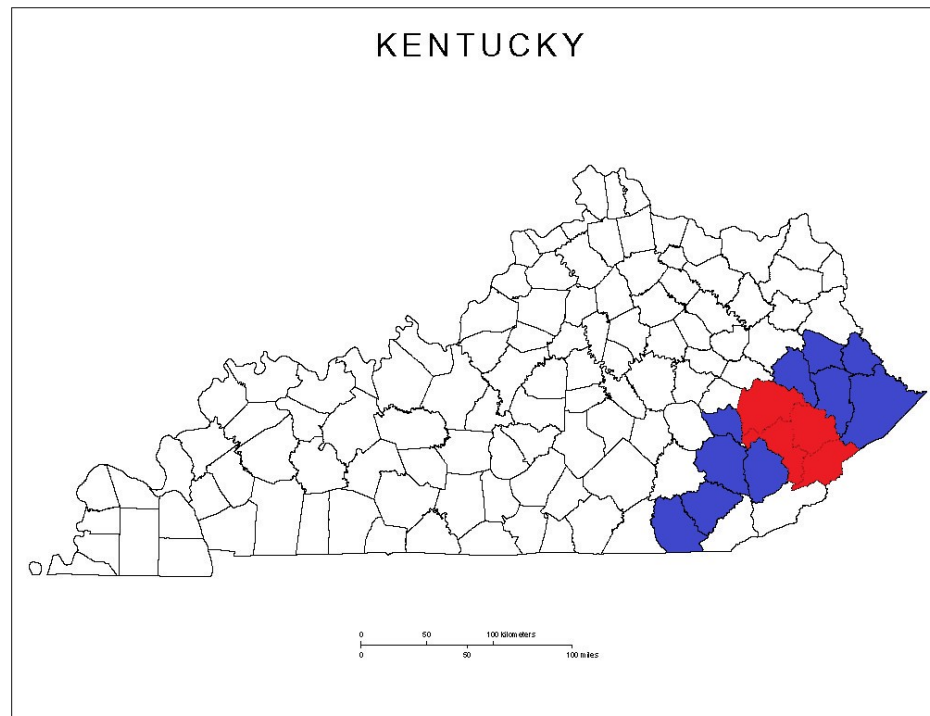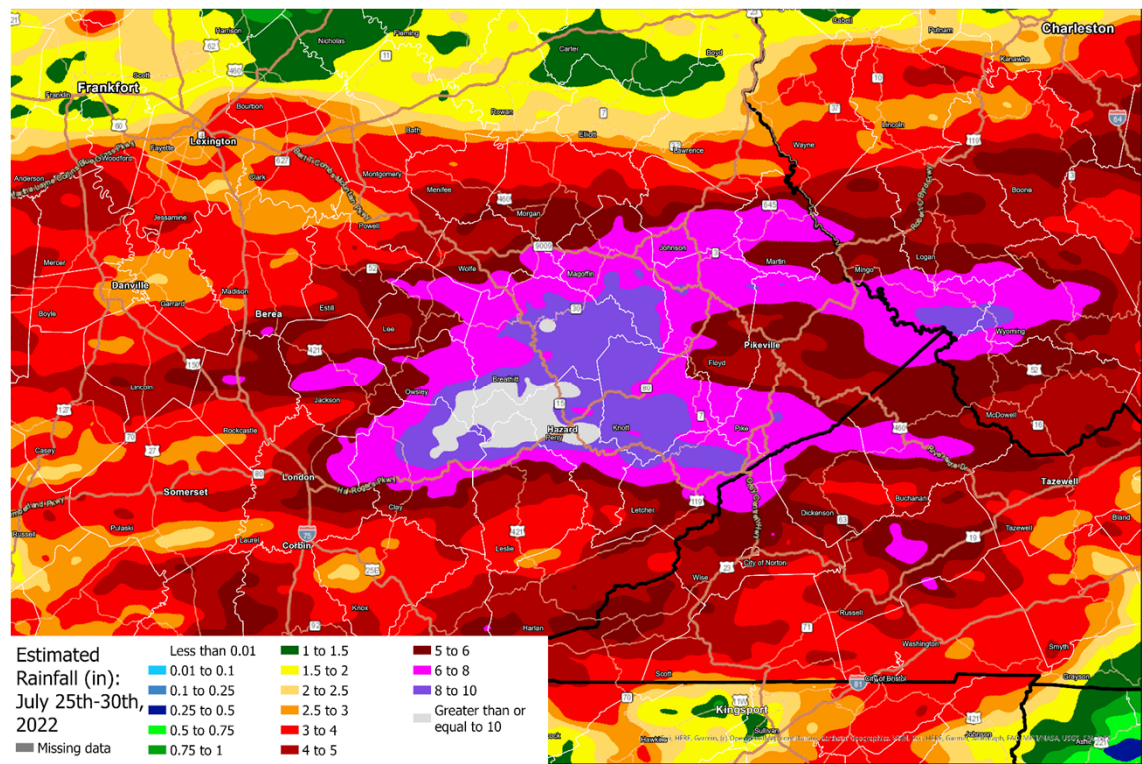# Geotech EMS

Limited Geotechnical investigations in the aftermath of flooding

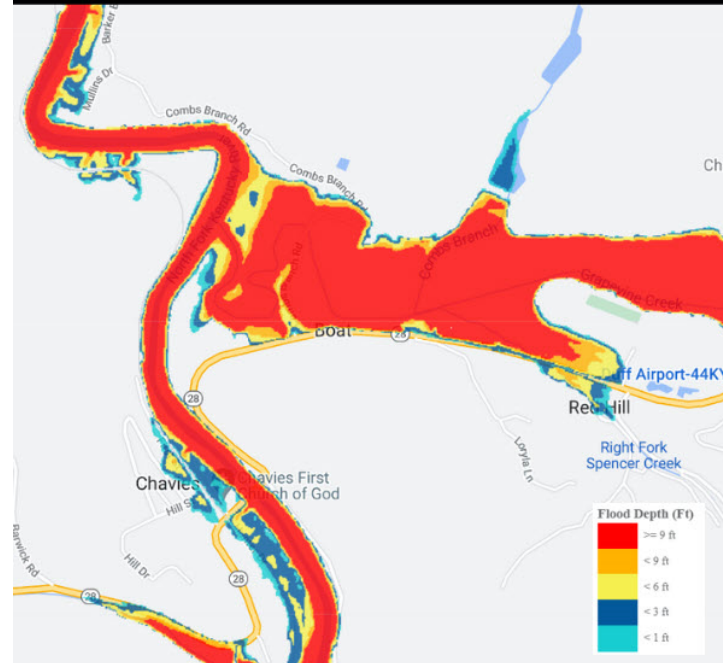# Outline

- Weather
- Damage done
- Scoping the damage
- Repair process
- Dam damage
- Sliding away

Flood area

Estimated Rainfall (in): July 25th-30th, 2022

	Less than 0.01	1 to 1.5	5 to 6
	0.01 to 0.1	1.5 to 2	6 to 8
	0.1 to 0.25	2 to 2.5	8 to 10
	0.25 to 0.5	2.5 to 3	Greater than or equal to 10
	0.5 to 0.75	3 to 4	
	0.75 to 1	4 to 5	

Missing data

FlashFlood - Kentucky (USA) 2022 - Flood Inundation by ICEYE as of July 29

|	
Lettings in August	7
Lettings in September	28
Lettings in October	13
Lettings in November	12
Lettings in December	15
Lettings in Early 2023	84
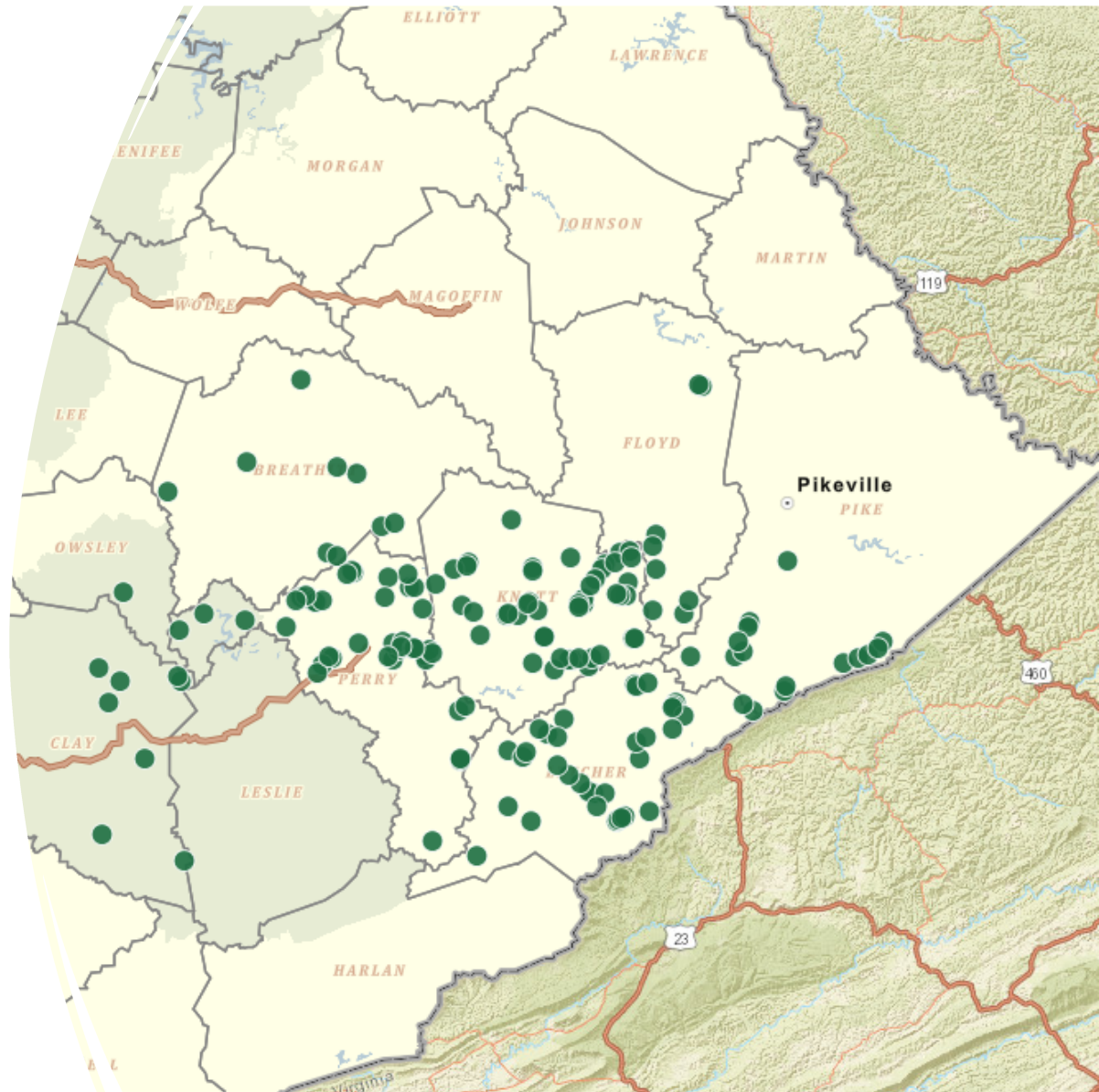
Flooded Structures - Work Type
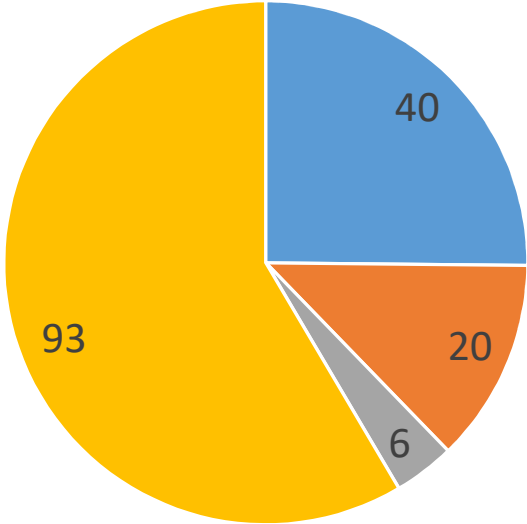
- ■ Repair Approach
- ■ Repair Toewalls
- ■ super replacement
- ■ total replacement

Geotech Response

- Subsurface investigations?
- Limited access
- Need for speed
- What is good enough?

Standard investigation

- Single span 2 borings on each end 1 sample-core one sounding
- 2 span add core and sounding at pier
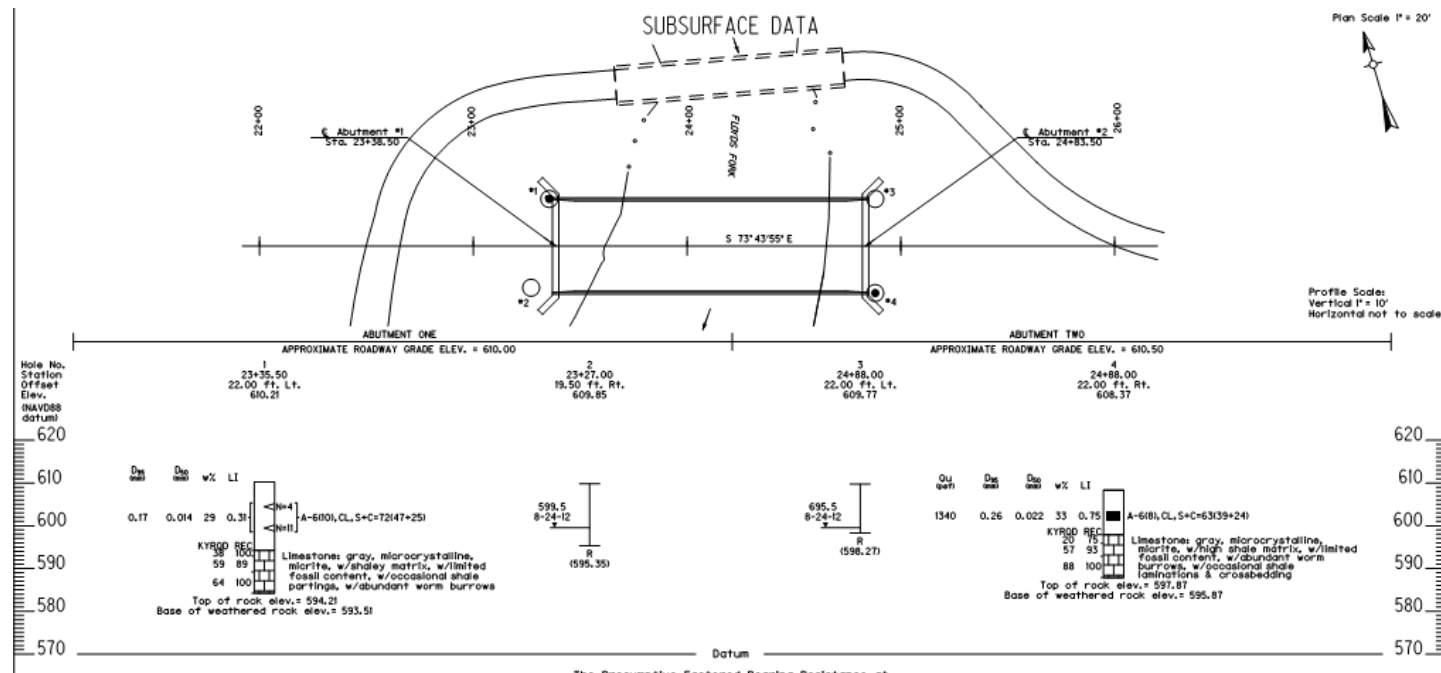
What we did

- Rockline sounding on each side of the bridge if possible
- Extend 2-3 feet into bedrock to confirm rock type and some idea of durability
- Hand sounding in some areas
- Rely on geologic mapping and old projects in the area.
- https://kgs.uky.edu/kgsweb/KYTC/search.asp
- https://kgs.uky.edu/kgsmap/basemap/viewer.asp?kytcLayers=true

Foundation types used

- Spread footing on rock 62 bridges
- H-piles to rock 30 bridges
- H-piles pre-drilled into rock 12 bridges
- Drilled shafts 3-4 foot 17 bridges

Info provided

IDEALIZED SOIL AND BEDROCK PROFILE

County, Route, Structure
Substructure Unit

Initials and Date

Top of Shaft

Elev. (ft.)

Overburden, Neglect for Support

Top of Rock Socket

*

Strata	Parameters for Lateral Load Analyses

Shale — Weak Rock

γ_t (lb/ft^3) = 150   Effective Unit Weight, γ_e (lb/in^3) = 0.087
q_u (psi) = 9760   Elastic Modulus, E_r (psi) = 976,000
q_{eb} (ksf) = 60   Uniaxial Compressive Strength, q_u (psi) = 9760
f_s (ksf) = 35.3   Cohesive Strength, c_u (psi) = 4880
(Side friction limited by Concrete Strength to fs = 21.1 ksf)

*

Shaft Tip

*   Elevations vary and are provided in the report body.

ADDITIONAL DATA FOR GEOTECHNICAL CALCULATIONS ONLY:	
min. f'$_c$ (psi) =	3500
p_a (psi) =	14.7

Allowable Stress Design (ASD)

DRILLED SHAFT AXIAL CAPACITY TABLE

County, Route, Structure
Substructure Unit

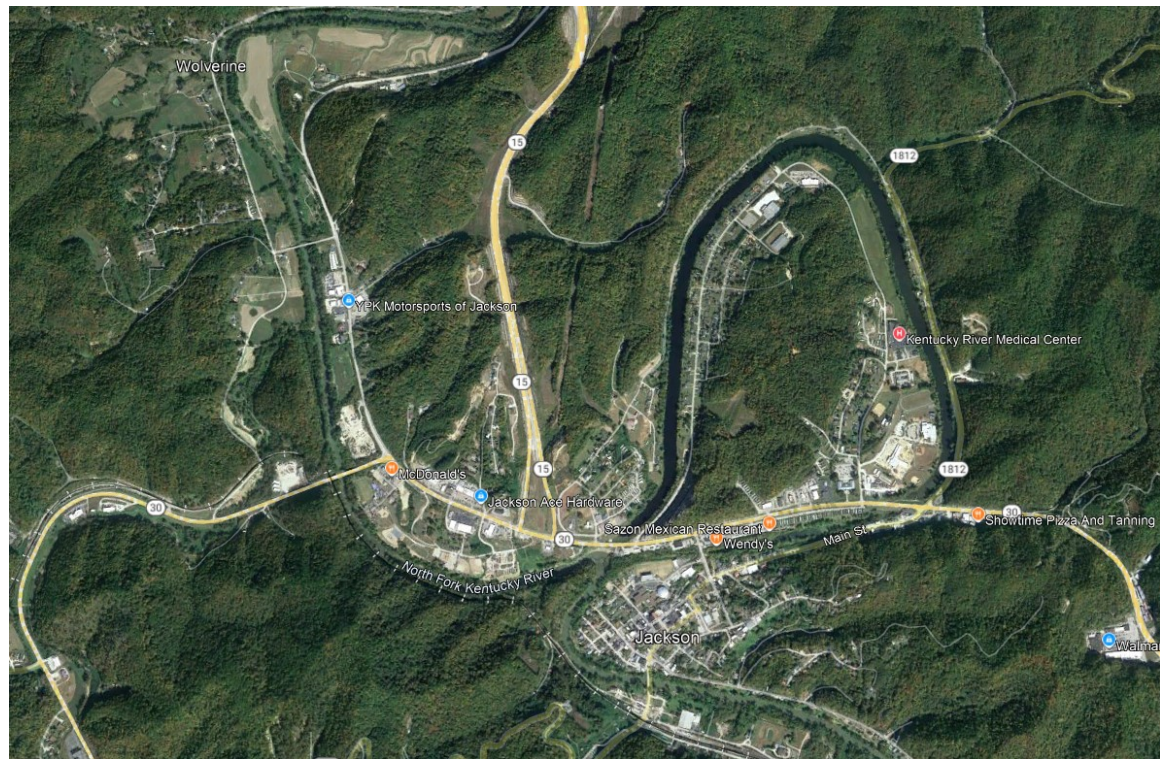Rock Socket Diameter = 3.5 feet
Rock Socket Diameter = 42 inches   Initials and Date

Rock Socket Length (ft.)	Ultimate Unit Side Shear q_{ss} (ksf)	Ultimate Unit End Bearing q_{eb} (ksf)	Ultimate Side Shear Q_{ss} (kips)	Ultimate End Bearing Q_{eb} (kips)	Total Ultimate Axial Capacity Q_{ut} (kips)	Total Allowable Axial Capacity Q_{at} (kips)	Total Allowable Uplift Capacity Q_{up} (kips)
0.0							
1.0	21.1	60	232	577	809	270	54
2.0	21.1	60	464	577	1041	347	108
3.0	21.1	60	696	577	1273	424	162
4.0	21.1	60	928	577	1505	502	217
5.0	21.1	60	1160	577	1737	579	271
6.0	21.1	60	1392	577	1969	656	325
>>> 7.0	21.1	60	1624	577	2201	734	379
8.0	21.1	60	1856	577	2433	811	433
9.0	21.1	60	2088	577	2665	888	487
10.0	21.1	60	2320	577	2897	966	541
11.0	21.1	60	2552	577	3129	1043	595
12.0	21.1	60	2784	577	3361	1120	650
13.0	21.1	60	3016	577	3593	1198	704
14.0	21.1	60	3248	577	3825	1275	758
15.0	21.1	60	3480	577	4057	1352	812
16.0	21.1	60	3712	577	4289	1430	866
17.0	21.1	60	3944	577	4521	1507	920
18.0	21.1	60	4176	577	4753	1584	974
19.0	21.1	60	4408	577	4985	1662	1029
20.0	21.1	60	4640	577	5217	1739	1083

D (ft.) = 3.5
>>> = Min. Socket Length   FS = 3.0

ABC

- https://transportation.ky.gov/StructuralDesign/Pages/Accelerated-Bridge-Construction.aspx
- Precast as much as possible
- Standard design

Panbowl Lake

Panbowl history

- Oxbow lake formed from Kentucky River
- KY 15 is located on both dams of the lake
- Kentucky River on the other side of the western dam
- Design project underway to correct water infiltration issue at the time of flooding
- Water noted flowing from KY river side into the lake during flood

Panbowl repairs

- Sheet pile wall designed and bid for west dam
- Secant pile wall of drilled shafts VE used
- Wall constructed in 2023
- Additional work began on the east dam and over flow areas in 2024

Then landslide repairs

- Over 300 landslides drilled by our office
- Maybe 15-20% of the total
- Rockline soundings and lots of them!!!
- Standard investigation is boring every 50-100 feet along the scarp
- Most of these got 3-4 borings unless very variable rockline

Typical Rail Install

https://transportation.ky.gov/Highway-Design/Standard%20Drawings%20DGNS%202020/Sepia031.pdf
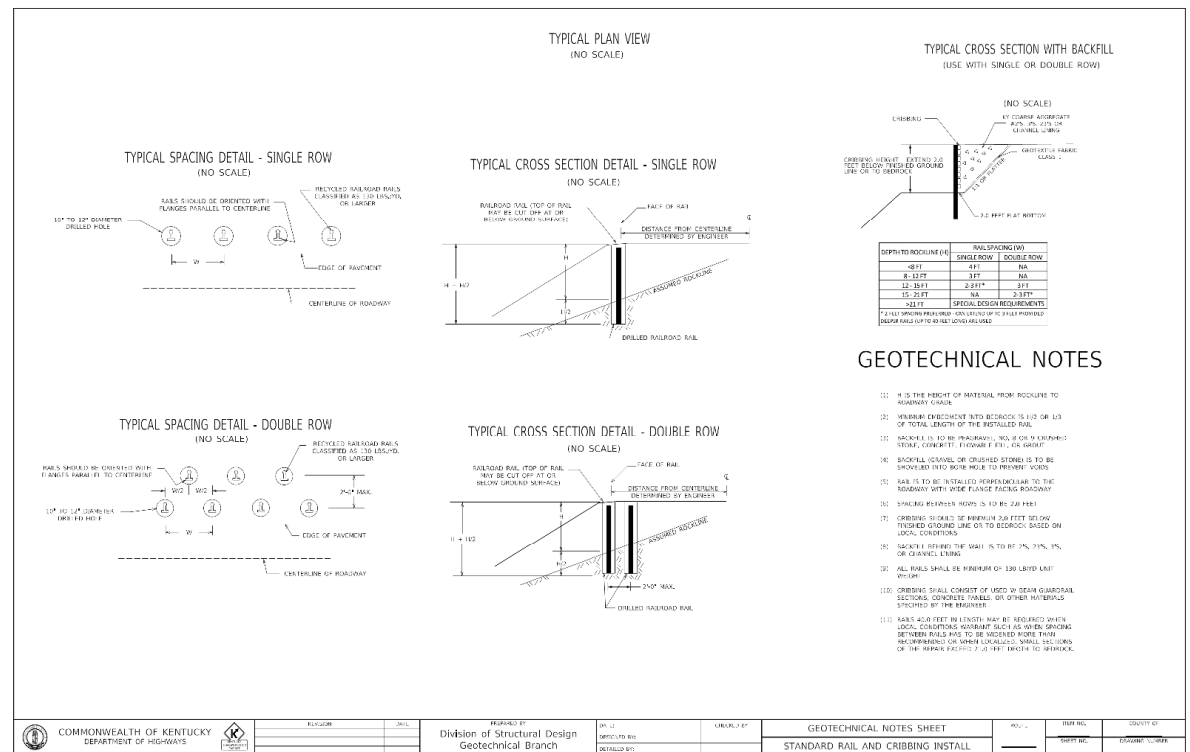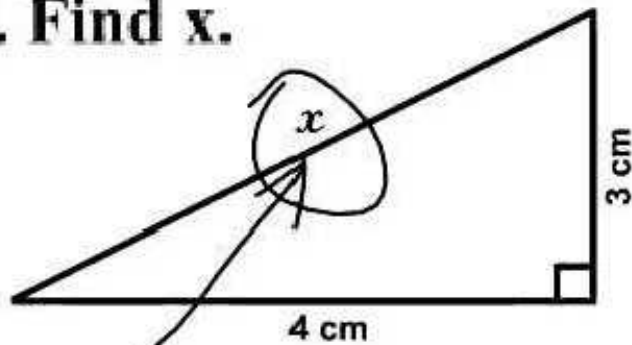
Soil Nails

- GSI on master contract with Division of Maintenance
- Used when depth to bedrock is to great for rails (~>20')
- Used when overhead clearance is an issue
- State provides traffic control and material hauling

Questions???

3. Find x.

x

3 cm

4 cm

Here it is