CTL Engineering Inc.
2860 Fisher Road, P.O. Box 44548, Columbus, Ohio 43204
Phone: 614/276-8123 · Fax: 614/276-6377
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November 14, 1997

Pike County Engineer
502 Pike Street
Waverly, Ohio 45690

Attention: Mr. Denny T. Salisbury, P.E., P.S.
County Engineer

Reference: Slope Stability Study
CR-50
Pike County, Ohio
CTL Project No. 97050249

Dear Mr. Salisbury:

CTL Engineering, Inc. has completed the slope stability study for the above referenced site. The subsurface investigation performed for this project and the recommended procedures for repair of the failed slope are included in the attached report.

Method of repair consists of either Cut and Fill or Drilled Pier Retaining Wall System. The estimated cost for Cut and Fill may be on the order of $167,000.00, while a Drilled Pier Retaining Wall will on the order of $395,000.00.

It should be noted that these estimates are rough estimates and are not intended for use in the bid documents. The actual estimates should be further investigated.

We appreciate the opportunity to be of service to you on this project, and look forward to meet with you to discuss these alternatives. If you have any questions or need further information, please do not hesitate contact us.

Respectfully Submitted,

CTL ENGINEERING, INC.

C.K. Satyapriya, M.S., P.E.
Project Engineer

SLOPE STABILITY STUDY

CR-50
PIKE COUNTY, OHIO
CTL PROJECT NO. 97050249

PREPARED FOR:

PIKE COUNTY ENGINEER
502 PIKE STREET
WAVERLY, OHIO 45690

PREPARED BY:

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204

NOVEMBER 14, 1997

CTL ENGINEERING INC

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I. PROJECT LOCATION AND DESCRIPTION

The project site is located on County Road 50, approximately 60 feet southwest of Ross/Pike County Line in Pike County, Ohio. The investigated section of the roadway is constructed into a hillside which slopes downwards in a northwesterly direction into a ditch located within the flood plain of the Scioto River. Site observation revealed the slope along the southbound lane of the existing roadway exhibits instability and related pavement distresses. The slope failure was measured to be on the order of 435 lineal feet. Also, site observation revealed that the hillside along the northbound lane, within the area of the slope failure, was stabilized at one time against slope movement using two rows of H-piles.

II. PURPOSE

The purpose of this study is 1) to determine the soil and rock conditions at the site, 2) to determine the likely cause(s) of the roadway failure and, 3) and to provide Pike County Engineer with general recommendations and design alternatives for repair of the failed roadway section. Detailed design along with design drawings and cost estimate will be provided in Task 2 upon approval of the County Engineer.

III. SUBSURFACE INVESTIGATION

Seven (7) test borings, designated as B-1 through B-7, were drilled at the locations shown on the enclosed plan sheet. Test borings B-1, B-2 and B-3 were drilled along the southbound lane of the existing roadway, while B-4, B-5 and B-6 were drilled along the northbound lane. Test boring B-7 was drilled near the toe of the slope approximately 135 feet west of the roadway. The test borings were drilled and/or cored to depths ranging from 9.9 feet in B-6 to 19.5 feet in B-2 and B-3.

The test borings were advanced with a skid mounted drilling machine utilizing hollow stem augers (HSA) on September 18 and 19, 1997. Standard penetration tests were conducted using a 140 pound automatic hammer falling 30 inches to drive a 2-inch O.D. split barrel sampler for 18 inches.

Rock coring was performed in borings B-1, B-2, B-3 and B-7 using a double tube core barrel with a diamond bit. The recovered rock was visually classified and percent core loss and Rock Quality Designation (RQD) values were determined.

Soil samples obtained from the drilling operation were preserved in glass jars, visually classified in the field and laboratory and tested for natural moisture content. Representative soil samples were subjected to laboratory testing including grain size distribution, Atterberg limits, direct shear, unit weight and hand penetrometer.

Surface elevations at the test boring locations were referenced to an assumed elevation of 100.00, being a temporary benchmark set on top of H-pile located at Ross/Pike County Line as shown on the enclosed plan sheet.

IV. SITE GEOLOGY

The general topography of area consists of moderate to steeply sloped hills which have thin soil covers on the hilltops, and thin to thick coarse gravel valley fills. The bedrock sequence in descending order generally consists of hilltops capped by Mississippian Sandstones, with Devonian Shales exposed on the hillsides. The sandstones weather out in massive blocks, and the Shales quickly weather to form thick scree piles along hillsides. There are no glacial deposits in the project area.

V. FINDINGS

Test borings B-1 through B-6 exhibited 6 to 18 inches of asphalt concrete pavement. Borings B-1 and B-3 encountered 12 inches and 6 inches of granular base course beneath the asphalt concrete pavement, respectively. Beneath the pavement structure, the test borings encountered brown or brown and gray clay-silt or sandy silt soils (A-2-4, A-4a or A-6a) containing varying amounts of sandstone and shale fragments. These soils extend to depths ranging from 4.5 feet in B-4 to 10.7 feet in B-1. Boring B-2 encountered silty sand layer with sandstone fragments between a depth of 7.1 and 12.5 feet. Beneath the soil overburden, the test borings encountered decomposed and/or weathered shale (clayshale) and sandstone rock.

Boring B-7 encountered fine sand to silty sand (creek sediments) to a depth of 6.4 feet overlying fine to coarse sand and gravel with sandstone fragments. Bedrock consisting of decomposed and/or weathered shale (clayshale) and sandstone was encountered beneath the soil overburden at a depth of 8.5 feet.

Standard penetration blowcount values in the soils ranged from 2 to 16 blows per foot (bpf) with natural moisture content values ranging from 11 to 25 percent. Blowcounts in excess of 16 bpf are due to striking on bedrock.

The recovered rock exhibited Rock Quality Designation (RQD) values ranging from 8 to 53 percent. Core loss values ranged from 0 to 37 percent.

A remolded soil sample obtained from boring B-2 at a depth of 7.0 to 8.5 feet indicated that these soils may attain an angle of internal friction of 26.5 degrees and cohesion of 135 psf when compacted to a dry unit weight of 118.1 pcf with a moisture content of 11.3 percent.

Groundwater and soil cave-in depths were recorded in the test borings as tabulated below.

Boring No.	Groundwater Depth (feet)			Soil Cave-In Depth (feet)
	During Drilling	At Completion	Delayed Reading	
B-1	None	6.5*	6.5 @ 24 hrs.	9.7
B-2	None	6.3*	8.5 @ 24 hrs.	10.9
B-3	None	5.9*	7.1 @ 5.0 hrs.	9.7
B-4	None	None	None @ 24 hrs.	5.9
B-5	None	None	None @ 24 hrs.	8.2
B-6	None	None	None @ 24 hrs.	6.0
B-7	None	6.3*	6.3 @ 0.5 hr.	7.0

* After rock coring (water was injected into hole during rock coring).

VI. CONCLUSIONS

1. The bedrock surface along the roadway profile slopes downwards in a northeasterly direction at a rate of 1 to 2.5 percent. Additionally, the bedrock surface within the failed pavement area slopes downwards in a northwesterly direction at a rate ranging from 3:1 H:V (horizontal to vertical) in the area of B-1 and B-6 to 15:1 H:V in the area of borings B-2 and B-5. The bedrock surface also slopes downwards towards the ravine following the existing topography of the slope, estimated to be at a rate ranging between 2:1 H:V and 3:1 H:V.

2. The soils beneath the existing pavement, particularly along the southbound lane exhibit low shearing strength as defined by the relatively low blowcounts.

3. Although no free water was encountered during drilling (mid September), it is expected the soil beneath the pavement particularly at the soil/rock interface is subjected to seepage water in the form of springs during late winter and early spring.

4. The roadway instability is mainly due to a "block type" slope failure of the soil mass beneath the existing pavement. The failure appears to be restricted to northwest portion of the roadway. It is CTL Engineering's opinion that the failure plane is located at the interface of the soft cohesive soils and shale bedrock. This zone is characterized by relatively higher natural moisture content values and low blowcounts resulting from the presence of groundwater and/or seepage water which reduces the adhesion of these soils. Saturation of the toe of the slope had also affected the stability of the roadway section.

VII. RECOMMENDATIONS

Based upon the above conclusions, it is recommended that the soils beneath the existing pavement be stabilized. Several alternatives were considered to stabilize these slopes including soil nailing, cut and fill, soldier piles with lagging and drilled pier retaining wall anchored into the underlying sound rock. The soil nailing and soldier pile with lagging alternatives were not further investigated due to the anticipated cost of installation and the limited number of contractors who would perform the work. However, the other two alternatives were investigated. Preliminary recommendations for these alternatives are provided in the following paragraphs.

Alternative 1: Cut and Fill

Under this alternative, it is recommended that the existing soil overburden in the failed area be removed, benches into the shale be made and the excavated soils be recompacted. A portion of the placed fill should be reinforced with layers of geogrid to maintain embankment stability; refer to Figure 1 for details of cut and fill. Preliminary site preparation and earthwork recommendations are provided in the following paragraphs. Detailed construction requirements, plan/profile sheets and quantities will be provided in Task 2 and upon approval of this alternative by the County Engineer.

1. The slopes within the proposed construction limits should be cleared and/or grubbed. Topsoil, wherever encountered within the proposed construction limits, should be stripped and may be stockpiled separately for reuse as cover material. Existing pavement should be removed and discarded or stockpiled separately for re-use provided that it is broken into pieces no larger than 8 inches in size.

2. Subsequent to site clearing, the soil overburden should be excavated to the bedrock surface. It is estimated that on the order of 4000 cubic yards of soils will require excavation. These soils may be stockpiled for reuse as engineered fill. The soil stockpiles should be located in areas where the weight of the material will not cause slope failure. Therefore, it is recommended that the excavated soils be totally or partially stockpiled off-site. Alternatively, the excavation may be performed in stages and the soils may be stockpiled in areas acceptable to both the County and the Soils Engineer. Under no circumstance any stockpiling should occur over the existing pavement, since this may overload the slope and cause catastrophic failure.

3. Subsequent to soil removal, benches with negative slopes should be cut into the shale, and lateral drains should be placed as shown on Figure 1. The lateral drains should be connected to a conduit or pipe culvert.

4. Fill required to restore the grade may consist of on-site excavated soils provided that proper moisture content is maintained during placement, and provided that these soils are inspected and approved by the Soils Engineer.

5. Fill embankment located at the edge of the roadway should be reinforced with layers of geogrid to maintain stability of the embankment. For estimating purposes, 12-foot wide layers of geogrid should be laid along the entire length of the embankment. The layers should be placed at 1.3 to 3.0 feet intervals. Refer to Figure 1 for details.

6. Depending upon time of construction and seasonal amount of precipitation, groundwater may be encountered during excavations particularly at the soil/rock interface. Dewatering may be accomplished by installing sump pumps or cutoff ditches. The method of dewatering should be determined by the Contractor during construction and approved by the Soils Engineer.

7. Under this alternative, surface water runoff and seepage water from the hillside located east of the roadway should be managed properly by improving the flow within the existing ditch along the eastern edge of the roadway.

8. The preliminary cost estimate for the Cut/Fill Alternative is tabulated below. The estimated quantities should be further investigated through a series of cross section of the roadway.

Item	Unit	Estimated Quantity	Estimated Unit Cost	Estimated Cost
Mobilization/Demobilization	Each	1	$10,000.00	$10,000.00
Clearing & Grubbing	L.S.	1	5,000.00	5,000.00
Excavation: Pavement	C.Y.	250	15.00	3,750.00
Soil	C.Y.	4000	6.00	24,000.00
Hard soil/soft shale	C.Y.	700	10.00	7,000.00
Backfill	C.Y.	4700	6.00	28,200.00
Geogrid	S.Y.	3000	10.00	30,000.00
Lateral Drains Installation	L.F.	1000	4.00	4,000.00
Longitudinal Drains Installation	L.F.	250	10.00	2,500.00
Guardrail	L.F.	450	12.00	5,400.00
Pavement Replacement:				
Item 304	C.Y.	150	25.00	3,750.00
Item 301	C.Y.	150	60.00	9,000.00
Item 402	C.Y.	45	80.00	3,600.00
Item 404	C.Y.	30	90.00	2,700.00
Ditch Improvement	L.F.	450	5.00	2,250.00
Conduit Installation	L.F.	200	20.00	4,000.00
Estimated Cost				$145,150.00
Contingency @ 15%				$21,775.00
TOTAL ESTIMATED COST				$167,000.00

Alternative 2: Drilled Pier Retaining Wall

The soil mass may be supported by a retaining system consisting of drilled piers installed along the northwestern edge of the roadway. The drilled piers should be socketed into the coreable underlying shale/sandstone bedrock. In order to minimize lateral stresses onto the retaining system, the drilled piers should be placed as close as possible to the southbound edge of pavement, within the area of the existing shoulder.

The drilled piers may have to be a minimum of 30 inches in diameter, spaced at 4.0 feet center to center. It is estimated that the piers should be embedded into the bedrock at a minimum depth equal to the height of the soil overburden. Rock coring is expected for the portion of the drilled shafts extending into the shale/sandstone rock.

Under this alternative, surface water runoff and seepage water from the hillside located south of the roadway should be managed properly by improving the flow within the existing ditch along the eastern edge of the roadway.

The preliminary cost estimate for the Drilled Pier Retaining Wall System is tabulated below. The estimated quantities should be further investigated.

Item	Unit	Estimated Quantity	Estimated Unit Cost	Estimated Cost
Mobilization/Demobilization	Each	1	$10,000.00	$10,000.00
Drilled Piers:				
in soil	L.F.	1100	80.00	88,000.00
in shale/sandstone	L.F.	1100	200.00	220,000.00
Traffic Control (One Lane Closed)	Day	30	350.00	10,500.00
Guardrail	L.F.	450	12.00	5,400.00
Pavement Resurfacing	C.Y.	45	100.00	4,500.00
Ditch Improvement	L.F.	450	5.00	2,250.00
Conduit Installation	L.F.	200	20.00	4,000.00
Estimated Cost				$345,000.00
Contingency @ 15%				$50,000.00
TOTAL ESTIMATED COST				$395,000.00

VIII. ADVANTAGES & DISADVANTAGES

DRILLED PIERS	CUT AND FILL
- Expensive	- Less expensive
- Project will be completed within reasonable time	- Project completion may take longer time
- Overlay or partial replacement of pavement	- Total removal and replacement of pavement
- Limited number of contractors	- Competitive bids
- One lane will be closed during construction	- Road should be closed during construction

IX. DISCLAIMER

CTL Engineering should be notified of the alternative used and should review and approve all construction and bid documents.

Experience shows that subsurface conditions in an area sometimes vary from the ones indicated in the borings at their specific locations. It is therefore recommended that a Soils Inspector, under the supervision of a qualified Soils Engineer, be retained on site to supervise all earthwork.

CTL Engineering, Inc. has prepared this report for your use in accordance with generally accepted soil and foundation engineering practices. Analysis, conclusions and other work product of CTL Engineering, Inc. are instruments of service for this project only.

CTL Engineering's assignment does not include, nor does this geotechnical report address the environmental aspects of the particular site.

Respectfully Submitted,

CTL ENGINEERING, INC.

for Ali Karaki, M.S., P.E.
Project Engineer

Joe Grani, M.S., P.E.
Project Engineer

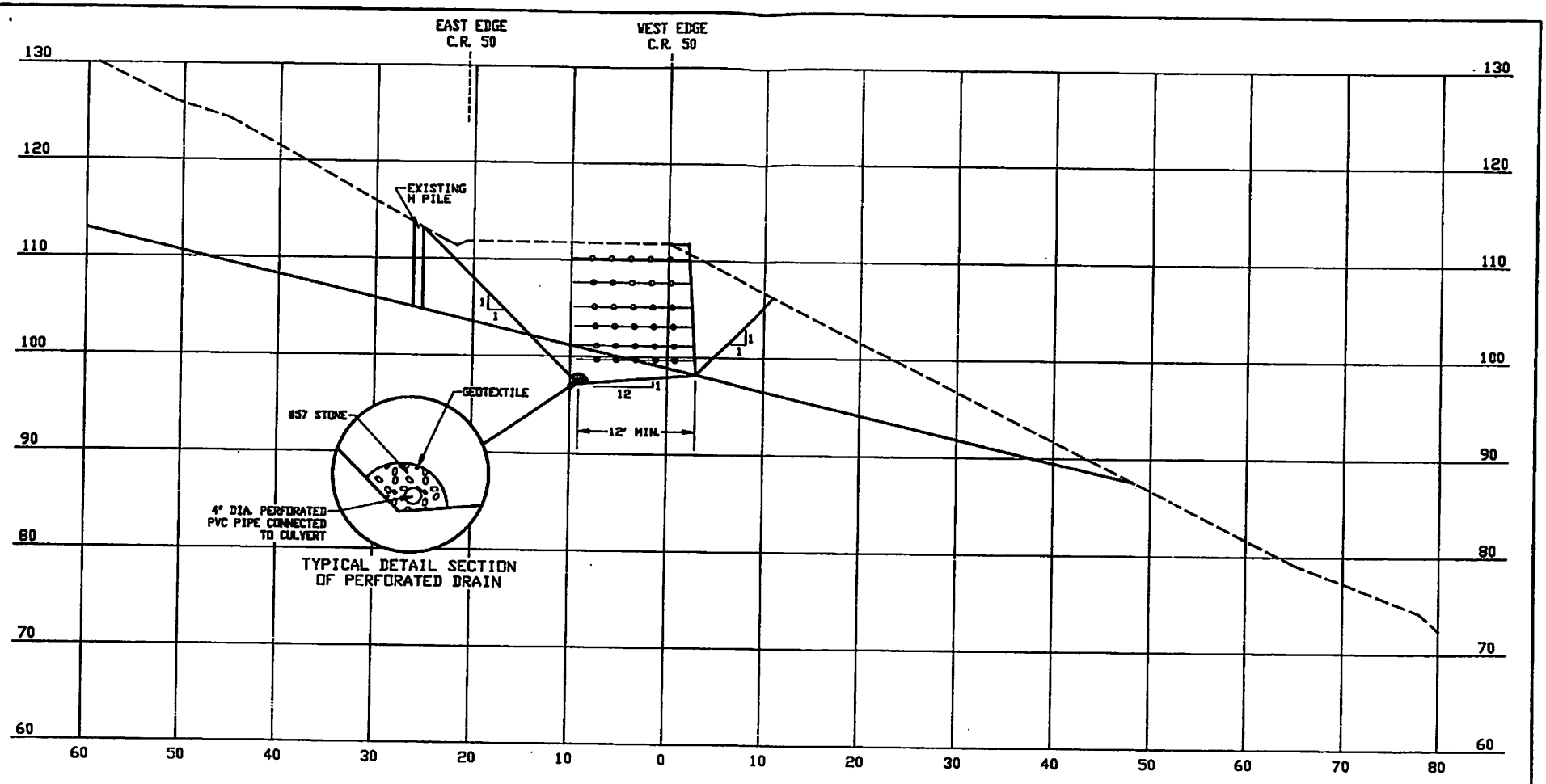

FIGURE 1
TYPICAL CUT AND FILL

CTL ENGINEERING INC.
CONSULTING ENGINEERS
TESTING & INSPECTION
LABORATORY SERVICES

CTL ENGINEERING

CUT & FILL

DATE 11-13-97	PIKE CO. ENGINEER
SCALE 1"=10'	SLOPE STABILITY STUDY
	C.R. 50, PIKE CO., OHIO

DRAWN BY	REVIEWED BY	PAGE	PROJECT NO.
M. TABB			97050249

APPENDIX A

TEST BORING RECORDS

SOIL DESCRIPTION

NON-COHESIVE SOIL DESCRIPTION	STANDARD PENETRATION BLOWCOUNTS PER FOOT (BPF)
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50

COHESIVE SOIL DESCRIPTION	STANDARD PENETRATION BLOWCOUNTS PER FOOT (BPF)
Very Soft	0 - 1
Soft	2 - 4
Medium Stiff	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Over 30

GRADATION COMPONENT	SIZE
Boulders	Larger Than 8"
Cobbles	8"- 3"
Coarse Gravel	Passing 3" Retained on 3/4"
Fine Gravel	Passing 3/4"Retained on #10
Coarse Sand	Passing #10 Retained on #40
Fine Sand	Passing #40 Retained on #200
Silt	0.074 mm to 0.005 mm
Clay	Smaller Than 0.005 mm

COMPONENT MODIFIERS	SIZE
Trace	0 - 10%
Little	11 - 20%
Some	21 - 35%
And	36 - 50%

MOISTURE TERMS	DESCRIPTION
Dry	Powdery
Damp	Below Plastic
Moist	Above Plastic, Below Liquid
Wet	Above Liquid

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-7

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-19-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-19-97

BORING ELEVATION: 67.8 — BORING METHOD: HSA/RC — HAMMER: Automatic

STATION : 2+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 135.0' Right of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 73°

DEPTH : 14.5 Feet — CORE SIZE : NX — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 6.3' after coring, At 0.5 hour 6.3', Caved in at 7.0'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
					1								
				SS-1	1	2	100	20					
		Very Loose, Damp, Brown FINE SAND TO SILTY SAND with Silt Seams and Roots (CREEK SEDIMENTS)			1								
					1								
				SS-2	1	2	100	25					
	5				1								
61.4			6.4'		4								
		Medium Dense, Wet, Brown SILTY FINE TO COARSE SAND AND GRAVEL with Sandstone Fragments		SS-3	6	12	100	15					
					6								
59.3			8.5'										
58.8		Gray Highly Weathered, Decomposed SHALE	9.0'	SS-4 9.5'	50 2"		100	8					
	10												
		Interbedded, Tan, Fine Grained SANDSTONE and Gray Weathered CLAYSHALE		CR-1 RQD= 53%			67						
54.8			13.0'										
53.3		Gray Weathered SHALE, Medium Bed Thickness	14.5'	14.5'									
	15	BOTTOM OF BORING											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
CR - Rock Core Sample
BS - Bag Sample

ABBREVIATIONS:
El = Stratum Elevation
D = Sample Depth
Ds = Stratum Depth
S# = Sample Number
N = Blows per 12"
R = % Recovery
W = Moisture Content
γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

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TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-6

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 107.5 — BORING METHOD: HSA — HAMMER: Automatic

STATION : 1+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 18.0' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 64°

DEPTH : 9.9 Feet — CORE SIZE : -- — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 6.0'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
106.8		**ASPHALT CONCRETE**	8"										
	x	Stiff, Damp to Moist,			7								
	x	Brown **CLAYEY SILT**, Some		SS-1	6	10	72	15	115.8	6.0*			
	x	Fine Sand	2.5'		4								
	x				2								
	x			SS-2	2	5	78	13					
	x	Loose, Moist, Brown **SILTY**			3								
	x	**FINE SAND**, Traces of Clay			3								
	5 x			SS-3	2	5	94	13	113.1				
102.0	x		5.5'		3								
	x				6								
	x			SS-4	7	17	78	13					
	x				10								
	x	Brown and Gray Highly			14								
	x	Decomposed, Weathered		SS-5	20	48	94	9					
	x	**SHALE** with Sandstone			28								
	x	Fragments			15								
	x			SS-6	47		88	9					
97.6	10 x		9.9'		50								
		BOTTOM OF BORING			5"								
		AUGER REFUSAL											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
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* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-5

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 111.8 — BORING METHOD: HSA — HAMMER: Automatic

STATION : 2+45 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 18.8' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 63°

DEPTH : 11.5 Feet — CORE SIZE : -- — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 8.2'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
111.0		**ASPHALT CONCRETE** 9"											
					3								
				SS-1	7	13	56	18	125.9	4.0*			
					6								
		Stiff, Damp, Brown and			6								
		Gray **CLAYEY SILT** with		SS-2	5	10	61	17	123.8	5.0*			
		Sandstone Fragments			5								
					5								
	5			SS-3	5	10	72	21	124.6	6.0*			
106.3			5.5'		5								
		Stiff, Moist, Brown and		SS-4A	5			24		4.0*			
105.3		Gray **SANDY SILT**, Traces	6.5'		7	12	83						
		of Clay with		SS-4B	5			15					
		Sandstone Fragments			3								
				SS-5	6	12	78	15					
103.3		Medium Dense, Damp,	8.5'		6								
		Brown **SILTY FINE TO**			5								
		COARSE SAND with		SS-6	19	35	72	13					
	10	Sandstone Fragments			16								
					25								
		Brown and Gray Highly		SS-7	39	89	89	8					
100.3		Decomposed, Weathered	11.5'		50								
		SHALE with Sandstone			6"								
		Layers											
		BOTTOM OF BORING											
		AUGER REFUSAL											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
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UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-4

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 108.8 — BORING METHOD: HSA — HAMMER: Automatic

STATION : 4+00 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 16.8' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 65°

DEPTH : 18.5 Feet — CORE SIZE : -- — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 5.9'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
108.0		ASPHALT CONCRETE	10"										
	x				3								
	x	Medium Stiff to Very		SS-1	4	8	61	19	128.3	8.0*			
	x	Stiff, Damp, Brown CLAYEY			4								
	x	SILT with Shale and			7								
	x	Sandstone Fragments		SS-2	6	16	78	13		7.0*			
	x				10								
104.3	x		4.5'	SS-3A	7			12					
	5 x				10	29	83						
	x			SS-3B	19			14					
	x				15								
	x			SS-4	22	52	72	11					
	x	Brown and Gray Highly,			30								
	x	Decomposed, Weathered			12								
	x	SHALE with Sandstone		SS-5	29	69	72	10					
	x	Layers			40								
	x				14								
	x			SS-6	30			9					
98.8	10 x		10.0'		50								
	-	BOTTOM OF BORING			4"								
		AUGER REFUSAL											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
CR - Rock Core Sample
BS - Bag Sample

ABBREVIATIONS:
El = Stratum Elevation
D = Sample Depth
Ds = Stratum Depth
S# = Sample Number
N = Blows per 12"
R = % Recovery
W = Moisture Content
γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-3

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 110.4 — BORING METHOD: HSA/RC — HAMMER: Automatic

STATION : 3+53 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 2.0' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 65°

DEPTH : 19.5 Feet — CORE SIZE : NX — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 5.9' after coring, At 5.0 hours 7.1', Caved in at 9.7'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
		ASPHALT CONCRETE (8") over **BASE COURSE** (6")											
109.2			14"		7								
				SS-1	6	12	44	12		9+*			
					6								
					3								
				SS-2	3	5	50	15		8.0*			
		Medium Stiff to Stiff,			2								
		Damp, Brown **SANDY SILT**,			3								
	5	Little Fine to Coarse		SS-3	4	7	72	15		9+*	25	22	3
		Gravel with Sandstone			3								
		Fragments, Cobbles and			2								
		Fine Sand Seams		SS-4	3	7	78	13					
		A-4a to A-2-4			4								
					3								
				SS-5	4	8	16	10			NP	NP	NP
101.9			8.5'		4								
				SS-6A	12			11					
		Rusty Brown Weathered			25	37	72						
100.4	10	**SANDSTONE**	10.0'	SS-6B	12			12					
				10.0'									
		Highly Weathered											
		Interbedded Tan **SANDSTONE**		CR-1									
		and Gray to Tan **SHALE**		RQD=			36						
				0%									
97.4			13.0'	13.0'									
		Light Gray to Tan,		CR-2									
95.8		Weathered **SHALE**	14.6'	RQD=			97						
	15	Tan Fine Grained		50%									
94.9		**SANDSTONE**	15.5'	15.5'									
		Light Gray, Weathered		CR-3									
		SHALE with Thin Interbeds		RQD=			65						
		of Fine Grained Sandstone		8%									
90.9			19.5'	19.5'									
	20	**BOTTOM OF BORING**											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
CR - Rock Core Sample
BS - Bag Sample

ABBREVIATIONS:
El = Stratum Elevation
D = Sample Depth
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S# = Sample Number
N = Blows per 12"
R = % Recovery
W = Moisture Content
γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-2

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 111.9 — BORING METHOD: HSA/RC — HAMMER: Automatic

STATION : 2+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 2.2' Left of B.L. — CASING DIA. : 3½" — TEMPERATURE: 65°

DEPTH : 19.5 Feet — CORE SIZE : NX — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 6.3' after coring, At 24 hours 8.6', Caved in at 10.9'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
111.4		**ASPHALT CONCRETE**	6"										
					4								
				SS-1	3	6	78	17		8.0*			
					3								
		Soft to Stiff, Damp,			2								
		Brown and Gray **SANDY**		SS-2	2	3	72	17		7.0*	30	20	10
		SILT TO CLAYEY SILT,			1								
		Little Fine to Coarse			7								
	5	Gravel with Sandstone		SS-3	4	10	44	18					
		Fragments and Cobbles			6								
		A-4a			4								
				SS-4	3	5	11	11					
104.8			7.1'		2								
					4								
				SS-5	2	5	67	14	120.0				
					3								
					3								
		Loose to Medium Dense,		SS-6	4	8	61	13					
	10	Damp, Brown **SILTY SAND,**			4								
		Some Clay with Sandstone			9								
		Fragments and Silt Seams		SS-7	6	14	100	18	120.8		32	17	15
		A-6a			8								
				SS-8A	7			15					
99.4			12.5'		8	22	100						
				SS-8B	14			13					
		Gray Weathered,			14								
		Decomposed **SHALE** with		SS-9	40		100	12					
97.4		Sandstone Layers	14.5'	14.5'	50								
	15				4"								
		Light Gray, Thinly		CR-1									
		Bedded Soft, Weathered		RQD=			63						
		SHALE		27%									
93.0			18.9'										
		Tan, Fine Grained, Well											
92.4		Sorted **SANDSTONE**	19.5'	19.5'									
	20	**BOTTOM OF BORING**											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
CR - Rock Core Sample
BS - Bag Sample

ABBREVIATIONS:
El = Stratum Elevation
D = Sample Depth
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S# = Sample Number
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R = % Recovery
W = Moisture Content
γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

GTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-1

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 107.7 — BORING METHOD: HSA/RC — HAMMER: Automatic

STATION : 1+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 3.2' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 65°

DEPTH : 18.5 Feet — CORE SIZE : NX — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 6.5' after coring, At 24 hours 6.6', Caved in at 9.7'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
		ASPHALT CONCRETE (12") over **CRUSHED ASPHALT** (6")											
106.2			1.5'	SS-1A	5			4					
		Loose, Damp, Brown **FINE**			5	8	22						
105.2		**TO COARSE SAND AND GRAVEL**	2.5'	SS-1B	3			6					
					2								
				SS-2	4	7	50	13		5.0*	35	18	7
					3								
					2								
	5	Soft to Stiff, Damp to		SS-3	2	4	28	13		4.0*			
		Moist, Brown **SANDY SILT**,			2								
		Some Fine to Coarse			1								
		Gravel, Little Clay with		SS-4	2	5	44	14		7.0*			
		Sandstone Fragments and			3								
		Cobbles			2								
		A-4a to A-2-4		SS-5	3	10	56	16		9+*			
					7								
					5								
				SS-6	5	12	50	22		6.0*			
	10				7								
97.0			10.7'		10								
				SS-7	13	33	61	10					
					20								
		Gray and Brown Weathered,		SS-8A	9			8					
		Decomposed **SHALE** with			20	48	83						
		Sandstone Layers		SS-8B	28			10					
94.2			13.5'	SS-9	50								
				13.5'	1"								
		Tan, Well Sorted, Fine		CR-1									
	15	Grained **SANDSTONE**		RQD=			71						
92.2			15.5'	42%									
				15.5'									
		Light Gray, Thinly											
		Bedded, Weathered **SHALE**,		CR-2									
		Some Iron Stained		RQD=			100						
		Inclined Fractures		53%									
89.2			18.5'	18.5'									
		BOTTOM OF BORING											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
CR - Rock Core Sample
BS - Bag Sample

ABBREVIATIONS:
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γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

APPENDIX B

TEST RESULTS

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-1	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-2	Tech:	M.E.
	Pike County, Ohio			Depth:	2.5'-4.0'
Project #	97050249			Assumed Gs:	2.70

Total Sample Weight =	196.41 grams	Hydrometer Sample Weight =	30.50 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	11.3	5.8	94.2
3/8"	40.3	20.5	79.5
#4	52.5	26.7	73.3
#10	61.9	31.5	68.5
#40	77.7	39.6	60.4
#200	7.4	54.2	45.8

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	25.0	5.5	19.5	38.23	0.01328	13.11	0.0340
15	17.0	5.5	11.5	22.55	0.01328	14.42	0.0130
60	14.0	5.5	8.5	16.66	0.01328	14.91	0.0066
250	11.0	5.5	5.5	10.78	0.01328	15.4	0.0033
1440	10.0	5.5	4.5	8.82	0.01328	15.56	0.0014

Summary of Grain Size Distribution

6	% COARSE GRAVEL
26	% FINE GRAVEL
8	% COARSE SAND
15	% FINE SAND
31	% SILT
14	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	35
Plastic Limit	18
Plasticity Index	7

Soil Description: SANDY SILT, some Gravel, little Clay

AASHTO Soil Classification(ODOT): A-4a (3)

CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-1	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-6	Tech:	M.E.
	Pike County, Ohio			Depth:	8.5'-10.0'
Project #	97050249			Assumed Gs:	2.70

Total Sample Weight =	188.43	grams	Hydrometer Sample Weight =	29.77	grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	11.9	6.3	93.7
3/8"	58.4	31.0	69.0
#4	71.9	38.2	61.8
#10	81.7	43.4	56.6
#40	101.7	54.0	46.0
#200	9.5	68.7	31.3

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	23.0	5.5	17.5	26.77	0.01328	13.44	0.0344
15	19.5	5.5	14.0	21.42	0.01328	14.01	0.0128
60	18.0	5.5	12.5	19.12	0.01328	14.26	0.0065
250	16.5	5.5	11.0	16.83	0.01328	14.5	0.0032
1440	14.5	5.5	9.0	13.77	0.01328	14.83	0.0013

Summary of Grain Size Distribution

6	% COARSE GRAVEL
37	% FINE GRAVEL
11	% COARSE SAND
15	% FINE SAND
13	% SILT
18	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	N.P.
Plastic Limit	N.P.
Plasticity Index	N.P.

Soil Description: SANDY GRAVEL, little Silt, little Clay

AASHTO Soil Classification(ODOT): A-2-4

CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-2	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-2	Tech:	M.E.
	Pike County, Ohio			Depth:	2.5'-4.0'
Project #	97050249			Assumed Gs:	2.70

Total Sample Weight =	206.62 grams	Hydrometer Sample Weight =	41.83 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	0.0	0.0	100.0
3/8"	31.9	15.4	84.6
#4	42.3	20.5	79.5
#10	51.4	24.9	75.1
#40	65.1	31.5	68.5
#200	5.1	39.8	60.2

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	36.0	5.5	30.5	49.45	0.01328	11.32	0.0316
15	28.0	5.5	22.5	36.48	0.01328	12.62	0.0122
60	21.5	5.5	16.0	25.94	0.01328	13.69	0.0063
250	18.5	5.5	13.0	21.08	0.01328	14.18	0.0032
1440	14.0	5.5	8.5	13.78	0.01328	14.91	0.0014

Summary of Grain Size Distribution

0	% COARSE GRAVEL
25	% FINE GRAVEL
7	% COARSE SAND
8	% FINE SAND
36	% SILT
24	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	30
Plastic Limit	20
Plasticity Index	10

Soil Description: CLAYEY SILT, some Gravel, little Sand

AASHTO Soil Classification(ODOT): A-4a (6)

GTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-2	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-7	Tech:	M.E.
	Pike County, Ohio			Depth:	10.0'-11.5
Project #	97050249			Assumed Gs:	2.68

Total Sample Weight =	167.52	grams	Hydrometer Sample Weight =	31.22	grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	0.0	0.0	100.0
3/8"	10.5	6.3	93.7
#4	11.3	6.7	93.3
#10	12.9	7.7	92.3
#40	38.7	23.1	76.9
#200	15.2	60.4	39.6

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	20.0	5.5	14.5	35.50	0.01336	13.93	0.0353
15	16.5	5.5	11.0	26.93	0.01336	14.5	0.0131
60	15.5	5.5	10.0	24.48	0.01336	14.67	0.0066
250	14.0	5.5	8.5	20.81	0.01336	14.91	0.0033
1440	13.0	5.5	7.5	18.36	0.01336	15.07	0.0014

Summary of Grain Size Distribution

0	% COARSE GRAVEL
8	% FINE GRAVEL
15	% COARSE SAND
37	% FINE SAND
17	% SILT
23	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	32
Plastic Limit	17
Plasticity Index	15

Soil Description: SAND, some Caly, little Silt, traces of Gravel

AASHTO Soil Classification(ODOT): A-6a (2)

CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-3	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-3	Tech:	M.E.
	Pike County, Ohio			Depth:	4.0'-5.5'
Project #	97050249			Assumed Gs:	2.68

Total Sample Weight =	202.94 grams	Hydrometer Sample Weight =	30.49 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	42.8	21.1	78.9
3/4"	42.8	21.1	78.9
3/8"	69.1	34.1	65.9
#4	85.4	42.1	57.9
#10	91.7	45.2	54.8
#40	103.1	50.8	49.2
#200	5.7	59.9	40.1

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	28.0	5.5	22.5	36.09	0.01336	12.62	0.0336
15	19.0	5.5	13.5	21.65	0.01336	14.09	0.0129
60	14.0	5.5	8.5	13.63	0.01336	14.91	0.0067
250	10.5	5.5	5.0	8.02	0.01336	15.48	0.0033
1440	8.5	5.5	3.0	4.81	0.01336	15.81	0.0014

Summary of Grain Size Distribution

21	% COARSE GRAVEL
24	% FINE GRAVEL
6	% COARSE SAND
9	% FINE SAND
29	% SILT
11	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	25
Plastic Limit	22
Plasticity Index	3

Soil Description: SILTY GRAVEL, little Sand, little Clay

AASHTO Soil Classification(ODOT): A-4a (1)

CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-3	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-5	Tech:	M.E.
	Pike County, Ohio			Depth:	7.0'-8.5'
Project #	97050249			Assumed Gs:	2.66

Total Sample Weight =	190.03 grams	Hydrometer Sample Weight =	30.59 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	33.1	17.4	82.6
3/4"	33.1	17.4	82.6
3/8"	34.9	18.3	81.7
#4	40.7	21.4	78.6
#10	45.7	24.0	76.0
#40	66.4	35.0	65.0
#200	17.4	72.0	28.0

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	17.0	5.5	11.5	24.39	0.01344	14.42	0.0361
15	15.0	5.5	9.5	20.15	0.01344	14.75	0.0133
60	13.0	5.5	7.5	15.90	0.01344	15.07	0.0067
250	11.5	5.5	6.0	12.72	0.01344	15.32	0.0033
1440	10.0	5.5	4.5	9.54	0.01344	15.56	0.0014

Summary of Grain Size Distribution

17	% COARSE GRAVEL
7	% FINE GRAVEL
11	% COARSE SAND
37	% FINE SAND
14	% SILT
14	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	N.P.
Plastic Limit	N.P.
Plasticity Index	N.P.

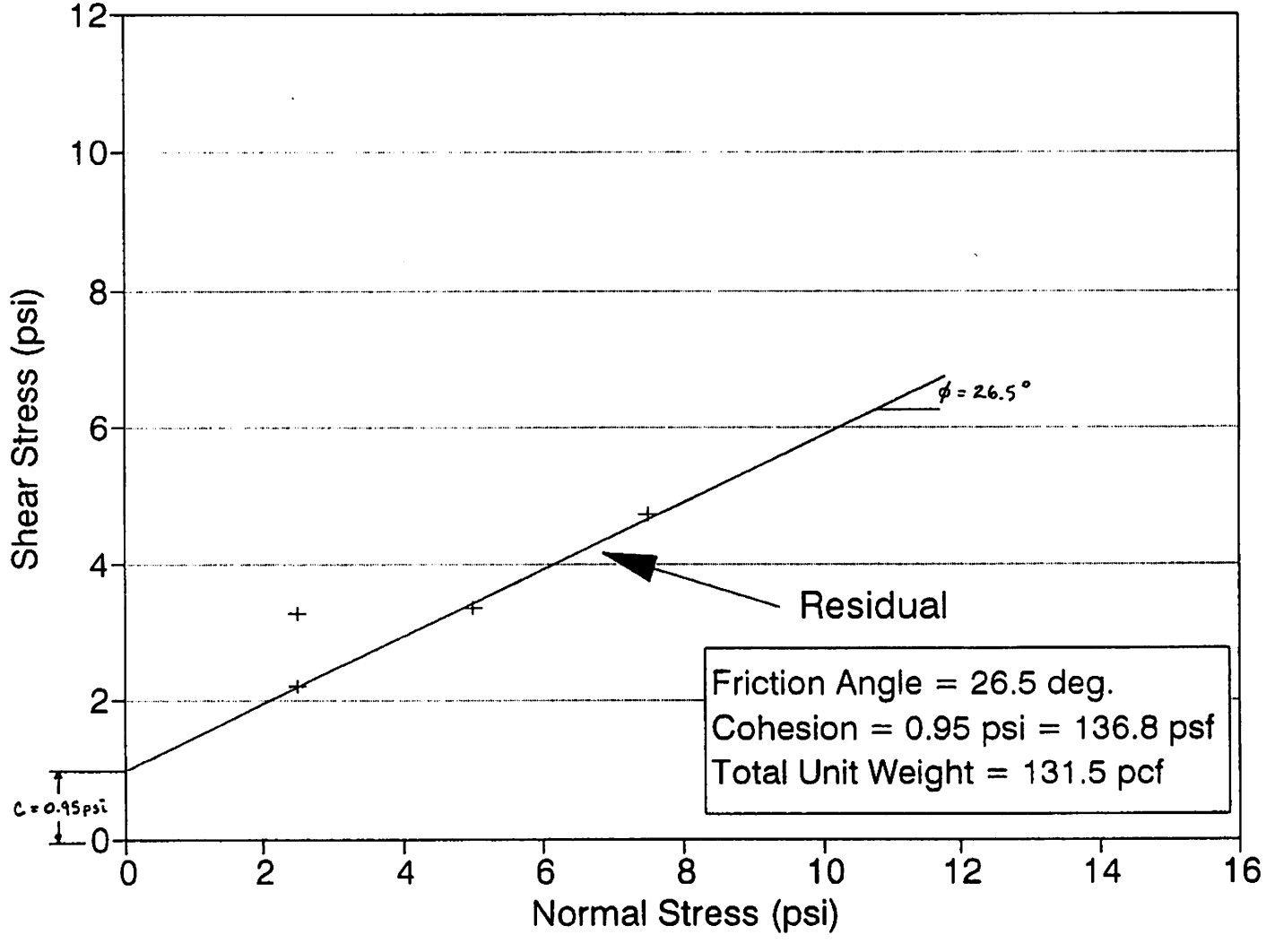
Soil Description: SAND AND GRAVEL, little Silt, little Clay

AASHTO Soil Classification(ODOT): A-2-4

CTL ENGINEERING

DIRECT SHEAR TEST
Pike County Engineer

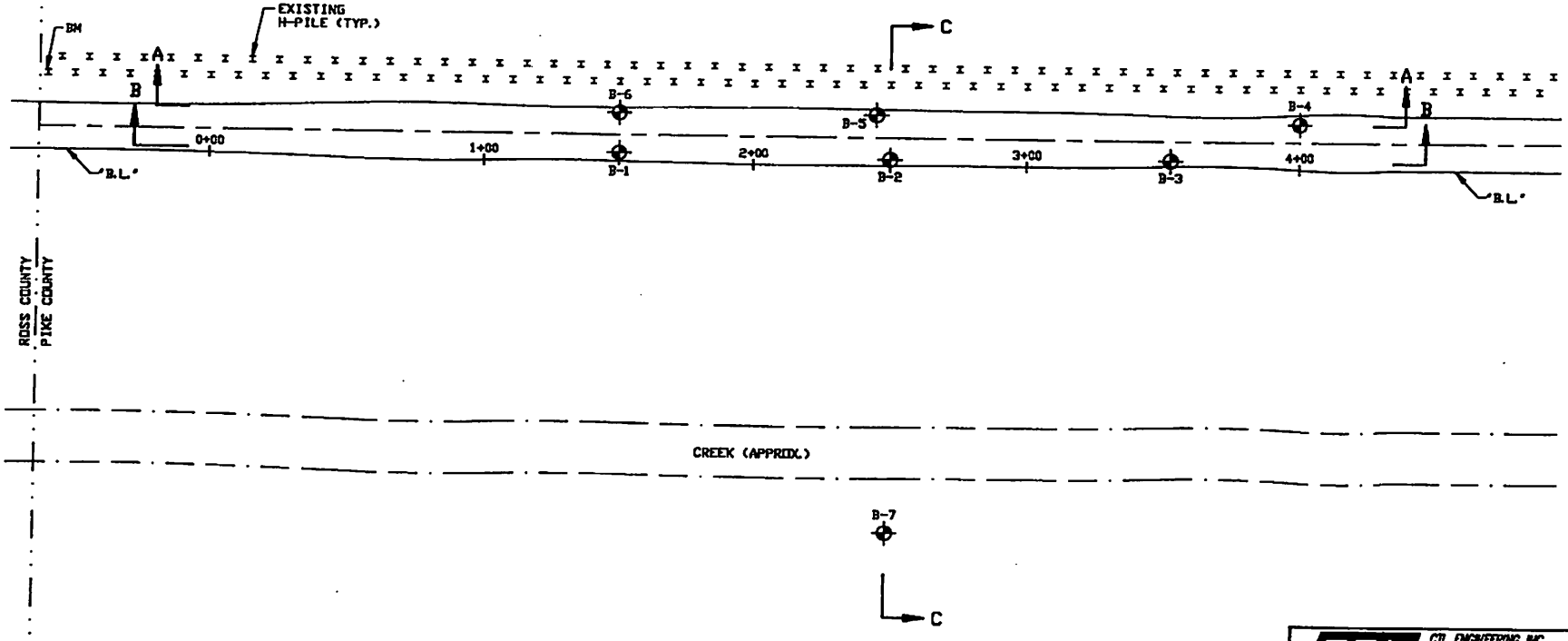
B-2, S-5, Depth: 7.0'-8.5'



APPENDIX C

SITE PLAN/PROFILE SHEETS

CTL ENGINEERING



0 40 80 100 120

BM = TOP OF H-PILE SEE SITE PLAN
ELEVATION ASSUMED AT 100.0

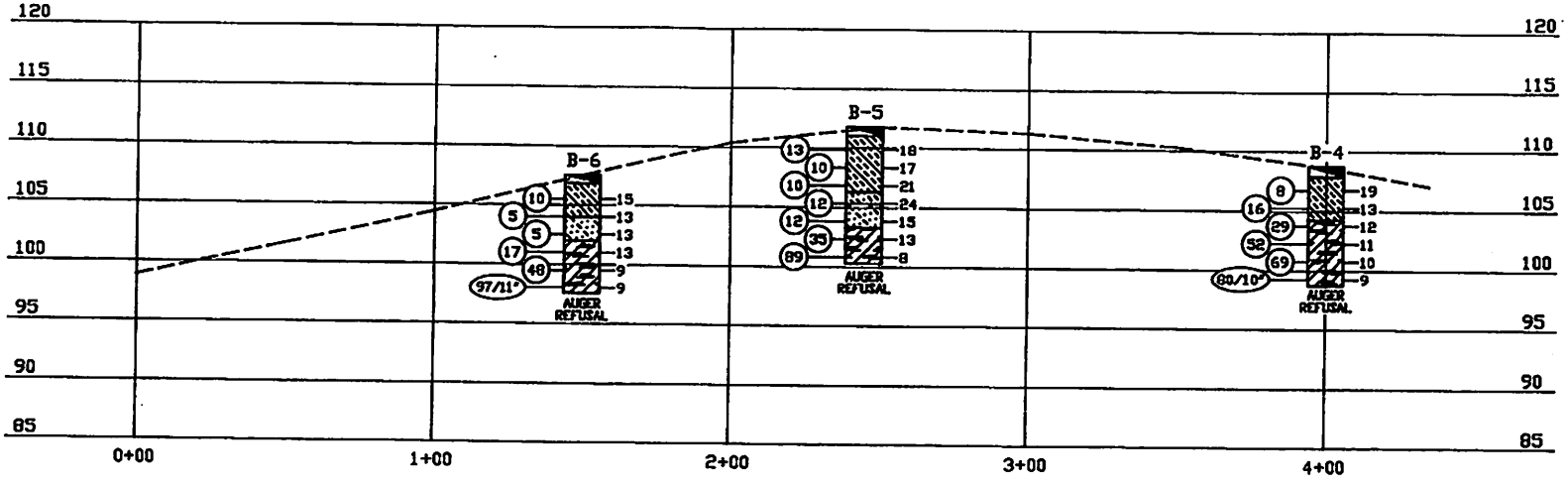
CTL ENGINEERING INC.
CONSULTING ENGINEERS
TESTING • INSPECTION
LABORATORY SERVICES

BORING LOCATION PLAN

DATE	PIKE CO. ENGINEER
10-1-97	SLOPE STABILITY STUDY
SCALE	C.R. 50, PIKE CO., OHIO
1"=40'	

DRAWN BY	REVIEWED BY	PAGE	PROJECT NO.
M. TABB	JKK	1 OF 6	97050249

SECTION A–A



SCALE: 1"=40' HORZ.
1"=10' VERT.

LEGEND

- TOPSOIL
- BITUMINOUS CONCRETE
- PORTLAND CEMENT CONCRETE
- CRUSHED AGGREGATE GRAVEL/COBBLES
- FILL
- PEAT
- CLAY
- SILT
- SAND
- BOULDERS
- SAND \ GRAVEL
- WEATHERED SHALE
- SILTSTONE
- SANDSTONE
- LIMESTONE
- COAL
- SHALE
- CLAYSHALE
- GROUND WATER DURING DRILLING
- GROUND WATER AT COMPLETION OF DRILLING
- GROUND WATER AT "N" HOURS AFTER COMPLETION
- w— MOISTURE CONTENT IN PERCENT (w)
- (N) STANDARD PENETRATION IN BLOWS PER FOOT (N)

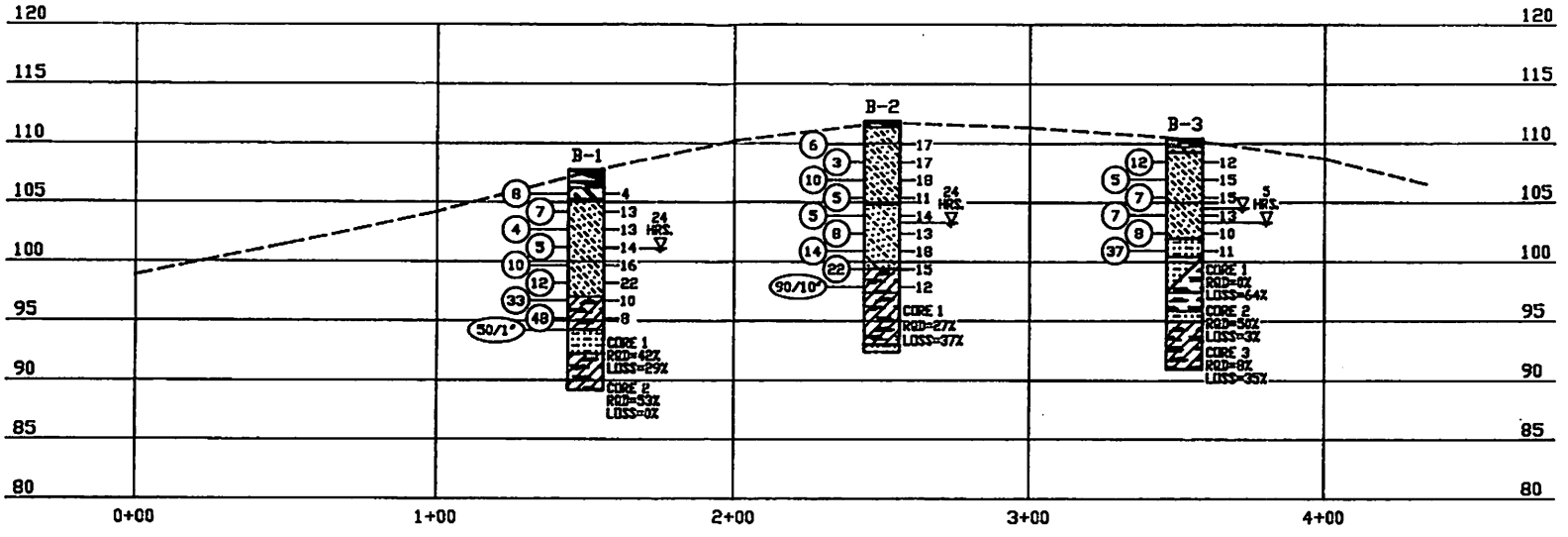
CTL ENGINEERING INC.
CONSULTING ENGINEERS
TESTING • INSPECTION
LABORATORY SERVICES

SECTION A-A

DATE	PIKE CO. ENGINEER
10-1-97	
SCALE	SLOPE STABILITY STUDY
AS SHOWN	C.R. 50, PIKE CO., OHIO

DRAWN BY	REVIEWED BY	PAGE	PROJECT NO.
M. TABB		2 OF 6	97050249

SECTION B–B



SCALE: 1'=40' HORZ.
1'=10' VERT.

LEGEND

- TOPSOIL
- BITUMINOUS CONCRETE
- PORTLAND CEMENT CONCRETE
- CRUSHED AGGREGATE GRAVEL/COBBLES
- FILL
- PEAT
- CLAY
- SILT
- SAND
- BOULDERS
- SAND \ GRAVEL
- WEATHERED SHALE
- SILTSTONE
- SANDSTONE
- LIMESTONE
- COAL
- SHALE
- CLAYSHALE
- GROUND WATER DURING DRILLING
- GROUND WATER AT COMPLETION OF DRILLING
- GROUND WATER AT "N" HOURS AFTER COMPLETION
- W— MOISTURE CONTENT IN PERCENT (w)
- (N) STANDARD PENETRATION IN BLOWS PER FOOT (N)

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SECTION B-B

DATE	PIKE CO. ENGINEER
10-1-97	SLOPE STABILITY STUDY
SCALE: AS SHOWN	C.R. 50, PIKE CO., OHIO

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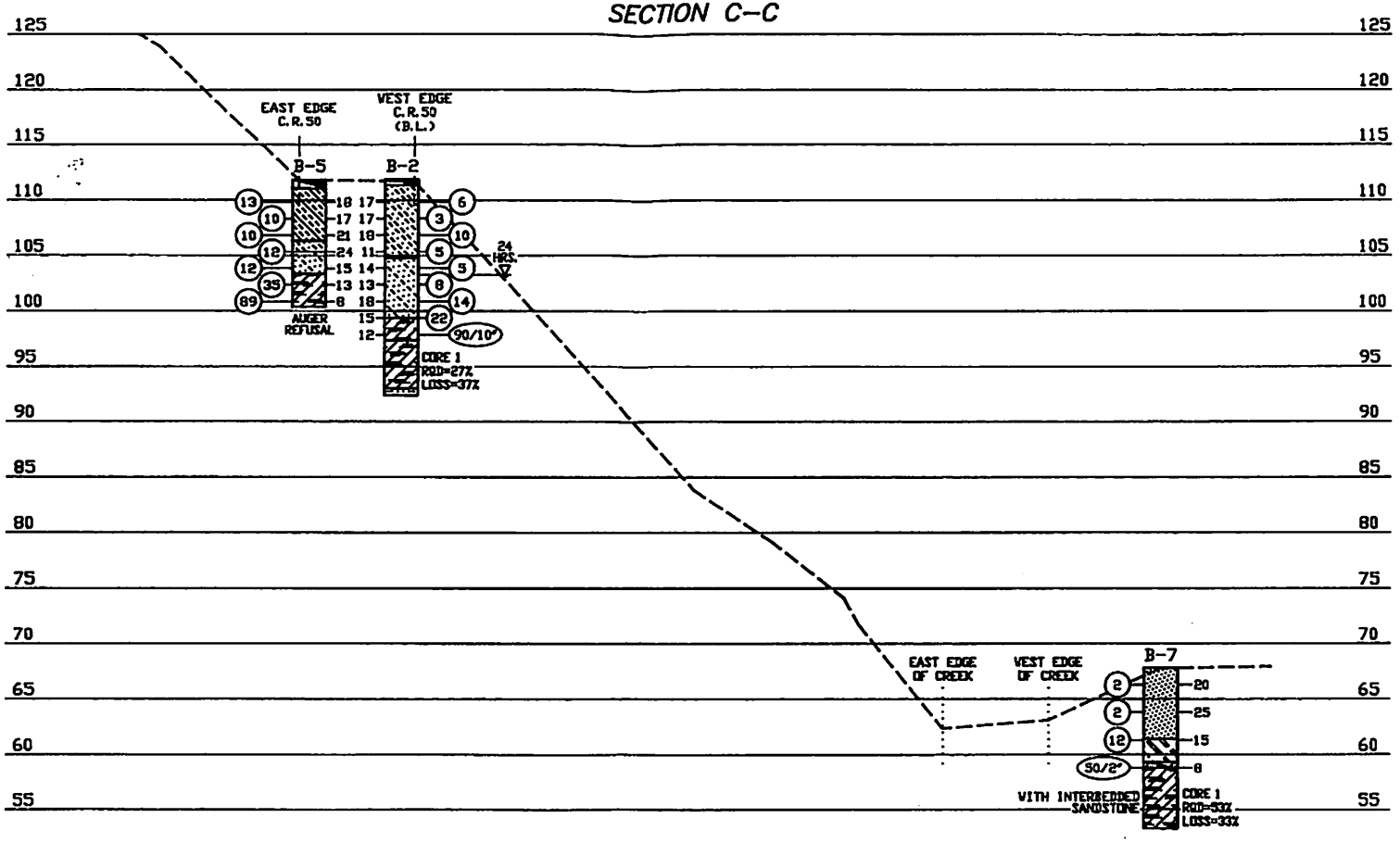
SECTION C-C



LEGEND

- TOPSOIL
- BITUMINOUS CONCRETE
- PORTLAND CEMENT CONCRETE
- CRUSHED AGGREGATE GRAVEL/COBBLES
- FILL
- PEAT
- CLAY
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- GROUND WATER AT COMPLETION OF DRILLING
- GROUND WATER AT "N" HOURS AFTER COMPLETION
- W— MOISTURE CONTENT IN PERCENT (w)
- (N) STANDARD PENETRATION IN BLOWS PER FOOT (N)

SCALE: 1"=20' HORZ.
1"=10' VERT.

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LABORATORY SERVICES

SECTION C-C

DATE	PIKE CO. ENGINEER
10-1-97	SLOPE STABILITY STUDY
SCALE: AS SHOWN	C.R. 50, PIKE CO., OHIO

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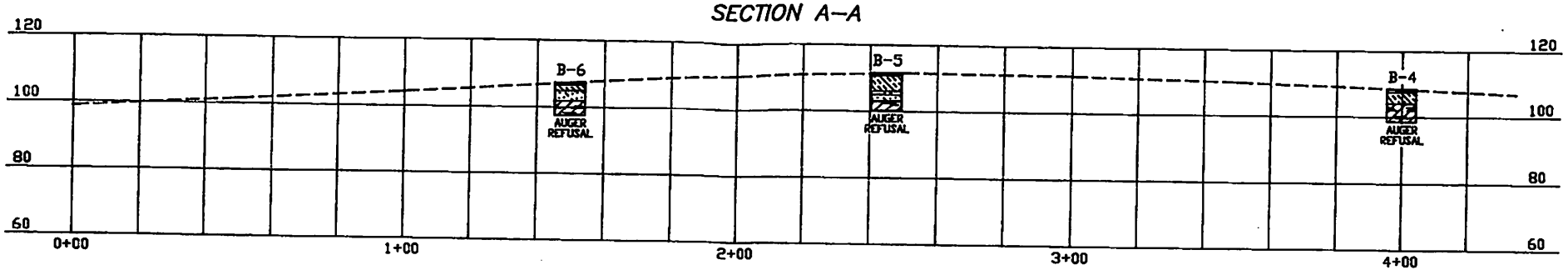
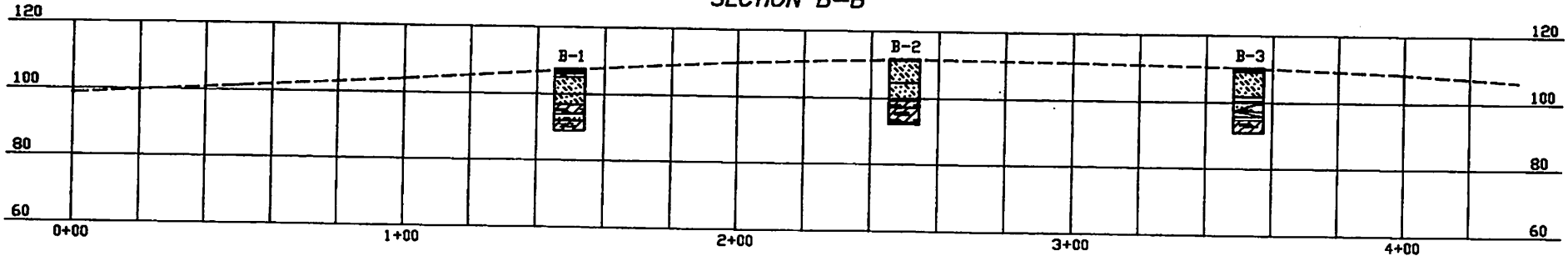
SECTION A–A



SECTION B–B



SCALE: 1"=30' HORZ.
1"=30' VERT.

TOPSOIL
BITUMINOUS CONCRETE
PORTLAND CEMENT CONCRETE
CRUSHED AGGREGATE GRAVEL/COBBLES
FILL
PEAT
CLAY
SILT
SAND
BOULDERS
SAND \ GRAVEL
WEATHERED SHALE
SILTSTONE
SANDSTONE
LIMESTONE
COAL
SHALE
CLAYSHALE

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SECTIONS

DATE	PIKE CO. ENGINEER
10-1-97	SLOPE STABILITY STUDY
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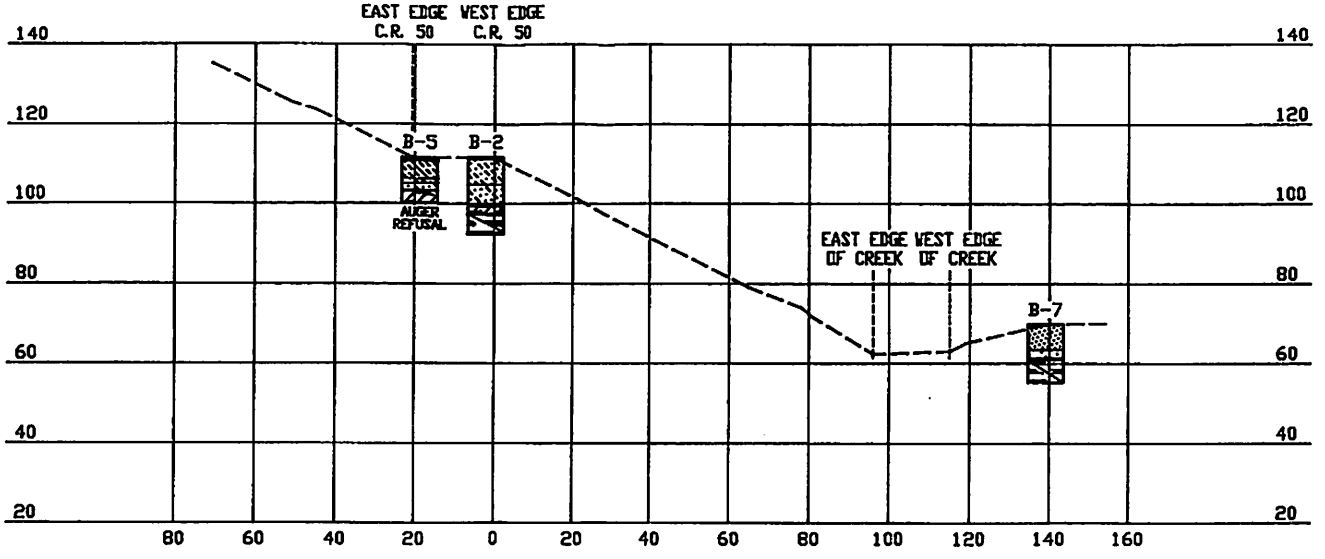
SECTION C–C



SCALE: 1"=30' HORZ.
1"=30' VERT.

TOPSOIL	CLAY	SILTSTONE
BITUMINOUS CONCRETE	SILT	SANDSTONE
PORTLAND CEMENT CONCRETE	SAND	LIMESTONE
CRUSHED AGGREGATE GRAVEL/COBBLES	BOULDERS	COAL
FILL	SAND \ GRAVEL	SHALE
PEAT	WEATHERED SHALE	CLAYSHALE

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SECTIONS

DATE 10-1-97	PIKE CO. ENGINEER
SCALE AS SHOWN	SLOPE STABILITY STUDY
	C.R. 50, PIKE CO., OHIO

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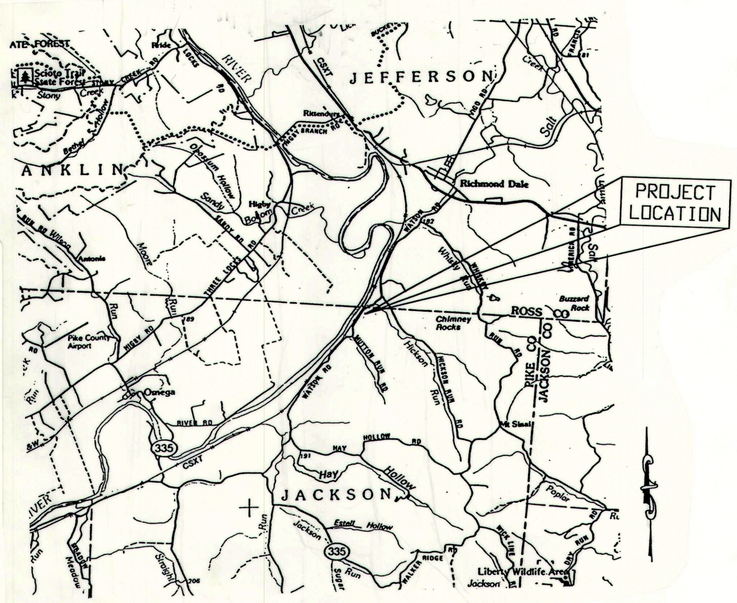
PID # 17792
FEDERAL PROJECT #
ER-000N (170)

PIKE COUNTY ENGINEER

SLOPE REPAIR PROJECT

COUNTY ROAD 50

PIKE COUNTY, OHIO



LOCATION MAP

INDEX OF SHEETS

STANDARD CONSTRUCTION DRAWINGS		SUPPLEMENTAL SPECIFICATIONS
MT-101.60 4-25-94		

THIS PROJECT ENTAILS THE REMOVAL OF SOIL IN FAILING AREAS, BENCHES CUT INTO HARD SHALE, DRAINS INSTALLED, AND EXCAVATED SOIL RECOMPACTED. PROJECT LENGTH IS APPROXIMATELY 435 FEET.

THE CURRENT 1997 STANDARD SPECIFICATIONS OF THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, INCLUDING CHANGES AND SUPPLEMENTAL SPECIFICATIONS LISTED IN THE PROPOSAL SHALL GOVERN THIS IMPROVEMENT.

I HEREBY APPROVE THESE PLANS AND DECLARE THAT THE MAKING OF THIS IMPROVEMENT WILL REQUIRE THE CLOSING OF TRAFFIC OF THE HIGHWAY.

STATE OF OHIO
JOSEPH R. GRANI
E-60435
REGISTERED
PROFESSIONAL ENGINEER

Denny Salisbury — 5-11-98
PIKE COUNTY ENGINEER — DATE

John F Hagan TME — 5-29-98
DEPUTY DIRECTOR OF TRANSPORTATION — DATE

6.10.98
DIRECTOR, DEPT. OF TRANSPORTATION — DATE

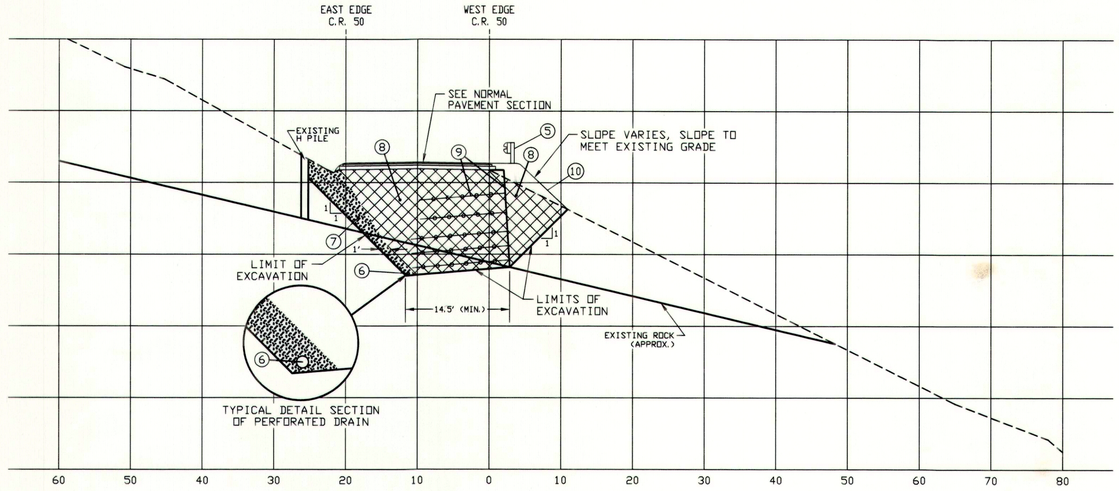
UNDERGROUND UTILITIES
2 WORKING DAYS
BEFORE YOU DIG
CALL 800-362-2764
TOLL FREE
NON MEMBERS
MUST BE CALLED DIRECTLY

PIK-CR 50
980599
8PGS
PID# 17792
09-09-98
DIST. 09

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: 614/276-8123 FAX: 614/276-6377

DRAWN	REVIEWED	DATE	CALCULATED
M.T.		4-7-98	CHECKED

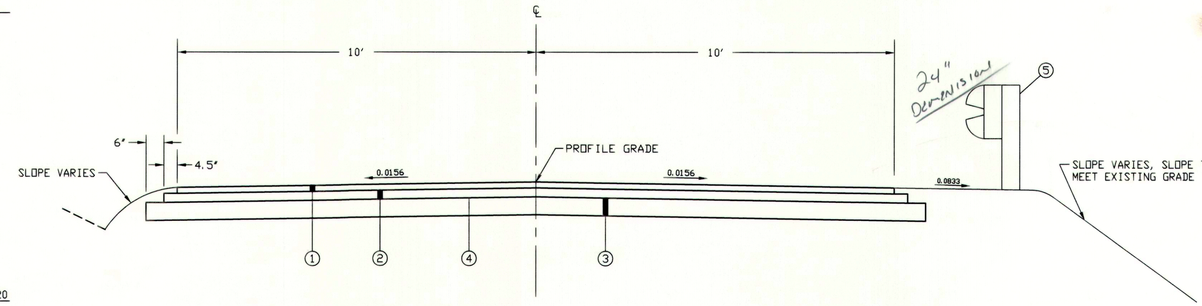
SLOPE REPAIR PROJECT
COUNTY ROAD 50
PIKE COUNTY, OHIO
1/8



NORMAL SECTION C.R. 50

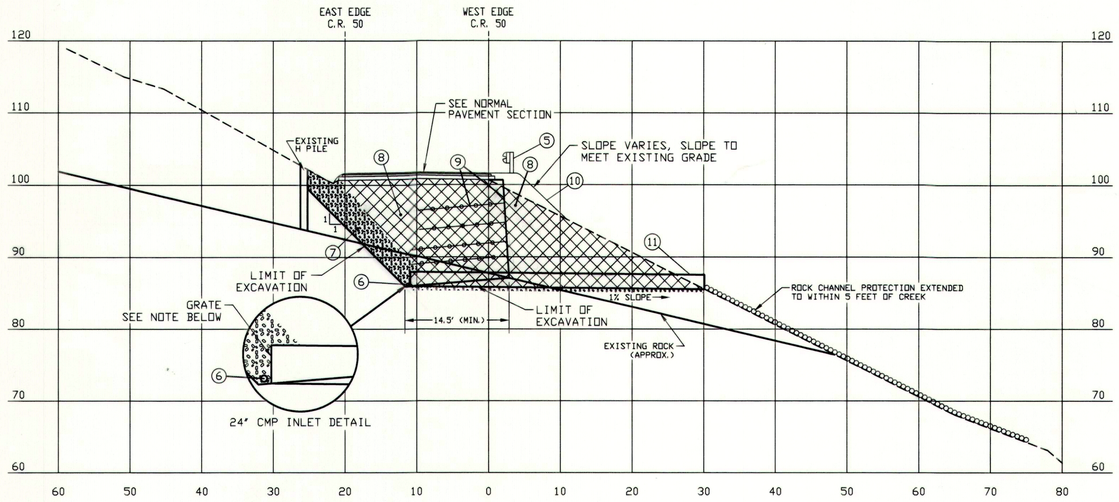
SCALE: 1" = 10'

INDICATES AREA TO BE EXCAVATED



NORMAL PAVEMENT SECTION – C.R. 50

SCALE: 1" = 2'



SECTION STA. 0+50 C.R. 50

SCALE: 1" = 10'

INDICATES AREA TO BE EXCAVATED

NOTE: A GRATE SHALL BE INSTALLED AT THE PIPE INLET TO PREVENT NO. 2 STONE FROM ENTERING PIPE. GRATE SHALL CONSIST OF GALVANIZED 5/8" DIAMETER REINFORCING STEEL WELDED TO INLET OPENING OF 24" CMP. THE REINFORCING STEEL SHOULD BE SPACED AT 2" ON-CENTER. THE COST OF THE GRATE SHOULD BE INCLUDED IN THE COST OF THE PIPE.

LEGEND

①	ITEM 448	2" ASPHALT CONCRETE
②	ITEM 301	3" BITUMINOUS AGGREGATE BASE
③	ITEM 304	6" AGGREGATE BASE
④	ITEM 408	BITUMINOUS PRIME COAT (APPLIED AT THE RATE OF 0.40 GALLON PER SQUARE YARD)
⑤	ITEM 606	GUARDRAIL, TYPE 5
⑥	ITEM 605	6" DIAMETER UNCLASSIFIED PIPE UNDER DRAIN, AS PER PLAN
⑦	ITEM 203	EMBANKMENT USING GRANULAR MATERIAL, AS PER PLAN (NO. 2 STONE)
⑧	ITEM 203	EMBANKMENT, AS PER PLAN
⑨	SPECIAL	GEOGRID TYPE P2, SEE GENERAL NOTES PAGES 3 AND 4 OF 8
⑩	ITEM 659	SEEDING AND MULCHING
⑪	ITEM 603	24-INCH CONDUIT, TYPE A, 707.01 OR 707.02, AS PER PLAN

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: 614/276-8123 FAX: 614/276-6377

DRAWN	REVIEWED	DATE	CALCULATED	CHECKED
M.T.		4-7-98		

SLOPE REPAIR PROJECT
COUNTY ROAD 50

PIKE COUNTY, OHIO

8/2

GENERAL NOTES

EXCAVATION AND EMBANKMENT

1. THE SLOPE WITHIN THE PROPOSED CONSTRUCTION LIMITS SHOULD BE CLEARED AND/OR GRUBBED. TOPSOIL SHOULD BE STRIPPED AND STOCKPILED SEPARATELY FOR REUSE AS COVER MATERIAL.

2. EXISTING PAVEMENT SHOULD BE REMOVED AND DISCARDED.

3. AS SHOWN ON THE PLANS, THE SOIL OVERBURDEN SHOULD BE EXCAVATED TO THE BEDROCK SURFACE. THESE SOILS MAY BE REUSED AS ENGINEERED FILL. THE SOIL STOCKPILES SHOULD BE LOCATED IN AREAS WHERE THE WEIGHT OF THE MATERIAL WILL NOT CAUSE SLOPE FAILURE (i.e. TOTALLY OR PARTIALLY STOCKPILED OFFSITE). ALTERNATELY, THE EXCAVATION MAY BE PERFORMED IN STAGES AND THE SOILS MAY BE STOCKPILED IN AREAS ACCEPTABLE TO THE ENGINEER.

4. DURING EARTHWORK OPERATIONS, CARE SHOULD BE TAKEN TO PROVIDE ADEQUATE DRAINAGE ON THE SURFACE OF THE CLAYSHALE AND SHALE TO AVOID SOFTENING OF THESE MATERIALS. A DRAINAGE PLAN SHALL BE SUBMITTED BY THE CONTRACTOR TO THE ENGINEER, BEFORE STARTING EXCAVATION, FOR APPROVAL. ANY COSTS ASSOCIATED WITH DRAINAGE DESCRIBED ABOVE SHOULD BE INCLUDED IN THE UNIT PRICES FOR ITEMS 203 AND 503.

5. FILL REQUIRED TO RESTORE GRADE WILL CONSIST OF ONSITE EXCAVATED MATERIALS AND BORROW MATERIALS CONFORMING TO ODOT STANDARD SPECIFICATION, SECTION 203.03. TOPSOIL OR ORGANICALLY CONTAMINATED SOILS ARE UNSUITABLE FOR USE AS BACKFILL. ALL FILL MATERIALS SHALL BE APPROVED BY THE ENGINEER OR HIS REPRESENTATIVES.

6. BACKFILL REQUIRED TO RESTORE GRADES AND EMBANKMENTS SHOULD BE PLACED AND COMPACTED IN ACCORDANCE WITH ODOT STANDARD SPECIFICATIONS, SECTION 203.12 AND RELATED SECTIONS.

7. EXCAVATION EXTENDING TO A DEPTH IN EXCESS OF 4 FEET SHOULD BE SLOPED OR SHORED IN ACCORDANCE WITH OSHA REGULATIONS.

8. GROUNDWATER SHOULD BE ANTICIPATED DURING CONSTRUCTION PARTICULARLY AT THE SOIL/ROCK INTERFACE. THE METHOD OF DEWATERING SHOULD BE DETERMINED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER.

9. THE MAJORITY OF ROCK EXCAVATION IS TO BE IN THE SOFTER SHALE LAYERS WHICH CAN BE REMOVED WITH NORMAL EARTH MOVING EQUIPMENT, I.E. BULLDOZERS AND EXCAVATORS. THE HARD ROCK EXCAVATION MAY REQUIRE THE USE OF JACK HAMMER TYPE EQUIPMENT, I.E. HOE-RAM. THE SOFT SHALE IS CHARACTERIZED IN THE BORINGS BY THE SHALE WHICH WAS AUGERED. THE HARD SHALE IS EXEMPLIFIED BY THE CORE BORE SAMPLES.

CULVERT AND DRAIN PIPES

10. CULVERT AND DRAIN PIPE SHALL BE INSTALLED IN ACCORDANCE WITH ODOT ITEM 603. THE 24 INCH DIAMETER CULVERT SHALL BE CORRUGATED METAL PIPE. A GRATE SHALL BE INSTALLED AT THE PIPE INLET TO PREVENT NO. 2 STONE FROM ENTERING PIPE. THE COST OF THE GRATE SHOULD BE INCLUDED IN THE COST OF THE PIPE. ALL EXCAVATION AND BACKFILL FOR CULVERT AND DRAIN PIPES SHALL BE INCLUDED IN UNIT COST OF EACH.

GEOGRID REINFORCEMENT OF SOIL EMBANKMENT

1.0 DESCRIPTION

THIS WORK SHALL INCLUDE THE FURNISHING AND INSTALLING OF GEOGRID REINFORCEMENT TO THE LINES, GRADES, AND ORIENTATION SHOWN IN THE PLANS, OR AS DIRECTED BY THE ENGINEER. THE GEOGRIDS SHALL BE OF THE TYPE SHOWN ON THE PLANS AND AS DETAILED HEREIN. SOIL EMBANKMENT AS DESCRIBED AND REQUIRED HEREIN SHALL BE PAID FOR UNDER ITEM 203.

2.0 MATERIALS

2.1 PHYSICAL PROPERTIES

THE GEOGRID SHALL BE A REGULAR NETWORK OF INTEGRALLY CONNECTED POLYMER ELEMENTS WITH APERTURE GEOMETRY SUFFICIENT TO PERMIT SIGNIFICANT MECHANICAL INTERLOCK WITH THE SURROUNDING SOIL OR ROCK. THE GEOGRID SHALL BE DIMENSIONALLY STABLE AND ABLE TO RETAIN ITS GEOMETRY UNDER CONSTRUCTION STRESSES. THE MATERIAL SHALL HAVE HIGH RESISTANCE TO ULTRAVIOLET DEGRADATION AND TO ALL FORMS OF CHEMICAL AND BIOLOGICAL DEGRADATION ENCOUNTERED IN THE SOIL BEING REINFORCED.

GEOGRIDS SHALL MEET THE FOLLOWING MINIMUM TENSILE PROPERTIES. TEST METHODS WITH THE GRI PREFIX REFER TO STANDARD PRACTICE OF THE GEOSYNTHETIC RESEARCH INSTITUTE. NO PRELOADING IS PERMITTED IN DETERMINATION OF TENSILE STRENGTH.

PROPERTY	METHOD	GEOGRID TYPE P2
TENSILE STRENGTH, 5% STRAIN (lb/ft)	ASTM D4595	3160
TENSILE STRENGTH, LONG-TERM DESIGN (lb/ft)	AS DEFINED BELOW (T_A)	2000

2.1.1 LONG-TERM DESIGN TENSILE STRENGTH

THE LONG-TERM DESIGN STRENGTH (T_A) SHALL BE DEFINED BY THE FOLLOWING:

$$T_A = \frac{T_{ULT}}{FS_{CR} \times FS_{ID} \times FS_{DU} \times FS_{JNT}}$$

2.1.2 ULTIMATE TENSILE STRENGTH, T_{ULT}

THE ULTIMATE TENSILE STRENGTH SHALL BE THE MINIMUM AVERAGE ROLL VALUE AS TESTED PER ASTM D4595.

2.1.3 PARTIAL FACTOR OF SAFETY FOR CREEP DEFORMATION, FSCR

THIS VALUE IS THE RATIO OF T_{ULT} TO THE CREEP LIMITED STRENGTH DETERMINED IN ACCORDANCE WITH ASTM D5262. THE TEST RESULTS SHALL BE EXTRAPOLATED FOR A 75-YEAR DESIGN LIFE PER GRI:GG3A OR GGI:GG2B. CREEP PERFORMANCE TESTING AT A DESIGNATED TEMPERATURE IS LIMITED TO ONE ORDER OF MAGNITUDE IN EXTRAPOLATION. ELEVATED TEMPERATURE TESTING FOR A MINIMUM 10,000 HOURS AND EXTRAPOLATION TO A MINIMUM 100,000 HOURS IS REQUIRED. CREEP TESTING SHALL BE PERFORMED ON REPRESENTATIVE SAMPLES OF THE PRODUCT AND NOT ON A SINGLE COMPONENT OF THE GEOGRID. DEFAULT VALUES FOR FS_{CR} SHALL NOT BE ACCEPTED. THE MINIMUM VALUE PERMITTED SHALL BE 2.00.

2.1.4 PARTIAL FACTOR OF SAFETY FOR INSTALLATION DAMAGE, FS_{ID}

THIS VALUE SHALL BE DETERMINED FROM CONSTRUCTION DAMAGE TESTS CONSISTENT WITH GRI:GG4A OR GRI:GG4B. THE BACKFILL AND COMPACTION METHODS USED FOR TESTING SHALL BE EQUAL TO OR MORE SEVERE THAN THOSE FOR THE PROPOSED CONSTRUCTION. IF TESTING ACCORDING TO THIS CRITERIA HAS NOT BEEN CONDUCTED, A DEFAULT VALUE OF 2.0 SHALL BE USED. THE MINIMUM VALUE PERMITTED SHALL BE 1.10.

2.1.5 PARTIAL FACTOR OF SAFETY FOR DURABILITY, FS_{DU}

THIS VALUE IS THE PARTIAL FACTOR OF SAFETY CONSIDERING CHEMICAL AND BIOLOGICAL DEGRADATION. IT SHALL BE DEFINED BY THE EQUATION:

$$FS_{DU} = \frac{1}{1 + R}$$

WHERE R IS THE STRENGTH REDUCTION RATIO OF THE 50 DEGREE CELSIUS INCUBATION TEST AT 120 DAYS AS DETERMINED BY TEST METHOD EPA 9090. THE INCUBATION FLUID SHALL HAVE A pH OF 12 OR HIGHER. STRENGTH SHALL BE DETERMINED BY GRI:GG1 ON THE LONGITUDINAL RIB. IF TESTING ACCORDING TO THIS CRITERIA HAS NOT BEEN CONDUCTED, A DEFAULT VALUE OF 2.60 SHALL BE USED. THE MINIMUM VALUE PERMITTED FOR SPECIFIC POLYMER TYPES IS AS FOLLOWS:

HDPE	1.10
PET	2.00
PP	1.25

2.1.6 PARTIAL FACTOR OF SAFETY FOR JOINT STRENGTH, FS_{JNT}

THIS VALUE IS THE PARTIAL FACTOR OF SAFETY WHICH SHALL BE CONSIDERED WHEN SEPARATE LENGTHS OF GEOGRIDS ARE CONNECTED TOGETHER OR OVERLAPPED IN THE DIRECTION OF THE PRIMARY REINFORCEMENT. THE VALUE OF FS_{JNT} SHALL BE TAKEN AS THE RATIO OF THE UNJOINTED SPECIMEN STRENGTH TO THE JOINTED SPECIMEN STRENGTH. TESTING SHALL BE CONDUCTED IN ACCORDANCE WITH ASTM D4595 FOR MECHANICALLY CONNECTED JOINTS AND GRI:GG5 OR GRI:GT7. THE LOADING SHALL BE NOT LESS THAN THE LONG-TERM DESIGN TENSILE STRENGTH. DEFAULT VALUES FOR FS_{JNT} SHALL NOT BE ACCEPTED. THE MINIMUM VALUE PERMITTED SHALL BE 1.00 IF THERE IS NOT REDUCTION IN STRENGTH OF THE JOINTED SPECIMEN OF IF NO JOINTS ARE USED.

2.1.7 SOIL-REINFORCEMENT INTERACTION

THE GEOGRID SHALL DEVELOP A MINIMUM LONG-TERM INTERACTION COEFFICIENT OF 0.70 IN A FINE-GRAINED SOIL HAVING NOT LESS THAN 50 PERCENT PASSING THE NO. 200 SIEVE. THE VALUE SHALL BE DETERMINED IN ACCORDANCE WITH GRI:GG5 OR GRI:GT6.

2.2 CERTIFICATION AND TESTING

THE CONTRACTOR SHALL SUBMIT CERTIFIED TEST DATA, MEASURED IN FULL ACCORDANCE WITH THE TEST METHODS AND STANDARDS SPECIFIED, TO COVER EACH SHIPMENT OF MATERIAL. UPON REQUEST OF THE ENGINEER, THE CONTRACTOR SHALL PROVIDE DOCUMENTED TEST RESULTS FROM AN INDEPENDENT TESTING LABORATORY FOR ANY OF THE CRITERIA SPECIFIED. NO EXTRA PAYMENT WILL BE MADE FOR TESTING.

2.3 DEFECTS

DURING SHIPMENT AND STORAGE, THE GEOGRID SHALL BE PROTECTED FROM TEMPERATURES GREATER THAN 140 DEGREES F., MUD, DIRT, DUST AND DEBRIS. THE MANUFACTURER'S RECOMMENDATIONS REGARDING PROTECTION FROM DIRECT SUNLIGHT SHALL BE FOLLOWED. THE GEOGRID SHALL BE REJECTED IF IT HAS DEFECTS, TEARS, PUNCTURES, FLAWS, DETERIORATION, OR DAMAGE INCURRED DURING MANUFACTURING, TRANSPORTATION, OR STORAGE. IF APPROVED BY THE ENGINEER, TORN OR PUNCTURED SECTIONS MAY BE REPAIRED BY PLACING A PATCH OVER THE DAMAGED AREA.

3.0 CONSTRUCTION METHODS

3.1 INSTALLATION

THE GEOGRID SHALL BE PLACED HORIZONTALLY AT THE ELEVATIONS AND ORIENTATIONS SHOWN ON THE PLANS. THE VERTICAL POSITION OF EACH LAYER SHALL BE MAINTAINED WITHIN 2 INCHES. CORRECT ORIENTATION (ROLL DIRECTION) OF THE GEOGRID SHALL BE VERIFIED BY THE CONTRACTOR. TYPE P2 GEOGRID SHALL HAVE ITS ROLL DIRECTION PERPENDICULAR TO THE SLOPE FACE AND NO OVERLAP IS REQUIRED BETWEEN ADJACENT ROLLS.

THE GEOGRID SHALL BE SECURED IN-PLACE TO PREVENT MOVEMENT DURING FILL OPERATIONS. THE GEOGRID SHALL BE SECURED WITH STAPLES, PINS, SANDBAGS, FILL OR AS DIRECTED BY THE ENGINEER.

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2860 FISHER ROAD
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PHONE: 614/276-8123 FAX: 614/276-6377

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PROJECT
SLOPE REPAIR PROJECT
COUNTY ROAD 50
PIKE COUNTY, OHIO

GENERAL NOTES (CONT.)

3.2 CONNECTIONS AND OVERLAPS

THE GEOGRID SHALL BE PLACED IN CONTINUOUS STRIPS IN THE DIRECTION SPECIFIED. IF THE CONTRACTOR IS UNABLE TO COMPLETE THE REQUIRED CONTINUOUS LENGTH, TYPE P2 WILL BE PERMITTED TO BE JOINTED, WITH THE APPROVAL OF THE ENGINEER. NOT MORE THAN ONE JOINT PER LENGTH OF GEOGRID SHALL BE PERMITTED. JOINTS SHALL BE MADE BY EITHER A MECHANICAL CONNECTION OR AN OVERLAP. MECHANICAL CONNECTIONS SHALL USE A POLYMER BAR OR SEWING WITH KEVLAR THREAD. BAR CONNECTIONS SHALL BE PLACED, AS A MINIMUM, ON THE SECOND ROW OF APERTURES FROM THE END OF THE ROLL AND SHALL BE HELD TAUT DURING FILL PLACEMENT. OVERLAP CONNECTIONS SHALL BE NOT LESS THAN 5 FEET IN LENGTH, WITH NOT LESS THAN 4 INCHES SEPARATING THE TWO LAYERS.

JOINTS SHALL BE SET BACK NOT LESS THAN 15 FEET BEHIND THE FINISHED SLOPE SURFACE. JOINTS SHALL BE STAGGERED NOT LESS THAN 10 FEET BETWEEN ADJACENT ROLLS OR BETWEEN CONSECUTIVE LAYERS.

3.3 EMBANKMENT, AS PER PLAN

PLACEMENT OF THE EMBANKMENT MATERIAL SHALL CONFORM TO ALL APPLICABLE REQUIREMENTS OF ITEM 203, EXCEPT THAT COMPACTION SHALL BE NOT LESS THAN 100 PERCENT OF MAXIMUM DRY DENSITY AS DETERMINED BY AASHTO T99 (STANDARD METHOD) OR OTHER APPROVED METHOD. MATERIAL SHALL BE SOIL AS DEFINED IN 203.02, EXCEPT THAT NO ORGANIC CONTENT SHALL BE PERMITTED AND THE PLASTICITY INDEX, AS DETERMINED BY ASTM D4318, SHALL NOT BE GREATER THAN 20. ALL EMBANKMENT MATERIAL SHALL BE INSPECTED AND APPROVED BY THE ENGINEER.

EMBANKMENT SOILS SHALL HAVE A pH IN THE RANGE OF 3 TO 9. TESTING OF THE EMBANKMENT MATERIAL WITH RESPECT TO pH MAY NOT BE REQUIRED. AT THE ENGINEER'S DISCRETION, WHEN SOILS POTENTIALLY CORROSIVE TO THE GEOGRID ARE SUSPECTED, THE ENGINEER MAY ELECT TO PERFORM HIS OWN pH TESTING IN ACCORDANCE WITH ASTM G51. EMBANKMENT SOILS HAVING A pH OUTSIDE THE ACCEPTABLE RANGES SHALL BE REJECTED. THE MATERIAL SHALL BE PLACED, SPREAD, AND COMPACTED IN A MANNER THAT PREVENTS THE DEVELOPMENT OF WRINKLES OR MOVEMENT OF THE GEOGRID. TRACKED CONSTRUCTION EQUIPMENT SHALL NOT BE OPERATED DIRECTLY UPON THE GEOGRID. A MINIMUM FILL THICKNESS OF 6 INCHES IS REQUIRED PRIOR TO OPERATION OF TRACKED VEHICLES OVER THE GEOGRID. TURNING OF TRACKED VEHICLES SHALL BE KEPT TO A MINIMUM TO PREVENT TRACKS FROM DISPLACING THE FILL AND DAMAGING THE GEOGRID. RUBBER-TIRED EQUIPMENT MAY PASS OVER THE GEOGRID AT SLOW SPEEDS, LESS THAN 10 MPH. SUDDEN BRAKING AND SHARP TURNING SHALL BE AVOIDED. DAMAGED GEOGRIDS SHALL BE REPLACED OR REPAIRED AT NO ADDITIONAL COST.

3.4 ON-SITE REPRESENTATIVE

THE CONTRACTOR SHALL PROVIDE AN EXPERIENCED AND QUALIFIED REPRESENTATIVE OF THE GEOGRID MANUFACTURER ON-SITE AT THE INITIATION OF THE PROJECT. THE REPRESENTATIVE SHALL BE AVAILABLE AT LEAST THREE WORKING DAYS, UNLESS EXCUSED BY THE ENGINEER.

4.0 METHOD OF MEASUREMENT

MEASUREMENT OF GEOGRID SHALL BE BY SQUARE YARD AND SHALL BE COMPUTED ON THE TOTAL AREA OF GEOGRID SHOWN ON THE PLANS, EXCLUSIVE OF THE AREA OF ANY OVERLAPS. EMBANKMENT, AS PER PLAN SHALL BE MEASURED BY THE CUBIC YARD VOLUME SHOWN ON THE PLANS.

5.0 BASIS OF PAYMENT

THE ACCEPTED QUANTITIES OF GEOGRID SHALL BE PAID FOR PER SQUARE YARD IN-PLACE.

EMBANKMENT, AS PER PLAN SHALL BE PAID FOR PER CUBIC YARD IN-PLACE. PAYMENT SHALL BE MADE UNDER:

ITEM	UNIT	DESCRIPTION
SPECIAL	S.Y.	GEOGRID, TYPE P2
203	C.Y.	EMBANKMENT, AS PER PLAN

GENERAL SUMMARY

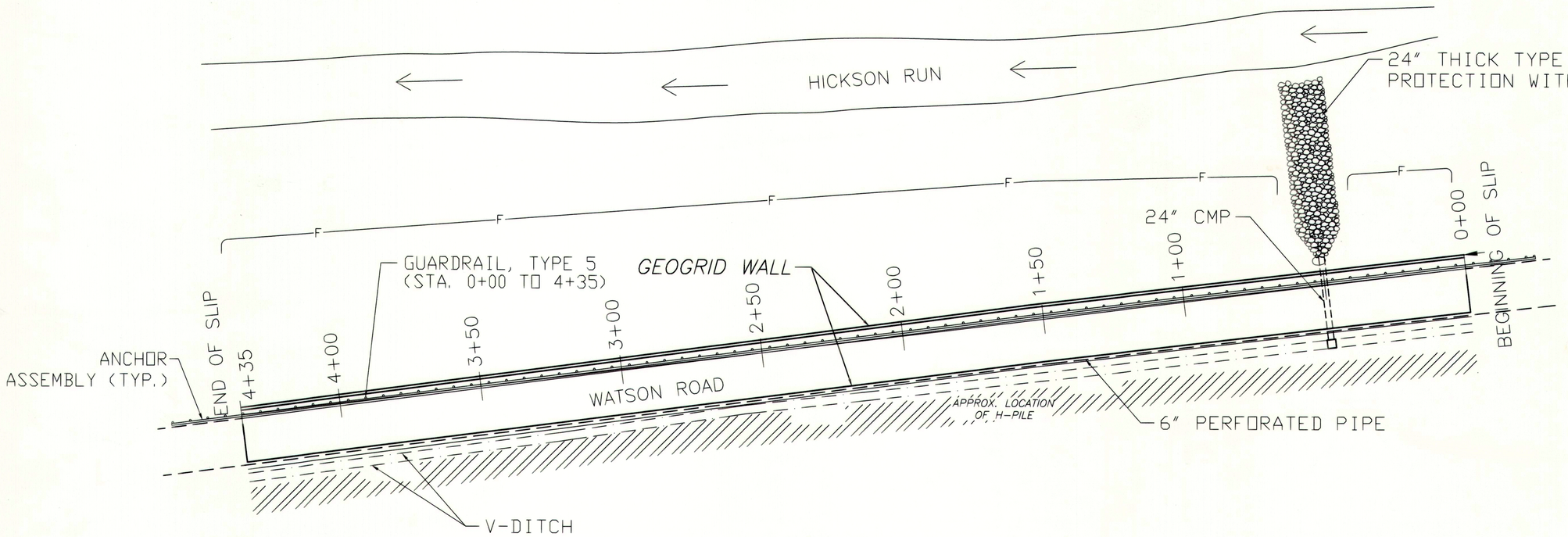
ITEM	ITEM EXT.	GRAND TOTAL	UNIT	DESCRIPTION
201	11000	Lump		CLEARING AND GRUBBING
203	20001	3425	Cu. Yd.	EMBANKMENT, AS PER PLAN
203	21001	500	Cu. Yd.	EMBANKMENT USING GRANULAR MATERIAL, AS PER PLAN (NO. 2 STONE)
207	30000	410	Lin. Ft.	FILTER FABRIC FENCE
301	46000	120	Cu. Yd.	BITUMINOUS AGGREGATE BASE, PG64-22
304	20000	310	Cu. Yd.	AGGREGATE BASE
448	47020	80	Cu. Yd.	ASPHALT CONCRETE SURFACE COURSE, TYPE 1, PG64-22
408	10000	490	Gallon	BITUMINOUS PRIME COAT
203	12001	3925	Cu. Yd.	EXCAVATION NOT INCLUDING EMBANKMENT CONSTRUCTION, AS PER PLAN
601	32100	75	Cu. Yd.	ROCK CHANNEL PROTECTION, TYPE B WITH FILTER
603	10201	45	Lin. Ft.	24-INCH CONDUIT, TYPE A, 707.01 OR 707.02, AS PER PLAN
605	13301	435	Lin. Ft.	6-INCH UNCLASSIFIED PIPE UNDERDRAIN, AS PER PLAN
606	13000	435	Lin. Ft.	GUARDRAIL, TYPE 5
606	25000	2	Each	ANCHOR ASSEMBLY, TYPE A
614	11000	Lump		MAINTAINING TRAFFIC
623	10000	Lump		CONSTRUCTION LAYOUT STAKES
624	10000	Lump		MOBILIZATION
659	10000	3500	Sq. Yd.	SEEDING AND MULCHING
SPECIAL	69012020	4100	Sq. Yd.	GEOGRID, TYPE P2 (SEE GENERAL NOTES PAGES 3 & 4 OF 8)

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: 614/276-8123 FAX: 614/276-6377

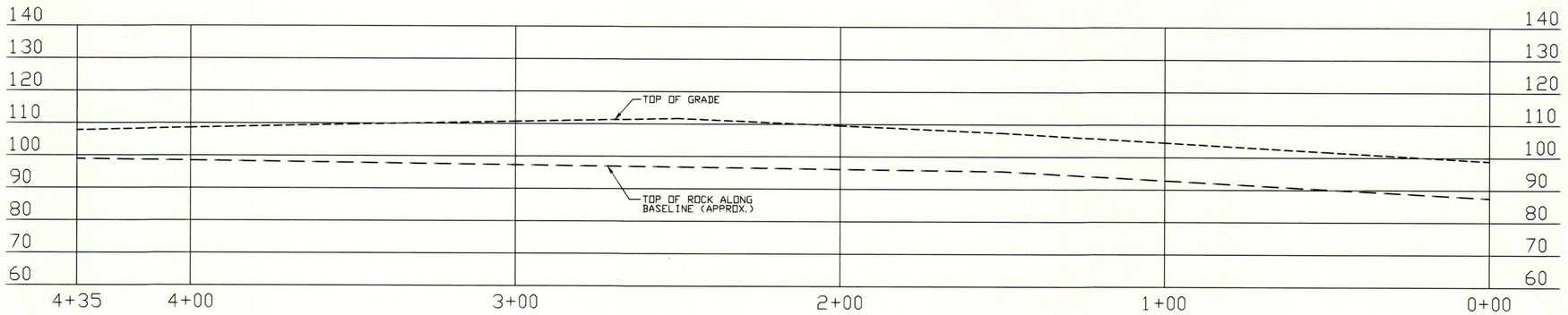
DRAWN M.T. | REVIEWED | DATE 4-7-98 | CALCULATED | CHECKED

SLOPE REPAIR PROJECT
COUNTY ROAD 50

PIKE COUNTY, OHIO



GEOGRID WALL PLAN



PROFILE

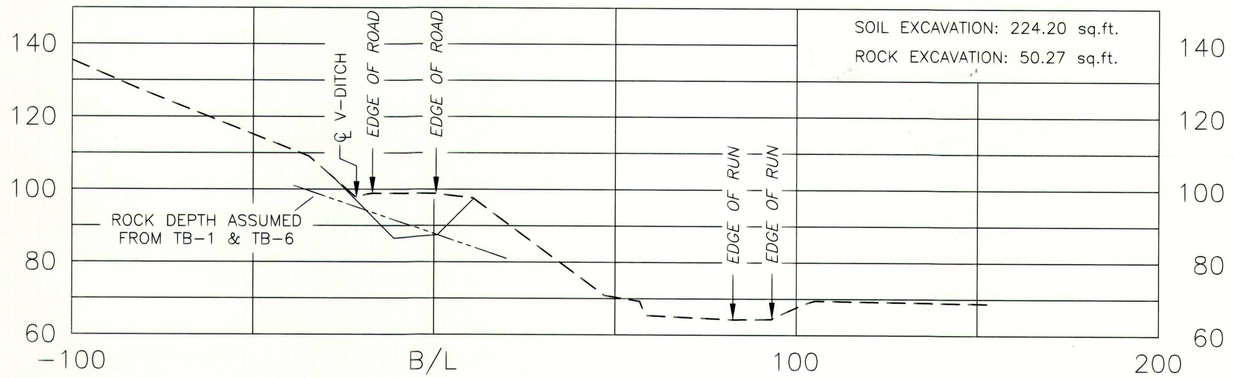
SLOPE REPAIR PROJECT
COUNTY ROAD 50

PIKE COUNTY, OHIO

DRAWN	REVIEWED	DATE	CALCULATED
M.T.		4-7-98	CHECKED

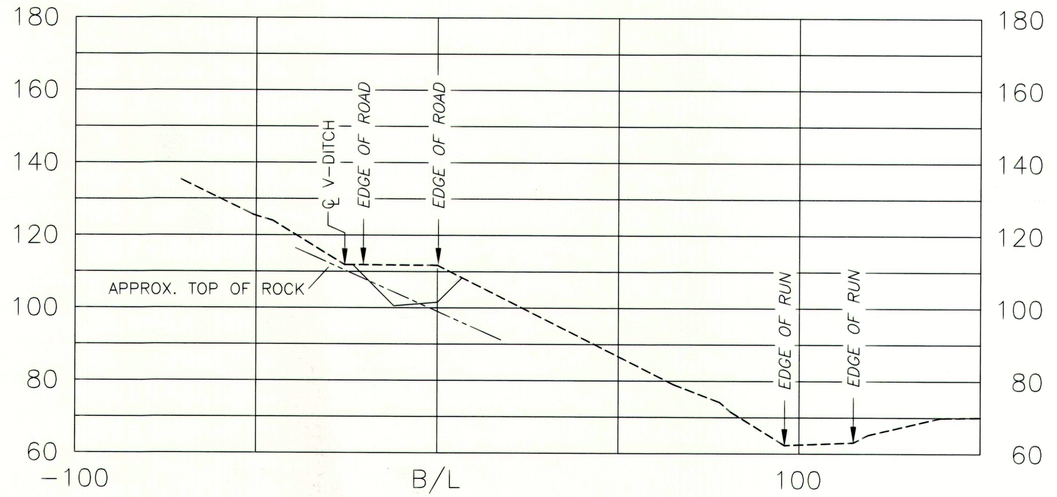
SCALE IN FEET
0 20 40 50 60

5/8

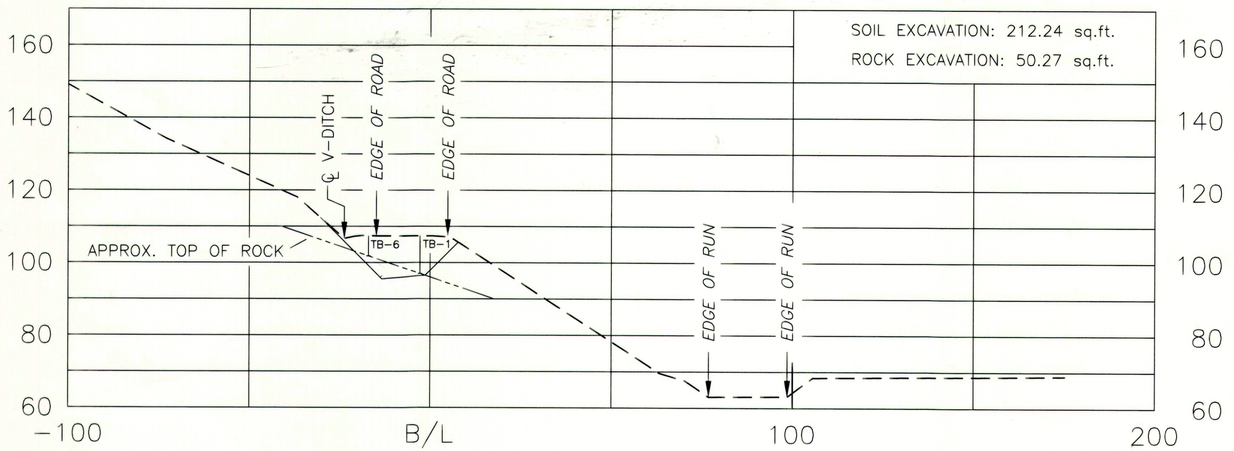


CROSS-SECTION 0+00

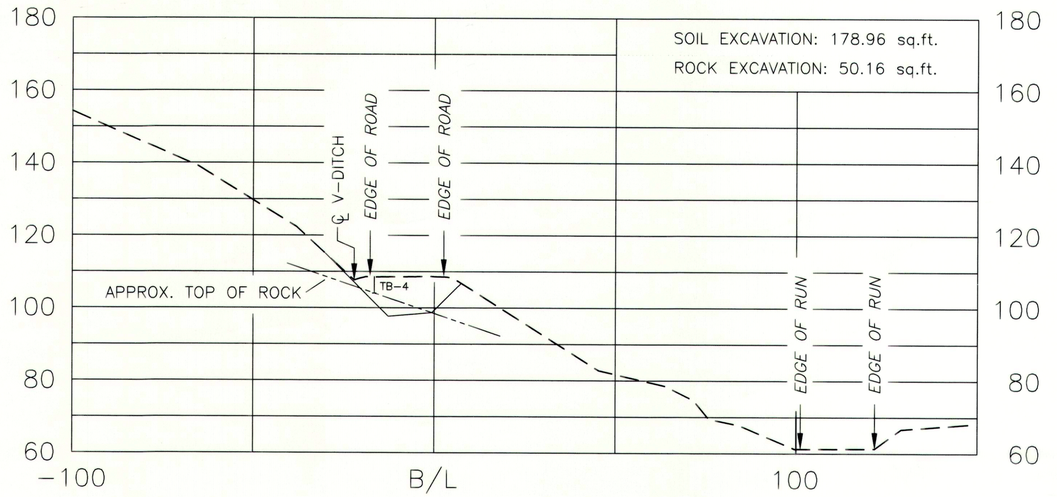
NOTE:
* STATION 0+00 ROCK DEPTH WAS ASSUMED FROM BORING TB-1 & TB-6 LOCATED AT STATION 1+50



CROSS-SECTION 2+50



CROSS-SECTION 1+50



CROSS-SECTION 4+00

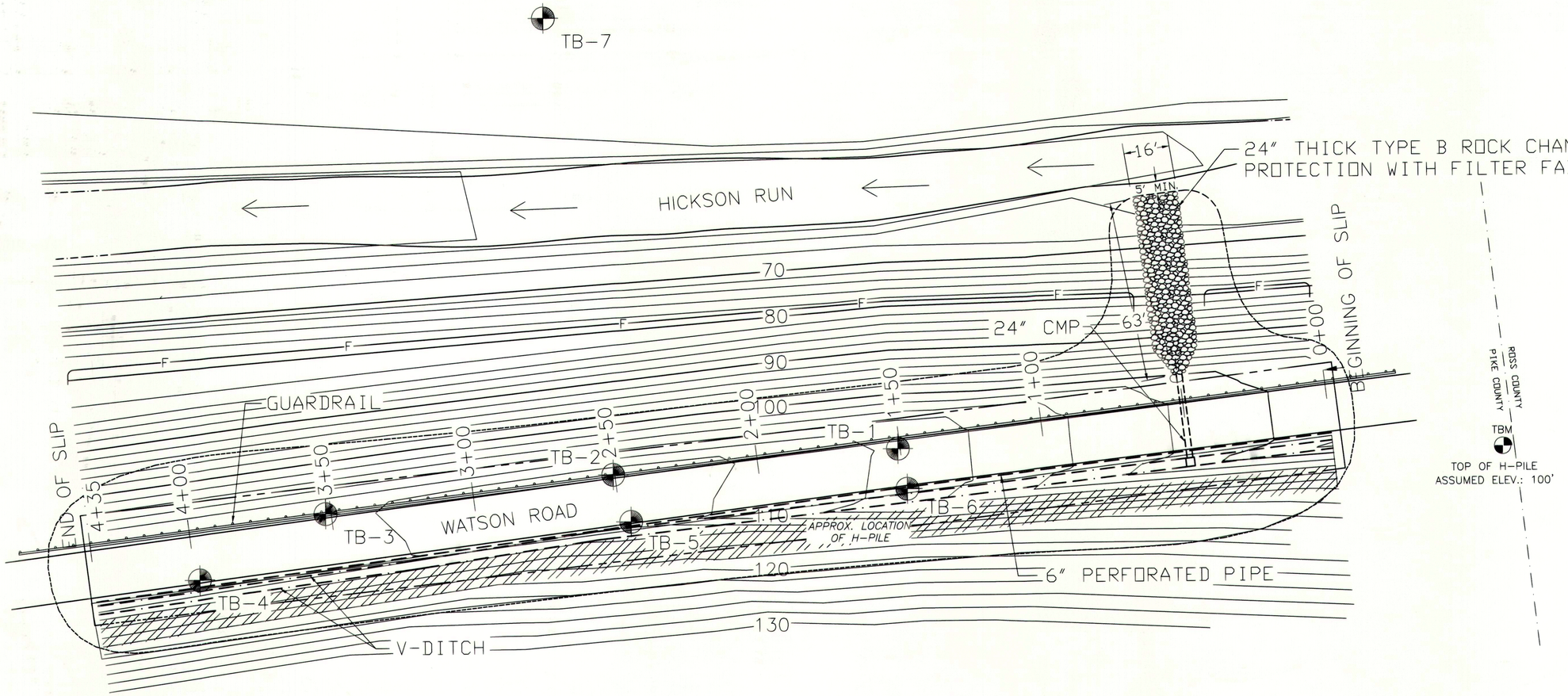
NOTE:
* STATION 4+35 ROCK DEPTH WAS ASSUMED FROM BORING TB-4 LOCATED AT STATION 4+00

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: 614/276-8123 FAX: 614/276-6377

DRAWN	REVIEWED	DATE	CALCULATED
M.T.		4-7-98	CHECKED

SLOPE REPAIR PROJECT
COUNTY ROAD 50

PIKE COUNTY, OHIO



BORING LOCATION PLAN & TOPOGRAPHICAL MAP

NOTES:

EXISTING TOPO WAS GENERATED FROM CROSS-SECTIONS 0+00, 1+50, & 4+00.

BARRICADES FOR ROAD CLOSURE PER ODOT STANDARD DRAWING MT 101.60 SHALL BE FURNISHED, ERECTED, & MAINTAINED BY THE CONTRACTOR. ALL ROAD CLOSURE BARRICADES LOCATED REMOTE FROM THE PROJECT SITE SHALL BE FURNISHED & MAINTAINED BY THE PIKE COUNTY HIGHWAY DEPARTMENT. ROAD CLOSURE SHALL BE LIMITED TO A MAXIMUM OF 45 DAYS.

LEGEND

130	EXISTING CONTOURS (10' INTERVALS)
	EXISTING CONTOURS (2' INTERVALS)
TB-1	TEST BORING LOCATION
	CONTRACTOR WORK LIMITS
	EXCAVATION WORK LIMITS
F	FILTER FABRIC FENCE
	APPROX. LOCATION OF H-PILE

N

0 20 40 50 60
SCALE IN FEET

DRAWN	REVIEWED	DATE	CALCULATED	CHECKED
M.T.		4-7-98		

SLOPE REPAIR PROJECT
COUNTY ROAD 50

PIKE COUNTY, OHIO

7/8

TEST BORING LOGS

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249
BORING ELEVATION: 107.7 BORING METHOD: HSA/RC HAMMER: Automatic
STATION : 1+50 RIG TYPE : CME 45c DRILLER : IC
OFFSET : 3.2' Left of B.L. CASING DIA. : 3¼" TEMPERATURE: 65°
DEPTH : 18.5 Feet CORE SIZE : NX WEATHER: Sunny
BORING NO.: B-1
SHEET 1 OF 1
DATE STARTED : 09-18-97
DATE COMPLETED: 09-18-97

GROUNDWATER: Encountered at Dry, At completion 6.5' after coring, At 24 hours 6.6', Caved in at 9.7'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
	_	**ASPHALT CONCRETE** (12") over **CRUSHED ASPHALT** (6")											
106.2	X		1.5'	SS-1A	5			4					
105.2	X	Loose, Damp, Brown **FINE TO COARSE SAND AND GRAVEL**	2.5'	SS-1B	5	8	22	6					
	X				3								
	X			SS-2	2	7	50	13		5.0*	35	18	7
	X				4								
	X				3								
5	X	Soft to Stiff, Damp to		SS-3	2	4	28	13		4.0*			
	X	Moist, Brown **SANDY SILT**,			2								
	X	Some Fine to Coarse			1								
	X	Gravel, Little Clay with		SS-4	2	5	44	14		7.0*			
	X	Sandstone Fragments and			3								
	X	Cobbles			2								
	X	A-4a to A-2-4		SS-5	3	10	56	16		9**			
	X				7								
	X				5								
10	X			SS-6	5	12	50	22		6.0*			
97.0	X		10.7'		7								
	X			SS-7	10	33	61	10					
	X				13								
	X	Gray and Brown Weathered,		SS-8A	20			8					
	X	Decomposed **SHALE** with			9								
	X	Sandstone Layers		SS-8B	28	48	83	10					
94.2	X		13.5'	SS-9	50								
				13.5'	1"								
	_	Tan, Well Sorted, Fine		CR-1	RQD=								
15	_	Grained **SANDSTONE**			42%		71						
92.2	_		15.5'		15.5'								
	_	Light Gray, Thinly											
	_	Bedded, Weathered **SHALE**,		CR-2	RQD=								
	_	Some Iron Stained			53%		100						
	_	Inclined Fractures	18.5'		18.5'								
89.2	_	**BOTTOM OF BORING**											

BORING METHOD: HSA - Hollow Stem Auger; SFA - Solid Flight Auger; RC - Rock Coring; MD - Mud Drilling; WD - Wash Drilling; HA - Hand Auger
SAMPLING METHOD: SS - Split Spoon Sample; ST - Shelby Tube Sample; CR - Rock Core Sample; BS - Bag Sample
ABBREVIATIONS: El = Stratum Elevation; D = Sample Depth; Ds = Stratum Depth; S# = Sample Number; N = Blows per 12"; R = % Recovery; W = Moisture Content; γ = Unit Weight, pcf; UC= Unconf.Comp.,Ksf; * = Hand Penetrometer; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; SPT= Standard Penetration Test

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249
BORING ELEVATION: 111.9 BORING METHOD: HSA/RC HAMMER: Automatic
STATION : 2+50 RIG TYPE : CME 45c DRILLER : IC
OFFSET : 2.2' Left of B.L. CASING DIA. : 3¼" TEMPERATURE: 65°
DEPTH : 19.5 Feet CORE SIZE : NX WEATHER: Sunny
BORING NO.: B-2
SHEET 1 OF 1
DATE STARTED : 09-18-97
DATE COMPLETED: 09-18-97

GROUNDWATER: Encountered at Dry, At completion 6.3' after coring, At 24 hours 8.6', Caved in at 10.9'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
111.4	_	**ASPHALT CONCRETE**	6"										
	X				4								
	X			SS-1	3	6	78	17		8.0*			
	X				2								
	X	Soft to Stiff, Damp,			2								
	X	Brown and Gray **SANDY**		SS-2	1	3	72	17		7.0*	30	20	10
	X	**SILT TO CLAYEY SILT**,			2								
	X	Little Fine to Coarse			1								
5	X	Gravel with Sandstone		SS-3	4	10	44	18					
	X	Fragments and Cobbles			6								
	X	A-4a			6								
	X			SS-4	3	5	11	11					
104.8	X		7.1'		2								
	X			SS-5	4	5	67	14	120.0				
	X				2								
	X				3								
	X	Loose to Medium Dense,		SS-6	3	8	61	13					
10	X	Damp, Brown **SILTY SAND**,			4								
	X	Some Clay with Sandstone			4								
	X	Fragments and Silt Seams		SS-7	9	14	100	18	120.8		32	17	15
	X	A-6a			6								
	X				8								
	X			SS-8A	7			15					
99.4	X		12.5'		8	22	100						
	X	Gray Weathered,		SS-8B	14			13					
	X	Decomposed **SHALE** with			14								
	X	Sandstone Layers	14.5'	SS-9	40		100	12					
97.4	X			SS-9	50								
				14.5'	4"								
15	_												
	_	Light Gray, Thinly		CR-1	RQD=								
	_	Bedded Soft, Weathered			27%		63						
	_	**SHALE**											
	_		18.9'										
93.0	_	Tan, Fine Grained, Well											
92.4	_	Sorted **SANDSTONE**	19.5'		19.5'								
20	_	**BOTTOM OF BORING**											

BORING METHOD: HSA - Hollow Stem Auger; SFA - Solid Flight Auger; RC - Rock Coring; MD - Mud Drilling; WD - Wash Drilling; HA - Hand Auger
SAMPLING METHOD: SS - Split Spoon Sample; ST - Shelby Tube Sample; CR - Rock Core Sample; BS - Bag Sample
ABBREVIATIONS: El = Stratum Elevation; D = Sample Depth; Ds = Stratum Depth; S# = Sample Number; N = Blows per 12"; R = % Recovery; W = Moisture Content; γ = Unit Weight, pcf; UC= Unconf.Comp.,Ksf; * = Hand Penetrometer; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; SPT= Standard Penetration Test

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249
BORING ELEVATION: 110.4 BORING METHOD: HSA/RC HAMMER: Automatic
STATION : 3+53 RIG TYPE : CME 45c DRILLER : IC
OFFSET : 2.0' Left of B.L. CASING DIA. : 3¼" TEMPERATURE: 65°
DEPTH : 19.5 Feet CORE SIZE : NX WEATHER: Sunny
BORING NO.: B-3
SHEET 1 OF 1
DATE STARTED : 09-18-97
DATE COMPLETED: 09-18-97

GROUNDWATER: Encountered at Dry, At completion 5.9' after coring, At 5.0 hours 7.1', Caved in at 9.7'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
	_	**ASPHALT CONCRETE** (8") over **BASE COURSE** (6")											
109.2	X		14"		7								
	X			SS-1	6	12	44	12		9+*			
	X				6								
	X				3								
	X			SS-2	3	5	50	15		8.0*			
	X				3								
	X	Medium Stiff to Stiff,			2								
	X	Damp, Brown **SANDY SILT**,			3								
5	X	Little Fine to Coarse		SS-3	4	7	72	15		9+*	25	22	3
	X	Gravel with Sandstone			3								
	X	Fragments, Cobbles and			2								
	X	Fine Sand Seams		SS-4	3	7	78	13					
	X	A-4a to A-2-4			4								
	X				3								
	X			SS-5	4	8	16	10			NP	NP	NP
101.9	X		8.5'		4								
	X			SS-6A	12			11					
	X	Rusty Brown Weathered			25								
100.4	10 X	**SANDSTONE**	10.0'	SS-6B	12	37	72	12					
	_			10.0'									
	_	Highly Weathered		CR-1									
	_	Interbedded Tan **SANDSTONE**		RQD=									
	_	and Gray to Tan **SHALE**		0%									
97.4	_		13.0'	13.0'				36					
	_												
	_	Light Gray to Tan,		CR-2									
95.8	_	Weathered **SHALE**	14.6'	RQD=									
15	_	Tan Fine Grained		50%									
94.9	_	**SANDSTONE**	15.5'	15.5'									
	_												
	_	Light Gray, Weathered		CR-3									
	_	**SHALE** with Thin Interbeds		RQD=									
	_	of Fine Grained Sandstone		8%				65					
	_												
90.9	_		19.5'	19.5'									
20	_	**BOTTOM OF BORING**											

BORING METHOD: HSA - Hollow Stem Auger; SFA - Solid Flight Auger; RC - Rock Coring; MD - Mud Drilling; WD - Wash Drilling; HA - Hand Auger
SAMPLING METHOD: SS - Split Spoon Sample; ST - Shelby Tube Sample; CR - Rock Core Sample; BS - Bag Sample
ABBREVIATIONS: El = Stratum Elevation; D = Sample Depth; Ds = Stratum Depth; S# = Sample Number; N = Blows per 12"; R = % Recovery; W = Moisture Content; γ = Unit Weight, pcf; UC= Unconf.Comp.,Ksf; * = Hand Penetrometer; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; SPT= Standard Penetration Test

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249
BORING ELEVATION: 108.8 BORING METHOD: HSA HAMMER: Automatic
STATION : 4+00 RIG TYPE : CME 45c DRILLER : IC
OFFSET : 16.8' Left of B.L. CASING DIA. : 3¼" TEMPERATURE: 65°
DEPTH : 18.5 Feet CORE SIZE : -- WEATHER: Sunny
BORING NO.: B-4
SHEET 1 OF 1
DATE STARTED : 09-18-97
DATE COMPLETED: 09-19-97

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 5.9'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
108.0	_	**ASPHALT CONCRETE**	10"										
	X				3								
	X	Medium Stiff to Very		SS-1	4	8	61	19	128.3	8.0*			
	X	Stiff, Damp, Brown **CLAYEY**			4								
	X	**SILT** with Shale and			7								
	X	Sandstone Fragments		SS-2	6	16	78	13		7.0*			
	X				10								
104.3	X		4.5'	SS-3A	7			12					
5	X				10	29	83						
	X			SS-3B	19			14					
	X				15								
	X			SS-4	22	52	72	11					
	X	Brown and Gray Highly,			30								
	X	Decomposed, Weathered			12								
	X	**SHALE** with Sandstone		SS-5	29	69	72	10					
	X	Layers			40								
	X				14								
	X			SS-6	30			9					
98.8	10 X		10.0'		50								
	_	**BOTTOM OF BORING**			4"								
	_	**AUGER REFUSAL**											

BORING METHOD: HSA - Hollow Stem Auger; SFA - Solid Flight Auger; RC - Rock Coring; MD - Mud Drilling; WD - Wash Drilling; HA - Hand Auger
SAMPLING METHOD: SS - Split Spoon Sample; ST - Shelby Tube Sample; CR - Rock Core Sample; BS - Bag Sample
ABBREVIATIONS: El = Stratum Elevation; D = Sample Depth; Ds = Stratum Depth; S# = Sample Number; N = Blows per 12"; R = % Recovery; W = Moisture Content; γ = Unit Weight, pcf; UC= Unconf.Comp.,Ksf; * = Hand Penetrometer; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; SPT= Standard Penetration Test

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249
BORING ELEVATION: 111.8 BORING METHOD: HSA HAMMER: Automatic
STATION : 2+45 RIG TYPE : CME 45c DRILLER : IC
OFFSET : 18.8' Left of B.L. CASING DIA. : 3¼" TEMPERATURE: 63°
DEPTH : 11.5 Feet CORE SIZE : -- WEATHER: Sunny
BORING NO.: B-5
SHEET 1 OF 1
DATE STARTED : 09-18-97
DATE COMPLETED: 09-18-97

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 8.2'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
111.0	_	**ASPHALT CONCRETE**	9"										
	X				3								
	X			SS-1	7	13	56	18	125.9	4.0*			
	X				6								
	X	Stiff, Damp, Brown and			6								
	X	Gray **CLAYEY SILT** with		SS-2	5	10	61	17	123.8	5.0*			
	X	Sandstone Fragments			5								
	X				5								
5	X			SS-3	5	10	72	21	124.6	6.0*			
106.3	X		5.5'		5								
	X	Stiff, Moist, Brown and		SS-4A	5			24		4.0*			
105.3	X	Gray **SANDY SILT**, Traces	6.5'		7	12	83						
	X	of Clay with Sandstone		SS-4B	5			15					
	_	Fragments			3								
	X			SS-5	6	12	78	15					
103.3	X	Medium Dense, Damp,	8.5'		6								
	X	Brown **SILTY FINE TO**			5								
	X	**COARSE SAND** with		SS-6	19	35	72	13					
10	X	Sandstone Fragments			16								
	X				25								
	X	Brown and Gray Highly		SS-7	39	89	89	8					
100.3	X	Decomposed, Weathered	11.5'		50								
	_	**SHALE** with Sandstone			6"								
	_	Layers											
	_	**BOTTOM OF BORING**											
	_	**AUGER REFUSAL**											

BORING METHOD: HSA - Hollow Stem Auger; SFA - Solid Flight Auger; RC - Rock Coring; MD - Mud Drilling; WD - Wash Drilling; HA - Hand Auger
SAMPLING METHOD: SS - Split Spoon Sample; ST - Shelby Tube Sample; CR - Rock Core Sample; BS - Bag Sample
ABBREVIATIONS: El = Stratum Elevation; D = Sample Depth; Ds = Stratum Depth; S# = Sample Number; N = Blows per 12"; R = % Recovery; W = Moisture Content; γ = Unit Weight, pcf; UC= Unconf.Comp.,Ksf; * = Hand Penetrometer; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; SPT= Standard Penetration Test

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249
BORING ELEVATION: 107.5 BORING METHOD: HSA HAMMER: Automatic
STATION : 1+50 RIG TYPE : CME 45c DRILLER : IC
OFFSET : 18.0' Left of B.L. CASING DIA. : 3¼" TEMPERATURE: 64°
DEPTH : 9.9 Feet CORE SIZE : -- WEATHER: Sunny
BORING NO.: B-6
SHEET 1 OF 1
DATE STARTED : 09-19-97
DATE COMPLETED: 09-19-97

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 6.0'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
106.8	_	**ASPHALT CONCRETE**	8"										
	X	Stiff, Damp to Moist,			7								
	X	Brown **CLAYEY SILT**, Some		SS-1	6	10	72	15	115.8	6.0*			
	X	Fine Sand	2.5'		4								
	X				2								
	X	Loose, Moist, Brown **SILTY**		SS-2	2	5	78	13					
	X	**FINE SAND**, Traces of Clay			3								
5	X			SS-3	3								
102.0	X		5.5'		2	5	94	13	113.1				
	X				3								
	X			SS-4	6								
	X				7	17	78	13					
	X	Brown and Gray Highly			14								
	X	Decomposed, Weathered		SS-5	20	48	94	9					
	X	**SHALE** with Sandstone			28								
	X	Fragments			15								
	X			SS-6	47		88	9					
97.6	10 X		9.9'		50								
	_	**BOTTOM OF BORING**			5"								
	_	**AUGER REFUSAL**											

BORING METHOD: HSA - Hollow Stem Auger; SFA - Solid Flight Auger; RC - Rock Coring; MD - Mud Drilling; WD - Wash Drilling; HA - Hand Auger
SAMPLING METHOD: SS - Split Spoon Sample; ST - Shelby Tube Sample; CR - Rock Core Sample; BS - Bag Sample
ABBREVIATIONS: El = Stratum Elevation; D = Sample Depth; Ds = Stratum Depth; S# = Sample Number; N = Blows per 12"; R = % Recovery; W = Moisture Content; γ = Unit Weight, pcf; UC= Unconf.Comp.,Ksf; * = Hand Penetrometer; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; SPT= Standard Penetration Test

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249
BORING ELEVATION: 67.8 BORING METHOD: HSA/RC HAMMER: Automatic
STATION : 2+50 RIG TYPE : CME 45c DRILLER : IC
OFFSET : 135.0' Right of B.L. CASING DIA. : 3¼" TEMPERATURE: 73°
DEPTH : 14.5 Feet CORE SIZE : NX WEATHER: Sunny
BORING NO.: B-7
SHEET 1 OF 1
DATE STARTED : 09-19-97
DATE COMPLETED: 09-19-97

GROUNDWATER: Encountered at Dry, At completion 6.3' after coring, At 0.5 hour 6.3', Caved in at 7.0'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
	_												
	X				1								
	X			SS-1	1	2	100	20					
	X	Very Loose, Damp, Brown			1								
	_	**FINE SAND TO SILTY SAND**											
	_	with Silt Seams and Roots											
	X	(**CREEK SEDIMENTS**)			1								
	X			SS-2	1	2	100	25					
5	X				1								
	_												
	X		6.4'		4								
61.4	X	Medium Dense, Wet, Brown		SS-3	6	12	100	15					
	X	**SILTY FINE TO COARSE SAND**			6								
	_	**AND GRAVEL** with Sandstone											
59.3	_	Fragments	8.5'										
58.8	X	Gray Highly Weathered,	9.0'	SS-4	50		100	8					
	_	Decomposed **SHALE**		9.5'	2"								
10	_												
	_												
	_	Interbedded, Tan, Fine											
	_	Grained **SANDSTONE** and		CR-1									
	_	Gray Weathered **CLAYSHALE**		RQD=									
	_			53%			67						
54.8	_		13.0'										
	_												
	_	Gray Weathered **SHALE**,											
53.3	_	Medium Bed Thickness	14.5'	14.5'									
15	_	**BOTTOM OF BORING**											

BORING METHOD: HSA - Hollow Stem Auger; SFA - Solid Flight Auger; RC - Rock Coring; MD - Mud Drilling; WD - Wash Drilling; HA - Hand Auger
SAMPLING METHOD: SS - Split Spoon Sample; ST - Shelby Tube Sample; CR - Rock Core Sample; BS - Bag Sample
ABBREVIATIONS: El = Stratum Elevation; D = Sample Depth; Ds = Stratum Depth; S# = Sample Number; N = Blows per 12"; R = % Recovery; W = Moisture Content; γ = Unit Weight, pcf; UC= Unconf.Comp.,Ksf; * = Hand Penetrometer; LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; SPT= Standard Penetration Test

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: 614/276-8123 FAX: 614/276-6377

CALCULATED
CHECKED
DATE 4-7-98
REVIEWED
DRAWN M.T.

SLOPE REPAIR PROJECT
COUNTY ROAD 50
PIKE COUNTY, OHIO

G.H.SMITH AND ASSOCIATES
LAND SURVEYORS AND LAND PLANNERS

246 STRICKLAND RD. PIKETON,OHIO (614) 493-3186
539 W SECOND ST. WAVERLY,OHIO (614) 947-8106
5405 FAYRIDGE DR. CINCINNATI,OHIO (513) 922-8783
FAX (614) 947-1080
CENTRAL OFFICE

DESCRIPTION APPROVED BY DENNY SALISBURY PIKE COUNTY ENGINEER
APR - 2 1998
CHECKED BY BB

D E S C R I P T I O N F O R

TEMPORARY EASEMENT FOR THE PURPOSE OF CONSTRUCTION TO BE TERMINATED UPON THE COMPLETION OF THE PROJECT

SITUATED IN JACKSON TOWNSHIP, PIKE COUNTY, OHIO. AND BEING A PART OF SECTION 17, TOWNSHIP 7 NORTH, RANGE 20 WEST, AND ALSO SITUATED IN JEFFERSON TOWNSHIP, ROSS COUNTY, OHIO. AND BEING PART OF SECTION 15, TOWNSHIP 7 NORTH, RANGE 20 WEST, REBECCA CASH, AS RECORDED IN OFFICIAL RECORD VOLUME 22, PAGES 334 AND 335, IN THE PIKE COUNTY RECORDER OFFICE, PIKE COUNTY, OHIO. AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BEGINNING AT A SET P.K.NAIL IN THE INTERSECTION OF THE SOUTH LINE OF SECTION 15, TOWNSHIP 7 NORTH, RANGE 20 WEST, IN JEFFERSON TOWNSHIP, ROSS COUNTY, OHIO. AND THE NORTH LINE OF SECTION 17, TOWNSHIP 7 NORTH, RANGE 20 WEST, IN JACKSON TOWNSHIP, PIKE COUNTY, OHIO. AND ITS INTERSECTION WITH THE CENTERLINE OF WATSON ROAD (40.0' WIDE RIGHT-OF-WAY),

THENCE South 70 degrees 47 minutes 56 seconds West for a distance of 95.41 feet LEAVING THE SAID SECTION LINES OF 15 AND 17 AND INTO PIKE COUNTY ALONG THE CENTERLINE OF WATSON ROAD TO ANOTHER SET P.K.NAIL,

THENCE South 72 degrees 33 minutes 21 seconds West for a distance of 123.97 feet CONTINUING WITH THE CENTERLINE OF SAID ROAD TO ANOTHER SET P.K.NAIL,

THENCE South 67 degrees 10 minutes 15 seconds West for a distance of 56.86 feet CONTINUING WITH THE CENTERLINE OF THE SAID ROAD TO ANOTHER SET P.K.NAIL,

THENCE South 65 degrees 53 minutes 48 seconds West for a distance of 99.50 feet CONTINUING WITH THE CENTERLINE OF THE SAID ROAD TO ANOTHER SET P.K.NAIL,

THENCE North 84 degrees 05 minutes 39 seconds West for a distance of 62.20 feet LEAVING THE CENTERLINE OF WATSON ROAD TO A SET 1/2" REBAR WITH PLASTIC I.D.CAP STAMPED G.H.SMITH\S-5888, AND BEING A COMMON CORNER OF THE C & O RAILROAD, PLAT SHEET 46 OF 55-STATION 2821+00 TO 2874+00 DATED DEC.31, 1927,

THENCE North 35 degrees 45 minutes 00 seconds East for a distance of 192.20 feet WITH THE COMMON LINE OF THE C & O RAILROAD AND THE CASH'S TO ANOTHER SET 1/2" REBAR WITH I.D. CAP, AND BEING A POINT ON THE NORTH LINE OF SECTION 17, IN PIKE COUNTY, AND ALSO A POINT ON THE SOUTH LINE OF SECTION 15, IN ROSS COUNTY, AND ALSO A COMMON CORNER OF THE C & O RAILROAD AND CASH'S,

THENCE North 43 degrees 28 minutes 18 seconds East for a distance of 82.21 feet LEAVING THE SOUTH LINE OF SECTION 15, INTO ROSS COUNTY TO ANOTHER SET 1/2" REBAR WITH I.D.CAP,

THENCE North 83 degrees 46 minutes 10 seconds East for a distance of 153.62 feet TO ANOTHER SET 1/2" REBAR WITH I.D.CAP,

THENCE North 68 degrees 13 minutes 23 seconds East for a distance of 206.47 feet TO ANOTHER SET 1/2" REBAR WITH I.D.CAP,

THENCE South 77 degrees 02 minutes 23 seconds East for a distance of 214.17 feet TO A SET P.K.NAIL, BEING IN THE CENTERLINE OF WATSON ROAD,

THENCE South 57 degrees 15 minutes 13 seconds West for a distance of 104.30 feet CONTINUING WITH THE SAID CENTERLINE TO ANOTHER SET P.K.NAIL,

THENCE South 68 degrees 56 minutes 55 seconds West for a distance of 129.33 feet CONTINUING WITH THE SAID CENTERLINE OF SAID ROAD TO ANOTHER SET P.K.NAIL,

THENCE South 71 degrees 40 minutes 01 seconds West for a distance of 105.49 feet CONTINUING WITH THE SAID CENTERLINE OF SAID ROAD TO THE PLACE OF BEGINNING,

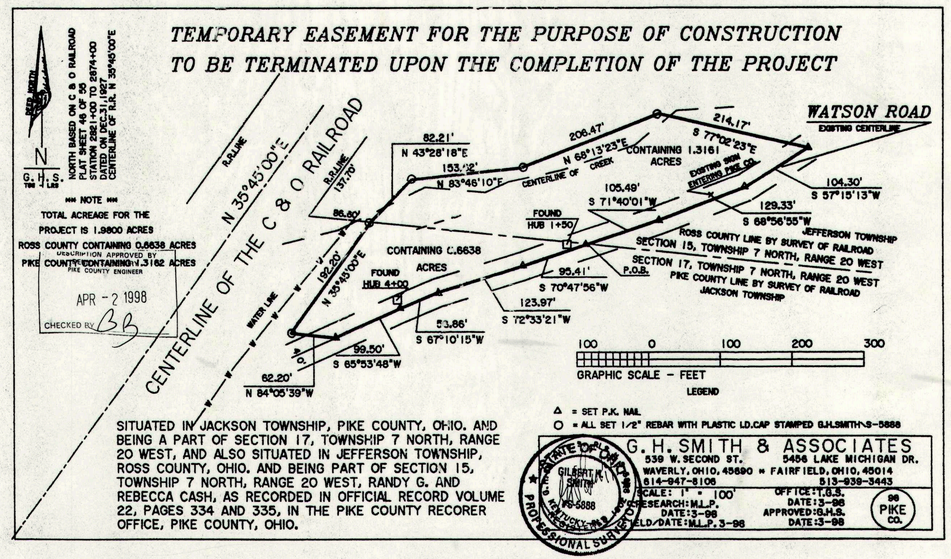
Together with and subject to covenants, easements, and restrictions of record. THIS DESCRIPTION FROM A SURVEY BY G.H.SMITH AND ASSOCIATES ON MARCH 1998, FOR THE PIKE COUNTY ENGINEER OFFICE. NORTH BASED ON THE C AND O RAILROAD PLAT SHEET 46 OF 55-2821+00 TO 2874+00 DATED ON DEC.31, 1927, CENTERLINE NORTH 35 DEGREES 45 MINUTES 00 SECONDS EAST.

Said property contains 1.9800 acres more or less.
ROSS COUNTY CONTAINING 0.6638 ACRES, PIKE COUNTY CONTAINING 1.3162 ACRES.

98PIKECO.LEG.

GILBERT H. SMITH, P.S.
R.L.S.No.S-5888

STATE OF OHIO GILBERT H. SMITH #S-5888 REGISTERED PROFESSIONAL SURVEYOR



STATE OF OHIO

DEPARTMENT OF TRANSPORTATION

PIK-CR 50-3.52

(WATSON ROAD)

JACKSON TOWNSHIP

PIKE COUNTY

END PROJECT STA. 14+35.50

BEGIN PROJECT STA. 10+67.07

LOCATION MAP

LATITUDE: N 39° 10' 19" LONGITUDE: W 82° 50' 16"

SCALE IN MILES 0 1 2

PORTION TO BE IMPROVED

INTERSTATE & DIVIDED HIGHWAY

UNDIVIDED STATE & FEDERAL ROUTES

OTHER ROADS

DESIGN DESIGNATION

CURRENT ADT (2011) 600

DESIGN SPEED 55 MPH

LEGAL SPEED 55 MPH

DESIGN FUNCTIONAL CLASSIFICATION:
MAJOR COLLECTOR

INDEX OF SHEETS:

PROJECT DESCRIPTION

EMERGENCY REPAIR PROJECT TO CORRECT LANDSLIDE, BY MEANS OF DRILL SHAFTS BELOW THE APPARENT FAILURE SURFACE AND SUBSEQUENT RECONSTRUCTION OF THE SLOPE. PROJECT ALSO INCLUDES GUARDRAIL CONSTRUCTION AND SUBSEQUENT GRADING.

PROJECT EARTH DISTURBED AREA±..... 0.09 AC.
CONTRACTOR EARTH DISTURBED AREA±..... 0.22 AC.
NOI EARTH DISTURBED AREA±..... (NOI NOT REQUIRED)

2010 SPECIFICATIONS

THE STANDARD SPECIFICATIONS OF THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, INCLUDING CHANGES AND SUPPLEMENTAL SPECIFICATIONS LISTED IN THE PROPOSAL SHALL GOVERN THIS IMPROVEMENT.

I HEREBY APPROVE THESE PLANS AND DECLARE THAT THE MAKING OF THIS IMPROVEMENT WILL NOT REQUIRE THE CLOSING TO TRAFFIC OF THE HIGHWAY EXCEPT AS NOTED ON SHEET 3, PROVISIONS FOR THE MAINTENANCE AND SAFETY OF TRAFFIC WILL BE AS SET FORTH ON THE PLANS AND ESTIMATES.

APPROVED Denny T. Salisbury
DATE 9-22-11 DENNY T. SALISBURY, P.E., P.S., PIKE COUNTY ENGINEER

APPROVED Virginia E. Nelson
DATE 9-26-11 DISTRICT DEPUTY DIRECTOR

APPROVED
DATE 9-30-11 DIRECTOR, DEPARTMENT OF TRANSPORTATION

STANDARD CONSTRUCTION DRAWINGS								SUPPLEMENTAL SPECIFICATIONS	
BP-2.1	7/18/08	TC-41.20	1/19/01	MT-98.11	1/18/09	TST-1-99	4/18/08	800	7/15/11
BP-2.2	7/18/08	TC-42.20	1/21/11	MT-98.20	10/15/10			802	4/15/11
BP-3.1	10/19/07	TC-52.10	1/19/07	MT-98.26	1/18/09			823	7/15/11
		TC-52.20	1/19/07	MT-97.10	10/15/10			832	5/5/09
DM-1.1	1/21/11	TC-61.30	7/15/11	MT-97.12	10/15/10			902	7/16/10
DM-4.4	4/17/09			MT-101.90	1/18/09			961	10/17/08
				MT-105.10	1/18/09				
GR-1.1	7/16/04								
GR-2.1	1/16/04								
GR-2.2	1/20/06								
GR-3.6	10/18/09							SPECIAL PROVISIONS	
GR-4.2	1/19/07								
RM-4.2	10/15/10								

ENGINEERS SEAL:

STATE OF OHIO SEAN JENQ E-58574 REGISTERED PROFESSIONAL ENGINEER

SIGNED: Sean Jenq
DATE: 09/19/2011

PLANS PREPARED BY:
COLUMBUS ENGINEERING CONSULTANTS, INC.
CONSULTING ENGINEERS AND SURVEYORS
840 MICHIGAN AVENUE
COLUMBUS, OHIO 43215
PHONE: (614) 228-3500
FAX: (614) 228-3519

UNDERGROUND UTILITIES
CONTACT BOTH SERVICES
CALL TWO WORKING DAYS
BEFORE YOU DIG
CALL
1-800-362-2764
(TOLL FREE)
OHIO UTILITIES PROTECTION SERVICE
NON-MEMBERS
MUST BE CALLED DIRECTLY
OIL & GAS PRODUCERS PROTECTIVE SERVICE CALL: 1-800-928-0988

FEDERAL PROJECT NO. E111240 (PIK-007)
PID NO. 91368
CONSTRUCTION PROJECT NO.
RAILROAD INVOLVEMENT NONE
PIK-CR 50-3.52
1/18

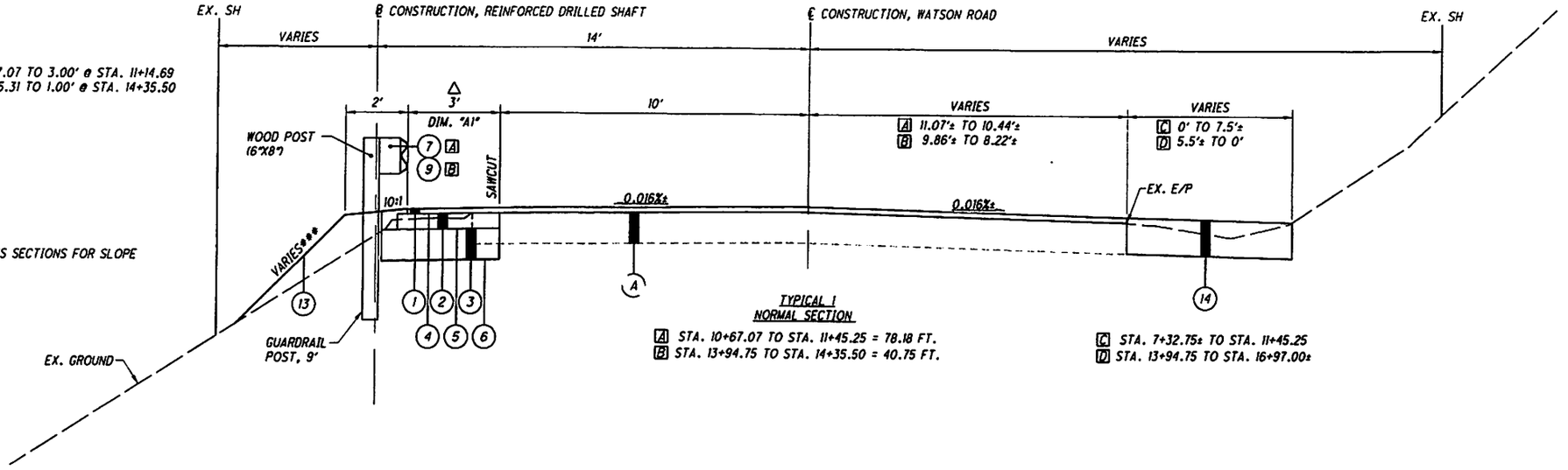
PIK- CR - 50-3.52 (Watson Road)
117016
Dist 9
PID 91368
10/20/2011

Contract Proposal available @www.contracts.dot.state.oh.us/home

NOTE: CONNECT PROPOSED GUARDRAIL, TYPE 5 TO EXISTING GUARDRAIL AT STA. 11+02.32±, RT. AND STA. 14+59.13± LT.

DIM. "A1"
FROM 1.00' @ STA. 10+67.07 TO 3.00' @ STA. 11+14.69
FROM 3.00' @ STA. 14+25.31 TO 1.00' @ STA. 14+35.50

*** SEE CROSS SECTIONS FOR SLOPE

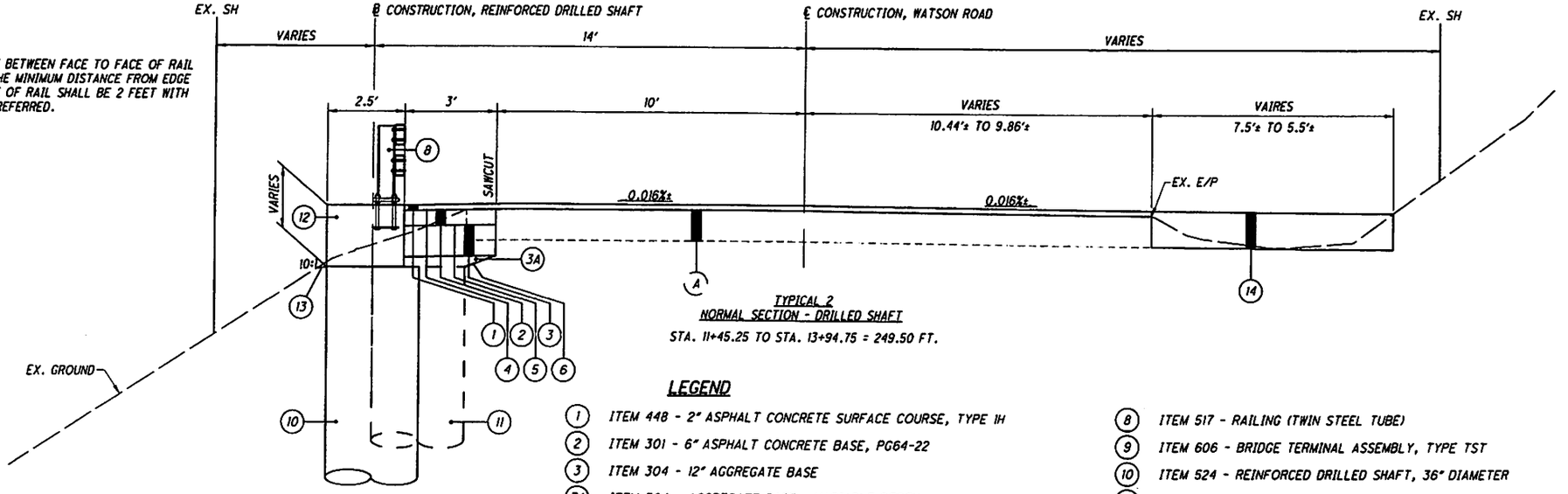


TYPICAL 1
NORMAL SECTION

A STA. 10+67.07 TO STA. 11+45.25 = 78.18 FT.
B STA. 13+94.75 TO STA. 14+35.50 = 40.75 FT.

C STA. 7+32.75± TO STA. 11+45.25
D STA. 13+94.75 TO STA. 16+97.00±

△ THE MINIMUM DISTANCE BETWEEN FACE TO FACE OF RAIL SHALL BE 24 FEET. THE MINIMUM DISTANCE FROM EDGE OF PAVEMENT TO FACE OF RAIL SHALL BE 2 FEET WITH 4 FEET OF GREATER PREFERRED.



TYPICAL 2
NORMAL SECTION - DRILLED SHAFT

STA. 11+45.25 TO STA. 13+94.75 = 249.50 FT.

LEGEND

1. ITEM 448 - 2" ASPHALT CONCRETE SURFACE COURSE, TYPE 1H
2. ITEM 301 - 6" ASPHALT CONCRETE BASE, PG64-22
3. ITEM 304 - 12" AGGREGATE BASE
3A. ITEM 304 - AGGREGATE BASE, VARIABLE DEPTH
4. ITEM 407 - TACK COAT (APPLIED AT A RATE OF 0.075 GAL./ SQ. YD.)
5. ITEM 408 - PRIME COAT (APPLIED AT A RATE OF 0.40 GAL./SQ. YD.)
6. ITEM 204 - SUBGRADE COMPACTION
7. ITEM 606 - GUARDRAIL, TYPE 5
8. ITEM 517 - RAILING (TWIN STEEL TUBE)
9. ITEM 606 - BRIDGE TERMINAL ASSEMBLY, TYPE TST
10. ITEM 524 - REINFORCED DRILLED SHAFT, 36" DIAMETER
11. ITEM 524 - UNREINFORCED DRILLED SHAFT, 36" DIAMETER
12. ITEM 511 - CLASS C CONCRETE
13. ITEM 659 - SEEDING AND MULCHING
14. ITEM 615 - PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN

A. EXISTING PAVEMENT, VARIES

CALCULATED PEK
CHECKED JJ

TYPICAL SECTIONS

PIK-CR 50-3.52

ROUNDING

THE ROUNDING AT SLOPE BREAKPOINTS SHOWN ON THE TYPICAL SECTIONS APPLIES TO ALL CROSS-SECTIONS EVEN THOUGH OTHERWISE SHOWN.

UTILITIES

THERE ARE NO KNOWN UNDERGROUND OR OVERHEAD UTILITIES WITHIN THE PROJECT LIMITS.

WORK LIMITS

THE WORK LIMITS SHOWN ON THESE PLANS ARE FOR PHYSICAL CONSTRUCTION ONLY. PROVIDE THE INSTALLATION AND OPERATION OF ALL WORK ZONE TRAFFIC CONTROL AND WORK ZONE TRAFFIC CONTROL DEVICES REQUIRED BY THESE PLANS WHETHER INSIDE OR OUTSIDE THESE WORK LIMITS.

CLEARING AND GRUBBING, AS PER PLAN

ALTHOUGH THERE ARE NO TREES OR STUMPS SPECIFICALLY MARKED FOR REMOVAL WITHIN THE LIMITS OF THE PROJECT, A LUMP SUM QUANTITY IS INCLUDED IN THE GENERAL SUMMARY FOR ITEM 201, CLEARING AND GRUBBING. NO TREES WITH A DIAMETER OF 8" OR GREATER SHALL BE DISTURBED. ALL PROVISIONS AS SET FORTH IN THE SPECIFICATIONS UNDER THIS ITEM ARE INCLUDED IN THE LUMP SUM PRICE BID FOR ITEM 201, CLEARING AND GRUBBING.

SEEDING AND MULCHING

THE FOLLOWING QUANTITIES ARE PROVIDED TO PROMOTE GROWTH AND CARE OF PERMANENT SEEDED AREAS:

659, REPAIR SEEDING AND MULCHING	10 SQ. YD.
659, COMMERCIAL FERTILIZER	0.05 TON
659, LIME	0.04 ACRES
659, WATER	1 M. GAL.

SEEDING AND MULCHING SHALL BE APPLIED TO ALL AREAS OF EXPOSED SOIL BETWEEN THE RIGHT-OF-WAY LINES, AND WITHIN THE CONSTRUCTION LIMITS FOR AREAS OUTSIDE THE RIGHT-OF-WAY LINES COVERED BY WORK AGREEMENT OR SLOPE EASEMENT. QUANTITY CALCULATIONS FOR SEEDING AND MULCHING ARE BASED ON THESE LIMITS.

ELEVATION DATUM

ELEVATIONS ARE BASED ON ASSUMED DATUM. FOR CONTROL SEE SHEET 12.

GRADE CORRECTION

GRADE CORRECTIONS FOR BEDROCK ELEVATIONS WERE DETERMINED BASED ON A SLOPE STABILITY STUDY PERFORMED BY CTL ENGINEERING, INC. ON WATSON ROAD FOR THE PIKE COUNTY ENGINEER'S OFFICE IN NOVEMBER 1997.

FARM DRAINS

ALL FARM DRAINS, WHICH ARE ENCOUNTERED DURING CONSTRUCTION, SHALL BE PROVIDED WITH UNOBSTRUCTED OUTLETS. EXISTING COLLECTORS WHICH ARE LOCATED BELOW THE ROADWAY DITCH ELEVATIONS, AND WHICH CROSS THE ROADWAY, SHALL BE REPLACED WITHIN THE (RIGHT OF WAY)(CONSTRUCTION) LIMITS BY ITEM 603 CONDUIT, TYPE B, ONE COMMERCIAL SIZE LARGER THAN THE EXISTING CONDUIT.

EXISTING COLLECTORS AND ISOLATED FARM DRAINS, WHICH ARE ENCOUNTERED ABOVE THE ELEVATION OF ROADWAY DITCHES, SHALL BE OUTLETTED INTO THE ROADWAY DITCH BY 603 TYPE F CONDUIT. THE OPTIMUM OUTLET ELEVATION SHALL BE ONE FOOT (300 MILLIMETERS) ABOVE THE FLOWLINE ELEVATION OF THE DITCH. LATERAL FIELD TILES WHICH CROSS THE ROADWAY SHALL BE INTERCEPTED BY 603, TYPE E CONDUIT, AND CARRIED IN A LONGITUDINAL DIRECTION TO AN ADEQUATE OUTLET OR ROADWAY CROSSING.

THE LOCATION, TYPE, SIZE AND GRADE OF REPLACEMENTS SHALL BE DETERMINED BY THE ENGINEER AND PAYMENT SHALL BE MADE ON FINAL MEASUREMENTS.

EROSION CONTROL PADS AND ANIMAL GUARDS SHALL BE PROVIDED AT THE OUTLET END OF ALL FARM DRAINS AS PER STANDARD CONSTRUCTION DRAWING DM-1.1, EXCEPT WHEN THEY OUTLET INTO A DRAINAGE STRUCTURE. PAYMENT FOR THE EROSION CONTROL PADS AND ANIMAL GUARDS AND ANY NECESSARY BENDS OR BRANCHES SHALL BE INCLUDED FOR PAYMENT IN THE PERTINENT CONDUIT ITEMS.

THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN INCLUDED IN THE GENERAL SUMMARY FOR THE WORK NOTED ABOVE:

603	6" CONDUIT, TYPE B	50 FT.
603	6" CONDUIT, TYPE E	50 FT.
603	6" CONDUIT, TYPE F	50 FT.

ITEM 524 - DRILLED SHAFTS, 36" DIAMETER, ABOVE BEDROCK, AS PER PLAN

THE BOTTOM ELEVATION OF UNREINFORCED DRILLED SHAFTS IS AS SPECIFIED IN THE PLANS OR ACTUAL TOP OF BED ROCK ELEVATION, WHICHEVER IS HIGHER.

ITEM 615 - PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN

THIS ITEM SHALL CONSIST OF 12" CLASS C CONCRETE AND SHALL CONFORM TO ITEM 452. TIEBARS OR HOOKBOLTS FOR LONGITUDINAL JOINTS ARE NOT REQUIRED. USE DOWELS ONLY AT TRANSVERSE EXPANSION AND CONSTRUCTION JOINTS. CONFORM TO THE QUALITY REQUIREMENTS SET FORTH IN 499.02 FOR THE MATERIALS, EXCEPT THE REQUIREMENTS OF 703.13.

ITEM 614 - MAINTAINING TRAFFIC

A MINIMUM OF ONE 10 FOOT LANE OF TRAFFIC SHALL BE MAINTAINED AT ALL TIMES USING SCD MT-96.11, SIGNALIZED CLOSING ONE LANE OF A 2-LANE HIGHWAY USING DRUMS IN LIEU OF PORTABLE CONCRETE BARRIER WHILE MAINTAINING DROP-OFF AND CLEAR ZONE REQUIREMENTS AND PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN.

LENGTH AND DURATION OF LANE CLOSURES AND RESTRICTIONS SHALL BE AT THE APPROVAL OF THE ENGINEER. IT IS THE INTENT TO MINIMIZE THE IMPACT TO THE TRAVELING PUBLIC. LANE CLOSURES AND RESTRICTIONS OVER SEGMENTS OF THE PROJECT IN WHICH NO WORK IS ANTICIPATED WITHIN A REASONABLE TIME FRAME, AS DETERMINED BY THE ENGINEER, SHALL NOT BE PERMITTED. THE LEVEL OF UTILIZATION OF MAINTENANCE OF TRAFFIC DEVICES SHALL BE COMMENSURATE WITH THE WORK IN PROGRESS.

BEFORE THE WORK BEGINS, THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER THE NAMES AND TELEPHONE NUMBERS OF A PERSON OR PERSONS WHO CAN BE CONTACTED TWENTY-FOUR (24) HOURS PER DAY BY THE OHIO DEPARTMENT OF TRANSPORTATION AND ALL INTERESTED POLICE ANGENCIES. THIS PERSON OR PERSONS SHALL BE RESPONSIBLE FOR PLACING OR REPLACING NECESSARY TRAFFIC CONTROL DEVICES IN ACCORDANCE WITH

THE OHIO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
THE CONTRACTOR WILL ADVISE THE DISTRICT PUBLIC INFORMATION OFFICER AT (740) 773-2691/(888) 819-8501, OR FAX (740) 775-4889 SEVEN (7) DAYS PRIOR TO THE START OF CONSTRUCTION ACTIVITIES. THE PROJECT ENGINEER WILL PROVIDE ASSISTANCE/CLARIFICATION FOR ANY QUESTIONS.

SEQUENCE OF CONSTRUCTION

INSTALL TEMPORARY TRAFFIC CONTROL DEVICES PER SCD MT-96.11, MT-96.20 AND PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN TO MAINTAIN ONE 10 FOOT LANE OF TRAFFIC. PERFORM CLEARING AND GRUBBING AND REMOVAL OF EXISTING GUARDRAIL AND SIGNAGE WITHIN SPECIFIED CONSTRUCTION LIMITS.

PERFORM CONSTRUCTION OF DRILL SHAFTS, PROPOSED GUARDRAIL, LAGGING, PAVEMENT WIDENING, RESURFACING, SIGNING AND GRADING PER THESE CONSTRUCTIONS PLANS TO CORRRECT LANDSLIDE.

THE CONTRACTOR SHALL USE CAUTION WHEN CONSTRUCTION IS TO TAKE PLACE IN THE AREA OF THE EXISTING 24" STORM SEWER AT STA. 13+17± AS TO NOT DAMAGE THE EXISTING PIPE. THE CONTRACTOR SHALL PERFORM A PRE/POST INSPECTION OF THE EXISTING PIPE TO ASSURE POSITIVE DRAINAGE. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO THE EXISTING 24" STORM SEWER DUE IN PART TO THE CONSTRUCTION TO CORRECT LANDSLIDE.

EXISTING GUARDRAIL REMOVAL MAY ONLY TAKE PLACE AS IT PERTAINS TO THE DAILY WORK ZONE. PORTABLE CONCRETE BARRIER MAY BE ESTABLISHED AT THE END OF CONSTRUCTION HOURS IN LIEU OF GUARDRAIL AT THE APPROVAL OF THE ENGINEER.

REMOVE TEMPORARY TRAFFIC CONTROL DEVICES AND CONCRETE PAVEMENT AFTER LANDSLIDE CORRECTION HAS BEEN COMPLETED.

THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN INCLUDED IN THE GENERAL SUMMARY FOR USE AS DIRECTED BY THE ENGINEER FOR THE MAINTENANCE OF TRAFFIC:

ITEM - 615, PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN	445 SQ. YD.
ITEM - 622, PORTABLE CONCRETE BARRIER, 32"	390 FT.

ALL WORK AND TRAFFIC CONTROL DEVICES SHALL BE IN ACCORDANCE WITH CMS 614 AND OTHER APPLICABLE PORTIONS OF THE SPECIFICATIONS, AS WELL AS THE OHIO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES. PAYMENT FOR ALL LABOR, EQUIPMENT AND MATERIALS SHALL BE INCLUDED IN THE LUMP SUM CONTRACT PRICE FOR ITEM 614, MAINTAINING TRAFFIC, UNLESS SEPARATELY ITEMIZED IN THE PLAN.

DUST CONTROL

THE CONTRACTOR SHALL FURNISH AND APPLY WATER FOR DUST CONTROL AS DIRECTED BY THE ENGINEER. THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN INCLUDED FOR DUST CONTROL PURPOSES:

ITEM 616, WATER	1 M. GAL.

REVIEW OF DRAINAGE FACILITIES

BEFORE ANY WORK IS STARTED ON THE PROJECT AND AGAIN BEFORE FINAL ACCEPTANCE BY THE STATE, REPRESENTATIVES OF THE STATE AND THE CONTRACTOR, ALONG WITH LOCAL REPRESENTATIVES, SHALL MAKE AN INSPECTION OF ALL EXISTING SEWERS WHICH ARE TO REMAIN IN SERVICE AND WHICH MAY BE AFFECTED BY THE WORK. THE CONDITION OF THE EXISTING CONDUITS AND THEIR APPURTENANCE SHALL BE DETERMINED FROM FIELD OBSERVATIONS. RECORDS OF THE INSPECTION SHALL BE KEPT IN WRITING BY THE STATE.

ALL NEW CONDUITS, INLETS, CATCH BASINS, AND MANHOLES CONSTRUCTED AS A PART OF THE PROJECT SHALL BE FREE OF ALL FOREIGN MATTER AND IN A CLEAN CONDITION BEFORE THE PROJECT WILL BE ACCEPTED BY THE STATE. ALL EXISTING SEWERS INSPECTED INITIALLY BY THE ABOVE MENTIONED PARTIES SHALL BE MAINTAINED AND LEFT IN A CONDITION REASONABLY COMPARABLE TO THAT DETERMINED BY THE ORIGINAL INSPECTION. ANY CHANGE IN THE CONDITION RESULTING FROM THE CONTRACTOR'S OPERATIONS SHALL BE CORRECTED BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.

PAYMENT FOR ALL OPERATIONS DESCRIBED ABOVE SHALL BE INCLUDED IN THE CONTRACT PRICE FOR THE PERTINENT 603 CONDUIT ITEMS.

TRENCH FOR WIDENING

TRENCH EXCAVATION FOR BASE WIDENING SHALL BE ONLY ON ONE SIDE OF THE PAVEMENT AT A TIME. THE OPEN TRENCH SHALL BE ADEQUATELY MAINTAINED AND PROTECTED WITH DRUMS OR BARRICADES AT ALL TIMES. PLACEMENT OF PROPOSED SUBBASE AND BASE MATERIAL SHALL FOLLOW AS CLOSELY AS POSSIBLE BEHIND EXCAVATION OPERATIONS. THE LENGTH OF WIDENING TRENCH WHICH IS OPEN AT ANY ONE TIME SHALL BE HELD TO A MINIMUM AND SHALL AT ALL TIMES BE SUBJECT TO APPROVAL OF THE ENGINEER.

OVERNIGHT TRENCH CLOSING

THE BASE WIDENING SHALL BE COMPLETED TO A DEPTH OF NO MORE THAN 6 INCHES BELOW THE EXISTING PAVEMENT BY THE END OF EACH WORK DAY. NO TRENCH SHALL BE LEFT OPEN OVERNIGHT EXCEPT FOR A SHORT LENGTH (25 FEET OR LESS) OF A WORK SECTION AT THE END OF THE TRENCH IN CASE WORK MUST BE SUSPENDED BECAUSE OF INCLEMENT WEATHER OR OTHER REASONS, THE TRENCH FOR THE UNCOMPLETED BASE WIDENING SHALL BE BACKFILLED AT THE DIRECTION OF THE ENGINEER.

WORK ZONE MARKINGS AND SIGNS

THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN CARRIED TO THE GENERAL SUMMARY FOR USE AT THE LOCATIONS IDENTIFIED BY THE ENGINEER FOR WORK ZONE PAVEMENT MARKINGS AND SIGNS PER THE REQUIREMENTS OF CMS 614.04 AND 614.11.

ITEM 614, WORK ZONE MARKING SIGN	2 EACH
ITEM 614, WORK ZONE CENTER LINE, CLASS 1, 642 PAINT	0.23 MILE
ITEM 614, WORK ZONE EDGE LINE, CLASS 1, 642 PAINT	0.46 MILE

FULLY-ACTUATED OPERATION OF WORK ZONE TRAFFIC SIGNAL

THE WORK ZONE SIGNAL CONTROL REQUIRED FOR THIS PROJECT AND SHOWN ON SHEETS 3 AND SCD'S MT-96.11, 96.20, AND 96.26 SHALL BE FULLY TRAFFIC-ACTUATED AND OPERATE IN A MANNER SIMILAR TO THAT DESCRIBED IN SECTION 733.02 OT THE CONSTRUCTION AND MATERIALS SPECIFICATIONS.

THE INITIAL CONTROLLER TIMING SHALL BE AS FOLLOWS:

	PHASE*			
	1	2	3	4
INITIAL	7±	10	8	10±
VEHICLE	4	3	4	3
MAXIMUM	11	30	12	30
YELLOW	3	3.5	3	3.5
ALL RED	2	2	2	2
RECALL	ON±	OFF	ON	OFF±

*PHASES AS SHOWN ON SCD MT-96.26 FOR ACTUATED CONTROL
± PROVIDE TIMING FOR THE SIGNAL LOCATION UNDER CONSIDERATION

THE CONTRACTOR SHALL ALSO DESIGN, FURNISH, INSTALL AND MAINTAIN A TRAFFIC DETECTOR ON EACH TRAFFIC APPROACH WHICH WILL RELIABLY DETECT ALL LEGAL TRAFFIC APPROACHING (BUT NOT LEAVING) THE SIGNAL AS IT PASSES OR WAITS IN THE DESIGNATED DETECTOR ZONE SHOWN IN THE PLANS. DETECTOR DESIGNS WHICH DO NOT PROVIDE RELIABLE DETECTION, FREE FROM FALSE CALLS, SHALL BE IMMEDIATELY REPLACED BY THE CONTRACTOR.

PAYMENT OF TEMPORARY SIGNAL SHALL BE INCORPORATED INTO TO THE LUMP SUM BID FOR ITEM 614, MAINTAINING TRAFFIC.

CONNECTION BETWEEN EXISTING AND PROPOSED GUARDRAIL

WHEN IT IS NECESSARY TO SPLICE PROPOSED GUARDRAIL TO EXISTING GUARDRAIL, ONLY THE EXISTING GUARDRAIL SHALL BE CUT, DRILLED, OR PUNCHED. THE CONNECTION SHALL BE MADE USING A "W-BEAM RAIL SPLICE" AS SHOWN IN AASHTO M 180. PAYMENT SHALL BE INCLUDED IN THE CONTRACT PRICE FOR THE RESPECTIVE GUARDRAIL ITEMS.

CALCULAT PEK
CHECKED JJ

GENERAL NOTES

PIK-CR 50-3.52

SHEET NUMBER					ITEM	ITEM EXT.	QUAN.	UNIT	DESCRIPTION	SHEET NO.
3	5	11	14	18						
									ROADWAY	
LUMP					201	11001	LUMP		CLEARING AND GRUBBING, AS PER PLAN	3
	292				202	38000	292	FT.	GUARDRAIL REMOVED	
		115			203	10000	115	CU. YD.	EXCAVATION	
		18			203	20000	18	CU. YD.	EMBANKMENT	
	130				204	10000	130	SQ. YD.	SUBGRADE COMPACTION	
	112.5				606	13000	112.5	FT.	GUARDRAIL, TYPE 5	
	29				606	18500	29	EACH	GUARDRAIL POST, 9 FEET	
	2				606	32160	2	EACH	BRIDGE TERMINAL ASSEMBLY, TYPE TST	
									EROSION CONTROL	
1					616	10000	1	M.GAL.	WATER	
		205			659	10000	205	SQ. YD.	SEEDING AND MULCHING	
	10				659	14000	10	SQ. YD.	REPAIR SEEDING & MULCHING	
	0.05				659	20000	0.05	TON	COMMERCIAL FERTILIZER	
	0.04				659	31000	0.04	ACRE	LIME	
	1				659	35000	1	M. GAL.	WATER	
					832	30000	1000	EACH	EROSION CONTROL	
									DRAINAGE	
50					603	00900	50	FT.	6" CONDUIT, TYPE B	
50					603	01400	50	FT.	6" CONDUIT, TYPE E	
50					603	01500	50	FT.	6" CONDUIT, TYPE F	
									PAVEMENT	
	371				252	01500	371	FT.	FULL DEPTH PAVEMENT SAWING	
	19				301	46000	19	CU. YD.	ASPHALT CONCRETE BASE. PG64-22	
	57				304	20000	57	CU. YD.	AGGREGATE BASE	
	9				407	10000	9	GALLON	TACK COAT (0.075 GAL./SQ. YD.)	
	48				408	10000	48	GALLON	PRIME COAT (0.40 GAL./SQ, YD.)	
	53				448	50000	53	CU. YD.	ASPHALT CONCRETE SURFACE COURSE, TYPE 1H	
									TRAFFIC CONTROL	
	8				626	00100	8	EACH	BARRIER REFLECTOR	
	26.0				630	03100	26.0	FT.	GROUND MOUNTED SUPPORT, NO. 3 POST	
	17.8				630	80100	17.8	SQ. FT.	SIGN, FLAT SHEET	
	6				630	84900	6	EACH	REMOVAL OF GROUND MOUNTED SIGN AND DISPOSAL	
	6				630	86002	6	EACH	REMOVAL OF GROUND MOUNTED POST SUPPORT AND DISPOSAL	
									STRUCTURES	
				6078	509	10000	6078	POUND	EPOXY COATED REINFORCING STEEL	
	63				511	46000	63	CU. YD.	CLASS C CONCRETE	
	141				512	10100	141	SQ. YD.	SEALING OF CONCRETE SURFACES (EPOXY-URETHANE)	
	248.67				517	70000	248.67	FT.	RAILING (TWIN STEEL TUBE)	
			577		524	94702	577	FT.	DRILLED SHAFTS, 36" DIAMETER, ABOVE BEDROCK	
			555		524	94703	555	FT.	DRILLED SHAFTS, 36" DIAMETER, ABOVE BEDROCK, AS PER PLAN	3
			735		524	94704	735	FT.	DRILLED SHAFTS, 36" DIAMETER, INTO BEDROCK	
									MAINTENANCE OF TRAFFIC	
2					614	12460	2	EACH	WORK ZONE MARKING SIGN	
0.23					614	21100	0.23	MILE	WORK ZONE CENTER LINE, CLASS 1, 642 PAINT	
0.46					614	22100	0.46	MILE	WORK ZONE EDGE LINE, CLASS 1, 642 PAINT	
	445				615	20001	445	SQ. YD.	PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN	3
390					622	40020	390	FT.	PORTABLE CONCRETE BARRIER, 32"	
LUMP					614	11000	LUMP		MAINTAINING TRAFFIC	
					619	16010	2	MONTH	FIELD OFFICE, TYPE B	
					623	10000	LUMP		CONSTRUCTION LAYOUT STAKES	
					624	10000	LUMP		MOBILIZATION	

CALCULATED PEK
CHECKED JJ

GENERAL SUMMARY

PIK-CR 50-3.52

ITEM		204		301	
STATION TO STATION	TYPICAL	SUBGRADE COMPACTION	SQ. YD.	6" ASPHALT CONCRETE BASE, PG64-22	CU. YD.
10+67.07 TO 11+45.25	1	(2.50' + 4.50')/2 x 78.18'/9	30.40	(1.33' + 3.33')/2 x 78.18' x (6/12)/27	3.37
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50'/9	83.17	(3.00' + 3.00')/2 x 249.50' x (6/12)/27	13.86
13+94.75 TO 14+35.50	1	(2.50' + 4.50')/2 x 40.75'/9	15.85	(3.33' + 1.33')/2 x 40.75' x (6/12)/27	1.76
TOTALS CARRIED TO GENERAL SUMMARY			130		19

PAVEMENT CALCULATIONS

ITEM		304		304	
STATION TO STATION	TYPICAL	12" AGGREGATE BASE	CU. YD.	AGGREGATE BASE, VARIABLE DEPTH	CU. YD.
10+67.07 TO 11+45.25	1	(1.83' + 3.83')/2 x 78.18' x (12/12)/27	8.19		
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50' x (12/12)/27	27.72	(1.59 SQ. FT. + 2.05 SQ. FT.)/2 x 249.50'/27	16.82
13+94.75 TO 14+35.50	1	(3.83' + 1.83')/2 x 40.75' x (12/12)/27	4.27		
TOTAL CARRIED TO GENERAL SUMMARY			40		17
					57

PAVEMENT CALCULATIONS

ITEM		407		408	
STATION TO STATION	TYPICAL	TACK COAT (0.075 GAL./SQ. YD.)	GAL.	PRIME COAT (0.40 GAL./SQ. YD.)	GAL.
10+67.07 TO 11+45.25	1	(1.33' + 3.33')/2 x 78.18'/9 x 0.075	1.52	(1.83' + 3.83')/2 x 78.18'/9 x 0.40	9.83
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50'/9 x 0.075	6.24	(3.00' + 3.00')/2 x 249.50'/9 x 0.40	33.27
13+94.75 TO 14+35.50	1	(3.33' + 1.33')/2 x 40.75'/9 x 0.075	0.79	(3.83' + 1.83')/2 x 40.75'/9 x 0.40	5.13
TOTALS CARRIED TO GENERAL SUMMARY			9		48

PAVEMENT CALCULATIONS

ITEM		448		448	
STATION TO STATION	TYPICAL	2" ASPHALT CONCRETE SURFACE COURSE, TYPE IH	CU. YD.	2" ASPHALT CONCRETE SURFACE COURSE, TYPE IH	CU. YD.
10+67.07 TO 11+45.25	1	(1.00' + 3.00')/2 x 78.18' x (2/12)/27	0.97		
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50' x (2/12)/27	4.62		
13+94.75 TO 14+35.50	1	(3.00' + 1.00')/2 x 40.75' x (2/12)/27	0.50		
10+67.07 TO 14+35.50	1 & 2			7593 SQ. FT. x (2/12)/27	46.87
TOTAL CARRIED TO GENERAL SUMMARY			6		47
					53

PAVEMENT CALCULATIONS

ITEM		615			
STATION TO STATION	TYPICAL	PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN	SQ. YD.		
7+32.75± TO 11+45.25	1	(0.00' + 7.50'±)/2 x 412.50'/9	171.88		
11+45.25 TO 13+94.75	2	(7.5'± + 5.50'±)/2 x 249.50'/9	180.19		
13+94.75 TO 16+97.00±	1	(5.50'± + 0.00')/2 x 302.25'/9	92.35		
TOTAL CARRIED TO GENERAL SUMMARY			445		

ESTIMATED QUANTITIES

REF. NO.	SHT. NO.	STATION TO STATION	SIDE	202 GUARDRAIL REMOVED (FT.)	252 FULL DEPTH PAVEMENT SAWING (FT.)	517 RAILING (TWIN STEEL TUBE) (FT.)	606 GUARDRAIL, TYPE 5 (FT.)	606 GUARDRAIL POST, 9' (EACH)	606 BRIDGE TERMINAL ASSEMBLY, TYPE TST (EACH)	630 GROUND MOUNTED SUPPORT, NO. 3 POST (FT.)	630 SIGN, FLAT SHEET (SQ. FT.)	630 REMOVAL OF GROUND MOUNTED SIGN AND DISPOSAL (EACH)	630 REMOVAL OF GROUND MOUNTED POST SUPPORT AND DISPOSAL (EACH)
P-1	12	10+67.07 TO 14+35.50	RT		370.49								
GR-1	12	11+02.32± TO 14+59.13±	RT			248.67	112.5	29	2				
R-1	12	11+02.32± TO 13+93.24	L/R	291.16									
R-2	12	11+71.82 TO 13+03.94	RT									4	4
S-1	12	12+50.00	RT							13.0	9.0	1	1
S-2	12	13+60.00	LT							13.0	8.8	1	1
TOTALS CARRIED TO GENERAL SUMMARY				292	371	248.67	112.5	29	2	26.0	17.8	6	6

ITEM 511 CLASS C CONCRETE

CAP SIDE AREA = 628.44 SQ. FT., WIDTH = 2.50 FT.
CAST-IN-PLACE WALL HEIGHT = 6.00 FT., PLAN AREA = 18.70 SQ. FT.
TOTAL VOLUME = (628.44 x 2.50) + (6.00 x 18.70) = 1683.30 CU. FT.
/ 27 = 62.34 CU. YD.

TOTAL CARRIED TO GENERAL SUMMARY 63 CU. YD.

ITEM 511 SEALING OF CONCRETE SURFACES

L1 = STA. 11+45.25 - STA. 13+94.75 = 249.50', CAP WIDTH = 2.50'
TOP AREA = 249.50 x 2.50 = 623.75 SQ. FT.
END AREA = 2.50' x 2.00' x 2 = 10.00 SQ. FT.
CAP SIDE AREA = 628.44 SQ. FT.
TOTAL AREA = (623.75 + 10.00 + 628.44) / 9 = 140.24 SQ. YD.

TOTAL CARRIED TO GENERAL SUMMARY 141 SQ. YD.

ITEM 626 BARRIER REFLECTOR

L1 = STA. 11+02.32± - STA. 14+59.13± = 356.81'
NO. OF BARRIER REFLECTORS (N)=(L1/50+1) = 8

TOTAL CARRIED TO GENERAL SUMMARY 8

ITEM 659 LIME		ITEM 659 REPAIR SEEDING & MULCHING	
205 SQ. YD. x 9 S.F./1 SQ. YD. x 1 ACRE/43560 S.F.		205 SQ. YD. x 5%	
TOTAL CARRIED TO GENERAL NOTES	0.04 ACRE	TOTAL CARRIED TO GENERAL NOTES	10 S.Y.

ITEM 659 COMMERCIAL FERTILIZER		ITEM 659 WATER	
205 SQ. YD. x 9 SQ. FT./1 SQ. YD. x (30 LBS./1000 SQ. FT. + 20 LBS./1000 SQ. FT.)/2000 LBS./ 1 TON		205 SQ. YD. x 9 SQ. FT./1 SQ. YD. x (300 GAL./1000 SQ. FT. + 300 GAL./1000 SQ. FT.)/1000 GAL.	
TOTAL CARRIED TO GENERAL NOTES	0.05 TON	TOTAL CARRIED TO GENERAL NOTES	1 M. GAL.

DESIGN PEK
CHECK JJ

ESTIMATED QUANTITIES AND CALCULATIONS

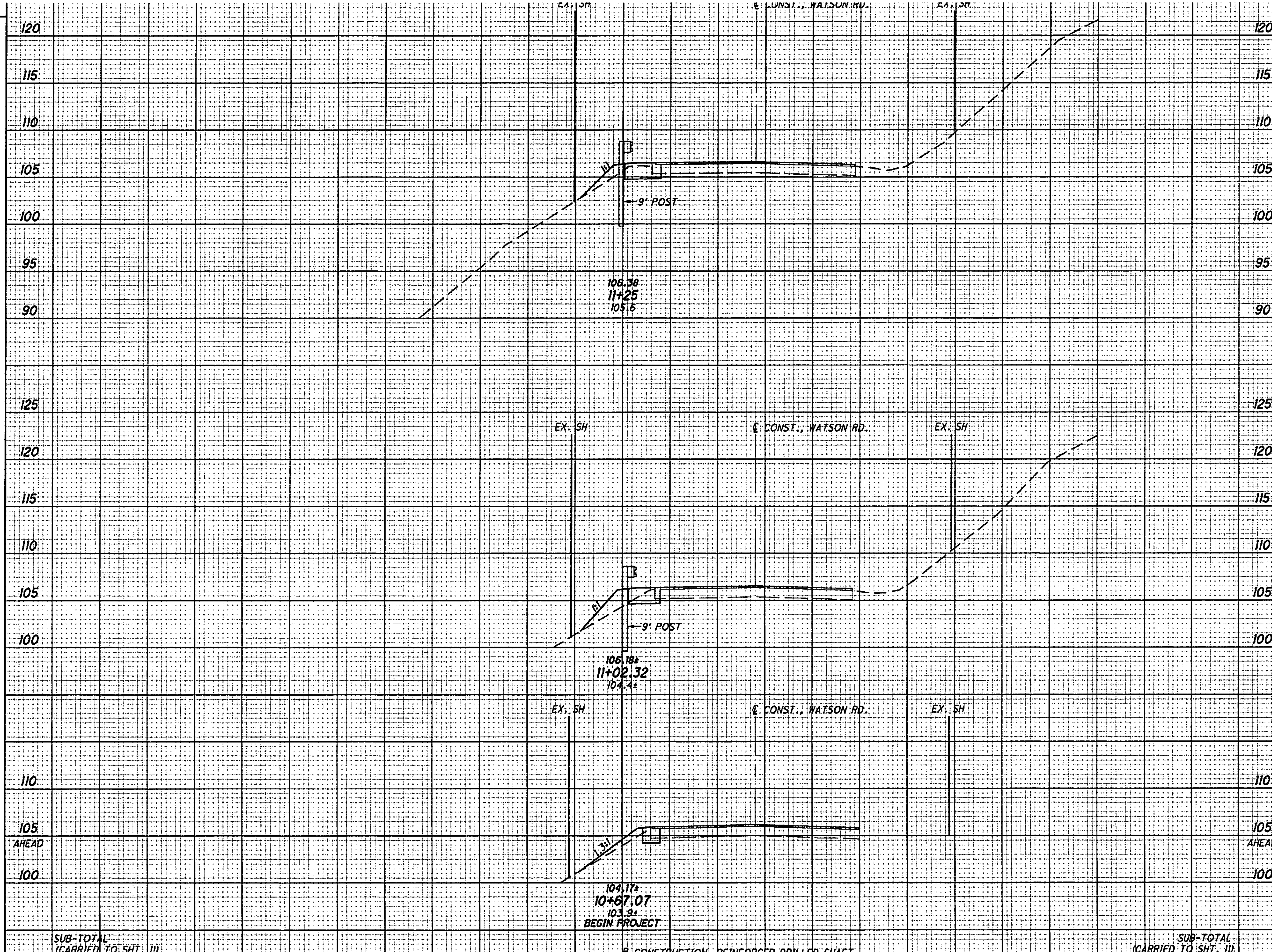
PIK-CR 50-3.52

CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 10+67.07 TO STA. 11+25.00

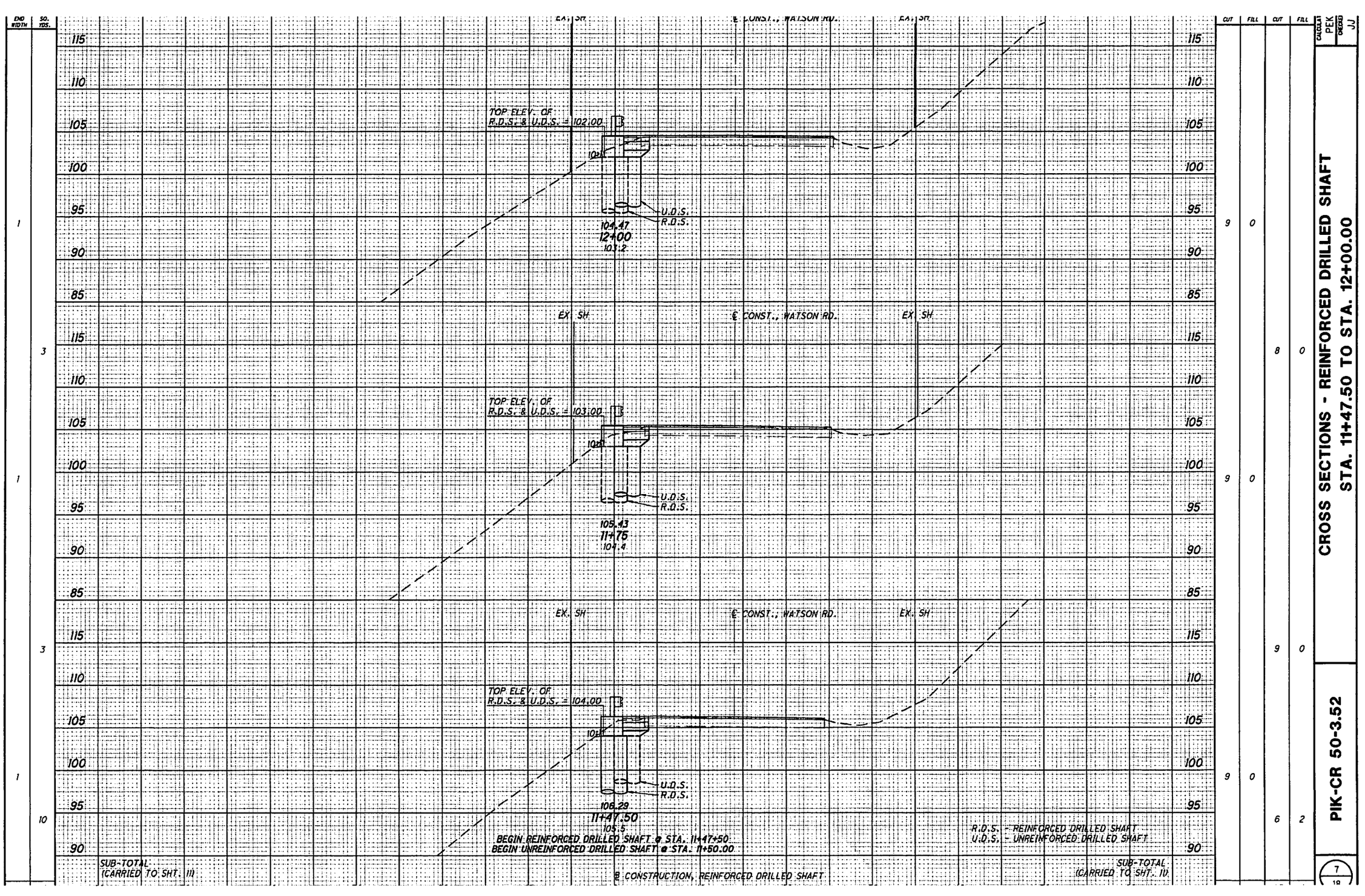
PIK-CR 50-3.52

CALCULATED PEK CHECKED JJ

Sheet 6 / 18



END WIDTH	SQ. YDS.	CUT	FILL	CUT	FILL
7		5	4		
	19			3	4
8		3	6		
	33			4	7
9		3	4		



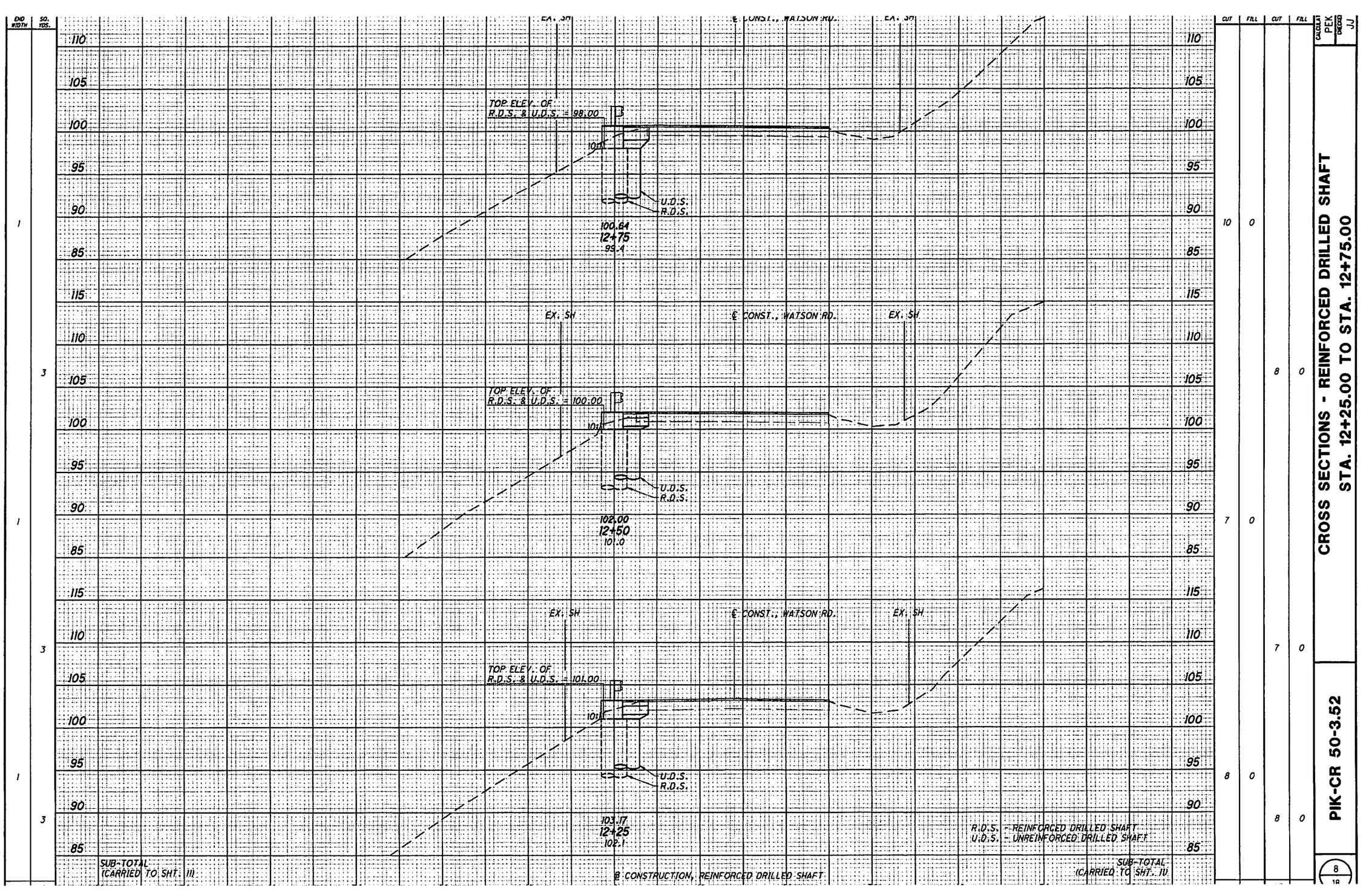
END WIDTH	SQ. YDS.	CUT	FILL	CUT	FILL
1	3	9	0		
1	3	9	0	8	0
1	3	9	0	9	0
1	10	9	0	6	2

CALCULATED PEK
CHECKED JJ

CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 11+47.50 TO STA. 12+00.00

PIK-CR 50-3.52

7



END WIDTH	SQ. YDS.
1	3
1	3
1	3
1	3

CUT	FILL	CUT	FILL
10	0		
		8	0
7	0		
		7	0
8	0		
		8	0

SUB-TOTAL (CARRIED TO SHT. 11)

SUB-TOTAL (CARRIED TO SHT. 10)

R.D.S. - REINFORCED DRILLED SHAFT
U.D.S. - UNREINFORCED DRILLED SHAFT

℄ CONSTRUCTION, REINFORCED DRILLED SHAFT

CALCULATED PEK
CHECKED JJ

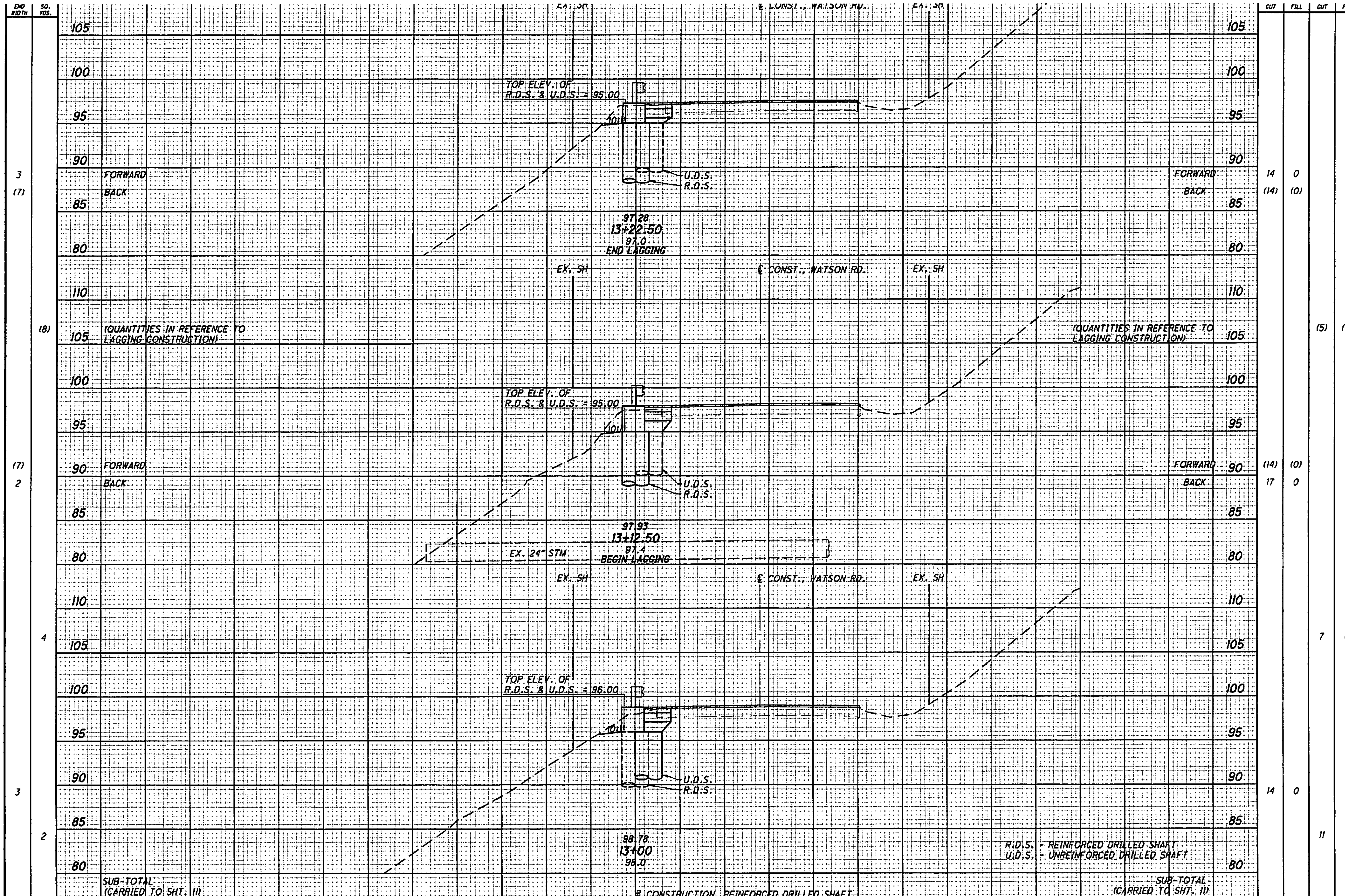
CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 12+25.00 TO STA. 12+75.00

PIK-CR 50-3.52

8
16

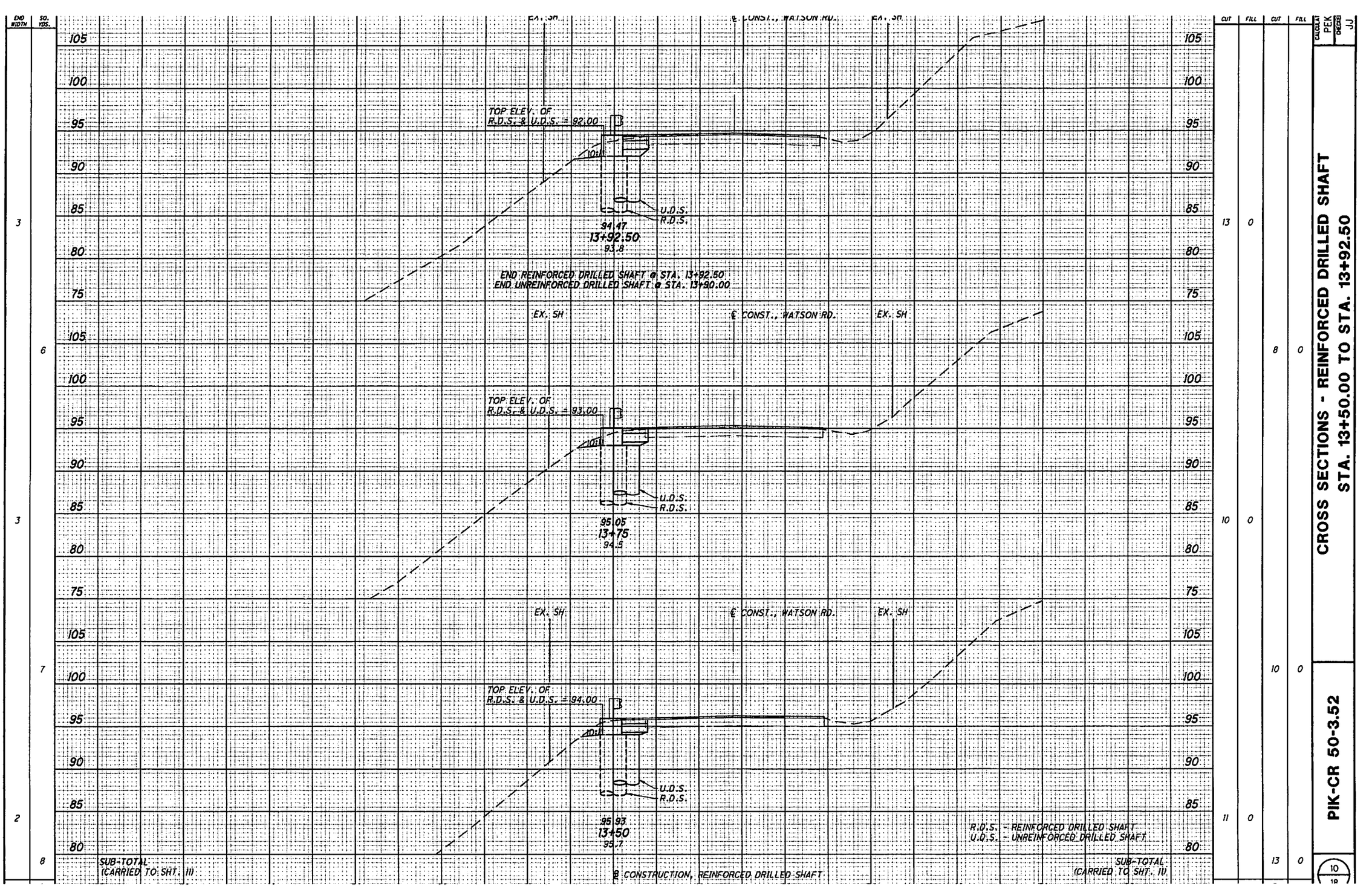
CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 13+00.00 TO STA. 13+22.50

PIK-CR 50-3.52

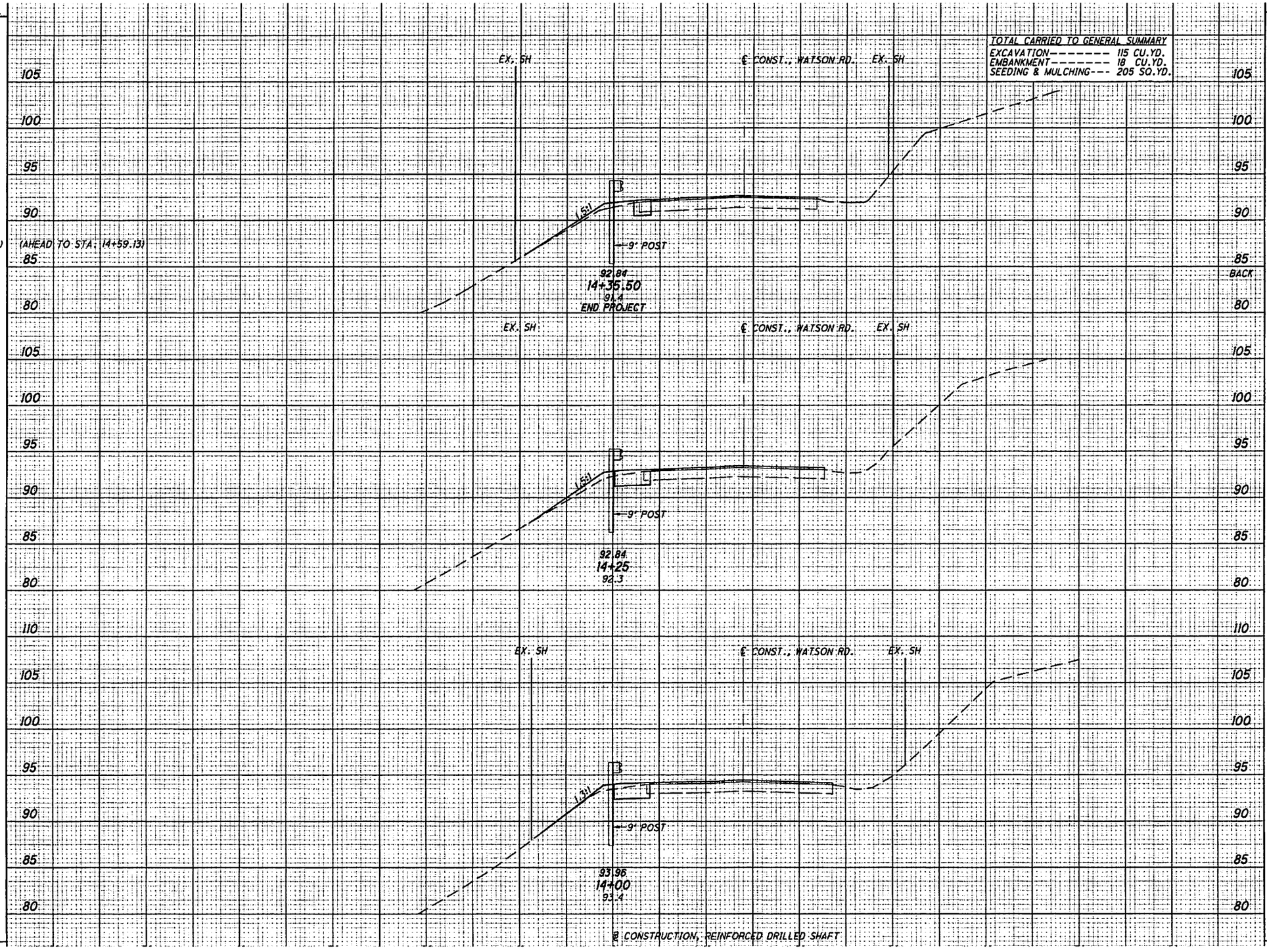


CALCULATED PEK
CHECKED JJ

9
18


END WIDTH
SQ. YDS.
EX. SH
℄ CONST., WATSON RD.
EX. SH
TOP ELEV. OF R.D.S. & U.D.S. = 92.00
10'±
U.D.S.
R.D.S.
94.47
13+92.50
93.8
END REINFORCED DRILLED SHAFT @ STA. 13+92.50
END UNREINFORCED DRILLED SHAFT @ STA. 13+90.00
TOP ELEV. OF R.D.S. & U.D.S. = 93.00
95.05
13+75
94.5
TOP ELEV. OF R.D.S. & U.D.S. = 94.00
95.93
13+50
95.7
R.D.S. - REINFORCED DRILLED SHAFT
U.D.S. - UNREINFORCED DRILLED SHAFT
3
6
3
7
2
8
SUB-TOTAL (CARRIED TO SHT. III)
SUB-TOTAL (CARRIED TO SHT. III)
℄ CONSTRUCTION, REINFORCED DRILLED SHAFT
CUT
FILL
CUT
FILL
13 0
8 0
10 0
10 0
11 0
13 0
CALCULAT PEK
DRCD JJ
CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 13+50.00 TO STA. 13+92.50
PIK-CR 50-3.52
10

END WIDTH	SQ. YDS.
14	(40)
	15
12	
	32
11	
	6



CUT	FILL	CUT	FILL
3	4		
BACK			
		2	2
5	4		
		5	3
5	2		
		1	0

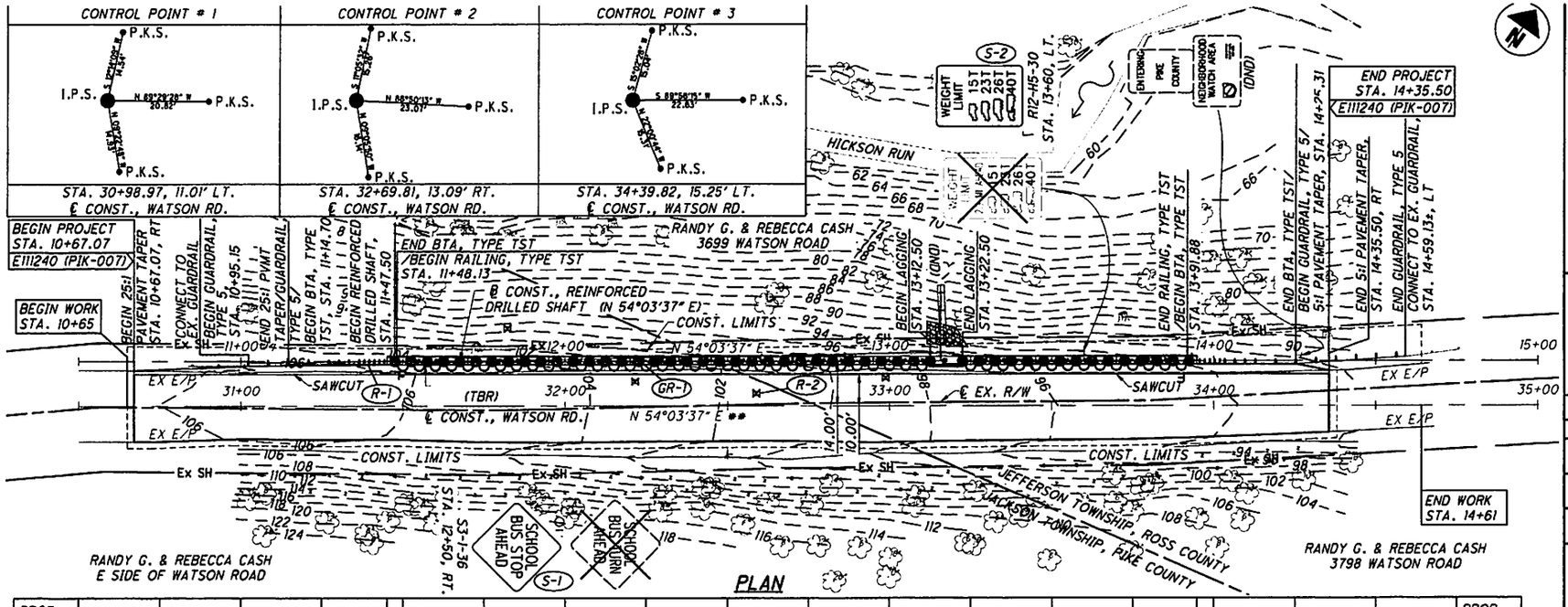
℄ CONSTRUCTION, REINFORCED DRILLED SHAFT

CALCULAT PEK
CHECKED JJ

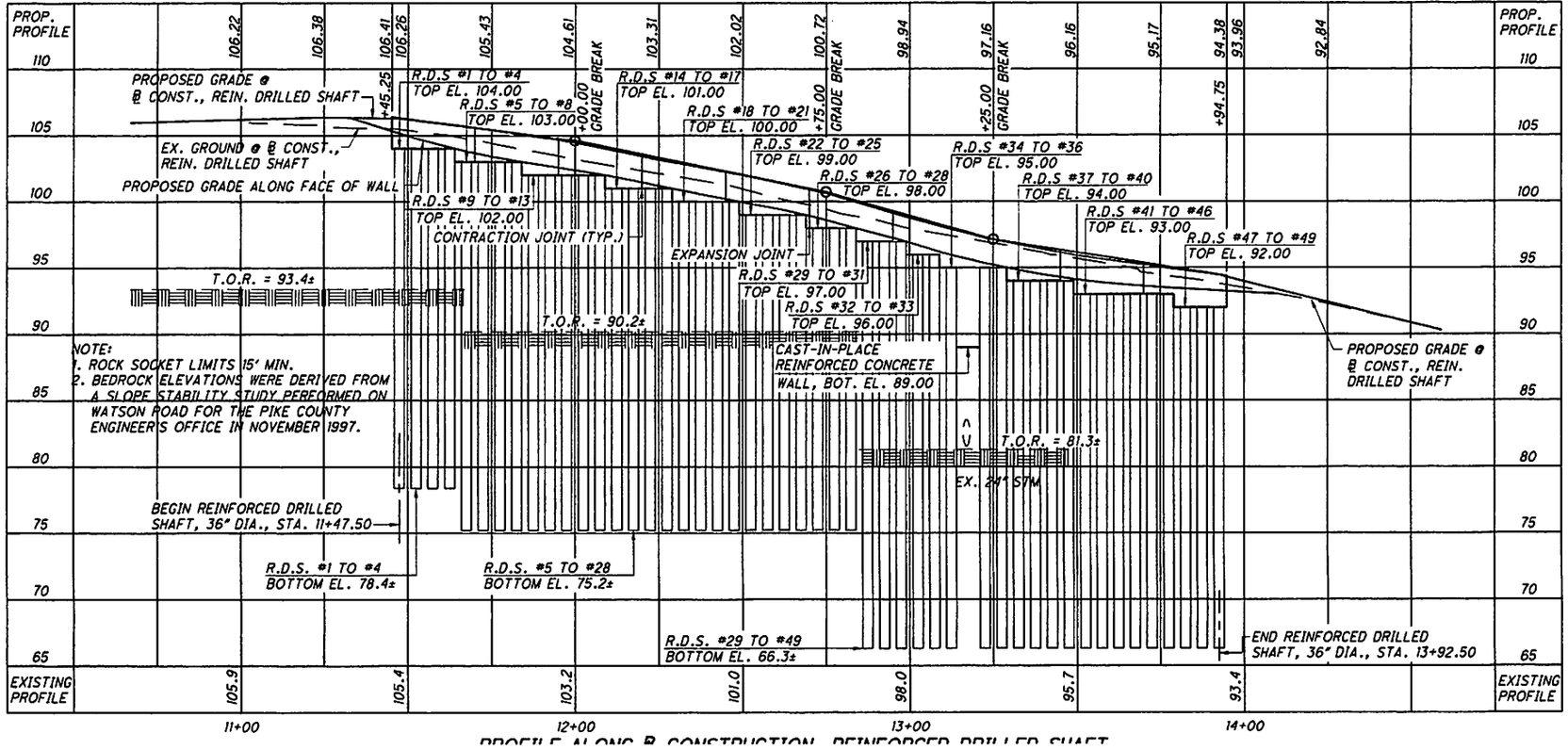
CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 14+00.00 TO STA. 14+35.50

PIK-CR 50-3.52

11
18



PLAN



PROFILE ALONG ℄ CONSTRUCTION, REINFORCED DRILLED SHAFT

TO BE REMOVED	EX. SIGN, SINGLE POST
REINFORCED DRILLED SHAFT	PROP. GUARDRAIL
UNREINFORCED DRILLED SHAFT	(R-1) QUANTITY REFERENCE
PROPOSED SIGN	T.O.R. TOP OF BED ROCK
EXISITNG SIGN	R.D.S. REINFORCED DRILLED SHAFT
EX. SIGN, TBR	TBR TO BE REMOVED
PROP. SIGN, SINGLE POST	DND DO NOT DISTURB
	PVMT PAVEMENT
	BTA BRIDGE TERMINAL ASSEMBLY
	TST TWIN STEEL TUBE

NOTES:

1. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS-SECTIONS.
2. FOR ROADWAY GRADING, REFER TO ROADWAY PLANS.

SURVEY CONTROL POINTS *

POINT	NORTHING	EASTING	ELEV.
CONTROL PT #1 (I.P.S.)	4829.1437	5000.0000	106.16
CONTROL PT #2 (I.P.S.)	5000.0000	5000.0000	100.00
CONTROL PT #3 (I.P.S.)	5170.0225	4999.9106	91.29

IPS = PIN SET - (30" LONG 3/4" INNER DIAMETER PIPE SET W/ 'CEC INC.' CAPS)

BENCH MARKS

SOURCE BENCH MARK
ELEVATION IS BASED ON AN ASSUMED ELEVATION ON CEC POINT NUMBER 2.
ELEVATION= 100.00 (ASSUMED)

BM #1 (SITE)
BENCHTIE IN GUARDRAIL 6.3' SOUTH OF IPS #1 AND 3' WEST OF WATSON ROAD.
ELEVATION = 106.48 (ASSUMED)

BM #2 (SITE)
TOP OF THE WEST END OF PILING AT THE INTERSECTION OF THE WEB AND THE FLANGE. PILING LOCATED 36.3' SOUTHEAST OF CEC CONTROL POINT #2.
ELEVATION = 104.03 (ASSUMED)

BM #3 (SITE)
TOP OF THE WEST END OF PILING AT THE INTERSECTION OF THE WEB AND THE FLANGE. PILING LOCATED 31.8' SOUTHEAST OF CEC CONTROL POINT #32.
ELEVATION = 96.14 (ASSUMED)

BM #4 (SITE)
BENCHTIE IN GUARDRAIL 24' NORTH OF IPS #3 WEST OF WATSON ROAD.
ELEVATION = 90.06 (ASSUMED)

℄ CONSTRUCTION, DRILL SHAFT CONTROL*

	NORTHING	EASTING
PT STA. 10+50.00	4780.2176	4996.4175
PT STA. 15+00.00	5230.1842	5001.8963

* - CONTROL POINTS AND BENCH MARKS ARE ON ASSUMED COORDINATES.

** - BEARINGS ARE BASED ON AN ASSUMED MERIDIAN AND ARE FOR ANGULAR MEASUREMENTS ONLY.

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 BRYDEN ROAD, COLUMBUS, OH 43205
TEL: 614-252-3500

DATE 07/11
REVIEWED JJ STRUCTURE FILE NUMBER -
DRAWN PEK REVISED
DESIGNED PEK CHECKED YSJ/SS

SITE PLAN

PIK-CR 50-3.52
PID NO. 91368

12
16

DRILLED SHAFT LAYOUT

DESIGNED	DRAWN	REVISED	CHECKED
PEK	PEK	-	YSJ/SS

REVISED	DATE	STRUCTURE FILE NUMBER
JJ	07/11	-

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
940 KINNEAN AVENUE, COLUMBUS, OH 43212
TELEPHONE 228-3500

36" DIA. REINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲	⑳
STA.	11+47.50	11+52.50	11+57.50	11+62.50	11+67.50	11+72.50	11+77.50	11+82.50	11+87.50	11+92.50	11+97.50	12+02.50	12+07.50	12+12.50	12+17.50	12+22.50	12+27.50	12+32.50	12+37.50	12+42.50
OFFSET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOP ELEV.	104.00	104.00	104.00	104.00	103.00	103.00	103.00	103.00	102.00	102.00	102.00	102.00	102.00	101.00	101.00	101.00	101.00	100.00	100.00	100.00
BOT. ELEV.	78.40±	78.40±	78.40±	78.40±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±
R.D.S.L.	26.00'±	26.00'±	26.00'±	26.00'±	28.00±	28.00'±	28.00'±	28.00'±	27.00'±	27.00'±	27.00'±	27.00'±	27.00'±	26.00'±	26.00'±	26.00'±	26.00'±	25.00'±	25.00'±	25.00'±

36" DIA. REINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	㉑	㉒	㉓	㉔	㉕	㉖	㉗	㉘	㉙	㉚	㉛	㉜	㉝	㉞	㉟	㊱	㊲	㊳	㊴	㊵
STA.	12+47.50	12+52.50	12+57.50	12+62.50	12.67.50	12+72.50	12+77.50	12+82.50	12+87.50	12+92.50	12+97.50	13+02.50	13+07.50	13+12.50	13+22.50	13+27.50	13+32.50	13+37.50	13+42.50	13+47.50
OFFSET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOP ELEV.	100.00	99.00	99.00	99.00	99.00	98.00	98.00	98.00	97.00	97.00	97.00	96.00	96.00	95.00	95.00	95.00	94.00	94.00	94.00	94.00
BOT. ELEV.	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±
R.D.S.L.	25.00'±	24.00'±	24.00'±	24.00'±	24.00'±	23.00'±	23.00'±	23.00'±	31.00'±	31.00'±	31.00'±	30.00'±	30.00'±	29.00'±	29.00'±	29.00'±	28.00'±	28.00'±	28.00'±	28.00'±

36" DIA. REINFORCED DRILLED SHAFT LAYOUT TABLE									
D.S. NO.	㊶	㊷	㊸	㊹	㊺	㊻	㊼	㊽	㊾
STA.	13+52.50	13+57.50	13+62.50	13+67.50	13+72.50	13+77.50	13+82.50	13+87.50	13+92.50
OFFSET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOP ELEV.	93.00	93.00	93.00	93.00	93.00	93.00	92.00	92.00	92.00
BOT. ELEV.	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±
R.D.S.L.	27.00'±	27.00'±	27.00'±	27.00'±	27.00'±	27.00'±	26.00'±	26.00'±	26.00'±

ITEM 524 DRILLED SHAFT, 36" DIAMETER, ABOVE BEDROCK

R.D.S.L. FROM STA. 11+47.50 TO STA. 13+92.50 = 1312 FT.
MINIMUM DEPTH INTO BEDROCK = 15 FT.
TOTAL LENGTH = 1312 FT. - 49 (DRILLED SHAFTS) x 15 FT. = 577 FT.

TOTAL CARRIED TO GENERAL SUMMARY 577 FT.

ITEM 524 DRILLED SHAFT, 36" DIAMETER, INTO BEDROCK

MINIMUM DEPTH INTO BEDROCK = 15 FT.
TOTAL LENGTH = 49 (DRILLED SHAFTS) x 15 FT. = 735 FT.

TOTAL CARRIED TO GENERAL SUMMARY 735 FT.

36" DIA. UNREINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲	⑳
STA.	11+50.00	11+55.00	11+60.00	11+65.00	11+70.00	11+75.00	11+80.00	11+85.00	11+90.00	11+95.00	12+00.00	12+05.00	12+10.00	12+15.00	12+20.00	12+25.00	12+30.00	12+35.00	12+40.00	12+45.00
OFFSET	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.
TOP ELEV.	104.00	104.00	104.00	103.00	103.00	103.00	103.00	102.00	102.00	102.00	102.00	102.00	101.00	101.00	101.00	101.00	100.00	100.00	100.00	100.00
BOT. ELEV.	93.40'±	93.40'±	93.40'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±
U.D.S.L.	11.00'±	11.00'±	11.00'±	13.00'±	13.00'±	13.00'±	13.00'±	12.00'±	12.00'±	12.00'±	12.00'±	12.00'±	11.00'±	11.00'±	11.00'±	11.00'±	10.00'±	10.00'±	10.00'±	10.00'±

36" DIA. UNREINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	㉑	㉒	㉓	㉔	㉕	㉖	㉗	㉘	㉙	㉚	㉛	㉜	㉝	㉞	㉟	㊱	㊲	㊳	㊴	㊵
STA.	12+50.00	12+55.00	12+60.00	12+65.00	12+70.00	12+75.00	12+80.00	12+85.00	12+90.00	12+95.00	13+00.00	13+05.00	13+10.00	13+25.00	13+30.00	13+35.00	13+40.00	13+45.00	13+50.00	13+55.00
OFFSET	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.
TOP ELEV.	99.00	99.00	99.00	99.00	98.00	98.00	98.00	97.00	97.00	97.00	96.00	96.00	95.00	95.00	94.00	94.00	94.00	94.00	93.00	93.00
BOT. ELEV.	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±
U.D.S.L.	9.00'±	9.00'±	9.00'±	9.00'±	8.00'±	8.00'±	8.00'±	16.00'±	16.00'±	16.00'±	15.00'±	15.00'±	14.00'±	14.00'±	13.00'±	13.00'±	13.00'±	13.00'±	12.00'±	12.00'±

36" DIA. UNREINFORCED DRILLED SHAFT LAYOUT TABLE							
D.S. NO.	㊶	㊷	㊸	㊹	㊺	㊻	㊼
STA.	13+60.00	13+65.00	13+70.00	13+75.00	13+80.00	13+85.00	13+90.00
OFFSET	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.
TOP ELEV.	93.00	93.00	93.00	93.00	92.00	92.00	92.00
BOT. ELEV.	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±
U.D.S.L.	12.00'±	12.00'±	12.00'±	12.00'±	11.00'±	11.00'±	11.00'±

- THE BOTTOM ELEVATION OF UNREINFORCED DRILLED SHAFTS IS AS SPECIFIED OR ACTUAL TOP OF BED ROCK ELEVATION, WHICHEVER IS HIGHER.

ITEM 524 DRILLED SHAFT, 36" DIAMETER, ABOVE BEDROCK, AS PER PLAN

U.D.S.L. FROM STA. 11+50.00 TO STA. 13+90.00 = 555 FT.

TOTAL CARRIED TO GENERAL SUMMARY 555 FT.

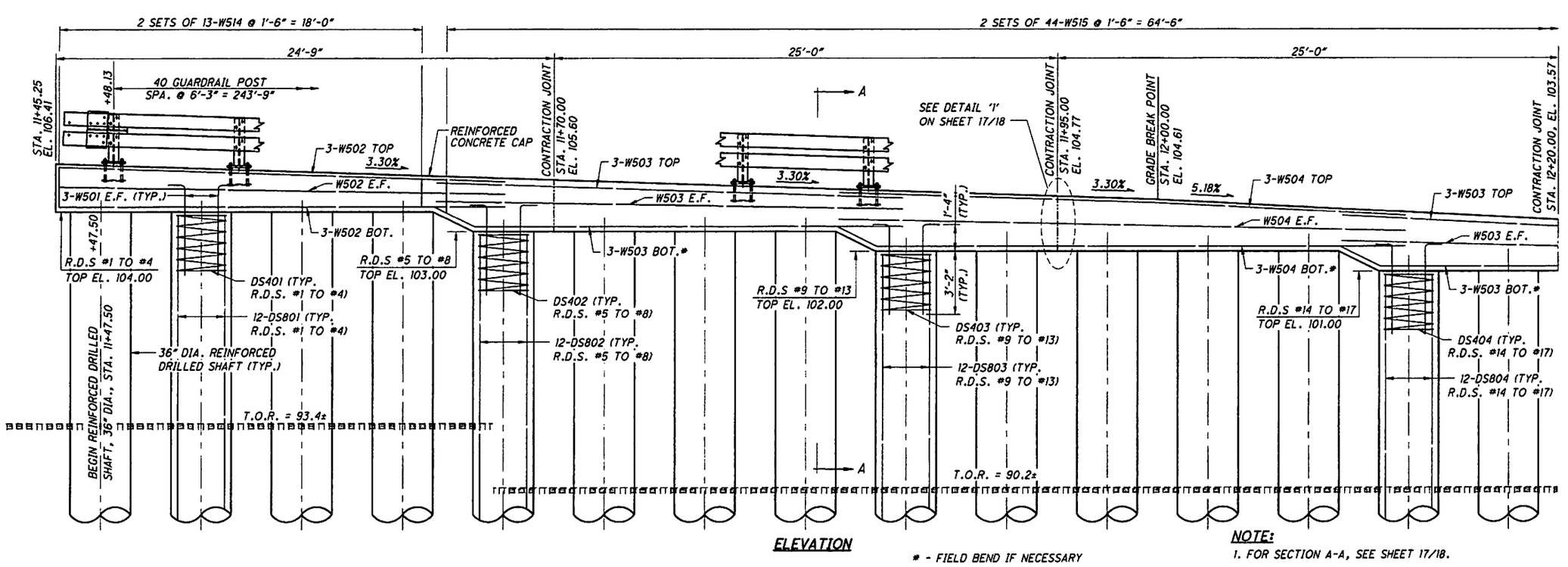
R.D.S.L. = REINFORCED DRILLED SHAFT LENGTH
U.D.S.L. = UNREINFORCED DRILLED SHAFT LENGTH

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
640 MICHIGAN AVENUE, COLUMBUS, OH 43215
TELEPHONE 221-3500

DESIGNED PEK | DRAWN PEK | REVIEWED JJ | DATE 07/11 | STRUCTURE FILE NUMBER -
CHECKED YSJ/SS | REVISED

DRILLED SHAFT LAYOUT

PIK-CR 50-3.52
PID NO. 91368

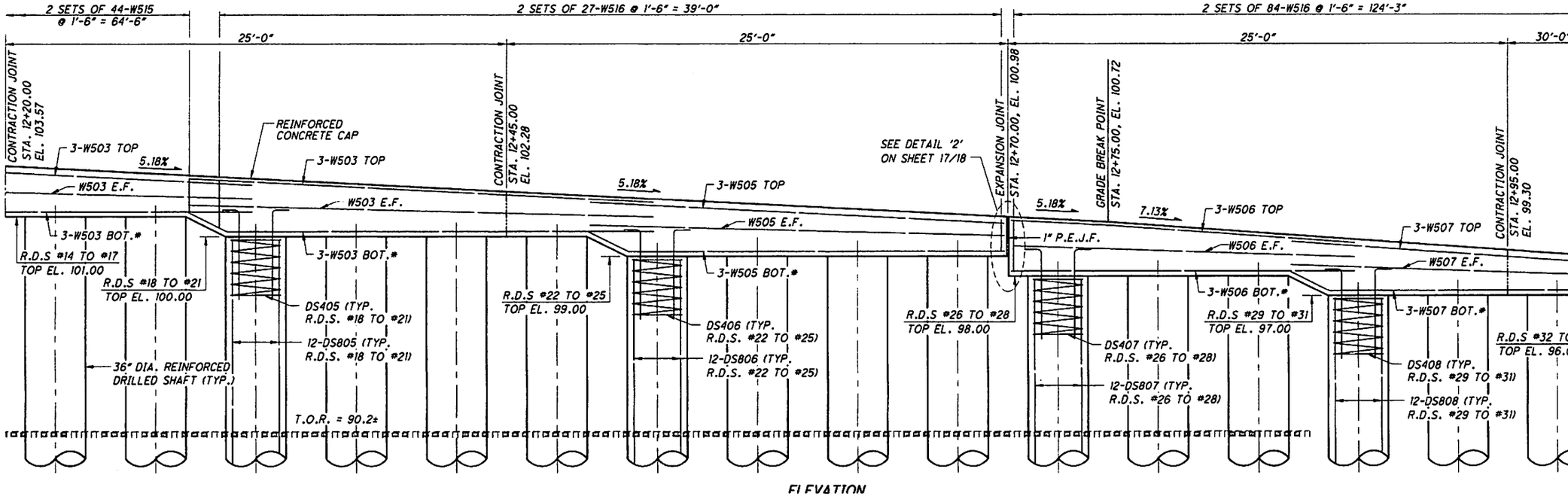


ELEVATION

* - FIELD BEND IF NECESSARY

NOTE:

1. FOR SECTION A-A, SEE SHEET 17/18.



ELEVATION

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MORRISON ROAD, COLUMBUS, OH 43213
TELEPHONE (614) 863-3500

DESIGNED	DRAWN	REVIEWED	DATE
PEK	PEK	JJ	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

WALL CAP REINFORCING DETAILS - I

PIK-CR 50-3.52
PID NO. 91368

WALL CAP REINFORCING DETAILS - II

DESIGNED	DRAWN	REVISED	DATE
PEK	PEK	JL	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 KOSKUSKA AVENUE, COLUMBUS, OH 43215
TELEPHONE 222-3600

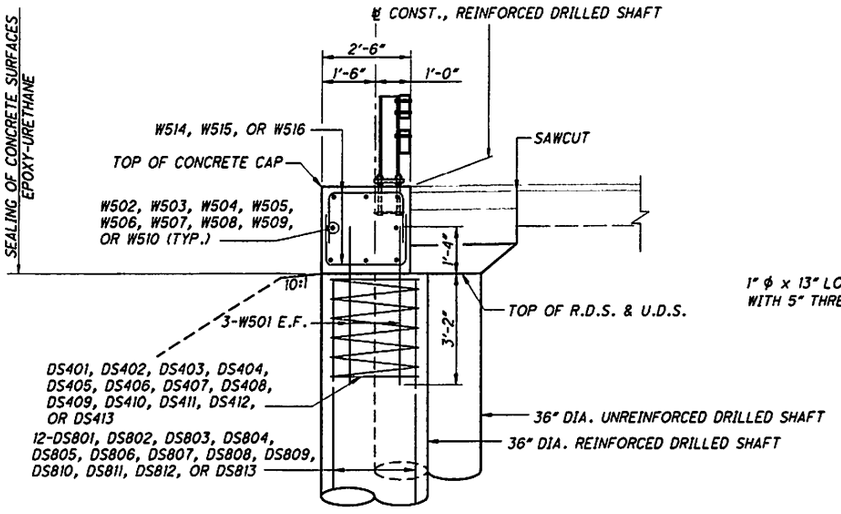
ELEVATION

* - FIELD BEND IF NECESSARY

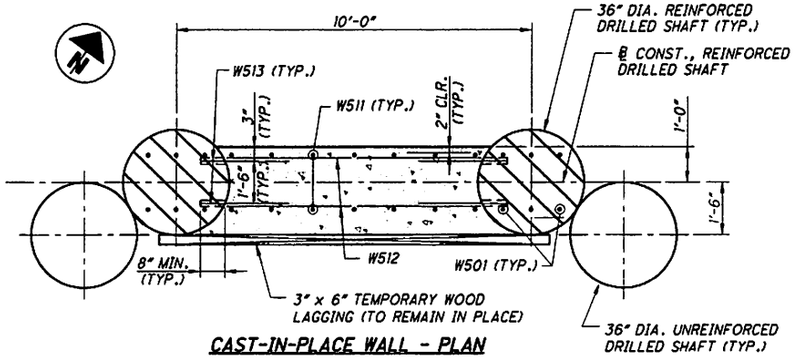
NOTES:
1. FOR SECTION A-A, SEE SHEET 17/18.
2. MINIMUM LAP LENGTHS:
   LAP NO.5 BARS 3'-2"
   LAP NO.8 BARS 6'-4"

LEGEND:
R.D.S. = REINFORCED DRILLED SHAFT
U.D.S. = UNREINFORCED DRILLED SHAFT
T.O.R. = TOP OF BEDROCK
F.F. = FRONT FACE
B.F. = BACK FACE
E.F. = EACH FACES
S.O. = SERIES OF

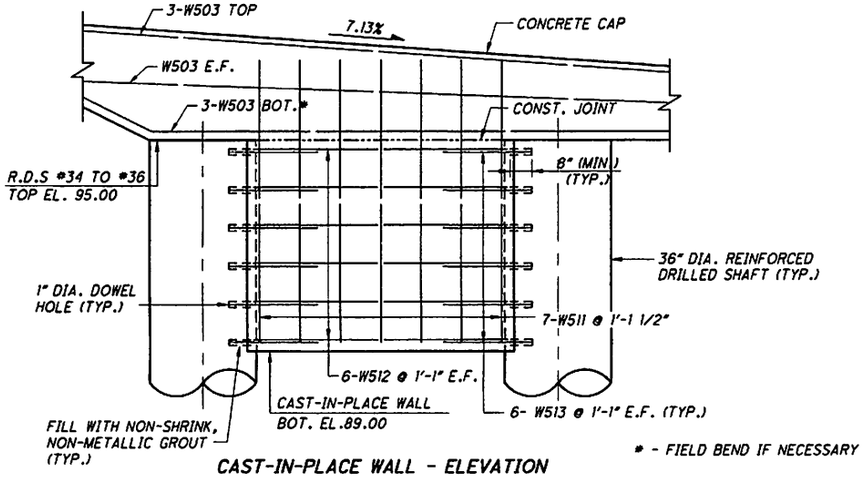
ELEVATION



SECTION A-A

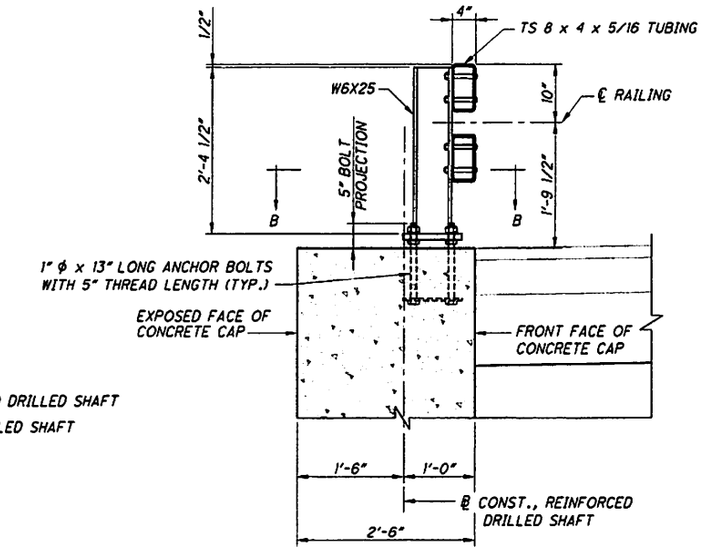


CAST-IN-PLACE WALL - PLAN



CAST-IN-PLACE WALL - ELEVATION

* - FIELD BEND IF NECESSARY



TST GUARDRAIL POST DETAILS

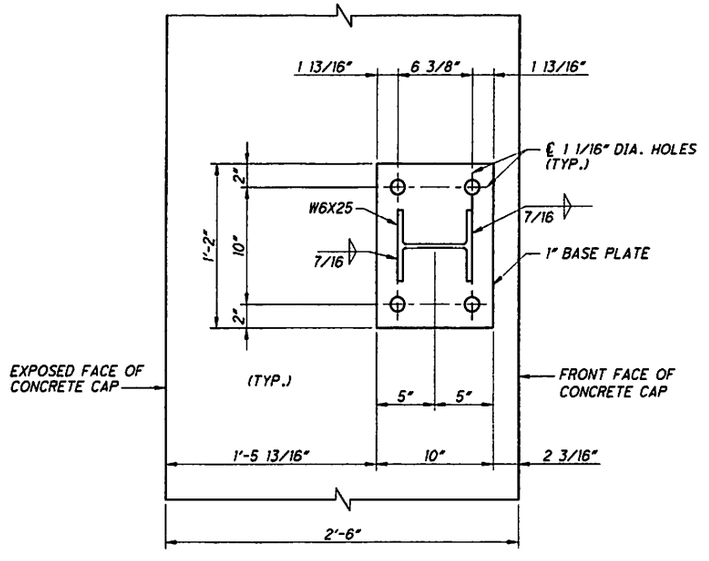
(SEE NOTE 3)

NOTES:

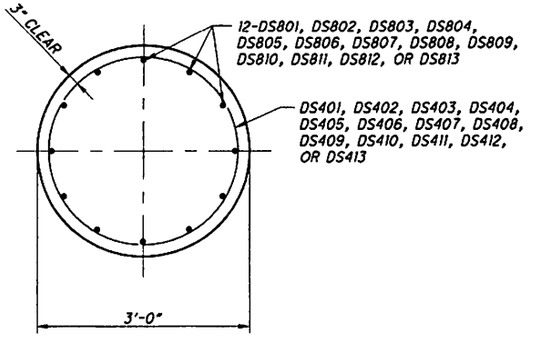
1. FOR LOCATION OF SECTION A-A, SEE SHEETS 15/18 & 16/18.
2. CAST-IN-PLACE CONCRETE WALL DOWEL BARS INTO DRILLED SHAFTS MAY BE MOVED 1"± TO AVOID DRILLING INTO DRILLED SHAFT REINFORCING STEEL.
3. FOR ADDITIONAL TWIN STEEL TUBE RAILING NOTES AND DETAILS, REFER TO STD. DWG. TST-1-99.

LEGEND:

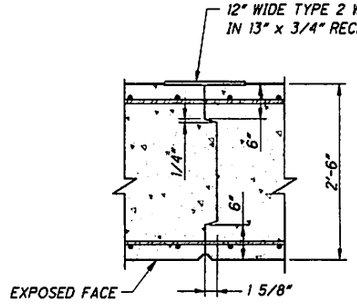
R.D.S. = REINFORCED DRILLED SHAFT
U.D.S. = UNREINFORCED DRILLED SHAFT
T.O.R. = TOP OF BEDROCK
F.F. = FRONT FACE
B.F. = BACK FACE
E.F. = EACH FACES
S.O. = SERIES OF



SECTION B-B

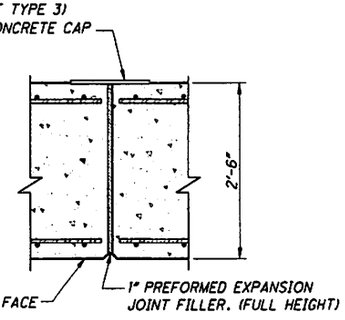


DRILLED SHAFT REINFORCEMENT DETAIL



CONTRACTION JOINT DETAIL

DETAIL '1'



EXPANSION JOINT DETAIL

DETAIL '2'

COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MORRISON ROAD, COLUMBUS, OHIO 43230 TELEPHONE 614-755-3500

DESIGNED	DRAWN	REVIEWED	DATE
PEK	PEK	JJ	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

WALL CAP REINFORCING DETAILS - III

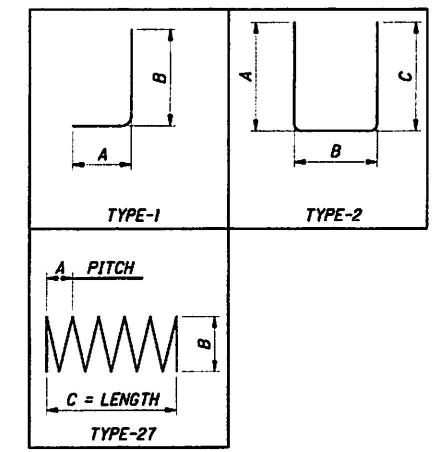
PIK-CR 50-3.52
PID NO. 91368

REINFORCING STEEL LIST

MARK	NUMBER TOTAL	LENGTH	WEIGHT	TYPE	DIMENSIONS A	B	C	D	INC
REINFORCED CONCRETE CAP:									
W501	294	5'-2"	1584	1	0'-10"	4'-6"			
W502	8	22'-2"	185	STR					
W503	40	23'-2"	967	STR					
W504	8	28'-2"	235	STR					
W505	8	20'-8"	172	STR					
W506	8	17'-2"	143	STR					
W507	8	18'-2"	152	STR					
W508	8	13'-2"	110	STR					
W509	8	33'-2"	277	STR					
W510	8	15'-8"	131	STR					
W511	7	17'-7"	127	2	8'-1"	1'-8"	8'-1"		
W512	12	7'-2"	90	STR					
W513	24	2'-6"	63	STR					
W514	26	4'-9"	129	2	1'-5"	2'-2"	1'-5"		
W515	88	5'-5"	497	2	1'-9"	2'-2"	1'-9"		
W516	222	5'-3"	1216	2	1'-8"	2'-2"	1'-8"		
		TOTAL = 6078 LB							
REINFORCED DRILLED SHAFTS (FOR INFORMATION ONLY):									
DS401	4	543'-0"	1451	27	0'-4 ½"	2'-6"	25'-2"		
DS402	4	587'-8"	1570	27	0'-4 ½"	2'-6"	27'-4"		
DS403	5	567'-0"	1894	27	0'-4 ½"	2'-6"	26'-4"		
DS404	4	546'-4"	1460	27	0'-4 ½"	2'-6"	25'-4"		
DS405	4	525'-8"	1405	27	0'-4 ½"	2'-6"	24'-4"		
DS406	4	505'-1"	1350	27	0'-4 ½"	2'-6"	23'-4"		
DS407	3	484'-5"	971	27	0'-4 ½"	2'-6"	22'-4"		
DS408	3	648'-0"	1299	27	0'-4 ½"	2'-6"	30'-3"		
DS409	2	627'-4"	838	27	0'-4 ½"	2'-6"	29'-3"		
DS410	3	606'-8"	1216	27	0'-4 ½"	2'-6"	28'-3"		
DS411	4	586'-0"	1566	27	0'-4 ½"	2'-6"	27'-3"		
DS412	6	565'-4"	2266	27	0'-4 ½"	2'-6"	26'-3"		
DS413	3	544'-8"	1092	27	0'-4 ½"	2'-6"	25'-3"		
DS801	48	25'-2"	3225	STR					
DS802	48	27'-4"	3503	STR					
DS803	60	26'-4"	4218	STR					
DS804	48	25'-4"	3246	STR					
DS805	48	24'-4"	3118	STR					

MARK	NUMBER TOTAL	LENGTH	WEIGHT	TYPE	DIMENSIONS A	B	C	D	INC
REINFORCED DRILLED SHAFTS (FOR INFORMATION ONLY) CONTINUED:									
DS806	48	23'-4"	2990	STR					
DS807	36	22'-4"	2146	STR					
DS808	36	30'-3"	2908	STR					
DS809	24	29'-3"	1874	STR					
DS810	36	28'-3"	2715	STR					
DS811	48	27'-3"	3492	STR					
DS812	72	26'-3"	5046	STR					
DS813	36	25'-3"	2427	STR					
		TOTAL = 59286 LB							
		INCLUDED WITH PAYMENT FOR DRILLED SHAFTS							

BENDING DIAGRAMS



NOTES:

1. THE BAR SIZE NUMBER IS SPECIFIED ON THE PLANS IN THE BAR MARK COLUMN. THE FIRST DIGIT WHERE THREE DIGITS ARE USED, AND THE FIRST TWO DIGITS WHERE FOUR ARE USED, INDICATES THE BAR SIZE NUMBER. FOR EXAMPLE, S501 IS A NO. 5 BAR. BAR DIMENSIONS SHOWN ARE OUT TO OUT UNLESS OTHERWISE NOTED. R INDICATES INSIDE RADIUS, UNLESS OTHERWISE NOTED.

2. ALL REINFORCING STEEL SHALL BE EPOXY COATED.

3. "STR" IN THE TYPE COLUMN INDICATES STRAIGHT BARS.

4. S.O. DENOTES SERIES OF.

5. REFER TO C.M.S. SECTION 509.05 FOR STANDARD BEND DIMENSIONS.

6. ALL REINFORCING STEEL CLEARANCES ARE 2" UNLESS OTHERWISE NOTED.

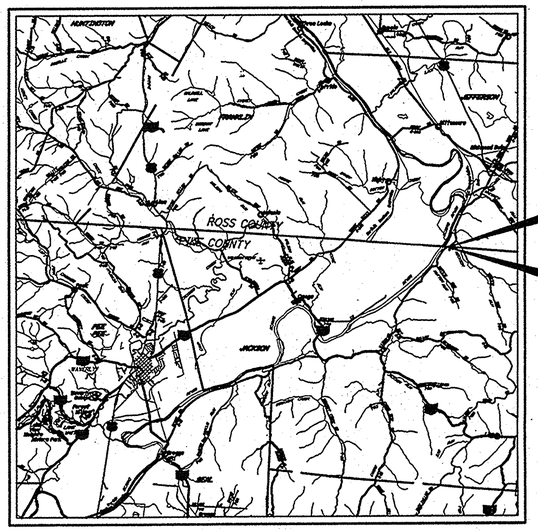
7. SPIRAL REINFORCING BAR SPACERS:
CONCRETE SPACERS OR OTHER APPROVED NONCORROSIVE SPACING DEVICES SHALL BE USED AT SUFFICIENT INTERVAL (NEAR THE BOTTOM AND AT INTERVALS NOT EXCEEDING 10 FEET) TO INSURE CONCENTRIC SPACING FOR THE ENTIRE CAGE LENGTH. SPACERS SHALL BE CONSTRUCTED OF APPROVED MATERIAL EQUAL IN QUALITY AND DURABILITY TO THE CONCRETE SPECIFIED FOR THE SHAFT. THE SPACERS SHALL HAVE ADEQUATE DIMENSIONS TO ENSURE A MINIMUM 3 INCH CLEAR SPACE BETWEEN THE OUTSIDE OF THE REINFORCING CAGE AND THE DESIGN DIMENSION OF THE DRILLED SHAFT OR COLUMN. CYLINDRICAL CONCRETE FEET (BOTTOM SUPPORTS) SHALL BE PROVIDED TO ENSURE THAT THE BOTTOM OF THE CAGE IS MAINTAINED AT THE PROPER DISTANCE ABOVE THE BASE.

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.

DESIGNED	DRAWN	REVIEWED	DATE
YSJ/SS	CEC	JJ	07/11
CHECKED JH	REVISED	STRUCTURE FILE NUMBER	

REINFORCING STEEL LIST

PIK-CR 50-3.52
PID No. 91368



LOCATION MAP

LATITUDE: N 39° 10′ 19″ LONGITUDE: W 82° 50′ 16″

SCALE IN MILES 0 1 2

PORTION TO BE IMPROVED
INTERSTATE & DIVIDED HIGHWAY
UNDIVIDED STATE & FEDERAL ROUTES
OTHER ROADS

DESIGN DESIGNATION

CURRENT ADT (2011) 600

DESIGN SPEED 55 MPH
LEGAL SPEED 55 MPH
DESIGN FUNCTIONAL CLASSIFICATION:
MAJOR COLLECTOR

STATE OF OHIO
DEPARTMENT OF TRANSPORTATION

PIK-CR 50-3.52
(WATSON ROAD)
JACKSON TOWNSHIP
PIKE COUNTY

INDEX OF SHEETS:

PROJECT DESCRIPTION

EMERGENCY REPAIR PROJECT TO CORRECT LANDSLIDE, BY MEANS OF DRILL SHAFTS BELOW THE APPARENT FAILURE SURFACE AND SUBSEQUENT RECONSTRUCTION OF THE SLOPE. PROJECT ALSO INCLUDES GUARDRAIL CONSTRUCTION AND SUBSEQUENT GRADING.

PROJECT EARTH DISTURBED AREA:..... 0.09 AC.
CONTRACTOR EARTH DISTURBED AREA:..... 0.22 AC.
NOI EARTH DISTURBED AREA:..... (NOI NOT REQUIRED)

2010 SPECIFICATIONS

THE STANDARD SPECIFICATIONS OF THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, INCLUDING CHANGES AND SUPPLEMENTAL SPECIFICATIONS LISTED IN THE PROPOSAL SHALL GOVERN THIS IMPROVEMENT.

I HEREBY APPROVE THESE PLANS AND DECLARE THAT THE MAKING OF THIS IMPROVEMENT WILL NOT REQUIRE THE CLOSING TO TRAFFIC OF THE HIGHWAY EXCEPT AS NOTED ON SHEET 3, PROVISIONS FOR THE MAINTENANCE AND SAFETY OF TRAFFIC WILL BE AS SET FORTH ON THE PLANS AND ESTIMATES.

APPROVED Denny T. Salisbury
DATE 9-22-11 DENNY T. SALISBURY, P.E., P.S., PIKE COUNTY ENGINEER

APPROVED Vaughn E. Wilson
DATE 9-26-11 DISTRICT DEPUTY DIRECTOR

APPROVED Jerry Wray PE
DATE 9-30-11 DIRECTOR, DEPARTMENT OF TRANSPORTATION

STANDARD CONSTRUCTION DRAWINGS								SUPPLEMENTAL SPECIFICATIONS	
BP-2.1	7/18/08	TC-41.20	1/19/01	MT-96.11	1/16/09	TST-1-99	4/18/08	800	7/15/11
BP-2.2	7/18/08	TC-42.20	1/21/11	MT-96.20	10/15/10			802	4/15/11
BP-3.1	10/19/07	TC-52.10	1/19/07	MT-96.26	1/16/09			823	7/15/11
		TC-52.20	1/19/07	MT-97.10	10/15/10			832	5/5/09
DM-1.1	1/21/11	TC-61.30	7/15/11	MT-97.12	10/15/10			902	7/16/10
DM-4.4	4/17/09			MT-101.90	1/16/09			961	10/17/08
				MT-105.10	1/16/09				
GR-1.1	7/16/04								
GR-2.1	1/16/04								
GR-2.2	1/20/06							SPECIAL PROVISIONS	
GR-3.6	10/16/09								
GR-4.2	1/19/07								
RM-4.2	10/15/10								

ENGINEERS SEAL:

STATE OF OHIO * SEAN JENQ E-58874 * REGISTERED PROFESSIONAL ENGINEER

SIGNED: Sean Jenq
DATE: 09/19/2011

PLANS PREPARED BY:
COLUMBUS ENGINEERING CONSULTANTS, INC.
CONSULTING ENGINEERS AND SURVEYORS
840 MICHIGAN AVENUE
COLUMBUS, OHIO 43215
PHONE: (614) 228-3500
FAX: (614) 228-3519

UNDERGROUND UTILITIES
CONTACT BOTH SERVICES CALL TWO WORKING DAYS
BEFORE YOU DIG
CALL 1-800-362-2764 (TOLL FREE)
OHIO UTILITIES PROTECTION SERVICE
NON-MEMBERS MUST BE CALLED DIRECTLY
OIL & GAS PRODUCERS PROTECTIVE SERVICE CALL: 1-800-928-0988

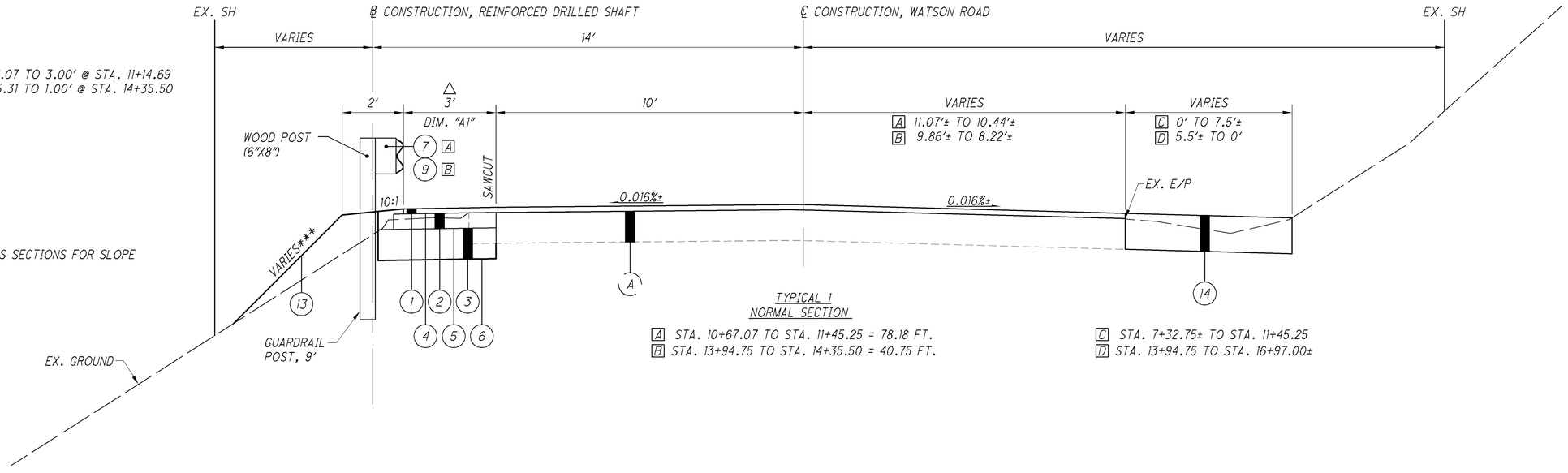
FEDERAL PROJECT NO. E111240 (PIK-007)
PID NO. 91368
CONSTRUCTION PROJECT NO.
RAILROAD INVOLVEMENT NONE
PIK-CR 50-3.52
1 / 18

PIK- CR - 50-3.52 (Watson Road)
117016
PID 91368
Dist 9
10/20/2011

NOTE: CONNECT PROPOSED GUARDRAIL, TYPE 5 TO EXISTING GUARDRAIL AT STA. 11+02.32±, RT. AND STA. 14+59.13± LT.

DIM. "A1"
FROM 1.00' @ STA. 10+67.07 TO 3.00' @ STA. 11+14.69
FROM 3.00' @ STA. 14+25.31 TO 1.00' @ STA. 14+35.50

*** SEE CROSS SECTIONS FOR SLOPE

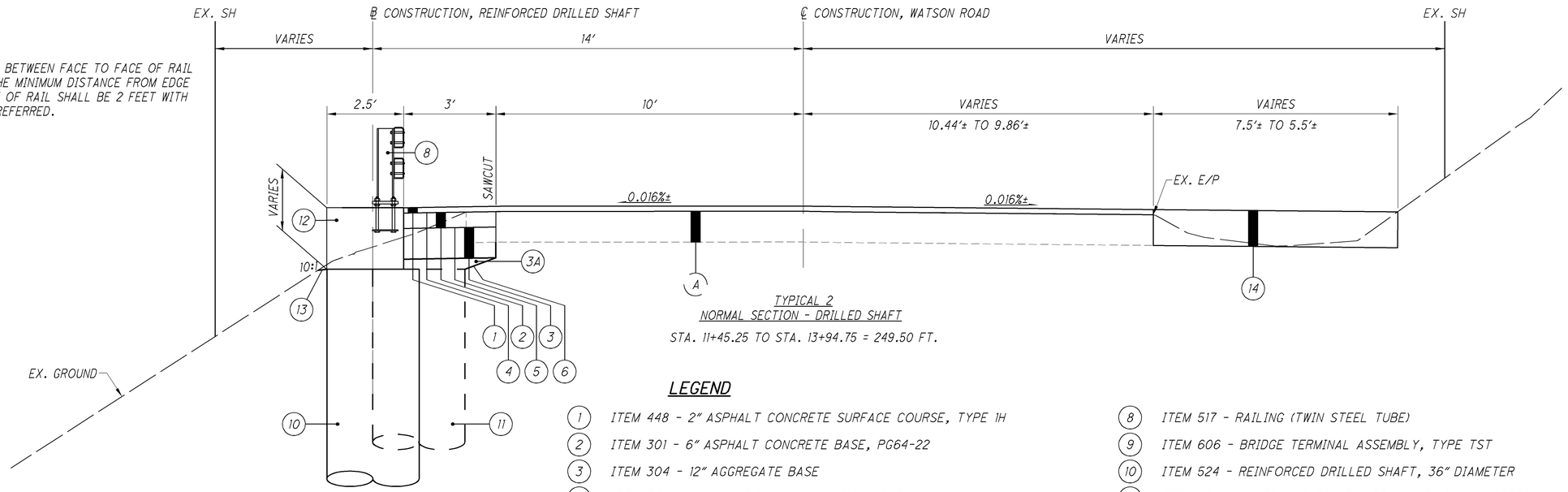


TYPICAL 1
NORMAL SECTION

A STA. 10+67.07 TO STA. 11+45.25 = 78.18 FT.
B STA. 13+94.75 TO STA. 14+35.50 = 40.75 FT.

C STA. 7+32.75± TO STA. 11+45.25
D STA. 13+94.75 TO STA. 16+97.00±

△ THE MINIMUM DISTANCE BETWEEN FACE TO FACE OF RAIL SHALL BE 24 FEET. THE MINIMUM DISTANCE FROM EDGE OF PAVEMENT TO FACE OF RAIL SHALL BE 2 FEET WITH 4 FEET OF GREATER PREFERRED.



TYPICAL 2
NORMAL SECTION - DRILLED SHAFT

STA. 11+45.25 TO STA. 13+94.75 = 249.50 FT.

LEGEND

1. ITEM 448 - 2" ASPHALT CONCRETE SURFACE COURSE, TYPE 1H
2. ITEM 301 - 6" ASPHALT CONCRETE BASE, PG64-22
3. ITEM 304 - 12" AGGREGATE BASE
3A. ITEM 304 - AGGREGATE BASE, VARIABLE DEPTH
4. ITEM 407 - TACK COAT (APPLIED AT A RATE OF 0.075 GAL./ SQ. YD.)
5. ITEM 408 - PRIME COAT (APPLIED AT A RATE OF 0.40 GAL./SQ. YD.)
6. ITEM 204 - SUBGRADE COMPACTION
7. ITEM 606 - GUARDRAIL, TYPE 5
8. ITEM 517 - RAILING (TWIN STEEL TUBE)
9. ITEM 606 - BRIDGE TERMINAL ASSEMBLY, TYPE TST
10. ITEM 524 - REINFORCED DRILLED SHAFT, 36" DIAMETER
11. ITEM 524 - UNREINFORCED DRILLED SHAFT, 36" DIAMETER
12. ITEM 511 - CLASS C CONCRETE
13. ITEM 659 - SEEDING AND MULCHING
14. ITEM 615 - PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN

A. EXISTING PAVEMENT, VARIES

CALCULATED PEK
CHECKED JJ

TYPICAL SECTIONS

PIK-CR 50-3.52

ROUNDING

THE ROUNDING AT SLOPE BREAKPOINTS SHOWN ON THE TYPICAL SECTIONS APPLIES TO ALL CROSS-SECTIONS EVEN THOUGH OTHERWISE SHOWN.

UTILITIES

THERE ARE NO KNOWN UNDERGROUND OR OVERHEAD UTILITIES WITHIN THE PROJECT LIMITS.

WORK LIMITS

THE WORK LIMITS SHOWN ON THESE PLANS ARE FOR PHYSICAL CONSTRUCTION ONLY. PROVIDE THE INSTALLATION AND OPERATION OF ALL WORK ZONE TRAFFIC CONTROL AND WORK ZONE TRAFFIC CONTROL DEVICES REQUIRED BY THESE PLANS WHETHER INSIDE OR OUTSIDE THESE WORK LIMITS.

CLEARING AND GRUBBING, AS PER PLAN

ALTHOUGH THERE ARE NO TREES OR STUMPS SPECIFICALLY MARKED FOR REMOVAL WITHIN THE LIMITS OF THE PROJECT, A LUMP SUM QUANTITY IS INCLUDED IN THE GENERAL SUMMARY FOR ITEM 201, CLEARING AND GRUBBING. NO TREES WITH A DIAMETER OF 8" OR GREATER SHALL BE DISTURBED. ALL PROVISIONS AS SET FORTH IN THE SPECIFICATIONS UNDER THIS ITEM ARE INCLUDED IN THE LUMP SUM PRICE BID FOR ITEM 201, CLEARING AND GRUBBING.

SEEDING AND MULCHING

THE FOLLOWING QUANTITIES ARE PROVIDED TO PROMOTE GROWTH AND CARE OF PERMANENT SEEDED AREAS:

659, REPAIR SEEDING AND MULCHING	10 SQ. YD.
659, COMMERCIAL FERTILIZER	0.05 TON
659, LIME	0.04 ACRES
659, WATER	1 M. GAL.

SEEDING AND MULCHING SHALL BE APPLIED TO ALL AREAS OF EXPOSED SOIL BETWEEN THE RIGHT-OF-WAY LINES, AND WITHIN THE CONSTRUCTION LIMITS FOR AREAS OUTSIDE THE RIGHT-OF-WAY LINES COVERED BY WORK AGREEMENT OR SLOPE EASEMENT. QUANTITY CALCULATIONS FOR SEEDING AND MULCHING ARE BASED ON THESE LIMITS.

ELEVATION DATUM

ELEVATIONS ARE BASED ON ASSUMED DATUM. FOR CONTROL SEE SHEET 12.

GRADE CORRECTION

GRADE CORRECTIONS FOR BEDROCK ELEVATIONS WERE DETERMINED BASED ON A SLOPE STABILITY STUDY PERFORMED BY CTL ENGINEERING, INC. ON WATSON ROAD FOR THE PIKE COUNTY ENGINEER'S OFFICE IN NOVEMBER 1997.

FARM DRAINS

ALL FARM DRAINS, WHICH ARE ENCOUNTERED DURING CONSTRUCTION, SHALL BE PROVIDED WITH UNOBSTRUCTED OUTLETS. EXISTING COLLECTORS WHICH ARE LOCATED BELOW THE ROADWAY DITCH ELEVATIONS, AND WHICH CROSS THE ROADWAY, SHALL BE REPLACED WITHIN THE (RIGHT OF WAY)(CONSTRUCTION) LIMITS BY ITEM 603 CONDUIT, TYPE B, ONE COMMERCIAL SIZE LARGER THAN THE EXISTING CONDUIT.

EXISTING COLLECTORS AND ISOLATED FARM DRAINS, WHICH ARE ENCOUNTERED ABOVE THE ELEVATION OF ROADWAY DITCHES, SHALL BE OUTLETTED INTO THE ROADWAY DITCH BY 603 TYPE F CONDUIT. THE OPTIMUM OUTLET ELEVATION SHALL BE ONE FOOT [300 MILLIMETERS] ABOVE THE FLOWLINE ELEVATION OF THE DITCH. LATERAL FIELD TILES WHICH CROSS THE ROADWAY SHALL BE INTERCEPTED BY 603, TYPE E CONDUIT, AND CARRIED IN A LONGITUDINAL DIRECTION TO AN ADEQUATE OUTLET OR ROADWAY CROSSING.

THE LOCATION, TYPE, SIZE AND GRADE OF REPLACEMENTS SHALL BE DETERMINED BY THE ENGINEER AND PAYMENT SHALL BE MADE ON FINAL MEASUREMENTS.

EROSION CONTROL PADS AND ANIMAL GUARDS SHALL BE PROVIDED AT THE OUTLET END OF ALL FARM DRAINS AS PER STANDARD CONSTRUCTION DRAWING DM-1.1, EXCEPT WHEN THEY OUTLET INTO A DRAINAGE STRUCTURE. PAYMENT FOR THE EROSION CONTROL PADS AND ANIMAL GUARDS AND ANY NECESSARY BENDS OR BRANCHES SHALL BE INCLUDED FOR PAYMENT IN THE PERTINENT CONDUIT ITEMS.

THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN INCLUDED IN THE GENERAL SUMMARY FOR THE WORK NOTED ABOVE:

603	6" CONDUIT, TYPE B	50 FT.
603	6" CONDUIT, TYPE E	50 FT.
603	6" CONDUIT, TYPE F	50 FT.

ITEM 524 - DRILLED SHAFTS, 36" DIAMETER, ABOVE BEDROCK, AS PER PLAN

THE BOTTOM ELEVATION OF UNREINFORCED DRILLED SHAFTS IS AS SPECIFIED IN THE PLANS OR ACTUAL TOP OF BED ROCK ELEVATION, WHICHEVER IS HIGHER.

ITEM 615 - PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN

THIS ITEM SHALL CONSIST OF 12" CLASS C CONCRETE AND SHALL CONFORM TO ITEM 452. TIEBARS OR HOOKBOLTS FOR LONGITUDINAL JOINTS ARE NOT REQUIRED. USE DOWELS ONLY AT TRANSVERSE EXPANSION AND CONSTRUCTION JOINTS. CONFORM TO THE QUALITY REQUIREMENTS SET FORTH IN 499.02 FOR THE MATERIALS, EXCEPT THE REQUIREMENTS OF 703.13.

ITEM 614 - MAINTAINING TRAFFIC

A MINIMUM OF ONE 10 FOOT LANE OF TRAFFIC SHALL BE MAINTAINED AT ALL TIMES USING SCD MT-96.11, SIGNALIZED CLOSING ONE LANE OF A 2-LANE HIGHWAY USING DRUMS IN LIEU OF PORTABLE CONCRETE BARRIER WHILE MAINTAINING DROP-OFF AND CLEAR ZONE REQUIREMENTS AND PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN.

LENGTH AND DURATION OF LANE CLOSURES AND RESTRICTIONS SHALL BE AT THE APPROVAL OF THE ENGINEER. IT IS THE INTENT TO MINIMIZE THE IMPACT TO THE TRAVELING PUBLIC. LANE CLOSURES AND RESTRICTIONS OVER SEGMENTS OF THE PROJECT IN WHICH NO WORK IS ANTICIPATED WITHIN A REASONABLE TIME FRAME, AS DETERMINED BY THE ENGINEER, SHALL NOT BE PERMITTED. THE LEVEL OF UTILIZATION OF MAINTENANCE OF TRAFFIC DEVICES SHALL BE COMMENSURATE WITH THE WORK IN PROGRESS.

BEFORE THE WORK BEGINS, THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER THE NAMES AND TELEPHONE NUMBERS OF A PERSON OR PERSONS WHO CAN BE CONTACTED TWENTY-FOUR (24) HOURS PER DAY BY THE OHIO DEPARTMENT OF TRANSPORTATION AND ALL INTERESTED POLICE ANGENCIES. THIS PERSON OR PERSONS SHALL BE RESPONSIBLE FOR PLACING OR REPLACING NECESSARY TRAFFIC CONTROL DEVICES IN ACCORDANCE WITH

THE OHIO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
THE CONTRACTOR WILL ADVISE THE DISTRICT PUBLIC INFORMATION OFFICER AT (740) 773-2691/(888) 819-8501, OR FAX (740) 775-4889 SEVEN (7) DAYS PRIOR TO THE START OF CONSTRUCTION ACTIVITIES. THE PROJECT ENGINEER WILL PROVIDE ASSISTANCE/CLARIFICATION FOR ANY QUESTIONS.

SEQUENCE OF CONSTRUCTION

INSTALL TEMPORARY TRAFFIC CONTROL DEVICES PER SCD MT-96.11, MT-96.20 AND PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN TO MAINTAIN ONE 10 FOOT LANE OF TRAFFIC. PERFORM CLEARING AND GRUBBING AND REMOVAL OF EXISTING GUARDRAIL AND SIGNAGE WITHIN SPECIFIED CONSTRUCTION LIMITS.

PERFORM CONSTRUCTION OF DRILL SHAFTS, PROPOSED GUARDRAIL, LAGGING, PAVEMENT WIDENING, RESURFACING, SIGNING AND GRADING PER THESE CONSTRUCTIONS PLANS TO CORRRECT LANDSLIDE.

THE CONTRACTOR SHALL USE CAUTION WHEN CONSTRUCTION IS TO TAKE PLACE IN THE AREA OF THE EXISTING 24" STORM SEWER AT STA. 13+17± AS TO NOT DAMAGE THE EXISTING PIPE. THE CONTRACTOR SHALL PERFORM A PRE/POST INSPECTION OF THE EXISTING PIPE TO ASSURE POSITIVE DRAINAGE. THE CONTRACTOR IS RESPONSIBLE FOR ANY DAMAGE TO THE EXISTING 24" STORM SEWER DUE IN PART TO THE CONSTRUCTION TO CORRECT LANDSLIDE.

EXISTING GUARDRAIL REMOVAL MAY ONLY TAKE PLACE AS IT PERTAINS TO THE DAILY WORK ZONE. PORTABLE CONCRETE BARRIER MAY BE ESTABLISHED AT THE END OF CONSTRUCTION HOURS IN LIEU OF GUARDRAIL AT THE APPROVAL OF THE ENGINEER.

REMOVE TEMPORARY TRAFFIC CONTROL DEVICES AND CONCRETE PAVEMENT AFTER LANDSLIDE CORRECTION HAS BEEN COMPLETED.

THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN INCLUDED IN THE GENERAL SUMMARY FOR USE AS DIRECTED BY THE ENGINEER FOR THE MAINTENANCE OF TRAFFIC:

ITEM - 615, PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN	445 SQ. YD.
ITEM - 622, PORTABLE CONCRETE BARRIER, 32"	390 FT.

ALL WORK AND TRAFFIC CONTROL DEVICES SHALL BE IN ACCORDANCE WITH CMS 614 AND OTHER APPLICABLE PORTIONS OF THE SPECIFICATIONS, AS WELL AS THE OHIO MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES. PAYMENT FOR ALL LABOR, EQUIPMENT AND MATERIALS SHALL BE INCLUDED IN THE LUMP SUM CONTRACT PRICE FOR ITEM 614, MAINTAINING TRAFFIC, UNLESS SEPARATELY ITEMIZED IN THE PLAN.

DUST CONTROL

THE CONTRACTOR SHALL FURNISH AND APPLY WATER FOR DUST CONTROL AS DIRECTED BY THE ENGINEER. THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN INCLUDED FOR DUST CONTROL PURPOSES:

ITEM 616, WATER	1 M. GAL.

REVIEW OF DRAINAGE FACILITIES

BEFORE ANY WORK IS STARTED ON THE PROJECT AND AGAIN BEFORE FINAL ACCEPTANCE BY THE STATE, REPRESENTATIVES OF THE STATE AND THE CONTRACTOR, ALONG WITH LOCAL REPRESENTATIVES, SHALL MAKE AN INSPECTION OF ALL EXISTING SEWERS WHICH ARE TO REMAIN IN SERVICE AND WHICH MAY BE AFFECTED BY THE WORK. THE CONDITION OF THE EXISTING CONDUITS AND THEIR APPURTENANCE SHALL BE DETERMINED FROM FIELD OBSERVATIONS. RECORDS OF THE INSPECTION SHALL BE KEPT IN WRITING BY THE STATE.

ALL NEW CONDUITS, INLETS, CATCH BASINS, AND MANHOLES CONSTRUCTED AS A PART OF THE PROJECT SHALL BE FREE OF ALL FOREIGN MATTER AND IN A CLEAN CONDITION BEFORE THE PROJECT WILL BE ACCEPTED BY THE STATE. ALL EXISTING SEWERS INSPECTED INITIALLY BY THE ABOVE MENTIONED PARTIES SHALL BE MAINTAINED AND LEFT IN A CONDITION REASONABLY COMPARABLE TO THAT DETERMINED BY THE ORIGINAL INSPECTION. ANY CHANGE IN THE CONDITION RESULTING FROM THE CONTRACTOR'S OPERATIONS SHALL BE CORRECTED BY THE CONTRACTOR TO THE SATISFACTION OF THE ENGINEER.

PAYMENT FOR ALL OPERATIONS DESCRIBED ABOVE SHALL BE INCLUDED IN THE CONTRACT PRICE FOR THE PERTINENT 603 CONDUIT ITEMS.

TRENCH FOR WIDENING

TRENCH EXCAVATION FOR BASE WIDENING SHALL BE ONLY ON ONE SIDE OF THE PAVEMENT AT A TIME. THE OPEN TRENCH SHALL BE ADEQUATELY MAINTAINED AND PROTECTED WITH DRUMS OR BARRICADES AT ALL TIMES. PLACEMENT OF PROPOSED SUBBASE AND BASE MATERIAL SHALL FOLLOW AS CLOSELY AS POSSIBLE BEHIND EXCAVATION OPERATIONS. THE LENGTH OF WIDENING TRENCH WHICH IS OPEN AT ANY ONE TIME SHALL BE HELD TO A MINIMUM AND SHALL AT ALL TIMES BE SUBJECT TO APPROVAL OF THE ENGINEER.

OVERNIGHT TRENCH CLOSING

THE BASE WIDENING SHALL BE COMPLETED TO A DEPTH OF NO MORE THAN 6 INCHES BELOW THE EXISTING PAVEMENT BY THE END OF EACH WORK DAY. NO TRENCH SHALL BE LEFT OPEN OVERNIGHT EXCEPT FOR A SHORT LENGTH (25 FEET OR LESS) OF A WORK SECTION AT THE END OF THE TRENCH IN CASE WORK MUST BE SUSPENDED BECAUSE OF INCLEMENT WEATHER OR OTHER REASONS, THE TRENCH FOR THE UNCOMPLETED BASE WIDENING SHALL BE BACKFILLED AT THE DIRECTION OF THE ENGINEER.

WORK ZONE MARKINGS AND SIGNS

THE FOLLOWING ESTIMATED QUANTITIES HAVE BEEN CARRIED TO THE GENERAL SUMMARY FOR USE AT THE LOCATIONS IDENTIFIED BY THE ENGINEER FOR WORK ZONE PAVEMENT MARKINGS AND SIGNS PER THE REQUIREMENTS OF CMS 614.04 AND 614.11.

ITEM 614, WORK ZONE MARKING SIGN	2 EACH
ITEM 614, WORK ZONE CENTER LINE, CLASS 1, 642 PAINT	0.23 MILE
ITEM 614, WORK ZONE EDGE LINE, CLASS 1, 642 PAINT	0.46 MILE

FULLY-ACTUATED OPERATION OF WORK ZONE TRAFFIC SIGNAL

THE WORK ZONE SIGNAL CONTROL REQUIRED FOR THIS PROJECT AND SHOWN ON SHEETS 3 AND SCD'S MT-96.11, 96.20, AND 96.26 SHALL BE FULLY TRAFFIC-ACTUATED AND OPERATE IN A MANNER SIMILAR TO THAT DESCRIBED IN SECTION 733.02 OT THE CONSTRUCTION AND MATERIALS SPECIFICATIONS.

THE INITIAL CONTROLLER TIMING SHALL BE AS FOLLOWS:

	PHASE*			
	1	2	3	4
INITIAL	7±	10	8	10±
VEHICLE	4	3	4	3
MAXIMUM	11	30	12	30
YELLOW	3	3.5	3	3.5
ALL RED	2	2	2	2
RECALL	ON±	OFF	ON	OFF±

*PHASES AS SHOWN ON SCD MT-96.26 FOR ACTUATED CONTROL
± PROVIDE TIMING FOR THE SIGNAL LOCATION UNDER CONSIDERATION

THE CONTRACTOR SHALL ALSO DESIGN, FURNISH, INSTALL AND MAINTAIN A TRAFFIC DETECTOR ON EACH TRAFFIC APPROACH WHICH WILL RELIABLY DETECT ALL LEGAL TRAFFIC APPROACHING (BUT NOT LEAVING) THE SIGNAL AS IT PASSES OR WAITS IN THE DESIGNATED DETECTOR ZONE SHOWN IN THE PLANS. DETECTOR DESIGNS WHICH DO NOT PROVIDE RELIABLE DETECTION, FREE FROM FALSE CALLS, SHALL BE IMMEDIATELY REPLACED BY THE CONTRACTOR.

PAYMENT OF TEMPORARY SIGNAL SHALL BE INCORPORATED INTO TO THE LUMP SUM BID FOR ITEM 614, MAINTAINING TRAFFIC.

CONNECTION BETWEEN EXISTING AND PROPOSED GUARDRAIL

WHEN IT IS NECESSARY TO SPLICE PROPOSED GUARDRAIL TO EXISTING GUARDRAIL, ONLY THE EXISTING GUARDRAIL SHALL BE CUT, DRILLED, OR PUNCHED. THE CONNECTION SHALL BE MADE USING A "W-BEAM RAIL SPLICE" AS SHOWN IN AASHTO M 180. PAYMENT SHALL BE INCLUDED IN THE CONTRACT PRICE FOR THE RESPECTIVE GUARDRAIL ITEMS.

CALCULATED PEK CHECKED JJ

GENERAL NOTES

PIK-CR 50-3.52

SHEET NUMBER					ITEM	ITEM EXT.	QUAN.	UNIT	DESCRIPTION	SEE SHEET NO.
3	5	11	14	18						
									ROADWAY	
LUMP					201	11001	LUMP		CLEARING AND GRUBBING, AS PER PLAN	3
	292				202	38000	292	FT.	GUARDRAIL REMOVED	
		115			203	10000	115	CU. YD.	EXCAVATION	
		18			203	20000	18	CU. YD.	EMBANKMENT	
	130				204	10000	130	SQ. YD.	SUBGRADE COMPACTION	
	112.5				606	13000	112.5	FT.	GUARDRAIL, TYPE 5	
	29				606	18500	29	EACH	GUARDRAIL POST, 9 FEET	
	2				606	32160	2	EACH	BRIDGE TERMINAL ASSEMBLY, TYPE TST	
									EROSION CONTROL	
1					616	10000	1	M.GAL.	WATER	
		205			659	10000	205	SQ. YD.	SEEDING AND MULCHING	
	10				659	14000	10	SQ. YD.	REPAIR SEEDING & MULCHING	
	0.05				659	20000	0.05	TON	COMMERCIAL FERTILIZER	
	0.04				659	31000	0.04	ACRE	LIME	
	1				659	35000	1	M. GAL.	WATER	
					832	30000	1000	EACH	EROSION CONTROL	
									DRAINAGE	
50					603	00900	50	FT.	6" CONDUIT, TYPE B	
50					603	01400	50	FT.	6" CONDUIT, TYPE E	
50					603	01500	50	FT.	6" CONDUIT, TYPE F	
									PAVEMENT	
	371				252	01500	371	FT.	FULL DEPTH PAVEMENT SAWING	
	19				301	46000	19	CU. YD.	ASPHALT CONCRETE BASE. PG64-22	
	57				304	20000	57	CU. YD.	AGGREGATE BASE	
	9				407	10000	9	GALLON	TACK COAT (0.075 GAL./SQ. YD.)	
	48				408	10000	48	GALLON	PRIME COAT (0.40 GAL./SQ, YD.)	
	53				448	50000	53	CU. YD.	ASPHALT CONCRETE SURFACE COURSE, TYPE 1H	
									TRAFFIC CONTROL	
	8				626	00100	8	EACH	BARRIER REFLECTOR	
	26.0				630	03100	26.0	FT.	GROUND MOUNTED SUPPORT, NO. 3 POST	
	17.8				630	80100	17.8	SQ. FT.	SIGN, FLAT SHEET	
	6				630	84900	6	EACH	REMOVAL OF GROUND MOUNTED SIGN AND DISPOSAL	
	6				630	86002	6	EACH	REMOVAL OF GROUND MOUNTED POST SUPPORT AND DISPOSAL	
									STRUCTURES	
				6078	509	10000	6078	POUND	EPOXY COATED REINFORCING STEEL	
	63				511	46000	63	CU. YD.	CLASS C CONCRETE	
	141				512	10100	141	SQ. YD.	SEALING OF CONCRETE SURFACES (EPOXY-URETHANE)	
	248.67				517	70000	248.67	FT.	RAILING (TWIN STEEL TUBE)	
			577		524	94702	577	FT.	DRILLED SHAFTS, 36" DIAMETER, ABOVE BEDROCK	
			555		524	94703	555	FT.	DRILLED SHAFTS, 36" DIAMETER, ABOVE BEDROCK, AS PER PLAN	3
			735		524	94704	735	FT.	DRILLED SHAFTS, 36" DIAMETER, INTO BEDROCK	
									MAINTENANCE OF TRAFFIC	
2					614	12460	2	EACH	WORK ZONE MARKING SIGN	
0.23					614	21100	0.23	MILE	WORK ZONE CENTER LINE, CLASS 1, 642 PAINT	
0.46					614	22100	0.46	MILE	WORK ZONE EDGE LINE, CLASS 1, 642 PAINT	
	445				615	20001	445	SQ. YD.	PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN	3
390					622	40020	390	FT.	PORTABLE CONCRETE BARRIER, 32"	
LUMP					614	11000	LUMP		MAINTAINING TRAFFIC	
					619	16010	2	MONTH	FIELD OFFICE, TYPE B	
					623	10000	LUMP		CONSTRUCTION LAYOUT STAKES	
					624	10000	LUMP		MOBILIZATION	

CALCULATED PEK
CHECKED JJ

GENERAL SUMMARY

PIK-CR 50-3.52

PAVEMENT CALCULATIONS

ITEM		204		301	
STATION TO STATION	TYPICAL	SUBGRADE COMPACTION	SQ. YD.	6" ASPHALT CONCRETE BASE, PG64-22	CU. YD.
10+67.07 TO 11+45.25	1	(2.50' + 4.50')/2 x 78.18'/9	30.40	(1.33' + 3.33')/2 x 78.18' x (6/12)/27	3.37
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50'/9	83.17	(3.00' + 3.00')/2 x 249.50' x (6/12)/27	13.86
13+94.75 TO 14+35.50	1	(2.50' + 4.50')/2 x 40.75'/9	15.85	(3.33' + 1.33')/2 x 40.75' x (6/12)/27	1.76
TOTALS CARRIED TO GENERAL SUMMARY			130		19

PAVEMENT CALCULATIONS

ITEM		304		304	
STATION TO STATION	TYPICAL	12" AGGREGATE BASE	CU. YD.	AGGREGATE BASE, VARIABLE DEPTH	CU. YD.
10+67.07 TO 11+45.25	1	(1.83' + 3.83')/2 x 78.18' x (12/12)/27	8.19		
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50' x (12/12)/27	27.72	(1.59 SQ. FT. + 2.05 SQ. FT.)/2 x 249.50'/27	16.82
13+94.75 TO 14+35.50	1	(3.83' + 1.83')/2 x 40.75' x (12/12)/27	4.27		
			40		17
TOTAL CARRIED TO GENERAL SUMMARY					57

PAVEMENT CALCULATIONS

ITEM		407		408	
STATION TO STATION	TYPICAL	TACK COAT (0.075 GAL./SQ. YD.)	GAL.	PRIME COAT (0.40 GAL./SQ. YD.)	GAL.
10+67.07 TO 11+45.25	1	(1.33' + 3.33')/2 x 78.18'/9 x 0.075	1.52	(1.83' + 3.83')/2 x 78.18'/9 x 0.40	9.83
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50'/9 x 0.075	6.24	(3.00' + 3.00')/2 x 249.50'/9 x 0.40	33.27
13+94.75 TO 14+35.50	1	(3.33' + 1.33')/2 x 40.75'/9 x 0.075	0.79	(3.83' + 1.83')/2 x 40.75'/9 x 0.40	5.13
TOTALS CARRIED TO GENERAL SUMMARY			9		48

PAVEMENT CALCULATIONS

ITEM		448		448	
STATION TO STATION	TYPICAL	2" ASPHALT CONCRETE SURFACE COURSE, TYPE 1H	CU. YD.	2" ASPHALT CONCRETE SURFACE COURSE, TYPE 1H	CU. YD.
10+67.07 TO 11+45.25	1	(1.00' + 3.00')/2 x 78.18' x (2/12)/27	0.97		
11+45.25 TO 13+94.75	2	(3.00' + 3.00')/2 x 249.50' x (2/12)/27	4.62		
13+94.75 TO 14+35.50	1	(3.00' + 1.00')/2 x 40.75' x (2/12)/27	0.50		
10+67.07 TO 14+35.50	1 & 2			7593 SQ. FT. x (2/12)/27	46.87
			6		47
TOTAL CARRIED TO GENERAL SUMMARY					53

PAVEMENT CALCULATIONS

ITEM		615			
STATION TO STATION	TYPICAL	PAVEMENT FOR MAINTAINING TRAFFIC, CLASS A, AS PER PLAN	SQ. YD.		
7+32.75± TO 11+45.25	1	(0.00' + 7.50'±)/2 x 412.50'/9	171.88		
11+45.25 TO 13+94.75	2	(7.5'± + 5.50'±)/2 x 249.50'/9	180.19		
13+94.75 TO 16+97.00±	1	(5.50'± + 0.00')/2 x 302.25'/9	92.35		
TOTAL CARRIED TO GENERAL SUMMARY			445		

ESTIMATED QUANTITIES

REF. NO.	SHT. NO.	STATION TO STATION	SIDE	202 GUARDRAIL REMOVED (FT.)	252 FULL DEPTH PAVEMENT SAWING (FT.)	517 RAILING (TWIN STEEL TUBE) (FT.)	606 GUARDRAIL, TYPE 5 (FT.)	606 GUARDRAIL POST, 9' (EACH)	606 BRIDGE TERMINAL ASSEMBLY, TYPE TST (EACH)	630 GROUND MOUNTED SUPPORT, NO. 3 POST (FT.)	630 SIGN, FLAT SHEET (SQ. FT.)	630 REMOVAL OF GROUND MOUNTED SIGN AND DISPOSAL (EACH)	630 REMOVAL OF GROUND MOUNTED POST SUPPORT AND DISPOSAL (EACH)
P-1	12	10+67.07 TO 14+35.50	RT		370.49								
GR-1	12	11+02.32± TO 14+59.13±	RT			248.67	112.5	29	2				
R-1	12	11+02.32± TO 13+93.24	L/R	291.16									
R-2	12	11+71.82 TO 13+03.94	RT									4	4
S-1	12	12+50.00	RT							13.0	9.0	1	1
S-2	12	13+60.00	LT							13.0	8.8	1	1
TOTALS CARRIED TO GENERAL SUMMARY				292	371	248.67	112.5	29	2	26.0	17.8	6	6

ITEM 511 CLASS C CONCRETE

CAP SIDE AREA = 628.44 SQ. FT., WIDTH = 2.50 FT.
CAST-IN-PLACE WALL HEIGHT = 6.00 FT., PLAN AREA = 18.70 SQ. FT.
TOTAL VOLUME = (628.44 x 2.50) + (6.00 x 18.70) = 1683.30 CU. FT.
/ 27 = 62.34 CU. YD.

TOTAL CARRIED TO GENERAL SUMMARY 63 CU. YD.

ITEM 511 SEALING OF CONCRETE SURFACES

L1 = STA. 11+45.25 - STA. 13+94.75 = 249.50', CAP WIDTH = 2.50'
TOP AREA = 249.50 x 2.50 = 623.75 SQ. FT.
END AREA = 2.50' x 2.00' x 2 = 10.00 SQ. FT.
CAP SIDE AREA = 628.44 SQ. FT.
TOTAL AREA = (623.75 + 10.00 + 628.44) / 9 = 140.24 SQ. YD.

TOTAL CARRIED TO GENERAL SUMMARY 141 SQ. YD.

ITEM 626 BARRIER REFLECTOR

L1 = STA. 11+02.32± - STA. 14+59.13± = 356.81'

NO. OF BARRIER REFLECTORS (N)=(L1/50+1) = 8

TOTAL CARRIED TO GENERAL SUMMARY 8

ITEM 659 LIME

205 SQ. YD. x 9 S.F./1 SQ. YD. x 1 ACRE/43560 S.F.

TOTAL CARRIED TO GENERAL NOTES 0.04 ACRE

ITEM 659 REPAIR SEEDING & MULCHING

205 SQ. YD. x 5%

TOTAL CARRIED TO GENERAL NOTES 10 S.Y.

ITEM 659 COMMERCIAL FERTILIZER

205 SQ. YD. x 9 SQ. FT./1 SQ. YD. x (30 LBS./1000 SQ. FT. + 20 LBS./1000 SQ. FT.)/2000 LBS./ 1 TON

TOTAL CARRIED TO GENERAL NOTES 0.05 TON

ITEM 659 WATER

205 SQ. YD. x 9 SQ. FT./1 SQ. YD. x (300 GAL./1000 SQ. FT. + 300 GAL./1000 SQ. FT.)/1000 GAL.

TOTAL CARRIED TO GENERAL NOTES 1 M. GAL.

CALCULATED PEK
CHECKED JJ

ESTIMATED QUANTITIES AND CALCULATIONS

PIK-CR 50-3.52

SEEDING	
END WIDTH	SQ. YDS.
7	19
8	33
9	52

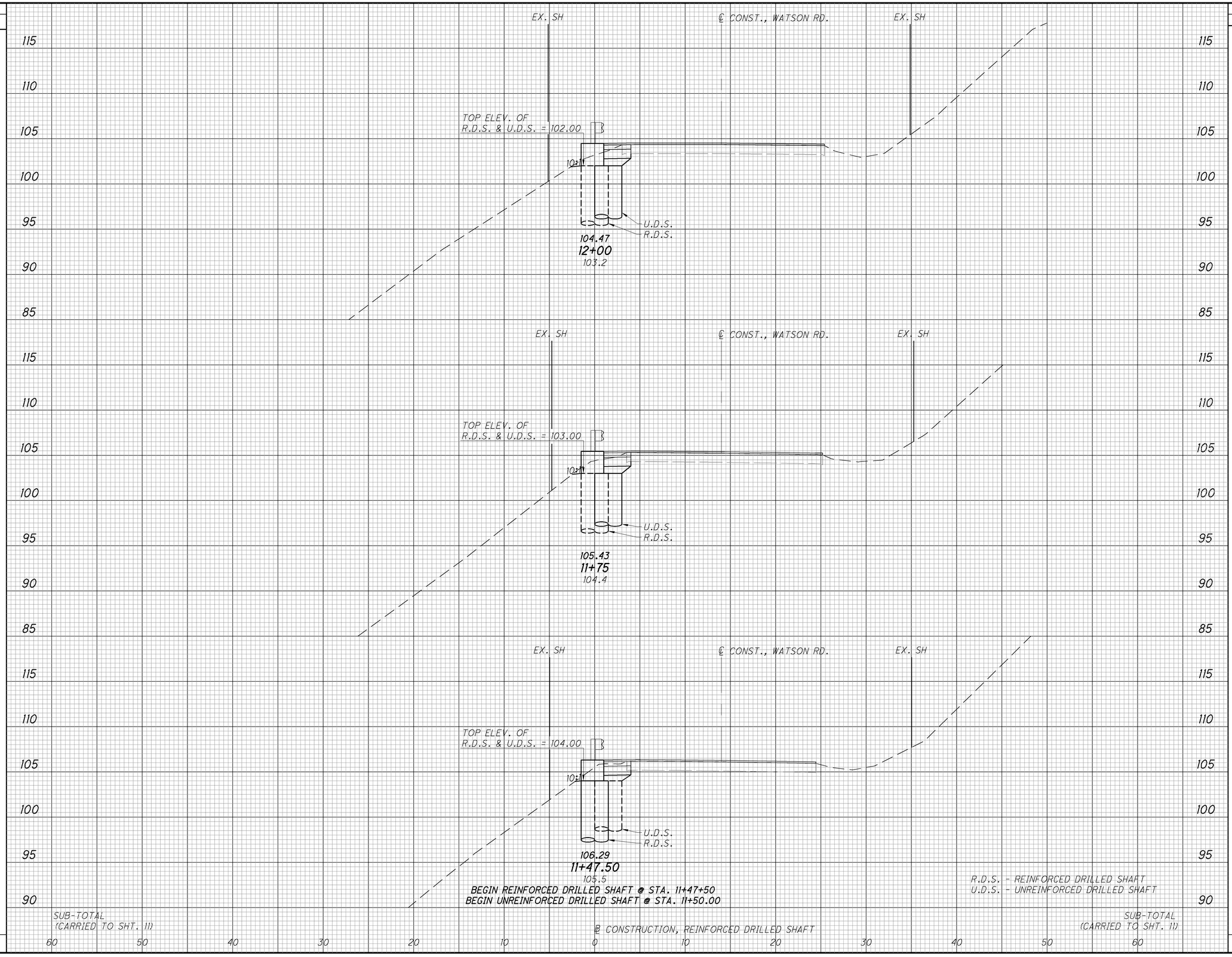
END AREA		VOLUME	
CUT	FILL	CUT	FILL
5	4		
		3	4
3	6		
		4	7
3	4		
		7	11

CALCULATED PEK
CHECKED JJ

CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 10+67.07 TO STA. 11+25.00

PIK-CR 50-3.52

SEEDING	
END WIDTH	SQ. YDS.
1	3
1	3
1	10
1	16



END AREA		VOLUME	
CUT	FILL	CUT	FILL
9	0		
		8	0
9	0		
		9	0
9	0		
		6	2
		23	2

CALCULATED PEK
CHECKED JJ

CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 11+47.50 TO STA. 12+00.00

PIK-CR 50-3.52

SEEDING	
END WIDTH	SQ. YDS.
1	
	3
1	
	3
1	
	3
	9

SUB-TOTAL
(CARRIED TO SHT. 11)

℄ CONSTRUCTION, REINFORCED DRILLED SHAFT

R.D.S. - REINFORCED DRILLED SHAFT
U.D.S. - UNREINFORCED DRILLED SHAFT

SUB-TOTAL
(CARRIED TO SHT. 11)

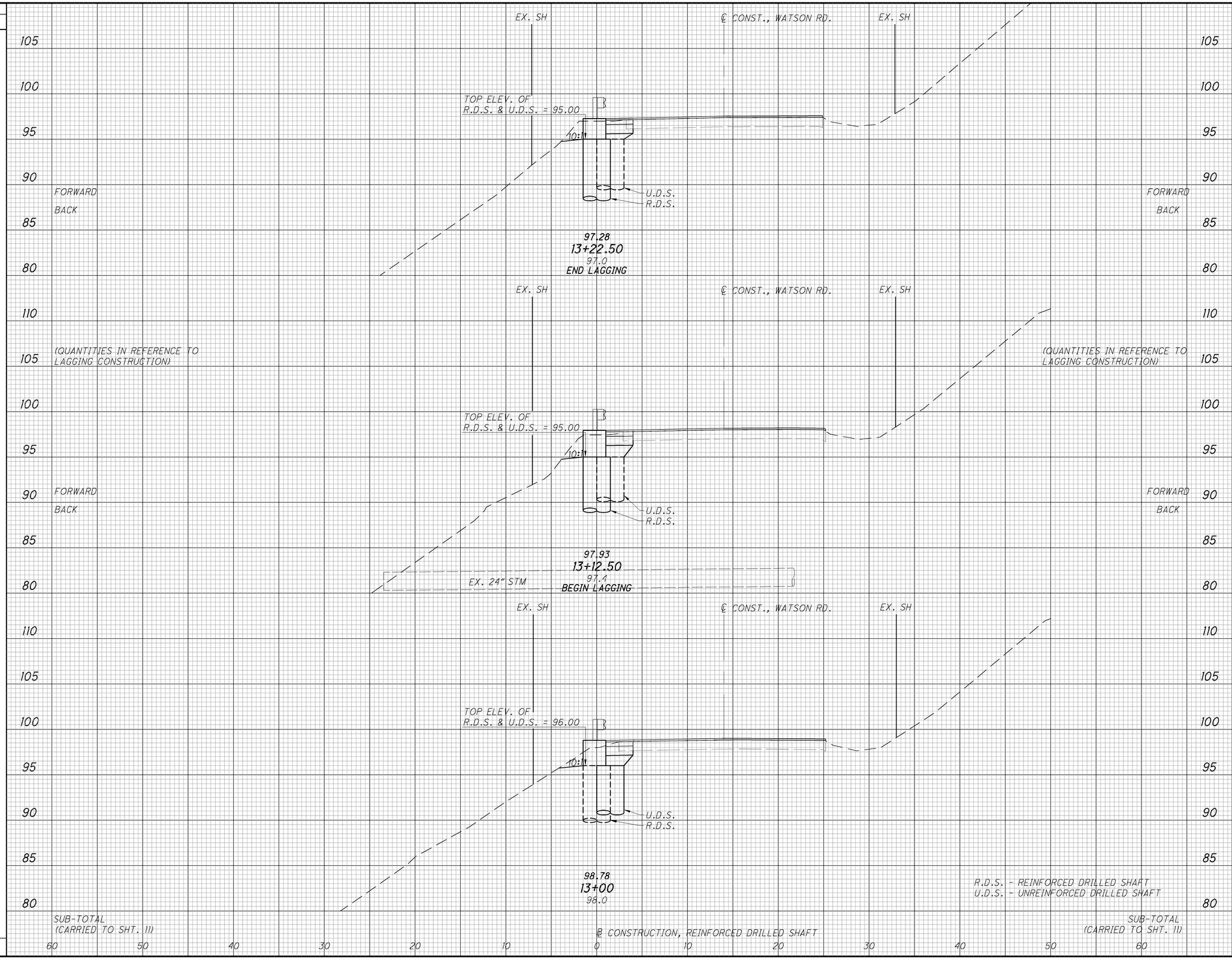
END AREA		VOLUME	
CUT	FILL	CUT	FILL
10	0		
		8	0
7	0		
		7	0
8	0		
		8	0
		23	0

CALCULATED PEK
CHECKED JJ

CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 12+25.00 TO STA. 12+75.00

PIK-CR 50-3.52

SEEDING END WIDTH	SEEDING SQ. YDS.		END AREA CUT	END AREA FILL	VOLUME CUT	VOLUME FILL
3		FORWARD	14	0		
(7)		BACK	(14)	(0)		
	(8)	(QUANTITIES IN REFERENCE TO LAGGING CONSTRUCTION)			(5)	(0)
(7)		FORWARD	(14)	(0)		
2		BACK	17	0		
	4				7	0
3			14	0		
	2				11	0
	14	SUB-TOTAL (CARRIED TO SHT. 11)			23	0

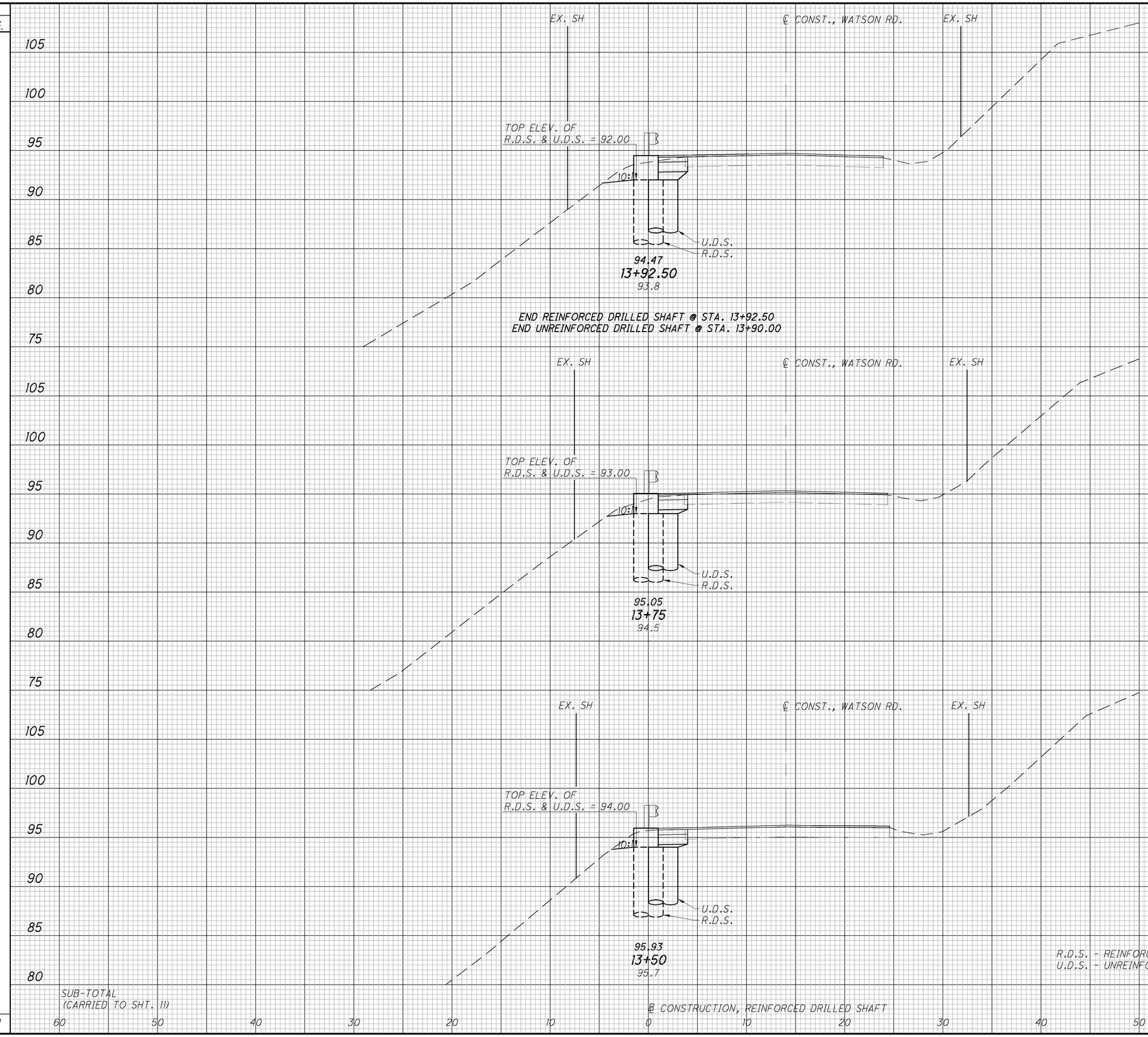


CALCULATED PEK
CHECKED JJ

CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 13+00.00 TO STA. 13+22.50

PIK-CR 50-3.52

SEEDING	
END WIDTH	SQ. YDS.
3	6
3	7
2	8
	21



END AREA		VOLUME	
CUT	FILL	CUT	FILL
13	0	8	0
10	0	10	0
11	0	13	0
		31	0

CALCULATED PEK
CHECKED JJ

CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 13+50.00 TO STA. 13+92.50

PIK-CR 50-3.52

SEEDING END WIDTH	SEEDING SQ. YDS.
14	(40)
	15
12	32
11	
	6
	93

(AHEAD TO STA. 14+59.13)

EX. SH ℄ CONST., WATSON RD. EX. SH

105 100 95 90 85 80

1.5:1

9' POST

92.84
14+35.50
91.4
END PROJECT

EX. SH ℄ CONST., WATSON RD. EX. SH

105 100 95 90 85 80

1.5:1

9' POST

92.84
14+25
92.3

EX. SH ℄ CONST., WATSON RD. EX. SH

110 105 100 95 90 85 80

1.3:1

9' POST

93.96
14+00
93.4

℄ CONSTRUCTION, REINFORCED DRILLED SHAFT

60 50 40 30 20 10 0 10 20 30 40 50 60

TOTAL CARRIED TO GENERAL SUMMARY
EXCAVATION-------- 115 CU.YD.
EMBANKMENT-------- 18 CU.YD.
SEEDING & MULCHING--- 205 SQ.YD.

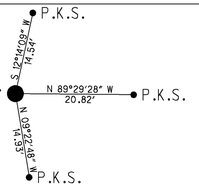
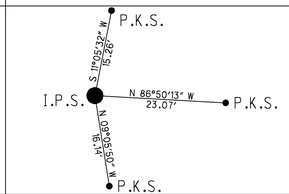
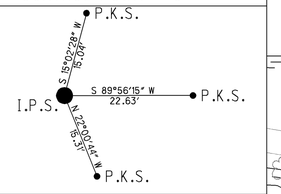
END AREA CUT	END AREA FILL	VOLUME CUT	VOLUME FILL
3	4		
BACK			
		2	2
5	4		
		5	3
5	2		
		1	0
		8	5

CALCULATED PEK
CHECKED JJ

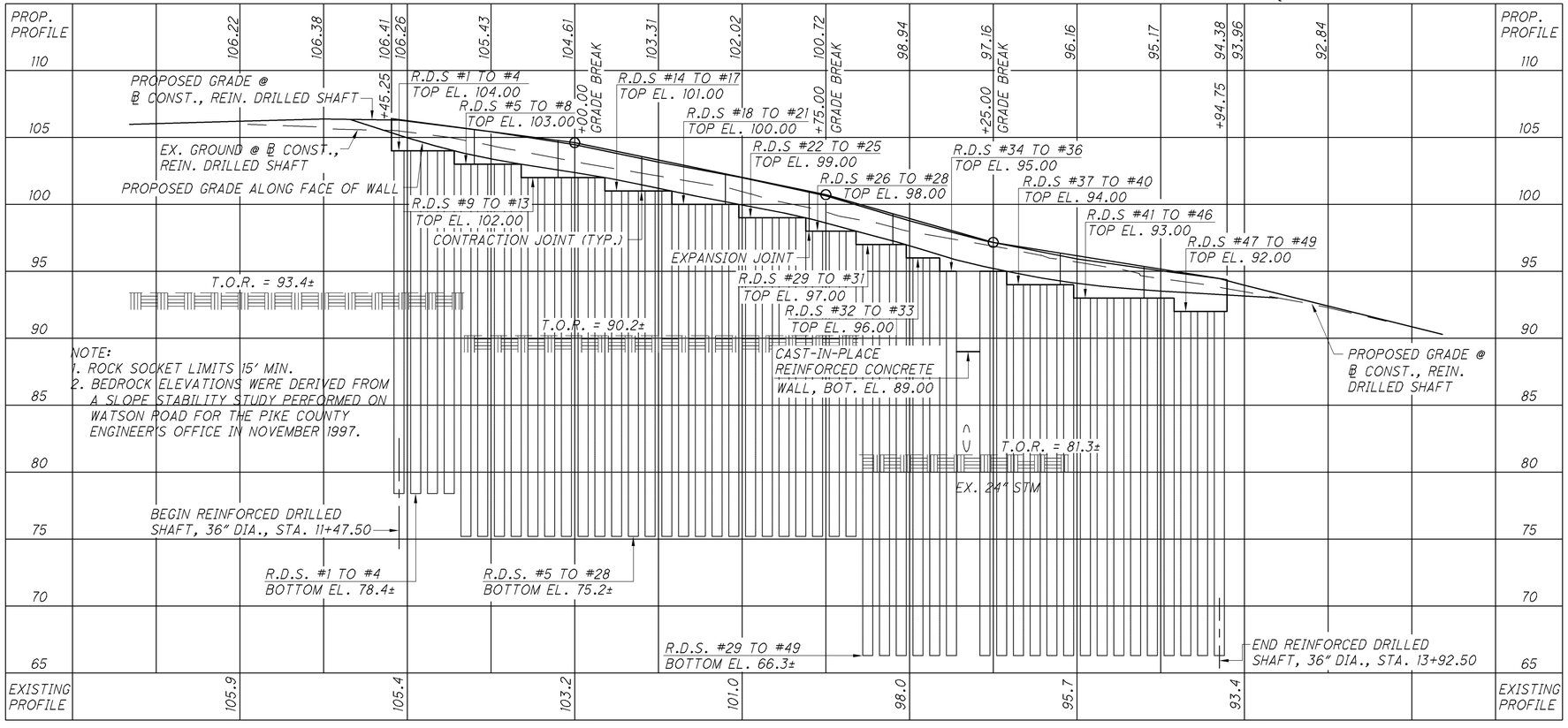
CROSS SECTIONS - REINFORCED DRILLED SHAFT
STA. 14+00.00 TO STA. 14+35.50

PIK-CR 50-3.52

11
18

CONTROL POINT # 1	CONTROL POINT # 2	CONTROL POINT # 3
		
STA. 30+98.97, 11.01' LT. ℄ CONST., WATSON RD.	STA. 32+69.81, 13.09' RT. ℄ CONST., WATSON RD.	STA. 34+39.82, 15.25' LT. ℄ CONST., WATSON RD.

PLAN



NOTE:
1. ROCK SOCKET LIMITS 15' MIN.
2. BEDROCK ELEVATIONS WERE DERIVED FROM A SLOPE STABILITY STUDY PERFORMED ON WATSON ROAD FOR THE PIKE COUNTY ENGINEER'S OFFICE IN NOVEMBER 1997.

PROFILE ALONG ℄ CONSTRUCTION, REINFORCED DRILLED SHAFT

LEGEND:

	TO BE REMOVED		EX. SIGN, SINGLE POST
	REINFORCED DRILLED SHAFT		PROP. GUARDRAIL
	UNREINFORCED DRILLED SHAFT	(R-1)	QUANTITY REFERENCE
	PROPOSED SIGN	T.O.R.	TOP OF BED ROCK
	EXISITNG SIGN	R.D.S.	REINFORCED DRILLED SHAFT
	EX. SIGN, TBR	TBR	TO BE REMOVED
	PROP. SIGN, SINGLE POST	DND	DO NOT DISTURB
		PVMT	PAVEMENT
		BTA	BRIDGE TERMINAL ASSEMBLY
		TST	TWIN STEEL TUBE

NOTES:

1. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS-SECTIONS.
2. FOR ROADWAY GRADING, REFER TO ROADWAY PLANS.

SURVEY CONTROL POINTS *

POINT	NORTHING	EASTING	ELEV.
CONTROL PT #1 (I.P.S.)	4829.1437	5000.0000	106.16
CONTROL PT #2 (I.P.S.)	5000.0000	5000.0000	100.00
CONTROL PT #3 (I.P.S.)	5170.0225	4999.9106	91.29

IPS = PIN SET - (30" LONG 3/4" INNER DIAMETER PIPE SET W/ 'CEC INC.' CAPS)

BENCH MARKS

SOURCE BENCH MARK
ELEVATION IS BASED ON AN ASSUMED ELEVATION ON CEC POINT NUMBER 2.
ELEVATION= 100.00 (ASSUMED)

BM #1 (SITE)
BENCHTIE IN GUARDRAIL 6.3' SOUTH OF IPS #1 AND 3' WEST OF WATSON ROAD.
ELEVATION = 106.48 (ASSUMED)

BM #2 (SITE)
TOP OF THE WEST END OF PILING AT THE INTERSECTION OF THE WEB AND THE FLANGE. PILING LOCATED 36.3' SOUTHEAST OF CEC CONTROL POINT #2.
ELEVATION = 104.03 (ASSUMED)

BM #3 (SITE)
TOP OF THE WEST END OF PILING AT THE INTERSECTION OF THE WEB AND THE FLANGE. PILING LOCATED 31.8' SOUTHEAST OF CEC CONTROL POINT #32.
ELEVATION = 96.14 (ASSUMED)

BM #4 (SITE)
BENCHTIE IN GUARDRAIL 24' NORTH OF IPS #3 WEST OF WATSON ROAD.
ELEVATION = 90.06 (ASSUMED)

℄ CONSTRUCTION, DRILL SHAFT CONTROL*

	NORTHING	EASTING
PT STA. 10+50.00	4780.2176	4996.4175
PT STA. 15+00.00	5230.1842	5001.8963

* - CONTROL POINTS AND BENCH MARKS ARE ON ASSUMED COORDINATES.

** - BEARINGS ARE BASED ON AN ASSUMED MERIDIAN AND ARE FOR ANGULAR MEASUREMENTS ONLY.

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MICHIGAN AVENUE, COLUMBUS, OH 43215
TEL:(614)228-3500

DESIGNED PEK | DRAWN PEK | CHECKED YSJ/SS | REVIEWED JJ | DATE 07/11 | STRUCTURE FILE NUMBER -

SITE PLAN

PIK-CR 50-3.52
PID NO. 91368

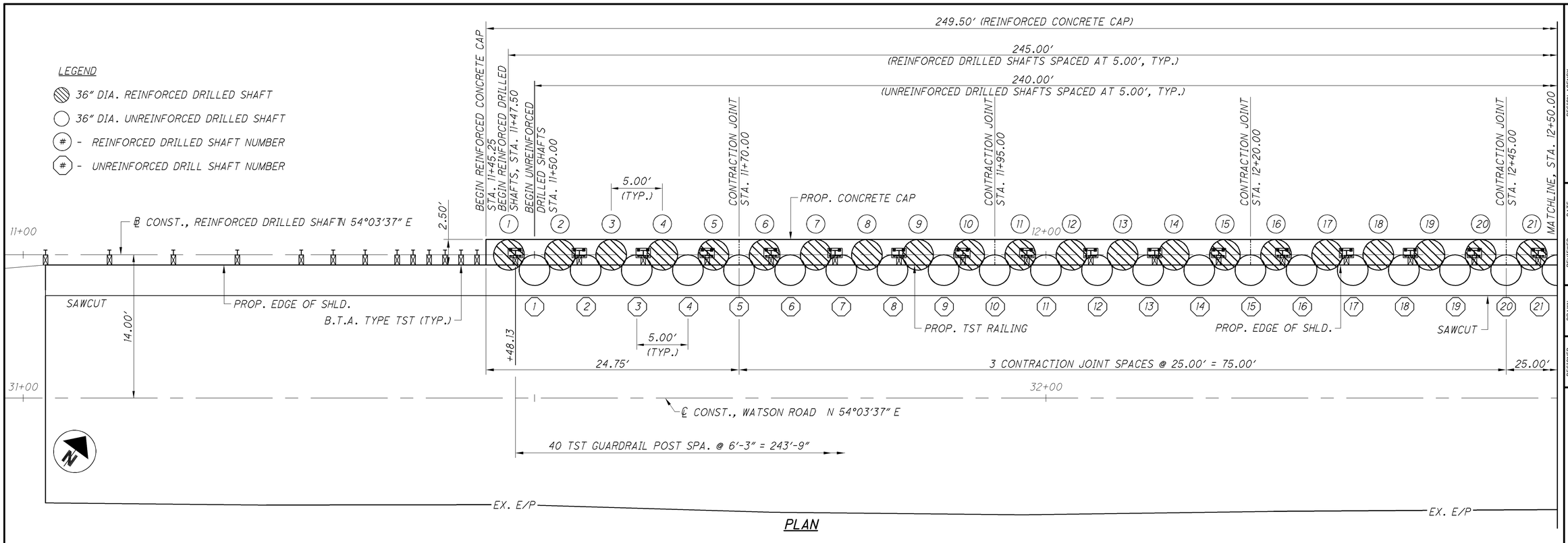
LEGEND

36" DIA. REINFORCED DRILLED SHAFT

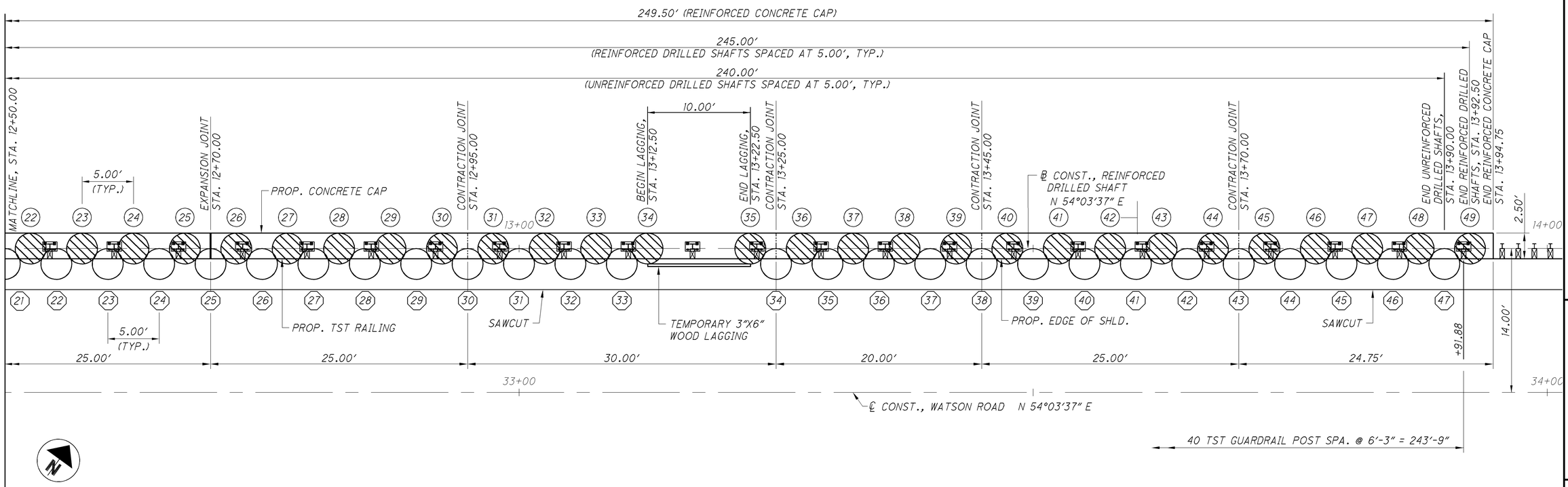
36" DIA. UNREINFORCED DRILLED SHAFT

(#) - REINFORCED DRILLED SHAFT NUMBER

(#) - UNREINFORCED DRILL SHAFT NUMBER



PLAN



PLAN

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MICHIGAN AVENUE, COLUMBUS, OH 43215
TEL:(614)228-3500

DESIGNED	DRAWN	REVIEWED	DATE
PEK	PEK	JJ	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

DRILLED SHAFT LAYOUT

PIK-CR 50-3.52
PID NO. 91368

36" DIA. REINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲	⑳
STA.	11+47.50	11+52.50	11+57.50	11+62.50	11+67.50	11+72.50	11+77.50	11+82.50	11+87.50	11+92.50	11+97.50	12+02.50	12+07.50	12+12.50	12+17.50	12+22.50	12+27.50	12+32.50	12+37.50	12+42.50
OFFSET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOP ELEV.	104.00	104.00	104.00	104.00	103.00	103.00	103.00	103.00	102.00	102.00	102.00	102.00	102.00	101.00	101.00	101.00	101.00	100.00	100.00	100.00
BOT. ELEV.	78.40±	78.40±	78.40±	78.40±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±
R.D.S.L.	26.00'±	26.00'±	26.00'±	26.00'±	28.00±	28.00'±	28.00'±	28.00'±	27.00'±	27.00'±	27.00'±	27.00'±	27.00'±	26.00'±	26.00'±	26.00'±	26.00'±	25.00'±	25.00'±	25.00'±

36" DIA. REINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	㉑	㉒	㉓	㉔	㉕	㉖	㉗	㉘	㉙	㉚	㉛	㉜	㉝	㉞	㉟	㊱	㊲	㊳	㊴	㊵
STA.	12+47.50	12+52.50	12+57.50	12+62.50	12.67.50	12+72.50	12+77.50	12+82.50	12+87.50	12+92.50	12+97.50	13+02.50	13+07.50	13+12.50	13+22.50	13+27.50	13+32.50	13+37.50	13+42.50	13+47.50
OFFSET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOP ELEV.	100.00	99.00	99.00	99.00	99.00	98.00	98.00	98.00	97.00	97.00	97.00	96.00	96.00	95.00	95.00	95.00	94.00	94.00	94.00	94.00
BOT. ELEV.	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	75.20±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±
R.D.S.L.	25.00'±	24.00'±	24.00'±	24.00'±	24.00'±	23.00'±	23.00'±	23.00'±	31.00'±	31.00'±	31.00'±	30.00'±	30.00'±	29.00'±	29.00'±	29.00'±	28.00'±	28.00'±	28.00'±	28.00'±

36" DIA. REINFORCED DRILLED SHAFT LAYOUT TABLE									
D.S. NO.	㊶	㊷	㊸	㊹	㊺	㊻	㊼	㊽	㊾
STA.	13+52.50	13+57.50	13+62.50	13+67.50	13+72.50	13+77.50	13+82.50	13+87.50	13+92.50
OFFSET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOP ELEV.	93.00	93.00	93.00	93.00	93.00	93.00	92.00	92.00	92.00
BOT. ELEV.	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±	66.30±
R.D.S.L.	27.00'±	27.00'±	27.00'±	27.00'±	27.00'±	27.00'±	26.00'±	26.00'±	26.00'±

ITEM 524 DRILLED SHAFT, 36" DIAMETER, ABOVE BEDROCK

R.D.S.L. FROM STA. 11+47.50 TO STA. 13+92.50 = 1312 FT.
MINIMUM DEPTH INTO BEDROCK = 15 FT.
TOTAL LENGTH = 1312 FT. - 49 (DRILLED SHAFTS) x 15 FT. = 577 FT.

TOTAL CARRIED TO GENERAL SUMMARY 577 FT.

ITEM 524 DRILLED SHAFT, 36" DIAMETER, INTO BEDROCK

MINIMUM DEPTH INTO BEDROCK = 15 FT.
TOTAL LENGTH = 49 (DRILLED SHAFTS) x 15 FT. = 735 FT.

TOTAL CARRIED TO GENERAL SUMMARY 735 FT.

36" DIA. UNREINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	⑲	⑳
STA.	11+50.00	11+55.00	11+60.00	11+65.00	11+70.00	11+75.00	11+80.00	11+85.00	11+90.00	11+95.00	12+00.00	12+05.00	12+10.00	12+15.00	12+20.00	12+25.00	12+30.00	12+35.00	12+40.00	12+45.00
OFFSET	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.
TOP ELEV.	104.00	104.00	104.00	103.00	103.00	103.00	103.00	102.00	102.00	102.00	102.00	102.00	101.00	101.00	101.00	101.00	100.00	100.00	100.00	100.00
BOT. ELEV.	93.40'±	93.40'±	93.40'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±
U.D.S.L.	11.00'±	11.00'±	11.00'±	13.00'±	13.00'±	13.00'±	13.00'±	12.00'±	12.00'±	12.00'±	12.00'±	12.00'±	11.00'±	11.00'±	11.00'±	11.00'±	10.00'±	10.00'±	10.00'±	10.00'±

36" DIA. UNREINFORCED DRILLED SHAFT LAYOUT TABLE																				
D.S. NO.	㉑	㉒	㉓	㉔	㉕	㉖	㉗	㉘	㉙	㉚	㉛	㉜	㉝	㉞	㉟	㊱	㊲	㊳	㊴	㊵
STA.	12+50.00	12+55.00	12+60.00	12+65.00	12+70.00	12+75.00	12+80.00	12+85.00	12+90.00	12+95.00	13+00.00	13+05.00	13+10.00	13+25.00	13+30.00	13+35.00	13+40.00	13+45.00	13+50.00	13+55.00
OFFSET	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.
TOP ELEV.	99.00	99.00	99.00	99.00	98.00	98.00	98.00	97.00	97.00	97.00	96.00	96.00	95.00	95.00	94.00	94.00	94.00	94.00	93.00	93.00
BOT. ELEV.	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	90.20'±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±
U.D.S.L.	9.00'±	9.00'±	9.00'±	9.00'±	8.00'±	8.00'±	8.00'±	16.00'±	16.00'±	16.00'±	16.00'±	15.00'±	15.00'±	14.00'±	14.00'±	13.00'±	13.00'±	13.00'±	12.00'±	12.00'±

36" DIA. UNREINFORCED DRILLED SHAFT LAYOUT TABLE							
D.S. NO.	㊶	㊷	㊸	㊹	㊺	㊻	㊼
STA.	13+60.00	13+65.00	13+70.00	13+75.00	13+80.00	13+85.00	13+90.00
OFFSET	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.	1.50 RT.
TOP ELEV.	93.00	93.00	93.00	93.00	92.00	92.00	92.00
BOT. ELEV.	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±	81.30±
U.D.S.L.	12.00'±	12.00'±	12.00'±	12.00'±	11.00'±	11.00'±	11.00'±

* - THE BOTTOM ELEVATION OF UNREINFORCED DRILLED SHAFTS IS AS SPECIFIED OR ACTUAL TOP OF BED ROCK ELEVATION, WHICHEVER IS HIGHER.

ITEM 524 DRILLED SHAFT, 36" DIAMETER, ABOVE BEDROCK, AS PER PLAN

U.D.S.L. FROM STA. 11+50.00 TO STA. 13+90.00 = 555 FT.

TOTAL CARRIED TO GENERAL SUMMARY 555 FT.

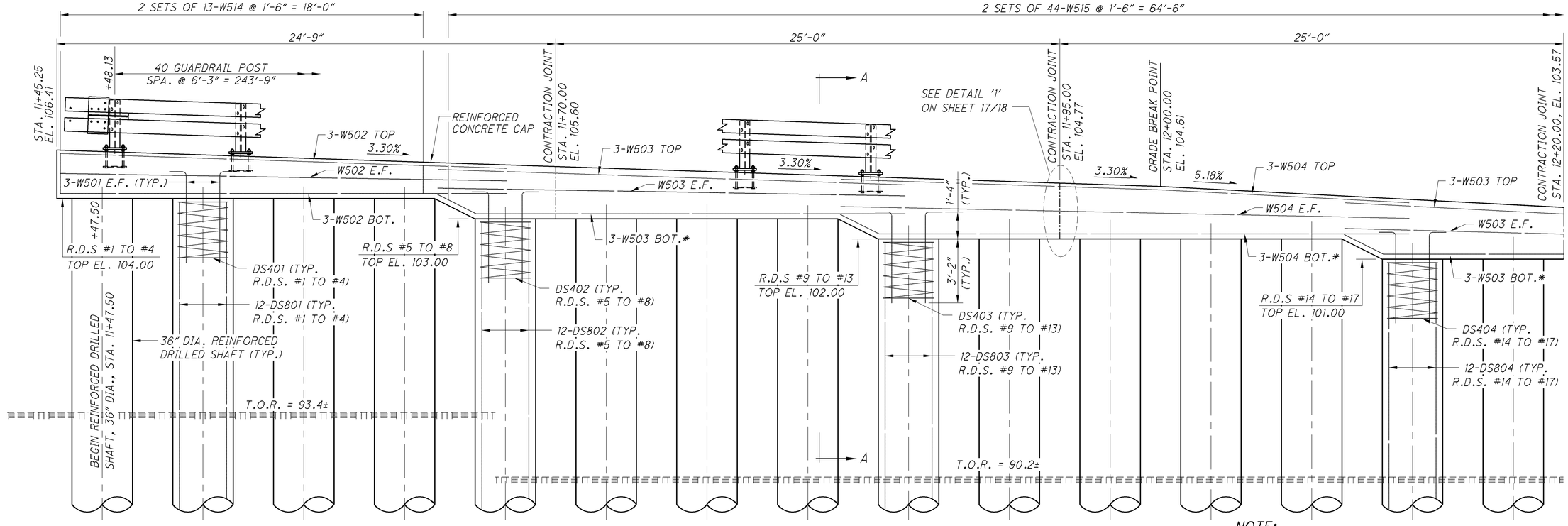
R.D.S.L. = REINFORCED DRILLED SHAFT LENGTH
U.D.S.L. = UNREINFORCED DRILLED SHAFT LENGTH

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MICHIGAN AVENUE, COLUMBUS, OH 43215
TEL:(614)228-3500

DESIGNED	DRAWN	REVIEWED	DATE
PEK	PEK	JJ	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

DRILLED SHAFT LAYOUT

PIK-CR 50-3.52
PID NO. 91368

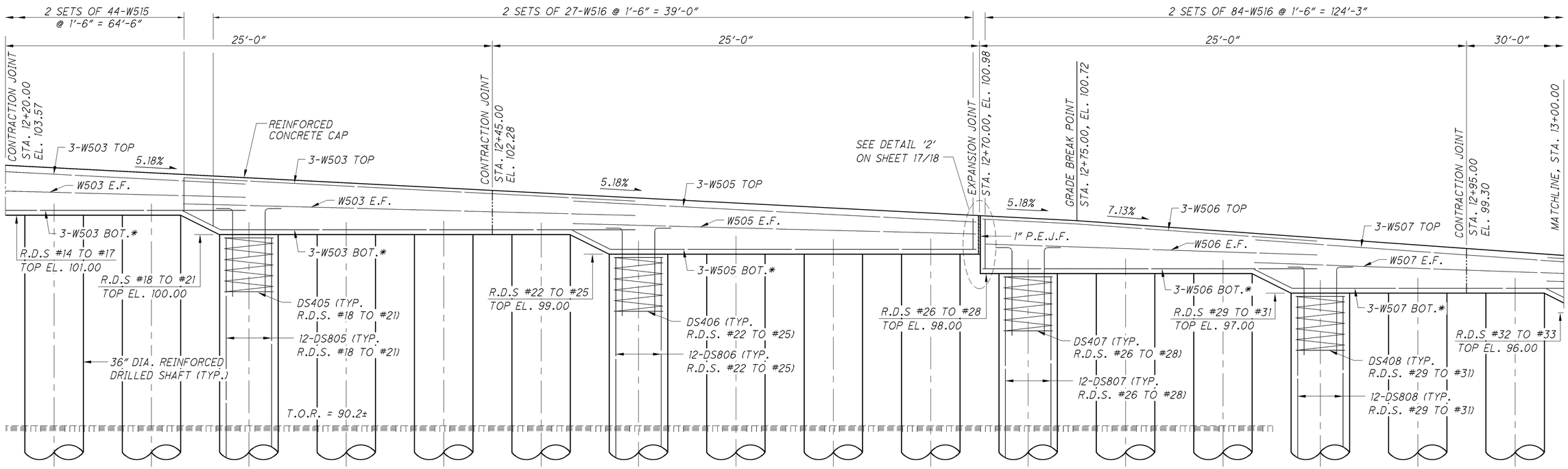


ELEVATION

* - FIELD BEND IF NECESSARY

NOTE:

1. FOR SECTION A-A, SEE SHEET 17/18.



ELEVATION

DESIGN AGENCY
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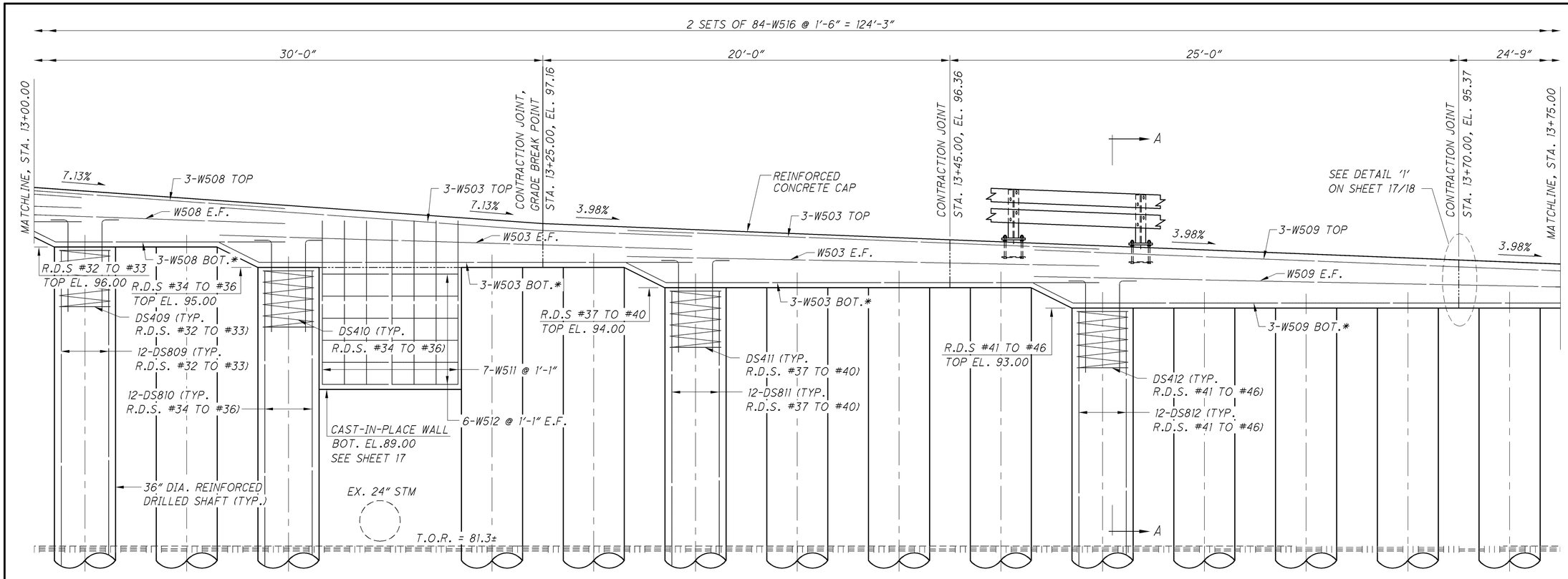
840 MICHIGAN AVENUE, COLUMBUS, OH 43215
TEL:(614)228-3500

DESIGNED	DRAWN	REVIEWED	DATE
PEK	PEK	JJ	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

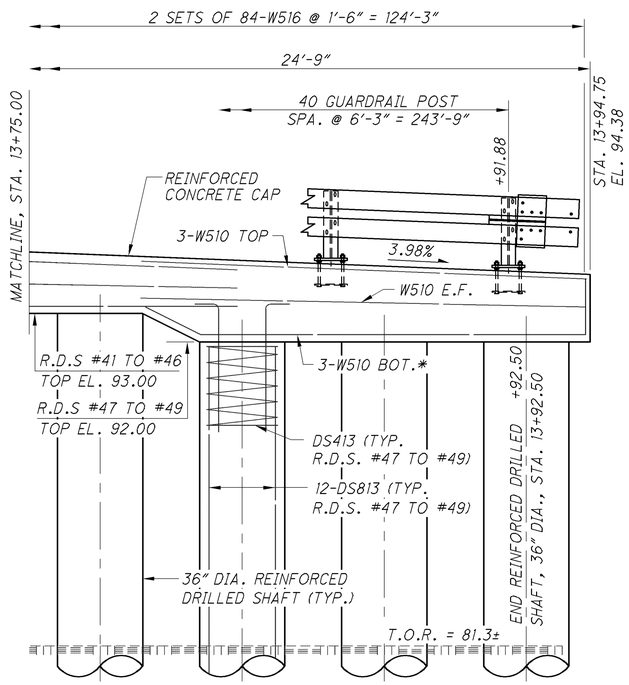
WALL CAP REINFORCING DETAILS - I

PIK-CR 50-3.52
PID NO. 91368

15
18



ELEVATION



ELEVATION

* - FIELD BEND IF NECESSARY

NOTES:

1. FOR SECTION A-A, SEE SHEET 17/18.

2. MINIMUM LAP LENGTHS:
   LAP NO.5 BARS 3'-2"
   LAP NO.8 BARS 6'-4"

LEGEND:

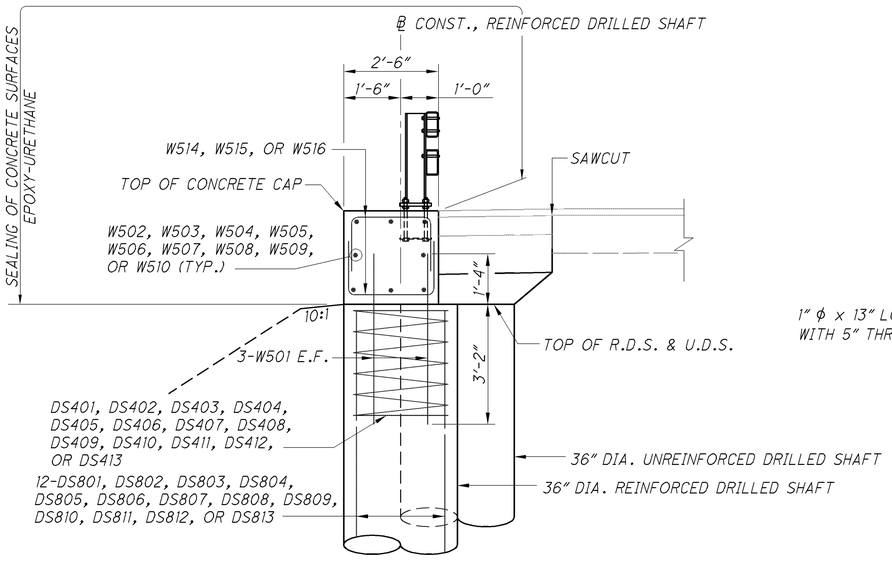
R.D.S. = REINFORCED DRILLED SHAFT
U.D.S. = UNREINFORCED DRILLED SHAFT
T.O.R. = TOP OF BEDROCK
F.F. = FRONT FACE
B.F. = BACK FACE
E.F. = EACH FACES
S.O. = SERIES OF

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MICHIGAN AVENUE, COLUMBUS, OH 43215
TEL:(614)228-3500

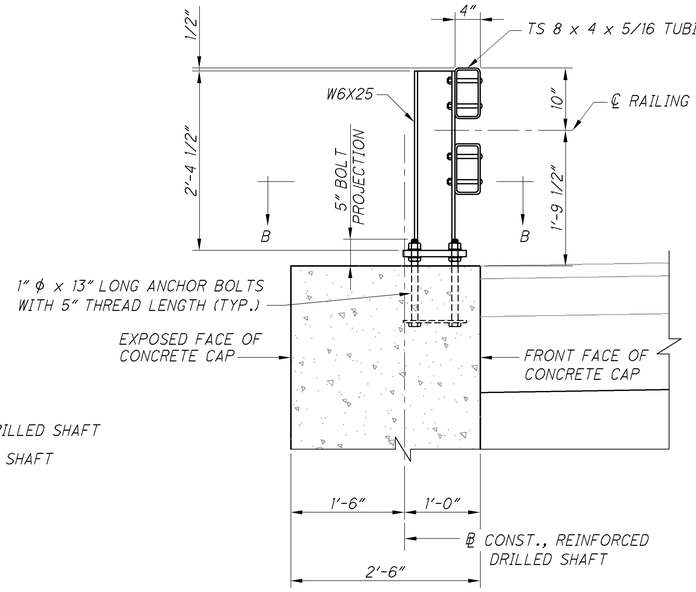
DESIGNED	DRAWN	REVIEWED	DATE
PEK	PEK	JJ	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

WALL CAP REINFORCING DETAILS - II

PIK-CR 50-3.52
PID NO. 91368

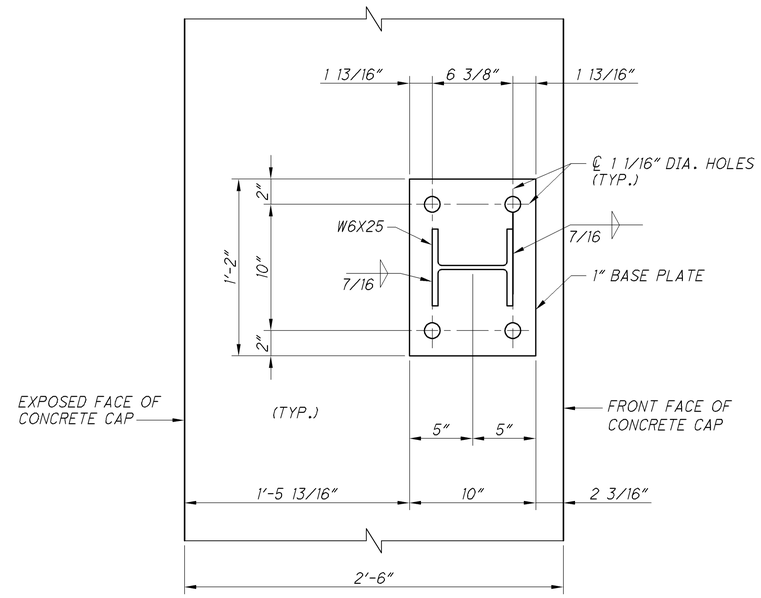


SECTION A-A

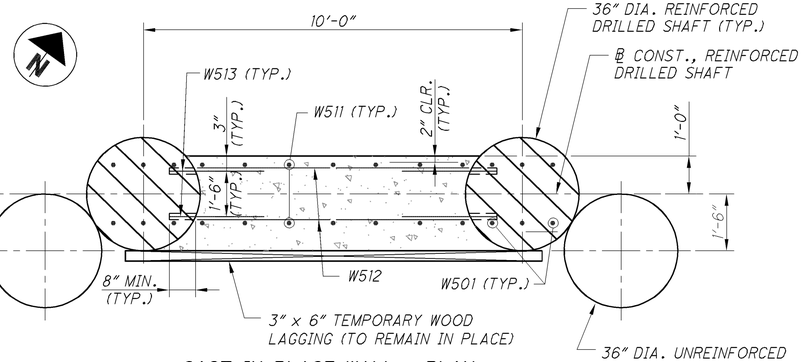


TST GUARDRAIL POST DETAILS

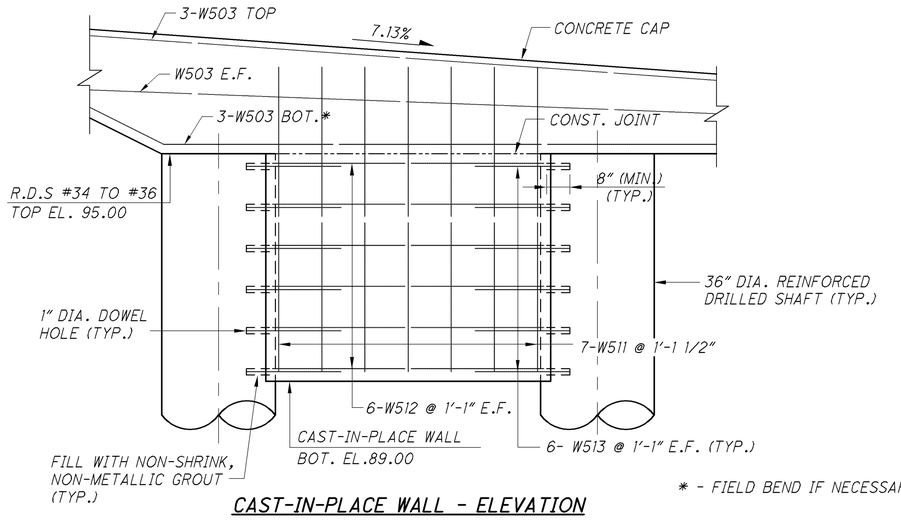
(SEE NOTE 3)



SECTION B-B



CAST-IN-PLACE WALL - PLAN



CAST-IN-PLACE WALL - ELEVATION

* - FIELD BEND IF NECESSARY

NOTES:

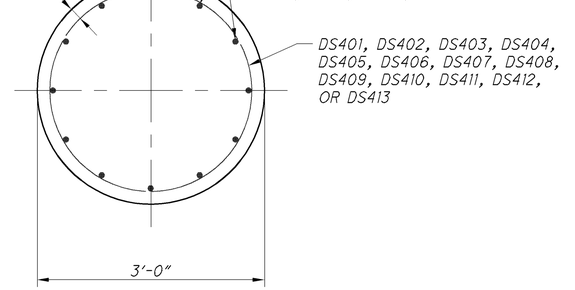
1. FOR LOCATION OF SECTION A-A, SEE SHEETS 15/18 & 16/18.

2. CAST-IN-PLACE CONCRETE WALL DOWEL BARS INTO DRILLED SHAFTS MAY BE MOVED 1"± TO AVOID DRILLING INTO DRILLED SHAFT REINFORCING STEEL.

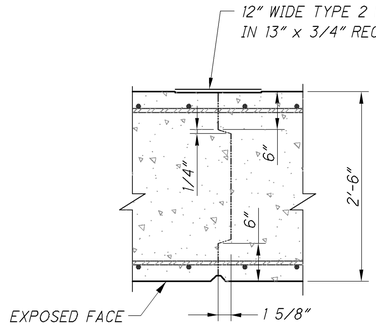
3. FOR ADDITIONAL TWIN STEEL TUBE RAILING NOTES AND DETAILS, REFER TO STD. DWG. TST-1-99.

LEGEND:

R.D.S. = REINFORCED DRILLED SHAFT
U.D.S. = UNREINFORCED DRILLED SHAFT
T.O.R. = TOP OF BEDROCK
F.F. = FRONT FACE
B.F. = BACK FACE
E.F. = EACH FACES
S.O. = SERIES OF

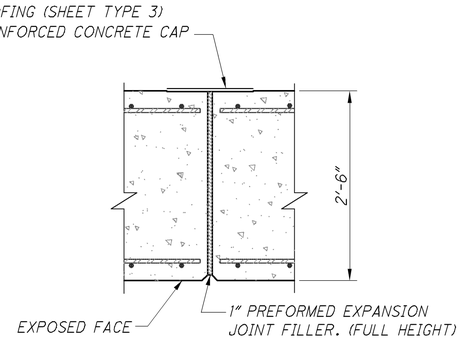


DRILLED SHAFT REINFORCEMENT DETAIL



CONTRACTION JOINT DETAIL

DETAIL '1'



EXPANSION JOINT DETAIL

DETAIL '2'

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MICHIGAN AVENUE, COLUMBUS, OH 43215
TEL:(614)228-3500

DESIGNED	DRAWN	REVIEWED	DATE
PEK	PEK	JJ	07/11
CHECKED	REVISED	STRUCTURE FILE NUMBER	
YSJ/SS		-	

WALL CAP REINFORCING DETAILS - III

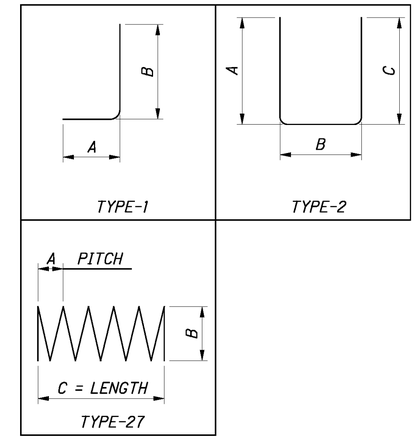
PIK-CR 50-3.52
PID NO. 91368

REINFORCING STEEL LIST

MARK	NUMBER TOTAL	LENGTH	WEIGHT	TYPE	DIMENSIONS A	B	C	D	INC
REINFORCED CONCRETE CAP:									
W501	294	5'-2"	1584	1	0'-10"	4'-6"			
W502	8	22'-2"	185	STR					
W503	40	23'-2"	967	STR					
W504	8	28'-2"	235	STR					
W505	8	20'-8"	172	STR					
W506	8	17'-2"	143	STR					
W507	8	18'-2"	152	STR					
W508	8	13'-2"	110	STR					
W509	8	33'-2"	277	STR					
W510	8	15'-8"	131	STR					
W511	7	17'-7"	127	2	8'-1"	1'-8"	8'-1"		
W512	12	7'-2"	90	STR					
W513	24	2'-6"	63	STR					
W514	26	4'-9"	129	2	1'-5"	2'-2"	1'-5"		
W515	88	5'-5"	497	2	1'-9"	2'-2"	1'-9"		
W516	222	5'-3"	1216	2	1'-8"	2'-2"	1'-8"		
		TOTAL = 6078 LB							
REINFORCED DRILLED SHAFTS (FOR INFORMATION ONLY):									
DS401	4	543'-0"	1451	27	0'-4 1/2"	2'-6"	25'-2"		
DS402	4	587'-8"	1570	27	0'-4 1/2"	2'-6"	27'-4"		
DS403	5	567'-0"	1894	27	0'-4 1/2"	2'-6"	26'-4"		
DS404	4	546'-4"	1460	27	0'-4 1/2"	2'-6"	25'-4"		
DS405	4	525'-8"	1405	27	0'-4 1/2"	2'-6"	24'-4"		
DS406	4	505'-1"	1350	27	0'-4 1/2"	2'-6"	23'-4"		
DS407	3	484'-5"	971	27	0'-4 1/2"	2'-6"	22'-4"		
DS408	3	648'-0"	1299	27	0'-4 1/2"	2'-6"	30'-3"		
DS409	2	627'-4"	838	27	0'-4 1/2"	2'-6"	29'-3"		
DS410	3	606'-8"	1216	27	0'-4 1/2"	2'-6"	28'-3"		
DS411	4	586'-0"	1566	27	0'-4 1/2"	2'-6"	27'-3"		
DS412	6	565'-4"	2266	27	0'-4 1/2"	2'-6"	26'-3"		
DS413	3	544'-8"	1092	27	0'-4 1/2"	2'-6"	25'-3"		
DS801	48	25'-2"	3225	STR					
DS802	48	27'-4"	3503	STR					
DS803	60	26'-4"	4218	STR					
DS804	48	25'-4"	3246	STR					
DS805	48	24'-4"	3118	STR					

MARK	NUMBER TOTAL	LENGTH	WEIGHT	TYPE	DIMENSIONS A	B	C	D	INC
REINFORCED DRILLED SHAFTS (FOR INFORMATION ONLY) CONTINUED:									
DS806	48	23'-4"	2990	STR					
DS807	36	22'-4"	2146	STR					
DS808	36	30'-3"	2908	STR					
DS809	24	29'-3"	1874	STR					
DS810	36	28'-3"	2715	STR					
DS811	48	27'-3"	3492	STR					
DS812	72	26'-3"	5046	STR					
DS813	36	25'-3"	2427	STR					
		TOTAL = 59286 LB							
		INCLUDED WITH PAYMENT FOR DRILLED SHAFTS							

BENDING DIAGRAMS



NOTES:

1. THE BAR SIZE NUMBER IS SPECIFIED ON THE PLANS IN THE BAR MARK COLUMN. THE FIRST DIGIT WHERE THREE DIGITS ARE USED, AND THE FIRST TWO DIGITS WHERE FOUR ARE USED, INDICATES THE BAR SIZE NUMBER. FOR EXAMPLE, S501 IS A NO. 5 BAR. BAR DIMENSIONS SHOWN ARE OUT TO OUT UNLESS OTHERWISE NOTED. R INDICATES INSIDE RADIUS, UNLESS OTHERWISE NOTED.

2. ALL REINFORCING STEEL SHALL BE EPOXY COATED.

3. "STR" IN THE TYPE COLUMN INDICATES STRAIGHT BARS.

4. S.O. DENOTES SERIES OF.

5. REFER TO C.M.S. SECTION 509.05 FOR STANDARD BEND DIMENSIONS.

6. ALL REINFORCING STEEL CLEARANCES ARE 2" UNLESS OTHERWISE NOTED.

7. SPIRAL REINFORCING BAR SPACERS:
CONCRETE SPACERS OR OTHER APPROVED NONCORROSIVE SPACING DEVICES SHALL BE USED AT SUFFICIENT INTERVAL (NEAR THE BOTTOM AND AT INTERVALS NOT EXCEEDING 10 FEET) TO INSURE CONCENTRIC SPACING FOR THE ENTIRE CAGE LENGTH. SPACERS SHALL BE CONSTRUCTED OF APPROVED MATERIAL EQUAL IN QUALITY AND DURABILITY TO THE CONCRETE SPECIFIED FOR THE SHAFT. THE SPACERS SHALL HAVE ADEQUATE DIMENSIONS TO ENSURE A MINIMUM 3 INCH CLEAR SPACE BETWEEN THE OUTSIDE OF THE REINFORCING CAGE AND THE DESIGN DIMENSION OF THE DRILLED SHAFT OR COLUMN. CYLINDRICAL CONCRETE FEET (BOTTOM SUPPORTS) SHALL BE PROVIDED TO ENSURE THAT THE BOTTOM OF THE CAGE IS MAINTAINED AT THE PROPER DISTANCE ABOVE THE BASE.

DESIGN AGENCY
COLUMBUS ENGINEERING CONSULTANTS, INC.
840 MICHIGAN AVENUE, COLUMBUS, OH 43215
TEL:(614)228-3500

DESIGNED YSJ/SS | DRAWN CEC | REVIEWED JJ | DATE 07/11 | CHECKED JH | REVISED | STRUCTURE FILE NUMBER .

REINFORCING STEEL LIST

PIK-CR 50-3.52
PID No. 91368

DLZ
ARCHITECTURE • ENGINEERING • PLANNING
SURVEYING • CONSTRUCTION SERVICES

INNOVATIVE IDEAS
EXCEPTIONAL DESIGN
UNMATCHED CLIENT SERVICE

DRAFT REPORT
OF
GEOHAZARD EXPLORATION - LANDSLIDE

PIK-CR50-03.40, PID NO. 108463

PIKE COUNTY, OHIO

PREPARED FOR:

Pike County Engineer's Office
502 Pike Street
Waverly, Ohio 45690

Prepared By:

DLZ OHIO, INC.

DLZ Job No. 1921-1004.00

March 6, 2020

EXECUTIVE SUMMARY

This report presents the findings of the Geohazard Exploration performed for the landslide remediation on County Route 50 (CR50), Watson Road, in Jackson Township, Pike County, Ohio. The project consists of remediating the existing failing roadway slope. Based on available information for the project site, it is understood that multiple repairs have been performed for slide remediation along this same section of roadway.

The geotechnical exploration performed at the site consisted of a total of six (6) borings, designated as B-001-0-19 through B-003-0-19 and B-001-1-19 through B-003-1-19. All the borings were performed within the limits of the existing roadway. The borings were performed to depths between 13.8 and 45 feet below the existing ground surface. Fill and or possible fill was encountered in borings B-001-0-19, B-002-0-19, B-002-1-19, and B-003-0-19 to depths ranging from 4.0 to 13.0 feet consisting of medium dense granular soils and stiff to very stiff cohesive soils. Beneath the fill and surface materials, the borings generally encountered stiff to hard fine-grained soils to depths ranging from of 11.5 to 19.0 feet below the existing ground surface.

Bedrock was encountered at depths ranging from approximately 11.5 to 19.0 feet. Sandstone and shale fragments were obtained using standard split-spoon methods at depths ranging from 11.5 to 25 feet below the existing ground surface before rock coring methods were used. The retrieved rock cores consisted of slightly to moderately weathered shale, sandstone, and interbedded shale and sandstone. The bedrock encountered had Rock Quality Designation (RQD) values ranging between 46 to 92 percent. Groundwater seepage was not encountered in any of the drilled borings.

Based on field observations, it appears the existing head scarp evident by cracking in the paved surface extends from approximately Station 11+90 to approximately Station 13+30, for a total of 140 linear feet. Given the site history with multiple slides, and the extent of previous repairs, a wall retaining system consisting of reinforced drilled shafts with plug piles is recommended. The limits of the proposed drilled shaft plug pile are from approximately Stations 11+50 to 14+04. Analysis was performed to analyze the proposed drilled shaft wall. Conventional earth pressure analysis was used to determine the loading on the shafts. Two critical sections were analyzed for the project alignment based on the subsurface conditions and topography of the site. The results of the analysis are summarized in the table below.

Summary of Drilled Shaft Wall Lateral Load Analyses Assumptions

Section	Retained Height (Depth to Failure Surface at wall), ft	Depth to Top of Rock at Wall (ft)	Shaft Diameter, in	Reinforcing Steel	Overall Shaft Length, ft
1 (Sta. 12+50)	18	28	42	12, No. 14 bars	40
2 (Sta. 14+00)	18	18	42	12, No. 14 bars	40

Summary of Drilled Shaft Wall Lateral Load Analyses Results

Section	Service Limit: Deflection at Top of Wall (Maximum Allowed)	Strength Limit: Maximum Moment, M (ft-kip) / Shear, V (kips)	Extreme Event II: Maximum Moment, M (ft-kip) / Shear, V (kips)
1 (Sta. 12+50)	2.0" (2.0")	M = 974 / V = 263	M = 1,228 / V = 323
2 (Sta. 14+00)	0.3" (2.0")	M = 582 / V = 279	M = 854 / V = 412

Caving and sloughing of wet and weak granular soils should be anticipated for open excavations. Even though groundwater was not encountered in the borings, perched or short term groundwater may be encountered during construction, particularly in granular strata. Temporary casing may be needed to prevent caving or sloughing of the drilled shaft excavations through granular materials, such as those encountered in the upper 7 feet of boring B-001-0-19.

Table of Contents

APPENDIX

1.0 INTRODUCTION

This report presents the findings of the Geohazard Exploration performed for the landslide remediation on County Route 50 (CR50) in Jackson Township, Pike County, Ohio. The project consists of remediating the existing failing roadway slope.

The purpose of this exploration was to 1) explore the subsurface conditions to the depths of the borings, 2) evaluate the engineering characteristics of the subsurface materials, and 3) provide design recommendations for the remediation of the landslide. The exploration presented in this report was performed essentially in accordance with DLZ Ohio, Inc.'s (DLZ) proposal for this project dated May 14, 2019. This exploration was also performed in general accordance with the latest revision of the Ohio Department of Transportation (ODOT) Specifications for Geotechnical Exploration (SGE), dated July 2019.

The geotechnical engineer has planned and supervised the performance of the geotechnical engineering services, considered the findings, and prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranties, either expressed or implied, are made as to the professional advice included in this report.

2.0 GENERAL PROJECT INFORMATION

The project site is located along CR-50 in Pike County, approximately 8 ½ miles northeast of Waverly, Ohio. CR-50 is a two-lane road carrying traffic southwest/northeast located along the east bank of the Scioto River Valley. A vicinity map showing the approximate project location is provide in the Appendix. This portion of roadway within the project limits was presumably constructed as a cut slopes or as a cut-to-fill roadway into the existing hillside (i.e. sidehill fill). Approximately 260 linear feet of roadway is the primary stability concern showing signs of movement evident by a head scarp in the outside lane of the roadway. Based on available information, a drilled shaft plug pile retaining wall was previously installed on the downhill slope of the adjacent segment of roadway, east of the current slip section of the CR-50 alignment (REF. PIK-CR50-3.52; PID No. 91368 plan set, dated September 30, 2011). The existing drilled shaft retaining wall extends northeast of the current slip area approximately 249.5 feet. Additionally, it is understood that approximately 216 feet of the 260 feet under consideration is located within an existing geogrid reinforced embankment from a previous slope repair (REF. PID No. 17792, plan set dated April 7, 1998). It should be noted that driven steel piles were observed in the field during the site reconnaissance on the uphill slope, parallel to the northbound lane of travel, as well as a single pile within the existing roadway (discussed in Section 3.0 herein). No construction or design documentation was available regarding the installation of the piles.

This report, and the recommendations provided herein, has been written under the consideration that the construction will be performed in accordance with the 2019 version of the ODOT Construction and Materials Specifications (CMS).

3.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

3.1 FIELD RECONNAISSANCE

A site reconnaissance was conducted on August 6, 2019. The project area is on CR-50, with the north end of the project located approximately 130 feet southwest of the Pike County/Ross County line and extends approximately 260 feet further south/southwest. The existing CR-50 is a two-lane road, approximately 24 feet wide along the project, which is situated along the east bank of the Scioto River valley. It appeared that the roadway was constructed using cut slopes or cut-to-fill. Bedrock outcrops were observed in the uphill slopes along the northbound lane indicating possible rock cut slopes for the roadway construction. CR-50 is a meandering road with a sloping site topography, generally towards south and west directions. During the site visit, differential settlement and cracking in the existing pavement in the vicinity of the scarp was observed, as well as leaning trees downslope of the existing failure. The ground conditions upslope and downslope could not be readily observed during the site visit due to the dense overgrowth of vegetation; however, DLZ survey crews reportedly observed hummocky ground conditions along the slope below the road. The surrounding area is primarily rural, woodland land usage.

It was observed during the site reconnaissance that the site drainage was primarily maintained through the ditch on the upslope side, toward the south/southwest. It should be noted that a heavily ponded portion of the ditch was observed approximately 290 feet southwest of the existing slip area and the ditch line between the ponded area and the existing slip area appeared to be very soft and saturated. Additionally, DLZ survey crews reportedly identified a drainage conduit downslope in this vicinity, at the southwest limit of the slip area. The slopes were generally covered by very dense vegetation. Driven steel pile sections were observed along the northbound lane, just upslope of the ditch. Additionally, a single steel pile was observed in the larger depressed section of the existing scarp, underneath the roadway surface and existing pavement section.

3.2 GENERAL GEOLOGY AND OFFICE RECONNAISSANCE

The site is located in the Shawnee-Mississippian Plateau in the Allegheny (Kanawha) Plateau Section of the Appalachian Provence. Generally, the region is characterized by highly dissected, high-relief, landslide prone topography with fine-grained rocks including Devonian- and Mississippian-age shales, siltstones, and locally thick sandstones. The area generally has relief from 400 feet to as much as 800 feet.

Based on Quaternary Geology of Ohio map by the Ohio Department of Natural Resources (ODNR), soils in the area are primarily colluvium along the hillsides and alluvium lower in the Scioto River Valley. According to the Abandoned Underground Maps of Ohio by the ODNR, the project site is located within 5 miles of nearby mine locations (extents unknown) in coal bearing rock areas. Soils in the area are primarily Teays-age Minford clays, silt loam, and channery colluvium. The colluvium derived from Mississippian-aged shales, including the Bedford Shale, along the Scioto River valley in the vicinity of the site is considered to be landslide prone, as identified in the GeoFacts No. 8 published by ODNR (Hansen, 1995).

4.0 EXPLORATION

4.1 FIELD EXPLORATION

The geotechnical exploration was performed between the dates of August 15 and 20, 2019, and consisted of a total of 6 borings located along CR-50, designated as B-001-0-18 through B-003-0-18 and offsets designated as B-001-1-19 through B-003-1-19. The borings were located in the field by DLZ personnel. The borings were drilled to depths of approximately between 13.8 and 45 feet beneath the existing ground surface.

The borings were drilled using a CME-75 truck-mounted drill rig and were advanced between sampling intervals with 3 ¼-inch ID Hollow-Stem Augers (HSA). Disturbed soil samples and weathered bedrock were obtained with a 2-inch OD split-barrel sampler in general accordance with ASTM D-1586 (AASHTO T206), i.e. Standard Penetration Test (SPT) Method, at 1.5-foot intervals. Between 12 feet and 25 feet of rock core was collected in the primary borings in accordance with ASTM D2113 procedures, using NQ_2 double tube, wire line, core barrels. The hammer system used for the CME-75 was calibrated on August 15, 2019 and had an average drill rod energy efficiency ratio (ER) of 83.7 percent.

The approximate as-drilled boring locations are shown on the boring location plan presented in the Appendix. Boring logs and information concerning the drilling procedures are also presented in the Appendix. The boring locations and ground surface elevations at the boring locations were surveyed by DLZ and the information is listed on the individual boring logs. Water level observations were made in each boring during drilling, and prior to adding coring water.

4.2 GEOPHYSICAL EXPLORATION

The geophysical exploration was performed by ODOT personnel at the site on September 12 and 16, 2019, and consisted of obtaining electrical resistivity (ER) data and seismic refraction (s-wave microtremor (ReMi) and p-wave) data near the proposed wall alignment. Details and results of the geophysical exploration are presented in the Appendix.

4.3 LABORATORY TESTING PROGRAM

The laboratory testing program consisted of visual classifications of soil and rock samples, general index tests of soil samples, and unconfined compressive strength (UCS) tests of rock samples. The samples were classified in general accordance with the ODOT SGE Section 600 Laboratory Testing. The general index tests on soil samples consisted of grain-size analyses, moisture content, and plasticity determinations. The results of the index testing and visual classifications are shown on the individual boring logs in the Appendix. Results of the laboratory UCS testing are included in the Appendix.

5.0 FINDINGS

The subsurface conditions encountered by the borings generally consisted of asphalt concrete pavement and fill, underlain by primarily cohesive native soils, underlain by bedrock. The following sections present the generalized subsurface conditions encountered by the borings. For more detailed information, please refer to the boring logs presented in Appendix I. Also note that the strata contact lines shown on the boring logs represent approximate boundaries between soil types and/or bedrock. In the field, the actual soil and bedrock transitions may vary, both vertically and laterally.

5.1 SOIL CONDITIONS

At the ground surface the borings encountered approximately between 8 and 18 inches of pavement materials consisting of 2 to 9 inches of asphalt concrete pavement underlain by 0 to 9 inches of aggregate base. With the exception of boring B-001-1-19, the borings encountered fill and/or possible fill consisting of medium dense granular soils and medium stiff to very stiff cohesive soils to depths of approximately 4.0 to 13.0 feet below the existing ground surface with asphalt fragments encountered to depths ranging from 2.5 to 5.5 feet. Sample number SS-7 from boring B-002-0-19 recovered a plastic fragment, which is believed to be geosynthetic reinforcement. It should be noted that the borings did not encounter drainage layer material anticipated from the 1998 construction records. Below the surface and fill materials, the borings generally encountered medium stiff to hard fine-grained soils (A-4a, A-6a, A-6b) containing bedrock stone fragments throughout the overburden. Samples were identified as soil, rather than weathered bedrock, if they lacked overall structure.

5.2 BEDROCK CONDITIONS

The top of bedrock was encountered in all the borings at depths ranging from approximately 6.5 to 19 feet below the existing ground surface and varied in depth and elevation along the project alignment in addition to sloping toward the river transverse to the alignment. It should be noted that the current exploration generally encountered bedrock at varying depths compared to borings provided with the 1998 construction records. In general, sandstone and shale fragments were observed in the overburden. Weathered bedrock was sampled using SPT methods before rock coring methods were used. The retrieved rock cores consisted of interbedded shale (70 to 80 percent) and sandstone (20 to 30 percent). The bedrock encountered had Rock Quality Designation (RQD) values ranging between 46 to 92 percent. Table 1 below summarizes the results of the unconfined compressive strength testing performed on selected rock samples.

Table 1: Summary of Unconfined Compressive Strength Testing of Intact Rock Core Samples

Boring	Run	Depth (ft)	Unconfined Compressive Strength, q_u (psi)	Rock Description
B-001-0-19	R-1	16’-16.5’	8,469	Sandstone
	R-1	18’-18.5’	9,774	Sandstone
	R-1	18.5’-19’	3,640	Sandstone
	R-1	20.5’-21’	1,804	Shale
B-002-0-19	R-1	28’-28.5’	2,103	Shale
B-003-0-19	R-2	21’-21.5’	6,715	Sandstone

5.3 GROUNDWATER CONDITIONS

Groundwater seepage was not observed in any of the drilled borings prior to rock coring. Depths to water levels after rock coring with water was complete are considered irrelevant. It should be noted that groundwater levels were measured inside hollow stem augers. Additionally, groundwater levels may fluctuate with season variations and following periods of heavy or prolonged precipitation. Long-term monitoring would be needed to obtain a more accurate estimate of the groundwater table elevation.

6.0 ANALYSES AND RECOMMENDATIONS

6.1 ANALYSES AND RECOMMENDATIONS

Site observations, survey of the slope, and review of the soil and bedrock from the borings indicate that the landslide causing the existing pavement failure is most likely due to the steep overburden slope below the road in conjunction with groundwater seepage. We anticipate this landslide is a rotational type failure with the base sliding along the hard colluvium and/or weathered bedrock surface, with a maximum depth below top of pavement at the wall alignment of approximately 18 feet.

Based on field observations, it appears the existing landslide head scarp, evident from cracking in the paved surface, extends from approximately Station 11+90 to approximately Station 13+30, for a total of 140 linear feet. However, it is understood the preference of the Pike County Engineer's Office (PCEO) is to extend the proposed repair to the existing drilled shaft wall to the east, as well as extend the limits to the west. Given the history of the site with multiple repairs within this segment of roadway, extending the repair limits is considered prudent. Given the marginally stable slopes below the existing roadway, the continued failure from the previous repair methods, and the variable depth to bedrock along the alignment, a wall retaining system is recommended to stabilize the slope. It is understood that a drilled shaft plug pile wall with a reinforced concrete cap for a traffic barrier foundation is the preferred remedial option by PCEO. The drilled shaft plug pile wall will serve to stabilize the landslide by load sharing to discreet, rigid, structural elements socketed into competent underlying bedrock. The proposed wall would not improve the groundwater conditions, and therefore hydrostatic loading is considered in the design. The limits of the proposed drilled shaft plug pile wall are from approximately Stations 11+50 to 14+04.

6.2 DRILLED SHAFT RETAINING WALL WITH PLUG PILES

Lateral Load analysis for a drilled shaft plug pile wall was performed using cross sections at Station 12+50 and Station 14+00. Subsurface conditions were determined using borings near the sections analyzed. The proposed wall alignment was based on an offset to maintain the existing roadway centerline and similarly match the existing adjacent wall. The proposed wall analyzed consisted of 42-inch diameter drilled shafts, reinforced with reinforcing steel, and spaced at five foot on center with unreinforced concrete plug piles in between, in lieu of lagging. The retained height of the wall was analyzed as the depth to the estimated slope failure surface at the anticipated wall location, based on the findings of the borings and the geophysical exploration.

In the analysis, the soil parameters used were selected based on correlations from the field and index testing results and engineering judgment, and then were used to calculate the lateral earth pressures the wall would resist. Conventional horizontal earth pressures were calculated using at-rest earth pressures to determine the loading on the proposed wall. The assumed sections for the analyses, including the assumed subsurface conditions are included in the Appendix.

The lateral analyses of the drilled shaft plug pile wall were performed using the computer program LPILE 2019 by Ensoft to model the soil-structure interaction. The drilled shaft size was determined by a deflection criterion of approximately two inches or one percent of the retained height, whichever is less, using the SERVICE-I loading case. All analyses were performed in accordance with AASHTO LRFD Specifications. Results of the analyses are included in the Appendix. Table 2 and 3 below summarizes the results of the wall analyses.

Table 2: Summary of Drilled Shaft Wall Lateral Load Analyses Assumptions

Section	Retained Height (Depth to Failure Surface at wall), ft	Depth to Top of Rock at Wall (ft)	Shaft Diameter, in	Reinforcing Steel	Overall Shaft Length, ft
1 (Sta. 12+50)	18	28	42	12, No. 14 bars	40
2 (Sta. 14+00)	18	18	42	12, No. 14 bars	40

Table 3: Summary of Drilled Shaft Wall Lateral Load Analyses Results

Section	Service Limit: Deflection at Top of Wall (Maximum Allowed)	Strength Limit: Maximum Moment, M (ft-kip) / Shear, V (kips)	Extreme Event II: Maximum Moment, M (ft-kip) / Shear, V (kips)
1 (Sta. 12+50)	2.0” (2.0”)	M = 974 / V = 263	M = 1,228/ V = 323
2 (Sta. 14+00)	0.3” (2.0”)	M = 582/ V = 279	M = 854/ V = 412

In the analysis, groundwater behind the wall was assumed to be at a depth 2 feet below the top of wall. Drilled shafts should be installed in accordance with the ODOT CMS Item 524. Excavations, including those for drilled shafts, may encounter cobbles and/or boulders within the overburden, as well as materials from previous repairs, such as buried piles, geogrid reinforced embankment, drainage pipe and aggregate materials. The drilled shaft wall should be designed in accordance with section 307.6 ODOT BDM, 2020 edition. It is recommended that if a variable shaft length is used due to the variable rock conditions along the proposed wall alignment, a minimum 12-foot length rock socket be required during construction.

6.3 EXCAVATIONS AND GROUNDWATER AND DRAINAGE CONSIDERATIONS

Free groundwater was not observed in any of the borings prior to rock coring. It should be noted that groundwater conditions vary seasonally and with the passage of time. Consequently, the contractor should be equipped to deal with groundwater, seepage, and surface water that may accumulate on the project site. It should be noted that the 1998 plans indicate drainage layers consisting of free draining aggregate were

recommended, which may contain short term or perched water conditions and could be encountered during construction.

Caving and sloughing of wet and weak granular soils should be anticipated for open excavations. Even though groundwater was not encountered in the borings, perched or short-term groundwater may be encountered during construction, particularly in granular strata. Temporary casing may be needed to prevent caving or sloughing of the drilled shaft excavations through granular materials, such as those encountered in the upper 7 feet of boring B-001-0-19. Clay soils and severely weathered shale and sandstone are prone to weathering and softening quickly when exposed, particularly in the presences of water. All excavations should be graded to drain to prevent ponding, during construction and long term, behind the structure or within the roadway slope.

7.0 CLOSING REMARKS

We appreciate having the opportunity to be of service to you on this project. Please do not hesitate to call if you have any questions concerning this report.

Respectfully submitted,

DLZ OHIO, INC.

Michael Kennedy, P.E.
Geotechnical Engineer

H. Jason Hughes, P.E.
Project Manager

MDK/hjh

APPENDIX

General Information – Drilling Procedures and Logs of Borings
Legend of Boring Log Terminology
Vicinity Map
Boring Location Plan
Boring Logs (6)
Bedrock Core Photographs
Lab Test Results – UCS
ODOT Geophysical Exploration
Historic Boring Logs and Lab Test Results
Calculations

GENERAL INFORMATION
DRILLING PROCEDURES AND LOGS OF BORINGS

Drilling and sampling were conducted in accordance with the Ohio Department of Transporation (ODOT) Specifications for Geotechnical Exploration (SGE) dated July 19, 2019. Borings were drilled with either a truck-mounted or ATV-mounted drill rig.

Drive split-barrel sampling was performed in 1.5 foot increments at intervals not exceeding 5 feet. In the event the sampler encountered resistance to penetration of 6 inches or less after 50 blows of the drop hammer, the sampling increment was discontinued. Standard penetration data were recorded and one or more representative samples were preserved from each sampling increment.

In borings where rock was cored, NXM or NQ size diamond coring tools were used.

In the laboratory all samples were visually classified by a geotechnical engineer. Moisture contents of all soil samples were determined. A limited number of samples, based on SGE requirements, were selected for performance of grain-size analyses and plasticity characteristics tests. The results of these tests are shown on the boring logs.

The boring logs included in the Appendix have been prepared on the basis of the field record of drilling and sampling, and the results of the laboratory examination and testing of samples. Stratification lines on the boring logs indicating changes in soil stratigraphy represent depths of changes approximated by the driller, by sampling effort and recovery, and by laboratory test results. Actual depths to changes may differ somewhat from the estimated depths, or transitions may occur gradually and not be sharply defined. The boring logs presented in this report therefore contain both factual and interpretative information and are not an exact copy of the field log.

Although it is considered that the borings have disclosed information generally representative of site conditions, it should be expected that between borings conditions may occur which are not precisely represented by any one of the borings. Soil deposition processes and natural geologic forces are such that soil and rock types and conditions may change in short vertical intervals and horizontal distances.

Soil/rock samples will be stored at our laboratory for a period as dictated by the requirement of the SGE. After this period of time, they will be discarded, unless notified to the contrary by the client.

LEGEND – BORING LOG TERMINOLOGY

Explanation of each column, progressing from left to right

1. Depth (in feet) – refers to distance below the ground surface.

2. Elevation (in feet) – is referenced to mean sea level, unless otherwise noted.

3. Standard Penetration (N) – the number of blows required to drive a 2-inch O.D., 1-3/8 inch I.D., split-barrel sampler, using a 140-pound hammer with a 30-inch free fall. The blows are recorded in 6-inch drive increments. Standard penetration resistance is determined from the total number of blows required for one foot of penetration by summing the second and third 6-inch increments of an 18-inch drive.

   50/n – indicates number of blows (50) to drive a split-barrel sampler a certain number of inches (n) other than the normal 6-inch increment.

4. The length of the sampler drive is indicated graphically by horizontal lines across the "Standard Penetration" and "Recovery" columns.

5. Sample recovery from each drive is indicated numerically in the column headed "Recovery".

6. The drive sample location is designated by the heavy vertical bar in the "Sample No., Drive" column.

7. The length of hydraulically pressed "Undisturbed" samples is indicated graphically by horizontal lines across the "Press" column.

8. Sample numbers are designated consecutively, increasing in depth.

9. Soil Description

   a. The following terms are used to describe the relative compactness and consistency of soils:

   Granular Soils – Compactness

Term	Blows/Foot Standard Penetration
Very Loose	less than 5
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 – 50
Very Dense	over 50

   Cohesive Soils – Consistency

Term	Unconfined Compression tons/sq.ft.	Blows/Foot Standard Penetration	Hand Manipulation
Very Soft	less than 0.25	less than 2	Easily penetrated 2-in. by fist
Soft	0.25 – 0.50	2 – 4	Easily penetrated 2-in. by thumb
Medium Stiff	0.50 – 1.0	5 – 8	Penetrated by thumb with moderate effort
Stiff	1.0 – 2.0	9 – 15	Readily indented by thumb but not penetrated
Very Stiff	2.0 – 4.0	16 – 30	Readily indented by thumbnail
Hard	over 4.0	over 30	Indented with difficulty by thumbnail

   b. Color – If a soil is a uniform color throughout, the term is single, modified by such adjective as light and dark. If the predominant color is shaded by a secondary color, the secondary color precedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled".

   c. Texture is based on the Ohio Department of Transportation Classification System. Soil particle size definitions are as follows:

Description		Size	Description		Size
Boulders		Larger than 12"	Sand	– Coarse	2.0 mm to 0.42 mm
Cobbles		12" to 3"		– Fine	0.42 mm to 0.074 mm
Gravel	– Coarse	3" to ¾"	Silt		0.074 mm to 0.005 mm
	– Fine	¾" to 2.0 mm	Clay		smaller than 0.005 mm

d. The main soil component is listed first. The minor components are listed in order of decreasing percentage of particle size.

e. Modifiers to main soil descriptions are indicated as a percentage by weight of particle sizes.

trace	0 to 10%
little	10 to 20%
some	20 to 35%
"and"	35 to 50%

f. Moisture content of **cohesionless soils** (sands and gravels) is described as follows:

Term	Relative Moisture or Appearance
Dry	Soil leaves no moisture when pressed between fingers
Damp	Soil leaves very little moisture when pressed between fingers.
Moist	Soil leaves small amount of moisture when pressed between fingers.
Wet	The pore space is filled with water and water can be poured from sample with ease.

g. The moisture content of **cohesive soils** (silts and clays) is expressed relative to plastic properties.

Term	Relative Moisture or Appearance
Dry	Brittle to powdery; Moisture content well below plastic limit
Damp	Moisture content below plastic limit
Moist	Moisture content above plastic limit to -3% liquid limit
Wet	Moisture content near or above liquid limit

10. Rock Hardness and Rock Quality Designation

a. The following terms are used to describe the relative strength of the **bedrock**.

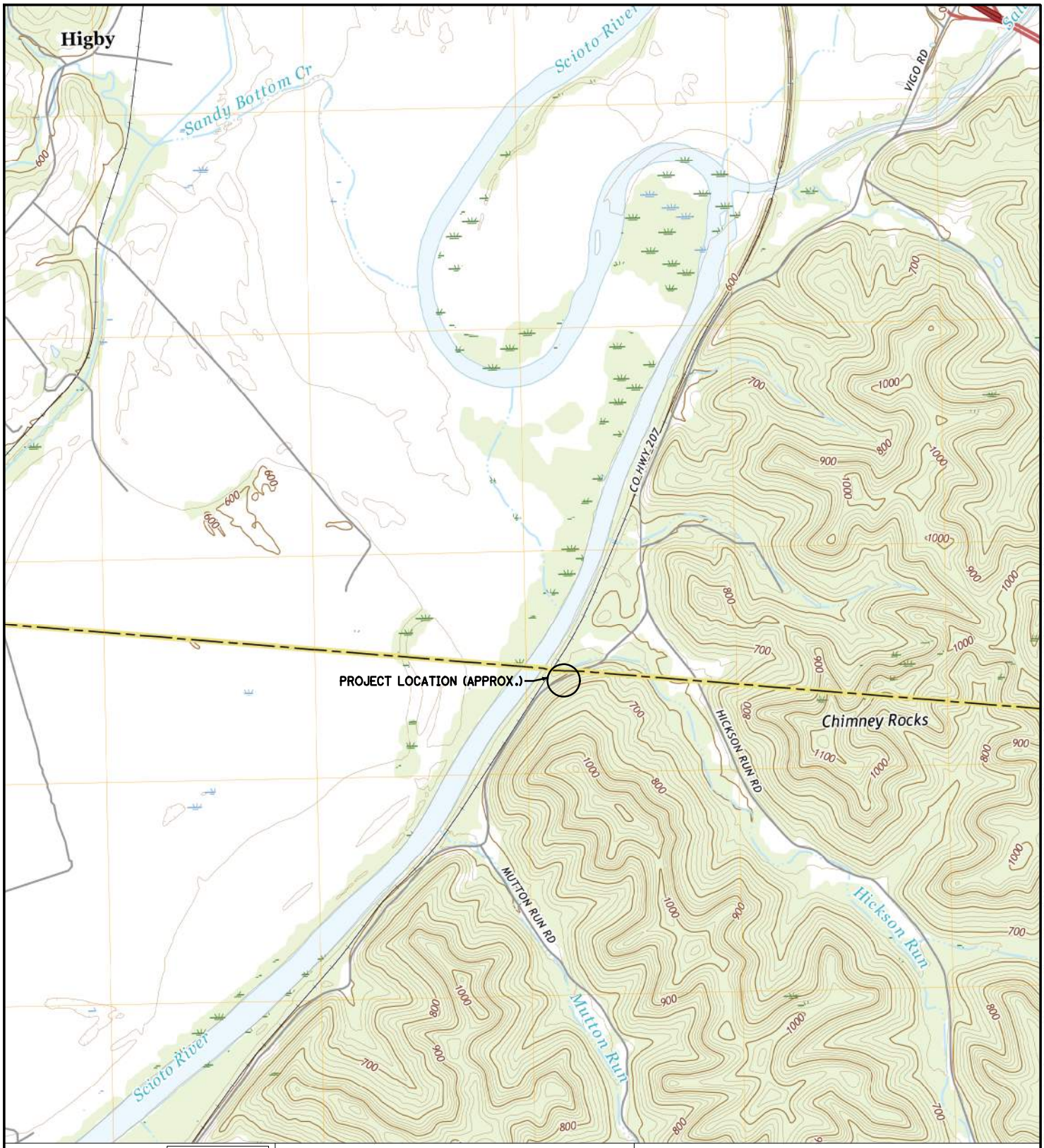
Term	Description
Very Weak	Core can be carved with a knife and scratched by fingernail. Can be excavated readily with a point of a pick. Pieces 1-inch or more in thickness can be broken by finger pressure.
Weak	Core can be grooved or gouged readily by a knife or pick. Can be excavated in small fragments by moderate blows of a pick point. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Core can be grooved or gouged 0.05 inch deep by firm pressure of a knife or pick point. Can be excavated in small chips to pieces about 1-inch maximum size by hard blows of the point of a geologist's pick.
Moderately Strong	Core can be scratched with a knife or pick. Grooves or gouges to ¼" deep can be excavated by hand blows of a geologist's pick. Requires moderate hammer blows to detach hand specimen.
Strong	Core can be scratched with a knife or pick only with difficulty. Requires hard hammer blows to detach hand specimen. Sharp and resistant edges are present on hand specimen.
Very Strong	Core cannot be scratched by a knife or sharp pick. Breaking of hand specimens requires hard repeated blows of the geologist hammer.
Extremely Strong	Core cannot be scratched by a knife or sharp pick. Chipping of hand specimens requires hard repeated blows of the geologist hammer.

b. Rock Quality Designation, RQD – This value is expressed in percent and is an indirect measure of rock soundness. It is obtained by summing the total length of all core pieces which are at least four inches long, and then dividing this sum by the total length of the core run.

11. Gradation – when tests are performed, the percentage of each particle size is listed in the appropriate column (defined in Item 9c).

12. When a test is performed to determine the natural moisture content, liquid limit moisture content, or plastic limit moisture content, the moisture content is indicated in tabular form.

13. The corrected standard penetration (N_{60}) value in blows per foot is indicated in tabular form.



PROJECT LOCATION
PIKE COUNTY, OHIO

USGS TOPOGRAPHIC MAP:
7.5-MINUTE MAP FOR RICHMOND DALE, OH
2019

SCALE (FEET)

0 1000 2000 4000

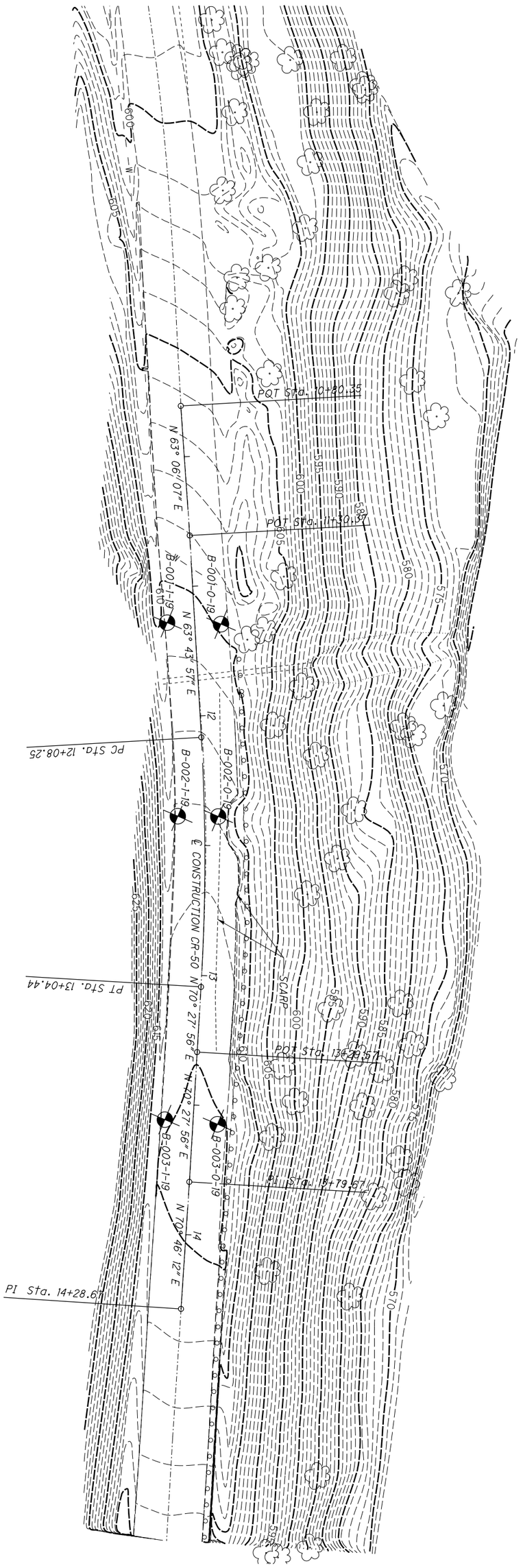
DLZ OHIO, INC.
6121 HUNTLEY RD
COLUMBUS, OH 43229
OFFICE: (614) 888-0040
WWW.DLZ.COM

VICINITY MAP

PIK-CR50-3.40
Landslide Exploration

DLZ PROJECT NUMBER	1921-1004.00
DRAWN BY (DATE)	DML (03/04/2020)
CHECKED BY (DATE)	MDK (03/04/2020)
SCALE	GRAPHIC

X:\Projects\GFL\2019\1921\100400_PCE-PIK-CR50\PIK\108463\Design\Geotechnical\Sheets\Scratch\boring_plan.dgn Sheet 3/6/2020 4:46:25 PM mkennedy



	1 / 1	**PIK-CR50-3.40**	**LANDSLIDE EXPLORATION BORING PLAN**	DRAWN SEB / CHECKED MDK	0 10 20 40 HORIZONTAL SCALE IN FEET

PROJECT: PIK-CR50-03.40	DRILLING FIRM / OPERATOR: DLZ / K. REINHART	DRILL RIG: '19 CME 75-079-797	STATION / OFFSET: 11+65, 10' LT.
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: DLZ / P. MORGAL	HAMMER: CME AUTOMATIC	ALIGNMENT: CR-50
PID: 108463 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/15/19	ELEVATION: 610.0 (MSL) EOB: 40.0 ft.
START: 8/16/19 END: 8/16/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 83.7	LAT / LONG: 39.171609, -82.838559

EXPLORATION ID B-001-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT = 8" BASE = 4"	610.0																	
MEDIUM DENSE TO DENSE, DARK BROWN, **COARSE AND FINE SAND**, LITTLE SILT, TRACE TO LITTLE GRAVEL, CONTAINS ASPHALT FRAGMENTS, DAMP **[FILL]**	609.0		8 13 13	36	67	1	-	-	-	-	-	-	-	-	-	12	A-3a (V)	
			7 6 7	18	39	2	-	-	-	-	-	-	-	-	-	4	A-3a (V)	
MEDIUM DENSE, LIGHT BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, CONTAINS ASPHALT FRAGMENTS, DAMP **[FILL]**	606.0		4 7 6	18	50	3	-	44	27	10	14	5	NP	NP	NP	6	A-1-b (0)	
MEDIUM DENSE, LIGHT BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, DAMP	604.5		6 5 4	13	61	4	-	49	20	7	15	9	20	12	8	6	A-2-4 (0)	
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, CONTAINS IRON OXIDE STAINING, DAMP	603.0		3 3 3	8	89	5	2.50	-	-	-	-	-	-	-	-	16	A-4a (V)	
			3 4 4	11	56	6	3.25	8	5	6	47	34	31	21	10	17	A-4a (8)	
HARD, BROWN, **SILT AND CLAY**, TRACE SAND, CONTAINS IRON OXIDE STAINING, DAMP	600.0		6 16 21	52	67	7	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)	
			6 21 38	62	78	8	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
	595.5	TR	11 5 3	11	33	9	-	-	-	-	-	-	-	-	-	11	A-6a (V)	
INTERBEDDED SHALE (80%) AND SANDSTONE (20%), SLIGHTLY STRONG TO STRONG, SLIGHTLY FRACTURED, RQD 81%, REC. 99%; **SHALE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG; **SANDSTONE**, LIGHT GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, SLIGHTLY ARGILLACEOUS, SLIGHTLY FRACTURED. @15.0'-16.3', REDDISH BROWN SANDSTONE, MODERATELY WEATHERED, CONTAINS IRON OXIDE STAINING @16.0'-16.5', Qu = 8,469 PSI [SANDSTONE] @16.0'-18.5', STRONG @18.0'-18.5', Qu = 9,774 PSI [SANDSTONE] @18.5'-19.0', Qu = 3,640 PSI [SANDSTONE] @20.5'-21.0', Qu = 1,804 PSI [SHALE]			50/2"	-	100	10	-	-	-	-	-	-	-	-	-	9	Rock (V)	
			71		100	NQ2-R-1											CORE	
			68		98	NQ2-R-2											CORE	

PID: 108463	SFN:	PROJECT: PIK-CR50-03.40	STATION / OFFSET: 11+65, 10' LT.	START: 8/16/19	END: 8/16/19	PG 2 OF 2	B-001-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
INTERBEDDED SHALE (80%) AND SANDSTONE (20%), SLIGHTLY STRONG TO STRONG, SLIGHTLY FRACTURED, RQD 81%, REC. 99%; **SHALE**, GRAY, SLIGHTLY WEATHERED, SLIGHTLY TO MODERATELY STRONG; **SANDSTONE**, LIGHT GRAY, MODERATELY WEATHERED, SLIGHTLY TO MODERATELY STRONG, SLIGHTLY ARGILLACEOUS, SLIGHTLY FRACTURED. *(continued)*	580.0	31	89		99	NQ2-R-3											CORE	
		32																
		33																
		34																
		35																
		36																
		37																
		38	92		100	NQ2-R-4											CORE	
		39																
	570.0	EOB 40																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; SOIL MIXED WITH BENTONITE CHIPS; BACKFILLED WITH BENTONITE GROUT

PROJECT: PIK-CR50-03.40	DRILLING FIRM / OPERATOR: DLZ / K. REINHART	DRILL RIG: '19 CME 75-079-797	STATION / OFFSET: 11+63, 9' RT.	EXPLORATION ID B-001-1-19
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: DLZ / P. MORGAL	HAMMER: CME AUTOMATIC	ALIGNMENT: CR-50	
PID: 108463 SFN:	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 8/15/19	ELEVATION: 610.5 (MSL) EOB: 14.7 ft.	PAGE 1 OF 1
START: 8/20/19 END: 8/20/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 83.7	LAT / LONG: 39.171556, -82.838532	

MATERIAL DESCRIPTION AND NOTES	ELEV. 610.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT = 9" BASE = 9"	609.0	1																
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE TO LITTLE GRAVEL, DAMP		2	6 4 5	13	78	1	3.50	-	-	-	-	-	-	-	-	15	A-6a (V)	
		3	3 5 7	17	78	2	3.25	10	5	7	48	30	31	18	13	13	A-6a (9)	
	605.0	4	4 5 8	18	83	3	4.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
HARD, LIGHT BROWN, **SILT AND CLAY**, TRACE SAND, DAMP		5	6 12 22	47	94	4	4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	
		6	6 11 13	33	89	5	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	
		7	6 14 17	43	78	6	4.5+	-	-	-	-	-	-	-	-	12	A-6a (V)	
@10.0'-11.5, CONTAINS LITTLE SANDSTONE		8																
@11.0', ENCOUNTERED HARD AUGER SCRAPING	599.0	9	7 14 50/5"	-	88	7	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	
	TR	10																
SHALE, GRAY, WEATHERED, CONTAINS TRACE IRON OXIDE STAINING.		11	33 50/3"	-	78	8	-	-	-	-	-	-	-	-	-	9	Rock (V)	
		12																
		13	28 50/2"	-	75	9	-	-	-	-	-	-	-	-	-	7	Rock (V)	
	595.8	14																
	EOB		50/2"	-	100	10	-	-	-	-	-	-	-	-	-	7	Rock (V)	

NOTES: AUGER REFUSAL AT 14.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; SOIL MIXED WITH BENTONITE CHIPS

PROJECT: PIK-CR50-03.40	DRILLING FIRM / OPERATOR: DLZ / K. REINHART	DRILL RIG: '19 CME 75-079-797	STATION / OFFSET: 12+39, 5' LT.	EXPLORATION ID B-002-0-19
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: DLZ / P. MORGAL	HAMMER: CME AUTOMATIC	ALIGNMENT: CR-50	
PID: 108463 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/15/19	ELEVATION: 613.0 (MSL) EOB: 45.0 ft.	PAGE 1 OF 2
START: 8/19/19 END: 8/19/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 83.7	LAT / LONG: 39.171686, -82.838317	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT = 9"	613.0 / 612.2																	
STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, LITTLE GRAVEL, CONTAINS TRACE ASPHALT FRAGMENTS, IRON OXIDE STAINING, DAMP **[FILL]**	610.5		2 3 4	10	78	1	1.50	-	-	-	-	-	-	-	-	15	A-6a (V)	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE TO LITTLE GRAVEL, CONTAINS IRON OXIDE STAINING, DAMP **[FILL]**			3 4 4	11	72	2	1.75	18	13	10	33	26	31	16	15	15	A-6a (7)	
			3 3 4	10	78	3	1.75	-	-	-	-	-	-	-	-	15	A-6a (V)	
			2 4 4	11	72	4	2.00	-	-	-	-	-	-	-	-	4	A-6a (V)	
			2 3 4	10	67	5	2.00	-	-	-	-	-	-	-	-	15	A-6a (V)	
	603.0		1 3 3	8	89	6	1.25	-	-	-	-	-	-	-	-	16	A-6a (V)	
VERY STIFF, BROWN AND GRAY, **SILT AND CLAY**, SOME GRAVEL, LITTLE SAND, CONTAINS PLASTIC FRAGMENT, DAMP **[FILL]**	601.5		2 4 5	13	78	7	2.50	21	6	6	37	30	30	18	12	15	A-6a (7)	
HARD, LIGHT BROWN, **SILT AND CLAY**, TRACE SAND, CONTAINS MICA, DAMP			12 30 48	109	50	8	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
			50/3"	-	133	9	-	-	-	-	-	-	-	-	-	11	A-6a (V)	
@16.0'-19.0', CONTAINS WEATHERED SHALE FRAGMENTS			15 37 50/5"	-	71	10	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
			8 50/4"	-	70	11	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	
			50/3"	-	67	12	-	-	-	-	-	-	-	-	-	8	A-6a (V)	
	594.0	TR	31 50/3"	-	33	13	-	-	-	-	-	-	-	-	-	6	Rock (V)	
SHALE, GRAY, WEATHERED.			50/4"	-	75	14	-	-	-	-	-	-	-	-	-	5	Rock (V)	
			50/4"	-	50	15	-	-	-	-	-	-	-	-	-	5	Rock (V)	
	588.0		50/3"	-	100	16	-	-	-	-	-	-	-	-	-	5	Rock (V)	
INTERBEDDED SHALE (80%) AND SANDSTONE (20%), SLIGHTLY FRACTURED, RQD 81%, REC. 98%; **SHALE**, GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, ARENACEOUS; **SANDSTONE**, LIGHT GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, FINE GRAINED, SLIGHTLY FRACTURED. @28.0'-28.5', Qu = 2,103 PSI [SHALE]			79		97	NQ2-R-1											CORE	

PID: 108463	SFN:	PROJECT: PIK-CR50-03.40	STATION / OFFSET: 12+39, 5' LT.	START: 8/19/19	END: 8/19/19	PG 2 OF 2	B-002-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
INTERBEDDED SHALE (80%) AND SANDSTONE (20%), SLIGHTLY FRACTURED, RQD 81%, REC. 98%; **SHALE**, GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, ARENACEOUS; **SANDSTONE**, LIGHT GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG, FINE GRAINED, SLIGHTLY FRACTURED. *(continued)* @31.5'-36.5', CONTAINS IRON OXIDE STAINING	583.0	31																
		32																
		33																
		34	82		100	NQ2-R-2											CORE	
		35																
		36																
		37																
		38																
		39																
		40																
		41	82		98	NQ2-R-3											CORE	
		42																
		43																
		44																
	568.0	EOB 45																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; SOIL MIXED WITH BENTONITE CHIPS; BACKFILLED WITH BENTONITE GROUT

PROJECT: PIK-CR50-03.40	DRILLING FIRM / OPERATOR: DLZ / K. REINHART	DRILL RIG: '19 CME 75-079-797	STATION / OFFSET: 12+39, 8' RT.	EXPLORATION ID B-002-1-19
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: DLZ / P. MORGAL	HAMMER: CME AUTOMATIC	ALIGNMENT: CR-50	
PID: 108463 SFN:	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 8/15/19	ELEVATION: 613.1 (MSL) EOB: 13.8 ft.	PAGE 1 OF 1
START: 8/20/19 END: 8/20/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 83.7	LAT / LONG: 39.171647, -82.838296	

MATERIAL DESCRIPTION AND NOTES	ELEV. 613.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT = 7" BASE = 3"	612.2																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, CONTAINS ASPHALT FRAGMENTS, CONTAINS IRON OXIDE STAINING, DAMP **[FILL]** @2.5'-4.0', CONTAINS STONE FRAGMENTS	609.1	1 2 3 4	3 3 4	10	0	1	-	-	-	-	-	-	-	-	-	-		
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, CONTAINS IRON OXIDE STAINING, DAMP	606.6	5 6	2 3 3	8	28	2	-	-	-	-	-	-	-	-	-	10	A-6a (V)	
			2 3 3	8	67	3	1.50	14	14	12	33	27	29	15	14	12	A-6a (7)	
SHALE, LIGHT BROWN, SEVERELY WEATHERED, MICACEOUS, CONTAINS IRON OXIDE STAINING.		TR 7	5 4 15	27	83	4	-	-	-	-	-	-	-	-	-	11	A-6a (V)	
		8	16 28 43	99	89	5	4.5+	-	-	-	-	-	-	-	-	9	Rock (V)	
		9	15 38 50/3"	-	87	6	4.5+	-	-	-	-	-	-	-	-	10	Rock (V)	
		10 11	17 46 50/3"	-	60	7	4.5+	-	-	-	-	-	-	-	-	9	Rock (V)	
		12	15 50/3"	-	56	8	4.5+	-	-	-	-	-	-	-	-	10	Rock (V)	
	599.3	EOB 13	50/3"	-	100	9	-	-	-	-	-	-	-	-	-	9	Rock (V)	

NOTES: AUGER REFUSAL AT 13.8'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; SOIL MIXED WITH BENTONITE CHIPS

PROJECT: PIK-CR50-03.40	DRILLING FIRM / OPERATOR: DLZ / K. REINHART	DRILL RIG: '19 CME 75-079-797	STATION / OFFSET: 13+57, 9' LT.	EXPLORATION ID B-003-0-19
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: DLZ / P. MORGAL	HAMMER: CME AUTOMATIC	ALIGNMENT: CR-50	
PID: 108463 SFN:	DRILLING METHOD: 3.25" HSA / NQ2	CALIBRATION DATE: 8/15/19	ELEVATION: 615.3 (MSL) EOB: 40.0 ft.	PAGE 1 OF 2
START: 8/15/19 END: 8/15/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 83.7	LAT / LONG: 39.171813, -82.837933	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
ASPHALT = 2"	615.3																	
BASE = 6"	614.6																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, CONTAINS TRACE ASPHALT FRAGMENTS, SANDSTONE FRAGMENTS, DAMP **[POSSIBLE FILL]**	612.8		2 5 8	18	17	1	3.25	-	-	-	-	-	-	-	-	11	A-6a (V)	
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE TO SOME SAND, LITTLE TO SOME GRAVEL, CONTAINS IRON OXIDE STAINING, DAMP **[POSSIBLE FILL]**			4 4 5	13	50	2	3.00	21	9	10	34	26	30	19	11	14	A-6a (5)	
@4.0-5.5', CONTAINS LARGE STONE FRAGMENT			2 3 3	8	28	3	2.50	-	-	-	-	-	-	-	-	16	A-6a (V)	
			2 3 4	10	39	4	2.00	-	-	-	-	-	-	-	-	14	A-6a (V)	
			2 3 4	10	56	5	2.50	-	-	-	-	-	-	-	-	21	A-6a (V)	
@10.0'-11.5', CONTAINS TRACE SANDSTONE FRAGMENTS, LITTLE GRAVEL, NO IRON OXIDE STAINING			1 3 5	11	61	6	3.75	13	11	9	37	30	31	17	14	14	A-6a (8)	
@11.5'-13.0', AND SAND, TRACE GRAVEL			4 5 7	17	94	7	3.25	-	-	-	-	-	-	-	-	14	A-6a (V)	
	602.3		2 4 8	17	67	8	3.50	8	19	16	28	29	27	16	11	16	A-6a (5)	
HARD, LIGHT BROWN, **SILT AND CLAY**, TRACE SAND, CONTAINS WEATHERED SHALE FRAGMENTS, IRON OXIDE STAINING			5 30 50/5"	-	53	9	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
	599.3		6 21 50/1"	-	62	10	-	-	-	-	-	-	-	-	-	11	A-6a (V)	
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), MODERATELY FRACTURED, CONTAINS MICA, TRACE IRON OXIDE STAINING, RQD 60%, REC. 99%; **SHALE**, GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED; **SANDSTONE**, LIGHT GRAY, MODERATELY WEATHERED, MODERATELY STRONG, FINE GRAINED, SLIGHTLY ARGILLACEOUS, CONTAINS TRACE IRON OXIDE STAINING.		TR.	75		97	NQ2-R-1											CORE	
@16.0'-16.7', REDDISH BROWN SANDSTONE, CONTAINS VERTICAL FRACTURE, IRON OXIDE STAINING																		
@21.0-21.5', Qu = 6,715 PSI [SANDSTONE]			48		100	NQ2-R-2											CORE	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 3/5/20 14:02 - X:\SHARED\DISCIPLINE\GEOTECH\GINT_COLUMBUS\PROJECTS\1921-1004.00 PIK-CR50-3.40.GPJ

PID: 108463	SFN:	PROJECT: PIK-CR50-03.40	STATION / OFFSET: 13+57, 9' LT.	START: 8/15/19	END: 8/15/19	PG 2 OF 2	B-003-0-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
INTERBEDDED SHALE (70%) AND SANDSTONE (30%), MODERATELY FRACTURED, CONTAINS MICA, TRACE IRON OXIDE STAINING, RQD 60%, REC. 99%;	585.3	31	46		98	NQ2-R-3											CORE	
SHALE, GRAY, MODERATELY WEATHERED, SLIGHTLY STRONG, LAMINATED;		32																
SANDSTONE, LIGHT GRAY, MODERATELY WEATHERED, MODERATELY STRONG, FINE GRAINED, SLIGHTLY ARGILLACEOUS, CONTAINS TRACE IRON OXIDE STAINING. *(continued)*		33																
@34.0'-40.0', CONTAINS IRON OXIDE STAINING		34																
		35																
		36																
		37	76		100	NQ2-R-4											CORE	
		38																
@38.4'-40.0', VERTICAL FRACTURE		39																
	575.3	EOB 40																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; SOIL MIXED WITH BENTONITE CHIPS; BACKFILLED WITH BENTONITE GROUT

PROJECT: PIK-CR50-03.40	DRILLING FIRM / OPERATOR: DLZ / K. REINHART	DRILL RIG: '19 CME 75-079-797	STATION / OFFSET: 13+56, 9' RT.	EXPLORATION ID B-003-1-19
TYPE: LANDSLIDE	SAMPLING FIRM / LOGGER: DLZ / P. MORGAL	HAMMER: CME AUTOMATIC	ALIGNMENT: CR-50	
PID: 108463 SFN:	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 8/15/19	ELEVATION: 615.0 (MSL) EOB: 15.5 ft.	PAGE 1 OF 1
START: 8/20/19 END: 8/20/19	SAMPLING METHOD: SPT	ENERGY RATIO (%): 83.7	LAT / LONG: 39.171760, -82.837910	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	615.0																	
ASPHALT = 8"	614.1																	
BASE = 3"																		
MEDIUM STIFF TO STIFF, BROWN, **SILTY CLAY**, LITTLE TO SOME SAND, LITTLE TO SOME GRAVEL, DAMP		1	3 3 3	8	28	1	-	12	13	12	34	29	32	16	16	10	A-6b (8)	
@1.0'-2.5', CONTAINS STONE FRAGMENTS		2																
@2.5'-8.5', CONTAINS TRACE IRON OXIDE STAINING		3	1 3 3	8	50	2	-	-	-	-	-	-	-	-	-	15	A-6b (V)	
		4																
		5	2 2 1	4	50	3	1.50	-	-	-	-	-	-	-	-	13	A-6b (V)	
		6	1 2 2	6	72	4	1.25	23	11	10	30	26	32	15	17	14	A-6b (7)	
		7																
		8	1 2 2	6	67	5	0.75	-	-	-	-	-	-	-	-	18	A-6b (V)	
@8.5'-9.0', HP = 0.5 TSF	606.0																	
HARD, LIGHT BROWN, **SILT AND CLAY**, TRACE SAND, CONTAINS MICA, DAMP		9	2 6 15	29	67	6	4.5+	-	-	-	-	-	-	-	-	7	A-6a (V)	
		10																
	603.5	11	20 29 48	107	94	7	-	-	-	-	-	-	-	-	-	10	A-6a (V)	
		TR																
SHALE, GRAY, WEATHERED, CONTAINS MICA, IRON OXIDE STAINING.		12	16 50/5"	-	64	8	-	-	-	-	-	-	-	-	-	9	A-6a (V)	
		13																
		14	16 50/5"	-	55	9	-	-	-	-	-	-	-	-	-	7	A-6a (V)	
		15																
@14.5', GRAY	599.5		49 50/2"	-	-	10	-	-	-	-	-	-	-	-	-	8	Rock (V)	
		EOB																

DRAFT

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; SOIL MIXED WITH BENTONITE CHIPS

Boring: B-001-0-19 **Run: R-1** **Depth: 15.0'-21.0'** **REC: 100%** **RQD: 71%**

Boring: B-001-0-19 **Run: R-2** **Depth: 21.0'-26.0'** **REC: 100%** **RQD: 71%**

Boring: B-001-0-19 **Run: R-3** **Depth: 26.0'-36.0'** **REC: 99%** **RQD: 89%**

Boring: B-001-0-19 **Run: R-4** **Depth: 36.0'-40.0'** **REC: 100%** **RQD: 92%**

Boring: B-002-0-19 **Run: R-1** **Depth: 25.0'-31.5'** **REC: 97%** **RQD: 79%**

Boring: B-002-0-19 **Run: R-2** **Depth: 31.5'-36.5'** **REC: 100%** **RQD: 82%**

Boring: B-002-0-19 **Run: R-3** **Depth: 36.5'-45.0'** **REC: 98%** **RQD: 82%**

Boring: B-003-0-19 **Run: R-1** **Depth: 16.0'-21.0'** **REC: 97%** **RQD: 75%**
Boring: B-003-0-19 **Run: R-2** **Depth: 21.0'-26.0'** **REC: 100%** **RQD: 48%**

Boring: B-003-0-19 **Run: R-3** **Depth: 26.0'-34.0'** **REC: 98%** **RQD: 46%**

Boring: B-003-0-19 **Run: R-4** **Depth: 34.0'-40.0'** **REC: 100%** **RQD: 76%**

CLIENT	**PCEO**	DLZ JOB NUMBER	**1921-1004.00**		
PROJECT	**PIK-CR50-03.40**	SHEET NO.	1	OF	4
SUBJECT		TEST COMP. BY	WV	DATE	9/30/19
EQUIPMENT	Concrete Load Frame	CHECKED BY	SR	DATE	9/30/19

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012, Method C)

Boring No.: B-001-0-19 Rock Description: Sandstone

Run No.: R-1 Moisture Condition at Test: As Received

Depth: 16'-16.5'

Diameter:	1.981	1.977	1.978	1.976	1.978	1.981	**1.978** in
	(D_1)	(D_2)	(D_3)	(D_4)	(D_5)	(D_6)	(D_{AVG})

Length:	4.338	4.384	4.324	**4.349** in	L/D =	2.198
	(L_1)	(L_2)	(L_3)	(L_{AVG})		

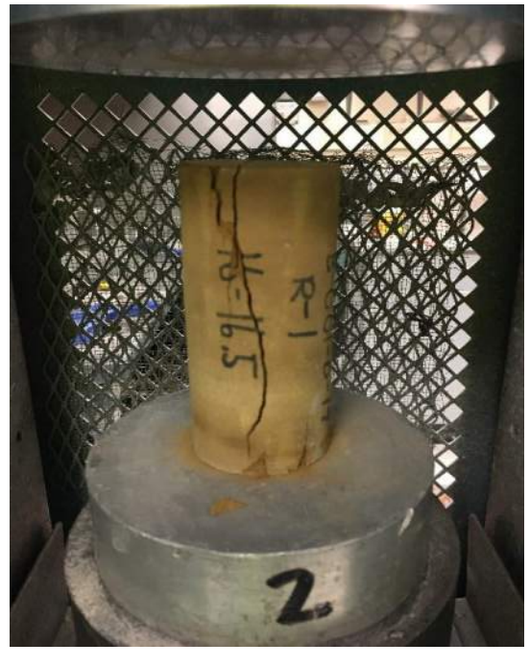
Volume: 0.007730767 ft^3 Mass: 469.50 g Unit Weight: **133.89** pcf

Failure Load: 26,030 lbs

Strength: 8,469 psi

Original Specimen

Fractured Specimen



Remarks:

6121 Huntley Road * Columbus, Ohio 43229-1003 * (614) 888-0040 * FAX (614) 431-4024

CLIENT	**PCEO**	DLZ JOB NUMBER	**1921-1004.00**
PROJECT	**PIK-CR50-03.40**	SHEET NO.	6 OF 6
SUBJECT		TEST COMP. BY	WV DATE 9/26/19
EQUIPMENT	Concrete Load Frame	CHECKED BY	SR DATE 9/26/19

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012, Method C)

Boring No.: B-001-0-19 Rock Description: Sandstone

Run No.: R-1 Moisture Condition at Test: As Received

Depth: 18.5'-19'

Diameter:	1.977 (D_1)	1.980 (D_2)	1.970 (D_3)	1.979 (D_4)	1.981 (D_5)	1.973 (D_6)	**1.977** in (D_{AVG})

Length:	4.220 (L_1)	4.211 (L_2)	4.220 (L_3)	**4.217** in (L_{AVG})	$\frac{L}{D}$ = 2.133

Volume: 0.007485369 ft^3 Mass: 490.14 g Unit Weight: **144.36** pcf

Failure Load: 11,170 lbs

Strength: 3,640 psi

Original Specimen

Fractured Specimen

Remarks:

6121 Huntley Road * Columbus, Ohio 43229-1003 * (614) 888-0040 * FAX (614) 431-4024

CLIENT	**PCEO**	DLZ JOB NUMBER	**1921-1004.00**		
PROJECT	**PIK-CR50-03.40**	SHEET NO.	5	OF	6
SUBJECT		TEST COMP. BY	WV	DATE	9/26/19
EQUIPMENT	Concrete Load Frame	CHECKED BY	SR	DATE	9/26/19

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012, Method C)

Boring No.: B-001-0-19 Rock Description: Sandstone

Run No.: R-1 Moisture Condition at Test: As Received

Depth: 18'-18.5'

Diameter:	1.983	1.980	1.976	1.986	1.981	1.979	**1.981** in
	(D_1)	(D_2)	(D_3)	(D_4)	(D_5)	(D_6)	(D_{AVG})

Length:	4.210	4.199	4.209	**4.206** in	$\frac{L}{D}$ =	2.123
	(L_1)	(L_2)	(L_3)	(L_{AVG})		

Volume: 0.007497352 ft^3 Mass: 489.11 g Unit Weight: **143.83** pcf

Failure Load: 30,120 lbs

Strength: 9,774 psi

Original Specimen

Fractured Specimen

Remarks:

6121 Huntley Road * Columbus, Ohio 43229-1003 * (614) 888-0040 * FAX (614) 431-4024

CLIENT	PCEO	DLZ JOB NUMBER	1921-1004.00		
PROJECT	PIK-CR50-03.40	SHEET NO.	2	OF	4
SUBJECT		TEST COMP. BY	WV	DATE	9/30/19
EQUIPMENT	Concrete Load Frame	CHECKED BY	SR	DATE	9/30/19

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012, Method C)

Boring No.: B-001-0-19 Rock Description: Shale

Run No.: R-1 Moisture Condition at Test: As Received

Depth: 20.5'-21'

Diameter:	(D_1)	(D_2)	(D_3)	(D_4)	(D_5)	(D_6)	(D_{AVG})
	1.951	1.962	1.962	1.938	1.947	1.953	**1.952** in

Length:	(L_1)	(L_2)	(L_3)	(L_{AVG})	L/D =
	4.364	4.382	4.373	**4.373** in	2.240

Volume: 0.007569755 ft^3 Mass: 535.64 g Unit Weight: **156.00** pcf

Failure Load: 5,400 lbs

Strength: 1,804 psi

Original Specimen

Fractured Specimen

Remarks:

6121 Huntley Road * Columbus, Ohio 43229-1003 * (614) 888-0040 * FAX (614) 431-4024

CLIENT	**PCEO**	DLZ JOB NUMBER	**1921-1004.00**		
PROJECT	**PIK-CR50-03.40**	SHEET NO.	3	OF	4
SUBJECT		TEST COMP. BY	WV	DATE	9/27/19
EQUIPMENT	Concrete Load Frame	CHECKED BY	SR	DATE	9/27/19

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012, Method C)

Boring No.: B-002-0-19 Rock Description: Shale

Run No.: R-1 Moisture Condition at Test: As Received

Depth: 28'-28.5'

Diameter:	1.963 (D_1)	1.985 (D_2)	1.959 (D_3)	1.975 (D_4)	1.968 (D_5)	1.968 (D_6)	**1.969** in (D_{AVG})

Length:	4.564 (L_1)	4.586 (L_2)	4.571 (L_3)	**4.574** in (L_{AVG})	$\frac{L}{D}$ = 2.322

Volume: 0.008058615 ft^3 Mass: 572.49 g Unit Weight: **156.62** pcf

Failure Load: 6,405 lbs

Strength: 2,103 psi

Original Specimen

Fractured Specimen

Remarks:

6121 Huntley Road * Columbus, Ohio 43229-1003 * (614) 888-0040 * FAX (614) 431-4024

CLIENT	**PCEO**	DLZ JOB NUMBER	**1921-1004.00**
PROJECT	**PIK-CR50-03.40**	SHEET NO.	4 OF 4
SUBJECT		TEST COMP. BY	WV DATE 9/30/19
EQUIPMENT	Concrete Load Frame	CHECKED BY	SR DATE 9/30/19

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012, Method C)

Boring No.: B-003-0-19 Rock Description: Sandstone

Run No.: R-2 Moisture Condition at Test: As Received

Depth: 21'-21.5'

Diameter:	1.977 (D_1)	1.765 (D_2)	1.979 (D_3)	1.979 (D_4)	1.978 (D_5)	1.979 (D_6)	**1.943** in (D_{AVG})

Length:	4.773 (L_1)	4.759 (L_2)	4.773 (L_3)	**4.768** in (L_{AVG})	$\frac{L}{D}$ = 2.455

Volume: 0.008173653 ft^3 Mass: 523.63 g Unit Weight: **141.24** pcf

Failure Load: 19,900 lbs

Strength: 6,715 psi

Original Specimen

Fractured Specimen

Remarks:

6121 Huntley Road * Columbus, Ohio 43229-1003 * (614) 888-0040 * FAX (614) 431-4024

ODOT Geophysical Exploration

Jason Hughes

From: Andrew.Jalbrzikowski@dot.ohio.gov
Sent: Wednesday, October 2, 2019 12:57 PM
To: Jason Hughes
Cc: Justin.Gardner@dot.ohio.gov; 'Pike County Engineers Office'; 1921.1004; 1921.1005; Christopher Selvaggio; Paul.Painter@dot.ohio.gov; Michael Kennedy, P.E.; Chris.Merklin@dot.ohio.gov; Christopher.Pridemore@dot.ohio.gov; Adam.Ross@dot.ohio.gov
Subject: PIK-CR50-3.40 PID 108463 Geophysical Testing
Attachments: PIK-CR50-3.40 Geophysics Summary.pdf

Jason,

The results of the geophysical exploration for the subject project are attached. The latitude, longitude, and elevation values used in these exhibits are from a Trimble Geo7X handheld GPS. The field work was completed on September 12 and 16, 2019.

The electrical resistivity (ER) data was collected with an Advanced Geosciences Inc. (AGI) SuperSting R8 control unit. Fifty-six electrodes were spaced approximately 5 feet for the survey line. The electrodes were used to measure the potential field with Dipole-Dipole and Strong Gradient Arrays. The data was processed, and surface elevation corrected using AGI's EarthImager 2D software.

The ER survey line was completed downslope of the guardrail, very close to the wall alignment. There is a sharp resistivity increase ranging from an approximate elevation of 585 to the west and rising to an approximate elevation of 600 to the east. This indicates the top of rock is approximately 5-10 feet lower at the proposed alignment in comparison to what was encountered in the borings.

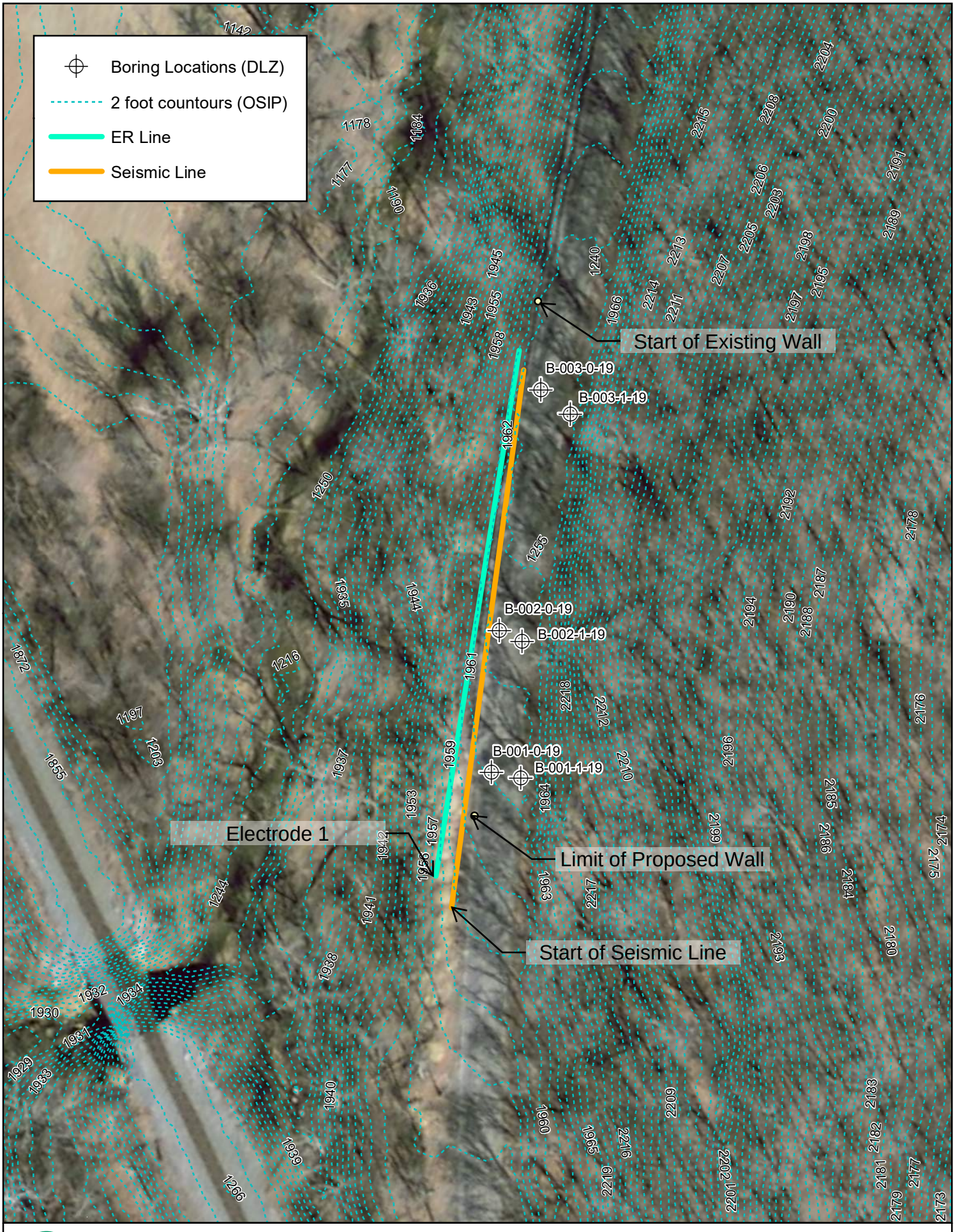
The s-wave refraction microtremor (ReMi) and p-wave refraction data was collected with a SeismicSource DAQlink III 24 channel seismograph along one survey line using 24 geophones spaced approximately 10 feet apart. For the refraction survey, seventy-five P-wave records were collected. Each consisted of a 0.5 second record using a .125 millisecond sampling interval collected at fifteen shot locations. Due to equipment problems, only three ReMi records were collected. The ReMi data consisted of 30 second records using a 2-millisecond sampling interval. Data was recorded with a laptop computer using SeismicSource Vibrascope software. A 16-pound sledge hammer struck against an aluminum plate or the pavement surface was used as the seismic source. The data was processed and surface elevation corrected by SubTerraSeis using Vibrascope, Geogiga Seismic Pro, and Golden Surfer software packages.

The seismic line was completed upslope of the guard rail, on and along the edge of the road. Both the refraction section and ReMi profile indicate a sharp increase in velocity at a depth of 30-40 feet. This could indicate the presence of sandstone below the shale encountered in the borings. The change in p-wave velocities from 3,000 to 4,000 ft/sec corresponds to the approximate top of rock.

I hope you find this information useful in the design of the landslide remediation. Please don't hesitate to call if you have any questions.

Thanks,

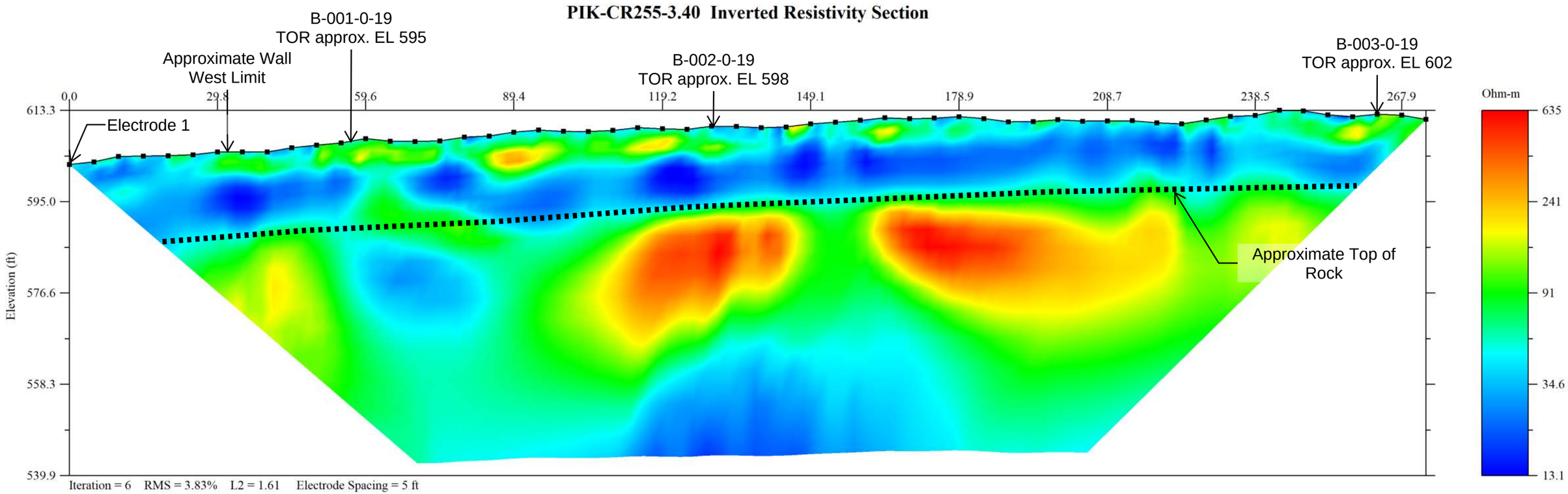
Andrew M. Jalbrzikowski
Field Exploration Manager
ODOT Office of Geotechnical Engineering
1600 W. Broad Street, Columbus, Ohio 43223
614.275.1305
transportation.ohio.gov

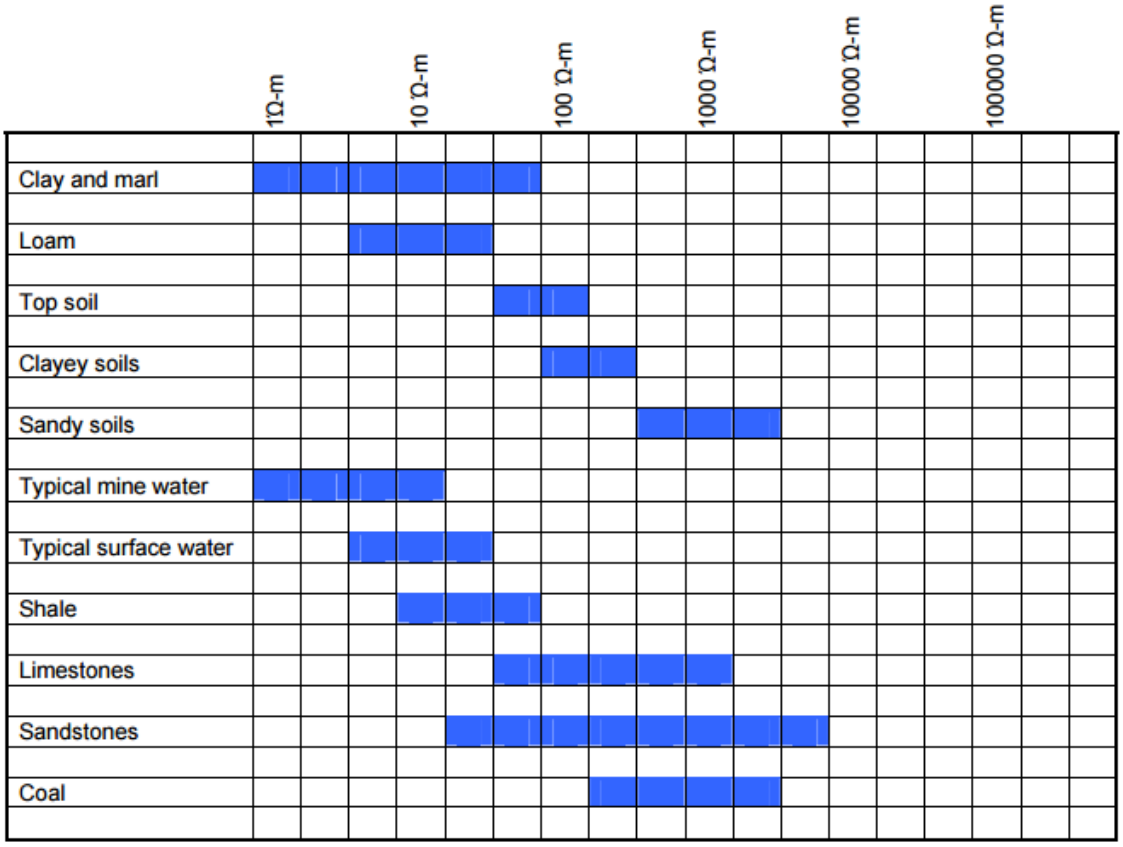


PIK-CR50-3.40
Exploration Plan

0 20 40 80
Feet

PIK-CR255-3.40 Inverted Resistivity Section





Typical resistivity range of earth materials in ohm-meters

Johnson, J. (2003) Application of the Electrical Resistivity Method for Detection of Underground Mine Workings. Monroeville, PA. Retrieved December 17, 2015 from: https://www.fhwa.dot.gov/engineering/geotech/hazards/mine/workshops/ktwkshp/ky0311.pdf

PIK-CR50-3.40 2D Refraction Section

West

East

Approximate West Wall Limit

B-001-0-19
TOR approx. EL 595

B-002-0-19
TOR approx. EL 598

B-003-0-19
TOR approx. EL 602

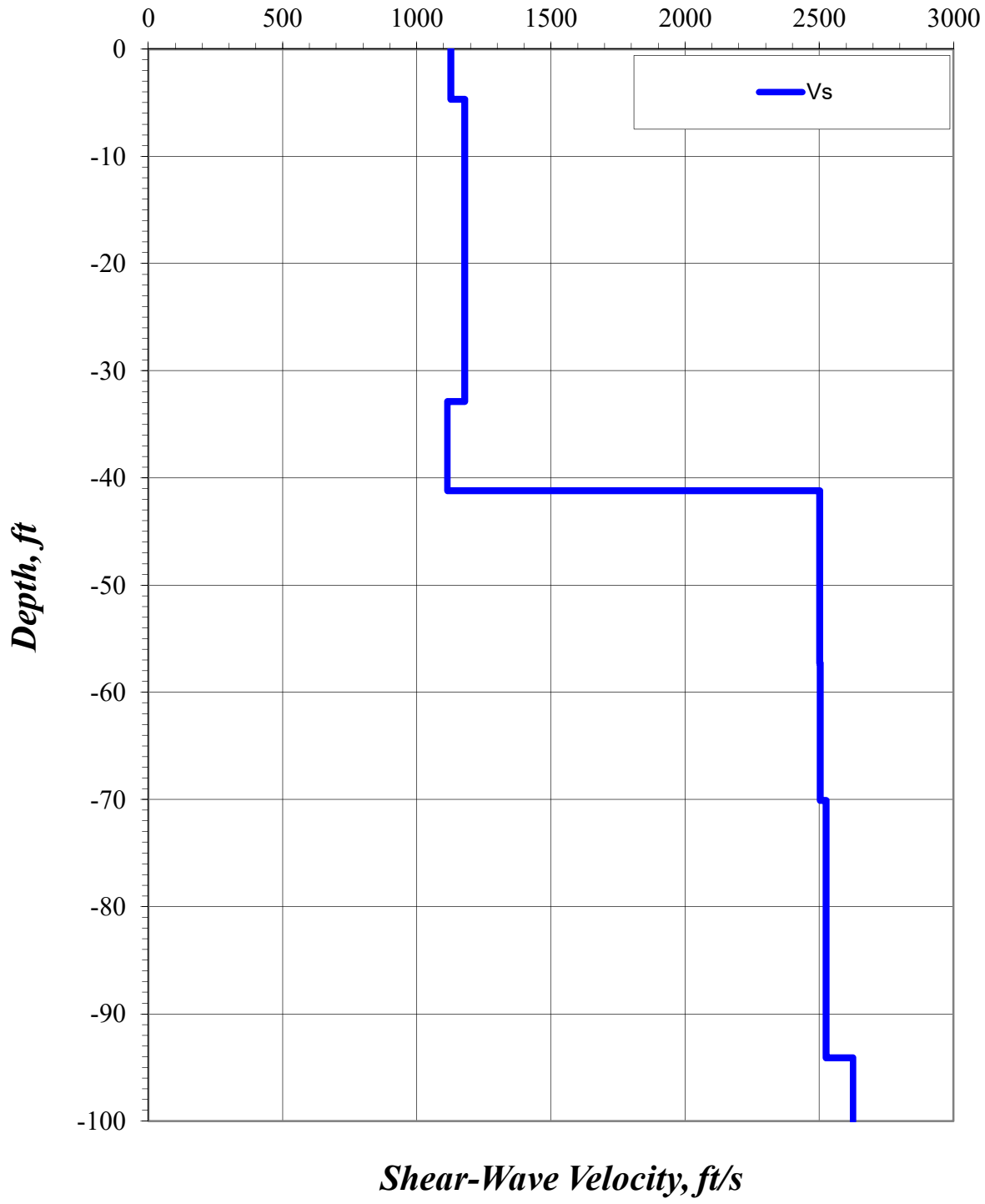
Approximate Top of Rock

Elevation, ft

Distance, ft

Vp, ft/s

PIK-CR50-0340 ReMi: Vs Model

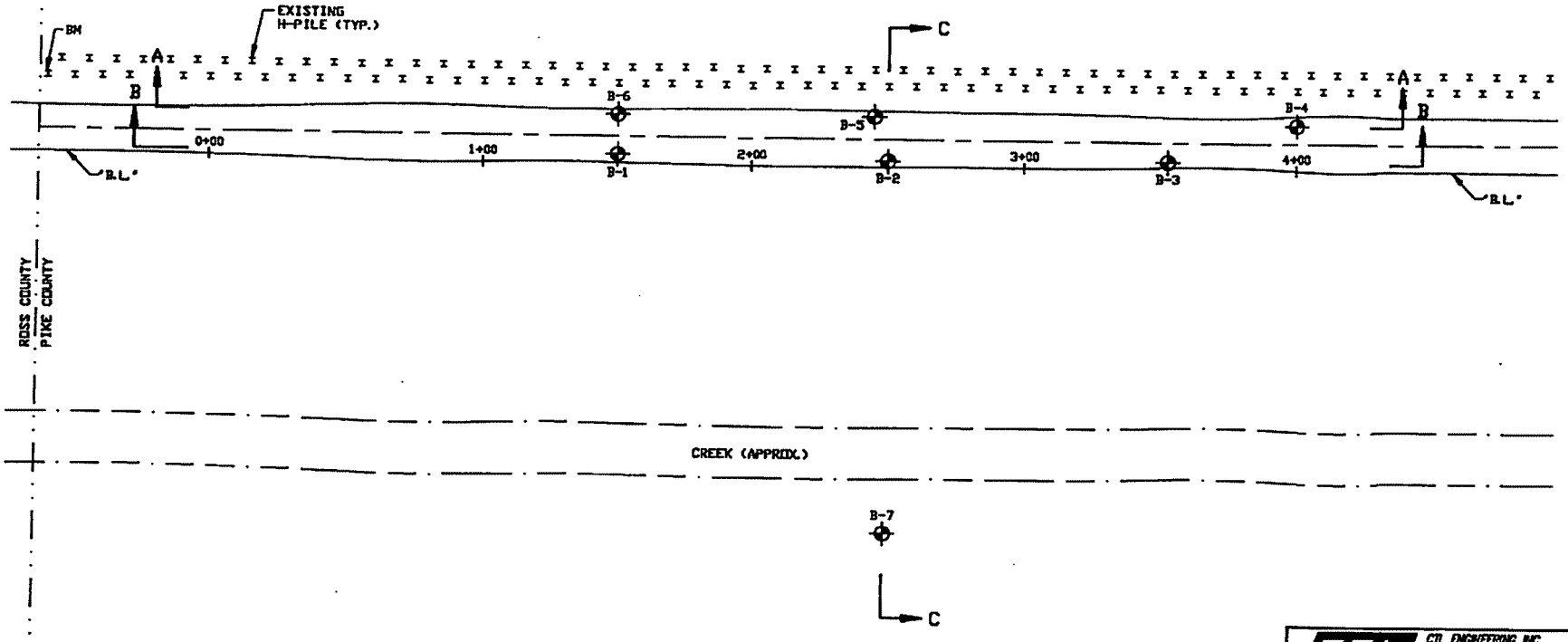


Parameters That Influence Seismic Velocity

Type of formation	P wave velocity (m/s) range		S wave velocity (m/s) range		Density (g/cm^3)	P wave velocity (ft/s) range		S wave velocity (ft/s) range	
	Low	High	Low	High		Low	High	Low	High
Scree, vegetal soil	300	700	100	300	1.7-2.4	980	2290	320	980
Dry sands	400	1200	100	500	1.5-1.7	1310	3930	320	1640
Wet sands	1500	2000	400	600	1.9-2.1	4920	6560	1310	1960
Saturated shales and clays	1100	2500	200	800	2.0-2.4	3600	8200	650	2620
Marls	2000	3000	750	1500	2.1-2.6	6560	9840	2460	4920
Saturated shale and sand sections	1500	2200	500	750	2.1-2.4	4920	7210	1640	2460
Porous and saturated sandstones	2000	3500	800	1800	2.1-2.4	6560	11480	2620	5900
Limestones	3500	6000	2000	3300	2.4-2.7	11480	19680	6560	10820
Chalk	2300	2600	1100	1300	1.8-3.1	7540	8530	3600	4260
Salt	4500	5500	2500	3100	2.1-2.3	14760	18040	8200	10170
Anhydrite	4000	5500	2200	3100	2.9-3.0	13120	18040	7210	10170
Dolomite	3500	6500	1900	3600	2.5-2.9	11480	21320	6230	11810
Granite	4500	6000	2500	3300	2.5-2.7	14760	19680	8200	10820
Basalt	5000	6000	2800	3400	2.7-3.1	16400	19680	9180	11150
Gneiss	4400	5200	2700	3200	2.5-2.7	14430	17060	8850	10490
Coal	2200	2700	1000	1400	1.3-1.8	7210	8850	3280	4590
Water	1450	1500	-	-	1.0	4750	4920	-	-
Ice	3400	3800	1700	1900	0.9	11150	12460	5570	6230
Oil	1200	1250	-	-	0.6-0.9	3930	4100	-	-

Adapted from typical rock velocities, from Bourbié, Coussy, and Zinszner. (1987) Acoustics of Porous Media, Gulf Publishing.

Historic Boring Records



0 40 80 100 120

BM = TOP OF H-PILE SEE SITE PLAN
ELEVATION ASSUMED AT 100.0

CTL ENGINEERING INC.
CONSULTING ENGINEERS
TESTING • INSPECTION
LABORATORY SERVICES

BORING LOCATION PLAN

DATE	PIKE CO. ENGINEER
10-1-97	SLOPE STABILITY STUDY
SCALE 1"=40'	C.R. 50, PIKE CO., OHIO

DRAWN BY	REVIEWED BY	PAGE	PROJECT NO.
M. TABB	JKA	1 OF 6	97050249

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-7

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-19-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-19-97

BORING ELEVATION: 67.8 — BORING METHOD: HSA/RC — HAMMER: Automatic

STATION : 2+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 135.0' Right of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 73°

DEPTH : 14.5 Feet — CORE SIZE : NX — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 6.3' after coring, At 0.5 hour 6.3', Caved in at 7.0'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
		Very Loose, Damp, Brown FINE SAND TO SILTY SAND with Silt Seams and Roots (CREEK SEDIMENTS)		SS-1	1 1 1	2	100	20					
				SS-2	1 1 1	2	100	25					
61.4		Medium Dense, Wet, Brown SILTY FINE TO COARSE SAND AND GRAVEL with Sandstone Fragments	6.4'	SS-3	4 6 6	12	100	15					
59.3			8.5'										
58.8		Gray Highly Weathered, Decomposed SHALE	9.0'	SS-4 9.5'	50 2"		100	8					
	10												
		Interbedded, Tan, Fine Grained SANDSTONE and Gray Weathered CLAYSHALE		CR-1 RQD= 53%			67						
54.8			13.0'										
53.3		Gray Weathered SHALE, Medium Bed Thickness	14.5'	14.5'									
	15	BOTTOM OF BORING											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
CR - Rock Core Sample
BS - Bag Sample

ABBREVIATIONS:
El = Stratum Elevation
D = Sample Depth
Ds = Stratum Depth
S# = Sample Number
N = Blows per 12"
R = % Recovery
W = Moisture Content
γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-6

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 107.5 — BORING METHOD: HSA — HAMMER: Automatic

STATION : 1+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 18.0' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 64°

DEPTH : 9.9 Feet — CORE SIZE : -- — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 6.0'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
		ASPHALT CONCRETE											
106.8			8"										
	x	Stiff, Damp to Moist,			7								
	x	Brown **CLAYEY SILT**, Some		SS-1	6	10	72	15	115.8	6.0*			
	x	Fine Sand	2.5'		4								
	x				2								
	x			SS-2	2	5	78	13					
	x	Loose, Moist, Brown **SILTY**			3								
	x	**FINE SAND**, Traces of Clay			3								
5	x			SS-3	2	5	94	13	113.1				
102.0	x		5.5'		3								
	x				6								
	x			SS-4	7	17	78	13					
	x				10								
	x	Brown and Gray Highly			14								
	x	Decomposed, Weathered		SS-5	20	48	94	9					
	x	**SHALE** with Sandstone			28								
	x	Fragments			15								
	x			SS-6	47		88	9					
97.6	10 x		9.9'		50								
		BOTTOM OF BORING			5"								
		AUGER REFUSAL											

BORING METHOD
HSA - Hollow Stem Auger
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γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-5

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 111.8 — BORING METHOD: HSA — HAMMER: Automatic

STATION : 2+45 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 18.8' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 63°

DEPTH : 11.5 Feet — CORE SIZE : -- — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 8.2'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
111.0		**ASPHALT CONCRETE** 9"											
					3								
				SS-1	7	13	56	18	125.9	4.0*			
					6								
		Stiff, Damp, Brown and			6								
		Gray **CLAYEY SILT** with		SS-2	5	10	61	17	123.8	5.0*			
		Sandstone Fragments			5								
					5								
	5			SS-3	5	10	72	21	124.6	6.0*			
106.3			5.5'		5								
		Stiff, Moist, Brown and		SS-4A	5			24		4.0*			
105.3		Gray **SANDY SILT**, Traces	6.5'		7	12	83						
		of Clay with		SS-4B	5			15					
		Sandstone Fragments			3								
				SS-5	6	12	78	15					
103.3		Medium Dense, Damp,	8.5'		6								
		Brown **SILTY FINE TO**			5								
		COARSE SAND with		SS-6	19	35	72	13					
	10	Sandstone Fragments			16								
					25								
		Brown and Gray Highly		SS-7	39	89	89	8					
100.3		Decomposed, Weathered	11.5'		50								
		SHALE with Sandstone			6"								
		Layers											
		BOTTOM OF BORING											
		AUGER REFUSAL											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
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HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
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UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

GTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-4

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 108.8 — BORING METHOD: HSA — HAMMER: Automatic

STATION : 4+00 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 16.8' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 65°

DEPTH : 18.5 Feet — CORE SIZE : -- — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion Dry, At 24 hours Dry, Caved in at 5.9'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
108.0		**ASPHALT CONCRETE**	10"										
	x				3								
	x	Medium Stiff to Very		SS-1	4	8	61	19	128.3	8.0*			
	x	Stiff, Damp, Brown **CLAYEY**			4								
	x	**SILT** with Shale and			7								
	x	Sandstone Fragments		SS-2	6	16	78	13		7.0*			
	x				10								
104.3	x		4.5'	SS-3A	7			12					
	5 x				10	29	83						
	x			SS-3B	19			14					
	x				15								
	x			SS-4	22	52	72	11					
	x	Brown and Gray Highly,			30								
	x	Decomposed, Weathered			12								
	x	**SHALE** with Sandstone		SS-5	29	69	72	10					
	x	Layers			40								
	x				14								
	x			SS-6	30			9					
98.8	10 x		10.0'		50								
	-	**BOTTOM OF BORING**			4"								
		AUGER REFUSAL											

BORING METHOD
HSA - Hollow Stem Auger
SFA - Solid Flight Auger
RC - Rock Coring
MD - Mud Drilling
WD - Wash Drilling
HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
ST - Shelby Tube Sample
CR - Rock Core Sample
BS - Bag Sample

ABBREVIATIONS:
El = Stratum Elevation
D = Sample Depth
Ds = Stratum Depth
S# = Sample Number
N = Blows per 12"
R = % Recovery
W = Moisture Content
γ = Unit Weight, pcf
UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer
PROJECT: Slope Stability Study
LOCATION: CR 50, Pike County, Ohio
PROJECT NO.: 97050249

BORING NO.: B-3
SHEET 1 OF 1
DATE STARTED : 09-18-97
DATE COMPLETED: 09-18-97

BORING ELEVATION: 110.4
STATION : 3+53
OFFSET : 2.0' Left of B.L.
DEPTH : 19.5 Feet

BORING METHOD: HSA/RC
RIG TYPE : CME 45c
CASING DIA. : 3½"
CORE SIZE : NX

HAMMER: Automatic
DRILLER : IC
TEMPERATURE: 65°
WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 5.9' after coring, At 5.0 hours 7.1', Caved in at 9.7'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
		ASPHALT CONCRETE (8") over **BASE COURSE** (6")											
109.2			14"		7								
				SS-1	6	12	44	12		9+*			
					6								
					3								
				SS-2	3	5	50	15		8.0*			
		Medium Stiff to Stiff,			2								
		Damp, Brown **SANDY SILT**,			3								
	5	Little Fine to Coarse		SS-3	4	7	72	15		9+*	25	22	3
		Gravel with Sandstone			3								
		Fragments, Cobbles and			2								
		Fine Sand Seams		SS-4	3	7	78	13					
		A-4a to A-2-4			4								
					3								
				SS-5	4	8	16	10			NP	NP	NP
101.9			8.5'		4								
				SS-6A	12			11					
		Rusty Brown Weathered			25	37	72						
100.4	10	**SANDSTONE**	10.0'	SS-6B	12			12					
				10.0'									
		Highly Weathered											
		Interbedded Tan **SANDSTONE**		CR-1									
		and Gray to Tan **SHALE**		RQD=			36						
				0%									
97.4			13.0'	13.0'									
		Light Gray to Tan,		CR-2									
95.8		Weathered **SHALE**	14.6'	RQD=			97						
	15	Tan Fine Grained		50%									
94.9		**SANDSTONE**	15.5'	15.5'									
		Light Gray, Weathered		CR-3									
		SHALE with Thin Interbeds		RQD=			65						
		of Fine Grained Sandstone		8%									
90.9			19.5'	19.5'									
	20	**BOTTOM OF BORING**											

BORING METHOD
HSA - Hollow Stem Auger
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SAMPLING METHOD
SS - Split Spoon Sample
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UC= Unconf.Comp.,Ksf
* = Hand Penetrometer
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
SPT= Standard Penetration Test

CTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-2

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 111.9 — BORING METHOD: HSA/RC — HAMMER: Automatic

STATION : 2+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 2.2' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 65°

DEPTH : 19.5 Feet — CORE SIZE : NX — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 6.3' after coring, At 24 hours 8.6', Caved in at 10.9'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
111.4		ASPHALT CONCRETE	6"										
					4								
				SS-1	3	6	78	17		8.0*			
					3								
		Soft to Stiff, Damp,			2								
		Brown and Gray SANDY		SS-2	2	3	72	17		7.0*	30	20	10
		SILT TO CLAYEY SILT,			1								
		Little Fine to Coarse			7								
	5	Gravel with Sandstone		SS-3	4	10	44	18					
		Fragments and Cobbles			6								
		A-4a			4								
				SS-4	3	5	11	11					
104.8			7.1'		2								
					4								
				SS-5	2	5	67	14	120.0				
					3								
					3								
		Loose to Medium Dense,		SS-6	4	8	61	13					
	10	Damp, Brown SILTY SAND,			4								
		Some Clay with Sandstone			9								
		Fragments and Silt Seams		SS-7	6	14	100	18	120.8		32	17	15
		A-6a			8								
				SS-8A	7			15					
99.4			12.5'		8	22	100						
				SS-8B	14			13					
		Gray Weathered,			14								
		Decomposed SHALE with		SS-9	40		100	12					
97.4		Sandstone Layers	14.5'	14.5'	50								
	15				4"								
		Light Gray, Thinly		CR-1									
		Bedded Soft, Weathered		RQD=			63						
		SHALE		27%									
93.0			18.9'										
		Tan, Fine Grained, Well											
92.4		Sorted SANDSTONE	19.5'	19.5'									
	20	BOTTOM OF BORING											

BORING METHOD
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HA - Hand Auger

SAMPLING METHOD
SS - Split Spoon Sample
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ABBREVIATIONS:
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SPT= Standard Penetration Test

GTL ENGINEERING

TEST BORING RECORD

CLIENT: Pike County Engineer — BORING NO.: B-1

PROJECT: Slope Stability Study — SHEET 1 OF 1

LOCATION: CR 50, Pike County, Ohio — DATE STARTED : 09-18-97

PROJECT NO.: 97050249 — DATE COMPLETED: 09-18-97

BORING ELEVATION: 107.7 — BORING METHOD: HSA/RC — HAMMER: Automatic

STATION : 1+50 — RIG TYPE : CME 45c — DRILLER : IC

OFFSET : 3.2' Left of B.L. — CASING DIA. : 3¼" — TEMPERATURE: 65°

DEPTH : 18.5 Feet — CORE SIZE : NX — WEATHER: Sunny

GROUNDWATER: Encountered at Dry, At completion 6.5' after coring, At 24 hours 6.6', Caved in at 9.7'

El	D	SOIL/MATERIAL DESCRIPTION	DS	S#	SPT per 6"	N	R	W	γ	UC	Atterberg Limits LL	PL	PI
		ASPHALT CONCRETE (12") over **CRUSHED ASPHALT (6")**											
106.2			1.5'	SS-1A	5			4					
		Loose, Damp, Brown **FINE**			5	8	22						
105.2		**TO COARSE SAND AND GRAVEL**	2.5'	SS-1B	3			6					
					2								
				SS-2	4	7	50	13		5.0*	35	18	7
					3								
					2								
	5	Soft to Stiff, Damp to		SS-3	2	4	28	13		4.0*			
		Moist, Brown **SANDY SILT,**			2								
		Some Fine to Coarse			1								
		Gravel, Little Clay with		SS-4	2	5	44	14		7.0*			
		Sandstone Fragments and			3								
		Cobbles			2								
		A-4a to A-2-4		SS-5	3	10	56	16		9+*			
					7								
					5								
				SS-6	5	12	50	22		6.0*			
	10				7								
97.0			10.7'		10								
				SS-7	13	33	61	10					
					20								
		Gray and Brown Weathered,		SS-8A	9			8					
		Decomposed **SHALE** with			20	48	83						
		Sandstone Layers		SS-8B	28			10					
94.2			13.5'	SS-9	50								
				13.5'	1"								
		Tan, Well Sorted, Fine		CR-1									
	15	Grained **SANDSTONE**		RQD=			71						
92.2			15.5'	42%									
				15.5'									
		Light Gray, Thinly											
		Bedded, Weathered **SHALE,**		CR-2									
		Some Iron Stained		RQD=			100						
		Inclined Fractures		53%									
89.2			18.5'	18.5'									
		BOTTOM OF BORING											

BORING METHOD
HSA - Hollow Stem Auger
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WD - Wash Drilling
HA - Hand Auger

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LL = Liquid Limit
PL = Plastic Limit
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CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-1	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-2	Tech:	M.E.
	Pike County, Ohio			Depth:	2.5'-4.0'
Project #	97050249			Assumed Gs:	2.70

Total Sample Weight =	196.41 grams	Hydrometer Sample Weight =	30.50 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	11.3	5.8	94.2
3/8"	40.3	20.5	79.5
#4	52.5	26.7	73.3
#10	61.9	31.5	68.5
#40	77.7	39.6	60.4
#200	7.4	54.2	45.8

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	25.0	5.5	19.5	38.23	0.01328	13.11	0.0340
15	17.0	5.5	11.5	22.55	0.01328	14.42	0.0130
60	14.0	5.5	8.5	16.66	0.01328	14.91	0.0066
250	11.0	5.5	5.5	10.78	0.01328	15.4	0.0033
1440	10.0	5.5	4.5	8.82	0.01328	15.56	0.0014

Summary of Grain Size Distribution

6	% COARSE GRAVEL
26	% FINE GRAVEL
8	% COARSE SAND
15	% FINE SAND
31	% SILT
14	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	35
Plastic Limit	18
Plasticity Index	7

Soil Description: SANDY SILT, some Gravel, little Clay

AASHTO Soil Classification(ODOT): A-4a (3)

CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-1	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-6	Tech:	M.E.
	Pike County, Ohio			Depth:	8.5'-10.0'
Project #	97050249			Assumed Gs:	2.70

Total Sample Weight =	188.43	grams	Hydrometer Sample Weight =	29.77	grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	11.9	6.3	93.7
3/8"	58.4	31.0	69.0
#4	71.9	38.2	61.8
#10	81.7	43.4	56.6
#40	101.7	54.0	46.0
#200	9.5	68.7	31.3

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	23.0	5.5	17.5	26.77	0.01328	13.44	0.0344
15	19.5	5.5	14.0	21.42	0.01328	14.01	0.0128
60	18.0	5.5	12.5	19.12	0.01328	14.26	0.0065
250	16.5	5.5	11.0	16.83	0.01328	14.5	0.0032
1440	14.5	5.5	9.0	13.77	0.01328	14.83	0.0013

Summary of Grain Size Distribution

6	% COARSE GRAVEL
37	% FINE GRAVEL
11	% COARSE SAND
15	% FINE SAND
13	% SILT
18	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	N.P.
Plastic Limit	N.P.
Plasticity Index	N.P.

Soil Description: SANDY GRAVEL, little Silt, little Clay

AASHTO Soil Classification(ODOT): A-2-4

GTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-2	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-2	Tech:	M.E.
	Pike County, Ohio			Depth:	2.5'-4.0'
Project #	97050249			Assumed Gs:	2.70

Total Sample Weight =	206.62 grams	Hydrometer Sample Weight =	41.83 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	0.0	0.0	100.0
3/8"	31.9	15.4	84.6
#4	42.3	20.5	79.5
#10	51.4	24.9	75.1
#40	65.1	31.5	68.5
#200	5.1	39.8	60.2

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	36.0	5.5	30.5	49.45	0.01328	11.32	0.0316
15	28.0	5.5	22.5	36.48	0.01328	12.62	0.0122
60	21.5	5.5	16.0	25.94	0.01328	13.69	0.0063
250	18.5	5.5	13.0	21.08	0.01328	14.18	0.0032
1440	14.0	5.5	8.5	13.78	0.01328	14.91	0.0014

Summary of Grain Size Distribution

0	% COARSE GRAVEL
25	% FINE GRAVEL
7	% COARSE SAND
8	% FINE SAND
36	% SILT
24	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	30
Plastic Limit	20
Plasticity index	10

Soil Description: CLAYEY SILT, some Gravel, little Sand

AASHTO Soil Classification(ODOT): A-4a (6)

CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-2	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-7	Tech:	M.E.
	Pike County, Ohio			Depth:	10.0'-11.5
Project #	97050249			Assumed Gs:	2.68

Total Sample Weight =	167.52 grams	Hydrometer Sample Weight =	31.22 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	0.0	0.0	100.0
3/4"	0.0	0.0	100.0
3/8"	10.5	6.3	93.7
#4	11.3	6.7	93.3
#10	12.9	7.7	92.3
#40	38.7	23.1	76.9
#200	15.2	60.4	39.6

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	20.0	5.5	14.5	35.50	0.01336	13.93	0.0353
15	16.5	5.5	11.0	26.93	0.01336	14.5	0.0131
60	15.5	5.5	10.0	24.48	0.01336	14.67	0.0066
250	14.0	5.5	8.5	20.81	0.01336	14.91	0.0033
1440	13.0	5.5	7.5	18.36	0.01336	15.07	0.0014

Summary of Grain Size Distribution	
0	% COARSE GRAVEL
8	% FINE GRAVEL
15	% COARSE SAND
37	% FINE SAND
17	% SILT
23	% CLAY (<0.005mm)

Atterberg Limits	
Liquid Limit	32
Plastic Limit	17
Plasticity Index	15

Soil Description: SAND, some Caly, little Silt, traces of Gravel

AASHTO Soil Classification(ODOT): A-6a (2)

GTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-3	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-3	Tech:	M.E.
	Pike County, Ohio			Depth:	4.0'-5.5'
Project #	97050249			Assumed Gs:	2.68

Total Sample Weight =	202.94 grams	Hydrometer Sample Weight =	30.49 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	42.8	21.1	78.9
3/4"	42.8	21.1	78.9
3/8"	69.1	34.1	65.9
#4	85.4	42.1	57.9
#10	91.7	45.2	54.8
#40	103.1	50.8	49.2
#200	5.7	59.9	40.1

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	28.0	5.5	22.5	36.09	0.01336	12.62	0.0336
15	19.0	5.5	13.5	21.65	0.01336	14.09	0.0129
60	14.0	5.5	8.5	13.63	0.01336	14.91	0.0067
250	10.5	5.5	5.0	8.02	0.01336	15.48	0.0033
1440	8.5	5.5	3.0	4.81	0.01336	15.81	0.0014

Summary of Grain Size Distribution	
21	% COARSE GRAVEL
24	% FINE GRAVEL
6	% COARSE SAND
9	% FINE SAND
29	% SILT
11	% CLAY (<0.005mm)

Atterberg Limits	
Liquid Limit	25
Plastic Limit	22
Plasticity Index	3

Soil Description: SILTY GRAVEL, little Sand, little Clay

AASHTO Soil Classification(ODOT): A-4a (1)

CTL ENGINEERING

Particle-Size Analysis
ASTM D-422

Client:	Pike County Engineer	Boring #	B-3	Date:	10/14/97
Project	Slope Stability Study, CR 50	Sample #	SS-5	Tech:	M.E.
	Pike County, Ohio			Depth:	7.0'-8.5'
Project #	97050249			Assumed Gs:	2.66

Total Sample Weight =	190.03 grams	Hydrometer Sample Weight =	30.59 grams

Sieve Sizes	Weight Retained	% Retained	% Passing
1"	33.1	17.4	82.6
3/4"	33.1	17.4	82.6
3/8"	34.9	18.3	81.7
#4	40.7	21.4	78.6
#10	45.7	24.0	76.0
#40	66.4	35.0	65.0
#200	17.4	72.0	28.0

Elapsed Time (min)	Hydro Reading	Temp. Correct. Value	Corrected Hydro Reading	% Total in Susp.	K	Effective Length (cm)	Particle Diameter (mm)
2	17.0	5.5	11.5	24.39	0.01344	14.42	0.0361
15	15.0	5.5	9.5	20.15	0.01344	14.75	0.0133
60	13.0	5.5	7.5	15.90	0.01344	15.07	0.0067
250	11.5	5.5	6.0	12.72	0.01344	15.32	0.0033
1440	10.0	5.5	4.5	9.54	0.01344	15.56	0.0014

Summary of Grain Size Distribution

17	% COARSE GRAVEL
7	% FINE GRAVEL
11	% COARSE SAND
37	% FINE SAND
14	% SILT
14	% CLAY (<0.005mm)

Atterberg Limits

Liquid Limit	N.P.
Plastic Limit	N.P.
Plasticity Index	N.P.

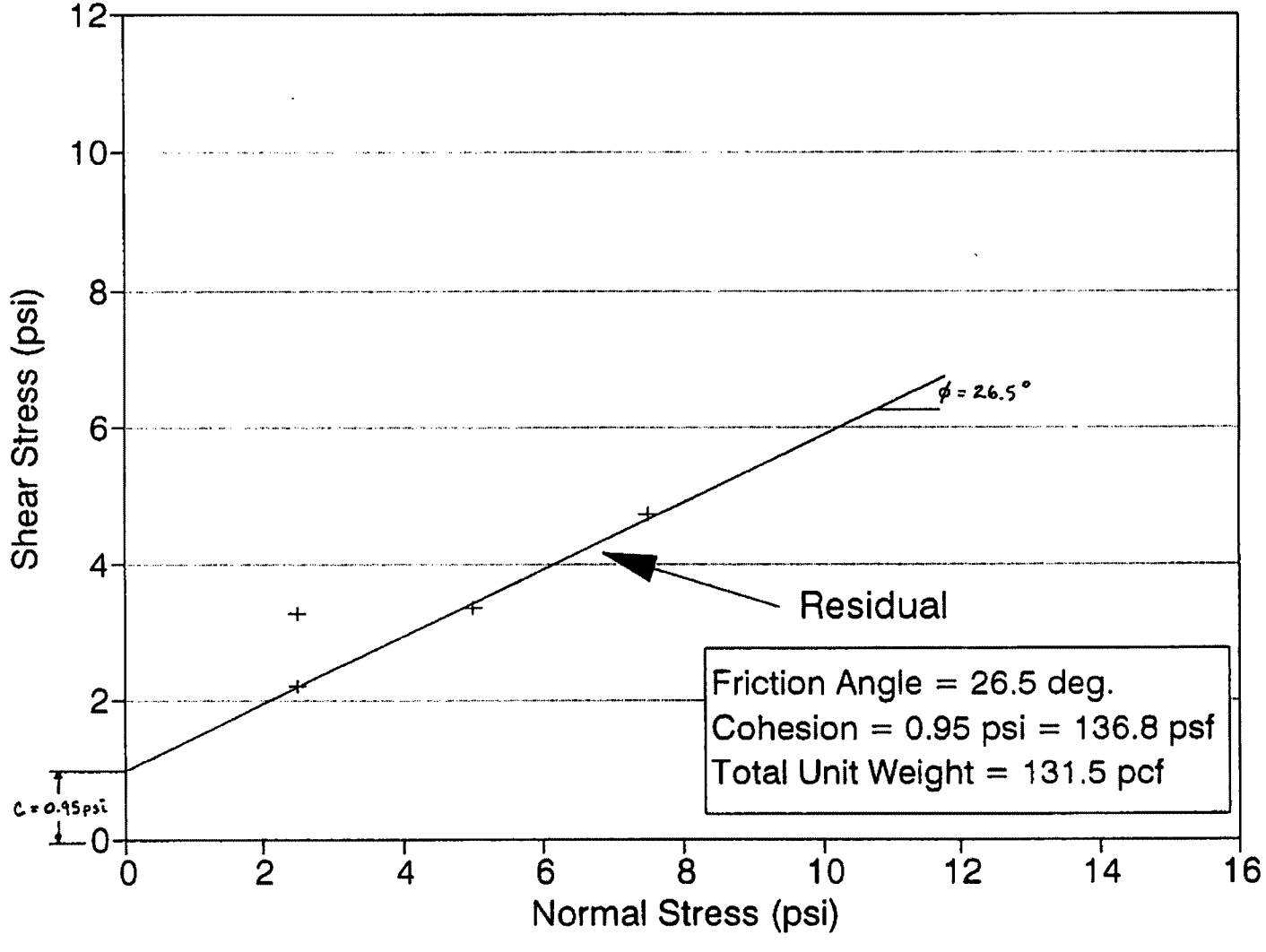
Soil Description: SAND AND GRAVEL, little Silt, little Clay

AASHTO Soil Classification(ODOT): A-2-4

GTL ENGINEERING

DIRECT SHEAR TEST
Pike County Engineer

B-2, S-5, Depth: 7.0'-8.5'



Calculations

CLIENT	Pike County Engineer	JOB NUMBER	1921-1004.00		
PROJECT	Pike county wall	SHEET NO.	1	OF	2
SUBJECT	Drilled Shaft Wall - Lateral Load Anlysis STA 14+00	COMP. BY	MNW	DATE	2/17/2020
	Software: Lpile v 2019-11 by Ensoft, Inc.	CHECKED BY	HJH	DATE	2/17/2020
	Case: Top of Rock at 18'				

1 Assumptions

1 Load and Resistance Factor Design (LRFD) Methodology; AASHTO LRFD BDS, 8th Ed and ODOT 2019 BDM
2 Geotechnical information from DLZ Geotechnical Exploration Report
3 Survey information provided by DLZ
4 Cantilever wall height of 18 feet in front of wall. Rankine at-rest earth pressure above assumed at failure surface (top of bedrock)
5 Slide mass left in place
6 No drainage behind wall. Consider water at 2ft below top of wall/ground surface .
7 Guardrail mounted on top of grade beam. Vehicle Collision load included for extreme event loading condition.
8 Ground sloping in front of wall (i.e. top of rock) at 14 degrees from horizontal
9 Assume drilled shaft is spaced @ 5 feet on center with plug piles between.

2 Soil/Rock Profile for LPile Analysis

No.	Layer Description	Lpile Model	Top* (ft)	Bot.* (ft)	Eff. UW, γ' (pcf)	q_u (psi)	E_i (psi)	RQD (%)	k
2	Weathered Bedrock	Weak Rock	18	23	80	8000	200000	95	1E-05
3	Unweathered Bedrock	Weak Rock	23	50	88	2300	50000	80	5E-05

*Add 3 feet to all depths (i.e. assumed height of collision load) for extreme event load condition

3 Pile Properties

Section Input

Section Diameter = 42 in
Concrete Compressive Strength, f_c' = 4,000 psi
Max. Coarse Aggregate Size = 0.75 in
Reinforcing Steel - No.14 bars equally spaced (12 total) with 4.5 in cover (assumes No. 4 spiral)
As = 27.00 in 1.95%
Yield Stress, F_y = 60 ksi
Steel Elastic Modulus, E = 29000 ksi

Section	Lpile Model	Physical Model	Length (ft)
1	AISC Strong Axis	Guardrail	3
2	Bored Pile	Drilled Shaft	40

Note:
1 Bored Pile section length includes concrete cap thickness to account for lateral pressures against it.
2 A fictitious W section was considered on top of the drilled shaft in the model to evaluate the collision load transmitted to the shaft from the guardrail as a point load applied on a relatively rigid section.

4 Passive resistance reduction factor

p-multiplier, p = N/A No overburden in front of wall in model.

5 Distributed Load (per Pile) for Each Limit State

Depth (ft)	Service Limit Factored Load	Strength Limit Factored Load	Extreme Event II Factored Load
0	21 lb/in	36 lb/in	10 lb/in
2	79 lb/in	115 lb/in	69 lb/in
18	730 lb/in	848 lb/in	719 lb/in

Add 3 feet to depths listed above for entry into Lpile Extreme Event II (i.e. horizontal loads below guardrail)

CLIENT	Pike County Engineer	JOB NUMBER	1921-1004.00		
PROJECT	Pike county wall	SHEET NO.	2	OF	2
SUBJECT	Drilled Shaft Wall - Lateral Load Anlysis STA 14+00	COMP. BY	MNW	DATE	2/17/2020
	Software: Lpile v 2019-11 by Ensoft, Inc.	CHECKED BY	HJH	DATE	2/17/2020
	Case: Top of Rock at 18'				

6 Pile-Head Loading

Load Case	Shear (in)	Moment (in-lbs)	Axial Load lbs
Service	0	0	0
Strength	0	0	0
Extreme Event II	19,000	0	0

7 Results

Load Case	Deflection	Max Moment @ Depth		Max Shear@ Depth	
	(in)	(in-kips)	(ft)	(kips)	(ft)
Service	0.249	5,697	18.0	208	19.0
Strength	0.344	6,988	18.0	279	19.0
Extreme Event II	0.884	10,243	18.0	412	19.0

Depths listed for Extreme Event II exclude the 3-ft high extension included in L-Pile

See structural analysis for Moment and Shear checks.

Client	Pike County Engineer	Project No.	1921-1004.00		
Project	PIK-CR50-3.40	Sheet No.	1	of	2
Subject	Drilled Shaft Wall with Plug Piles	Comp. By	MNW	Date	2/17/2020
	Lateral Load Analysis	Checked By	HJH	Date	2/17/2020

Wall Properties/Parameters for Analysis

Top of Wall	613	ft
Design Grade	595	ft
Design GW El	611	ft
Design Height, H	18.0	ft
Wall Type	Drilled Shaft	
CTC Spacing, S	5	ft
Bar Size & Qty	12 #14 Bars	
Shaft Diameter	42	inches
p-multiplier	0.72	overburden only

Shaft Properties:

Diameter	42	in^2
Area	1385	in
Concrete Strength, f_c'	4000	psi
Concrete Cover (to bar)	4.5	in
Concrete Elastic Mod, E_c	3,600,000	psi
Moment of Inertia, I_{xx}	152,745	in^4
Sectional Modulus, S_{xx}	7,274	in^3
Bending Stiffness, EI_{xx}	5.499E+11	$lb*in^2$

*Use Ec=4000000 for strength and extreme event in Lpile

Retained Soil Parameters

Description	Existing Soil/Slide Mass	
Slope, β	0	degrees
Shear Strength Paramaters		
Effective Stress		
ϕ'	26	degrees
c'	0	psf
Total Stress (Cohesive Soils, Short Term Only)		
ϕ	0	degrees
C	N/A	psf
Unit Weight		
Moist, γ_m	125	pcf
Sat., γ_s	125	pcf
OCR (est.)	1	
Earth Pressure Coefficients (Rankine)		
Active, Ka	0.390	(Frictionless)
At-Rest, Ko	0.562	

Assumptions:

1 Slide mass left in place
2 No drainage behind wall. Consider water from 2ft below top of wall.
3 Height of wall assumed as elevation of failure surface
4 Rankine at-rest earth pressure loading on wall above assumed shear failure
5 Load combinations per AASHTO LRFD BDS, 8th Ed., 2017
6 Guardrail mounted on top of grade beam. Vehicle Collision load included (extreme event II loading).

Calculate Nominal Lateral Loads for Service, Strength, and EEII (i.e. distributed load along pile)

γ	125 pcf		
Ko	0.562	H_{eq}	2 ft
H	18.0 ft		
S	5 ft		

depth (ft)	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	$\Sigma\sigma_h$ (lb/ft)
0.0	-	250	-	250
2.0	703	250	-	953
18.0	3,517	250	4,992	8,759
		Total		78,894 lbs

Client	Pike County Engineer	Project No.	1921-1004.00		
Project	PIK-CR50-3.40	Sheet No.	2	of	2
Subject	Drilled Shaft Wall with Plug Piles	Comp. By	MNW	Date	2/17/2020
	Lateral Load Analysis	Checked By	HJH	Date	2/17/2020

Calculate Factored Lateral Loads for Service, Strength, and EEII (i.e. distributed load along pile)

	EH	LL	WA	CT
Strength I	1.35	1.75	1.00	0.00
Service I	1.00	1.00	1.00	0.00
Ext. Event II	1.00	0.50	1.00	1.00

*see Tables 3.4.1-1 & -2, AASHTO BDS, 7th Ed

Service I

depth (ft)

	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	Σsh (lb/ft)	$\Sigma\sigma_h$ (lb/in)
0.0	-	250	-	250	21
2.0	703	250	-	953	79
18.0	3,517	250	4,992	8,759	730

Strength I

depth (ft)

	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	Σsh (lb/ft)	$\Sigma\sigma_h$ (lb/in)
0.0	-	438	-	438	36
2.0	948	438	-	1,386	115
18.0	4,748	438	4,992	10,177	848

Extreme Event II *Apply point load CT at top of pile +3ft with load factor = 1.0 and magnitude = 19 kips*

Add 3 feet to depths below for entry into LPile model (i.e. 3 feet below guardrail)

depth (ft)

	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	Σsh (lb/ft)	$\Sigma\sigma_h$ (lb/in)
0.0	-	125	-	125	10
2.0	703	125	-	828	69
18.0	3,517	125	4,992	8,634	719

```
================================================================================

                    LPile for Windows, Version 2019-11.002

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations on this computer:
\Projects\GFL\2019\1921\100400 PCE-PIK-CR50\PIK\108463\Design\Geotechnical\Sprea
dsheets & Calcs\Lateral Load Analysis\LPile\Service Limit\

Name of the input data file:
Service limit slope14 at-rest TOR18.lp11

Name of the output report file:
Service limit slope14 at-rest TOR18.lp11

Name of the plot output file:
Service limit slope14 at-rest TOR18.lp11

Name of the runtime message file:
Service limit slope14 at-rest TOR18.lp11

--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  February 17, 2020          Time:   9:17:41
```

Problem Title

Project Name: PIK-CR50-03.40

Job Number: 1921-1004.00

Client: Pike County

Engineer: Jason Hughes

Description:

Program Options and Settings

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	80

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)

- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	40.000 ft
Depth of ground surface below top of pile	=	18.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	42.0000
2	40.000	42.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	14.000	degrees
	=	0.244	radians
Pile Batter Angle	=	0.000	degrees
	=	0.000	radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	18.000000	ft
Distance from top of pile to bottom of layer	=	23.000000	ft
Effective unit weight at top of layer	=	80.000000	pcf
Effective unit weight at bottom of layer	=	80.000000	pcf
Uniaxial compressive strength at top of layer	=	8000.	psi
Uniaxial compressive strength at bottom of layer	=	8000.	psi
Initial modulus of rock at top of layer	=	200000.	psi
Initial modulus of rock at bottom of layer	=	200000.	psi
RQD of rock at top of layer	=	95.000000	%
RQD of rock at bottom of layer	=	95.000000	%
k rm of rock at top of layer	=	0.0000100	
k rm of rock at bottom of layer	=	0.0000100	

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	23.000000	ft
Distance from top of pile to bottom of layer	=	50.000000	ft
Effective unit weight at top of layer	=	88.000000	pcf
Effective unit weight at bottom of layer	=	88.000000	pcf
Uniaxial compressive strength at top of layer	=	2300.	psi
Uniaxial compressive strength at bottom of layer	=	2300.	psi
Initial modulus of rock at top of layer	=	50000.	psi
Initial modulus of rock at bottom of layer	=	50000.	psi
RQD of rock at top of layer	=	80.000000	%
RQD of rock at bottom of layer	=	80.000000	%
k rm of rock at top of layer	=	0.0000500	

k rm of rock at bottom of layer = 0.0000500

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	18.000	1.0000	1.0000
2	32.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 3 points

Point No.	Depth X in	Dist. Load lb/in
1	0.000	21.000
2	24.000	79.000
3	216.000	730.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	4.500000 in
Number of Reinforcing Bars	=	12 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1385. sq. in.
Total Area of Reinforcing Steel	=	27.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.95 percent
Edge-to-Edge Bar Spacing	=	6.409848 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.55
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	6238.704 kips

Tensile Load for Cracking of Concrete = -655.324 kips
Nominal Axial Tensile Capacity = -1620.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.693000	2.250000	15.653500	0.00000
2	1.693000	2.250000	13.556329	7.826750
3	1.693000	2.250000	7.826750	13.556329
4	1.693000	2.250000	0.00000	15.653500
5	1.693000	2.250000	-7.826750	13.556329
6	1.693000	2.250000	-13.556329	7.826750
7	1.693000	2.250000	-15.653500	0.00000
8	1.693000	2.250000	-13.556329	-7.826750
9	1.693000	2.250000	-7.826750	-13.556329
10	1.693000	2.250000	0.00000	-15.653500
11	1.693000	2.250000	7.826750	-13.556329
12	1.693000	2.250000	13.556329	-7.826750

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.410 inches
between bars 7 and 8.

Ratio of bar spacing to maximum aggregate size = 8.55

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.341649 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg
0.0000006250	455.2545306522	728407249.	20.9999777443	
0.0000012500	908.6343072563	726907446.	20.9999776737	
0.0000018750	1360.	725407643.	20.9999776027	
0.0000025000	1810.	723907839.	20.9999775314	
0.0000031250	2258.	722408036.	20.9999774597	
0.0000037500	2703.	720908233.	20.9999773876	
0.0000043750	3147.	719408430.	20.9999773151	
0.0000050000	3590.	717908626.	20.9999772422	
0.0000056250	3590.	638141001.	12.1965732467	C
0.0000062500	3590.	574326901.	12.2003991673	C
0.0000068750	3590.	522115365.	12.2042333669	C
0.0000075000	3590.	478605751.	12.2080758818	C
0.0000081250	3590.	441789924.	12.2119267489	C
0.0000087500	3590.	410233501.	12.2157860050	C
0.0000093750	3590.	382884601.	12.2196536874	C
0.0000100000	3590.	358954313.	12.2235298335	C
0.0000106250	3590.	337839354.	12.2274144812	C
0.0000112500	3590.	319070501.	12.2313076682	C
0.0000118750	3590.	302277316.	12.2352094330	C
0.0000125000	3590.	287163451.	12.2391198138	C
0.0000131250	3590.	273489001.	12.2430388496	C
0.0000137500	3590.	261057682.	12.2469665792	C
0.0000143750	3590.	249707348.	12.2509030419	C
0.0000150000	3590.	239302875.	12.2548482773	C
0.0000156250	3590.	229730760.	12.2588023252	C
0.0000162500	3590.	220894962.	12.2627652256	C
0.0000168750	3590.	212713667.	12.2667370189	C

0.0000175000	3590.	205116750.	12.2707177458	C
0.0000181250	3703.	204293328.	12.2747074470	C
0.0000187500	3829.	204222578.	12.2787061639	C
0.0000193750	3955.	204151689.	12.2827139378	C
0.0000200000	4082.	204080662.	12.2867308106	C
0.0000206250	4208.	204009497.	12.2907568242	C
0.0000212500	4334.	203938191.	12.2947920211	C
0.0000218750	4460.	203866745.	12.2988364438	C
0.0000225000	4585.	203795158.	12.3028901354	C
0.0000231250	4711.	203723430.	12.3069531389	C
0.0000237500	4837.	203651559.	12.3110254981	C
0.0000243750	4962.	203579546.	12.3151072566	C
0.0000256250	5213.	203435089.	12.3232991488	C
0.0000268750	5463.	203290052.	12.3315291727	C
0.0000281250	5713.	203144433.	12.3397976903	C
0.0000293750	5963.	202998225.	12.3481050689	C
0.0000306250	6212.	202851423.	12.3564516811	C
0.0000318750	6461.	202704021.	12.3648379050	C
0.0000331250	6710.	202556015.	12.3732641241	C
0.0000343750	6958.	202407398.	12.3817307274	C
0.0000356250	7205.	202258169.	12.3902305933	C
0.0000368750	7453.	202108459.	12.3985086550	C
0.0000381250	7700.	201958143.	12.4068257245	C
0.0000393750	7946.	201807215.	12.4151821810	C
0.0000406250	8192.	201655669.	12.4235784095	C
0.0000418750	8438.	201503501.	12.4320148006	C
0.0000431250	8683.	201350705.	12.4404917508	C
0.0000443750	8928.	201197275.	12.4490096625	C
0.0000456250	9173.	201043204.	12.4575689439	C
0.0000468750	9417.	200888488.	12.4661700097	C
0.0000481250	9660.	200733120.	12.4748132808	C
0.0000493750	9903.	200577093.	12.4834991844	C
0.0000506250	10146.	200420403.	12.4922281543	C
0.0000518750	10389.	200263042.	12.5010006311	C
0.0000531250	10631.	200105004.	12.5098170622	C
0.0000543750	10872.	199946283.	12.5186779018	C
0.0000556250	11113.	199786873.	12.5275836114	C
0.0000568750	11354.	199626765.	12.5365346597	C
0.0000581250	11594.	199465955.	12.5455315228	C
0.0000593750	11834.	199304434.	12.5545746846	C
0.0000606250	12073.	199142196.	12.5636646364	C
0.0000618750	12312.	198979234.	12.5728018778	C
0.0000631250	12550.	198815540.	12.5819869161	C
0.0000643750	12788.	198651108.	12.5912202671	C
0.0000656250	13026.	198485929.	12.6005024551	C
0.0000668750	13263.	198319997.	12.6098340129	C
0.0000681250	13499.	198153303.	12.6192154822	C
0.0000693750	13735.	197985840.	12.6286474137	C
0.0000706250	13971.	197817599.	12.6381303674	C
0.0000718750	14206.	197648574.	12.6476649127	C

0.0000731250	14441.	197478755.	12.6572516286	C
0.0000743750	14675.	197308134.	12.6668911041	C
0.0000793750	15607.	196617463.	12.7059887401	C
0.0000843750	16529.	195897357.	12.7456319143	CY
0.0000893750	17345.	194064964.	12.7610167864	CY
0.0000943750	18038.	191130418.	12.7501118060	CY
0.0000993750	18495.	186110051.	12.6841183841	CY
0.0001043750	18879.	180877307.	12.6098936127	CY
0.0001093750	19260.	176089510.	12.5452018739	CY
0.0001143750	19637.	171687521.	12.4888650975	CY
0.0001193750	20010.	167622075.	12.4399063331	CY
0.0001243750	20347.	163597736.	12.3884146454	CY
0.0001293750	20582.	159085458.	12.3119345602	CY
0.0001343750	20733.	154292069.	12.2193701889	CY
0.0001393750	20877.	149788599.	12.1335556141	CY
0.0001443750	21018.	145582599.	12.0553705022	CY
0.0001493750	21158.	141643873.	11.9840856967	CY
0.0001543750	21294.	137938971.	11.9162794708	CY
0.0001593750	21428.	134451225.	11.8536625413	CY
0.0001643750	21560.	131161596.	11.7965587314	CY
0.0001693750	21689.	128052204.	11.7445233308	CY
0.0001743750	21815.	125105945.	11.6972809937	CY
0.0001793750	21940.	122311023.	11.6542921065	CY
0.0001843750	22061.	119654793.	11.6152548284	CY
0.0001893750	22181.	117126346.	11.5798753943	CY
0.0001943750	22298.	114717422.	11.5475670007	CY
0.0001993750	22413.	112415394.	11.5167304901	CY
0.0002043750	22525.	110212365.	11.4882063301	CY
0.0002093750	22619.	108031007.	11.4562209750	CY
0.0002143750	22699.	105885384.	11.4214639731	CY
0.0002193750	22766.	103777053.	11.3843761383	CY
0.0002243750	22810.	101658503.	11.3405894282	CY
0.0002293750	22847.	99603715.	11.2967974681	CY
0.0002343750	22870.	97580311.	11.2503241747	CY
0.0002393750	22893.	95638405.	11.2065188475	CY
0.0002443750	22916.	93774308.	11.1649712380	CY
0.0002493750	22938.	91982741.	11.1251947042	CY
0.0002543750	22958.	90253982.	11.0850509973	CY
0.0002593750	22978.	88590630.	11.0468656715	CY
0.0002643750	22998.	86989099.	11.0105005598	CY
0.0002693750	23017.	85445930.	10.9758595070	CY
0.0002743750	23036.	83956697.	10.9431530557	CYT
0.0003043750	23141.	76028975.	10.7764396703	CYT
0.0003343750	23236.	69490102.	10.6441021612	CYT
0.0003643750	23320.	63999101.	10.5380635396	CYT

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	0.000	23034.593	0.00300000

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	23035.	0.0000	14972.	197087458.
1	0.75	23035.	0.0000	17276.	194219089.
1	0.90	23035.	0.0000	20731.	154351076.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	18.0000	0.00	N.A.	Yes	N.A.	N.A.
2	23.0000	5.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only

for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness in-lb^2
0.000	0.24867	1.460E-05	0.000	0.000	7.284E+11
0.50000	0.24108	443.25000	180.37500	0.000	7.284E+11
1.00000	0.23349	2165.	436.87500	0.000	7.284E+11
1.50000	0.22590	5686.	780.37500	0.000	7.284E+11
2.00000	0.21831	11529.	1213.	0.000	7.284E+11
2.50000	0.21072	20243.	1750.	0.000	7.284E+11
3.00000	0.20313	32532.	2407.	0.000	7.284E+11
3.50000	0.19554	49131.	3187.	0.000	7.284E+11
4.00000	0.18795	70771.	4088.	0.000	7.284E+11
4.50000	0.18037	98184.	5111.	0.000	7.284E+11
5.00000	0.17279	132103.	6256.	0.000	7.284E+11
5.50000	0.16522	173261.	7524.	0.000	7.284E+11
6.00000	0.15766	222389.	8913.	0.000	7.284E+11
6.50000	0.15010	280220.	10425.	0.000	7.284E+11
7.00000	0.14257	347486.	12058.	0.000	7.284E+11
7.50000	0.13505	424921.	13814.	0.000	7.284E+11
8.00000	0.12755	513255.	15692.	0.000	7.281E+11
8.50000	0.12007	613222.	17692.	0.000	7.276E+11
9.00000	0.11263	725553.	19813.	0.000	7.273E+11
9.50000	0.10522	850982.	22057.	0.000	7.270E+11
10.00000	0.09786	990241.	24423.	0.000	7.265E+11
10.50000	0.09054	1144061.	26911.	0.000	7.260E+11
11.00000	0.08328	1313176.	29521.	0.000	7.255E+11
11.50000	0.07608	1498318.	32254.	0.000	7.249E+11
12.00000	0.06896	1700219.	35108.	0.000	7.242E+11
12.50000	0.06193	1919611.	38084.	0.000	7.235E+11
13.00000	0.05499	2157227.	41182.	0.000	7.227E+11
13.50000	0.04815	2413800.	44403.	0.000	7.218E+11

14.00000	0.04144	2690061.	47745.	0.000	7.209E+11
14.50000	0.03486	2986743.	51210.	0.000	7.199E+11
15.00000	0.02843	3304578.	54796.	0.000	7.188E+11
15.50000	0.02217	3644299.	58505.	0.000	2.047E+11
16.00000	0.01655	4006639.	62336.	0.000	2.041E+11
16.50000	0.01163	4392328.	66289.	0.000	2.039E+11
17.00000	0.007492	4802101.	70363.	0.000	2.037E+11
17.50000	0.004200	5236689.	74560.	0.000	2.034E+11
18.00000	0.001835	5696825.	-32327.	-36701.	2.032E+11
18.50000	0.000480	4848769.	-175606.	-11421.	2.036E+11
19.00000	-1.851E-05	3589549.	-208336.	511.25960	3.822E+11
19.50000	-0.000179	2348734.	-189963.	5613.	7.221E+11
20.00000	-0.000222	1309988.	-149701.	7808.	7.255E+11
20.50000	-0.000200	552327.	-102900.	7792.	7.279E+11
21.00000	-0.000150	75188.	-60209.	6438.	7.284E+11
21.50000	-9.717E-05	-170180.	-27291.	4535.	7.284E+11
22.00000	-5.253E-05	-252305.	-5733.	2651.	7.284E+11
22.50000	-2.035E-05	-238980.	5536.	1105.	7.284E+11
23.00000	6.072E-09	-185877.	8850.	-0.08819	7.284E+11
23.50000	1.118E-05	-132776.	8331.	-173.03232	7.284E+11
24.00000	1.579E-05	-85904.	7034.	-259.45410	7.284E+11
24.50000	1.616E-05	-48373.	5413.	-280.86792	7.284E+11
25.00000	1.414E-05	-20953.	3793.	-259.14985	7.284E+11
25.50000	1.108E-05	-2863.	2374.	-213.60470	7.284E+11
26.00000	7.875E-06	7538.	1255.	-159.36829	7.284E+11
26.50000	5.046E-06	12202.	456.46475	-106.92907	7.284E+11
27.00000	2.821E-06	13016.	-51.68759	-62.45505	7.284E+11
27.50000	1.238E-06	11581.	-324.84791	-28.59839	7.284E+11
28.00000	2.284E-07	9117.	-427.12008	-5.49233	7.284E+11
28.50000	-3.309E-07	6456.	-418.78098	8.27203	7.284E+11
29.00000	-5.711E-07	4092.	-351.13329	14.27720	7.284E+11
29.50000	-6.091E-07	2242.	-262.62283	15.22629	7.284E+11
30.00000	-5.362E-07	940.62089	-176.72936	13.40487	7.284E+11
30.50000	-4.168E-07	121.53239	-105.25101	10.42125	7.284E+11
31.00000	-2.915E-07	-322.39123	-52.12489	7.28746	7.284E+11
31.50000	-1.821E-07	-503.96623	-16.60646	4.55201	7.284E+11
32.00000	-9.757E-08	-521.66871	4.36735	2.43925	7.284E+11
32.50000	-3.884E-08	-451.55805	14.59827	0.97105	7.284E+11
33.00000	-2.431E-09	-346.48948	17.69378	0.06079	7.284E+11
33.50000	1.685E-08	-239.23265	16.61203	-0.42137	7.284E+11
34.00000	2.432E-08	-147.14514	13.52411	-0.60794	7.284E+11
34.50000	2.451E-08	-76.94333	9.86222	-0.61269	7.284E+11
35.00000	2.090E-08	-28.79849	6.45699	-0.52238	7.284E+11
35.50000	1.586E-08	0.54060	3.70038	-0.39649	7.284E+11
36.00000	1.085E-08	15.60613	1.69714	-0.27126	7.284E+11
36.50000	6.613E-09	20.90624	0.38740	-0.16532	7.284E+11
37.00000	3.408E-09	20.25493	-0.36417	-0.08520	7.284E+11
37.50000	1.205E-09	16.53623	-0.71014	-0.03012	7.284E+11
38.00000	-1.814E-10	11.73326	-0.78689	0.004536	7.284E+11
38.50000	-9.877E-10	7.09358	-0.69920	0.02469	7.284E+11

39.00000	-1.443E-09	3.34283	-0.51687	0.03609	7.284E+11
39.50000	-1.734E-09	0.89116	-0.27857	0.04335	7.284E+11
40.00000	-1.980E-09	0.000	0.000	0.04951	7.284E+11

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.24867423 inches
Computed slope at pile head      =    -0.00126535 radians
Maximum bending moment           =       5696825. inch-lbs
Maximum shear force              =       -208336. lbs
Depth of maximum bending moment  =    18.00000000 feet below pile head
Depth of maximum shear force     =    19.00000000 feet below pile head
Number of iterations             =             87
Number of zero deflection points =              5
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =              0. lbs
Moment     =              0. in-lbs
Axial Load =              0. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
40.00000	0.24867423	5696825.	-208336.
38.00000	0.25138882	5744374.	-222113.
36.00000	0.24627650	5697026.	-220793.
34.00000	0.26931251	5958558.	-233064.
32.00000	0.24864913	5697207.	-208308.
30.00000	0.24318345	5697289.	-208099.
28.00000	0.26146275	5887825.	-227113.
26.00000	0.26836088	5887535.	-235833.
24.00000	0.25029566	5697505.	-215773.
22.00000	0.26020867	5840343.	-222237.
20.00000	0.26607821	5697622.	-336273.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.248674	-0.001265	-208336.	5696825.

Maximum pile-head deflection = 0.2486742276 inches
Maximum pile-head rotation = -0.0012653470 radians = -0.072499 deg.

Summary of Warning Messages

The following warning was reported 6547 times

***** Warning *****

The input value for k_rm used by the weak rock criteria is smaller than 0.00005. This value is outside the recommended range of 0.00005 to 0.0005. Please check your input data for accuracy.

The following warning was reported 10000 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.

Files Used for Analysis

Path to file locations on this computer:
\Projects\GFL\2019\1921\100400 PCE-PIK-CR50\PIK\108463\Design\Geotechnical\Spreadsheets & Calcs\Lateral Load Analysis\LPile\Strength Limit\

Name of the input data file:
Strength limit slope14 at-rest TOR18.lp11d

Name of the output report file:
Strength limit slope14 at-rest TOR18.lp11o

Name of the plot output file:
Strength limit slope14 at-rest TOR18.lp11p

Name of the runtime message file:
Strength limit slope14 at-rest TOR18.lp11r

Date and Time of Analysis

Date: February 14, 2020 Time: 16:10:09

Problem Title

Project Name: PIK-CR50-03.40

Job Number: 1921-1004.00

Client: Pike County

Engineer: Jason Hughes

Description:

Program Options and Settings

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	80

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)

- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	40.000 ft
Depth of ground surface below top of pile	=	18.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	42.0000
2	40.000	42.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	14.000	degrees
	=	0.244	radians
Pile Batter Angle	=	0.000	degrees
	=	0.000	radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	18.000000	ft
Distance from top of pile to bottom of layer	=	23.000000	ft
Effective unit weight at top of layer	=	80.000000	pcf
Effective unit weight at bottom of layer	=	80.000000	pcf
Uniaxial compressive strength at top of layer	=	8000.	psi
Uniaxial compressive strength at bottom of layer	=	8000.	psi
Initial modulus of rock at top of layer	=	200000.	psi
Initial modulus of rock at bottom of layer	=	200000.	psi
RQD of rock at top of layer	=	95.000000	%
RQD of rock at bottom of layer	=	95.000000	%
k rm of rock at top of layer	=	0.0000100	
k rm of rock at bottom of layer	=	0.0000100	

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	23.000000	ft
Distance from top of pile to bottom of layer	=	50.000000	ft
Effective unit weight at top of layer	=	88.000000	pcf
Effective unit weight at bottom of layer	=	88.000000	pcf
Uniaxial compressive strength at top of layer	=	2300.	psi
Uniaxial compressive strength at bottom of layer	=	2300.	psi
Initial modulus of rock at top of layer	=	50000.	psi
Initial modulus of rock at bottom of layer	=	50000.	psi
RQD of rock at top of layer	=	80.000000	%
RQD of rock at bottom of layer	=	80.000000	%
k rm of rock at top of layer	=	0.0000500	

k rm of rock at bottom of layer = 0.0000500

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	18.000	1.0000	1.0000
2	32.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 3 points

Point No.	Depth X in	Dist. Load lb/in
1	0.000	36.000
2	24.000	115.000
3	216.000	848.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	4.500000 in
Number of Reinforcing Bars	=	12 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1385. sq. in.
Total Area of Reinforcing Steel	=	27.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.95 percent
Edge-to-Edge Bar Spacing	=	6.409848 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.55
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	6238.704 kips

Tensile Load for Cracking of Concrete = -655.324 kips
Nominal Axial Tensile Capacity = -1620.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.693000	2.250000	15.653500	0.00000
2	1.693000	2.250000	13.556329	7.826750
3	1.693000	2.250000	7.826750	13.556329
4	1.693000	2.250000	0.00000	15.653500
5	1.693000	2.250000	-7.826750	13.556329
6	1.693000	2.250000	-13.556329	7.826750
7	1.693000	2.250000	-15.653500	0.00000
8	1.693000	2.250000	-13.556329	-7.826750
9	1.693000	2.250000	-7.826750	-13.556329
10	1.693000	2.250000	0.00000	-15.653500
11	1.693000	2.250000	7.826750	-13.556329
12	1.693000	2.250000	13.556329	-7.826750

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.410 inches
between bars 7 and 8.

Ratio of bar spacing to maximum aggregate size = 8.55

Concrete Properties:

Compressive Strength of Concrete = 4000. psi
Modulus of Elasticity of Concrete = 3604997. psi
Modulus of Rupture of Concrete = -474.341649 psi
Compression Strain at Peak Stress = 0.001886
Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg
0.0000006250	455.2545306522	728407249.	20.9999777443	
0.0000012500	908.6343072563	726907446.	20.9999776737	
0.0000018750	1360.	725407643.	20.9999776027	
0.0000025000	1810.	723907839.	20.9999775314	
0.0000031250	2258.	722408036.	20.9999774597	
0.0000037500	2703.	720908233.	20.9999773876	
0.0000043750	3147.	719408430.	20.9999773151	
0.0000050000	3590.	717908626.	20.9999772422	
0.0000056250	3590.	638141001.	12.1965732467	C
0.0000062500	3590.	574326901.	12.2003991673	C
0.0000068750	3590.	522115365.	12.2042333669	C
0.0000075000	3590.	478605751.	12.2080758818	C
0.0000081250	3590.	441789924.	12.2119267489	C
0.0000087500	3590.	410233501.	12.2157860050	C
0.0000093750	3590.	382884601.	12.2196536874	C
0.0000100000	3590.	358954313.	12.2235298335	C
0.0000106250	3590.	337839354.	12.2274144812	C
0.0000112500	3590.	319070501.	12.2313076682	C
0.0000118750	3590.	302277316.	12.2352094330	C
0.0000125000	3590.	287163451.	12.2391198138	C
0.0000131250	3590.	273489001.	12.2430388496	C
0.0000137500	3590.	261057682.	12.2469665792	C
0.0000143750	3590.	249707348.	12.2509030419	C
0.0000150000	3590.	239302875.	12.2548482773	C
0.0000156250	3590.	229730760.	12.2588023252	C
0.0000162500	3590.	220894962.	12.2627652256	C
0.0000168750	3590.	212713667.	12.2667370189	C

0.0000175000	3590.	205116750.	12.2707177458	C
0.0000181250	3703.	204293328.	12.2747074470	C
0.0000187500	3829.	204222578.	12.2787061639	C
0.0000193750	3955.	204151689.	12.2827139378	C
0.0000200000	4082.	204080662.	12.2867308106	C
0.0000206250	4208.	204009497.	12.2907568242	C
0.0000212500	4334.	203938191.	12.2947920211	C
0.0000218750	4460.	203866745.	12.2988364438	C
0.0000225000	4585.	203795158.	12.3028901354	C
0.0000231250	4711.	203723430.	12.3069531389	C
0.0000237500	4837.	203651559.	12.3110254981	C
0.0000243750	4962.	203579546.	12.3151072566	C
0.0000256250	5213.	203435089.	12.3232991488	C
0.0000268750	5463.	203290052.	12.3315291727	C
0.0000281250	5713.	203144433.	12.3397976903	C
0.0000293750	5963.	202998225.	12.3481050689	C
0.0000306250	6212.	202851423.	12.3564516811	C
0.0000318750	6461.	202704021.	12.3648379050	C
0.0000331250	6710.	202556015.	12.3732641241	C
0.0000343750	6958.	202407398.	12.3817307274	C
0.0000356250	7205.	202258169.	12.3902305933	C
0.0000368750	7453.	202108459.	12.3985086550	C
0.0000381250	7700.	201958143.	12.4068257245	C
0.0000393750	7946.	201807215.	12.4151821810	C
0.0000406250	8192.	201655669.	12.4235784095	C
0.0000418750	8438.	201503501.	12.4320148006	C
0.0000431250	8683.	201350705.	12.4404917508	C
0.0000443750	8928.	201197275.	12.4490096625	C
0.0000456250	9173.	201043204.	12.4575689439	C
0.0000468750	9417.	200888488.	12.4661700097	C
0.0000481250	9660.	200733120.	12.4748132808	C
0.0000493750	9903.	200577093.	12.4834991844	C
0.0000506250	10146.	200420403.	12.4922281543	C
0.0000518750	10389.	200263042.	12.5010006311	C
0.0000531250	10631.	200105004.	12.5098170622	C
0.0000543750	10872.	199946283.	12.5186779018	C
0.0000556250	11113.	199786873.	12.5275836114	C
0.0000568750	11354.	199626765.	12.5365346597	C
0.0000581250	11594.	199465955.	12.5455315228	C
0.0000593750	11834.	199304434.	12.5545746846	C
0.0000606250	12073.	199142196.	12.5636646364	C
0.0000618750	12312.	198979234.	12.5728018778	C
0.0000631250	12550.	198815540.	12.5819869161	C
0.0000643750	12788.	198651108.	12.5912202671	C
0.0000656250	13026.	198485929.	12.6005024551	C
0.0000668750	13263.	198319997.	12.6098340129	C
0.0000681250	13499.	198153303.	12.6192154822	C
0.0000693750	13735.	197985840.	12.6286474137	C
0.0000706250	13971.	197817599.	12.6381303674	C
0.0000718750	14206.	197648574.	12.6476649127	C

0.0000731250	14441.	197478755.	12.6572516286	C
0.0000743750	14675.	197308134.	12.6668911041	C
0.0000793750	15607.	196617463.	12.7059887401	C
0.0000843750	16529.	195897357.	12.7456319143	CY
0.0000893750	17345.	194064964.	12.7610167864	CY
0.0000943750	18038.	191130418.	12.7501118060	CY
0.0000993750	18495.	186110051.	12.6841183841	CY
0.0001043750	18879.	180877307.	12.6098936127	CY
0.0001093750	19260.	176089510.	12.5452018739	CY
0.0001143750	19637.	171687521.	12.4888650975	CY
0.0001193750	20010.	167622075.	12.4399063331	CY
0.0001243750	20347.	163597736.	12.3884146454	CY
0.0001293750	20582.	159085458.	12.3119345602	CY
0.0001343750	20733.	154292069.	12.2193701889	CY
0.0001393750	20877.	149788599.	12.1335556141	CY
0.0001443750	21018.	145582599.	12.0553705022	CY
0.0001493750	21158.	141643873.	11.9840856967	CY
0.0001543750	21294.	137938971.	11.9162794708	CY
0.0001593750	21428.	134451225.	11.8536625413	CY
0.0001643750	21560.	131161596.	11.7965587314	CY
0.0001693750	21689.	128052204.	11.7445233308	CY
0.0001743750	21815.	125105945.	11.6972809937	CY
0.0001793750	21940.	122311023.	11.6542921065	CY
0.0001843750	22061.	119654793.	11.6152548284	CY
0.0001893750	22181.	117126346.	11.5798753943	CY
0.0001943750	22298.	114717422.	11.5475670007	CY
0.0001993750	22413.	112415394.	11.5167304901	CY
0.0002043750	22525.	110212365.	11.4882063301	CY
0.0002093750	22619.	108031007.	11.4562209750	CY
0.0002143750	22699.	105885384.	11.4214639731	CY
0.0002193750	22766.	103777053.	11.3843761383	CY
0.0002243750	22810.	101658503.	11.3405894282	CY
0.0002293750	22847.	99603715.	11.2967974681	CY
0.0002343750	22870.	97580311.	11.2503241747	CY
0.0002393750	22893.	95638405.	11.2065188475	CY
0.0002443750	22916.	93774308.	11.1649712380	CY
0.0002493750	22938.	91982741.	11.1251947042	CY
0.0002543750	22958.	90253982.	11.0850509973	CY
0.0002593750	22978.	88590630.	11.0468656715	CY
0.0002643750	22998.	86989099.	11.0105005598	CY
0.0002693750	23017.	85445930.	10.9758595070	CY
0.0002743750	23036.	83956697.	10.9431530557	CYT
0.0003043750	23141.	76028975.	10.7764396703	CYT
0.0003343750	23236.	69490102.	10.6441021612	CYT
0.0003643750	23320.	63999101.	10.5380635396	CYT

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	0.000	23034.593	0.00300000

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	23035.	0.0000	14972.	197087458.
1	0.75	23035.	0.0000	17276.	194219089.
1	0.90	23035.	0.0000	20731.	154351076.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	18.0000	0.00	N.A.	Yes	N.A.	N.A.
2	23.0000	5.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only

for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness lb-in^2
0.000	0.34431	-1.909E-05	-9.360E-08	0.000	7.284E+11
0.50000	0.33370	736.87500	290.06250	0.000	7.284E+11
1.00000	0.32310	3481.	683.81250	0.000	7.284E+11
1.50000	0.31249	8943.	1196.	0.000	7.284E+11
2.00000	0.30188	17833.	1828.	0.000	7.284E+11
2.50000	0.29127	30879.	2588.	0.000	7.284E+11
3.00000	0.28067	48888.	3484.	0.000	7.284E+11
3.50000	0.27006	72687.	4518.	0.000	7.284E+11
4.00000	0.25946	103100.	5689.	0.000	7.284E+11
4.50000	0.24887	140951.	6997.	0.000	7.284E+11
5.00000	0.23828	187066.	8443.	0.000	7.284E+11
5.50000	0.22770	242268.	10026.	0.000	7.284E+11
6.00000	0.21714	307383.	11747.	0.000	7.284E+11
6.50000	0.20658	383234.	13605.	0.000	7.284E+11
7.00000	0.19605	470647.	15601.	0.000	7.283E+11
7.50000	0.18554	570447.	17734.	0.000	7.278E+11
8.00000	0.17506	683457.	20005.	0.000	7.274E+11
8.50000	0.16461	810503.	22413.	0.000	7.271E+11
9.00000	0.15421	952409.	24958.	0.000	7.267E+11
9.50000	0.14385	1110000.	27641.	0.000	7.261E+11
10.00000	0.13354	1284100.	30461.	0.000	7.256E+11
10.50000	0.12330	1475534.	33419.	0.000	7.249E+11
11.00000	0.11313	1685127.	36514.	0.000	7.242E+11
11.50000	0.10305	1913702.	39747.	0.000	7.235E+11
12.00000	0.09306	2162086.	43117.	0.000	7.227E+11
12.50000	0.08318	2431103.	46624.	0.000	7.218E+11
13.00000	0.07342	2721576.	50269.	0.000	7.208E+11
13.50000	0.06380	3034331.	54051.	0.000	7.197E+11

14.00000	0.05432	3370193.	57971.	0.000	7.186E+11
14.50000	0.04502	3729985.	62028.	0.000	2.043E+11
15.00000	0.03638	4114534.	66223.	0.000	2.041E+11
15.50000	0.02846	4524662.	70555.	0.000	2.038E+11
16.00000	0.02133	4961195.	75025.	0.000	2.036E+11
16.50000	0.01509	5424958.	79632.	0.000	2.033E+11
17.00000	0.009808	5916775.	84376.	0.000	2.030E+11
17.50000	0.005574	6437471.	89258.	0.000	2.027E+11
18.00000	0.002483	6987870.	-56009.	-49669.	2.024E+11
18.50000	0.000636	5765364.	-249161.	-15137.	2.031E+11
19.00000	-0.000190	3997938.	-278821.	5250.	2.041E+11
19.50000	-0.000311	2419511.	-233764.	9769.	7.218E+11
20.00000	-0.000311	1192768.	-171590.	10956.	7.258E+11
20.50000	-0.000252	360430.	-109225.	9833.	7.284E+11
21.00000	-0.000175	-117926.	-57237.	7496.	7.284E+11
21.50000	-0.000104	-326411.	-20209.	4846.	7.284E+11
22.00000	-4.890E-05	-360438.	1734.	2468.	7.284E+11
22.50000	-1.178E-05	-305598.	11058.	639.37527	7.284E+11
23.00000	1.024E-05	-227741.	12530.	-148.79173	7.284E+11
23.50000	2.101E-05	-155241.	11108.	-325.18068	7.284E+11
24.00000	2.411E-05	-94447.	8944.	-396.03055	7.284E+11
24.50000	2.253E-05	-47910.	6581.	-391.64297	7.284E+11
25.00000	1.859E-05	-15473.	4384.	-340.84754	7.284E+11
25.50000	1.389E-05	4694.	2558.	-267.79701	7.284E+11
26.00000	9.412E-06	15221.	1183.	-190.47812	7.284E+11
26.50000	5.690E-06	18890.	249.79863	-120.57799	7.284E+11
27.00000	2.902E-06	18218.	-304.71933	-64.26133	7.284E+11
27.50000	1.014E-06	15233.	-567.79019	-23.42895	7.284E+11
28.00000	-1.204E-07	11405.	-629.39419	2.89429	7.284E+11
28.50000	-6.915E-07	7680.	-568.84827	17.28768	7.284E+11
29.00000	-8.831E-07	4579.	-450.75519	22.07668	7.284E+11
29.50000	-8.483E-07	2271.	-320.89958	21.20853	7.284E+11
30.00000	-7.014E-07	727.76433	-204.67234	17.53389	7.284E+11
30.50000	-5.184E-07	-184.65972	-113.19055	12.96004	7.284E+11
31.00000	-3.446E-07	-630.52225	-48.46735	8.61436	7.284E+11
31.50000	-2.019E-07	-766.26793	-7.48109	5.04773	7.284E+11
32.00000	-9.712E-08	-720.29538	14.94573	2.42788	7.284E+11
32.50000	-2.792E-08	-586.91918	24.32339	0.69801	7.284E+11
33.00000	1.227E-08	-428.41471	25.49736	-0.30668	7.284E+11
33.50000	3.128E-08	-280.95084	22.23120	-0.78204	7.284E+11
34.00000	3.641E-08	-161.64029	17.15433	-0.91025	7.284E+11
34.50000	3.355E-08	-75.09892	11.90730	-0.83875	7.284E+11
35.00000	2.698E-08	-18.75271	7.36764	-0.67446	7.284E+11
35.50000	1.948E-08	13.31279	3.88324	-0.48700	7.284E+11
36.00000	1.264E-08	27.84616	1.47425	-0.31599	7.284E+11
36.50000	7.175E-09	31.00383	-0.01188	-0.17939	7.284E+11
37.00000	3.244E-09	27.70360	-0.79330	-0.08109	7.284E+11
37.50000	6.808E-10	21.48421	-1.08762	-0.01702	7.284E+11
38.00000	-8.202E-10	14.65213	-1.07717	0.02050	7.284E+11
38.50000	-1.597E-09	8.55819	-0.89589	0.03992	7.284E+11

39.00000	-1.951E-09	3.90149	-0.62981	0.04877	7.284E+11
39.50000	-2.112E-09	1.00047	-0.32512	0.05279	7.284E+11
40.00000	-2.223E-09	0.000	0.000	0.05558	7.284E+11

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.34431374 inches
Computed slope at pile head      =    -0.00176814 radians
Maximum bending moment           =       6987870. inch-lbs
Maximum shear force              =       -278821. lbs
Depth of maximum bending moment  =    18.00000000 feet below pile head
Depth of maximum shear force     =    19.00000000 feet below pile head
Number of iterations             =             36
Number of zero deflection points =              5
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =              0. lbs
Moment     =              0. in-lbs
Axial Load =              0. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
40.00000	0.34431374	6987870.	-278821.
38.00000	0.34287772	7044694.	-279673.
36.00000	0.34558117	6988101.	-271359.
34.00000	0.37186063	7300644.	-286156.
32.00000	0.34659433	6988308.	-275779.
30.00000	0.34342223	6988403.	-285431.
28.00000	0.37032870	7216091.	-294184.
26.00000	0.36220425	7215753.	-289453.
24.00000	0.35089961	6988650.	-294407.
22.00000	0.36109072	7159342.	-292746.
20.00000	0.35952623	6988783.	-411988.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.344314	-0.001768	-278821.	6987870.

Maximum pile-head deflection = 0.3443137360 inches
Maximum pile-head rotation = -0.0017681441 radians = -0.101307 deg.

Summary of Warning Messages

The following warning was reported 8042 times

***** Warning *****

The input value for k_rm used by the weak rock criteria is smaller than 0.00005. This value is outside the recommended range of 0.00005 to 0.0005. Please check your input data for accuracy.

The following warning was reported 10000 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.

==

LPile for Windows, Version 2019-11.002

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==

This copy of LPile is being used by:

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is a violation of the software license agreement.

Files Used for Analysis

Path to file locations on this computer:
\Projects\GFL\2019\1921\100400 PCE-PIK-CR50\PIK\108463\Design\Geotechnical\Spreadsheets & Calcs\Lateral Load Analysis\LPile\Extreme Event\

Name of the input data file:
Extreme event slope14 at-rest TOR18.lp11

Name of the output report file:
Extreme event slope14 at-rest TOR18.lp11

Name of the plot output file:
Extreme event slope14 at-rest TOR18.lp11

Name of the runtime message file:
Extreme event slope14 at-rest TOR18.lp11

Date and Time of Analysis

Date: February 17, 2020 Time: 9:27:14

Problem Title

Project Name: PIK-CR50-03.40

Job Number: 1921-1004.00

Client: Pike County

Engineer: Jason Hughes

Description:

Program Options and Settings

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	86

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)

- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 2
Total length of pile = 43.000 ft
Depth of ground surface below top of pile = 21.0000 ft

Pile diameters used for p-y curve computations are defined using 4 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	11.1000
2	3.000	11.1000
3	3.000	42.0000
4	43.000	42.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a AISC strong axis steel pile
Length of section = 3.000000 ft

AISC Section Type = W

AISC Section Name = W18X86

Pile width = 11.100000 in
Shear capacity of section = 0.0000 lbs

Pile Section No. 2:

Section 2 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 40.000000 ft
Shaft Diameter = 42.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 14.000 degrees
= 0.244 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer = 21.000000 ft
Distance from top of pile to bottom of layer = 26.000000 ft
Effective unit weight at top of layer = 80.000000 pcf
Effective unit weight at bottom of layer = 80.000000 pcf
Uniaxial compressive strength at top of layer = 8000. psi
Uniaxial compressive strength at bottom of layer = 8000. psi
Initial modulus of rock at top of layer = 200000. psi
Initial modulus of rock at bottom of layer = 200000. psi
RQD of rock at top of layer = 95.000000 %
RQD of rock at bottom of layer = 95.000000 %

k rm of rock at top of layer	=	0.0000100
k rm of rock at bottom of layer	=	0.0000100

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	26.000000 ft
Distance from top of pile to bottom of layer	=	50.000000 ft
Effective unit weight at top of layer	=	88.000000 pcf
Effective unit weight at bottom of layer	=	88.000000 pcf
Uniaxial compressive strength at top of layer	=	2300. psi
Uniaxial compressive strength at bottom of layer	=	2300. psi
Initial modulus of rock at top of layer	=	50000. psi
Initial modulus of rock at bottom of layer	=	50000. psi
RQD of rock at top of layer	=	80.000000 %
RQD of rock at bottom of layer	=	80.000000 %
k rm of rock at top of layer	=	0.0000500
k rm of rock at bottom of layer	=	0.0000500

(Depth of the lowest soil layer extends 7.000 ft below the pile tip)

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p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	21.000	1.0000	1.0000
2	35.000	1.0000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 5 points

Point No.	Depth X in	Dist. Load lb/in
1	0.000	0.000
2	35.999	0.000
3	36.000	10.000
4	60.000	69.000
5	252.000	719.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 19000. lbs	M = 0.0000 in-lbs	0.0000000

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Steel AISC Strong Axis:

Length of Section	=	3.000000 ft
Flange Width	=	11.100000 in
Section Depth	=	18.400000 in
Flange Thickness	=	0.770000 in
Web Thickness	=	0.480000 in
Yield Stress of Pipe	=	36.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	25.300000 sq. in.
Moment of Inertia	=	1530. in^4
Elastic Bending Stiffness	=	44370000. kip-in^2
Plastic Modulus, Z	=	186.000000in^3
Plastic Moment Capacity = Fy Z	=	6696.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	910.800 kips
Nominal Axial Tensile Capacity	=	-910.800 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg
0.0000047530	209.4921816318	44075512.	9.2000000000	
0.0000095061	418.9843632636	44075512.	9.2000000000	
0.0000142591	628.4765448954	44075512.	9.2000000000	
0.0000190121	837.9687265272	44075512.	9.2000000000	
0.0000237651	1047.	44075512.	9.2000000000	
0.0000285182	1257.	44075512.	9.2000000000	
0.0000332712	1466.	44075512.	9.2000000000	
0.0000380242	1676.	44075512.	9.2000000000	
0.0000427773	1885.	44075512.	9.2000000000	

0.0000475303	2095.	44075512.	9.2000000000	
0.0000522833	2304.	44075512.	9.2000000000	
0.0000570363	2514.	44075512.	9.2000000000	
0.0000617894	2723.	44075512.	9.2000000000	
0.0000665424	2933.	44075512.	9.2000000000	
0.0000712954	3142.	44075512.	9.2000000000	
0.0000760485	3352.	44075512.	9.2000000000	
0.0000808015	3561.	44075512.	9.2000000000	
0.0000855545	3771.	44075512.	9.2000000000	
0.0000903075	3980.	44075512.	9.2000000000	
0.0000950606	4190.	44075512.	9.2000000000	
0.0000998136	4399.	44075512.	9.2000000000	
0.0001045666	4609.	44075512.	9.2000000000	
0.0001093197	4818.	44075512.	9.2000000000	
0.0001140727	5028.	44075512.	9.2000000000	
0.0001188257	5237.	44075512.	9.2000000000	
0.0001235788	5447.	44075512.	9.2000000000	
0.0001283318	5656.	44075512.	9.2000000000	
0.0001330848	5866.	44075512.	9.2000000000	
0.0001378378	6060.	43965553.	9.2000000000	Y
0.0001425909	6185.	43375755.	9.2000000000	Y
0.0001473439	6240.	42352393.	9.2000000000	Y
0.0001520969	6267.	41203596.	9.2000000000	Y
0.0001568500	6290.	40100537.	9.2000000000	Y
0.0001616030	6311.	39050735.	9.2000000000	Y
0.0001663560	6330.	38050555.	9.2000000000	Y
0.0001711090	6348.	37096242.	9.2000000000	Y
0.0001758621	6364.	36185394.	9.2000000000	Y
0.0001806151	6379.	35315658.	9.2000000000	Y
0.0001853681	6392.	34484538.	9.2000000000	Y
0.0001948742	6417.	32928494.	9.2000000000	Y
0.0002043802	6438.	31500436.	9.2000000000	Y
0.0002138863	6457.	30187336.	9.2000000000	Y
0.0002233924	6473.	28974677.	9.2000000000	Y
0.0002328984	6487.	27853007.	9.2000000000	Y
0.0002424045	6500.	26812706.	9.2000000000	Y
0.0002519105	6511.	25845353.	9.2000000000	Y
0.0002614166	6521.	24943705.	9.2000000000	Y
0.0002709226	6530.	24101482.	9.2000000000	Y
0.0002804287	6538.	23313213.	9.2000000000	Y
0.0002899348	6545.	22574097.	9.2000000000	Y
0.0002994408	6552.	21879778.	9.2000000000	Y
0.0003089469	6558.	21225600.	9.2000000000	Y
0.0003184529	6563.	20609194.	9.2000000000	Y
0.0003279590	6568.	20027335.	9.2000000000	Y
0.0003374651	6573.	19476451.	9.2000000000	Y
0.0003469711	6577.	18955325.	9.2000000000	Y
0.0003564772	6581.	18460416.	9.2000000000	Y
0.0003659832	6584.	17991005.	9.2000000000	Y
0.0003754893	6588.	17544066.	9.2000000000	Y

0.0003849953	6591.	17119197.	9.2000000000	Y
0.0003945014	6594.	16713595.	9.2000000000	Y
0.0004040075	6596.	16327011.	9.2000000000	Y
0.0004135135	6599.	15957673.	9.2000000000	Y
0.0004230196	6601.	15604389.	9.2000000000	Y
0.0004325256	6603.	15266635.	9.2000000000	Y
0.0004420317	6605.	14942769.	9.2000000000	Y
0.0004515377	6607.	14632288.	9.2000000000	Y
0.0004610438	6609.	14334610.	9.2000000000	Y
0.0004705499	6611.	14048551.	9.2000000000	Y
0.0004800559	6612.	13773499.	9.2000000000	Y
0.0004895620	6614.	13509128.	9.2000000000	Y
0.0004990680	6615.	13254829.	9.2000000000	Y
0.0005085741	6616.	13009488.	9.2000000000	Y
0.0005180801	6617.	12773109.	9.2000000000	Y
0.0005275862	6619.	12545248.	9.2000000000	Y
0.0005370923	6620.	12325453.	9.2000000000	Y
0.0005465983	6621.	12112962.	9.2000000000	Y
0.0005561044	6622.	11907608.	9.2000000000	Y
0.0005656104	6623.	11709156.	9.2000000000	Y
0.0006036347	6626.	10977208.	9.2000000000	Y
0.0006416589	6629.	10331257.	9.2000000000	Y
0.0006796831	6631.	9756535.	9.2000000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	6631.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Pile Section No. 2:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	4.500000 in
Number of Reinforcing Bars	=	12 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1385. sq. in.
Total Area of Reinforcing Steel	=	27.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.95 percent
Edge-to-Edge Bar Spacing	=	6.409848 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.55
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	6238.704 kips
Tensile Load for Cracking of Concrete	=	-655.324 kips
Nominal Axial Tensile Capacity	=	-1620.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.693000	2.250000	15.653500	0.00000
2	1.693000	2.250000	13.556329	7.826750
3	1.693000	2.250000	7.826750	13.556329
4	1.693000	2.250000	0.00000	15.653500
5	1.693000	2.250000	-7.826750	13.556329
6	1.693000	2.250000	-13.556329	7.826750
7	1.693000	2.250000	-15.653500	0.00000
8	1.693000	2.250000	-13.556329	-7.826750
9	1.693000	2.250000	-7.826750	-13.556329
10	1.693000	2.250000	0.00000	-15.653500
11	1.693000	2.250000	7.826750	-13.556329
12	1.693000	2.250000	13.556329	-7.826750

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.410 inches
between bars 7 and 8.

Ratio of bar spacing to maximum aggregate size = 8.55

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg
0.0000006250	455.2545306522	728407249.	20.9999777443	
0.0000012500	908.6343072563	726907446.	20.9999776737	
0.0000018750	1360.	725407643.	20.9999776027	
0.0000025000	1810.	723907839.	20.9999775314	

0.0000031250	2258.	722408036.	20.9999774597	
0.0000037500	2703.	720908233.	20.9999773876	
0.0000043750	3147.	719408430.	20.9999773151	
0.0000050000	3590.	717908626.	20.9999772422	
0.0000056250	3590.	638141001.	12.1965732467	C
0.0000062500	3590.	574326901.	12.2003991673	C
0.0000068750	3590.	522115365.	12.2042333669	C
0.0000075000	3590.	478605751.	12.2080758818	C
0.0000081250	3590.	441789924.	12.2119267489	C
0.0000087500	3590.	410233501.	12.2157860050	C
0.0000093750	3590.	382884601.	12.2196536874	C
0.0000100000	3590.	358954313.	12.2235298335	C
0.0000106250	3590.	337839354.	12.2274144812	C
0.0000112500	3590.	319070501.	12.2313076682	C
0.0000118750	3590.	302277316.	12.2352094330	C
0.0000125000	3590.	287163451.	12.2391198138	C
0.0000131250	3590.	273489001.	12.2430388496	C
0.0000137500	3590.	261057682.	12.2469665792	C
0.0000143750	3590.	249707348.	12.2509030419	C
0.0000150000	3590.	239302875.	12.2548482773	C
0.0000156250	3590.	229730760.	12.2588023252	C
0.0000162500	3590.	220894962.	12.2627652256	C
0.0000168750	3590.	212713667.	12.2667370189	C
0.0000175000	3590.	205116750.	12.2707177458	C
0.0000181250	3703.	204293328.	12.2747074470	C
0.0000187500	3829.	204222578.	12.2787061639	C
0.0000193750	3955.	204151689.	12.2827139378	C
0.0000200000	4082.	204080662.	12.2867308106	C
0.0000206250	4208.	204009497.	12.2907568242	C
0.0000212500	4334.	203938191.	12.2947920211	C
0.0000218750	4460.	203866745.	12.2988364438	C
0.0000225000	4585.	203795158.	12.3028901354	C
0.0000231250	4711.	203723430.	12.3069531389	C
0.0000237500	4837.	203651559.	12.3110254981	C
0.0000243750	4962.	203579546.	12.3151072566	C
0.0000256250	5213.	203435089.	12.3232991488	C
0.0000268750	5463.	203290052.	12.3315291727	C
0.0000281250	5713.	203144433.	12.3397976903	C
0.0000293750	5963.	202998225.	12.3481050689	C
0.0000306250	6212.	202851423.	12.3564516811	C
0.0000318750	6461.	202704021.	12.3648379050	C
0.0000331250	6710.	202556015.	12.3732641241	C
0.0000343750	6958.	202407398.	12.3817307274	C
0.0000356250	7205.	202258169.	12.3902305933	C
0.0000368750	7453.	202108459.	12.3985086550	C
0.0000381250	7700.	201958143.	12.4068257245	C
0.0000393750	7946.	201807215.	12.4151821810	C
0.0000406250	8192.	201655669.	12.4235784095	C
0.0000418750	8438.	201503501.	12.4320148006	C
0.0000431250	8683.	201350705.	12.4404917508	C

0.0000443750	8928.	201197275.	12.4490096625	C
0.0000456250	9173.	201043204.	12.4575689439	C
0.0000468750	9417.	200888488.	12.4661700097	C
0.0000481250	9660.	200733120.	12.4748132808	C
0.0000493750	9903.	200577093.	12.4834991844	C
0.0000506250	10146.	200420403.	12.4922281543	C
0.0000518750	10389.	200263042.	12.5010006311	C
0.0000531250	10631.	200105004.	12.5098170622	C
0.0000543750	10872.	199946283.	12.5186779018	C
0.0000556250	11113.	199786873.	12.5275836114	C
0.0000568750	11354.	199626765.	12.5365346597	C
0.0000581250	11594.	199465955.	12.5455315228	C
0.0000593750	11834.	199304434.	12.5545746846	C
0.0000606250	12073.	199142196.	12.5636646364	C
0.0000618750	12312.	198979234.	12.5728018778	C
0.0000631250	12550.	198815540.	12.5819869161	C
0.0000643750	12788.	198651108.	12.5912202671	C
0.0000656250	13026.	198485929.	12.6005024551	C
0.0000668750	13263.	198319997.	12.6098340129	C
0.0000681250	13499.	198153303.	12.6192154822	C
0.0000693750	13735.	197985840.	12.6286474137	C
0.0000706250	13971.	197817599.	12.6381303674	C
0.0000718750	14206.	197648574.	12.6476649127	C
0.0000731250	14441.	197478755.	12.6572516286	C
0.0000743750	14675.	197308134.	12.6668911041	C
0.0000793750	15607.	196617463.	12.7059887401	C
0.0000843750	16529.	195897357.	12.7456319143	CY
0.0000893750	17345.	194064964.	12.7610167864	CY
0.0000943750	18038.	191130418.	12.7501118060	CY
0.0000993750	18495.	186110051.	12.6841183841	CY
0.0001043750	18879.	180877307.	12.6098936127	CY
0.0001093750	19260.	176089510.	12.5452018739	CY
0.0001143750	19637.	171687521.	12.4888650975	CY
0.0001193750	20010.	167622075.	12.4399063331	CY
0.0001243750	20347.	163597736.	12.3884146454	CY
0.0001293750	20582.	159085458.	12.3119345602	CY
0.0001343750	20733.	154292069.	12.2193701889	CY
0.0001393750	20877.	149788599.	12.1335556141	CY
0.0001443750	21018.	145582599.	12.0553705022	CY
0.0001493750	21158.	141643873.	11.9840856967	CY
0.0001543750	21294.	137938971.	11.9162794708	CY
0.0001593750	21428.	134451225.	11.8536625413	CY
0.0001643750	21560.	131161596.	11.7965587314	CY
0.0001693750	21689.	128052204.	11.7445233308	CY
0.0001743750	21815.	125105945.	11.6972809937	CY
0.0001793750	21940.	122311023.	11.6542921065	CY
0.0001843750	22061.	119654793.	11.6152548284	CY
0.0001893750	22181.	117126346.	11.5798753943	CY
0.0001943750	22298.	114717422.	11.5475670007	CY
0.0001993750	22413.	112415394.	11.5167304901	CY

0.0002043750	22525.	110212365.	11.4882063301	CY
0.0002093750	22619.	108031007.	11.4562209750	CY
0.0002143750	22699.	105885384.	11.4214639731	CY
0.0002193750	22766.	103777053.	11.3843761383	CY
0.0002243750	22810.	101658503.	11.3405894282	CY
0.0002293750	22847.	99603715.	11.2967974681	CY
0.0002343750	22870.	97580311.	11.2503241747	CY
0.0002393750	22893.	95638405.	11.2065188475	CY
0.0002443750	22916.	93774308.	11.1649712380	CY
0.0002493750	22938.	91982741.	11.1251947042	CY
0.0002543750	22958.	90253982.	11.0850509973	CY
0.0002593750	22978.	88590630.	11.0468656715	CY
0.0002643750	22998.	86989099.	11.0105005598	CY
0.0002693750	23017.	85445930.	10.9758595070	CY
0.0002743750	23036.	83956697.	10.9431530557	CYT
0.0003043750	23141.	76028975.	10.7764396703	CYT
0.0003343750	23236.	69490102.	10.6441021612	CYT
0.0003643750	23320.	63999101.	10.5380635396	CYT

Summary of Results for Nominal Moment Capacity for Section 2

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	0.000	23034.593	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2

1	0.65	23035.	0.0000	14972.	197087458.
1	0.75	23035.	0.0000	17276.	194219089.
1	0.90	23035.	0.0000	20731.	154351076.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	21.0000	0.00	N.A.	Yes	N.A.	N.A.
2	26.0000	5.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 19000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness in-lb^2
0.000	0.88442	-5.437E-07	19000.	0.000	4.408E+10
0.50000	0.85727	114000.	19000.	0.000	4.408E+10
1.00000	0.83021	228000.	19000.	0.000	4.408E+10
1.50000	0.80334	342000.	19000.	0.000	4.408E+10
2.00000	0.77675	456000.	19000.	0.000	4.408E+10

2.50000	0.75054	570000.	19000.	0.000	4.408E+10
3.00000	0.72479	684000.	19021.	0.000	4.408E+10
3.50000	0.69959	798246.	19115.	0.000	7.271E+11
4.00000	0.67444	913384.	19308.	0.000	7.269E+11
4.50000	0.64933	1029943.	19589.	0.000	7.264E+11
5.00000	0.62427	1148456.	19961.	0.000	7.260E+11
5.50000	0.59927	1269477.	20438.	0.000	7.256E+11
6.00000	0.57434	1393714.	21035.	0.000	7.253E+11
6.50000	0.54947	1521897.	21754.	0.000	7.248E+11
7.00000	0.52468	1654758.	22594.	0.000	7.243E+11
7.50000	0.49997	1793028.	23557.	0.000	7.240E+11
8.00000	0.47534	1937438.	24641.	0.000	7.234E+11
8.50000	0.45082	2088720.	25847.	0.000	7.229E+11
9.00000	0.42640	2247604.	27175.	0.000	7.224E+11
9.50000	0.40209	2414823.	28625.	0.000	7.218E+11
10.00000	0.37790	2591106.	30197.	0.000	7.212E+11
10.50000	0.35384	2777187.	31891.	0.000	7.206E+11
11.00000	0.32992	2973794.	33706.	0.000	7.199E+11
11.50000	0.30615	3181661.	35644.	0.000	7.193E+11
12.00000	0.28254	3401519.	37703.	0.000	7.185E+11
12.50000	0.25910	3634097.	39884.	0.000	2.048E+11
13.00000	0.23630	3880129.	42187.	0.000	2.042E+11
13.50000	0.21418	4140344.	44612.	0.000	2.040E+11
14.00000	0.19279	4415475.	47159.	0.000	2.039E+11
14.50000	0.17218	4706252.	49828.	0.000	2.037E+11
15.00000	0.15240	5013407.	52618.	0.000	2.035E+11
15.50000	0.13351	5337671.	55531.	0.000	2.034E+11
16.00000	0.11557	5679775.	58565.	0.000	2.032E+11
16.50000	0.09863	6040451.	61721.	0.000	2.030E+11
17.00000	0.08276	6420429.	64999.	0.000	2.027E+11
17.50000	0.06803	6820442.	68399.	0.000	2.025E+11
18.00000	0.05452	7241219.	71921.	0.000	2.022E+11
18.50000	0.04229	7683494.	75565.	0.000	2.020E+11
19.00000	0.03144	8147996.	79330.	0.000	2.017E+11
19.50000	0.02204	8635456.	83218.	0.000	2.014E+11
20.00000	0.01418	9146608.	87227.	0.000	2.011E+11
20.50000	0.007957	9682180.	91358.	0.000	2.007E+11
21.00000	0.003473	10242906.	-113847.	-69457.	2.004E+11
21.50000	0.000829	8316017.	-380397.	-19749.	2.016E+11
22.00000	-0.000329	5678147.	-412406.	9080.	2.032E+11
22.50000	-0.000481	3367144.	-339833.	15112.	7.186E+11
23.00000	-0.000464	1600156.	-245424.	16358.	7.245E+11
23.50000	-0.000368	422056.	-153230.	14373.	7.284E+11
24.00000	-0.000251	-238604.	-77823.	10762.	7.284E+11
24.50000	-0.000146	-511823.	-25106.	6810.	7.281E+11
25.00000	-6.606E-05	-539871.	5329.	3334.	7.279E+11
25.50000	-1.288E-05	-447880.	17430.	699.25676	7.284E+11
26.00000	1.816E-05	-330716.	18736.	-263.76788	7.284E+11
26.50000	3.286E-05	-223047.	16419.	-508.52061	7.284E+11
27.00000	3.653E-05	-133685.	13093.	-600.16536	7.284E+11

27.50000	3.360E-05	-65930.	9541.	-583.96926	7.284E+11
28.00000	2.741E-05	-19197.	6281.	-502.44740	7.284E+11
28.50000	2.027E-05	9448.	3602.	-390.83368	7.284E+11
29.00000	1.359E-05	24023.	1604.	-275.06855	7.284E+11
29.50000	8.105E-06	28695.	263.46277	-171.75022	7.284E+11
30.00000	4.037E-06	27184.	-519.94003	-89.38405	7.284E+11
30.50000	1.312E-06	22456.	-878.98503	-30.29762	7.284E+11
31.00000	-3.032E-07	16636.	-948.00690	7.29033	7.284E+11
31.50000	-1.096E-06	11080.	-843.93893	27.39899	7.284E+11
32.00000	-1.341E-06	6509.	-661.15413	33.52927	7.284E+11
32.50000	-1.265E-06	3146.	-465.71525	31.61702	7.284E+11
33.00000	-1.033E-06	920.57323	-293.41034	25.81795	7.284E+11
33.50000	-7.553E-07	-375.16567	-159.31214	18.88145	7.284E+11
34.00000	-4.963E-07	-991.17243	-65.44232	12.40849	7.284E+11
34.50000	-2.864E-07	-1160.	-6.73626	7.16020	7.284E+11
35.00000	-1.338E-07	-1072.	24.78159	3.34575	7.284E+11
35.50000	-3.423E-08	-863.09441	37.38641	0.85585	7.284E+11
36.00000	2.271E-08	-623.37057	38.25108	-0.56763	7.284E+11
36.50000	4.884E-08	-404.08145	32.88550	-1.22090	7.284E+11
37.00000	5.500E-08	-228.74462	25.09813	-1.37489	7.284E+11
37.50000	4.985E-08	-102.90383	17.23471	-1.24625	7.284E+11
38.00000	3.962E-08	-21.92814	10.52454	-0.99047	7.284E+11
38.50000	2.830E-08	23.39063	5.43035	-0.70759	7.284E+11
39.00000	1.814E-08	43.23602	1.94671	-0.45362	7.284E+11
39.50000	1.012E-08	46.75114	-0.17334	-0.25306	7.284E+11
40.00000	4.411E-09	41.15596	-1.26335	-0.11027	7.284E+11
40.50000	7.334E-10	31.59090	-1.64918	-0.01834	7.284E+11
41.00000	-1.383E-09	21.36575	-1.60048	0.03457	7.284E+11
41.50000	-2.443E-09	12.38512	-1.31354	0.06108	7.284E+11
42.00000	-2.891E-09	5.60326	-0.91347	0.07228	7.284E+11
42.50000	-3.062E-09	1.42351	-0.46694	0.07656	7.284E+11
43.00000	-3.163E-09	0.000	0.000	0.07908	7.284E+11

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     0.88441573 inches
Computed slope at pile head      =    -0.00452471 radians
Maximum bending moment           =      10242906. inch-lbs
Maximum shear force              =       -412406. lbs
Depth of maximum bending moment  =    21.00000000 feet below pile head
Depth of maximum shear force     =    22.00000000 feet below pile head
Number of iterations             =            106
Number of zero deflection points =              5
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear   =   19000. lbs
Moment   =   0. in-lbs
Axial Load =   0. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
43.00000	0.88441573	10242906.	-412406.
40.85000	0.93985495	10673694.	-448096.
38.70000	0.91020032	10416327.	-467517.
36.55000	0.92587290	10531577.	-473040.
34.40000	0.91501115	10474761.	-460013.
32.25000	0.88356451	10243370.	-426937.
30.10000	0.88975804	10243432.	-451674.
27.95000	0.90962810	10387716.	-459351.
25.80000	0.94151987	10587732.	-464194.
23.65000	0.92124029	10444917.	-503850.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	0.884416	-0.004525	-412406.	10242906.

Maximum pile-head deflection = 0.8844157346 inches
Maximum pile-head rotation   = -0.0045247122 radians = -0.259247 deg.

Summary of Warning Messages

The following warning was reported 6763 times

***** Warning *****

The input value for k_rm used by the weak rock criteria is smaller than 0.00005. This value is outside the recommended range of 0.00005 to 0.0005. Please check your input data for accuracy.

The following warning was reported 10000 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.

CLIENT	Pike County Engineer	JOB NUMBER	1921-1004.00		
PROJECT	Pike county wall	SHEET NO.	1	OF	2
SUBJECT	Drilled Shaft Wall - Lateral Load Anlysis - STA 12+50	COMP. BY	MNW	DATE	2/17/2020
	Software: Lpile v 2019-11 by Ensoft, Inc.	CHECKED BY	HJH	DATE	2/17/2020
	Case: Top of Rock at 28'				

1 Assumptions

1 Load and Resistance Factor Design (LRFD) Methodology; AASHTO LRFD BDS, 8th Ed and ODOT 2019 BDM
2 Geotechnical information from DLZ Geotechnical Exploration Report
3 Survey information provided by DLZ
4 Cantilever wall height of 18 feet in front of wall. Rankine at-rest earth pressure above assumed at failure surface
5 Slide mass left in place
6 No drainage behind wall. Consider water at 2ft below top of wall/ground surface .
7 Guardrail mounted on top of grade beam. Vehicle Collision load included for extreme event loading condition.
8 Ground sloping in front of wall at 26 degrees from horizontal.
9 Assume drilled shaft is spaced @ 5 feet on center with plug piles between.

2 Soil/Rock Profile for LPile Analysis

No.	Layer Description	Lpile Model	Top* (ft)	Bot.* (ft)	Eff. UW, γ' (pcf)	q_u (psi)	E_i (psi)	RQD (%)	k	Undrained Cohesion
1	Stiff clay w/o free water	Stiff Clay	18	28	62.6				0.005	4000
2	Weathered Bedrock	Weak Rock	28	38	75	500	10000	5	5E-05	
3	Unweathered Bedrock	Weak Rock	38	50	88	2300	50000	75	1E-05	

*Add 3 feet to all depths (i.e. assumed height of collision load) for extreme event load condition

3 Pile Properties

Section Input

Section Diameter = 42 in
Concrete Compressive Strength, f_c' 4,000 psi
Max. Coarse Aggregate Size = 0.75 in May need pea gravel mix if reinforcing is closely spaced.
Reinforcing Steel - No.14 bars equally spaced (12 total) with 4.5 in cover (assumes No. 4 spiral)
As = 27.00 in 1.95%
Yield Stress, F_y = 60 ksi
Steel Elastic Modulus, E = 29000 ksi

Section	Lpile Model	Physical Model	Length (ft)
1	AISC Strong Axis	Guardrail	3
2	Bored Pile	Drilled Shaft	40

Note:
1 Bored Pile section length includes concrete cap thickness to account for lateral pressures against it.
2 A fictitious W section was considered on top of the drilled shaft in the model to evaluate the collision load transmitted to the shaft from the guardrail as a point load applied on a relatively rigid section.

4 Passive resistance reduction factor

p-multiplier, p = 0.72 within soil overburden only

5 Distributed Load (per Pile) for Each Limit State

Depth (ft)	Service Limit Factored Load	Strength Limit Factored Load	Extreme Event II Factored Load
0	21 lb/in	36 lb/in	10 lb/in
2	79 lb/in	115 lb/in	69 lb/in
18	730 lb/in	848 lb/in	719 lb/in

Add 3 feet to depths listed above for entry into Lpile Extreme Event II (i.e. horizontal loads below guardrail)

CLIENT	Pike County Engineer	JOB NUMBER	1921-1004.00		
PROJECT	Pike county wall	SHEET NO.	2	OF	2
SUBJECT	Drilled Shaft Wall - Lateral Load Anlysis - STA 12+50	COMP. BY	MNW	DATE	2/17/2020
	Software: Lpile v 2019-11 by Ensoft, Inc.	CHECKED BY	HJH	DATE	2/17/2020
	Case: Top of Rock at 28'				

6 Pile-Head Loading

Load Case	Shear (in)	Moment (in-lbs)	Axial Load lbs
Service	0	0	0
Strength	0	0	0
Extreme Event II	19,000	0	0

7 Results

Load Case	Deflection	Max Moment @ Depth		Max Shear@ Depth	
	(in)	(in-kips)	(ft)	(kips)	(ft)
Service	2.01	9,194	26.0	197	30.0
Strength	2.63	11,682	27.0	263	30.5
Extreme Event II	3.72	14,737	26.5	323	30.5

Depths listed for Extreme Event II exclude the 3-ft high extension included in L-Pile

See structural analysis for Moment and Shear checks.

Client	Pike County Engineer		Project No.	1921-1004.00	
Project	PIK-CR50-3.40		Sheet No.	1 of	2
Subject	Drilled Shaft Wall with Plug Piles		Comp. By	MNW Date	2/14/2020
	Lateral Load Analysis		Checked By	HJH Date	2/14/2020

Wall Properties/Parameters for Analysis

Top of Wall	613	ft
Design Grade	595	ft
Design GW El	611	ft
Design Height, H	18.0	ft
Wall Type	Drilled Shaft	
CTC Spacing, S	5	ft
Bar Size & Qty	12 #14 Bars	
Shaft Diameter	42	inches
p-multiplier	0.72	overburden only

Shaft Properties:

Diameter	42	in^2
Area	1385	in
Concrete Strength, f_c'	4000	psi
Concrete Cover (to bar)	4.5	in
Concrete Elastic Mod, E_c	3,600,000	psi
Moment of Inertia, I_{xx}	152,745	in^4
Sectional Modulus, S_{xx}	7,274	in^3
Bending Stiffness, EI_{xx}	5.499E+11	$lb*in^2$

Retained Soil Parameters

Description	Existing Soil/Slide Mass	
Slope, β	0	degrees
Shear Strength Paramaters		
Effective Stress		
ϕ'	26	degrees
c'	0	psf
Total Stress (Cohesive Soils, Short Term Only)		
ϕ	0	degrees
C	N/A	psf
Unit Weight		
Moist, γ_m	125	pcf
Sat., γ_s	125	pcf
OCR (est.)	1	
Earth Pressure Coefficients (Rankine)		
Active, Ka	0.390	(Frictionless)
At-Rest, Ko	0.562	

Assumptions:

1 Slide mass left in place
2 No drainage behind wall. Consider water from 2ft below top of wall.
3 Height of wall assumed as elevation of failure surface
4 Rankine at-rest earth pressure loading on wall above assumed shear failure
5 Load combinations per AASHTO LRFD BDS, 8th Ed., 2017
6 Guardrail mounted on top of grade beam. Vehicle Collision load included (extreme event II loading).

Calculate Nominal Lateral Loads for Service, Strength, and EEII (i.e. distributed load along pile)

γ	125 pcf		
Ko	0.562	H_{eq}	2 ft
H	18.0 ft		
S	5 ft		

depth (ft)	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	$\Sigma\sigma_h$ (lb/ft)
0.0	-	250	-	250
2.0	703	250	-	953
18.0	3,517	250	4,992	8,759
		Total		78,894 lbs

Client	Pike County Engineer	Project No.	1921-1004.00		
Project	PIK-CR50-3.40	Sheet No.	2	of	2
Subject	Drilled Shaft Wall with Plug Piles	Comp. By	MNW	Date	2/14/2020
	Lateral Load Analysis	Checked By	HJH	Date	2/14/2020

Calculate Factored Lateral Loads for Service, Strength, and EEII (i.e. distributed load along pile)

	EH	LL	WA	CT
Strength I	1.35	1.75	1.00	0.00
Service I	1.00	1.00	1.00	0.00
Ext. Event II	1.00	0.50	1.00	1.00

*see Tables 3.4.1-1 & -2, AASHTO BDS, 7th Ed

Service I

depth (ft)

	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	Σsh (lb/ft)	$\Sigma\sigma_h$ (lb/in)
0.0	-	250	-	250	21
2.0	703	250	-	953	79
18.0	3,517	250	4,992	8,759	730

Strength I

depth (ft)

	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	Σsh (lb/ft)	$\Sigma\sigma_h$ (lb/in)
0.0	-	438	-	438	36
2.0	948	438	-	1,386	115
18.0	4,748	438	4,992	10,177	848

Extreme Event II *Apply point load CT at top of pile +3ft with load factor = 1.0 and magnitude = 19 kips*

Add 3 feet to depths below for entry into LPile model (i.e. 3 feet below guardrail)

depth (ft)

	EH (lb/ft)	LL (lb/ft)	WA (lb/ft)	Σsh (lb/ft)	$\Sigma\sigma_h$ (lb/in)
0.0	-	125	-	125	10
2.0	703	125	-	828	69
18.0	3,517	125	4,992	8,634	719

==

LPile for Windows, Version 2019-11.002

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==

This copy of LPile is being used by:

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Files Used for Analysis

Path to file locations on this computer:
\Projects\GFL\2019\1921\100400 PCE-PIK-CR50\PIK\108463\Design\Geotechnical\Spreadsheets & Calcs\Lateral Load Analysis\LPile\Service Limit\

Name of the input data file:
Service limit slope26 at-rest TOR28.lp11

Name of the output report file:
Service limit slope26 at-rest TOR28.lp11

Name of the plot output file:
Service limit slope26 at-rest TOR28.lp11

Name of the runtime message file:
Service limit slope26 at-rest TOR28.lp11

Date and Time of Analysis

Date: February 14, 2020 Time: 11:26:29

Problem Title

Project Name: PIK-CR50-03.40

Job Number: 1921-1004.00

Client: Pike County

Engineer: Jason Hughes

Description:

Program Options and Settings

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	80

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)

- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	40.000 ft
Depth of ground surface below top of pile	=	18.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	42.0000
2	40.000	42.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	26.000	degrees
	=	0.454	radians
Pile Batter Angle	=	0.000	degrees
	=	0.000	radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	18.000000	ft
Distance from top of pile to bottom of layer	=	28.000000	ft
Effective unit weight at top of layer	=	62.600000	pcf
Effective unit weight at bottom of layer	=	62.600000	pcf
Undrained cohesion at top of layer	=	4000.	psf
Undrained cohesion at bottom of layer	=	4000.	psf
Epsilon-50 at top of layer	=	0.005000	
Epsilon-50 at bottom of layer	=	0.005000	

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	28.000000	ft
Distance from top of pile to bottom of layer	=	38.000000	ft
Effective unit weight at top of layer	=	75.000000	pcf
Effective unit weight at bottom of layer	=	75.000000	pcf
Uniaxial compressive strength at top of layer	=	500.000000	psi
Uniaxial compressive strength at bottom of layer	=	500.000000	psi
Initial modulus of rock at top of layer	=	10000.	psi
Initial modulus of rock at bottom of layer	=	10000.	psi
RQD of rock at top of layer	=	5.000000	%
RQD of rock at bottom of layer	=	5.000000	%
k rm of rock at top of layer	=	0.0005000	
k rm of rock at bottom of layer	=	0.0005000	

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	38.000000 ft
Distance from top of pile to bottom of layer	=	50.000000 ft
Effective unit weight at top of layer	=	88.000000 pcf
Effective unit weight at bottom of layer	=	88.000000 pcf
Uniaxial compressive strength at top of layer	=	2300. psi
Uniaxial compressive strength at bottom of layer	=	2300. psi
Initial modulus of rock at top of layer	=	50000. psi
Initial modulus of rock at bottom of layer	=	50000. psi
RQD of rock at top of layer	=	75.000000 %
RQD of rock at bottom of layer	=	75.000000 %
k rm of rock at top of layer	=	0.0001000
k rm of rock at bottom of layer	=	0.0001000

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

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p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	18.000	0.7200	1.0000
2	28.000	0.7200	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 3 points

Point No.	Depth X in	Dist. Load lb/in

1	0.000	21.000
2	24.000	79.000
3	216.000	730.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	4.500000 in
Number of Reinforcing Bars	=	12 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi

Gross Area of Shaft	=	1385. sq. in.
Total Area of Reinforcing Steel	=	27.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.95 percent
Edge-to-Edge Bar Spacing	=	6.409848 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.55
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	6238.704 kips
Tensile Load for Cracking of Concrete	=	-655.324 kips
Nominal Axial Tensile Capacity	=	-1620.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.693000	2.250000	15.653500	0.00000
2	1.693000	2.250000	13.556329	7.826750
3	1.693000	2.250000	7.826750	13.556329
4	1.693000	2.250000	0.00000	15.653500
5	1.693000	2.250000	-7.826750	13.556329
6	1.693000	2.250000	-13.556329	7.826750
7	1.693000	2.250000	-15.653500	0.00000
8	1.693000	2.250000	-13.556329	-7.826750
9	1.693000	2.250000	-7.826750	-13.556329
10	1.693000	2.250000	0.00000	-15.653500
11	1.693000	2.250000	7.826750	-13.556329
12	1.693000	2.250000	13.556329	-7.826750

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.410 inches
between bars 7 and 8.

Ratio of bar spacing to maximum aggregate size = 8.55

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886

Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg
0.0000006250	455.2545306522	728407249.	20.9999777443	
0.0000012500	908.6343072563	726907446.	20.9999776737	
0.0000018750	1360.	725407643.	20.9999776027	
0.0000025000	1810.	723907839.	20.9999775314	
0.0000031250	2258.	722408036.	20.9999774597	
0.0000037500	2703.	720908233.	20.9999773876	
0.0000043750	3147.	719408430.	20.9999773151	
0.0000050000	3590.	717908626.	20.9999772422	
0.0000056250	3590.	638141001.	12.1965732467	C
0.0000062500	3590.	574326901.	12.2003991673	C
0.0000068750	3590.	522115365.	12.2042333669	C
0.0000075000	3590.	478605751.	12.2080758818	C
0.0000081250	3590.	441789924.	12.2119267489	C
0.0000087500	3590.	410233501.	12.2157860050	C
0.0000093750	3590.	382884601.	12.2196536874	C

0.0000100000	3590.	358954313.	12.2235298335	C
0.0000106250	3590.	337839354.	12.2274144812	C
0.0000112500	3590.	319070501.	12.2313076682	C
0.0000118750	3590.	302277316.	12.2352094330	C
0.0000125000	3590.	287163451.	12.2391198138	C
0.0000131250	3590.	273489001.	12.2430388496	C
0.0000137500	3590.	261057682.	12.2469665792	C
0.0000143750	3590.	249707348.	12.2509030419	C
0.0000150000	3590.	239302875.	12.2548482773	C
0.0000156250	3590.	229730760.	12.2588023252	C
0.0000162500	3590.	220894962.	12.2627652256	C
0.0000168750	3590.	212713667.	12.2667370189	C
0.0000175000	3590.	205116750.	12.2707177458	C
0.0000181250	3703.	204293328.	12.2747074470	C
0.0000187500	3829.	204222578.	12.2787061639	C
0.0000193750	3955.	204151689.	12.2827139378	C
0.0000200000	4082.	204080662.	12.2867308106	C
0.0000206250	4208.	204009497.	12.2907568242	C
0.0000212500	4334.	203938191.	12.2947920211	C
0.0000218750	4460.	203866745.	12.2988364438	C
0.0000225000	4585.	203795158.	12.3028901354	C
0.0000231250	4711.	203723430.	12.3069531389	C
0.0000237500	4837.	203651559.	12.3110254981	C
0.0000243750	4962.	203579546.	12.3151072566	C
0.0000256250	5213.	203435089.	12.3232991488	C
0.0000268750	5463.	203290052.	12.3315291727	C
0.0000281250	5713.	203144433.	12.3397976903	C
0.0000293750	5963.	202998225.	12.3481050689	C
0.0000306250	6212.	202851423.	12.3564516811	C
0.0000318750	6461.	202704021.	12.3648379050	C
0.0000331250	6710.	202556015.	12.3732641241	C
0.0000343750	6958.	202407398.	12.3817307274	C
0.0000356250	7205.	202258169.	12.3902305933	C
0.0000368750	7453.	202108459.	12.3985086550	C
0.0000381250	7700.	201958143.	12.4068257245	C
0.0000393750	7946.	201807215.	12.4151821810	C
0.0000406250	8192.	201655669.	12.4235784095	C
0.0000418750	8438.	201503501.	12.4320148006	C
0.0000431250	8683.	201350705.	12.4404917508	C
0.0000443750	8928.	201197275.	12.4490096625	C
0.0000456250	9173.	201043204.	12.4575689439	C
0.0000468750	9417.	200888488.	12.4661700097	C
0.0000481250	9660.	200733120.	12.4748132808	C
0.0000493750	9903.	200577093.	12.4834991844	C
0.0000506250	10146.	200420403.	12.4922281543	C
0.0000518750	10389.	200263042.	12.5010006311	C
0.0000531250	10631.	200105004.	12.5098170622	C
0.0000543750	10872.	199946283.	12.5186779018	C
0.0000556250	11113.	199786873.	12.5275836114	C
0.0000568750	11354.	199626765.	12.5365346597	C

0.0000581250	11594.	199465955.	12.5455315228	C
0.0000593750	11834.	199304434.	12.5545746846	C
0.0000606250	12073.	199142196.	12.5636646364	C
0.0000618750	12312.	198979234.	12.5728018778	C
0.0000631250	12550.	198815540.	12.5819869161	C
0.0000643750	12788.	198651108.	12.5912202671	C
0.0000656250	13026.	198485929.	12.6005024551	C
0.0000668750	13263.	198319997.	12.6098340129	C
0.0000681250	13499.	198153303.	12.6192154822	C
0.0000693750	13735.	197985840.	12.6286474137	C
0.0000706250	13971.	197817599.	12.6381303674	C
0.0000718750	14206.	197648574.	12.6476649127	C
0.0000731250	14441.	197478755.	12.6572516286	C
0.0000743750	14675.	197308134.	12.6668911041	C
0.0000793750	15607.	196617463.	12.7059887401	C
0.0000843750	16529.	195897357.	12.7456319143	CY
0.0000893750	17345.	194064964.	12.7610167864	CY
0.0000943750	18038.	191130418.	12.7501118060	CY
0.0000993750	18495.	186110051.	12.6841183841	CY
0.0001043750	18879.	180877307.	12.6098936127	CY
0.0001093750	19260.	176089510.	12.5452018739	CY
0.0001143750	19637.	171687521.	12.4888650975	CY
0.0001193750	20010.	167622075.	12.4399063331	CY
0.0001243750	20347.	163597736.	12.3884146454	CY
0.0001293750	20582.	159085458.	12.3119345602	CY
0.0001343750	20733.	154292069.	12.2193701889	CY
0.0001393750	20877.	149788599.	12.1335556141	CY
0.0001443750	21018.	145582599.	12.0553705022	CY
0.0001493750	21158.	141643873.	11.9840856967	CY
0.0001543750	21294.	137938971.	11.9162794708	CY
0.0001593750	21428.	134451225.	11.8536625413	CY
0.0001643750	21560.	131161596.	11.7965587314	CY
0.0001693750	21689.	128052204.	11.7445233308	CY
0.0001743750	21815.	125105945.	11.6972809937	CY
0.0001793750	21940.	122311023.	11.6542921065	CY
0.0001843750	22061.	119654793.	11.6152548284	CY
0.0001893750	22181.	117126346.	11.5798753943	CY
0.0001943750	22298.	114717422.	11.5475670007	CY
0.0001993750	22413.	112415394.	11.5167304901	CY
0.0002043750	22525.	110212365.	11.4882063301	CY
0.0002093750	22619.	108031007.	11.4562209750	CY
0.0002143750	22699.	105885384.	11.4214639731	CY
0.0002193750	22766.	103777053.	11.3843761383	CY
0.0002243750	22810.	101658503.	11.3405894282	CY
0.0002293750	22847.	99603715.	11.2967974681	CY
0.0002343750	22870.	97580311.	11.2503241747	CY
0.0002393750	22893.	95638405.	11.2065188475	CY
0.0002443750	22916.	93774308.	11.1649712380	CY
0.0002493750	22938.	91982741.	11.1251947042	CY
0.0002543750	22958.	90253982.	11.0850509973	CY

0.0002593750	22978.	88590630.	11.0468656715	CY
0.0002643750	22998.	86989099.	11.0105005598	CY
0.0002693750	23017.	85445930.	10.9758595070	CY
0.0002743750	23036.	83956697.	10.9431530557	CYT
0.0003043750	23141.	76028975.	10.7764396703	CYT
0.0003343750	23236.	69490102.	10.6441021612	CYT
0.0003643750	23320.	63999101.	10.5380635396	CYT

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	0.000	23034.593	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	23035.	0.0000	14972.	197087458.
1	0.75	23035.	0.0000	17276.	194219089.
1	0.90	23035.	0.0000	20731.	154351076.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	18.0000	0.00	N.A.	No	0.00	549555.
2	28.0000	10.0000	No	Yes	N.A.	N.A.
3	38.0000	20.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness in-lb^2
0.000	2.01075	9.884E-05	-7.488E-07	0.000	7.284E+11
0.50000	1.96774	443.25003	180.37500	0.000	7.284E+11
1.00000	1.92472	2165.	436.87500	0.000	7.284E+11
1.50000	1.88171	5686.	780.37500	0.000	7.284E+11
2.00000	1.83870	11529.	1213.	0.000	7.284E+11
2.50000	1.79569	20243.	1750.	0.000	7.284E+11
3.00000	1.75268	32532.	2407.	0.000	7.284E+11
3.50000	1.70967	49131.	3187.	0.000	7.284E+11
4.00000	1.66666	70771.	4088.	0.000	7.284E+11
4.50000	1.62366	98184.	5111.	0.000	7.284E+11
5.00000	1.58066	132103.	6256.	0.000	7.284E+11
5.50000	1.53767	173261.	7524.	0.000	7.284E+11
6.00000	1.49469	222389.	8913.	0.000	7.284E+11
6.50000	1.45171	280220.	10425.	0.000	7.284E+11
7.00000	1.40876	347486.	12058.	0.000	7.284E+11

7.50000	1.36581	424921.	13814.	0.000	7.284E+11
8.00000	1.32289	513255.	15692.	0.000	7.281E+11
8.50000	1.28000	613222.	17692.	0.000	7.276E+11
9.00000	1.23713	725553.	19813.	0.000	7.273E+11
9.50000	1.19431	850982.	22057.	0.000	7.270E+11
10.00000	1.15152	990241.	24423.	0.000	7.265E+11
10.50000	1.10878	1144061.	26911.	0.000	7.260E+11
11.00000	1.06610	1313176.	29521.	0.000	7.255E+11
11.50000	1.02349	1498318.	32254.	0.000	7.249E+11
12.00000	0.98095	1700219.	35108.	0.000	7.242E+11
12.50000	0.93849	1919611.	38084.	0.000	7.235E+11
13.00000	0.89613	2157227.	41182.	0.000	7.227E+11
13.50000	0.85387	2413800.	44403.	0.000	7.218E+11
14.00000	0.81174	2690061.	47745.	0.000	7.209E+11
14.50000	0.76974	2986743.	51210.	0.000	7.199E+11
15.00000	0.72789	3304578.	54796.	0.000	7.188E+11
15.50000	0.68621	3644299.	58505.	0.000	2.047E+11
16.00000	0.64517	4006639.	62336.	0.000	2.041E+11
16.50000	0.60483	4392328.	66289.	0.000	2.039E+11
17.00000	0.56527	4802101.	70363.	0.000	2.037E+11
17.50000	0.52656	5236689.	74560.	0.000	2.034E+11
18.00000	0.48877	5696825.	75281.	-831.92104	2.032E+11
18.50000	0.45199	6140059.	71360.	-837.36223	2.029E+11
19.00000	0.41631	6553149.	66324.	-841.43425	2.026E+11
19.50000	0.38179	6935947.	61267.	-844.08133	2.024E+11
20.00000	0.34850	7288359.	56199.	-845.24326	2.022E+11
20.50000	0.31651	7610341.	51129.	-844.85460	2.020E+11
21.00000	0.28587	7901909.	46066.	-842.84372	2.018E+11
21.50000	0.25665	8163134.	41020.	-839.13158	2.017E+11
22.00000	0.22888	8394151.	36002.	-833.63025	2.015E+11
22.50000	0.20261	8595157.	31022.	-826.24100	2.014E+11
23.00000	0.17788	8766418.	26093.	-816.85192	2.013E+11
23.50000	0.15471	8908272.	21226.	-805.33476	2.012E+11
24.00000	0.13314	9021135.	16436.	-791.54088	2.011E+11
24.50000	0.11318	9105502.	11735.	-775.29576	2.011E+11
25.00000	0.09486	9161958.	7140.	-756.39154	2.010E+11
25.50000	0.07817	9191185.	2667.	-734.57662	2.010E+11
26.00000	0.06313	9193966.	-1665.	-709.54083	2.010E+11
26.50000	0.04974	9171204.	-5836.	-680.89358	2.010E+11
27.00000	0.03799	9123930.	-9823.	-648.13070	2.011E+11
27.50000	0.02787	9053323.	-13600.	-610.58209	2.011E+11
28.00000	0.01937	8960736.	-27368.	-3979.	2.012E+11
28.50000	0.01248	8724904.	-71388.	-10694.	2.013E+11
29.00000	0.007147	8104083.	-133079.	-9869.	2.017E+11
29.50000	0.003260	7127962.	-178055.	-5123.	2.023E+11
30.00000	0.000641	5967420.	-196814.	-1130.	2.030E+11
30.50000	-0.000919	4766189.	-194824.	1794.	2.037E+11
31.00000	-0.001636	3629528.	-178923.	3507.	2.048E+11
31.50000	-0.001716	2619110.	-156389.	4005.	7.212E+11
32.00000	-0.001665	1752864.	-131764.	4203.	7.241E+11

32.50000	-0.001527	1037937.	-106717.	4146.	7.263E+11
33.00000	-0.001338	472261.	-82620.	3886.	7.283E+11
33.50000	-0.001125	46495.	-60513.	3483.	7.284E+11
34.00000	-0.000910	-253901.	-41096.	2990.	7.284E+11
34.50000	-0.000707	-446657.	-24749.	2459.	7.284E+11
35.00000	-0.000527	-550884.	-11575.	1932.	7.279E+11
35.50000	-0.000374	-585556.	-1455.	1441.	7.277E+11
36.00000	-0.000249	-568342.	5897.	1009.	7.278E+11
36.50000	-0.000153	-514788.	10874.	649.33776	7.281E+11
37.00000	-8.250E-05	-437858.	13918.	365.33790	7.284E+11
37.50000	-3.342E-05	-347776.	15477.	154.35471	7.284E+11
38.00000	-1.526E-06	-252137.	16050.	36.70722	7.284E+11
38.50000	1.790E-05	-155177.	14817.	-447.56950	7.284E+11
39.00000	2.966E-05	-74329.	11250.	-741.56803	7.284E+11
39.50000	3.775E-05	-20177.	6194.	-943.72808	7.284E+11
40.00000	4.484E-05	0.000	0.000	-1121.	7.284E+11

Output Summary for Load Case No. 1:

Pile-head deflection = 2.01075014 inches
Computed slope at pile head = -0.00716877 radians
Maximum bending moment = 9193966. inch-lbs
Maximum shear force = -196814. lbs
Depth of maximum bending moment = 26.00000000 feet below pile head
Depth of maximum shear force = 30.00000000 feet below pile head
Number of iterations = 87
Number of zero deflection points = 2

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

Shear = 0. lbs
Moment = 0. in-lbs
Axial Load = 0. lbs

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
40.00000	2.01075014	9193966.	-196814.
38.00000	1.98969565	9276641.	-199572.
36.00000	2.01470585	9207828.	-196848.
34.00000	2.02886443	9490603.	-204028.
32.00000	2.13989120	9114183.	-288793.

30.00000 9.24351201 7782256. -283374.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	2.010750	-0.007169	-196814.	9193966.

Maximum pile-head deflection = 2.0107501364 inches
Maximum pile-head rotation = -0.0071687747 radians = -0.410741 deg.

Summary of Warning Messages

The following warning was reported 696 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.

==

LPile for Windows, Version 2019-11.002

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==

This copy of LPile is being used by:

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Files Used for Analysis

Path to file locations on this computer:
\Projects\GFL\2019\1921\100400 PCE-PIK-CR50\PIK\108463\Design\Geotechnical\Spreadsheets & Calcs\Lateral Load Analysis\LPile\Strength Limit\

Name of the input data file:
Strength limit slope 26 at-rest TOR 28.lp11

Name of the output report file:
Strength limit slope 26 at-rest TOR 28.lp11

Name of the plot output file:
Strength limit slope 26 at-rest TOR 28.lp11

Name of the runtime message file:
Strength limit slope 26 at-rest TOR 28.lp11

Date and Time of Analysis

Date: February 14, 2020 Time: 12:47:26

Problem Title

Project Name: PIK-CR50-03.40

Job Number: 1921-1004.00

Client: Pike County

Engineer: Jason Hughes

Description:

Program Options and Settings

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	80

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)

- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	40.000 ft
Depth of ground surface below top of pile	=	18.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	42.0000
2	40.000	42.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	26.000	degrees
	=	0.454	radians
Pile Batter Angle	=	0.000	degrees
	=	0.000	radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	18.000000	ft
Distance from top of pile to bottom of layer	=	28.000000	ft
Effective unit weight at top of layer	=	62.600000	pcf
Effective unit weight at bottom of layer	=	62.600000	pcf
Undrained cohesion at top of layer	=	4000.	psf
Undrained cohesion at bottom of layer	=	4000.	psf
Epsilon-50 at top of layer	=	0.005000	
Epsilon-50 at bottom of layer	=	0.005000	

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	28.000000	ft
Distance from top of pile to bottom of layer	=	38.000000	ft
Effective unit weight at top of layer	=	75.000000	pcf
Effective unit weight at bottom of layer	=	75.000000	pcf
Uniaxial compressive strength at top of layer	=	500.000000	psi
Uniaxial compressive strength at bottom of layer	=	500.000000	psi
Initial modulus of rock at top of layer	=	10000.	psi
Initial modulus of rock at bottom of layer	=	10000.	psi
RQD of rock at top of layer	=	5.000000	%
RQD of rock at bottom of layer	=	5.000000	%
k rm of rock at top of layer	=	0.0005000	
k rm of rock at bottom of layer	=	0.0005000	

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	38.000000 ft
Distance from top of pile to bottom of layer	=	50.000000 ft
Effective unit weight at top of layer	=	88.000000 pcf
Effective unit weight at bottom of layer	=	88.000000 pcf
Uniaxial compressive strength at top of layer	=	2300. psi
Uniaxial compressive strength at bottom of layer	=	2300. psi
Initial modulus of rock at top of layer	=	50000. psi
Initial modulus of rock at bottom of layer	=	50000. psi
RQD of rock at top of layer	=	75.000000 %
RQD of rock at bottom of layer	=	75.000000 %
k rm of rock at top of layer	=	0.0001000
k rm of rock at bottom of layer	=	0.0001000

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	18.000	0.7200	1.0000
2	28.000	0.7200	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 3 points

Point No.	Depth X in	Dist. Load lb/in

1	0.000	36.000
2	24.000	115.000
3	216.000	848.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs
1	1	V = 0.0000 lbs	M = 0.0000 in-lbs	0.0000000

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	4.500000 in
Number of Reinforcing Bars	=	12 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi

Gross Area of Shaft	=	1385. sq. in.
Total Area of Reinforcing Steel	=	27.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.95 percent
Edge-to-Edge Bar Spacing	=	6.409848 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.55
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	6238.704 kips
Tensile Load for Cracking of Concrete	=	-655.324 kips
Nominal Axial Tensile Capacity	=	-1620.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.693000	2.250000	15.653500	0.00000
2	1.693000	2.250000	13.556329	7.826750
3	1.693000	2.250000	7.826750	13.556329
4	1.693000	2.250000	0.00000	15.653500
5	1.693000	2.250000	-7.826750	13.556329
6	1.693000	2.250000	-13.556329	7.826750
7	1.693000	2.250000	-15.653500	0.00000
8	1.693000	2.250000	-13.556329	-7.826750
9	1.693000	2.250000	-7.826750	-13.556329
10	1.693000	2.250000	0.00000	-15.653500
11	1.693000	2.250000	7.826750	-13.556329
12	1.693000	2.250000	13.556329	-7.826750

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.410 inches
between bars 7 and 8.

Ratio of bar spacing to maximum aggregate size = 8.55

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886

Tensile Strain at Fracture of Concrete = -0.0001154
Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg
0.0000006250	455.2545306522	728407249.	20.9999777443	
0.0000012500	908.6343072563	726907446.	20.9999776737	
0.0000018750	1360.	725407643.	20.9999776027	
0.0000025000	1810.	723907839.	20.9999775314	
0.0000031250	2258.	722408036.	20.9999774597	
0.0000037500	2703.	720908233.	20.9999773876	
0.0000043750	3147.	719408430.	20.9999773151	
0.0000050000	3590.	717908626.	20.9999772422	
0.0000056250	3590.	638141001.	12.1965732467	C
0.0000062500	3590.	574326901.	12.2003991673	C
0.0000068750	3590.	522115365.	12.2042333669	C
0.0000075000	3590.	478605751.	12.2080758818	C
0.0000081250	3590.	441789924.	12.2119267489	C
0.0000087500	3590.	410233501.	12.2157860050	C
0.0000093750	3590.	382884601.	12.2196536874	C

0.0000100000	3590.	358954313.	12.2235298335	C
0.0000106250	3590.	337839354.	12.2274144812	C
0.0000112500	3590.	319070501.	12.2313076682	C
0.0000118750	3590.	302277316.	12.2352094330	C
0.0000125000	3590.	287163451.	12.2391198138	C
0.0000131250	3590.	273489001.	12.2430388496	C
0.0000137500	3590.	261057682.	12.2469665792	C
0.0000143750	3590.	249707348.	12.2509030419	C
0.0000150000	3590.	239302875.	12.2548482773	C
0.0000156250	3590.	229730760.	12.2588023252	C
0.0000162500	3590.	220894962.	12.2627652256	C
0.0000168750	3590.	212713667.	12.2667370189	C
0.0000175000	3590.	205116750.	12.2707177458	C
0.0000181250	3703.	204293328.	12.2747074470	C
0.0000187500	3829.	204222578.	12.2787061639	C
0.0000193750	3955.	204151689.	12.2827139378	C
0.0000200000	4082.	204080662.	12.2867308106	C
0.0000206250	4208.	204009497.	12.2907568242	C
0.0000212500	4334.	203938191.	12.2947920211	C
0.0000218750	4460.	203866745.	12.2988364438	C
0.0000225000	4585.	203795158.	12.3028901354	C
0.0000231250	4711.	203723430.	12.3069531389	C
0.0000237500	4837.	203651559.	12.3110254981	C
0.0000243750	4962.	203579546.	12.3151072566	C
0.0000256250	5213.	203435089.	12.3232991488	C
0.0000268750	5463.	203290052.	12.3315291727	C
0.0000281250	5713.	203144433.	12.3397976903	C
0.0000293750	5963.	202998225.	12.3481050689	C
0.0000306250	6212.	202851423.	12.3564516811	C
0.0000318750	6461.	202704021.	12.3648379050	C
0.0000331250	6710.	202556015.	12.3732641241	C
0.0000343750	6958.	202407398.	12.3817307274	C
0.0000356250	7205.	202258169.	12.3902305933	C
0.0000368750	7453.	202108459.	12.3985086550	C
0.0000381250	7700.	201958143.	12.4068257245	C
0.0000393750	7946.	201807215.	12.4151821810	C
0.0000406250	8192.	201655669.	12.4235784095	C
0.0000418750	8438.	201503501.	12.4320148006	C
0.0000431250	8683.	201350705.	12.4404917508	C
0.0000443750	8928.	201197275.	12.4490096625	C
0.0000456250	9173.	201043204.	12.4575689439	C
0.0000468750	9417.	200888488.	12.4661700097	C
0.0000481250	9660.	200733120.	12.4748132808	C
0.0000493750	9903.	200577093.	12.4834991844	C
0.0000506250	10146.	200420403.	12.4922281543	C
0.0000518750	10389.	200263042.	12.5010006311	C
0.0000531250	10631.	200105004.	12.5098170622	C
0.0000543750	10872.	199946283.	12.5186779018	C
0.0000556250	11113.	199786873.	12.5275836114	C
0.0000568750	11354.	199626765.	12.5365346597	C

0.0000581250	11594.	199465955.	12.5455315228	C
0.0000593750	11834.	199304434.	12.5545746846	C
0.0000606250	12073.	199142196.	12.5636646364	C
0.0000618750	12312.	198979234.	12.5728018778	C
0.0000631250	12550.	198815540.	12.5819869161	C
0.0000643750	12788.	198651108.	12.5912202671	C
0.0000656250	13026.	198485929.	12.6005024551	C
0.0000668750	13263.	198319997.	12.6098340129	C
0.0000681250	13499.	198153303.	12.6192154822	C
0.0000693750	13735.	197985840.	12.6286474137	C
0.0000706250	13971.	197817599.	12.6381303674	C
0.0000718750	14206.	197648574.	12.6476649127	C
0.0000731250	14441.	197478755.	12.6572516286	C
0.0000743750	14675.	197308134.	12.6668911041	C
0.0000793750	15607.	196617463.	12.7059887401	C
0.0000843750	16529.	195897357.	12.7456319143	CY
0.0000893750	17345.	194064964.	12.7610167864	CY
0.0000943750	18038.	191130418.	12.7501118060	CY
0.0000993750	18495.	186110051.	12.6841183841	CY
0.0001043750	18879.	180877307.	12.6098936127	CY
0.0001093750	19260.	176089510.	12.5452018739	CY
0.0001143750	19637.	171687521.	12.4888650975	CY
0.0001193750	20010.	167622075.	12.4399063331	CY
0.0001243750	20347.	163597736.	12.3884146454	CY
0.0001293750	20582.	159085458.	12.3119345602	CY
0.0001343750	20733.	154292069.	12.2193701889	CY
0.0001393750	20877.	149788599.	12.1335556141	CY
0.0001443750	21018.	145582599.	12.0553705022	CY
0.0001493750	21158.	141643873.	11.9840856967	CY
0.0001543750	21294.	137938971.	11.9162794708	CY
0.0001593750	21428.	134451225.	11.8536625413	CY
0.0001643750	21560.	131161596.	11.7965587314	CY
0.0001693750	21689.	128052204.	11.7445233308	CY
0.0001743750	21815.	125105945.	11.6972809937	CY
0.0001793750	21940.	122311023.	11.6542921065	CY
0.0001843750	22061.	119654793.	11.6152548284	CY
0.0001893750	22181.	117126346.	11.5798753943	CY
0.0001943750	22298.	114717422.	11.5475670007	CY
0.0001993750	22413.	112415394.	11.5167304901	CY
0.0002043750	22525.	110212365.	11.4882063301	CY
0.0002093750	22619.	108031007.	11.4562209750	CY
0.0002143750	22699.	105885384.	11.4214639731	CY
0.0002193750	22766.	103777053.	11.3843761383	CY
0.0002243750	22810.	101658503.	11.3405894282	CY
0.0002293750	22847.	99603715.	11.2967974681	CY
0.0002343750	22870.	97580311.	11.2503241747	CY
0.0002393750	22893.	95638405.	11.2065188475	CY
0.0002443750	22916.	93774308.	11.1649712380	CY
0.0002493750	22938.	91982741.	11.1251947042	CY
0.0002543750	22958.	90253982.	11.0850509973	CY

0.0002593750	22978.	88590630.	11.0468656715	CY
0.0002643750	22998.	86989099.	11.0105005598	CY
0.0002693750	23017.	85445930.	10.9758595070	CY
0.0002743750	23036.	83956697.	10.9431530557	CYT
0.0003043750	23141.	76028975.	10.7764396703	CYT
0.0003343750	23236.	69490102.	10.6441021612	CYT
0.0003643750	23320.	63999101.	10.5380635396	CYT

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	0.000	23034.593	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	23035.	0.0000	14972.	197087458.
1	0.75	23035.	0.0000	17276.	194219089.
1	0.90	23035.	0.0000	20731.	154351076.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	18.0000	0.00	N.A.	No	0.00	549555.
2	28.0000	10.0000	No	Yes	N.A.	N.A.
3	38.0000	20.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 0.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness in-lb^2
0.000	2.63067	0.000126	7.488E-07	0.000	7.284E+11
0.50000	2.57447	736.87504	290.06249	0.000	7.284E+11
1.00000	2.51828	3481.	683.81250	0.000	7.284E+11
1.50000	2.46208	8943.	1196.	0.000	7.284E+11
2.00000	2.40589	17834.	1828.	0.000	7.284E+11
2.50000	2.34969	30879.	2588.	0.000	7.284E+11
3.00000	2.29350	48888.	3484.	0.000	7.284E+11
3.50000	2.23731	72687.	4518.	0.000	7.284E+11
4.00000	2.18113	103100.	5689.	0.000	7.284E+11
4.50000	2.12495	140951.	6997.	0.000	7.284E+11
5.00000	2.06877	187066.	8443.	0.000	7.284E+11
5.50000	2.01261	242268.	10026.	0.000	7.284E+11
6.00000	1.95645	307383.	11747.	0.000	7.284E+11
6.50000	1.90032	383234.	13605.	0.000	7.284E+11
7.00000	1.84420	470647.	15601.	0.000	7.283E+11

7.50000	1.78810	570447.	17734.	0.000	7.278E+11
8.00000	1.73203	683457.	20005.	0.000	7.274E+11
8.50000	1.67600	810503.	22413.	0.000	7.271E+11
9.00000	1.62001	952409.	24958.	0.000	7.267E+11
9.50000	1.56406	1110000.	27641.	0.000	7.261E+11
10.00000	1.50817	1284100.	30461.	0.000	7.256E+11
10.50000	1.45234	1475534.	33419.	0.000	7.249E+11
11.00000	1.39659	1685127.	36514.	0.000	7.242E+11
11.50000	1.34092	1913702.	39747.	0.000	7.235E+11
12.00000	1.28534	2162086.	43117.	0.000	7.227E+11
12.50000	1.22988	2431103.	46624.	0.000	7.218E+11
13.00000	1.17453	2721576.	50269.	0.000	7.208E+11
13.50000	1.11932	3034331.	54051.	0.000	7.197E+11
14.00000	1.06426	3370193.	57971.	0.000	7.186E+11
14.50000	1.00937	3729985.	62028.	0.000	2.043E+11
15.00000	0.95514	4114534.	66223.	0.000	2.041E+11
15.50000	0.90163	4524662.	70555.	0.000	2.038E+11
16.00000	0.84893	4961195.	75025.	0.000	2.036E+11
16.50000	0.79710	5424958.	79632.	0.000	2.033E+11
17.00000	0.74623	5916775.	84376.	0.000	2.030E+11
17.50000	0.69641	6437471.	89258.	0.000	2.027E+11
18.00000	0.64773	6987870.	90319.	-892.59595	2.024E+11
18.50000	0.60030	7521297.	86208.	-898.92195	2.021E+11
19.00000	0.55420	8022362.	80799.	-903.82442	2.018E+11
19.50000	0.50954	8490890.	75366.	-907.24461	2.015E+11
20.00000	0.46639	8926756.	69917.	-909.11917	2.012E+11
20.50000	0.42485	9329895.	64462.	-909.37925	2.009E+11
21.00000	0.38497	9700296.	59010.	-907.94964	2.007E+11
21.50000	0.34683	10038011.	53572.	-904.74748	2.005E+11
22.00000	0.31050	10343155.	48158.	-899.68083	2.003E+11
22.50000	0.27602	10615910.	42781.	-892.64679	2.001E+11
23.00000	0.24346	10856530.	37453.	-883.52919	2.000E+11
23.50000	0.21285	11065343.	32186.	-872.19560	1.998E+11
24.00000	0.18423	11242757.	26994.	-858.49344	1.997E+11
24.50000	0.15764	11389265.	21891.	-842.24486	1.996E+11
25.00000	0.13310	11505452.	16895.	-823.23991	1.995E+11
25.50000	0.11064	11592003.	12021.	-801.22721	1.995E+11
26.00000	0.09027	11649710.	7290.	-775.90091	1.994E+11
26.50000	0.07201	11679484.	2722.	-746.88230	1.994E+11
27.00000	0.05585	11682370.	-1660.	-713.69295	1.994E+11
27.50000	0.04180	11659564.	-5828.	-675.71500	1.994E+11
28.00000	0.02986	11612431.	-21156.	-4434.	1.995E+11
28.50000	0.02001	11405692.	-70560.	-12034.	1.996E+11
29.00000	0.01222	10765712.	-143900.	-12412.	2.000E+11
29.50000	0.006372	9678895.	-211176.	-10013.	2.007E+11
30.00000	0.002256	8231600.	-253140.	-3975.	2.016E+11
30.50000	-0.000390	6641210.	-262778.	762.18423	2.026E+11
31.00000	-0.001857	5078259.	-248556.	3979.	2.035E+11
31.50000	-0.002425	3658537.	-219648.	5657.	2.046E+11
32.00000	-0.002349	2442484.	-184891.	5928.	7.217E+11

32.50000	-0.002151	1439844.	-149589.	5839.	7.251E+11
33.00000	-0.001882	647419.	-115668.	5468.	7.275E+11
33.50000	-0.001581	51824.	-84584.	4894.	7.284E+11
34.00000	-0.001277	-367585.	-57309.	4197.	7.284E+11
34.50000	-0.000992	-635884.	-34371.	3448.	7.276E+11
35.00000	-0.000738	-780041.	-15908.	2706.	7.272E+11
35.50000	-0.000523	-826785.	-1744.	2016.	7.271E+11
36.00000	-0.000348	-800967.	8530.	1409.	7.271E+11
36.50000	-0.000213	-724427.	15468.	903.89031	7.273E+11
37.00000	-0.000114	-615347.	19699.	506.27482	7.276E+11
37.50000	-4.581E-05	-488041.	21852.	211.58788	7.282E+11
38.00000	-1.422E-06	-353117.	22590.	34.20363	7.284E+11
38.50000	2.551E-05	-216963.	20779.	-637.77349	7.284E+11
39.00000	4.172E-05	-103768.	15737.	-1043.	7.284E+11
39.50000	5.280E-05	-28123.	8647.	-1320.	7.284E+11
40.00000	6.249E-05	0.000	0.000	-1562.	7.284E+11

Output Summary for Load Case No. 1:

```
Pile-head deflection             =     2.63066744 inches
Computed slope at pile head      =    -0.00936586 radians
Maximum bending moment           =      11682370. inch-lbs
Maximum shear force              =       -262778. lbs
Depth of maximum bending moment  =    27.00000000 feet below pile head
Depth of maximum shear force     =    30.50000000 feet below pile head
Number of iterations             =             36
Number of zero deflection points =              2
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =              0. lbs
Moment     =              0. in-lbs
Axial Load =              0. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
40.00000	2.63066744	11682370.	-262778.
38.00000	2.59925298	11791954.	-262070.
36.00000	2.64586780	11698448.	-258735.
34.00000	2.65994251	12043294.	-271143.
32.00000	3.05085957	11370312.	-395576.

30.00000 20.31597078 9408104. -333255.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	2.630667	-0.009366	-262778.	11682370.

Maximum pile-head deflection = 2.6306674448 inches
Maximum pile-head rotation = -0.0093658635 radians = -0.536624 deg.

Summary of Warning Messages

The following warning was reported 288 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.

==========

LPile for Windows, Version 2019-11.002

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

==========

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Files Used for Analysis

Path to file locations on this computer:
\Projects\GFL\2019\1921\100400 PCE-PIK-CR50\PIK\108463\Design\Geotechnical\Spreadsheets & Calcs\Lateral Load Analysis\LPile\Extreme Event\

Name of the input data file:
Extreme event slope26 at-rest TOR 28.lp11

Name of the output report file:
Extreme event slope26 at-rest TOR 28.lp11

Name of the plot output file:
Extreme event slope26 at-rest TOR 28.lp11

Name of the runtime message file:
Extreme event slope26 at-rest TOR 28.lp11

Date and Time of Analysis

Date: February 14, 2020 Time: 11:31:19

Problem Title

Project Name: PIK-CR50-03.40

Job Number: 1921-1004.00

Client: Pike County

Engineer: Jason Hughes

Description:

Program Options and Settings

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	86

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Analysis uses p-y modification factors for p-y curves
 - Analysis uses layering correction (Method of Georgiadis)

- Analysis includes loading by one distributed lateral load acting on pile
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using narrow report formats
  (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 2
Total length of pile = 43.000 ft
Depth of ground surface below top of pile = 21.0000 ft

Pile diameters used for p-y curve computations are defined using 4 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	11.1000
2	3.000	11.1000
3	3.000	42.0000
4	43.000	42.0000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a AISC strong axis steel pile
Length of section = 3.000000 ft

AISC Section Type = W

AISC Section Name = W18X86

Pile width = 11.100000 in
Shear capacity of section = 0.0000 lbs

Pile Section No. 2:

Section 2 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 40.000000 ft
Shaft Diameter = 42.000000 in
Shear capacity of section = 0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle = 26.000 degrees
= 0.454 radians

Pile Batter Angle = 0.000 degrees
= 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer = 21.000000 ft
Distance from top of pile to bottom of layer = 31.000000 ft
Effective unit weight at top of layer = 62.600000 pcf
Effective unit weight at bottom of layer = 62.600000 pcf
Undrained cohesion at top of layer = 4000. psf
Undrained cohesion at bottom of layer = 4000. psf
Epsilon-50 at top of layer = 0.005000
Epsilon-50 at bottom of layer = 0.005000

Layer 2 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	31.000000 ft
Distance from top of pile to bottom of layer	=	41.000000 ft
Effective unit weight at top of layer	=	75.000000 pcf
Effective unit weight at bottom of layer	=	75.000000 pcf
Uniaxial compressive strength at top of layer	=	500.000000 psi
Uniaxial compressive strength at bottom of layer	=	500.000000 psi
Initial modulus of rock at top of layer	=	10000. psi
Initial modulus of rock at bottom of layer	=	10000. psi
RQD of rock at top of layer	=	5.000000 %
RQD of rock at bottom of layer	=	5.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	41.000000 ft
Distance from top of pile to bottom of layer	=	50.000000 ft
Effective unit weight at top of layer	=	88.000000 pcf
Effective unit weight at bottom of layer	=	88.000000 pcf
Uniaxial compressive strength at top of layer	=	2300. psi
Uniaxial compressive strength at bottom of layer	=	2300. psi
Initial modulus of rock at top of layer	=	50000. psi
Initial modulus of rock at bottom of layer	=	50000. psi
RQD of rock at top of layer	=	75.000000 %
RQD of rock at bottom of layer	=	75.000000 %
k rm of rock at top of layer	=	0.0001000
k rm of rock at bottom of layer	=	0.0001000

(Depth of the lowest soil layer extends 7.000 ft below the pile tip)

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	21.000	0.7200	1.0000
2	31.000	0.7200	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Distributed Lateral Loading Used For All Load Cases

Distributed lateral load intensity defined using 5 points

Point No.	Depth X in	Dist. Load lb/in
1	0.000	0.000
2	35.999	0.000
3	36.000	10.000
4	60.000	69.000
5	252.000	719.000

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1		Condition 2		Axial Thrust Force, lbs
1	1	V =	19000. lbs	M =	0.0000 in-lbs	0.0000000

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with
specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Steel AISC Strong Axis:

Length of Section	=	3.000000 ft
Flange Width	=	11.100000 in
Section Depth	=	18.400000 in
Flange Thickness	=	0.770000 in
Web Thickness	=	0.480000 in
Yield Stress of Pipe	=	36.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	25.300000 sq. in.
Moment of Inertia	=	1530. in^4
Elastic Bending Stiffness	=	44370000. kip-in^2
Plastic Modulus, Z	=	186.000000in^3
Plastic Moment Capacity = Fy Z	=	6696.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	910.800 kips
Nominal Axial Tensile Capacity	=	-910.800 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 0.000 kips

Bending	Bending	Bending	Depth to	Run

Curvature rad/in.	Moment in-kip	Stiffness kip-in2	N Axis in	Msg
0.0000047530	209.4921816318	44075512.	9.2000000000	
0.0000095061	418.9843632636	44075512.	9.2000000000	
0.0000142591	628.4765448954	44075512.	9.2000000000	
0.0000190121	837.9687265272	44075512.	9.2000000000	
0.0000237651	1047.	44075512.	9.2000000000	
0.0000285182	1257.	44075512.	9.2000000000	
0.0000332712	1466.	44075512.	9.2000000000	
0.0000380242	1676.	44075512.	9.2000000000	
0.0000427773	1885.	44075512.	9.2000000000	
0.0000475303	2095.	44075512.	9.2000000000	
0.0000522833	2304.	44075512.	9.2000000000	
0.0000570363	2514.	44075512.	9.2000000000	
0.0000617894	2723.	44075512.	9.2000000000	
0.0000665424	2933.	44075512.	9.2000000000	
0.0000712954	3142.	44075512.	9.2000000000	
0.0000760485	3352.	44075512.	9.2000000000	
0.0000808015	3561.	44075512.	9.2000000000	
0.0000855545	3771.	44075512.	9.2000000000	
0.0000903075	3980.	44075512.	9.2000000000	
0.0000950606	4190.	44075512.	9.2000000000	
0.0000998136	4399.	44075512.	9.2000000000	
0.0001045666	4609.	44075512.	9.2000000000	
0.0001093197	4818.	44075512.	9.2000000000	
0.0001140727	5028.	44075512.	9.2000000000	
0.0001188257	5237.	44075512.	9.2000000000	
0.0001235788	5447.	44075512.	9.2000000000	
0.0001283318	5656.	44075512.	9.2000000000	
0.0001330848	5866.	44075512.	9.2000000000	
0.0001378378	6060.	43965553.	9.2000000000	Y
0.0001425909	6185.	43375755.	9.2000000000	Y
0.0001473439	6240.	42352393.	9.2000000000	Y
0.0001520969	6267.	41203596.	9.2000000000	Y
0.0001568500	6290.	40100537.	9.2000000000	Y
0.0001616030	6311.	39050735.	9.2000000000	Y
0.0001663560	6330.	38050555.	9.2000000000	Y
0.0001711090	6348.	37096242.	9.2000000000	Y
0.0001758621	6364.	36185394.	9.2000000000	Y
0.0001806151	6379.	35315658.	9.2000000000	Y
0.0001853681	6392.	34484538.	9.2000000000	Y
0.0001948742	6417.	32928494.	9.2000000000	Y
0.0002043802	6438.	31500436.	9.2000000000	Y
0.0002138863	6457.	30187336.	9.2000000000	Y
0.0002233924	6473.	28974677.	9.2000000000	Y
0.0002328984	6487.	27853007.	9.2000000000	Y
0.0002424045	6500.	26812706.	9.2000000000	Y
0.0002519105	6511.	25845353.	9.2000000000	Y
0.0002614166	6521.	24943705.	9.2000000000	Y

0.0002709226	6530.	24101482.	9.2000000000	Y
0.0002804287	6538.	23313213.	9.2000000000	Y
0.0002899348	6545.	22574097.	9.2000000000	Y
0.0002994408	6552.	21879778.	9.2000000000	Y
0.0003089469	6558.	21225600.	9.2000000000	Y
0.0003184529	6563.	20609194.	9.2000000000	Y
0.0003279590	6568.	20027335.	9.2000000000	Y
0.0003374651	6573.	19476451.	9.2000000000	Y
0.0003469711	6577.	18955325.	9.2000000000	Y
0.0003564772	6581.	18460416.	9.2000000000	Y
0.0003659832	6584.	17991005.	9.2000000000	Y
0.0003754893	6588.	17544066.	9.2000000000	Y
0.0003849953	6591.	17119197.	9.2000000000	Y
0.0003945014	6594.	16713595.	9.2000000000	Y
0.0004040075	6596.	16327011.	9.2000000000	Y
0.0004135135	6599.	15957673.	9.2000000000	Y
0.0004230196	6601.	15604389.	9.2000000000	Y
0.0004325256	6603.	15266635.	9.2000000000	Y
0.0004420317	6605.	14942769.	9.2000000000	Y
0.0004515377	6607.	14632288.	9.2000000000	Y
0.0004610438	6609.	14334610.	9.2000000000	Y
0.0004705499	6611.	14048551.	9.2000000000	Y
0.0004800559	6612.	13773499.	9.2000000000	Y
0.0004895620	6614.	13509128.	9.2000000000	Y
0.0004990680	6615.	13254829.	9.2000000000	Y
0.0005085741	6616.	13009488.	9.2000000000	Y
0.0005180801	6617.	12773109.	9.2000000000	Y
0.0005275862	6619.	12545248.	9.2000000000	Y
0.0005370923	6620.	12325453.	9.2000000000	Y
0.0005465983	6621.	12112962.	9.2000000000	Y
0.0005561044	6622.	11907608.	9.2000000000	Y
0.0005656104	6623.	11709156.	9.2000000000	Y
0.0006036347	6626.	10977208.	9.2000000000	Y
0.0006416589	6629.	10331257.	9.2000000000	Y
0.0006796831	6631.	9756535.	9.2000000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load No.	Axial Thrust kips	Nominal Moment Capacity in-kips
1	0.00000000	6631.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Pile Section No. 2:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	40.000000 ft
Shaft Diameter	=	42.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	4.500000 in
Number of Reinforcing Bars	=	12 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	1385. sq. in.
Total Area of Reinforcing Steel	=	27.000000 sq. in.
Area Ratio of Steel Reinforcement	=	1.95 percent
Edge-to-Edge Bar Spacing	=	6.409848 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	8.55
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	6238.704 kips
Tensile Load for Cracking of Concrete	=	-655.324 kips
Nominal Axial Tensile Capacity	=	-1620.000 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.693000	2.250000	15.653500	0.00000
2	1.693000	2.250000	13.556329	7.826750
3	1.693000	2.250000	7.826750	13.556329
4	1.693000	2.250000	0.00000	15.653500
5	1.693000	2.250000	-7.826750	13.556329
6	1.693000	2.250000	-13.556329	7.826750

7	1.693000	2.250000	-15.653500	0.00000
8	1.693000	2.250000	-13.556329	-7.826750
9	1.693000	2.250000	-7.826750	-13.556329
10	1.693000	2.250000	0.00000	-15.653500
11	1.693000	2.250000	7.826750	-13.556329
12	1.693000	2.250000	13.556329	-7.826750

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 6.410 inches
between bars 7 and 8.

Ratio of bar spacing to maximum aggregate size = 8.55

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	0.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 0.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Run Msg
0.0000006250	455.2545306522	728407249.	20.9999777443	
0.0000012500	908.6343072563	726907446.	20.9999776737	
0.0000018750	1360.	725407643.	20.9999776027	
0.0000025000	1810.	723907839.	20.9999775314	
0.0000031250	2258.	722408036.	20.9999774597	
0.0000037500	2703.	720908233.	20.9999773876	
0.0000043750	3147.	719408430.	20.9999773151	
0.0000050000	3590.	717908626.	20.9999772422	
0.0000056250	3590.	638141001.	12.1965732467	C
0.0000062500	3590.	574326901.	12.2003991673	C
0.0000068750	3590.	522115365.	12.2042333669	C
0.0000075000	3590.	478605751.	12.2080758818	C
0.0000081250	3590.	441789924.	12.2119267489	C
0.0000087500	3590.	410233501.	12.2157860050	C
0.0000093750	3590.	382884601.	12.2196536874	C
0.0000100000	3590.	358954313.	12.2235298335	C
0.0000106250	3590.	337839354.	12.2274144812	C
0.0000112500	3590.	319070501.	12.2313076682	C
0.0000118750	3590.	302277316.	12.2352094330	C
0.0000125000	3590.	287163451.	12.2391198138	C
0.0000131250	3590.	273489001.	12.2430388496	C
0.0000137500	3590.	261057682.	12.2469665792	C
0.0000143750	3590.	249707348.	12.2509030419	C
0.0000150000	3590.	239302875.	12.2548482773	C
0.0000156250	3590.	229730760.	12.2588023252	C
0.0000162500	3590.	220894962.	12.2627652256	C
0.0000168750	3590.	212713667.	12.2667370189	C
0.0000175000	3590.	205116750.	12.2707177458	C
0.0000181250	3703.	204293328.	12.2747074470	C
0.0000187500	3829.	204222578.	12.2787061639	C
0.0000193750	3955.	204151689.	12.2827139378	C
0.0000200000	4082.	204080662.	12.2867308106	C
0.0000206250	4208.	204009497.	12.2907568242	C
0.0000212500	4334.	203938191.	12.2947920211	C
0.0000218750	4460.	203866745.	12.2988364438	C
0.0000225000	4585.	203795158.	12.3028901354	C
0.0000231250	4711.	203723430.	12.3069531389	C
0.0000237500	4837.	203651559.	12.3110254981	C
0.0000243750	4962.	203579546.	12.3151072566	C
0.0000256250	5213.	203435089.	12.3232991488	C
0.0000268750	5463.	203290052.	12.3315291727	C
0.0000281250	5713.	203144433.	12.3397976903	C

0.0000293750	5963.	202998225.	12.3481050689	C
0.0000306250	6212.	202851423.	12.3564516811	C
0.0000318750	6461.	202704021.	12.3648379050	C
0.0000331250	6710.	202556015.	12.3732641241	C
0.0000343750	6958.	202407398.	12.3817307274	C
0.0000356250	7205.	202258169.	12.3902305933	C
0.0000368750	7453.	202108459.	12.3985086550	C
0.0000381250	7700.	201958143.	12.4068257245	C
0.0000393750	7946.	201807215.	12.4151821810	C
0.0000406250	8192.	201655669.	12.4235784095	C
0.0000418750	8438.	201503501.	12.4320148006	C
0.0000431250	8683.	201350705.	12.4404917508	C
0.0000443750	8928.	201197275.	12.4490096625	C
0.0000456250	9173.	201043204.	12.4575689439	C
0.0000468750	9417.	200888488.	12.4661700097	C
0.0000481250	9660.	200733120.	12.4748132808	C
0.0000493750	9903.	200577093.	12.4834991844	C
0.0000506250	10146.	200420403.	12.4922281543	C
0.0000518750	10389.	200263042.	12.5010006311	C
0.0000531250	10631.	200105004.	12.5098170622	C
0.0000543750	10872.	199946283.	12.5186779018	C
0.0000556250	11113.	199786873.	12.5275836114	C
0.0000568750	11354.	199626765.	12.5365346597	C
0.0000581250	11594.	199465955.	12.5455315228	C
0.0000593750	11834.	199304434.	12.5545746846	C
0.0000606250	12073.	199142196.	12.5636646364	C
0.0000618750	12312.	198979234.	12.5728018778	C
0.0000631250	12550.	198815540.	12.5819869161	C
0.0000643750	12788.	198651108.	12.5912202671	C
0.0000656250	13026.	198485929.	12.6005024551	C
0.0000668750	13263.	198319997.	12.6098340129	C
0.0000681250	13499.	198153303.	12.6192154822	C
0.0000693750	13735.	197985840.	12.6286474137	C
0.0000706250	13971.	197817599.	12.6381303674	C
0.0000718750	14206.	197648574.	12.6476649127	C
0.0000731250	14441.	197478755.	12.6572516286	C
0.0000743750	14675.	197308134.	12.6668911041	C
0.0000793750	15607.	196617463.	12.7059887401	C
0.0000843750	16529.	195897357.	12.7456319143	CY
0.0000893750	17345.	194064964.	12.7610167864	CY
0.0000943750	18038.	191130418.	12.7501118060	CY
0.0000993750	18495.	186110051.	12.6841183841	CY
0.0001043750	18879.	180877307.	12.6098936127	CY
0.0001093750	19260.	176089510.	12.5452018739	CY
0.0001143750	19637.	171687521.	12.4888650975	CY
0.0001193750	20010.	167622075.	12.4399063331	CY
0.0001243750	20347.	163597736.	12.3884146454	CY
0.0001293750	20582.	159085458.	12.3119345602	CY
0.0001343750	20733.	154292069.	12.2193701889	CY
0.0001393750	20877.	149788599.	12.1335556141	CY

0.0001443750	21018.	145582599.	12.0553705022	CY
0.0001493750	21158.	141643873.	11.9840856967	CY
0.0001543750	21294.	137938971.	11.9162794708	CY
0.0001593750	21428.	134451225.	11.8536625413	CY
0.0001643750	21560.	131161596.	11.7965587314	CY
0.0001693750	21689.	128052204.	11.7445233308	CY
0.0001743750	21815.	125105945.	11.6972809937	CY
0.0001793750	21940.	122311023.	11.6542921065	CY
0.0001843750	22061.	119654793.	11.6152548284	CY
0.0001893750	22181.	117126346.	11.5798753943	CY
0.0001943750	22298.	114717422.	11.5475670007	CY
0.0001993750	22413.	112415394.	11.5167304901	CY
0.0002043750	22525.	110212365.	11.4882063301	CY
0.0002093750	22619.	108031007.	11.4562209750	CY
0.0002143750	22699.	105885384.	11.4214639731	CY
0.0002193750	22766.	103777053.	11.3843761383	CY
0.0002243750	22810.	101658503.	11.3405894282	CY
0.0002293750	22847.	99603715.	11.2967974681	CY
0.0002343750	22870.	97580311.	11.2503241747	CY
0.0002393750	22893.	95638405.	11.2065188475	CY
0.0002443750	22916.	93774308.	11.1649712380	CY
0.0002493750	22938.	91982741.	11.1251947042	CY
0.0002543750	22958.	90253982.	11.0850509973	CY
0.0002593750	22978.	88590630.	11.0468656715	CY
0.0002643750	22998.	86989099.	11.0105005598	CY
0.0002693750	23017.	85445930.	10.9758595070	CY
0.0002743750	23036.	83956697.	10.9431530557	CYT
0.0003043750	23141.	76028975.	10.7764396703	CYT
0.0003343750	23236.	69490102.	10.6441021612	CYT
0.0003643750	23320.	63999101.	10.5380635396	CYT

Summary of Results for Nominal Moment Capacity for Section 2

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	0.000	23034.593	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	23035.	0.0000	14972.	197087458.
1	0.75	23035.	0.0000	17276.	194219089.
1	0.90	23035.	0.0000	20731.	154351076.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	21.0000	0.00	N.A.	No	0.00	549555.
2	31.0000	10.0000	No	Yes	N.A.	N.A.
3	41.0000	20.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 19000.0 lbs
Applied moment at pile head = 0.0 in-lbs
Axial thrust load on pile head = 0.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Soil Res. p lb/inch	Bending Stiffness in-lb^2
0.000	4.23573	-3.262E-06	19000.	0.000	4.408E+10
0.50000	4.14879	114000.	19000.	0.000	4.408E+10
1.00000	4.06194	228000.	19000.	0.000	4.408E+10
1.50000	3.97528	342000.	19000.	0.000	4.408E+10
2.00000	3.88890	456000.	19000.	0.000	4.408E+10
2.50000	3.80289	570000.	19000.	0.000	4.408E+10
3.00000	3.71735	684000.	19021.	0.000	4.408E+10
3.50000	3.63237	798246.	19115.	0.000	7.271E+11
4.00000	3.54742	913384.	19308.	0.000	7.269E+11
4.50000	3.46253	1029943.	19589.	0.000	7.264E+11
5.00000	3.37768	1148456.	19961.	0.000	7.260E+11
5.50000	3.29289	1269477.	20438.	0.000	7.256E+11
6.00000	3.20816	1393714.	21035.	0.000	7.253E+11
6.50000	3.12350	1521897.	21754.	0.000	7.248E+11
7.00000	3.03892	1654758.	22594.	0.000	7.243E+11
7.50000	2.95442	1793028.	23557.	0.000	7.240E+11
8.00000	2.87000	1937438.	24641.	0.000	7.234E+11
8.50000	2.78569	2088720.	25847.	0.000	7.229E+11
9.00000	2.70148	2247604.	27175.	0.000	7.224E+11
9.50000	2.61738	2414823.	28625.	0.000	7.218E+11
10.00000	2.53340	2591106.	30197.	0.000	7.212E+11
10.50000	2.44955	2777187.	31891.	0.000	7.206E+11
11.00000	2.36584	2973794.	33706.	0.000	7.199E+11
11.50000	2.28228	3181661.	35644.	0.000	7.193E+11
12.00000	2.19887	3401519.	37703.	0.000	7.185E+11
12.50000	2.11564	3634097.	39884.	0.000	2.048E+11
13.00000	2.03305	3880129.	42187.	0.000	2.042E+11
13.50000	1.95114	4140344.	44612.	0.000	2.040E+11
14.00000	1.86996	4415475.	47159.	0.000	2.039E+11
14.50000	1.78956	4706252.	49828.	0.000	2.037E+11
15.00000	1.70999	5013407.	52618.	0.000	2.035E+11
15.50000	1.63131	5337671.	55531.	0.000	2.034E+11
16.00000	1.55358	5679775.	58565.	0.000	2.032E+11
16.50000	1.47685	6040451.	61721.	0.000	2.030E+11
17.00000	1.40119	6420429.	64999.	0.000	2.027E+11
17.50000	1.32667	6820442.	68399.	0.000	2.025E+11
18.00000	1.25337	7241219.	71921.	0.000	2.022E+11
18.50000	1.18135	7683494.	75565.	0.000	2.020E+11
19.00000	1.11070	8147996.	79330.	0.000	2.017E+11
19.50000	1.04151	8635456.	83218.	0.000	2.014E+11
20.00000	0.97386	9146608.	87227.	0.000	2.011E+11
20.50000	0.90785	9682180.	91358.	0.000	2.007E+11

21.00000	0.84357	10242906.	91665.	-953.53526	2.004E+11
21.50000	0.78114	10782155.	86995.	-960.09096	2.000E+11
22.00000	0.72065	11286840.	81219.	-965.15525	1.997E+11
22.50000	0.66219	11756780.	75417.	-968.66779	1.994E+11
23.00000	0.60585	12191848.	69600.	-970.56340	1.991E+11
23.50000	0.55172	12591975.	63776.	-970.77124	1.988E+11
24.00000	0.49987	12957155.	57956.	-969.21381	1.985E+11
24.50000	0.45037	13287443.	52151.	-965.80580	1.983E+11
25.00000	0.40328	13582962.	46372.	-960.45250	1.981E+11
25.50000	0.35867	13843905.	40631.	-953.04805	1.979E+11
26.00000	0.31656	14070538.	34942.	-943.47300	1.977E+11
26.50000	0.27702	14263206.	29317.	-931.59140	1.976E+11
27.00000	0.24008	14422337.	23770.	-917.24690	1.975E+11
27.50000	0.20577	14548447.	18318.	-900.25773	1.974E+11
28.00000	0.17411	14642148.	12976.	-880.40999	1.973E+11
28.50000	0.14512	14704154.	7762.	-857.44855	1.973E+11
29.00000	0.11882	14735291.	2696.	-831.06460	1.973E+11
29.50000	0.09520	14736511.	-2199.	-800.87808	1.973E+11
30.00000	0.07428	14708898.	-6901.	-766.41257	1.973E+11
30.50000	0.05603	14653695.	-11382.	-727.05895	1.973E+11
31.00000	0.04046	14572318.	-27913.	-4783.	1.974E+11
31.50000	0.02755	14318737.	-81371.	-13036.	1.976E+11
32.00000	0.01725	13595868.	-161063.	-13528.	1.981E+11
32.50000	0.009421	12385976.	-241521.	-13291.	1.989E+11
33.00000	0.003832	10697611.	-301646.	-6751.	2.001E+11
33.50000	0.000167	8766219.	-322878.	-326.29442	2.013E+11
34.00000	-0.001930	6823080.	-311452.	4135.	2.025E+11
34.50000	-0.002813	5028789.	-279357.	6564.	2.035E+11
35.00000	-0.002807	3470798.	-238411.	7085.	7.183E+11
35.50000	-0.002627	2167862.	-195761.	7131.	7.227E+11
36.00000	-0.002340	1121660.	-153979.	6796.	7.260E+11
36.50000	-0.001996	320110.	-115056.	6179.	7.284E+11
37.00000	-0.001637	-259013.	-80386.	5378.	7.284E+11
37.50000	-0.001290	-644517.	-50793.	4486.	7.275E+11
38.00000	-0.000976	-868535.	-26602.	3578.	7.270E+11
38.50000	-0.000704	-963739.	-7718.	2717.	7.266E+11
39.00000	-0.000480	-961145.	6267.	1945.	7.267E+11
39.50000	-0.000304	-888537.	15970.	1290.	7.269E+11
40.00000	-0.000172	-769500.	22126.	762.23442	7.272E+11
40.50000	-7.802E-05	-623023.	25494.	360.39903	7.276E+11
41.00000	-1.476E-05	-463571.	27640.	354.88245	7.284E+11
41.50000	2.560E-05	-291343.	26785.	-639.92093	7.284E+11
42.00000	5.155E-05	-142153.	20999.	-1289.	7.284E+11
42.50000	7.048E-05	-39360.	11846.	-1762.	7.284E+11
43.00000	8.747E-05	0.000	0.000	-2187.	7.284E+11

Output Summary for Load Case No. 1:

Pile-head deflection = 4.23572628 inches
Computed slope at pile head = -0.01448983 radians

```
Maximum bending moment           =      14736511. inch-lbs
Maximum shear force              =       -322878. lbs
Depth of maximum bending moment  =    29.50000000 feet below pile head
Depth of maximum shear force     =    33.50000000 feet below pile head
Number of iterations             =            106
Number of zero deflection points =              2
```

Pile-head Deflection vs. Pile Length for Load Case 1

Boundary Condition Type 1, Shear and Moment

```
Shear      =          19000. lbs
Moment     =              0. in-lbs
Axial Load =              0. lbs
```

Pile Length feet	Pile Head Deflection inches	Maximum Moment ln-lbs	Maximum Shear lbs
43.00000	4.23572628	14736511.	-322878.
40.85000	4.33886301	15135305.	-335648.
38.70000	4.23567018	14951625.	-327314.
36.55000	4.27430347	15059794.	-353882.
34.40000	8.21602123	13842184.	-500992.

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	1	4.235726	-0.014490	-322878.	14736511.

Maximum pile-head deflection = 4.2357262785 inches
Maximum pile-head rotation   = -0.0144898252 radians = -0.830206 deg.

Summary of Warning Messages

The following warning was reported 848 times

**** Warning ****

An unreasonable input value for unconfined compressive strength has been specified for a soil defined using the weak rock criteria. The input value is greater than 500 psi. Please check your input data for correctness.

The analysis ended normally.