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SCI-823-0.00

PID No. 19415

S.R. 823 RAMP B (S.B.) OVER U.S. 52

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

TABLE OF CONTENTS

<u>Table of Contents</u>	<u>Page No.</u>
1. Introduction.....	1
2. Design Criteria.....	1
3. Subsurface Conditions and Foundation Recommendation.....	1
4. Roadway.....	1
5. Proposed Structure Configurations.....	2
6. Preliminary Probable Bridge Construction Cost.....	4
7. Summary.....	5
8. Recommendations.....	6
APPENDIX A	5 Sheets
• Preliminary Probable Construction Cost Comparison	
APPENDIX B	2 Sheets
• Preliminary Site Plan – Alternative 1 (Sheet 1 of 2)	
• Structural Details – Alternative 1 (Sheets 2 of 2)	
APPENDIX C	1 Sheets
• Preliminary Vertical Clearance Calculations	
APPENDIX D	1 Sheet
• Conceptual Plans – Alternative 2 (Sheet 1 of 1)	
APPENDIX E	
• Preliminary Geotechnical Report	

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 Ramp (Ramp B) over U.S. Route 52 at the proposed US 52 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, three test borings (TR-64, TR-66 and TR-77) were drilled and all of them encountered sandstone bedrock between 10.5, 17.0 and 11.0 feet below the existing ground surface, respectively.. The materials encountered generally were interbedded cohesive (sandy silt to silt & clay) and granular (sandy silt to gravel). 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.

Due to the structure curvature and long span, the abutments and piers were assumed for Alternative 1 & 2 to be supported on HP12x53 piles with a maximum design load of 70 tons. Since the piles will be driven to refusal onto hard bedrock, steel points, if required, 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 to be critical at this structure location. More than 17'-0" of preferred vertical clearance could be provided for all the alternatives considered for this study. The vertical clearance over US 52 dictated the vertical clearance provided for this structure. In accordance with the L&D manual, Volume 1, a 14.0' minimum horizontal offset to the toe of the Type D barrier placed in front of the MSE wall will need to be maintained beneath 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 mainline profile is located on the outside edge of pavement and is along a 1.80 % sloping grade. The horizontal and vertical geometry for all alternatives considered are the same. Embankment slopes for the alternatives 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 for a construction and aesthetic considerations to use similar structure type for that interchange. Due to the curved alignment and heavy skew, most of the concrete superstructure alternatives considered did not meet the span configuration studied for this structure. 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	2 span Continuous Steel Girders	5 span Continuous Steel Girders
Proposed Beam Spacing	3 Spaces @ 9'-0"	3 Spaces @ 9'-0"
No. of Spans	2	5
Abutment Type	Stub Type abutments with MSE-Walls	Stub Type abutments with spill-through slopes
No. of Piers	1	4
Pier Type	Cap & Column	T-type with integral pier cap
Substructure Orientation	72°15'31" to reference Chord	Abutments and Piers Radial
Approximate Bridge Length	354'	735'
Approximate Structure Depth		
Slab	8.75"	8.75"
Haunch	2"	2"
Girder	66"	72"
Total	76.75"(6.40')	82.75"(6.90')

Alternative Discussion:

Alternative 1

Span configuration: Various span configurations were investigated and they were refined to the 2-span layout configuration. Horizontal Clearance requirements dictated the types of the bridges that could be studied. Alternative 1 consists of a long, 2 span bridge with Mechanically Stabilized Earth (MSE) abutments located outside the horizontal clearances. These MSE walls could be continuous between the southbound ramp bridges over the existing Ohio River Road and the approach embankment. The bridge overall length is 354' (185'-169') from centerline of bearing to centerline of bearing measured along the curve.

Substructure: This alternative is comprised of two spans. 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 H- piles with MSE walls. The piles will be driven to bedrock. Straight or U-turned type wingwall will also be provided at each abutment. The details of the abutments and MSE wingwalls will follow ODOT Standard Construction drawings.
- II. Piers: Cap and Column type pier, will be provided in the median of US 52. It is anticipated that pier will be founded on H-piles driven to bedrock.

Superstructure: The preliminary design of this alternative indicates that 4 - continuous steel 66" Plate Girder spaced at 9'-0" would be required for each 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. The girders will be set straight with a bend point located at the field splice location. Variable deck overhangs will be required to accommodate the deck curvature.

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 abutment and pier units were placed perpendicular (radial) to the proposed ramp alignment. The bridge overall length is 735' from centerline of bearing to centerline of bearing.

Substructure: This alternative is comprised of five spans (100'-120'-205'-180'-130'). The abutments and piers were located 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 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 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 steel 72" 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. The girders will be set straight with a bend point located at the field splice location. Variable deck overhangs will be required to accommodate the deck curvature.

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 in the same manner 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	2-span continuous 66" steel Girders, A709 Grade 50 painted with a composite reinforced concrete deck slab supported by reinforced concrete stub abutments on piles	Structure Cost: \$2,520,000	1	<p><i>Advantages:</i></p> <ul style="list-style-type: none"> • This alternative is the least expensive to construct. • Shorter bridge length. <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> • Longer substructure units. • Heavy Skew
2	5-span continuous 72" 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: \$3,360,000	2	<p><i>Advantages:</i></p> <ul style="list-style-type: none"> • This alternative will eliminate the skew of the substructure units. <p><i>Disadvantages:</i></p> <ul style="list-style-type: none"> • Will increase the bridge length. • Provide complexity for future widening due to the pier type.

8. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 1 (Simple Span, 66" 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 structure for this site.
- MSE wall type embankment is required for the approach roadway therefore making this alternative more aesthetically pleasant.

APPENDIX A



**SCI-823-0.00 - PORTSMOUTH BYPASS
RAMP B (SB) OVER US 52 - US 52 INTERCHANGE,**

STRUCTURE TYPE STUDY

Date: 6/30/2005
Date: 7/7/2005

By: NFF
Checked: ELK

ALTERNATIVE COST SUMMARY

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	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
1	2	185.0' - 169.0'	354.00	4- Welded Plate Girders MSE wall abutment	66" Web PG Grade 50	\$1,219,000	\$592,000	\$289,800	\$420,200	\$2,520,000
2	5	100'-120'-205'-180'-130'	735.00	4 - Welded Plate Girders	72" Web PG Grade 50	\$2,068,000	\$346,000	\$386,200	\$560,000	\$3,360,000

NOTES:

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

**SCI-823-0.00 - PORTSMOUTH BYPASS
RAMP B (SB) OVER US 52 - US 52 INTERCHANGE.
STRUCTURE TYPE STUDY - STEEL GIRDER ALTERNATIVES- SUPERSTRUCTURE**

By: NFF
Checked: ELK
Date: 5/13/2005
Date: 7/7/2005

SUPERSTRUCTURE

Alternative No.	No. Spans	Span Arrangement 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	2	185.0' - 169.0'	354	361	468	\$279,500	\$117,400	\$82,500	4 - Welded Plate Girders MSE wall abutment	66" Web PG Grade 50	537,000	\$739,500	\$1,219,000
2	5	100'-120'-205'-180'-130'	735	742	982	\$586,400	\$246,400	\$30,300	4 - Welded Plate Girders	72" Web PG Grade 50	999,600	\$1,204,400	\$2,068,000

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.)
All 1		0.73	33.00
All 2		0.75	33.00
		Haunch & Overhang Area	Total Concrete Area
		2.4	35.0
		2.5	35.7

Note: Deck width is out to out 10% of deck area allowed for haunches and overhangs.

GC/QA Concrete, Class OSC2

Unit Cost (\$/cu. yd.):	Year	Annual Escalation
	2004	
Deck		
Parapets	\$491.00	3.5%
Parapets	\$615.00	3.5%
Weighted Average =	\$795.00	
Based on parapet and slab percentages of total concrete area	\$597.00	

Epoxy Coated Reinforcing Steel

Unit Cost (\$/lb):	Year	Annual Escalation
	2004	
Deck Reinforcing	\$0.77	3.5%
Assume 285 lbs of reinforcing steel per cubic yard of deck concrete		
	2007	
	\$0.88	

Structural Steel Unit Costs (\$/lb.):

Cost Ratio	Year	Annual Escalation
n/a	2004	
n/a	\$0.74	3.5%
n/a	\$1.05	3.5%
n/a	\$1.20	3.5%

Reinforced Concrete Approach Slabs (T=15')

Unit Cost (\$/sq. yd.):	Year	Annual Escalation
	2004	
	\$165.00	3.5%
	\$165.00	

Length = 25 ft. Wkth = 90 ft. Area = 250 sq. yd.
Length = 25 ft. Wkth = 33 ft. Area = 92 sq. yd.

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

Cost Ratio	Year	Annual Escalation
1.00	2003	
	\$863.00	3.5%
	\$1,097.98	

**SCI-823-0.00 - PORTSMOUTH BYPASS
RAMP B (SB) OVER US 52 - US 52 INTERCHANGE,
STRUCTURE TYPE STUDY - STEEL GIRDER ALTERNATIVES - SUBSTRUCTURE**

By: NFF
Checked: ELK

Date: 6/30/2005
Date: 7/17/2005

SUBSTRUCTURE -HP PILE

Alternative No.	Span Arrangement No. Spans	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	Temporary Girder Support Cost	Subtotal Substructure Cost
1	2	185.0' - 169.0'	4- Welded Plate Girders MSE wall abutment	66" Web PG Grade 50	\$52,500	\$12,000	\$207,100	\$34,000	\$43,600	\$242,400	\$0	\$0	\$592,000
2	5	100'-120'-205'-180'-130'	4 - Welded Plate Girders	72" Web PG Grade 50	\$170,500	\$38,800	\$82,600	\$10,300	\$83,700	\$0	\$0	\$0	\$346,000

COST SUPPORT CALCULATIONS

Pier OC/QA Concrete, Class QSC1 Cost: (HP-Pile)				Pier Foundation Unit Cost (\$/ft.)				HP 12x63 Piles, Furnished & Driven					
Component	Alt 1 Volume (cu. yd.)	Alt 2 Volume (cu. yd.)	Year 2004 Cost	Year 2008 Cost	Alt 1 Total Cost	Alt 2 Total Cost	Number of Piles	Total Pile Length	HP Drilled Shaft Option no. of HP	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost	Year 2008 Total Cost
Cap	43	110	\$421.00	\$483.00	\$20,660	\$53,170	58	1,294	58	\$20.15	3.5%	\$23.10	\$1,341
Columns	24	73	\$421.00	\$483.00	\$11,700	\$35,420	102	1,890	1,294	\$9.24	3.5%	\$10.60	\$1,167
Footings	42	169	\$421.00	\$483.00	\$20,130	\$81,860							
Total Cost					\$52,500	\$170,500							\$33,700
Pier OC/QA Concrete, Class QSC1 Cost: (HP-Pile/Drilled Shaft)				Shaft Foundation Unit Cost (\$/ft.)				MSE Abutment Unit Cost (\$/sq. ft.)					
Component	Alt 1 Volume (cu. yd.)	Alt 2 Volume (cu. yd.)	Year 2004 Cost	Year 2008 Cost	Alt 1 Total Cost	Alt 2 Total Cost	Number of Shafts	Furnished Total	Driven Total	Escalation	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost
Cap	0	0	\$421.00	\$483.00	\$0	\$0							
Columns	0	0	\$421.00	\$483.00	\$0	\$0							
Footings	0	0	\$421.00	\$483.00	\$0	\$0							
Total Cost					\$0	\$0							
Abutment QC/QA Concrete, Class QSC1 Cost:				Shaft Foundation Unit Cost (\$/ft.)				MSE Abutment Unit Cost (\$/sq. ft.)					
Alternative 1	Volume (cu. yd.)	Year 2004 Cost	Year 2008 Cost	Alt 1 Total Cost	Alt 2 Total Cost	Escalation	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost	Year 2008 Total Cost	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost
Abutment	380	\$421.00	\$483.00	\$188,300	\$188,300	3.5%	\$300.00	4.5%	\$358.00	\$131,160	\$300.00	4.5%	\$358.00
Wingwalls	39	\$421.00	\$483.00	\$18,800	\$18,800	3.5%	\$300.00	4.5%	\$358.00	\$13,116	\$300.00	4.5%	\$358.00
Alternative 2	Volume (cu. yd.)	Year 2004 Cost	Year 2008 Cost	Total Cost	Total Cost	Escalation <td>Year 2004 Unit Cost</td> <td>Annual Escalation <td>Year 2008 Unit Cost</td> <td>Year 2008 Total Cost</td> <td>Year 2004 Unit Cost</td> <td>Annual Escalation</td> <td>Year 2008 Unit Cost</td> </td>	Year 2004 Unit Cost	Annual Escalation <td>Year 2008 Unit Cost</td> <td>Year 2008 Total Cost</td> <td>Year 2004 Unit Cost</td> <td>Annual Escalation</td> <td>Year 2008 Unit Cost</td>	Year 2008 Unit Cost	Year 2008 Total Cost	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost
Abutment	118	\$421.00	\$483.00	\$56,900	\$56,900	3.5%	\$300.00	4.5%	\$358.00	\$38,484	\$300.00	4.5%	\$358.00
Wingwalls	12	\$421.00	\$483.00	\$5,700	\$5,700	3.5%	\$300.00	4.5%	\$358.00	\$620	\$300.00	4.5%	\$358.00
Epoxy Coated Reinforcing Steel				MSE Abutment Unit Cost (\$/sq. ft.)				Temporary Shoring and Support Unit Costs (\$/sq. ft.)					
Component	Volume (cu. yd.)	Year 2004 Cost	Year 2008 Cost	Alt 1 Total Cost	Alt 2 Total Cost	Escalation	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost	Year 2008 Total Cost	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost
Abutment	118	\$0.77	\$0.88	\$90.86	\$90.86	3.5%	\$0.77	3.5%	\$0.88	\$90.86	\$22.50	3.5%	\$25.80
Wingwalls	12	\$0.77	\$0.88	\$9.24	\$9.24	3.5%	\$0.77	3.5%	\$0.88	\$9.24	\$22.50	3.5%	\$25.80
Total				\$100.10	\$100.10					\$100.10	\$45.00		\$55.10
Temporary Shoring and Support Unit Costs (\$/sq. ft.)				Total Shaft Length				Temp. Shoring Area (sq. ft.)					
Component	Volume (cu. yd.)	Year 2004 Cost	Year 2008 Cost	Alt 1 Total Cost	Alt 2 Total Cost	Escalation	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost	Year 2008 Total Cost	Year 2004 Unit Cost	Annual Escalation	Year 2008 Unit Cost
Abutment	118	\$22.50	\$25.80	\$2,640	\$2,640	3.5%	\$22.50	3.5%	\$25.80	\$2,640	\$22.50	3.5%	\$25.80
Wingwalls	12	\$22.50	\$25.80	\$270	\$270	3.5%	\$22.50	3.5%	\$25.80	\$270	\$22.50	3.5%	\$25.80
Total				\$2,910	\$2,910					\$2,910	\$22.50		\$28.60

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

SCI-823-0.00 - PORTSMOUTH BYPASS
RAMP B (SB) OVER US 52 - US 52 INTERCHANGE,
STRUCTURE TYPE STUDY - STEEL GIRDER ALTERNATIVES - QUANTITY CALCULATIONS

By: NFF
Checked: ELK

Date: 6/30/2005
Date: 7/7/2005

Pier Location	Cap		Column		Footing		Total Volume
	Length	Area	Volume	Area	Volume	Area	
Pier 1	110	0	0	0	0	0	2934
Pier 2	0	0	0	0	0	0	0
Pier 3	0	0	0	0	0	0	0
Pier 4	0	0	0	0	0	0	0
Pier 5	0	0	0	0	0	0	0
Pier 6	0	0	0	0	0	0	0
Pier 7	0	0	0	0	0	0	0
Total (Cu.Yd.)	110	0	0	0	0	0	2934
Total (Cu.Yd.)	110	0	0	0	0	0	42

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	892	140	12	1.3	16	560.5	538.5	24.0	384
Pier 1	655	4	2620	440	140	22	1.25	26	565.5	553	12.0	312
Pier 2	0	0	0	0	140	0	1.25	0	0	0	0	0
Pier 3	0	0	0	0	140	0	1.25	0	0	0	0	0
Pier 4	0	0	0	0	140	0	1.25	0	0	0	0	0
Pier 5	0	0	0	0	140	0	1.25	0	0	0	0	0
Pier 6	0	0	0	0	140	0	1.25	0	0	0	0	0
Pier 7	0	0	0	0	140	0	1.25	0	0	0	0	0
Fwd. Abut.	200	4	800	686	140	11	1.3	14	567	534	33.0	462
Total								58				1284

Pier Location	Cap		Column		Footing		Total Volume
	Length	Area	Volume	Area	Volume	Area	
Pier 1	33	0	0	0	0	0	2382
Pier 2	33	0	0	0	0	0	2382
Pier 3	33	0	0	0	0	0	2382
Pier 4	33	0	0	0	0	0	2382
Pier 5	0	0	0	0	0	0	0
Pier 6	0	0	0	0	0	0	0
Pier 7	0	0	0	0	0	0	0
Total (Cu.Ft.)	198	0	0	0	0	0	9528
Total (Cu.Yd.)	110	0	0	0	0	0	323

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.	350	4	1400	250	140	7	1.25	9	520.5	538.5	35.0	315
Pier 1	500	4	2000	357	140	13	1.25	16	545.5	533	15.0	240
Pier 2	650	4	2600	400	140	21	1.25	26	545.5	533	15.0	390
Pier 3	650	4	2600	357	140	21	1.25	26	545.5	533	15.0	390
Pier 4	500	4	2000	357	140	17	1.25	21	545.5	533	15.0	315
Pier 5	0	0	0	0	140	0	1.25	0	0	0	0	0
Pier 6	0	0	0	0	140	0	1.25	0	0	0	0	0
Pier 7	0	0	0	0	140	0	1.25	0	0	0	0	0
Fwd. Abut.	200	4	800	239	140	7	1.25	9	567	534	35.0	462
Total								102				1890

Abut Location	Backwall		Beam Seat		Footing		Total Volume
	Length	Area	Volume	Area	Volume	Area	
Rear Abut.	130	1.75	12.94	953	4.33	2.5	1033
Pier 1	100	1.75	7.36	12.94	4.33	2.5	1033
Pier 2	100	1.75	7.36	12.94	4.33	2.5	1033
Pier 3	100	1.75	7.36	12.94	4.33	2.5	1033
Pier 4	100	1.75	7.36	12.94	4.33	2.5	1033
Pier 5	0	0	0	0	0	0	0
Pier 6	0	0	0	0	0	0	0
Pier 7	0	0	0	0	0	0	0
Total (Cu.Ft.)	530	11.0	29.72	1980	18.9	11.7	5133
Total (Cu.Yd.)	310	6.7	18.0	1190	11.7	7.2	3100

Location	Wt of girder (lb)	# Girders	Span Length	Total Weight	Superstructure Steel Quantities - Alt 2				
					Location	Wt of girder	# Girders		
Span 1	379	4	185	200636	Span 1	340	4	100	136000
Span 2	379	4	189	256364	Span 2	340	4	120	163200
Span 3	0	0	0	0	Span 3	340	4	205	278800
Span 4	0	0	0	0	Span 4	340	4	180	244800
Span 5	0	0	0	0	Span 5	340	4	130	176800
Span 6	0	0	0	0	Span 6	0	0	0	0
Span 7	0	0	0	0	Span 7	0	0	0	0
Span 8	0	0	0	0	Pier Cap	0	0	0	0
Total				537000	Total				959500

Location	Height		Area
	Length	Weight	
Pier 3	0	0	0
Pier 4	0	0	0
Pier 5	0	0	0
Total (Sq.Ft.)	0	0	0

Abut Location	Wall		Volume
	Height	Length	
Rear Abut.	7	100	1700.0
Pier 1	17	100	3910
Total (Cu.Ft.)			5610

Abut Location	No. Joints	Length	Total
Rear Abut.	0	0	0
Pier 1	0	0	0
Total (L.Ft.)			0

Pier Location	Cap		Column		Footing		Total Volume
	Length	Area	Volume	Area	Volume	Area	
Pier 1	0	0	0	0	0	0	0
Pier 2	0	0	0	0	0	0	0
Pier 3 (D.Shell)	0	0	0	0	0	0	0
Pier 4 (D.Shell)	0	0	0	0	0	0	0
Pier 5 (D.Shell)	0	0	0	0	0	0	0
Pier 6	0	0	0	0	0	0	0
Pier 7	0	0	0	0	0	0	0
Total (Cu.Ft.)	0	0	0	0	0	0	0
Total (Cu.Yd.)	0	0	0	0	0	0	0

Location	Load/girder (Kips)	# Girders	Total Load (Kips)	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	0	1.1	0	0	0	0	0
Pier 1	0	4	0	0	0	0	1.25	0	0	0	0	0
Pier 2	0	4	0	0	0	0	1.25	0	0	0	0	0
Pier 3	0	4	0	0	0	0	1.1	0	0	0	0	0
Pier 4	0	4	0	0	0	0	1.1	0	0	0	0	0
Pier 5	0	4	0	0	0	0	1.1	0	0	0	0	0
Pier 6	0	4	0	0	0	0	1.25	0	0	0	0	0
Pier 7	0	4	0	0	0	0	1.25	0	0	0	0	0
Fwd. Abut.	0	4	0	0	0	0	1.25	0	0	0	0	0
Total								0				0

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

total steel weight per girder (lb.) = 134250
Total Span length (ft.) = 354.00
Weight Per ft. = 379

**SCI-823-0.00
RAMP B (SB) OVER US 52 - US 52 INTERCHANGE,
STRUCTURE TYPE STUDY**

Dr. NFE
Checked: ELK
Date: 5/26/2005
Date: 7/17/2005

LIFE CYCLE MAINTENANCE COST

AIL No.	Span Arrangement		Structural Steel Painting		Superstructure Sealing		Approach Pavement Resurfacing		Total Relative Ownership Cost	
	No. Spans	Lengths	Cost Per Cycle	Number of Cycles	Cost Per Cycle	Number of Cycles	Cost Per Cycle	Number of Cycles		
1	2	354.00	4-- Welded Plate Girders MSE wall abutment	2	\$211,700	2	\$443,400	0	\$0	\$3,535,000
2	5	735.00	4-- Welded Plate Girders	2	\$920,800	0	\$0	0	\$0	\$5,477,000
3	0	0.00	0	0	\$0	2	\$0	7	#REF!	#REF!

AIL No.	Span Arrangement		Bridge Deck Overlay (5)		Deck Resurfacing (6)		Total Initial Construction Cost	Superstructure Life Cycle Maintenance Cost (1)	Total Life Cycle Cost
	No. Spans	Lengths	Deck Overlay	Cost	Deck Resurfacing Cost (2)	Deck Removal Cost			
1	2	354	1	\$78,300	n/a	n/a	\$96,700	\$1,015,000	\$2,520,000
2	5	735	1	\$162,600	n/a	n/a	\$200,800	\$2,117,000	\$3,360,000
3	0	0	1	#REF!	n/a	n/a	#REF!	#REF!	\$0

Structural Steel Painting:

AIL No.	Web Depth (in.)	Flange Width (in.)	Total Span Length (ft.)	Assumed Area (sq. ft.)	Annual Exclusion	Year
AIL 1	54	16.00	354.00	18,408	20%	2008
AIL 2	54	16.00	735.00	38,220	20%	2008
AIL 3	54	16.00	735.00	38,220	20%	2008
AIL 4	54	16.00	735.00	38,220	20%	2008
Total				\$10,033		

Superstructure Sealing:

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	26.00	11,682	3.5%	2008
AIL 2	2	12.73	24,255	3.5%	2008
AIL 3	2	12.73	24,255	3.5%	2008
AIL 4	2	12.73	24,255	3.5%	2008
Total			\$9,28		

Bridge Deck Overlay (Item 848):

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	11,682	\$9,28	3.5%	2008
AIL 2	2	24,255	\$9,28	3.5%	2008
AIL 3	2	24,255	\$9,28	3.5%	2008
AIL 4	2	24,255	\$9,28	3.5%	2008
Total			\$37,07		

Bridge Deck Resurfacing:

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	11,682	\$9,28	3.5%	2008
AIL 2	2	24,255	\$9,28	3.5%	2008
AIL 3	2	24,255	\$9,28	3.5%	2008
AIL 4	2	24,255	\$9,28	3.5%	2008
Total			\$37,07		

PS Concrete Area:

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	6	12,000	3.5%	2008
AIL 2	2	6	12,000	3.5%	2008
AIL 3	2	6	12,000	3.5%	2008
AIL 4	2	6	12,000	3.5%	2008
Total			\$9,68		

Bridge Decking:

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	11,682	\$9,28	3.5%	2008
AIL 2	2	24,255	\$9,28	3.5%	2008
AIL 3	2	24,255	\$9,28	3.5%	2008
AIL 4	2	24,255	\$9,28	3.5%	2008
Total			\$37,07		

Bridge Deck Overlay (Item 848):

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	11,682	\$9,28	3.5%	2008
AIL 2	2	24,255	\$9,28	3.5%	2008
AIL 3	2	24,255	\$9,28	3.5%	2008
AIL 4	2	24,255	\$9,28	3.5%	2008
Total			\$37,07		

Bridge Deck Resurfacing:

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	11,682	\$9,28	3.5%	2008
AIL 2	2	24,255	\$9,28	3.5%	2008
AIL 3	2	24,255	\$9,28	3.5%	2008
AIL 4	2	24,255	\$9,28	3.5%	2008
Total			\$37,07		

PS Concrete Area:

AIL No.	Disp.	No.	Total Area (sq. ft.)	Annual Exclusion	Year
AIL 1	1	6	12,000	3.5%	2008
AIL 2	2	6	12,000	3.5%	2008
AIL 3	2	6	12,000	3.5%	2008
AIL 4	2	6	12,000	3.5%	2008
Total			\$9,68		

- NOTES:**
- Life cycle maintenance costs assume a 75-year structure life, and are expressed in present value (2008 construction year) dollars.
 - Bridges are assumed to have semi-integral abutments, therefore no strip seal dock joints will be required.
 - See Superstructure Cost sheet.
 - See Alternative Cost Summary sheet.
 - 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.
 - Life cycle maintenance cost differences are assumed to be predominantly a function of superstructure maintenance costs. Consequently, substructure lifecycle maintenance costs are not included in this analysis.

Approach Pavement Resurfacing:
Resurfacing Perpetual Asphalt Pavement:
Resurfacing Units Costs:
Pavement Planning, Asphalt Concrete, per sq. yd. \$0.98
Asphalt Concrete Surface Course, per cu. yd. \$72.00
Asphalt Resurfacing Costs:
Approach Roadway Length (ft.) (4) 33.0
Resurfacing Area (sq. yd.) Thickness (in.) 1.50
Wearing Course Volume (cu. yd.) 0.0

Approach Resurfacing Costs:
Resurfacing Perpetual Asphalt Pavement:
Resurfacing Units Costs:
Pavement Planning, Asphalt Concrete, per sq. yd. \$0.98
Asphalt Concrete Surface Course, per cu. yd. \$72.00
Asphalt Resurfacing Costs:
Approach Roadway Length (ft.) (4) 33.0
Resurfacing Area (sq. yd.) Thickness (in.) 1.50
Wearing Course Volume (cu. yd.) 0.0

Bridge Deck Overlay (Item 848):
Bridge Deck Overlay Cost per sq. yd.:
Micro Silica Modified Concrete Overlay (Using Hydroexemplation)
Hand Chipping
Bridge Deck MSC Overlay Cost per sq. yd.:
Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only \$144.00

Bridge Deck Resurfacing:
Bridge Deck Resurfacing Cost per sq. yd.:
Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only \$144.00
Deck Area (3) Deck Area (sq. ft.) Deck Area (sq. ft.)
AIL 1 11,682 2,985
AIL 2 24,255 2,985
AIL 3 24,255 2,985
AIL 4 24,255 2,985
Total 84,447 11,940

PS Concrete Area:
PS Concrete Area Replacement Cost per foot:
Elastomeric Strip Seal Guard \$59.50
Assume girder replacement cost equals 25% of original deck joint construction cost.

Bridge Deck Overlay (Item 848):
Bridge Deck Overlay Cost per sq. yd.:
Micro Silica Modified Concrete Overlay (Using Hydroexemplation)
Hand Chipping
Bridge Deck MSC Overlay Cost per sq. yd.:
Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only \$144.00

Bridge Deck Resurfacing:
Bridge Deck Resurfacing Cost per sq. yd.:
Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only \$144.00
Deck Area (3) Deck Area (sq. ft.) Deck Area (sq. ft.)
AIL 1 11,682 2,985
AIL 2 24,255 2,985
AIL 3 24,255 2,985
AIL 4 24,255 2,985
Total 84,447 11,940

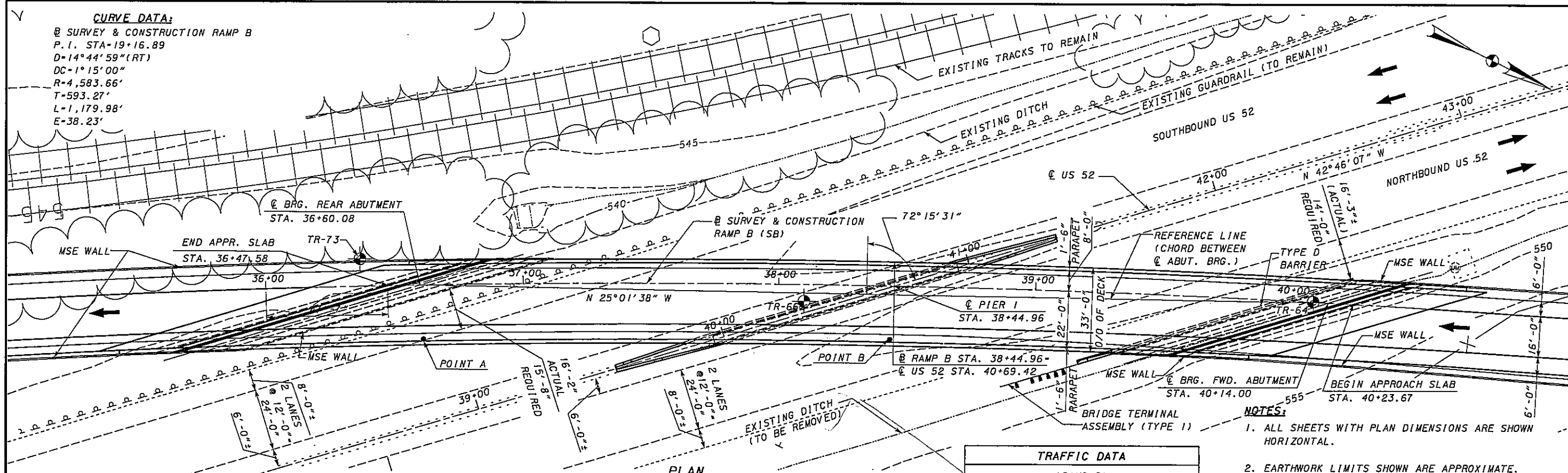
PS Concrete Area:
PS Concrete Area Replacement Cost per foot:
Elastomeric Strip Seal Guard \$59.50
Assume girder replacement cost equals 25% of original deck joint construction cost.

APPENDIX B



CURVE DATA:

@ SURVEY & CONSTRUCTION RAMP B
 P.I. STA. 19+16.89
 D=14°44'59" (RT)
 DC=1°15'00"
 R=4,583.66'
 T=593.27'
 L=1,179.98'
 E=38.23'



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.

PROPOSED STRUCTURE

TYPE: 2 SPAN CONTINUOUS STEEL PLATE GIRDER A709 GRADE 50 WITH COMPOSITE DECK REINFORCED CONCRETE SUPPORTED BY REINFORCED CONCRETE SUBSTRUCTURES ON PILES.
 SPANS: 185'-0", 169'-0"
 C/C BEARINGS (MEASURED ALONG CURVE).
 WIDTH: 30'-0" TOE TO TOE OF PARAPETS
 SKEW: 72°15'31" LEFT FORWARD (TO REFERENCE CHORD)
 LOADING: HS25, CASE 1 AND ALTERNATE MILITARY LOADING, FUTURE WEARING SURFACE OF 60 PSF.
 WEARING SURFACE: 1" MONOLITHIC CONCRETE
 APPROACH SLAB: AS-1-B1 (30'-0" LONG)
 ALIGNMENT: 1°15'00" CURVE RIGHT
 SUPERELEVATION: 0.0255 FT/FT AND 0.040 FT/FT
 LATITUDE:
 LONGITUDE:
 STRUCTURE FILE NO.:

TRAFFIC DATA
(RAMP B)

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

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

- NOTES:**
- ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
 - EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.
 - 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 12x53 PILES AND HAVE A MAXIMUM CAPACITY OF 70 TONS PER PILE.

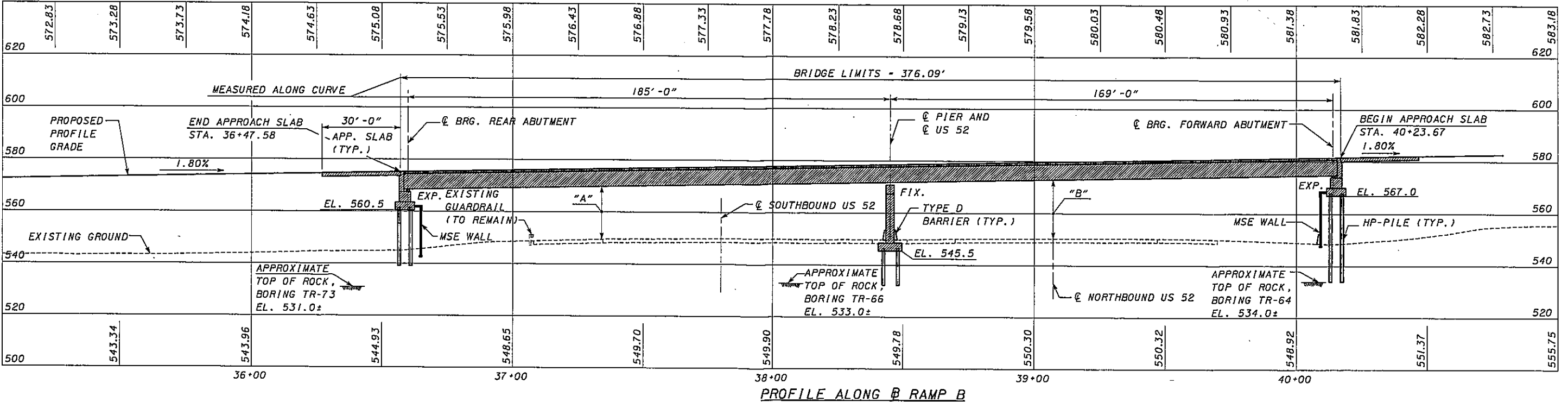
UTILITIES
UTILITIES DISPOSITION WILL BE ADDRESSED IN THE TS & L SUBMITTAL

TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	18.83'	21.20'
REQUIRED	17.0'	17.0'

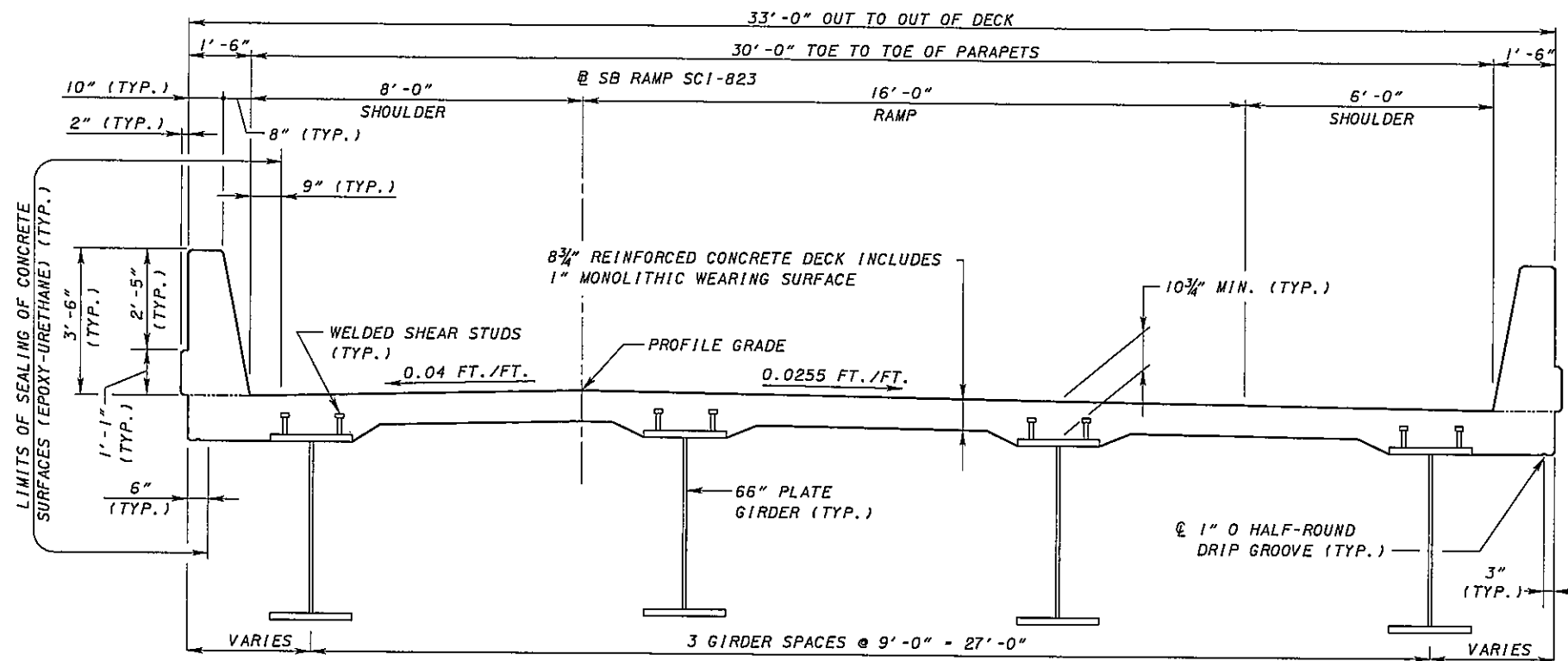
BORING LOCATIONS

BORING No.	STATION	OFFSET
TR-64	40+08.17	0'
TR-66	38+09.92	6.58' RT.
TR-73	36+37.08	10.67' RT.



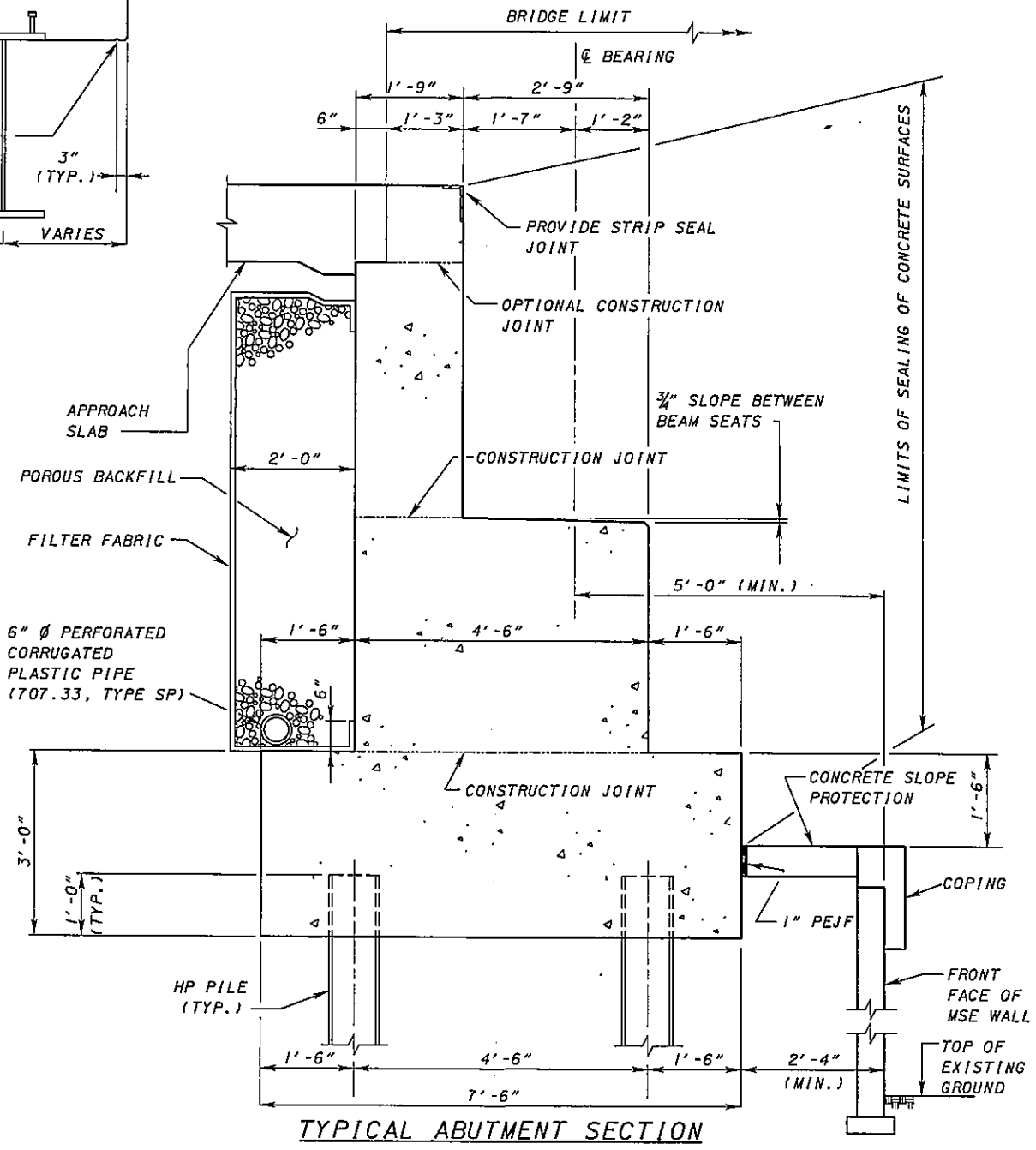
PROFILE ALONG @ RAMP B

DESIGN AGENCY: TRANS SYSTEMS CORPORATION
 DATE: 07/13/05
 REVIEWED: GHD
 DRAWN: NFF
 CHECKED: BTA
 SCIO TO COUNTY STA. 36+47.58 STA. 40+23.67
 PRELIMINARY SITE PLAN - ALTERNATIVE 1
 BRIDGE NO. SCI-823-XXXX
 S.R. 823 RAMP B (SB) OVER U.S. 52
 SCI-823-0.00
 PID 19415



TRANSVERSE SECTION

STEEL ALTERNATE STRUCTURE DEPTH	
SLAB	8 3/4"
HAUNCH	2"
GIRDER	66"
TOTAL	76.75"



TYPICAL ABUTMENT SECTION

DATE: 07/03/2005 FILE: g:\0003\0064\Bridges\BTS\03-5BRamp\J52\023-031.rvt.dgn

APPENDIX C

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 Structure _____
Description SR 823 SB RAMP OVER US 52 PID # 19415

Alternative 1 - 4 Steel Girders, 2 Span **Point Location: A**

Adjustment for Cross Slope

Comment	Grade	Offset			
2 Lanes:	-0.016	x	0	=	0.00
Shoulder to Beam CL:	-0.0255	x	20.5	=	-0.52
Total Adjustment =					-0.52

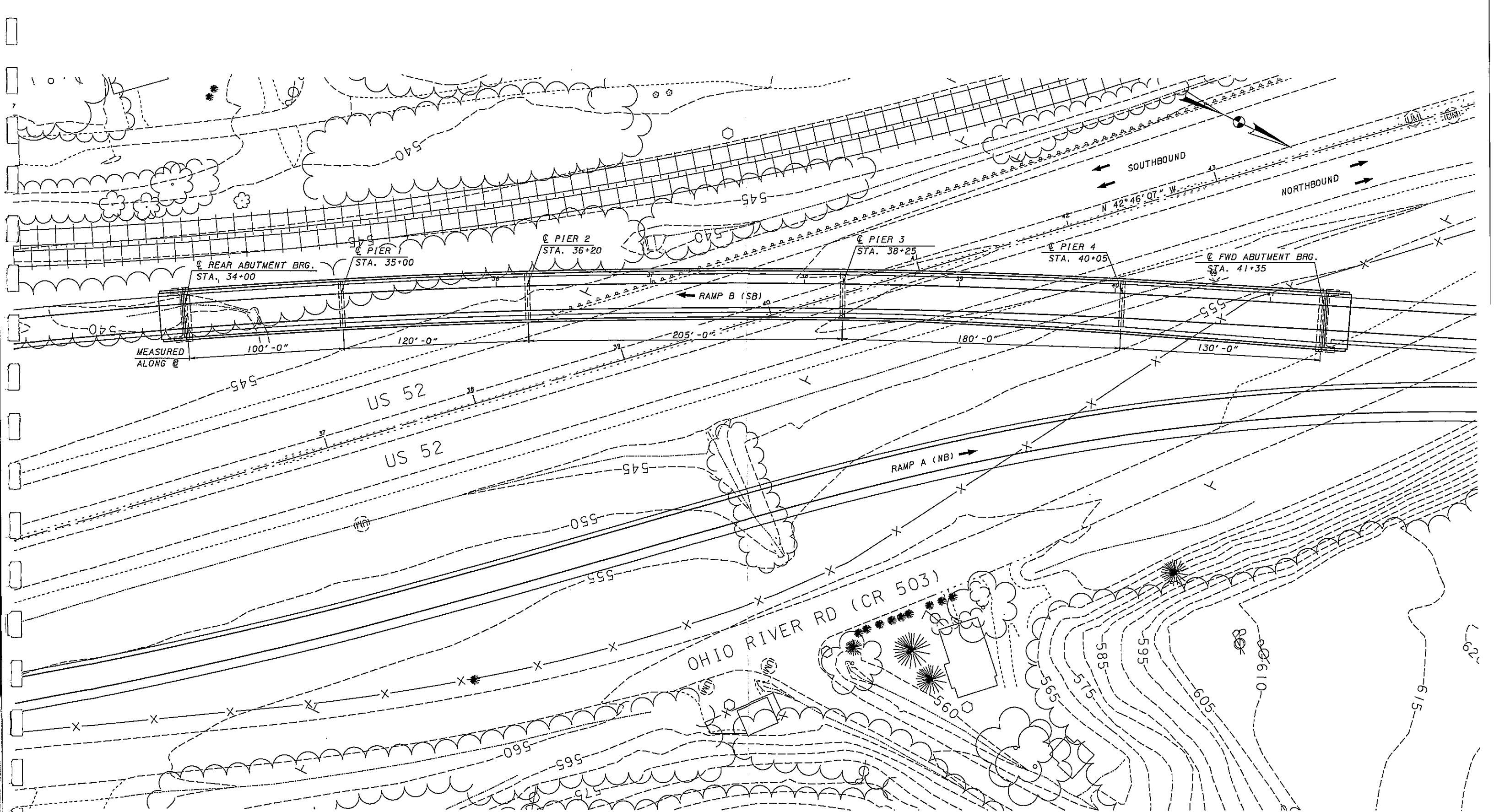
Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.75	0.73
Haunch:	2	0.17
Girder or Beam Depth:	<u>70</u>	<u>5.83</u>
	80.75	6.73
Total Superstructure Depth (ft) =		6.73

Vertical Clearance at Critical Point

	<u>US 52 Left</u>	<u>US 52 Left</u>	<u>US 52 Right</u>
Station @ Critical Point =	36+61.00	37+12.00	38+43.00
Offset Location @ Critical Point =	20.5' Right	20.5' Right	20.5' Right
Profile Grade Elevation at Critical Point =	575.28	576.20	578.55
Adjustment for Cross Slopes to Beam CL =	-0.52	-0.52	-0.52
Top of Deck Elevation @ Critical Point =	574.76	575.68	578.03
Total Superstructure Depth =	-6.73	-6.73	-6.73
Bottom of Beam Elevation @ Critical Point =	568.03	568.95	571.30
Approximate Top of Existing Ground @ Critical Point =	549.20	549.80	550.10
Actual Vertical Clearance =	18.83	19.15	21.20
Preferred Vertical Clearance =	17.0	17.0	17.0
Required Vertical Clearance =	16.5	16.5	16.5

APPENDIX D



RAMP B OVER U.S. 52 - ALTERNATIVE 2
 5-SPAN LAYOUT - CONTINUOUS STEEL PLATE GIRDERS

APPENDIX E





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.

Mr. Michael D. Weeks, P.E., P.S.

May 6, 2005

Page 2

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.

Mr. Michael D. Weeks, P.E., P.S.
May 6, 2005
Page 3

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.

Mr. Michael D. Weeks, P.E., P.S.
May 6, 2005
Page 4

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.



ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

Mr. Michael D. Weeks, P.E., P.S.

May 6, 2005

Page 5

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.



Mr. Michael D. Weeks, P.E., P.S.
May 6, 2005
Page 6

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

<u>Term</u>	<u>Blows/Foot Standard Penetration</u>
Very Loose	0 – 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	over 50

Cohesive Soils – Consistency

<u>Term</u>	<u>Unconfined Compression tons/sq.ft.</u>	<u>Blows/Foot Standard Penetration</u>	<u>Hand Manipulation</u>
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:

<u>Description</u>	<u>Size</u>	<u>Description</u>	<u>Size</u>
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:

<u>Term</u>	<u>Relative Moisture or Appearance</u>
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.

<u>Term</u>	<u>Relative Moisture or Appearance</u>
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

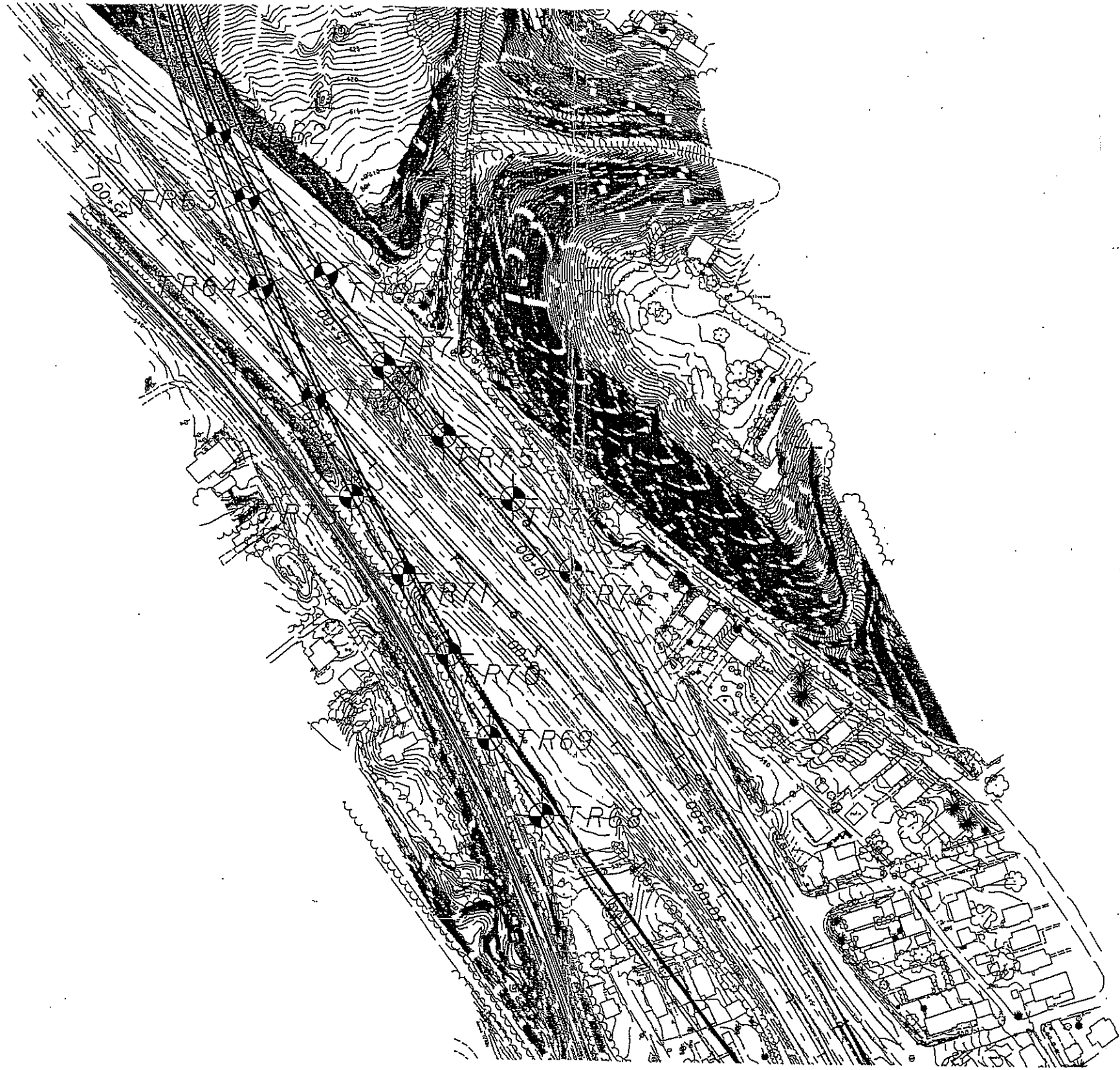
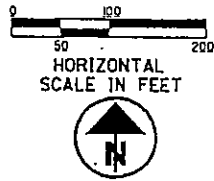
10. Rock Hardness and Rock Quality Designation

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

<u>Term</u>	<u>Description</u>
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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SCI-823-0.00
US 52 / SCI-823 Interchange

BORING LOCATION PLAN

LOG OF: Boring TR-62		Location: As Per Plan		Date Drilled: 3-18-05		GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL Blows per foot - ○ LL		
Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Hand Penetrometer (tsf)	WATER OBSERVATIONS:	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand		% F. Sand	% Silt
0	559.0	-	-	-	-	Water seepage at: None Water level at completion: 1.9' (with augers removed)		17	15	-	6	46	16
3.0	556.0	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.						
5.0		30/2	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						
16.0	543.0	Core 120"	Rec 120"	RQD R-1 78%			Bottom of Boring - 16.0'						

LOG OF: Boring TR-63

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetro-meter (tsf)	WATER OBSERVATIONS:	DESCRIPTION	GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL. ——— LL. ——— Blows per foot - ○ ——— 40			
				Drive	Press / Core				% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt		% Clay		
0	558.5						Water seepage at: none Water level at completion: 5.9' (includes drilling water)										
1.0	557.5	4			1	4.0		Topsoil - 12"									
		6	14					Very stiff to hard brown SANDY SILT (A-4a), some fine to coarse sand, little gravel; damp to moist.									
5		2			2	3.5											
		3	13														
		10			3												
		15	17														
		17															
9.0	549.5	13			4			Severely weathered gray SHALE fragments									
		50/5	8														
		50/4	2		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.									
14.0	544.5																
15																	
20																	
		Core 120"	Rec 113"		RQD 80%												
24.0	534.5							Bottom of Boring - 24.0'									
25																	
30																	

LOG OF: Boring TR-64

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (ft)	Sample No.	Drive	Hand Penetro-meter (tsf)	WATER OBSERVATIONS:	GRADATION							
								% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay		
0.1	549.0						<p>Water seepage at: None Water level at completion: 0.0' (inside hollow stem augers)</p> <p>DESCRIPTION</p> <p>Topsail - 1.0" Medium dense brown SANDY SILT (A-4a), trace to little gravel, trace clay; damp.</p> <p>@ 6.0', damp to moist</p> <p>Hard brown SANDSTONE; moderately weathered.</p> <p>Hard brown SANDSTONE; very fine to fine grained, slightly weathered, thinly bedded, highly fractured. @ 15.3', clay seam @ 15.7', gray.</p>								
5	548.9	6 7 5	14	1											
		7 11 12	16	2											
		7 11 15	17	3											
10	538.5	4 7 10	16	4											
10.5	537.5	50/4	2	5											
11.5															
15															
20															
21.5	527.5	Core 120"	Rec 1'18"	RQD R1 11%											
25															
30															

Bottom of Boring - 21.5'

Client: TranSystems, Inc.

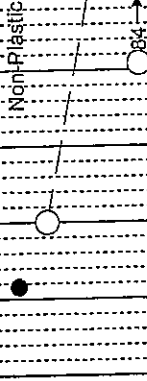
Project: SCI-823-0-00

LOG OF: Boring TR-65

Date Drilled: 3-22-05

Location: As Per Plan

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf)	WATER OBSERVATIONS: Water seepage at: 1.0' Water level at completion: 5.2' (includes drilling water)	DESCRIPTION	GRADATION						STANDARD PENETRATION (N) Natural Moisture Content, % - PL ——— LL Blows per foot - ○ — 40						
				Drive	Press / Core				% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay							
0	559.0																				
1		1	7	1		1.0		Very loose brown SILT (A-4b), little gravel, trace to little clay, some fine to coarse sand; damp to moist. @ 3.5', Medium dense.	11	16	—	9	48	16							
5		5	18	2		2.5															
		5	18	3		3.5															
		5	18	4																	
		6	17	5																	
		8	12	6																	
14.5	544.5	34	12	7																	
15		50/2	1																		
		50/1																			
19.0	540.0																				
20		Core 120"	Rec 120"	RQD R-1 54%																	
25																					
30		Core 60"	Rec 60"	RQD R-2 100%																	



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Job No. 0121-3070.03

Client: TranSystems, Inc.

Project: SCI-823-0.00

Date Drilled: 3-22-05

Location: As Per Plan

LOG OF: Boring TR-65

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Hand Penetrometer (tsf)	WATER OBSERVATIONS: Water seepage at: 1.0' Water level at completion: 5.2' (includes drilling water)	DESCRIPTION	GRADATION						STANDARD PENETRATION (N) Natural Moisture Content, % ● PL ○ LL	
								% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay		
30	529.0														
30.5	528.5						Bottom of Boring - 30.5'								
35															
40															
45															
50															
55															
60															

Client: TranSystems, Inc. Location: AS Per Plan Date Drilled: 3/30/05

LOG OF: Boring TR-66

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Hand Penetrometer (tsf)	WATER OBSERVATIONS:	GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - PL Blows per foot - LL
							% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	
0	550.0					Water seepage at: 16.0'-17.0' Water level at completion: 14.0' (prior to washing out) 8.0' (inside hollow stem augers)						
1.0	549.0	11				Asphalt Concrete Pavement - 10.0" Medium dense gray GRAVEL WITH SAND (A-1-b); damp. Medium dense brown SANDY SILT (A-4a), trace to little gravel; damp.						
2.0	548.0	10	12	1A 1B								
3.0	547.0	5		2	3.5	Very stiff brown SILT AND CLAY (A-6a), trace to little fine to coarse sand, trace gravel; damp. Medium dense brown SANDY SILT (A-4a), trace clay, trace gravel; contains sandstone fragments; damp.						
5	544.5	7	13									
10		10	10	3		@ 11.0'-12.5'; little clay; damp to moist.						
		7	9	4								
15		8	17	5	2.5	Hard brown SANDSTONE; fine grained, slightly weathered, thinly bedded, moderately fractured. @ 19.1', gray.						
		3	14	6								
17.0	533.0	11	13	7								
20		18										
25		50/3										
27.5	522.5	Core 120"	Rec 120"	RQD R1 58%								
30												Bottom of Boring - 27.5'

Project: SCI-823-0.00

Date Drilled: 4/27/04

Cifent: TranSystems, Inc.

LOG OF: Boring TR-68 Location: As Per Plan

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Drive Press / Core	Hand Penetro-meter (tsf)	WATER OBSERVATIONS:	GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL Blows per foot - ○	
								% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt		% Clay
0.3	537.0						Water seepage at: 13.5'							
3.0	536.7	4	9	16	1		Water level at completion: 4.5' (includes drilling water)							
5	534.0	4	8	13	2	4.0	Topsoil - 3"							
		5	6	11	3	3.5	POSSIBLE FILL: Very stiff brown SILT AND CLAY (A-6a), some fine to coarse sand, trace gravel; damp.							
10		5	8	11	4	1.0	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand; damp.							
11.0	526.0	5	15	21	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									
20		50/1	1		8									
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														
30														

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 Project: SCI-823-0.00

Job No. 0121-3070.03

Client: TranSystems, Inc. Location: As Per Plan Date Drilled: 4/27/04

LOG OF: Boring TR-68

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf)	WATER OBSERVATIONS: Water seepage at: 13.5' Water level at completion: 4.5' (includes drilling water)	GRADATION						STANDARD PENETRATION (N) Natural Moisture Content, % - PL ----- LL Blows per foot - O 40 10 20 30					
				Drive	Press / Core			% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay						
30	507.0						DESCRIPTION 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																			

Client: TranSystems, Inc. Project: SCI-823-0.00

Location: Approximately 16' east of boring location Date Drilled: 4/28/04

LOG OF: Boring TR-69

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Drive	Press / Core	Hand Penetrometer (tsf)	WATER OBSERVATIONS: Water seepage at: none Water level at completion: 5.0' (includes drilling water)	DESCRIPTION	GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ——— LL Blows per foot - ○ 40						
										% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt		% Clay					
0.3	539.0																				
5	538.7	5, 6, 8	15	1			3.0		Topsoil - 3" Very stiff to hard brown SILT AND CLAY (A-6a), little fine to coarse sand; damp.												
6.5		5, 9, 13	16	2			4.25														
9.0	532.5	7, 23, 23	18	3					Dense brown FINE SAND (A-3), little coarse sand, little gravel; moist.												
10	530.0	5, 12, 9	13	4			3.0		Very stiff brown SANDY SILT (A-4a), some fine to coarse sand; moist.												
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.												
15		50/2	0	6																	
19.5	519.5	50/1	0	7																	
20		50/1	0	8					Hard gray SANDSTONE; fine grained, slightly micaceous, occasional black laminations throughout.												
25									@ 26.8', 45 deg. fracture.												
29.6	509.4								@ 29.4'-29.6', medium hard gray SILTSTONE.												

Client: TranSystems, Inc.

Project: SCI-823-0.00

Date Drilled: 4/28/04

Location: Approximately 16' east of boring location

LOG OF: Boring TR-69

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Hand Penetrometer (tsf)	WATER OBSERVATIONS: Water seepage at: none Water level at completion: 5.0' (includes drilling water)	DESCRIPTION	GRADATION						STANDARD PENETRATION (N) Natural Moisture Content, % - PL ————— LL Blows per foot - ○ — 40													
								% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay														
30	509.0			Drive																							
				Press / Core																							

Bottom of Boring - 29.6'

Client: TranSystems, Inc.

Project: SCI-823-0.00

LOG OF: Boring TR-70

Location: 12' 3" east of boring location

Date Drilled: 4/28/04

Depth (ft)	Elev. (ft)	Blows per ft	Recovery (in)	Sample No.	Drive Press / Core	Hand Penetrometer (tsf)	WATER OBSERVATIONS:	DESCRIPTION	GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - PL ——— LL Blows per foot - 10 20 30 40				
									% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt		% Clay			
0	539.5						Water seepage at: none Water level at completion: 4.3' (includes drilling water)											
0.5	539.0							Topsoil - 6"										
5		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												
		1 5 5	11	3		1.5												
10		3 5 6	16	4		1.0		@ 11.0'-11.5', sand seam; contains few twigs; wet.										
		9 50/5	11	5A 5B		2.5		@ 11.5'-11.9', very stiff.										
13.8	525.7	58/4	2	6				@ 13.5'-13.8', weathered shale fragments. 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.										
20																		
23.8	515.7																	
25																		
30																		

Bottom of Boring - 23.8'

Project: SCI-823-0.00

Date Drilled: 4/28/04

Location: As Per Plan

LOG OF: Boring TR-71

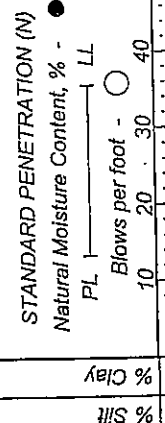
Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Drive	Hand Penetrometer (tsf)	WATER OBSERVATIONS:	GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - PL ———— LL Blows per foot — ○ — 40						
								% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt		% Clay					
0	544.0						Water seepage at: 8.5', 13.5'												
0.5	543.5						Water level at completion: 5.2' (includes drilling water)												
1		2	13	1		1.25	Topsoil - 6" Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand; moist.												
2		3				3.25													
3		4				1.75													
4		6	16	2			Medium dense brown SILT (A-4b), some fine sand, trace clay; wet. Medium dense brown COARSE AND FINE SAND (A-3a), little silt, trace gravel; wet. @ 12.4'-12.5', silty clay seam.												
5		7																	
6		8																	
7		9	18	3			Hard brown SANDY SILT (A-4a), some fine to coarse sand, trace gravel; damp. Brown and gray SHALE fragments.												
8	538.0																		
9		2	15	4A															
10	534.5	2		4B			Hard gray SANDSTONE; fine grained, occasional black laminations throughout. @ 18.8'-19.1', concretion.												
11		11																	
12		14	16	5															
13	530.5	14	10	6		4.5+	Brown and gray SHALE fragments.												
14		50/5																	
15		50/4	3	7															
16	528.0						Hard gray SANDSTONE; fine grained, occasional black laminations throughout. @ 18.8'-19.1', concretion.												
17		50/2	1	8															
18	525.3																		
19							Bottom of Boring - 28.7'												
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28																			
29																			
30																			

LOG OF: Boring TR-72

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf)	WATER OBSERVATIONS: Water seepage at: none Water level at completion: 4.7' (includes drilling water)	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				
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		5 9 8	17	2		3.75												
10		3 4 5 15		3		1.25		@ 6.0'-10.0', stiff.										
11.5	541.0	3 4 4 18		4		1.0		Dense brown GRAVEL WITH SAND (A-1-b), "and" fine to coarse sand, little silt; moist.										
13.5	539.0	7 23 45 29 50/2	15	5				Weathered gray SHALE fragments; also contains sandstone fragments.										
15		50/1	10	6														
19.2	533.3	50/1	0	8				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.										
25		Core 122"	Rec 122"	RQD 77%	R-1													
29.3	523.2																	
30																		Bottom of Boring - 29.3'

Client: TranSystems, Inc. Location: As Per Plan Date Drilled: 4/29/04

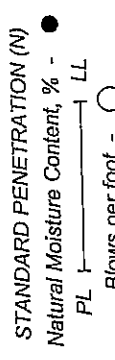
Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf)	WATER OBSERVATIONS:	GRADATION	STANDARD PENETRATION (N)
				Drive	Press / Core				
0	545.0						Water seepage at: 11.0'		
0.7	544.3	3		1		1.25	Water level at completion: 15.5' (includes drilling water)		
		3	8						
		4		2		1.5			
5		4	17						
		7							
		8		3		2.25			
		4	15						
		7							
		12		4		1.0			
		8	13						
		12							
11.0	534.0	26	9	5			Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand, trace gravel; moist.		
		50/3							
							Brown and gray SHALE fragments, little silty clay; wet.		
							@ 11.0'-11.8'; also contains sandstone fragments.		
							Medium hard gray SILTSTONE; broken.		
14.0	531.0	50/5	5	6			@ 14.0'-14.3'; hard brown sandstone.		
							Hard brown SANDSTONE; fine grained.		
15							@ 17.8'-24.0'; gray, occasional black laminations throughout.		
16.0	529.0						@ 23.5'-23.6', 23.7'-23.8'; high angle fractures.		
20		Core 120"	Rec 115"						
24.0	521.0						Bottom of Boring - 24.0'		
25									
30									



Project: SCI-823-0.00

Client: TranSystems, Inc. Location: As Per Plan Date Drilled: 4/29/04

LOG OF: Boring TR-74		Location: As Per Plan		Date Drilled: 4/29/04													
Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Hand Penetrometer (tsf)	WATER OBSERVATIONS: Water seepage at: 18.5' Water level at completion: 5.0' (includes drilling water)	GRADATION										
							% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay					
0	553.5																
0.5	553.0																
5																	
10																	
11.3	542.2																
15																	
19.2	534.3																
20																	
25																	
29.2	524.3																
30																	



DESCRIPTION

Topsoil - 6"
Very stiff to hard brown SANDY SILT (A-4a), some fine to coarse sand, trace gravel; damp.

Dense to very dense brown GRAVEL (A-1-a), some fine to coarse sand, trace silt; damp to moist.

@ 18.5'-18.7', gray siltstone fragments, little silty clay.

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.

Bottom of Boring - 29.2'

Core Rec RQD
120" 118" R-1
84%

Project: SCI-823-0.00

Date Drilled: 3/30/05

Client: TranSystems, Inc.

Location: As Per Plan

LOG OF: Boring TR-75

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.	Drive	Hand Penetro-meter (tsf)	WATER OBSERVATIONS:	DESCRIPTION	GRADATION					STANDARD PENETRATION (N) Natural Moisture Content, % - PL ——— LL Blows per foot - 10 20 30 40			
									% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt		% Clay		
0.1	553.0						Water seepage at: None Water level at completion: 18.0' (inside hollow stem augers)										
3.0	552.9	6 10	13	1		4.0		Topsoil - 1.0' FILL: Hard brown SILT AND CLAY (A-6a), trace fine to coarse sand, trace gravel; contains concrete fragments; damp.									
5	550.0	4 3 4	14	2		1.0		Loose to medium dense brown SANDY SILT (A-4a), trace clay.									
10		4 5 10	16	3		1.5		@ 11.0', little gravel.									
15		5 7 10	12	4													
14.0	539.0	14 14 14	17	5				Hard brown SANDSTONE; fine grained, slightly weathered, thinly bedded, highly fractured. @ 15.4', 16.4', 17.3', 20.9', clay seams @ 17.8', gray.									
20		12 50/5	10	6													
25.0	528.0	Core 120"	Rec 120"	RQD 61%	R1			Bottom of Boring - 25.0'									

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

Job No. 0121-3070.03

Client: TranSystems, Inc.

Project: SCI-823-0.00

LOG OF: Boring TR-76

Date Drilled: 3/30/05

Location: As Per Plan

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No.		Hand Penetrometer (tsf)	WATER OBSERVATIONS:	DESCRIPTION	GRADATION								
				Drive	Press / Core				% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay			
0.2	554.5						Water seepage at: None Water level at completion: 4.0' (inside hollow stem augers)										
5	549.0	4 6 7 12		1		4.5+		Topsoil - 2.0" Hard brown SILT AND CLAY (A-6a), trace fine to coarse sand, trace gravel; damp.									
		2 3 5 10		2		4.0		Medium dense brown SANDY SILT (A-4a), little gravel; damp.									
10		2 7 15 17		3													
		5 9 12 16		4													
		11 12 13 18		5				@ 11.0', contains sandstone fragments									
14.5	540.0	1 6 50/5 17		6				Medium hard brown SANDSTONE; decomposed.									
15																	
16.1	538.4							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.									
20		Core 120"	Rec 120"	RQD 64%	R1												
25.0	529.5							Bottom of Boring - 25.0'									

