STRUCTURAL ENGINEERING

JUL 1 9 2005

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SCI-823-0.00

PID NO. 19415

S.R. 823 RAMP A (N.B.) OVER OHIO RIVER ROAD (CR-503)

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 Ramps over Ohio River Road at the US 52 Proposed Interchange. 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, two test borings (TR-62 and TR-63) were drilled and all of them encountered sandstone bedrock between 3.0 and 9.0 feet below the existing ground surface. The subsurface materials encountered generally were interbedded granular and cohesive layers. For description of the material encountered, refer to the subsurface investigation report.

Based on the alternatives considered for this study, it is recommended that the abutment footings founded within the MSE wall fill, they may be designed based on an allowable bearing pressure of 4000 pounds per square foot. If piles through MSE wall fill are used to support the abutments, the piles should be driven to the top of rock and the full structural capacity of the pile may be used.

Abutment on spread footings are assumed for Alternative 1 and HP12x53 piles with a maximum design load of 70 tons are assumed for Alternative 2 in this Bridge Type Study report. Since the piles will be driven to refusal onto hard bedrock, steel points will be used according to 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 the town to another interchange with US 23 north of the town in Valley Township. Each of the proposed mainline bridge sections will consist of two 12'-0" travel lanes with 6'-0" median shoulders and 12'-0" outside shoulders with a type A1 inside median parapet and a 1'-6" outside straight face deflector parapet, each bridge deck width will be 89'-5 3/4" out to out. Horizontal and vertical sight distances, in accordance with the design standards, have been provided over the bridge for all alternatives considered. The proposed ramp alignments at the interchanges have been investigated as part of the alignment alternatives during the preliminary phases. The alignment shown here is part of the preferred alternative that was agreed to and being forwarded to preliminary engineering. The proposed ramp bridge will consist of a 16'-0" lane with an 8'-0" outside shoulder and 6'-0" inside shoulder. The bridge deck will be 30'-0" toe to toe of parapet.

Vertical and Horizontal Design - Since this structure's vertical alignment is dictated by the overall vertical design of the new bypass profile, clearance was considered critical at this structure location.. More than 17'-0" of preferred vertical clearance could be provided for all the alternatives considered for this study. In accordance with the L&D manual, Volume 1, a 7'-8" minimum horizontal offset with a Type D barrier will need to be maintained underneath both structures. The abutments for the recommended alternative were located to provide that minimum horizontal clearance from the edge of the pavement.

Drainage Design - The collection of storm water runoff will be addressed off the bridge. 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 if necessary.

Maintenance of Traffic - While the new bridge is under construction, traffic will be maintained on the existing road. It is anticipated that there will be limited closures during construction of the new structure.

5. Proposed Structure Configurations

Alignment & Profile: The proposed horizontal geometry is along a curved alignment across the entire length of the ramp structure. The proposed Ramp profile is located on the inside edge of pavement and is along a vertical curve 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 the type study.

Due to the close proximity of the two ramp alignments at the proposed grade separations over Ohio River road and US 52, it is important from a construction and aesthetic point to use similar structure type for the interchange. Due to the curved alignment and heavy skew, most of the concrete superstructure alternatives considered did not meet the span configuration studied and will most likely require adjustment in profile to accommodate the deeper prestressed concrete beams. In summary, two alternatives have been evaluated in this Structure Type Study, and are designated as Alternative 1 and 2. The appropriate structure types that were considered are outlined in the Structure Type Alternative Table:

STRUCTURE TYPE ALTERNATIVE TABLE		
Structure Type Alternative	**1**	**2**
Superstructure Type Description	Curved Steel Girders	Curved, Continuous Steel Girders
Proposed Beam Spacing	3 Spaces @ 9'-0"	3 Spaces @ 9'-0"
No. of Spans	1	4
Abutment Type	Stub Type abutments with MSE-Walls	Semi-Integral Type abutments with spill-through slopes
No. of Piers	0	2
Pier Type	N/A	T-Type
Substructure Orientation	70°50'22" to reference Line	90°00'00" (Radial)
Approximate Bridge Length	150'-9"	432'-3"
Approximate Structure Depth **Slab** **Haunch** **Girder** **Total**	 8.75" 2" 60" 70.75"(5.90')	 8.75" 2" 54" 64.75"(5.40')

Alternative Discussion:

Alternative 1

Span configuration: Various span configurations were investigated and they were refined to the 1-span layout configuration. Horizontal Clearance requirements dictated the types of the bridges that could be studied. Alternative 1 consists of a long, single–span bridge with Mechanically Stabilized Earth (MSE) abutments located outside the horizontal clearances. These MSE walls could be continuous between the northbound and southbound ramp bridges over the existing Ohio River Road. The bridge overall length is 150'-9" from centerline of bearing to centerline of bearing (measured along the curve).

Substructure: This alternative is comprised of one simple span. The abutments were both located parallel to the roadway alignment underneath the structure.

I. *Abutments:* The abutments will be a stub type abutment founded on spread footing with MSE walls. Straight or U-turned type wingwalls will also be provided at each abutment. The details of the abutments and MSE wingwalls will follow ODOT Standard Construction drawings.

II. *Piers:* none.

Superstructure: The preliminary design of this alternative indicates that 4 - continuous steel 60" Curved Plate Girder spaced at 9'-0"would be required for each structure to accommodate the HS25 design loading requirements. Each bridge width is 30'-0" from toe to toe of parapets with an overall bridge deck width of 33'-0.

Alternative 2

Span configuration: In order to reduce the heavy skew of the bridge, Alternative 2 was studied. This alternative has a similar horizontal layout as Alternative 1, except that the bridge substructure units were placed radial to the proposed ramp alignment. The bridge overall length is 432.25' from centerline of bearing to centerline of bearing.

Substructure: This alternative is comprised of four spans (96'-122.67'-117.58'-96.0') with a span ratio of 0.78. The abutments and piers were both located at a radial to the ramp alignment. Due to vertical clearances requirements, the pier caps will need to be designed integrally as part of the superstructure.

I. *Abutments:* The abutments will consist of stub type abutments supported on H-piles (HP 12x53) with a design capacity of 70-tons per pile driven to bedrock.

II. *Piers:* Due to the vertical clearances requirements and the intersection limits of the new ramp bridge and the US 52, it is anticipated that the piers will be single column type or two columns with integral cap type and will be founded on H-piles driven to bedrock.

Superstructure: The preliminary design of this alternative indicates that 4 - continuous curved steel 48" Plate Girder spaced at 9'-0"would be required for the structure to accommodate the HS25 design loading requirements. The bridge width is 30'-0" from toe to toe of parapets with an overall bridge deck width of 33'-0".

6. Preliminary Probable Bridge Construction Cost:

A preliminary probable bridge construction cost has been prepared for Alternatives 1, and 2 (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.

7. Summary:

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

We acknowledge that life cycle cost comparisons for all alternatives are to be included along with the initial construction costs. However, life cycle costs of both steel alternatives will increase as the bridge length increase, and therefore were not included as part of the cost comparison:

SUMMARY OF ALTERNATIVES AND RECOMMENDATIONS

STRUCTURE TYPE ALTERNATIVE	STRUCTURE TYPE	PROBABLE BRIDGE CONST. COST	RATING	ADVANTAGES/ DISADVANTAGES
1	1-simple span curved 60" steel Girders, A709 Grade 50 painted with a composite reinforced concrete deck slab supported by reinforced concrete stub abutments on piles	**Structure Cost:** **$1,310,000**	1	***Advantages:*** • This alternative is the least expensive to construct. • Shorter bridge length. ***Disadvantages:*** • Longer substructure units. • Heavy Skew • Curved Girders
2	4-span continuous curved 54" steel Girders, A709 Grade 50 painted with a composite reinforced concrete deck slab supported by reinforced concrete stub type abutments and single column piers on piles	**Structure Cost:** **$1,840,000**	2	***Advantages:*** • This alternative will eliminate the skew of the substructure units. ***Disadvantages:*** • Will increase the bridge length. • Provide complexity for future widening.

8. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 1 (Simple Span, 60" curved steel girders with stub type abutments and MSE walls)** for the Bridge. (See Appendix B for the Site Plan and Structure Details).

Our recommendation for Alternative 1 is based on the following items:

- This Alternative appears to be the most economical from a construction standpoint.

APPENDIX A

TranSystems Corporation

SCI-823-0.00 - PORTSMOUTH BYPASS

RAMP A (NB) OVER OHIO RIVER ROAD - US 52 INTERCHANGE,

STRUCTURE TYPE STUDY

By: NFF
Checked: ELK

Date: 6/27/2005
Date: 7/11/2005

ALTERNATIVE COST SUMMARY

Alternative No.	Span Arrangement		Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Subtotal Superstructure Cost	Subtotal Substructure Cost	Structure Incidental Cost (16%)	Structure Contingency Cost (20%)	Total Alternative Cost
	No. Spans	Lengths								
1	1	154.0' - MSE Wall Type Abutment	150.75	4~ Welded Curved Plate Girders	60" Web PG Grade 50	$505,000	$433,000	$150,100	$217,600	$1,310,000
2	4	96'-122.67'-117.58'-96'	432.25	4 ~ Welded Plate Girders	54" Web PG Grade 50	$1,133,000	$186,000	$211,000	$306,000	$1,840,000

NOTES:

1. Structure incidental cost allowance includes provision for structure excavation, porous backfill, sealing of concrete surfaces, structural steel painting, bearings, and crushed aggregate slope protection costs.

2. Estimated construction cost does not include existing structure removal (if any), which is common to all alternatives.

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RAMP A (NB) OVER OHIO RIVER ROAD - US 52 INTERCHANGE,

STRUCTURE TYPE STUDY - STEEL GIRDER ALTERNATIVES- SUPERSTRUCTURE

By: NFF
Checked: ELK

Date: 5/13/2005
Date: 7/11/2005

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Total Span Length (ft.)	Deck Length (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	Subtotal Superstructure Cost
1	1	154.0' - MSE Wall Type Abutment	151	158	205	$122,100	$51,300	$77,000	4~ Welded Curved Plate Girders	60" Web PG Grade 50	184,800	$254,500	$505,000
2	4	96'-122.67'-117.58'-96'	432.25	439.25	582	$347,200	$145,800	$77,000	4 ~ Welded Plate Girders	54" Web PG Grade 50	467,006	$562,700	$1,133,000

COST SUPPORT CALCULATIONS

Deck Cross-Sectional Area:

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Parapets	2	4.26	8.52
Split Median Barriers	0	4.52	0.00

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Alt. 1	0.73	33.00	24.1	2.4	35.0
Alt. 2	0.75	33.00	24.8	2.5	35.7

Note: Deck width is out to out
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 =			$597.00

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 2007
Deck Reinforcing	$0.77	3.5%	$0.88

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	
Level 4 Plate Girders - Grade 50W	n/a	$1.05	3.5%	$1.20	Straight Girders
level 5 Plate Girders - Grade 50W	n/a	$1.20	3.5%	$1.38	Curved Girders

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft.
Width = 84 ft
Area = 233 sq. yd.

	Year 2004	Annual Escalation	Year 2007
Approach Slabs	$144.00	3.5%	$165.00

Expansion Joints
Unit Costs ($/Lin.Ft.):

	Cost Ratio	Year 2003	Annual Escalation	Year 2008	
Modular Expansion Joints	1.00	$863.00	3.5%	$1,097.98	2001 Price

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RAMP A (NB) OVER OHIO RIVER ROAD - US 52 INTERCHANGE,

STRUCTURE TYPE STUDY - STEEL GIRDER ALTERNATIVES -SUBSTRUCTURE

By: NFF
Checked: ELK

Date: 6/27/2005
Date: 7/11/2005

SUBSTRUCTURE -HP PILE ALTERNATIVE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Abutment & Wingwall Cost	Temporary Shoring Cost	Temporay Girder Support Cost	Subtotal Substructure Cost
1	1	154.0' - MSE Wall Type Abutment	4~ Welded Curved Plate Girders	60" Web PG Grade 50	$0	$0	$171,000	$56,100	$0	$205,500	$0	$0	$433,000
2	4	96'-122.67'-117.58'-96'	4 ~ Welded Plate Girders	54" Web PG Grade 50	$65,000	$14,800	$47,700	$15,600	$42,500	$0	$0	$0	$186,000

COST SUPPORT CALCULATIONS

Pier QC/QA Concrete, Class QSC1 Cost: (HP-Pile)

Component	Alt 1 Volume (cu. yd.)	Alt 2 Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Alt 1 Total Cost	Alt 2 Total Cost
Cap	0	0	$421.00	3.5%	$483.00	$0	$0
Columns	0	90	$421.00	3.5%	$483.00	$0	$43,530
Footings	0	44	$421.00	3.5%	$483.00	$0	$21,470
Total Cost						$0	$65,000

Pier QC/QA Concrete, Class QSC1 Cost: (HP-Pile/Drilled Shaft)

Component	Alt 1 Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Alt 1 Total Cost
Cap	0	$421.00	3.5%	$483.00	$0
Columns	0	$421.00	3.5%	$483.00	$0
Footings	0	$421.00	3.5%	$483.00	$0
Total Cost					$0

Abutment QC/QA Concrete, Class QSC1 Cost:

Alternate 1

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	322	$421.00	3.5%	$483.00	$155,500
Wingwalls	32	$421.00	3.5%	$483.00	$15,500

Alternate 2

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	90	$421.00	3.5%	$483.00	$43,400
Wingwalls	9	$421.00	3.5%	$483.00	$4,300

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.):

	Total Area (sq. ft.)	Year 2004 Unit Cost	Annual Escalation	Year 2008
Alt. 1	3,315	$54.00	3.5%	$62.00
Alt. 2	0			

Note: MSE wingwall lengths are based on the difference between the maximum bridge length and the length of the alternative being considered.

Pile Foundation Unit Cost ($/ft.): *HP 12X53 Piles, Furnished & Driven*

	Number of Piles		Total Pile Length	HP/Drilled Shaft Option Length	no. of HP
Alt. 1	0	SEE QUANTITIES CALCU;ATION	0	0	0
Alt. 2	60	SEE QUANTITIES CALCU;ATION	1,260		

Pile Foundation Unit Cost ($/ft.):

	Year 2004 Unit Cost	Annual Escalation	Year 2008
Furnished	$20.15	3.5%	$23.10
Driven	$9.24	3.5%	$10.60
Total			$33.70

Shaft Foundation Unit Cost ($/ft.): 60" Drilled Shaft

	Number of Shafts		Total Shaft Length
Alt. 1	#DIV/0!	SEE QUANTITIES CALCU;ATION	#DIV/0!

Shaft Foundation Unit Cost ($/ft.):

Unit Cost	Escalation	2007
$300.00	4.5%	$358.00

Cost of Shafts: #DIV/0!

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

	Temp. Shoring Area (sq. ft.)	Temp. Girder Support (lump sum)
Alt. 1	0	$ -
Alt. 2	0	$ -

	Year 2004 Unit Cost	Annual Escalation	Year 2008
Temporary Shoring	$22.50	3.5%	$25.80
Cofferdam	$32.00	3.5%	$36.70

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RAMP A (NB) OVER OHIO RIVER ROAD - US 52 INTERCHANGE,

STRUCTURE TYPE STUDY - STEEL GIRDER ALTERNATIVES - QUANTITY CALCULATIONS

By: NFF
Checked: ELK

Date: 5/13/2005
Date: 7/11/2005

Pier Quantities Alternate 1 (HP-Piles Type Foundation)

Pier Location	Length	Cap				Column					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*	*# Column*	*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Pier 1	0	0	0	0.00	0	0	0	0.00	0	0	0	0	0	0	0	0
Pier 2	0	0	0	0.00	0						0	0	0	0	0	0
Pier 3	0	0	0	0.00	0						0	0	0	0	0	0
Pier 4	0	0	0	0.00	0						0	0	0	0	0	0
Pier 5	0	0	0	0.00	0						0	0	0	0	0	0
Pier 6	0	0	0	0.00	0						0	0	0	0	0	0
Pier 7	0	0	0	0	0	0	0	0.00	0	0	0	4	0	0	0	0
Total (Cu.Ft.)					**0**					**0**					**0**	**0**
Total (Cu.Yd.)					**0**					**0**					**0**	**0**

Pile Quantities Alternate 1

Location	Load/girder (Kips)	# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
Rear Abut.	0	0	0	0	140	0	1.1	*0*	0.0	0.0	2.0	*0*
Pier 1	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 2	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 3	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 4	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 5	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 6	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 7	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Fwd. Abut.	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
TotaL								**0**				**0**

Pier Quantities Alternate 2 (HP-Piles Type Foundation)

Pier Location	Length	Cap				Column					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*	*# Column*	*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Pier 1	0	0	0	0.00	0	5	31	19.63	1	608	10	3	100	1	300	908
Pier 2	0	0	0	0.00	0	5	31	19.63	2	1217	10	3	100	2	600	1817
Pier 3	0	0	0	0.00	0	5	31	19.63	1	608	10	3	100	1	300	908
Pier 4	0	0	0	0.00	0						0	0	0	0	0	0
Pier 5	0	0	0	0.00	0						0	0	0	0	0	0
Pier 6	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0
Pier 7																0
Total (Cu.Ft.)					**0**					**2434**					**1200**	**3634**
Total (Cu.Yd.)					**0**					**90**					**44**	**135**

Pile Quantities Alternate 2

Location	Load/girder (Kips)	# Girders	Total Load (Kips)	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
Rear Abut.	200	4	800	182	140	7	1.25	*9*	0.0	0.0	35.0	*315*
Pier 1	300	4	1200	136	140	10	1.25	*13*	0	0	15.0	*195*
Pier 2	350	4	1400	273	140	12	1.25	*15*	0	0	15.0	*225*
Pier 3	350	4	1400	136	140	11	1.25	*14*	0	0	15.0	*210*
Pier 4	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 5	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Pier 6	0	0	0	0	140	0	1.25	*0*	0	0	2.0	*0*
Fwd. Abut.	200	4	800	182	140	7	1.25	*9*	0	0	35.0	*315*
TotaL								**60**				**1260**

Abutment Quantities -Alternate 1

Abut Location	Length (feet)	Backwall				Beam Seat					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*		*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Rear Abut	110	1.75	6.9	12.08	1328	3.75	3.25	12.19		1341	6.25	3.25	20.3	1	2234	4903
Fwd. Abut	85	1.75	6.9	12.08	1026	3.75	3.25	12.19		1036	6.25	3.25	20.3	1	1727	3789
Total (Cu.Ft.)					**2355**					**2377**					**3961**	**8692**
Total (Cu.Yd.)					**87**					**88**					**147**	**322**

Superstructure Steel Quantities - Alt 1

Location	Wt.of girder (lb)/ft	# Girders	Span Length	Total Weight
Span 1	300	4	154	184800
Span 2	0	0	0	0
Span 3	0	0	0	0
Span 4	0	0	0	0
Span 5	0	0	0	0
Span 6	0	0	0	0
Span 7	0	0	0	0
Span 8	0	0	0	0
TotaL				184800

total steel weight per girder (lb.) =	46200
Total Span length (ft.)=	150.75
Weight Per ft. =	306

Superstructure Steel Quantities - Alt 2

Location	Wt.of girder	# Girders	Span Length	Total Weight
Span 1	239	4	96	91776
Span 2	239	4	123	117273
Span 3	239	4	118	112406
Span 4	239	4	96	91776
Span 5	0	0	0	0
Span 6	0	0	0	0
Span 7	0	0	0	0
Pier Cap	239	3	75	53775
TotaL				467006

MSE Abutment Wall Quantities -Alt. 1

Abut Location		Wall			
		Height	*Length*	*Area*	*Volume*
Rear Abut		17	110	1870.0	
Fwd. Abut		17	85	1445.0	
Total (Sq.Ft.)				**3315**	

Temporary Cofferdams

Location		Wall			
		Height	*Lengtl*	*width*	*Area*
Pier 3		0	0	0	0
Pier 4		0	0	0	0
Pier 5		0	0	0	0
Total (Sq.Ft.)					**0**

Expansion Deck Joints - Alt. 1

Abut Location		Special-Modular Joint			
		No. loc	*Length*	*Total*	
Rear Abut		0	0	0	
Fwd. Abut		0	0	0	
Total (Li.Ft.)				**0**	

48" Drilled Shafts Alernative Quantities for Piers in River Alternate 1

Location	Load/girder (Kips)	# Girders	Total Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Pile Length	Total Shaft Length (Feet)
Rear Abut.	0	4	0		0	0	1.1	*0*	0	0	0.0	*0*
Pier 1	0	4	0	0	0	0	1.25	*0*	0	0	0.0	*0*
Pier 2	0	4	0	0	0	0	1.25	*0*	0	0	0.0	*0*
Pier 3	0	4	0	0	0	#DIV/0!	1.1	*#DIV/0!*	0	0	2.0	*#DIV/0!*
Pier 4	0	0	0	0	0	#DIV/0!	1.1	*#DIV/0!*	0	0	2.0	*#DIV/0!*
Pier 5	0	0	0	0	0	#DIV/0!	1.1	*#DIV/0!*	0	0	2.0	*#DIV/0!*
Pier 6	0	0	0	0	0	0	1.25	*0*	0	0	0.0	*0*
Pier 7	0	0	0	0	0	0	1.25	*0*	0	0	0.0	*0*
Fwd. Abut.	0	4	0		0	0	1.25	*0*	0	0	0.0	*0*
TotaL								**#DIV/0!**				**#DIV/0!**

Pier Quantities Alternate 1 (HP-Piles/drilled Shaft Type Foundation)

Pier Location	Length	Cap				Column					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*	*# Column*	*Volume*	*Width*	*Depth*	*Area*	*# Footing*	*Volume*	
Pier 1	0	0	0	0.00	0	0	0	0.00	0	0	0	0	0	0	0	0
Pier 2	0	0	0	0.00	0						0	0	0	0	0	0
Pier 3 (D.Shaft)	0	0	0	0.00	0						0	0	0	0	0	0
Pier 4 (D.Shaft)	0	0	0	0.00	0						0	0	0	0	0	0
Pier 5 (D.Shaft)	0	0	0	0.00	0						0	0	0	0	0	0
Pier 6	0	0	0	0.00	0						0	0	0	0	0	0
Pier 7	0	0	0	0	0	0	0	0.00	0	0	0	0	0	0	0	0
Total (Cu.Ft.)					**0**					**0**					**0**	**0**
Total (Cu.Yd.)					**0**					**0**					**0**	**0**

SCI-823-0.00

RAMP A (NB) OVER OHIO RIVER ROAD - US 52 INTERCHANGE,
STRUCTURE TYPE STUDY

By: NFF
Checked:

Date: 5/26/2005
Date:

LIFE CYCLE MAINTENANCE COST

Alt. No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Structural Steel Painting Cost Per Cycle	Structural Steel Painting Number of Maintenance Cycles	Structural Steel Painting Total Life Cycle Cost	Superstructure Sealing Cost Per Cycle	Superstructure Sealing Number of Maintenance Cycles	Superstructure Sealing Total Life Cycle Cost	Approach Pavement Resurfacing Cost Per Cycle	Approach Pavement Resurfacing Number of Maintenance Cycles	Approach Pavement Resurfacing Total Life Cycle Cost
1	1	150.75	~ Welded Curved Plate Girde	$94,300	2	$188,600	$0	2	$0	$0	0	$0
2	4	432.25	4 ~ Welded Plate Girders	$270,800	2	$541,600	$0	0	$0	$0	0	$0
3	0	0.00	0	$0	0	$0	$0	2	$0	#REF!	7	#REF!

Alt. No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Bridge Deck Overlay (5) Deck Demo & Chipping	Bridge Deck Overlay (5) Deck Overlay	Bridge Deck Overlay (5) Deck Joint Gland (2)	Bridge Deck Overlay (5) Number of Maintenance Cycles	Bridge Deck Overlay (5) Total Life Cycle Cost	Bridge Redecking (5) Deck Concrete Cost (3)	Bridge Redecking (5) Deck Reinforcing Cost (3)	Bridge Redecking (5) Deck Joint Cost (2)	Bridge Redecking (5) Deck Removal Cost	Bridge Redecking (5) Number of Maintenance Cycles	Bridge Redecking (5) Total Life Cycle Cost	Superstructure Life Cycle Maintenance Cost (1)	Total Initial Construction Cost	Total Relative Ownership Cost
1	1	150.75	~ Welded Curved Plate Girde	$15,100	$18,300	n/a	1	$33,400	$122,100	$51,300	n/a	$41,200	1	$214,600	$437,000	$1,310,000	$1,747,000
2	4	432.25	4 ~ Welded Plate Girders	$43,200	$52,400	n/a	1	$95,600	$347,200	$145,800	n/a	$118,100	1	$611,100	$1,248,000	$1,840,000	$3,088,000
3	0	0	0	#REF!	#REF!	n/a	1	#REF!	#REF!	#REF!	n/a	#REF!	1	#REF!	#REF!	$0	#REF!

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	54	4	150.75	16.00	7,839	20%	9,400
Alt. 2	54	4	432.25	16.00	22,477	20%	27,000

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:
72" Modified AASHTO Type 4

	H	V	Diag.	No.	Total	
Bot. Flange	26			1	26.00	
		8		2	16.00	
Lower Fillets	9	9	12.73	2	25.46	
Web		46		2	92.00	
Upper Fillets	3	3	4.24	2	8.49	
	11	2	11.18	2	22.36	
Top Flange		4		2	8.00	
Total Exposed Perimeter					198.31	in.

36" AASHTO Type 2

	H	V	Diag.	No.	Total	
Bot. Flange	18			1	18.00	
		6		2	12.00	
Lower Fillets	6	6	8.49	2	16.98	
Web		15		2	30.00	
Upper Fillets	3	3	4.24	2	8.49	
Top Flange		6		2	12.00	
Total Exposed Perimeter					97.47	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. 3	4	0.00	0	10%	0
Alt. 4	4	0.00	0	10%	0

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	33.00	0
Alt. 2	33.00	0
Alt. 3	33.00	0
Alt. 4	33.00	0

Bridge Deck Removal Cost:

	Deck Area (3) (sq. ft.)	Year 2008	Deck Removal Cost
Alt. 1	4,975	$8.28	$41,200
Alt. 2	14,264	$8.28	$118,100
Alt. 3	#REF!	$8.28	#REF!
Alt. 4	0	$8.28	$0

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	4,975	553	14	12
Alt. 2	14,264	1,585	40	36
Alt. 3	#REF!	#REF!	#REF!	#REF!
Alt. 4	0	0	0	0

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:

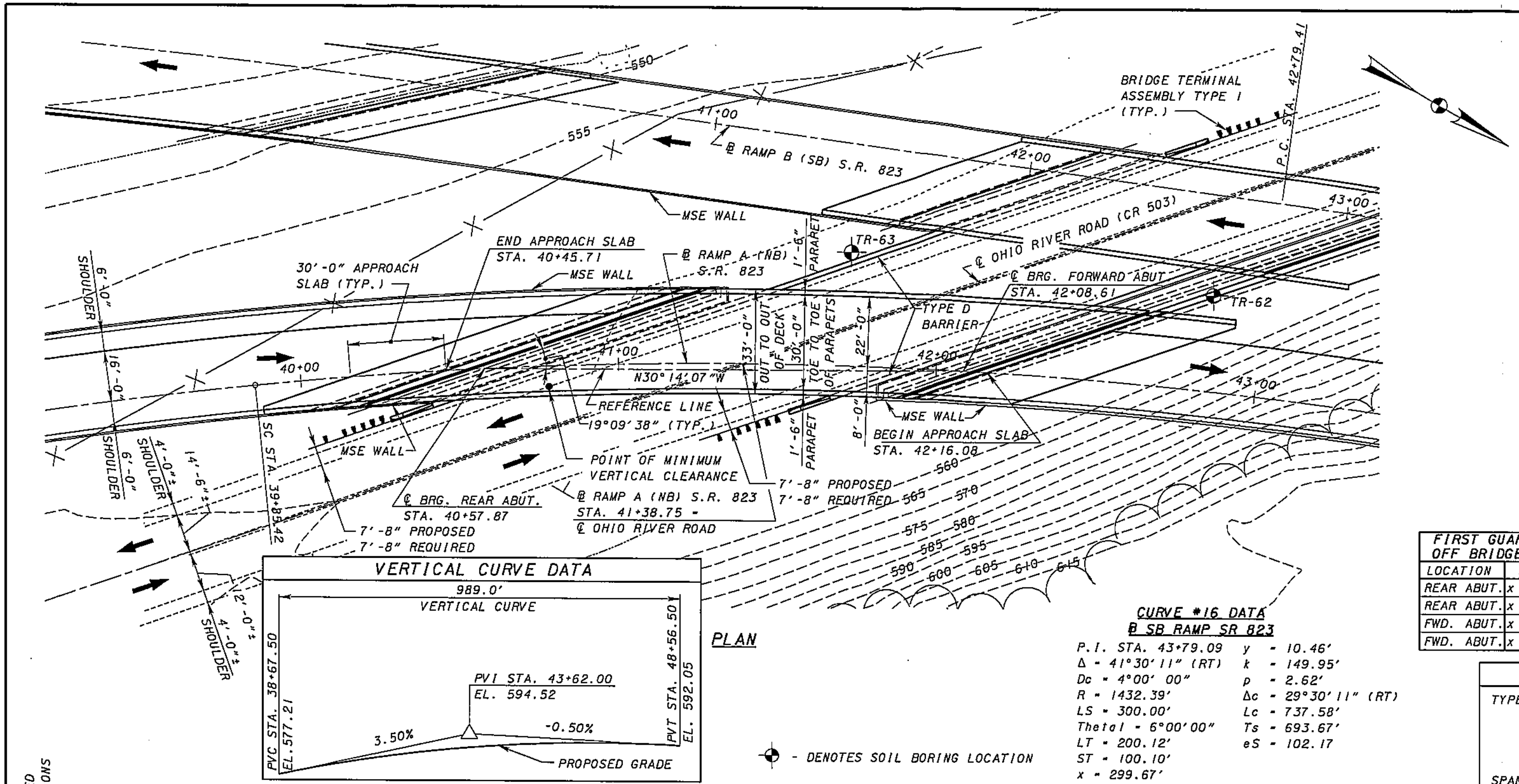
	Year 2004	Annual Escalation	Year 2008
Pavement Planing, Asphalt Concrete, per sq. yd. (Item 254)	$0.98	3.5%	$1.12
Asphalt Concrete Surface Course, per cu. yd.	$72.00	3.5%	$82.62

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	33.0	0	1.50	0.0
Alt. 2	0.0	33.0	0	1.50	0.0
Alt. 3	0.0	#REF!	#REF!	1.50	#REF!
Alt. 4	0.0	0.0	0	1.50	0.0

APPENDIX B

TRANSYSTEMS
CORPORATION

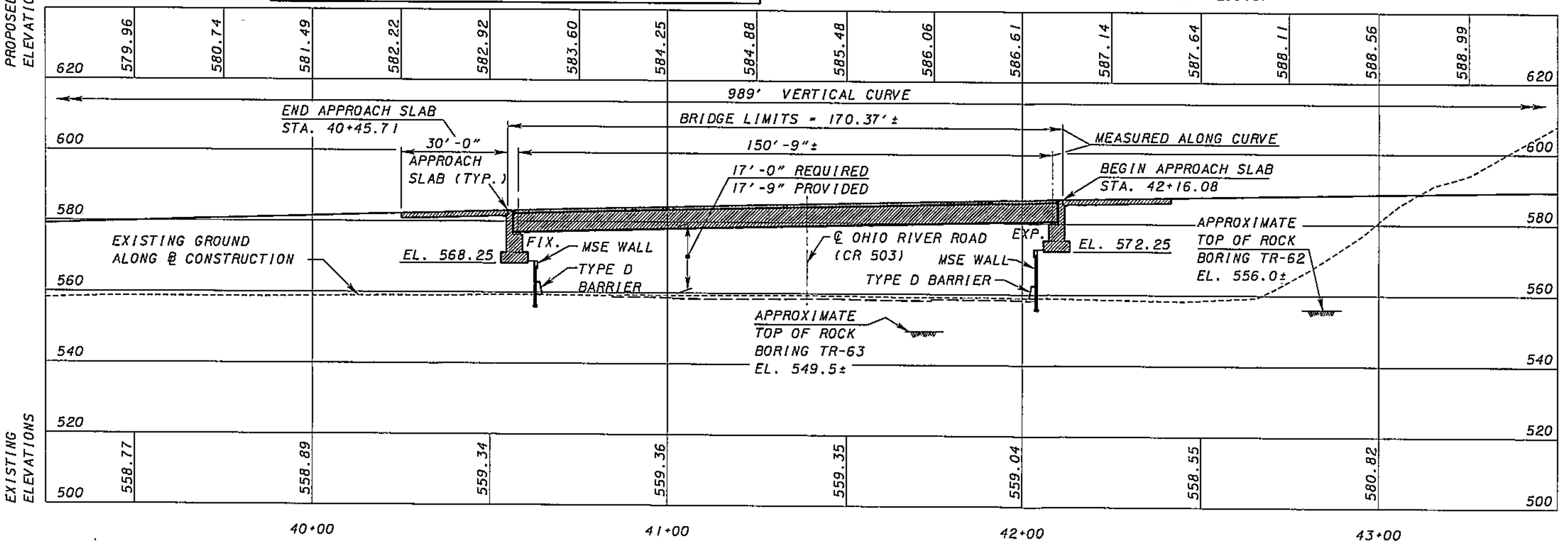


VERTICAL CURVE DATA

- DENOTES SOIL BORING LOCATION

CURVE #16 DATA
℄ SB RAMP SR 823

P.I. STA. 43+79.09	y = 10.46'
Δ = 41°30'11" (RT)	k = 149.95'
Dc = 4°00' 00"	p = 2.62'
R = 1432.39'	Δc = 29°30'11" (RT)
LS = 300.00'	Lc = 737.58'
Thetal = 6°00'00"	Ts = 693.67'
LT = 200.12'	eS = 102.17
ST = 100.10'	
x = 299.67'	



PROFILE ALONG ℄ RAMP A (NB)

BENCHMARK 1

(TO BE PROVIDED LATER)

BENCHMARK 2

(TO BE PROVIDED LATER)

TRAFFIC DATA

S.R. 823
CURRENT YEAR ADT (2010) = 13,400
DESIGN YEAR ADT (2030) = 21,000
CURRENT YEAR ADTT (2010) = 1,876
DESIGN YEAR ADTT (2030) = 2,940

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-62	42+62.39*	31.56' RT.*
TR-63	41+47.78*	33.98' RT.*

* - STATION AND OFFSETS ARE FROM THE ℄ OF RAMP B (SB) S.R. 823

PROPOSED STRUCTURE

TYPE: A SIMPLE SPAN CURVED STEEL PLATE GIRDER A709 GRADE 50 WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE SUBSTRUCTURE ON SPREAD FOOTINGS WITH MSE WALLS
SPANS: 150'-9" (MEASURED ALONG CURVE)
ROADWAY: 30'-0" TOE TO TOE OF PARAPETS
LOADING: HS 25 (CASE I) AND ALTERNATE MILITARY LOADING, FUTURE WEARING SURFACE OF 60 PSF
SKEW: 70°50'22" (TO REFERENCE LINE)
SUPERELEVATION: 0.08 FT./FT. AND 0.04 FT./FT.
ALIGNMENT: 4°00'00" CURVE RIGHT
WEARING SURFACE: 1" MONOLITHIC CONCRETE
APPROACH SLABS: AS-1-81 (30'-0" LONG)
LATITUDE:
LONGITUDE:
STRUCTURE FILE NO:

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:

THE ALLOWABLE BEARING PRESSURE IS 2.0 TONS PER SQUARE FOOT

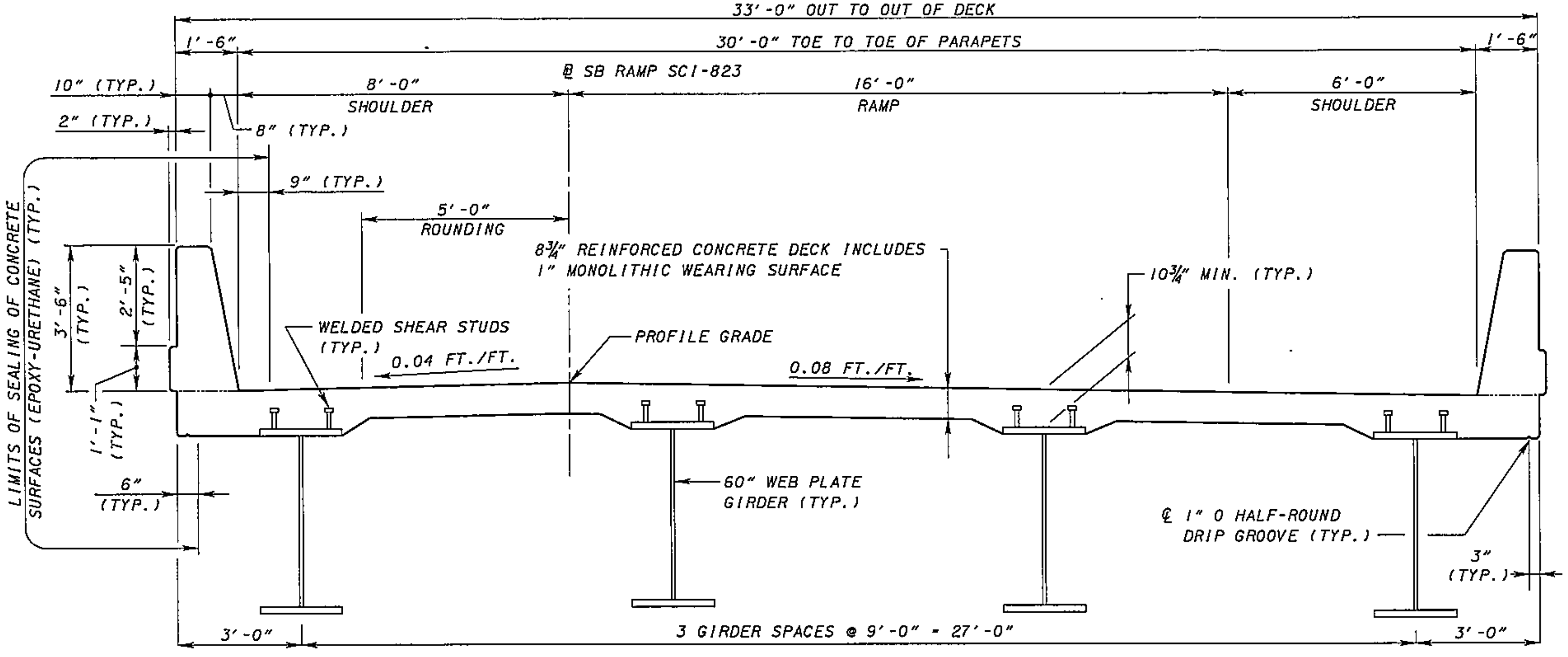
DESIGN AGENCY
TRANSYSTEMS CORPORATION
55 PUBLIC SQUARE, SUITE 1900
CLEVELAND, OHIO 44113-1901

DESIGNED	DRAWN	REVIEWED	DATE
NFF	RCK	RER	7/11/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
BTA			

SCIOTO COUNTY
STA. 40+45.71
STA. 42+16.08

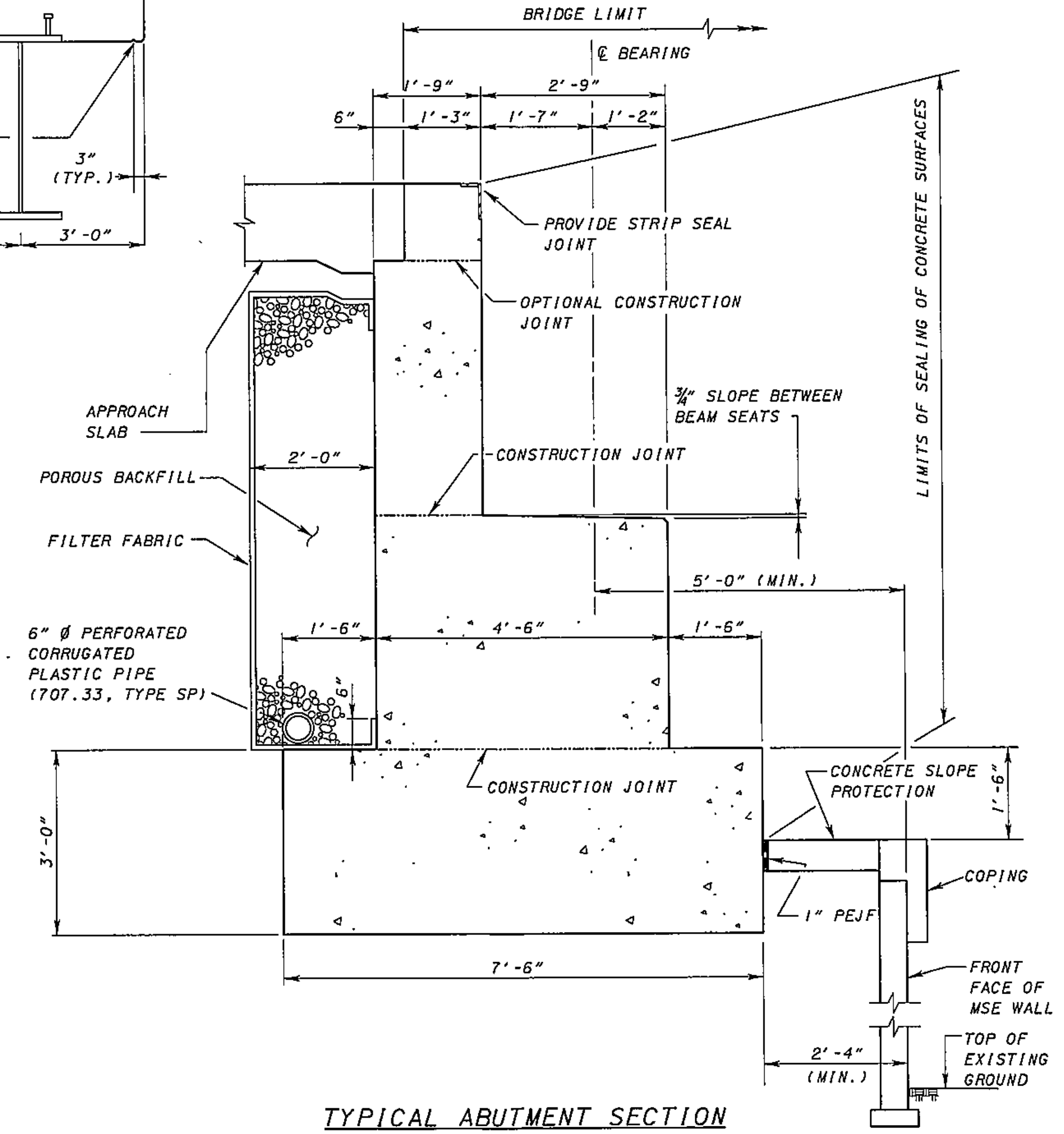
PRELIMINARY SITE PLAN - ALTERNATIVE I
BRIDGE NO. SCI-823-XXXX
S.R. 823 RAMP A (NB) OVER OHIO RIVER ROAD

SCI-823-0.00
PID 19415



TRANSVERSE SECTION

STEEL ALTERNATE STRUCTURE DEPTH	
SLAB	8¾"
HAUNCH	2"
GIRDER	60"
TOTAL	70.75"



TYPICAL ABUTMENT SECTION

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

DESIGNED	DRAWN	REVIEWED	DATE
NFF	MAK	RER	7/11/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
BTA			

TRANSVERSE SECTION - ALTERNATIVE I
BRIDGE NO. SCI-823-XXX
S.R. 823 RAMP A OVER OHIO RIVER ROAD (CR 503)

SCI-823-0.00
PID 19415

APPENDIX C

TRANSYSTEMS
CORPORATION

TRANSYSTEMS CORPORATION

Made By NFF Date 06/25/05 Job No. P403030064
Checked By ______ Date ______ Sheet No. ______

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 **Structure** ______
Description SR 823 NB RAMP OVER OHIO RIVER RD. **PID #** 19415

Alternative 1 - 4 Steel Girders, 1 Span — ***Point Location:*** *A*

Adjstment for Cross Slope

Comment	Grade		Offset		
2 Lanes:	-0.016	x	0	=	0.00
Shoulder to Beam CL:	-0.08	x	6.5	=	-0.52

Total Adjustment = **-0.52**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.75	0.73
Haunch:	2	0.17
Girder or Beam Depth:	60	5
	70.75	5.9

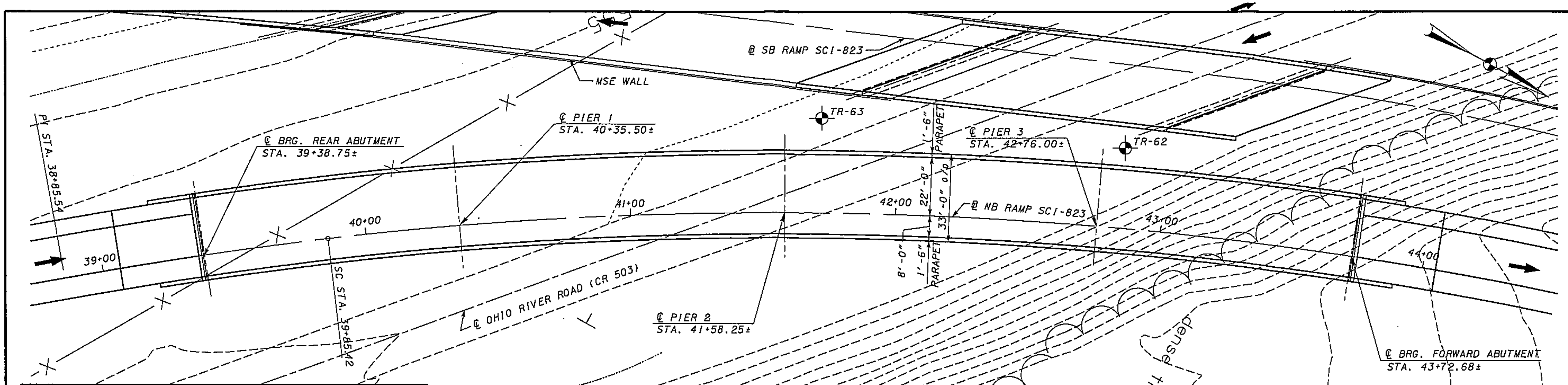
Total Superstructure Depth (ft) = **5.90**

Vertical Clearance at Critical Point

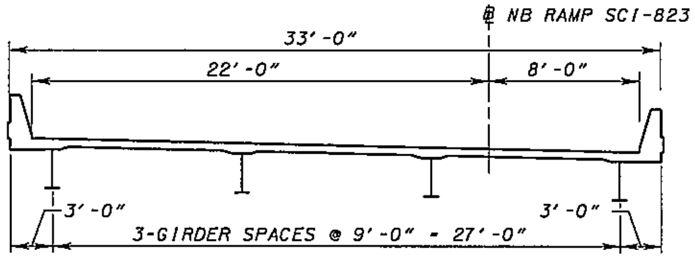
Station @ Critical Point	=	**40+81.00**	**41+55.00**
Offset Location @ Critical Point	=	**6.5' Right**	**6.5' Right**
Profile Grade Elevation at Critical Point	=	583.76	585.60
Adjustment for Cross Slopes to Beam CL	=	-0.52	-0.52
Top of Deck Elevation @ Critical Point	=	**583.24**	**585.08**
Total Superstructure Depth	=	-5.90	-5.90
Bottom of Beam Elevation @ Critical Point	=	**577.34**	**579.18**
Approximate Top of Existing Ground @ Critical Point	=	**559.60**	**559.50**
Actual Vertical Clearance	=	***17.74***	***19.68***
Preferred Vertical Clearance	=	*17.0*	*17.0*
Required Vertical Clearance	=	*16.5*	*16.5*

APPENDIX D

TRANSYSTEMS
CORPORATION



SUPERSTRUCTURE DATA



STRUCTURE DEPTH

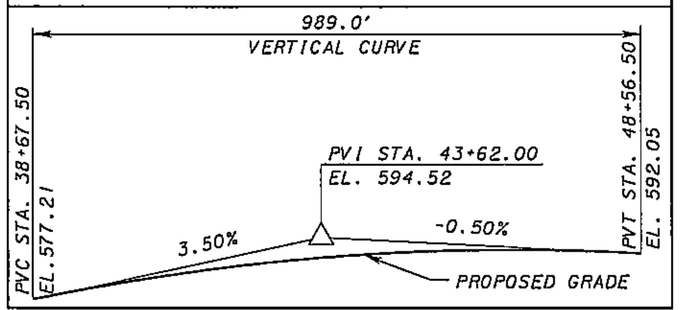
SLAB =	9"
HAUNCH =	2"
CURVED STEEL PLATE GIRDER =	54"
	5'-5"

CURVE #16 DATA
℗ SB RAMP SR 823

P.I. STA. 43+79.09	y = 10.46'
Δ = 41°30'11" (RT)	k = 149.95'
Dc = 4°00' 00"	p = 2.62'
R = 1432.39'	Δc = 29°30'11" (RT)
LS = 300.00'	Lc = 737.58'
Thetal = 6°00'00"	Ts = 693.67'
LT = 200.12'	eS = 102.17
ST = 100.10'	
x = 299.67'	

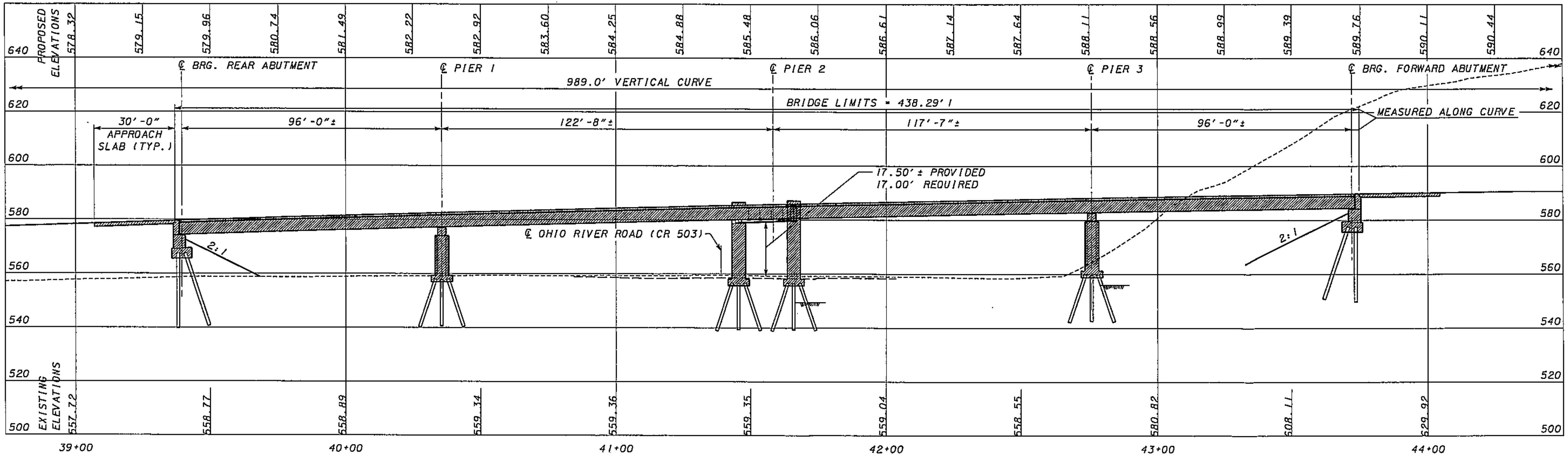
PLAN

VERTICAL CURVE DATA



PROPOSED STRUCTURE

TYPE: 4 SPAN CONTINUOUS CURVED STEEL PLATE GIRDER A709 GRADE 50 WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE SUBSTRUCTURE ON PILES



PROFILE ALONG ℗ RAMP A (NB)

FILE: g:\C003\0064\Bridge\BTS\01-NBRampOhioRiverRd\NBRmpOhioRvsp02.dgn
DATE: 07/11/2005

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

DESIGNED	DRAWN	REVIEWED	DATE
NFF	RCK		
CHECKED	REVISED	STRUCTURE FILE NUMBER	

SCIOTO COUNTY
STA.
STA.

PRELIMINARY SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 RAMP A (NB) OVER OHIO RIVER ROAD

SCI-823-0.00
PID 19415

1 / 1

$XXX
$YYY

APPENDIX E

TRANSYSTEMS
CORPORATION

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

May 6, 2005

Mr. Michael D. Weeks, P.E., P.S.
Project Manager
TranSystems Corporation
5747 Perimeter Dr., Suite 240
Dublin, OH 43017

Re: **US 52 and SCI-823-0.00 Interchange**
Preliminary Structural Foundation Recommendations
Project SCI-823-0.00
DLZ Job No.: 0121-3070.03

Dear Mr. Weeks:

This letter reports the findings of the subsurface exploration and preliminary foundation recommendations for the proposed structures at the US 52 and SCI-823-0.00 interchange to be located north of Wheelersburg, Ohio. It is anticipated that two proposed bridges and four MSE walls will be constructed as part of the interchange.

It is our understanding that the northern portion of the interchange will require mostly mechanically stabilized earth (MSE) wall construction. It is anticipated that these walls will lead to Ohio River Road, where an overpass will be constructed. It is anticipated that two more sets of MSE walls will be constructed south of the Ohio River Road overpass, one to continue the southbound lanes and one for the northbound lanes. It is our understanding that the southbound lanes will cross over US 52 and will require a second overpass along with a third MSE wall after crossing over US 52. At this time the embankment heights are unknown. However, it is anticipated that as much as 20 feet of fill may be required in some areas of embankment and up to 25 feet of fill in areas of MSE wall construction.

The existing area of the proposed interchange is located within the Scioto River valley with the overburden being primarily composed of glacial and alluvial deposits. The following table briefly outlines the anticipated structures, and the attached plan indicates the location of the structures in proximity to existing features.

Proposed Structure*	Approximate Location	Anticipated Number of Spans	Existing Grade Elevation**	Borings
Mainline Overpass #1	SCI-823 over Ohio River Rd	1	550 – 570	TR-62, TR-63
Mainline Overpass #2	SCI-823 over US 52.	2	540 – 555	TR-64, TR-66, TR-73

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. 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 fourteen structure borings, TR-62 through TR-66 and TR-68 through TR-76, were drilled at the proposed structures between April 27, 2004 and March 30, 2005. The structure borings were drilled to depths between 16 and 34 feet below the ground surface. The borings were extended into bedrock, which was verified by rock coring. Boring Logs and information concerning the drilling procedures are attached. 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 a brief discussion of the subsurface conditions at each structure, refer to the Conclusions and Recommendations section, or for more detailed information, please refer to the attached Boring Logs.

At the ground surface, topsoil was encountered to depths of 0 to 12 inches. However, in boring TR-66, 10 inches of Asphalt Concrete Pavement was observed. The subsurface materials encountered generally were interbedded granular and cohesive layers. The cohesive soils encountered ranged from sandy silt (A-4a) to silt and clay (A-6a), and ranged in consistency from medium stiff to hard. The granular soils encountered ranged from sandy silt (A-4a) to gravel (A-1-a), and ranged in compactness from very loose to very dense. Natural moisture contents of the cohesive and the granular layers were generally damp to wet.

Bedrock was encountered in all of the borings ranging in depth from 3.0 to 19.2 feet below the ground surface. The bedrock encountered was medium hard to hard and mostly sandstone although shale and siltstone were also encountered. Recovery of the core samples ranged from 93 to 100%, and RQD values ranged from 11 to 100% with an average RQD of 72%.

Seepage was detected in borings TR-65, TR-66, TR-68, TR-71, TR-73, and TR-74 ranging in depth from 1.0 to 18.5 feet below the ground surface. Water levels recorded at completion of drilling ranged from 1.9 to 18.0 feet below the ground surface. However, the final water levels include drilling water and may not be representative of the actual groundwater conditions. Groundwater levels may vary seasonally and will most likely be influenced by the Scioto River.

Conclusions and Recommendations

It appears that spread footings will be the best-suited foundation type for the support of the proposed structures. The following is a brief discussion of each structure.

Mainline Overpass - #1

Overpass #1 will be SCI-823-0.00 over Ohio River Road, for both the southbound and northbound lanes. Borings TR-62 and TR-63 were drilled for this structure. These borings encountered cohesive soils from ground surface to bedrock, consisting of sandy silt (A-4a) and silt (A-4b). Bedrock was encountered at depths of 3.0 and 9.0 feet below the ground surface.

Due to the depth of soil and soil types encountered, if spread footings are used, it is recommended that the proposed footings be designed with an allowable bearing pressure of 2,500 pounds per square foot at a minimum depth of 5 feet below existing grade. If the abutment footings are founded within the MSE wall fill, they may be designed based on an allowable bearing pressure of 4,000 pounds per square foot. An allowable bearing pressure of 8 tons per square foot is recommended for the design of footings bearing on the top of rock. The following table summarizes the site conditions and preliminary foundation recommendations. If piles through MSE wall fill are used to support the abutments, the piles should be driven to the top of rock and the full structural capacity of the pile may be used.

Foundation Recommendations – Mainline Overpass - #1

Boring Number	Structural Element	Existing Ground Surface Elevation* (Feet)	Top of Rock Elevation* (Feet)	Allowable Bearing Pressure for Spread Footings Founded in Soil** (PSF)	Allowable Bearing Pressure for Spread Footings Founded on Top of Rock (TSF)
TR-62	Northern Abutment	559.0	556.0	2500	8
TR-63	Southern Abutment	558.5	549.5	2500	8

*Existing ground surface elevation was estimated from the established topographic mapping.
**Footings founded a minimum of 5 feet below existing grade.

Mainline Overpass - #2

Overpass #1 will be SCI-823-0.00 over US 52. Borings TR-64, TR-66, and TR-73 were drilled for this structure. Borings TR-64 and TR-66 were mostly granular soils, consisting of sandy silt (A-4a) and gravel with sand (A-1-b). Boring TR-66 had a cohesive layer with silt and clay (A-6a). TR-73 encountered cohesive soil with silt and clay (A-6a) from ground surface to bedrock. Bedrock was encountered at depths of 10.5, 17.0, and 11.0 feet below the ground surface, respectively.

Due to the depth of soil and soil types encountered, if spread footings are used, it is recommended that the proposed footings be designed with an allowable bearing pressure of 2,500 pounds per square foot at a minimum depth of 5 feet below existing grade. If the abutment footings are founded within the MSE wall fill, they may be designed based on an allowable bearing pressure of 4,000 pounds per square foot. An allowable bearing pressure of 8 tons per square foot is recommended for the design of footings bearing on the top of rock. The following table summarizes the site conditions and preliminary foundation recommendations. If piles through MSE wall fill are used to support the abutments, the piles should be driven to the top of rock and the full structural capacity of the pile may be used.

Foundation Recommendations – Mainline Overpass - #2

Boring Number	Structural Element	Existing Ground Surface Elevation* (Feet)	Top of Rock Elevation* (Feet)	Allowable Bearing Pressure for Spread Footings Founded in soil** (PSF)	Allowable Bearing Pressure for Spread Footings Founded on Top of Rock (TSF)
TR-64	Rear Abutment	549.0	538.5	2500	8
TR-66	Pier	550.0	533.0	2500	8
TR-73	Forward Abutment	545.0	534.0	2500	8

*Existing ground surface elevation was estimated from the established topographic mapping.
**Footings founded a minimum of 5 feet below existing grade.

MSE Wall Stability

Several MSE walls are proposed within the interchange. Based upon the borings drilled across the proposed interchange, it appears that the global stability will not be an issue for the anticipated wall height. This is based on an assumption of a maximum wall height of 25 feet. Once the wall designs have been finalized, the geometries of each wall will need to be evaluated for the global stability, sliding, overturning, and bearing capacity at each location.

General Information

Minor amounts of settlement occurring within the very loose to loose granular soils are anticipated during construction of the embankments and MSE walls. Due to the granular nature of the soils, it is anticipated that most of the settlement will occur during the earthwork activities.

Because of the many geotechnical factors across the anticipated structure locations, and the design unknowns at this time, 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.

Closing

We encourage you to discuss with us any questions or concerns you have about the findings and conclusions presented in this report. Please do not hesitate to call if we can be of any further assistance.

Sincerely,

DLZ OHIO, INC.

Jamie North
Geotechnical Engineer

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

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

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.**

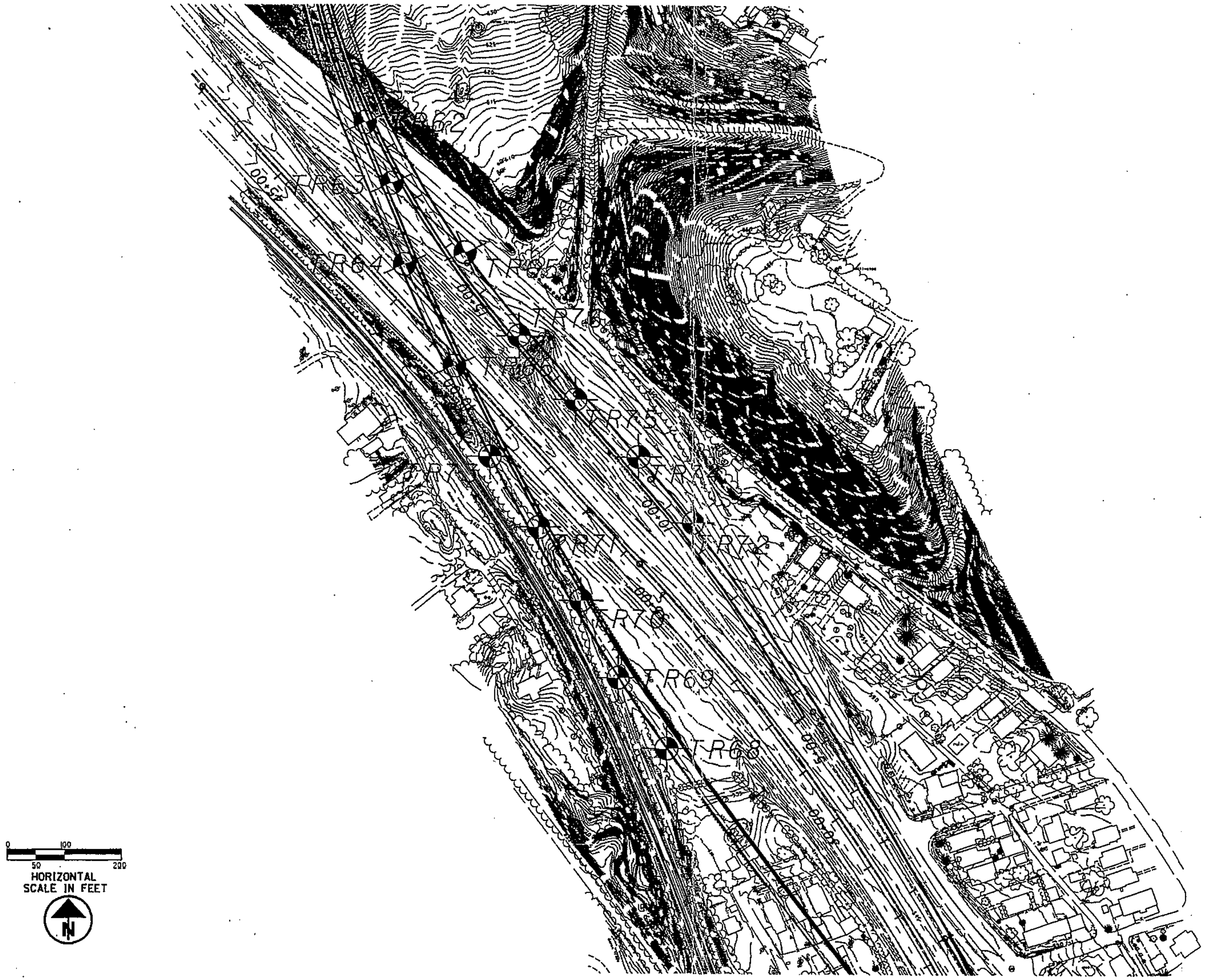
Term	Description
Very Soft	Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb)
Soft	Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed 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.



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6121 Huntley Road
Columbus, Ohio 43229-1003
Phone (614) 888-0040 Fax (614) 848-6712

SCI-823-0.00

US 52 / SCI-823 Interchange

BORING LOCATION PLAN

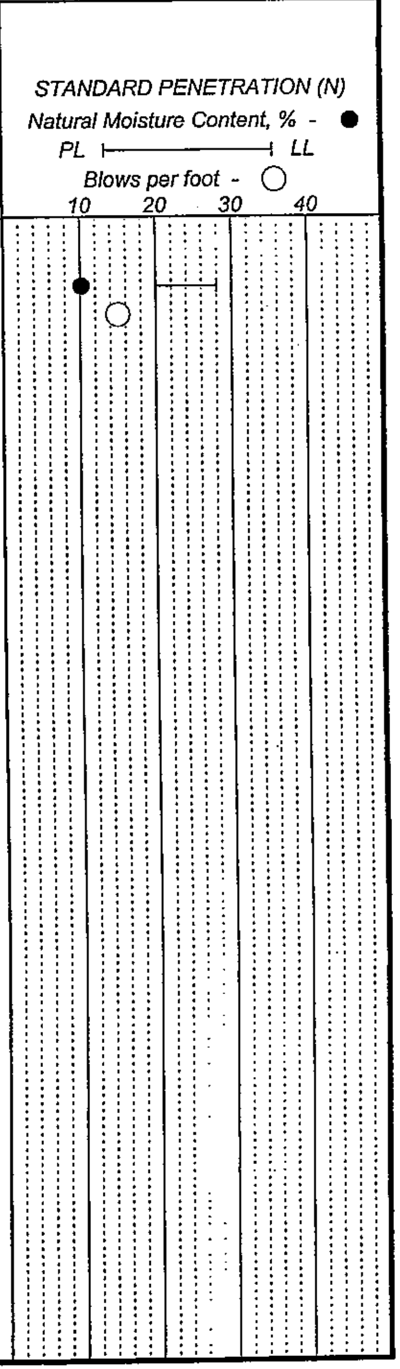
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-62
Location: As Per Plan
Date Drilled: 3-18-05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 1.9' (with augers removed)

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	559.0	8 9 6	14	1		3.5	Very stiff gray SILT (A-4b), little gravel, little clay, some fine to coarse sand; contains sandstone fragments; damp.	17	15	--	6	46	16
3.0	556.0	50/2	2	2			Hard gray SANDSTONE; fine grained, slightly weathered, siliceous, thinly bedded. @ 4.0'-5.5', slightly fractured with clay seams @ 11.2'-11.3' high angle fracture						
		Core 120"	Rec 120"	RQD 78%	R-1								
16.0	543.0						Bottom of Boring - 16.0'						



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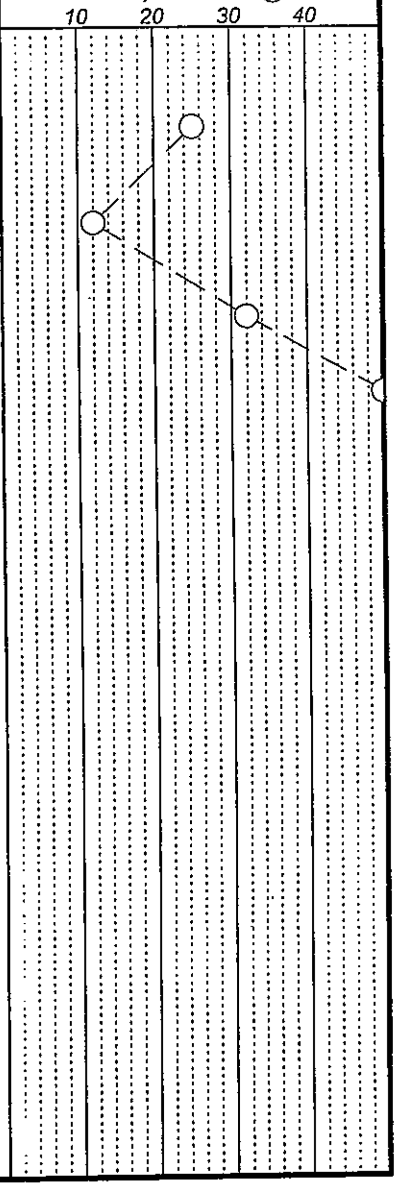
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-63 | *Location:* Approximately 16' east of staked location | *Date Drilled:* 5/4/04

WATER OBSERVATIONS: Water seepage at: none
Water level at completion: 5.9' (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	558.5						Topsoil - 12"						
1.0	557.5	4 6 19	14	1		4.0	Very stiff to hard brown SANDY SILT (A-4a), some fine to coarse sand, little gravel; damp to moist.						
		2 3 9	13	2		3.5							
		10 15 17	17	3		–							
9.0	549.5	13 50/5	8	4			Severely weathered gray SHALE fragments						
		50/4	2	5									
14.0	544.5	50/3	0	6			Hard gray SANDSTONE; fine grained, occasional black laminations throughout. @ 14.0'-15.7', highly fractured with horizontal to low-angle fractures, contains rust stains.						
		Core 120"	Rec 113"	RQD 80%	R-1								
24.0	534.5						Bottom of Boring - 24.0'						

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



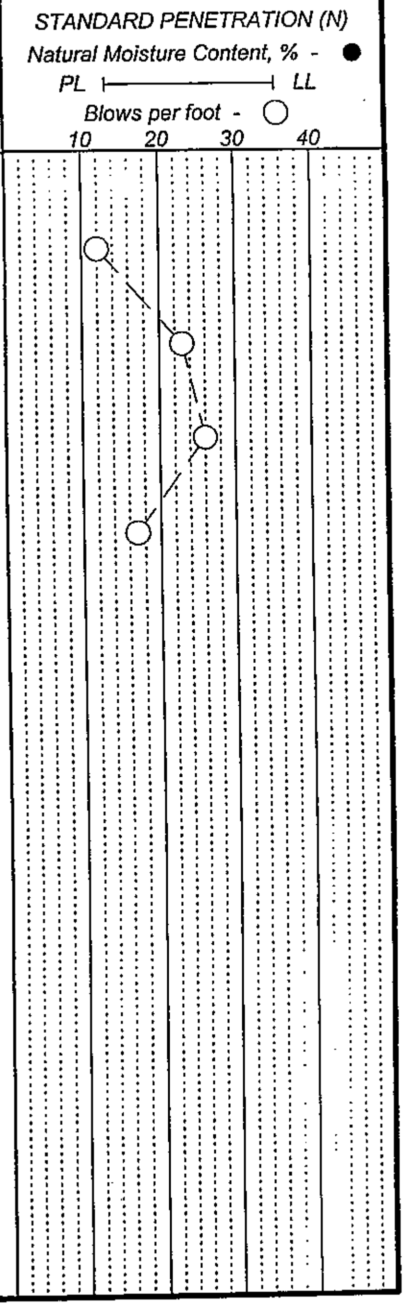
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-64 *Location:* As Per Plan *Date Drilled:* 3/30/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 0.0' (inside hollow stem augers)

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	549.0 548.9						Topsoil - 1.0"						
		6 7 5	14	1			Medium dense brown SANDY SILT (A-4a), trace to little gravel, trace clay; damp.						
		7 11 12	16	2									
5													
		7 11 15	17	3			@ 6.0', damp to moist						
		4 7 10	16	4									
10 10.5	538.5						Hard brown SANDSTONE; moderately weathered.						
		50/4	2	5									
11.5	537.5						Hard brown SANDSTONE; very fine to fine grained, slightly weathered, thinly bedded, highly fractured. @ 15.3', clay seam @ 15.7', gray.						
15		Core 120"	Rec 118"	RQD 11%	R1								
20													
21.5	527.5						Bottom of Boring - 21.5'						
25													
30													



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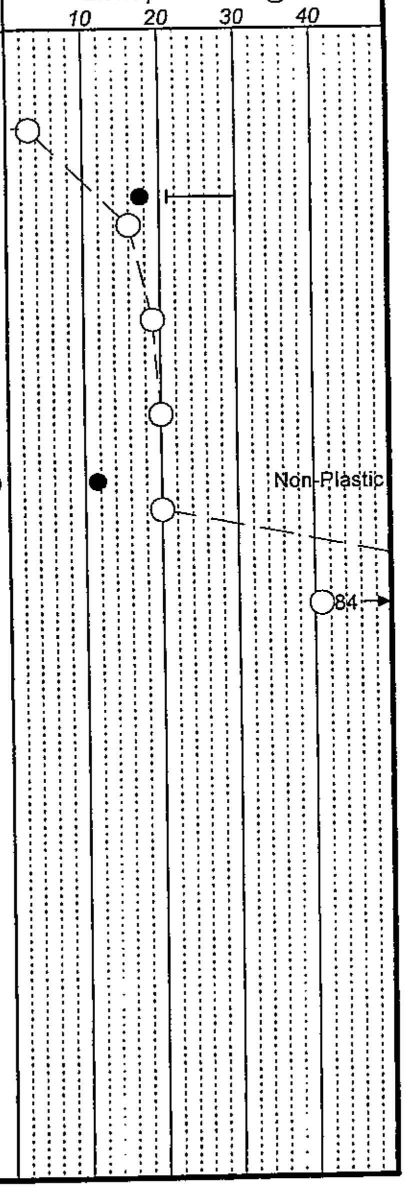
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-65
Location: As Per Plan
Date Drilled: 3-22-05

WATER OBSERVATIONS: Water seepage at: 1.0'
Water level at completion: 5.2' (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
0	559.0						Very loose brown SILT (A-4b), little gravel, trace to little clay, some fine to coarse sand; damp to moist.						
		1 1 2	7	1		1.0							
		5 8 8	18	2		2.5	@ 3.5', Medium dense.	11	16	--	9	48	16
5		5 8 11	18	3		3.5							
		5 9 11	18	4									
10		6 10 10	17	5				18	20	--	12	40	10
		8 34 50/2	12	6									
14.5	544.5						Hard brown SILTSTONE; moderately weathered, thinly bedded, moderately fractured. @ 17.1'-17.6', 18.9'-19.0', clay seams						
15		50/1	1	7									
19.0	540.0						Hard gray SANDSTONE; slightly weathered, thinly to medium bedded.						
20		Core 120"	Rec 120"	RQD 54%	R-1								
25		Core 60"	Rec 60"	RQD 100%	R-2								
30													

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



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-65
Location: As Per Plan
Date Drilled: 3-22-05

WATER OBSERVATIONS: Water seepage at: 1.0'
Water level at completion: 5.2' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
30	529.0													
30.5	528.5						Bottom of Boring - 30.5'							
35														
40														
45														
50														
55														
60														

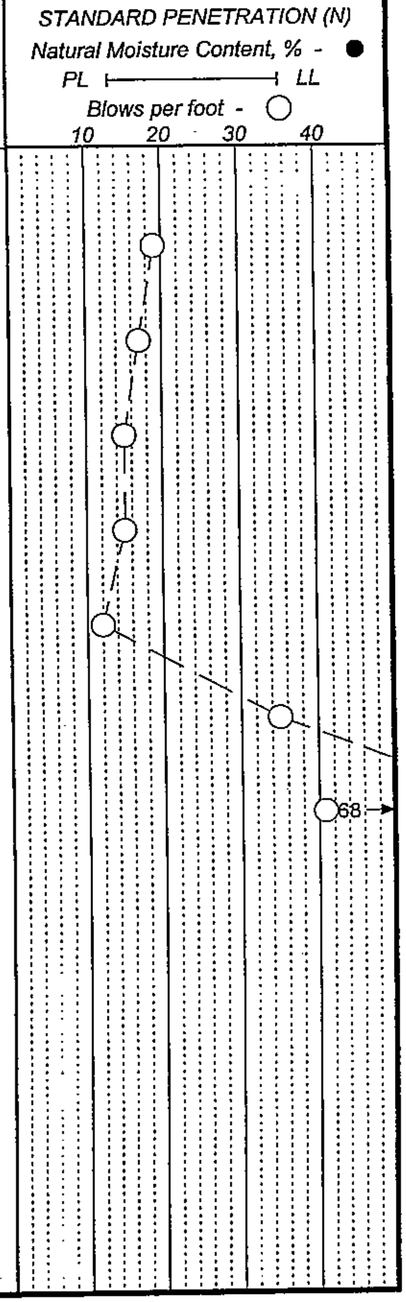
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-66
Location: AS Per Plan
Date Drilled: 3/30/05

WATER OBSERVATIONS: Water seepage at: 16.0'-17.0'
Water level at completion: 14.0' (prior to washing out)
8.0' (inside hollow stem augers)

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	550.0						Asphalt Concrete Pavement - 10.0"						
1.0	549.0	11 10 9	12	1A 1B			Medium dense gray GRAVEL WITH SAND (A-1-b); damp.						
2.0	548.0						Medium dense brown SANDY SILT (A-4a), trace to little gravel; damp.						
3.0	547.0	5 7 10	13	2		3.5	Very stiff brown SILT AND CLAY (A-6a), trace to little fine to coarse sand, trace gravel; damp.						
5 5.5	544.5	10 7 8	10	3			Medium dense brown SANDY SILT (A-4a), trace clay, trace gravel; contains sandstone fragments; damp.						
10		7 10 5	9	4									
		8 5 7	17	5		2.5	@ 11.0'-12.5', little clay; damp to moist.						
15		3 6 29	14	6									
		11 18 50/3	13	7									
17.0 20 25	533.0	Core 120"	Rec 120"	RQD 58%	R1		Hard brown SANDSTONE; fine grained, slightly weathered, thinly bedded, moderately fractured. @ 19.1', gray.						
27.5 30	522.5						Bottom of Boring - 27.5'						



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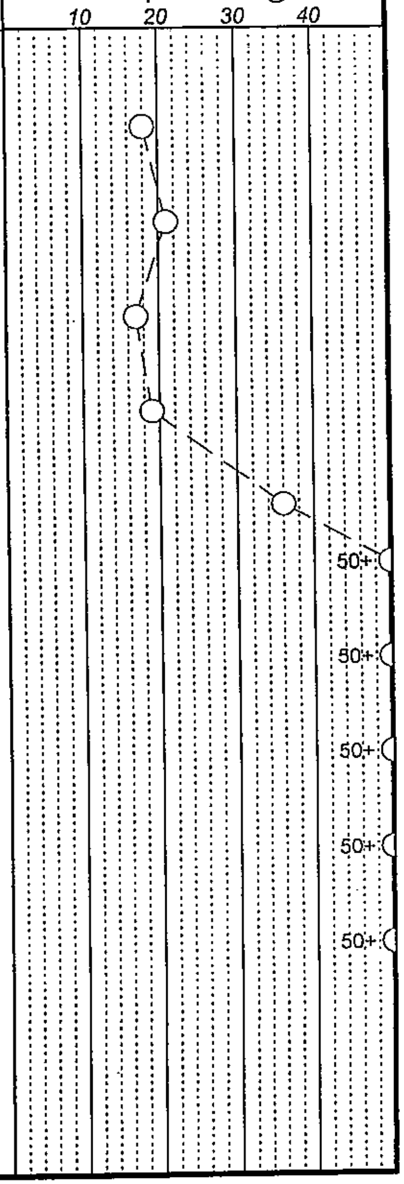
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-68
Location: As Per Plan
Date Drilled: 4/27/04

WATER OBSERVATIONS: Water seepage at: 13.5'
Water level at completion: 4.5' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	537.0												
0.3	536.7						Topsoil - 3"						
		4 9 9	16	1		--	POSSIBLE FILL: Very stiff brown SILT AND CLAY (A-6a), some fine to coarse sand, trace gravel; damp.						
3.0	534.0						Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand; damp.						
		4 8 13	15	2		4.0							
5													
		5 6 11	18	3		3.5							
		5 8 11	6	4		1.0							
10													
11.0	526.0	5 15 21	12	5			Dense brown GRAVEL WITH SAND (A-1-b), little silt; moist.						
13.5	523.5	50/5	2	6			Gray SANDSTONE fragments, little silty clay; wet.						
15													
		50/2	2	7									
		50/1	1	8									
20													
21.0	516.0	50/1	1	9			Gray SHALE fragments, little to some silty clay; wet.						
23.8	513.2	50/1	1	10			Hard gray SANDSTONE; fine grained, occasional black laminations throughout.						
25													
		Core 120"	Rec 116"	RQD 81%	R-1								
30													

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



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

LOG OF: Boring TR-68
Location: As Per Plan
Date Drilled: 4/27/04

WATER OBSERVATIONS: Water seepage at: 13.5'
Water level at completion: 4.5' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf)	DESCRIPTION	GRADATION						STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
				Drive	Press / Core			% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	
30	507.0						Hard gray SANDSTONE; fine grained, occasional black laminations throughout. @ 30.2'-30.6', high angle fracture. @ 32.8'-33.5', broken.							
33.8	503.2						Bottom of Boring - 33.8'							
35														
40														
45														
50														
55														
60														

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

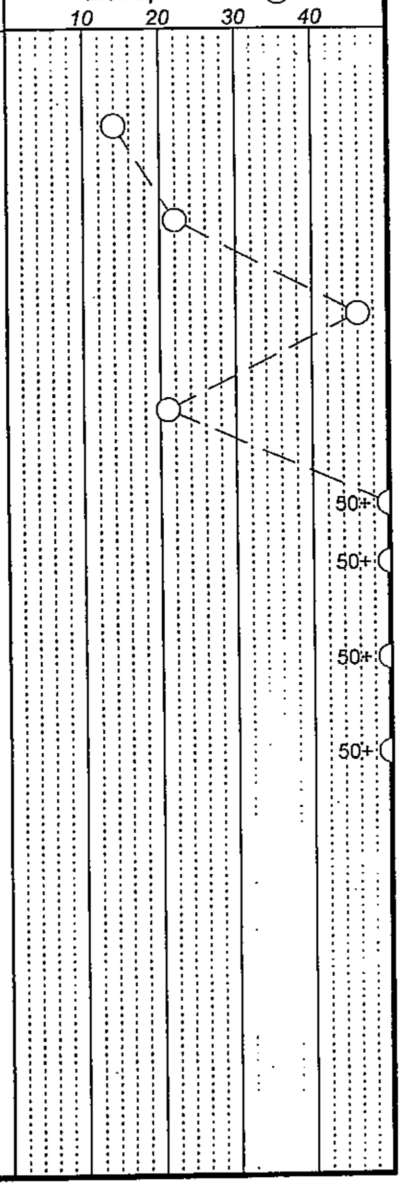
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-69
Location: Approximately 16' east of boring location
Date Drilled: 4/28/04

WATER OBSERVATIONS: Water seepage at: none
Water level at completion: 5.0' (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
0	539.0												
0.3	538.7						Topsoil - 3"						
		5 6 8	15	1		3.0	Very stiff to hard brown SILT AND CLAY (A-6a), little fine to coarse sand; damp.						
		5 9 13	16	2		4.25							
5													
6.5	532.5	7 23 23	18	3			Dense brown FINE SAND (A-3), little coarse sand, little gravel; moist.						
9.0	530.0	5 12 9	13	4		3.0	Very stiff brown SANDY SILT (A-4a), some fine to coarse sand; moist.						
10													
11.0	528.0	8 40 50/2	14	5A 5B			Very dense brown COARSE AND FINE SAND (A-3a), little silt, trace gravel; moist.						
12.0	527.0						Gray SANDSTONE fragments. @ 13.5'-18.6', no recovery.						
		50/2	0	6									
15													
		50/1	0	7									
		50/1	0	8									
19.5	519.5						Hard gray SANDSTONE; fine grained, slightly micaceous, occasional black laminations throughout.						
20													
		Core 121"	Rec 121"	RQD 98%	R-1								
25													
							@ 26.8', 45 deg. fracture.						
							@ 29.4'-29.6', medium hard gray SILTSTONE.						
29.6	509.4												

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



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

LOG OF: Boring TR-69
Location: Approximately 16' east of boring location
Date Drilled: 4/28/04

WATER OBSERVATIONS: Water seepage at: none
Water level at completion: 5.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
30	509.0						Bottom of Boring - 29.6'							
35														
40														
45														
50														
55														
60														

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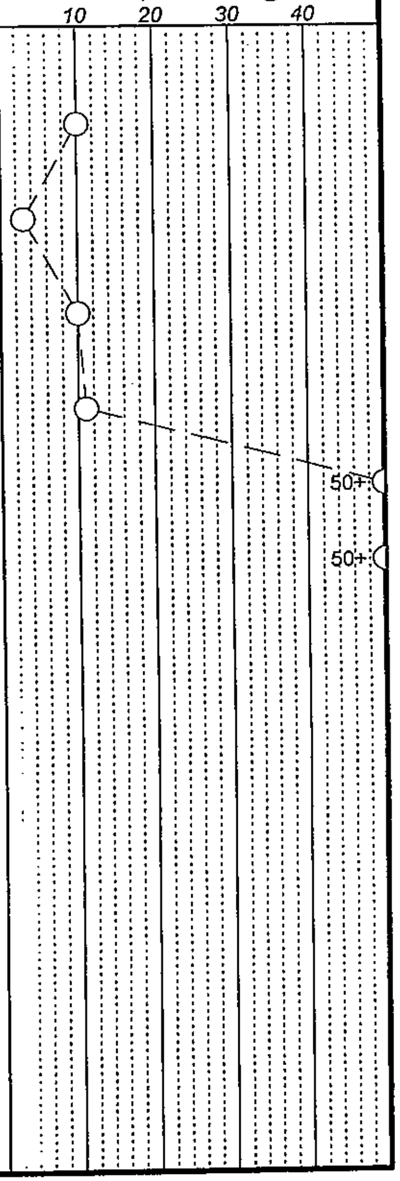
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-70
Location: 12' 3" east of boring location
Date Drilled: 4/28/04

WATER OBSERVATIONS: Water seepage at: none
Water level at completion: 4.3' (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	539.5												
0.5	539.0						Topsoil - 6"						
		5 5 5	11	1		1.25	Medium stiff to stiff brown SILT AND CLAY (A-6a), little to some fine to coarse sand, trace gravel; moist.						
		1 2 1	14	2		0.75							
5													
		1 5 5	11	3		1.5							
		3 5 6	16	4		1.0							
10							@ 11.0'-11.5', sand seam; contains few twigs; wet.						
		9 50/5	11	5A 5B		2.5	@ 11.5'-11.9', very stiff.						
							@ 13.5'-13.8', weathered shale fragments.						
13.8	525.7	50/4	2	6			Hard brown SANDSTONE; fine grained, occasional black laminations throughout.						
15							@ 13.8'-16.7', highly fractured with horizontal to low-angle fractures. @ 16.9', becomes gray.						
		Core 120"	Rec 112"	RQD 77%	R-1								
20													
23.8	515.7						Bottom of Boring - 23.8'						
25													
30													

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



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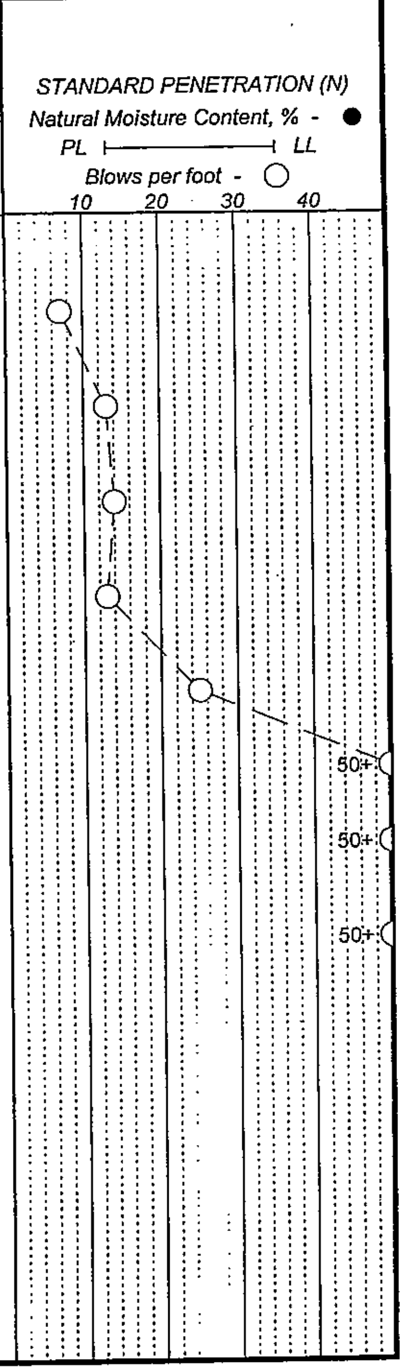
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-71

Location: As Per Plan
Date Drilled: 4/28/04

WATER OBSERVATIONS: Water seepage at: 8.5', 13.5'
Water level at completion: 5.2' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	544.0												
0.5	543.5						Topsoil - 6"						
		2 3 4	13	1		1.25	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand; moist.						
		4 6 7	16	2		3.25							
5													
		3 5 9	18	3		1.75							
8.0	536.0	2 2 11	15	4A 4B			Medium dense brown SILT (A-4b), some fine sand, trace clay; wet.						
9.5	534.5						Medium dense brown COARSE AND FINE SAND (A-3a), little silt, trace gravel; wet.						
10													
		1 11 14	16	5			@ 12.4'-12.5', silty clay seam.						
13.5	530.5	14 50/5	10	6		4.5+	Hard brown SANDY SILT (A-4a), some fine to coarse sand, trace gravel; damp.						
15													
16.0	528.0	50/4	3	7			Brown and gray SHALE fragments.						
18.7	525.3	50/2	1	8			Hard gray SANDSTONE; fine grained, occasional black laminations throughout. @ 18.8'-19.1', concretion.						
20													
		Core 120"	Rec 118"	RQD 91%	R-1								
25													
28.7	515.3						Bottom of Boring - 28.7'						
30													



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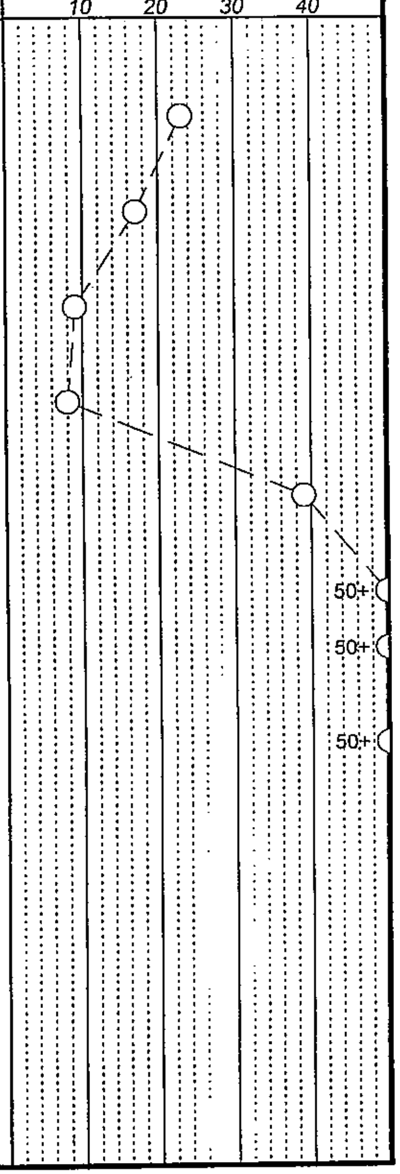
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-72
Location: As Per Plan
Date Drilled: 4/29/04

WATER OBSERVATIONS: Water seepage at: none
Water level at completion: 4.7' (includes drilling water)

Depth (ft)	*Elev. (ft)*	*Blows per 6"*	*Recovery (in)*	*Sample No. Drive*	*Sample No. Press / Core*	*Hand Penetro-meter (tsf)*	*DESCRIPTION*	*GRADATION % Aggregate*	*% C. Sand*	*% M. Sand*	*% F. Sand*	*% Silt*	*% Clay*
0	552.5						Topsoil - 12"						
1.0	551.5	5 11 12	15	1		4.5+	Very stiff to hard brown SILT AND CLAY (A-6a), little fine to coarse sand, trace gravel; damp to moist.						
		5 9 8	17	2		3.75							
5													
		3 4 5	15	3		1.25	@ 6.0'-10.0', stiff.						
		3 4 4	18	4		1.0							
10													
11.5	541.0	7 23 16	15	5			Dense brown GRAVEL WITH SAND (A-1-b), "and" fine to coarse sand, little silt; moist.						
13.5	539.0	45 29 50/2	10	6			Weathered gray SHALE fragments; also contains sandstone fragments.						
15													
		50/1	0	7									
		50/1	0	8									
19.2	533.3						Hard gray SANDSTONE; fine grained, occasional black laminations throughout. @ 19.2'-20.2', highly fractured to broken, contains rust stains. @ 21.9'-23.7', numerous black lamination.						
20													
		Core 122"	Rec 122"	RQD 77%	R-1								
25													
29.3	523.2						Bottom of Boring - 29.3'						
30													

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



FILE: 0121-3070-03 [5/6/2005 3:35 PM]

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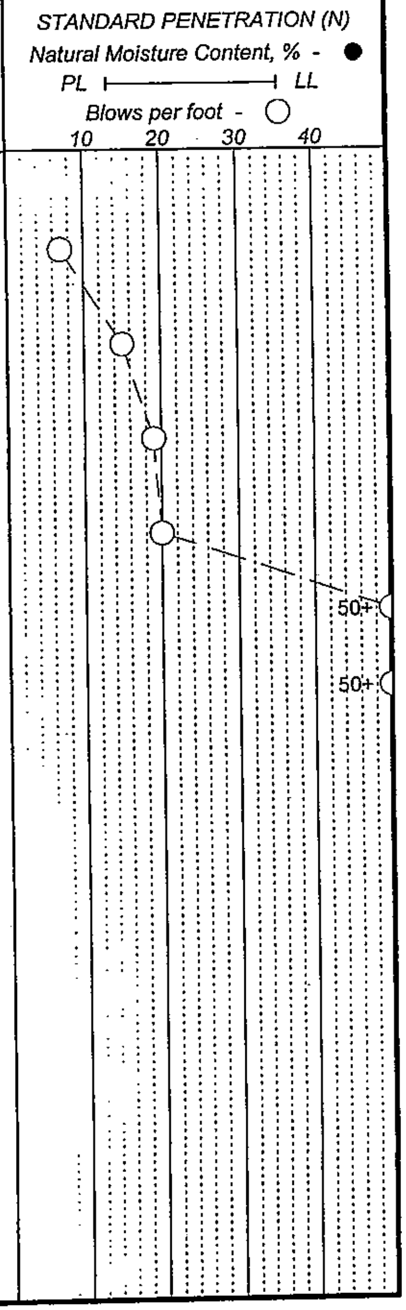
Client: TranSystems, Inc.	*Project:* SCI-823-0.00	*Job No.* 0121-3070.03
LOG OF: Boring TR-73	*Location:* As Per Plan	*Date Drilled:* 4/29/04

WATER OBSERVATIONS: Water seepage at: 11.0'
Water level at completion: 15.5' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	545.0						Topsoil - 8"						
0.7	544.3	3 3 4	8	1		1.25	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand, trace gravel; moist.						
5		4 7 8	17	2		1.5							
		4 7 12	15	3		2.25							
10		6 8 12	13	4		1.0							
11.0	534.0	26 50/3	9	5			Brown and gray SHALE fragments, little silty clay; wet. @ 11.0'-11.8', also contains sandstone fragments.						
14.0	531.0	50/5	5	6			Medium hard gray SILTSTONE; broken. @ 14.0'-14.3', hard brown sandstone.						
15													
16.0	529.0	Core 120"	Rec 115"	RQD 60%	R-1		Hard brown SANDSTONE; fine grained. @ 17.8'-24.0', gray, occasional black laminations throughout. @ 23.5'-23.6',23.7'-23.8', high angle fractures.						
20													
24.0	521.0						Bottom of Boring - 24.0'						
25													
30													



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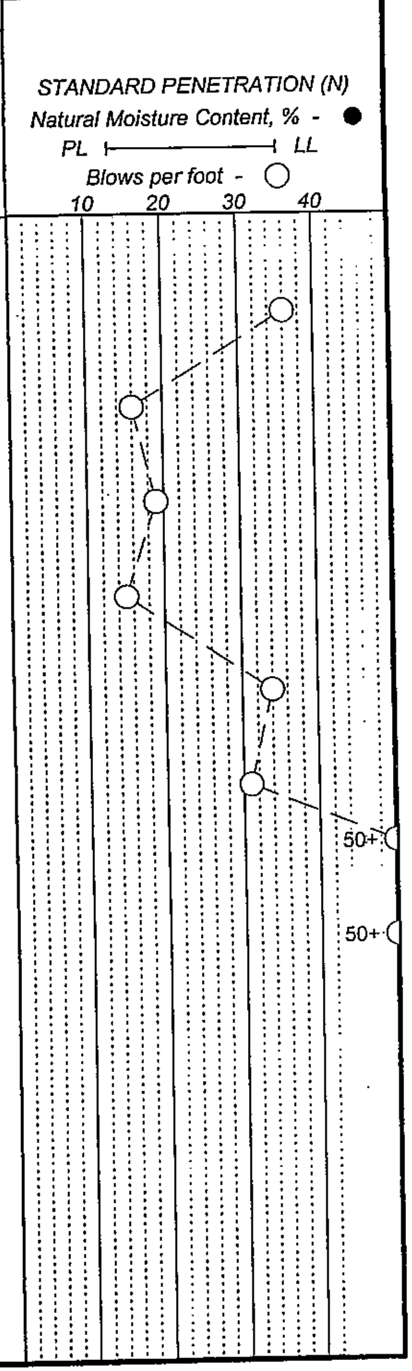
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-74
Location: As Per Plan
Date Drilled: 4/29/04

WATER OBSERVATIONS: Water seepage at: 18.5'
Water level at completion: 5.0' (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	553.5												
0.5	553.0						Topsoil - 6"						
		7 20 16	17	1		4.5+	Very stiff to hard brown SANDY SILT (A-4a), some fine to coarse sand, trace gravel; damp.						
5		4 6 10	17	2		2.75							
		4 8 11	18	3		2.75							
10		3 5 10	16	4		2.75							
11.3	542.2	8 12 22	17	5			Dense to very dense brown GRAVEL (A-1-a), some fine to coarse sand, trace silt; damp to moist.						
15		6 13 18	14	6									
		50/1	0	7									
		50/2	2	8			@ 18.5'-18.7', gray siltstone fragments, little silty clay.						
19.2	534.3	Core 120"	Rec 118"	RQD 84%	R-1		Hard gray SANDSTONE; fine grained, occasional black laminations throughout. @ 19.2'-21.2', highly fractured to broken, contains rust stains. @ 22.0'-23.3', numerous black laminations.						
29.2	524.3						Bottom of Boring - 29.2'						



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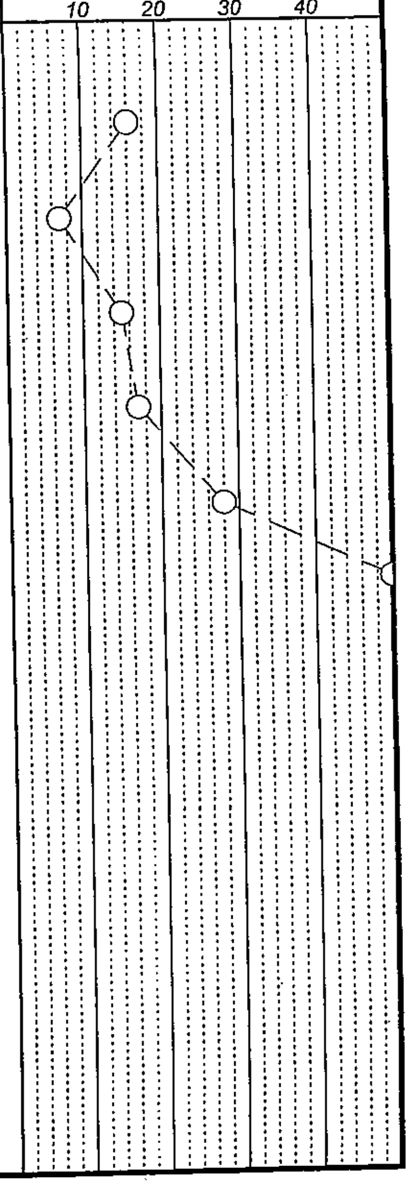
Client: TranSystems, Inc.
Project: SCI-823-0.00
Job No. 0121-3070.03

LOG OF: Boring TR-75
Location: As Per Plan
Date Drilled: 3/30/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 18.0' (inside hollow stem augers)

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
0.1	553.0 552.9						Topsoil - 1.0"						
		6 6 10	13	1		4.0	FILL: Hard brown SILT AND CLAY (A-6a), trace fine to coarse sand, trace gravel; contains concrete fragments; damp.						
3.0	550.0						Loose to medium dense brown SANDY SILT (A-4a), trace clay, trace gravel; damp.						
5		4 3 4	14	2		1.0							
		4 5 10	16	3		1.5							
10		5 7 10	12	4									
		14 14 14	17	5			@ 11.0', little gravel.						
14.0	539.0	12 50/5	10	6			Hard brown SANDSTONE; fine grained, slightly weathered, thinly bedded, highly fractured. @ 15.4', 16.4', 17.3', 20.9', clay seams @ 17.8', gray.						
15													
20		Core 120"	Rec 120"	RQD 61%	R1								
25.0	528.0						Bottom of Boring - 25.0'						
30													



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

LOG OF: Boring TR-76
Location: As Per Plan
Date Drilled: 3/30/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 4.0' (inside hollow stem augers)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	GRADATION % Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0.2	554.5 554.3						Topsoil - 2.0"						
		4 6 7	12	1		4.5+	Hard brown SILT AND CLAY (A-6a), trace fine to coarse sand, trace gravel; damp.						
		2 3 5	10	2		4.0							
5.5	549.0						Medium dense brown SANDY SILT (A-4a), little gravel; damp.						
		2 7 15	17	3									
		5 9 12	16	4									
							@ 11.0', contains sandstone fragments						
		11 12 13	18	5									
14.5	540.0	1 6 50/5	17	6			Medium hard brown SANDSTONE; decomposed.						
16.1	538.4	Core 120"	Rec 120"	RQD 64%	R1		Hard brown SANDSTONE; very fine to fine grained, moderately to highly weathered, medium bedded, moderately fractured. @ 16.4'-16.8', 17.3', 18.4', clay seams @ 19.4' gray @ 20.9'-21.3', fractured.						
25.0	529.5						Bottom of Boring - 25.0'