Soils and Site Assessments

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What is a soil?

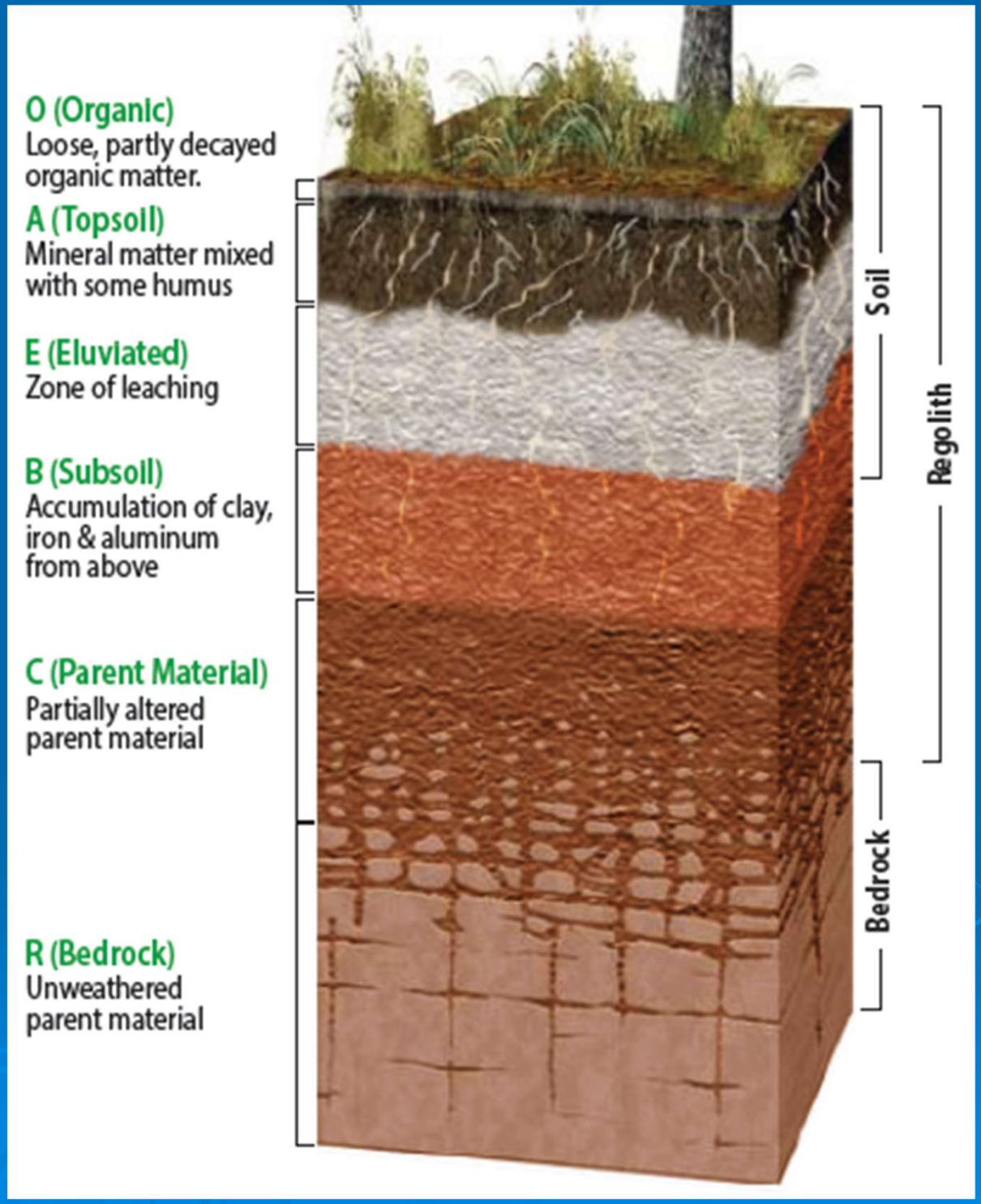
A soil is a porous natural body of mineral, air, water and organic matter that changes, or has changed, in response to climate, topography, time, and organisms.

Soil Forming Factors

(clorpt)

1. Climate
2. Organisms
3. Relief or topography
4. Parent material
5. Time

Typical Soil Profile



Soil properties that influence wastewater treatment

- Water movement
  - Texture
  - Structure
- Restrictive zones or horizons
- Wetness conditions
- Landscape

Soil Profile

- **Soil Texture**
- Structure
- Density
- Depth of each layer or horizon
- Rooting depth
- Moisture content
- Colour


Soil Texture

Soil Texture

- Use texture to make inferences into pore size
- From pore size begin to estimate water movement and treatment
  - Finer texture means slower water movement
  - Finer texture means greater treatment
- Texture by itself is not enough information to determine site suitability

Other factors that combine with texture

- Soil structure
- Organic matter and vegetation
- Soil mineralogy
- Land use
- Landscape position
- Parent material
- Soil wetness

Soil Texture Classification to CSSC*

- Mineral material only (not organic)
- Material > 2mm are coarse fragments
- Consider material < 2mm only for main textural classification

  ie. Sand, silt and clay sizes.

Canadian System of Soil Classification

Soil Texture
(mineral material only)

- Sand - gritty
- Silt - smooth, velvety
- Clay - slick, sticky

Particle Size Classification

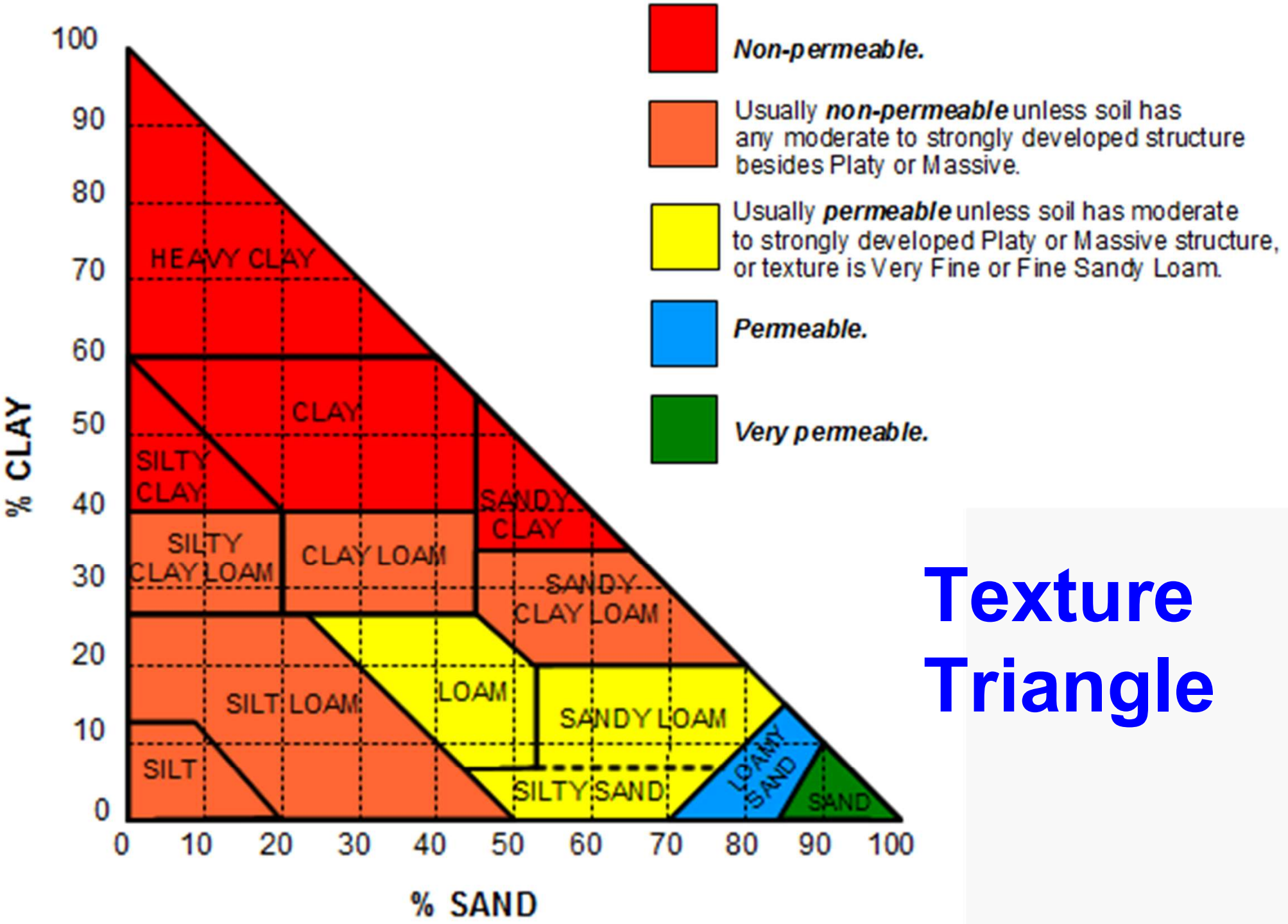
- Coarse fragments not included in CanSIS system include boulders, cobbles, stones and gravels
- Coarse fragments of more interest to engineers – use different classification systems for things like foundation support, slope stability, road construction, etc.

Relative Sizes of Primary Particles

- Sand 2.00 mm – 0.050 mm
- Silt 0.05 mm – 0.002 mm
- Clay < 0.002 mm

CSSC Textural Classes (12 main classes)

1. Sand
2. Loamy Sand
3. Sandy Loam
4. Loam
5. Silt Loam
6. Silt *(rare)*
7. Sandy Clay Loam
8. Silty Clay Loam
9. Clay Loam
10. Sandy Clay
11. Silty Clay
12. Clay

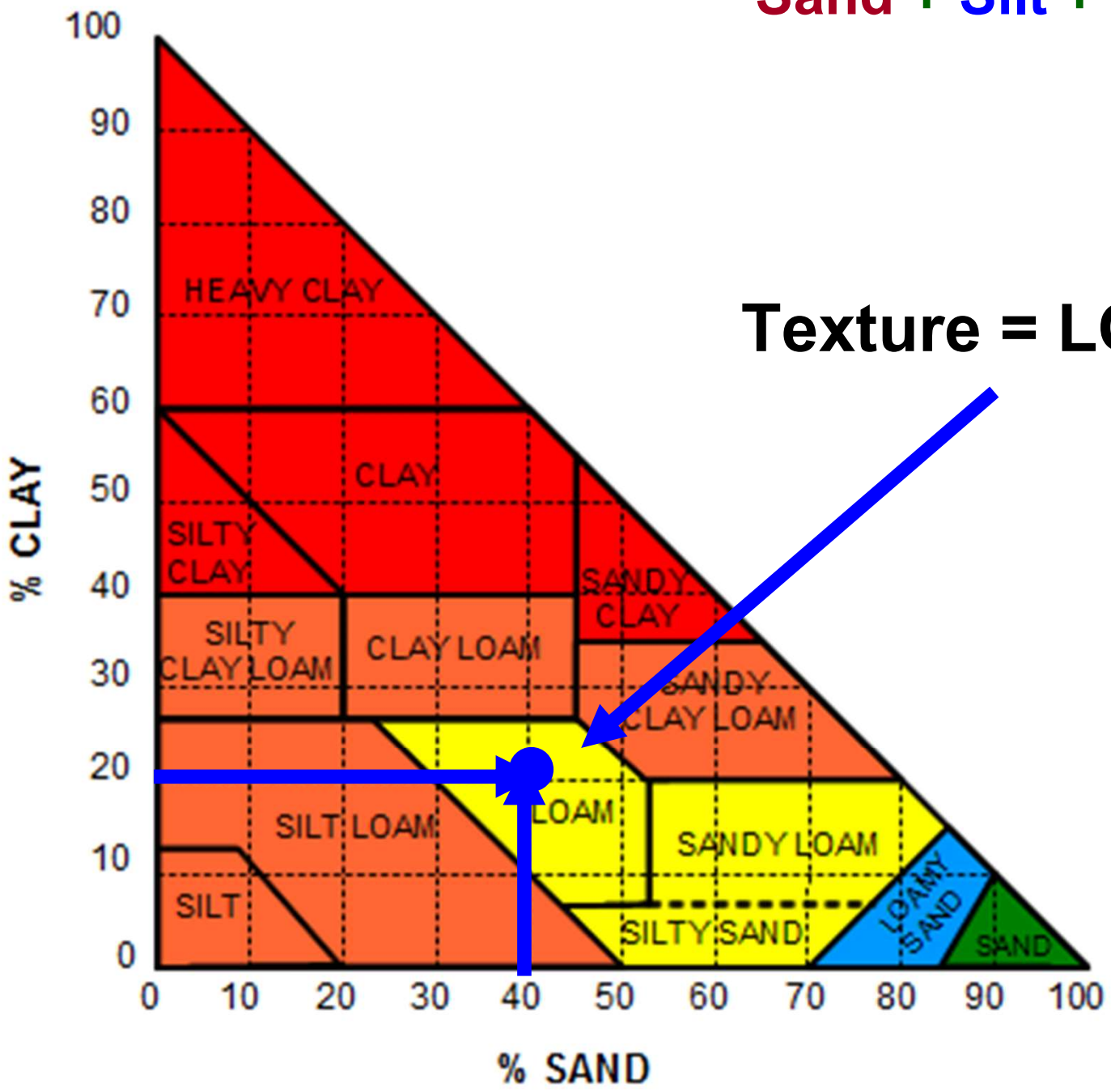


Texture Triangle

Soil Texture

- In the lab, relative proportions (%) determined and assigned a textural class
- In the field, a series of tests are performed to arrive at similar conclusion

Sand + Silt + Clay = 100%



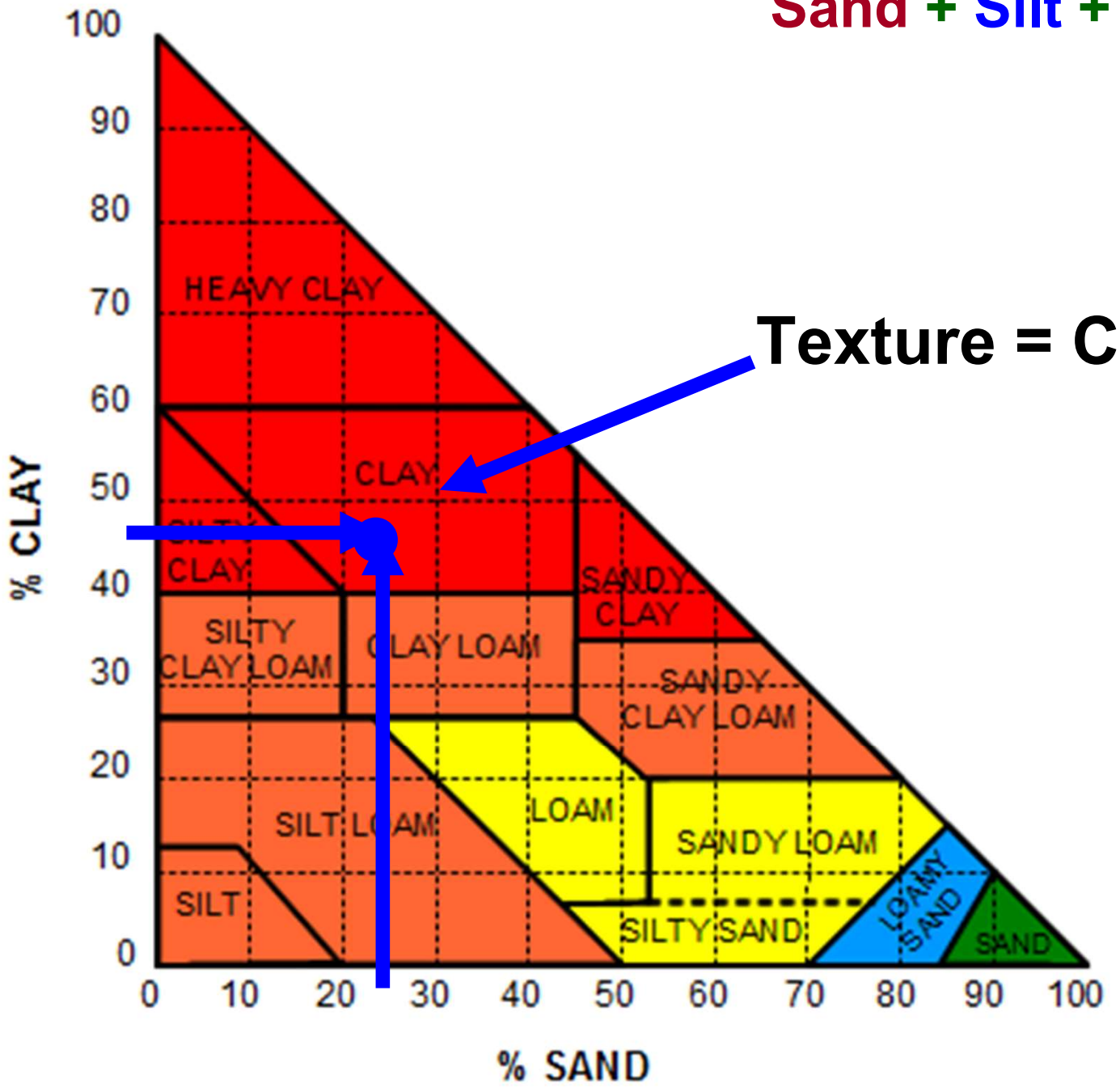
Texture = LOAM

40 % Sand

40 % Silt

20 % Clay

Sand + Silt + Clay = 100%



Texture = CLAY

25 % Sand
30 % Silt
45 % Clay

Sand Fractions

Fraction	Size (mm)
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05

Clays

- Clays are very important to the behaviour of soil
- Even in small quantities they are responsible for most of the reaction of soils including affecting water movement and treatment of the effluent.

Clay

- Too much clay can limit use of soil for on-site systems
- As little as 10-15 % can cause problems

Determining Texture

- We rely on field assessment methods (flow chart)
- Somewhat subjective though you get better with experience

Determination of Texture

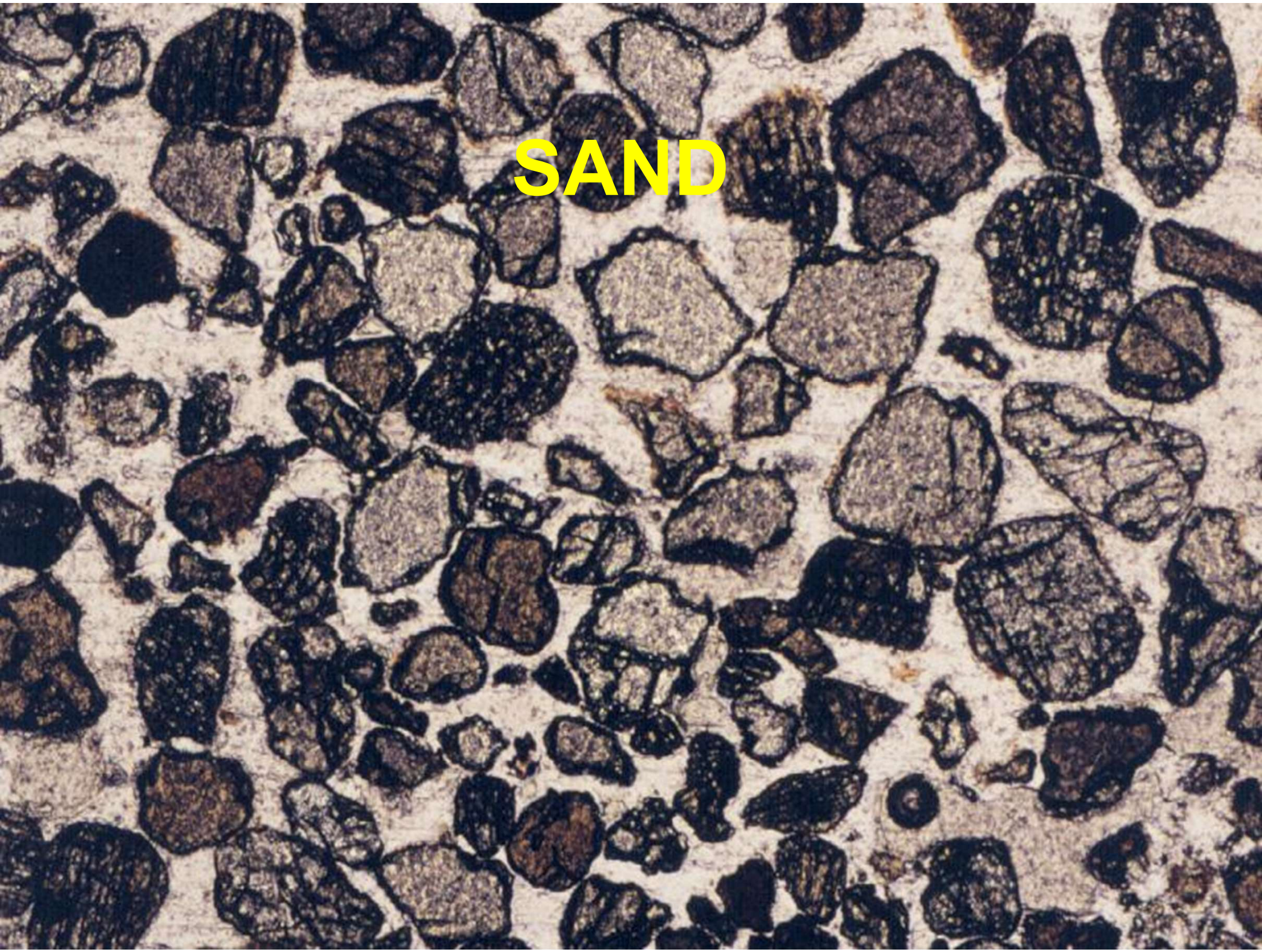
- Field procedure

(Texture by feel analysis)

- Laboratory procedure
  - Sieve analysis (EastTech Engineering)
  - Hydrometer
  - Pipette

Field determination of texture

- Soil must be moist, not saturated; moist enough to mold like putty when you try to form a ball in your hand.
- Does soil form a ball or *cast*?
- No - the texture is ***SAND***


SAND

Field determination of texture

- Does moist soil form a weak cast that cannot be handled without breaking?
- Yes - the texture is ***LOAMY SAND*.**

Making a ribbon

The length of the ribbon will depend on mineralogy as well as clay content

Field determination of texture- the ribbon test

1. Roll ball of moist soil into cylinder
2. Squeeze it upwards and out between thumb and forefinger to form longest ribbon possible

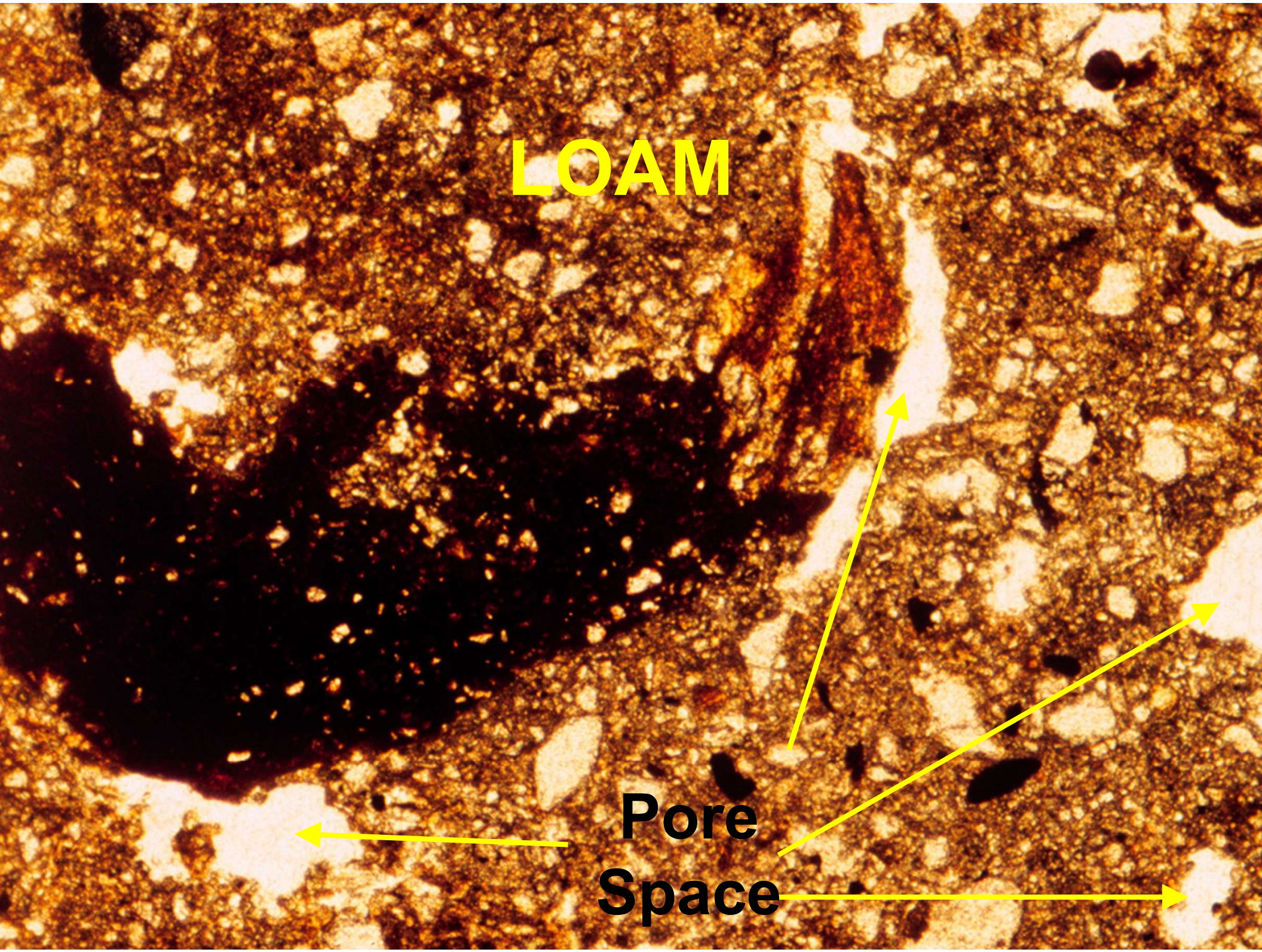
DON'T BE TOO GENTLE!

Field determination of texture

- If the soil forms a ***ribbon*** that extends past the forefinger, note the length of the ribbon.
- Next excessively wet a small sample in the palm and rub with the forefinger.

Field determination of texture

- If the ribbon was < 2.5 cm long when it broke, and the excessively wet sample feels:
  - Grainy/gritty, the texture is ***SANDY LOAM;***
  - Smooth, the texture is ***SILT LOAM;***
  - Smooth and gritty, the texture is ***LOAM.***


LOAM
Pore
Space

Field determination of texture

- If the ribbon was between 2.5 and 5 cm long when it broke the texture is ***SANDY CLAY LOAM, SILTY CLAY LOAM or CLAY LOAM.***
- If the ribbon was > 5 cm long when it broke the texture is ***SANDY CLAY, SILTY CLAY or CLAY.***

Stickiness

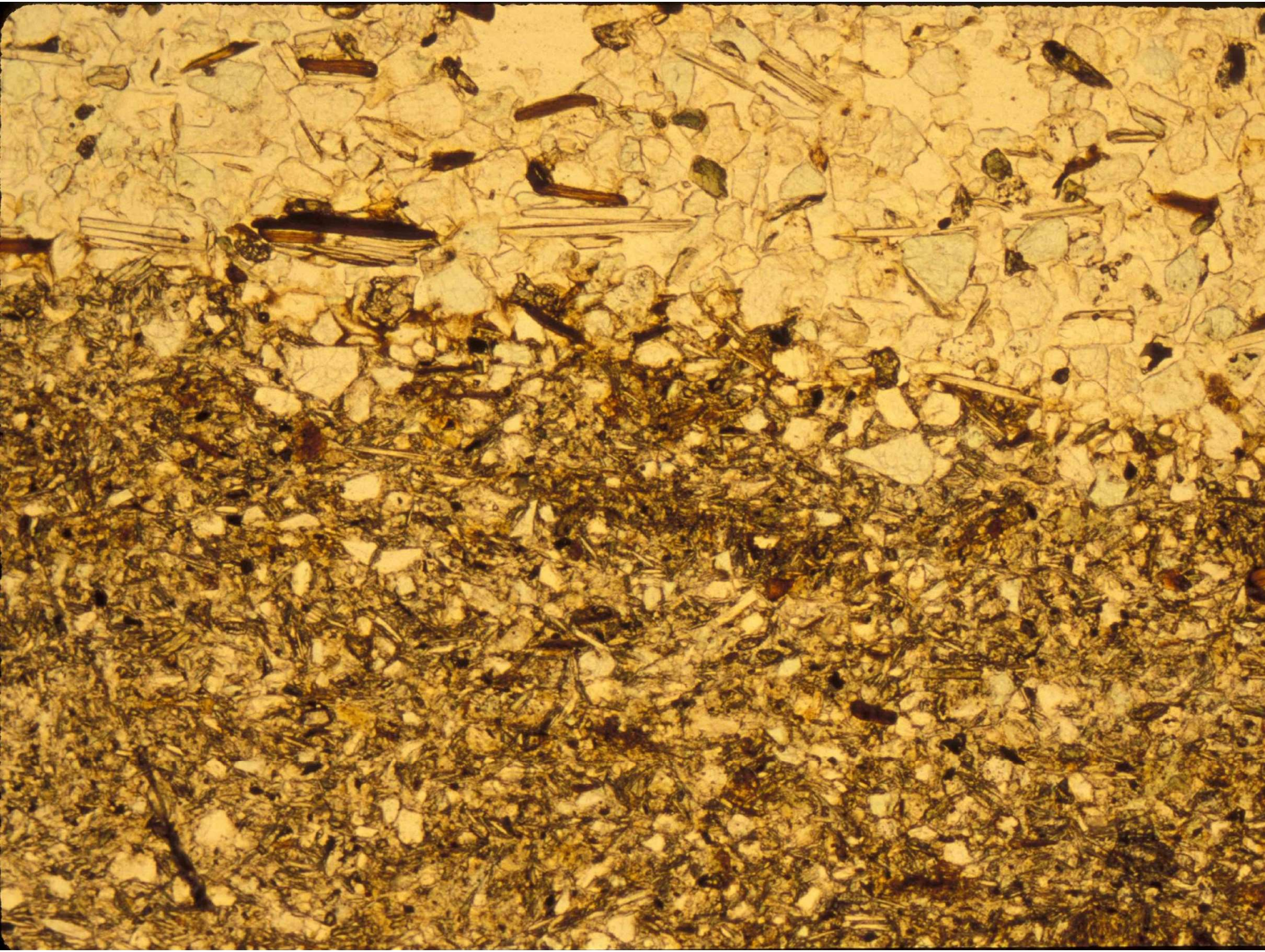
- The capacity of soil to adhere to other objects
- Estimated at moisture content that displays maximum adherence between thumb and fore finger

Stickiness Classes

- **Non-Sticky** – little or no soil adheres to fingers after release of pressure
- **Slightly Sticky** – soil adheres to both fingers after release of pressure with little stretching on separation of fingers
- **Moderately Sticky –** soil adheres to both fingers after release of pressure with some stretching on separation of fingers
- **Very Sticky -** soil adheres firmly to both fingers after release of pressure with stretches greatly on separation of fingers


Non-Sticky


Very Sticky



Field determination of texture

Moist Cast Test

Compress some moist soil by clenching it in your hand. If the soil holds together then test the strength of the cast by tossing it from hand to hand. The more durable it is, the more clay is present.

Graininess Test: Soil is rubbed between thumb and fingers to assess the % sand, or next to the ear to see if there is a grinding noise.

Dry Feel Test: For soils with >50% sand. Soil is rubbed in the palm of the hand to dry it and to separate and estimate the size of the individual sand particles The sand particles are then allowed to fall away – check for amount of silt & clay remaining.

Field determination of texture

Stickiness Test

A sample of the soil is wetted and compressed between the thumb and forefinger. The degree of stickiness is determined by noting how strongly it adheres to the thumb and forefinger upon release of pressure and how much it stretches.

Ribbon Test

Moist soil is rolled into a cigarette shape and then squeezed out between the thumb and forefinger to form the longest thinnest ribbon possible.

Field determination of texture

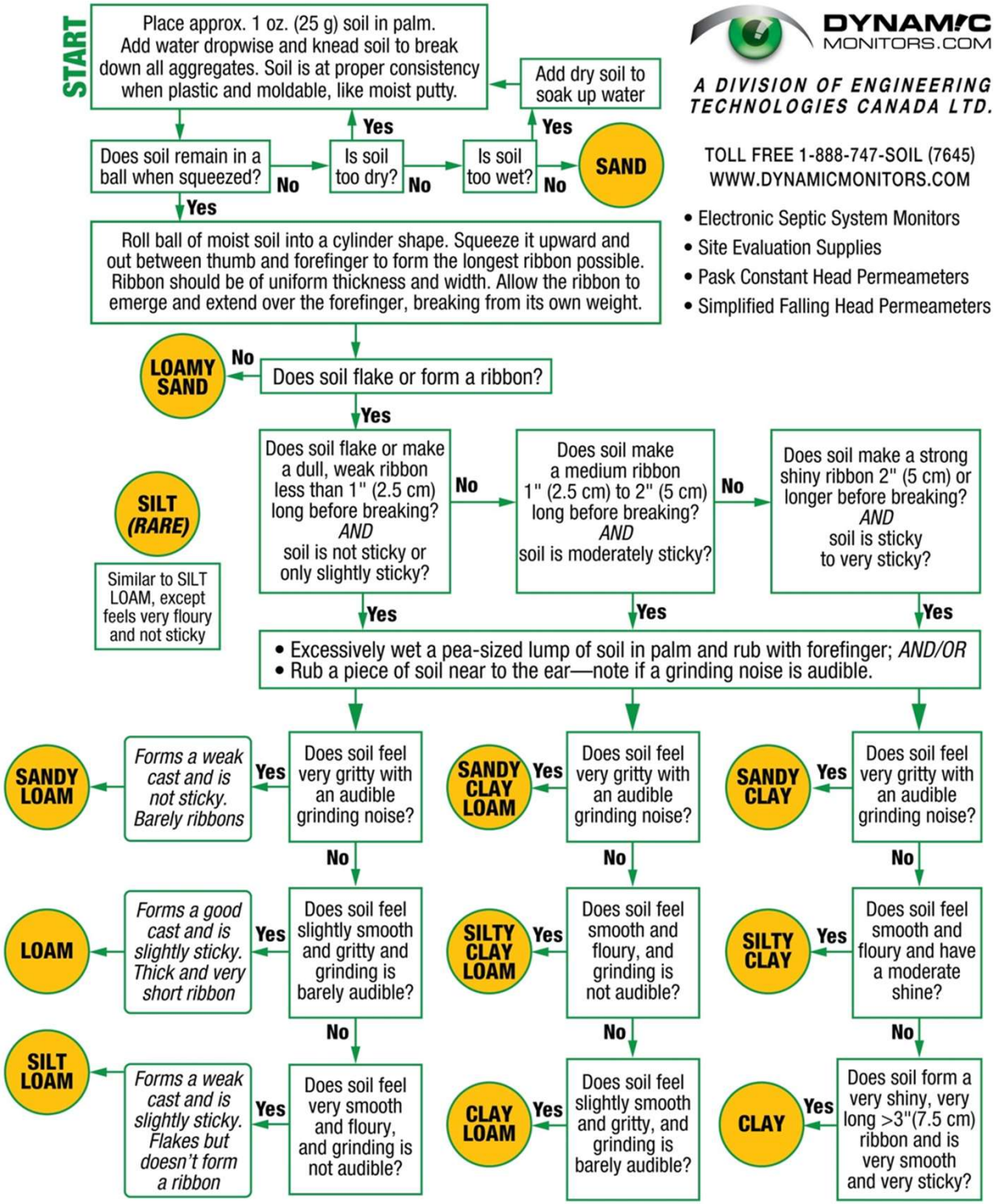
Shine Test

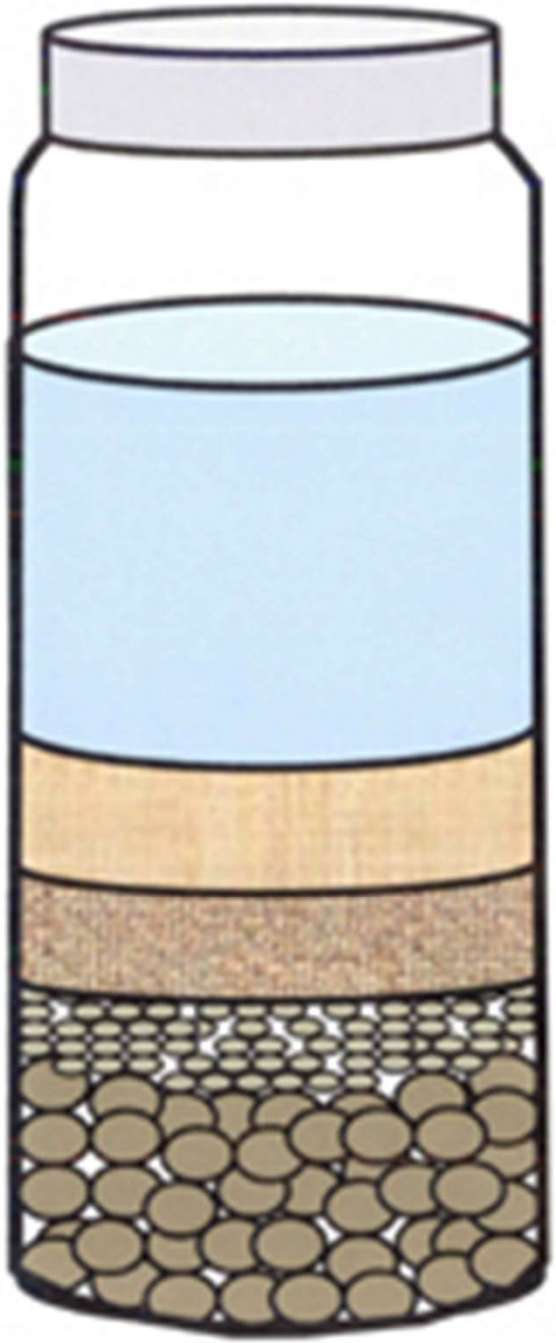
A small amount of moderately dry soil is rolled into a ball and rubbed once or twice against a hard , smooth object such as a knife blade or thumbnail. A shine on the ball indicates clay in the soil.

Taste Test

A small amount of soil is worked between the front teeth. Sand is distinguished as individual grains which grit sharply against the teeth. Silt particles are identified as a general fine grittiness, but individual grains cannot be identified. Clay particles have no grittiness.

Flow Diagram for Estimating Soil Texture By Feel





Jar test for estimating relative proportion of the soil particles

Clay layer – water clears

Silt layer – 2 hours

Sand layers – 1 minute