PLAN SUBMITTAL AND REVIEW:

Surface and Subsurface Drainage

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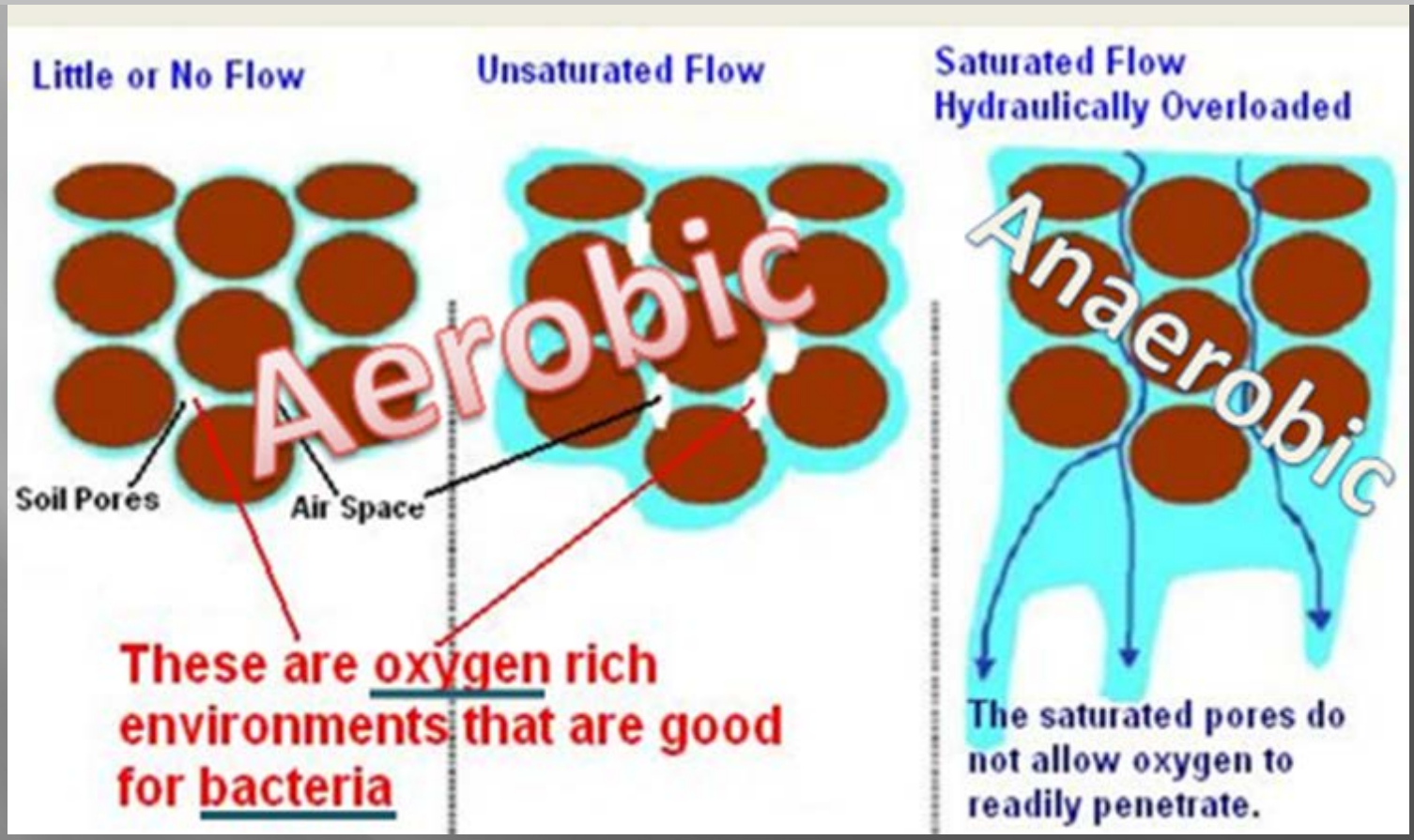
November 7, 2017

What is drainage?

- **Surface diversion**: Section 63 (a)(1)-(a)(5)

1) Eliminate effects of upslope competitive water
2) Minimum 0.2% grade
3) Sufficient depth and width to move surface water away from the soil absorption system
4) 10 ft away from the soil absorption system**
5) May be used with an onsite subsurface drainage system

Aerobic soils under the soil absorption field provide for better treatment



Remember???

Designer Checklist

- Surface Diversions

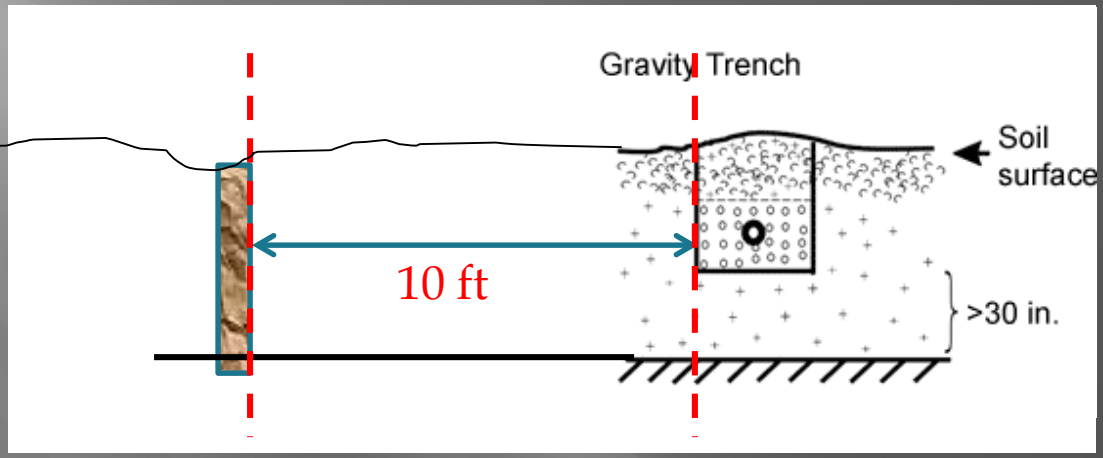
YES	N/A	Drainage	(410 IAC 6-10.1-63)	(Example Drawing)
		Surface Diversion (check all that apply)		
		Positive grade (minimum 0.2% slope)		
		Sufficient depth		
		Upslope of soil absorption field (SAF)		
		Minimum 10' from the outer edge of the cover soil in an ESM or sand-lined system		
		Minimum 10' from edge of soil cover or 10' from trench with no additional soil cover		

Consider the development and improvements being proposed for the site and address all of the water that is going to flow toward the OSS.
Intercept it, divert it and direct it away from the OSS site.

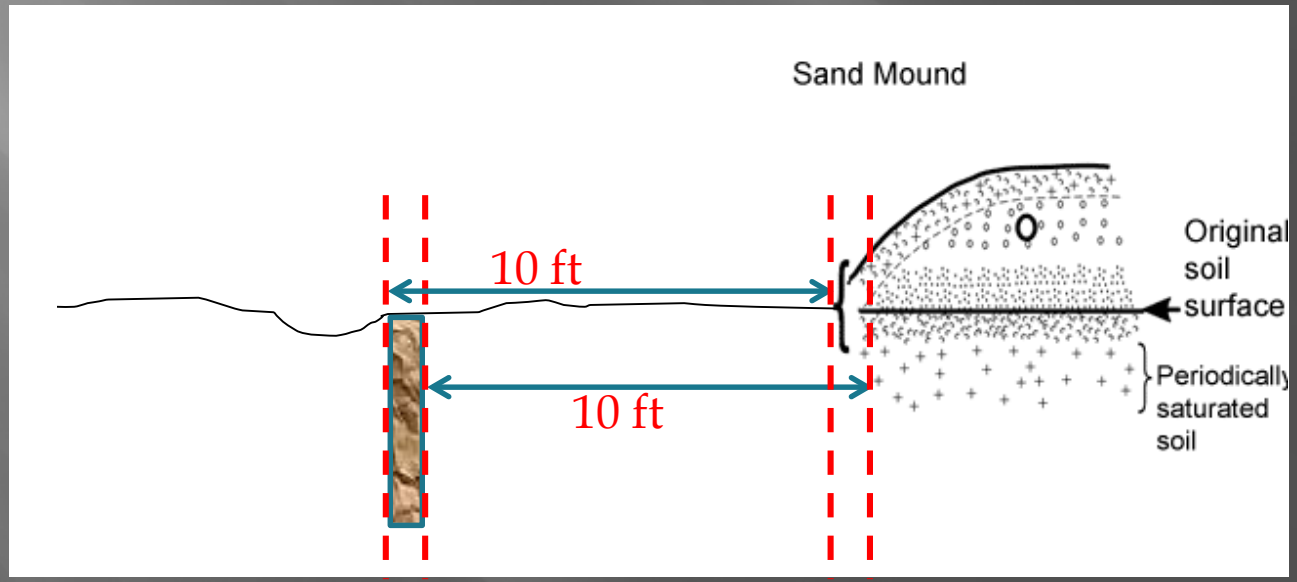
Surface diversion study

Location: Sec 63(a)(4)&(5)

4(A)



4(C)



Surface Diversions

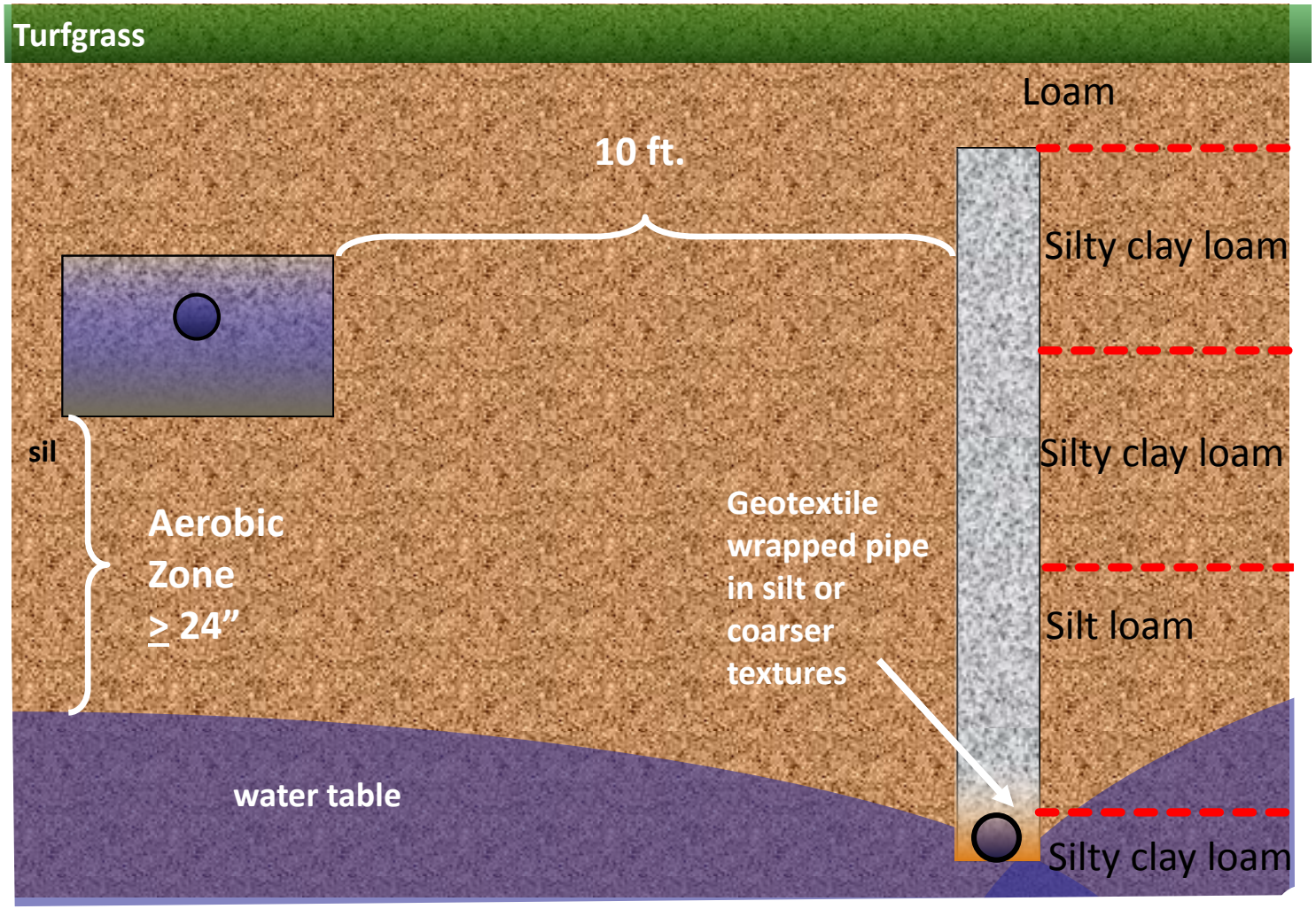
- Overlooked
- Assumed
- Forgotten
- Dismissed

Must be addressed

- Big impact for above grade OSS

Subsurface Drainage

Why do we utilize subsurface drainage?



Subsurface Drainage: Checklist

Subsurface Perimeter Drain (check all that apply)

- ☐ Drain trenches running parallel to trenches are not more than 65' apart at widest point
- ☐ Depth is 2" into massive clay, glacial till or fragipan
- ☐ Depth is 36" below adjacent trench bottom elevations
- ☐ Depth is 32" below grade (for elevated sand mounds (ESM))
- ☐ Drainage calculations provided (optional)
- ☐ Minimum 10' separation to SAF trenches, ESM sand or sand-lined system sand
- ☐ Outlet to existing approved tile
- ☐ Outlet to daylight with rodent guard
- ☐ Positive grade (0.2% for 4" pipe and 0.1% for 6" pipe)

NOTE: Must show all invert elevations c
elevations at the beginning and end of t

Perimeter Drain Slope Check (minimum of 0.2% for 4" and 0.1% for 6" pipe)

	Pipe Segment AB	Pipe Segment BC	Pipe Segment CD
Length of Pipe Segment (feet):			
Invert Elev. At Beginning (feet):			
Invert Elev. At End (feet):			
Calculated Slope (%):	#DIV/0!	#DIV/0!	#DIV/0!
	Pipe Segment DE	Pipe Segment EF	Pipe Segment FG
Length of Pipe Segment (feet):			
Invert Elev. At Beginning (feet):			
Invert Elev. At End (feet):			
Calculated Slope (%):	#DIV/0!	#DIV/0!	#DIV/0!
	Pipe Segment GH	Pipe Segment HI	Pipe Segment IJ
Length of Pipe Segment (feet):			
Invert Elev. At Beginning (feet):			
Invert Elev. At End (feet):			
Calculated Slope (%):	#DIV/0!	#DIV/0!	#DIV/0!
	Pipe Segment JK	Pipe Segment KL	Pipe Segment LM
Length of Pipe Segment (feet):			
Invert Elev. At Beginning (feet):			
Invert Elev. At End (feet):			
Calculated Slope (%):	#DIV/0!		

- ☐ ASTM F 405-05 polyethylene pipe
- ☐ ASTM F 667-12 polyethylene pipe
- ☐ NRCS 606, September 2003 polyethylene pipe
- ☐ Perimeter drain wrapped with geotextile fabric/"sock" (check rule for type of soils that require it)
- ☐ Appropriate backfill (check all that apply): (see 410 IAC 6-10.1-63(k))
  - ☐ Mixture of ½" - 2 ½" aggregate
  - ☐ INDOT Spec 8-11
  - ☐ INDOT Spec 23
  - ☐ Backfilled to surface with aggregate
  - ☐ Backfilled to within 6" of final grade with aggregate (with ISDH approved geotextile fabric on top of aggregate)

What is drainage?

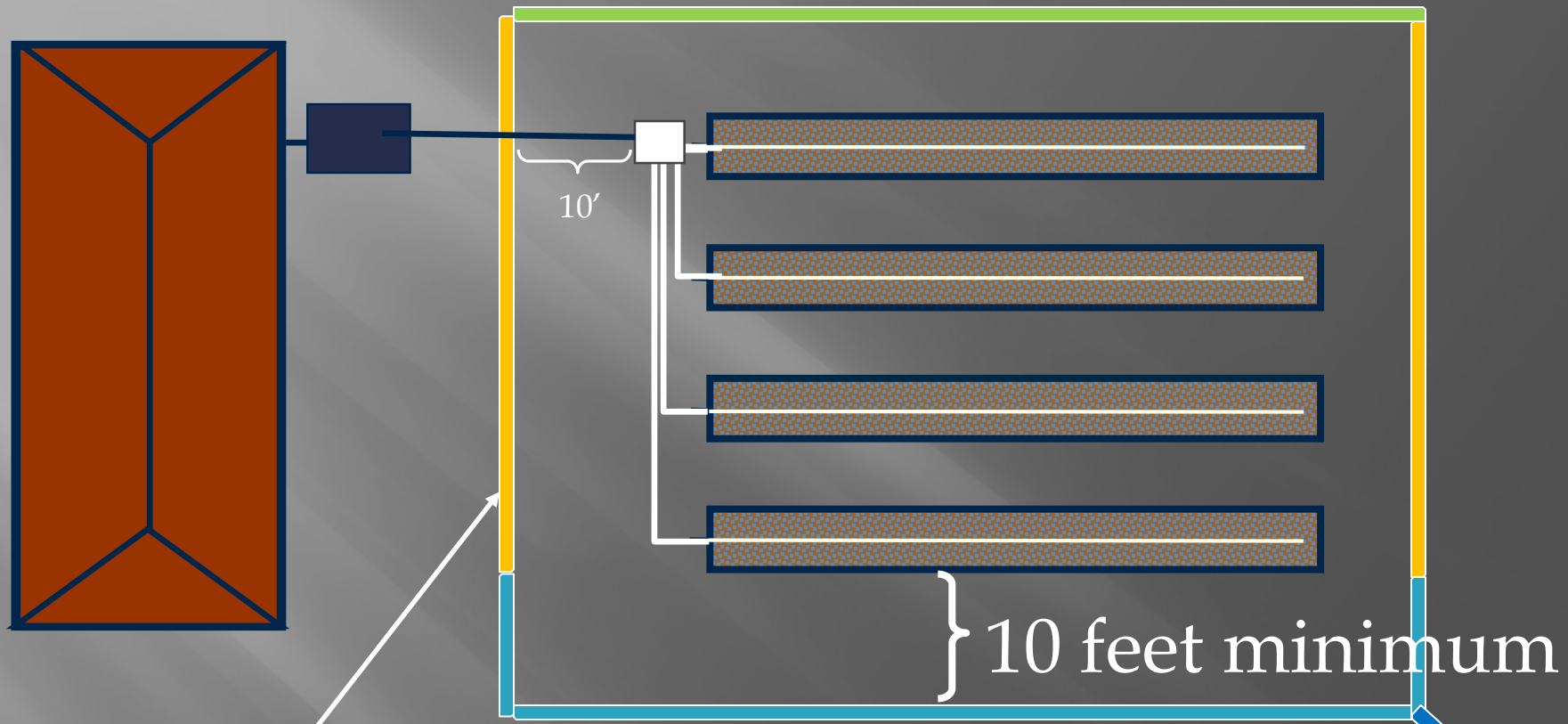
- **Subsurface drainage system:**
  Section 46 defined
  - Any pipe with or without a layer of gravel, stone, or coarse sand, placed below the surface of the ground and designed or constructed in such a manner as to:
    1. Effectively lower a seasonal high water table; or
    2. Prevent movement of subsurface water into a soil absorption system site.

  Interceptor drains, perimeter drains, and segment drains are types of subsurface drainage systems.

Upslope drain (Aggregate)=

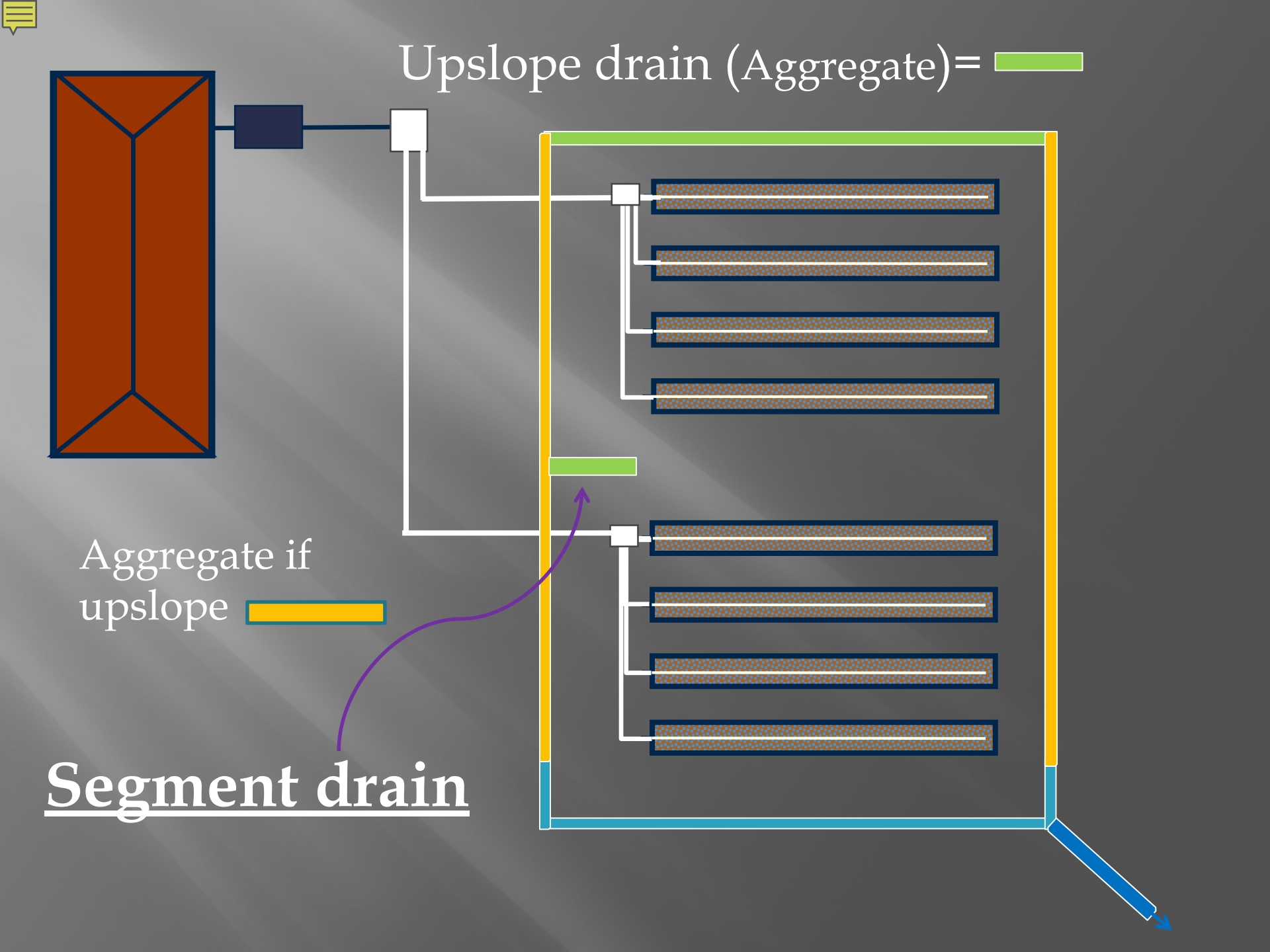
Downslope drain =

Aggregate if upslope



PERIMETER DRAIN

Main Drain: pipe drain to surface outlet


Upslope drain (Aggregate)=
Aggregate if upslope
Segment drain

Tandem Systems

Why utilize drainage?

- **Subsurface drainage system:**
  Section 46 defined
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    1. Effectively lower a seasonal high water table; or
    2. Prevent movement of subsurface water into a soil absorption system site.

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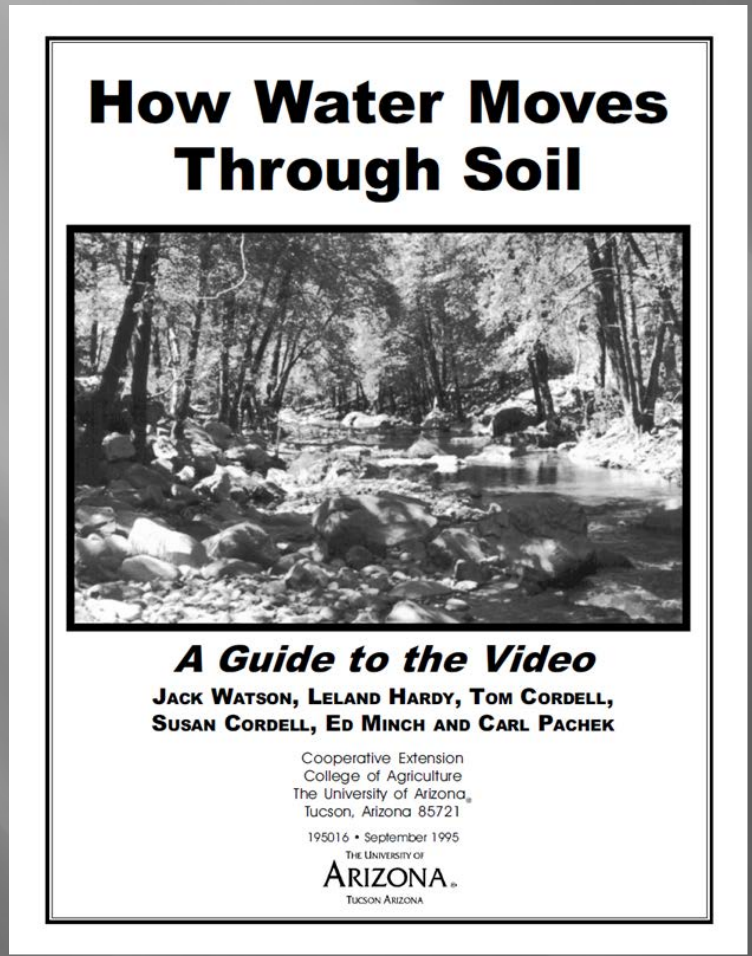
Keeping it Aerobic



How Water Moves Through Soil

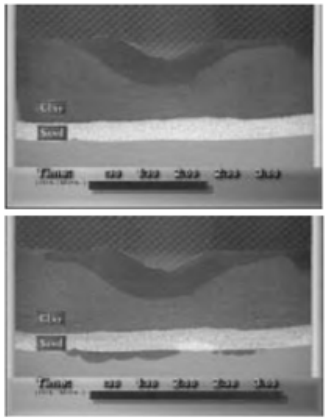
A Guide to the Video

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



NARRATOR: Soil is sometimes formed in layers of different textures near the surface. Each layer may have a different pore size, which affects the way water moves through the soil.

Video of clay over sand demonstration

NARRATOR: Abrupt changes in pore size affect water moving by capillary action. This soil profile shows soil with small pores overlying a layer of soil with large pores. Capillary force, also known as soil tension, refers to the soil's ability to attract and hold water. Capillary force is greater in the soil layer with small pores.

Many soils, especially those formed in alluvium or marine sediments, are layered . . . resulting in abrupt changes in pore size. Water is held back at each of these contacts, and will not move downward until the clay layer above the sand is saturated. Therefore, some soil horizons will hold more water than the available water capacity would otherwise indicate. When enough water has been added, gravitational forces will exceed capillary forces — and water moves downward into the coarse sand below.

Once water enters the coarse material, it moves rapidly and soon penetrates the bottom layer below the sand.

Subsurface Drainage Section 63 (b)-(o)

- Function
- Depth
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

(b) "Sufficiently deep"

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- to lower a seasonal high water table as required in
  - (d) prescriptive approach
  - (e) performance approach

(c) Drain type

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design
  - Perimeter drains utilized and segment drains when necessary

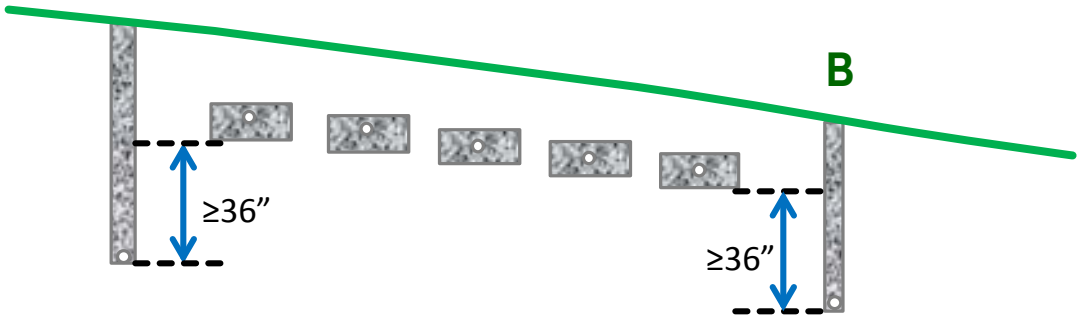
(d) Prescriptive approach

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

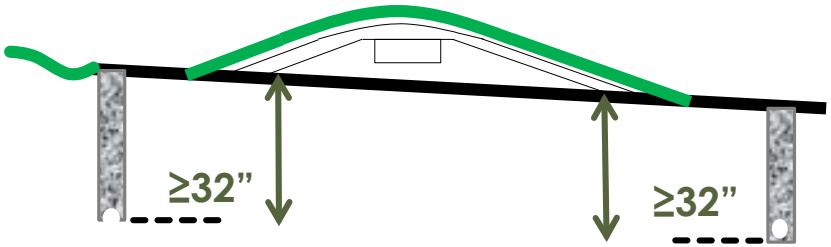
- 2” into the “limiting layer”
  - (1) 36” below invert elevation of the adjacent SAF trench bottom
  - (2) ESM: 32” below existing grade

What is the drain depth needed when there is no limiting layer?

36” below the elevation of the adjacent trench bottom elevation



OR 32” below the ground surface for ESM



(e) Performance approach

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- **Show the math!** The models or calculations used to generate design depth.
  - (1) Trenches: 24” below trench bottoms under center of SAF
  - (2) ESM: 20 “ below grade

(f) Location

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- (1) 10 ft from outside edge of SAF
- (2) 10 ft from Spec 23 sand for ESM
- **(3) Spacing for drainage ≤ 65 ft, unless calculations can prove otherwise**
- **(4)** Do **not** cross drainage and SAF

(g) Subsurface drain pipe…

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- (1) ≥ 4”
- Slotted
- Geotextile fabric wrapped when installed in: sands, loamy sands, sandy loams, fine sandy loams, loams, silt loam: or silts.

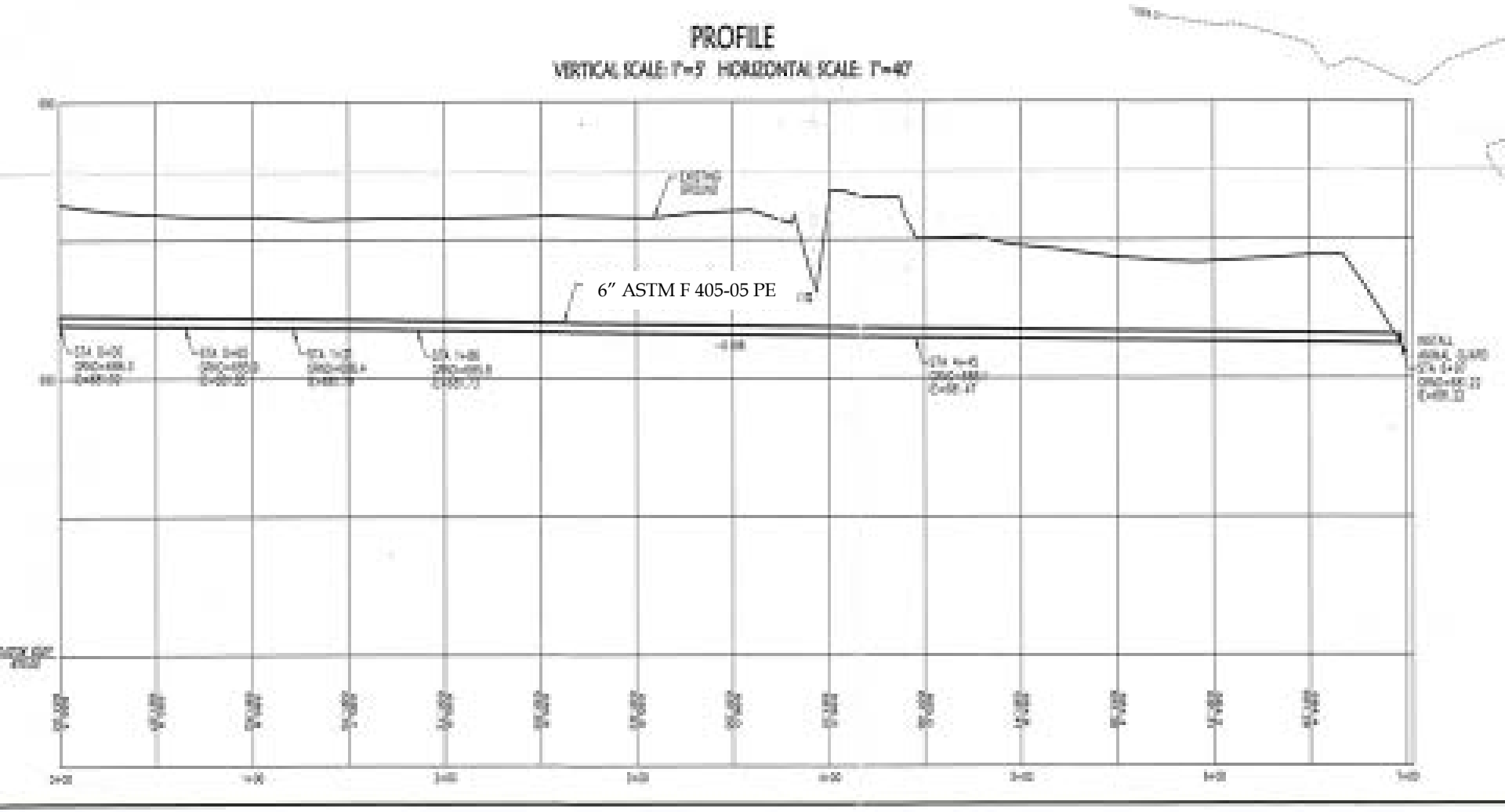
Piping-specs

•Subsurface Drainage System Pipe (w/ geotextile wrapping and w/out)

ASTM F 405-05

(h) Subsurface drain trench

- Function
- Depth
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design
  - (1) 4”: .2’ ft/ 100 ft
  - (2) 6”: .1’ ft/ 100 ft
  - (3) No sags.


PROFILE
VERTICAL SCALE: 1"=5' HORIZONTAL SCALE: 1"=40'
6″ ASTM F 405-05 PE

(i) Upslope portion: drainage

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- Subsurface drain trench (**UPSLOPE**) of an OSS **shall be**:
  - (1) to final grade, OR
  - (2) to within 6 " of final grade and 6" of cover soil material to final grade.

(j) Side and downslope drainage

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- Subsurface drain trench (**SIDES AND DOWNSLOPE**) of an OSS **<u>may</u> be**:
  - (1) to final grade, OR
  - (2) to within 6 " of final grade and 6" of cover soil material to final grade.

Backfill aggregate to the surface…

(k) Aggregate shall meet:

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- (1) Section 76, or
- (2) INDOT Spec 8-11, or
- (3) INDOT Spec 23 sand

(l) Spec 23 Sand backfill

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- If used: drainpipe **must** be wrapped with geotextile.

(m) If soil cover material will be used…

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- Aggregate must have geotextile barrier material placed on top before the soil cover material is placed on top.

(n) Must flow by gravity

- Function
- Depth
- Type
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- It's more than just a good idea, it's a LAW.

(o) Tile outlets

- Function
- Depth
- Slope
  - Trench
  - Pipe (4 and 6)
- Components
  - Aggregate
  - Pipe
  - Barrier Material
- Design

- Shall have rodent guards

Why a Rodent Guard?

Questions…