ISPLS 61st Annual Convention

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Indianapolis

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GENERATING AN ONSITE PLAN SUBMITTAL

SOILS - DEFINITION

- 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 is made of
  - Solid material
    - Minerals
    - Dead organic material
    - Living organic material
  - Pore space
    - Air
    - Water

SOILS AND ONSITE SYSTEMS

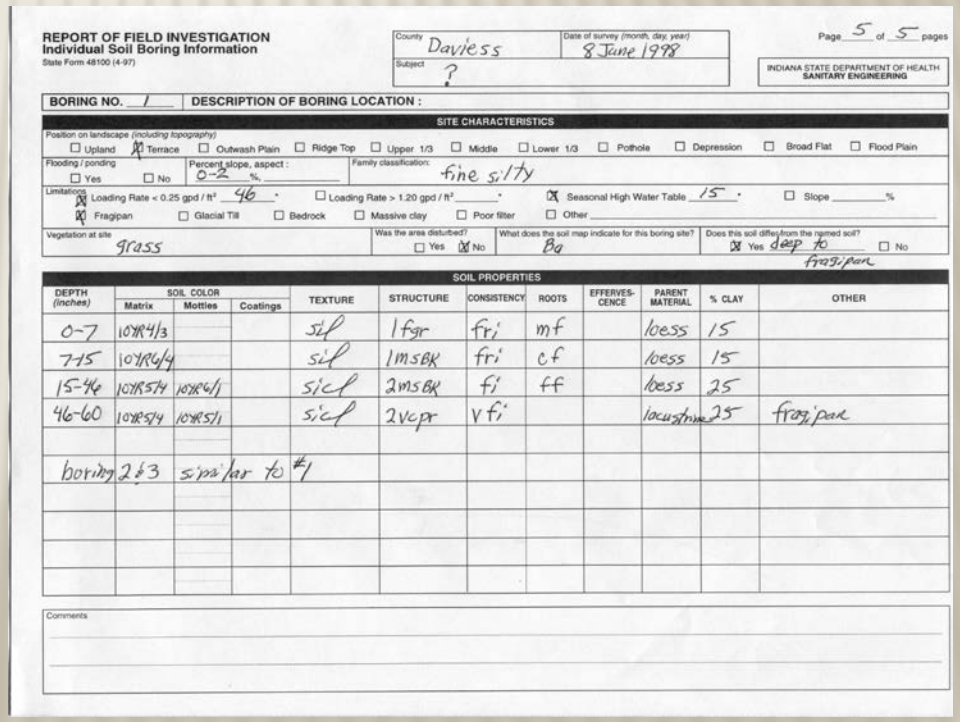
- Importance of Soil to On Onsite Sewage Systems
  - Biological treatment
  - Chemical treatment
  - Physical treatment
  - Dispersal

SOILS AND ONSITE SYSTEMS

- Ability of an on-site sewage disposal system to function properly determined by :
  - Position in landscape
  - Topography
  - Slope
  - Soil properties
    - Texture
    - Structure
    - Wetness
    - Restrictive horizons or layers

SOIL MORPHOLOGY

- Soil Morphology
  - the field observable attributes of the soil within the various soil horizons and the description of the kind and arrangement of the horizons



REPORT OF FIELD INVESTIGATION
Individual Soil Boring Information
State Form 48100 (4-97)

County: Daviess
Date of survey (month, day, year): 8 June 1998
Subject: ?
Page 5 of 5 pages
INDIANA STATE DEPARTMENT OF HEALTH
SANITARY ENGINEERING

BORING NO. 1 | DESCRIPTION OF BORING LOCATION :

SITE CHARACTERISTICS

Position on landscape (including topography): ☐ Upland ☒ Terrace ☐ Outwash Plain ☐ Ridge Top ☐ Upper 1/3 ☐ Middle ☐ Lower 1/3 ☐ Pothole ☐ Depression ☐ Broad Flat ☐ Flood Plain

Flooding / ponding: ☐ Yes ☐ No
Percent slope, aspect: 0-2 %, _____
Family classification: fine silty

Limitations: ☒ Loading Rate < 0.25 gpd / ft² 46 ; ☐ Loading Rate > 1.20 gpd / ft² _____ ; ☒ Seasonal High Water Table 15 ; ☐ Slope _____ %
☒ Fragipan ☐ Glacial Till ☐ Bedrock ☐ Massive clay ☐ Poor filter ☐ Other _____

Vegetation at site: grass
Was the area disturbed? ☐ Yes ☒ No
What does the soil map indicate for this boring site? Bg
Does this soil differ from the named soil? ☒ Yes deep to fragipan ☐ No

SOIL PROPERTIES

DEPTH (inches)	SOIL COLOR Matrix	Mottles	Coatings	TEXTURE	STRUCTURE	CONSISTENCY	ROOTS	EFFERVES-CENCE	PARENT MATERIAL	% CLAY	OTHER
0-7	10YR4/3			sil	1fgr	fri	mf		loess	15	
7-15	10YR6/4			sil	1msBK	fri	cf		loess	15	
15-46	10YR5/4	10YR6/1		sicl	2msBK	fi	ff		loess	25	
46-60	10YR5/4	10YR5/1		sicl	2vcpr	vfi			locustrine	25	fragipan
boring 2 & 3 similar to #1											

Comments

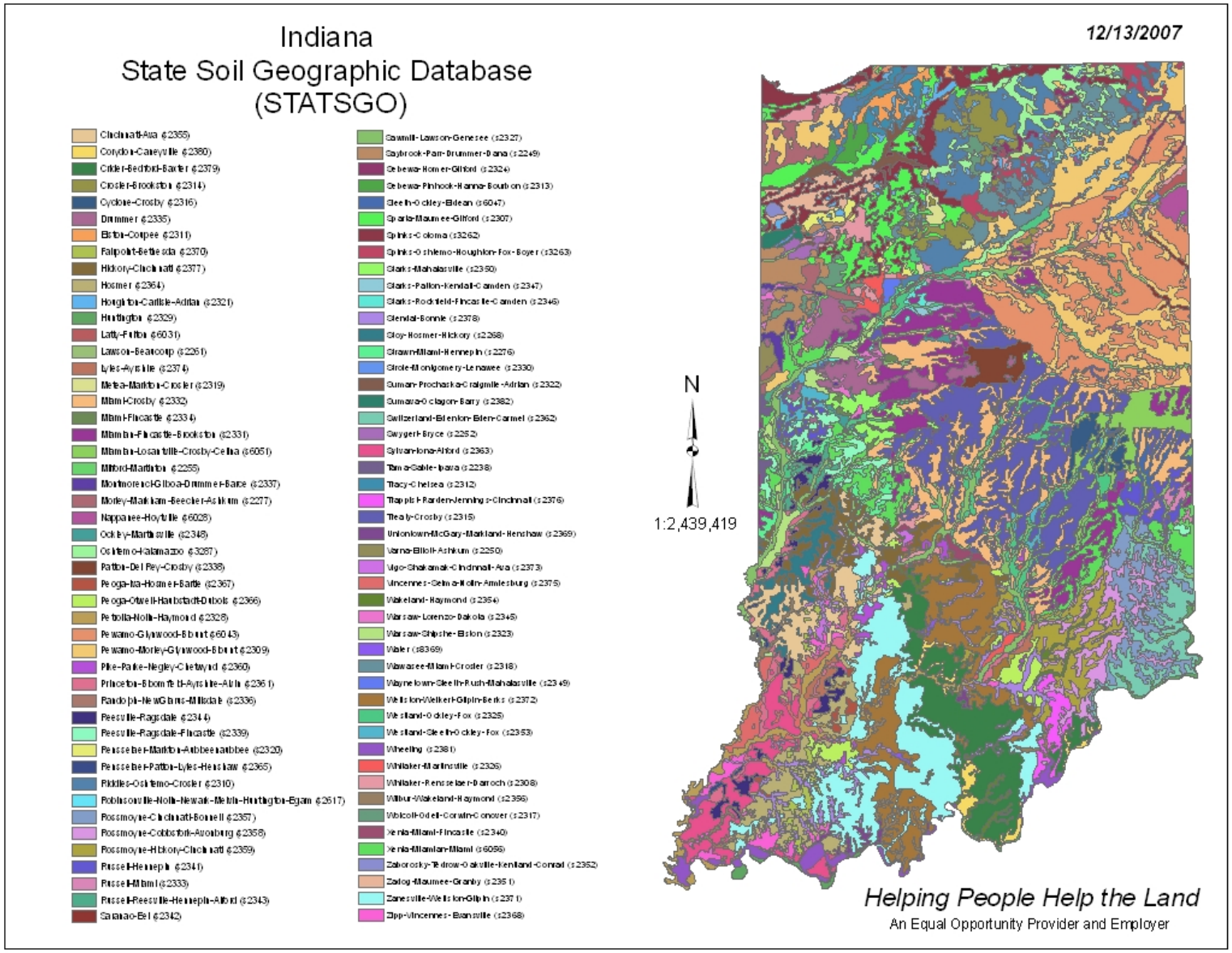
SOILS AND ONSITE SYSTEMS

- 410 IAC 6-8.3-56 and 410 IAC 6-10.1-64: Onsite Evaluation:
  - Topographic information:
    - Slope and slope aspect
    - Surface drainage characteristics
    - Location of proposed or existing structures and wells
    - Location of other major features or structures
    - Topographic position of the site

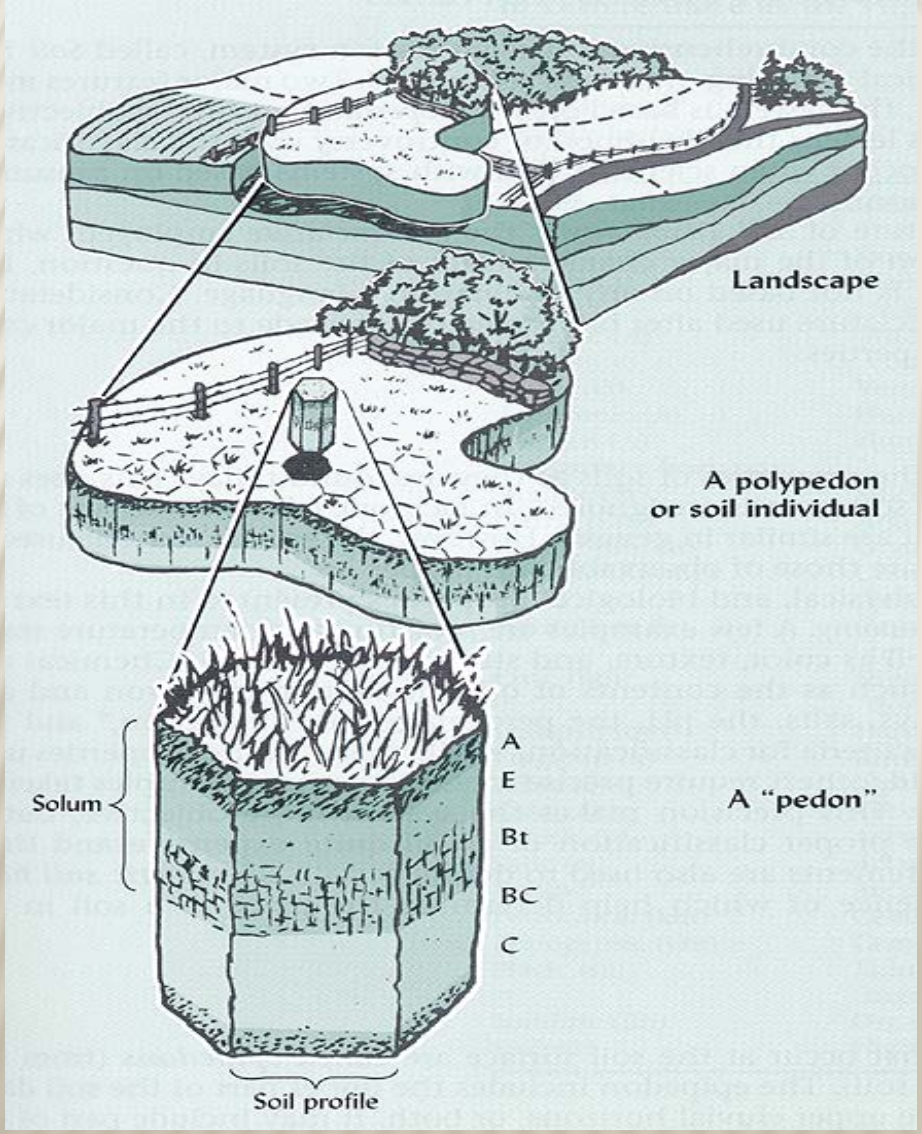
SOILS AND ONSITE SYSTEMS

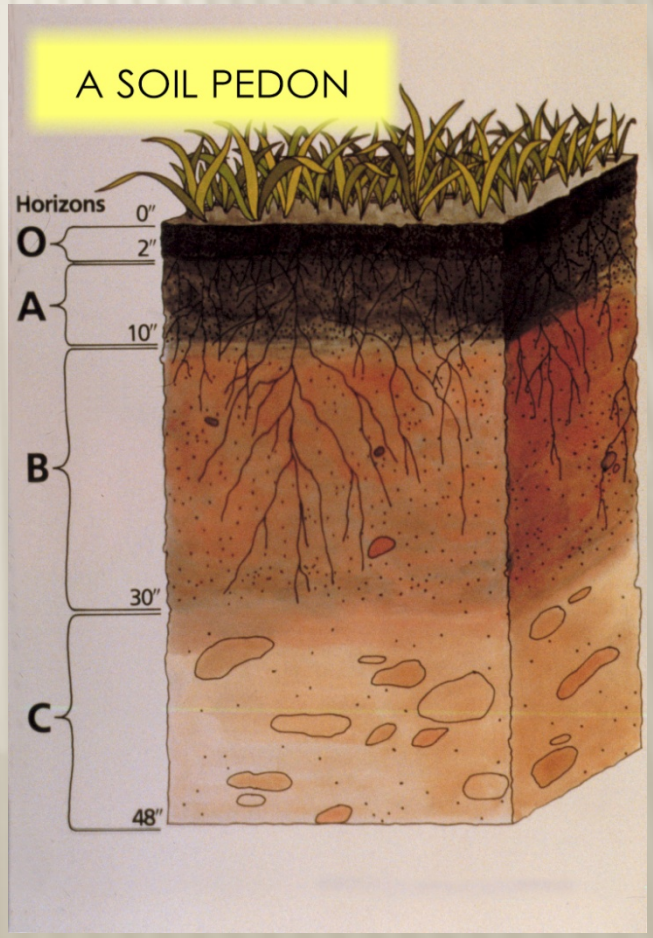
- 410 IAC 6-8.3-56 and 410 IAC 6-10.1-64: Onsite Evaluation:
  - Soil Characteristics:
    - Parent material
    - Soil color
    - Soil structure
    - Soil texture
    - Horizon designations
    - Depth to bedrock
    - Depth to seasonal high water table
    - Soil consistence
    - % coarse fragments
    - % clay if coarse fragments > 35%
    - Presence or absence of roots
    - Frost penetration depth
    - Depth to a layer with a SLR > 1.20 or < 0.25 gpd/ft^2

SOIL MAP OF INDIANA



SOILS - TOPOGRAPHY & PEDOLOGY

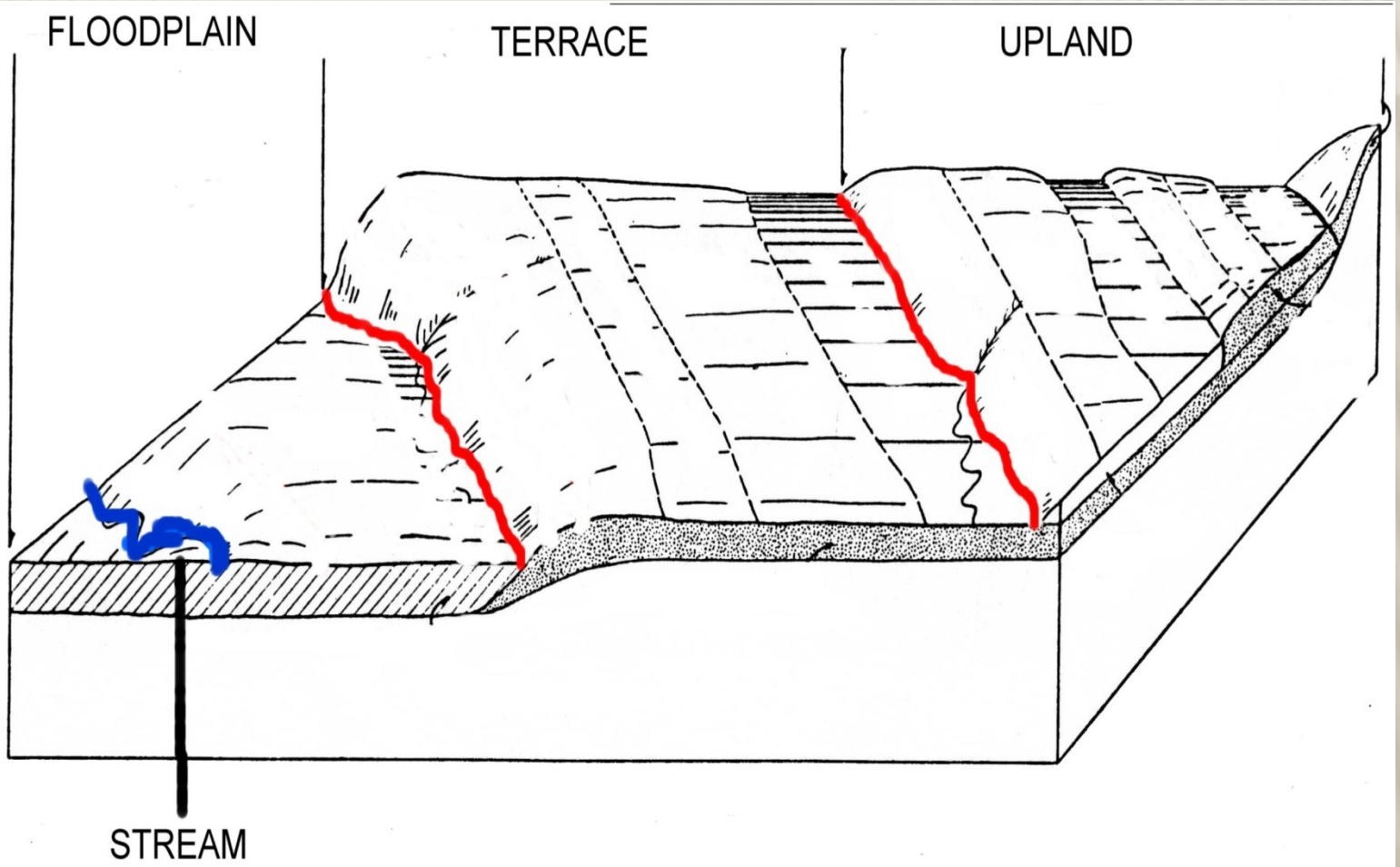




SOILS - TOPOGRAPHY

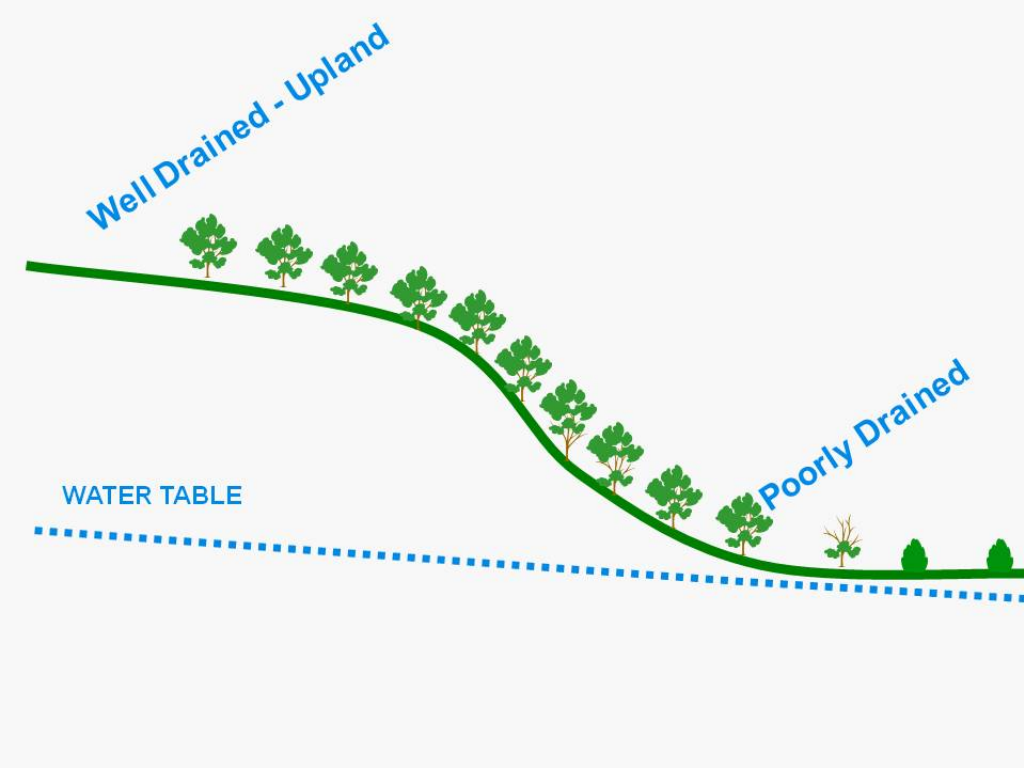
- Topography
  - Slope names, types, and positions
  - Landscape variation
  - Dissected regions
  - Broad, flat regions
  - Water movement

SOILS - TOPOGRAPHY



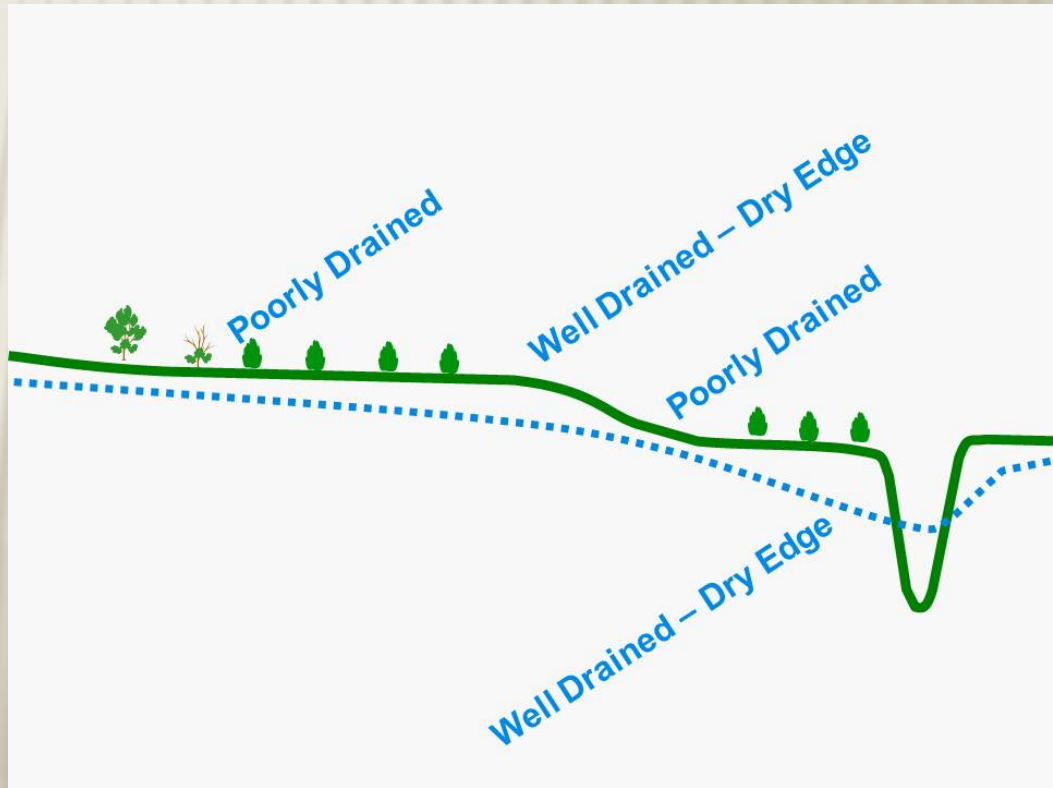
SOILS - TOPOGRAPHY

- Dissected regions
  - Well-drained soils at summit
  - Poorly-drained soils in low areas



SOILS - TOPOGRAPHY

- Broad, flat regions
  - Large distances between streams (interstream divides)
  - Poorly-drained soils may be at high points on landscape
  - Well drained soils closest to drainage



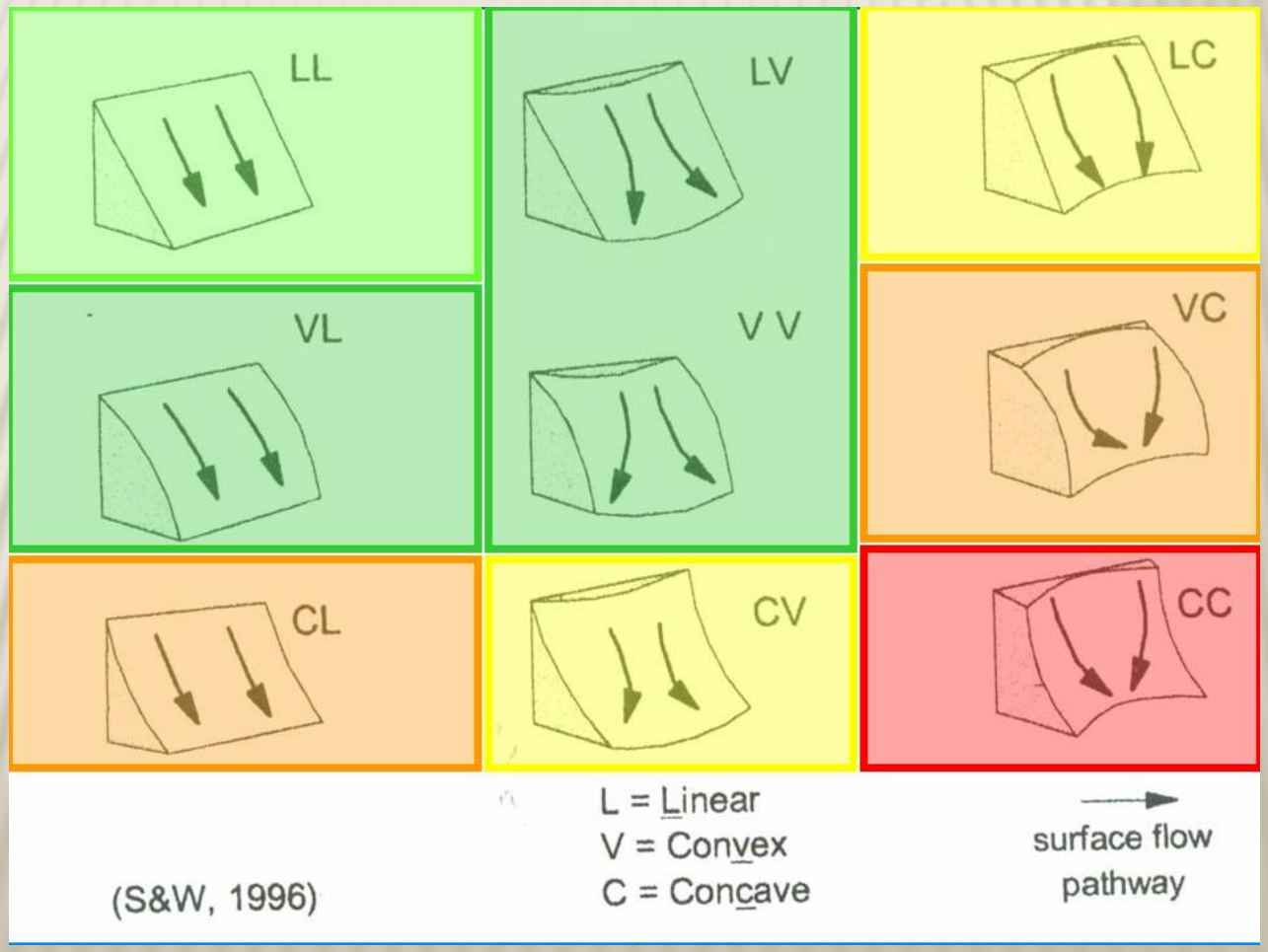
SOILS - TOPOGRAPHY

- Slope Names
  - Summit or Ridge top
  - Shoulder
  - Back or side slope
  - Foot slope
  - Toe slope
  - Terrace
  - Drain way or channel

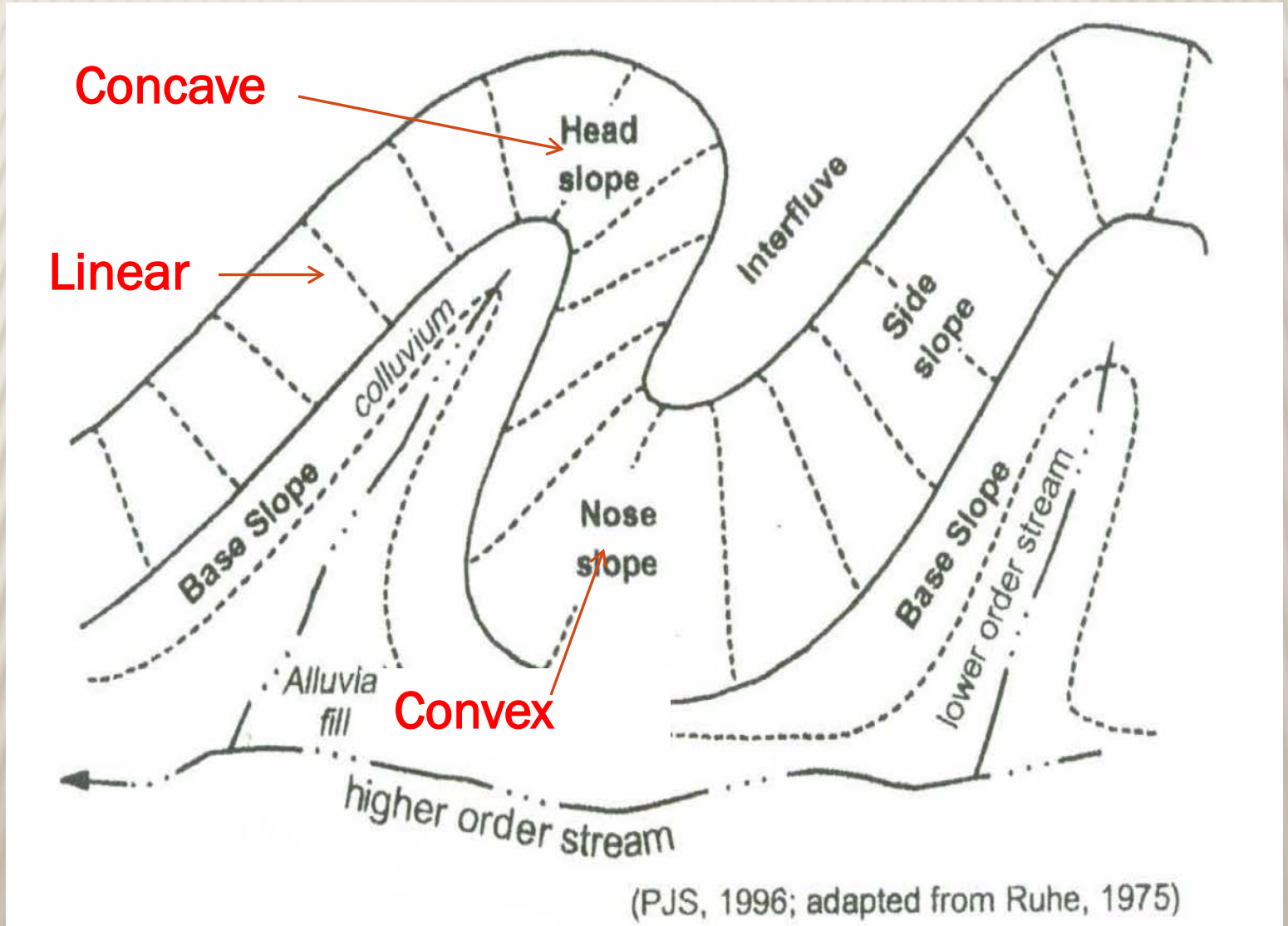
SOILS - TOPOGRAPHY

SOILS - TOPOGRAPHY

- Shapes of slopes

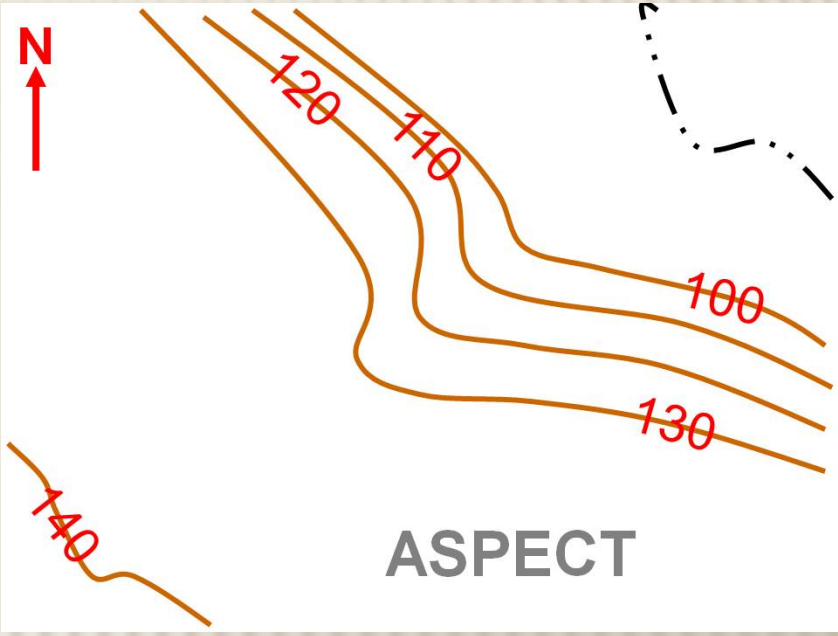


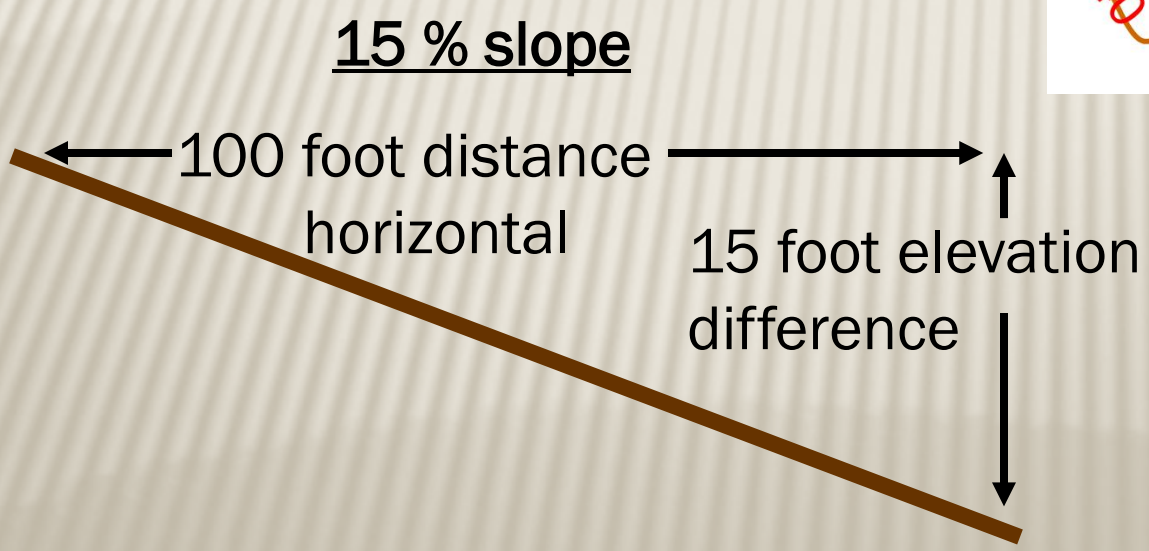
SOILS - TOPOGRAPHY



SOILS - TOPOGRAPHY

- Slopes
  - Percent & aspect





SOILS – COLOR & WETNESS

- Color patterns
  - Matrix color is the dominant (background) color in the soil.
  - Mottling is spots or blotches of color in the soil that differ from the matrix color.
  - Redoximorphic features are mottles that relate to the aeration or drainage of the soil.

SOILS – COLOR & WETNESS

- Color indicates periods of soil saturation
  - Depth to seasonal high water table
    - Redoximorphic features (colors)
    - Determines need for ability to drain the site

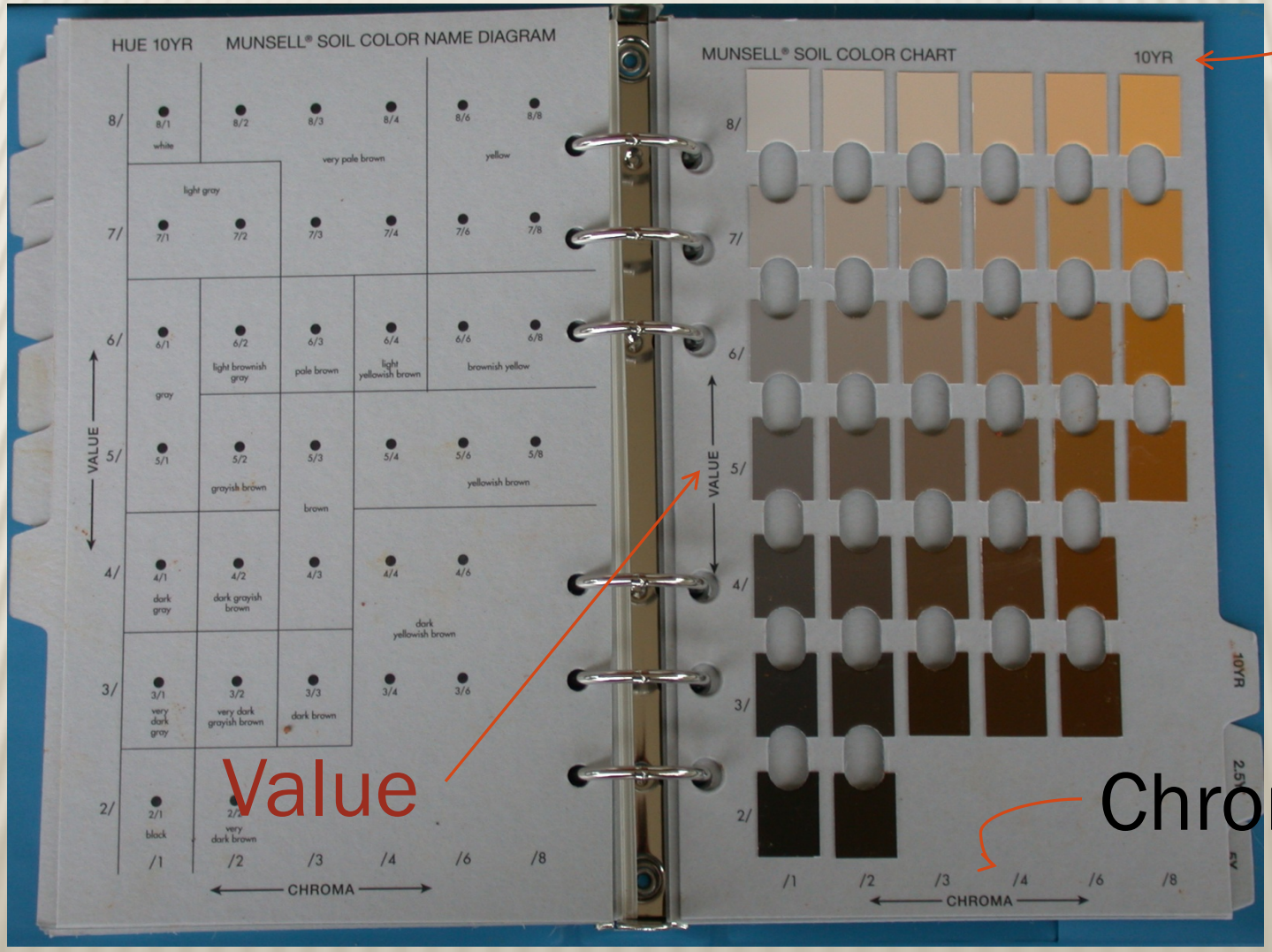
SOILS – COLOR & WETNESS

- Wetness
  - Seasonal high water table
  - Naturally occurring
  - Very shallow in many soils in Indiana
  - Can many times be lowered by drainage

SOILS – COLOR & WETNESS

- Munsell Color System
- Hue refers to the dominant wavelength of light (red, yellow, green, etc.).
- Value refers to the lightness and darkness of a color in relation to a neutral gray scale.
- Chroma is the relative purity or strength of the Hue.
- Notation
  - Hue Value/Chroma
  - 10YR 5/6

SOILS – COLOR & WETNESS



SOILS – COLOR & WETNESS

- Colors indicate duration of wetness
  - Brown matrix, brown mottles – well drained
  - Brown matrix, gray mottles – poorly drained
  - Gray matrix, brown mottles – very poorly drained

SOILS – COLOR & WETNESS

Well Drained

Poorly Drained

SOILS – HORIZONS

- Soil horizon
  - a layer roughly parallel to the surface
  - physical characteristics differ from the layers above and beneath
  - each soil type has at least one, usually three or four horizons
  - horizons are defined in most cases by obvious physical features, chiefly color, texture and structure.

SOILS – HORIZON DESIGNATIONS

- Capital letters, lowercase letters, and Arabic numerals are used to form horizon designators.
  - Capital letters are used to designate master horizons. These letters are the base symbols to which other characters are added to complete the designations. Most horizons and layers are given a single capital-letter symbol; some require two.{O, A, E, B, C, R}
  - Lowercase letters are used as suffixes to indicate specific characteristics of the master horizon. {Ap, Bw, Cg}
  - Arabic numerals are used as suffixes to indicate vertical subdivisions within a horizon {Bw1, Bw2, Cg1, Cg2}

SOILS – HORIZONS

- **O horizon** - a surface layer, dominated by the presence of large amounts of organic material in varying stages of decomposition.
- **A horizon - t**he top layer of the soil horizons or 'topsoil'.
- **E horizon -** a horizon that has been significantly leached of its mineral and/or organic content
- **B horizon -** commonly referred to as "subsoil"
- **C horizon - a** layer is little affected by soil forming processes (weathering), and the lack of pedological development is one of the defining attributes.
- **R horizon - bedrock**

SOILS – HORIZONS

- Subordinate Distinctions of B Horizons
  - Bw Development of color or structure
  - Bt Accumulation of clay
  - Bg Strong gleying, indicates prolonged periods of saturation
  - Fragipan; dense, restrictive horizon

SOILS – HORIZONS

- Bt Horizon Considerations
  - Higher clay content than overlying horizon
  - Weakly to strongly structured
  - May appear massive in auger borings
  - Can restrict water movement even if no redoximorphic features are present
  - May contain redoximorphic features particularly around roots and ped faces

SOILS – HORIZONS

- Bx Horizon Considerations
  - Apparently cemented horizon but will slake in water
  - Dense and brittle
  - Appear massive but may have a secondary prismatic structure
  - Restrictive to water movement often causing a perched water table
  - May contain redoximorphic features ☐

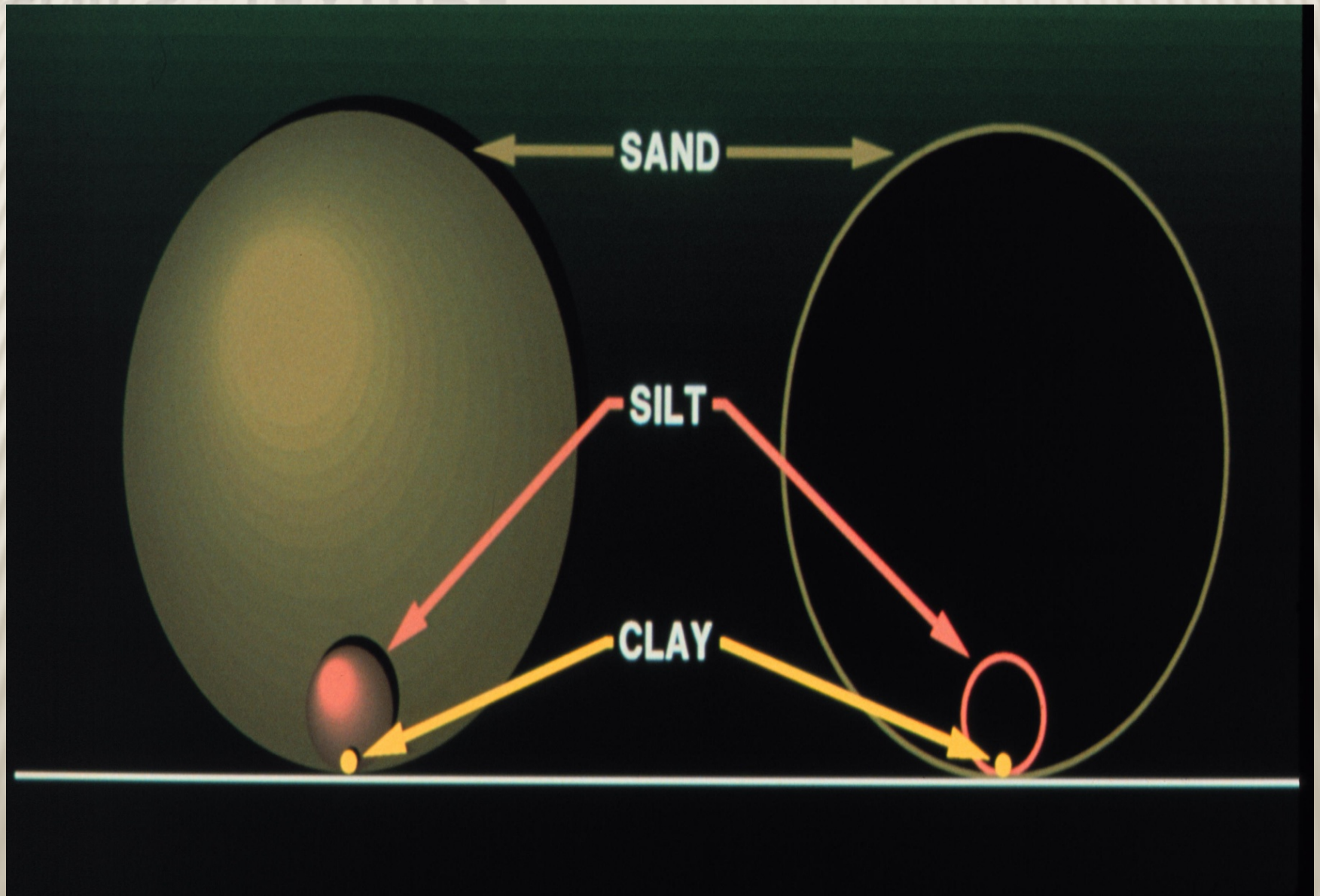
SOILS – HORIZONS

- C Horizon
  - Referred to as substratum. These horizons and layers are little affected by soil forming processes (unweathered geologic material).
  - Little affected by soil forming processes
  - Lack of color development, color of unweathered geologic material
  - Dense, often massive
  - Restrictive to water movement

SOILS - TEXTURE

- Sand
- Silt
- Clay

SOILS - TEXTURE

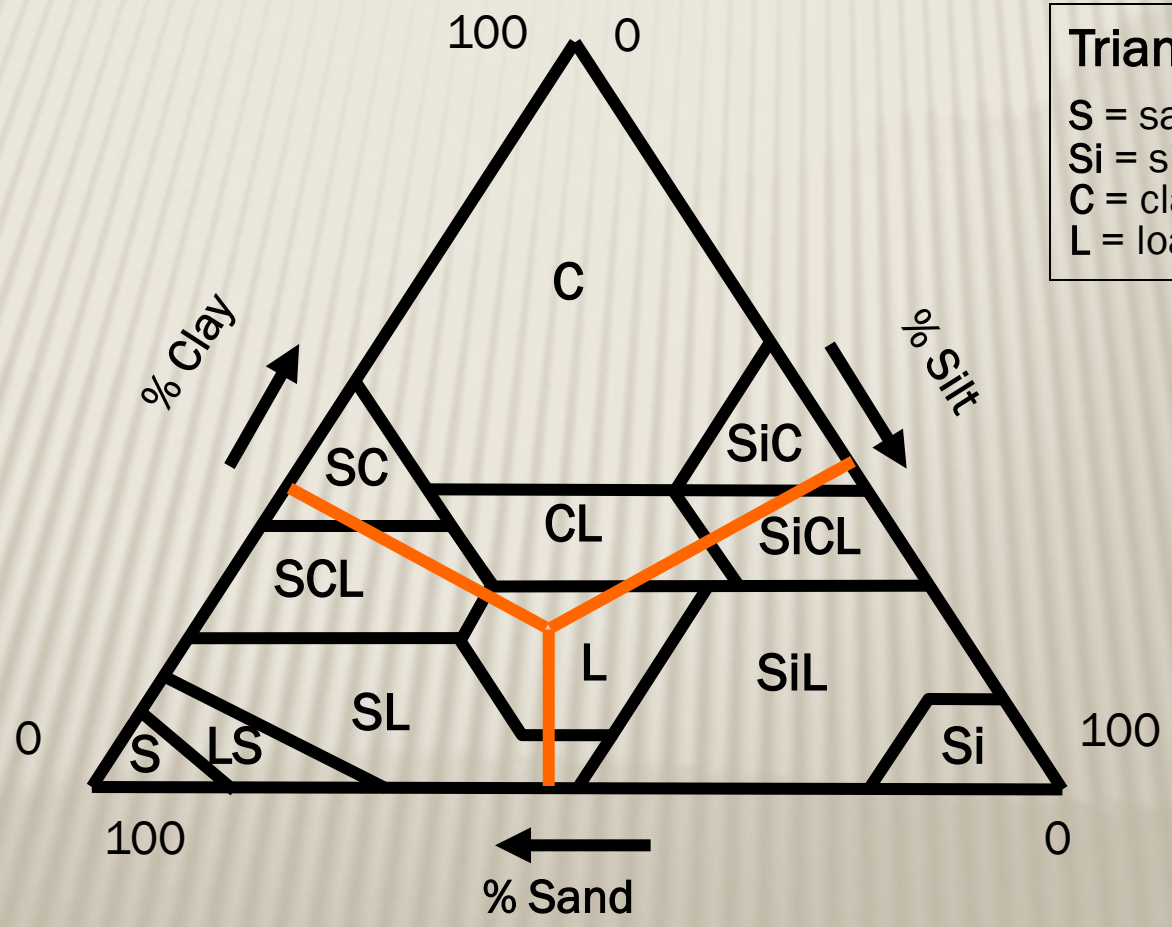


SOILS - TEXTURE

- USDA Textural Classes (12)
  - Sand
  - Loamy Sand
  - Sandy Loam
  - Loam
  - Silt Loam
  - Silt
  - Sandy Clay Loam
  - Silty Clay Loam
  - Clay Loam
  - Sandy Clay
  - Silty Clay
  - Clay

SOILS - TEXTURE

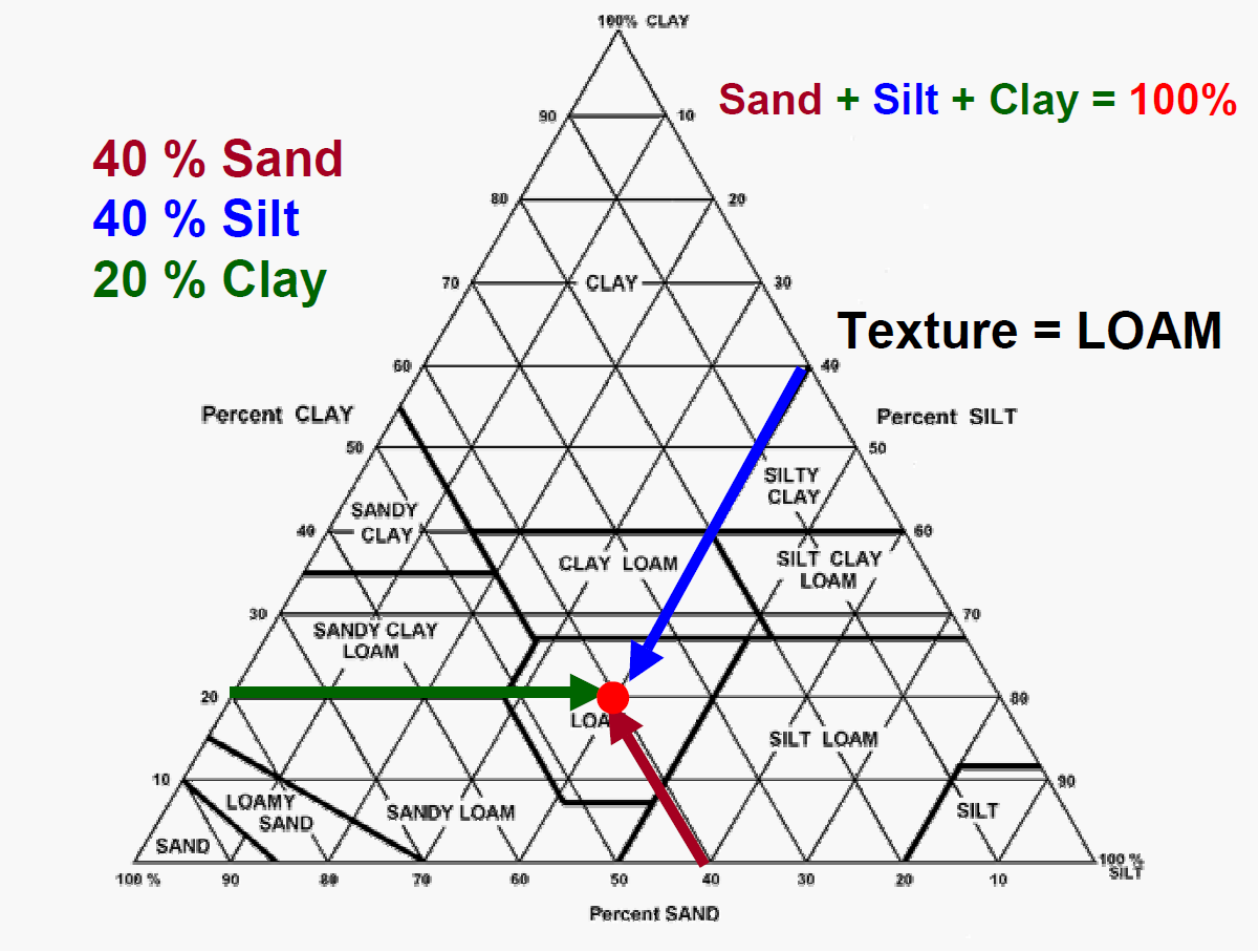
Soil Texture Triangle



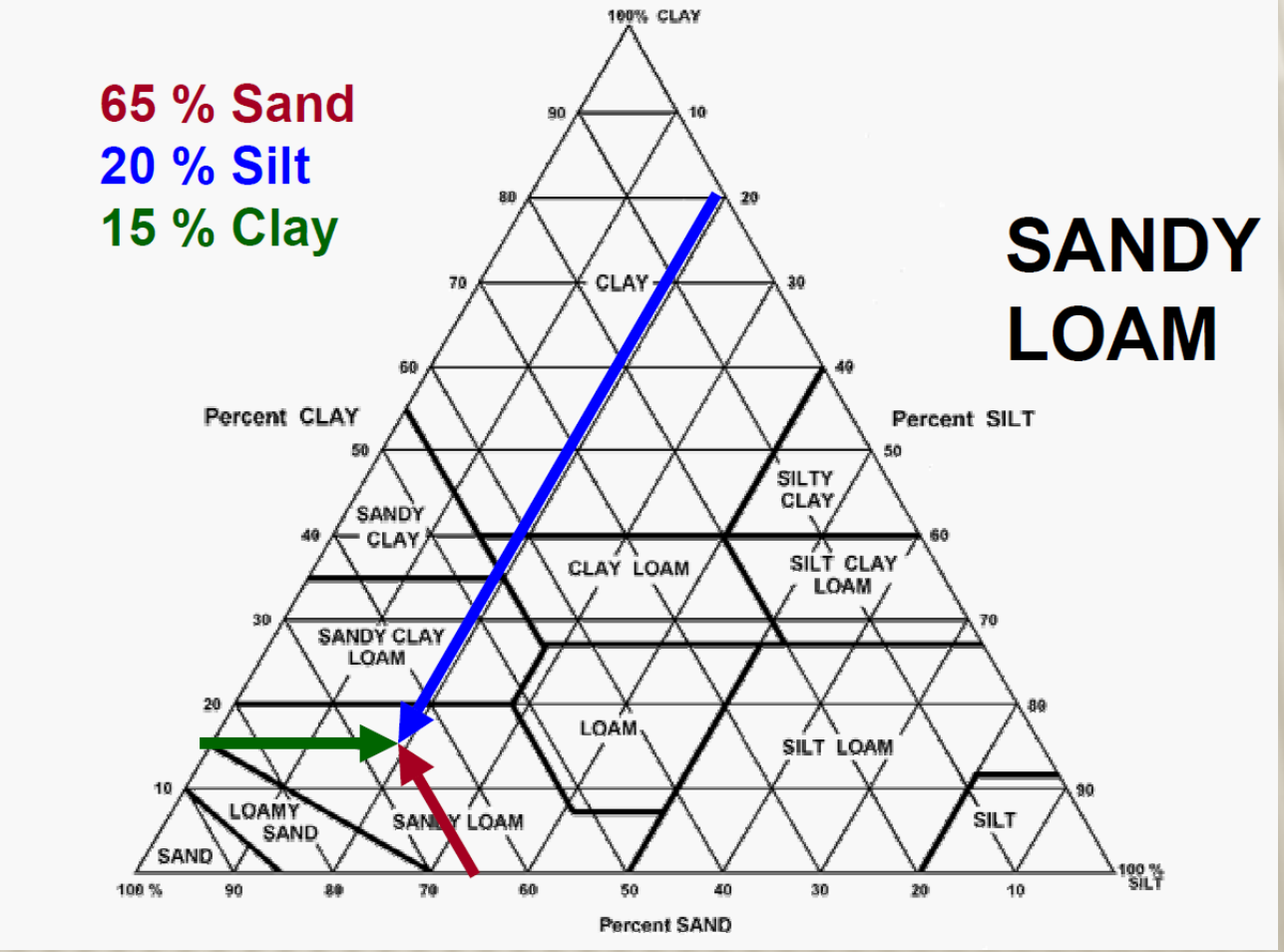
Triangle Key:

S = sand or sandy
Si = silt or silty
C = clay
L = loam or loamy

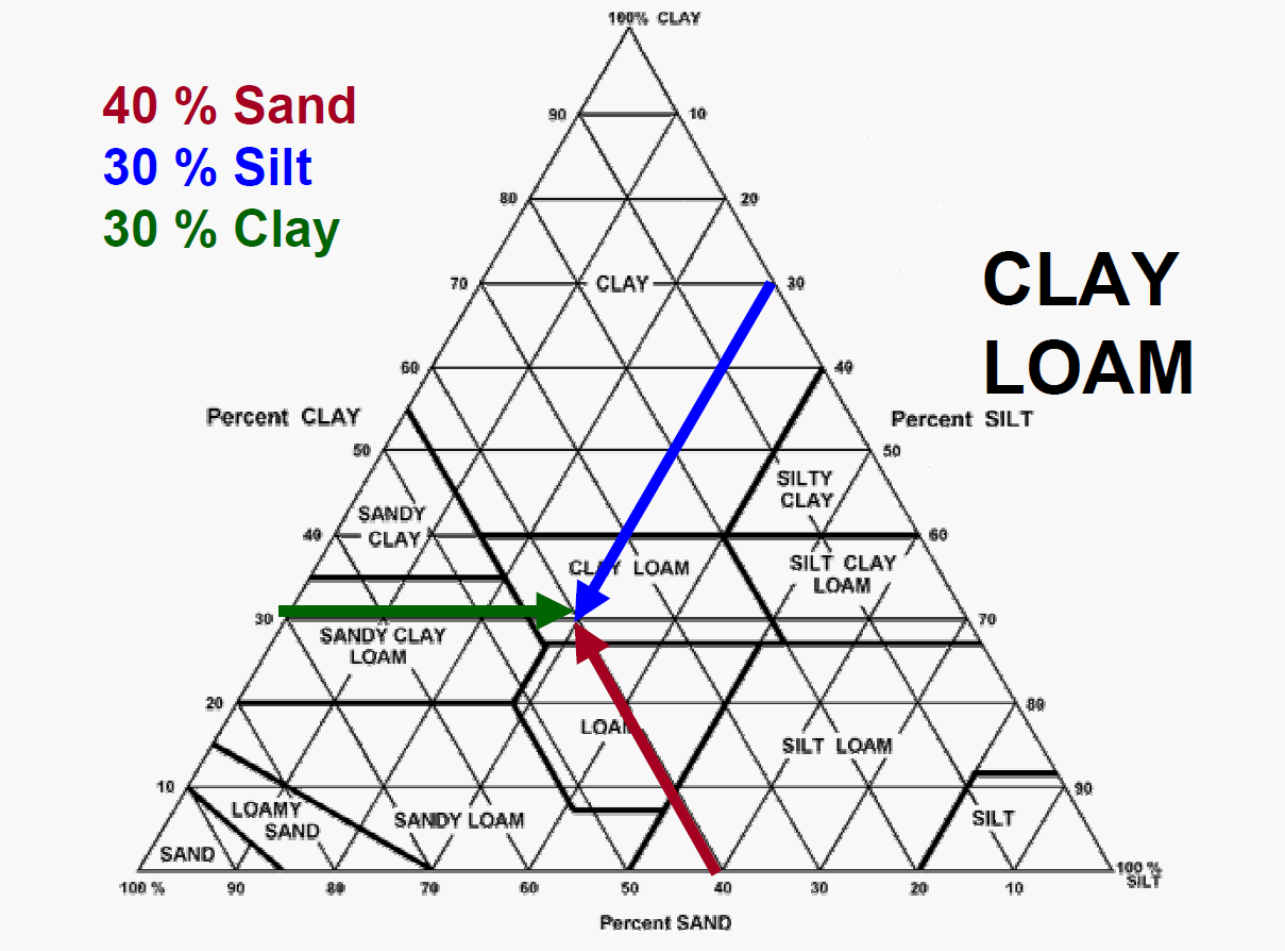
SOILS - TEXTURE



SOILS - TEXTURE



SOILS - TEXTURE

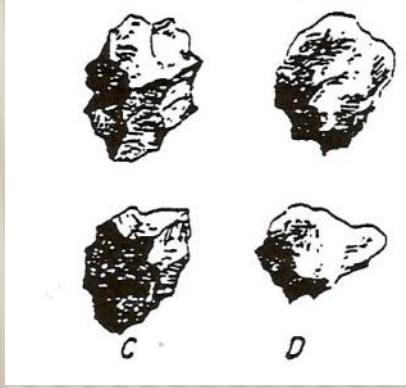


SOILS - TEXTURE

- Coarser soils:
  - Faster movement
  - Less surface area
  - Less removal sites
- Finer soils:
  - Slower movement
  - More surface area
  - More removal sites

SOILS - STRUCTURE

- Structure is the shape and arrangement of soil particles into clusters, peds, or aggregates.
- Structure is very important because of its effect upon permeability – how air and water move through the soil



SOILS - STRUCTURE

- Soil structure is the way the soil particles are arranged into larger units called peds. Aggregation of soil particles can occur in different patterns, resulting in different soil structures.
- The movement of water through the soil varies greatly according to structure. A soil with good soil structure has many more channels, or macropores, for the movement of air and water.

SOILS - STRUCTURE

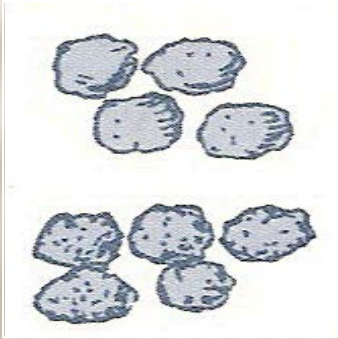
- Soil Structure
  - Single Grain
  - Granular
  - Blocky
  - Prismatic
  - Platy
  - Massive

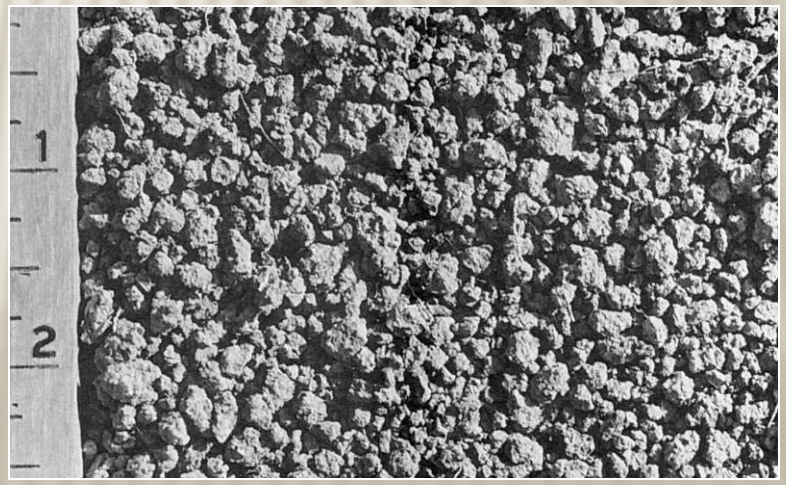
SOILS - STRUCTURE

- Single Grain
  - Loose material
  - Found only in sandy soils
  - No binding substance to hold the particles together

SOILS - STRUCTURE

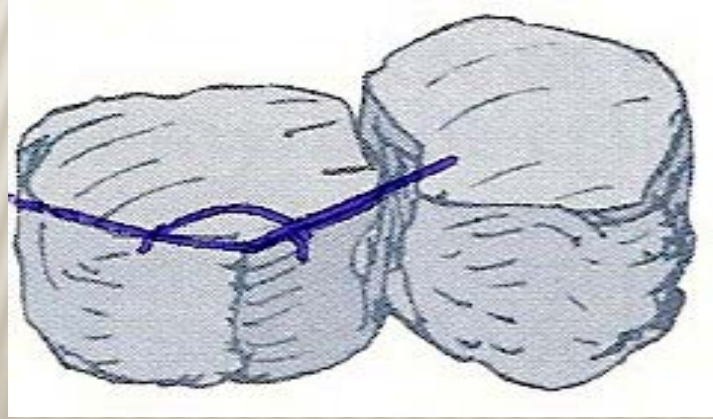
- Granular
  - Small aggregates with rounded edges
    - Round in shape – no flat sides
    - About size of a pea or smaller
  - Closely related to organic matter (roots), thus "A" horizon





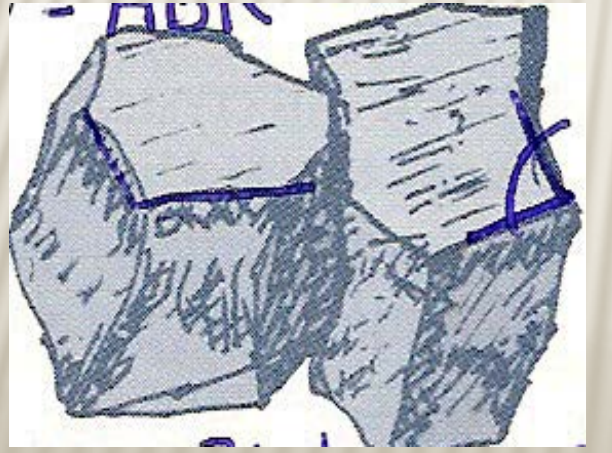
SOILS - STRUCTURE

- Subangular blocky
  - Breaks into more of an octagon than a cube
  - Edges are slightly rounded
  - Common in B horizons, but may occur in A horizons



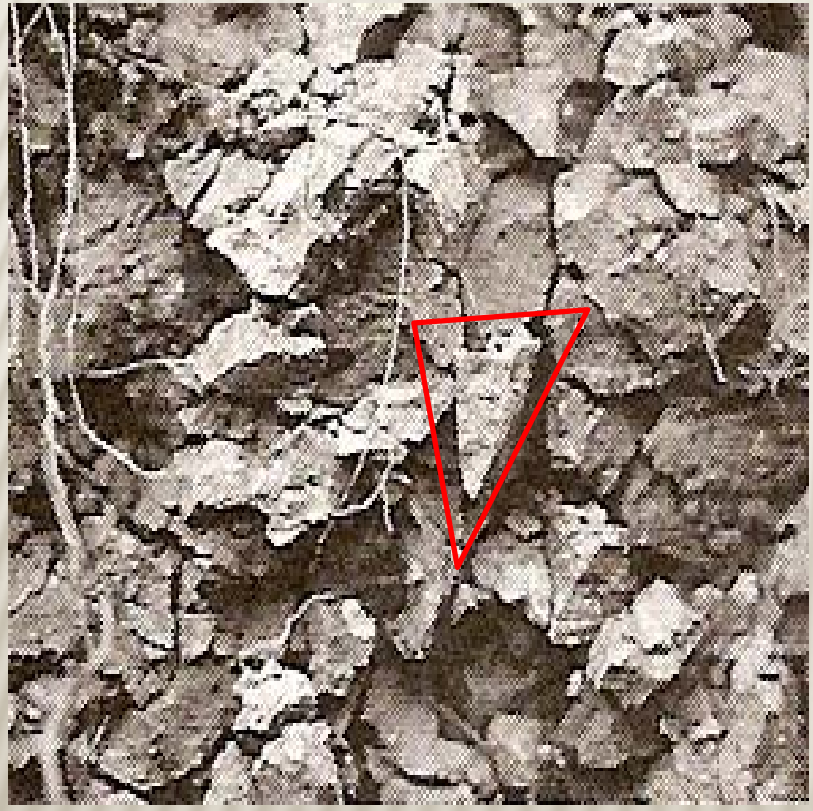
SOILS - STRUCTURE

- Angular blocky
  - Cubes with sharp edges
  - Not common except in “B” horizons w/> 40% clay



SOILS - STRUCTURE

COMPARISON OF ABK & SBK



Sharp edges

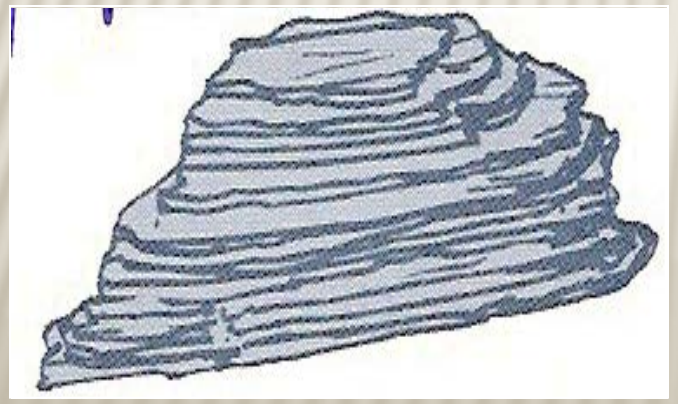
Rounded edges

SOILS - STRUCTURE

- Prismatic
  - Prominent vertical faces w/ a <u>flat top</u>
  - Taller than wide *(think rectangle on end)*
  - Usually found in B horizons of prairie soils

SOILS - STRUCTURE

- Platy
  - Flat and plate-like, wider than high
  - Common in E horizons, but may occur in “A” and maybe “B”
  - Often caused by compaction from traffic, but can be inherited from parent material



SOILS - STRUCTURE

- Massive
  - Materials that have <u>no internal structural</u> arrangement
  - When soil is broken out, it consists mainly of fragments and some mineral grains
  - Found in “C” horizon
    - Unweathered parent material
    - Dense glacial till

SOILS - STRUCTURE

Structural Type and Porosity

Most Porous	Granular (crumb)
	Cube-Like
	•Subangular Blocky
	•Angular Blocky
	Prism-Like
	•Prismatic
	•Columnar
Least Porous	Platy

SOILS - STRUCTURE

- Till
  - Unsorted, unstratified materials deposited directly from glacial ice. Generally, dense and low permeability
- Fragipan
  - A dense, natural subsurface layer of hard soil with slow permeability to water, mostly because of its extreme density or compactness rather than its high clay content or cementation.

SOILS - CONSISTENCY

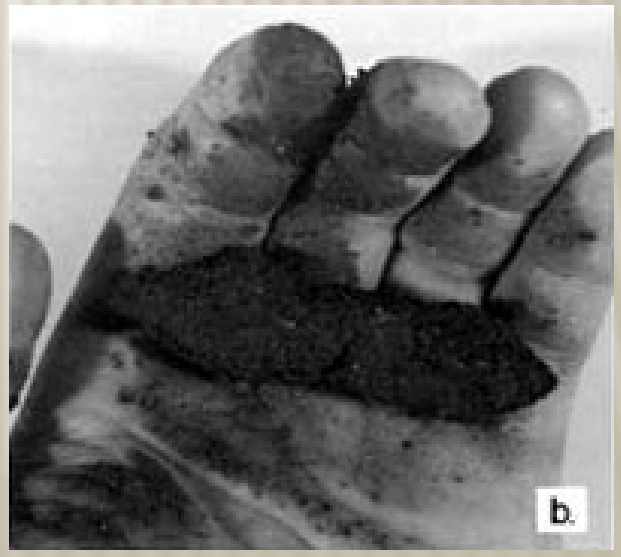
- Soil consistency is the strength with which soil materials are held together or the resistance of soils to deformation and rupture.
- Soils consistency
  - loose, soft or friable consistency provides few barriers to water movement.
  - hard, firm or rigid consistency is often a sign of reduced permeability
  - very hard, rigid and very strongly indurated consistency is likely to severely restrict water movement.

CONSISTENCY - LOOSE

- Non-coherent
- No pressure needed
- Not able to obtain a cube intact
- Usually sands

CONSISTENCY - VERY FRIABLE

- Crushes easily under very gentle pressure applied slowly between thumb and forefinger
- Usually sandy or high organic content



CONSISTENCY - FRIABLE

- Crushes easily under gentle pressure applied slowly between thumb and forefinger
- Topsoil usually

CONSISTENCY - FIRM

- Crushes easily under <u>moderate</u> pressure applied slowly between thumb and forefinger
- Resistance is distinctly noticeable
- Subsoil commonly

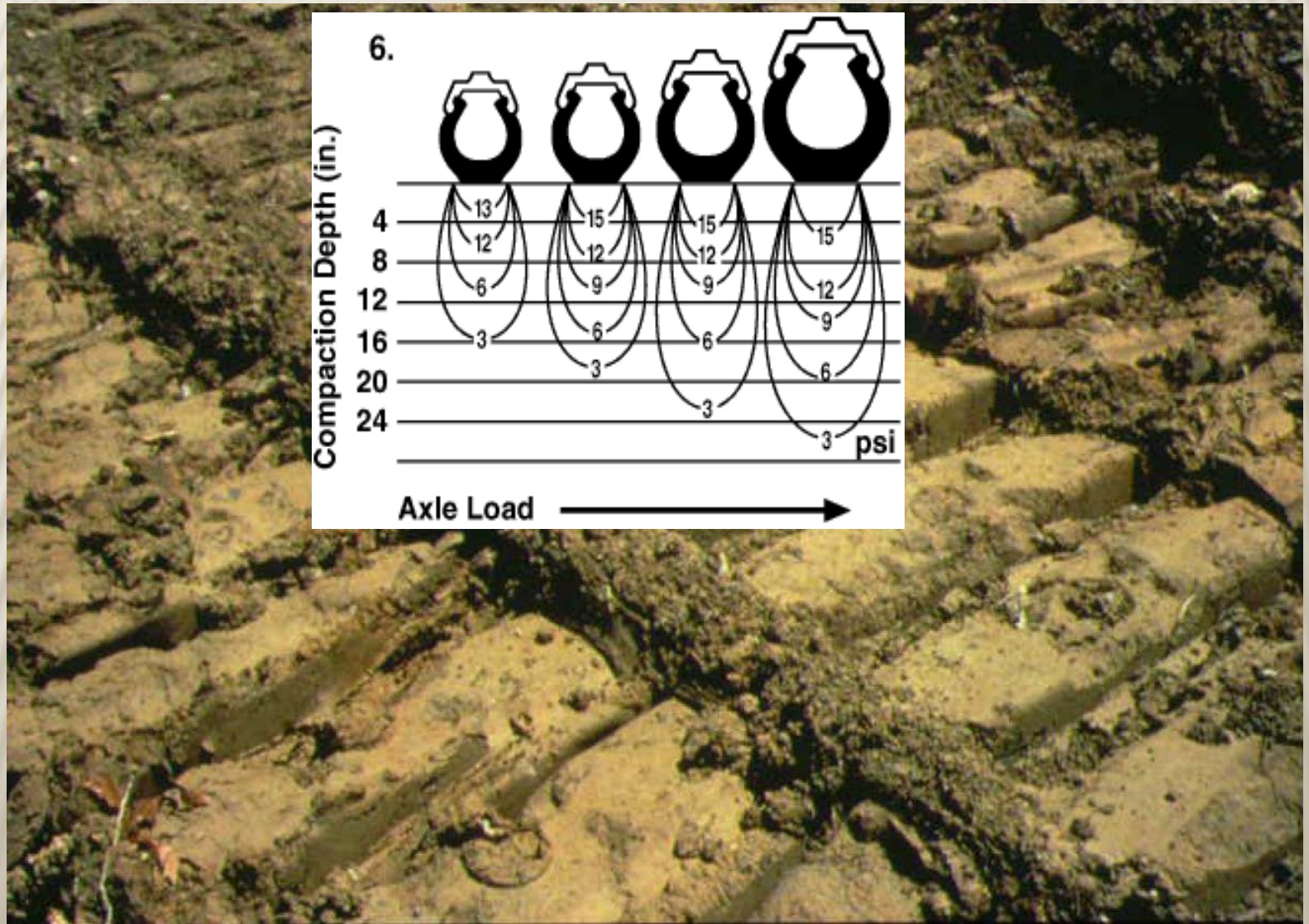
CONSISTENCY - VERY FIRM

- Barely crushable under <u>strong</u> pressure applied slowly between thumb and forefinger
- Resistance is distinctly noticeable
- Usually associated with:
  - SiC, SC, C

CONSISTENCY - EXTREMELY FIRM

- Cannot be crushed with thumb and forefinger
- Fragipans, dense glacial till

COMPACTION


6.
Compaction Depth (in.)
4
8
12
16
20
24
13
12
6
3
15
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9
6
3
15
12
9
6
3
15
12
9
6
3
psi
Axle Load

COMPACTION

- Platy structure
- Permeability is drastically reduced
  - Subsurface trench systems
  - Elevated sand mounds
- Plant roots don't grow well in dense soil (problem with cover vegetation over a system)
- Decreased air movement resulting in anaerobic trenches

COMPACTION

- Shallow compaction at depths of 12 inches or less can be remedied with tillage (dry conditions)
- Re-evaluation by a soil scientist

FILL SOIL MATERIAL

- The soil loading rates:
  - Developed by Purdue University
  - Apply only to natural, undisturbed soils
- Problems:
  - High variability
  - Reduced permeability
  - Can’t apply soil loading rates
  - Can’t determine depth to seasonal high water table
  - Filled sites are usually those that were wet or otherwise unsuitable to begin with

SOILS – HYDRAULIC CONDUCTIVITY

- Hydraulic conductivity (permeability) determined by
  - Texture
  - Structure
  - Consistency

SOIL LOADING RATE (SLR)

- Function of hydraulic conductivity (permeability)
- Expressed in gpd/ft^2
- Ranges:
  - < 0.25 - impermeable layers
  - > 1.20 - rapidly permeable layers

SOIL LOADING RATE (SLR)

Table IV - Soil Loading Rates for Subsurface Trench Onsite Sewage Systems (in gpd/ft^2)								
	SOIL STRUCTURE CLASSES							
SOIL TEXTURE CLASSES	Single Grain	Granular	Strong: Angular, Sub-Angular Blocky, Prismatic	Moderate: Angular, Sub-Angular Blocky, Prismatic	Weak: Angular, Sub-Angular Blocky, Prismatic; Platy[1]	Fragic Characteristics: Very Coarse Prismatic	Structureless, Massive, Friable, V. Friable	Structureless, Massive, Compact, Firm, V. Firm; Platy[2]
Gravel, Coarse Sand	>1.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Loamy Coarse Sand, Medium Sand	1.20	1.20	N/A	N/A	1.20	N/A	N/A	N/A
Fine Sand, Loamy Sand, Loamy Fine Sand	0.75	0.60	N/A	0.75	0.75	N/A	0.75	N/A
Very Fine Sand, Loamy V. Fine Sand	0.50	0.50	N/A	0.75	0.60	N/A	0.60	N/A
Sandy Loam, Coarse Sandy Loam	N/A	0.75	N/A	0.60	0.60	0.00	0.60	0.00
Fine Sandy Loam, V. Fine Sandy Loam	N/A	0.75	N/A	0.60	0.60	0.00	0.60	0.00
Loam	N/A	0.75	0.75	0.50	0.50	0.00	0.50	0.00
Silt Loam, Silt	N/A	0.75	0.75	0.50	0.30	0.00	0.30	0.00
Sandy Clay Loam	N/A	0.60	0.60	0.50	0.30	0.00	0.30	0.00
Silty Clay Loam, Clay Loam, Sandy Clay	N/A	0.60	0.60	0.30	0.25	0.00	0.25	0.00
Silty Clay, Clay	N/A	0.60	0.50	0.30	0.25	N/A	0.25	0.00
Organic Soil Materials	N/A	N/A	N/A	N/A	N/A	N/A	0.00	N/A
Limnic Soil Materials	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.00
Bedrock	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

SOIL LOADING RATE (SLR)

- SLR > 1.20 gpd/ft^2 Includes:
  - Gravel
  - Coarse Sand
  - Coarse Sand & Gravel
- Unsuitable for soil absorption field due to rapid permeability

SOIL LOADING RATE (SLR)

- SLR < 0.25 gpd/ft^2 Includes:
  - Fragipans
  - Fragic layers
  - Dense firm till
  - Densic layers
  - Bedrock
  - Muck & Marl
- Unsuitable for soil absorption field due to very slow permeability

TABLE FOR ONSITE SEWAGE SYSTEM SELECTION

Table VI - Table for Onsite Sewage System Selection based on requirements of 410 IAC 6-8.3						
Site Requirements	Subsurface Trench Onsite Sewage Systems					Elevated Sand Mound Onsite Sewage Systems (Sec. 72)
	Gravity Flow[1] (Sec. 70, 71)		Flood Dosing or Alt. Fields[1] (Sec. 70, 71)	Flood Dosing[1] (Sec. 70, 71)	Pressure Dist. (Sec. 70, 71)	
Slope	≤ 15%		≤ 15%	≤15%	≤15%	≤ 6%
Design Daily Flow	≥ 450	< 450	Any	Any	Any	Any
Acceptable Loading Rate Range for determining system size	≥ 0.25 ≤ 0.75	≥ 0.25 ≤ 0.75	≥ 0.25 ≤ 0.75	≥ 0.25 ≤ 0.75	≥ 0.25 ≤ 1.20	≥ 0.25 ≤ 1.20
Distance from Trench Bottom (ground surface for mounds) to Layer with a Soil Loading Rate < 0.25 gpd/ft^2	≥ 30	≥ 24	≥ 24	≥ 24	≥ 24	≥ 20
Distance from Trench Bottom (ground surface for mounds) to Layer with a Soil Loading Rate > 1.20 gpd/ft^2	≥ 24	≥ 24	≥ 24	≥ 24	≥ 24	≥ 20
Distance from Trench Bottom (ground surface for mounds) to Layer with a Soil Loading Rate = 1.20 gpd/ft^2	≥ 24	≥ 24	≥ 24	≥ 24	Press. Dist. required for SLR = 1.20	≥ 0
Distance from Trench Bottom (ground surface for mounds) to a Soil Horizon Developed from Wisconsin Glacial Till That Shows Effervescence[3]	≥ 30	≥ 24	≥ 24	≥ 24	≥ 24	≥ 20
Distance from Trench Bottom (ground surface for mounds) to Soil Horizon with < 20% Clay and > 35% Coarse Fragments by Volume	≥ 30	≥ 24	≥ 24	≥ 24	≥ 24	≥ 20
Distance from Trench Bottom (ground surface for mounds) to Soil Horizon with > 20% Clay and > 60% Coarse Fragments by Volume	≥ 30	≥ 24	≥ 24	≥ 24	≥ 24	≥ 20
Distance from Trench Bottom (ground surface for mounds) to Seasonal High Water Table[2]	≥ 24	≥ 24	≥ 24	≥ 24	≥ 24	≥ 20
Total Lineal Feet of Trench	≤ 500	≤ 500	≤ 500 for Alt. Fields	Any	Any	N/A

VERTICAL SEPARATION DISTANCES

- Minimum Separation Distance Between Absorption Field Infiltrative Surface and Soil Limitation

SLR > 0.75

- Gravity ≥ 24”
- Flood Dose ≥ 24”

SLR < 0.25

- Gravity ≥ 30”
- Flood Dose ≥ 24”

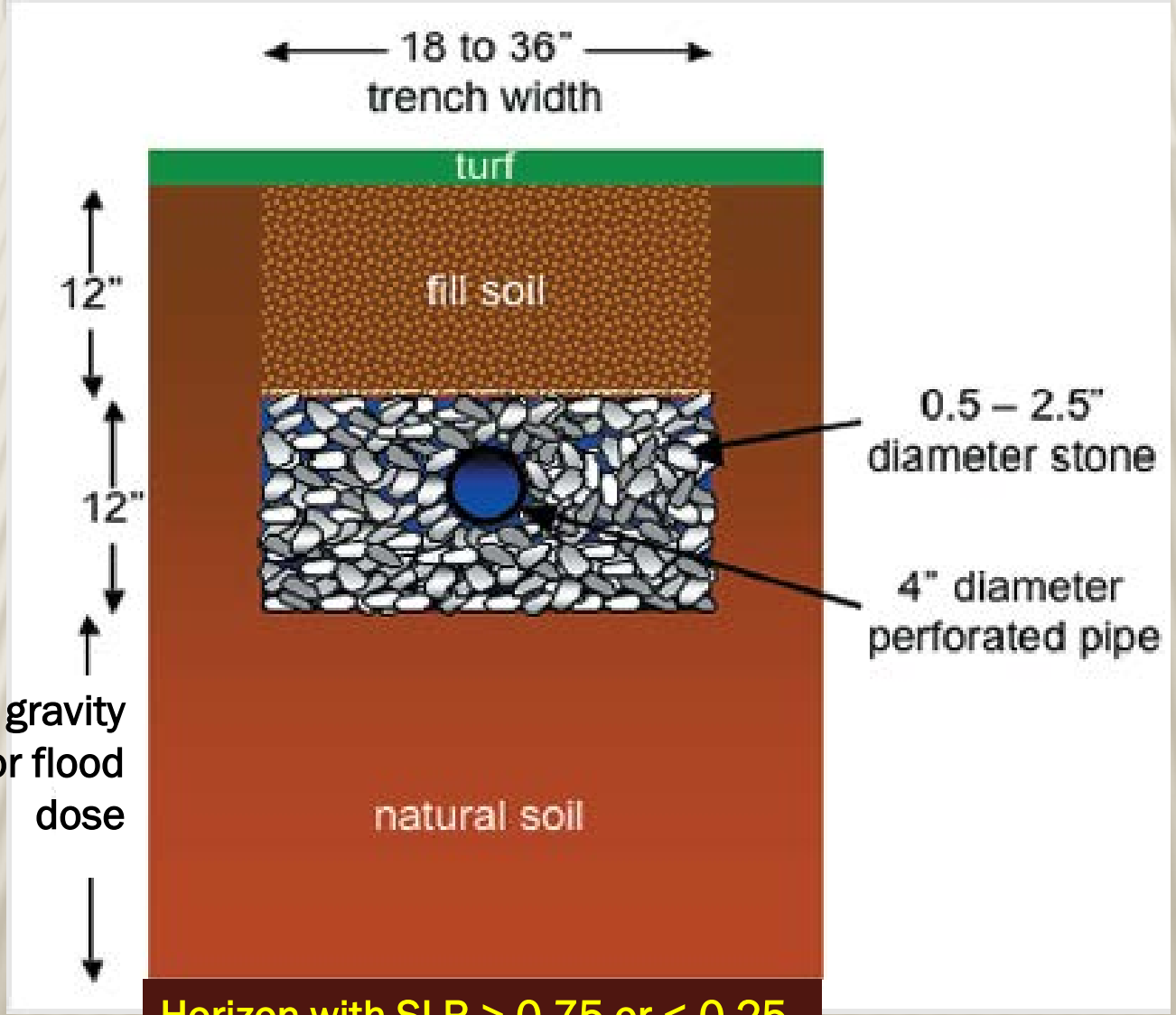
SLR > 1.20 or < 0.25

- Pressure Dist. ≥ 24”
- Sand Mound ≥ 20”

VERTICAL SEPARATION DISTANCES

- Minimum Separation Distance Between Absorption Field Infiltrative Surface and seasonal high water table (after drainage)
  - Gravity ≥ 24”
  - Flood Dose ≥ 24”
  - Pressure Dist. ≥ 24”
  - Sand Mound ≥ 20”

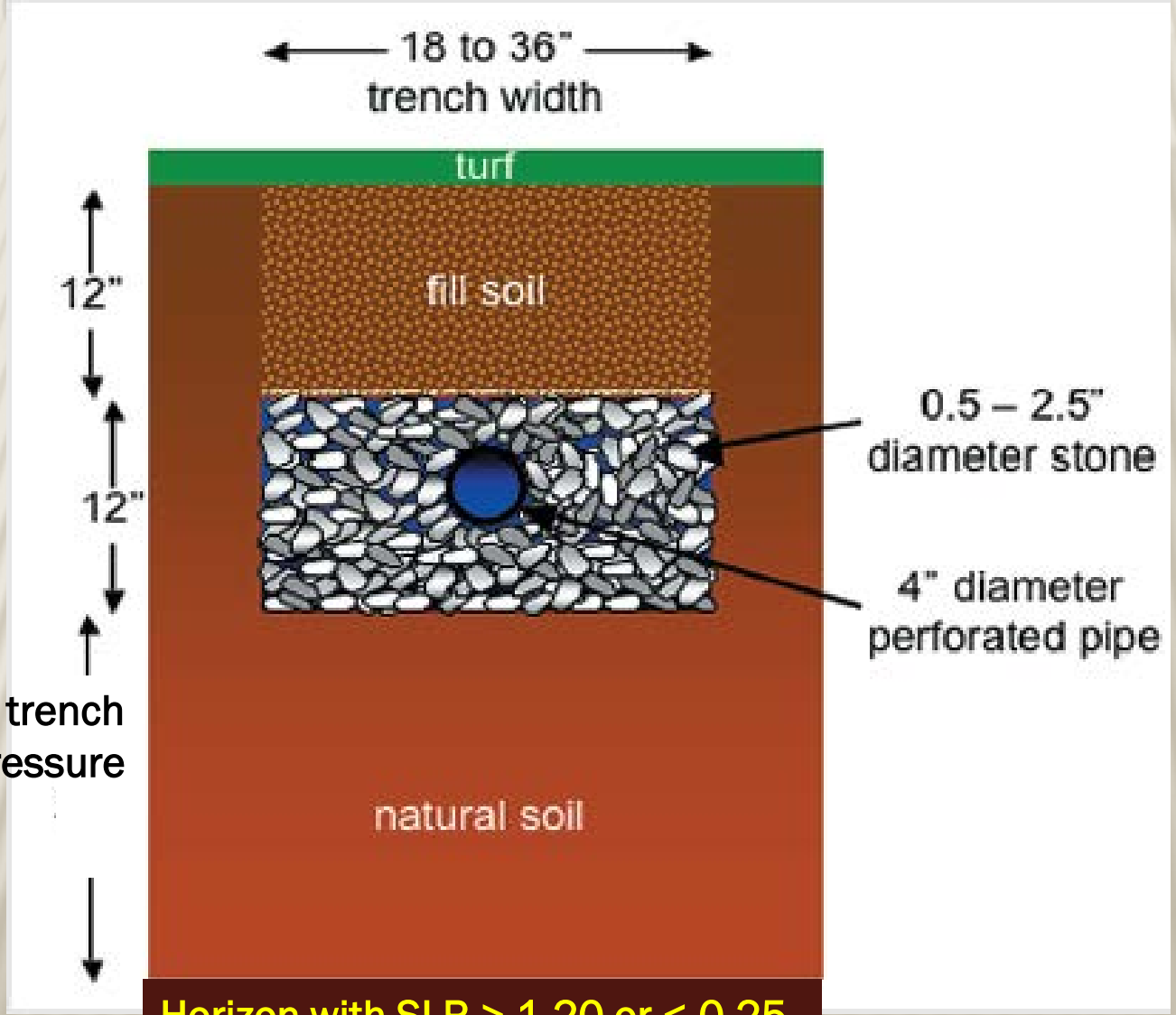
VERTICAL SEPARATION DISTANCES



30” for gravity
24” for flood
dose

Horizon with SLR > 0.75 or < 0.25

VERTICAL SEPARATION DISTANCES



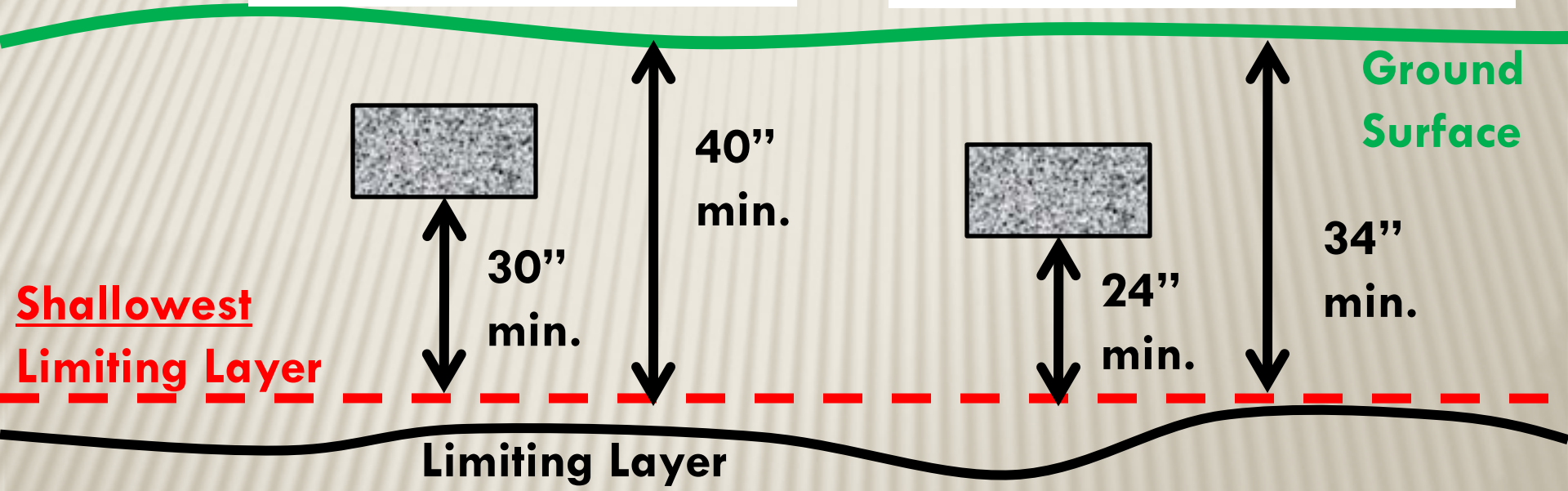
24" for trench pressure

Horizon with SLR > 1.20 or < 0.25

TRENCH DEPTH DETERMINATION

Gravity Systems
DDF ≥ 450gpd
(3 or more bedrooms)

Flood Dosed Systems and Gravity with DDF <450 gpd (2 or less bedrooms)

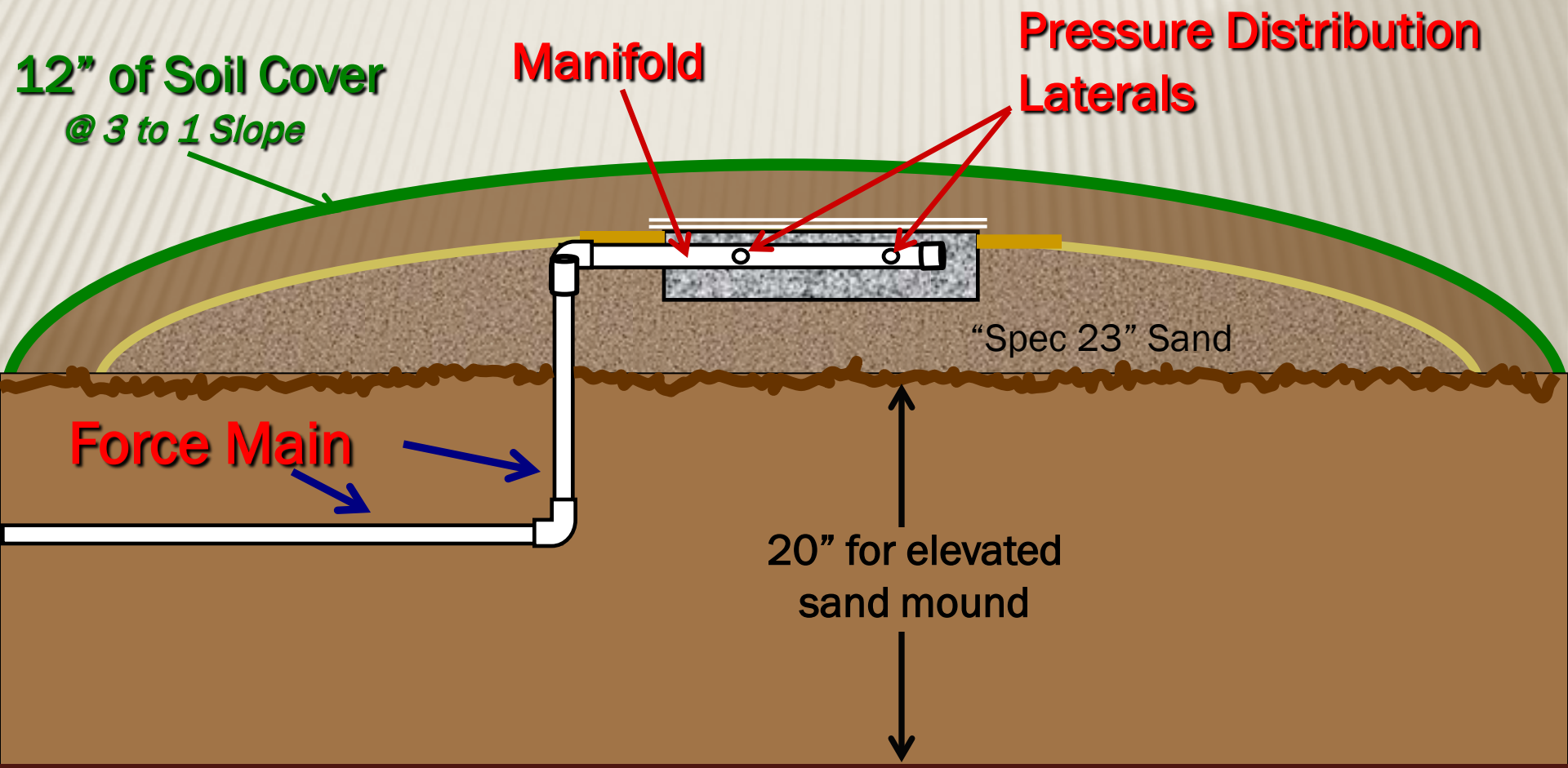


Maximum Trench Depth = Depth of Limiting Layer minus 30"

Maximum Trench Depth = Depth of Limiting Layer minus 24"

Min. Trench Depth =10" - Max. Trench Depth = 36"

Elevated Sand Mound



Horizon with SLR > 1.20 or < 0.25

TABLE FOR ONSITE SEWAGE SYSTEM SELECTION

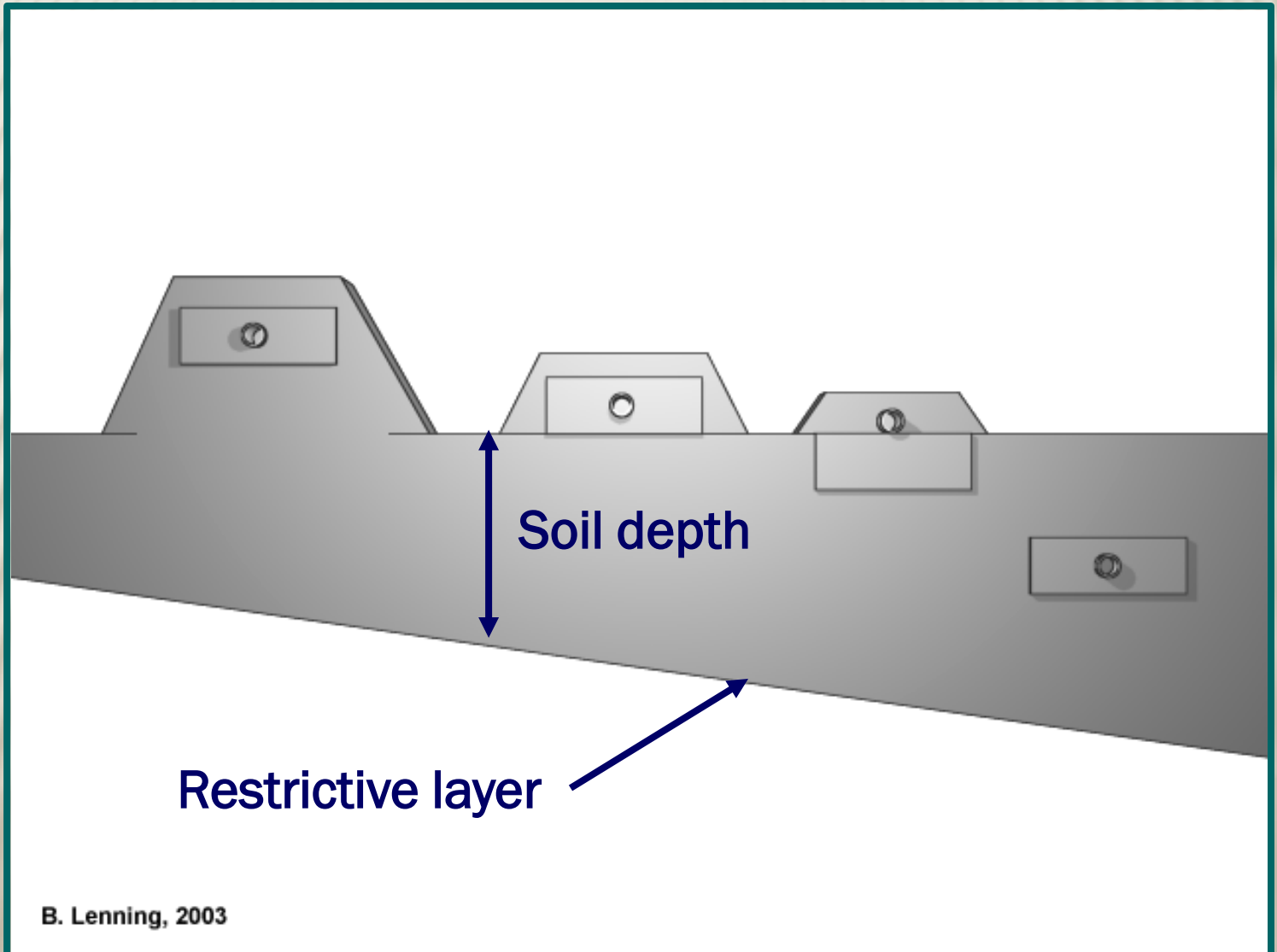


TABLE FOR ONSITE SEWAGE SYSTEM SELECTION

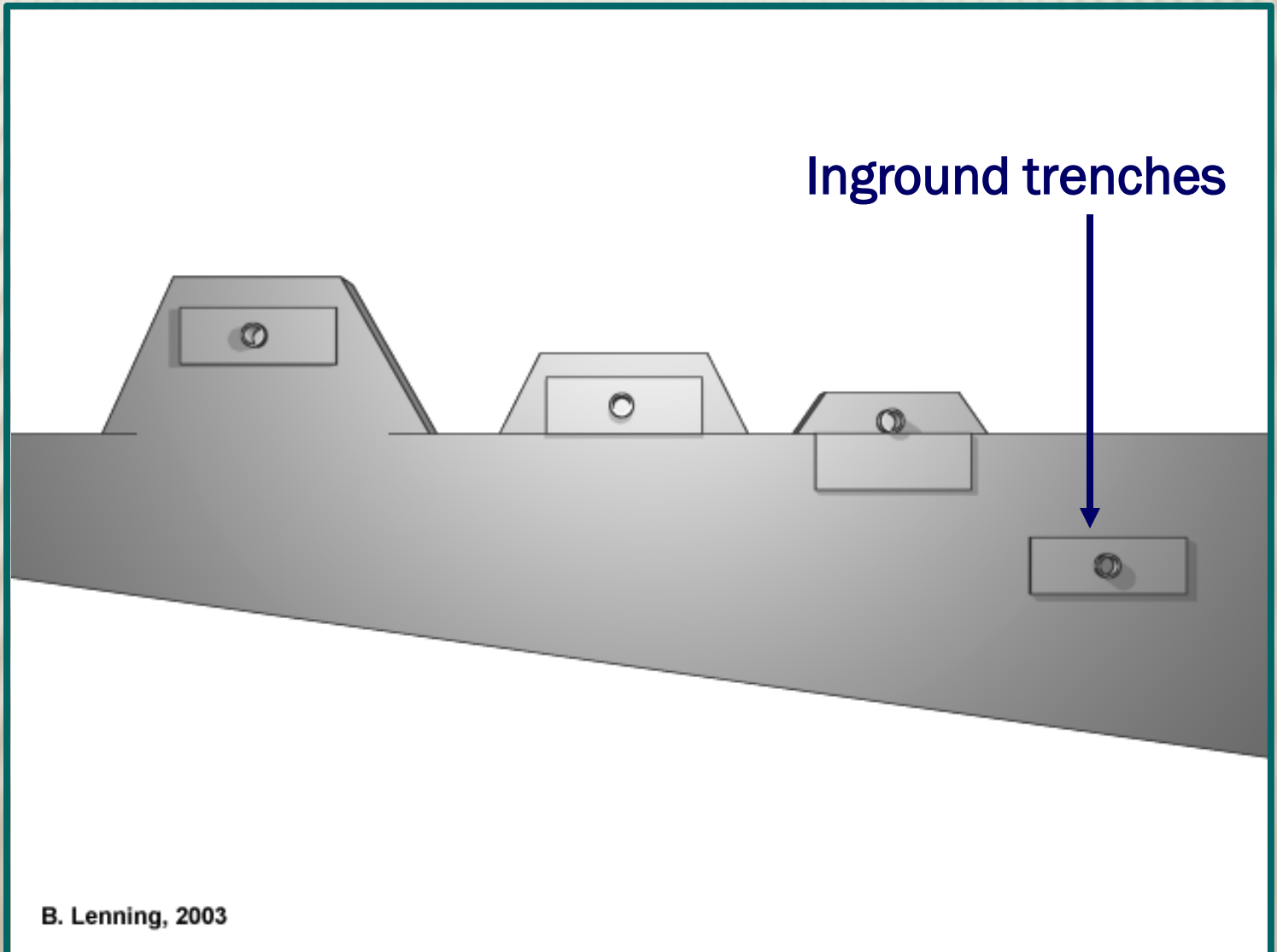


TABLE FOR ONSITE SEWAGE SYSTEM SELECTION

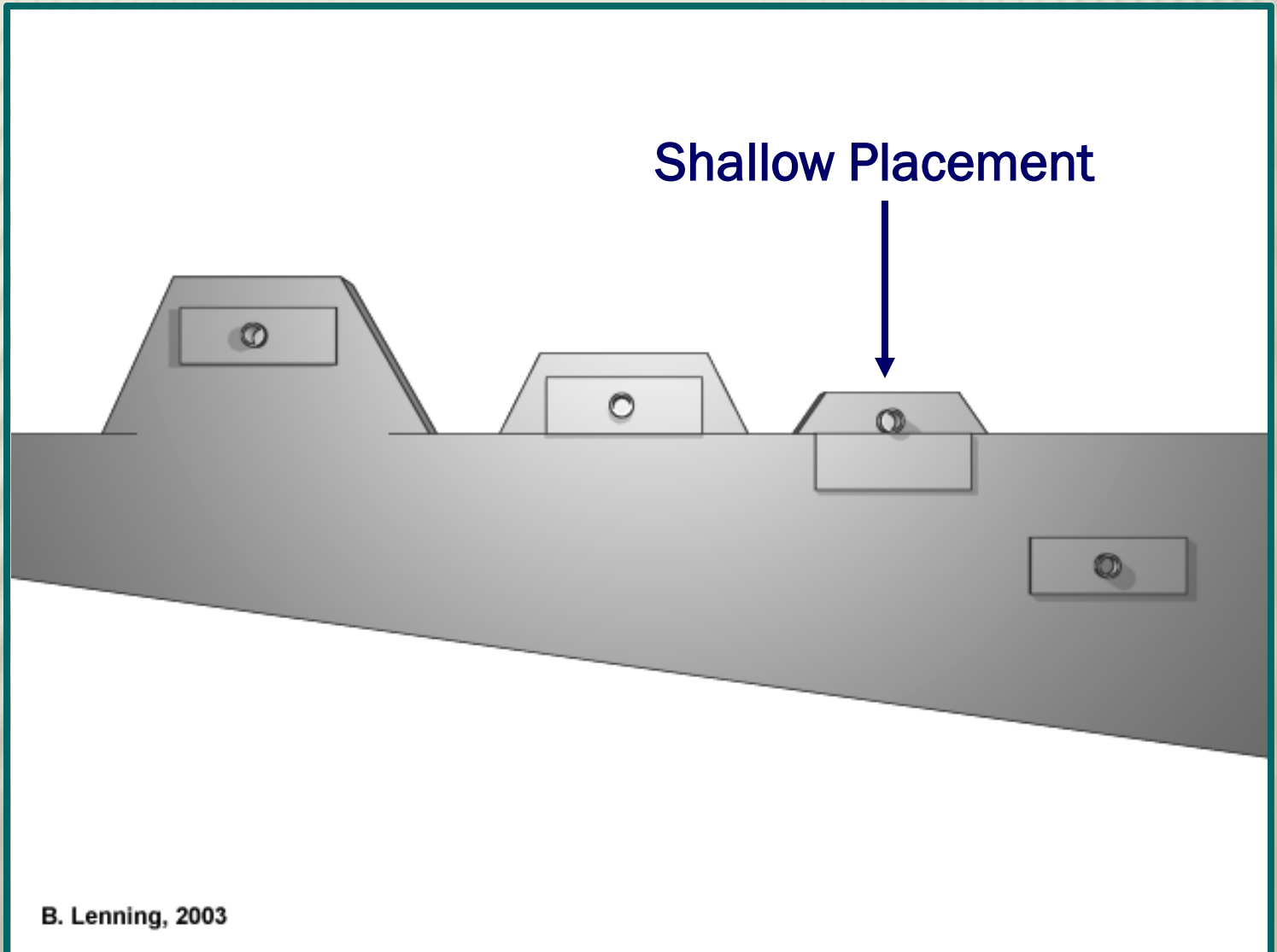


TABLE FOR ONSITE SEWAGE SYSTEM SELECTION

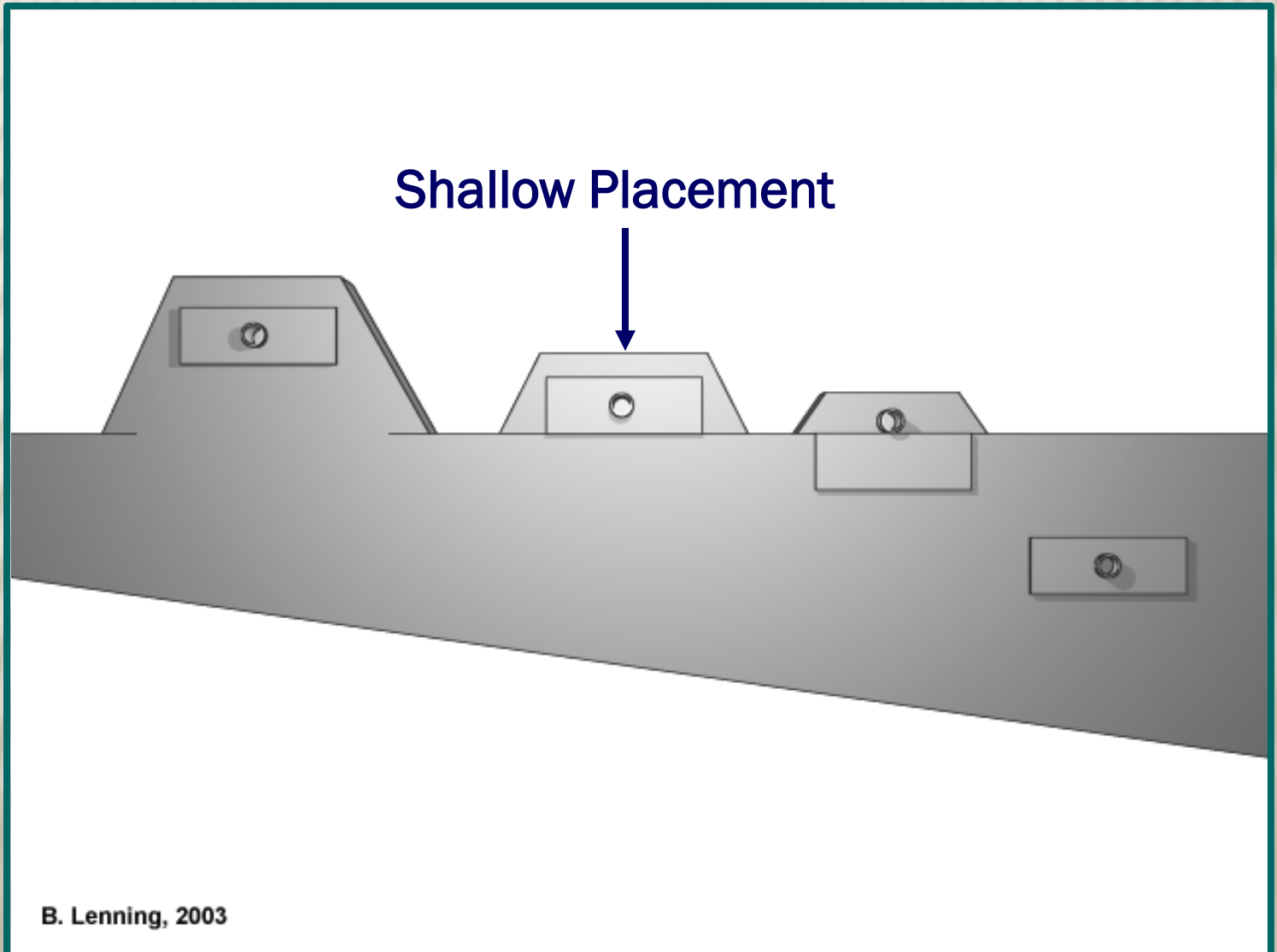
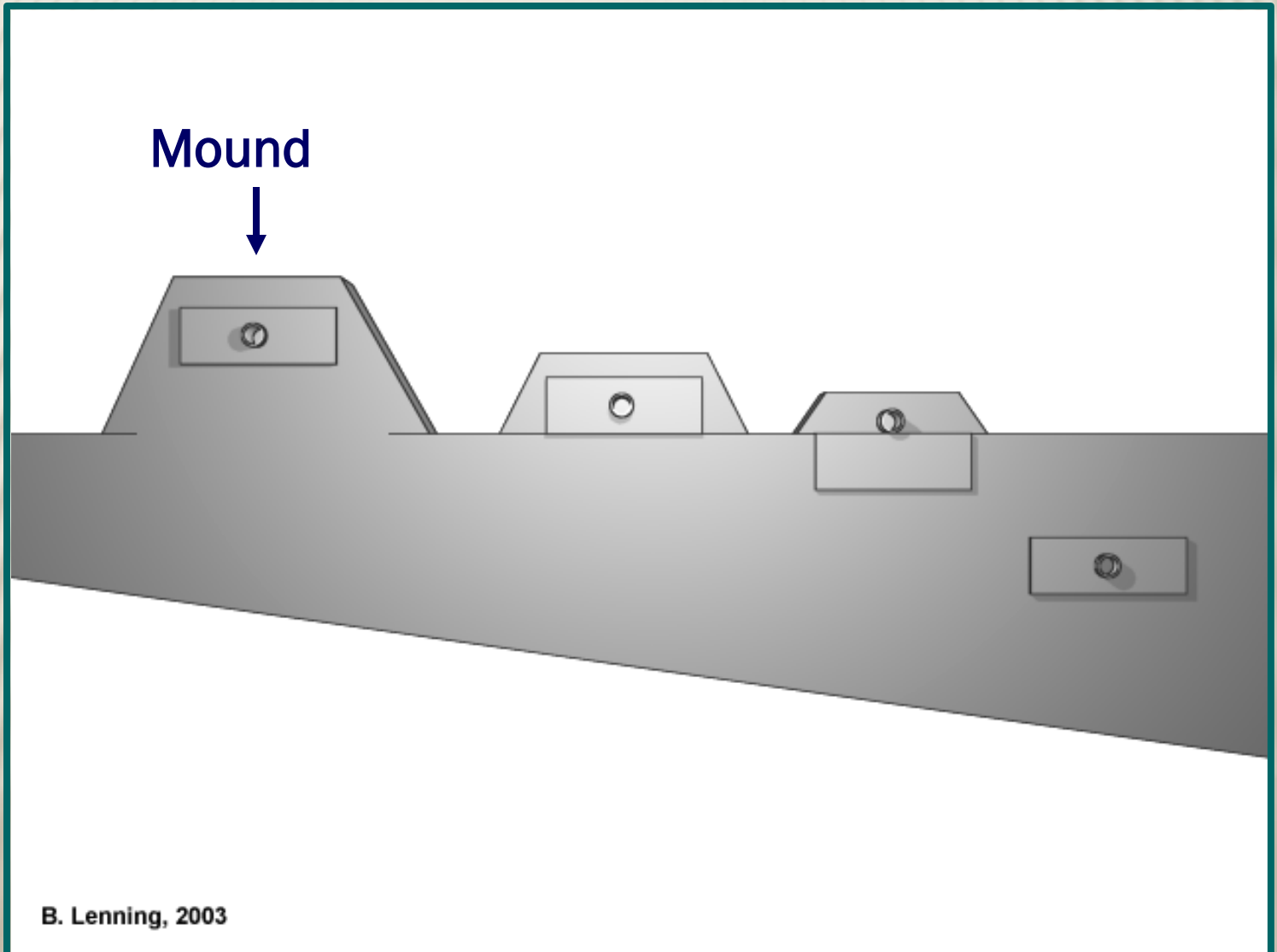


TABLE FOR ONSITE SEWAGE SYSTEM SELECTION



GENERATING THE PLAN

The field work

ABSORPTION FIELD

- Site Layout & Protection
  - Stake out the trenches & dispersal area
  - Protect the absorption field and dispersal area from traffic

Protect absorption field from all traffic and material storage

Presby: Pumped System Notes:

*See Presby details .
*Adjust bed to meet existing conditions and contours.
*Minimum pipe spacing is 1.5 feet centerline to centerline.
*Protect absorption field from all traffic and material storage.
*Existing ground contours are supplied by Sauer Land Surveying, Inc..
*Maintain 50 feet clearance between well and septic system
*Electric work will require a separate permit from the County Building Permit Dept.
*Force Main is to drain back into dosing tank.

Pipe Legend: A= SDR 35, 4 inch PVC Pipe, Minimum slope is 4 inches per 25 feet
B= SDR 26 or Schedule 40 PVC pipe
C= ASTM F405-89, 4 inch, PE perforated pipe

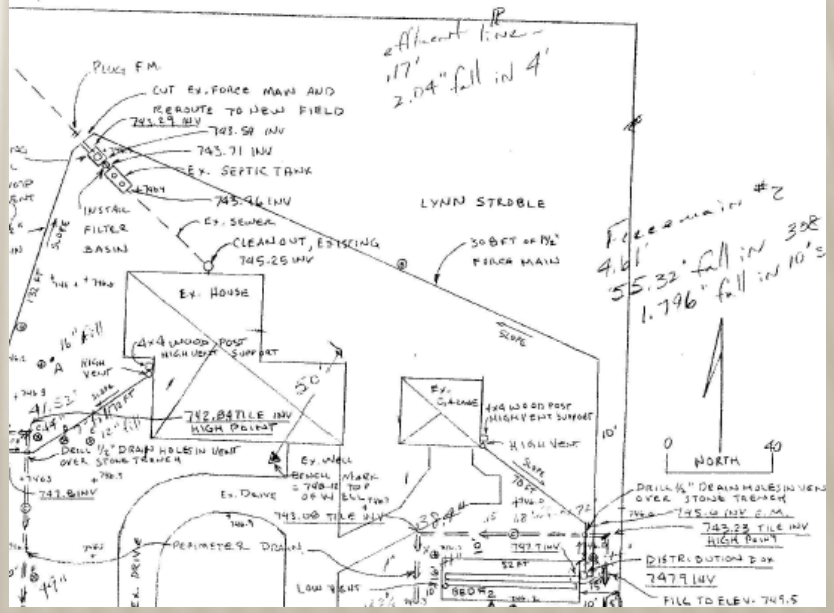
The pump is designed based on the installation of 132.4 lft of 1 1/2 force main with 13.7 ft of TDH at 22.3GPM. If these conditions can not be met, contact design engineer. Do not use larger pump than what is specified. Installer responsible to use and protect the bench mark [illegible] and to construct the system using the design elevations where indicated.

Any changes in the layout of the [illegible] System Permit has been issued will result in a redesign and resubmittal to the Health Department and [illegible] or those who are responsible for causing the changes will be responsible for the costs involved, including [illegible] fees. This includes moving the house from the designed location.

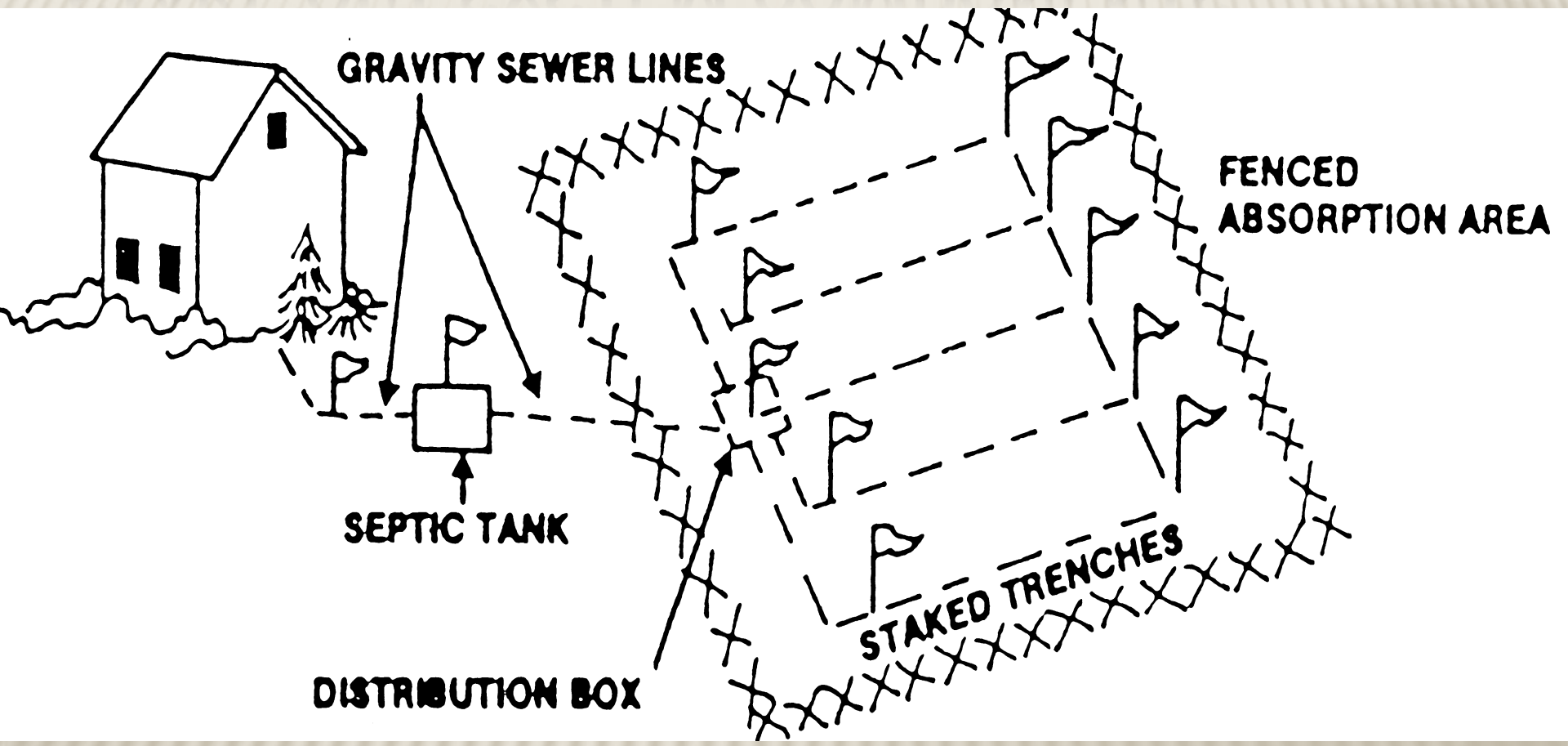
The effluent filter basin with alarm shall be a Zagel A100-8x26-VC-FP or equal with a Smart Filter Alarm. Ph 1-800-221-5742
The filter shall conform to ANSI/NSF Standard 46 and provide for a minimum scum space of 6 inches. It shall have a gas deflection device and installed according to manufacturer's recommendations. It shall not require a person to enter into the tank or basin for maintenance. It shall be maintained by the owner and remain in service for the life of the septic tank. It shall be serviced at the very least when the septic tank is pumped. The filter shall not interfere with the pumping and cleaning of the septic tank and shall have an alarm that is activated when service of the filter is required.

Notes: Duplex Pump Controls

1. Install two pumps which are to be Zoeller Pumps Model No. 53, 0.3 HP, 115 V, 1 Phase
2. Pump rate for Bed #1 is 22.3 GPM at 13.7 Ft of TDH. Pump rate for Bed #2 is 16.0 GPM at 15.1 Ft of TDH. Do not use a larger pump than what is specified. Pump Dose is 57 gal/dose
3. Pumps are to automatically alternate between doses, with an hour meter on each pump
4. All controls are to be in a water tight control panel, see number 2. below.
5. Control Panel shall contain a mechanical alternator, alarm light, alarm horn, a running time meter for each pump, a HOA switch for each pump, float controls, and circuit breaker. Do not use junction boxes inside of tank.
6. Audiovisual High Water Alarm shall be connected to a separate power circuit and to lock ON with any pump failure and have a manual reset control
7. Force Mains shall be installed as follows: 132 lft of 1 1/2 inch force main to Bed #1 ; 308 lft of 1 1/2 inch force main to Bed #2
8. Electrical work will require a separate permit from the Building Permit Department
9. Pumps are to have a breakaway pipe flange for easy removal



STAKE OUT SYSTEM COMPONENTS



CAUTION TAPE POSITIONED FOR PROTECTION

ABSORPTION FIELD

- Trench Layout
  - Follow contours on sloping sites
    - Common trench depth
  - Equal length
    - Proportionate loading to trenches

CONVEX VS. CONCAVE

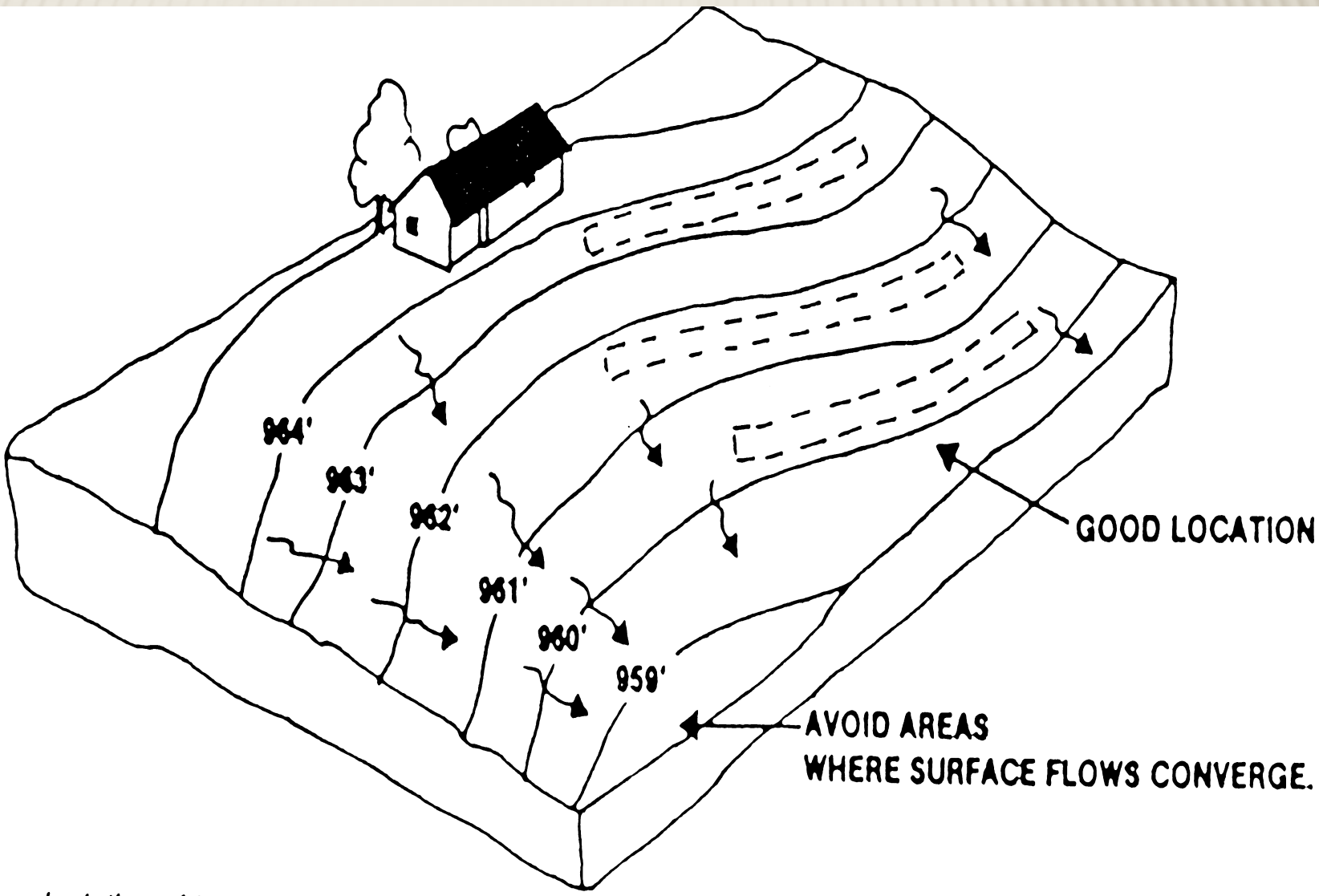


Figure 2. Proper orientation of trenches on complex slopes

ABSORPTION FIELD

- Trench Excavation
  - Site Conditions
    - Wetness
    - Compaction
    - Vegetation

RULE 410 IAC 6-8.3 REFERENCES TO CONTOUR 11 TIMES

- Subsurface Drainage: 59(f)(3)
- Subsurface OSS:
  Section 73(Table VI); 74(g)(1); **74(n)**
- Elevated Sand Mound design:
  79(d)(1); 80(g); 81(a)
- Elevated Sand Mound site preparation:
  86(a)(4); 86(a)(4)(A); 86(a)(4)(B)(i); 86(b)(2)

Trees

1. Route trenches around trees, still following the contour.
2. Remove tree and root ball as long as the resulting excavation is not larger or deeper than the allowable trench depth and width.

PLOWED FIELDS

- Furrows
- Dirt Clods
- Crop Stubble

Manicured Lawn

CONTOUR

1. the outline of a figure or body; the edge or line that defines or bounds a shape or object.

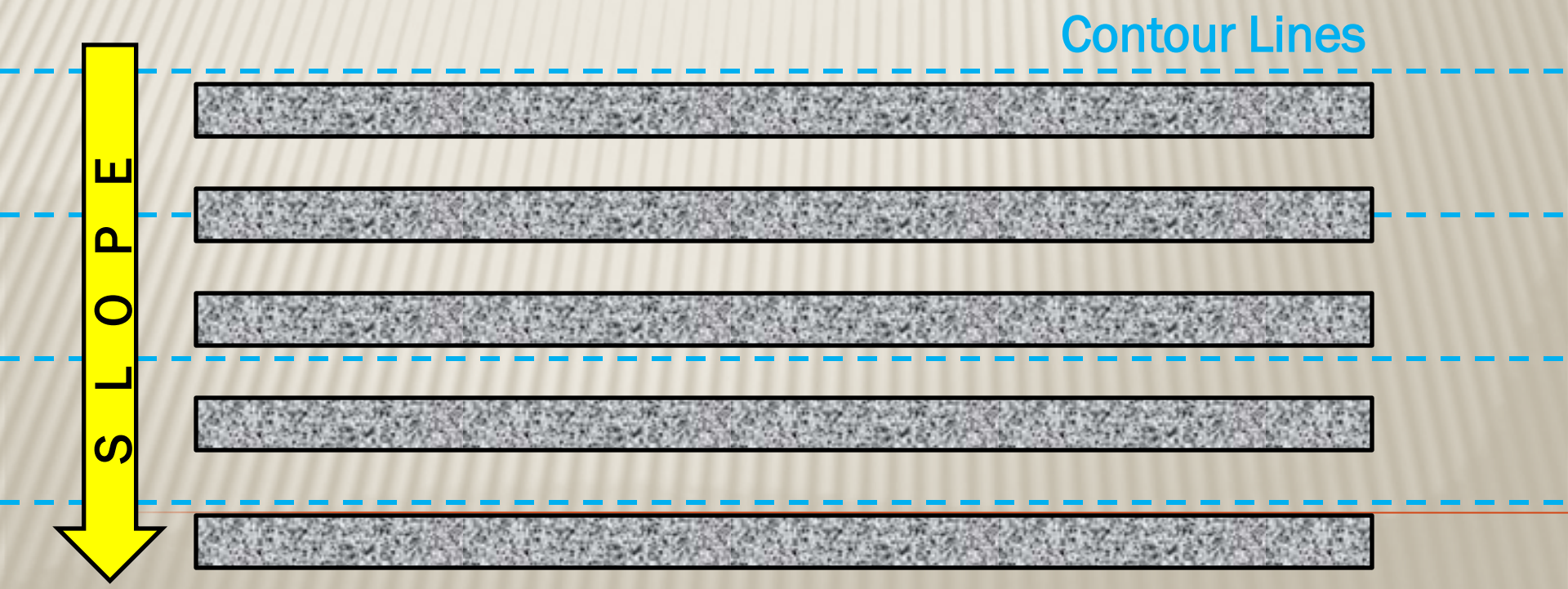
Contour Line

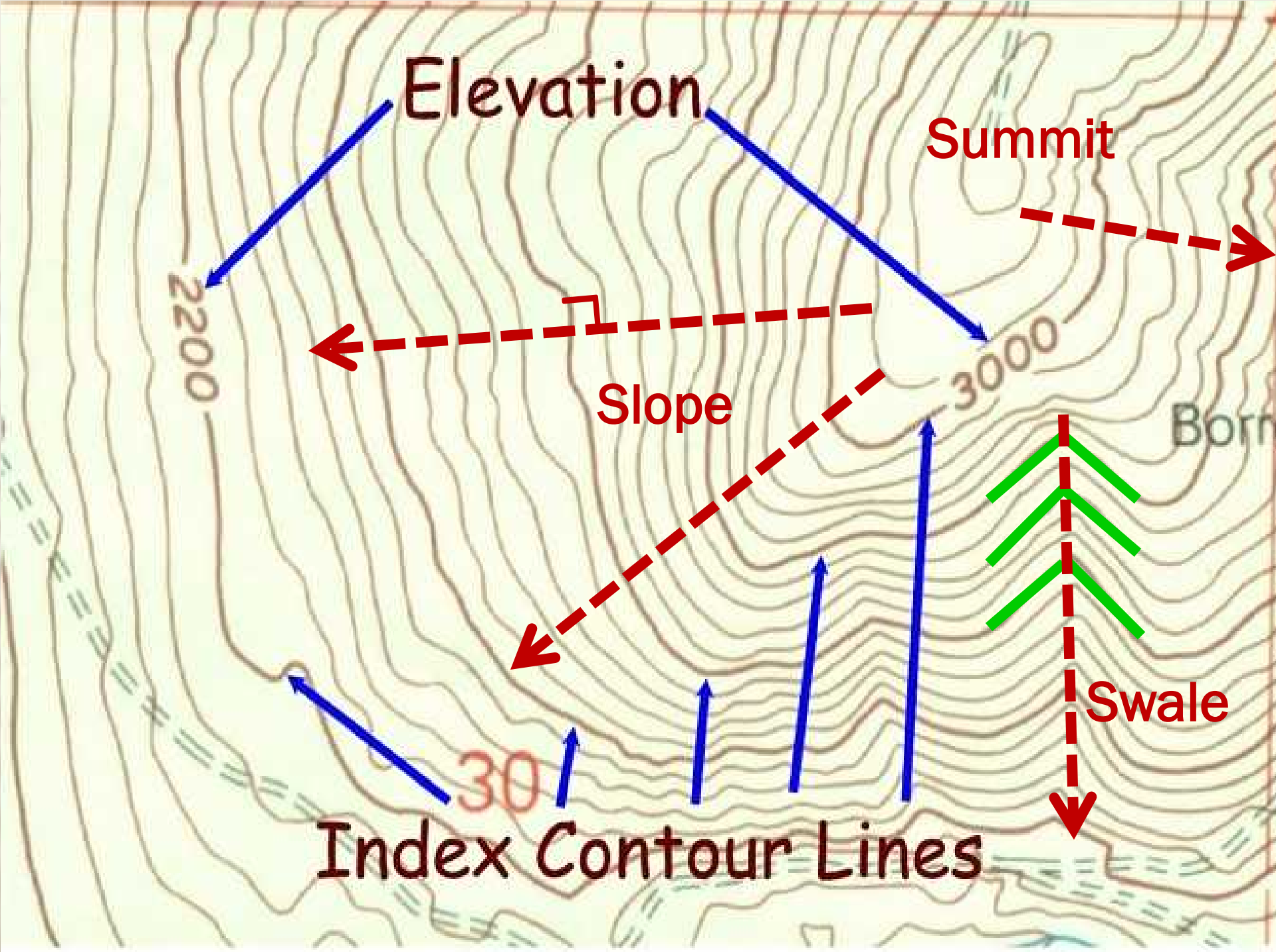
1. A line joining points of equal elevation on a surface.
2. The representation of such a line on a map

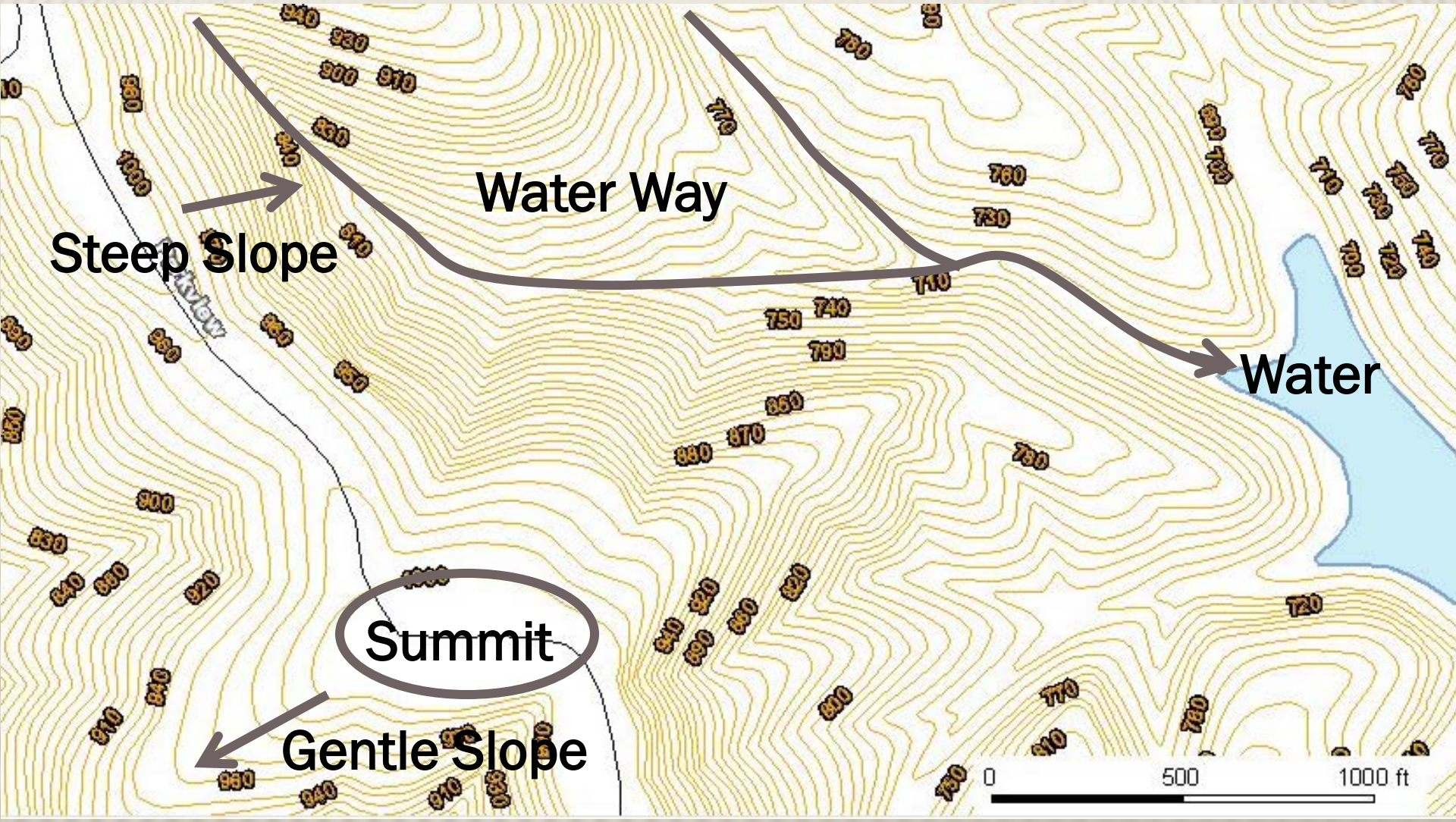
Contour Map

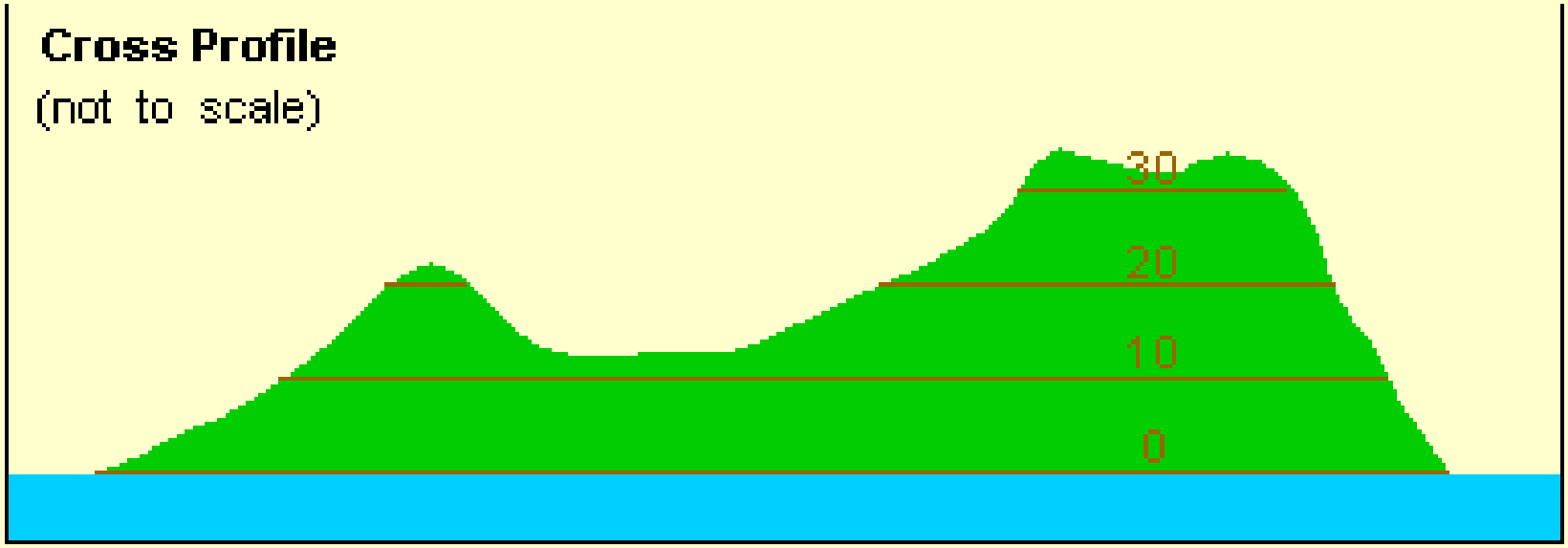
1. a topographic map on which the shape of the land surface is shown by contour lines, the relative spacing of the lines indicating the relative slope of the surface.

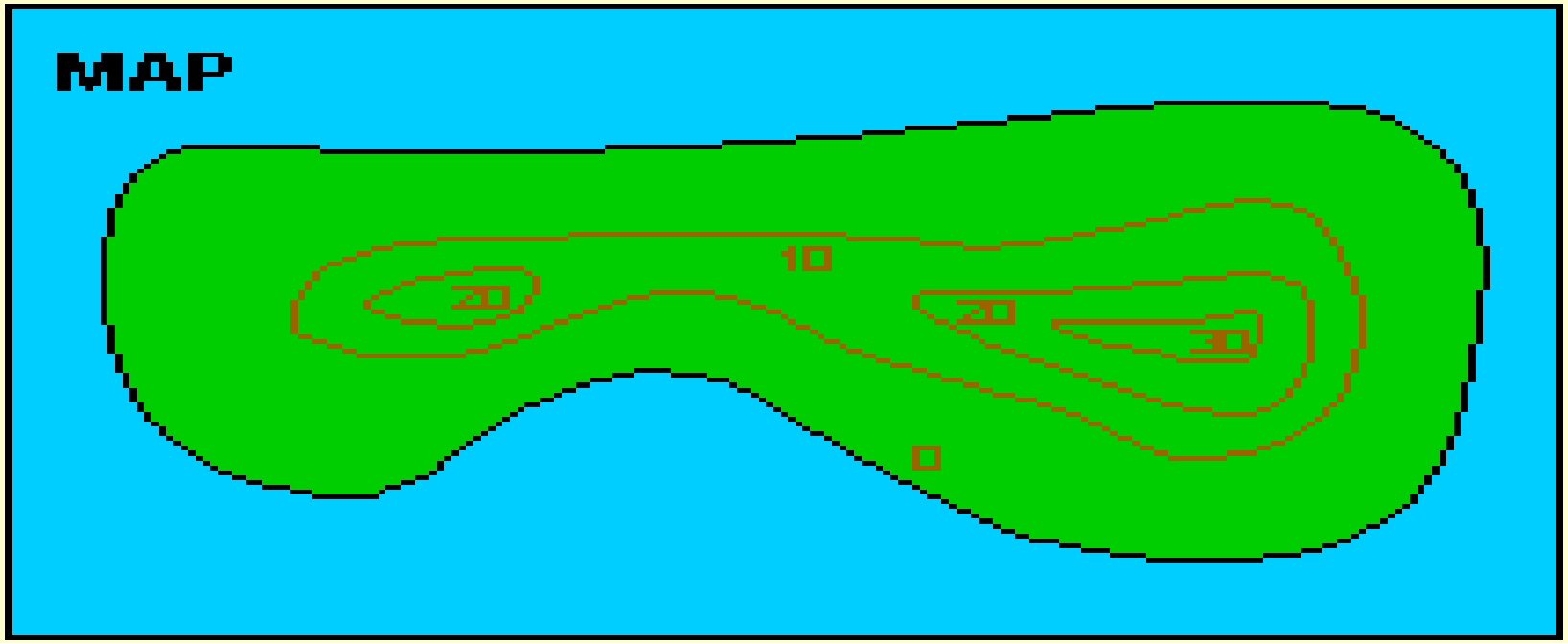
CONTOUR




Elevation
Summit
2200
3000
Slope
Born
Swale
30
Index Contour Lines


Water Way
Steep Slope
Water
Summit
Gentle Slope
0
500
1000 ft


Cross Profile
(not to scale)
30
20
10
0


MAP
10
20
20
30
0

TOPOGRAPHY MAPS

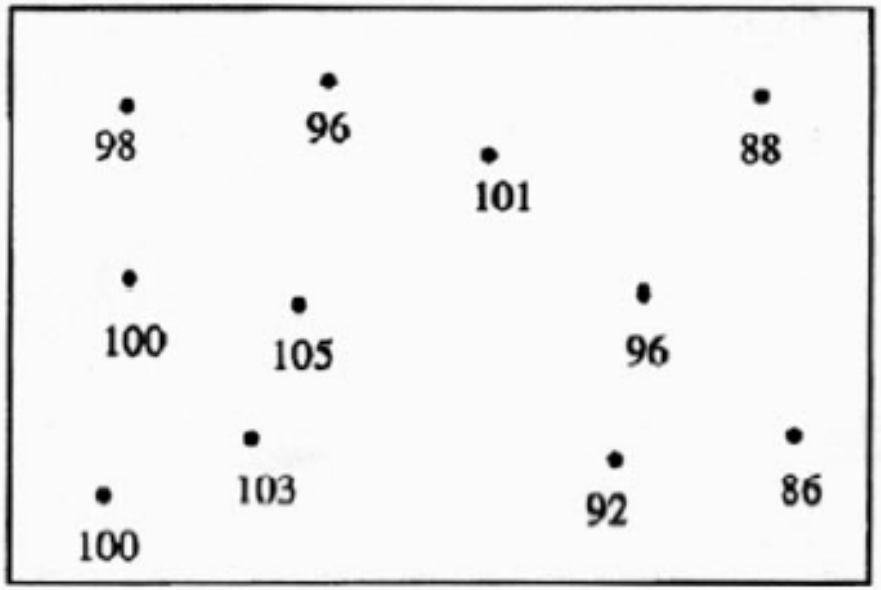


Fig. 1. Map points with elevations.

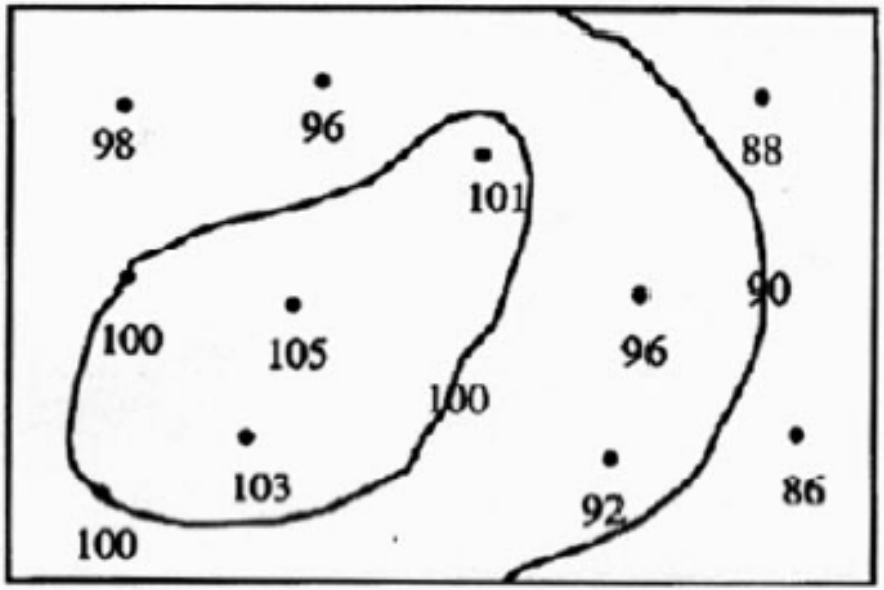


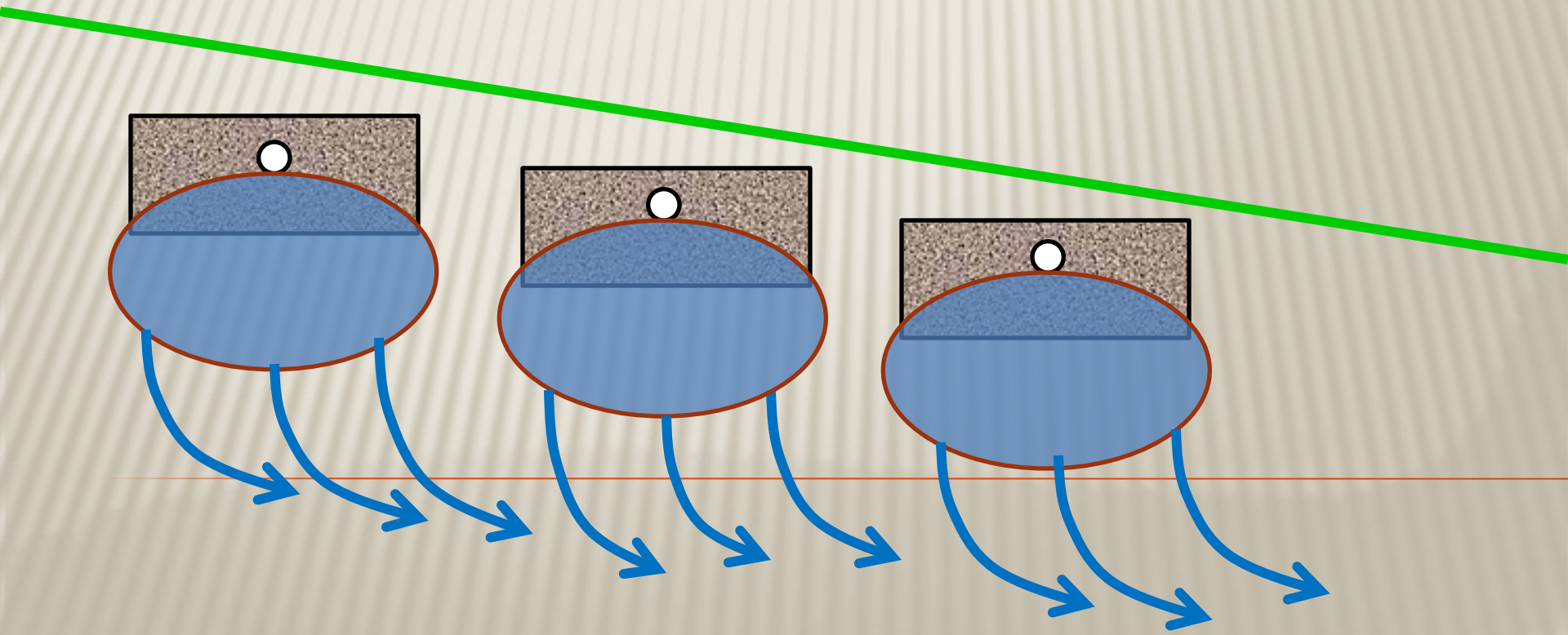
Fig. 2. Same points with 90 and 100 ft contour lines added.

- Elevation shots are obtained.
- Elevations between the shots are interpolated
- Approximate contour lines are drawn.

CONTOUR

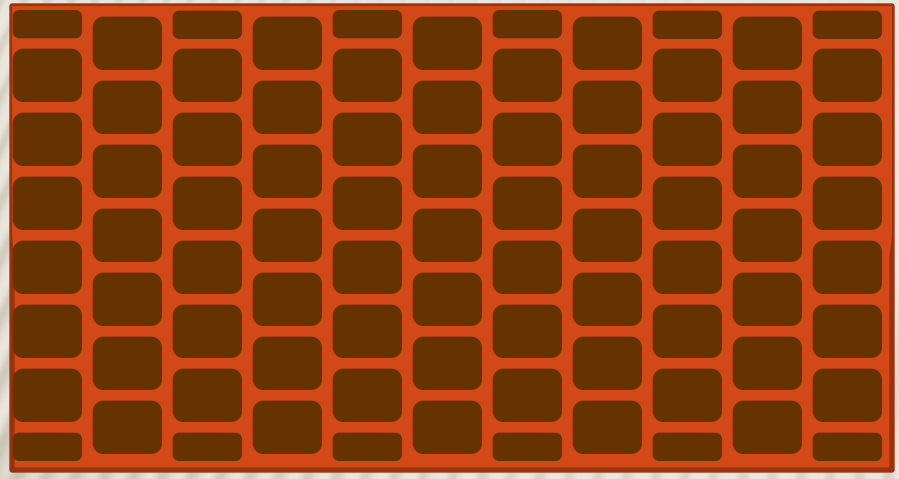
How does water move?

- Capillary Action
  - Until the soil is saturated
- Gravity



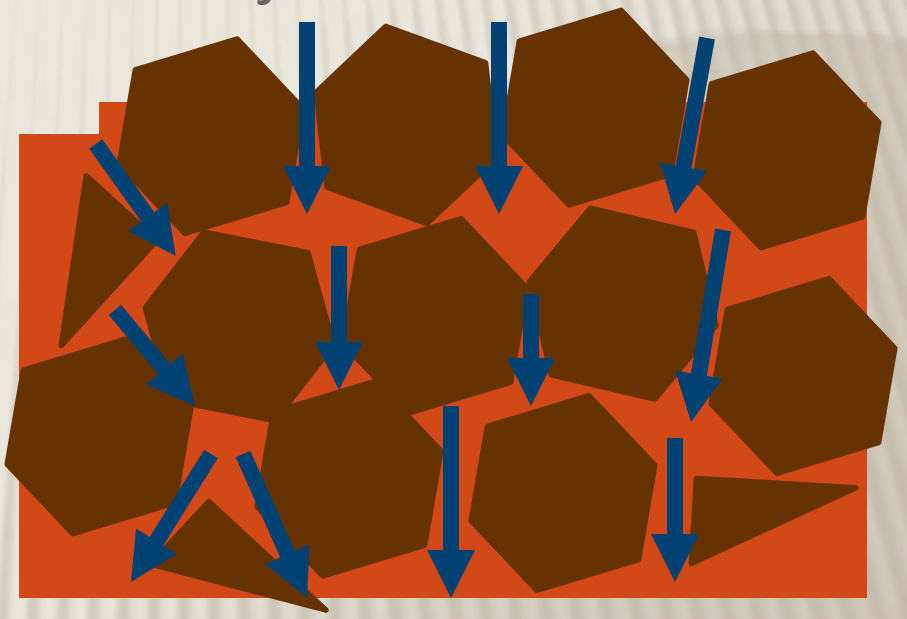
WATER MOVEMENT IN SOIL

- Clayey soil



Small Particle Size
Small Pore Spaces
Large pore area – high water retention
Strong Adhesive and cohesive forces
Water moves slowly

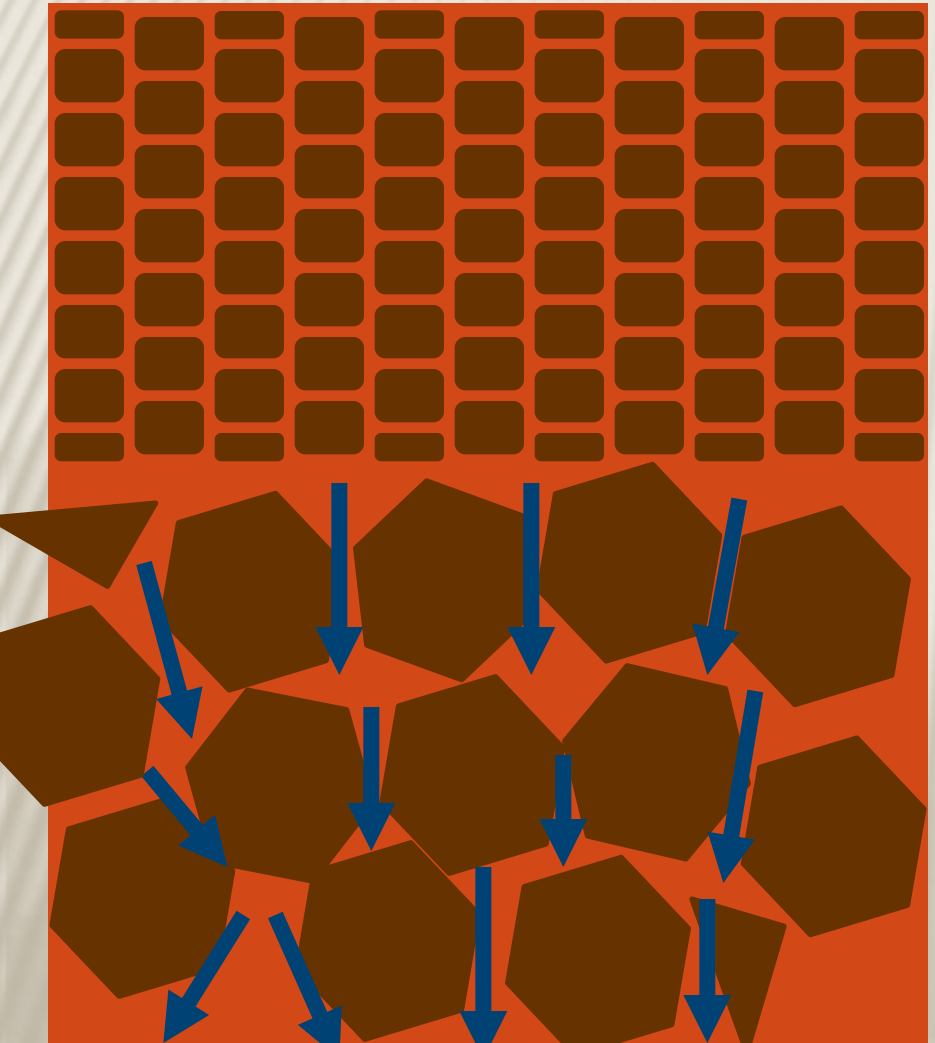
- Sandy soil



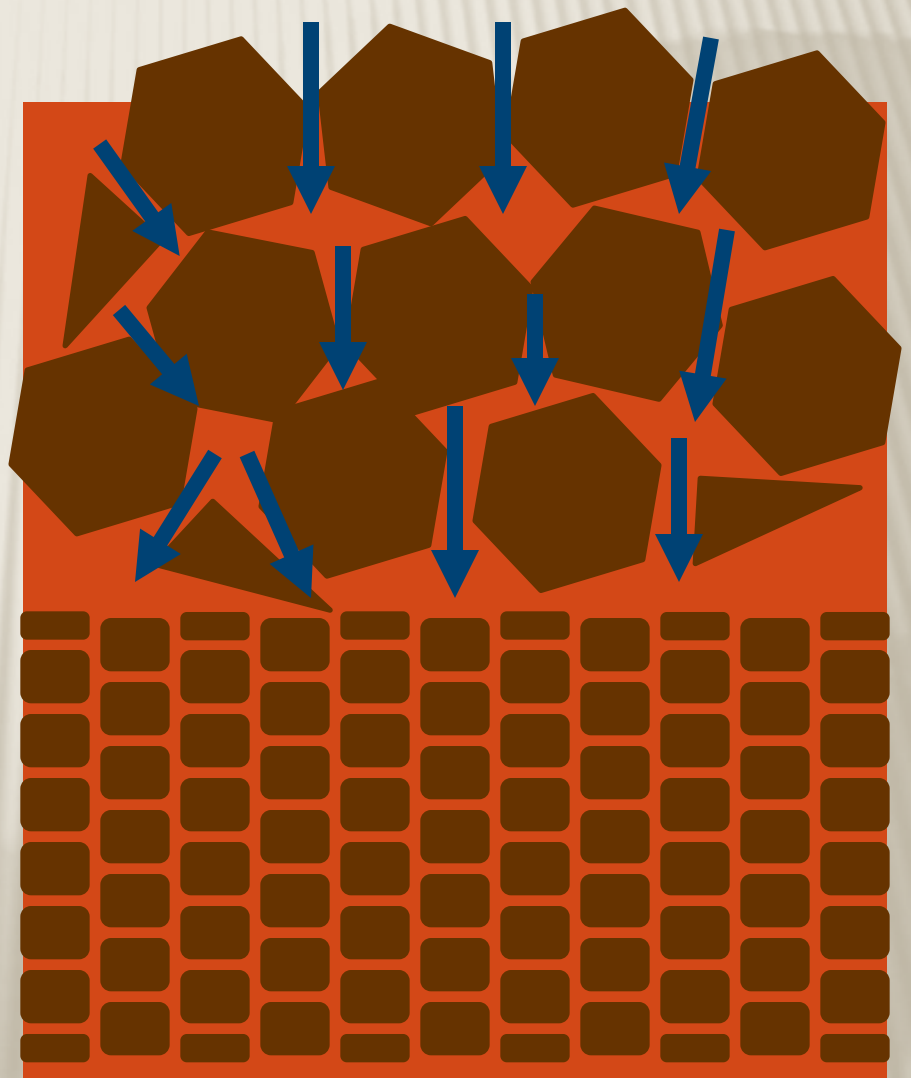
Large Particle Size
Large Pore Spaces
Smaller pore area – lower water retention
Weaker Adhesive and cohesive forces
Water moves rapidly

WATER MOVEMENT IN SOIL

Clayey soil

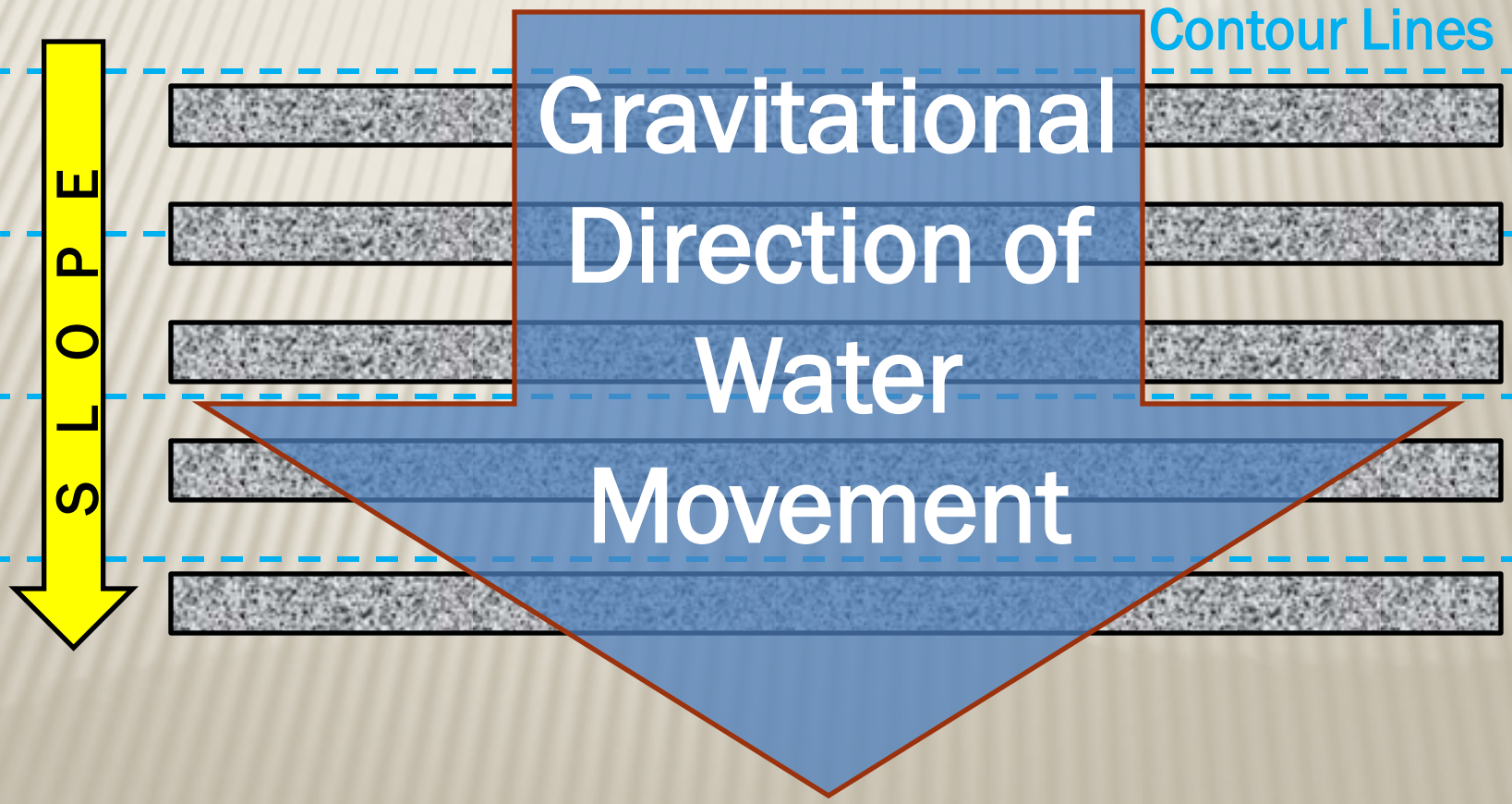


Sandy soil



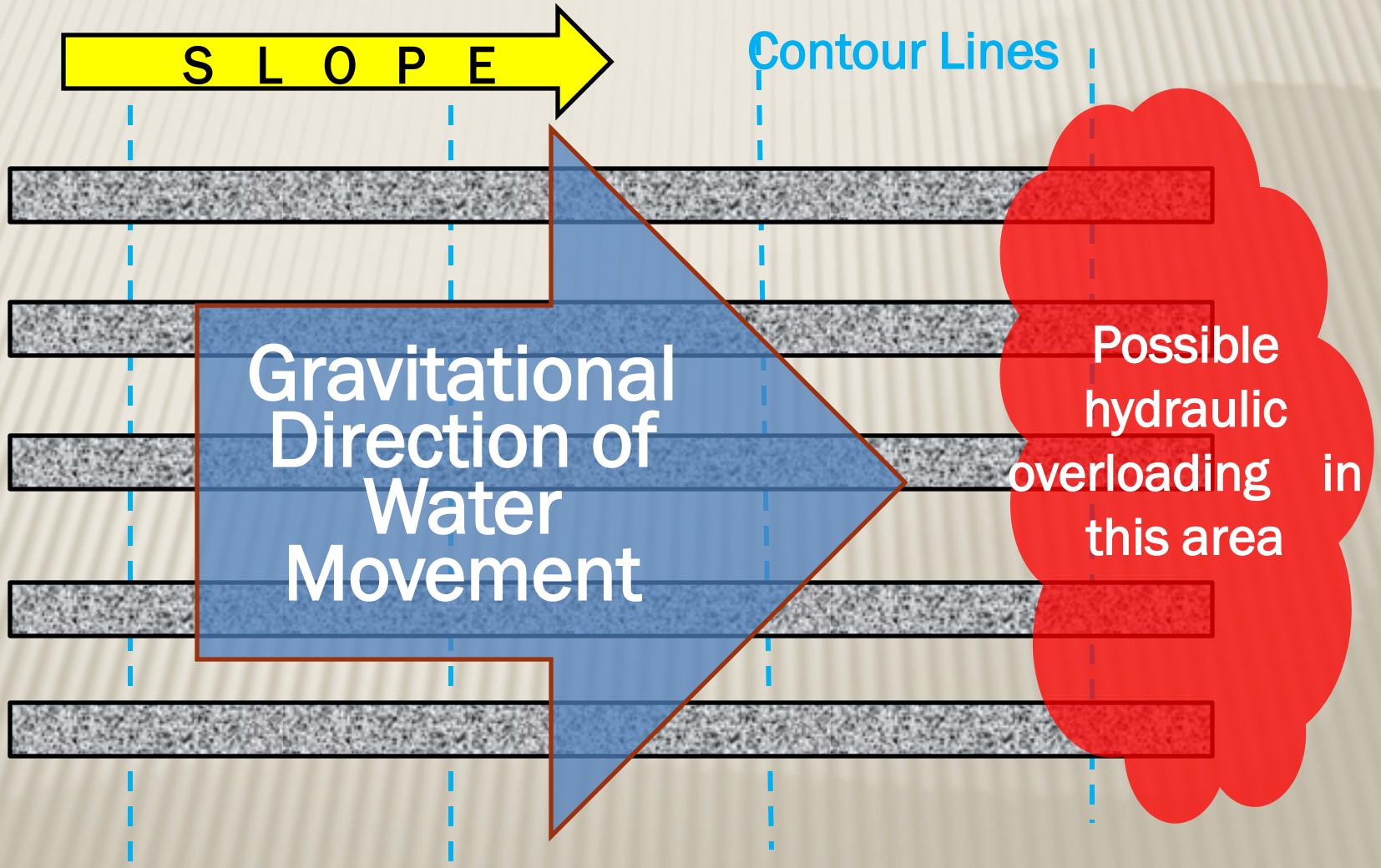
Contour

How does water move?



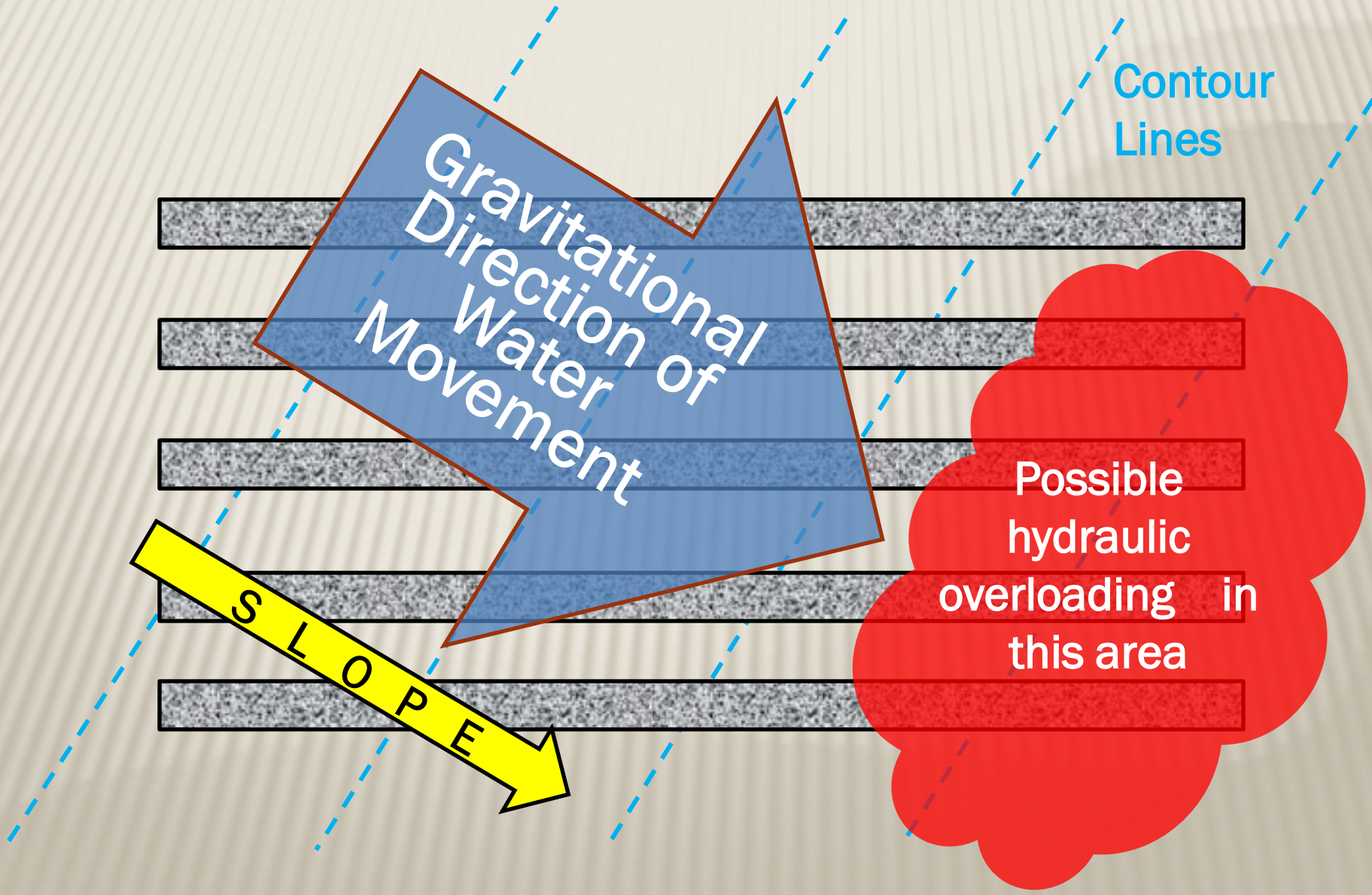
Contour

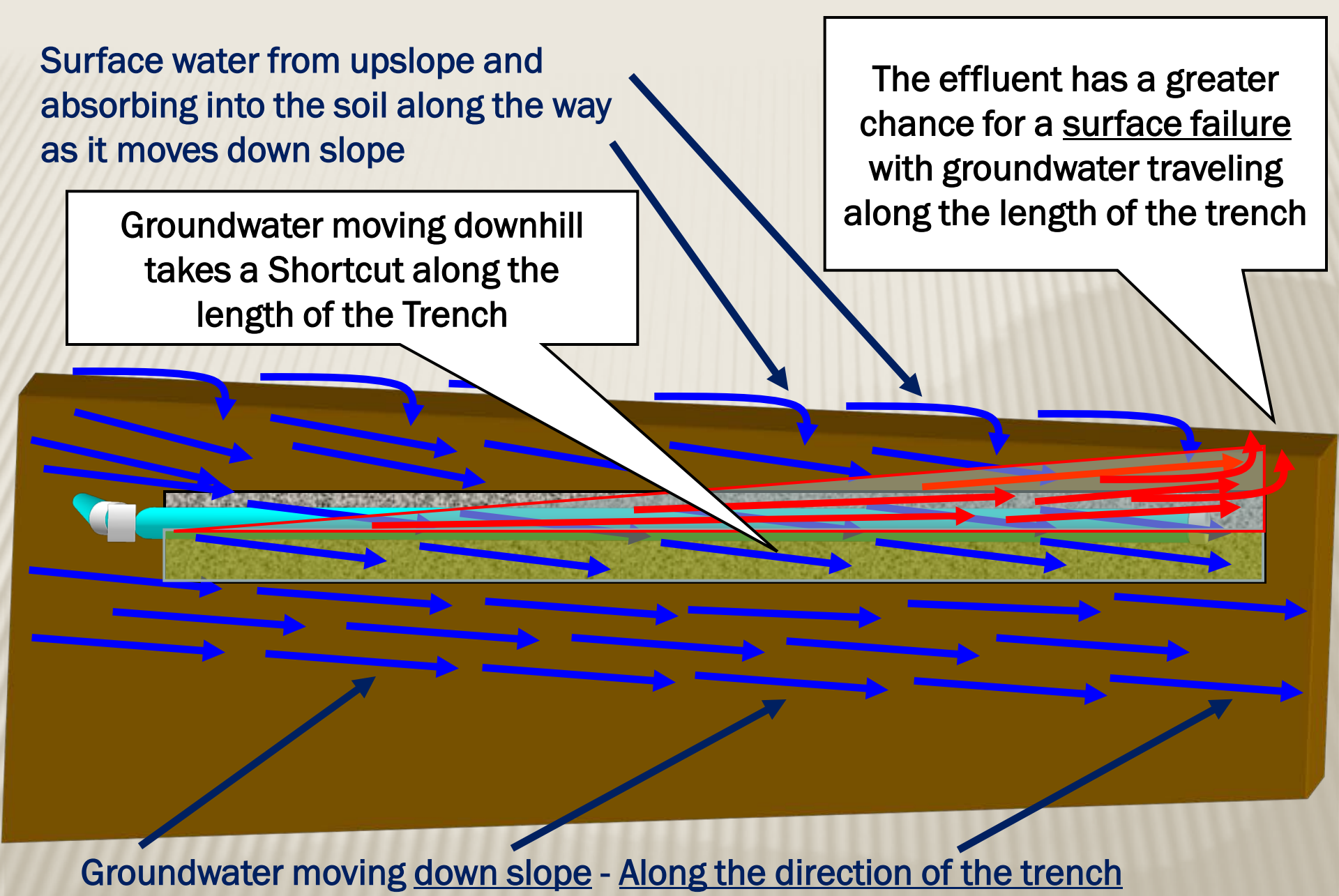
How does water move?



Contour

How does water move?

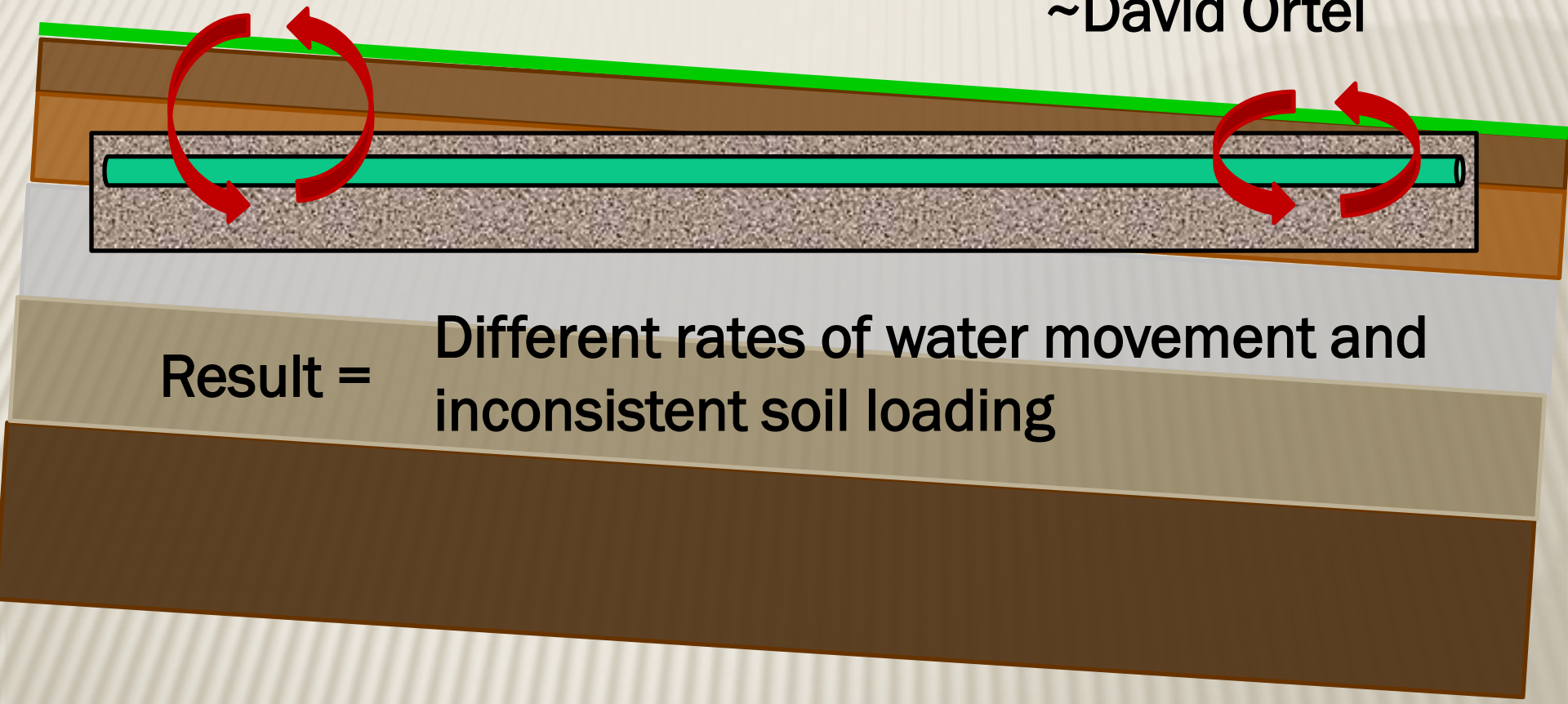




Side View of Trench Not Installed Along the "Contour"

Differing Rates of Oxygen Exchange

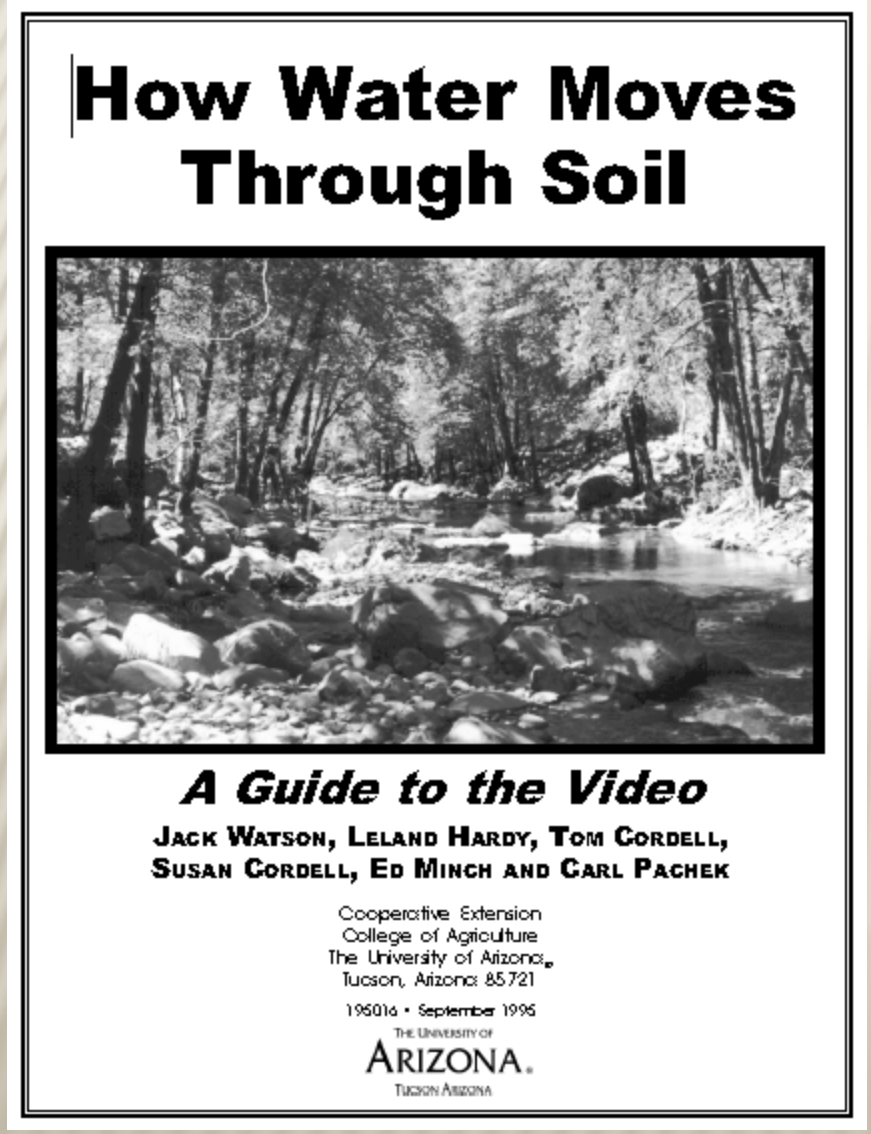
"Topography is working against the system."
~David Ortel



Result = Different rates of water movement and inconsistent soil loading

Differing soil textures, structures, density, and elevation above water table impact the rate of water movement

HOW WATER MOVES THROUGH SOIL


How Water Moves Through Soil

A Guide to the Video

Jack Watson, Leland Hardy, Tom Cordell, Susan Cordell, Ed Minch and Carl Pachek

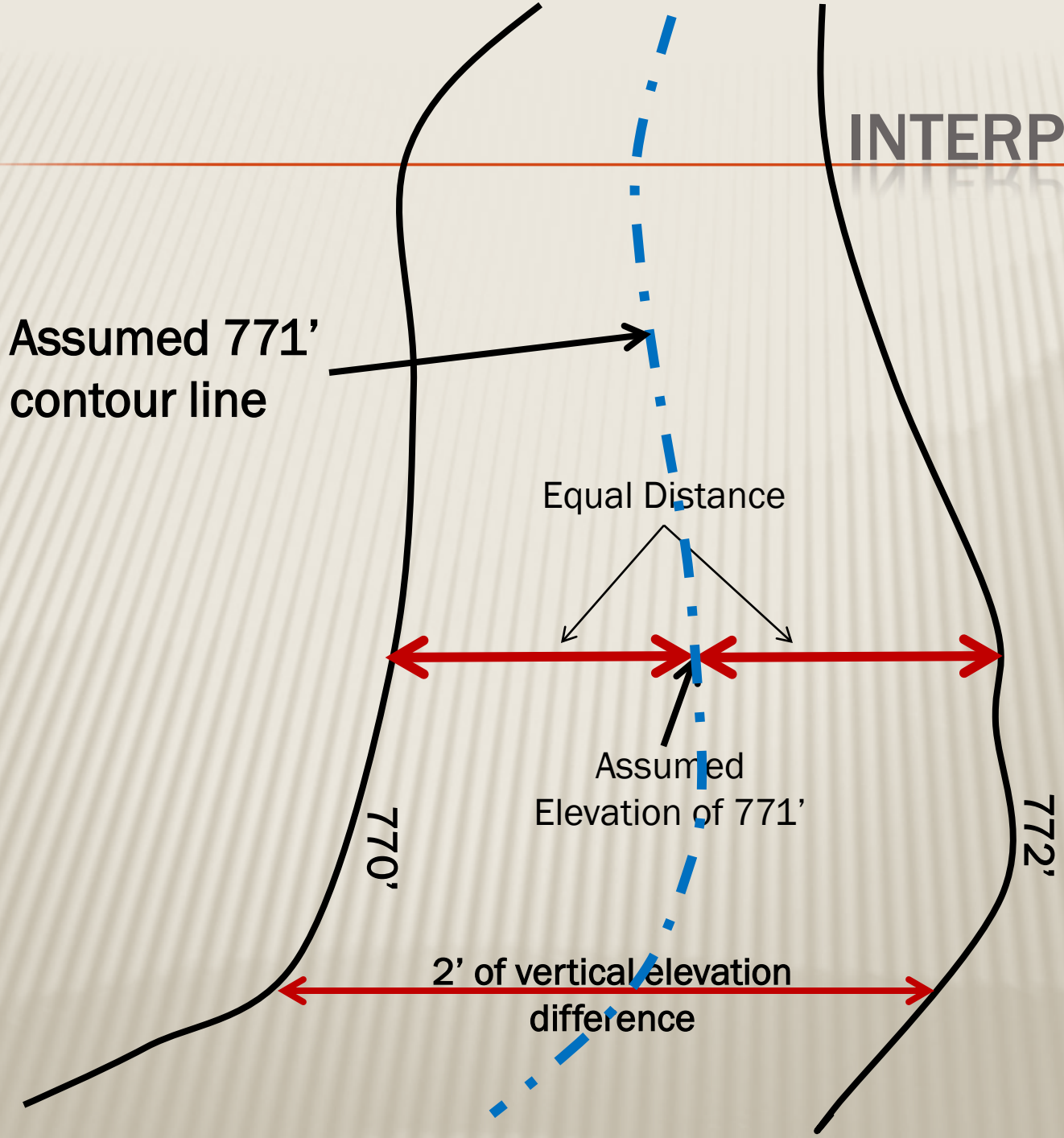
Cooperative Extension
College of Agriculture
The University of Arizona,
Tucson, Arizona 85721

195016 • September 1995

The University of Arizona.
Tucson Arizona

- cals.*arizona*.edu/pubs/*water*/az9516.pdf
- Video may be purchased online at ag.arizona.edu/calsmart
- ***http://soilandwater.bee.cornell.edu/research/pfweb/extensions/videoclips/video_water.htm*** (view video in sections)

INTERPOLATION

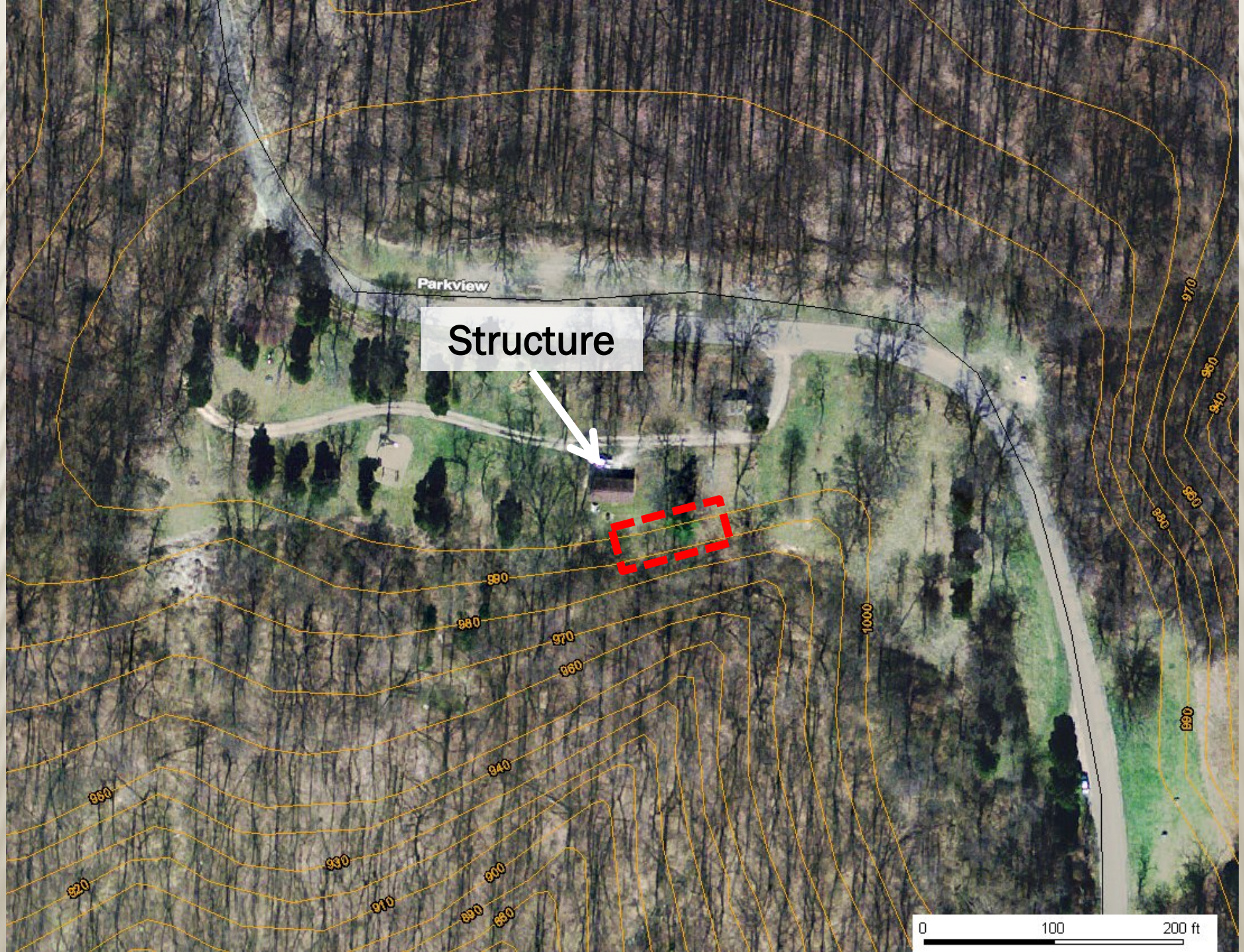


Don’t Cross that Contour Line!

Using Topographic Maps as a Tool to Aid in System Design

And

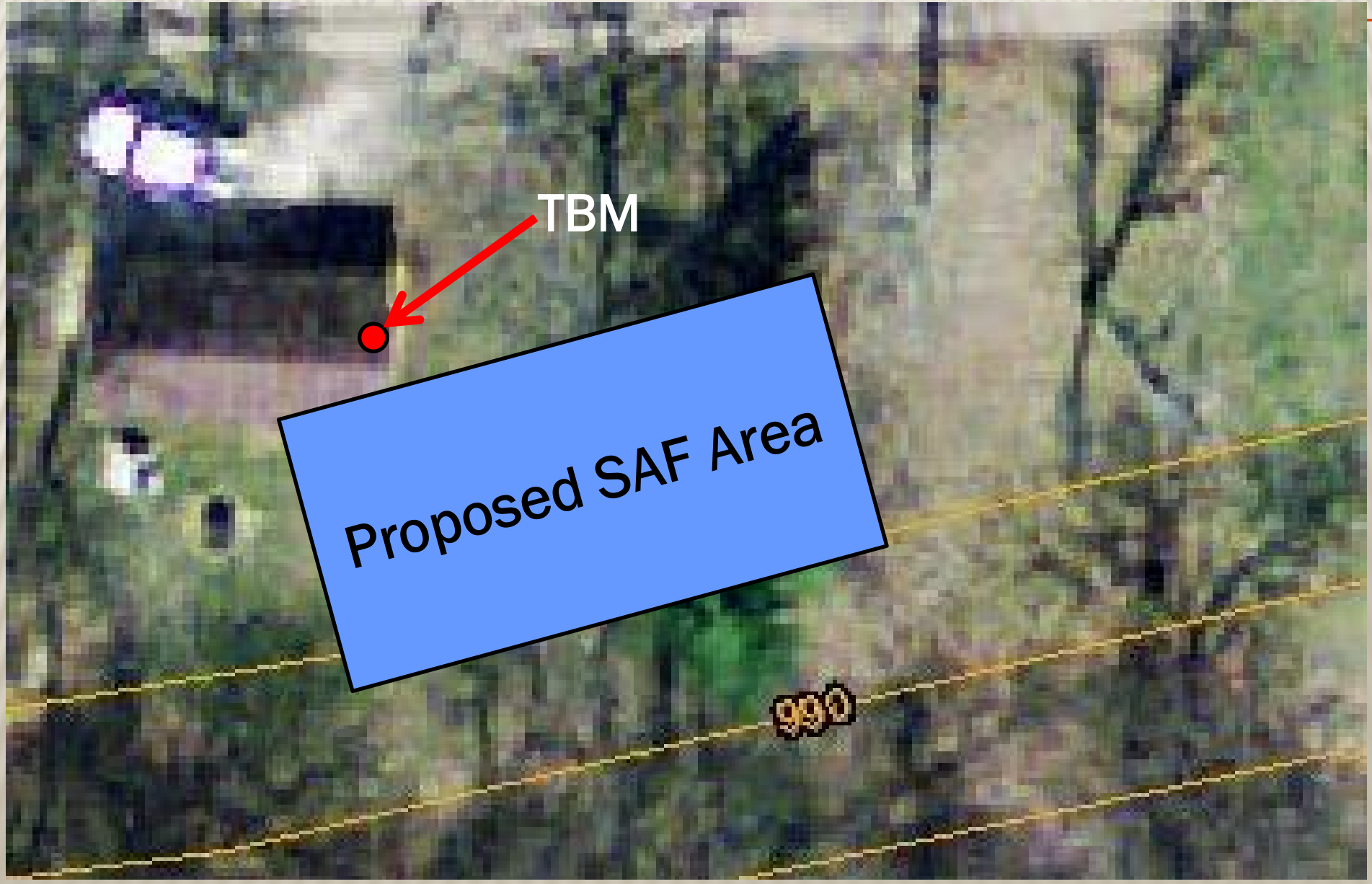
Designing On Contour

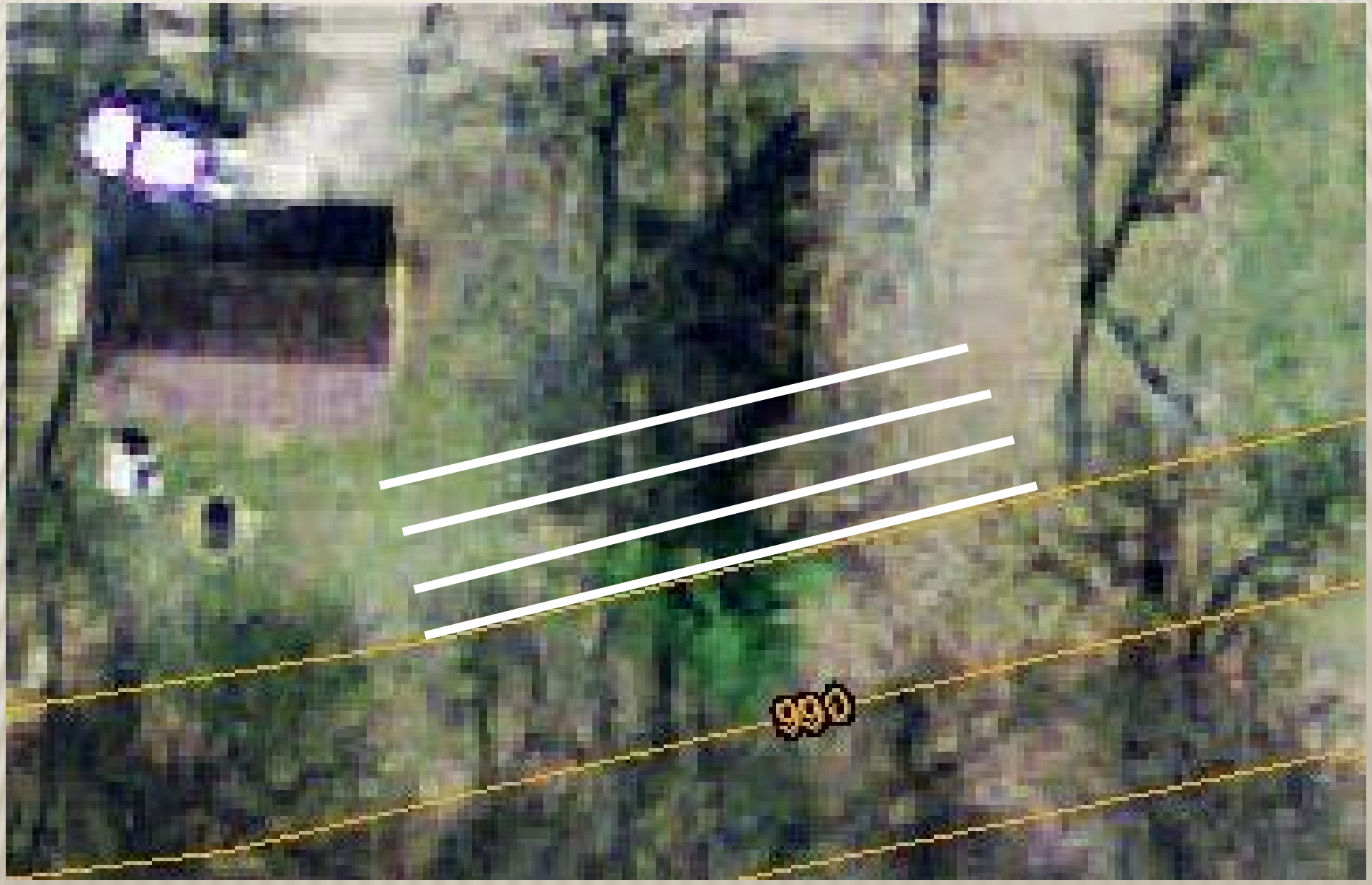

Parkview
Structure
990
980
970
960
940
930
920
910
900
890
880
1000
970
960
940
930
920
0
100
200 ft

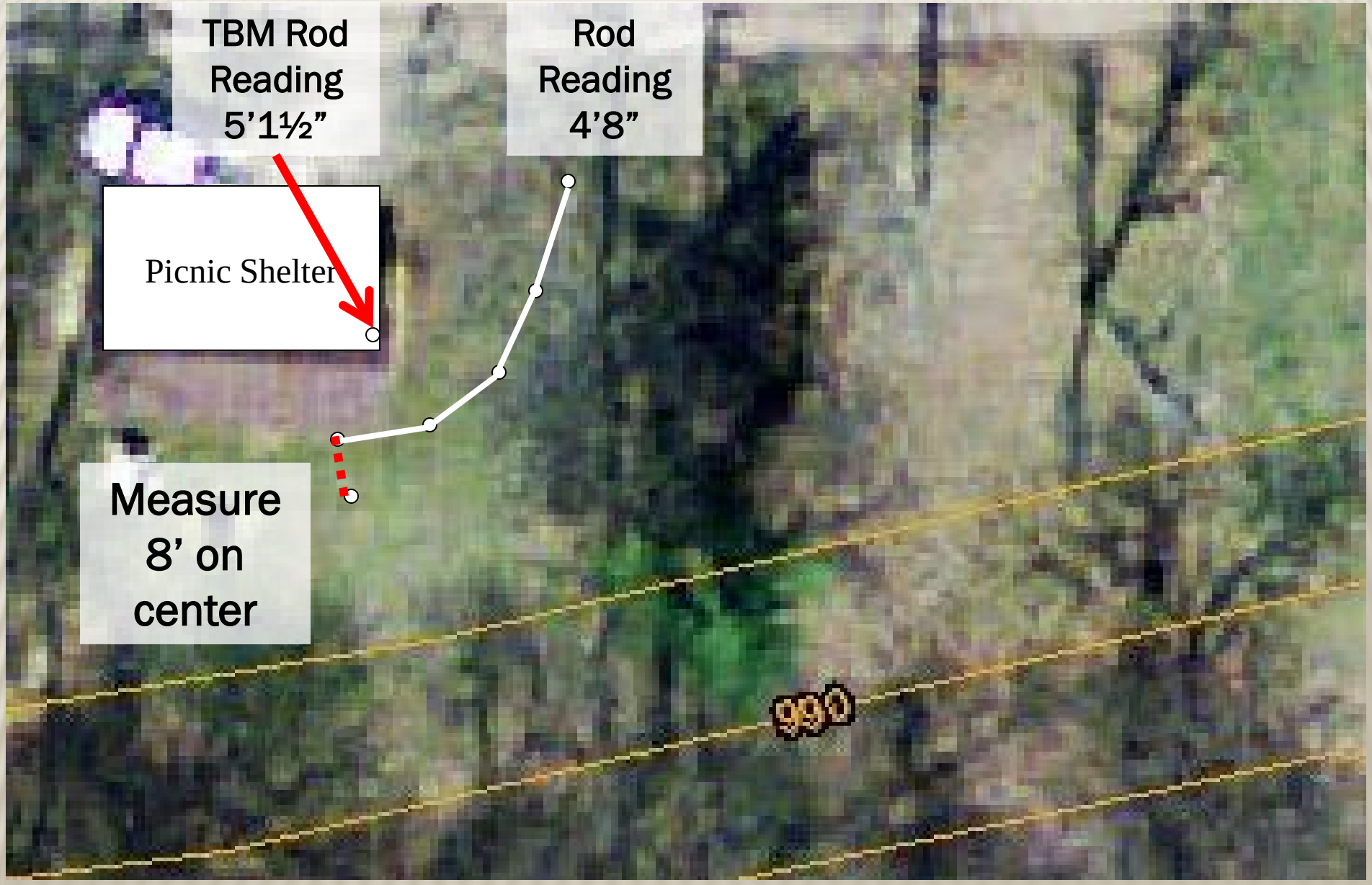
TEMPORARY BENCHMARK (TBM)

- Control point
- Grade shot and location recorded
- Elevation of TBM will not change
- Must be in place until at least system is completed
- May be used to replicate system design

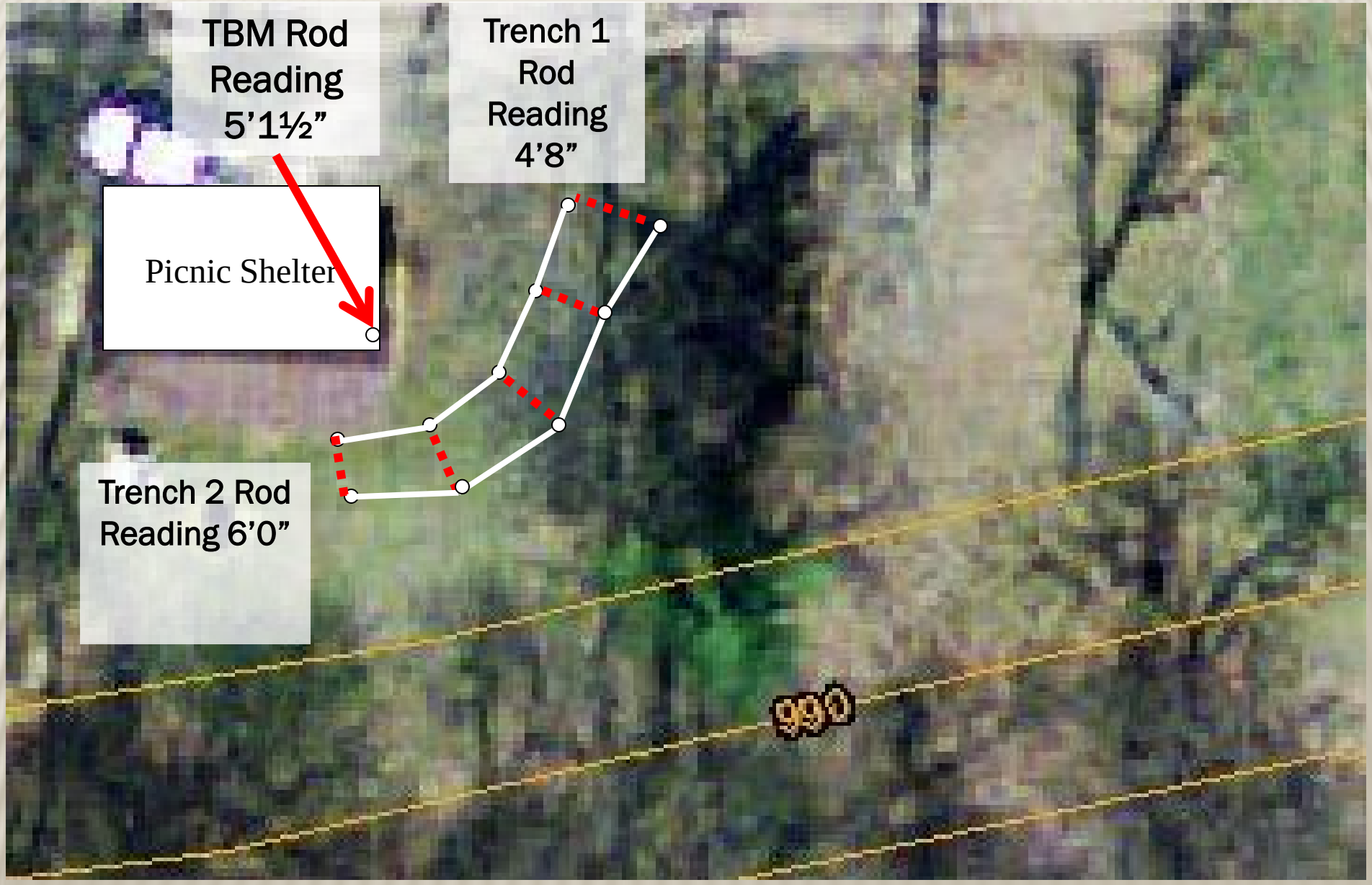
TBM LOCATION

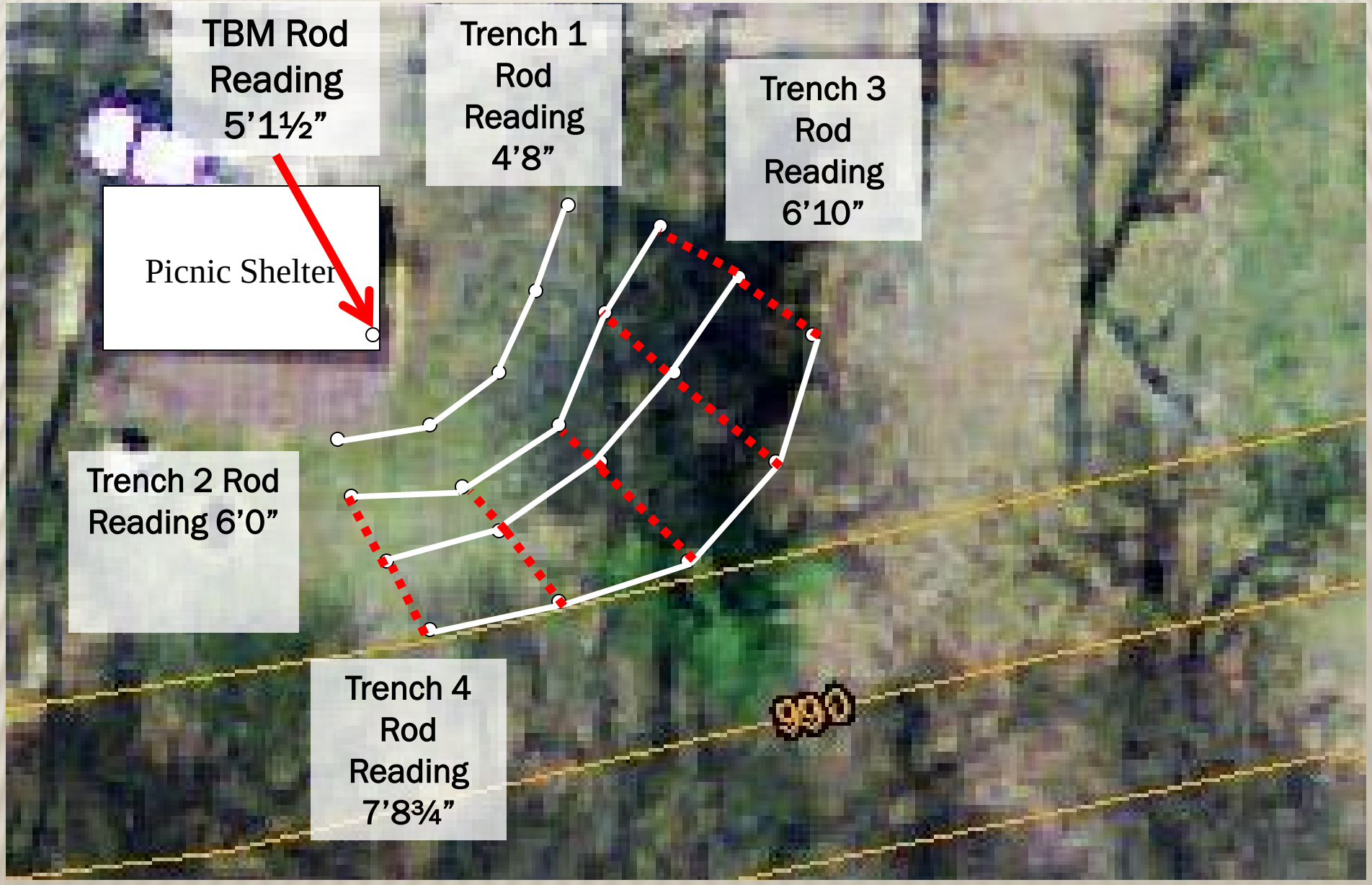


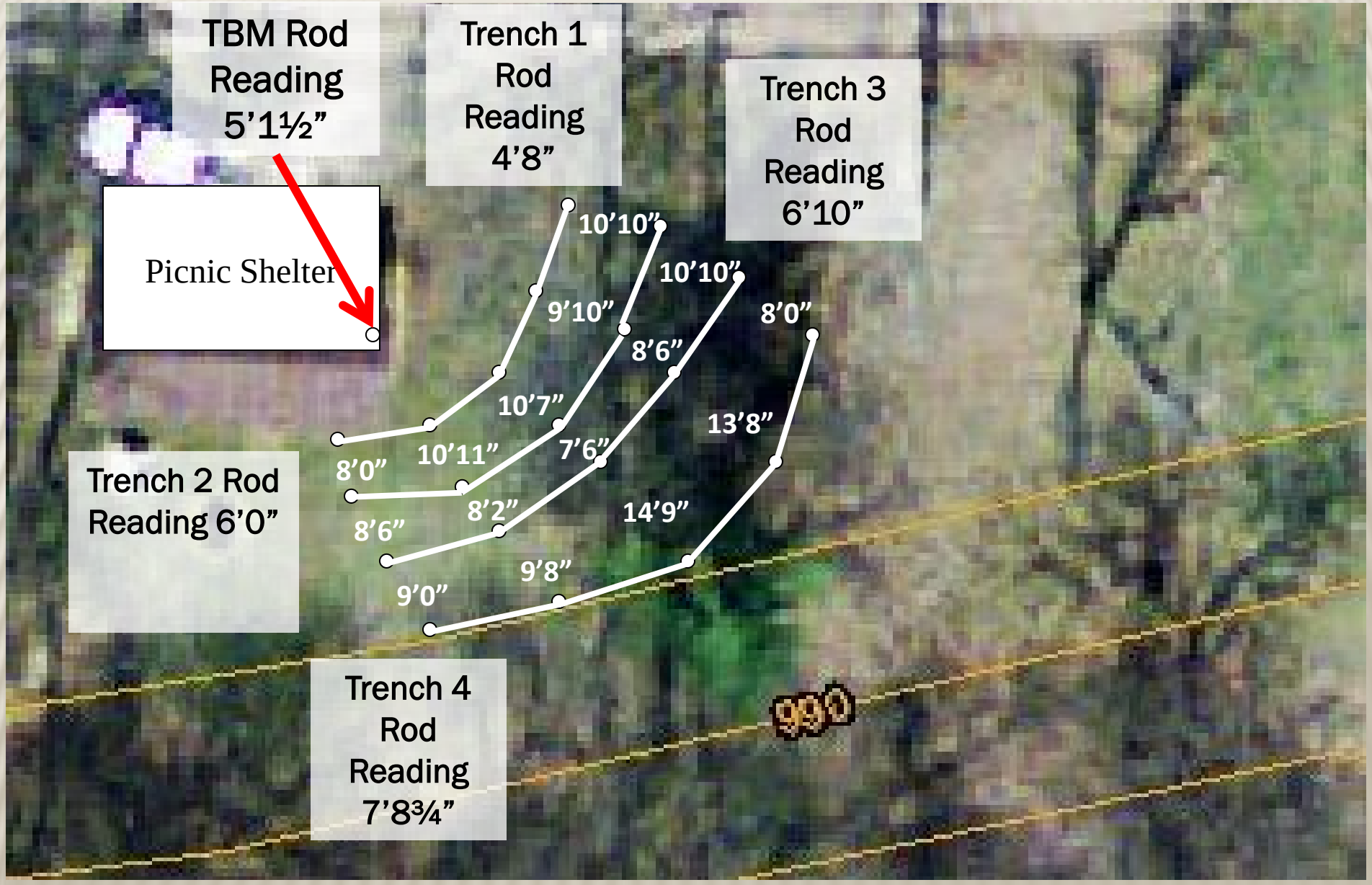

990

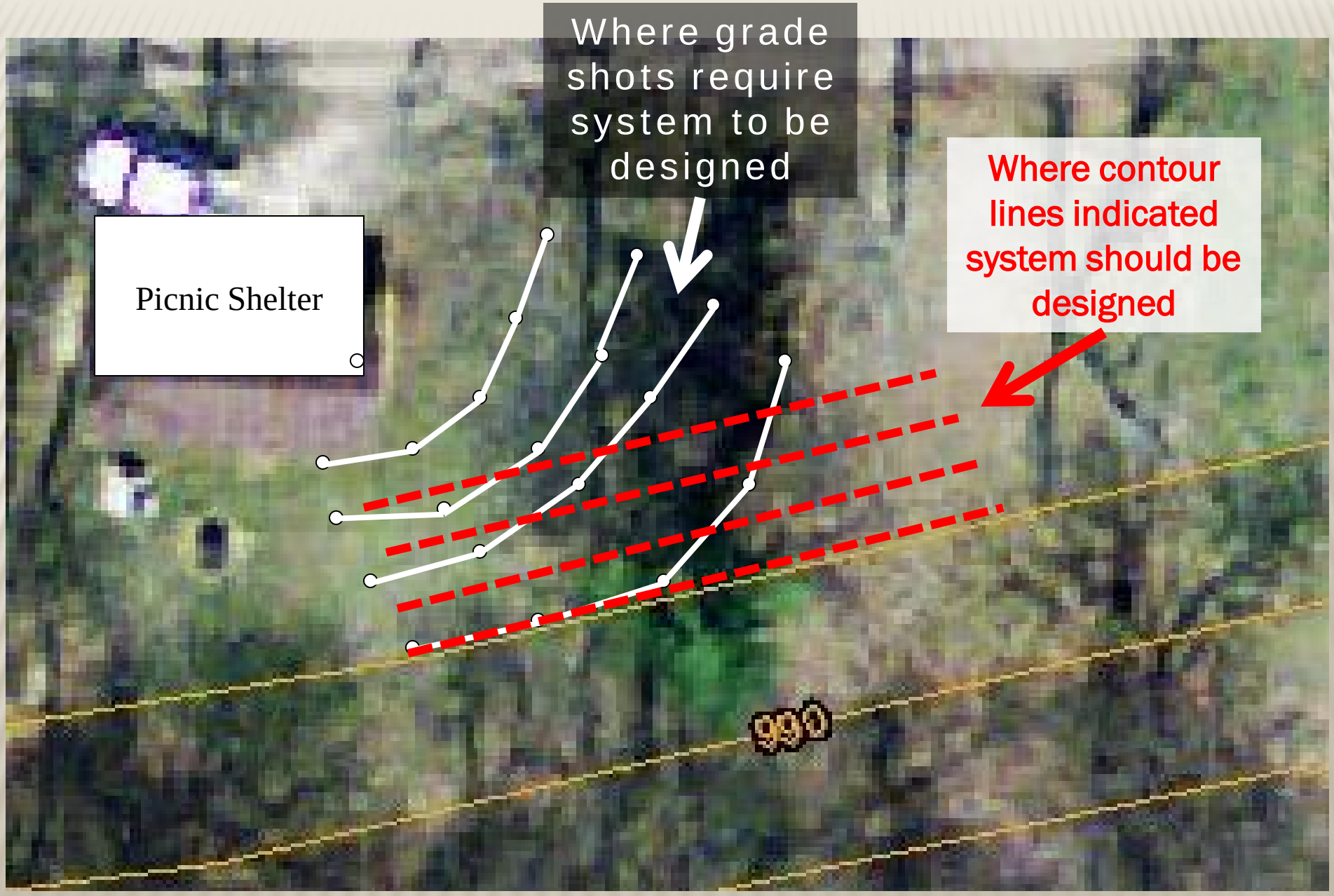

TBM Rod Reading 5’1½”
Rod Reading 4’8”
Picnic Shelter
Measure 8’ on center
990

Measuring
Rod

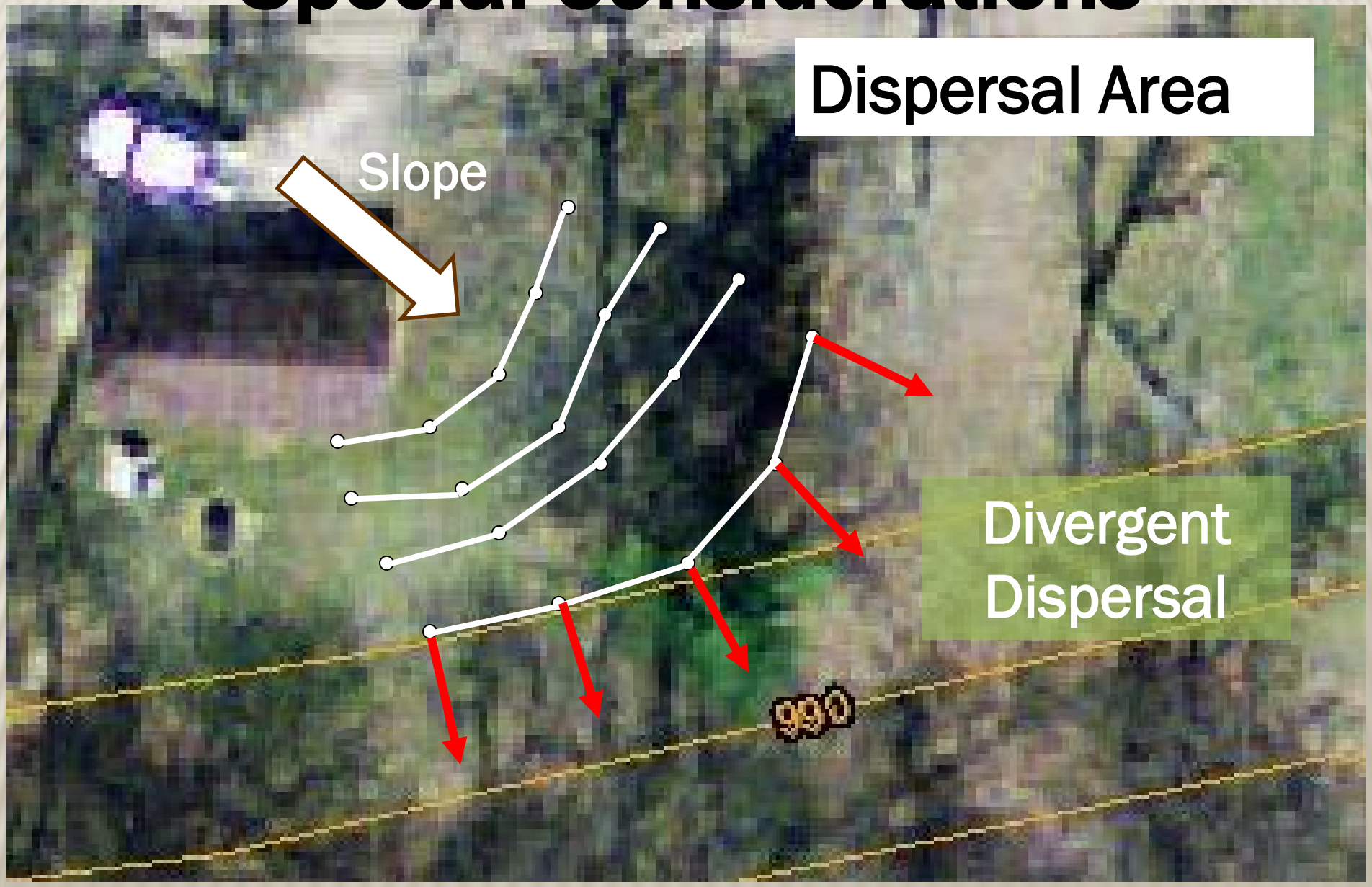

TBM Rod Reading 5’1½”
Trench 1 Rod Reading 4’8”
Picnic Shelter
Trench 2 Rod Reading 6’0”
990

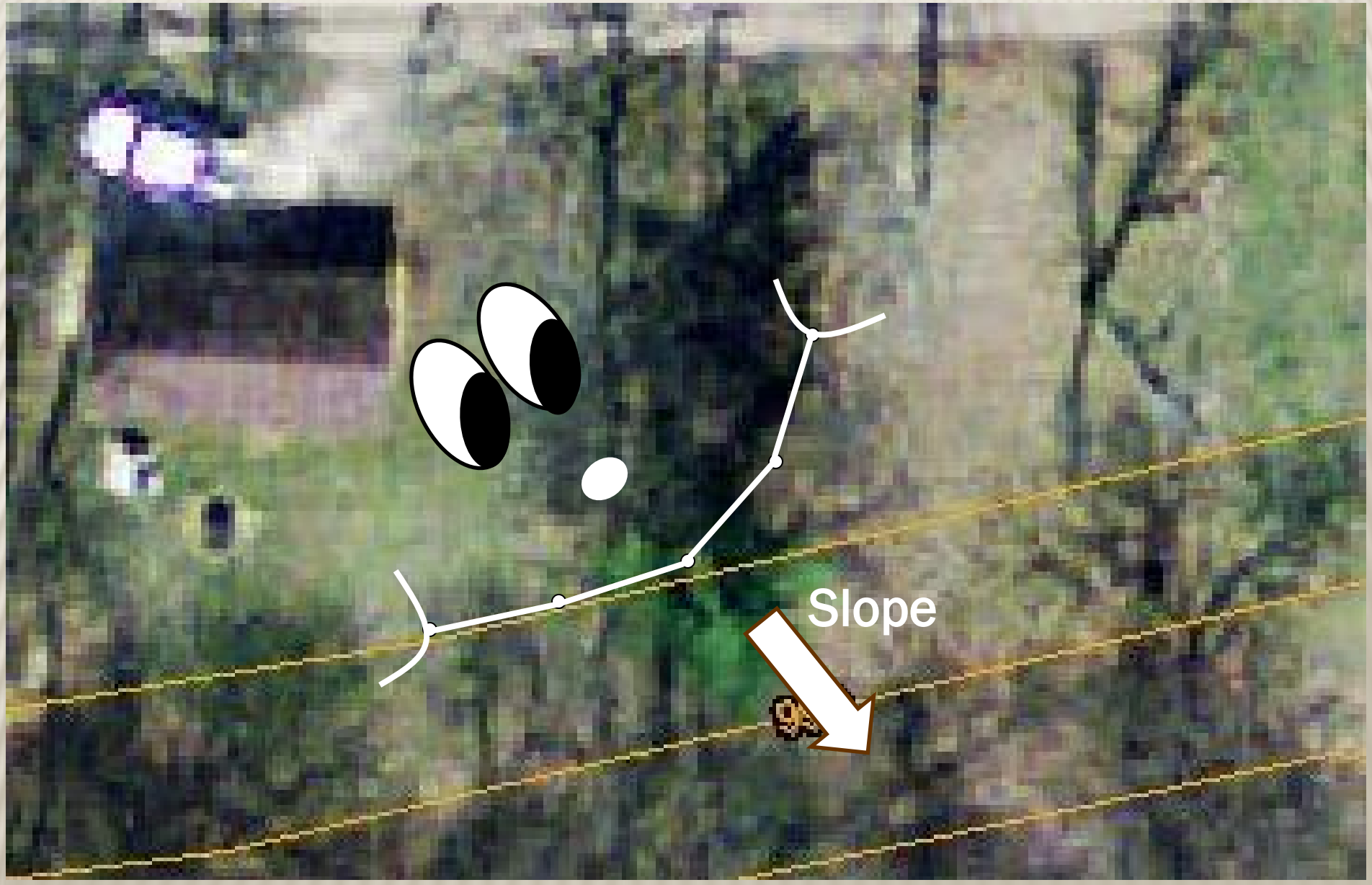

TBM Rod Reading 5’1½”
Trench 1 Rod Reading 4’8”
Trench 3 Rod Reading 6’10”
Picnic Shelter
Trench 2 Rod Reading 6’0”
Trench 4 Rod Reading 7’8¾”
990


TBM Rod Reading 5’1½”
Picnic Shelter
Trench 1 Rod Reading 4’8”
Trench 3 Rod Reading 6’10”
Trench 2 Rod Reading 6’0”
Trench 4 Rod Reading 7’8¾”
10’10”
10’10”
9’10”
8’0”
8’6”
10’7”
13’8”
8’0”
10’11”
7’6”
8’2”
14’9”
8’6”
9’8”
9’0”
990

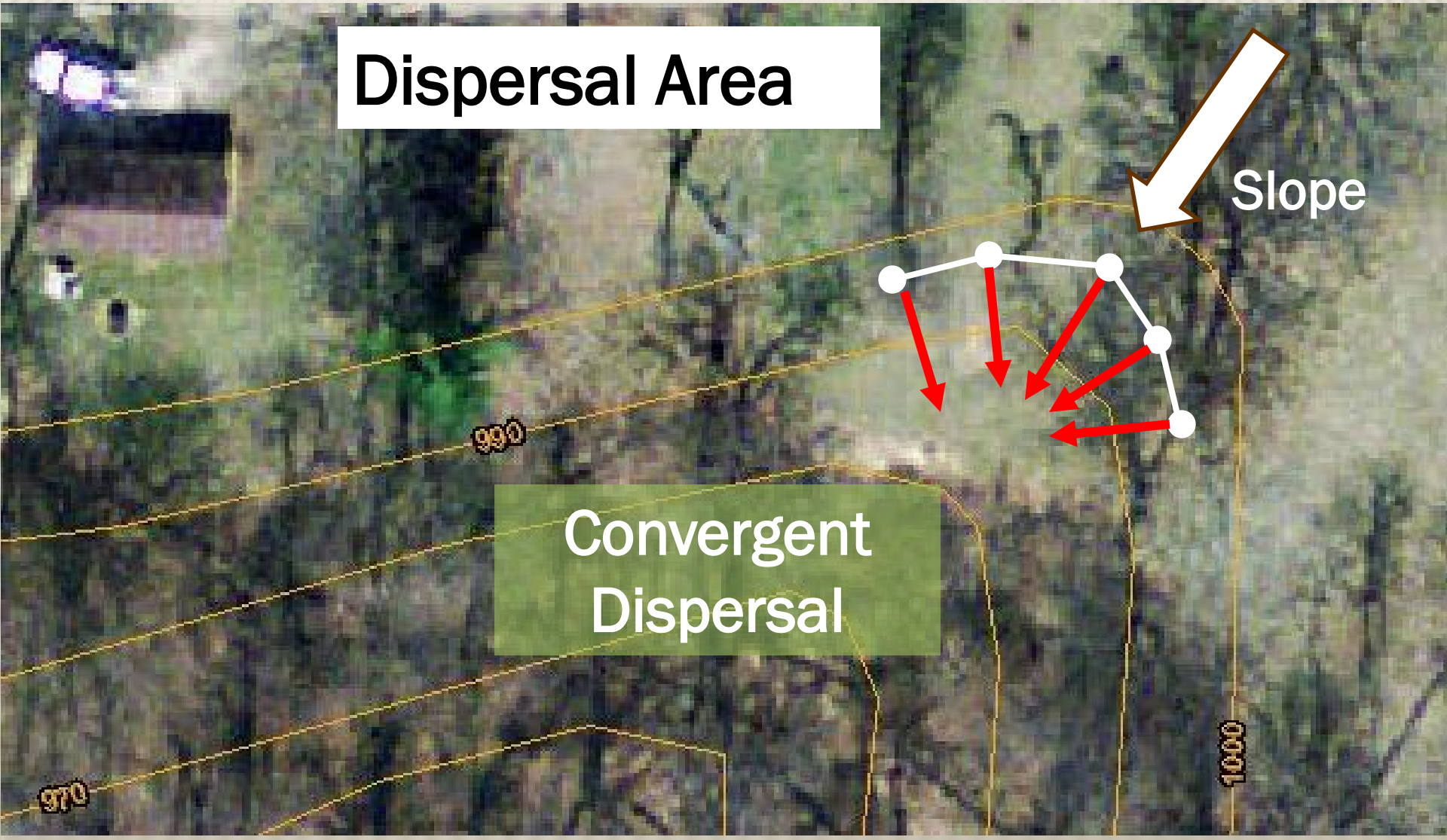

Where grade shots require system to be designed
Where contour lines indicated system should be designed
Picnic Shelter
990

Special Considerations

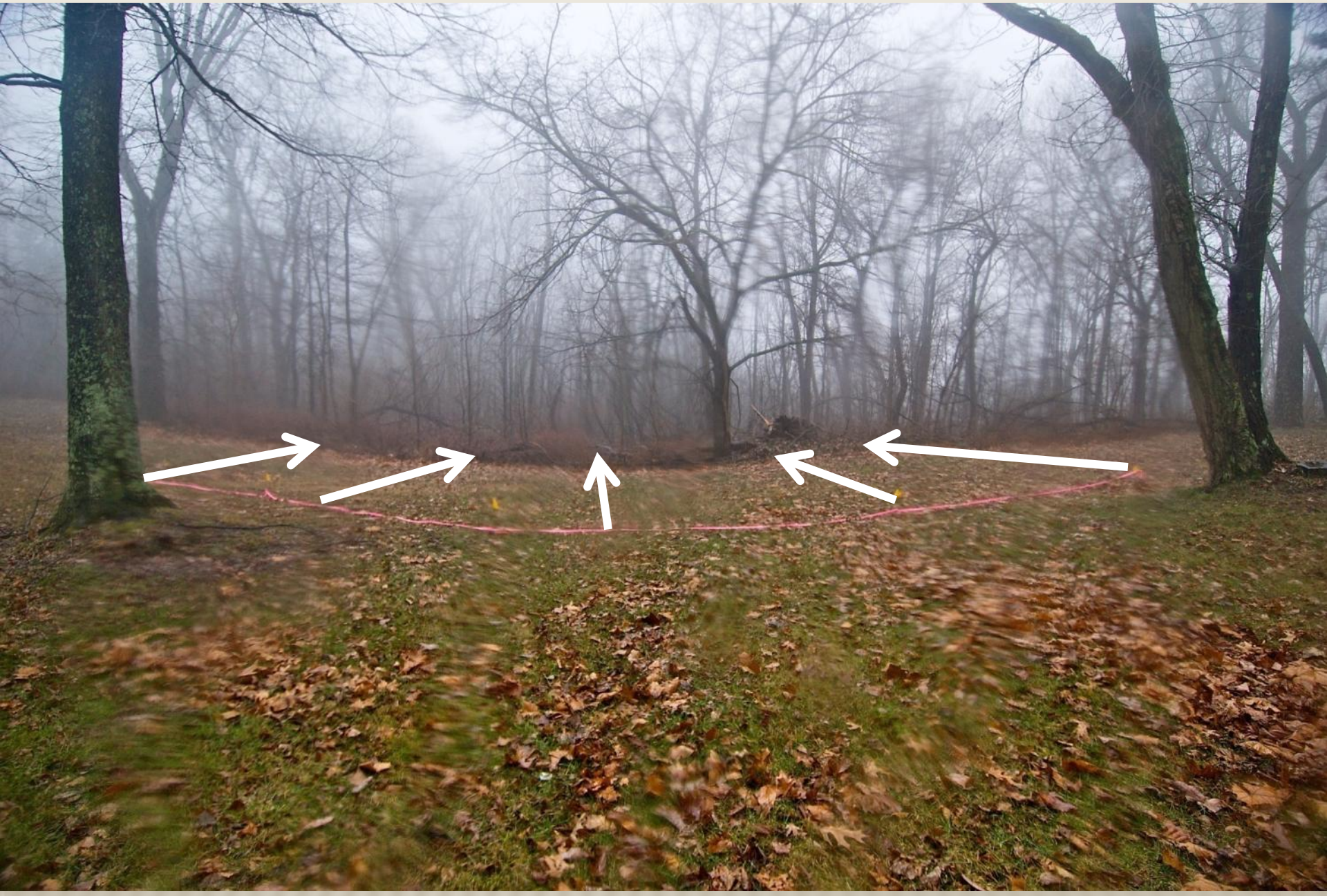


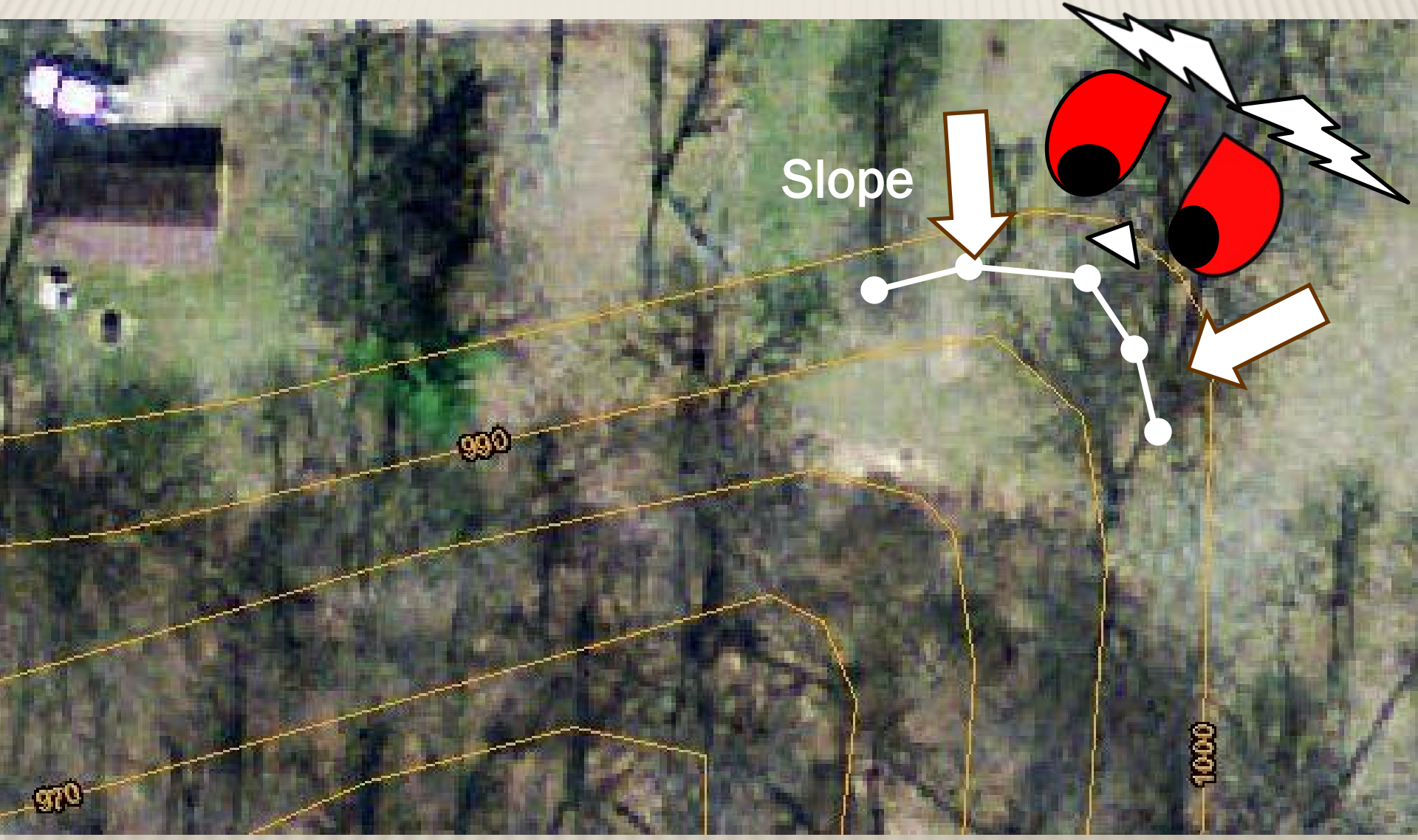

Slope

SPECIAL CONSIDERATIONS



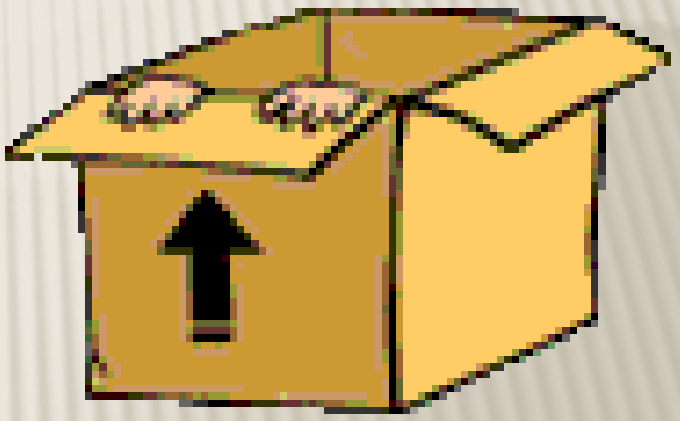
Slope




Slope
990
970
1000

ACHIEVING CONTOUR WITH COMPLEX SLOPES

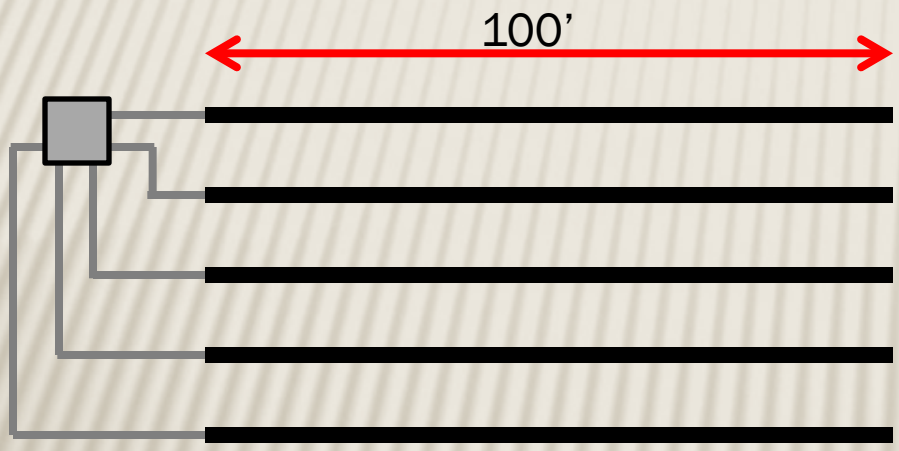
- Shorten Trenches
- Vary on center spaces
- Vary trench lengths
  - Header with discharge pipes
  - Spider valve
  - Creative D-box use
- Position of D-Box (butterfly system)
- Shift SAF trenches

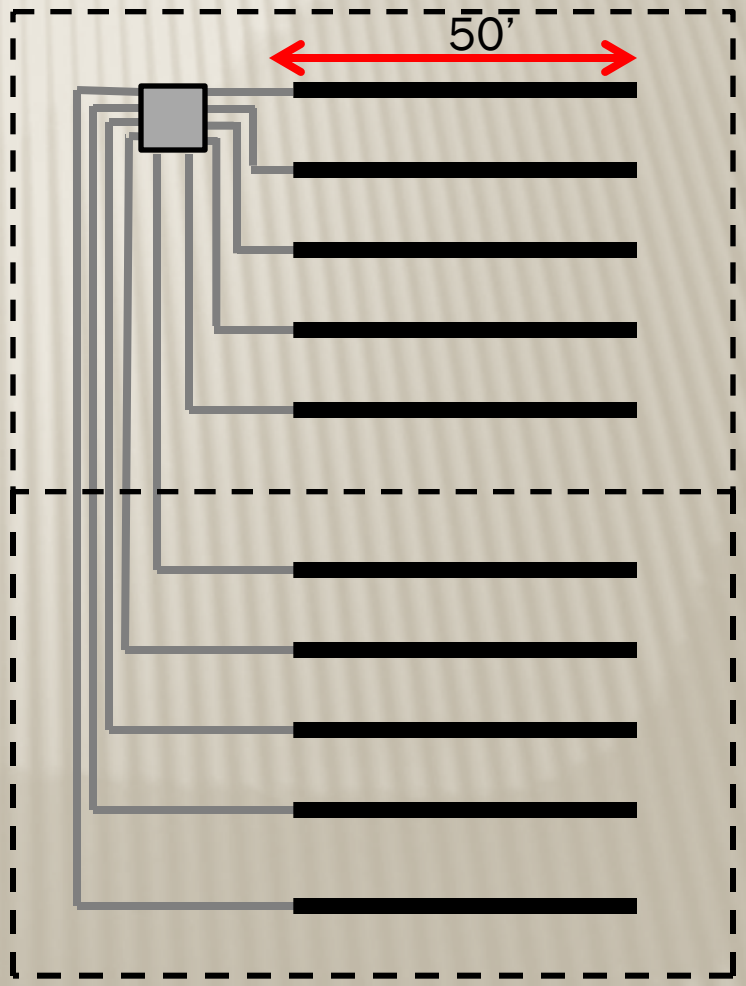


Get out of the box!

SHORTEN TRENCHES

- 1500 ft^2 soil absorption field required

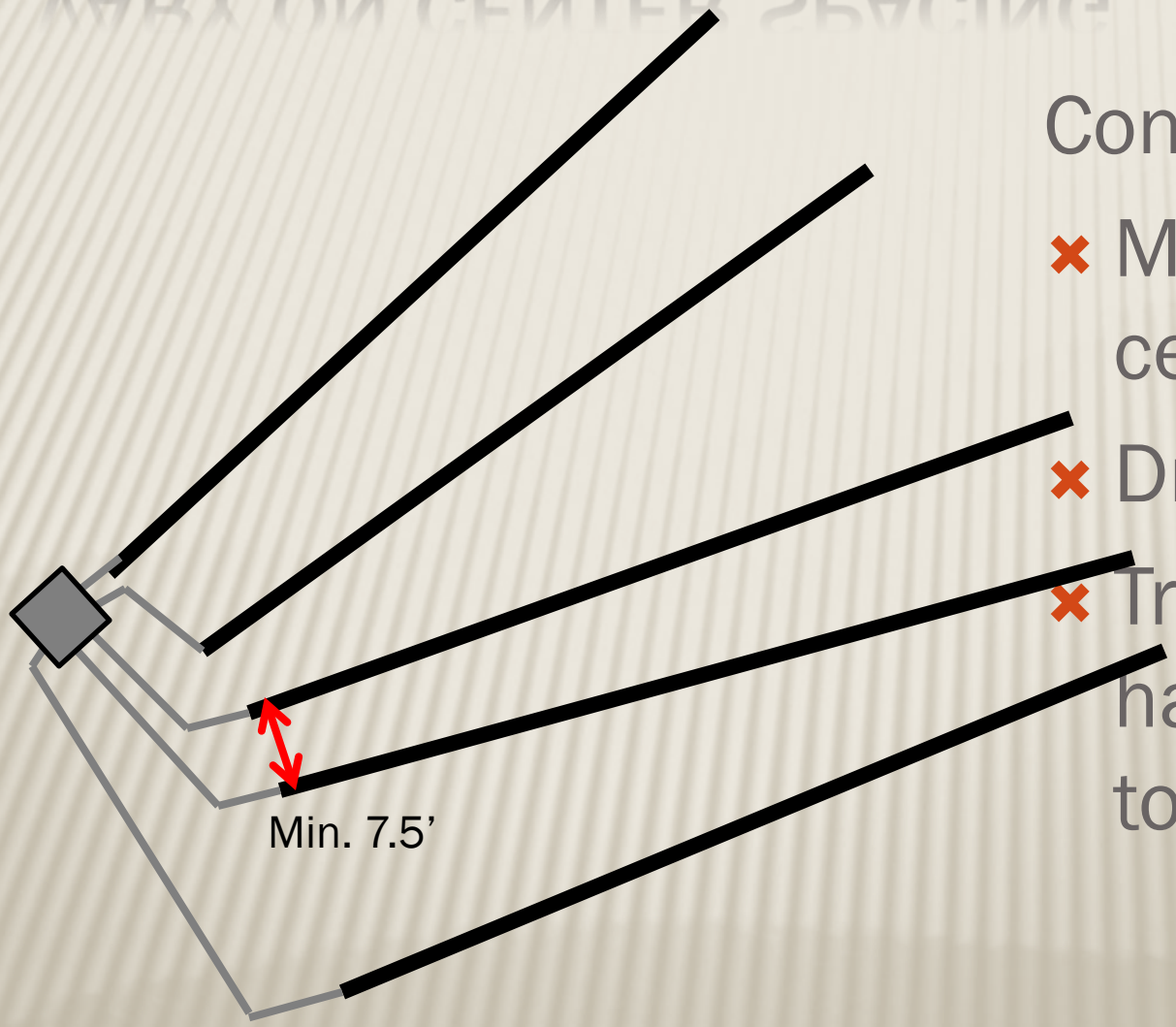




Considerations

- Drain spacing ≤ 65’

VARY ON CENTER SPACING

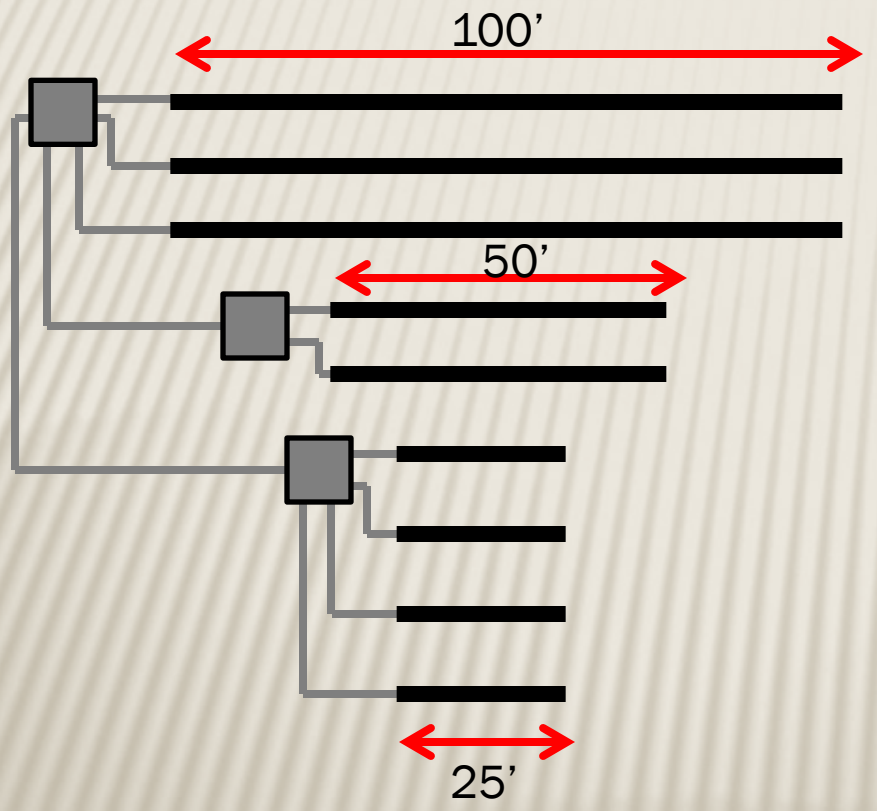


Considerations

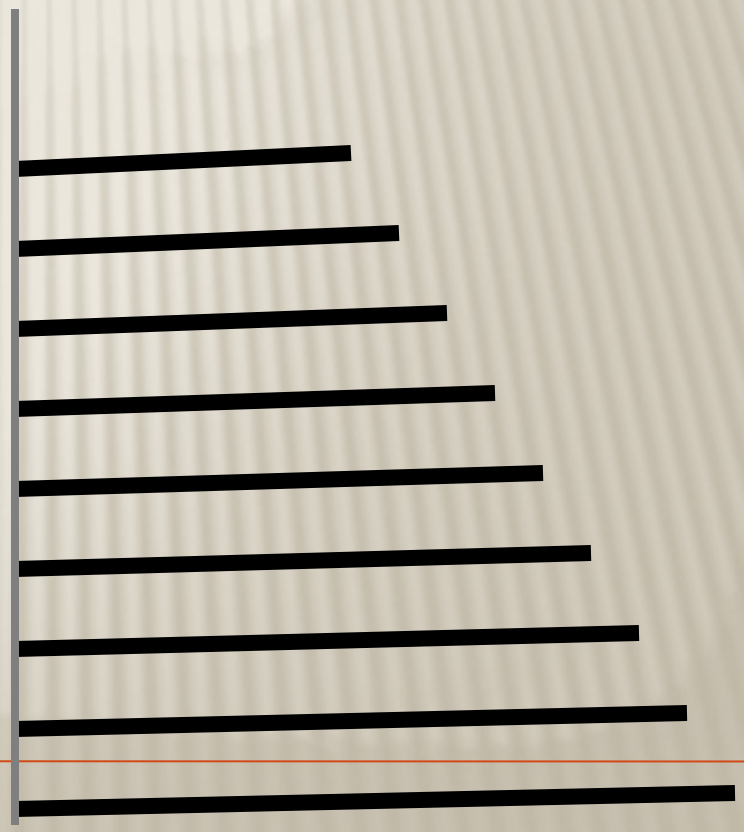
- Min. 7.5’ on center
- Drainage Spacing
- Trenches do not have to be parallel to each other

VARY TRENCH LENGTHS

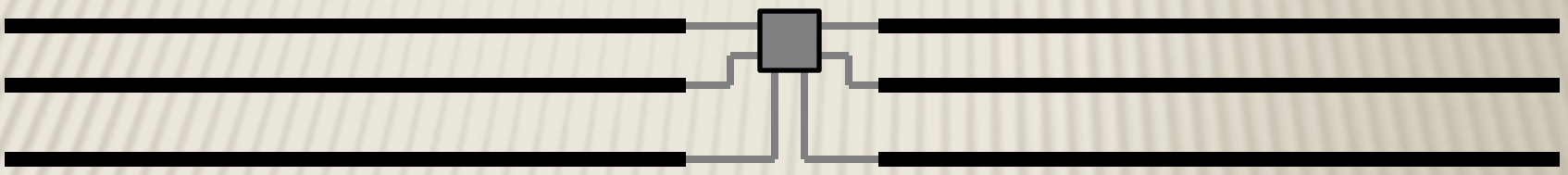
MULTIPLE D-BOXES



SPIDER VALVE OR PRESSURE MANIFOLD



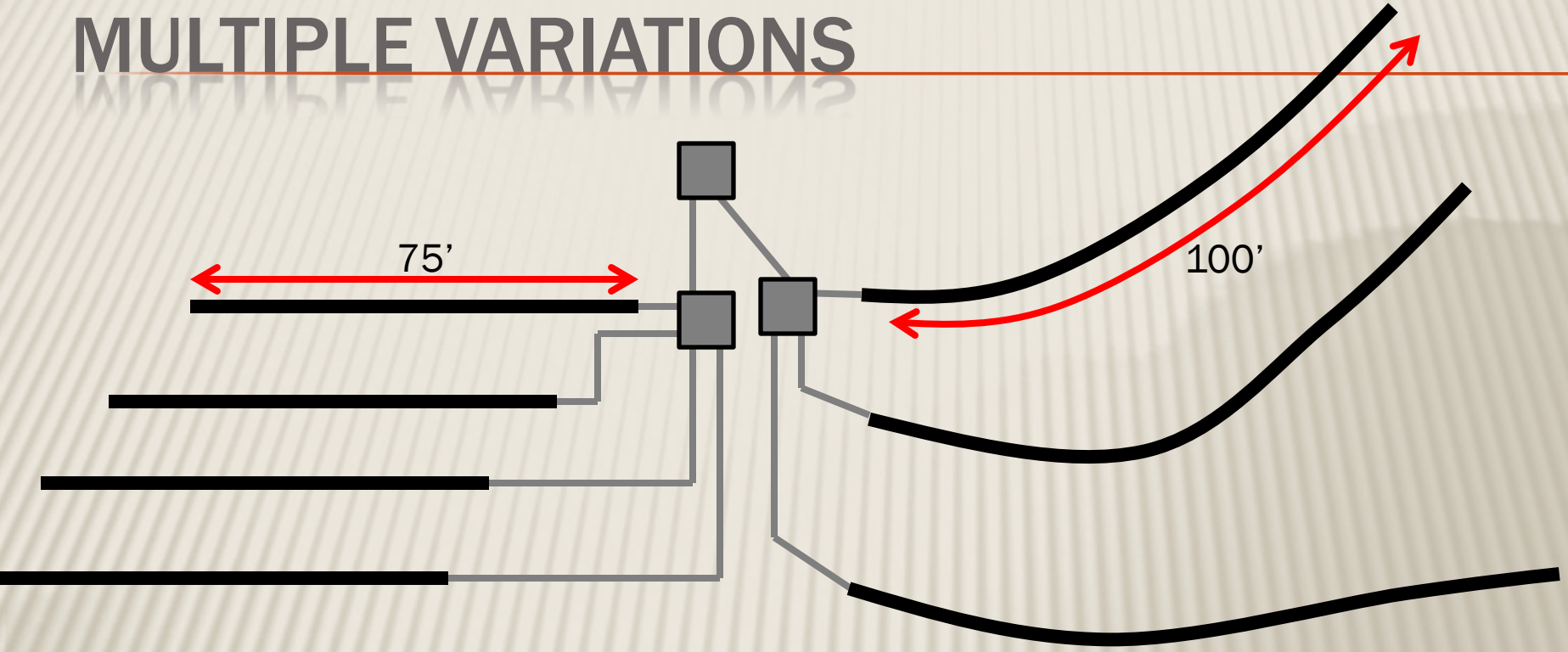
POSITION LATERALS IN A BUTTERFLY POSITION



Considerations

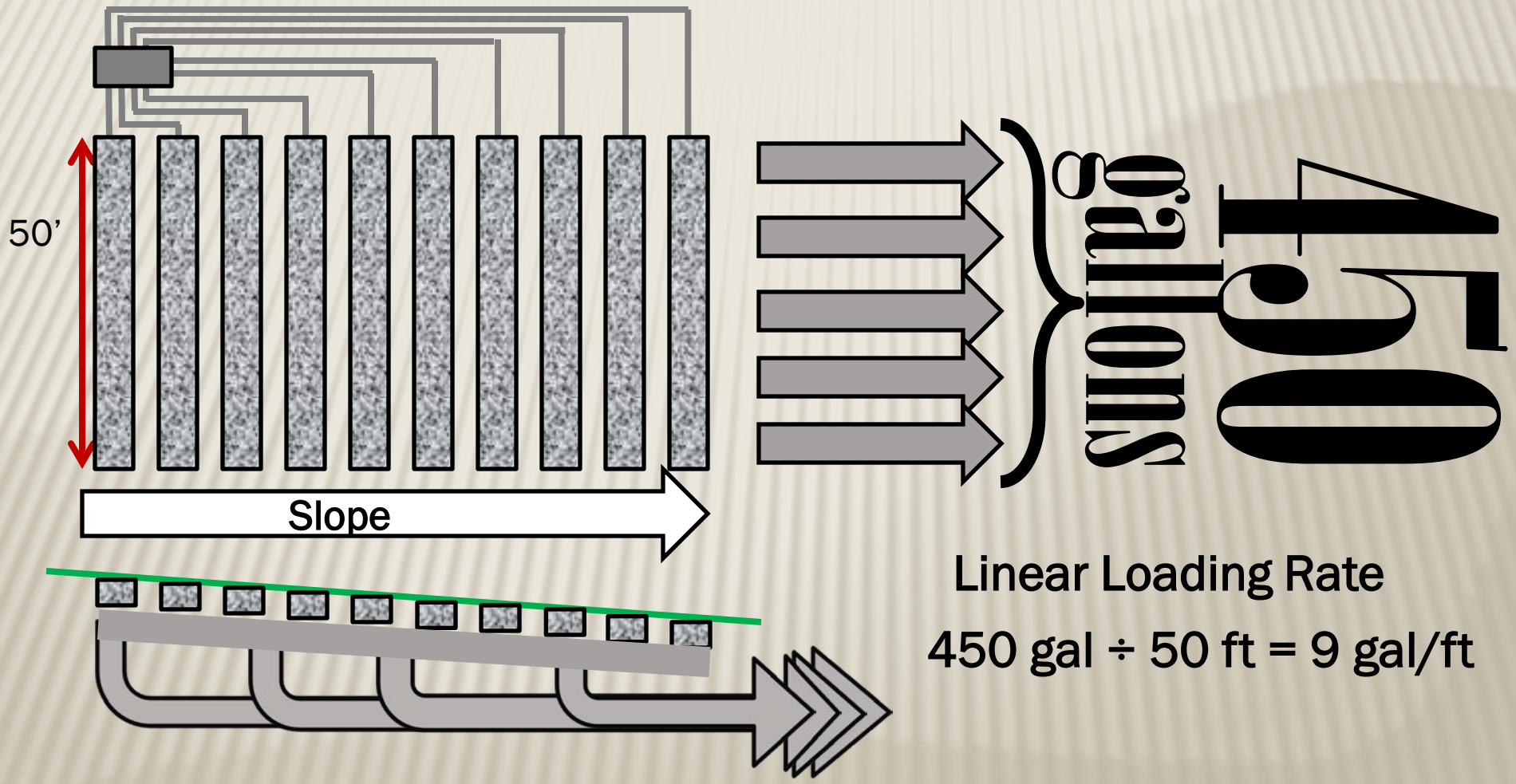
- Drainage spacing reduced
- Improves linear loading rate

MULTIPLE VARIATIONS



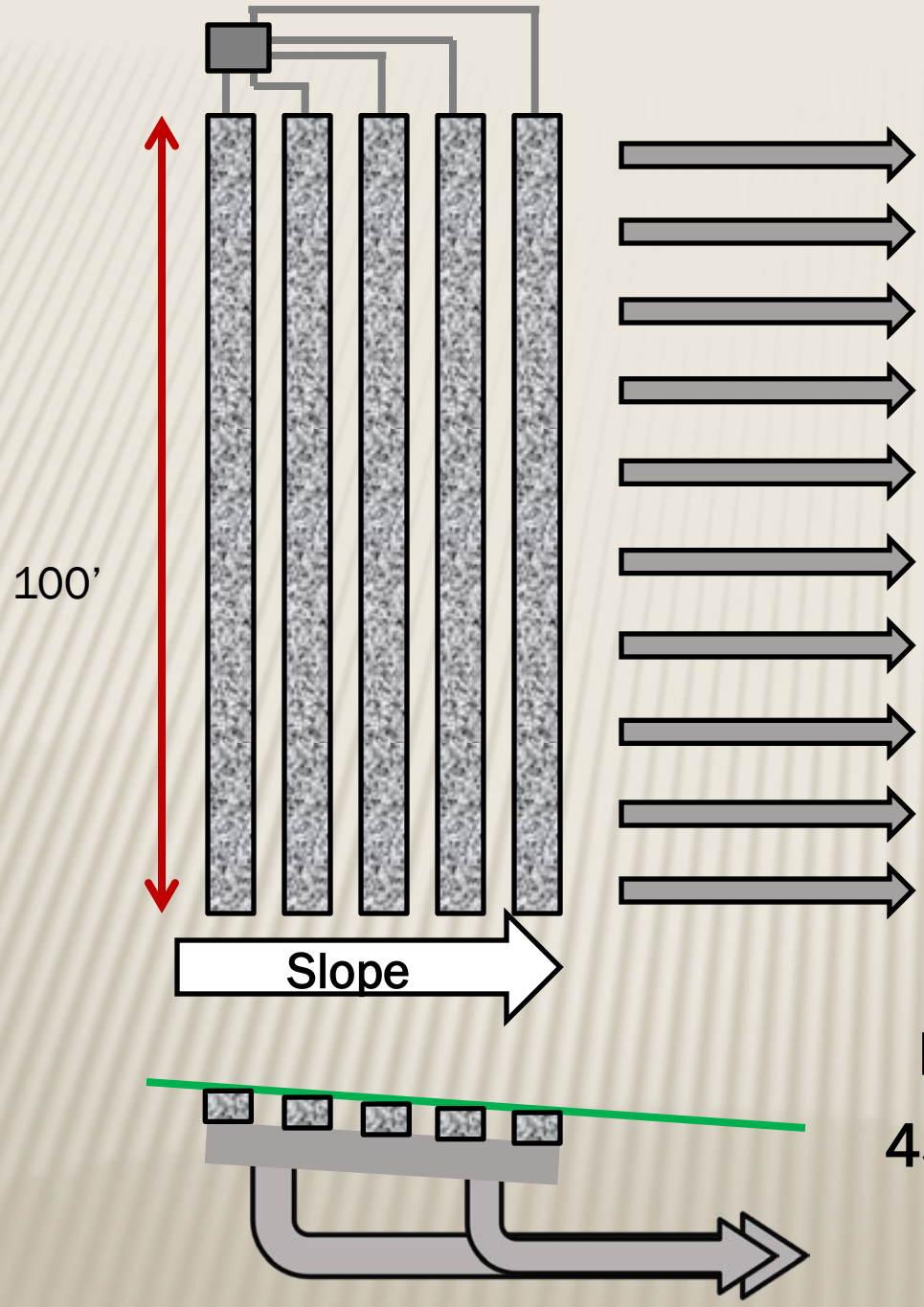
- Trenches of various lengths
- Split field
- Various on center separation
- Multiple D-boxes

LINEAR LOADING RATE



Linear Loading Rate

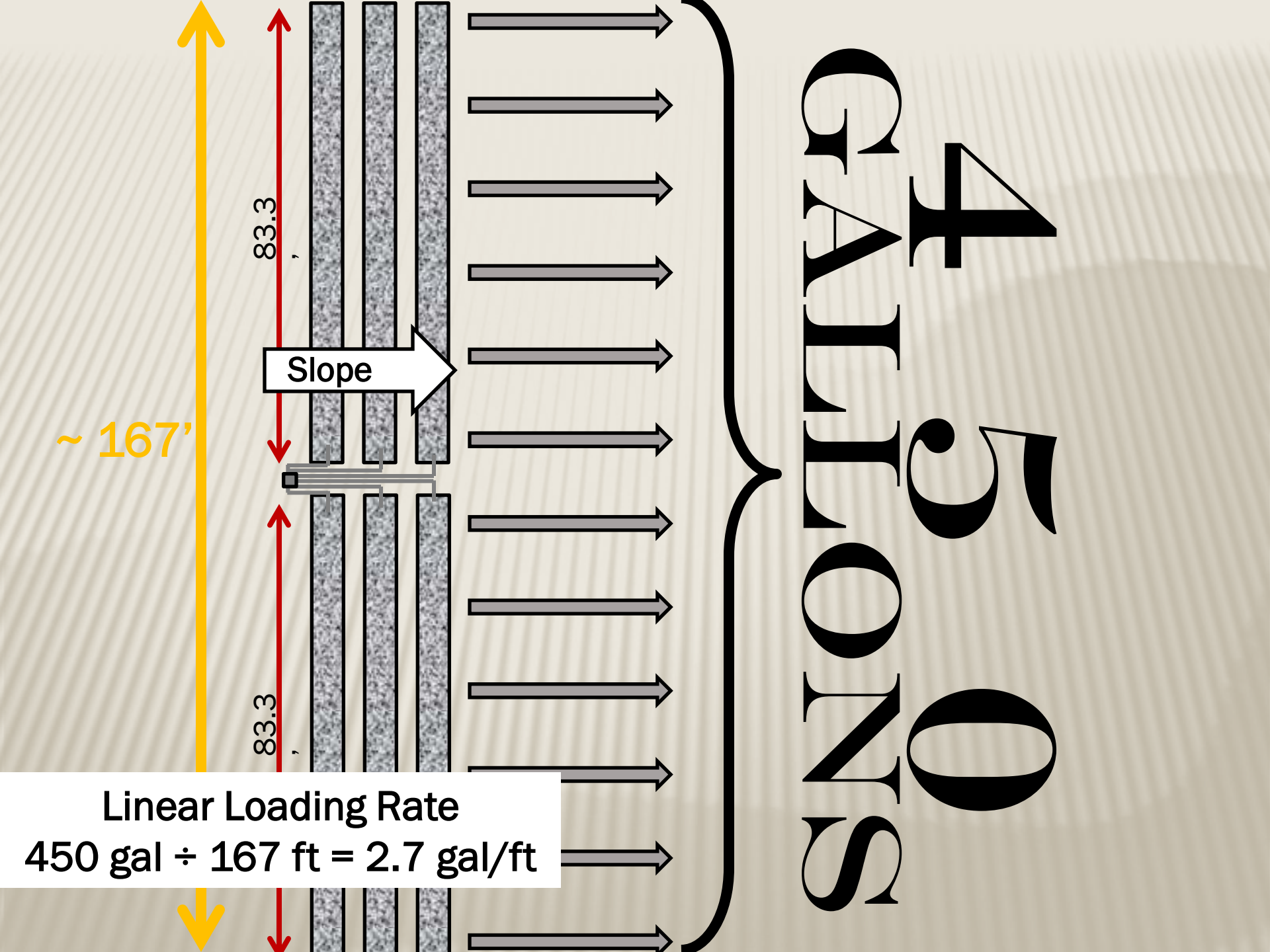
450 gal ÷ 50 ft = 9 gal/ft

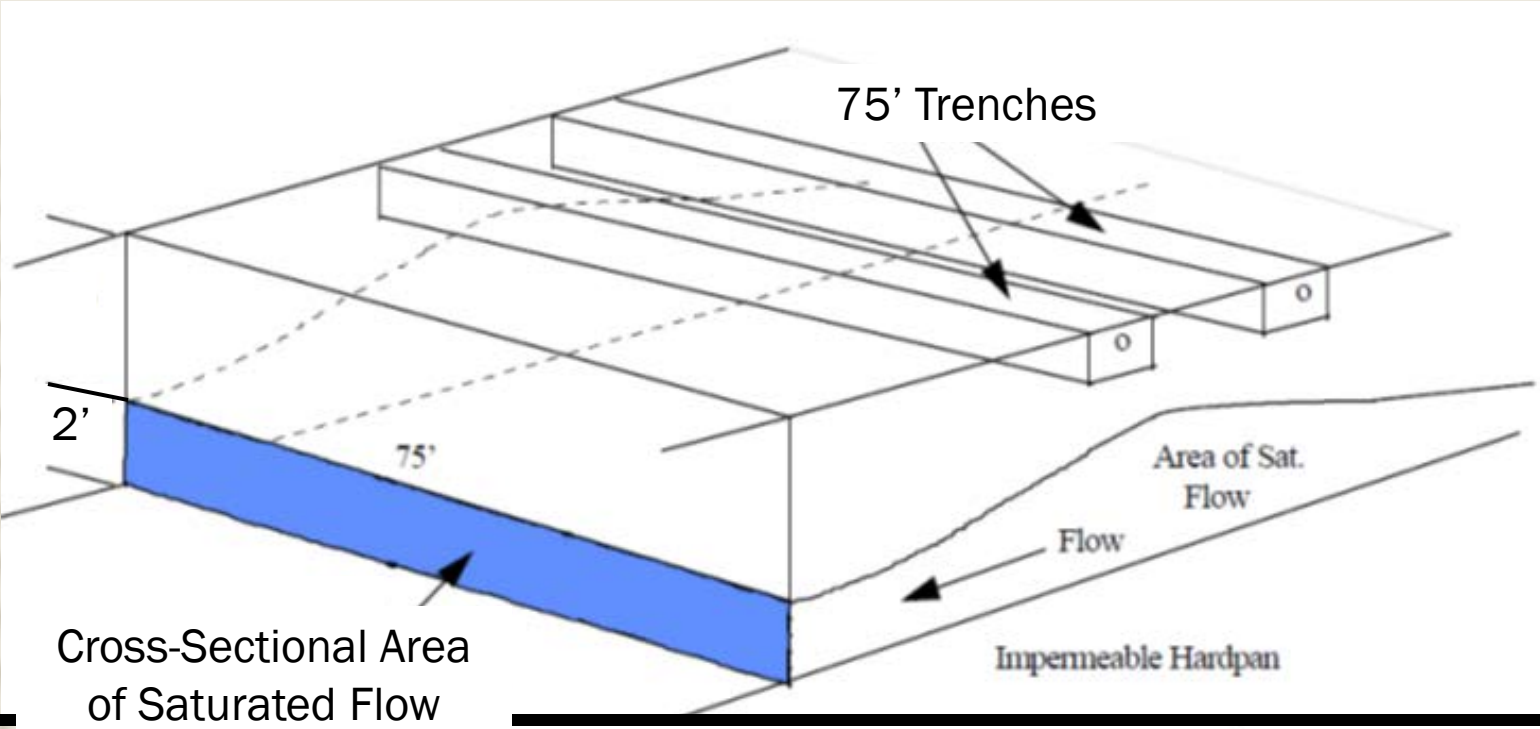


450 gallons

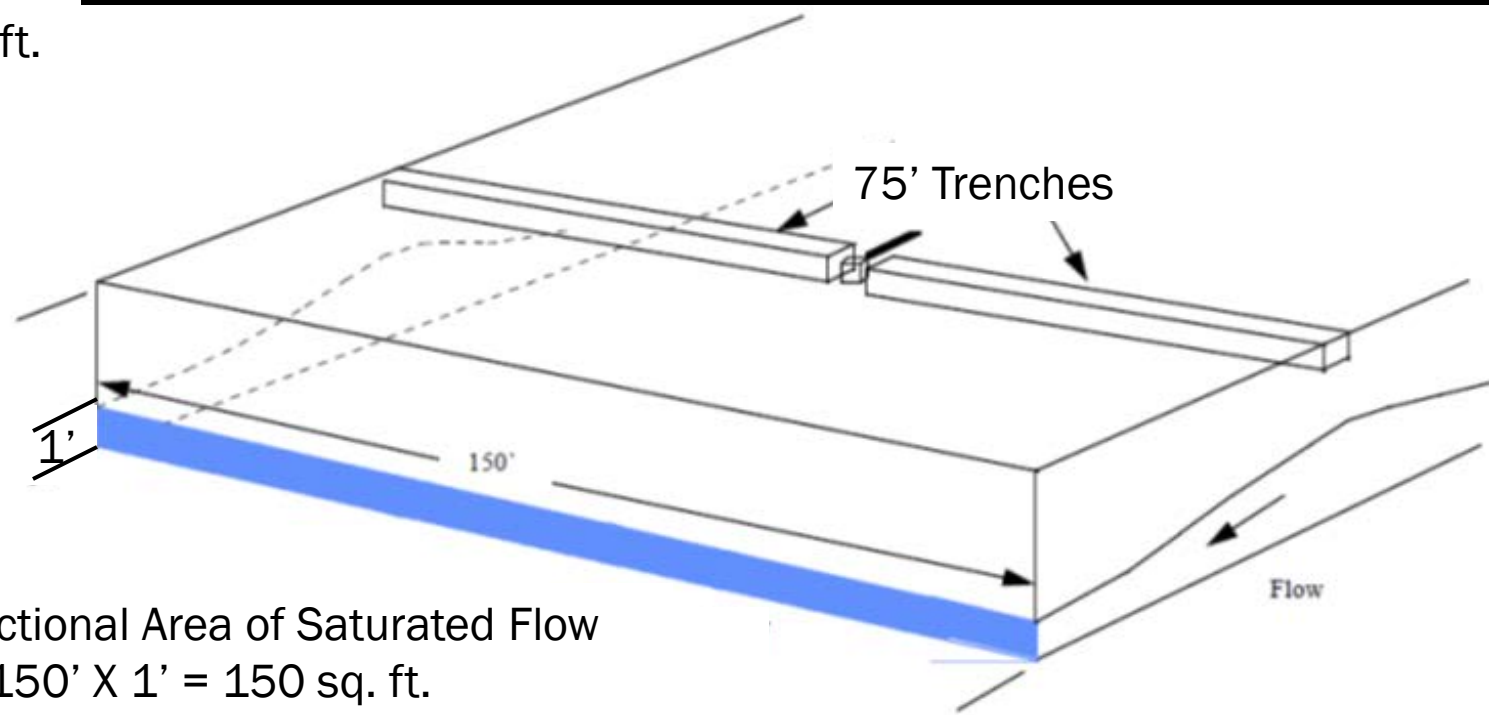
Linear Loading Rate

450 gal ÷ 100 ft = 4.5 gal/ft


450 GALLONS
83.3'
83.3'
Slope
~ 167'
Linear Loading Rate
450 gal ÷ 167 ft = 2.7 gal/ft



Cross-Sectional Area of Saturated Flow
75' X 2' = 150 sq. ft.



Cross-Sectional Area of Saturated Flow
150' X 1' = 150 sq. ft.

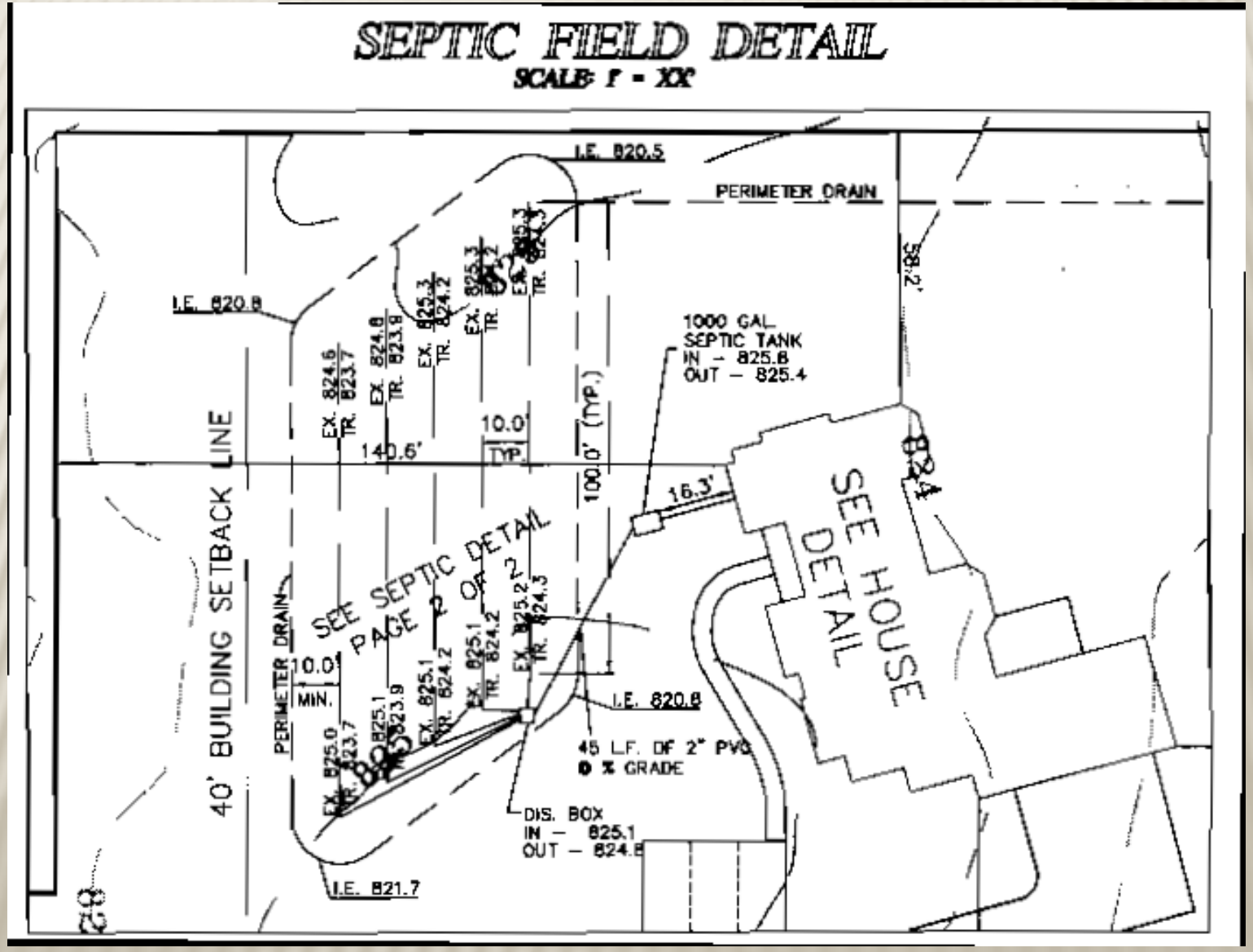
THE QUESTION?

How much variation is allowed?

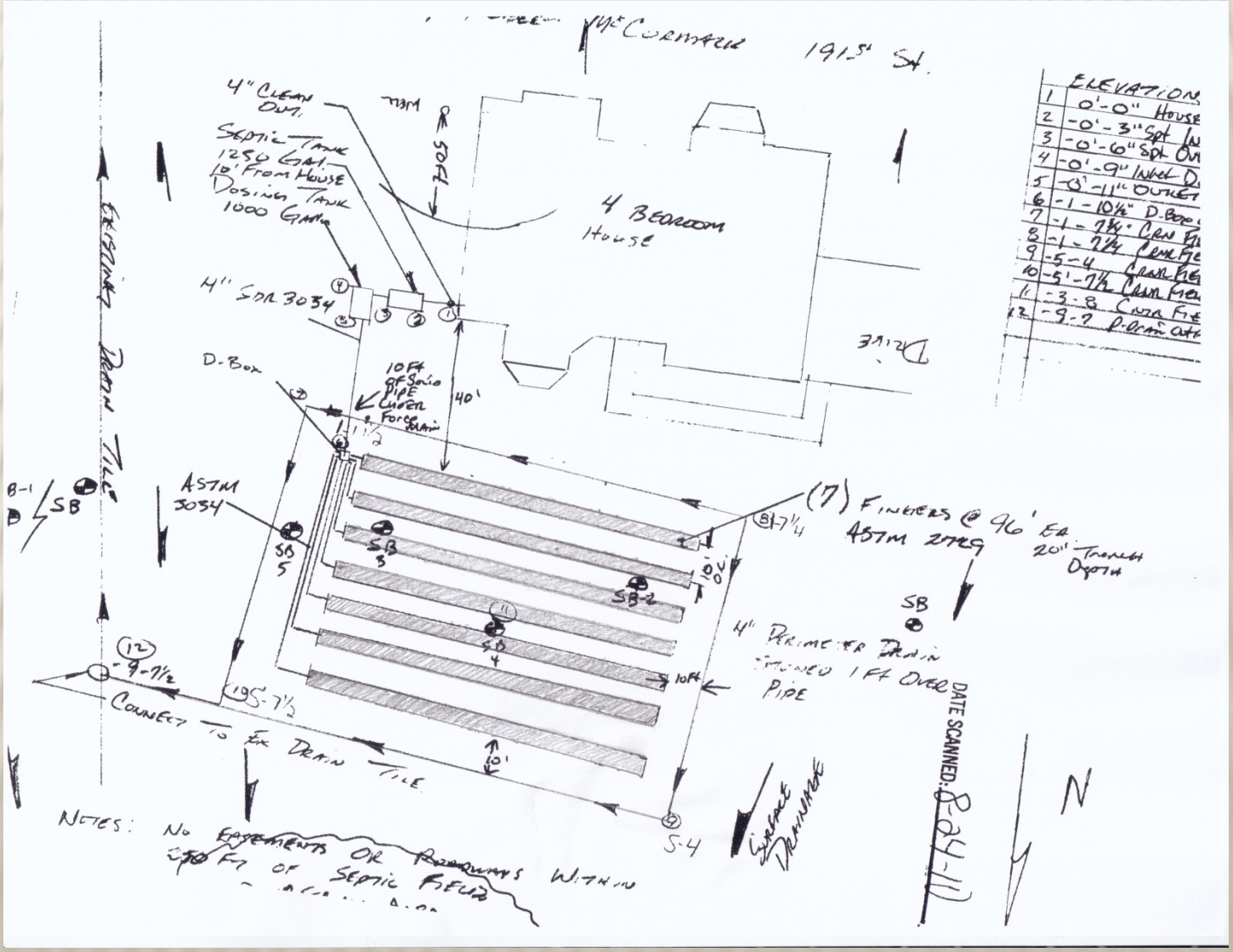
- New construction or replacement?
- What is the minimum/maximum trench depth?
- Informed homeowners / buyers?

- In the end it is a LHD call….

PLAN SUBMITTAL EXAMPLE



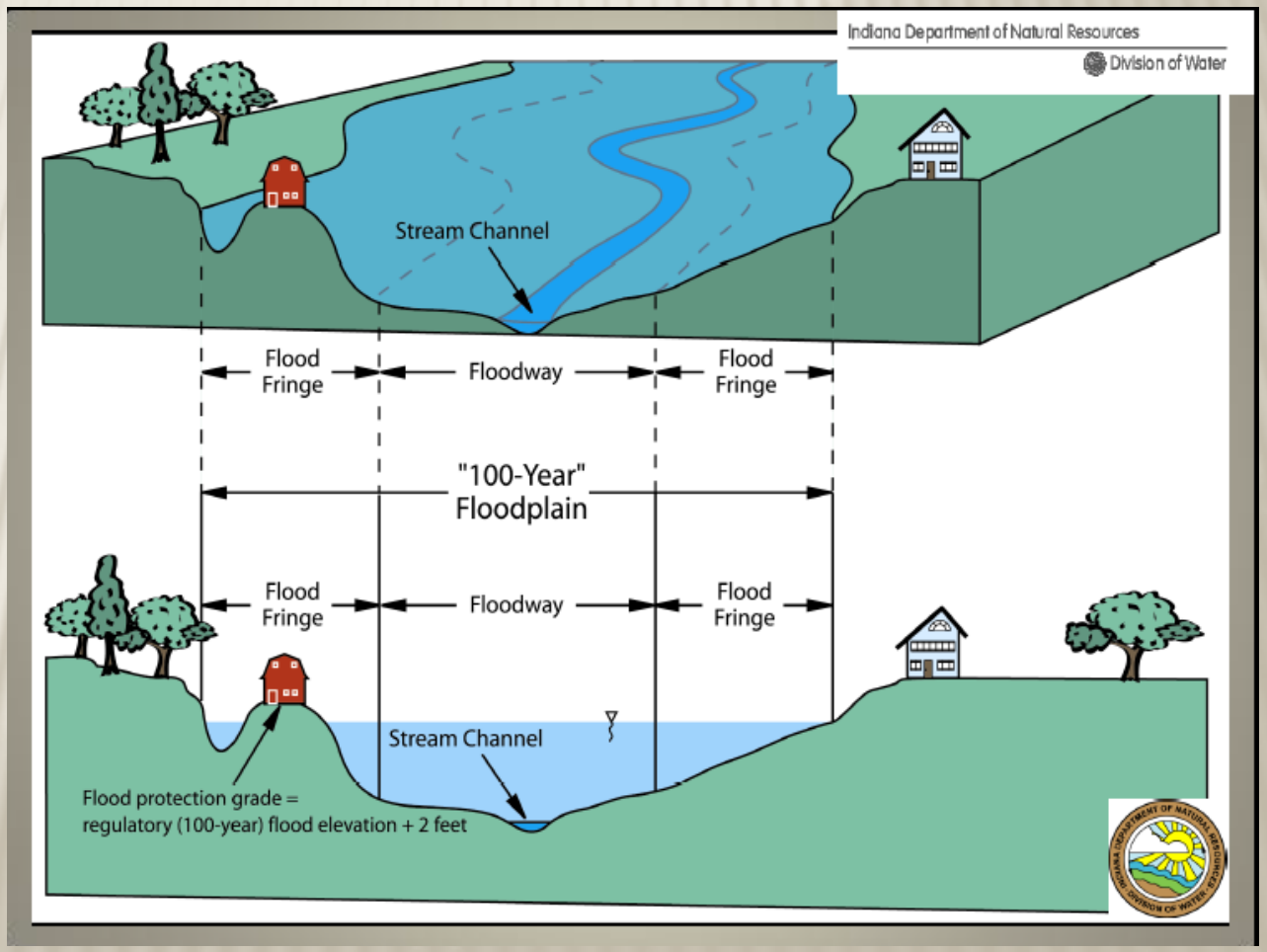
PLAN SUBMITTAL EXAMPLE



Section 30

REGULATORY FLOOD ELEVATION

- AKA “RFE” as defined in Rule 410 IAC 6-8.3

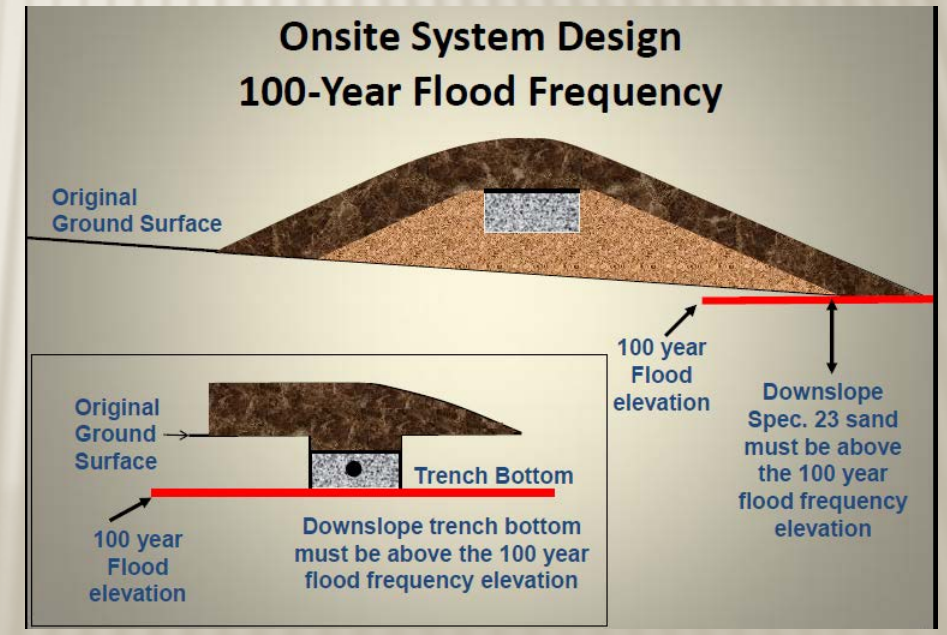


ONSITE SEWAGE SYSTEM - IMPACT

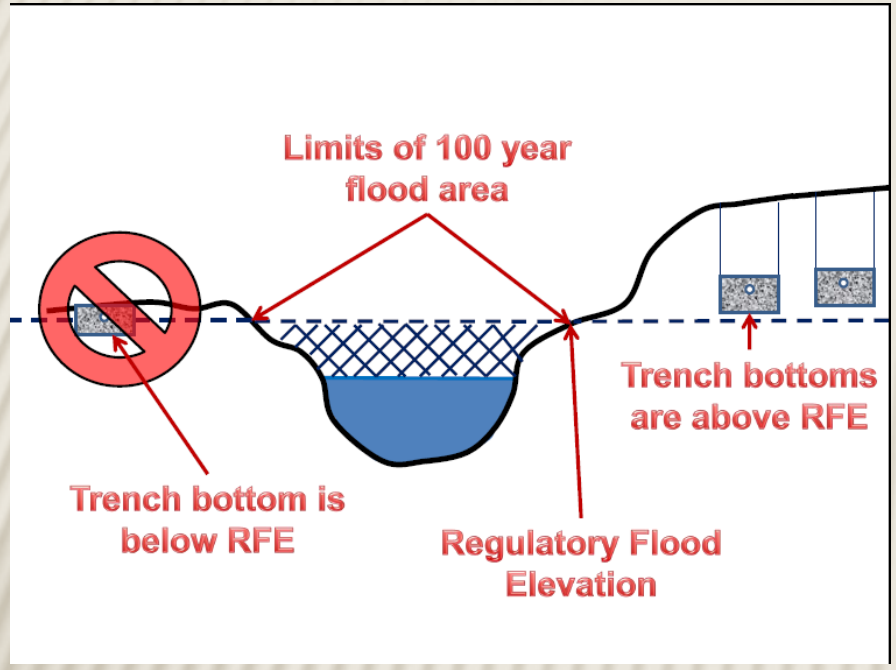
100 year Floodplain Elevation

Base Flood elevation (BFE)

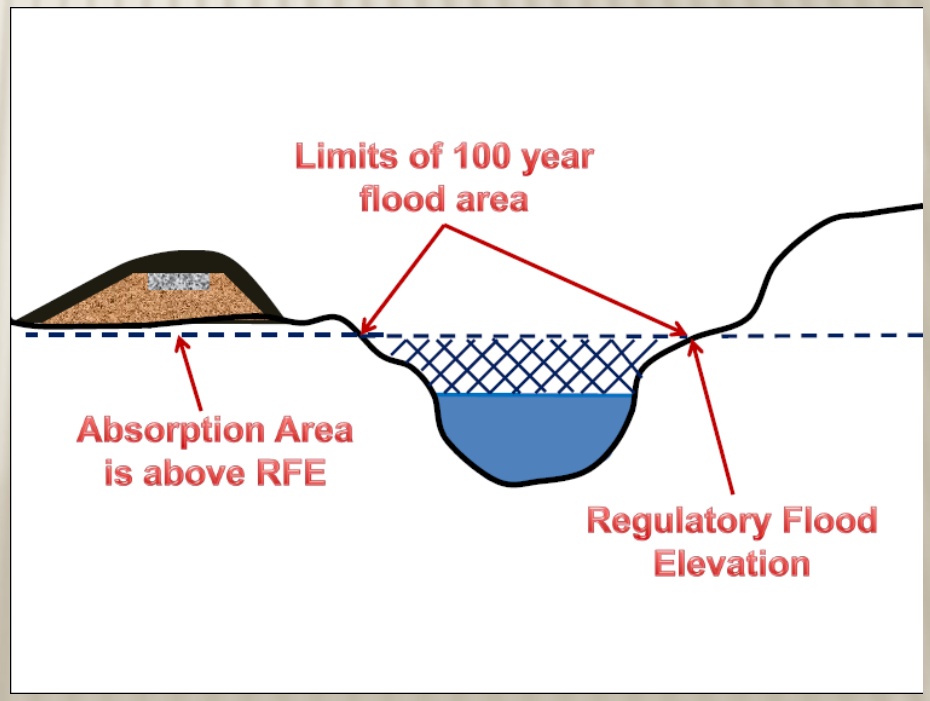
Regulatory Flood elevation (RFE)



ONSITE AND RFE



- Land surveyor must locate a monument with an elevation.
- Locate that elevation at the site.
- An elevation a minimum of 10” (trench depth) above the benchmark elevation must be located for system placement.



ADDITIONAL RESOURCES

INFIP

Indiana Floodplain

Information Portal

www.in.gov/dnr/water/

IGIC

Indiana Geographical

Information Council

Indiana Map

www.igic.org

Local GIS Resources

Floodplain info

- What if an area does not have a delineated flood plain?
  - The area has not been studied.
  - The study has not been approved by FEMA.
- Who to contact with questions

  Andrea Gromeaux,

  IDNR, Section Chief – Technical Services

  agromeaux@dnr.in.gov

  317-233-5636
- eFARA request

Additional Info (USACE, IDEM, DNR)

- www.wetlands.IN.gov

DRAINAGE

- Subsurface drainage system – any pipe and layer of:
  - gravel
  - Stone
  - or coarse sand
  - or any combination of those components, placed below the surface of the ground

DRAINAGE

- Subsurface drainage system – designed or constructed to
  - effectively lower a seasonal high water table, or
  - prevent movement of subsurface water into a soil absorption field site

DRAINAGE

- Interceptor drain – a subsurface drainage system constructed only on the upslope side of a SAF.

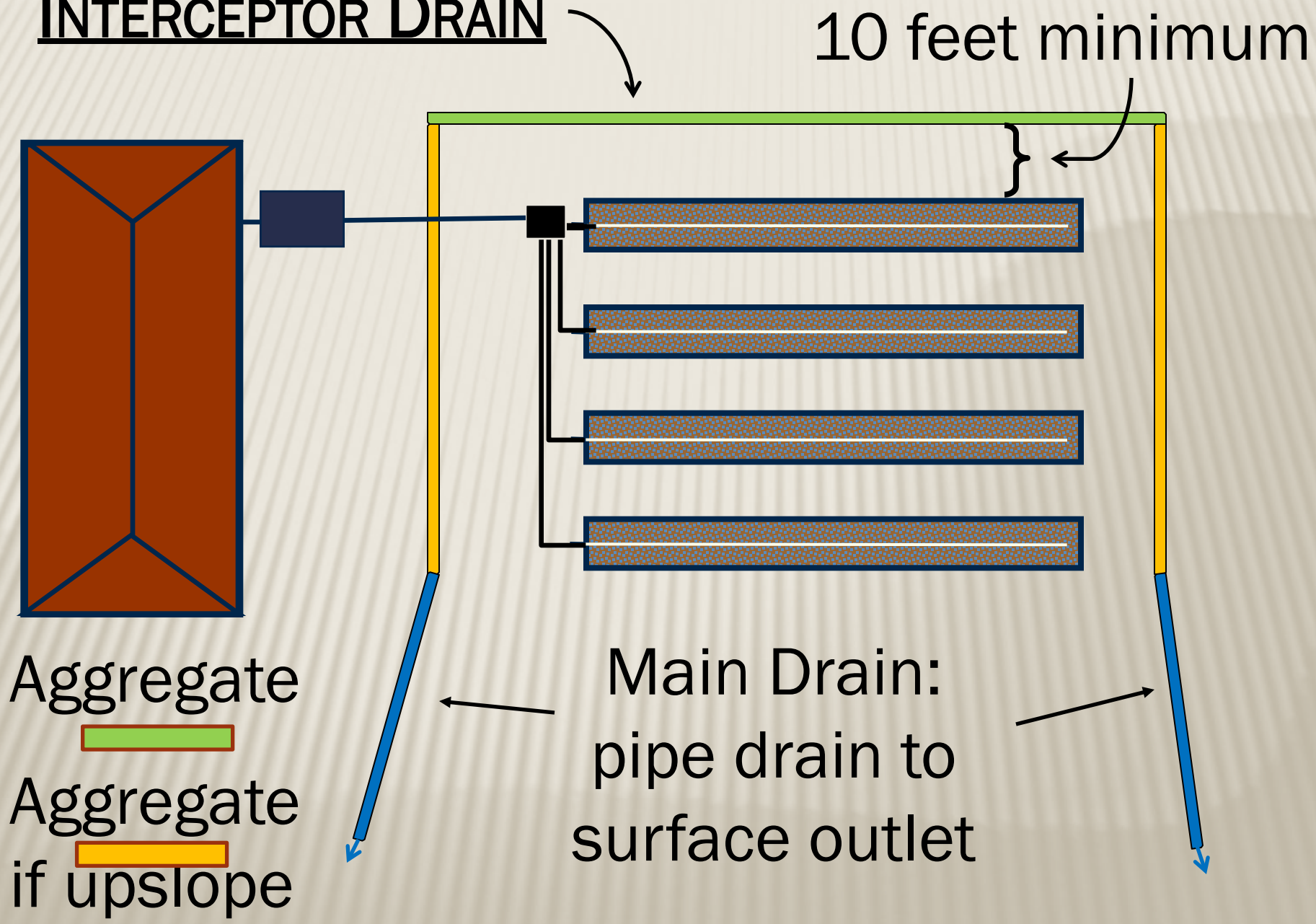
DRAINAGE

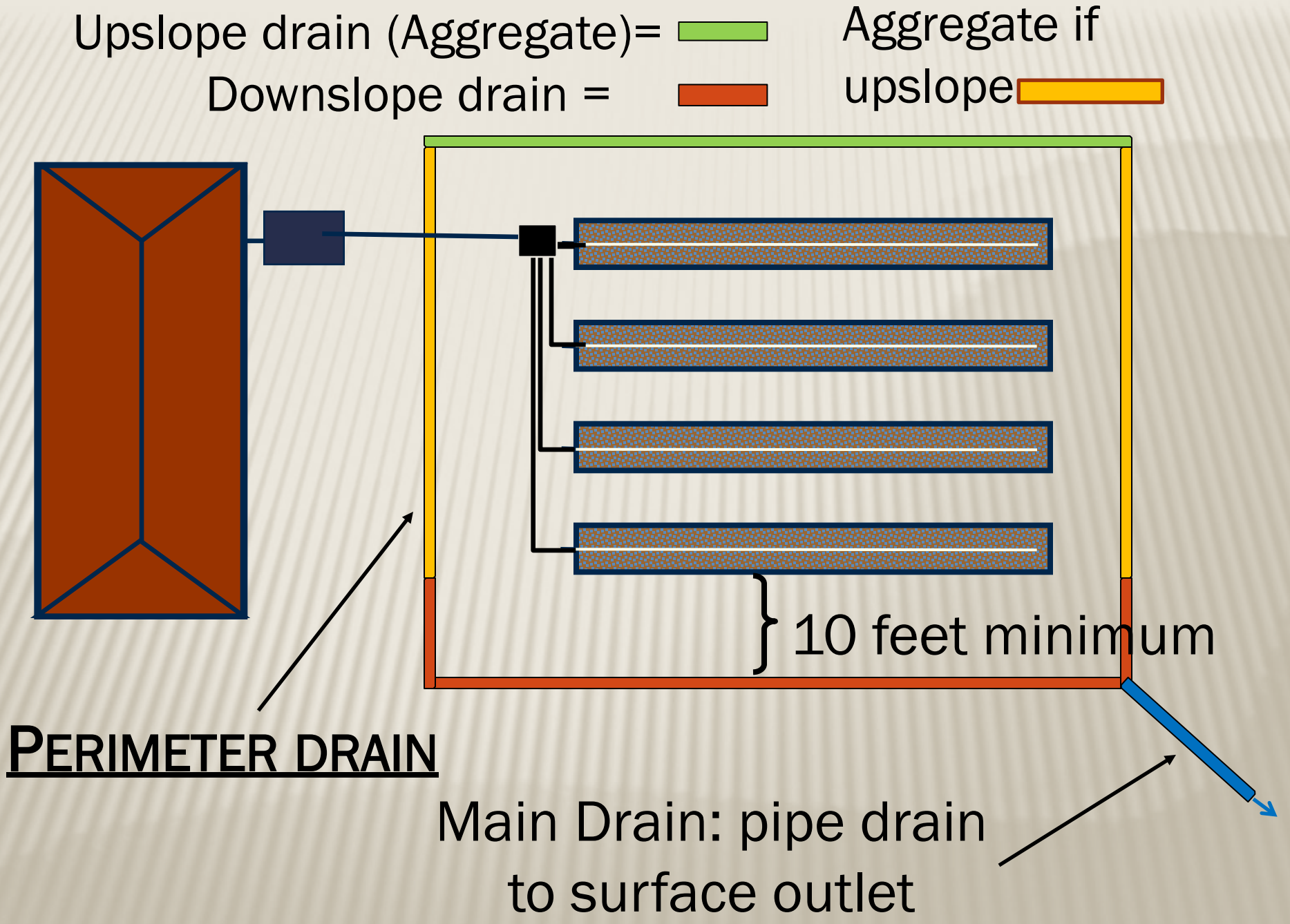
- Perimeter drain – a subsurface drainage system that completely surrounds a SAF.

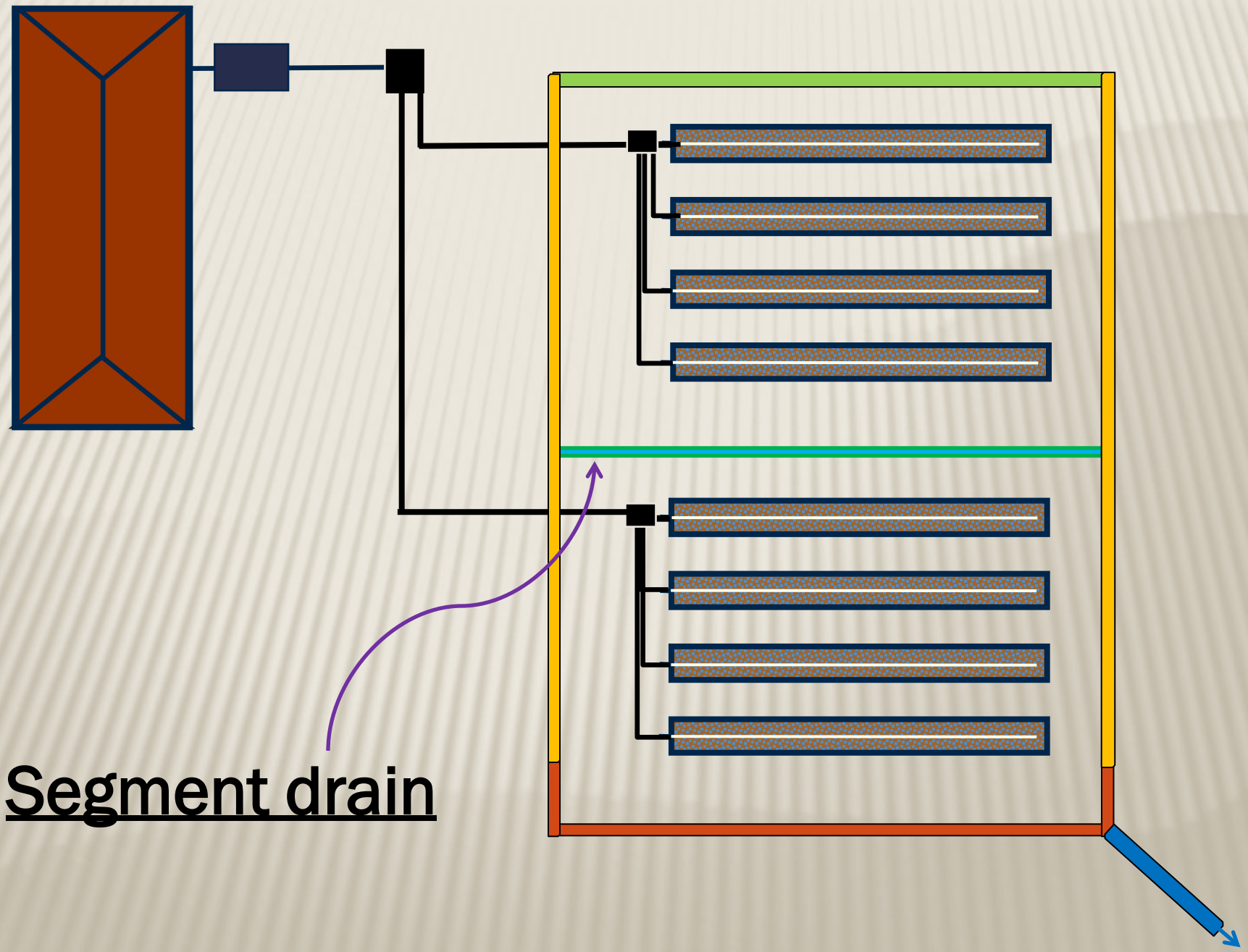
DRAINAGE

- Segment drain – a subsurface drainage system constructed between 2 SAF in the same onsite system.

Interceptor Drain




Upslope drain (Aggregate)=
Downslope drain =
Aggregate if upslope
10 feet minimum
PERIMETER DRAIN
Main Drain: pipe drain to surface outlet


Segment drain

DRAINAGE

DRAINAGE

- A surface diversion may be used in combination with an onsite subsurface drainage system.

DRAINAGE

- Site slope ≤ 2 %, perimeter drain required.
- Site slope > 2 %, drain <u>may</u> be constructed only on the upslope side.
- Which means: The LHD may require a perimeter drain on slopes > 2 %

DRAINAGE

- 6 inch drain pipe
- trench slope of $\geq$ 0.10 feet per 100 feet

DRAINAGE

- drain trench aggregate backfill
  - washed aggregate
  - INDOT Specifications 8 thru 11
  - INDOT Specification 23 sand

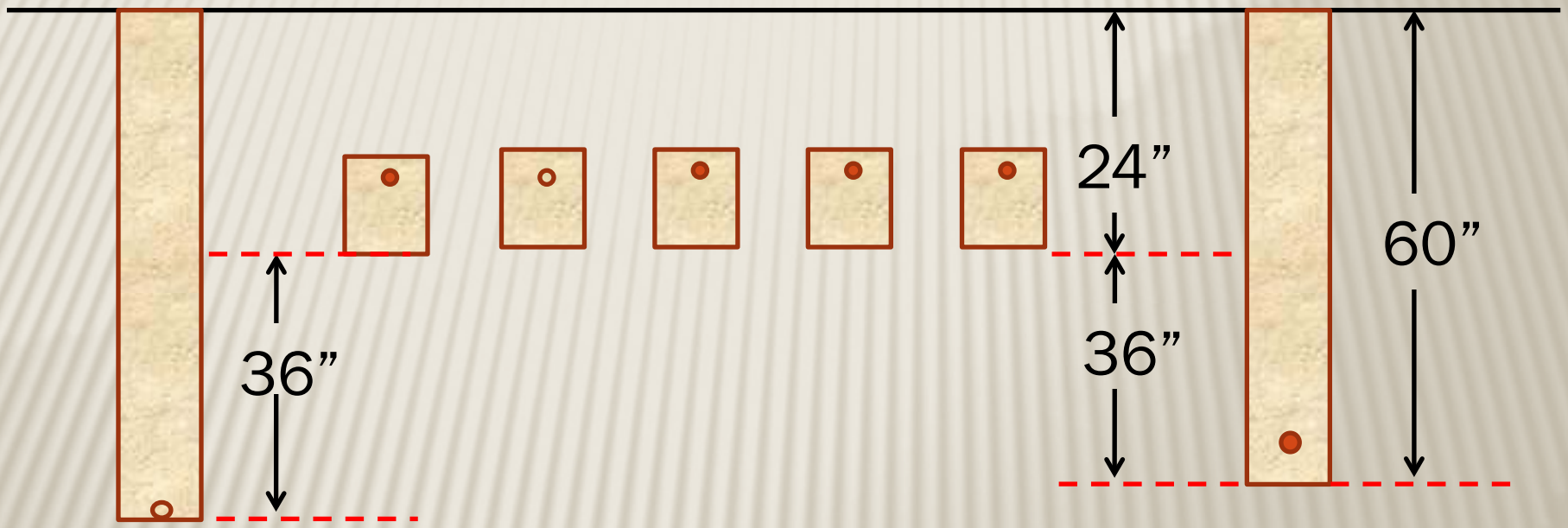
DRAINAGE

- IF INDOT Specification 23 sand – drain pipe must be wrapped with geotextile fabric
- If backfill not to surface – cover with geotextile fabric

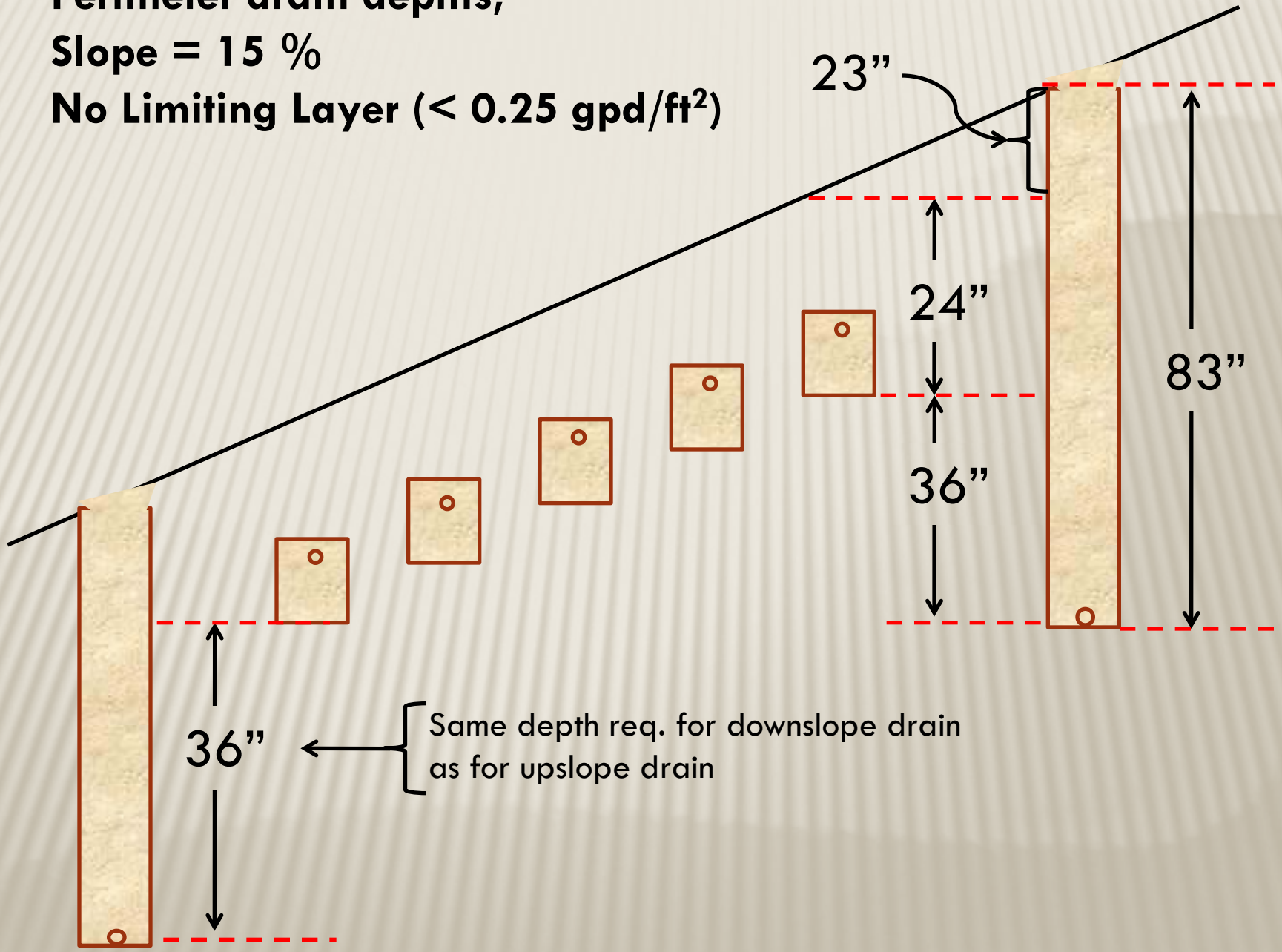
DRAINAGE

- Subsurface trench SAF
  - ≥ 36 inches below the elevation of the adjacent trench
  - or calculations
- ESM
  - ≥ 32 inches below existing grade
- or calculations

Perimeter drain depths;
Slope = 0 %
No Limiting Layer (< 0.25 gpd/ft^2)



Perimeter drain depths;
Slope = 15 %
No Limiting Layer (< 0.25 gpd/ft^2)



DRAINAGE

- Subsurface trench SAF
  - ≥ 10 feet from the outside edge of the nearest SAF trench
- ESM
  - ≥ 10 feet from the outside edge of the INDOT Specification 23 sand

DRAINAGE

- Drains ≤ 65 feet – parallel sides along the long axis of the SAF
  - unless calculations provide for a greater spacing

CONTACT INFORMATION

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317-412-2136

Alan M. Dunn
adunn@isdh.in.gov
317-233-7179

Web sites for today's materials and additional resources:

www.eph.isdh.in.gov (Indiana State Dept of Health)

www.iehaind.org (Wastewater Management Committee)

www.iowpa.org (Indiana Onsite Wastewater Professional Assoc.)

(Jan. 28-29, 2013-Camp Camby)

www.extension.purdue.edu/NENV (Purdue University)

www.pumpershow.com (Feb. 25-28, 2013-Indy)