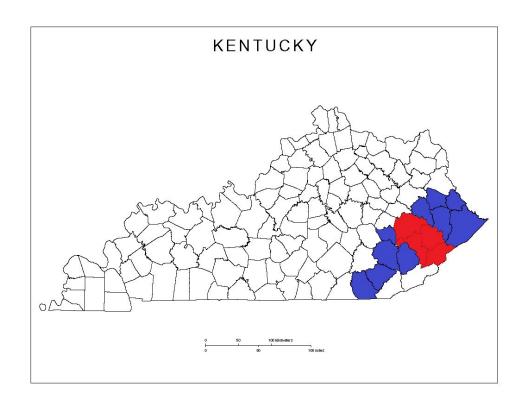
# Geotech EMS

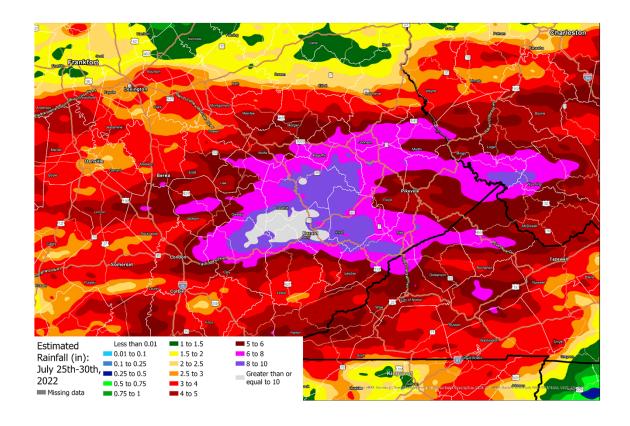
Limited Geotechnical investigations in the aftermath of flooding

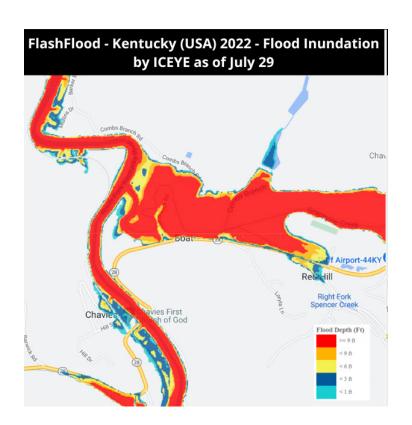
### Outline

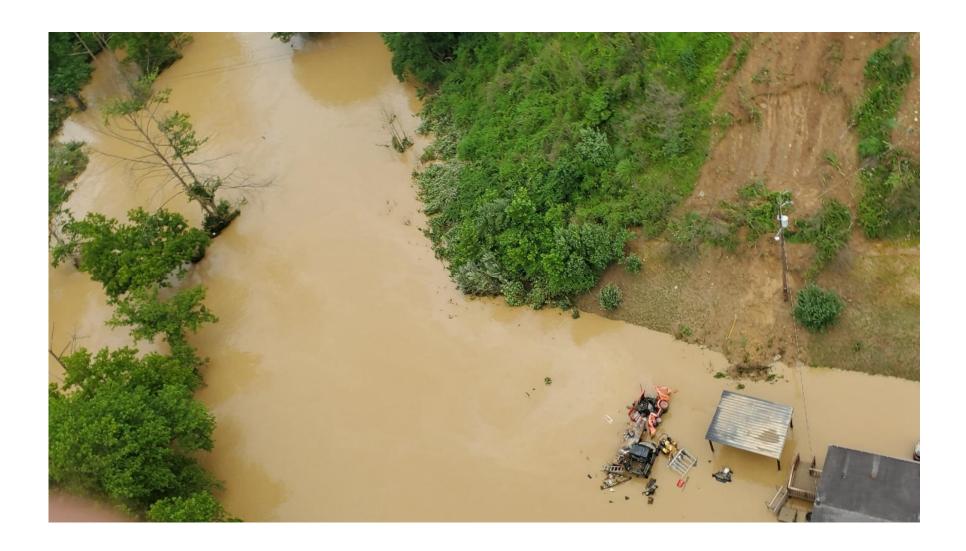
- Weather
- Damage done
- Scoping the damage
- Repair process
- Dam damage
- Sliding away

# Flood area









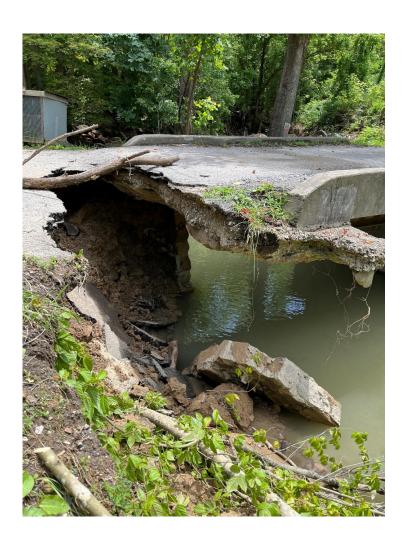


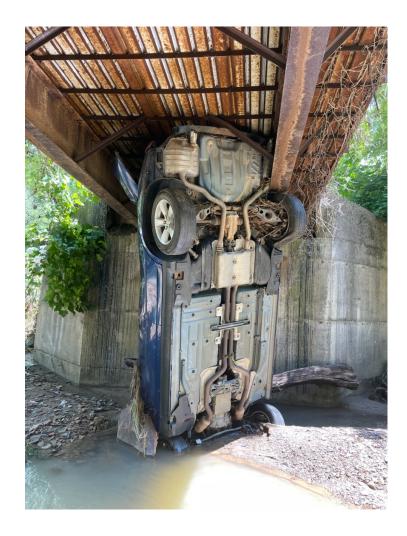










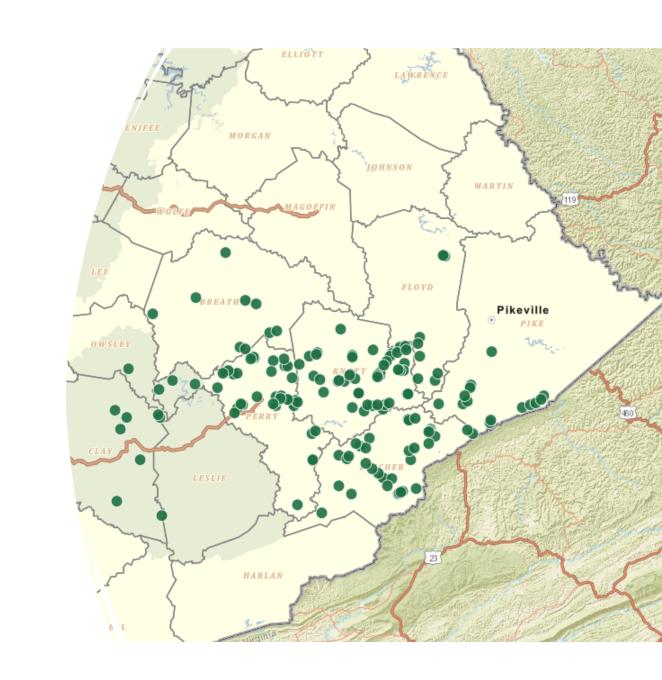






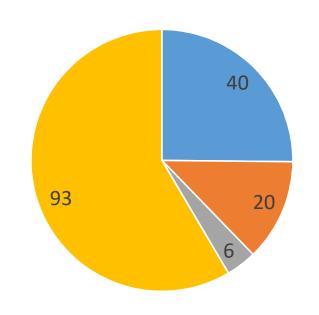






### Flooded Structures - Work Type

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



■ Repair Approach ■ Repair Toewalls

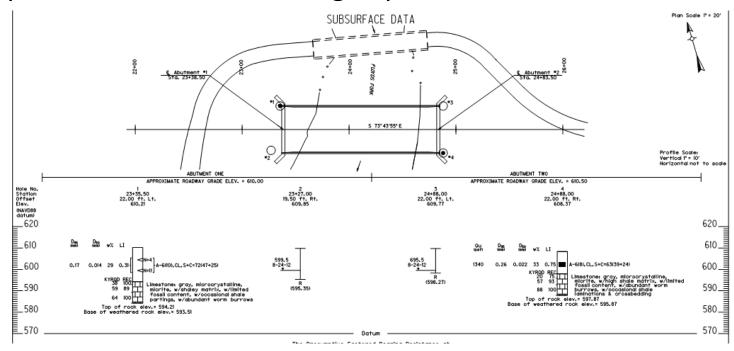
■ super replacement ■ total replacement

# 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

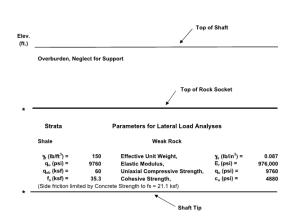
- Spread footing on rock 62 bridges
- H-piles to rock 30 bridges
- H-piles pre-drilled into rock 12 bridges
- Drilled shafts 3-4 foot 17 bridges

# Info provided

#### **IDEALIZED SOIL AND BEDROCK PROFILE**

County, Route, Structure Substructure Unit

Initials and Date



\* Elevations vary and are provided in the report body.

ADDITIONAL	DATA FOR GEO	TECHNICAL CALCUL	ATIONS ONLY:	
min. f c (psi) =	3500			
p <sub>a</sub> (psi) =	14.7			

#### Allowable Stress Design (ASD)

#### DRILLED SHAFT AXIAL CAPACITY TABLE

#### County, Route, Structure Substructure Unit

3.5 feet

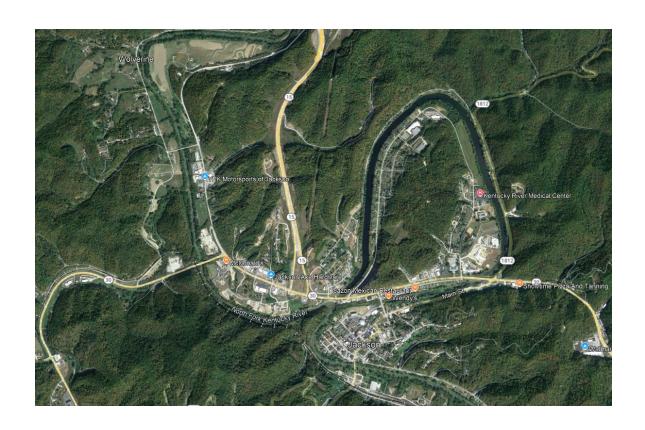
Rock Socket Diameter =

Rock   Ultimate   Unit   Unit   Side   End   Shear   Qas   Qas   Qas   Qas   (kips)   (kip	Rock Socket Diameter =		42 inches		Initials and Date				
Capacity   Capacity	Roc	k	Ultimate	Ultimate			Total	Total	Total
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Sock	et	Unit	Unit	Ultimate	Ultimate	Ultimate	Allowable	Allowable
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Leng	th	Side	End	Side	End	Axial	Axial	Uplift
(ft.) (ksf) (ksf) (kips) (kips) (kips) (kips) (kips) (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  928  577  1505  502  217  5.0  21.1  60  1160  577  1737  579  271  6.0  21.1  60  1160  577  1737  579  271  6.0  21.1  60  1160  577  1737  579  271  6.0  21.1  60  1160  577  1201  734  379  8.0  21.1  60  1624  577  2201  734  379  8.0  21.1  60  2088  577  2201  734  379  8.0  21.1  60  2320  577  2665  888  487  10.0  21.1  60  2320  577  2897  966  541  11.0  21.1  60  2784  577  3301  1120  580  130  21.1  60  3248  577  3359  1198  680  130  21.1  60  3248  577  3259  1198  704  140  21.1  60  3248  577  3259  1198  704  140  21.1  60  3248  577  3259  1198  704  140  21.1  60  3248  577  3251  1275  788  150  21.1  60  3480  577  4851  1507  1352  1180  20.0  21.1  60  3480  577  4851  1507  20.0  21.1  60  3480  577  4851  1507  20.0  20.0  21.1  60  4408  577  5217  1739  1083			Shear	Bearing	Shear	Bearing	Capacity	Capacity	Capacity
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  1595  502  217  5.0  21.1  60  1160  577  1737  579  271  6.0  21.1  60  1624  577  2201  734  379  8.0  21.1  60  1856  577  2201  734  379  8.0  21.1  60  1856  577  2433  811  433  9.0  21.1  60  2320  577  2897  2897  966  541  11.0  21.1  60  2320  577  2897  966  541  11.0  21.1  60  2320  577  2897  966  541  11.0  21.1  60  2784  577  3593  1198  704  14.0  21.1  60  3784  577  3825  1257  788  15.0  21.1  60  3480  577  3691  175  1860  175  1870  1880  1770  1880  1770  1880  1870  1880  1877  1880  1890  1980			qss	q <sub>eb</sub>	Q <sub>ss</sub>	Q <sub>eb</sub>	Q <sub>ut</sub>	Q <sub>at</sub>	Q <sub>up</sub>
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 1595 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 1624 577 2201 734 379 8.0 21.1 60 2088 577 2665 888 487 10.0 21.1 60 2088 577 2665 888 487 11.0 21.1 60 2320 577 2965 888 487 11.0 21.1 60 2552 577 3129 1043 595 12.0 21.1 60 3248 577 3361 1120 650 13.0 21.1 60 3248 577 3361 1120 650 13.0 21.1 60 3248 577 3825 1275 758 15.0 21.1 60 3480 577 3825 1275 758 15.0 21.1 60 3480 577 4289 1430 866 17.0 21.1 60 3944 577 4289 1430 866 17.0 21.1 60 3944 577 4289 1430 866 17.0 21.1 60 3944 577 4289 1430 866 17.0 21.1 60 3944 577 4289 1430 866 17.0 21.1 60 3944 577 4289 1430 866 17.0 21.1 60 4408 577 4521 1507 920 20.0 21.1 60 4408 577 4851 1562 1029 20.0 21.1 60 4408 577 5217 1739 1083	(ft.)		(ksf)	(ksf)	(kips)	(kips)	(kips)	(kips)	(kips)
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 1856 577 2201 734 379 8.0 21.1 60 1856 577 2201 734 339 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 2320 577 3897 966 541 11.0 21.1 60 3248 577 325 1129 650 13.0 21.1 60 3016 577 3593 1198 704 14.0 21.1 60 3248 577 3625 1275 754 15.0 21.1 60 3480 577 4057 1352 1275 754 15.0 21.1 60 3480 577 4057 1352 1275 754 15.0 21.1 60 3480 577 4521 1275 754 15.0 21.1 60 3480 577 4521 1507 920 18.0 21.1 60 3944 577 4521 1507 920 18.0 21.1 60 3480 577 4521 1507 920 18.0 21.1 60 3480 577 4521 1507 920 18.0 21.1 60 4408 577 4521 1507 920 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4640 577 5217 1739 1083		0.0							
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 2088 577 2665 888 487 11.0 21.1 60 2320 577 2897 966 541 11.0 21.1 60 2552 577 3129 1043 595 12.0 21.1 60 3016 577 3361 1120 650 13.0 21.1 60 3016 577 3393 1198 704 14.0 21.1 60 3248 577 3825 1125 758 15.0 21.1 60 3480 577 407 1352 812 16.0 21.1 60 3712 577 4289 1430 866 17.0 21.1 60 3712 577 4289 1430 866 17.0 21.1 60 3712 577 4289 1430 866 17.0 21.1 60 3944 577 4521 1507 920 18.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 5217 1739 1083		1.0	21.1	60	232	577	809	270	54
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 1160 577 1737 579 271 6.0 21.1 60 1392 577 1969 656 325 577 9.0 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 3997 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 3248 577 3893 1198 704 14.0 21.1 60 3248 577 3893 1198 704 14.0 21.1 60 3248 577 3825 1275 758 15.0 21.1 60 3400 577 3825 1275 758 15.0 21.1 60 3400 577 3407 1352 812 14.0 21.1 60 3400 577 3407 1352 812 1507 200 13.0 21.1 60 3400 577 457 1352 812 1507 920 18.0 21.1 60 3400 577 4521 1507 920 18.0 21.1 60 3400 577 4521 1507 920 18.0 21.1 60 4408 577 4521 1507 920 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 5217 1739 1083		2.0	21.1	60	464	577	1041	347	108
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 3823 1198 704 14.0 21.1 60 3248 577 3825 1275 788 15.0 21.1 60 3480 577 4057 1352 812 15.0 21.1 60 3480 577 4057 1352 812 16.0 21.1 60 3480 577 4057 1352 812 17.0 21.1 60 3480 577 4521 1507 920 18.0 21.1 60 3440 577 4521 1507 920 18.0 21.1 60 4408 577 4753 1584 974 19.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4640 577 5217 1739 1083		3.0	21.1	60	696	577	1273	424	162
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 2764 577 3361 1120 650  13.0 21.1 60 3764 577 3361 1120 650  13.0 21.1 60 3486 577 3825 1275 788  15.0 21.1 60 3480 577 4057 3825 1275 788  15.0 21.1 60 3712 577 4457 1352 812  16.0 21.1 60 3712 577 4289 1430 866  17.0 21.1 60 3944 577 4851 1507 920  18.0 21.1 60 4408 577 4985 1662 1029  20.0 21.1 60 4640 577 5217 1739 1083		4.0	21.1	60	928	577	1505	502	217
>>> 7.0		5.0	21.1	60	1160	577	1737	579	271
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 2320 577 3897 966 541 11.0 21.1 60 2552 577 3129 1043 955 12.0 21.1 60 2784 577 3361 1120 650 13.0 21.1 60 3016 577 3361 1120 650 13.0 21.1 60 3016 577 3593 1198 704 14.0 21.1 60 3248 577 3825 1275 788 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 4408 577 4521 1507 920 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4640 577 5217 1739 1083		6.0	21.1	60	1392	577	1969	656	325
9.0 21.1 60 2088 577 2665 888 487 10.0 21.1 60 2320 577 2697 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 3400 577 4289 1430 866 17.0 21.1 60 3944 577 4289 1430 866 17.0 21.1 60 3944 577 4281 1507 920 18.0 21.1 60 4408 577 4521 1507 920 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4640 577 5217 1739 1083	>>	7.0			1624	577			
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11.0 21.1 60 2552 577 3129 1043 595 12.0 21.1 60 2764 577 3361 1120 650 13.0 21.1 60 3016 577 3593 1198 704 14.0 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 4408 577 4521 1507 920 20.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4640 577 5217 1739 1083		9.0	21.1	60	2088	577	2665	888	487
12.0 21.1 60 2784 577 3381 1120 650 13.0 21.1 60 3016 577 3593 1198 704 14.0 21.1 60 3248 577 3825 1275 788 15.0 21.1 60 3480 577 4057 1352 812 16.0 21.1 60 3480 577 4057 1352 812 17.0 21.1 60 3712 577 4289 1430 886 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 4753 1584 974 19.0 21.1 60 4408 577 4753 1584 974 19.0 21.1 60 4640 577 5217 1739 1083		10.0	21.1	60	2320	577	2897	966	541
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 312 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		11.0	21.1	60	2552	577	3129	1043	595
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 4821 1507 920 18.0 21.1 60 4476 577 4753 1584 974 19.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4640 577 5217 1739 1083									
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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		14.0	21.1	60	3248	577	3825	1275	758
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		15.0					4057	1352	812
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		16.0			3712	577		1430	
19.0 21.1 60 4408 577 4985 1662 1029 20.0 21.1 60 4640 577 5217 1739 1083		17.0	21.1			577	4521	1507	
20.0 21.1 60 4640 577 5217 1739 1083								1584	
D (ft.) = 3.5		19.0	21.1	60	4408	577			
		20.0	21.1	60	4640	577	5217	1739	1083
>>> = Min. Socket Length FS = 3.0	• • • • • • • • • • • • • • • • • • • •							D (ft.) =	3.5
	>>> = Min. Socket Length						FS =	3.0	

### ABC

- <a href="https://transportation.ky.gov/StructuralDesign/Pages/Accelerated-Bridge-Construction.aspx">https://transportation.ky.gov/StructuralDesign/Pages/Accelerated-Bridge-Construction.aspx</a>
- 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

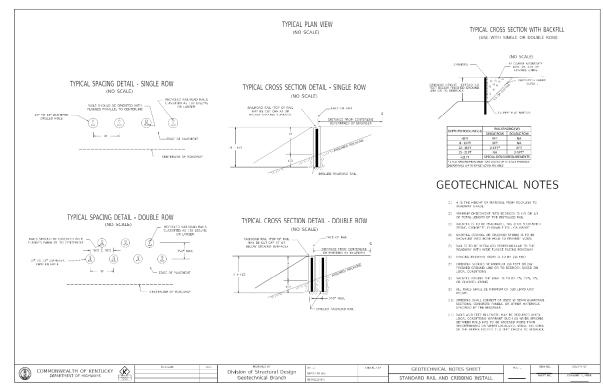
- Sheet pile wall designed and bid for west dam
- Secant pile wall of drilled shafts VE used
- Wall constructed in 2023
- Additional work began on the east dam and over flow areas in 2024

### 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???

