STRUCTURAL ENGINEERING

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SCI-823-0.00

PID No. 19415

S.R. 823 OVER LUCASVILLE-MINFORD ROAD (C.R. 28)

STRUCTURE TYPE STUDY SUBMITTAL

Prepared for:
OHIO DEPARTMENT OF TRANSPORTATION
DISTRICT 9
650 EASTERN AVE.
CHILLICOTHE, OHIO 45601

JULY 15, 2005

Prepared by:

TRANSYSTEMS
CORPORATION

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BRIDGE TYPE STUDY NARRATIVE

1. Introduction

TranSystems Corporation is providing engineering services to the Ohio Department of Transportation for the design of new left and right overpass structures that will carry the proposed S.R. 823 bypass over Lucasville-Minford Road (CR 28). As requested by the Scope of Services, a Bridge Type Study report is to be submitted before any plan development. The purpose of this report is to investigate various span arrangements and superstructure and substructure types in order to determine the most appropriate and economical structure type that will meet the project requirements.

2. Design Criteria

The proposed structure will be designed according to the most current version of the Ohio Department of Transportation Bridge Design Manual and the 2002 AASHTO Standard Specifications for Highway Bridges.

3. Subsurface Conditions and Foundation Recommendation

DLZ Ohio, Inc. performed the subsurface exploration for the proposed bridge and prepared the Preliminary Bridge Foundation Recommendations. It is included in Appendix E.

In summary, four (4) test borings (TR-11, TR-12, TR-13 and TR-14) were drilled which all encountered sandstone bedrock between 38 and 43 feet below the existing ground surface. Additionally, generally cohesive soils were encountered below the 3"-6" topsoil layer, to the top of bedrock. The cohesive soils ranged from sandy silt (A-4a) to clay (A-7-6), and were generally soft to very stiff.

Based on the alternatives considered for this study, only one foundation type was considered applicable for various substructure elements. As the location of bedrock is at moderate depths, the HP pile foundation appears to be best suited for all alternative's substructure locations. Both the rear and forward abutment's foundations will be located on compacted embankment fill. Subsequently, it is recommended that the piles at the abutments not be driven until the majority of primary consolidation settlement of both the in-situ soil, which may be compressible, and the embankment has occurred. This will avoid having high down-drag forces that could significantly reduce the load-carrying capacity of the piles. Additionally, the piles could be sleeved to prevent any possible down-drag forces.

HP14x73 piles with a maximum design load of 95 tons are assumed for this Bridge Type Study. Since the piles will be driven to refusal onto hard bedrock, the feasibility of using steel points will be investigated as required by Section 202.2.3.2.a of the ODOT Bridge Design Manual.

4. Roadway

The purpose of this project is to construct a new bypass state route around the town of Portsmouth, Ohio. The proposed alignment will carry two lanes of traffic, 15 plus miles in either direction, from an interchange with US 52 just east of Portsmouth to another interchange with US 23, located north of Portsmouth in Valley Township.

2' offset

Each structure has a unique cross section. The left structure's cross section will consist of two 12'-0" travel lanes with 6'-0" median shoulders and 12'-0" outside shoulders. Including a 1'-6" inside median parapet and a 1'-6" outside straight face deflector parapet yields a left structure deck width of 45'-0" out to out.

The right structure, however, has a variable width cross section due to a tapered acceleration lane. From left to right, this bridge's cross section consists of a 1'-6" median parapet, a 6'-0" median shoulder, two 12'-0" travel lanes, a tapered acceleration ramp, an 8'-0" wide shoulder and a 1'-6" outside parapet. Thus the out to out width varies.

The distance from the centerline of construction of SR 823 to the near edge of both the left and right structures is constant at 22'-6". Horizontal and vertical sight distances, in accordance with the design standards, have been provided over the bridge for all alternatives considered.

Vertical and Horizontal Design – Since the proposed vertical alignment for all overpass structures on this project was dictated by the overall design of the new bypass profile, vertical clearance was not a critical design issue for each alternative proposed herein. For this report, more than 17'-0" of preferred vertical clearance could be provided for each structure's alternatives considered.

For Alternative 1, a 13'-7" minimum horizontal offset from edge of pavement to center pier will be maintained underneath the proposed SR 823 (along the south side of Lucasville-Minford Road). Thus, for this Alternative a Type D barrier will be required, providing a 10'-0" shoulder.

For Alternates 2 & 3, a 21'-8" minimum horizontal offset from edge of pavement to center pier will be maintained on the north side of Lucasville-Minford Road, while a 26'-0" minimum horizontal offset will be provided on the south side.

The existing Lucasville-Minford Road will remain on its current horizontal and vertical alignment. The cross section will be widened from 2-lanes with 22'-0" pavement width, to a 3-lane cross section with 36'-0" pavement width.

Drainage Design - The collection of storm water runoff will be addressed off of the bridge, thus scuppers will not be required. The type of drainage system will be investigated as part of the preliminary design.

Utilities - No utilities will be placed on the bridge. However, lighting and ITS conduits will be provided as necessary.

Maintenance of Traffic - While the new bridges are under construction, traffic will be maintained on the existing Lucasville-Minford Rd. It is anticipated that there will be limited closures during construction for beam setting.

5. Proposed Structure Configurations

Alignment & Profile: The proposed horizontal geometry is along a tangent alignment across the entire length of both the left and right structures. The proposed mainline profile grade line is located on the inside edge of pavement for both bridges and is along a variable sloping grade. The horizontal and vertical geometry for all alternatives considered are the same. Embankment slopes will be a maximum 2:1 in order to minimize right-of-way impacts.

Structure: As per the Scope of Services, we investigated several bridge types and alternates as part of this type study.

Three (3) alternatives have been evaluated in this Structure Type Study, and are designated as Alternative 1 though 3. The appropriate structure types that were considered are outlined in the Structure Type Alternative Table:

STRUCTURE TYPE ALTERNATIVE TABLE

Structure Type Alternative		1	2	3
Superstructure Type Description		Tangent, 54" continuous steel plate girder Grade 50W	Tangent, Prestressed Concrete Girders 54" Modified AASHTO Type 4	Tangent, continuous W36 rolled steel beams Grade 50W
Proposed Beam Spacing	**Left Bridge**	5 Spaces @ 8'-0"	5 Spaces @ 8'-0" 9'3"	5 Spaces @ 8'-0"
	Right Bridge	6 Variable Spaces	6 Variable Spaces	6 Variable Spaces
No. of Spans		2	2	2
Abutment Type		Stub Type abutments with 2:1 spill-through slopes (Semi Integral Type)	Stub Type abutments with MSE Walls (Semi Integral Type)	Stub Type abutments with MSE Walls (Semi Integral Type)
No. of Piers		1	1	1
Pier Type		Cap & Column	Cap & Column	Cap & Column
Substructure Orientation		00°00'00"	24°00'00"LF	24°00'00"LF
Approximate Bridge Length		279'	200'	200'
Approximate Structure Depth	**Slab** **Haunch** **Beam**	8.5" 2" 57"	8.5" 2" 54"	8.5" 2" 36"
	Total	67.5" (5.625')	64.5" (5.375')	46.5" (3.875')

Alternatives Discussion:

As stated above, various span configurations were investigated and were refined to the 2-span layout configuration chosen for all three alternatives. The location of the creek and Lucasville-Minford Road dictated that a 2-span bridge would be most economical, with horizontal clearances to the roadway affecting the locations of the pier and abutments. The proposed vertical profile was a determining factor, as the large fill heights for the spill through abutment alternative illustrate. The different alternatives discussed below modify the location and orientation of the abutments, as well as the type of abutment and type of superstructure.

Alternative 1

Span configuration: This alternative consists of a 152'-0" span and a 127'-0" span, for an overall bridge length of 279'-0" from centerline bearings at abutments, for both the left and right structures. The abutments and pier are oriented perpendicular to the roadway, and thus have no skew. 2:1 spill through slopes are employed, thus extending the length of the bridge superstructure versus the MSE wall alternatives below.

Substructure:

I. *Abutments:* Both the forward and rear abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal. As stated above, spill-through slopes will be used to provide the embankment for the approach roadways, thus increasing the overall length of the bridges. The details of the abutments will follow ODOT Standard Construction drawings.

II. *Pier:* The single pier will consist of cap & column type piers also supported on H-piles (HP14x73) with a design capacity of 95-tons per pile, driven to refusal

Superstructure: The preliminary design of this alternative indicates that a 6 - 54" Grade 50W plate girders, spaced at 8'-0" for the left bridge, and 7 - 54" Grade 50W plate girders at variable spaces for the right bridge. Both bridge will have constant 2'-6" overhangs, and will accommodate the HS25 design loadings. The left bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0, while the right bridge will be 52'-0 ½" max to 49'-6" min toe to toe of parapets, and 55'-0 ½" max to 49'-8" min overall bridge width.

Alternative 2

Span configuration: This alternative consists of two 100'-0" spans, for an overall bridge length of 200'-0" from centerline bearings at abutments, for both the left and right structures. Unlike the previous alternative, the abutments and pier for Alternative 2 are oriented with a 24°00'00"LF skew, relative to a line perpendicular to the centerline roadways.

Substructure:

I. *Abutments:* Both the forward and rear abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal. As stated above, MSE walls will be employed to retain both the fill in front of the abutments and on the sides of the approach roadways, thus no wing-walls will be required. The MSE walls at the rear abutment will be located 2'-0" from the abutments, measured from the face of wall to edge of abutment footing. shoulder. The MSE walls at the forward abutment are set to provide a minimum 15'-0" offset from the stream centerline. The details of the abutments will follow ODOT Standard Construction drawings, and the MSE walls will be proprietary items.

II. *Pier:* The single pier will consist of cap & column type piers also supported on H-piles (HP14x73) with a design capacity of 95-tons per pile, driven to refusal.

Superstructure: The preliminary design of this alternative indicates that 5-AASHTO Type 4 prestressed beams spaced at 9'-3" for the Left bridge (6 beams at variable spaces for the Right bridge) with 4'-0" overhangs would be required for each structure to accommodate the HS25 design loading requirements. The bridges will be simple span for non-composite dead loads and continuous for superimposed and live loads. The left bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0, while the right bridge will be 51'-3 ½" max to 46'-9 ¾" min toe to toe of parapets, and 54'-3 ½" max to 49'-9 ¾" min overall bridge width.

Alternative 3

Span configuration: Similar to Alternative 2, this alternative consists of two 100'-0" spans, for an overall bridge length of 200'-0" from centerline bearings at abutments, for both the left and right structures. Also, similar to Alternative 2, the abutments and pier are oriented with a 24°00'00" LF skew, relative to a line perpendicular to the centerline roadways.

Substructure:

I. *Abutments:* Both the forward and rear abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal. As stated above, MSE walls will be employed to retain both the fill in front of the abutments and on the sides of the approach roadways, thus no wing-walls will be required. The MSE walls at the rear abutment will be located 2'-0" from the abutments, measured from the face of wall to edge of abutment footing. shoulder. The MSE walls at the forward abutment are set to provide a minimum 15'-0" offset from the stream centerline. The details of the abutments will follow ODOT Standard Construction drawings, and the MSE walls will be proprietary items.

II. *Pier:* The single pier will consist of cap & column type piers also supported on H-piles (HP14x73) with a design capacity of 95-tons per pile, driven to refusal

Superstructure: The preliminary design of this alternative indicates that 6-W33 Grade 50W continuous rolled steel beams spaced at 8'-0" for the Left bridge (7 beams at variable spaces for the Right bridge) with 2'-6" overhangs would be required for each structure to accommodate the HS25 design loading requirements. The left bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0, while the right bridge will be 51'-3 ½" max to 46'-9 ¾" min toe to toe of parapets, and 54'-3 ½" max to 49'-9 ¾" min overall bridge width.

6. Preliminary Probable Bridge Construction Cost:

A preliminary probable bridge construction cost has been prepared for Alternatives 1 through 3 (See Appendix A). The unit prices were based on ODOT's Summary of Contracts Awarded Year 2004 inflated 3.5% each year to the 2008 sale date. This estimate will be used as a comparison between alternatives and as a guide to select the most economical structure. Maintenance costs were included for each Alternative, with Alternative 1 being the baseline cost for approach roadway and embankments as it is the longest overall structure.

7. Summary:

A Summary of Alternatives and Recommendation Table have been provided to facilitate review of the costs for the Structure Alternatives Types investigated:

SUMMARY OF ALTERNATIVES AND RECOMMENDATIONS

STRUCTURE TYPE ALTERNATIVE	STRUCTURE TYPE	PROBABLE BRIDGE CONSTRUCTION COST	RATING	ADVANTAGES/ DISADVANTAGES
1	2-span continuous tangent plate girders, A709 Grade 50W with a composite reinforced concrete deck slab supported by semi-integral abutments with 2:1 slopes and cap & columns piers, all on HP pile foundations	**Structure Cost:** **$4,229,000** **Additional Life Cycle Cost:** **$1,220,000** **Total Relative Ownership Cost:** **$5,449,000**	3	***Advantages:*** • Long span bridge provides more open line of sight for roadway underneath • Weathering steel provides for lower life cycle cost and ease of maintenance for high structure ***Disadvantages:*** • Most expensive alternative • Long plate girder lengths may have trouble with transportation • Uncertainty with Steel Prices
2	2-span continuous for live load 54" AASHTO Type 4 Prestressed Concrete Beams with a composite reinforced concrete deck slab supported by semi-integral abutments with MSE walls and cap & columns piers, all on HP pile foundations	**Structure Cost:** **$3,576,000** **Additional Life Cycle Cost:** **$984,000** **Total Relative Ownership Cost:** **$4,560,000**	1	***Advantages:*** • Potentially less maintenance than the steel Alternatives • Least expensive for structure cost and total relative ownership cost ***Disadvantages:*** • Construction lead time for Prestressed may affect schedule
3	3-span continuous tangent rolled steel beams, A709 Grade 50W with a composite reinforced concrete deck slab supported by semi-integral abutments with MSE walls and cap & columns piers, all on HP pile foundations	**Structure Cost:** **$3,686,000** **Additional Life Cycle Cost:** **$903,000** **Total Relative Ownership Cost:** **$4,589,000**	2	***Advantages:*** • Weathering steel provides for lower life cycle cost and ease of maintenance for high structure ***Disadvantages:*** • Uncertainty with Steel Prices • Initial structure cost higher than prestressed alternative

8. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 2**, which consists of 2-span 54" AASHTO Type 4 prestressed concrete beams with semi-integral abutments, MSE walls and cap & column pier, for both the left and right structures. (See Appendix B for the Site Plan and Structure Details).

Our recommendation for Alternative 2 is based on the following items:

- This Alternative appears to be the most economical from the 3 alternates studied
- Prestressed concrete beams tend to have lower maintenance costs than painted steel
- The 100' prestressed beam lengths are reasonable for transport

APPENDIX A

TRANSYSTEMS CORPORATION

SCI-823-0.00

SR 823 Over Lucasville-Minford Rd (Left and Right Structures)

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\12-CR28(LucasvilleMinford)\Estimates\[Lucasville Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/25/2005
Checked: ELK Date: 7/1/2005

COST COMPARISON SUMMARY

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Total Initial Superstructure Cost	Total Initial Construction Cost
1	2	152.00	127.00	279.00	6 ~ Steel Plate Girders (Left) 7 ~ Steel Plate Girders (Right)	54" Web - Grade 50W	$2,544,000	$4,229,000
2	2	100.00	100.00	200.00	6 ~ P.S. Concrete I-Beams (Left) 7 ~ P.S. Concrete I-Beams (Right)	AASHTO Type 4	$1,293,000	$3,576,000
3	2	100.00	100.00	200.00	6 ~ Rolled Steel Beams (Left) 7 ~ Rolled Steel Beams (Right)	W36 - Grade 50W	$1,394,000	$3,686,000

SCI-823-0.00

SR 823 Over Lucasville-Minford Rd (Left and Right Structures)

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\12-CR28(LucasvilleMinford)\Estimates\[Lucasville Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/25/2005
Checked: ELK Date: 7/1/2005

ALTERNATIVE COST SUMMARY

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Subtotal Superstructure Cost	Subtotal Substructure Cost	Approach Roadway Length (1)	Approach Roadway Cost (2, 3)	Structure Incidental Cost (16%)	Structure Contingency Cost (20%)	Structure Initial Construction Cost
1	2	152.00	127.00	279.00	6 ~ Steel Plate Girders (Left) 7 ~ Steel Plate Girders (Right)	54" Web - Grade 50W	$2,544,000	$494,000	0.0	$0	$486,000	$705,000	$4,229,000
2	2	100.00	100.00	200.00	6 ~ P.S. Concrete I-Beams (Left) 7 ~ P.S. Concrete I-Beams (Right)	AASHTO Type 4	$1,293,000	$1,240,000	79.0	$50,000	$405,000	$588,000	$3,576,000
3	2	100.00	100.00	200.00	6 ~ Rolled Steel Beams (Left) 7 ~ Rolled Steel Beams (Right)	W36 - Grade 50W	$1,394,000	$1,218,000	79.0	$50,000	$418,000	$606,000	$3,686,000

NOTES:

1. Approach roadway length equals the difference between the maximum bridge length and the bridge length for the alternative being considered.

2. Use 2004 pvm't cost = $33.20 /sq. yd. Allow 3.5% escalation for years 2005 - 2008
2008 Unit Cost = $38.10 /sq. yd.

Pavement Widths:

Alternative	Left Bridge Rear/Fwd Appr.		Right Bridge Rear Appr.		Right Bridge Fwd Appr.		Average Rear Approach		Average Fwd. Approach		Combined Average	
Alt. 1	45.00	ft.	55.05	ft.	49.48	ft.	50.03	ft.	47.24	ft.	48.63	ft.
Alt. 2	45.00	ft.	54.29	ft.	49.81	ft.	49.65	ft.	47.41	ft.	48.53	ft.
Alt. 3	45.00	ft.	54.29	ft.	49.81	ft.	49.65	ft.	47.41	ft.	48.53	ft.

3. Use 2004 Concrete Barrier, Single Slope, Type B1 cost = $50.30 /ft.
Allow 3.5% escalation for years 2005 - 2008 2008 Unit Cost = $57.70 /ft.

4. Structure incidental cost allowance includes provision for structure excavation, porous backfill & drainage pipe, sealing of concrete surfaces, structural steel painting, bearings, (minor) temporary shoring, crushed aggregate slope protection, pile driving equipment mobilization, shear connectors, settlement platforms, expansion joints, joint sealers, and joint fillers costs.

5. Estimated construction cost does not include existing structure removal, which should be quantified separately, if required.

6. No profile adjustment costs associated with raising the profiles have been considered, since all alternatives satisfy the minimum required vertical clearance of 17'-0" for steel structures and 17'-0" for concrete structures.

Alternative	Vertical Clearance Provided (ft.)		Profile Adjustment Required (ft.)	
Alt. 1	0.00	ft.	0.00	ft.
Alt. 2	0.00	ft.	0.00	ft.
Alt. 3	0.00	ft.	0.00	ft.

SCI-823-0.00 (Portsmouth Bypass)

SR 823 Over Lucasville-Minford Rd (Left and Right Structures)

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\12-CR28(LucasvilleMinford)\Estimates\[Lucasville Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/24/2005
Checked: ELK Date: 7/1/2005

SUPERSTRUCTURE

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Total Span Length (ft.)	Deck Length (ft.)	Deck Area (sq. ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Stringer Section	Structural Steel Weight (pounds)	Structural Steel Cost	Prestressed Girder Cost	Initial Superstructure Cost
1	2	152.00	127.00	279.00	562.00	27,300	966	$569,000	$242,300	$89,000	6 ~ Steel Plate Girders (Left) 7 ~ Steel Plate Girders (Right)	54" Web - Grade 50W	1364006	$1,643,500	$0	**$2,544,000**
2	2	100.00	100.00	200.00	404.00	19,600	693	$408,300	$173,900	$89,000	6 ~ P.S. Concrete I-Beams (Left) 7 ~ P.S. Concrete I-Beams (Right)	AASHTO Type 4	0	$0	$621,600	**$1,293,000**
3	2	100.00	100.00	200.00	404.00	19,600	693	$408,300	$173,900	$89,000	6 ~ Rolled Steel Beams (Left) 7 ~ Rolled Steel Beams (Right)	W36 - Grade 50W	851551	$723,100	$0	**$1,394,000**

Deck Cross-Sectional Area:

Number of structures = 2

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Edge	1	4.26	4.26
Median	1	4.26	4.26

Slab:

	T (ft.)	Ave. W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Alt. 1	0.71	48.63	34.4	3.4	46.4
Alt. 2	0.71	48.53	34.4	3.4	46.3
Alt. 3	0.71	48.53	34.4	3.4	46.3

Note: Deck width measured as average width.
10% of deck area allowed for haunches and overhangs.

QC/QA Concrete, Class QSC2
Unit Cost ($/cu. yd):

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$589.00

Based on parapet and slab percentages of total concrete area

Epoxy Coated Reinforcing Steel
Unit Cost ($/lb):
Assume 285 lbs of reinforcing steel per cubic yard of deck concrete

	Year 2004	Annual Escalation	Year 2008
Deck Reinforcing	$0.77	3.5%	$0.88

Prestressed Concrete Girders
Unit Costs:

	Year 2004		Annual Escalation	Year 2008		No. Required
Alt. 2						
AASHTO Type IV Beams						
Type 4 I-Beams	$16,000	ea	3.5%	$18,360	ea.	26
Pier Diaphragms	$1,800	ea	3.5%	$2,070	ea.	11
Abutment Diaphragms	$1,200	ea	3.5%	$1,380	ea.	22
Intermediate Diaphragms	$1,200	ea	3.5%	$1,380	ea.	66

Structural Steel
Unit Costs ($/lb.):

	Cost Ratio	Year 2004	Annual Escalation	Year 2008
Rolled Beams - Grade 50	n/a	$0.74	3.5%	$0.85
Plate Girders - Grade 50	n/a	$1.05	3.5%	$1.20
Hybrid Plate Girders - Grade 50/70\	1.10	$1.16	3.5%	$1.33

Note - all structural steel weight will be estimated 30 pounds per each square foot of bridge deck area for long-span tangent girders.
and 25 pounds per each square foot of bridge deck area for short-span tangent girders.

	Year 2008		Quantity Per Beam		No. Required	Total	
Alt. 1							
64" Plate Girder							
Plate Girder - Grade 50	$1.20	/lb	95,385	lb/ea	13	1,240,005	lbs
Crossframes (10% of beam weight)	$1.20	/lb	9,539	lb/ea	13	124,001	lbs
Total			104,924	lb/ea		1,364,006	lbs
Alt. 3							
W33x241 Grade 50							
Rolled Beams - Grade 50	$0.85	/lb	59,549	lb/ea	13	774,137	lbs
Crossframes (10% of beam weight)	$0.85	/lb	5,955	lb/ea	13	77,414	lbs
Total			65,504	lb/ea		851,551	lbs

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft.
Area = 135 sq. yd.
Average Width = 48.56 ft

	Year 2004	Annual Escalation	Year 2008
Approach Slabs	$144.00	3.5%	$165.00

SCI-823-0.00 (Portsmouth Bypass)

SR 823 Over Lucasville-Minford Rd (Left and Right Structures)

STRUCTURE TYPE STUDY - Alternate 1 - Substructure Quantity Calculations

By: JDH
Checked: ELK

Date: 6/22/2005
Date: 7/1/2005

Pier Quantities (HP-Piles Type Foundation)

Pier Location	Length	Cap				Column					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Dia*	*Height*	*Area*	*# Column*	*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Pier 1 Left	42	3	4	12.00	504	3.5	28.5	9.62	3	822	11	3	121	3	1089	2415
Pier 1 Right	46	3	4	12.00	552	3.5	28.5	9.62	3	822	11	3	121	3	1089	2463
Total (Cu.Ft.)					**1056**					**1644**					**2178**	**4878**
Total (Cu.Yd.)					**39**					**61**					**81**	**181**

HP 14x73 Pile Quantities Left Bridge

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles (Spacing)	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut.	91	73	164	6	984	284	190	7	12	1	*12*	738.0	672	68.0	*816*
Pier 1	282	144	426	6	2556	362	190	15	-	1.05	*16*	709.3	674	37.0	*592*
Fwd. Abut.	66	71	137	6	822	284	190	6	12	1	*12*	740.6	679	64.0	*768*
TotaL	**439**	**288**	**727**	**18**	**4362**	**929**		**28**			**40**				**2176**

HP 14x73 Pile Quantities Right Bridge

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles at Abut's	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut.	91	73	164	7	1148	340	190	8	16	1	*16*	738.0	672	68.0	*1088*
Pier 1	282	144	426	7	2982	369	190	18	-	1	*18*	709.3	674	37.0	*666*
Fwd. Abut.	66	71	137	7	959	321	190	7	14	1	*14*	740.6	679	64.0	*896*
TotaL	**439**	**288**	**727**	**21**	**5089**	**1031**		**33**			**48**				**2650**

piles per row at abutments = 2

Semi-Integral Abutment Quantities

Abut Location	Length	Backwall				Beam Seat					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*		*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Rear Abutment																
Left	45	3	5	15	675	3	3	9.00		405	6	3	18	1	810	1890
Right	54	3	5	15	810	3	3	9.00		486	6	3	18	1	972	2268
Total																*4158*
Fwd Abutment																
Left	45	3	5	15	675	3	3	9.00		405	6	3	18	1	810	1890
Right	51	3	5	15	765	3	3	9.00		459	6	3	18	1	918	2142
Total																*4032*
Total (Cu.Ft.)					**2925**					**1755**					**3510**	**8190**
Total (Cu.Yd.)					**108**					**65**					**130**	**303**

MSE Abutment Wall Quantities

Abutment Location	Wall			
	Height	*Return*	*Length*	*Area*
Rear Abutment				
Left	0	0	45	0
Right	0	0	54	0
Fwd Abutment				
Left	0	0	45	0
Right	0	0	51	0
Total (Sq.Ft.)				0

Note: Wingwall volume calculations on Substructure sheet

SCI-823-0.00 (Portsmouth Bypass)

SR 823 Over Lucasville-Minford Rd (Left and Right Structures)

STRUCTURE TYPE STUDY - Alternates 2 AND 3 - Substructure Quantity Calculations

By: JDH
Checked: ELK

Date: 6/22/2005
Date: 7/1/2005

Pier Quantities (HP-Piles Type Foundation)

Pier Location	Length	Cap				Column					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Dia*	*Height*	*Area*	*# Column*	*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Pier 1 Left	45	3	3.5	10.50	473	3	28.5	7.07	3	604	11	3	121	3	1089	2166
Pier 1 Right	55	3	3.5	10.50	578	3	28.5	7.07	4	805	11	3	121	4	1452	2835
Total (Cu.Ft.)					1050					1409					2541	5000
Total (Cu.Yd.)					39					52					94	185

Semi-Integral Abutment Quantities

Abut Location	Length	Backwall				Beam Seat					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*		*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Rear Abutment																
Left	50	3	3.5	10.5	525	3	2	6.00		300	6	3	18	1	900	1725
Right	61	3	3.5	10.5	641	3	2	6.00		366	6	3	18	1	1098	2105
Total																*3830*
Fwd Abutment																
Left	50	3	3.5	10.5	525	3	2	6.00		300	6	3	18	1	900	1725
Right	56	3	3.5	10.5	588	3	2	6.00		336	6	3	18	1	1008	1932
Total																*3657*
Total (Cu.Ft.)					**2279**					**1302**					**3906**	**7487**
Total (Cu.Yd.)					**84**					**48**					**145**	**277**

MSE Abutment Wall Quantities

Abutment Location	Wall			
	Height	*Return*	*Length*	*Area*
Rear Abutment				
Left	30	45	95	2850
Right	30	45	106	3180
Between Rear Abut	30	0	50	1500
Total Rear Abutment				7530
Forward Abutment				
Left	20	30	80	1600
Right	20	30	86	1720
Between Fwd Abut	20	0	50	1000
Total Fwd Abutment				4320
Total (Sq.Ft.)				**11850**

Note: Return = (3/2) * Height and is less than (2/1 slope) since it is assumed that the bottom of MSE wall will be stepped

HP 14x73 Pile Quantities Left Bridge - Alt 2

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles (Spacing)	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut.	115	71	186	6	1116	259	190	7	14	1	*14*	738.6	672	69.0	*966*
Pier 1	351	238	589	6	3534	325	190	20	-	1.05	*21*	709.3	674	37.0	*777*
Fwd. Abut.	115	71	186	6	1116	259	190	7	14	1	*14*	741.2	679	64.0	*896*
TotaL	**581**	**380**	**961**	**18**	**5766**	**842**		**34**			**49**				**2639**

HP 14x73 Pile Quantities Right Bridge - Alt 2

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles at Abut's	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut.	115	71	186	7	1302	316	190	9	18	1	*18*	738.6	672	69.0	*1242*
Pier 1	351	238	589	7	4123	425	190	24	-	1	*24*	709.3	674	37.0	*888*
Fwd. Abut.	115	71	186	7	1302	290	190	8	16	1	*16*	741.2	679	64.0	*1024*
TotaL	**581**	**380**	**961**	**21**	**6727**	**1031**		**41**			**58**				**3154**

HP 14x73 Pile Quantities Left Bridge - Alt 3

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles (Spacing)	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut.	69	71	140	6	840	259	190	6	14	1	*14*	738.6	672	69.0	*966*
Pier 1	240	112	352	6	2112	325	190	13	-	1.15	*15*	709.3	674	37.0	*555*
Fwd. Abut.	69	71	140	6	840	259	190	6	14	1	*14*	741.2	679	64.0	*896*
TotaL	**378**	**254**	**632**	**18**	**3792**	**842**		**25**			**43**				**2417**

HP 14x73 Pile Quantities Right Bridge - Alt 3

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles at Abut's	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut.	69	71	140	7	980	316	190	7	18	1	*18*	738.6	672	69.0	*1242*
Pier 1	240	112	352	7	2464	425	190	15	-	1.05	*16*	709.3	674	37.0	*592*
Fwd. Abut.	69	71	140	7	980	290	190	7	16	1	*16*	741.2	679	64.0	*1024*
TotaL	**378**	**254**	**632**	**21**	**4424**	**1031**		**29**			**50**				**2858**

piles per row at abutments = 2 since semi integral abutment

SCI-823-0.00

SR 823 Over Lucasville-Minford Rd (Left and Right Structures)

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\12-CR28(LucasvilleMinford)\Estimates\[Lucasville Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/24/2005
Checked: ELK Date: 7/1/2005

SUBSTRUCTURE

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Abutment Wall Cost	Temporary Shoring Cost	Initial Substructure Cost
1	2	152.00	127.00	279.00	6 ~ Steel Plate Girders (Left) 7 ~ Steel Plate Girders (Right)	54" Web - Grade 50W	$87,300	$19,900	$161,100	$26,400	$199,300	$0	$0	**$494,000**
2	2	100.00	100.00	200.00	6 ~ P.S. Concrete I-Beams (Left) 7 ~ P.S. Concrete I-Beams (Right)	AASHTO Type 4	$89,500	$20,400	$133,900	$22,000	$239,300	$734,700	$0	**$1,240,000**
3	2	100.00	100.00	200.00	6 ~ Rolled Steel Beams (Left) 7 ~ Rolled Steel Beams (Right)	W36 - Grade 50W	$89,500	$20,400	$133,900	$22,000	$217,900	$734,700	$0	**$1,218,000**

Pier QC/QA Concrete, Class QSC1 Cost:

Alt. 1

Component	Volume	Year 2004	Annual Escalation	Year 2008	Total Cost	
Cap	39.1	$421.00	3.5%	$483.00	$18,890	
Columns	60.9	$421.00	3.5%	$483.00	$29,420	
Footings	80.7	$421.00	3.5%	$483.00	$38,960	
Total Pier Cost					$87,300	All Piers

Alt. 2 & 3

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost	
Cap	38.9	$421.00	3.5%	$483.00	$18,780	
Columns	52.2	$421.00	3.5%	$483.00	$25,210	
Footings	94.1	$421.00	3.5%	$483.00	$45,460	
Total Pier Cost					$89,500	All Piers

Abutment QC/QA Concrete, Class QSC1 Cost:

Alt. 1

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	154.0	$421.00	3.5%	$483.00	$74,400
Forward	149.3	$421.00	3.5%	$483.00	$72,100
Wingwalls					
Rear	15.4	$421.00	3.5%	$483.00	$7,400
Forward	14.9	$421.00	3.5%	$483.00	$7,200

Note: Wingwall concrete estimated at 10% of Abutment concrete quantity

Alt. 2 & 3

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	141.8	$421.00	3.5%	$483.00	$68,500
Forward	135.4	$421.00	3.5%	$483.00	$65,400

Pile Foundation Unit Cost ($/ft.):

HP14 x 73 Steel Piles, Furnished & Driven
Abutment and Pier Piles

	Number	Total Pile Length	Total Cost
Alt. 1	88	4,826	$199,300
Alt. 2	107	5,793	$239,300
Alt. 3	93	5,275	$217,900

HP14 x 73 Steel Piles, Furnished & Driven

	Year 2004 Unit Cost	Annual Escalation	Year 2008
Furnished	$24.41	3.5%	$28.00
Driven	$11.57	3.5%	$13.30
Total			$41.30

Temporary Shoring and Temporary MSE Wall Unit Costs ($/sq. ft.):

	Temp. Shoring Area (sq. ft.)	Temp. MSE Wall Area (sq. ft.)	Total Cost
Alt. 1	0	0	$0
Alt. 2	0	0	$0
Alt. 3	0	0	$0

	Year 2004 Unit Cost	Annual Escalation	Year 2008
Temporary Shoring	$23.50	3.5%	$27.00
Temporary MSE Wall	$27.50	3.5%	$31.60

Epoxy Coated Reinforcing Steel Unit Cost ($/lb):

Assume 125 lbs of reinforcing steel per cubic yard of pier concrete.
Assume 90 lbs of reinforcing steel per cubic yard of abutment concrete.

	Year 2004	Annual Escalation	Year 2008
Pier	$0.77	3.5%	$0.88
Abutment	$0.77	3.5%	$0.88

MSE Abutment Unit Cost ($/sq. ft.):

	Rear Abutment Area (sq. ft.)	Forward Abutment Area (sq. ft.)	Total Cost
Alt. 1	0	0	$0
Alt. 2	7,530	4,320	$734,700
Alt. 3	7,530	4,320	$734,700

	Year 2004 Unit Cost	Annual Escalation	Year 2008
MSE Wall	$54.00	3.5%	$62.00

SCI-823-0.00

SR 823 Over Lucasville-Minford Rd (Left and Right Structures)

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\12-CR28(LucasvilleMinford)\Estimates\[Lucasville Structure Cost Comparison.xls]Life Cycle Cost
By: JDH
Checked: ELK
Date: 6/25/2005
Date: 7/1/2005

LIFE CYCLE MAINTENANCE COST

		Span Arrangement				Structural Steel Painting			Superstructure Sealing			Approach Pavement Resurfacing		
Alt. No.	No. Spans	Span 1	Span 2	Total Span Length (ft.)	Framing Alternative	Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost	Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost	Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost
1	2	152	127	279	6 ~ Steel Plate Girders (Left) 7 ~ Steel Plate Girders (Right)	$727,200	0	$0	$0	0	$0	$0	0	$0
2	2	100	100	200	6 ~ P.S. Concrete I-Beams (Left) 7 ~ P.S. Concrete I-Beams (Right)	$0	0	$0	$40,600	2	$81,200	$3,900	7	$27,300
3	2	100	100	200	6 ~ Rolled Steel Beams (Left) 7 ~ Rolled Steel Beams (Right)	$296,900	0	$0	$0	0	$0	$3,900	7	$27,300

		Span Arrangement				Bridge Deck Overlay (5)					Bridge Redecking (5)								
Alt. No.	No. Spans	Span 1	Span 2	Total Span Length (ft.)	Framing Alternative	Deck Demo & Chipping	Deck Overlay	Deck Joint Gland (2)	Number of Maintenance Cycles	Total Life Cycle Cost	Deck Concrete Cost (3)	Deck Reinforcing Cost (3)	Deck Joint Cost (2)	Deck Removal Cost	Number of Maintenance Cycles	Total Life Cycle Cost	Superstructure Life Cycle Maintenance Cost (1)	Total Initial Construction Cost	Total Relative Ownership Cost
1	2	152	127	279	6 ~ Steel Plate Girders (Left) 7 ~ Steel Plate Girders (Right)	$82,800	$100,300	n/a	1	$183,100	$569,000	$242,300	n/a	$226,000	1	$1,037,300	$1,220,000	$4,229,000	$5,449,000
2	2	100	100	200	6 ~ P.S. Concrete I-Beams (Left) 7 ~ P.S. Concrete I-Beams (Right)	$59,400	$72,000	n/a	1	$131,400	$408,300	$173,900	n/a	$162,300	1	$744,500	$984,000	$3,576,000	$4,560,000
3	2	100	100	200	6 ~ Rolled Steel Beams (Left) 7 ~ Rolled Steel Beams (Right)	$59,400	$72,000	n/a	1	$131,400	$408,300	$173,900	n/a	$162,300	1	$744,500	$903,000	$3,686,000	$4,589,000

Structural Steel Painting:

Structural Steel Area:

	Web Depth (in.)	No. Stringers	Total Span Length (ft.)	Assumed Ave. Bot. Flange Width (in.)	Nominal Exposed Girder Area (sq. ft.)	Secondary Member Allowance	Total Exposed Steel Area (sq. ft.)
Alt. 1	64	13	279.00	24.00	60,450	20%	72,500
Alt. 3	33	13	200.00	16.00	24,700	20%	29,600

Painting Cost per sq. ft.:

	Year 2004	Annual Escalation	Year 2008
Prep.	$5.00	3.5%	$5.74
Prime	$1.25	3.5%	$1.43
Intermed.	$1.25	3.5%	$1.43
Finish	$1.25	3.5%	$1.43
Total			$10.03

Superstructure Sealing:

PS Concrete I-Beam Area:
54" AASHTO Type IV

	H	V	Diag.	No.	Total
Bot. Flange	26			1	26.00
		8		2	16.00
Lower Fillets	9	9	8.49	2	16.98
Web		23		2	46.00
Upper Fillets	6	6	8.49	2	16.97
Top Flange		8		2	16.00
Total Exposed Perimeter					137.95 in.

PS Concrete Area:

	No. Stringers	Total Span Length (ft.)	Nominal Exposed Beam Area (sq. ft.)	Secondary Member Allowance	Total Exposed Concrete Area (sq. yd.)
Alt. 2	13	200.00	29,889	10%	3,650

Sealing Cost per sq. yd.:

	Year 2004	Annual Escalation	Year 2008
Epoxy-Urethane Sealer	$9.68	3.5%	$11.11

Bridge Redecking:

Bridge Deck Joint Cost per foot:

	Year 2004	Annual Escalation	Year 2008
Structural Expansion Joint Including Elastomeric Strip Seal	$238.00	3.5%	$273.11

	Bridge Width	No. Joints
Alt. 1	48.63	0
Alt. 2	48.53	0
Alt. 3	48.53	0

Bridge Deck Removal Cost:

	Deck Area (3) (sq. ft.)	Year 2008	Deck Removal Cost
Alt. 1	27,300	$8.28	$226,000
Alt. 2	19,600	$8.28	$162,300
Alt. 3	19,600	$8.28	$162,300

Bridge Deck Overlay (Item 848):

Bridge Deck MSC Overlay Cost per sq. yd.:

	Year 2004	Annual Escalation	Year 2008
Micro Silica Modified Concrete Overlay Using Hydrodemolition (1.25" thick)	$25.58	3.5%	$29.35
Surface Preparation Using Hydrodemolition	$22.85	3.5%	$26.22
Hand Chipping	$37.07	3.5%	$42.54

Bridge Deck MSC Overlay Cost per cu. yd.:

Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only	$144.00	3.5%	$165.24

	Deck Area (3) (sq. ft.)	Deck Area (sq. yd.)	Hand Chipping (sq. yd.)	Variable Thickness Repair (cu. yd.)
Alt. 1	27,300	3,033	76	68
Alt. 2	19,600	2,178	54	49
Alt. 3	19,600	2,178	54	49

Assume 25% of deck area requires removal to depth of 4.5" (3.25" additional removal).

Bridge Deck Joint Gland Replacement Cost per foot:

	Year 2004	Annual Escalation	Year 2008
Elastomeric Strip Seal Gland	$59.50	3.5%	$68.28

Assume gland replacement cost equals 25% of original deck joint construction cost.

NOTES:

1. Life cycle maintenance costs assume a 75 -year structure life, and are expressed in present value (2008 construction year) dollars.
2. Bridges are assumed to have semi-integral abutments, therefore no strip seal deck joints will be required.
3. See Superstructure Cost sheet.
4. See Alternative Cost Summary sheet.
5. Assume bridge deck overlay at Year 25 and bridge deck replacement at Year 50.
Assume superstructures are painted or sealed on a 25-year recurrence interval.
Assume complete bridge replacement at Year 75.
6. Life cycle maintenance cost differences are assumed to be predominately a function of superstructure maintenance costs.
Consequently, substructure lifecycle maintenance costs are not included in this analysis.

Approach Pavement Resurfacing:

Resurface Perpetual Asphalt Pavement:
Resurfacing Units Costs:

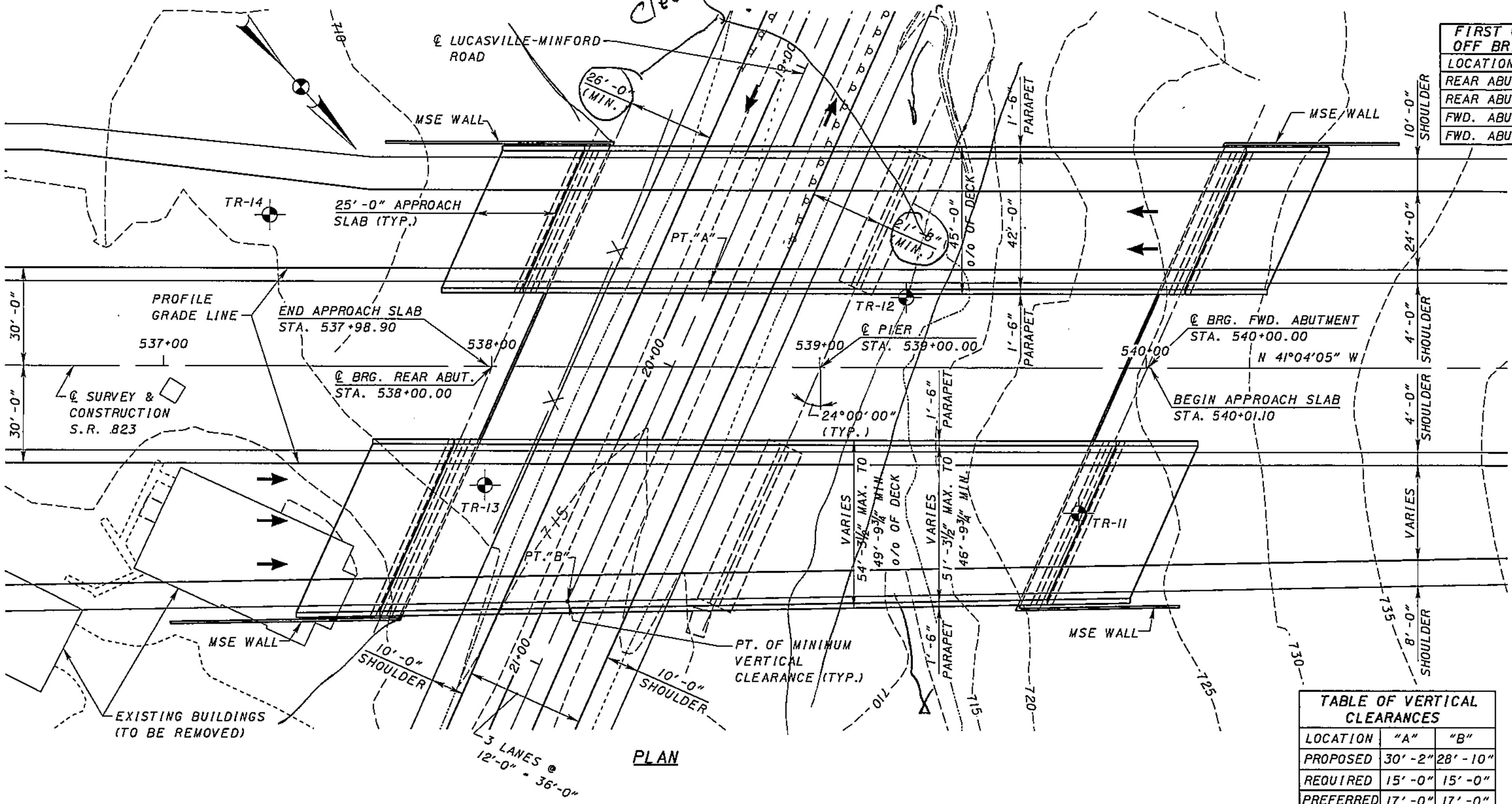
	Year 2004	Annual Escalation	Year 2008
Pavement Planing, Asphalt Concrete, per sq. yd. (Item 254)	$0.98	3.5%	$1.12
Asphalt Concrete Surface Course, per cu. yd.	$72.00	3.5%	$82.62

Asphalt Resurfacing Costs:

	Approach Roadway Length (ft.) (4)	Approach Roadway Width (ft.)	Resurfacing Area (sq. yd.)	Wearing Course Thickness (in.)	Wearing Course Volume (cu. yd.)
Alt. 1	0.0	97.3	0	1.50	0.0
Alt. 2	79.0	97.1	852	1.50	35.5
Alt. 3	79.0	97.1	852	1.50	35.5

APPENDIX B

TRANSYSTEMS CORPORATION



PLAN

FIRST GUARDRAIL POST OFF BRIDGE LOCATIONS		
LOCATION	STATION	SIDE
REAR ABUT.	x	RT.
REAR ABUT.	x	LT.
FWD. ABUT.	x	RT.
FWD. ABUT.	x	LT.

BORING LOCATIONS		
BORING No.	STATION	OFFSET
TR-11	xx+xx.xx	xx.xx' LT.
TR-12	xx+xx.xx	xx.xx' LT.
TR-13	xx+xx.xx	xx.xx' LT.
TR-14	xx+xx.xx	xx.xx' LT.

BENCHMARK 1	BENCHMARK 2
(TO BE PROVIDED LATER)	(TO BE PROVIDED LATER)

TRAFFIC DATA

(SR 823)

CURRENT YEAR ADT (2010) - 19,800
DESIGN YEAR ADT (2030) - 26,000
CURRENT YEAR ADTT (2010) -2770
DESIGN YEAR ADTT (2030) - 3640

PROPOSED STRUCTURE

TYPE: 2-SPAN CONTINUOUS FOR LIVE LOAD PRESTRESSED AASHTO TYPE IV BEAMS WITH COMPOSITE DECK SUPPORTED ON REINFORCED CONCRETE SUBSTRUCTURE UNITS.

SPANS: 90'-0" AND 90'-0" ℄ BEARINGS

ROADWAY: LEFT: 42'-0" TOE TO TOE OF PARAPETS
RIGHT: VARIES TOE TO TOE OF PARAPETS

LOADING: HS-25 AND ALTERNATE MILITARY LOADING
FWS-60PSF

SKEW: 24°00'00" LF

CROWN: 0.016 FT./FT.

ALIGNMENT: TANGENT

WEARING SURFACE: 1" MONOLITHIC CONCRETE

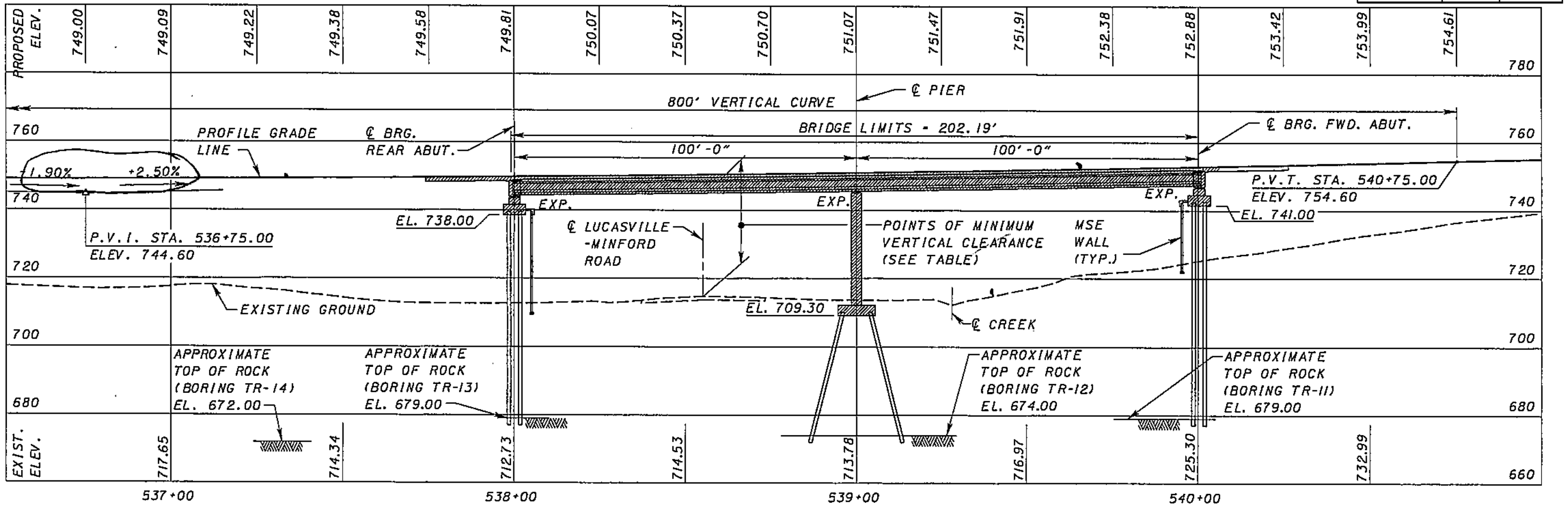
APPROACH SLABS: AS-1-81 (25'-0" LONG)

LATITUDE:

LONGITUDE:

STRUCTURE FILE NUMBER:

TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	30'-2"	28'-10"
REQUIRED	15'-0"	15'-0"
PREFERRED	17'-0"	17'-0"



ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.
3. THE PROPOSED PROFILE GRADE IS WITHIN BRIDGE LIMITS. SEE ROADWAY PLANS FOR PAVEMENT ELEVATIONS BEYOND BRIDGE LIMITS.

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 14X73 PILES AND HAVE A MAXIMUM CAPACITY OF 95 TONS PER PILE.

UTILITIES

UTILITIES DISPOSITION WILL BE ADDRESSED DURING TS&L SUBMITTAL.

DESIGN AGENCY
TRANSYSTEMS CORPORATION
55 PUBLIC SQUARE, SUITE 1900
CLEVELAND, OHIO 44113-1901

DESIGNED JDH	CHECKED RER
DRAWN MLR	REVISED
REVIEWED NFF	DATE 07-10-05
STRUCTURE FILE NUMBER	

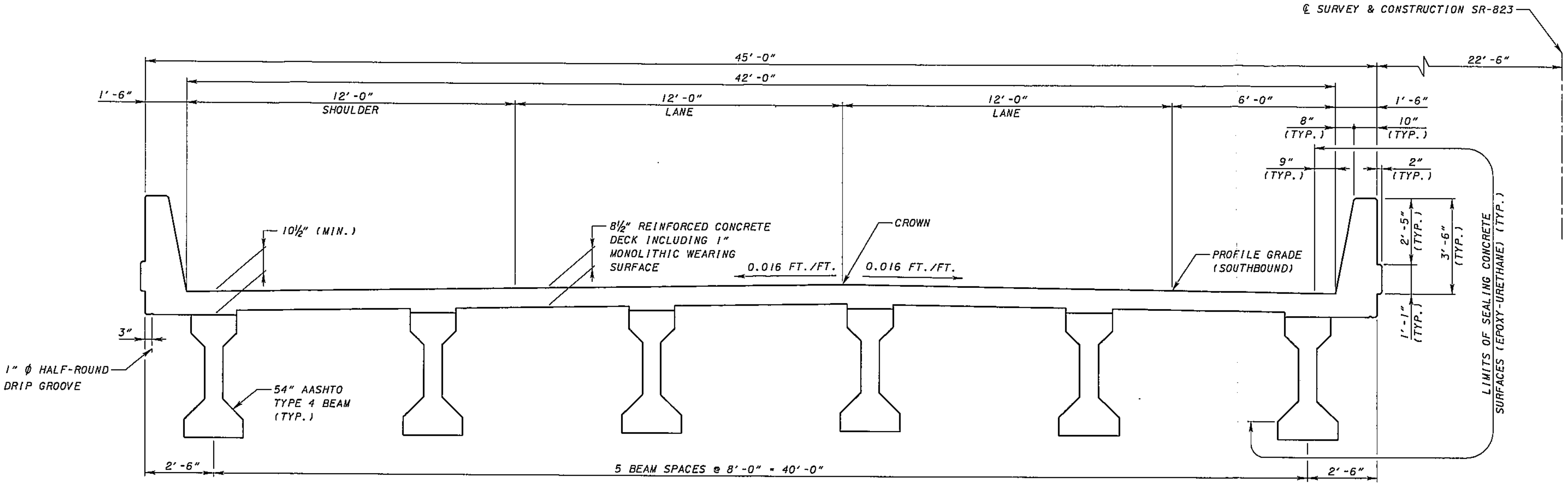
SCIOTO COUNTY
STA. 537+98.90
STA. 540+01.10

PRELIMINARY SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER LUCASVILLE-MINFORD ROAD (CR-28)

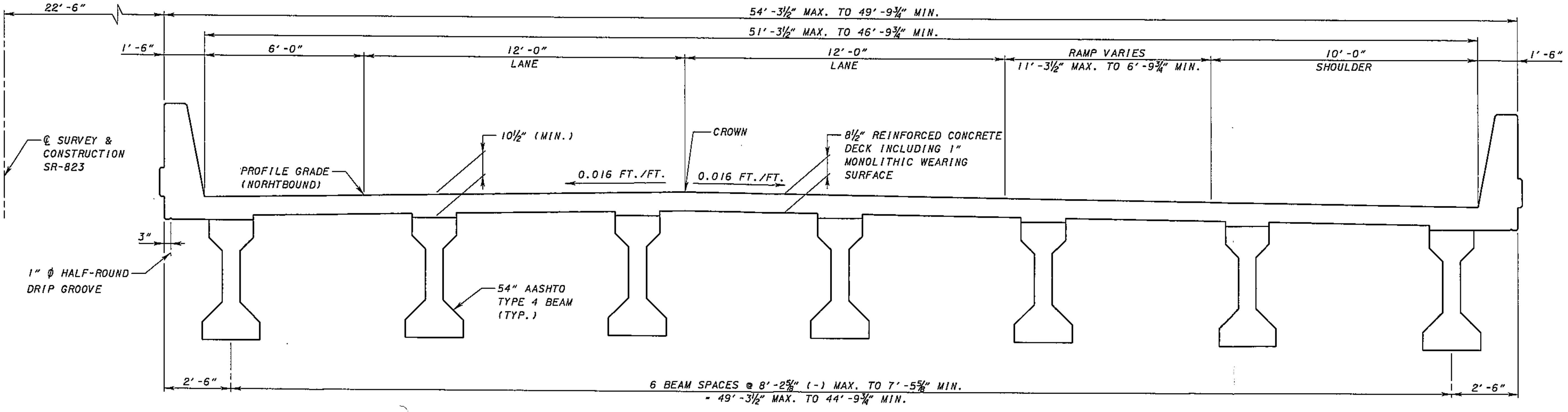
SCI-823-0.00
PID 19415

1 / 3

$XXX
$YYY



LEFT BRIDGE



RIGHT BRIDGE

DESIGN AGENCY
TRANSYSTEMS CORPORATION
55 PUBLIC SQUARE, SUITE 1900
CLEVELAND, OHIO 44113-1901

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	07/10/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

TRANSVERSE SECTION-ALTERNATIVE 2

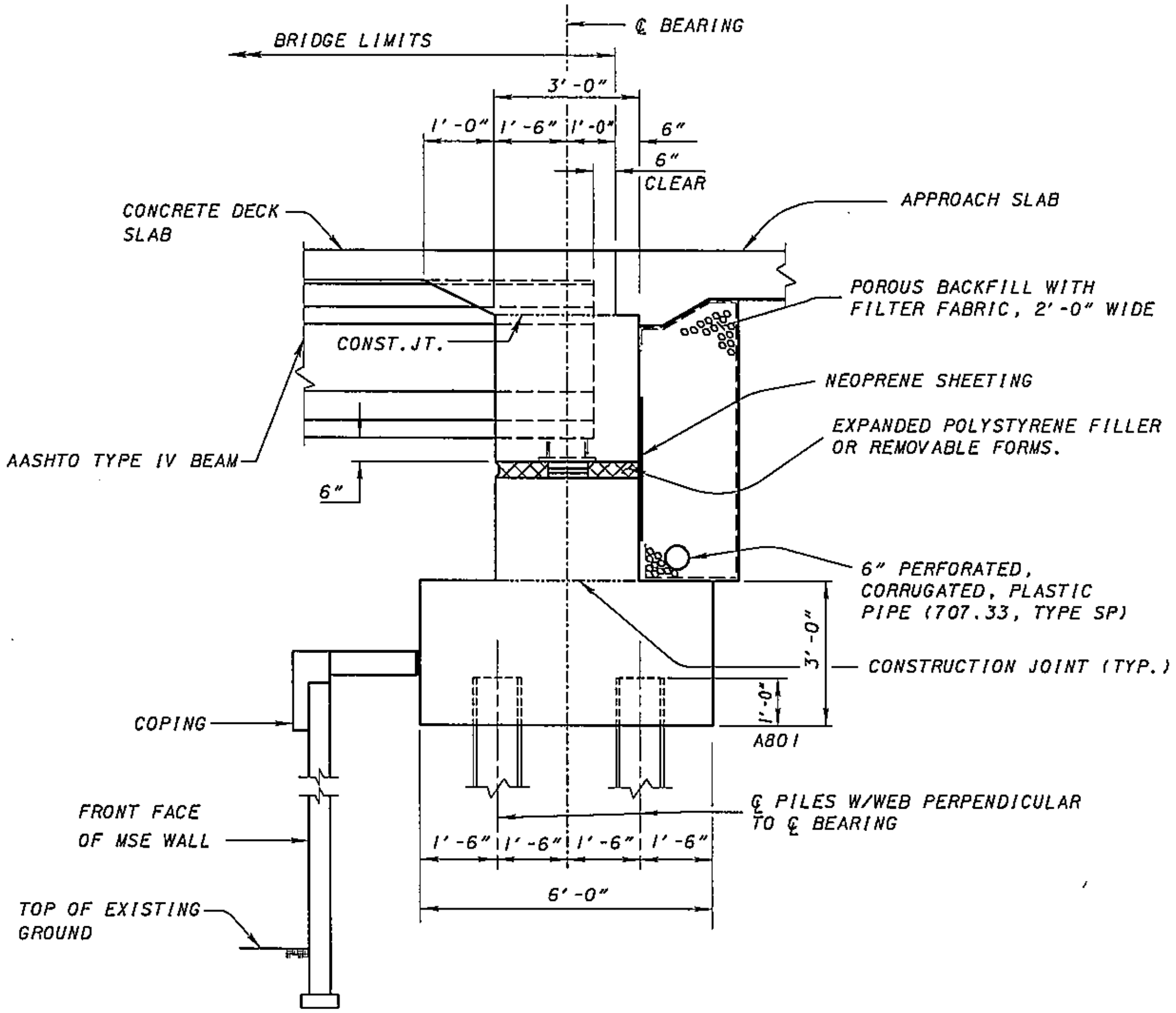
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER LUCASVILLE-MINFORD ROAD (CR-28)

SCI-823-0.00
PID 19415

2/3

$XXX
$YYY

DATE: 07/13/2005 FILE: g:\C003\0064\Bridge\BTS\2-CR28LucasvilleMinford\823-12ts01.dgn



TYPICAL ABUTMENT SECTION

TYPICAL ABUTMENT SECTION-ALTERNATIVE 2

BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER LUCASVILLE-MINFORD ROAD (CR-28)

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	7/10/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

DESIGN AGENCY
TRANSYSTEMS CORPORATION
55 PUBLIC SQUARE, SUITE 1900
CLEVELAND, OHIO 44113-1901

SCI-823-0.00
PID 19415

$XXX
$YYY

APPENDIX C

TRANSYSTEMS
CORPORATION

TRANSYSTEMS CORPORATION

Made By	JDH	**Date**	07/06/05
Checked By		**Date**	
Job No.	P403030064	**Sheet No.**	

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00

Structure

Description S.R. 823 OVER LUCASVILLE-MINFORD RD

PID # 19415

Alternative 2 - Six AASHTO Type IV Beams Left, Seven Right [total = 13] ***Point Location:*** ***B***

Adjstment for Cross Slope

Comment	Grade		Offset		
1 Lanes:	0.016	x	12	=	0.19
1 Lanes:	-0.016	x	12	=	-0.19
1 Variable Ramp:	-0.016	x	8.167	=	-0.13
Shoulder to Beam CL:	-0.016	x	9	=	-0.14
			Total Adjustment	=	**-0.27**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	54	4.5
	64.5	5.38

Total Superstructure Depth (ft) = **5.38**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**538+23.80**	
Offset Location @ Critical Point	=	**72.33 '**	**Right**
Profile Grade Elevation at Critical Point	=	750.06	
Adjustment for Cross Slopes to Beam CL	=	-0.27	
Top of Deck Elevation @ Critical Point	=	**749.79**	
Total Superstructure Depth	=	-5.38	
Bottom of Beam Elevation @ Critical Point	=	**744.41**	
Approximate Top of Existing Ground @ Critical Point	=	**715.60**	
Actual Vertical Clearance	=	***28.81***	
Preferred Vertical Clearance	=	*17.0*	
Required Vertical Clearance	=	*15.0*	

TRANSYSTEMS CORPORATION

Made By JDH Date 07/06/05 Job No. P403030064
Checked By Date Sheet No.

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 **Structure**
Description S.R. 823 OVER LUCASVILLE-MINFORD RD **PID #** 19415

Alternative 2 - Six AASHTO Type IV Beams Left, Seven Right [total = 13] *Point Location:* *A*

Adjstment for Cross Slope

Comment	Grade		Offset		
PGL to Beam CL:	-0.016	x	5	=	-0.08

Total Adjustment = **-0.08**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	54	4.5
	64.5	5.38

Total Superstructure Depth (ft) = **5.38**

Vertical Clearance at Critical Point

Station @ Critical Point = **538+66.60**

Offset Location @ Critical Point = **25.5 '** **Left**

Profile Grade Elevation at Critical Point = 750.58

Adjustment for Cross Slopes to Beam CL = -0.08

Top of Deck Elevation @ Critical Point = **750.50**

Total Superstructure Depth = -5.38

Bottom of Beam Elevation @ Critical Point = **745.12**

Approximate Top of Existing Ground @ Critical Point = **715.00**

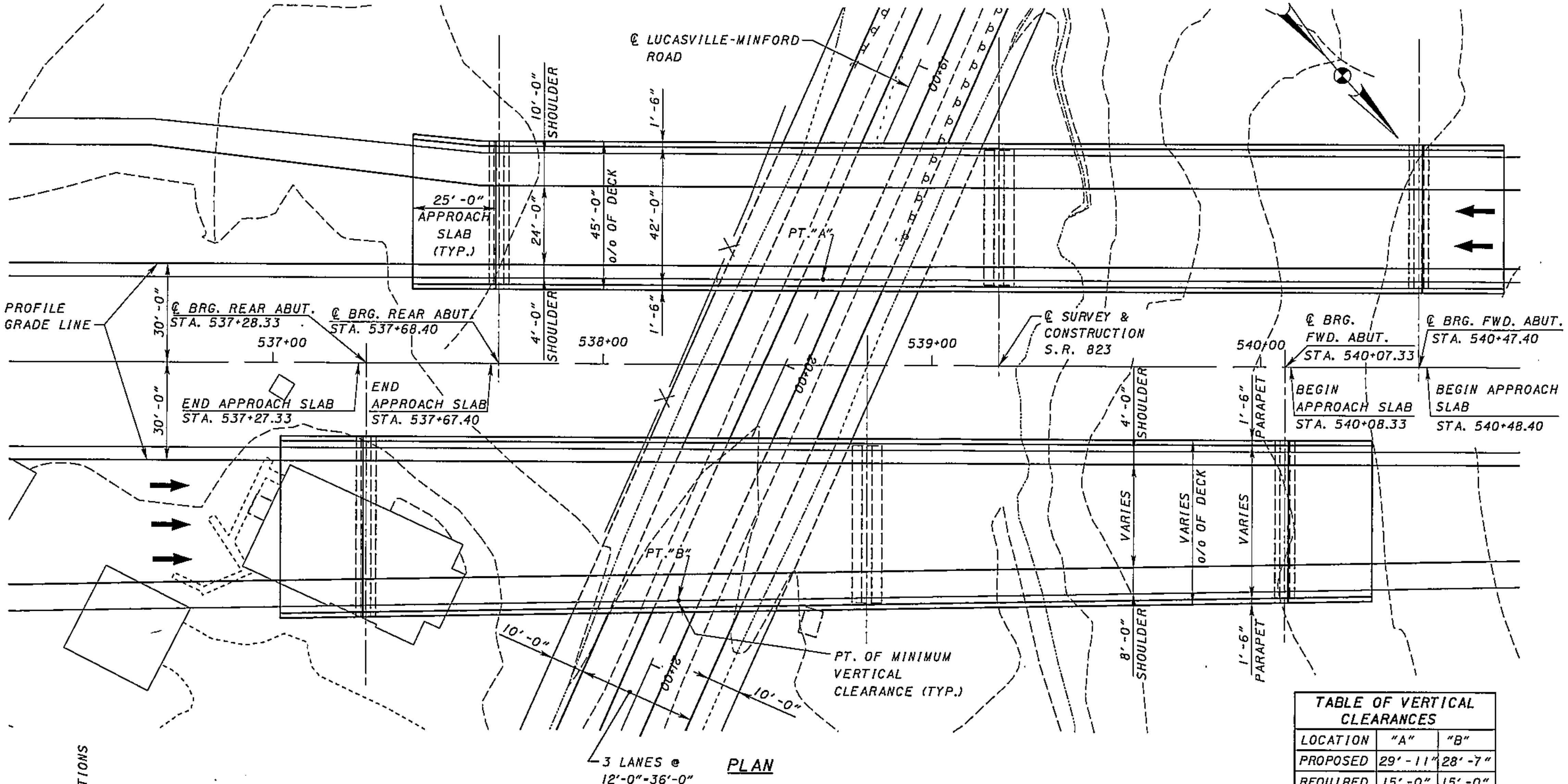
Actual Vertical Clearance = ***30.12***

Preferred Vertical Clearance = *17.0*

Required Vertical Clearance = *15.0*

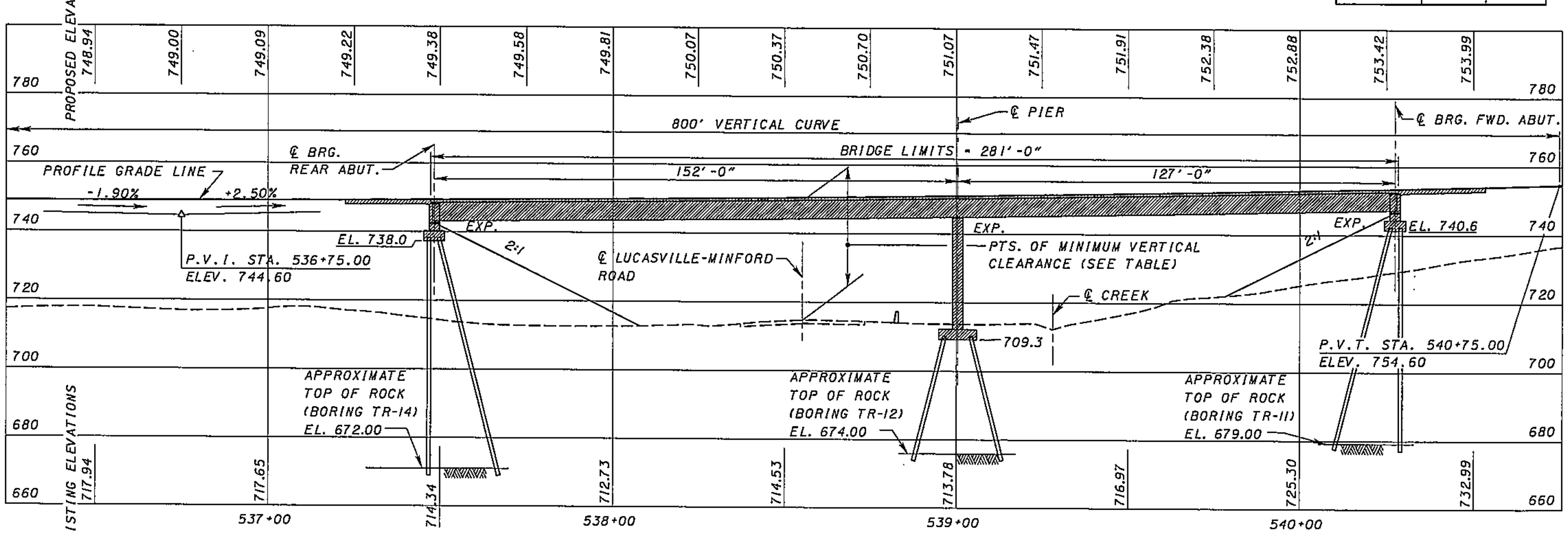
APPENDIX D

TRANSYSTEMS
CORPORATION



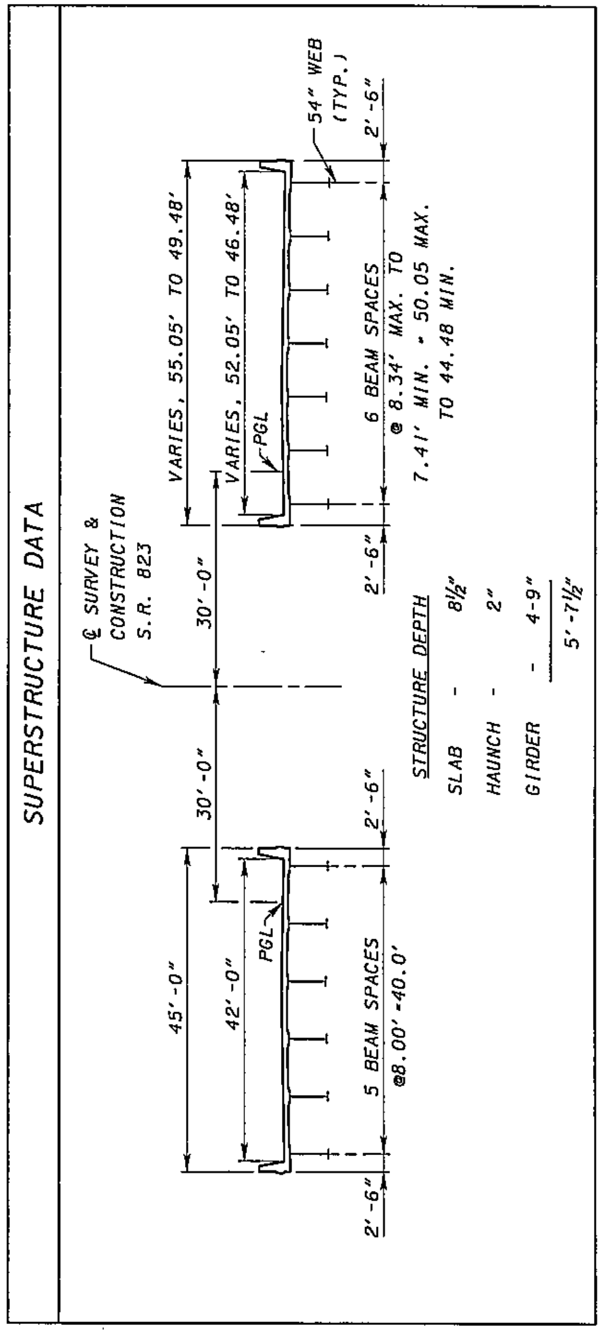
PLAN

TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	29'-11"	28'-7"
REQUIRED	15'-0"	15'-0"



ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

SUPERSTRUCTURE DATA



STRUCTURE DEPTH

SLAB - 8½"
HAUNCH - 2"
GIRDER - 4'-9"
5'-7½"

NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.
3. THE PROPOSED PROFILE GRADE IS WITHIN BRIDGE LIMITS. SEE ROADWAY PLANS FOR PAVEMENT ELEVATIONS BEYOND BRIDGE LIMITS.

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 14x73 PILES AND HAVE A MAXIMUM CAPACITY OF 95 TONS PER PILE.

DESIGN AGENCY
TRANSYSTEMS CORPORATION
55 PUBLIC SQUARE, SUITE 1900
CLEVELAND, OHIO 44113-1901

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	7/10/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	

SCIOTO COUNTY
STA. 537+27.33
STA. 540+48.40

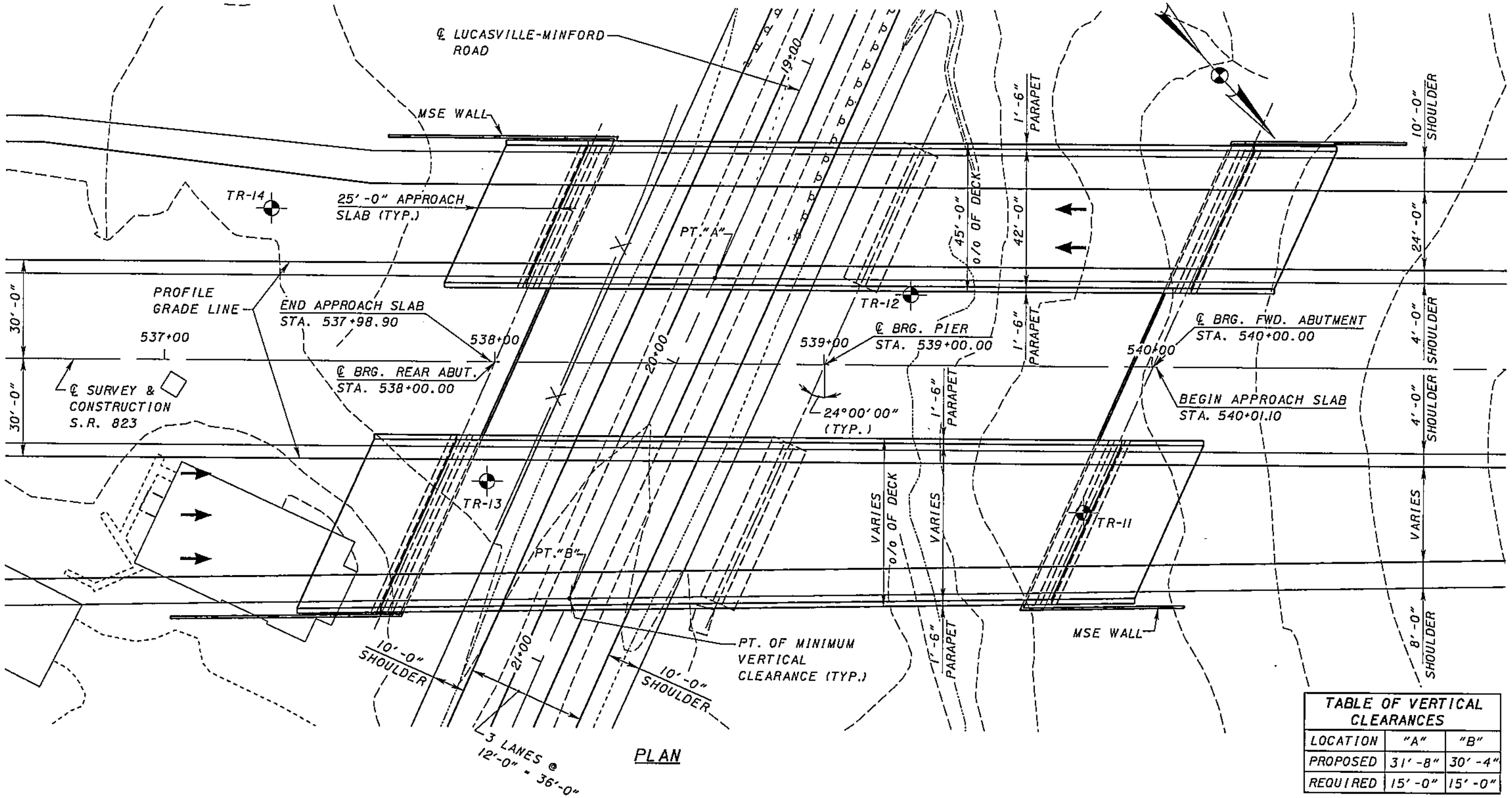
PRELIMINARY SITE PLAN - ALTERNATIVE I
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER LUCASVILLE-MINFORD ROAD

SCI-823-0.00
PID 19415

1/1

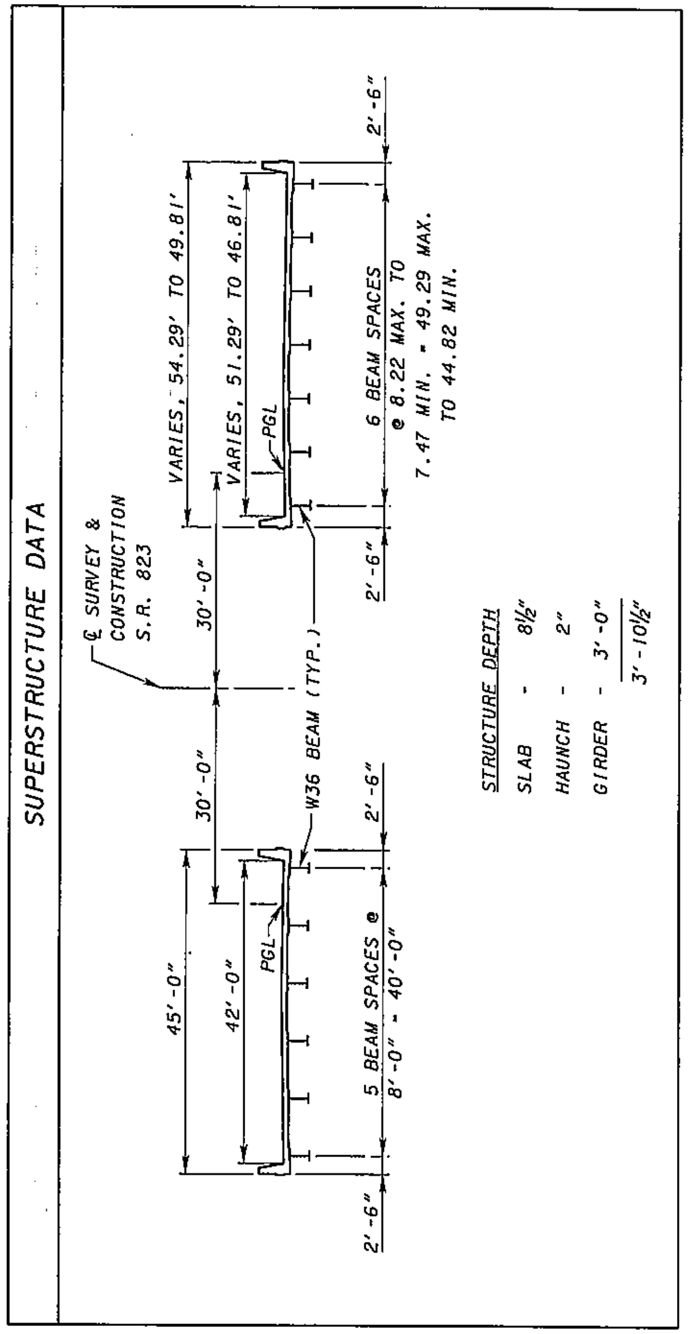
$XXX
$YYY

DATE: 7/13/2005 FILE: g:\C003\0054\Bridge\BTS\12-CR28\LucasvilleMinford\823-12sp01.dgn

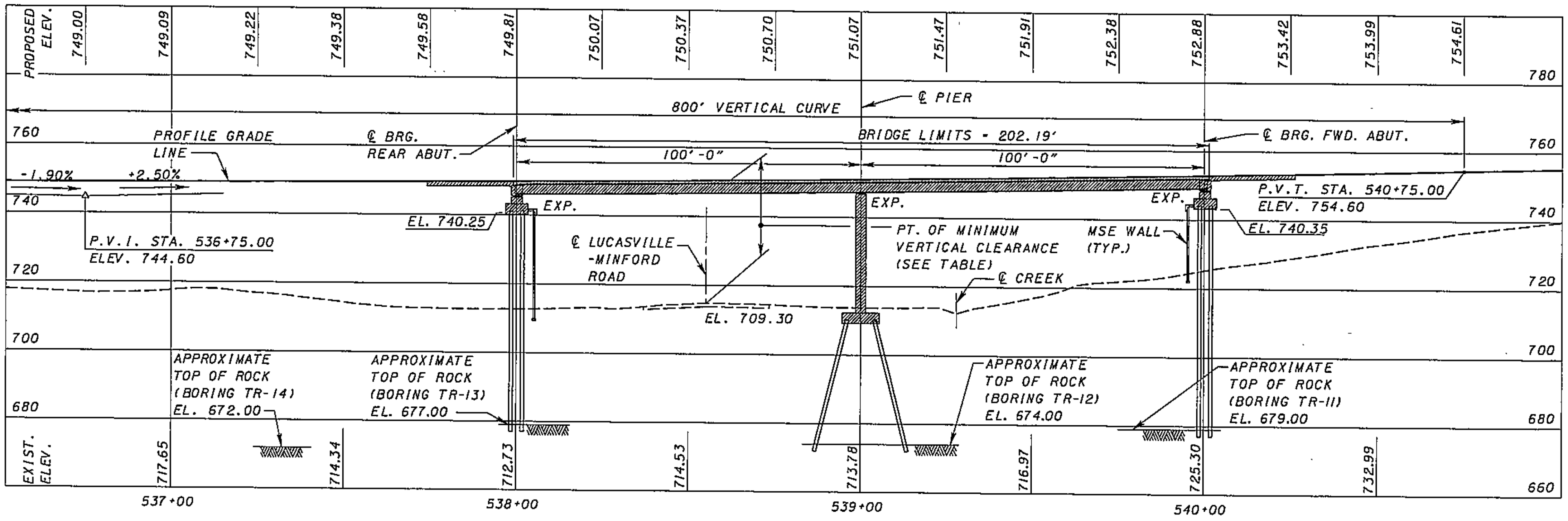


PLAN

TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	31'-8"	30'-4"
REQUIRED	15'-0"	15'-0"



STRUCTURE DEPTH
SLAB - 8½"
HAUNCH - 2"
GIRDER - 3'-0"
3'-10½"



ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.
3. THE PROPOSED PROFILE GRADE IS WITHIN BRIDGE LIMITS. SEE ROADWAY PLANS FOR PAVEMENT ELEVATIONS BEYOND BRIDGE LIMITS.

FOUNDATION DATA:

UTILITIES DISPOSITION WILL BE ADDRESSED DURING TS&L SUBMITTAL.

DESIGN AGENCY
TRANSYSTEMS CORPORATION
55 PUBLIC SQUARE, SUITE 1900
CLEVELAND, OHIO 44113-1901

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	07/10/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	

SCIOTO COUNTY
STA. 537+98.90
STA. 540+01.10

PRELIMINARY SITE PLAN - ALTERNATIVE 3
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER LUCASVILLE-MINFORD ROAD

SCI-823-0.00
PID 19415

1 / 1

$XXX
$YYY

DATE: 7/13/2005 FILE: g:\C003\0064\Bridge\BTS\12-CR28(LucasvilleMinford)\823-12sp03.dgn

APPENDIX E

TranSystems Corporation

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

March 31, 2005

Mr. Greg Parsons, P.E.
Project Manager
TranSystems Corporation
5747 Perimeter Dr., Suite 240
Dublin, OH 43017

Re: **SCI-823-0.00 over Lucasville-Minford Rd (SR-728)**
Preliminary Structural Foundation Recommendations
Project SCI-823-0.00
DLZ Job No.: 0121-3070.03

Dear Mr. Parsons:

This letter reports the findings of the subsurface exploration and preliminary foundation recommendations for the proposed structure SCI-823-0.00 over Lucasville-Minford Rd (SR 728). It is anticipated that the proposed structure will be a three-span, elevated bridge with embankment fills at both abutments. The existing grade at the proposed new bridge location is relatively flat with an elevation between 712 and 722. It is anticipated that the SCI-823-0.00 mainline will require an embankment height of approximately 45 feet. The existing area is located within a broad valley with the overburden primarily composed of glacial lake deposits.

The findings and recommendations presented in this report should be considered preliminary. It is understood that the final number and locations of substructure units have not been determined yet. After the substructure unit locations have been established, the results of the borings should be reviewed to determine if additional exploration is needed to finalize the foundation recommendations for the new structure.

Field Exploration

A total of four borings, TR-11 through TR-14, were drilled at the proposed structure. Borings TR-13 and TR-14 were drilled between June 4 and 8, 2004, and TR-11 and TR-12 were drilled between March 16 and 17, 2005. The borings were drilled to depths between 50 and 57 feet. The borings were extended into bedrock, which was verified by rock coring. Boring Logs and information concerning the drilling procedures are attached.

The boring locations were selected by TranSystems Corporation. Ground surface elevations at the boring locations were estimated from the established topographic mapping for the project and are presented on the attached Boring Logs.

Findings

The following text presents generalized subsurface conditions encountered by the borings. For more detailed information, please refer to the attached Boring Logs.

At the ground surface, topsoil was encountered to depths of 3 to 6 inches. Beneath the topsoil, generally cohesive soils were encountered to the top of bedrock. The cohesive soils encountered ranged from sandy silt (A-4a) to clay (A-7-6), and were generally soft to very stiff. The material was generally highly plastic with relatively high moisture contents.

Bedrock was encountered between 38 and 43 feet below the ground surface, which was generally a medium hard shale that was slightly broken to intact. Recovery of the core samples ranged from 50 to 100%, and RQD values ranged from 25 to 92% with an average RQD of 71%.

Seepage was detected in all of the borings ranging in depth from 23.5 to 38.5 feet below the ground surface. Water levels recorded at completion of drilling ranged from 8.9 to 28.6 feet. However, the final water levels include drilling water and may not be representative of the actual groundwater conditions. Groundwater levels may vary seasonally.

Conclusions and Recommendations

It appears that driven H-piles to rock or drilled shafts to rock will be the best-suited foundation types for the support of the proposed structure. Due to the size of the structure, if H-piles are used it is anticipated that HP 14X73 H-pile sections, with a 95-ton capacity, will be used. If high lateral or uplift loads are anticipated drilled shafts or socketed H-piles into bedrock may be needed. The actual lengths of the rock sockets will need to be designed based upon actual loading conditions. The following table summarizes the site conditions and preliminary foundation recommendations.

Foundation Recommendations

Boring Number	Structural Element	Existing Ground Surface Elevation* (Feet)	Top of Rock Elevation* (Feet)	Estimated H-pile Tip Elevation* (HP 14X73 95 Ton capacity)	Estimated Drilled Shaft Tip Elevation*	Allowable Bearing Capacity for Drilled Shafts (TSF)
TR-11	Forward Abutment	722	679	675	673	15
TR-12	Pier 2	712	674	672	669	15
TR-13	Pier 1	718	679	677	672	15
TR-14	Rear Abutment	715	672	671	668	15

*Existing ground surface elevation was estimated from the established topographic mapping.

Additionally, since the SCI-823-0.00 mainline will be located on a relatively large embankment through the valley area, and could be potentially underlain by compressible soils, the abutment locations may need special construction procedures, and/or an additional load added to the design loads to account for negative skin friction associated with the embankment settlement.

It should be noted that if driven H-piles are selected, special pile-driving techniques may be required. Wet silts and fine sands, such as those encountered within this area, tend to produce exaggerated blow counts during pile driving, due to increased pore pressures during driving, which do not reflect the actual load carrying ability of the strata. Piles should be driven to the design capacity, allowed to sit at least 24 hours to allow pore pressures to dissipate, then re-driven to ensure that the design capacity has been achieved. If the design capacity has not been achieved, the pile should be re-driven until the design capacity has been achieved with confirmation after 24 hours.

Because of the many geotechnical factors across the anticipated structure location, such as, large potential lateral loads, large embankment heights, depths of relatively compressible soils, and potential for differential settlement, a detailed evaluation of all geotechnical parameters will need to be considered for the final design. It is strongly recommended that we discuss the proposed foundation design after TranSystems has had a chance to review these recommendations.

No grain-size analyses were performed for scour analysis since the proposed structure location is not located along a stream.

Closing

If you have any questions please contact our office.

Sincerely,

DLZ OHIO, INC.

P. Paul Painter

P. Paul Painter
Engineering Geologist

Dorothy A. Adams for

Arthur (Pete) Nix, P.E.
Geotechnical Division Manager

Attachments: General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Boring Location Plan
Boring Logs TR-11, TR-12, TR-13, TR-14

cc: File

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GENERAL INFORMATION
DRILLING PROCEDURES AND LOGS OF BORINGS

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standardized methods of investigation of subsurface conditions concerning geotechnical engineering considerations. 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 representative fine-grained soil samples were determined. A limited number of samples, considered representative of foundation materials present, 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 of six months. 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	0 – 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 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	below 2	Easily penetrated by fist
Soft	0.25 – 0.50	2 – 4	Easily penetrated by thumb
Medium Stiff	0.50 – 1.0	4 – 8	Penetrated by thumb with moderate pressure
Stiff	1.0 – 2.0	8 – 15	Readily indented by thumb but not penetrated
Very Stiff	2.0 – 4.0	15 – 30	Readily indented by thumb nail
Hard	over 4.0	over 30	Indented with difficulty by thumb nail

   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 8"	Sand	– Coarse	2.0 mm to 0.42 mm
Cobbles		8" 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

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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	No moisture present
Damp	Internal moisture, but none to little surface moisture
Moist	Free water on surface
Wet	Voids filled with free water

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

Term	Relative Moisture or Appearance
Dry	Powdery
Damp	Moisture content slightly below plastic limit
Moist	Moisture content above plastic limit but below liquid limit
Wet	Moisture content above liquid limit

10. Rock Hardness and Rock Quality Designation

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

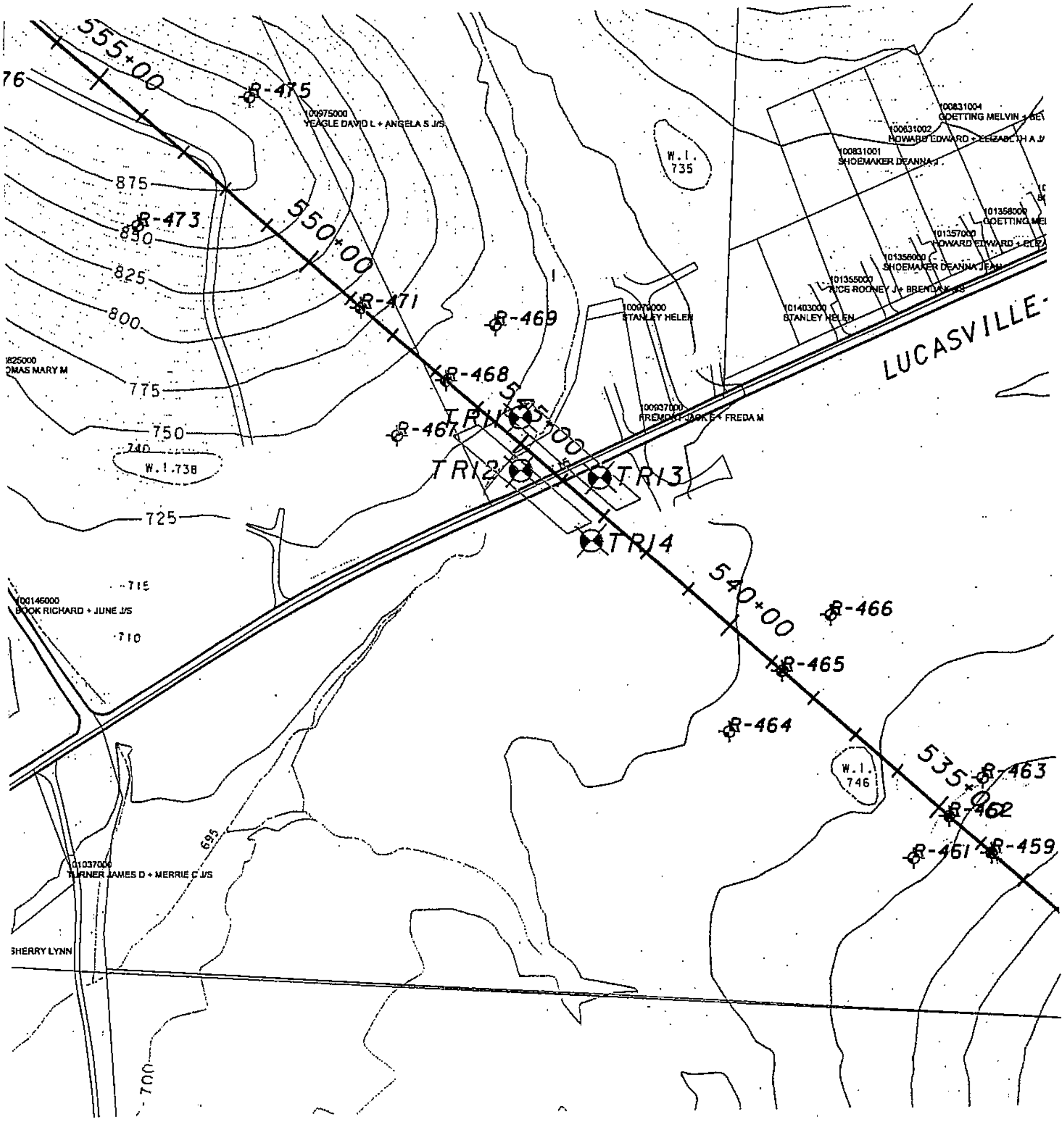
Term	Description
Very Soft	Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb)
Soft	Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed hammer)
Medium Hard	Resists pencil point, but can be scratched with a knife blade. (Breaks easily under single hammer blow, but with crumbly edges.)
Hard	Can be deformed or broken by light to moderate hammer blows. (Breaks under one or two strong hammer blow, but with resistant sharp edges.)
Very Hard	Can be broken only by heavy and in some rocks repeated hammer blows.

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 graphically.

13. The standard penetration (N) value in blows per foot is indicated graphically.



Source: Topographic Mapping provided by TranSystems Corporation, Dated 2004

NORTH

DLZ
ENGINEERS * ARCHITECTS * SCIENTISTS

SITE PLAN

Lucasvill-Minford Road
SCI-823 over SR 728
SCI-823-0.00

FIGURE 1.

DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

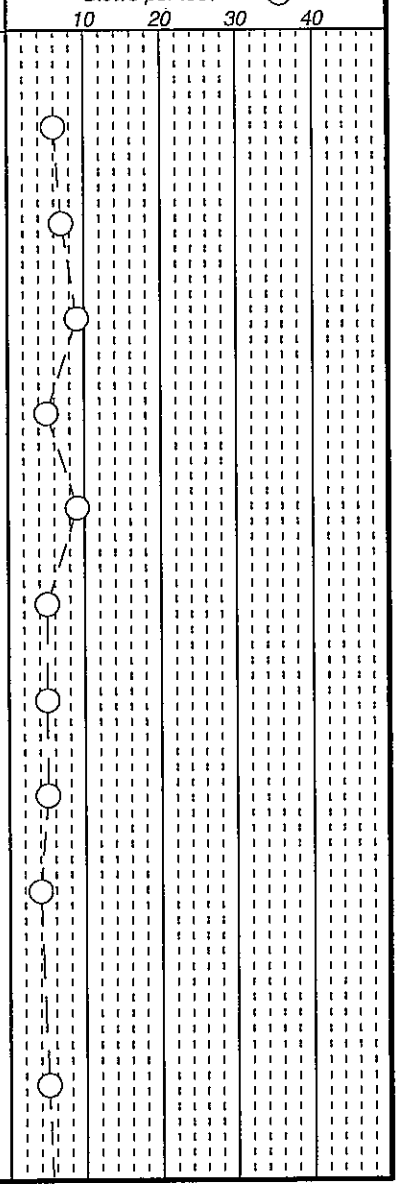
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-11
Location: Forward Abutment SCI-823 over SR 728
Date Drilled: 3-16-05 to 3-17-05

WATER OBSERVATIONS:
Water seepage at: 23.5'
Water level at completion: Dry (Prior to coring)
21.9' (Includes drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0							Stiff to very stiff light brown CLAY (A-7-6), trace silt; damp.						
		1 3 3	18	1		2.5							
5		2 3 4	18	2		2.5							
		3 4 5	18	3		1.5	@ 6.0', 45° fractures.						
10		2 2 3	18	4		2.0							
		4 4 5	18	5		2.5	@ 11.0', gray.						
13.0							Soft to medium stiff gray CLAY (A-7-6); moist.						
15		2 2 3	18	6		0.75							
		2 2 3	18	7		0.75							
20		WOH 2 3	18	8		0.5							
		1 2 2	18	9		0.5							
25		WOH WOH 3	18	10		0.5							
		1 2 3	18	11		0.5							
30		WOH WOH 3	18	12		0.75	@ 28.5', contains sandstone fragments.						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



FILE: 0121-3070-03 [3/31/2005 9:35 AM]

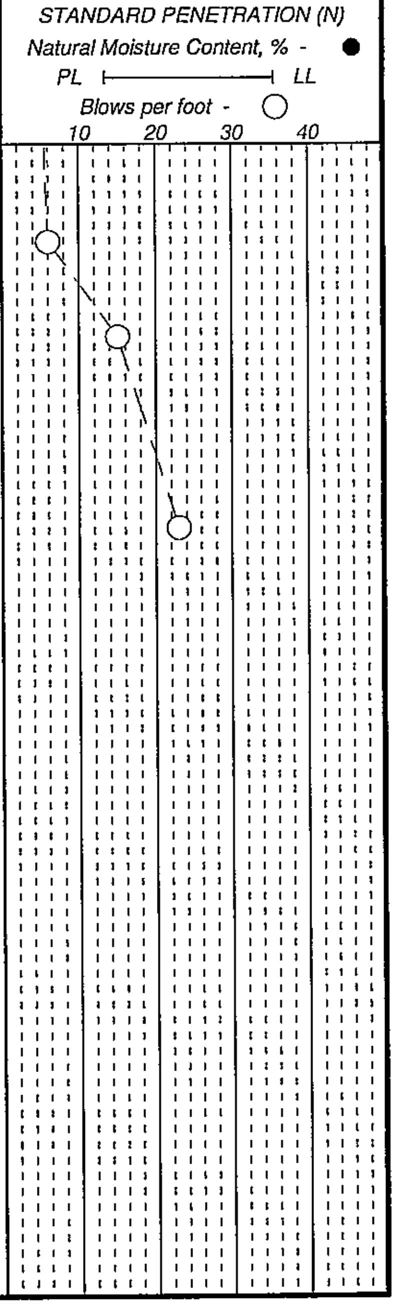
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-11
Location: Forward Abutment SCI-823 over SR 728
Date Drilled: 3-16-05 to 3-17-05

WATER OBSERVATIONS:
Water seepage at: 23.5'
Water level at completion: Dry (Prior to coring)
21.9' (Includes drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf)	DESCRIPTION	GRADATION					
				Drive	Press / Core			% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30							Soft to medium stiff light brown CLAY (A-7-6); moist.						
		1 2 4	18	13		0.5							
33.0							Very stiff gray SILTY CLAY (A-6b), trace fine sand; damp to moist.						
		8 6 9	18	14		0.75							
35													
		7 8 15	18	15		2.5							
40													
43.0							Soft to medium hard gray SHALE; moderately to highly weathered.						
		50/5	5	16		—							
45													
47.0							Medium hard gray SHALE; slightly to moderately weathered, micaceous, thinly laminated to very thinly bedded, slightly fractured.						
50													
		Core 120"	Rec 120"	RQD 91%	R1								
55													
57.0							Bottom of Boring - 57.0'						
60													



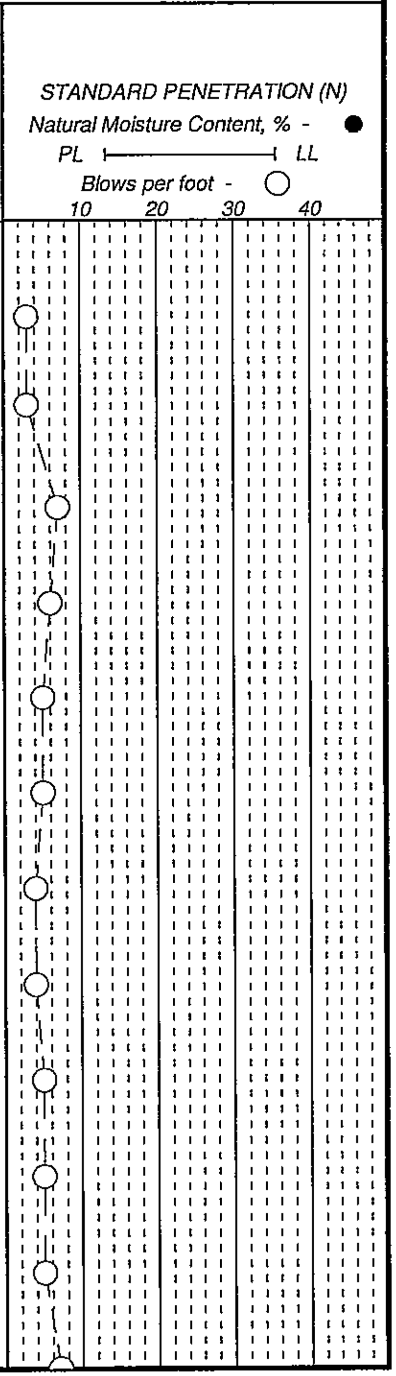
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-12
Location: Pier #2 SCI-823 over SR 728
Date Drilled: 3/17/05

WATER OBSERVATIONS:
Water seepage at: 10.5'-30.5'
Water level at completion: 10.1' (Including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0		1 1 2	18	1		0.75-1.25	POSSIBLE FILL: Medium stiff to stiff brown GRAVEL WITH SAND AND SILT (A-2-4), some fine to coarse sand, trace gravel; moist to wet.						
		WOH 1 2	16	2		'—							
5 5.5		3 3 4	18	3		2.5	Very stiff brown and gray CLAY (A-7-6); varved; moist.						
		1 2 4	18	4		2.25							
10 10.5		WOH 2 3	18	5		0.75	Medium stiff brownish gray CLAY (A-7-6); varved; moist to wet.						
		WOH 2 3	18	6		0.75							
15		WOH 2 2	18	7		0.5							
		WOH 2 2	18	8		0.5							
20		WOH 2 3	18	9		0.5							
		1 2 3	18	10		0.75							
25		1 2 3	18	11		0.5							
30		3 3 4	18	12		0.5							



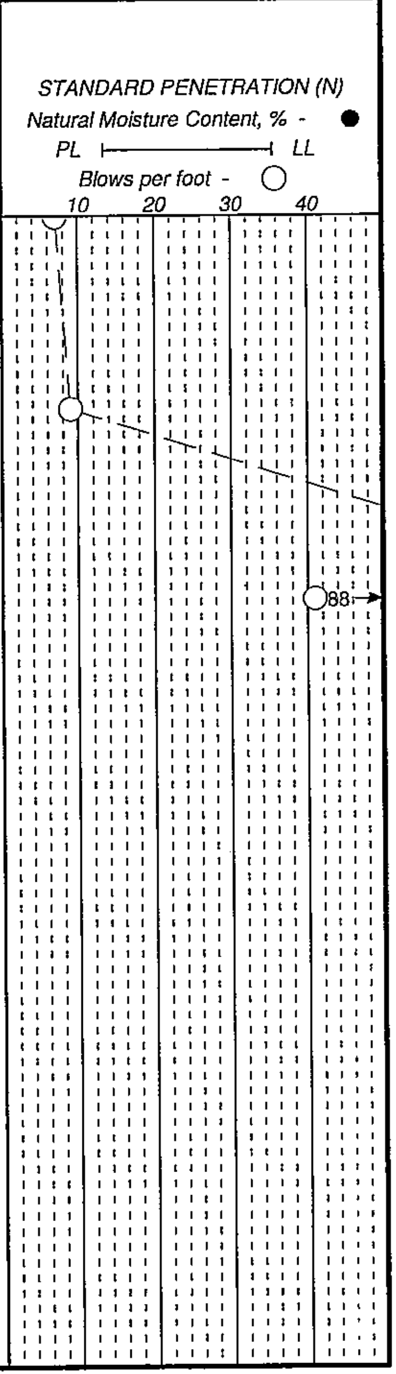
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-12

Location: Pier #2 SCI-823 over SR 728
Date Drilled: 3/17/05

WATER OBSERVATIONS:
Water seepage at: 10.5'-30.5'
Water level at completion: 10.1' (Including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30													
30.5		2 3 6	18	13		1.5	Stiff gray and brown SANDY SILT (A-4a), little gravel; varved; damp.						
38.5		12 38 50/4	16	14		4.5+	Soft gray SHALE; highly weathered to decomposed.						
40.0		Core 120"	Rec 120"	RQD 92%	R1		Medium hard gray SHALE; slightly weathered. @ 45.9'-48.2', light brown siltstone layer.						
50.0							Bottom of Boring - 50.0'						



Depth scale: 30, 30.5, 35, 38.5, 40.0, 45, 50.0, 55, 60

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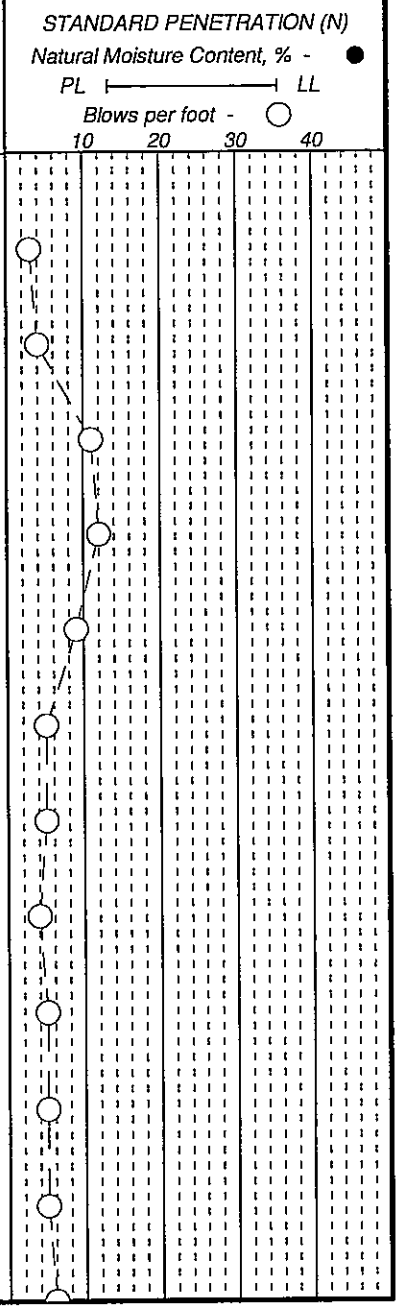
Client: TranSystems, Inc. *Project:* SCI-823-0.00 *Job No.* 0121-3070.03

LOG OF: Boring TR-13 *Location:* Pier #1 SCI-823 over SR 728 *Date Drilled:* 6/8/04

WATER OBSERVATIONS:
Water seepage at: 33.5'-35.0'
Water level at completion: Dry (Prior to coring)
28.6'(Including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0 0.6							Topsoil - 6"						
		1 1 2	10	1		1.75	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand, trace to little gravel; moist.						
5		1 2 2	16	2		1.25							
		2 4 7	18	3		3.5	@6.0' - 7.5', gray, contains rust stains.						
8.5 10		3 5 7	18	4		3.25	Stiff to very stiff mottled brown and gray CLAY (A-7-6), little fine to coarse sand; moist.						
		2 3 6	18	5		2.25							
15		1 2 3	18	6		1.25							
		1 2 3	18	7		2.0							
20		1 2 2	18	8		1.5							
		1 2 3	18	9		0.75	@21.0' - 22.5', medium stiff, gray.						
25		1 2 3	18	10		1.0							
25.5		WOH 2 3	18	11		1.5	Stiff grayish brown SILT AND CLAY (A-6a), little fine sand; moist.						
28.0 30		2 2 4	18	12		1.5	Stiff grayish brown CLAY (A-7-6), little fine sand; moist.						



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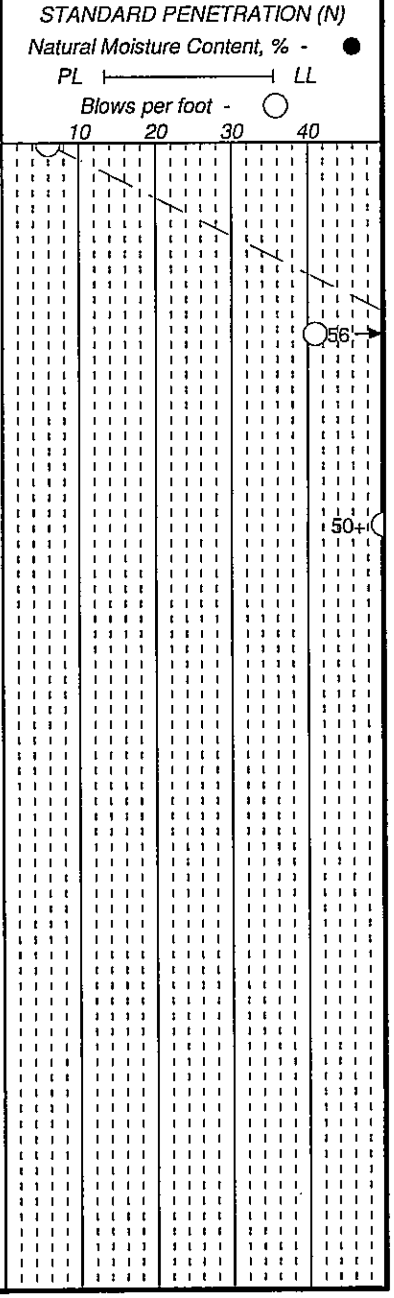
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-13
Location: Pier #1 SCI-823 over SR 728
Date Drilled: 6/8/04

WATER OBSERVATIONS:
Water seepage at: 33.5'-35.0'
Water level at completion: Dry (Prior to coring)
28.6'(Including drill water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0							Very stiff to hard brown and gray SANDY SILT (A-4a), little gravel; contains rock fragments; damp to moist. (SEVERELY WEATHERED AND DECOMPOSED SHALE)						
35		8 24 32	18	13		3.0							
		27 49 50/2	16	14		4.5+							
40.0							Medium hard gray SILTSTONE; fissile.						
							@40.0' - 44.9', core loss.						
45		Core 120"	Rec 61"	RQD 25%	R-1								
							@46.6' - 46.8', clay seam.						
							@47.8' - 50.0', broken to highly fractured with occasional clay seams.						
50.0							Bottom of Boring - 50.0'						
55													
60													



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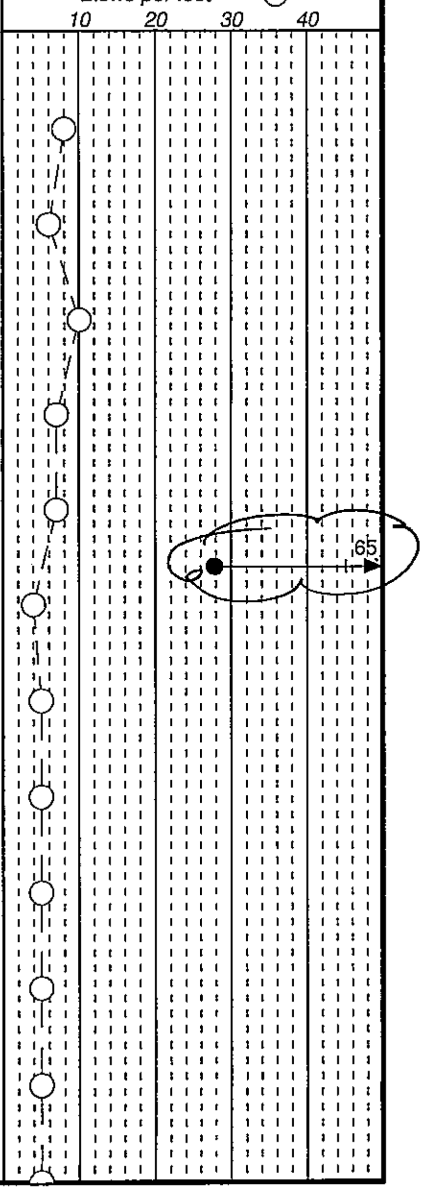
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-14 | Location: Rear Abutment SCI-823 over SR 728 | Date Drilled: 6/4/04 to 6/7/04

WATER OBSERVATIONS:
Water seepage at: 33.5', 38.5'
Water level at completion: 24.8' (Prior to coring)
8.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0							Very stiff brown and gray SILTY CLAY (A-6b), little fine to coarse sand; moist.						
		2 3 5	18	1		2.25							
5		2 2 4	18	2		3.75							
		2 4 6	18	3		2.75	@6.0' - 7.5', gray.						
8.5							Stiff to very stiff brown CLAY (A-7-6), trace to little fine to coarse sand; damp to moist.						
10		2 3 4	18	4		2.75							
		2 3 4	18	5		2.25							
		WOH 2 2	18	6	ST-1	1.0	@13.5', becomes gray.	0	0	--	0	7	93
15		WOH 2 3	18	7		1.5							
		1 2 3	18	8		1.25							
20		1 2 3	18	9		1.25							
25		1 2 3	18	10		1.5							
		2 2 3	18	11		1.25							
30		2 2 3	18	12		2.0							

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢—⊣ LL
Blows per foot - ○



FILE: 0121-3070-03 [3/31/2005 9:35 AM]

DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-14
Location: Rear Abutment SCI-823 over SR 728
Date Drilled: 6/4/04 to 6/7/04

WATER OBSERVATIONS:
Water seepage at: 33.5', 38.5'
Water level at completion: 24.8' (Prior to coring)
8.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	%Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0							Very dense brown SANDY SILT (A-4a), some gravel; contains rock fragments; moist.						
35		14 28 40	18	13									
40		40 50/4	12	14									
43.5		50/4	4	15			Severely weathered gray SILTSTONE.						
44.0 45		Core 60"	Rec 54"	RQD 72%	R-1		Medium hard gray SILTSTONE; fissile. @45.7', 46.4', 49.3', 50.7',53.0'; clay seams @46.1' - 46.7', 49.0' - 49.3'; broken to highly fractured.						
50		Core 60"	Rec 56"	RQD 77%	R-2		@53.5' - 53.7', vertical fracture.						
54.0 55 60							Bottom of Boring - 54.0'						

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ *LL*
Blows per foot - ○