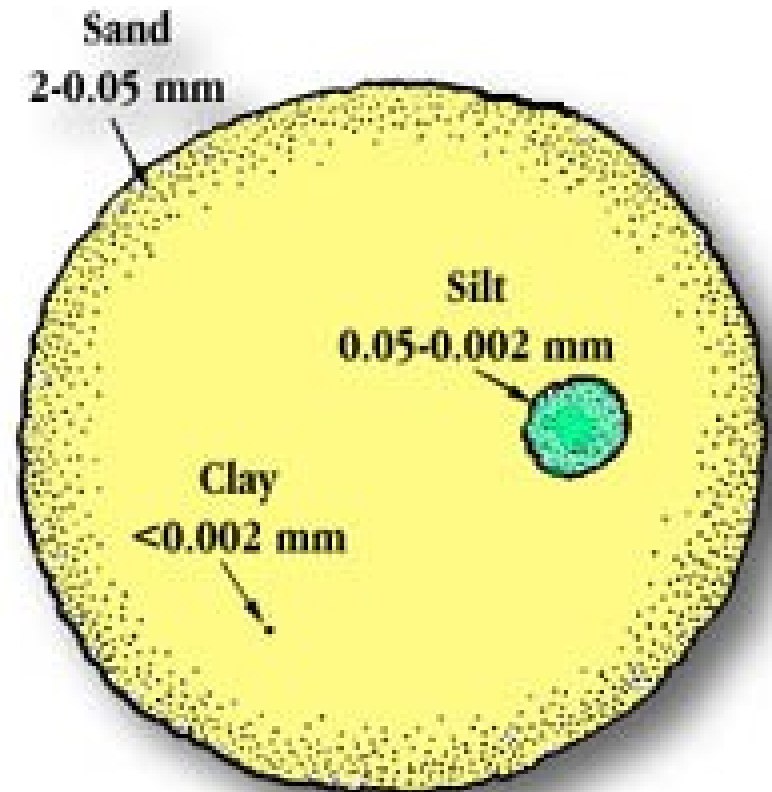


Fig 5-1. Classification of the soil mantle (regolith) as viewed in soil science and in hydrology. L, F and H are the litter, fermentation and humus layers, respectively.

# Soil Mineral Complex

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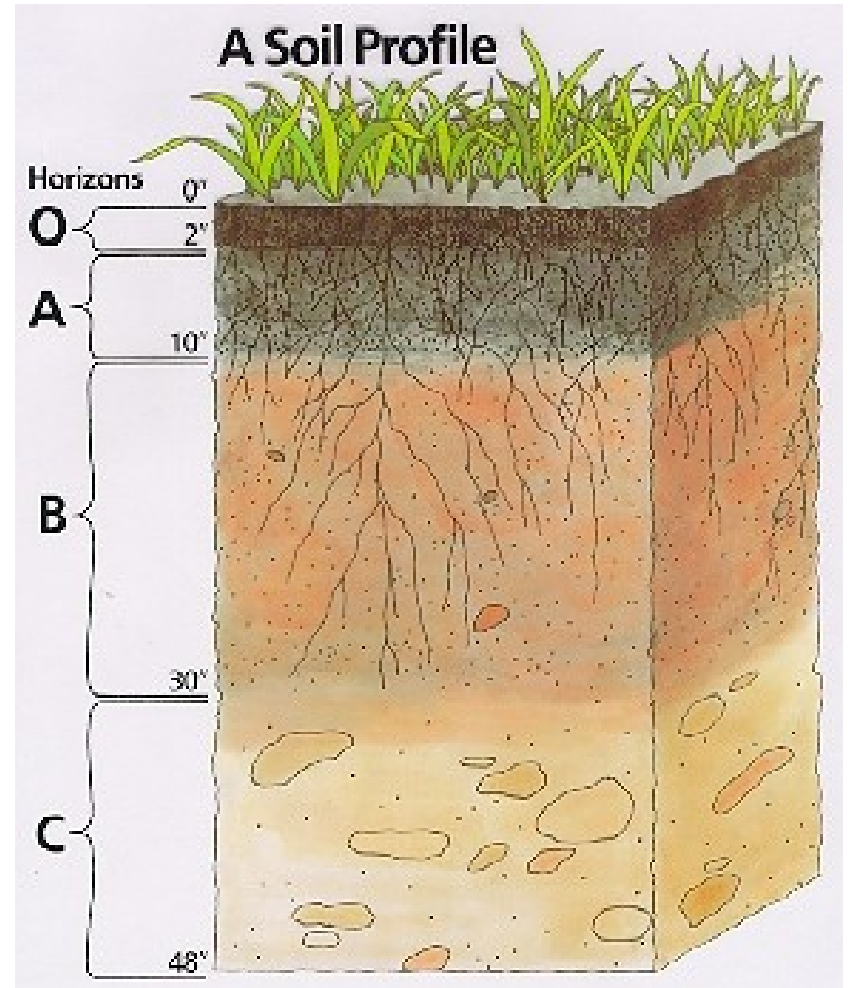
- Divided into 5 particle sizes
  - Gravel  $> 2$  mm
  - Coarse sand  $0.2 - 2$  mm
  - Fine sand  $0.02 - 0.2$  mm
  - Silt  $0.002 - 0.02$  mm
  - Clay  $< 0.002$  mm
- Texture - determined by relative amounts of material in each particle class





# Soil Mineral Complex

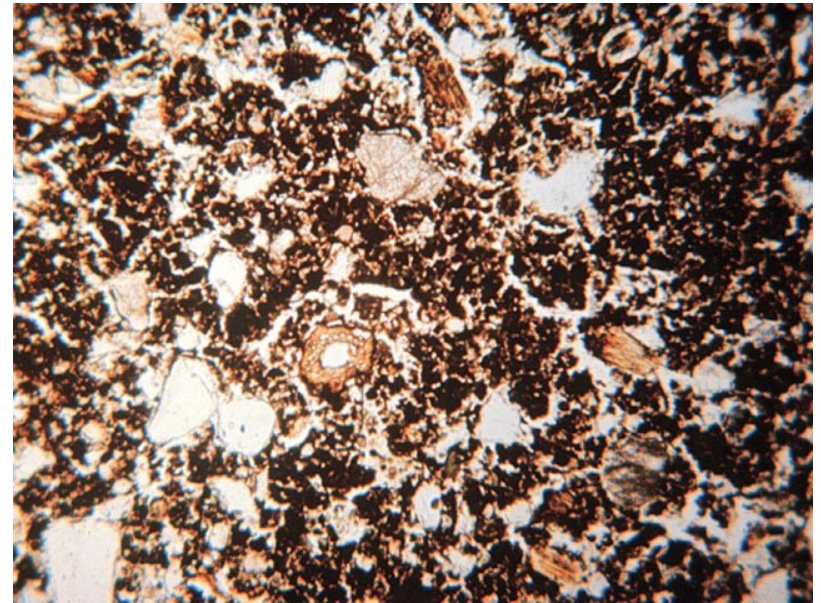
- Structure – results from tendency of soils to aggregate into crumbs, columns, clods or blocks
- Pore space – varies from 35% when poorly aggregated to 65% when well aggregated



# Soil Mineral Complex

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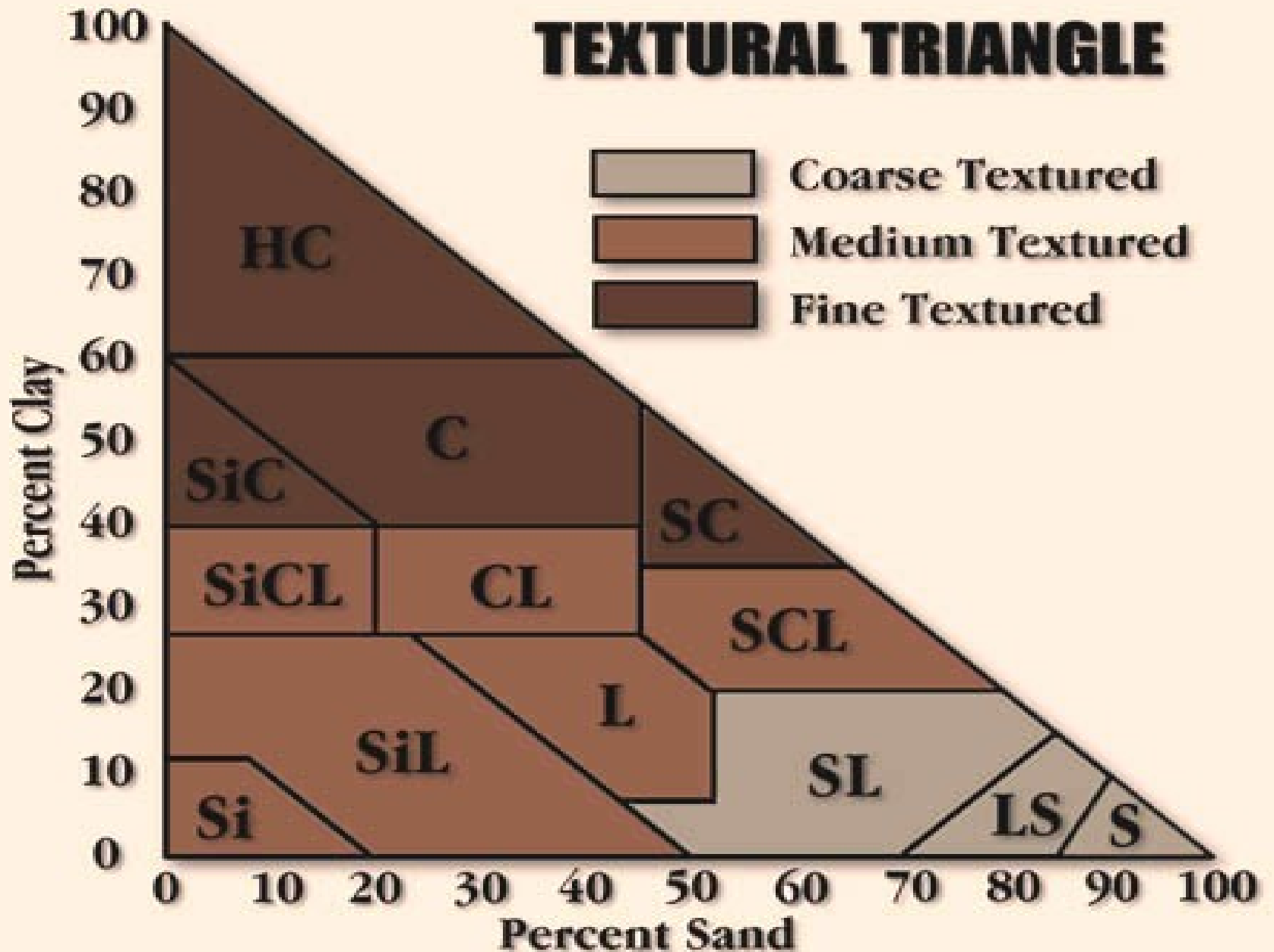
- Texture and structure affect distribution of pore space which affects hydrologic and biological processes such as
  - Infiltration
  - Detention storage
  - Water movement
  - Soil moisture storage
  - Plant growth



**Mineral fraction of soil with pore space**

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# TEXTURAL TRIANGLE



# Soil Moisture

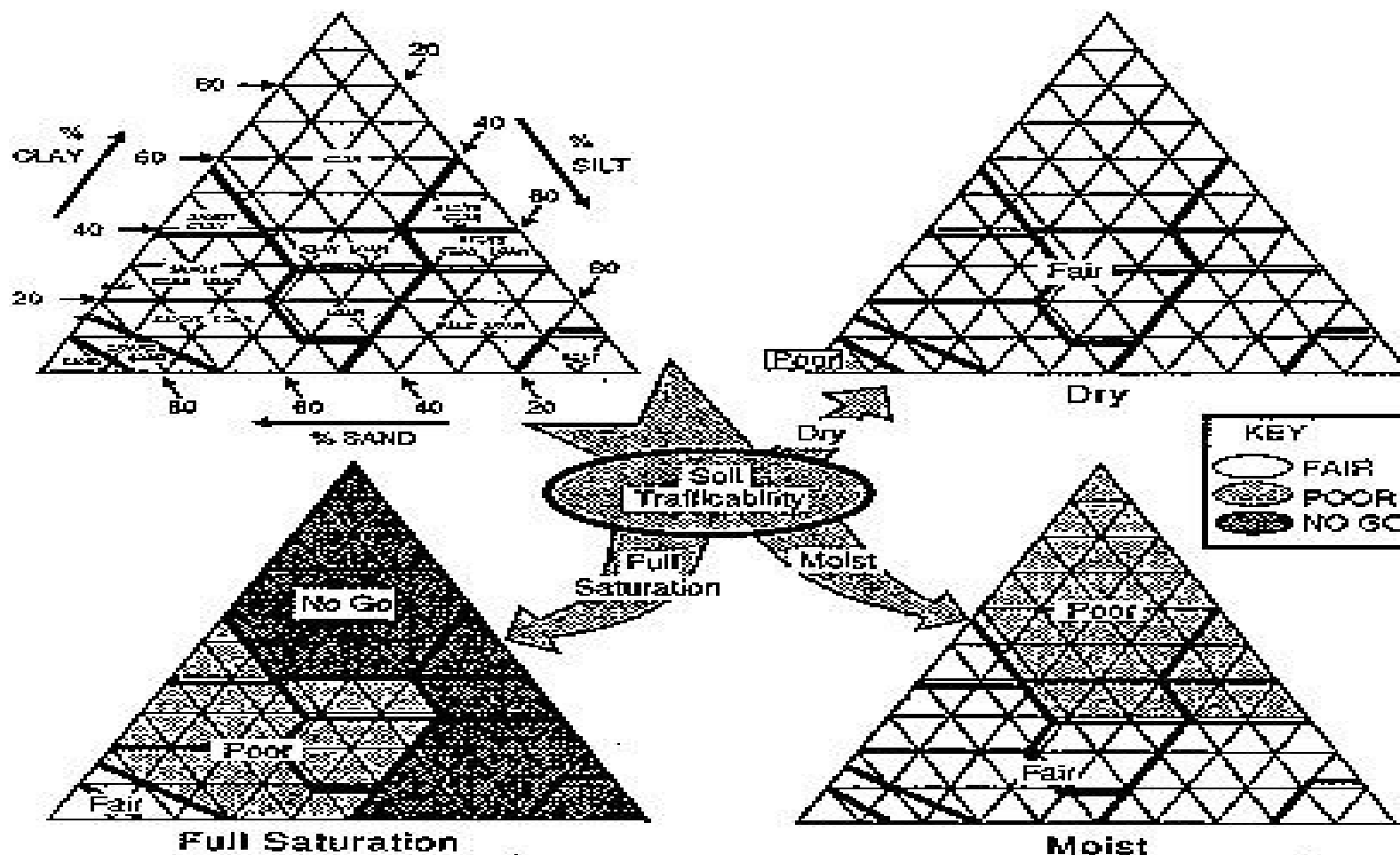
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- A given volume of soil,  $V$ , consists of
  - Solid matter,  $V_s$ ,
  - Water,  $V_w$ , and
  - Air,  $V_a$ , where
  - $V = V_s + V_w + V_a$
- Bulk density –
  - dry mass of soil occupying a given space in soil mantle
  - mass per unit volume of dry soil,
  - the volume representing the exact space the soil occupies in the field

$$B = \frac{\text{Mass of the dry soil in g}}{\text{In situ volume in cm}^3}$$

$$B = \frac{\text{Weight soil in lbs in situ volume in ft}^3}{62.4 \text{ lbs./ft}^3}$$

### SOIL TEXTURE TRIANGLE AND TRAFFICABILITY



**DRY:**  
The soil remains dry. In this condition, soils generally provide the best trafficability.

**MOIST:**  
The intermediate classification between full saturation and dry. A moist soil experiences some degradation of trafficability depending on its ability to drain off excess water.

**FULL SATURATION:**  
Standing water present. A soil that is fully saturated usually provides poor trafficability.

# Water Movement in Soil

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- Determines relationship between precipitation and water yields over a watershed
  - Movement determined by physical properties of a given type of soil and the physical properties of water
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# Energy of Water in Soil

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- Cohesion – attraction of water molecules to each other
  - Adhesion – attraction between soil particles and water
  - Meniscus – curved air-water interface developed as water drains from soil
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# Energy of Water in Soil

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- Energy of water is determined by,
    - Mass – amount of water
    - Pressure potential – potential to do work, i.e. move given amount of water over a given distance
    - Gravity potential – potential to do work based on position of mass within the gravity field
    - Osmotic potential – movement of water from areas of low solute concentration to areas of high solute concentration
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# Soil Water Movement

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- Water moves from area of higher to area of lower total moisture potential
  - Direction of movement within soil layer can be up, down, or sideways depending strictly on relative moisture potential
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# Soil Water Movement

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- Factors determining movement include
    - Soil texture
      - Size soil particles
      - Pore space
    - Soil moisture content
    - Slope of soil or rock layer relative to direction of force of gravity
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# Soil Water Movement

- Movements very complicated and hard to predict