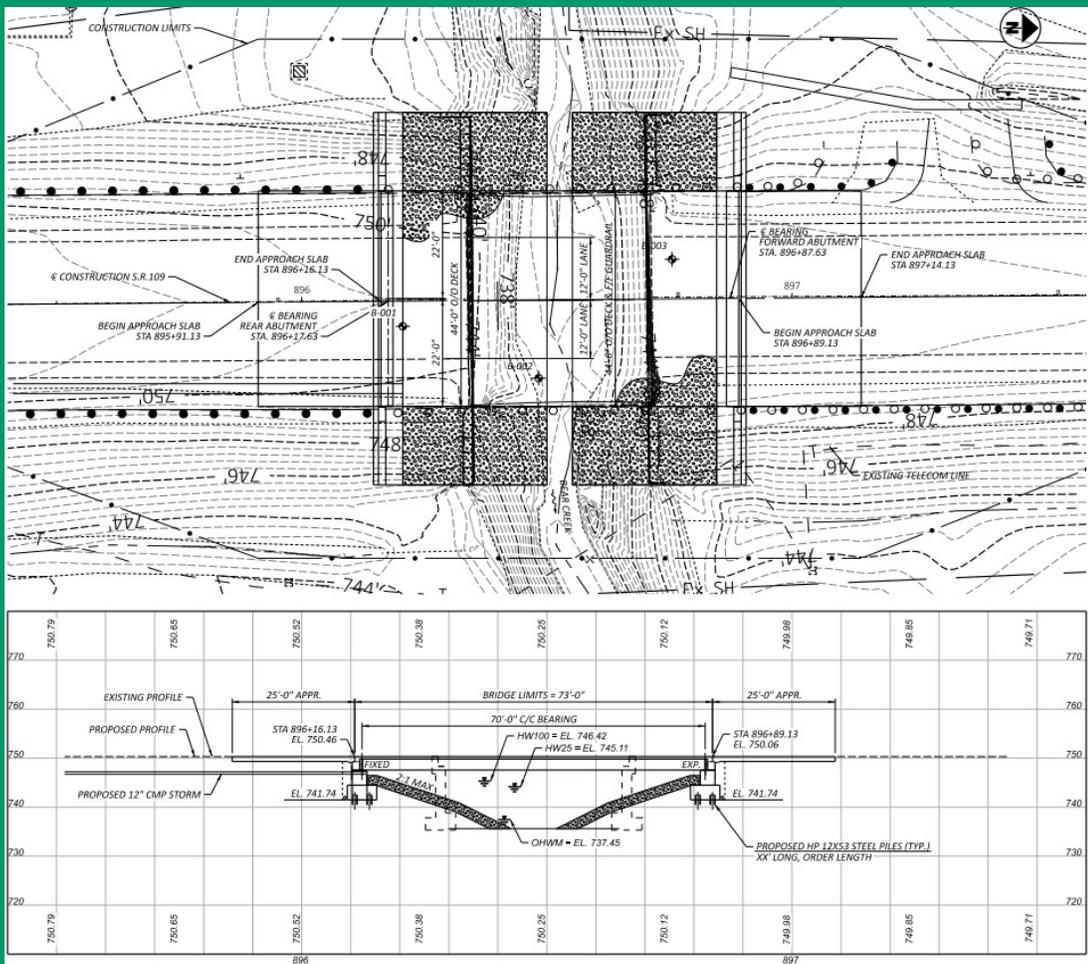


FINAL STRUCTURE EXPLORATION REPORT

FUL-109-16.98, PID 102931

Bridge No. FUL-109-1698

Replacement of the existing structure on SR 109 over Bear Creek in Fulton County; in addition to necessary related work.



Submitted to ODOT District 2
February 2025

Prepared by
ODOT Office of Geotechnical Engineering



EXECUTIVE SUMMARY

Subgrade:

For short projects in terms of subgrade construction, such as bridge replacement projects, typically use Appendix C of the PDM or match the existing pavement buildup. The normal procedures of subgrade compaction and proof rolling as per the ODOT Location and Design Manual, Volume 3 (L&D V3) Plan Note G121 do not apply.

Structures:

Driven piles are recommended at the forward and rear abutments of bridge no. FUL-109-1698, over Bear Creek. CIP friction piles (pipe piles) are recommended to support the bridge where bedrock was not encountered in any of the project or historic borings. See the Analyses and Recommendations section for recommended pile sizes, estimated and order lengths, and recommended pile wall thicknesses for pipe piles.

Temporary sheet pile shoring will not be required for the construction of the bridge at either the rear or the forward abutments. However, a pay item for Cofferdams and Excavation Bracing is required in accordance with the BDM Section 307.10.3.1 when excavation extends below the ground water table or below an elevation defined as 3-ft above the OHWM.

Recommendations have been provided in the Analysis and Recommendations Section for each applicable structure.

INTRODUCTION

This project will enhance safety on SR109 by replacing the existing SR 109 structure over Bear Creek in Fulton County. The project also includes performing necessary related work.

This document includes the geotechnical exploration and roadway and bridge foundation recommendations for the proposed SR109 bridge replacement. Geotechnical exploration for the roadway subgrade was not performed.

This exploration and the design recommendations presented were performed and prepared in accordance with the following design manuals and specifications:

- ODOT Specifications for Geotechnical Explorations (SGE), July 2024.
- ODOT Bridge Design Manual (BDM), January 2025.
- ODOT Geotechnical Design Manual, January 2025.
- AASHTO LRFD Bridge Design Specifications (AASHTO BDS), 10TH Edition, 2024.

GEOLOGY AND OBSERVATIONS OF THE PROJECT

Geology

The project is located within the Maumee Lake Plains physiographic region at the transition with the Maumee Sand Plains of the larger Huron-Erie Lake Plains section. This area is characterized by very low relief from an ice-aged lake basin with slightly dissected modern stream channels. The Ohio Department of Natural Resources (ODNR) interactive geologic map indicates that the area contains predominately cohesive soils with areas of non-cohesive soils found associated with beach ridges, bars, dunes and deltas. The overburden soils are underlain by Shale and Sandstone of the Coldwater Shale and Sunbury Shale, Berea Sandstone, and Bedford Shale, undivided, all of Mississippian age.

Observations of the Project

Field reconnaissance was completed by personnel from the Office of Geotechnical Engineering (OGE) on June 29, 2022. The existing structure was noted as being in poor condition with a cracked concrete beam present. The roadway was in very good condition from a recent resurfacing project. The existing stream channel was well vegetated with slight sediment buildup upstream from the structure. No signs of bank erosion were noted. Beyond the well vegetated riparian corridor and grassy right of way the adjacent area was noted as agricultural and commercial.

EXPLORATION

Historic Records

No historical geotechnical records were found for this project.

Project Exploration

Three (3) borings, B-001-0-22 through B-003-0-22, were completed as part of the subsurface exploration between July 25 and 27, 2022, utilizing a truck mounted CME 55 rotary drill rig. The borings were advanced through overburden soils using 3.25-inch I.D. Hollow stem augers. Disturbed soil samples were collected in accordance with the standard penetration test (AASHTO T206) at continuous, 2.5, and 5.0-foot intervals. The hammer system used was calibrated on April 18, 2022, with a drill rod energy ratio (ER) of 87%.

EXPLORATION FINDINGS

Borings B-001-0-22 and B-003-0-22 were completed adjacent to the abutments within the existing roadway, encountering 13 and 11-inches of asphalt, respectively. Beneath the surface materials, both borings encountered non-cohesive materials classified as very loose to medium dense Fine Sand (A-3) and Coarse and Fine Sand (A-3a) each ranging from damp to moist in condition. At elevation 741.7 feet, B-001-0-22 encountered cohesive soils alternating in layers of soft to very stiff Sandy Silt (A-4a) and stiff to hard Silt and Clay (A-6a) each in moist condition into which the boring was terminated. At elevation 741.3 feet, B-003-0-22 encountered very stiff Sandy Silt (A-4a) in moist condition underlain by very stiff to hard Silt and Clay (A-6a) in damp to moist condition into which the boring was terminated.

Boring B-002-0-22 was completed through the existing structure for collection of scour samples, initially cored through the bridge deck encountering 4.5-inches of asphalt and 8-inches of concrete. From bridge deck to stream bed measured 14-feet in depth. At elevation 735.8 feet, B-002-0-22 encountered very stiff to hard Silt and Clay (A-6a) in damp to moist condition into which the boring was terminated.

Test results of sandy silt (A-4a) and Silt and Clay (A-6a) soil samples revealed slightly to moderately organic conditions ranging from 3.0 to 4.0% organic content in B-001-0-22 SS-6 and SS-7 and B-003-0-22 SS-5. These results are presented in tabular form, see organic content by loss on ignition test table.

Free water was noted in B-001-0-22 and B-002-0-22 at elevations 735.7 and 735.8 feet, respectively. B-003-0-22 was dry upon completion.

ANALYSES AND RECOMMENDATIONS

It is understood that the existing three-span SR 109 bridge over Bear Creek will be replaced with a single-span new bridge. The recommended foundation type is 14-inch diameter cast-in-place reinforced concrete piles. This report provides roadway subgrade, bridge foundation, and temporary shoring recommendations.

Roadway Subgrade

For short projects in terms of subgrade construction, such as bridge replacement projects, typically use Appendix C of the PDM or match the existing pavement buildup. The normal procedures of subgrade compaction and proof rolling as per the ODOT Location and Design Manual, Volume 3 (L&D V3) Plan Note G121 do not apply. Only if the District is concerned about subgrade issues and wants to include contingency quantities, use the plan note provided in Appendix A: Geotechnical Plan Notes.

Bridge Foundations, FUL-109-1698, over Bear Creek:

Based on the provided bridge loads; the recommended foundation type is presented below. We have performed drivability analyses to determine pile driving stresses, steel grade, and minimum pile wall thicknesses.

Table 14-inch Cast-in-Place Reinforced Concrete Pile Foundation Recommendations

FUL-109-16.98, PID 102931
Structure Exploration Report - February 2025

Substructure Unit and Soil Boring	Factored Load (kips)	UBV (kips)	Frictional Resistance Lost Due to Scour (kips)	Pile Type and Size	Geotechnical Pile Length (ft)	Estimated Length (ft)	Order Length (ft)	Pile Thickness (in)
Rear Abutment B-001-0-24	154	231	11	14" CIP Pile	39.5	45	50	0.250
Forward Abutment B-003-0-24	154	231	11	14" CIP Pile	48.5	50	55	0.250

¹ the Geotechnical Pile Length includes the Pile Cap Embedment depth of 1.0 ft at the abutments.

² Steel for 14" CIP conforms to ASTM A252, Grade 3

For the 14-inch CIP reinforced concrete piles, according to the BDM Equations C305.3.2.4-4 and C305.3.2.4-5 and based on the calculated EOID and UBV values, the estimated driving resistance indicates that driving losses would result in an increase in pile length during driving by more than 10 feet at EOID as compared to the UBV, and thus, soil setup need to be accounted for in the design at the abutment piles.

We have performed GRLWEAP drivability analyses and find that the driving stresses in the piles will not exceed the permissible driving stresses for Steel CIP Piles ASTM A252, Grade 3 - Yield Strength 45 ksi, using the minimum pile wall thickness of 0.250 in. The driving stresses must be kept below 90% of the steel yield strength per AASHTO LRFD Bridge Design Specifications Article 10.7.8. For Grade 3 Steel with yield strength of 45 ksi, the compressive driving stresses must be kept below 40.5 ksi.

As the bridge has short capped-pile stub abutments, we anticipate the lateral loadings on the piles to be insignificant (and their freedom of movement to be extremely limited), and therefore, we do not consider LPILE analyses or other lateral load analyses on the bridge foundations to be necessary. The piles have a factored shear resistance more than 10 times the factored lateral load provided by the structural designer at the abutments.

The current cohesive streambed elevation is approximately 735.8 feet. Scour holes are predicted up to approximately 3 feet deep from the bottom of abutment footing elevations, extending to elevation 738.74 ft for the design and check flood events at the rear and forward abutments. The scour hole would result in a loss of frictional resistance due to scour of approximately 11 (kips) for the piles. Pile downdrag and drag loading are not anticipated to be significant, as there is a minimal change in the grade behind the proposed abutment. No assessment of overall (global) stability has been performed, as there was no instability noted in the field and there is to be minimal to no change in the existing grade. Based on the encountered overburden at the project site, conical pile points are not required to protect the piles, per the BDM 305.3.5.6.

Temporary Shoring

Temporary shoring at the roadway elevation will not be required for the construction of the bridge at either the rear or the forward abutments. However, in accordance with the BDM Section 307.10.3.1, a pay item for Cofferdams and Excavation Bracing is required when excavation extends below the ground water table or below an elevation defined as 3-ft above the OHWM. Thus, Cofferdams is not required at the front face of the rear and the forward abutments, but it might be needed for the removal of the existing abutment walls to top of footings and placement of the rock channel protection. Check to see if this is needed or add a note to state limit the excavation elevation to 740.45 ft.

CLOSING REMARKS

If you have any questions, please feel free to contact either myself at 614-387-2379, or Alex Dettloff, at 614-275-1308.

Thank you,
AM

APPENDICES

- Appendix A: Geotechnical Plan Notes.
- Appendix B: Snapshot of ODNR Bedrock Topography of the Lyons, Ohio, Quadrangle Map at the Project Site.
- Appendix C: Boring Location Plan
- Appendix D: Project Boring Logs
- Appendix E: Grain Size Distribution Charts.
- Appendix F: Calculations
- Appendix F-1: Pile Nominal Resistance versus Embedment Depth Graphs
 - REAR ABUTMENT – B-001-0-24:
 - FORWARD ABUTMENT – B-003-0-24
- Appendix F-2: GRLWEAP Drivability Analyses
 - REAR ABUTMENT – B-001-0-24:
 - FORWARD ABUTMENT – B-003-0-24

Appendix A: Geotechnical Plan Notes

Use the following plan note, only if the District is concerned about subgrade issues and wants to include contingency quantities:

UNSTABLE OR UNSUITABLE SOILS FOR PAVEMENT STABILIZATION:

THE FOLLOWING ITEMS AND QUANTITIES ARE TO BE USED AS DIRECTED BY THE ENGINEER TO ADDRESS UNSTABLE OR UNSUITABLE SOILS ENCOUNTERED BELOW THE PROPOSED SUBGRADE ELEVATION IN THE AREAS OF PAVEMENT CONSTRUCTION

- ITEM 204 - EXCAVATION OF SUBGRADE, 100 CY
- ITEM 204 - GRANULAR MATERIAL, TYPE B, 100 CY
- ITEM 204 - GEOTEXTILE FABRIC, 50 SY

The following plan notes need to be included with the Project Plans:

Add to the BDM Sample Note [602.3-1] DESIGN DATA:
STEEL CIP PILES - ASTM A252 GRADE 3 - YIELD STRENGTH 45 KSI.

SCOUR ELEVATIONS:

THE DESIGN FLOOD AND CHECK FLOOD SCOUR ELEVATIONS ARE PROVIDED BELOW:

	REAR ABUTMENT	FORWARD ABUTMENT
DESIGN FLOOD	738.74	738.74
CHECK FLOOD	738.74	738.74

PILE DESIGN LOADS (ULTIMATE BEARING VALUE):

THE ULTIMATE BEARING VALUE (UBV) IS 231 KIPS PER PILE FOR THE FORWARD AND REAR ABUTMENT PILES. THE UBV FOR THE ABUTMENT PILES INCLUDES AN ADDITIONAL 11 KIPS PER PILE DUE TO THE POSSIBILITY OF LOSING 3.0 FT. OF FRICTIONAL RESISTANCE DUE TO SCOUR.

- REAR ABUTMENT PILES:
 - 14" CIP REINFORCED CONCRETE PILES, 50 FEET LONG, ORDER LENGTH
- FORWARD ABUTMENT PILES:
 - 14" CIP REINFORCED CONCRETE PILES, 55 FEET LONG, ORDER LENGTH
 - 1 DYNAMIC LOAD TESTING ITEMS
 - 1 RESTRIKE LOAD TESTING ITEMS

PROVIDE PLAIN CYLINDRICAL CASINGS WITH A MINIMUM PILE WALL THICKNESS OF 0.25 INCH FOR THE CAST-IN-PLACE REINFORCED CONCRETE PILES.

PILES DRIVEN TO FULL ESTIMATED LENGTH WITH PILE/SOIL SETUP:

THE ULTIMATE BEARING VALUE (UBV) IS 231 KIPS PER PILE FOR THE FORWARD AND REAR ABUTMENT PILES. PART OF THE UBV WILL BE ACHIEVED THROUGH PILE/SOIL SETUP, WHICH IS A TIME DEPENDENT INCREASE IN RESISTANCE THAT OCCURS IN SOME SOILS. NOTIFY THE ENGINEER AT LEAST 5 DAYS BEFORE DRIVING PILES SO THAT THE ENGINEER CAN NOTIFY THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING.

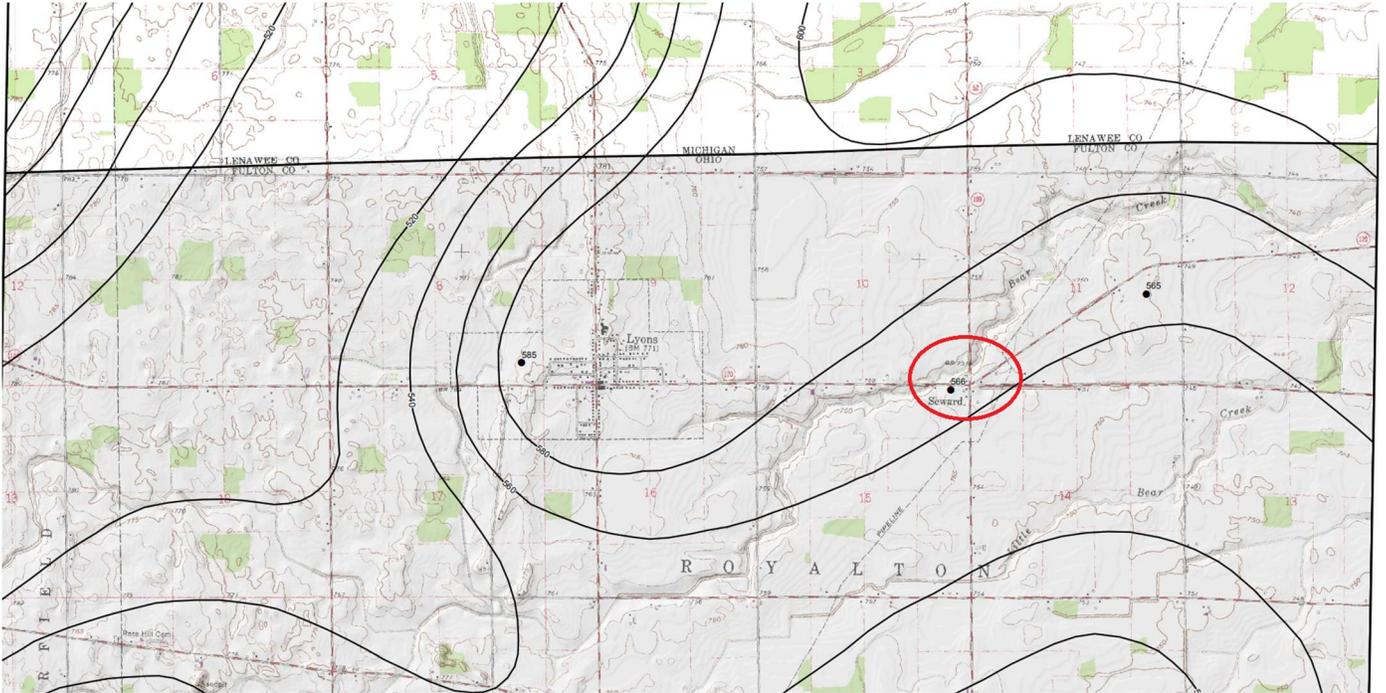
DRIVE THE FIRST TWO PILES AT THE FORWARD ABUTMENT TO THE FULL ESTIMATED LENGTH OF 50 FEET. PERFORM DYNAMIC LOAD TESTING ON BOTH PILES WHILE DRIVING. IF THE DYNAMIC LOAD TESTING DURING THE INITIAL DRIVING (BEFORE THE WAITING PERIOD) INDICATES A PILE HAS ACHIEVED THE REQUIRED UBV PRIOR TO DRIVING THE FULL ESTIMATED LENGTH, STOP DRIVING AND NOTIFY THE ENGINEER. AFTER DRIVING AND TESTING THE FIRST TWO PILES, DRIVE THE REMAINING PILES IN THE SUBSTRUCTURE TO THE SAME DEPTH AS THE FIRST TWO PILES. AFTER DRIVING ALL PILES TO THE ESTIMATED LENGTH, CEASE ALL DRIVING OPERATIONS AT THE SUBSTRUCTURE FOR A PERIOD OF 14 DAYS. INCLUDE THE WAITING PERIOD AS A SEPARATE ACTIVITY IN THE PROGRESS SCHEDULE. AFTER THE WAITING PERIOD, PERFORM PILE RESTRIKES ON BOTH OF THE FIRST TWO PILES (ONE RESTRIKE ITEM). SUBMIT ALL TEST RESULTS TO THE ENGINEER. IF THE RESTRIKE TEST RESULTS INDICATE THAT BOTH PILES ACHIEVED THE REQUIRED UBV, ALL PILES IN THE SUBSTRUCTURE MAY BE ACCEPTED BY THE ENGINEER.

IF THE RESTRIKE TEST RESULTS INDICATE THAT EITHER OF THE TWO PILES DID NOT ACHIEVE THE REQUIRED UBV, IMMEDIATELY NOTIFY THE ENGINEER SO THAT THE ENGINEER CAN NOTIFY THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING. THE ENGINEER WILL REVIEW THE TEST RESULTS AND ESTABLISH ADDITIONAL RESTRIKE TESTING OR DRIVING CRITERIA FOR THE PILING IN THE SUBSTRUCTURE WITH THE ASSISTANCE OF THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING.

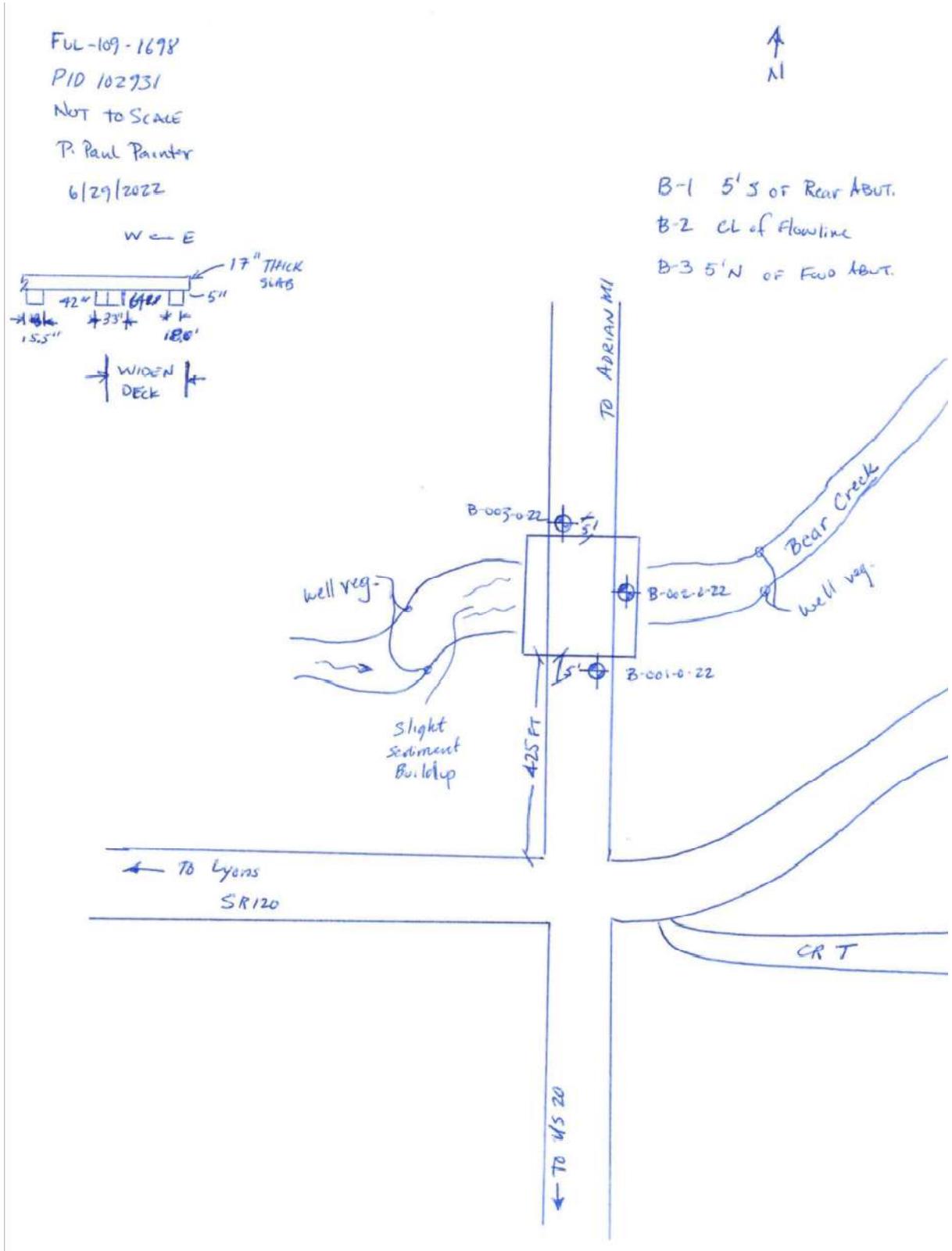
IF DIRECTED BY THE ENGINEER, PERFORM ADDITIONAL RESTRIKE TESTING OR DRIVE ALL PILES IN THE SUBSTRUCTURE TO THE ESTABLISHED DRIVING CRITERIA. THE DEPARTMENT WILL PAY FOR SPLICING OF THE PILES BEYOND THE ESTIMATED LENGTH PROVIDED IN THE PLANS UNDER C&MS 109.05 WITH A NEGOTIATED PRICE PER SPLICE.

THIS PLAN NOTE INCLUDES A QUANTITY OF ONE EACH ITEM 523 DYNAMIC LOAD TESTING, AS PER PLAN AND A QUANTITY OF ONE EACH ITEM 523 RESTRIKE, AS PER PLAN PER EACH SUBSTRUCTURE UNIT.

Appendix B: Snapshot of ODNR Bedrock Topography of the Lyons, Ohio, Quadrangle Map at the Project Site



Appendix C: Boring Location Plan



Appendix D: Project Boring Logs

FUL-109-16.98, PID 102931
Structure Exploration Report - February 2025

PROJECT: FUL-109-16.98		DRILLING FIRM / OPERATOR: ODOT / CAREY		DRILL RIG: CME 55 TRUCK		STATION / OFFSET: _____		EXPLORATION ID											
TYPE: BRIDGE		SAMPLING FIRM / LOGGER: ODOT / MCLEISH		HAMMER: CME AUTOMATIC		ALIGNMENT: CL SR 109		B-001-0-22											
PID: 102931 SFN: _____		DRILLING METHOD: 3.25" HSA		CALIBRATION DATE: 4/18/22		ELEVATION: 750.2 (ft) EOB: 50.0 ft.		PAGE											
START: 7/25/22 END: 7/26/22		SAMPLING METHOD: SPT		ENERGY RATIO (%): 87		LAT / LONG: 41.701056, -84.036816		1 OF 1											
MATERIAL DESCRIPTION AND NOTES		ELEV.	DEPTHS	SPT/RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
									GR	CS	FS	SI	CL	LL	PL	PI			
ASPHALT (13")		750.2																	
MEDIUM DENSE, BROWN, COARSE AND FINE SAND, TRACE STONE FRAGMENTS, TRACE SILT, TRACE CLAY, DAMP		749.1	1	7															
VERY LOOSE, BROWN, FINE SAND, TRACE COARSE SAND, TRACE SILT, TRACE CLAY, DAMP		747.2	2	6	14	56	SS-1	-	9	13	65	7	6	NP	NP	NP	5	A-3a (0)	
			3	2	4	50	SS-2	-	0	6	86	6	2	NP	NP	NP	5	A-3 (0)	
			4	1	2														
			5	1	3	67	SS-3	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			6	1	1														
			7	1	3	78	SS-4	-	-	-	-	-	-	-	-	-	6	A-3 (V)	
			8																
SOFT, BROWN AND GRAY, SANDY SILT, SOME CLAY, TRACE GRAVEL AND STONE FRAGMENTS, MODERATELY ORGANIC, MOIST		741.7	9	1	3	89	SS-5	0.25	-	-	-	-	-	-	-	-	20	A-4a (V)	
@11.0'; MODERATELY ORGANIC (LOI = 4.0%)			10	1	1														
			11	1	3	67	SS-6	0.25	3	6	39	30	22	24	14	10	23	A-4a (3)	
STIFF, BROWN WITH GRAY, SILT AND CLAY, SOME SAND, TRACE GRAVEL AND STONE FRAGMENTS, SLIGHTLY ORGANIC (LOI = 3.7%), MOIST		737.7	12	1	1														
			13	1	3	7	SS-7	1.00	7	5	21	32	35	26	14	12	21	A-6a (7)	
VERY STIFF, GRAY, SILT AND CLAY, LITTLE SAND, TRACE GRAVEL, MOIST		736.2	14	4	7	25	SS-8	4.00	4	5	11	33	47	28	13	15	14	A-6a (10)	
@15.5'; SPLITSPOON BLOCKED BY LARGE STONE FRAGMENTS			15	7	10														
			16	22	22	68	SS-9	4.00	9	4	9	35	43	27	13	14	14	A-6a (10)	
			17	22	25														
			18	12	8	26	SS-10	4.00	3	4	11	34	48	28	13	15	15	A-6a (10)	
@18.5' - 22.5'; HARD, USED 3" SPLITSPOON FOR SAMPLE, LITTLE GRAVEL			19	8	10														
			20	19	21	64	SS-11	4.00	18	3	8	30	41	27	14	13	13	A-6a (8)	
			21	21	23														
			22	15	20	55	SS-12	4.00	-	-	-	-	-	-	-	-	14	A-6a (V)	
			23	18															
@23.5'; CONTAINS TRACE SILT SEAMS			24	8	12	39	SS-13	4.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
			25	15															
@26.0'; VERY STIFF			26	10	12	39	SS-14	3.50	3	1	5	46	45	24	13	11	17	A-6a (8)	
			27	15															
@28.5'; HARD			28																
			29	22	24	71	SS-15	4.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
			30	25															
			31																
			32																
			33																
VERY STIFF, GRAY, SANDY SILT, "AND" CLAY, TRACE GRAVEL, MOIST		716.7	34	30	21	55	SS-16	3.50	2	2	7	48	41	24	14	10	14	A-4a (8)	
			35	17															
			36																
			37																
			38																
HARD, GRAY, SILT AND CLAY, LITTLE SAND, TRACE GRAVEL, MOIST		711.7	39	6	12	39	SS-17	4.50	3	3	9	34	51	28	14	14	15	A-6a (10)	
			40	15															
			41																
			42																
			43																
@43.5'; VERY STIFF			44	6	10	36	SS-18	3.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
			45	15															
			46																
			47																
			48																
			49	7	11	38	SS-19	3.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
			50	15															
		700.2	EOB																

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 9/21/22 13:02 - X:\GINT\PROJECTS\600986.GPJ

NOTES: HOLE DRY UPON COMPLETION. LAT/LONG/ELEV FROM DISTRICT SURVEY GRADE INSTRUMENTS.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 25 LB. BENTONITE CHIPS

FUL-109-16.98, PID 102931
Structure Exploration Report - February 2025

PROJECT: FUL-109-16.98	DRILLING FIRM / OPERATOR: ODOT / CAREY	DRILL RIG: CME 55 TRUCK	STATION / OFFSET:	EXPLORATION ID B-002-0-22
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / MCLEISH	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR 109	
PID: 102931 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/18/22	ELEVATION: 735.8 (ft) EOB: 9.0 ft.	PAGE 1 OF 1
START: 7/26/22 END: 7/26/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87	LAT / LONG: 41.701133, -84.036779	

MATERIAL DESCRIPTION AND NOTES	ELEV. 735.8	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	ABAN- DONED
								GR	CS	FS	SI	CL	LL	PL	PI			
VERY STIFF, GRAY, SILT AND CLAY, LITTLE SAND, TRACE GRAVEL, MOIST @4.5'; HARD, DAMP @6.0'; CONTAINS WOOD FRAGMENTS, MOIST @7.5'; CONTAINS WOOD FRAGMENTS			1															
	1	1	3	6	83	SS-1	3.00	3	4	10	35	48	27	15	12	16	A-6a (9)	
	2	1	3	13	83	SS-2	3.50	4	7	10	33	46	26	15	11	16	A-6a (8)	
	3	1	6															
	4	1	4	14	89	SS-3	4.00	4	4	10	35	47	26	15	11	15	A-6a (8)	
	5	3	5	17	100	SS-4	4.50	6	4	12	36	42	25	14	11	13	A-6a (8)	
	6	3	7	23	100	SS-5	4.50	5	4	14	35	42	24	13	11	14	A-6a (8)	
	7	6	10															
	8	5	7	30	67	SS-6	4.50	4	4	11	34	47	27	15	12	16	A-6a (9)	
	726.8	EOB	9	14														

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 9/21/22 13:06 - X:\GINT\PROJECTS\600986.GPJ

NOTES: DRILLED THROUGH BRIDGE DECK (ASPHALT 4.5" & CONCRETE 8"). 14.0' FROM DECK TO STREAM BED. LAT/LONG/ELEV FROM DISTRICT SURVEY GRADE INSTRUMENTS.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: NONE

FUL-109-16.98, PID 102931
Structure Exploration Report - February 2025

PROJECT: FUL-109-16.98	DRILLING FIRM / OPERATOR: ODOT / CAREY	DRILL RIG: CME 55 TRUCK	STATION / OFFSET: CL SR 109
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: ODOT / MCLEISH	HAMMER: CME AUTOMATIC	ALIGNMENT: CL SR 109
PID: 102931 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 4/18/22	ELEVATION: 749.8 (ft) EOB: 50.0 ft.
START: 7/26/22 END: 7/27/22	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87	LAT / LONG: 41.701206, -84.036870

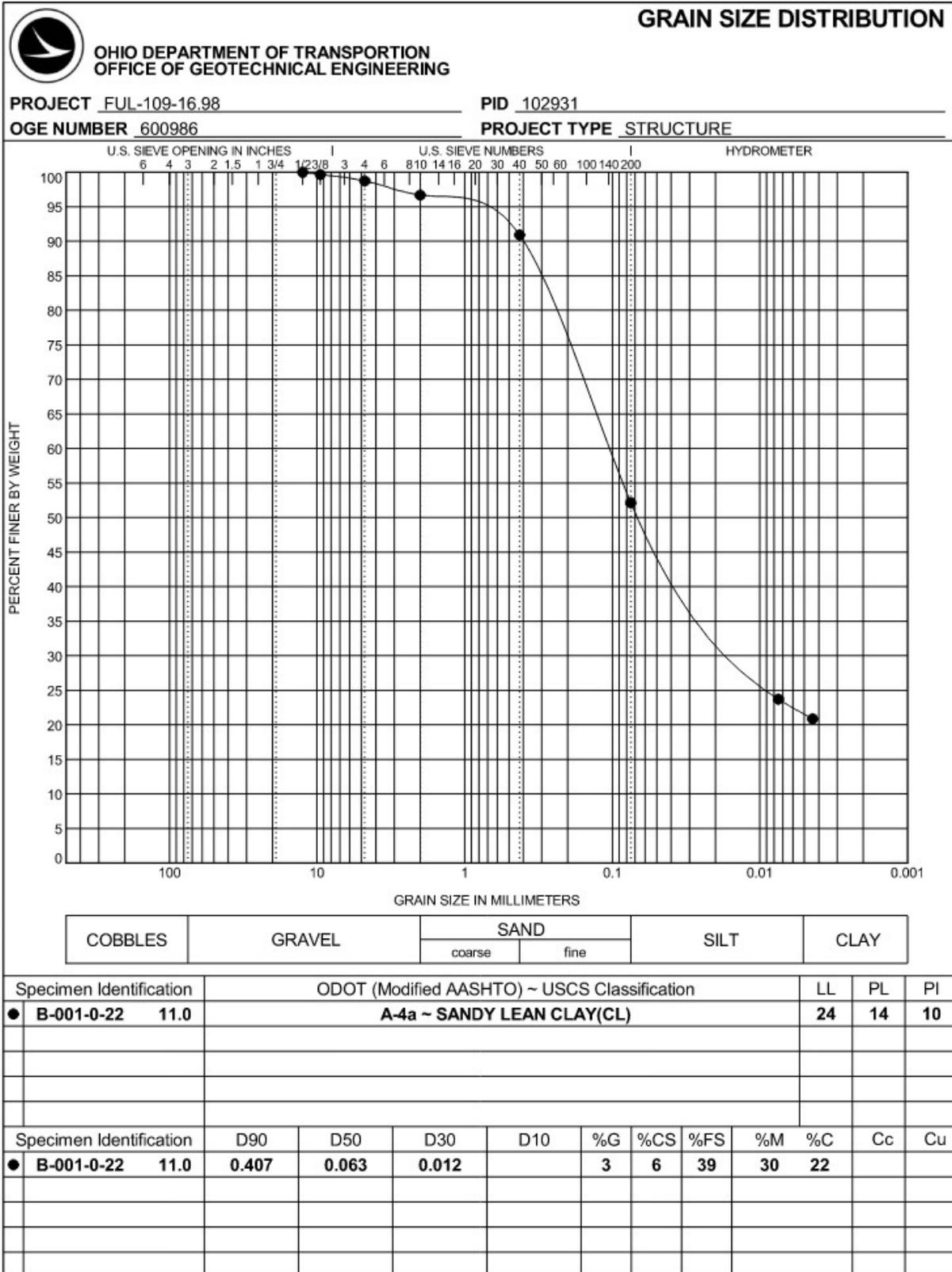
EXPLORATION ID
B-003-0-22
PAGE
1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	BACK FILL
								GR	CS	FS	SI	CL	LL	PL	PI			
ASPHALT (11")	749.8	1																
MEDIUM DENSE, BROWN, FINE SAND, TRACE SILT, TRACE COARSE SAND, TRACE CLAY, TRACE GRAVEL, DAMP	748.9	2	6	16	56	SS-1	-	1	5	83	9	2	NP	NP	NP	7	A-3 (0)	
@3.0'; LOOSE, NO GRAVEL		3	2	7	67	SS-2	-	0	3	88	6	3	NP	NP	NP	8	A-3 (0)	
		4	2	3														
		5	2	7	61	SS-3	-	-	-	-	-	-	-	-	-	8	A-3 (V)	
@6.0'; VERY LOOSE, MOIST		6	2	3														
		7	1	3	89	SS-4	-	-	-	-	-	-	-	-	-	11	A-3 (V)	
		8	1	1														
VERY STIFF, GRAY AND BROWN, SANDY SILT, SOME CLAY, TRACE GRAVEL, SLIGHTLY ORGANIC (LOI = 3.0%), MOIST	741.3	9	1	7	100	SS-5	2.50	3	7	26	30	34	26	17	9	20	A-4a (6)	
		10	2	3														
VERY STIFF, BROWN, SILT AND CLAY, LITTLE SAND, TRACE GRAVEL, DAMP	738.8	11	2	6	8	SS-6	4.00	6	5	14	32	43	27	16	11	15	A-6a (8)	
@13.5'; HARD, GRAY		12	6	8														
		13	5	9	11	SS-7	4.50	2	5	12	34	47	27	15	12	14	A-6a (9)	
@16.0'; VERY STIFF		14	5	7	12	SS-8	4.00	-	-	-	-	-	-	-	-	14	A-6a (V)	
		15	7	10	12													
@18.5'; HARD, MOIST		16	7	10	12	SS-9	4.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		17	6	9	14	SS-10	4.50	2	3	9	34	52	27	16	11	16	A-6a (8)	
		18	6	9	14													
@23.5' - 25.0'; USED 3" SPLITSPOON FOR SAMPLE.		19	8	12	15	SS-11	4.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
		20	8	12	15													
		21	5	8	14	SS-12	4.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
		22	5	8	14													
		23	7	10	14	SS-13	4.50	3	3	10	41	43	24	13	11	14	A-6a (8)	
		24	7	10	14													
		25	7	10	12	SS-14	4.00	-	-	-	-	-	-	-	-	14	A-6a (V)	
		26	7	10	12													
@38.5' - 40.0'; USED 3" SPLITSPOON FOR SAMPLE.		27	4	12	19	SS-15	4.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
		28	4	12	19													
		29	7	11	12	SS-16	4.00	6	4	8	33	49	27	14	13	16	A-6a (9)	
		30	7	11	12													
		31	7	11	12													
		32	7	11	12													
		33	7	11	12													
		34	7	11	12													
		35	7	11	12													
		36	7	11	12													
		37	7	11	12													
		38	7	11	12													
		39	7	11	12													
		40	7	11	12													
		41	7	11	12													
		42	7	11	12													
		43	7	11	12													
		44	7	11	12													
		45	7	11	12													
		46	7	11	12													
		47	7	11	12													
		48	7	11	12													
		49	8	11	12	SS-17	4.00	-	-	-	-	-	-	-	-	17	A-6a (V)	
		50	8	11	12													

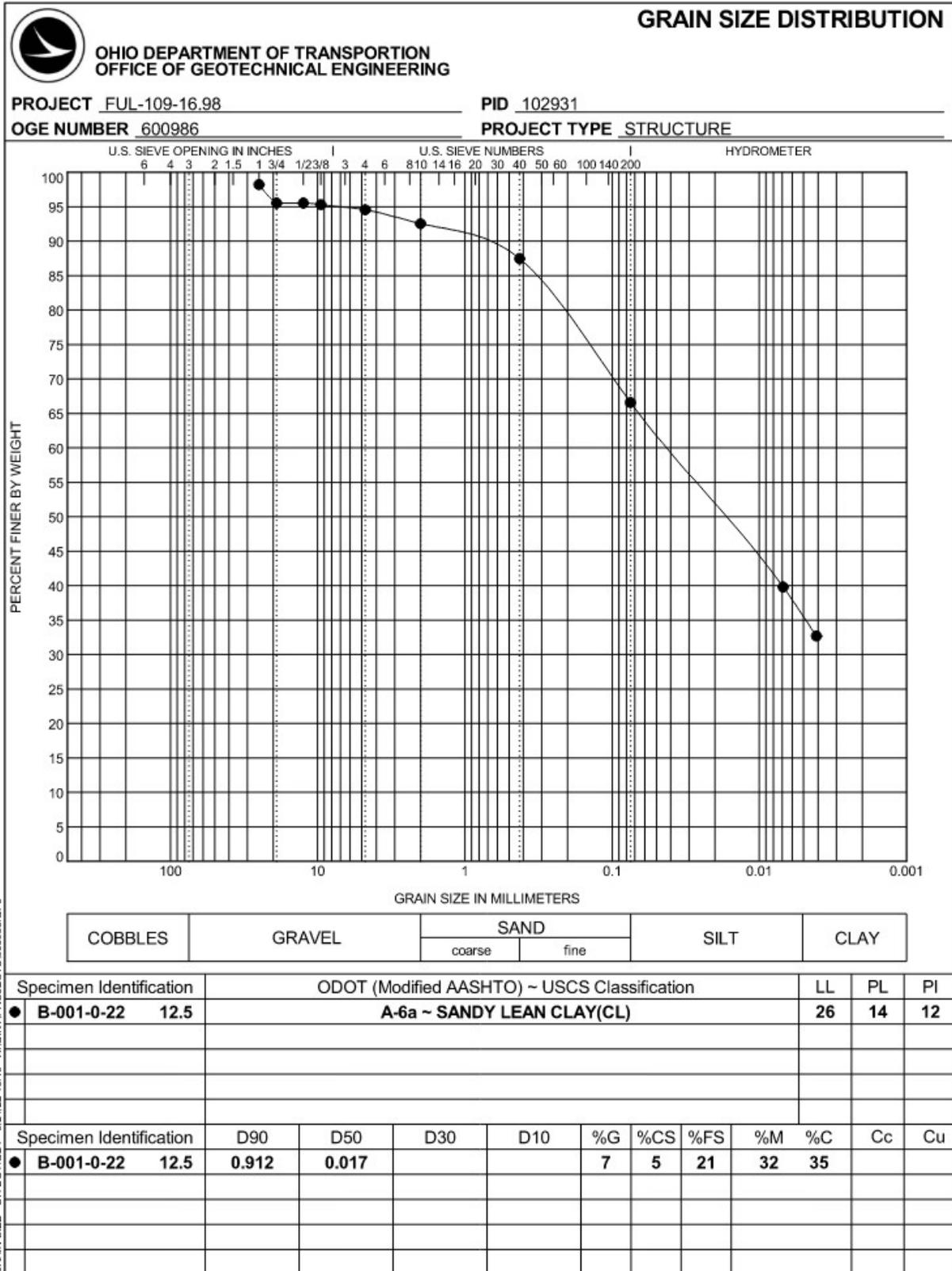
NOTES: HOLE DRY UPON COMPLETION. LAT/LONG/ELEV FROM DISTRICT SURVEY GRADE INSTRUMENTS.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH 25 LB. BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 9/21/22 13:03 - X:\GINT\PROJECTS\600986.GPJ

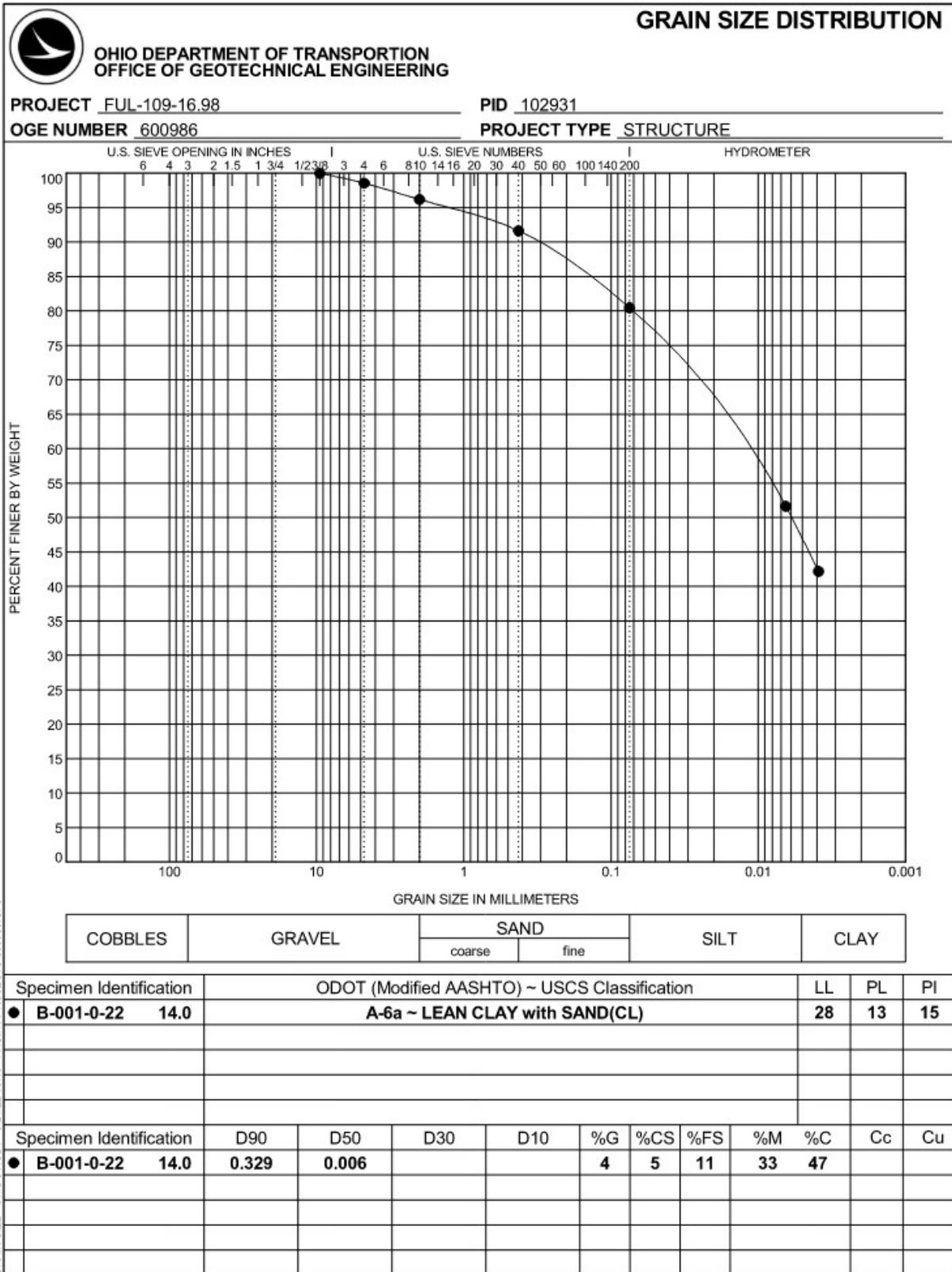
Appendix E: Grain Size Distribution Charts



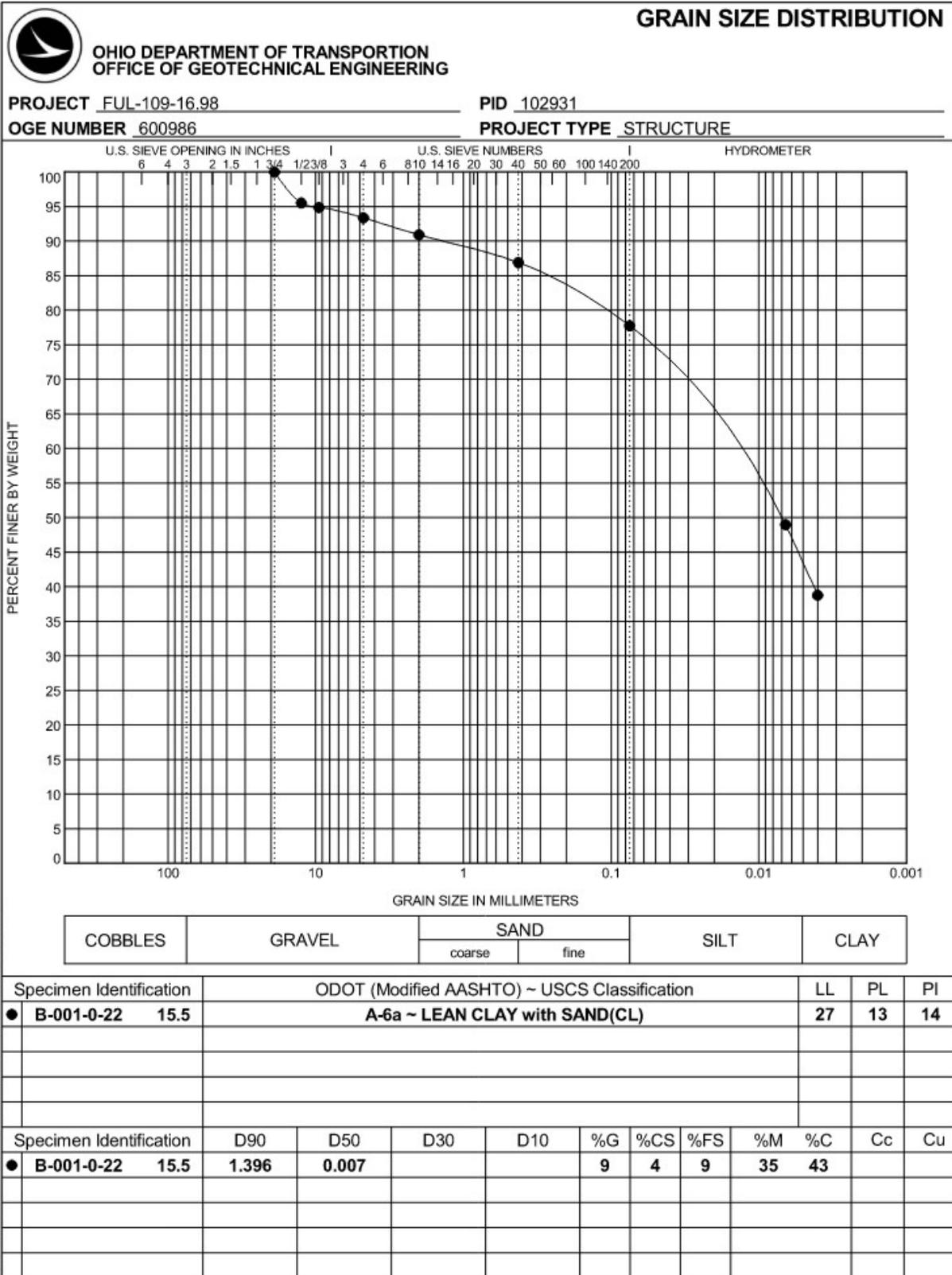
GRAIN SIZE - OH DOT.GDT - 9/21/22 13:19 - X:\GINT\PROJECTS\600986.GPJ



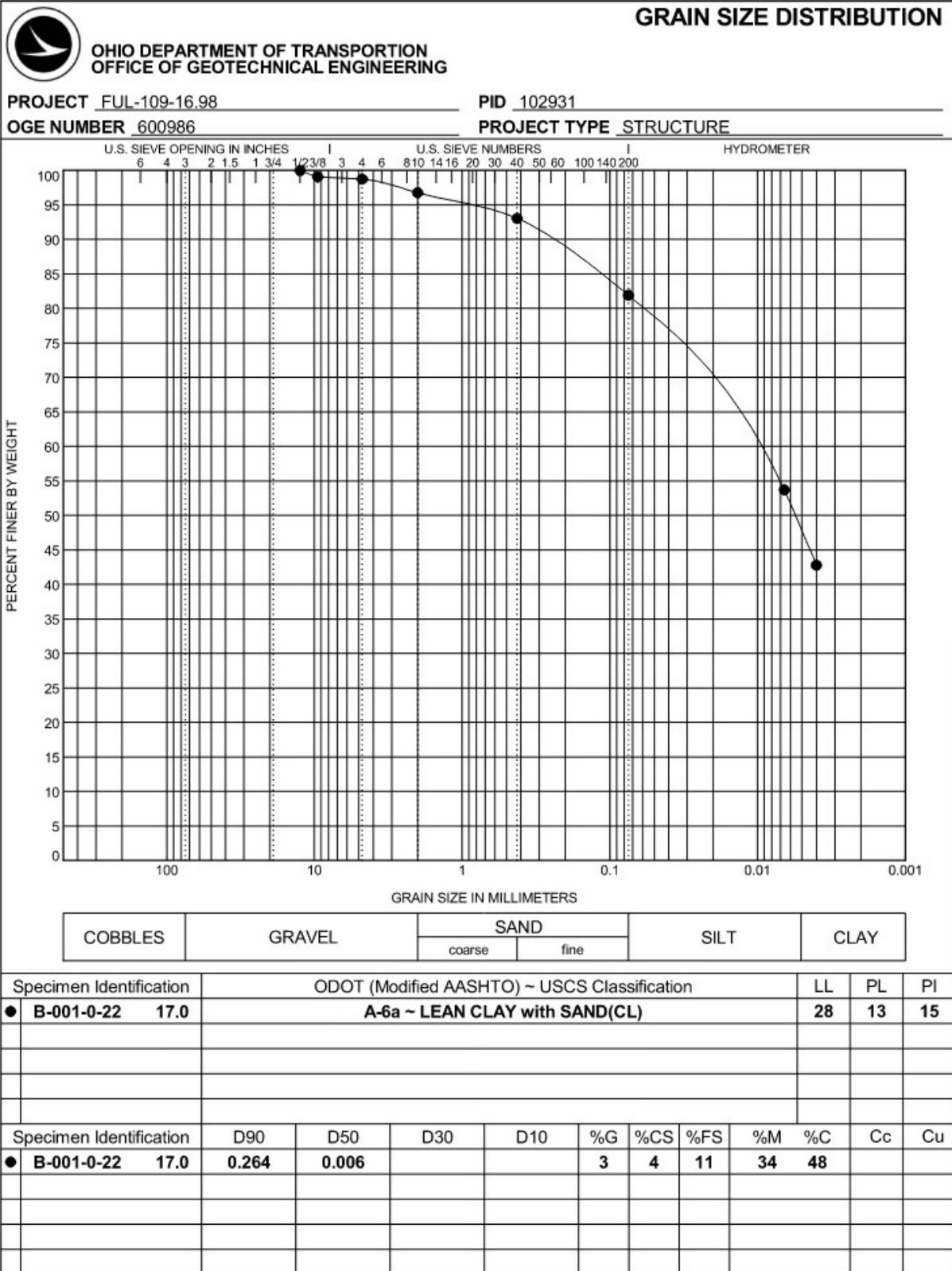
GRAIN SIZE - OH DOT.GDT - 9/21/22 13:19 - X:\GINT\PROJECTS\600986.GPJ



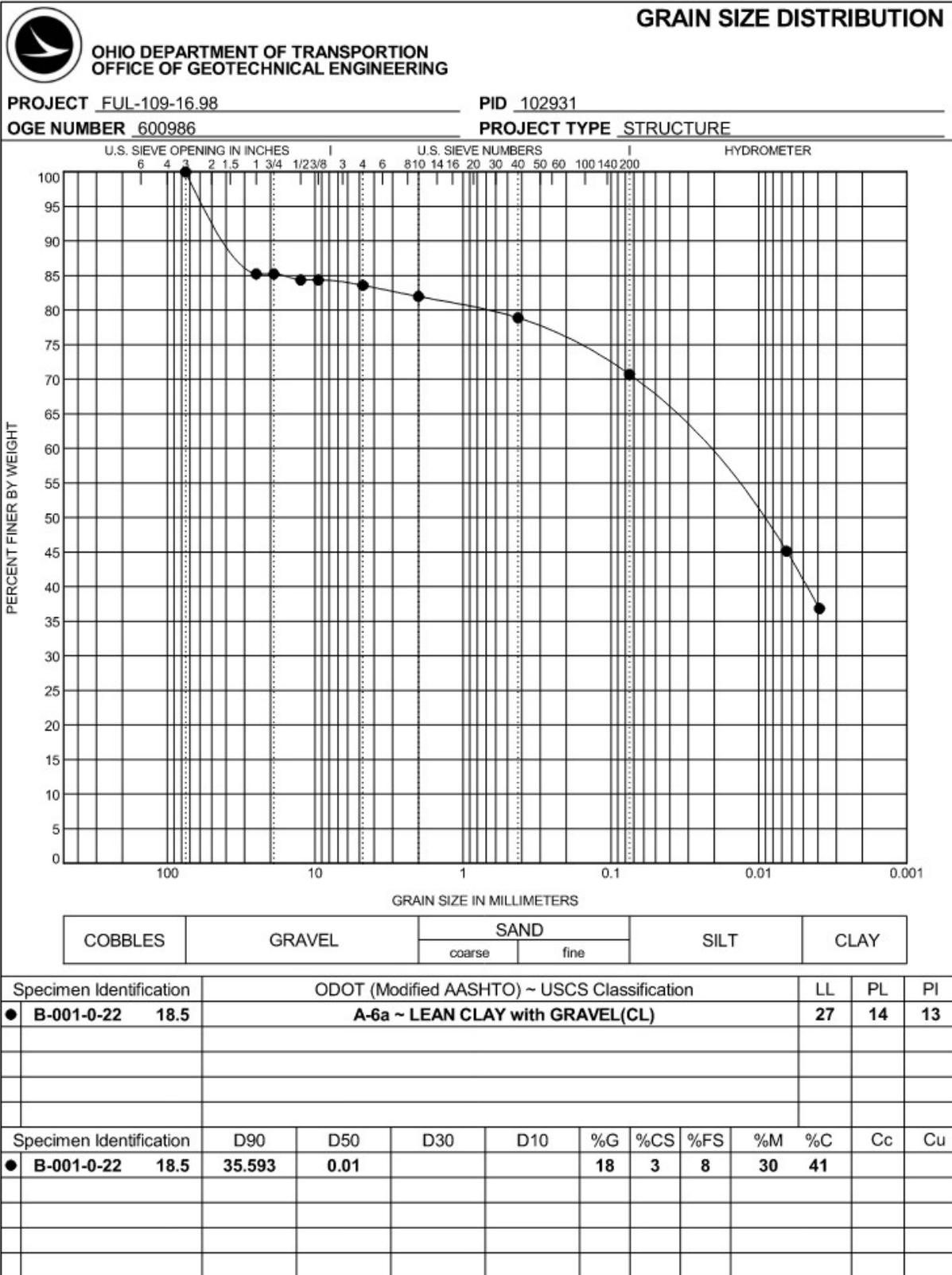
GRAIN SIZE - OH DOT.GDT - 9/27/22 13:19 - X:\GINT\PROJECTS\600986.GPJ



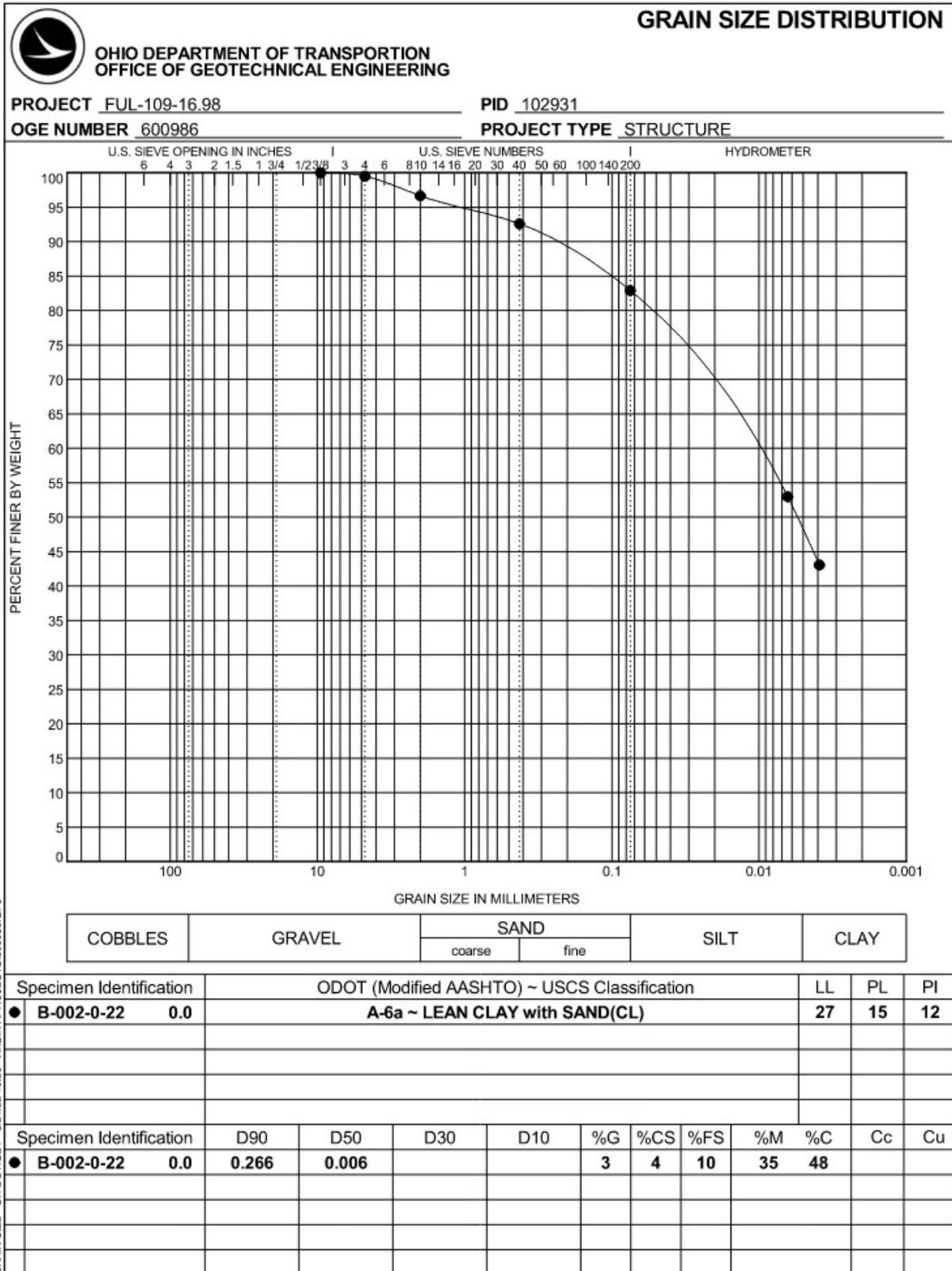
GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ



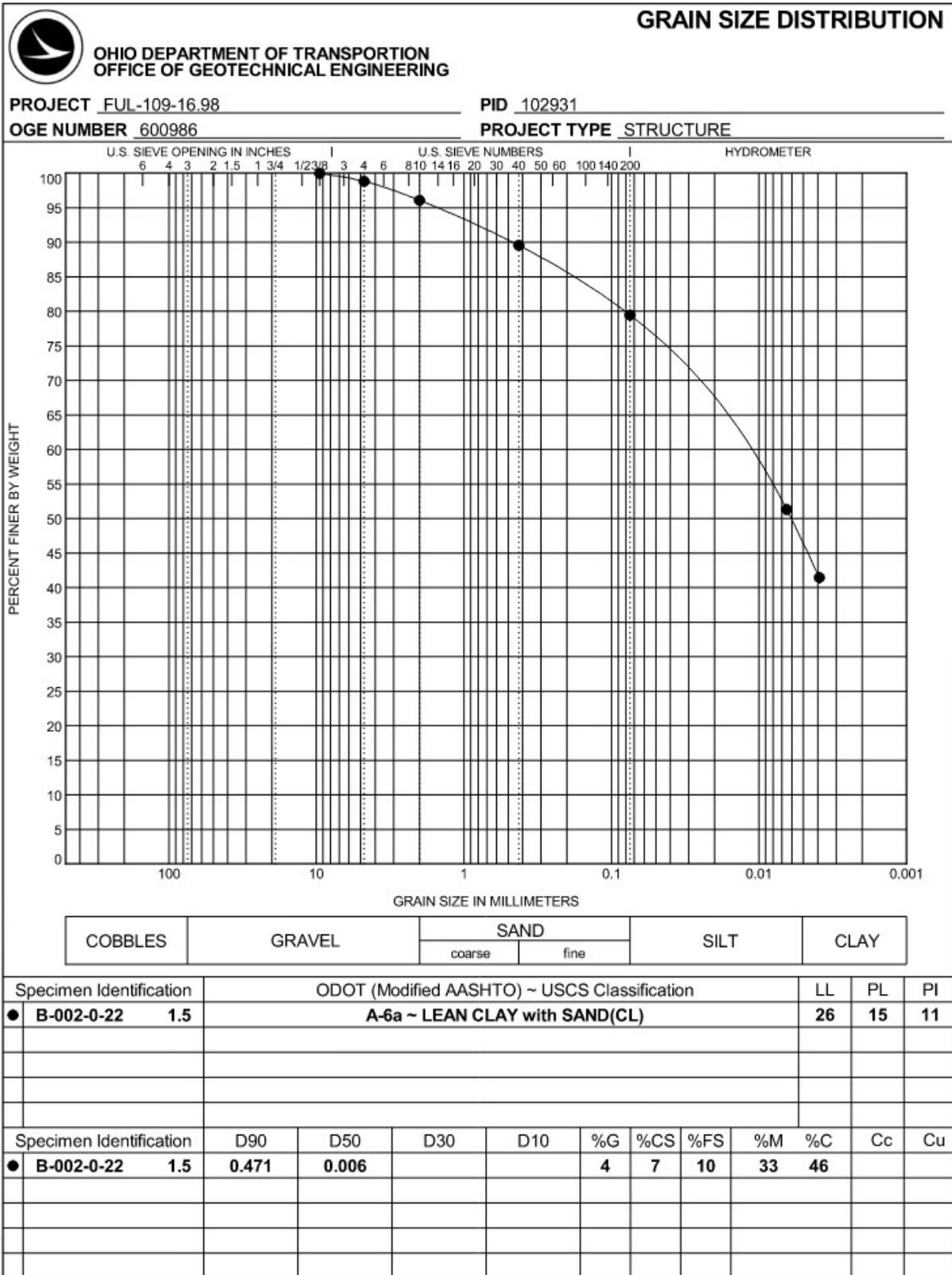
GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ



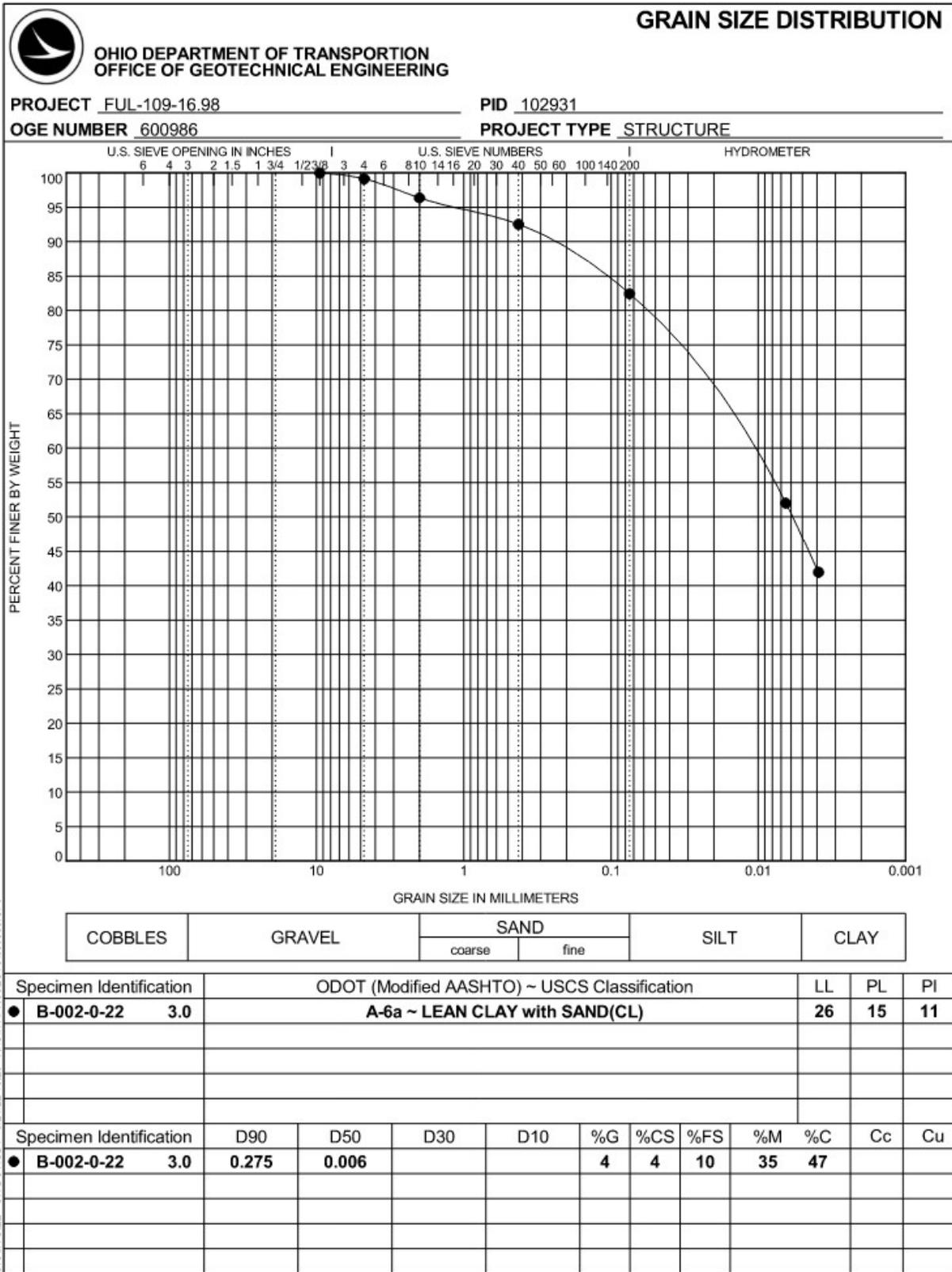
GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ

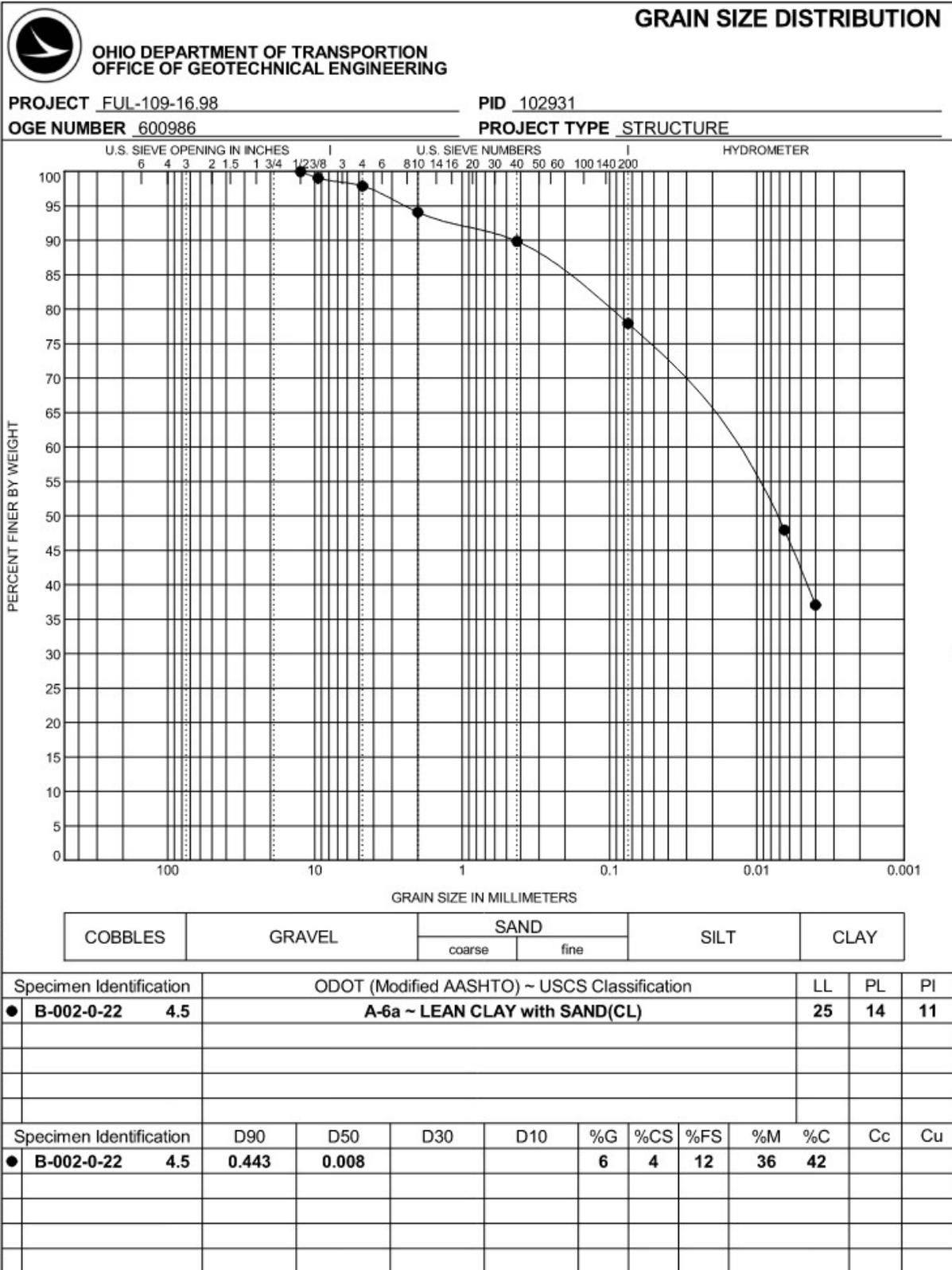


GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ

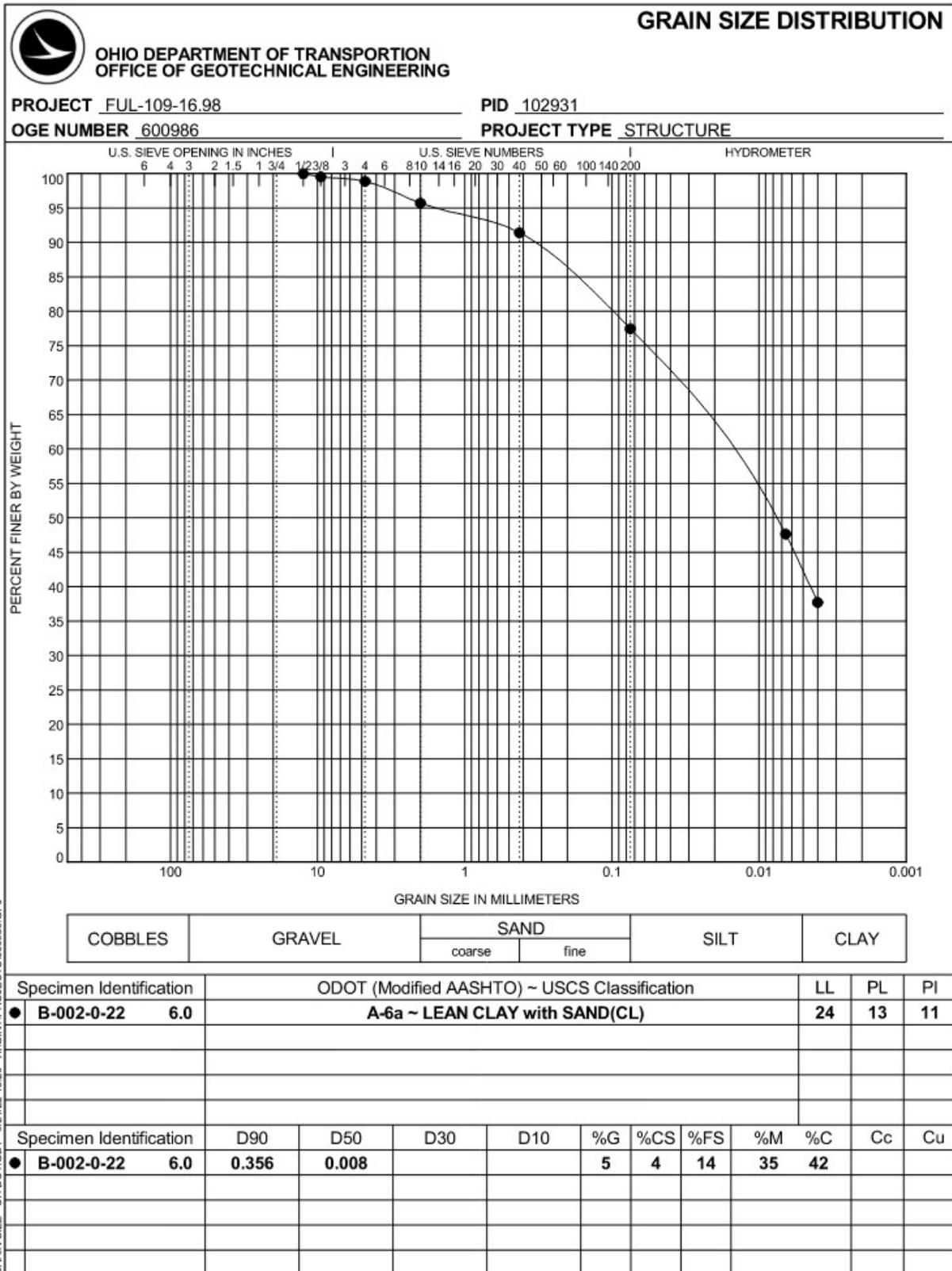


GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ

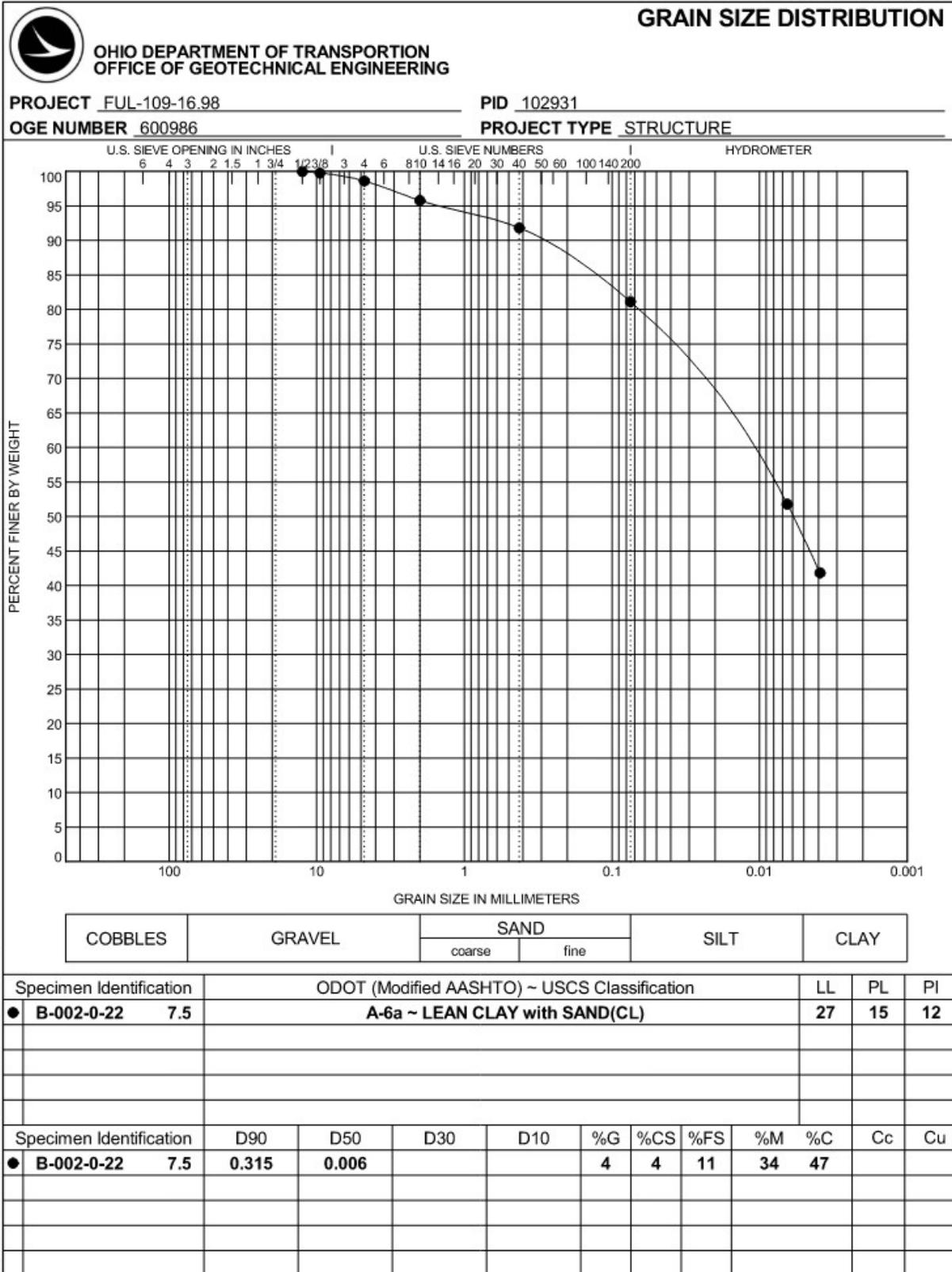




GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ



GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ



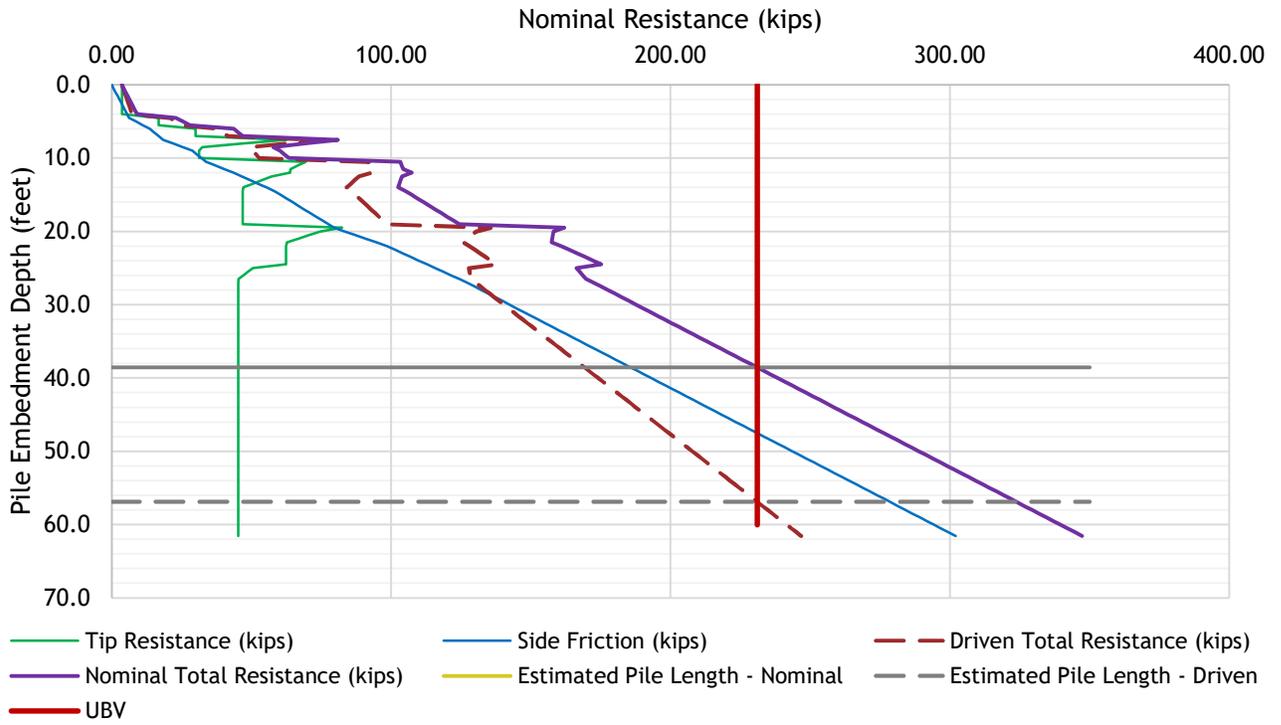
GRAIN SIZE - OH DOT.GDT - 9/21/22 13:20 - X:\GINT\PROJECTS\600986.GPJ

Appendix F: Calculations

Appendix F-1: Pile Nominal Resistance versus Embedment Depth Graphs

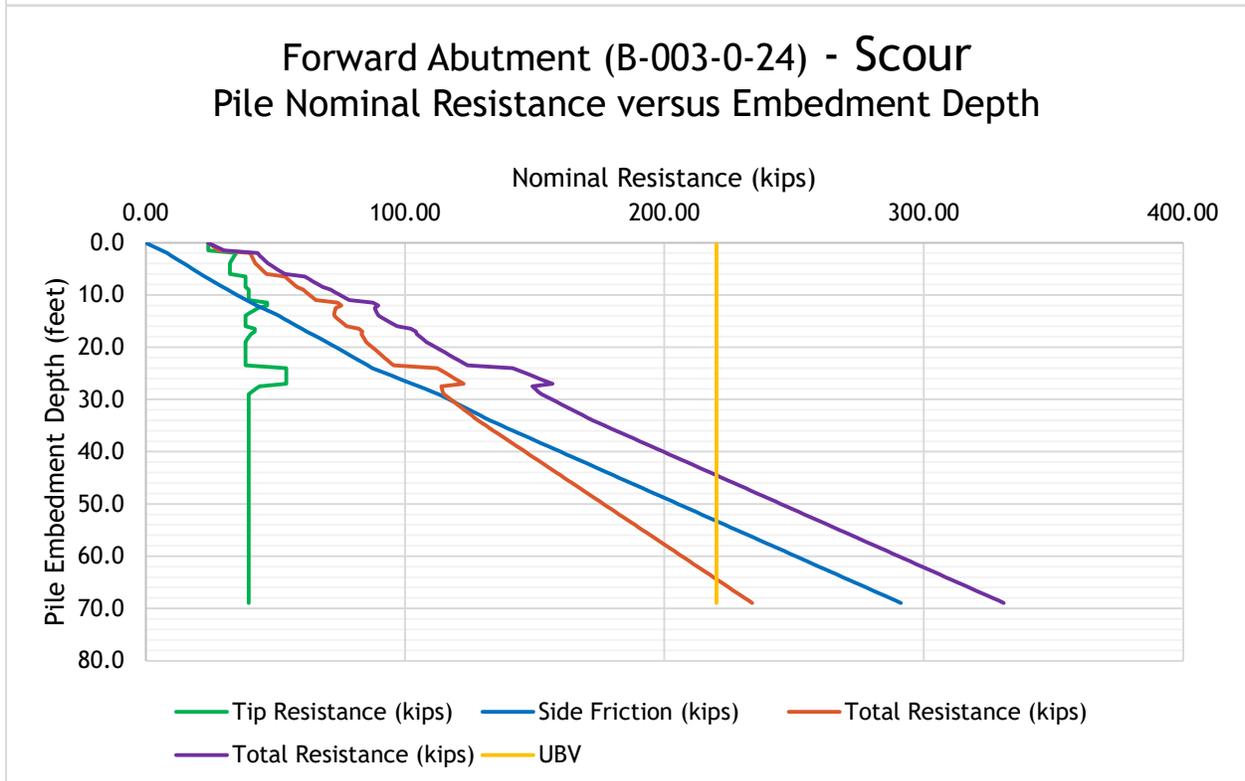
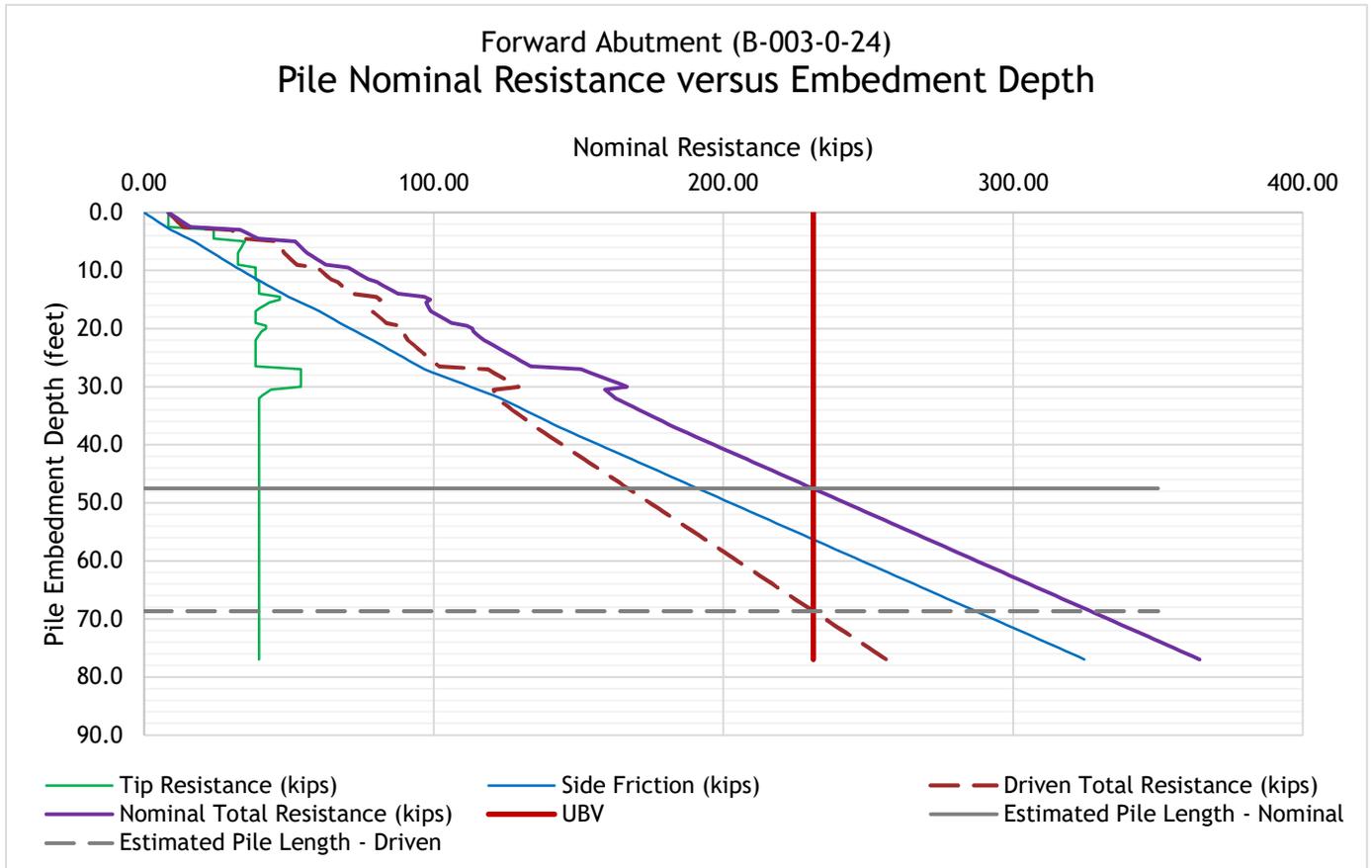
-

Rear Abutment (B-001-0-24) Pile Nominal Resistance versus Embedment Depth



Rear Abutment (B-001-0-24) - Scour Pile Nominal Resistance versus Embedment Depth



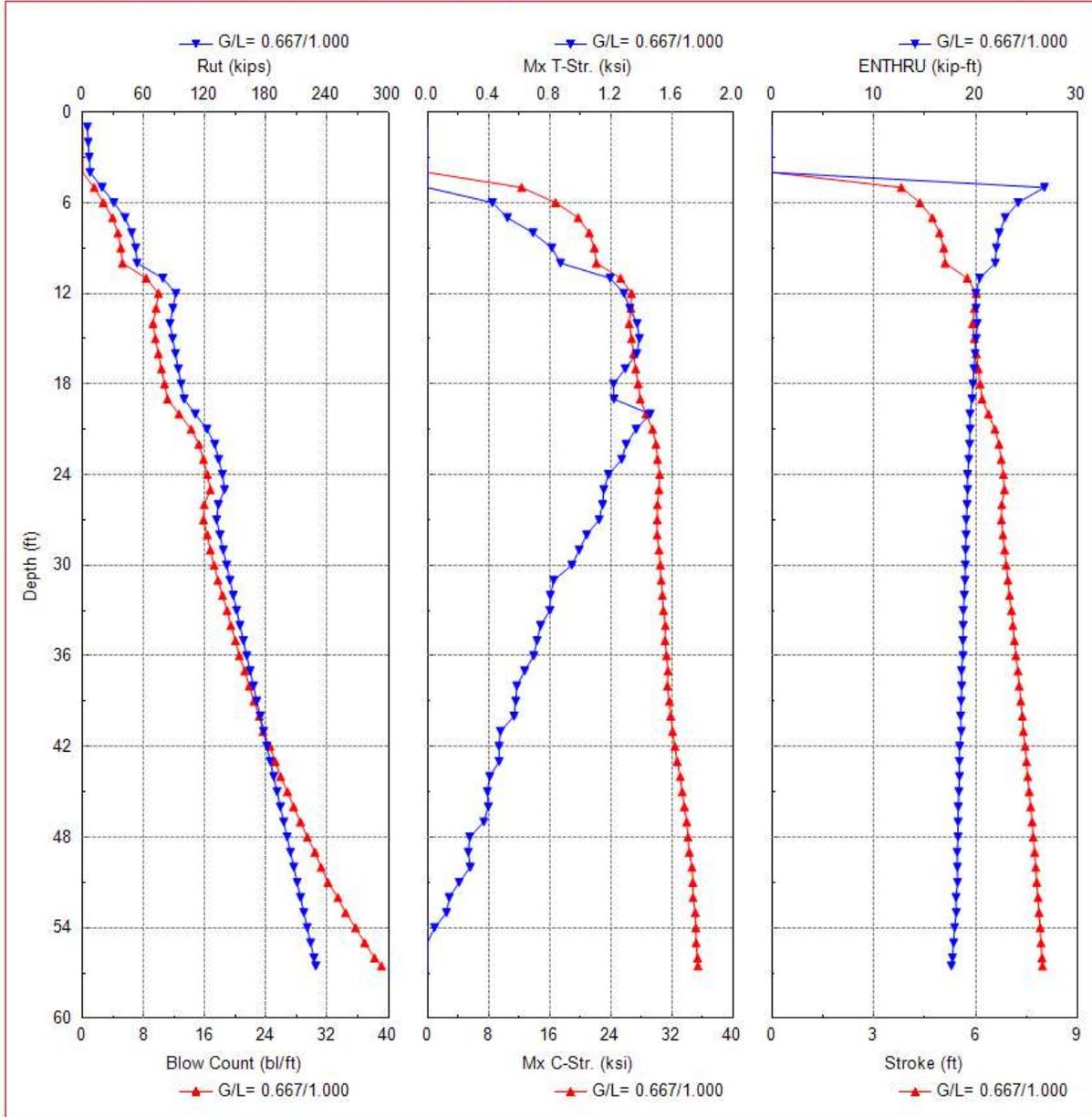


APPENDIX F-2: GRLWEAP Drivability Analyses

REAR ABUTMENT - B-001-0-24:

OHIO DEPARTMENT OF TRANSPORTATION
 FUL-109-16.98, PID 102931, Rear Abutment, B-001 + CIP pipe

2/24/2025
 GRLWEAP 14.1.20.1



FUL-109-16.98, PID 102931

Structure Exploration Report - February 2025

OHIO DEPARTMENT OF TRANSPORTATION

FUL-109-16.98, PID 102931, Rear Abutment, B-001 + CIP pipe

2/24/2025

GRLWEAP 14.1.20.1

Gain/Loss 1 at Shaft and Toe 0.667/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	4.5	0.9	3.6	0.0	0.00	0.00	0.00	0.0	D 19-42
2.0	5.4	1.8	3.6	0.0	0.00	0.00	0.00	0.0	D 19-42
3.0	6.4	2.8	3.6	0.0	0.00	0.00	0.00	0.0	D 19-42
4.0	7.3	3.7	3.6	0.0	0.00	0.00	0.00	0.0	D 19-42
5.0	19.0	6.9	12.1	1.5	12.35	0.00	3.81	26.7	D 19-42
6.0	30.6	9.7	20.9	2.7	16.79	0.43	4.35	24.2	D 19-42
7.0	41.5	11.8	29.7	3.9	19.74	0.52	4.73	22.9	D 19-42
8.0	48.0	16.4	31.6	4.6	21.20	0.69	4.94	22.3	D 19-42
9.0	52.0	19.9	32.1	5.0	21.87	0.81	5.06	22.0	D 19-42
10.0	53.3	22.0	31.3	5.2	22.13	0.87	5.10	21.9	D 19-42
11.0	78.6	26.3	52.3	8.3	25.30	1.20	5.75	20.4	D 19-42
12.0	91.4	30.5	61.0	9.9	26.71	1.29	6.02	20.0	D 19-42
13.0	88.6	34.4	54.2	9.6	26.64	1.33	5.97	20.0	D 19-42
14.0	85.7	38.3	47.4	9.2	26.41	1.37	5.90	20.2	D 19-42
15.0	88.2	41.2	47.1	9.5	26.73	1.39	5.96	20.0	D 19-42
16.0	91.0	44.0	47.0	9.9	26.99	1.37	6.02	19.9	D 19-42
17.0	93.8	46.9	46.9	10.3	27.28	1.30	6.07	19.8	D 19-42
18.0	96.6	49.7	46.9	10.7	27.59	1.22	6.13	19.7	D 19-42
19.0	99.5	52.6	46.9	11.1	27.87	1.22	6.19	19.6	D 19-42
20.0	110.5	57.5	53.0	12.6	28.61	1.46	6.38	19.4	D 19-42
21.0	121.9	62.5	59.3	14.2	29.49	1.37	6.56	19.5	D 19-42
22.0	129.7	67.0	62.7	15.2	29.94	1.30	6.69	19.4	D 19-42
23.0	133.5	70.9	62.6	15.8	30.13	1.27	6.75	19.3	D 19-42
24.0	137.2	74.7	62.5	16.3	30.40	1.19	6.82	19.2	D 19-42
25.0	139.2	78.6	60.6	16.7	30.32	1.15	6.85	19.2	D 19-42
26.0	133.2	82.4	50.8	15.9	30.12	1.15	6.77	19.2	D 19-42
27.0	131.4	86.0	45.4	15.8	30.09	1.12	6.76	19.1	D 19-42
28.0	134.7	89.3	45.4	16.3	30.08	1.04	6.80	19.1	D 19-42
29.0	138.0	92.6	45.3	16.7	30.34	0.99	6.85	19.0	D 19-42
30.0	141.2	95.9	45.3	17.2	30.50	0.95	6.90	19.0	D 19-42
31.0	144.5	99.2	45.3	17.7	30.61	0.83	6.95	19.0	D 19-42
32.0	147.8	102.5	45.3	18.3	30.76	0.80	7.00	18.9	D 19-42
33.0	151.1	105.8	45.3	18.9	30.91	0.80	7.05	18.8	D 19-42
34.0	154.4	109.1	45.3	19.4	31.17	0.74	7.10	18.8	D 19-42
35.0	157.7	112.4	45.3	20.0	31.11	0.72	7.14	18.8	D 19-42
36.0	161.0	115.7	45.3	20.5	31.32	0.70	7.19	18.8	D 19-42
37.0	164.3	119.0	45.3	21.2	31.50	0.64	7.24	18.6	D 19-42
38.0	167.6	122.3	45.3	21.8	31.43	0.59	7.28	18.6	D 19-42
39.0	170.9	125.6	45.3	22.4	31.68	0.58	7.33	18.6	D 19-42
40.0	174.2	128.9	45.3	23.1	31.85	0.57	7.37	18.5	D 19-42
41.0	177.5	132.2	45.3	23.6	32.09	0.48	7.40	18.6	D 19-42
42.0	180.8	135.5	45.3	24.5	32.40	0.47	7.46	18.4	D 19-42
43.0	184.1	138.8	45.3	25.2	32.71	0.47	7.50	18.4	D 19-42
44.0	187.4	142.1	45.3	25.9	33.11	0.41	7.53	18.4	D 19-42
45.0	190.7	145.4	45.3	26.8	33.37	0.39	7.58	18.4	D 19-42
46.0	194.0	148.7	45.3	27.6	33.64	0.40	7.62	18.3	D 19-42
47.0	197.3	152.0	45.3	28.5	33.94	0.37	7.66	18.3	D 19-42
48.0	200.6	155.3	45.3	29.4	34.11	0.28	7.69	18.3	D 19-42
49.0	203.9	158.6	45.3	30.4	34.29	0.27	7.74	18.2	D 19-42
50.0	207.2	161.9	45.3	31.2	34.64	0.28	7.77	18.2	D 19-42
51.0	210.5	165.2	45.3	32.1	34.76	0.21	7.80	18.2	D 19-42
52.0	213.8	168.5	45.3	33.4	34.77	0.14	7.84	18.1	D 19-42
53.0	217.1	171.8	45.3	34.4	35.07	0.13	7.86	18.1	D 19-42
54.0	220.4	175.1	45.3	35.7	35.13	0.05	7.90	17.9	D 19-42
55.0	223.7	178.4	45.3	36.9	35.18	0.00	7.92	17.8	D 19-42
56.0	227.0	181.7	45.3	38.2	35.37	0.00	7.95	17.7	D 19-42
56.5	228.8	183.5	45.3	39.1	35.43	0.00	7.97	17.6	D 19-42

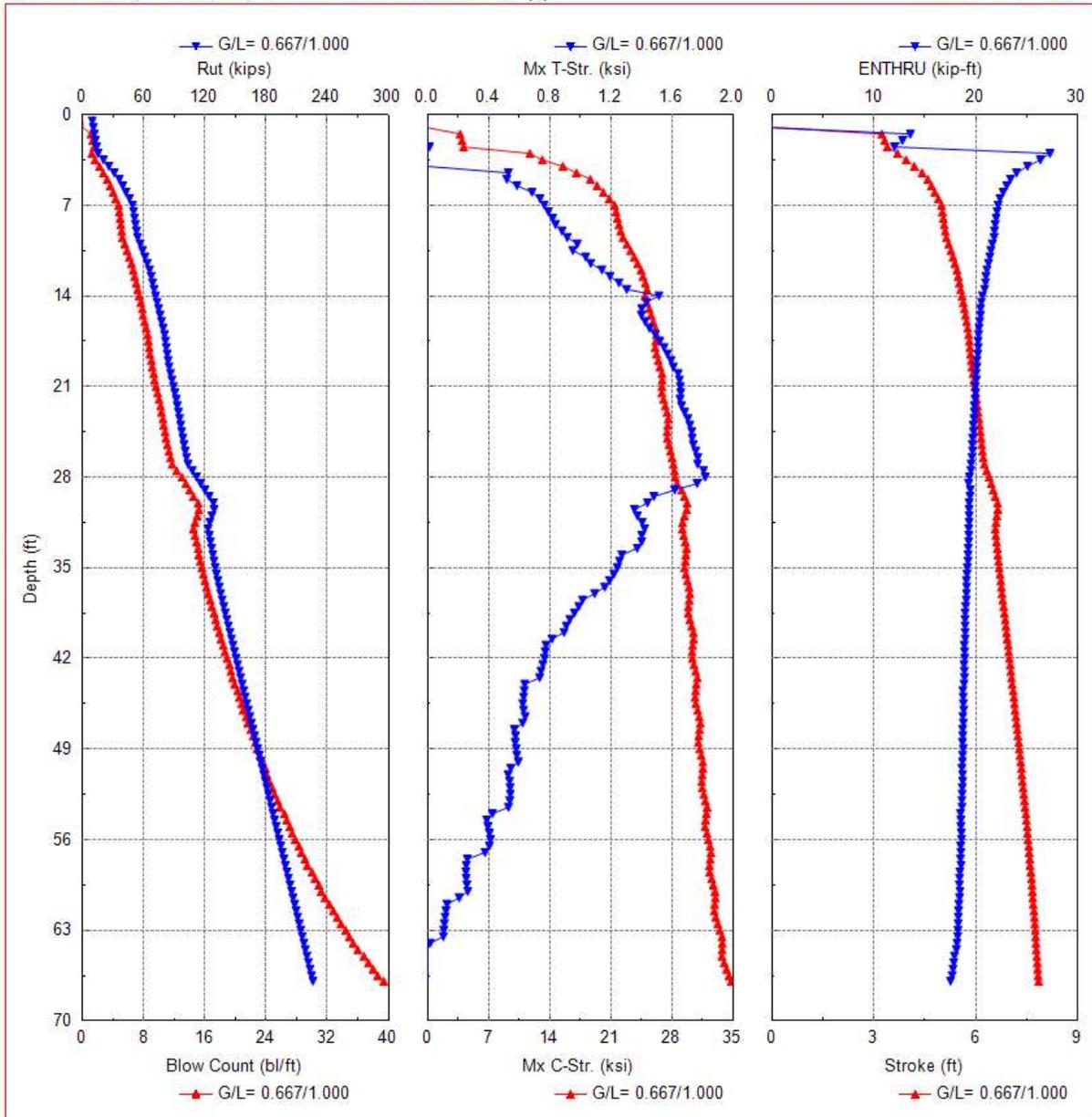
Total driving time: 22 minutes; Total Number of Blows: 973 (starting at penetration 3.3 ft)

FUL-109-16.98, PID 102931
Structure Exploration Report - February 2025

FORWARD ABUTMENT - B-003-0-24:

OHIO DEPARTMENT OF TRANSPORTATION
FUL-109-16.98, PID 102931, Forward Abutment B-003 + CIP pipe

2/24/2025
GRLWEAP 14.1.20.1



FUL-109-16.98, PID 102931

Structure Exploration Report - February 2025

OHIO DEPARTMENT OF TRANSPORTATION 2/24/2025
 FUL-109-16.98, PID 102931, Forward Abutment B-003 + CIP pipe GRLWEAP 14.1.20.1

Gain/Loss 1 at Shaft and Toe 0.667/1.000									
Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/ft	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
1.0	10.5	2.0	8.4	0.0	0.00	0.00	0.00	0.0	D 19-42
2.0	12.5	4.1	8.4	1.3	3.96	0.00	3.32	12.8	D 19-42
3.0	15.0	6.2	8.9	1.2	11.74	0.00	3.70	27.3	D 19-42
4.0	25.6	8.9	16.7	2.2	15.52	0.00	4.19	25.1	D 19-42
5.0	35.9	11.6	24.3	3.2	18.68	0.52	4.59	23.4	D 19-42
6.0	42.6	13.8	28.8	4.0	20.16	0.69	4.80	22.7	D 19-42
7.0	49.0	16.0	33.0	4.7	21.42	0.77	4.99	22.2	D 19-42
8.0	50.9	18.1	32.8	4.9	21.76	0.82	5.05	22.0	D 19-42
9.0	52.8	20.3	32.6	5.1	22.15	0.88	5.10	21.8	D 19-42
10.0	56.3	22.5	33.8	5.5	22.86	0.98	5.20	21.6	D 19-42
11.0	61.1	24.9	36.2	6.1	23.70	1.04	5.33	21.4	D 19-42
12.0	65.7	27.2	38.5	6.6	24.47	1.14	5.45	21.1	D 19-42
13.0	68.6	29.6	39.0	7.0	24.97	1.25	5.52	21.0	D 19-42
14.0	71.5	32.0	39.5	7.4	24.93	1.52	5.60	20.7	D 19-42
15.0	74.5	34.7	39.7	7.8	25.41	1.40	5.67	20.5	D 19-42
16.0	77.4	37.6	39.9	8.1	25.86	1.43	5.73	20.4	D 19-42
17.0	80.3	40.4	39.9	8.5	26.23	1.49	5.79	20.3	D 19-42
18.0	82.1	42.7	39.3	8.7	26.09	1.55	5.83	20.3	D 19-42
19.0	83.8	45.1	38.7	9.0	26.44	1.60	5.87	20.1	D 19-42
20.0	86.2	47.6	38.6	9.3	26.88	1.64	5.92	20.0	D 19-42
21.0	89.0	50.1	38.9	9.6	26.87	1.66	5.98	20.0	D 19-42
22.0	91.8	52.7	39.1	10.0	27.06	1.65	6.03	20.0	D 19-42
23.0	94.0	55.1	38.9	10.3	27.44	1.68	6.07	19.9	D 19-42
24.0	96.2	57.4	38.7	10.6	27.53	1.72	6.12	19.8	D 19-42
25.0	98.3	59.8	38.5	10.9	27.49	1.73	6.16	19.7	D 19-42
26.0	100.7	62.2	38.5	11.3	27.84	1.76	6.20	19.7	D 19-42
27.0	103.4	64.6	38.8	11.7	28.17	1.77	6.25	19.6	D 19-42
28.0	111.7	68.1	43.5	13.0	28.39	1.82	6.40	19.4	D 19-42
29.0	120.0	71.7	48.3	14.0	29.13	1.62	6.51	19.5	D 19-42
30.0	128.2	75.2	53.1	15.1	29.75	1.44	6.64	19.4	D 19-42
31.0	126.8	78.7	48.2	15.0	29.47	1.37	6.62	19.4	D 19-42
32.0	123.1	82.2	40.9	14.5	29.21	1.42	6.58	19.3	D 19-42
33.0	125.4	84.9	40.5	14.9	29.54	1.40	6.62	19.3	D 19-42
34.0	127.7	87.6	40.2	15.2	29.61	1.27	6.65	19.3	D 19-42
35.0	130.0	90.3	39.8	15.6	29.45	1.24	6.69	19.2	D 19-42
36.0	132.7	93.0	39.7	16.0	29.80	1.19	6.74	19.1	D 19-42
37.0	135.4	95.7	39.7	16.4	30.07	1.10	6.78	19.1	D 19-42
38.0	138.4	98.7	39.7	16.9	29.89	0.99	6.82	19.0	D 19-42
39.0	141.4	101.8	39.7	17.4	30.08	0.93	6.87	18.9	D 19-42
40.0	144.5	104.8	39.7	17.9	30.47	0.89	6.91	19.0	D 19-42
41.0	147.5	107.8	39.7	18.4	30.40	0.78	6.96	18.9	D 19-42
42.0	150.5	110.8	39.7	18.9	30.35	0.77	6.99	18.9	D 19-42
43.0	153.5	113.9	39.7	19.4	30.72	0.74	7.04	18.9	D 19-42
44.0	156.6	116.9	39.7	19.9	30.82	0.64	7.08	18.9	D 19-42
45.0	159.6	119.9	39.7	20.5	30.67	0.63	7.13	18.8	D 19-42
46.0	162.6	122.9	39.7	21.0	30.96	0.63	7.16	18.8	D 19-42
47.0	165.6	126.0	39.7	21.6	31.27	0.62	7.20	18.8	D 19-42
48.0	168.7	129.0	39.7	22.3	31.07	0.58	7.24	18.7	D 19-42
49.0	171.7	132.0	39.7	22.8	31.19	0.58	7.28	18.8	D 19-42
50.0	174.7	135.0	39.7	23.5	31.54	0.60	7.33	18.7	D 19-42
51.0	177.7	138.1	39.7	24.1	31.48	0.53	7.36	18.7	D 19-42
52.0	180.8	141.1	39.7	24.8	31.49	0.54	7.40	18.7	D 19-42
53.0	183.8	144.1	39.7	25.5	31.83	0.54	7.44	18.6	D 19-42
54.0	186.8	147.1	39.7	26.4	31.95	0.43	7.48	18.5	D 19-42
55.0	189.8	150.2	39.7	27.1	31.80	0.40	7.51	18.5	D 19-42
56.0	192.9	153.2	39.7	27.8	32.18	0.41	7.54	18.6	D 19-42
57.0	195.9	156.2	39.7	28.6	32.50	0.38	7.57	18.6	D 19-42
58.0	198.9	159.2	39.7	29.4	32.32	0.26	7.60	18.6	D 19-42
59.0	201.9	162.3	39.7	30.4	32.55	0.25	7.64	18.4	D 19-42
60.0	205.0	165.3	39.7	31.2	32.94	0.26	7.67	18.5	D 19-42
61.0	208.0	168.3	39.7	32.3	32.91	0.13	7.70	18.4	D 19-42
62.0	211.0	171.3	39.7	33.3	33.02	0.12	7.73	18.3	D 19-42
63.0	214.0	174.4	39.7	34.4	33.50	0.11	7.76	18.3	D 19-42
64.0	217.1	177.4	39.7	35.4	33.79	0.02	7.78	18.2	D 19-42
65.0	220.1	180.4	39.7	36.8	33.74	0.00	7.81	17.9	D 19-42
66.0	223.1	183.4	39.7	38.0	34.27	0.00	7.83	17.8	D 19-42
66.9	226.0	186.3	39.7	39.4	34.80	0.00	7.85	17.5	D 19-42

Total driving time: 25 minutes; Total Number of Blows: 1098 (starting at penetration 3.3 ft)