SCI-823-0.00

PID No. 19415

S.R. 823 over S.R. 335 and Little Scioto River

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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TRANSYSTEMS CORPORATION

	TRUCK	HS20L	
@ 1.5			
M = 1788		2928	230
			240
			230
@ pier		-2743	
@ 2.5		1991	

$.08 w l^2$ — SPAN 1.5

$-.1 w l^2$ — @ pier

$0.025 w l^2$ @ 2.5

08/08/05 SUMMARY BY STRUCTURE OF SUPERLOAD ANALYSES FOR PERMIT -- 705792

STRUCTURE	POSTED RATING	SUPER LOAD
520-279	156.6	97.3

BRIDGE TYPE STUDY NARRATIVE

1. Introduction

TranSystems Corporation is providing engineering services to the Ohio Department of Transportation for the design of a new overpass structure that will carry the proposed S.R. 823 bypass over existing S.R. 335 and the Little Scioto River. 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, seven (7) test borings (TR-29, TR-30, TR-31, TR-32, TR-33, TR-34 and TR-35) were drilled which all encountered sandstone bedrock at various elevations. In general, south of the Little Scioto River, bedrock was found at the deepest elevations, from 80' to 41' below existing ground, from south to north respectively. In the vicinity of the River the bedrock elevations were higher and ranged from 34' to 38' below existing ground. North of SR 335 bedrock was encountered just below the 0" to 6" topsoil layer in the three (3) borings on the steep slope.

The 4 borings south of the SR 335 had generally cohesive soils in the top layers: The 2 borings in the vicinity of the River had no top soil, and consisted of cohesive soils ranging from silt (A-4b) to silt and clay (A-6a), which were generally stiff. The next boring south, located on the north slope, had approximately 7"of top soil, and had stiff soils ranging from sandy silt (A-4a) to fine sand (A-3). Finally, the boring furthest south had 4" of topsoil and a very stiff profile, with soils ranging from sandy silt (A-4a) to clay (A-7-6).

Based on the alternatives considered for this study, two foundation types were considered applicable for substructure elements, as recommended in the Foundation Report:

For the south abutment, which will be on embankment fill, 3'-0" diameter drilled shafts with a maximum design load of 20 tsf should be used. Rock sockets will provide both vertical and lateral resistance as required. The top 3 feet of the rock socket shall be considered ineffective for capacity. Actual rock socket length will be provided once final design loads are determined.

For the piers located south of SR 335, 5'-0" diameter shafts will be used with 20 tsf allowable load. The heavy loads from both the tall T-Type piers and the superstructure necessitated the used of the larger shaft diameter to reduce the quantity. The same provisions regarding rock socket will be used as stated previously for the smaller shafts.

Finally, the pier(s) located to the north of SR 335 and the forward abutment shall be founded on spread footings. Both of these locations have bedrock very near or at the ground surface, thus a cut into rock will be required for each foundation. The pier(s) should utilize 15tsf allowable loads, and the forward abutment 20 tsf.

4. Roadway

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

Both the northbound and southbound traffic will be carried by a single structure. From left to right the structure consists of: a 1'-6" outside straight faced deflector parapet, a 12'-0" shoulder, two 12'-0" lanes, a 6'-0" shoulder, a 2'-5 ¾" median barrier, a 6'-0" shoulder, two 12'-0" lanes, a 12'-0" shoulder and finally another 1'-6" outside parapet. The total structure width out to out equals 89'-5 ¾".

The distance from the centerline of construction of SR 823 to the profile grade line, which is located at the edge of inside pavement for both northbound and southbound, is 7'-2 7/8" Horizontal and vertical sight distances, in accordance with the design standards, have been provided over the bridge for all alternatives considered.

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

In accordance with the ODOT L&D manual, Volume 1, for the structure at SR 335, a 12'-0" horizontal offset from edge of pavement will be maintained underneath the proposed SR 823.

The existing SR 335 will remain on its current horizontal and vertical alignment. The cross section will remain unchanged.

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

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

Maintenance of Traffic - While the new bridge is under construction, traffic will be maintained on the existing SR 335. It is anticipated that there will be limited closures during construction for beam setting.

5. Proposed Structure Configurations

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

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

Three alternatives have been evaluated in this Structure Type Study, and are designated as Alternative 1 though 4. The appropriate structure types that were considered are outlined in the Structure Type Alternative Table:

STRUCTURE TYPE ALTERNATIVE TABLE				
Structure Type Alternative	**1**	**2**	**3**	**4**
Superstructure Type Description	Dog-legged, 90"web, continuous steel plate girder	Prestressed Concrete Girders 72" Modified AASHTO Type 4	Dog-legged, 74"web, continuous steel plate girder	Dog-legged, 84"web, continuous steel plate girder
Proposed Beam Spacing	9 Spaces @ 9'-3"	10 Spaces @ 8'-4"	9 Spaces @ 9'-3"	9 Spaces @ 9'-3"
No. of Spans	3	5	5	5
Abutment Type	Stub Type abutments with 2:1 spill-through slopes	Stub Type abutments with 2:1 spill-through slopes	Stub Type abutments with 2:1 spill-through slopes	Stub Type abutments with 2:1 spill-through slopes
No. of Piers	2	4	4	4
Pier Type	T-Type Pier	T-Type Pier	T-Type Pier	T-Type Pier
Substructure Orientation	33°00'00" RF	33°00'00" RF	33°00'00" RF	00°00'00"
Approximate Bridge Length	684'	662'	684'	710'
<u>Approximate Structure Depth</u>				
Slab	8.75"	8.5"	8.75"	8.75"
Haunch	2"	2"	2"	2"
Beam	95"	72"	78"	88"
Total	105.75" (8.813')	82.5" (6.875')	88.75" (7.396')	98.75" (8.229')

Alternatives Discussion:

As stated above, various span configurations were investigated and were refined to the layouts discussed below. The location of the Little Scioto River and S.R. 335 dictated that either a 3-span or 5-span bridge would be most economical, with horizontal clearances to the roadway and Little Scioto River affecting the locations of the piers and abutments. The proposed vertical profile was not a determining factor in comparing the alternatives, as all they all utilize the same embankment fills and abutments. The different alternatives discussed below modify the location and the number of piers, as well as the type of superstructure.

Alternative 1

Span configuration: This alternative is comprised of a 3-span structure with span lengths of 210'-0", 264'-0" and 210'-0", for an overall bridge length of 684'-0" from centerline bearings at abutments. The abutments and pier are oriented with a 33°00'00" RF skew with respect to the chord from intersection of centerline of construction and abutment bearing centerlines. Embankment slopes of 2:1 are used for the rear abutment, with the forward abutment founded in part in the existing bedrock slope. Due to the proposed S.R. 823 alignment as it crosses into the hill, it is anticipated that part of the forward abutment (northeast corner) will be supported on fill. This will require that a portion of the abutment be supported on drilled shafts.

Substructure:

I. *Abutments:* The rear abutment will be a typical stub type supported on 3'-0" diameter drilled shafts which in turn are supported on rock sockets. The shafts shall have a design capacity of 20 tsf in end bearing. The forward abutment shall be founded on a continuous spread footing (with a design capacity of 20 tsf) embedded in bedrock, except for part of the northbound bridge where 3'-0" diameter drilled shafts supported on rock sockets will be used. The details of the abutments will follow ODOT Standard Construction drawings.

II. *Pier:* The 2 piers will each consist of 2 T-type columns, each supported on an independent cap founded on 5'-0" diameter drilled shafts. Similar to the rear abutment shafts, the shafts shall be embedded in bedrock via rock sockets. The design capacity of the shafts is 20 tsf in end bearing.

Superstructure: The preliminary design of this alternative indicates that 10 - 95" Grade 50W plate girders, spaced at 9'-3" with 3'-1 3/8" minimum and 4'-0" maximum overhangs, would be required to accommodate the HS25 design loading. The girders will be dog-legged to accommodate the large radius curve, and will maintain the overhang requirement of 4'-0" maximum. The structure width will be 86'-5 ¾" from toe to toe of outside parapets with an overall bridge deck width of 89'-5 ¾".

Alternative 2

Span configuration: This alternative is comprised of a 5-span structure with span lengths of 121'-0", 140'-0", 140'-0", 140'-0" and 121'-0", for an overall bridge length of 662'-0" from centerline bearings at abutments. The abutments and piers are oriented with a 33°00'00" RF skew with respect to the chord from intersection of centerline of construction and abutment bearing centerlines. Embankment slopes of 2:1 are used for the rear abutment, with the forward abutment founded in part in the existing bedrock slope. Due to the proposed S.R. 823 alignment as it crosses into the hill, it is anticipated that part of the forward abutment (northeast corner) will be supported on fill. This will require that a portion of the abutment be supported on drilled shafts.

Substructure:

I. *Abutments:* The rear abutment will be a typical stub type supported on 3'-0" diameter drilled shafts which in turn are supported on rock sockets. The shafts shall have a design capacity of 20 tsf in end bearing. The forward abutment shall be founded on a continuous spread footing (with a design capacity of 20 tsf) embedded in bedrock, except for part of the northbound bridge where 3'-0" diameter drilled shafts supported on rock sockets will be used. The details of the abutments will follow ODOT Standard Construction drawings.

II. *Piers:* The 4 piers will each consist of 2 T-type columns, each supported on an independent cap founded on 5'-0" diameter drilled shafts. Similar to the rear abutment shafts, the shafts shall be embedded in bedrock via rock sockets. The design capacity of the shafts is 20 tsf in end bearing.

Superstructure: The preliminary design of this alternative indicates that 11-AASHTO Type 4 Modified 72" prestressed beams, spaced at 8'-4" with 3'-1" minimum and 4'-0" maximum overhangs, would be required to accommodate the HS25 design loading. The structures will be simple span for non-composite dead loads and continuous for superimposed and live loads. The structure width will be 86'-5 ¾" from toe to toe of outside parapets with an overall bridge deck width of 89'-5 ¾".

Alternative 3

Span configuration: This alternative is comprised of a 5-span structure with span lengths of 112'-0", 150'-0", 180'-0", 135'-0" and 107'-0", for an overall bridge length of 684'-0" from centerline bearings at abutments. The abutments and piers are oriented with a 33°00'00" RF skew with respect to the chord from intersection of centerline of construction and abutment bearing centerlines. Embankment slopes of 2:1 are used for the rear abutment, with the forward abutment founded in part in the existing bedrock slope. Due to the proposed S.R. 823 alignment as it crosses into the hill, it is anticipated that part of the forward abutment (northeast corner) will be supported on fill. This will require that a portion of the abutment be supported on drilled shafts.

Substructure:

I. *Abutments:* The rear abutment will be a typical stub type supported on 3'-0" diameter drilled shafts which in turn are supported on rock sockets. The shafts shall have a design capacity of 20 tsf in end bearing. The forward abutment shall be founded on a continuous spread footing (with a design capacity of 20 tsf) embedded in bedrock, except for part of the northbound bridge where 3'-0" diameter drilled shafts supported on rock sockets will be used. The details of the abutments will follow ODOT Standard Construction drawings.

II. *Piers:* The 4 piers will each consist of 2 T-type columns, each supported on an independent cap founded on 5'-0" diameter drilled shafts. Similar to the rear abutment shafts, the shafts shall be embedded in bedrock via rock sockets. The design capacity of the shafts is 20 tsf in end bearing.

Superstructure: The preliminary design of this alternative indicates that 10 - 78" Grade 50W plate girders, spaced at 9'-3" with 3'-1 3/8" minimum and 4'-0" maximum overhangs, would be required to accommodate the HS25 design loading. The girders will be dog-legged to accommodate the large radius curve, and will maintain the overhang requirement of 4'-0" maximum. The structure width will be 86'-5 ¾" from toe to toe of outside parapets with an overall bridge deck width of 89'-5 ¾".

Alternative 4

Span configuration: This alternative is comprised of a 5-span structure with span lengths of 105'-0", 150'-0", 200'-0", 150'-0" and 105'-0", for an overall bridge length of 710'-0" from centerline bearings at abutments. The abutments and piers are oriented perpendicular to the S.R. 823 construction centerline at each substructure location, thus there is no skew. Embankment slopes of 2:1 are used for the rear abutment, with the forward abutment founded in part in the existing bedrock slope. Due to the proposed S.R. 823 alignment as it crosses into the hill, it is anticipated that part of the forward abutment (northeast corner) will be supported on fill. This will require that a portion of the abutment be supported on drilled shafts.

Substructure:

III. *Abutments:* The rear abutment will be a typical stub type supported on 3'-0" diameter drilled shafts which in turn are supported on rock sockets. The shafts shall have a design capacity of 20 tsf in end bearing. The forward abutment shall be founded on a continuous spread footing (with a design capacity of 20 tsf) embedded in bedrock, except for part of the northbound bridge where 3'-0" diameter drilled shafts supported on rock sockets will be used. The details of the abutments will follow ODOT Standard Construction drawings.

IV. *Piers:* The 4 piers will each consist of 2 T-type columns, each supported on an independent cap founded on 5'-0" diameter drilled shafts. Similar to the rear abutment shafts, the shafts shall be embedded in bedrock via rock sockets. The design capacity of the shafts is 20 tsf in end bearing.

Superstructure: The preliminary design of this alternative indicates that 10 - 88" Grade 50W plate girders, spaced at 9'-3" with 3'-1 3/8" minimum and 4'-0" maximum overhangs, would be required to accommodate the HS25 design loading. The girders will be dog-legged to accommodate the large radius curve, and will maintain the overhang requirement of 4'-0" maximum. The structure width will be 86'-5 ¾" from toe to toe of outside parapets with an overall bridge deck width of 89'-5 ¾".

6. Preliminary Probable Bridge Construction Cost:

A preliminary probable bridge construction cost has been prepared for Alternatives 1 through 4 (See Appendix A). The unit prices were based on ODOT's Summary of Contracts Awarded Year 2004 inflated 3.5% each year to the 2008 sale date. This estimate will be used as a comparison between alternatives and as a guide to select the most economical structure. Maintenance costs were included for each Alternative.

7. **Summary:**

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

SUMMARY OF ALTERNATIVES AND RECOMMENDATIONS

STRUCTURE TYPE ALTERNATIVE	STRUCTURE TYPE	PROBABLE BRIDGE CONSTRUCTION COST	RATING	ADVANTAGES/ DISADVANTAGES
1	3-span continuous dog-legged plate girders, A709 Grade 50W with a composite reinforced concrete deck slab, supported by stub-type abutments and T-type double piers on either 3'-0" or 5'-0" diameter shafts, or spread footings in bedrock.	**Structure Cost: $12,385,000** **Additional Life Cycle Cost: $2,801,000** **Total Relative Ownership Cost: $15,186,000**	4	***Advantages:*** • Long span bridge provides more open line of sight for roadway underneath • Most aesthetically pleasing • Weathering steel provides for reduced maintenance ***Disadvantages:*** • Most expensive alternative • Long plate girder lengths may have trouble with transportation and construction • Construction lead time for deep plate girders • Additional 40' high retaining wall would be required at forward abutment, which is not included in structure cost • Heavy skew
2	5-span continuous for live load 72" Modified AASHTO Type 4 Prestressed Concrete Beams with a composite reinforced concrete deck slab, supported by stub-type abutments and T-type double piers on either 3'-0" or 5'-0" diameter shafts, or spread footings in bedrock.	**Structure Cost: $9,700,000** **Additional Life Cycle Cost: $2,989,000** **Total Relative Ownership Cost: $12,689,000**	3	***Advantages:*** • Concrete beams may provide for reduced maintenance costs ***Disadvantages:*** • Construction lead time for Prestressed beams may cause construction delays • Shorter span length provides less available width for the Little Scioto River • Possible scour issues due to close proximity of piers to Little Scioto River • Additional 40' high retaining wall would be required at forward abutment, which is not included in structure cost • Heavy skew
3	5-span continuous dog-legged plate girders, A709 Grade 50W with a composite reinforced concrete deck slab, supported by stub-type abutments and T-type double piers on either 3'-0" or 5'-0" diameter shafts, or spread footings in bedrock.	**Structure Cost: $9,472,000** **Additional Life Cycle Cost: $2,801,000** **Total Relative Ownership Cost: $12,273,000**	2	***Advantages:*** • Weathering steel provides for reduced maintenance • The alternative has the lowest initial and relative cost of ownership ***Disadvantages:*** • Additional 40' high retaining wall would be required at forward abutment, which is not included in structure cost • Construction lead time for deep plate girders • Heavy skew • Multiple length of girders is required
4	5-span continuous dog-legged plate girders, A709 Grade 50W with a composite reinforced concrete deck slab, supported by stub-type abutments and T-type double piers on either 3'-0" or 5'-0" diameter shafts, or spread footings in bedrock.	**Structure Cost: $9,781,000** **Additional Life Cycle Cost: $2,898,000** **Total Relative Ownership Cost: $12,679,000**	1	***Advantages:*** • Weathering steel provides for reduced maintenance • Abutments and Piers have no skew, thus facilitating construction and erection of girders • Shortens the length of the retaining wall required at the forward abutment • Shorter expansion joints since no skew ***Disadvantages:*** • Construction lead time for deep plate girders

8. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 4,** which consists of a 5-span 88" A709 Grade 50W continuous plate girder with stub-type abutments, 2:1 slopes and T-Type piers. (See Appendix B for the Site Plan and Structure Details).

Our recommendation for Alternative 4 is based on the following items:

- Weathering steel provides for reduced maintenance costs
- Abutments and Piers have no skew, thus facilitating substructure construction and erection of girders
- Piers are located further outside of the banks of the Little Scioto River, thus reducing the future scour potential
- Girder fabrication will be simple using a more balanced span configuration (equal spans)
- Provides shorter length for the proposed high retaining wall at the forward abutment northeast corner

APPENDIX A

TRANSYSTEMS CORPORATION

SCI-823-0.00

SR 823 Over Little Scioto Creek and SR 335

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\Estimates\[Little Scioto Structure Cost Comparison.xls]Sub-Qty-Alt4
By: JDH Date: 6/30/2005
Checked: ELK Date: 7/7/2005

COST COMPARISON SUMMARY

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Total Initial Superstructure Cost	Total Initial Construction Cost
1	3	210.00	264.00	210.00	0.00	684.00	10 ~ Steel Plate Girders	90" Web - Grade 50W	$7,183,000	$12,385,000
2	5	121.00	140.00	140.00	140.00	662.00	11 ~ P.S. Concrete I-Beams	AASHTO Type 4 Mod (72")	$3,811,000	$9,700,000
3	5	112.00	150.00	180.00	135.00	684.00	10 ~ Steel Plate Girders	74" Web - Grade 50W	$4,686,000	$9,472,000
4	5	105.00	150.00	200.00	150.00	710.00	10 ~ Steel Plate Girders	84" Web - Grade 50W	$5,059,000	$9,781,000

SCI-823-0.00
SR 823 Over Little Scioto Creek and SR 335
STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\Estimates\[Little Scioto Structure Cost Comparison.xls]Sub-Qty-Alt4
By: JDH Date: 6/30/2005
Checked: ELK Date: 7/7/2005

ALTERNATIVE COST SUMMARY

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Span 5	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section
1	3	210.00	264.00	210.00	0.00	0.00	684.00	10 ~ Steel Plate Girders	90" Web - Grade 50W
2	5	121.00	140.00	140.00	140.00	121.00	662.00	11 ~ P.S. Concrete I-Beams	AASHTO Type 4 Mod (72")
3	5	112.00	150.00	180.00	135.00	107.00	684.00	10 ~ Steel Plate Girders	74" Web - Grade 50W
4	5	105.00	150.00	200.00	150.00	105.00	710.00	10 ~ Steel Plate Girders	84" Web - Grade 50W

Alternative No.	Framing Alternative	Subtotal Superstructure Cost	Subtotal Substructure Cost	Approach Roadway Length (1)	Approach Roadway Cost (2, 3)	Structure Incidental Cost (16%)	Structure Contingency Cost (20%)	Total Initial Construction Cost
1	10 ~ Steel Plate Girders	$7,183,000	$1,704,000	26.0	$14,000	$1,422,000	$2,062,000	$12,385,000
2	11 ~ P.S. Concrete I-Beams	$3,811,000	$3,139,000	48.0	$26,000	$1,112,000	$1,612,000	$9,700,000
3	10 ~ Steel Plate Girders	$4,686,000	$2,109,000	26.0	$14,000	$1,087,000	$1,576,000	$9,472,000
4	10 ~ Steel Plate Girders	$5,059,000	$1,968,000	0.0	$0	$1,124,000	$1,630,000	$9,781,000

NOTES:

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

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

   Pavement Widths:

Alternative	Rear Appr.		Fwd Appr.		Combined Average	
Alt. 1	89.48	ft.	89.48	ft.	89.48	ft.
Alt. 2	89.48	ft.	89.48	ft.	89.48	ft.
Alt. 3	89.48	ft.	89.48	ft.	89.48	ft.
Alt. 4	89.48	ft.	89.48	ft.	89.48	ft.

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

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

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

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

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

SCI-823-0.00 (Portsmouth Bypass)
SR 823 Over Little Scioto Creek and SR 335
STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\Estimates\[Little Scioto Structure Cost Comparison.xls]Sub-Qty-Alt4
By: JDH Date: 6/30/2005
Checked: ELK Date: 7/7/2005

SUPERSTRUCTURE

Alternative No.	No. Spans	Span 1	Span 2	Span 3	Span 4	Span 5	Total Span Length (ft.)	Deck Length (ft.)	Deck Area (sq. ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost
	Span Arrangement												
1	3	210.00	264.00	210.00	0.00	0.00	684.00	686.00	61,400	2,230	$1,313,300	$559,200	$82,000
2	5	121.00	140.00	140.00	140.00	121.00	662.00	664.00	59,400	2,108	$1,241,500	$528,600	$82,000
3	5	112.00	150.00	180.00	135.00	107.00	684.00	686.00	61,400	2,230	$1,313,300	$559,200	$82,000
4	5	105.00	150.00	200.00	150.00	105.00	710.00	712.00	63,700	2,314	$1,363,100	$580,400	$82,000

Alternative No.	Framing Alternative	Proposed Stringer Section	Structural Steel Weight (pounds)	Structural Steel Cost	Prestressed Girder Cost	Initial Superstructure Cost
1	10 ~ Steel Plate Girders	90" Web - Grade 50W	4,339,334	$5,228,500	$0	$7,183,000
2	11 ~ P.S. Concrete I-Beams AASHTO Type 4 Mod (72")		0	$0	$1,958,600	$3,811,000
3	10 ~ Steel Plate Girders	74" Web - Grade 50W	2,267,200	$2,731,700	$0	$4,686,000
4	10 ~ Steel Plate Girders	84" Web - Grade 50W	2,517,900	$3,033,800	$0	$5,059,000

Deck Cross-Sectional Area:

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Edge	2	4.26	8.52
Median	1	7.47	7.47

Slab:

	T (ft.)	Ave. W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Alt. 1	0.73	89.48	65.2	6.5	87.8
Alt. 2	0.71	89.48	63.4	6.3	85.7
Alt. 3	0.73	89.48	65.2	6.5	87.8
Alt. 4	0.73	89.48	65.2	6.5	87.8

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

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

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

Based on parapet and slab percentages of total concrete area

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

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

Unit Costs:

Alt. 2

AASHTO Type IV Mod	Year 2004		Annual Escalation	Year 2008		No. Required
Type 4 Mod (72") I beams	$26,000	ea.	3.5%	$29,840	ea.	55
Pier Diaphragms	$1,800	ea.	3.5%	$2,070	ea.	40
Abutment Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	20
Intermediate Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	150

Structural Steel
Unit Costs ($/lb.):

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

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

	Year 2008		Quantity Per Beam		No. Required	Total	
Alt. 1							
Plate Girder							
90" Web - Plate Girder - Grade 50W	$1.20	/lb	398,104	lb/ea	10	3,981,040	lbs
Crossframes (10% of beam weight)	$1.20	/lb	39,810	lb/ea	9	358,294	lbs
Total			437,914	lb/ea		4,339,334	lbs
Alt. 3							
Plate Girder							
74" Web - Plate Girder - Grade 50W	$1.20	/lb	208,000	lb/ea	10	2,080,000	lbs
Crossframes (10% of beam weight)	$1.20	/lb	20,800	lb/ea	9	187,200	lbs
Total			228,800	lb/ea		2,267,200	lbs
Alt. 4							
Plate Girder							
84" Web - Plate Girder - Grade 50W	$1.20	/lb	231,000	lb/ea	10	2,310,000	lbs
Crossframes (10% of beam weight)	$1.20	/lb	23,100	lb/ea	9	207,900	lbs
Total			254,100	lb/ea		2,517,900	lbs

Reinforced Concrete Approach Slabs (T=15")

Unit Cost ($/sq. yd.):
Length = 25 ft. Average Width = 89.48 ft
Area = 249 sq. yd.

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

NA.

SCI-823-0.00 (Portsmouth Bypass)

SR 823 Over Little Scioto Creek and SR 335

STRUCTURE TYPE STUDY - Alternate 1 - Substructure Quantity Calculations

By: JDH
Checked: ELK

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

Pier Quantities (T-Type Pier Cap)

Pier Location	Number of T-Type	Length	Pier Cap				Single Rectangular Column					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height	Depth	# Column	Volume	Width	Height	Area	Depth	# Footing	Volume	
Pier 1	2	48	4	8	320	1280	16	74	4	1	4736	37	4	148	22	1	3256	18544
Pier 2	2	48	4	8	320	1280	16	68	4	1	4352	37	4	148	22	1	3256	17776
Total (Cu.Ft.)						2560					9088						6512	36320
Total (Cu.Yd.)						95					337						241	1345

Typical Abutment Quantities

Abut Location	Number of T-Type	Length	Backwall				Beam Seat					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height		Area	Volume	Width	Depth		Area	# Footing	Volume	
Rear Abutment	1	103	1.75	9.3	16.275	1676	4.75	3		14.25	1468	7.25	3		21.75	1	2240	5384
Fwd Abutment	1	103	1.75	9.3	16.275	1676	4.75	3		14.25	1468	7.25	3		21.75	1	2240	5384
Total (Cu.Ft.)						3353					2936						4481	10769
Total (Cu.Yd.)						124					109						166	399

MSE Abutment Wall Quantities

Abutment Location	Wall			
	Height	Return	Length	Area
Rear Abutment	0	0	103	0
Fwd Abutment	0	0	103	0
Total (Sq.Ft.)				0

Drilled Shaft Quantities

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Substr. Length	Subst Wt (kips)	Shaft Dia	Shaft Cap. (Kips)	Min No. Shafts (Capacity)	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Shaft Length	Total Shaft Length (Feet)
	DL	LL + I	Total													
Rear Abut.	141	105	246	10	2460	103	808	3.0	282.7	12	1	12	575.0	469	108.0	1296
Pier 1	496	236	732	10	7320	48	2782	5.00	785.4	13	0.95	12	500.0	475	27.0	324
Pier 2	496	236	732	10	7320	48	2666	5.00	785.4	13	0.95	12	513.0	470	45.0	540
* Fwd. Abut.	140	105	245	10	2450		808	3.0	282.7	12	0.5	6	596.0	580	18.0	108
TotaL	1273	682	1955	40	19550		7063	See Below for Total Shafts								
								3.0		12		12				1404
								5.0		38		30				864

* Note that northbound portion of Fwd Abutment is on Drilled Shafts since on fill. Southbound portion of Fwd abutment on Spread footing since in cut.

Bearing Capacity Drilled Shaft = 20 TSF

Shaft Dia	Capacity		min spacing 3*D
3	282.7	kips	9
3.5	384.8	kips	10.5
4	502.7	kips	12
4.5	636.2	kips	13.5
5	785.4	kips	15
5.5	950.3	kips	16.5

SCI-823-0.00 (Portsmouth Bypass)

SR 823 Over Little Scioto Creek and SR 335

STRUCTURE TYPE STUDY - Alternate 2 - Substructure Quantity Calculations

By: JDH
Checked: ELK

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

Pier Quantities (T-Type Pier Cap)

Pier Location	Number of T-Type	Length	Pier Cap				Single Rectangular Column					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height	Depth	# Column	Volume	Width	Height	Area	Depth	# Footing	Volume	
Pier 1	2	48	4	8	320	1280	16	69.4	4	1	4442	37	5	185	37	1	6845	25133
Pier 2	2	48	4	8	320	1280	16	89.4	4	1	5722	37	5	185	37	1	6845	27693
Pier 3	2	48	4	8	320	1280	16	93.3	4	1	5971	37	5	185	37	1	6845	28192
Pier 4	2	48	4	8	320	1280	16	58.3	4	1	3731	31	4	124	13	1	1612	13246
Total (Cu.Ft.)						5120					19866						22147	94265
Total (Cu.Yd.)						190					736						820	3491

Drilled Shaft Quantities

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Substr. Length	Subst Wt (kips)	Shaft Dia	Shaft Cap. (Kips)	Min No. Shafts (Capacity)	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Shaft Length	Total Shaft Length (Feet)
	DL	LL + I	Total													
Rear Abut.	159	92	251	11	2761	103	751	3.0	282.7	13	1	13	578.0	469	111.0	1443
Pier 1	498	366	864	11	9504	48	3770	5.0	785.4	17	1.06	18	504.0	477	29.0	522
Pier 2	502	364	866	11	9526	48	4154	5.0	785.4	18	1	18	487.0	467	22.0	396
Pier 3	502	364	866	11	9526	48	4229	5.0	785.4	18	1	18	487.0	470	19.0	342
Pier 4	498	366	864	11	9504	48	1987	Pier 4 = Spread footing on Rock								
* Fwd. Abut.	159	92	251	11	2761	103	751	3.0	282.7	13	0.5	7	596.0	580	18.0	126
TotaL	2318	1644	3962	66	43582		15642	See Below for Total Shafts								
								3.0		13		13				1569
								5.0		66		54				1260

* Note that northbound portion of Fwd Abutment is on Drilled Shafts since on fill. Southbound portion of Fwd abutment on Spread footing since in cut.

Bearing Capacity Drilled Shaft = 20 TSF

Shaft Dia	Capacity		min spacing 3*D
3	282.7	kips	9
3.5	384.8	kips	10.5
4	502.7	kips	12
4.5	636.2	kips	13.5
5	785.4	kips	15

Typical Abutment Quantities

Abut Location	Number of T-Type	Length	Backwall				Beam Seat					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height		Area	Volume	Width	Depth		Area	# Footing	Volume	
Rear Abutment	1	103	1.75	7.2	12.6	1298	4.75	3		14.25	1468	7.25	3		21.75	1	2240	5006
Fwd Abutment	1	103	1.75	7.2	12.6	1298	4.75	3		14.25	1468	7.25	3		21.75	1	2240	5006
Total (Cu.Ft.)						2596					2936						4481	10012
Total (Cu.Yd.)						96					109						166	371

MSE Abutment Wall Quantities

Abutment Location	Wall			
	Height	Return	Length	Area
Rear Abutment				
Left	0	0	103	0
Right	0	0	#REF!	#REF!
Fwd Abutment				
Left	0	0	103	0
Right	0	0	#REF!	#REF!
Total (Sq.Ft.)				#REF!

SCI-823-0.00 (Portsmouth Bypass)
SR 823 Over Little Scioto Creek and SR 335
STRUCTURE TYPE STUDY - Alternate 3 - Substructure Quantity Calculations

By: JDH
Checked: ELK

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

Pier Quantities (T-Type Pier Cap)

Pier Location	Number of T-Type	Length	Pier Cap				Single Rectangular Column					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height	Depth	# Column	Volume	Width	Height	Area	Depth	# Footing	Volume	
Pier 1	2	48	4	8	320	1280	16	51.9	3	1	2491	22	4	88	22	1	1936	11414
Pier 2	2	48	4	8	320	1280	16	76.8	3	1	3686	29	4	116	29	1	3364	16661
Pier 3	2	48	4	8	320	1280	16	80	3	1	3840	29	4	116	29	1	3364	16968
Pier 4	2	48	4	8	320	1280	16	56.9	3	1	2731	29	4	116	13	1	1508	11038
Total (Cu.Ft.)						5120					12749						10172	56082
Total (Cu.Yd.)						190					472						377	2077

Drilled Shaft Quantities

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Substr. Length	Subst Wt (kips)	Shaft Dia	Shaft Cap. (Kips)	Min No. Shafts (Capacity)	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Shaft Length	Total Shaft Length (Feet)
	DL	LL + I	Total													
Rear Abut.	77	82	159	10	1590	103	751	3.0	282.7	9	1	9	578.0	469	111.0	999
Pier 1	259	152	411	10	4110	48	1712	5.0	785.4	8	1	8	522.0	477	47.0	376
Pier 2	324	172	496	10	4960	48	2499	5.0	785.4	10	1	10	500.0	467	35.0	350
Pier 3	309	167	476	10	4760	48	2545	5.0	785.4	10	1	10	502.0	470	34.0	340
Pier 4	231	143	374	10	3740	48	1656	Pier 4 = Spread footing on Rock								
* Fwd. Abut	76	82	158	10	1580	103	751	3.0	282.7	9	0.5	5	596.0	580	18.0	90
TotaL	1276	798	2074	60	20740		9914	See Below for Total Shafts								
								3.0		9		9				1089
								5.0		37		28				1066

* Note that northbound portion of Fwd Abutment is on Drilled Shafts since on fill. Southbound portion of Fwd abutment on Spread footing since in cut.

Bearing Capacity Drilled Shaft = 20 TSF

Shaft Dia	Capacity		min spacing 3*D
3	282.7	kips	9
3.5	384.8	kips	10.5
4	502.7	kips	12
4.5	636.2	kips	13.5
5	785.4	kips	15

Typical Abutment Quantities

Abut Location	Number of T-Type	Length	Backwall				Beam Seat					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height		Area	Volume	Width	Depth		Area	# Footing	Volume	
Rear Abutment	1	103	1.75	7.2	12.6	1298	4.75	3		14.25	1468	7.25	3		21.75	1	2240	5006
Fwd Abutment	1	103	1.75	7.2	12.6	1298	4.75	3		14.25	1468	7.25	3		21.75	1	2240	5006
Total (Cu.Ft.)						2596					2936						4481	10012
Total (Cu.Yd.)						96					109						166	371

MSE Abutment Wall Quantities

Abutment Location		Wall			
		Height	Return	Length	Area
Rear Abutment					
	Left	0	0	103	0
	Right	0	0	#REF!	#REF!
Fwd Abutment					
	Left	0	0	103	0
	Right	0	0	#REF!	#REF!
Total (Sq.Ft.)					#REF!

SCI-823-0.00 (Portsmouth Bypass)

SR 823 Over Little Scioto Creek and SR 335

STRUCTURE TYPE STUDY - Alternate 4 - Substructure Quantity Calculations

By: JDH
Checked: ELK

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

Pier Quantities (T-Type Pier Cap)

Pier Location	Number of T-Type	Length	Pier Cap				Single Rectangular Column					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height	Depth	# Column	Volume	Width	Height	Area	Depth	# Footing	Volume	
Pier 1	2	40	4	8	267	1067	13.33	51.26	3	1	2050	37	4	148	22	1	3256	12746
Pier 2	2	40	4	8	267	1067	13.33	75.8	3	1	3032	37	4	148	22	1	3256	14709
Pier 3	2	40	4	8	267	1067	13.33	76	3	1	3040	37	4	148	22	1	3256	14725
Pier 4	2	40	4	8	267	1067	13.33	46.9	3	1	1876	29	4	116	13	1	1508	8901
Total (Cu.Ft.)						4267					9998						11276	51082
Total (Cu.Yd.)						158					370						418	1892

Drilled Shaft Quantities

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Substr. Length	Subst Wt (kips)	Shaft Dia	Shaft Cap. (Kips)	Min No. Shafts (Capacity)	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Shaft Length	Total Shaft Length (Feet)
	DL	LL + I	Total													
Rear Abut.	61	82	143	10	1430	89	587	3.0	282.7	8	1	8	578.0	469	111.0	888
Pier 1	309	161	470	10	4700	40	1912	5.0	785.4	9	1	9	521.0	477	46.0	414
Pier 2	419	189	608	10	6080	40	2206	5.0	785.4	11	1	11	501.0	467	36.0	396
Pier 3	419	189	608	10	6080	40	2209	5.0	785.4	11	1	11	506.0	470	38.0	418
Pier 4	309	161	470	10	4700	40	1335	Pier 4 = Spread footing on Rock								
* Fwd. Abut.	60	82	142	10	1420	89	587	3.0	282.7	8	0.25	2	595.0	570	27.0	54
TotaL	1577	864	2441	60	24410		8837	See Below for Total Shafts								
								3.0		8		8				942
								5.0		39		31				1228

* Note that a portion of Fwd Abutment is on Drilled Shafts since on fill. Southbound portion of Fwd abutment on Spread footing since in cut.

Bearing Capacity Drilled Shaft = 20 TSF

Shaft Dia	Capacity		min spacing 3*D
3	282.7	kips	9
3.5	384.8	kips	10.5
4	502.7	kips	12
4.5	636.2	kips	13.5
5	785.4	kips	15

Typical Abutment Quantities

Abut Location	Number of T-Type	Length	Backwall				Beam Seat					Footing						Total Volume
			Width	Depth	Area	Volume	Width	Height		Area	Volume	Width	Depth		Area	# Footing	Volume	
Rear Abutment	1	89	1.75	8	14	1246	3.75	3		11.25	1001	6.25	3		18.75	1	1669	3916
Fwd Abutment	1	89	1.75	8	14	1246	3.75	3		11.25	1001	6.25	3		18.75	1	1669	3916
Total (Cu.Ft.)						2492					2003						3338	7832
Total (Cu.Yd.)						92					74						124	290

MSE Abutment Wall Quantities

Abutment Location		Wall			
		Height	Return	Length	Area
Rear Abutment					
	Left	0	0	89	0
	Right	0	0	#REF!	#REF!
Fwd Abutment					
	Left	0	0	89	0
	Right	0	0	#REF!	#REF!
Total (Sq.Ft.)					#REF!

SCI-823-0.00

SR 823 Over Little Scioto Creek and SR 335

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\Estimates\[Little Scioto Structure Cost Comparison.xls]Sub-Qty-Alt4
By: JDH — Date: 6/30/2005
Checked: ELK — Date: 7/7/2005

SUBSTRUCTURE

Alternative No.	No. Spans	Span 1	Span 2	Span 3	Span 4	Span 5	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Drilled Shaft Foundation Cost	MSE Abutment Wall Cost	Temporary Shoring Cost	Initial Substructure Cost
1	3	210.00	264.00	210.00	0.00	0.00	684.00	10 ~ Steel Plate Girders	90" Web - Grade 50W	$649,800	$148,000	$211,800	$34,700	$660,000	$0	$0	$1,704,000
2	5	121.00	140.00	140.00	140.00	121.00	662.00	11 ~ P.S. Concrete I-Beams	AASHTO Type 4 Mod (72")	$1,686,400	$384,000	$197,000	$32,300	$838,900	$0	$0	$3,139,000
3	5	112.00	150.00	180.00	135.00	107.00	684.00	10 ~ Steel Plate Girders	74" Web - Grade 50W	$1,003,200	$228,400	$197,000	$32,300	$648,200	$0	$0	$2,109,000
4	5	105.00	150.00	200.00	150.00	105.00	710.00	10 ~ Steel Plate Girders	84" Web - Grade 50W	$913,800	$208,200	$154,200	$25,300	$666,000	$0	$0	$1,968,000

(Span 1 – Span 5: Span Arrangement)

Pier QC/QA Concrete, Class QSC1 Cost:

Number of T-type columns per pier: 2

Alternate 1

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Cap	94.8	$421.00	3.5%	$483.00	$45,800
Columns	336.6	$421.00	3.5%	$483.00	$162,570
Footings	241.2	$421.00	3.5%	$483.00	$116,490
Total Pier Cost					$649,800

Alternate 2

Component	Volume	Year 2004	Annual Escalation	Year 2008	Total Cost
Cap	189.6	$421.00	3.5%	$483.00	$91,590
Columns	735.8	$421.00	3.5%	$483.00	$355,370
Footings	820.3	$421.00	3.5%	$483.00	$396,190
Total Pier Cost					$1,686,400

Alternate 3

Component	Volume	Year 2004	Annual Escalation	Year 2008	Total Cost
Cap	189.6	$421.00	3.5%	$483.00	$91,590
Columns	472.2	$421.00	3.5%	$483.00	$228,060
Footings	376.7	$421.00	3.5%	$483.00	$181,970
Total Pier Cost					$1,003,200

Alternate 4

Component	Volume	Year 2004	Annual Escalation	Year 2008	Total Cost
Cap	158.0	$421.00	3.5%	$483.00	$76,330
Columns	370.3	$421.00	3.5%	$483.00	$178,860
Footings	417.6	$421.00	3.5%	$483.00	$201,720
Total Pier Cost					$913,800

Drilled Shafts Foundation Unit Cost ($/ft.):

Abutment and Pier Shafts

Alternate	Diameter	Number	Total Pile Length	Total Cost
Alt. 1	3.0	12	1,404	$362,500
	5.0	30	864	$297,500
Alt. 2	3.0	13	1,569	$405,100
	5.0	54	1,260	$433,800
Alt. 3	3.0	9	1,089	$281,200
	5.0	28	1,066	$367,000
Alt. 4	3.0	8	942	$243,200
	5.0	31	1,228	$422,800

Diameter	Year 2004 Unit Cost	Annual Escalation	Year 2008
3.0	$225.00 /LF	3.5%	$258.20 /LF
5.0	$300.00 /LF	3.5%	$344.30 /LF

Abutment QC/QA Concrete, Class QSC1 Cost:

Alternate 1

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	199.4	$421.00	3.5%	$483.00	$96,300
Forward	199.4	$421.00	3.5%	$483.00	$96,300
Wingwalls					
Rear	19.9	$421.00	3.5%	$483.00	$9,600
Forward	19.9	$421.00	3.5%	$483.00	$9,600

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

Alternate 2

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	185.4	$421.00	3.5%	$483.00	$89,500
Forward	185.4	$421.00	3.5%	$483.00	$89,500
Wingwalls					
Rear	18.5	$421.00	3.5%	$483.00	$9,000
Forward	18.5	$421.00	3.5%	$483.00	$9,000

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

Alternate 3

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	185.4	$421.00	3.5%	$483.00	$89,500
Forward	185.4	$421.00	3.5%	$483.00	$89,500
Wingwalls					
Rear	18.5	$421.00	3.5%	$483.00	$9,000
Forward	18.5	$421.00	3.5%	$483.00	$9,000

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

Alternate 4

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	145.0	$421.00	3.5%	$483.00	$70,100
Forward	145.0	$421.00	3.5%	$483.00	$70,100
Wingwalls					
Rear	14.5	$421.00	3.5%	$483.00	$7,000
Forward	14.5	$421.00	3.5%	$483.00	$7,000

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

Epoxy Coated Reinforcing Steel

Unit Cost ($/lb):

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

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

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

	Rear Abutment Area (sq. ft.)	Forward Abutment Area (sq. ft.)	Total Cost
Alt. 1	0	0	$0
Alt. 2	0	0	$0
Alt. 3	0	0	$0
Alt. 4	0	0	$0

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

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

	Temp. Shoring Area (sq. ft.)	Temp. MSE W Area (sq. ft.)	Total Cost
Alt. 1	0	0	$0
Alt. 2	0	0	$0
Alt. 3	0	0	$0
Alt. 4	0	0	$0

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

SCI-823-0.00

SR 823 Over Little Scioto Creek and SR 335

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\Estimates\[Little Scioto Structure Cost Comparison.xls]Sub-Qty-Alt4
By: JDH
Checked: ELK
Date: 6/25/2005
Date: 7/6/2005

LIFE CYCLE MAINTENANCE COST

Alt. No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Span 5	Total Span Length (ft.)	Framing Alternative	Structural Steel Painting: Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost	Superstructure Sealing: Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost	Approach Pavement Resurfacing: Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost
1	3	210	264	210	0	0	684	10 ~ Steel Plate Girders	$1,729,200	0	$0	$0	0	$0	$1,200	7	$8,400
2	5	121	140	140	140	121	662	11 ~ P.S. Concrete I-Beams	$0	0	$0	$156,800	2	$313,600	$2,200	7	$15,400
3	5	112	150	180	135	107	684	10 ~ Steel Plate Girders	$1,509,500	0	$0	$0	0	$0	$1,200	7	$8,400
4	5	105	150	200	150	105	710	10 ~ Steel Plate Girders	$1,709,100	0	$0	$0	0	$0	$0	0	$0

Alt. No.	Framing Alternative	Bridge Deck Overlay (5): Deck Demo & Chipping	Deck Overlay	Deck Joint Gland (2)	Number of Maintenance Cycles	Total Life Cycle Cost	Bridge Redecking (5): Deck Concrete Cost (3)	Deck Reinforcing Cost (3)	Deck Joint Cost (2)	Deck Removal Cost	Number of Maintenance Cycles	Total Life Cycle Cost	Superstructure Life Cycle Maintenance Cost (1)	Total Initial Construction Cost	Total Relative Ownership Cost
1	10 ~ Steel Plate Girders	$186,100	$225,700	n/a	1	$411,800	$1,313,300	$559,200	n/a	$508,400	1	$2,380,900	$2,801,000	$12,385,000	$15,186,000
2	11 ~ P.S. Concrete I-Beams	$180,100	$218,300	n/a	1	$398,400	$1,241,500	$528,600	n/a	$491,800	1	$2,261,900	$2,989,000	$9,700,000	$12,689,000
3	10 ~ Steel Plate Girders	$186,100	$225,700	n/a	1	$411,800	$1,313,300	$559,200	n/a	$508,400	1	$2,380,900	$2,801,000	$9,472,000	$12,273,000
4	10 ~ Steel Plate Girders	$193,100	$234,100	n/a	1	$427,200	$1,363,100	$580,400	n/a	$527,400	1	$2,470,900	$2,898,000	$9,781,000	$12,679,000

Structural Steel Painting:
Structural Steel Area:

Alternate	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.)
1	90	10	684.00	24.00	143,640	20%	172,400
3	74	10	684.00	24.00	125,400	20%	150,500
4	84	10	710.00	24.00	142,000	20%	170,400

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" AASHTO Type IV

	H	V	Diag.	No.	Total
Bot. Flange	26			1	26.00
		8		2	16.00
Lower Fillets	9	9	8.49	2	16.98
Web		46		2	92.00
Upper Fillets	7	14	15.65	2	31.30
Top Flange		4		2	8.00
Total Exposed Perimeter					190.28 in.

PS Concrete Area:

	No. Stringers	Total Span Length (ft.)	Nominal Exposed Beam Area (sq. ft.)	Secondary Member Allowance	Total Exposed Concrete Area (sq. yd.)
Alt. 2	11	662.00	115,471	10%	14,110

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	89.48	0
Alt. 2	89.48	0
Alt. 3	89.48	0
Alt. 4	89.48	0

Bridge Deck Removal Cost:

	Deck Area (3) (sq. ft.)	Year 2008	Deck Removal Cost
Alt. 1	61,400	$8.28	$508,400
Alt. 2	59,400	$8.28	$491,800
Alt. 3	61,400	$8.28	$508,400
Alt. 3	63,700	$8.28	$527,400

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.:

	Year 2004	Annual Escalation	Year 2008
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	61,400	6,822	171	154
Alt. 2	59,400	6,600	165	149
Alt. 3	61,400	6,822	171	154
Alt. 3	63,700	7,078	177	160

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	26.0	89.5	258	1.50	10.8
Alt. 2	48.0	89.5	477	1.50	19.9
Alt. 3	26.0	89.5	258	1.50	10.8

APPENDIX B

TRANSYSTEMS CORPORATION

KA - Support on H-Piles

Comparison "H" vs "drilled"

1.) Maximize spacing on girders

2) Super vs substructure Costs

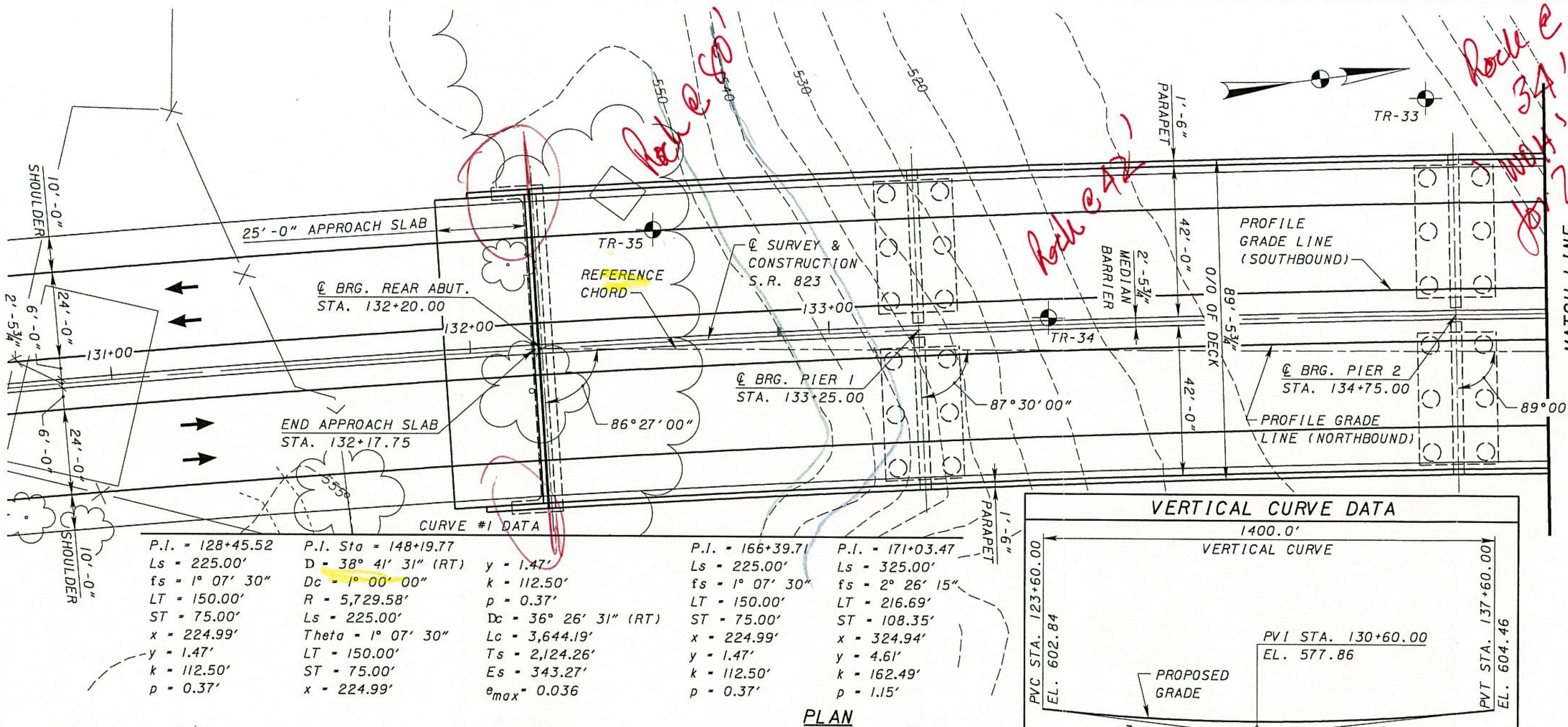
Comparison graph ✓

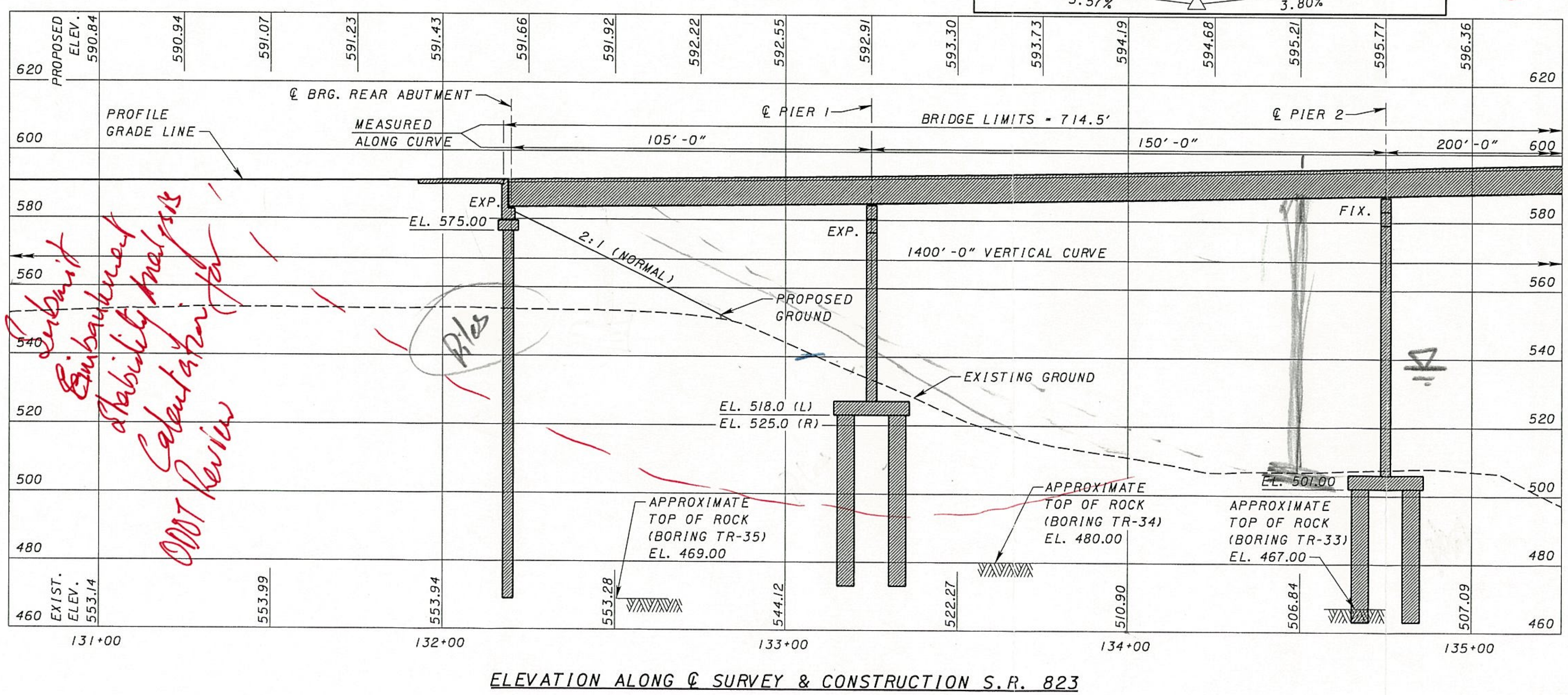
3) Question $Hw_{100} = 538$

4) Stability Analysis

5) Geotech Issues

40 Scale H+V





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-29	140+26.71	84.49' LT.
TR-30	139+35.00	52.27' LT.
TR-31	138+68.69	66.40' LT.
TR-32	136+60.60	10.36' LT.
TR-33	134+67.78	60.60' LT.
TR-34	133+61.14	2.01' LT.
TR-35	132+52.32	31.48' LT.

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

TRAFFIC DATA

(SR 823)
CURRENT YEAR ADT (2010) = 21,200
DESIGN YEAR ADT (2030) = 31,200
CURRENT YEAR ADTT (2010) = 2970
DESIGN YEAR ADTT (2030) = 4370

PROPOSED STRUCTURE

TYPE: 5-SPAN CONTINUOUS A709 GRADE 50 W PLATE GIRDER WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE SUBSTRUCTURE UNITS.
SPANS: 105'-0", 150'-0", 200'-0", 150'-0", 105'-0" c/c BEARINGS (MEASURED ALONG CURVE).
ROADWAY: 2 - 42'-0" TOE TO TOE OF PARAPETS
LOADING: HS-25 (CASE I) AND ALTERNATE MILITARY LOADING, FWS = 60 PSF
SKEW: VARIES ~~XXX~~ To Ref Chord (Constant)
SUPERELEVATION: 0.036 FT/FT
ALIGNMENT: 1°00'00"
WEARING SURFACE: 1" MONOLITHIC CONCRETE
APPROACH SLABS: AS-1-81 (25'-0" LONG)
LATITUDE:
LONGITUDE:
STRUCTURE FILE NUMBER:

HYDRAULIC DATA

DRAINAGE AREA - sq.mi. - ~~acres~~
Q_{50} - cfs　　Q_{100} - cfs
V_{50} - fps　　V_{100} - fps
EL -　　EL -
(TO BE PROVIDED LATER)

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:

DRILLED SHAFTS SHALL BE 3'-0" DIAMETER AT ABUTMENTS AND 5'-0" DIAMETER AT PIERS AND HAVE AN ALLOWABLE END BEARING CAPACITY OF 20 TSF. SPREAD FOOTINGS SHALL HAVE AN ALLOWABLE BEARING CAPACITY OF 15 TSF.

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

DESIGNED	JDH	CHECKED	RER
DRAWN	MLR	REVISED	
REVIEWED	NFF	DATE	07/14/05
STRUCTURE FILE NUMBER			

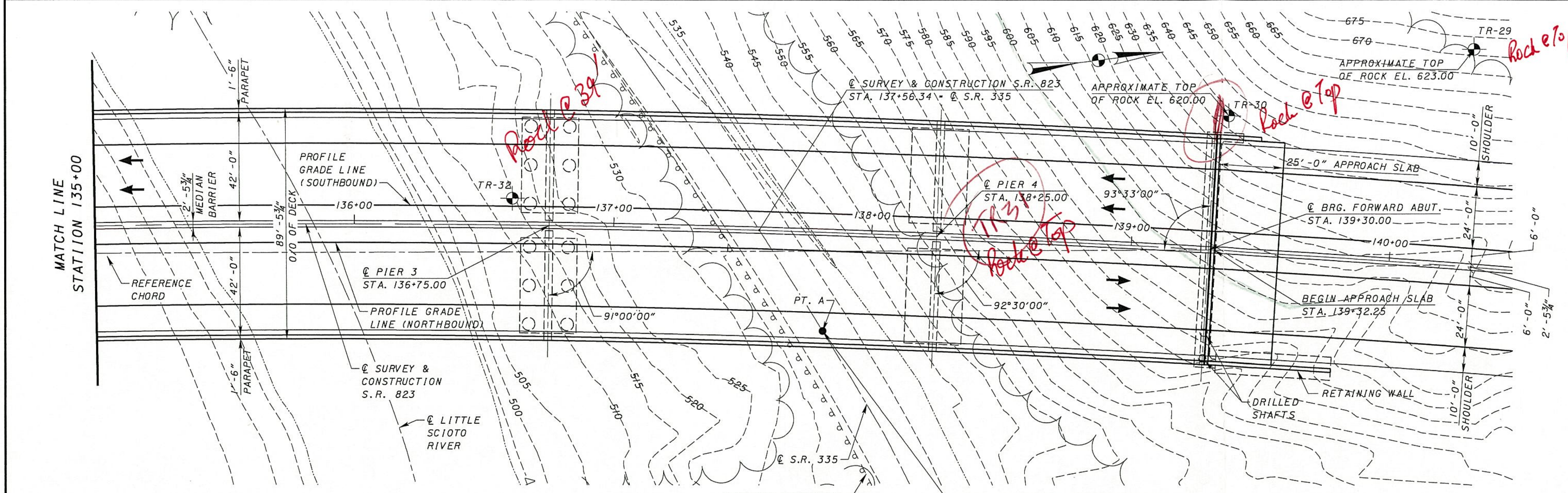
Johnathan Hren

PRELIMINARY SITE PLAN - ALTERNATIVE 4
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R. 335 AND THE LITTLE SCIOTO RIVER
SCIOTO COUNTY
STA. 132+17.75
STA. 139+32.25

SCI-823-0.00
PID 19415

1 / 3

DATE: 7/14/2005　FILE: g:\C003\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\823-07sp07.dgn



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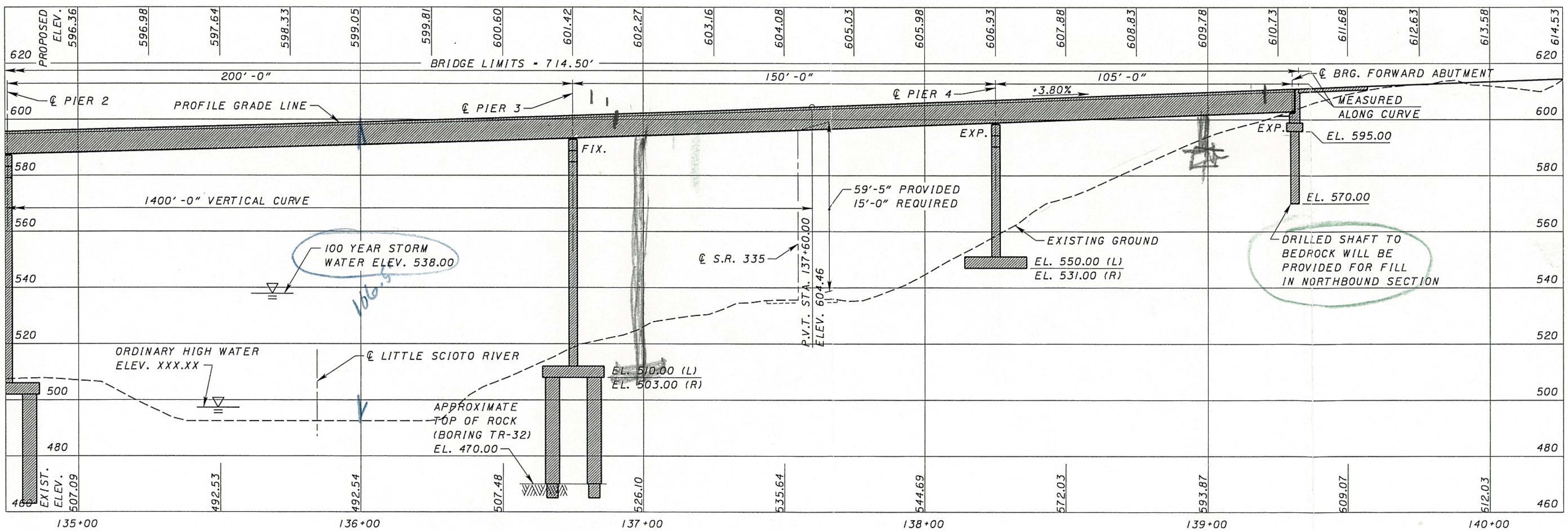

ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

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CLEVELAND, OHIO 44113-1901

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STA. 131+17.75
STA. 139+32.25

PRELIMINARY SITE PLAN - ALTERNATIVE 4
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

2/3

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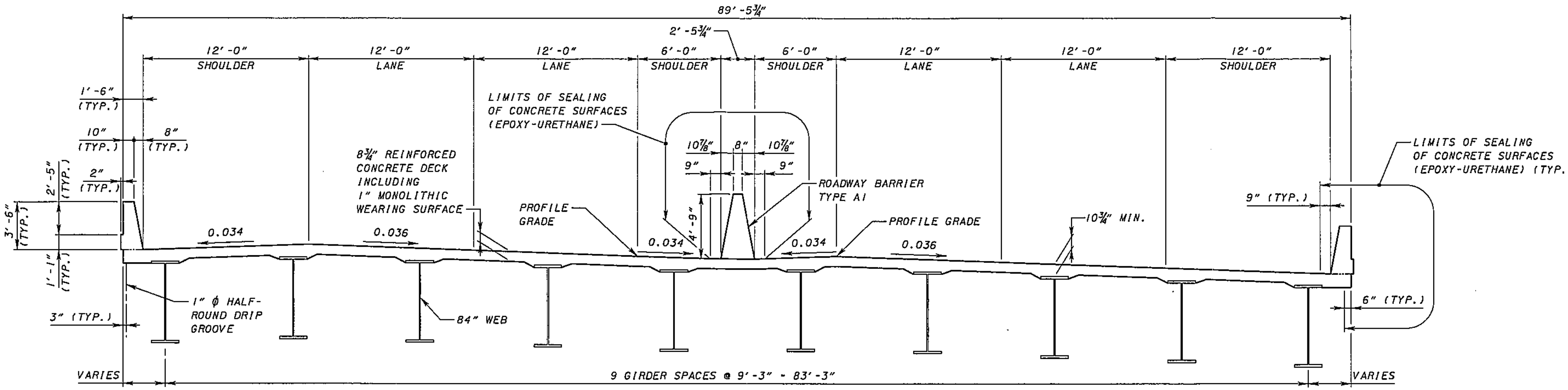
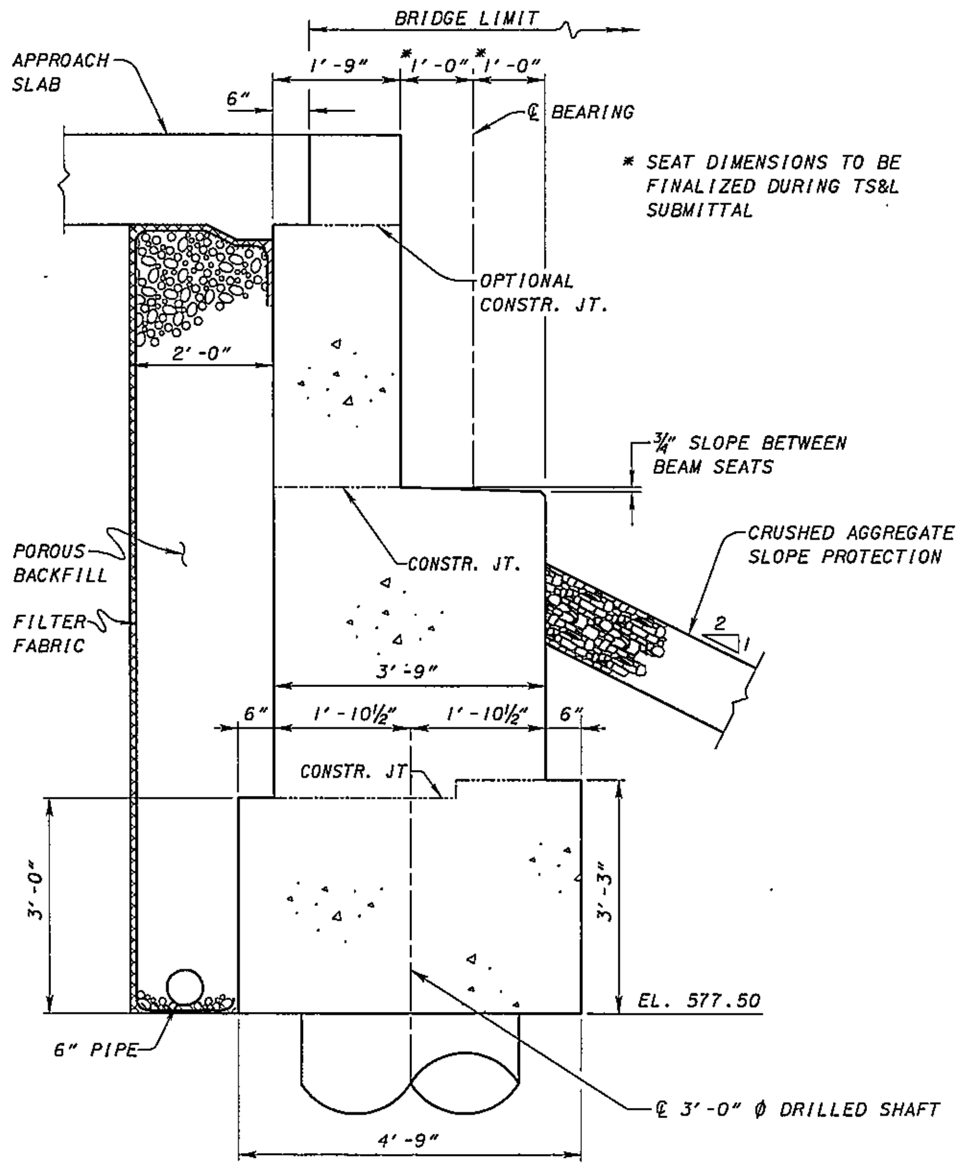
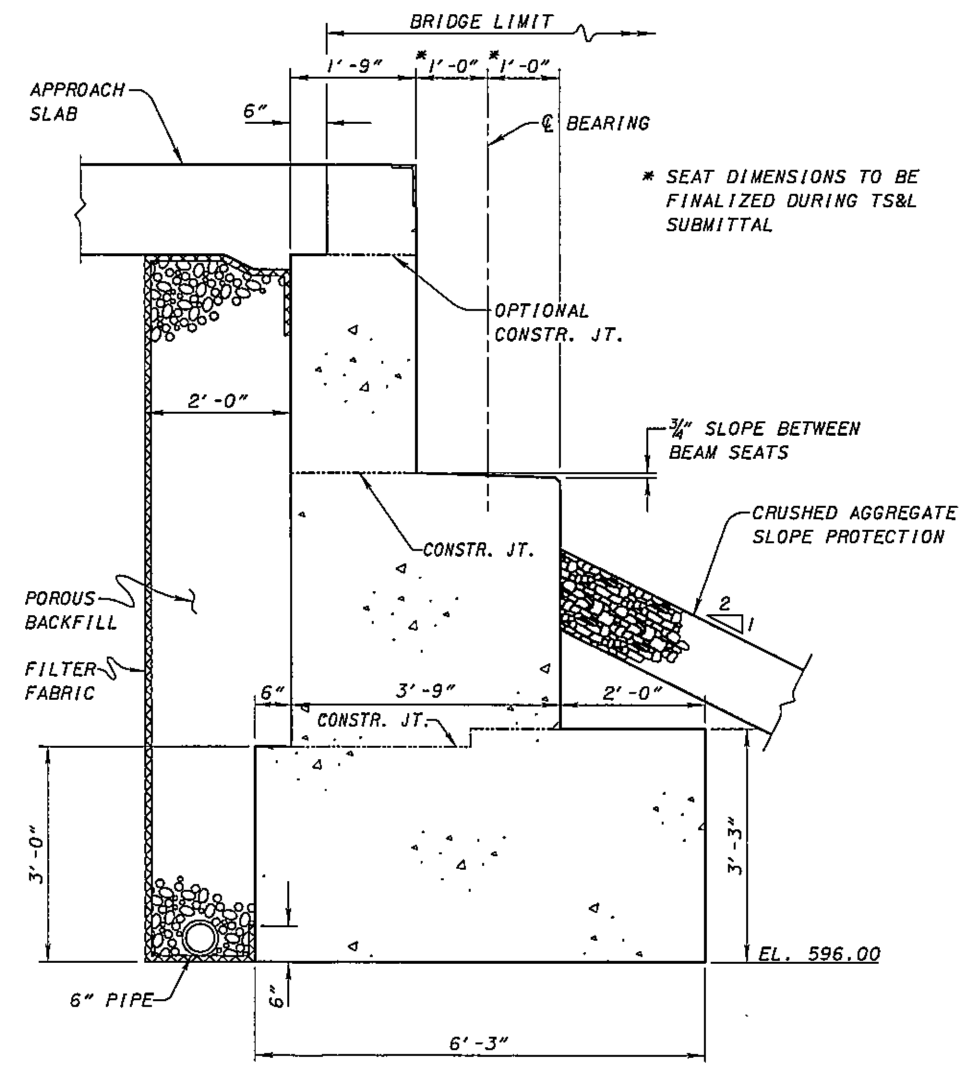


PROPOSED TRANSVERSE SECTION



REAR ABUTMENT SECTION



FORWARD ABUTMENT SECTION

SUPERSTRUCTURE DEPTH	
ITEM	DEPTH
SLAB (INCLUDING WEARING SURFACE)	8¾"
HAUNCH (BOTTOM OF SLAB TO TOP OF FLANGE)	2"
GIRDER DEPTH	88"
TOP OF WEARING SURFACE TO BOTTOM OF BEAM FLANGE (INCH)	98¾"
TOP OF WEARING SURFACE TO BOTTOM OF BEAM FLANGE (FEET)	8.23'

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

DESIGNED JDH | CHECKED RER | DRAWN MLR | REVISED | REVIEWED NFF | DATE 7/14/05 | STRUCTURE FILE NUMBER

TRANSVERSE SECTION - ALTERNATIVE 4
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R. 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

3 / 3

DATE: 7/14/2005 FILE: g:\C003\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\823-07ts01_alt4.dgn

APPENDIX C

TRANSYSTEMS CORPORATION

TRANSYSTEMS CORPORATION

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

VERTICAL CLEARANCE CALCULATIONS

Job Name SCI-823-0.00 **Structure**

Description S.R. 823 OVER SR335 and LITTLE SCIOTO RIVER **PID #** 19415

Alternative 4 - Ten 88" deep Plate Girders at 9.25' spacing — ***Point Location: A***

Adjstment for Cross Slope

Comment	Grade		Offset		
1 Lanes:	-0.036	x	12	=	-0.43
1 Lanes:	-0.036	x	12	=	-0.43
Shoulder to Beam CL:	-0.036	x	10.385	=	-0.37
			Total Adjustment	=	**-1.23**

Superstructure Depth

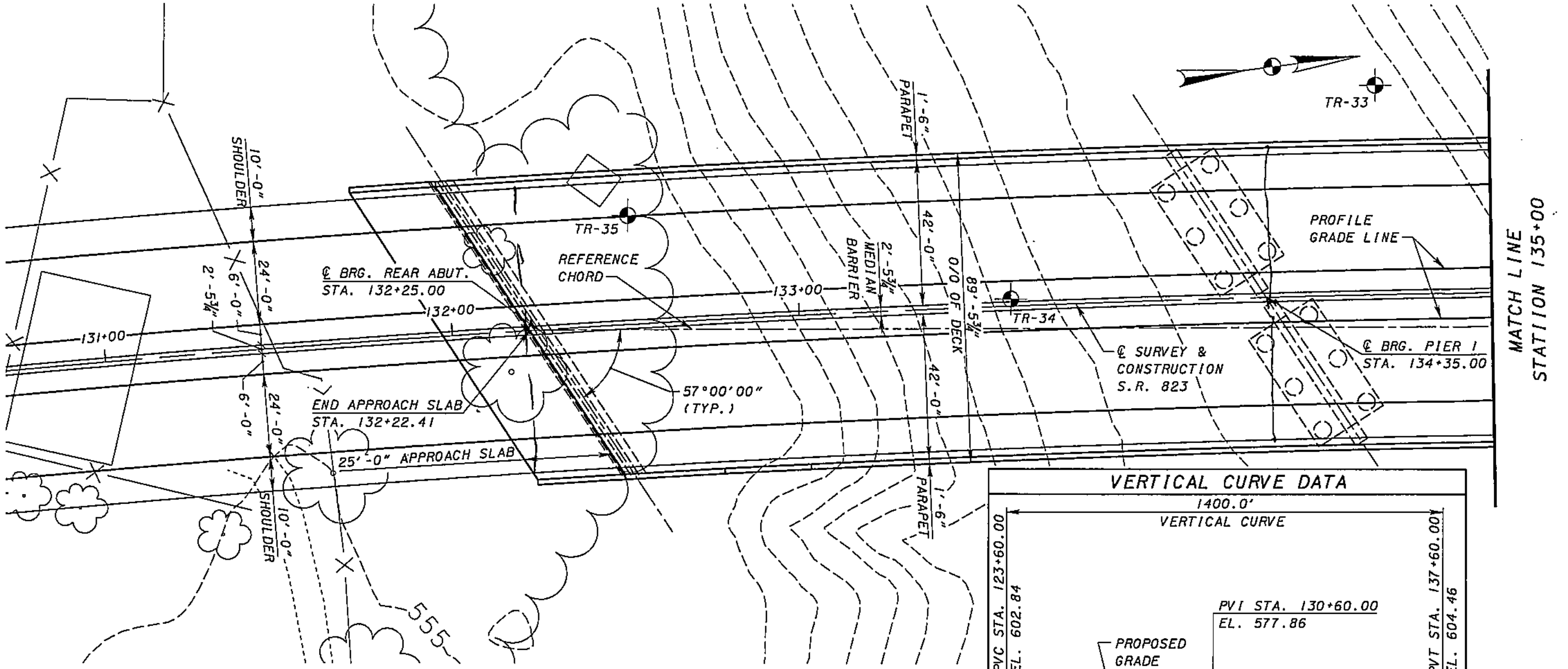
Comment	Depth (in)	Depth (ft)		
Deck Thickness:	8.75	0.73		
Haunch:	2	0.17		
Girder or Beam Depth:	88	7.33		
	98.75	8.23		
	Total Superstructure Depth (ft)		=	**8.23**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**137+85.00**	
Offset Location @ Critical Point	=	**41.63 '**	**Right**
Profile Grade Elevation at Critical Point	=	605.41	
Adjustment for Cross Slopes to Beam CL	=	-1.23	
Top of Deck Elevation @ Critical Point	=	**604.18**	
Total Superstructure Depth	=	-8.23	
Bottom of Beam Elevation @ Critical Point	=	**595.95**	
Approximate Top of Existing Ground @ Critical Point	=	**536.50**	
Actual Vertical Clearance	=	***59.45***	
Preferred Vertical Clearance	=	*17.0*	
Required Vertical Clearance	=	*15.0*	

APPENDIX D

TRANSYSTEMS CORPORATION



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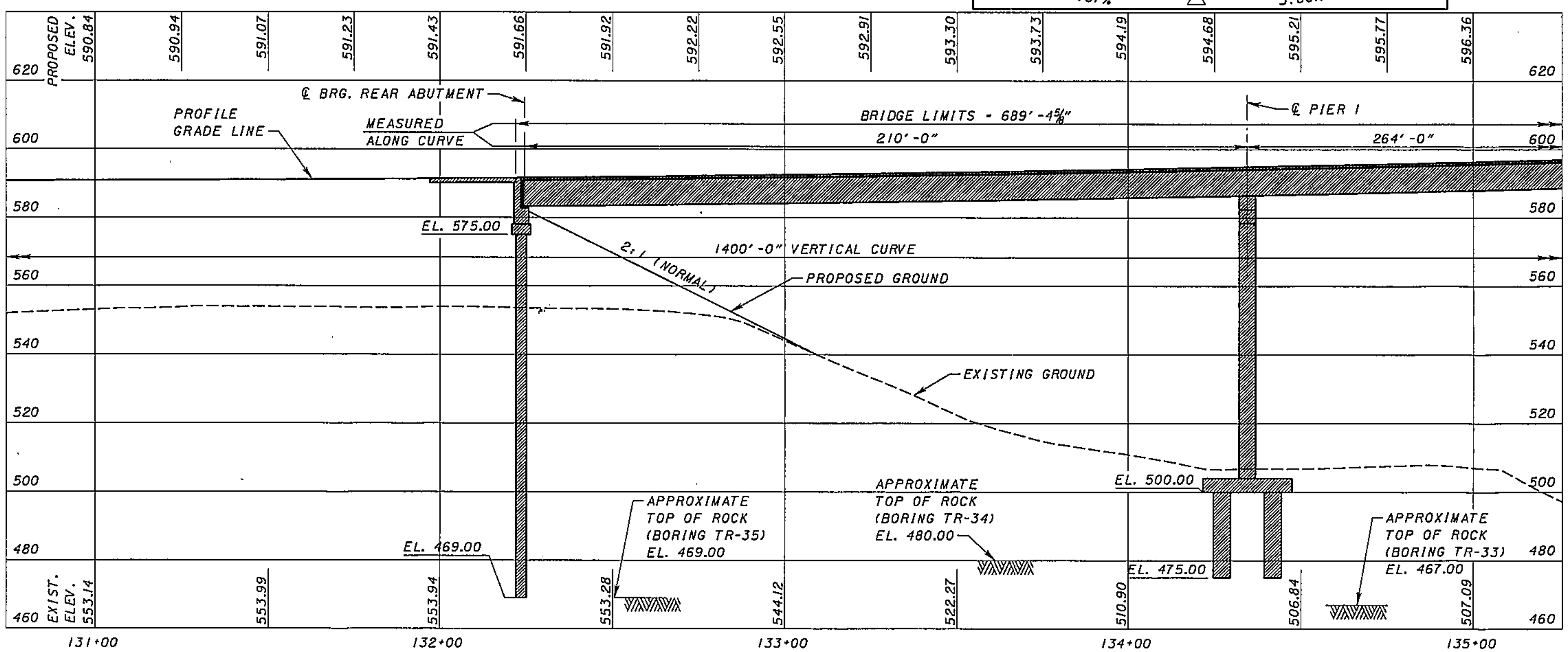

ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

SUPERSTRUCTURE DATA

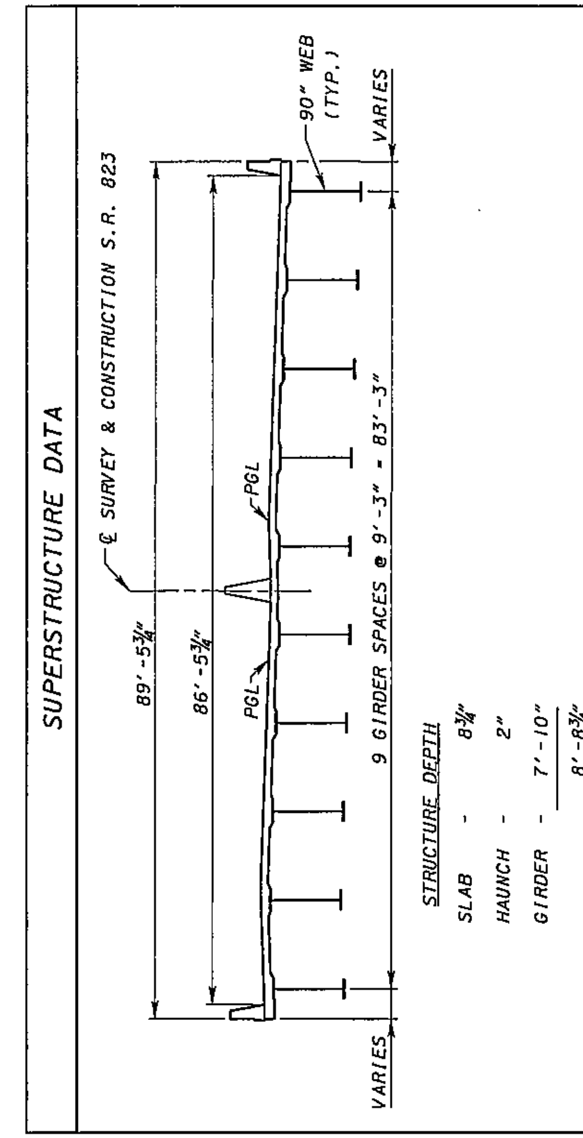

TABLE OF VERTICAL CLEARANCES			
LOCATION	"A"		
PROPOSED	59'-4"		
REQUIRED	15'-0"		

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:

DRILLED SHAFTS SHALL BE EITHER 3'-0" DIAMETER (REAR ABUTMENT) OR 5'-0" DIAMETER AND HAVE AN ALLOWABLE END BEARING CAPACITY OF 20 TSF. SPREAD FOOTINGS SHALL HAVE AN ALLOWABLE BEARING CAPACITY OF 15 TSF.

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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	07/14/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

SCIOTO COUNTY
STA. 132+22.41
STA. 139+11.80

PRELIMINARY SITE PLAN - ALTERNATIVE 1
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

1 / 2

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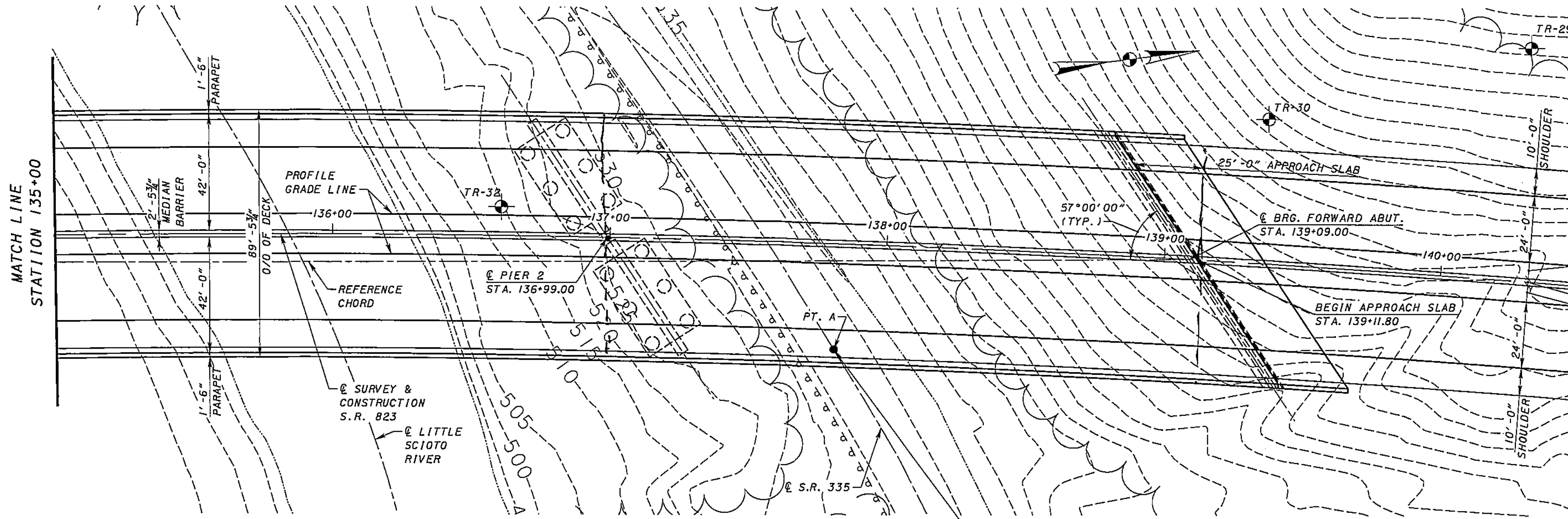

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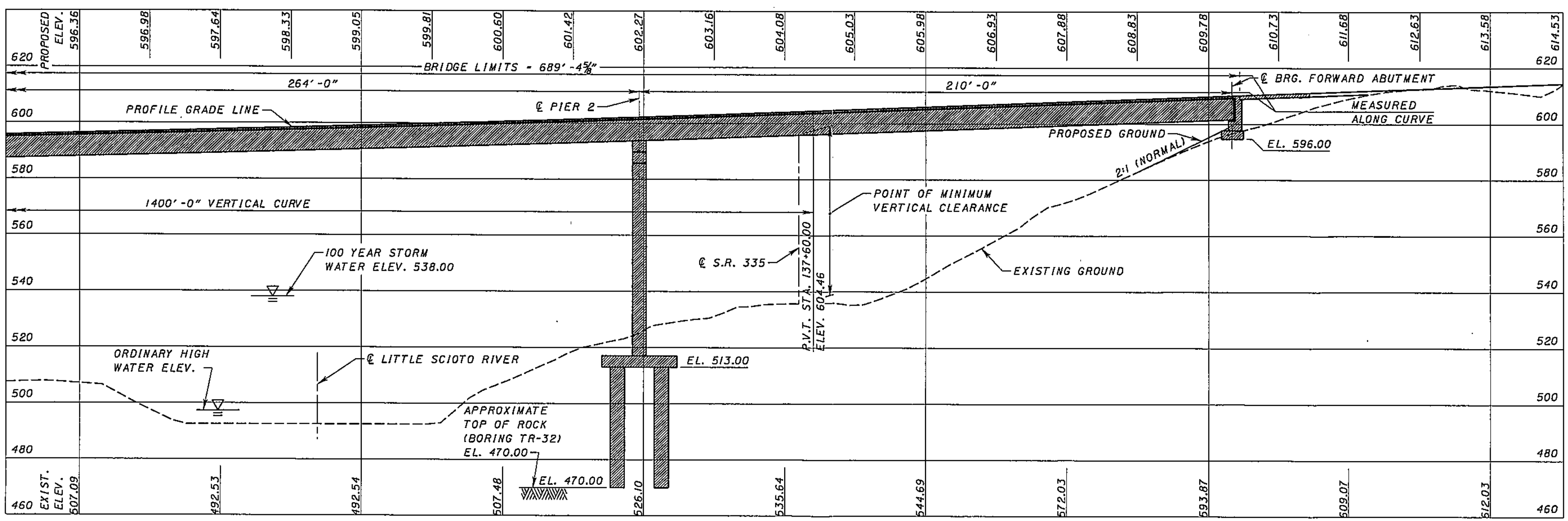

ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

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

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STRUCTURE FILE NUMBER	
DRAWN MLR	REVISED
DESIGNED JDH	CHECKED RER

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PRELIMINARY SITE PLAN - ALTERNATIVE I
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

2 / 2

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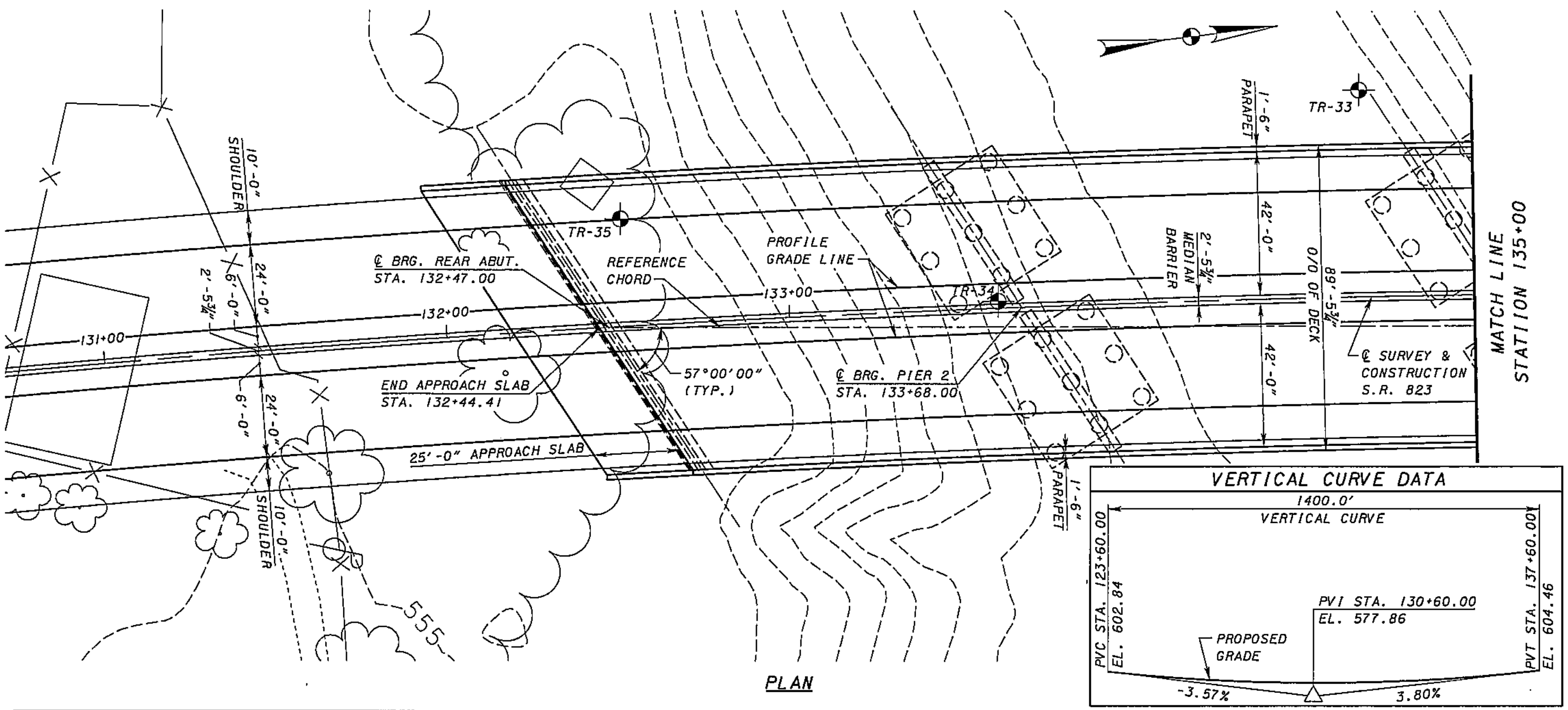

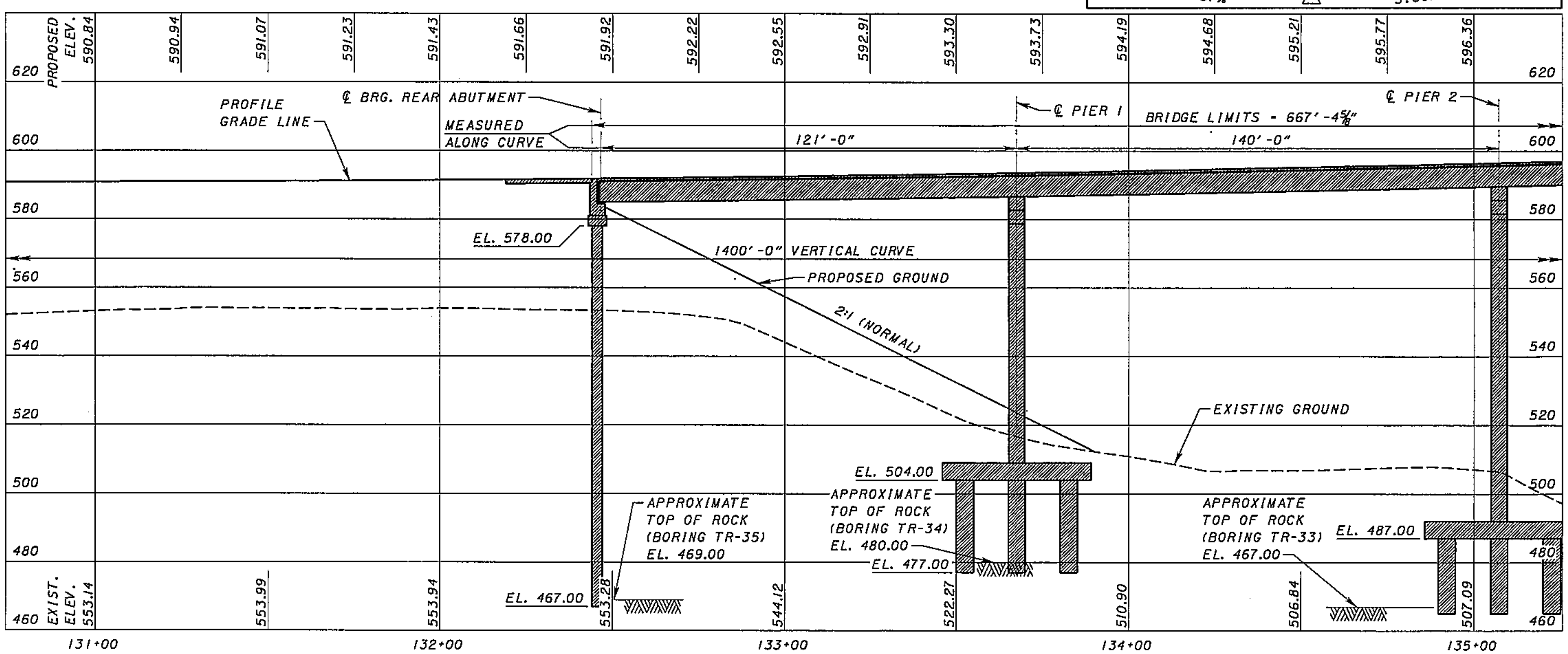

ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

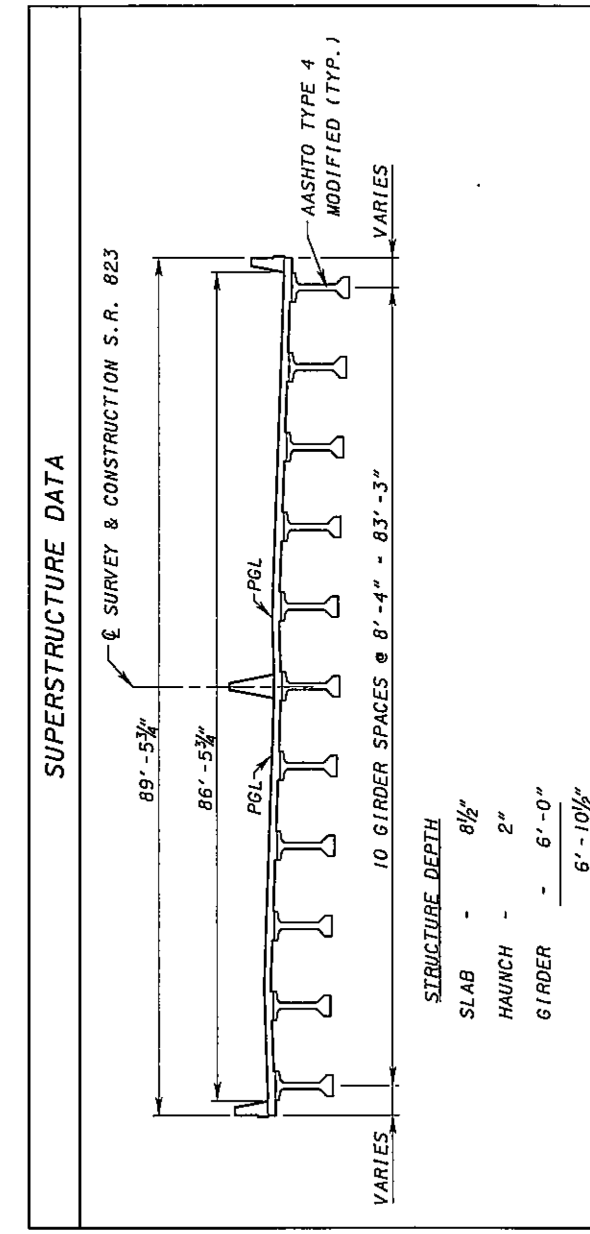

TABLE OF VERTICAL CLEARANCES			
LOCATION	"A"		
PROPOSED	61'-2"		
REQUIRED	15'-0"		

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:

DRILLED SHAFTS SHALL BE EITHER 3'-0" DIAMETER (REAR ABUTMENT) OR 5'-0" DIAMETER AND HAVE AN ALLOWABLE END BEARING CAPACITY OF 20 TSF. SPREAD FOOTINGS SHALL HAVE AN ALLOWABLE BEARING CAPACITY OF 15 TSF.

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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	07/14/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

SCIOTO COUNTY
STA. 132+44.41
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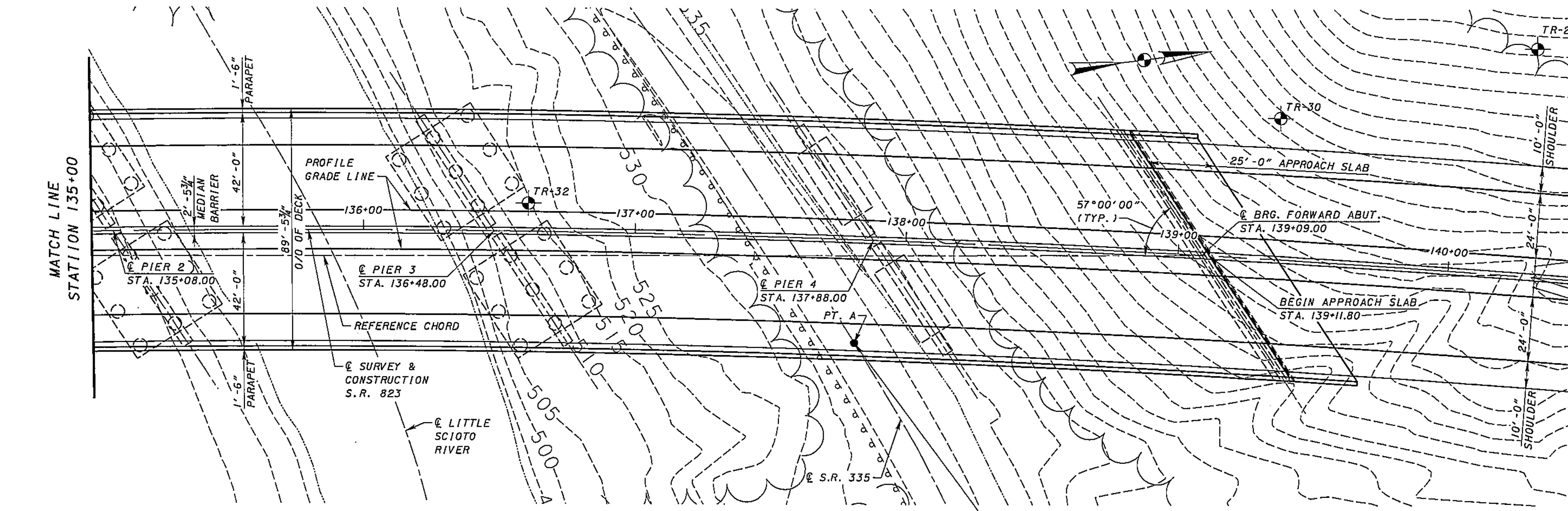
PRELIMINARY SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

DATE: 7/14/2005



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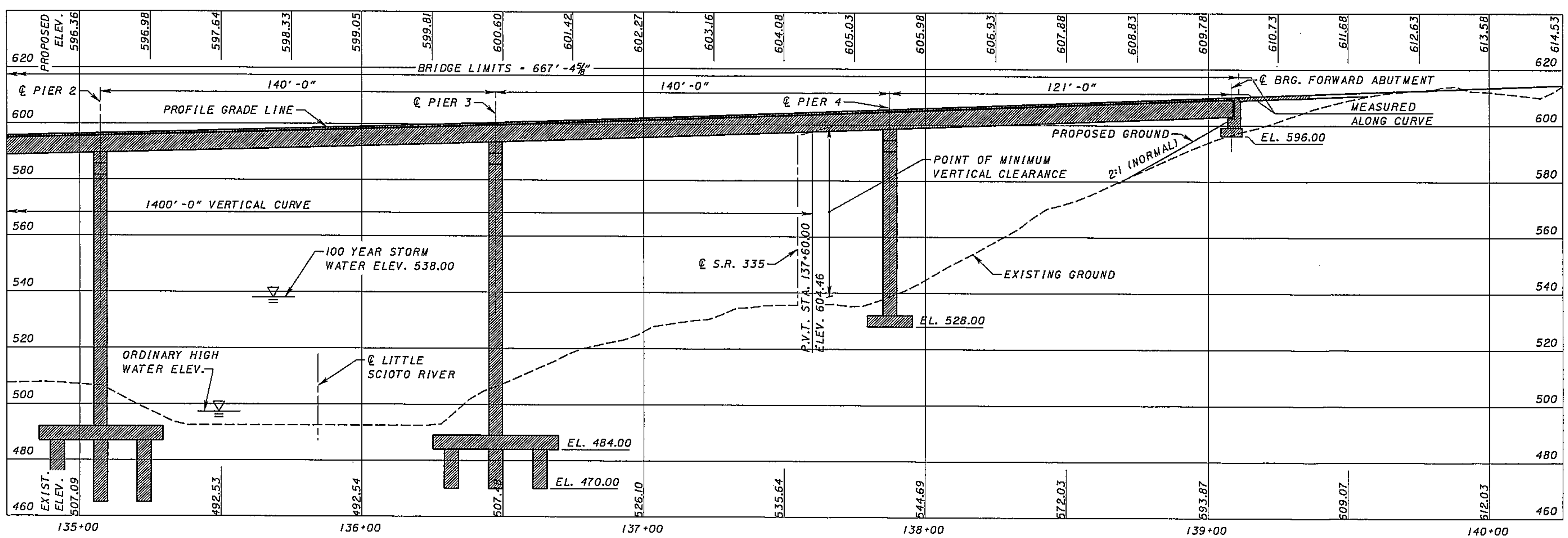

ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	07/14/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

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PRELIMINARY SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

2/2

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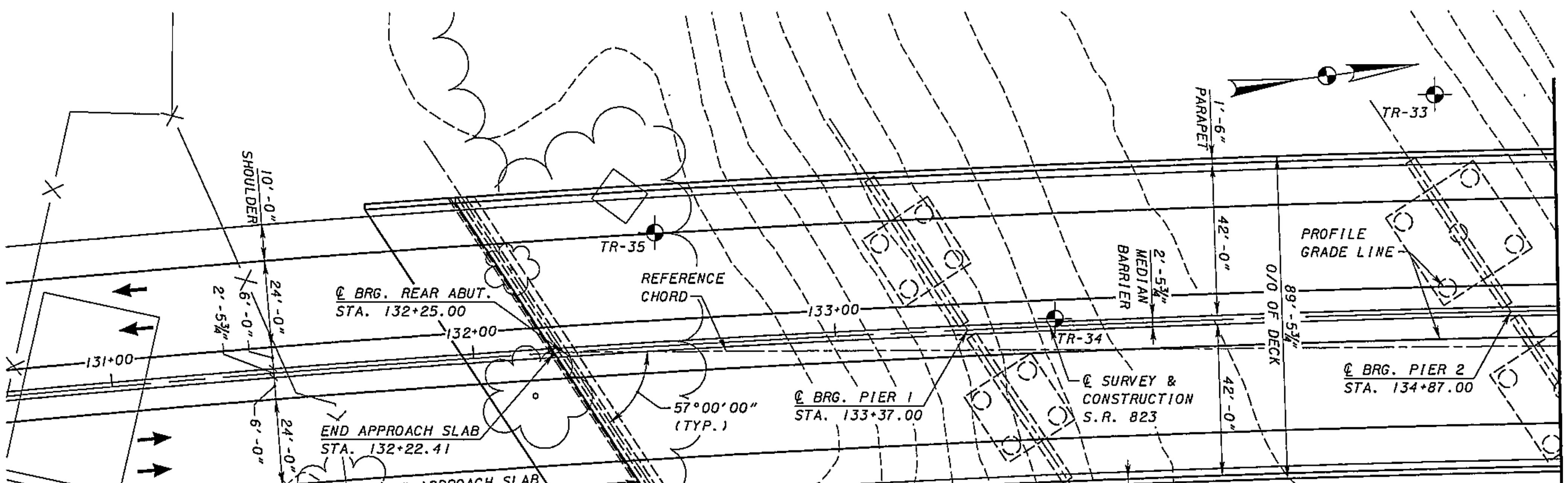
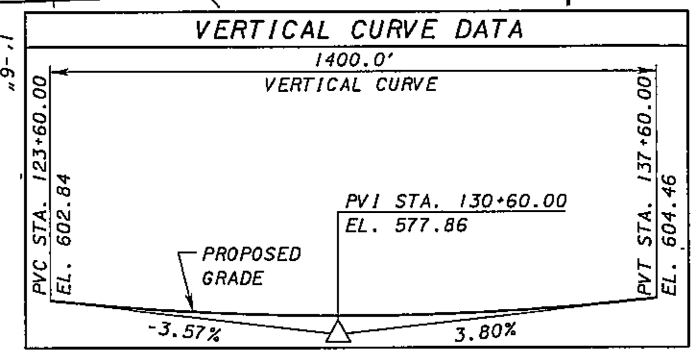
DATE: 7/14/2005



PLAN



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

BORING LOCATIONS		
BORING No.	STATION	OFFSET
TR-29	xx+xx.xx	xx.xx' LT.
TR-30	xx+xx.xx	xx.xx' LT.
TR-31	xx+xx.xx	xx.xx' LT.
TR-32	xx+xx.xx	xx.xx' LT.
TR-33	xx+xx.xx	xx.xx' LT.
TR-34	xx+xx.xx	xx.xx' LT.
TR-35	xx+xx.xx	xx.xx' LT.

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

TRAFFIC DATA

(SR 823)

CURRENT YEAR ADT (2010) = 21,200
DESIGN YEAR ADT (2010) = 2970
CURRENT YEAR ADTT (2030) = 31,200
DESIGN YEAR ADTT (2030) = 4370

PROPOSED STRUCTURE

TYPE: 5-SPAN CONTINUOUS A709 GRADE 50 W PLATE GIRDER WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE SUBSTRUCTURE UNITS.

SPANS: 112'-0", 150'-0", 180'-0", 135'-0", 107'-0" c/c BEARINGS.

ROADWAY: 2 - 42'-0" TOE TO TOE OF PARAPETS

LOADING: HS-25 (CASE I) AND ALTERNATE MILITARY LOADING, FWS = 60 PSF

SKEW: 33°00'00" MEASURED TO REFERENCE CHORD

CROWN: 0.036 FT/FT

ALIGNMENT: 1°00'00"

WEARING SURFACE: 1" MONOLITHIC CONCRETE

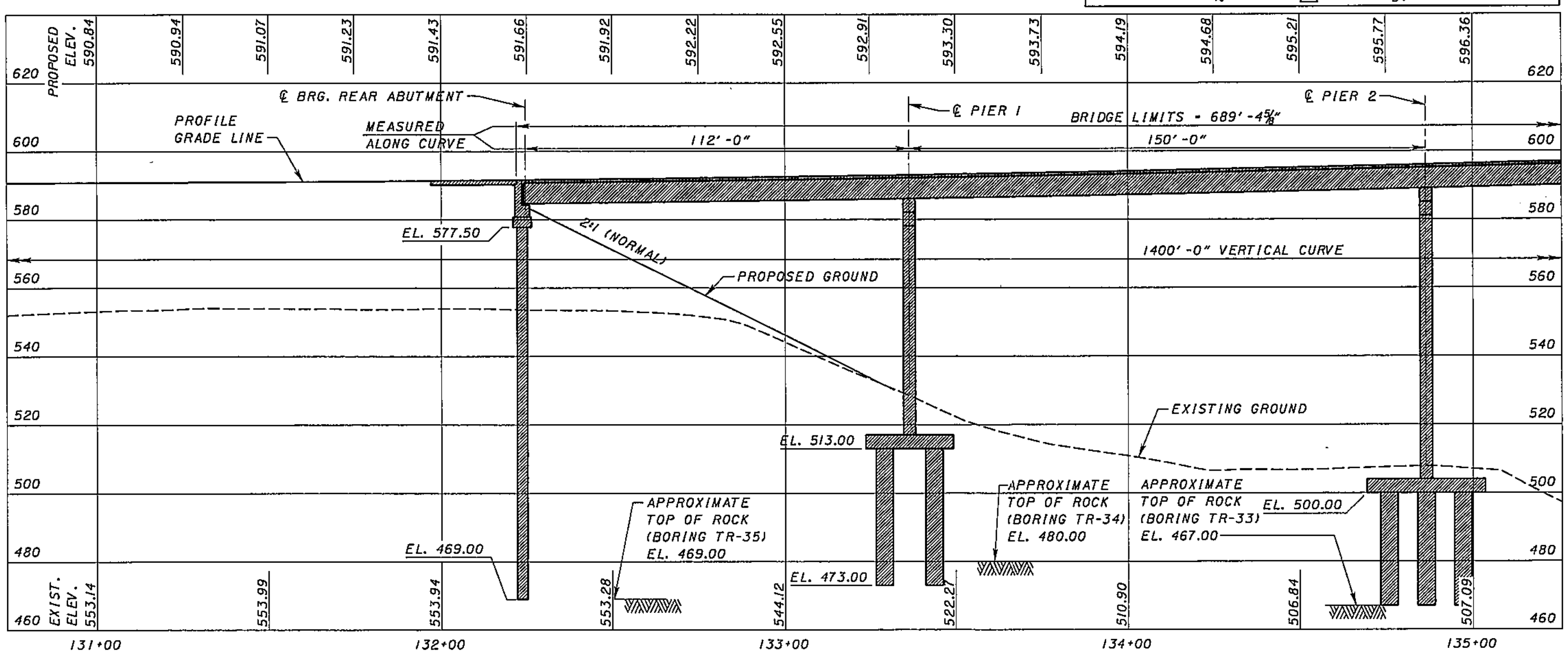
APPROACH SLABS: AS-1-81 (25'-0" LONG)

LATITUDE:

LONGITUDE:

STRUCTURE FILE NUMBER:

TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	
PROPOSED	60'-10"	
REQUIRED	15'-0"	



ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

NOTES:

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

FOUNDATION DATA:

DRILLED SHAFTS SHALL BE EITHER 3'-0" DIAMETER (REAR ABUTMENT) OR 5'-0" DIAMETER AND HAVE AN ALLOWABLE END BEARING CAPACITY OF 20 TSF. SPREAD FOOTINGS SHALL HAVE AN ALLOWABLE BEARING CAPACITY OF 15 TSF.

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

REVIEWED NFF DATE 07/14/05 STRUCTURE FILE NUMBER
DRAWN MLR REVISED
DESIGNED JDH CHECKED RER

SCIOTO COUNTY STA. 132+22.41 STA. 139+11.80

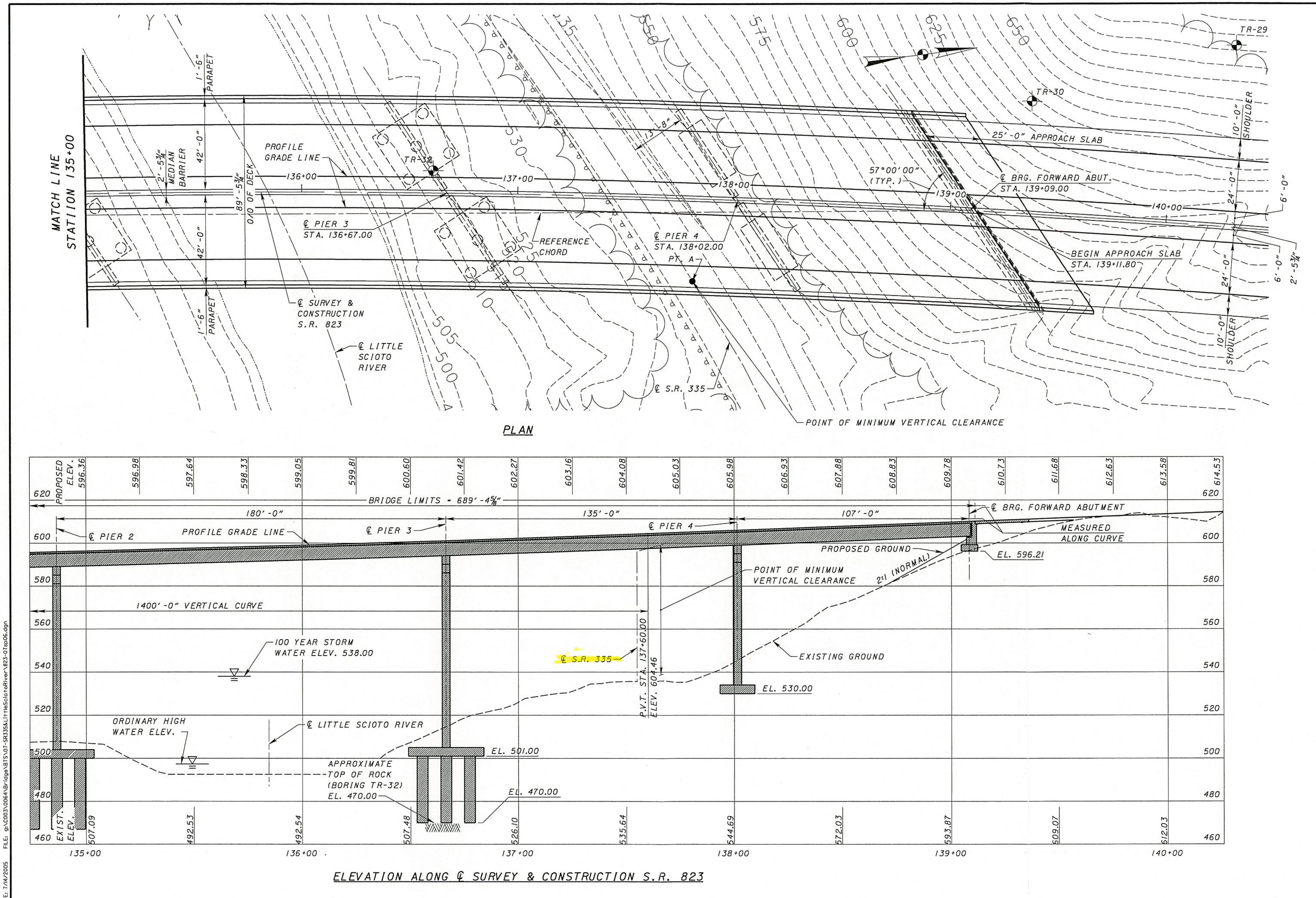
PRELIMINARY SITE PLAN - ALTERNATIVE 3

S.R. 823 OVER S.R 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00 PID 19415

1 / 3

FILE: g:\C003\C0064\Bridge\TS\07-SR335&LittleSciotoRiver\823-07sp05.dgn
DATE: 7/14/2005



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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	07/14/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

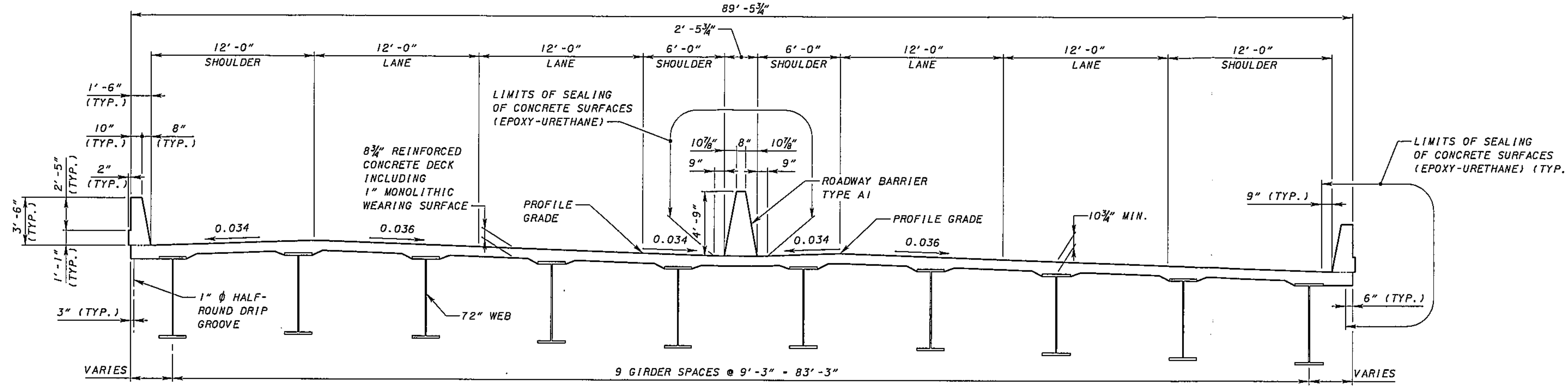
SCIOTO COUNTY
STA. 132+22.41
STA. 139+11.80

PRELIMINARY SITE PLAN - ALTERNATIVE 3
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

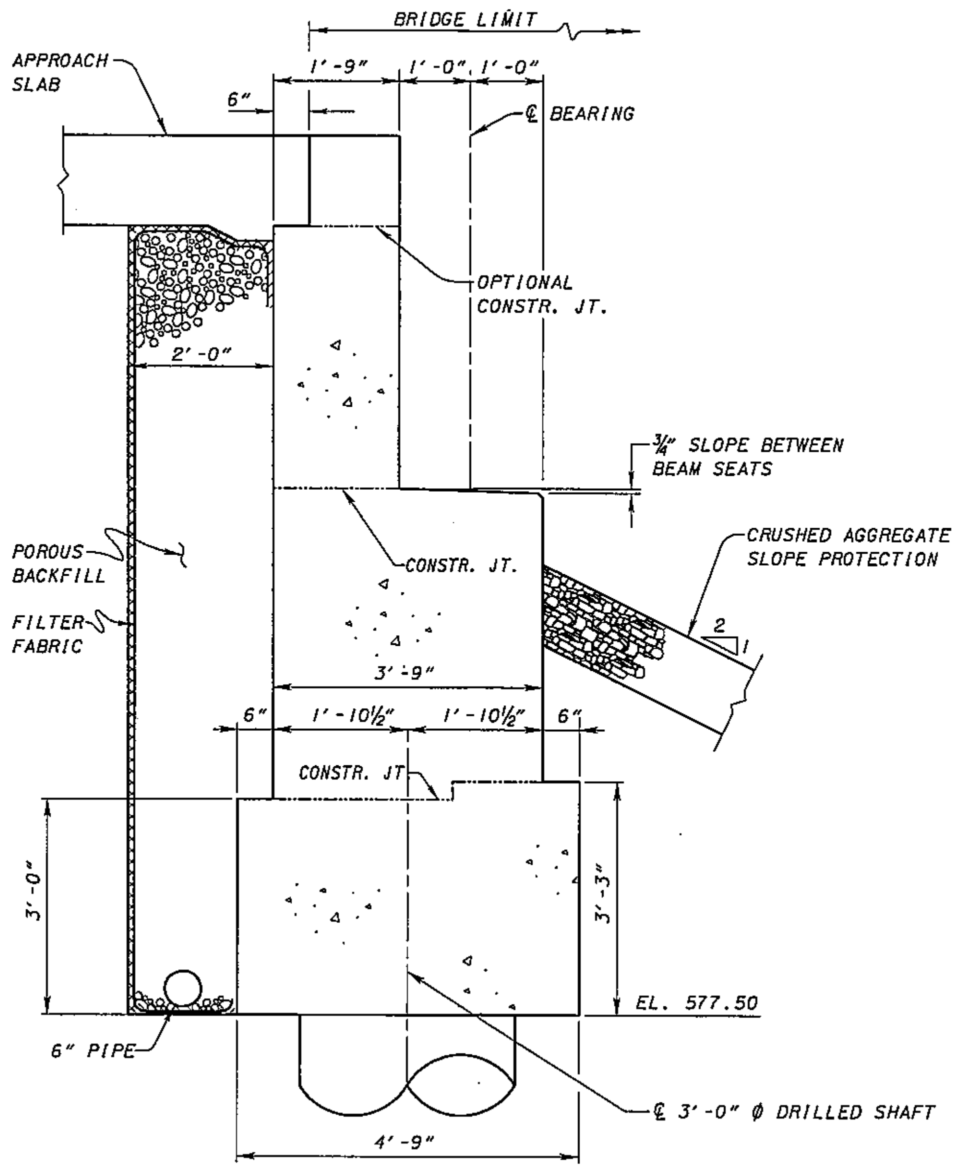
2 / 3

DATE: 7/14/2005 FILE: g:\C003\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\823-07sp06.dgn

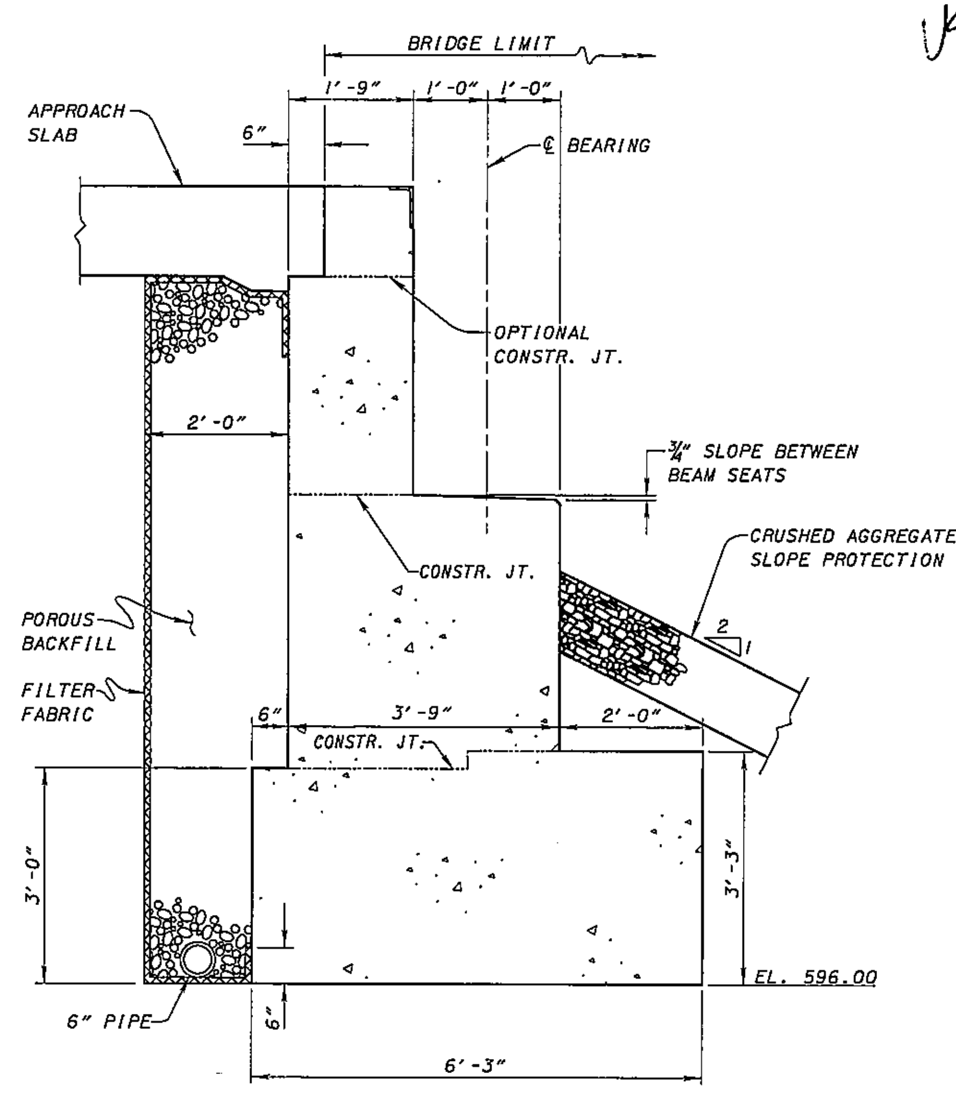


PROPOSED TRANSVERSE SECTION

Use 9 girders = spaced ~12'



REAR ABUTMENT SECTION



FORWARD ABUTMENT SECTION

SUPERSTRUCTURE DEPTH	
ITEM	DEPTH
SLAB (INCLUDING WEARING SURFACE)	8¾"
HAUNCH (BOTTOM OF SLAB TO TOP OF FLANGE)	2"
BEAM DEPTH	75"
TOP OF WEARING SURFACE TO BOTTOM OF BEAM FLANGE (INCH)	85¾"
TOP OF WEARING SURFACE TO BOTTOM OF BEAM FLANGE (FEET)	7.15'

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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	07/14/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

TRANSVERSE SECTION - ALTERNATE 3

BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R. 335 AND THE LITTLE SCIOTO RIVER

SCI-823-0.00
PID 19415

3 / 3

DATE: 7/14/2005 FILE: g:\C003\0064\Bridge\BTS\07-SR335&LittleSciotoRiver\823-07te01.dgn

APPENDIX E

TRANSYSTEMS CORPORATION

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

March 31, 2005

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

Re: **SCI-823-0.00 over Little Scioto River (Highland Bend)**
Preliminary Structural Foundation Recommendations
Project SCI-823-0.00
DLZ Job No.: 0121-3070.03

Dear Mr. Parsons:

This letter reports the findings of the subsurface exploration and preliminary foundation recommendations for the proposed structure SCI-823-0.00 over SR 335 and the Little Scioto River within the Highland Bend area.

It is anticipated that the proposed structure will be a six-span, elevated bridge with embankment fills at the rear abutment, and rock cut at the forward abutment. The existing grade at the proposed new bridge location varies greatly. It is anticipated that the rear abutment and Piers 1, 2, and 3 will be located along or within the Little Scioto River floodplain, which is primarily composed of glacial lacustrine and alluvial deposits. Piers 4, 5, and the forward abutment, will be above SR 335, located on the steeply sloping hillside rising up from the Little Scioto River floodplain. The anticipated alignment is located along the western edge of a large drainage feature with the area immediately above SR 335 being a rock cut section with sandstone exposed. The entire hillside has relatively thin overburden along the entire slope face. It is anticipated that the SCI-823-0.00 mainline will require an embankment constructed south of the rear abutment to an approximate height of 55 feet. The forward abutment will be located in a cut section within the hillside. At the present time the anticipated forward abutment will be located in a 57-foot cut section along the mainline with an 80-foot cut for the left backslope.

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

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Field Exploration

A total of seven borings, TR-29 through TR-35, were drilled at the proposed structure between February 22, 2005 and March 11, 2005. The borings were drilled to depths between 59 and 100.5 feet. All borings were extended into bedrock, which was verified by rock coring. Boring logs and information concerning the drilling procedures are attached.

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

Findings

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

Generally, two types of subsurface conditions were encountered along the proposed structure. From SR 335 north the subsurface conditions consisted of shallow overburden underlain by sandstone. South of SR 335 the subsurface conditions consisted of thick overburden underlain by bedrock.

Borings TR-29, 30 and 31, which were drilled along the steep hillside north of SR 335, encountered between 5 and 6inches of topsoil, underlain by residual soils or decomposed bedrock. Generally, this material was removed prior to drilling during creation of a working platform. Bedrock samples collected at or near the surface generally consisted of sandstone. The upper 9 to 20 feet of the sandstone was soft to medium hard and highly weathered to decomposed. Twenty feet of rock core was collected from each boring, except at TR-29, which had 80 feet of rock core collected due to the anticipated cut depth. Recovery of the core samples ranged from 25 to 100%, and RQD values ranged from 0 to 100% with an average RQD of 84%.

The borings drilled within the Little Scioto floodplain (TR-32, 33, 34, and 35) encountered topsoil at the ground surface to depths of 3 to 4 inches. Beneath the topsoil, natural soils generally consisting of cohesive material were encountered. Granular soils were encountered beneath the cohesive soils on top of bedrock. The cohesive soils encountered ranged from sandy silt (A-4a) to clay (A-7-6), and were generally stiff to very stiff. The granular soils ranged from sandy silt (A-4a), gravel with sand and silt (A-2-4), and fine sand (A-3). The granular soils were generally very loose to medium dense. Bedrock was encountered between 34 and 80 feet below the ground surface, which was generally a medium hard to hard sandstone that was slightly broken to intact. Twenty feet of rock core was collected from each boring. Recovery of the core samples ranged from 80 to 100%, and RQD values ranged from 70 to 100% with an average RQD of 94%.

Seepage was not observed within the borings drilled along the hillside, and there were no recorded water levels in the borings prior to coring. Water levels recorded at completion of the drilling ranged from 5.3 to 48.7 feet below ground surface. Seepage was detected in all of the borings within the floodplain ranging in depth from 4.0 to 30.0 feet below the ground surface. Seepage was generally detected within granular layers. Water levels recorded prior to coring ranged from 7.0 to 50.0 feet below the ground surface with levels at completion of drilling ranged from 3.0 to 15.0 feet below the ground surface. However, the final water levels included drilling water and may not be representative of the actual groundwater conditions. It should be noted that the majority of the subsurface materials encountered had high silt contents with high moistures. This type of material will produce water seepage if an excavation is allowed to remain open. Groundwater levels may vary seasonally, and water levels within the floodplain may be influenced by the level of the Little Scioto River, especially areas immediately adjacent to the river.

Conclusions and Recommendations

It appears that no single foundational element is best suited for support of all the anticipated substructures. The following is a brief discussion of the recommendations for each substructure.

For the substructure elements that are to be located along the steep hillside above SR 335 (forward abutment, and Piers 4 and 5), it appears that spread footing bearing on bedrock will be the best-suited foundation type. Competent bedrock was encountered at shallow depths at the pier locations and the forward abutment will be located in a rock cut section. The footings should be embedded into the bedrock. If an alternative foundation type is required due to lateral or uplift loads, a drilled shaft type foundation can be used. Either drilled shafts with rock sockets or H-piles with pre-bored sockets into bedrock can be utilized.

For the substructure elements to be located adjacent to the Little Scioto River, Pier 2 and 3, it appears that drilled shafts socketed into bedrock will be the best-suited foundation type. Bedrock was encountered at a relatively shallow depth. It is assumed that the scour analysis will indicate that the overburden soils will be scoured to top of rock. Therefore no bearing support can be assumed from these layers.

For the substructure elements to be located south of the Little Scioto River, Pier 1 and the rear abutment, it appears that driven H-piles or drilled shafts to rock will be the best-suited foundation type for support. Due to the size of the structure, if H-piles are used it is anticipated that HP 14X73 H-piles, with a 95-ton capacity, will be used. If high lateral or uplift loads are anticipated, drilled shafts or H-piles socketed into bedrock may be required.

For either drilled shafts or H-pile rock sockets, the actual rock socket lengths will need to be determined based upon actual loading conditions. The upper three feet of the rock socket should be neglected during design. Recommendations for the length of the rock sockets can be provided once the anticipated loads are determined.

The following table summarizes the site conditions and foundation recommendations at each anticipated substructure element.

Foundation Recommendations

Boring Number	Structural Element	Existing Ground Surface Elevation* (Feet)	Approximate Bearing Elevation* (Feet)	Recommended Foundation Type	Allowable Bearing Capacity
TR-29	Forward Abutment	685	623	Spread Footing	20 TSF
TR-30	Pier 5	625	620	Spread Footing	15 TSF
TR-31	Pier 4	580	575	Spread Footing	15 TSF
TR-32	Pier 3	512	470	Drilled Shafts	20 TSF
TR-33	Pier 2	505	467	Drilled Shafts	20 TSF
TR-34	Pier 1	525	483**	H-Piles**	N/A
			480	Drilled Shafts	20 TSF
TR-35	Rear Abutment	552	472**	H-Piles**	N/A
			469	Drilled Shafts	20 TSF

*Existing ground surface elevation was estimated from the established topographic mapping.
** Tip Elevation for an HP 14X73, 95 ton, driven H-pile.

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

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

Additionally, since the forward abutment for the SCI-823-0.00 mainline will be located within a cut section, the cut slopes should be evaluated to ensure that adequate stability of the backslope is achieved. If the backslope should experience instability, then the abutments may also experience instability.

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

Grain-size analyses were performed for scour evaluation since the proposed structure location is located along the Little Scioto River. The following table outlines the D_{85} and D_{50} particle sizes from the grain-size analysis. The laboratory data sheets for the grain-size analyses are attached.

Grain-size Data For Scour

Boring Number	Existing Ground Surface Elevation (Feet)*	Sample Depth (Feet)	ODOT Classification	D_{85} (mm)	D_{50} (mm)
TR-32	512	5.0-6.5	A-4b	0.127	0.0259
TR-32	512	7.5-9.0	A-4b	0.0761	0.0213
TR-32	512	10.0-11.5	A-4b	0.171	0.0339
TR-32	512	12.5-14.0	A-6a	0.0912	0.0133
TR-32	512	15.0-16.5	A-4b	0.0561	0.0166
TR-32	512	17.5-19.0	A-4b	0.0624	0.0172
TR-32	512	20.0-21.5	A-4b	0.0534	0.0161
TR-32	512	22.5-24.0	A-4b	0.117	0.0226
TR-32	512	25.0-26.5	A-4b	0.545	0.312
TR-32	512	27.5-29.0	A-4b	0.152	0.0416
TR-32	512	30.0-31.5	A-4b	0.141	0.0389
TR-32	512	35.0-36.5	A-4a	0.264	0.0921
TR-33	505	1.5-3.0	A-4b	0.0882	0.0219
TR-33	505	4.0-5.5	A-4a	0.193	0.0295
TR-33	505	6.5-8.0	A-4b	0.0845	0.0175
TR-33	505	9.0-10.5	A-4b	0.0793	0.0206
TR-33	505	11.5-13.0	A-4b	0.0696	0.0150
TR-33	505	14.0-15.5	A-4b	0.0425	0.0148
TR-33	505	16.5-18.0	A-4b	0.184	0.0331
TR-33	505	19.0-20.5	A-4b	0.202	0.0413
TR-33	505	21.5-23.0	A-2-4	0.483	0.146

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

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Closing

If you have any questions, please contact our office for clarification.

Sincerely,

DLZ OHIO, INC.

P. Paul Painter
Engineering Geologist

Dorothy A. Adams, P.E.
Senior Geotechnical Engineer

Attachments: General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Boring Location Plan
Boring Logs TR-29, TR-30, TR-31, TR-32, TR-33, TR-34, TR-35
Grain-size data sheets

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**.

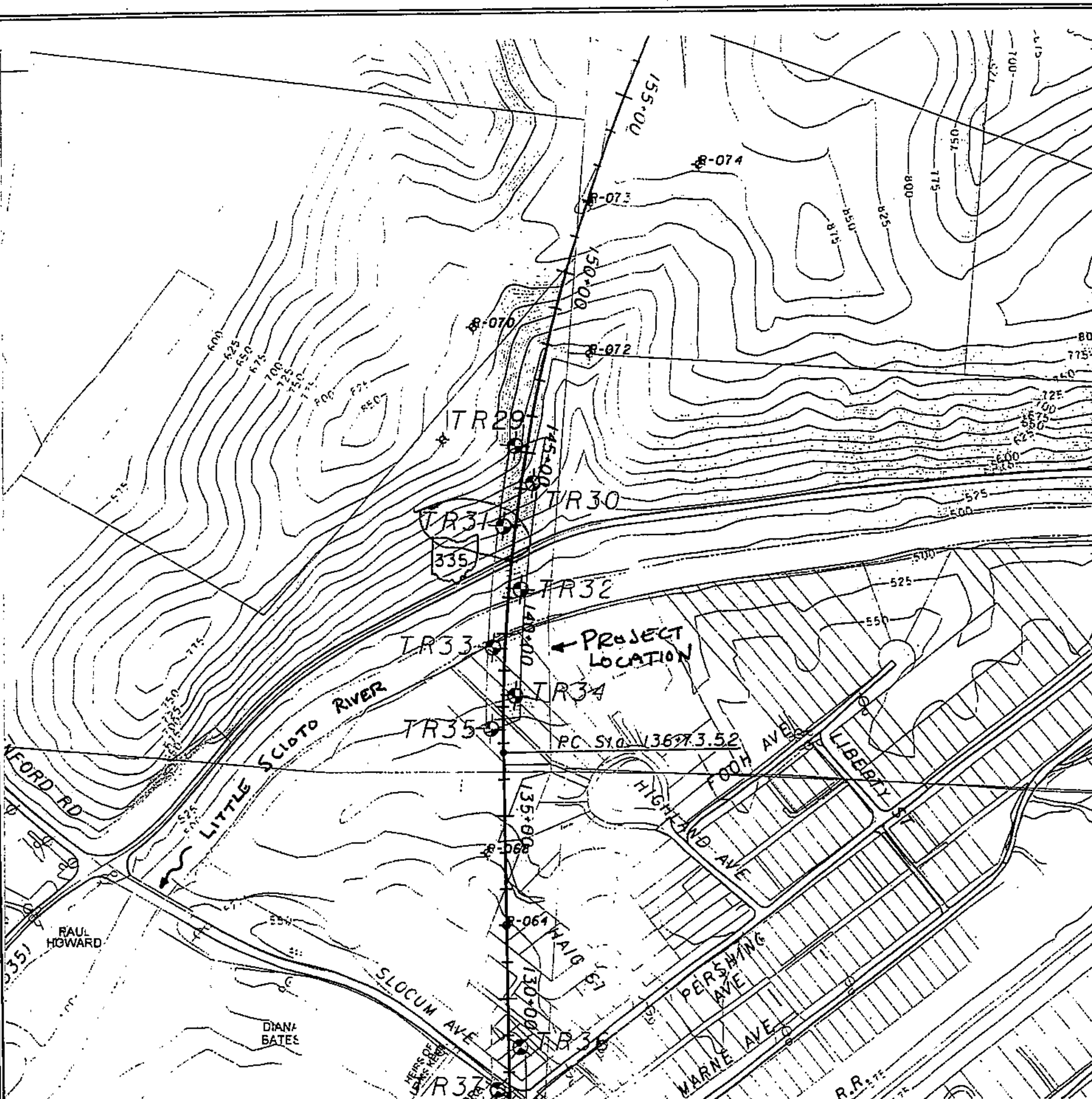
Term	Description
Very Soft	Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb)
Soft	Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed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



Source: Topographic Mapping provided by TranSystems Corporation, Dated 2004

↑ NORTH	DLZ ENGINEERS · ARCHITECTS · SCIENTISTS	**SITE PLAN** **Little Scioto River Crossing** **SCI-823 over SR 335 & Little Scioto** **SCI-823-0.00** FIGURE 1.

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

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

LOG OF: Boring TR-29 | Location: Forward Abutment - Little Scioto Crossing | Date Drilled: 3/8/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: Dry (Prior to coring)
48.7 (after 48 hrs.)

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	STANDARD PENETRATION (N)
0	685.0	Core 120"	Rec 30"	RQD 0%	R-1		Soft brown SANDSTONE; very fine to fine grained, decomposed, argillaceous, thinly bedded, very broken. @ 0.0'-0.4', Topsoil - 5"; 3' drilling bench cut on hillside.							
9.5	675.5	Core 36"	Rec 36"	RQD 64%	R-2		Soft to medium hard brown and gray SANDSTONE; very fine to fine grained, highly weathered to decomposed, argillaceous, thinly bedded to thickly bedded, highly fractured, with typically low angle clay filled fractures. @ 15.4'-15.5', high angle rust stained fracture.							
17.6	667.4	Core 120"	Rec 120"	RQD 92%	R-3		Medium hard to hard brown and gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded. @ 21.0',22.0',22.3', low angle clay filled fractures. @ 27.5'-28.1', high angle rust stained fracture. @ 28.2', low angle rust stained fracture.							
		Core 120"	Rec 120"	RQD 92%	R-4									

STANDARD PENETRATION (N): Natural Moisture Content, % - ● ; PL ├──┤ LL ; Blows per foot - ○ ; scale 10 20 30 40

Depth scale: 0, 5, 10, 15, 20, 25, 30

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

LOG OF: Boring TR-29 | *Location:* Forward Abutment - Little Scioto Crossing | *Date Drilled:* 3/8/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: Dry (Prior to coring)
48.7 (after 48 hrs.)

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	STANDARD PENETRATION (N)
30	655.0						Medium hard to hard brown and gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded.							
35							@ 31.1',34.6',35.3', low angle clay filled fractures.							
		Core 120"	Rec 120"	RQD 100%	R-5									
40														
45														
		Core 120"	Rec 120"	RQD 100%	R-6									
50							@ 53.9'-54.4',58.2'-59.5', high angle rust stained fractures.							
55							@ 56.2',56.9', low angle rust stained fractures.							
		Core 120"	Rec 120"	RQD 82%	R-7									
59.6	625.4													

Standard Penetration legend: Natural Moisture Content, % - ● ; PL ⊢⊣ LL ; Blows per foot - ○ ; scale 10, 20, 30, 40

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

LOG OF: Boring TR-29 | *Location:* Forward Abutment - Little Scioto Crossing | *Date Drilled:* 3/8/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: Dry (Prior to coring)
48.7 (after 48 hrs.)

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	STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
60	625.0						Hard gray SANDSTONE interbedded with SHALE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thinly bedded to thickly bedded.							
60–85		Core 120"	Rec 120"	RQD 100%	R-8		Hard gray SANDSTONE interbedded with SHALE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thinly bedded to thickly bedded.							
		Core 120"	Rec 120"	RQD 100%	R-9									
		Core 24"	Rec 24"	RQD 100%	R10									
85.0	600.0						Bottom of Boring - 85.0'							

Depth scale: 60, 65, 70, 75, 80, 85.0, 90

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-30 | Location: Pier 5 - Little Scioto Crossing | Date Drilled: 3/8/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: Dry (Prior to coring); 12.2' (Including 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	STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
0 – 11.0	625.0 – 614.0	Core 120"	Rec 120"	RQD 62%	R-1		Soft to medium hard gray and brown SANDSTONE; very fine to fine grained, highly weathered to decomposed, argillaceous, thinly bedded to thickly bedded, highly fractured, with typically low angle clay filled fractures. @ 0.0'-0.4', Topsoil - 5"; 3.2' drilling bench cut on hillside. @ 1.0'-1.3',5.0'-5.1', broken zones. @ 3.6'-3.9', clay filled zone. @ 3.9'-4.7', high angle clay filled fracture.							
11.0 – 20.0	614.0 – 605.0	Core 120"	Rec 120"	RQD 100%	R-2		Medium hard gray SANDSTONE interbedded with SHALE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded. @ 11.9',15.9',16.8',18.8' low angle clay filled fractures.							
20.0	605.0						Bottom of Boring - 20.0'							

Depth scale: 0, 5, 10, 15, 20, 25, 30

FILE: 0121-3070-03 [3/28/2005 8:52 AM]

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

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

LOG OF: Boring TR-31 | *Location:* Pier 4 - Little Scioto Crossing | *Date Drilled:* 3/8/05

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: Dry (Prior to coring)
5.3' (Including 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	STANDARD PENETRATION (N)
0	580.0	Core 120"	Rec 110"	RQD 50%	R-1		Soft to medium hard brown SANDSTONE; very fine to fine grained, highly weathered to decomposed, argillaceous, thinly bedded to thickly bedded, highly fractured, with typically low angle clay filled fractures. @ 0.0'-0.5', Topsoil - 6"; 4' drilling bench cut on hillside. @ 0.0'-0.9', lost recovery. @ 0.9'-2.0', broken zones. @ 5.1'-5.4',6.8'-7.0',7.7'-7.9' high angle clay filled fractures.							
9.8	570.2	Core 120"	Rec 116"	RQD 96%	R-2		Medium hard to hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded. @ 10.4'-10.5', broken zone. @ 11.0'-11.4',11.9'-12.1',15.2' rust stained zones. @ 11.2', low angle rust stained fracture. @ 19.6'-20.0', lost recovery.							
20.0	560.0						Bottom of Boring - 20.0'							

Depth scale: 0, 5, 15, 25, 30

STANDARD PENETRATION (N): Natural Moisture Content, % - ● ; PL ⊢—⊣ LL ; Blows per foot - ○ ; scale 10, 20, 30, 40

FILE: 0121-3070-03 [3/28/2005 8:52 AM]

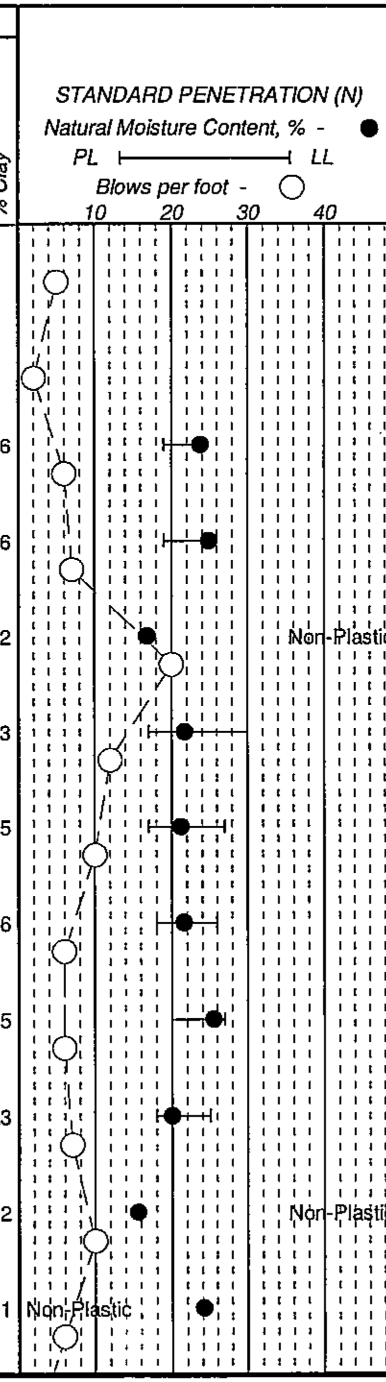
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-32 | *Location:* Pier 3 - Little Scioto Crossing | *Date Drilled:* 3/10/05

WATER OBSERVATIONS:
Water seepage at: 4.0'-11.0', 26.5'-38.0'
Water level at completion: 7.0' (Prir to coring)
3.0' (Including 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	512.0	1 2 3	18	1			Loose brown SILT (A-4b), little fine sand; moist to wet.						
		1 1 1	16	2			@ 4.0', gray.						
5		2 2 4	15	3				0	0	--	26	58	16
		3 3 4	17	4				0	0	--	15	69	16
10		4 12 8	18	5			@ 10.0'-12.5', medium dense, trace coarse sand.	1	5	--	24	58	12
12.5	499.5	4 5 7	16	6			Stiff gray SILT AND CLAY (A-6a), little fine to coarse sand; moist.	0	3	--	15	49	33
15.0	497.0	5 5 5	16	7			Loose gray SILT (A-4b), trace fine sand; moist to wet.	0	1	--	9	66	25
		3 3 3	17	8				0	1	--	11	63	26
20		WOH 3 3	15	9				0	0	--	8	67	25
		3 4 3	18	10			@ 22.0', little fine to coarse sand, trace gravel.	2	2	--	18	55	23
25		1 4 6	18	11				7	9	--	14	58	12
		2 2 4	18	12			@ 27.0', some fine sand. trace gravel.	0	1	--	33	56	11
30													



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

LOG OF: Boring TR-32 | *Location:* Pier 3 - Little Scioto Crossing | *Date Drilled:* 3/10/05

WATER OBSERVATIONS:
Water seepage at: 4.0'-11.0', 26.5'-38.0'
Water level at completion: 7.0' (Prir to coring)
3.0' (Including 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	STANDARD PENETRATION (N)
30	482.0	1 1 1	17	13			Loose gray SILT (A-4b), some fine sand; moist to wet.	0	1	--	31	56	12	Non-Plastic
33.0	479.0						Medium dense gray SANDY SILT (A-4a), trace gravel; wet.							
35		2 8 13	18	14				3	3	--	51	37	7	Non-Plastic
38.0	474.0						Medium hard to hard gray SANDSTONE; very fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded.							
		Core 120"	Rec 120"	RQD 100%	R-1		@ 39.6',42.0',43.1', low angle fractures.							
							@ 40.1'-40.4', clay filled zone.							
		Core 120"	Rec 120"	RQD 100%	R-2									
59.0	453.0						Bottom of Boring - 59.0'							

STANDARD PENETRATION (N): Natural Moisture Content, % - ●; PL ├──┤ LL; Blows per foot - ○; scale 10, 20, 30, 40

Depth scale: 30, 35, 40, 45, 50, 55, 60

FILE: 0121-3070-03 [3/28/2005 8:52 AM]

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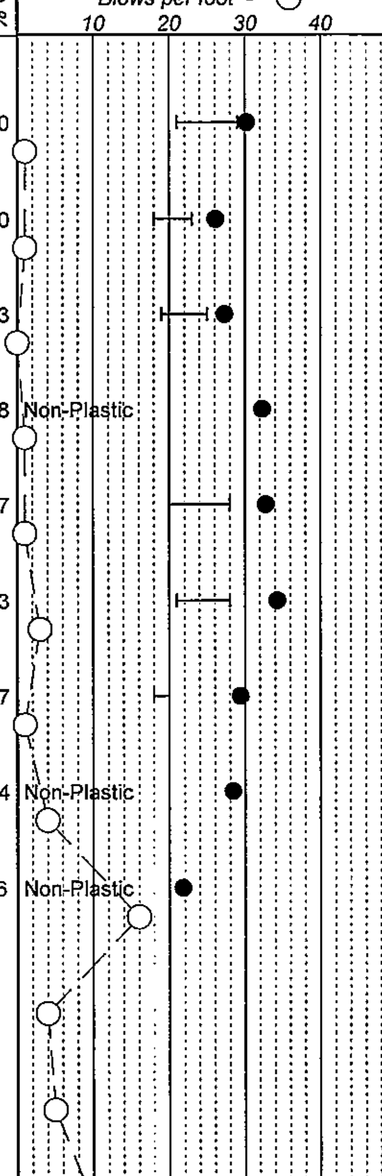
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-33 | Location: Pier 2 - Little Scioto Crossing | Date Drilled: 2/23/05 to 2/24/05

WATER OBSERVATIONS: Water seepage at: 5.5'-34.0'
Water level at completion: 15.0' (Prior to coring)

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	505.0						Very soft brown SILT (A-4b), little fine sand; wet.						
		WOH WOH 1	12	1		0.25		0	0	--	18	62	20
3.0	502.0						Very soft brown SANDY SILT (A-4a), some fine sand; wet.						
5		1 WOH 1	16	2		0.25		0	1	--	32	47	20
5.5	499.5						Very soft brown SILT (A-4b), little fine sand; wet.						
		WOH WOH WOH	3	3		0.25		0	0	--	17	60	23
							@ 8.0'-10.0', very loose.						
10		WOH WOH 1	18	4				0	0	--	16	66	18
		WOH WOH 1	18	5		0.25		0	0	--	14	60	27
							@ 13.0'-16.0', trace fine sand.						
15		WOH 1 2	18	6		0.5		0	0	--	4	73	23
							@ 16.0', some fine sand.						
		WOH WOH 1	18	7		0.25		0	0	--	32	51	17
							@ 18.5', very loose to loose.						
20		WOH 2 2	18	8		---		0	0	--	36	50	14
21.0	484.0						Medium dense gray GRAVEL WITH SAND AND SILT (A-2-4); wet.						
		2 9 7	18	9				7	10	--	54	22	6
23.5	481.5						Loose gray FINE SAND (A-3), trace silt; wet.						
25		2 2 2	18	10									
		1 2 3	18	11									
28.5	476.5						Loose gray SANDY SILT (A-4a); moist to wet.						
30		2 4		12									

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



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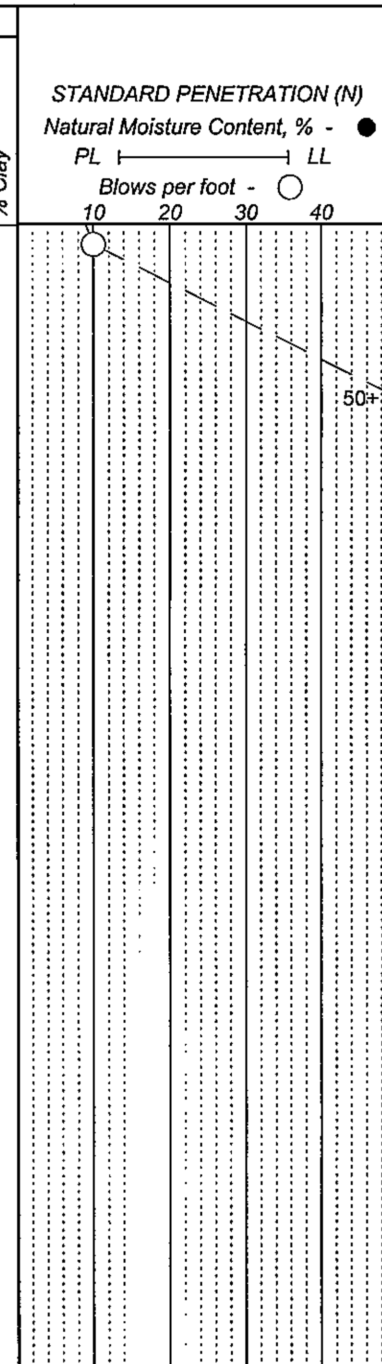
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-33 | Location: Pier 2 - Little Scioto Crossing | Date Drilled: 2/23/05 to 2/24/05

WATER OBSERVATIONS: Water seepage at: 5.5'-34.0'
Water level at completion: 15.0' (Prior to coring)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	475.0	6					Loose gray SANDY SILT (A-4a); moist to wet.						
34.0	471.0	50/1	0	13			Medium hard to hard gray SANDSTONE; very fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded. @ 34.6', 30° fracture.						
34.7	470.3	Core 42"	Rec 42"		R-1								
36.1	468.9						Hard gray SHALE; slightly weathered, arenaceous, laminated to thinly bedded, moderately fractured.						
							Hard gray SANDSTONE; very fine grained, slighty weathered, argillaceous, micaceous, thinly bedded to thickly bedded.						
40		Core 60"	Rec 60"		R-2		@ 41.9', clay seam. @ 42.4', low angle fracture.						
45		Core 60"	Rec 60"		R-3								
50		Core 60"	Rec 60"		R-4								
		Core 18"	Rec 18"		R-5								
54.0	451.0						Bottom of Boring - 54.0'						
55													
60													



FILE: 0121-3070-03 (3/31/2005 3:32 PM)

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

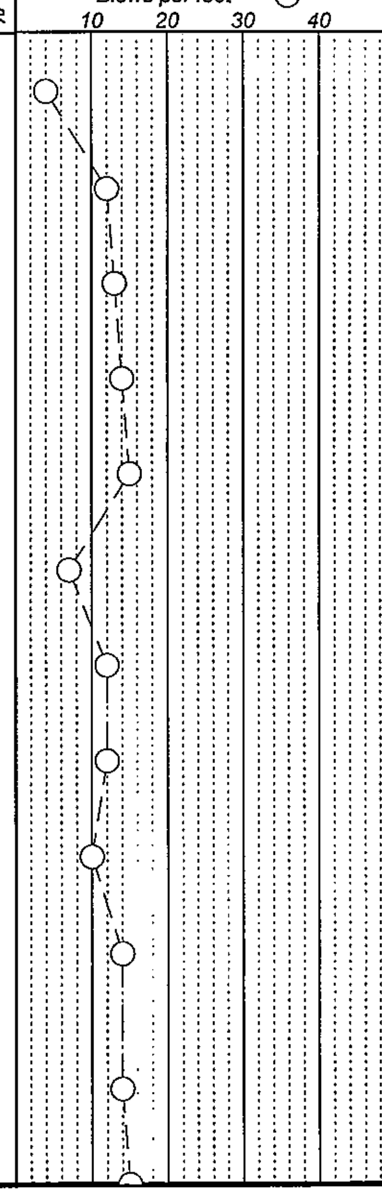
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-34 | Location: Pier 1 - Little Scioto Crossing | Date Drilled: 2/24/05 to 3/2/05

WATER OBSERVATIONS: Water seepage at: 30.0'-38.0'
Water level at completion: 20.0' (Prior to coring)
6.0' (Including 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	525.0												
0.6	524.4	1 2 2	16	1		2.5	Topsoil - 7" Very stiff brown SANDY SILT (A-4a); damp.						
2.0	523.0	4 5 7	18	2		4.0	Hard brown SILTY CLAY (A-6b), trace fine sand; damp.						
5		4 5 8	18	3		4.5	@ 6.0', contains occasional very thin gray seams with dissication cracking.						
		3 6 8	18	4		4.5+							
10.0	515.0	3 6 9	18	5		4.5+	Hard brown and gray CLAY (A-7-6); varved; damp.						
		2 3 4	18	6		2.25	@ 12.0', very stiff; damp to moist.						
15		2 5 7	18	7		3.25							
17.0	508.0	2 5 7	18	8		2.25	Very stiff gray SANDY SILT (A-4a); slightly organic; damp.						
20		2 4 6	0	9		---							
22.0	503.0	3 6 8	18	10		3.75	Very stiff gray CLAY (A-7-6); damp.						
25.0	500.0	4 6 8	18	11		2.25	Very stiff grayish brown SILTY CLAY (A-6b), trace fine sand; slightly organic; damp.						
30		3 6 9	0	12		---							

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



FILE: 0121-3070-03 [3/31/2005 3:30 PM]

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

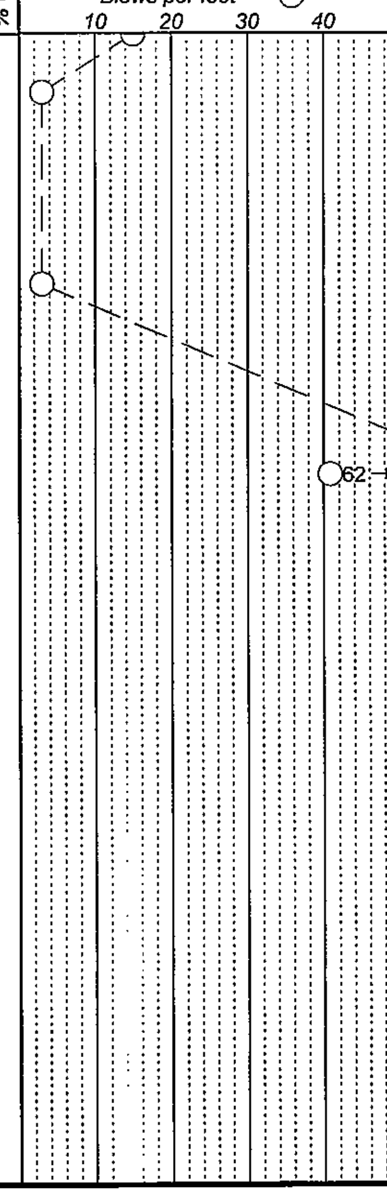
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-34 | Location: Pier 1 - Little Scioto Crossing | Date Drilled: 2/24/05 to 3/2/05

WATER OBSERVATIONS: Water seepage at: 30.0'-38.0'
Water level at completion: 20.0' (Prior to coring)
6.0' (Including drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0	495.0	2 1 2	0	13			Very loose gray FINE SAND (A-3); wet.						
35		0 1 2	18	14									
38.0	487.0						Medium dense gray GRAVEL WITH SAND AND SILT (A-2-4); moist.						
40		10 12 50/4	14	15									
41.3	483.7	Core 12"	Rec 12"	RQD 75%	R-1		Soft to medium hard gray SANDSTONE interbedded with SHALE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded.						
45		Core 60"	Rec 60"	RQD 70%	R-2		@ 42.2',43.6',44.7', low angle clay filled fractures. @ 47.1',47.2',47.6', low angle clay filled fractures. @ 44.2'-44.4',45.0'-45.1',46.7' high angle clay filled fractures.						
48.0	477.0						Hard gray SANDSTONE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thinly bedded to thickly bedded.						
50		Core 60"	Rec 60"	RQD 100%	R-3								
55		Core 60"	Rec 60"	RQD 97%	R-4		@ 53.4',53.5', low angle clay filled fractures.						
60		Core 48"	Rec 48"	RQD 100%	R-5								

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



FILE: 0121-3070-03 [3/31/2005 3:30 PM]

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-34 | *Location:* Pier 1 - Little Scioto Crossing | *Date Drilled:* 2/24/05 to 3/2/05

WATER OBSERVATIONS: Water seepage at: 30.0'-38.0'
Water level at completion: 20.0' (Prior to coring)
6.0' (Including 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	STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
60	465.0						Hard gray SANDSTONE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thinly bedded to thickly bedded.							
62.0	463.0						Bottom of Boring - 62.0'							
65														
70														
75														
80														
85														
90														

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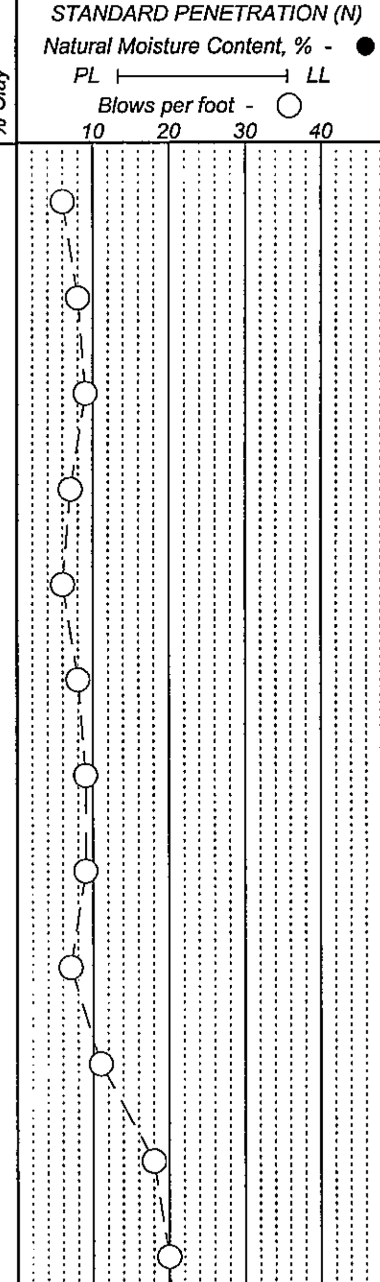
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-35 | *Location:* Rear Abutment - Little Scioto Crossing | *Date Drilled:* 2/22/05 to 2/23/05

WATER OBSERVATIONS: Water seepage at: 7.0'-22.0', 63.0'-76.5'
Water level at completion: 50.0' (Prior to coring)
7.4' (including 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	552.0												
0.3	551.7	1 2 4	18	1		3.75	Topsoil - 4" Very stiff brown SANDY SILT (A-4a); contains roots; damp.						
		3 3 5	18	2		2.0	@ 2.5', stiff; moist. @ 3.5', wet seam.						
5		3 5 4	18	3		1.75							
7.0	545.0						Medium stiff to stiff brown SILT (A-4b); moist to wet.						
		2 3 4	18	4		0.75							
10		1 2 4	18	5		1.75							
		2 4 4	18	6		1.0							
15		2 3 6	18	7		3.0	@ 15.0'-17.5', very stiff.						
		1 3 6	18	8		1.25	@ 15.0'-17.5', brownish gray.						
20		2 3 4	18	9		1.25							
22.0	530.0						Very stiff gray CLAY (A-7-6), trace fine sand; varved; damp.						
		2 4 7	18	10		2.75							
25		4 8 10	18	11		4.25	@ 25.0', hard.						
		5 8 12	18	12		4.0							
30													

STANDARD PENETRATION (N)

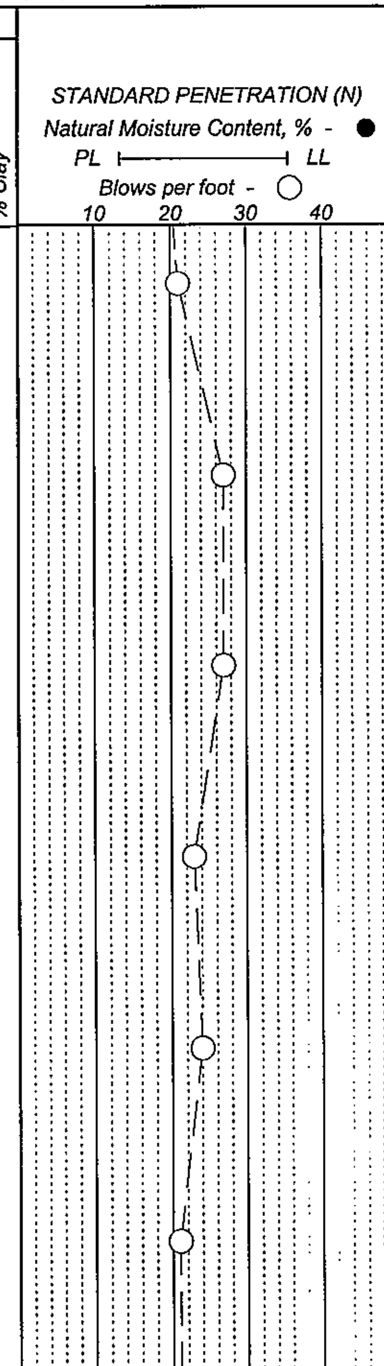


Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-35 | Location: Rear Abutment - Little Scioto Crossing | Date Drilled: 2/22/05 to 2/23/05

WATER OBSERVATIONS: Water seepage at: 7.0'-22.0', 63.0'-76.5'
Water level at completion: 50.0' (Prior to coring)
7.4' (including drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	522.0	6 8 13	18	13		4.5+	Hard gray CLAY (A-7-6), trace fine sand; varved; damp.						
35		7 11 16	18	14		4.5+							
40		4 12 15	18	15		4.5+							
45		7 9 14	18	16		4.5+							
50		7 10 14	18	17		4.5+							
55.0	497.0	5 8 13	18	18		3.75	Very stiff to hard dark gray SANDY SILT (A-4a), trace fine sand; slightly organic, contains very thin fine grained sand seams; damp to moist.						
60													



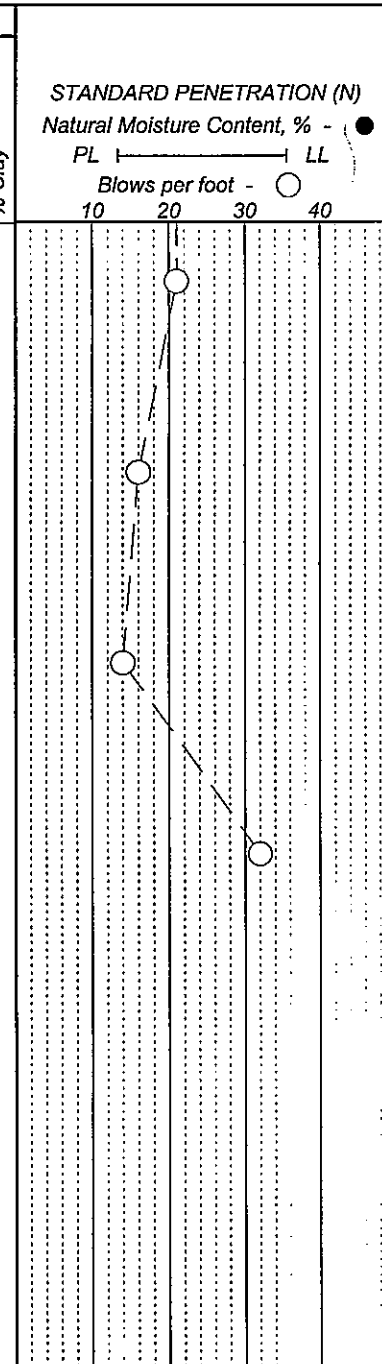
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-35 | Location: Rear Abutment - Little Scioto Crossing | Date Drilled: 2/22/05 to 2/23/05

WATER OBSERVATIONS: Water seepage at: 7.0'-22.0', 63.0'-76.5'
Water level at completion: 50.0' (Prior to coring)
7.4' (including 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
60	492.0	4 9 12	18	19		2.75-4.5+	Very stiff to hard dark gray SANDY SILT (A-4a), trace fine sand; slightly organic, contains very thin fine grained sand seams; damp to moist.						
63.0	489.0						Medium dense gray SANDY SILT (A-4a); moist to wet.						
65		5 8 8	18	20									
70		0 6 8	18	21									
73.0	479.0						Dense gray GRAVEL WITH SAND AND SILT (A-2-4); moist.						
75		11 16 16	12	22									
80.0	472.0	Core 30"	Rec 24"	RQD 80%	R-1		Medium hard to hard gray SANDSTONE interbedded with SHALE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thinly bedded to thickly bedded. @ 82.8',84.7',84.8', low angle clay filled fractures. @ 83.8'-83.9', high angle clay filled fracture.						
84.8	467.2	Core 60"	Rec 60"	RQD 90%	R-2		Hard gray SANDSTONE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thinly bedded to thickly bedded.						
		Core 60"	Rec 60"	RQD 100%	R-3								
90													



FILE: 0121-3070-03 [3/31/2005 2:28 PM]

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

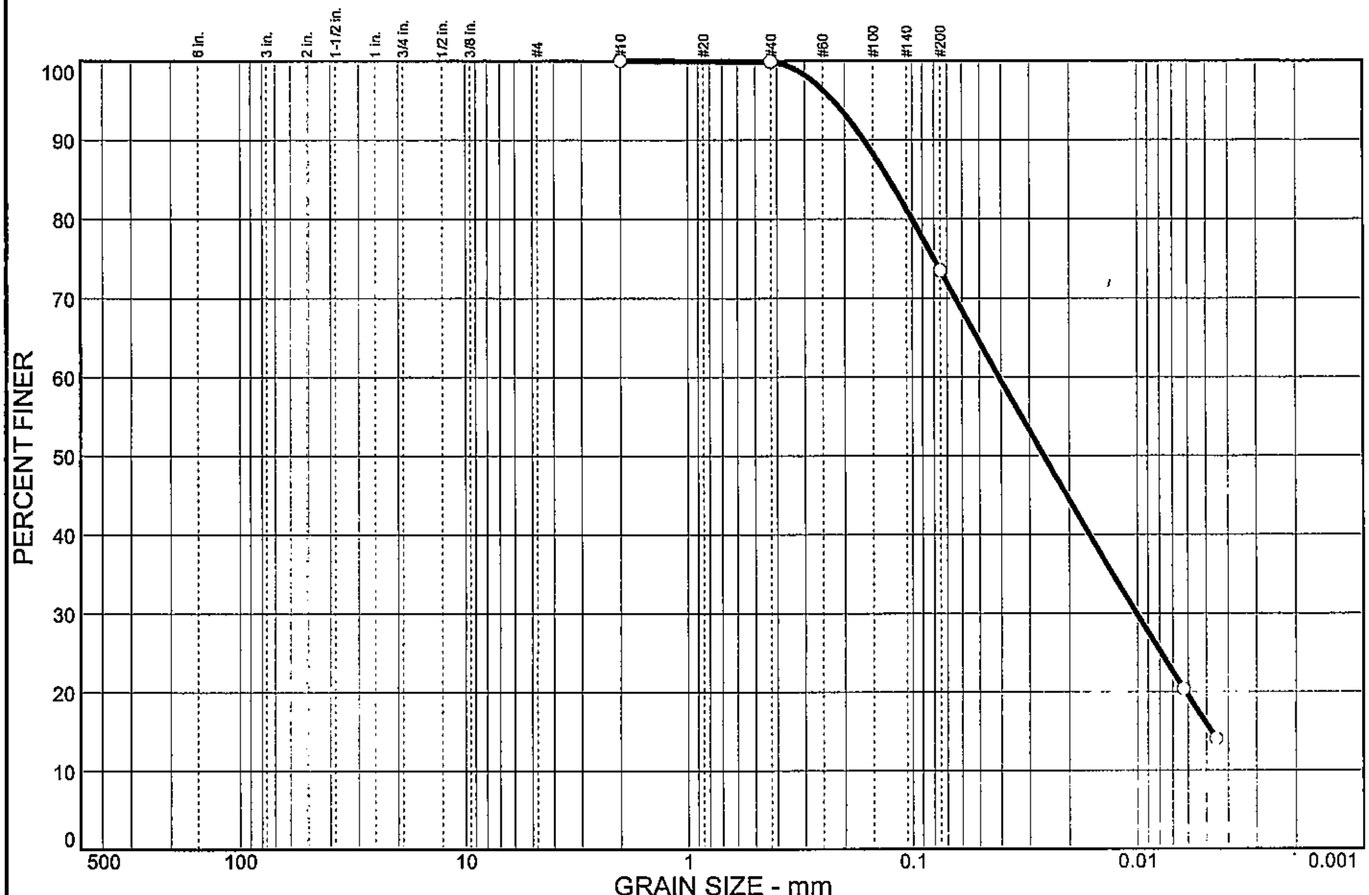
LOG OF: Boring TR-35 | Location: Rear Abutment - Little Scioto Crossing | Date Drilled: 2/22/05 to 2/23/05

WATER OBSERVATIONS: Water seepage at: 7.0'-22.0', 63.0'-76.5'
Water level at completion: 50.0' (Prior to coring)
7.4' (including 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	STANDARD PENETRATION (N)
90	462.0						Hard gray SANDSTONE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thinly bedded to thickly bedded.							
95		Core 60"	Rec 60"	RQD 100%	R-4		@ 91.1', low angle clay filled fracture.							
100		Core 36"	Rec 36"	RQD 100%	R-5									
100.5	451.5						Bottom of Boring - 100.5'							
105														
110														
115														
120														

STANDARD PENETRATION (N): Natural Moisture Content, % - ● ; PL ⊢—⊣ LL ; Blows per foot - ○ ; 10 20 30 40

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	26.4	57.5	16.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.9		
#200	73.5		

* (no specification provided)

Soil Description

Silty clay with sand

Atterberg Limits

PL= 19 LL= 23 PI= 4

Coefficients

D_{85}= 0.127 D_{60}= 0.0409 D_{50}= 0.0259
D_{30}= 0.0101 D_{15}= 0.0048 D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(1)

Remarks

Moisture Content= 23.8%

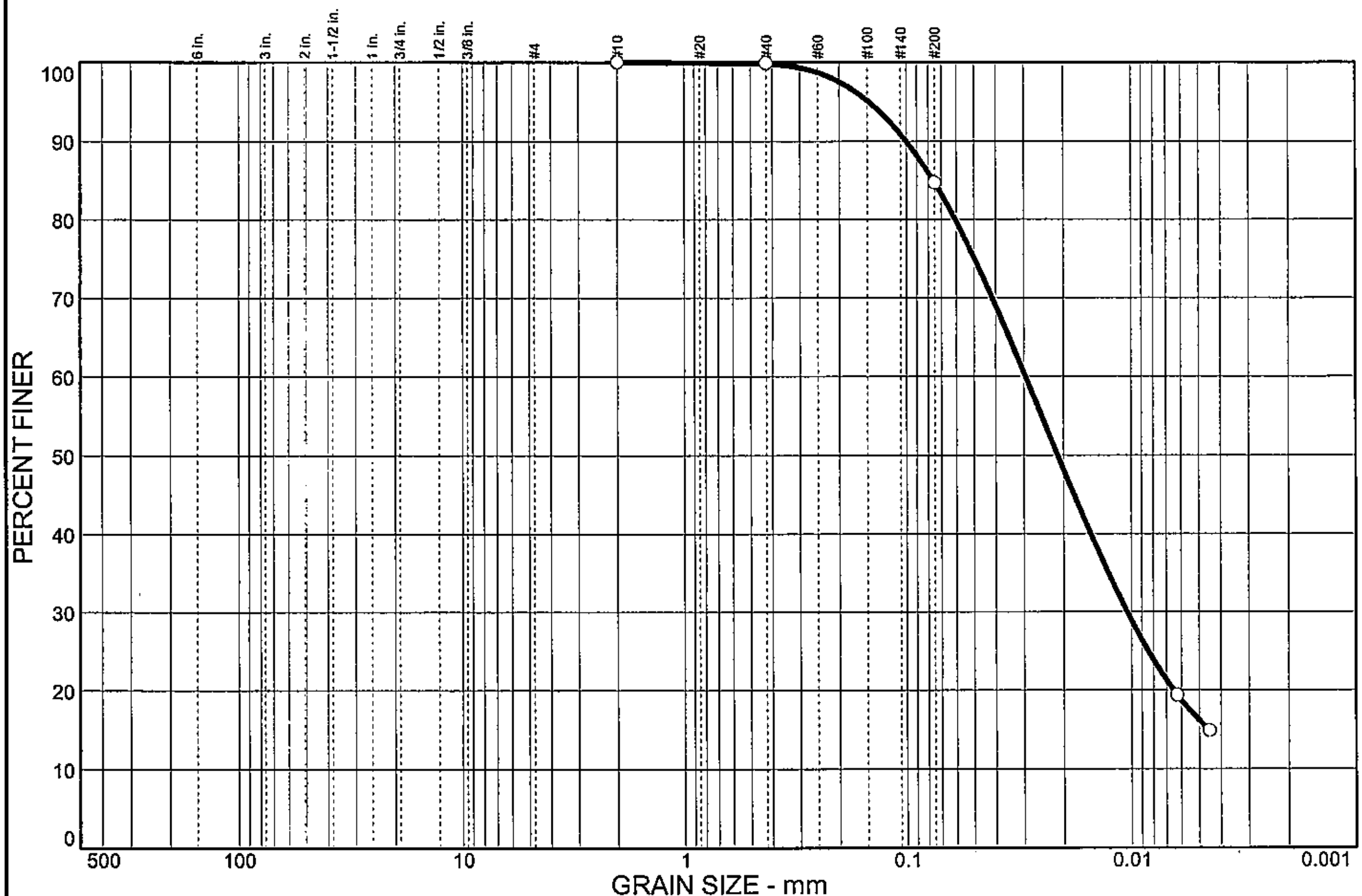
Sample No.: 3 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 5

DLZ

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

Project No: 0121-3070.03 **Figure**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	15.2	68.5	16.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.9		
#200	84.7		

* (no specification provided)

Soil Description

Silty clay with sand

Atterberg Limits

PL= 19 LL= 24 PI= 5

Coefficients

D_{85}= 0.0761 D_{60}= 0.0296 D_{50}= 0.0213
D_{30}= 0.0105 D_{15}= 0.0045 D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(2)

Remarks

Moisture Content= 24.9%

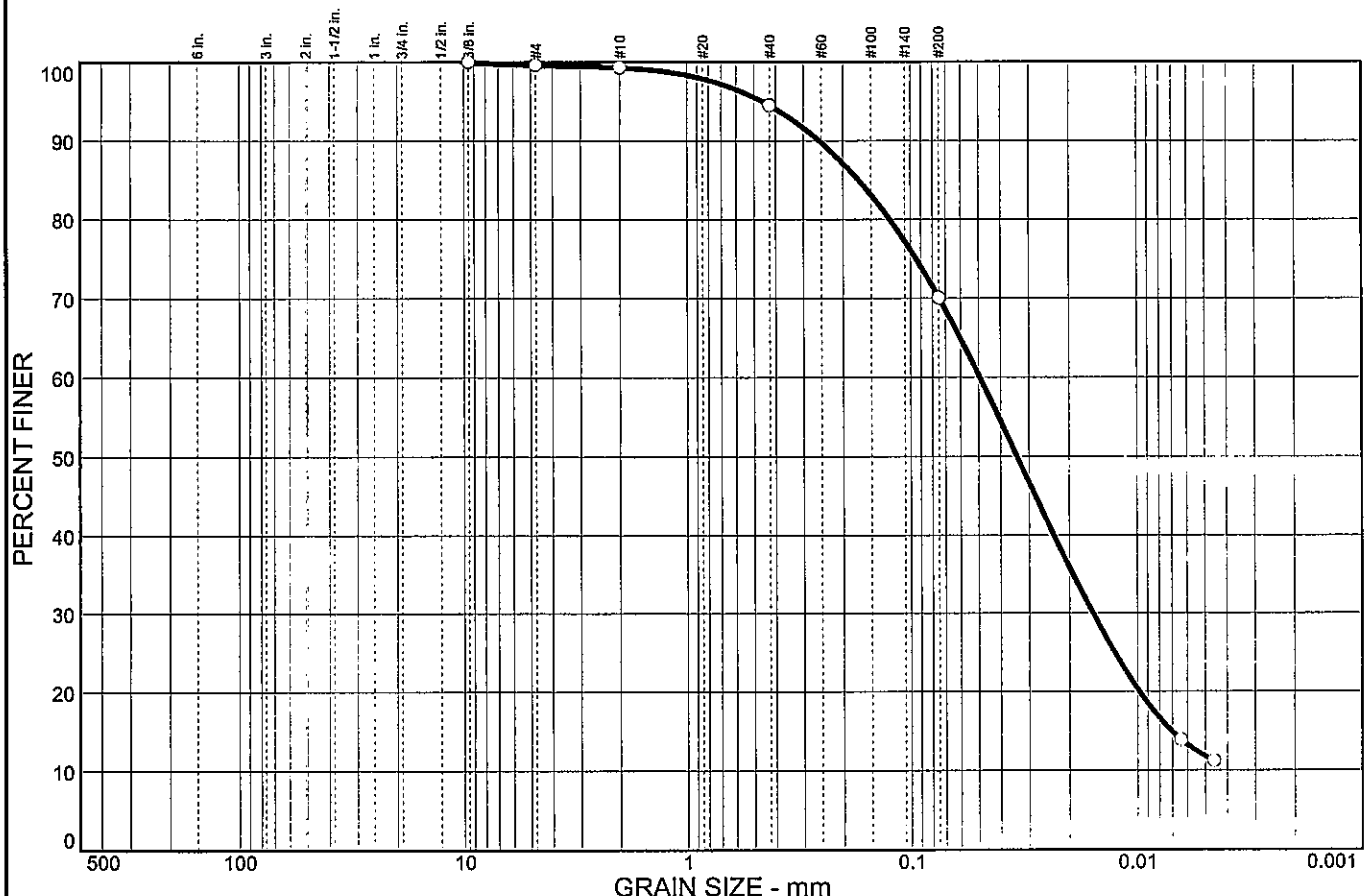
Sample No.: 4 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 7.5

DLZ

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

Project No: 0121-3070.03 **Figure**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.4	0.3	4.8	24.4	58.3	11.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.6		
#10	99.3		
#40	94.5		
#200	70.1		

* (no specification provided)

Soil Description

Silt with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.171 D_{60}= 0.0495 D_{50}= 0.0339
D_{30}= 0.0157 D_{15}= 0.0071 D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

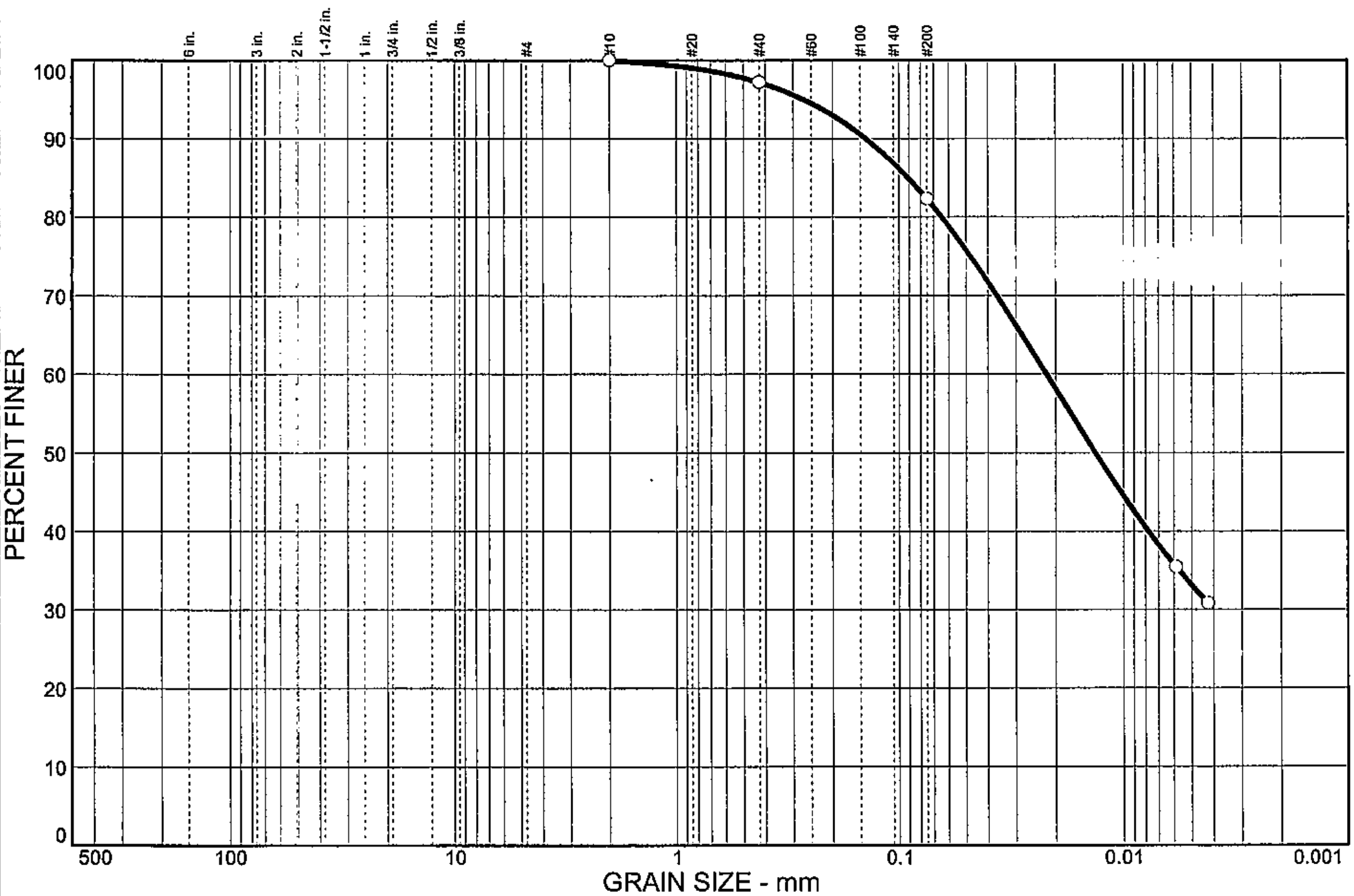
Moisture Content= 16.8%

Sample No.: 5 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 10

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	2.8	14.9	49.2	33.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	97.2		
#200	82.3		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 17 LL= 30 PI= 13

Coefficients

D_{85}= 0.0912 D_{60}= 0.0220 D_{50}= 0.0133
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-6(9)

Remarks

Moisture Content= 21.7%

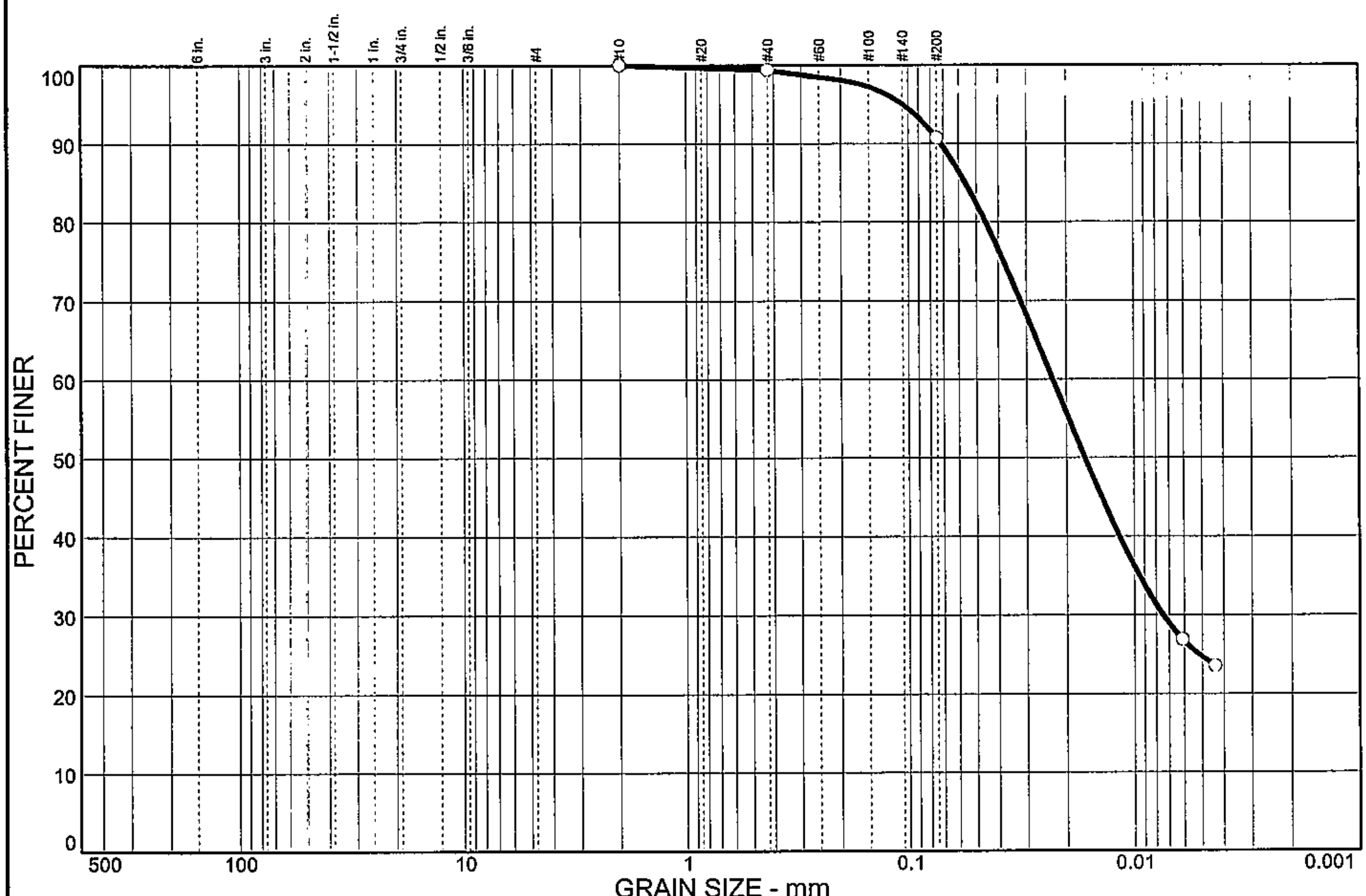
Sample No.: 6 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 12.5

DLZ

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

Project No: 0121-3070.03 **Figure**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.6	8.7	65.9	24.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.4		
#200	90.7		

* (no specification provided)

Soil Description

Lean clay

Atterberg Limits

PL= 17 LL= 27 PI= 10

Coefficients

D_{85}= 0.0561 D_{60}= 0.0230 D_{50}= 0.0166
D_{30}= 0.0074 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-4(8)

Remarks

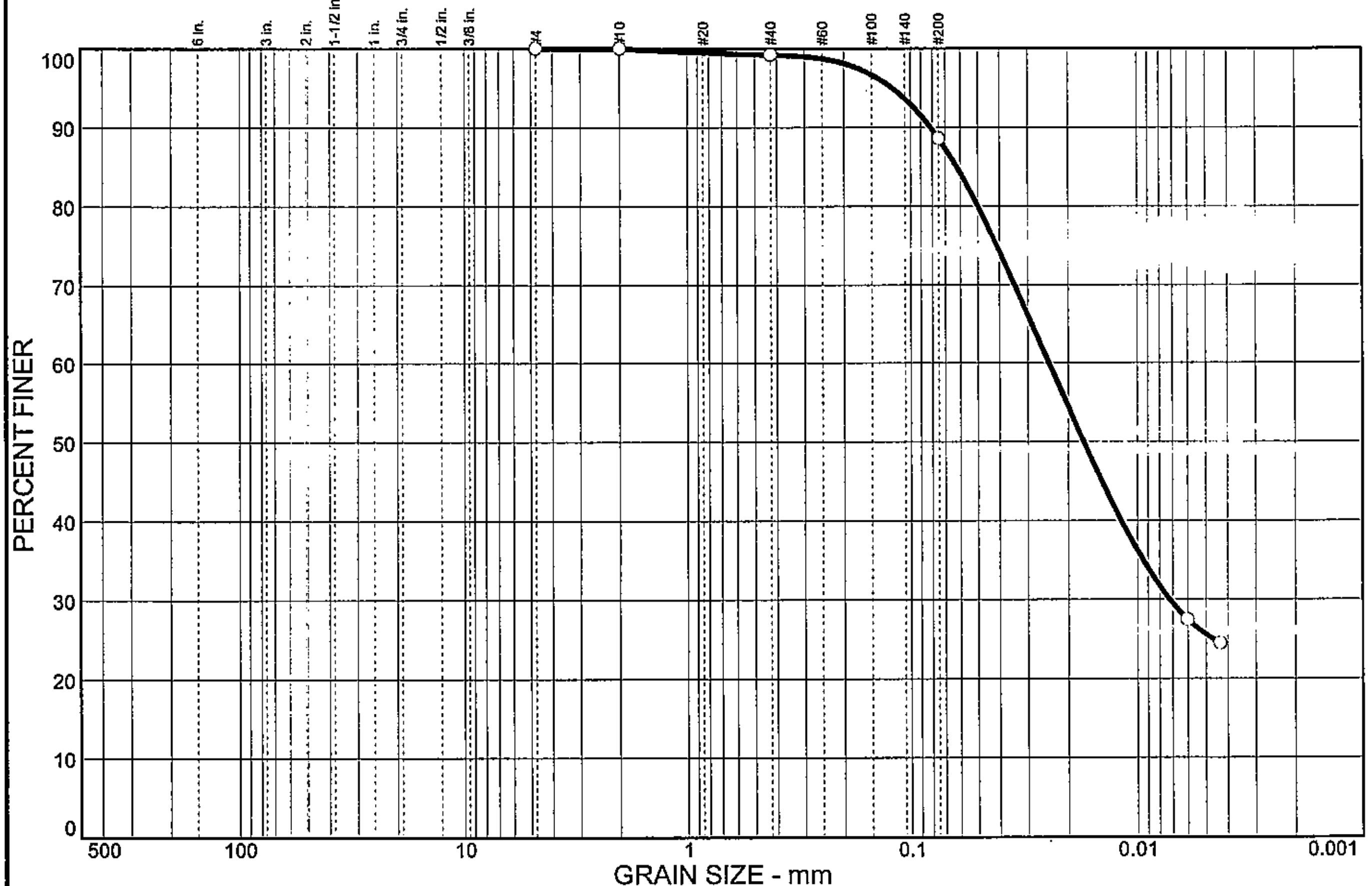
Moisture Content= 21.2%

Sample No.: 7 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 15

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.8	10.6	63.0	25.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#40	99.2		
#200	88.6		

* (no specification provided)

Soil Description

Lean clay

Atterberg Limits

PL= 18 LL= 26 PI= 8

Coefficients

D_{85}= 0.0624 D_{60}= 0.0243 D_{50}= 0.0172
D_{30}= 0.0072 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-4(6)

Remarks

Moisture Content= 21.6%

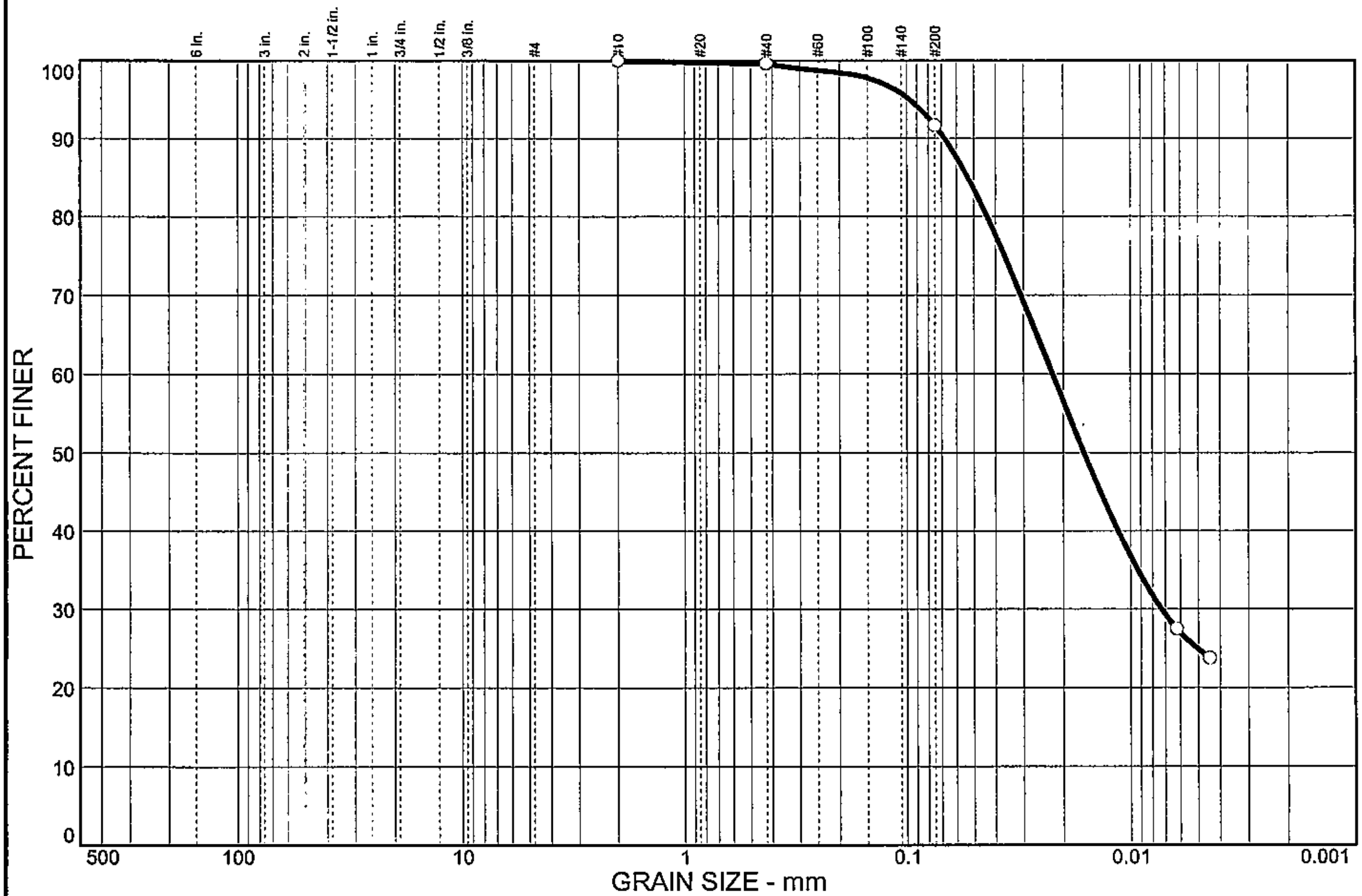
Sample No.: 8 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 17.5

DLZ

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

Project No: 0121-3070.03 **Figure**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.4	7.9	66.8	24.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.6		
#200	91.7		

* (no specification provided)

Soil Description

Silty clay

Atterberg Limits

PL= 20 LL= 27 PI= 7

Coefficients

D_{85}= 0.0534 D_{60}= 0.0223 D_{50}= 0.0161
D_{30}= 0.0073 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(5)

Remarks

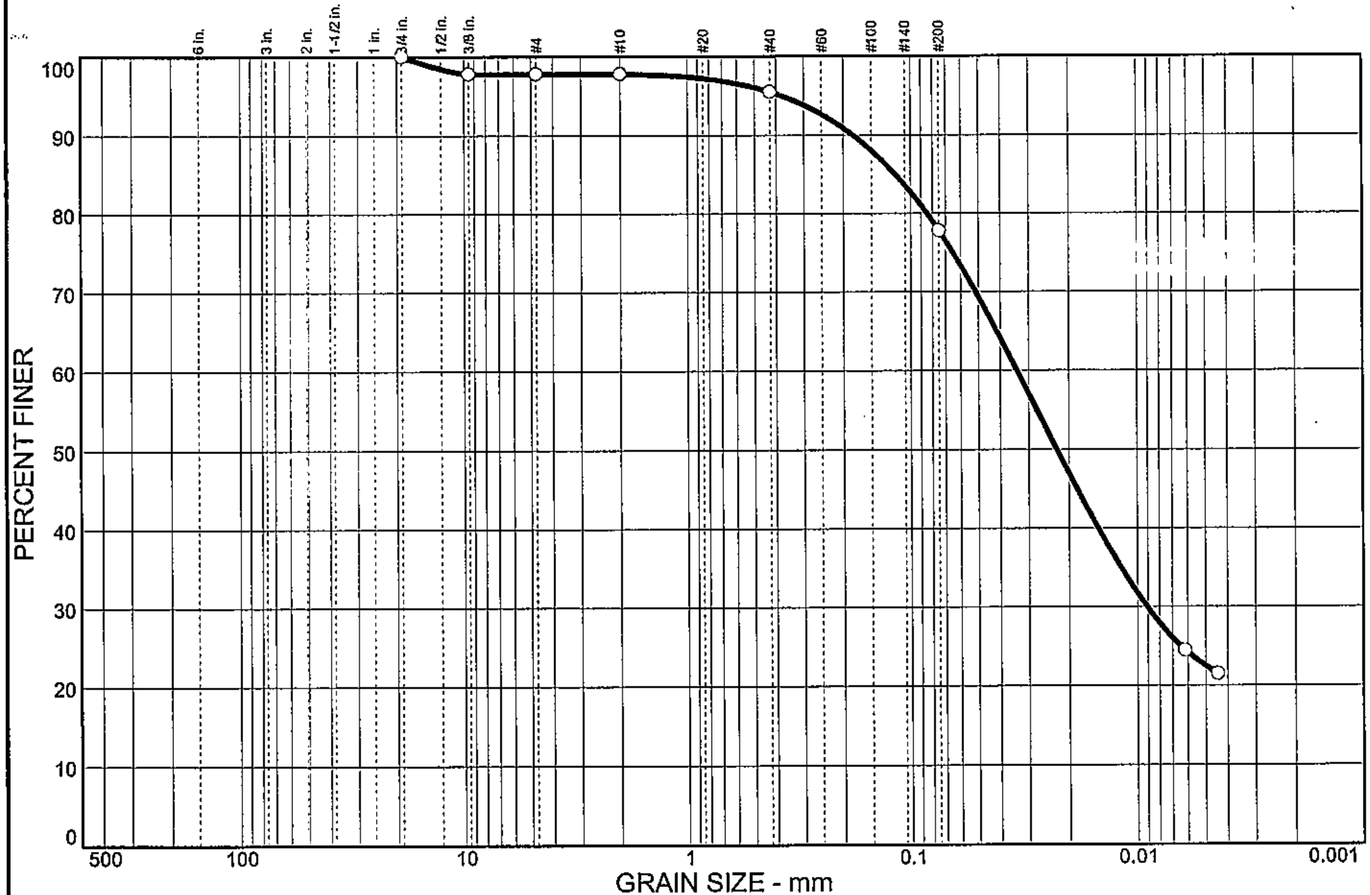
Moisture Content= 25.5%

Sample No.: 9 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 20

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	2.2	0.0	2.3	17.7	55.3	22.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	97.8		
#4	97.8		
#10	97.8		
#40	95.5		
#200	77.8		

* (no specification provided)

Soil Description

Silty clay with sand

Atterberg Limits

PL= 18 LL= 25 PI= 7

Coefficients

D_{85}= 0.117 D_{60}= 0.0338 D_{50}= 0.0226
D_{30}= 0.0091 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(3)

Remarks

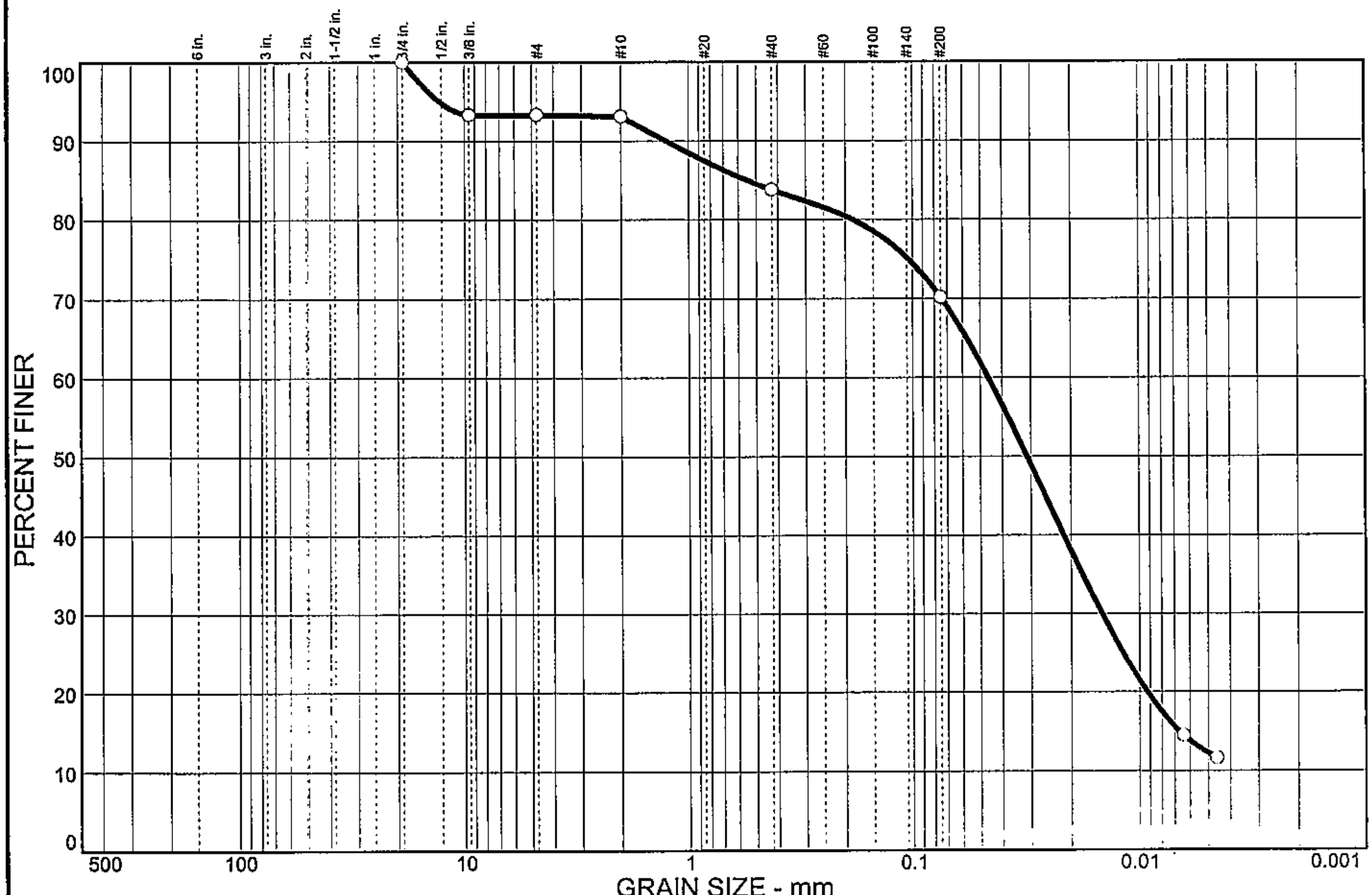
Moisture Content= 20.0%

Sample No.: 10 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 22.5

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	6.7	0.2	9.3	13.6	57.9	12.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	93.3		
#4	93.3		
#10	93.1		
#40	83.8		
#200	70.2		

* (no specification provided)

Soil Description

Silt with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.545 D_{60}= 0.0462 D_{50}= 0.0312
D_{30}= 0.0146 D_{15}= 0.0067 D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

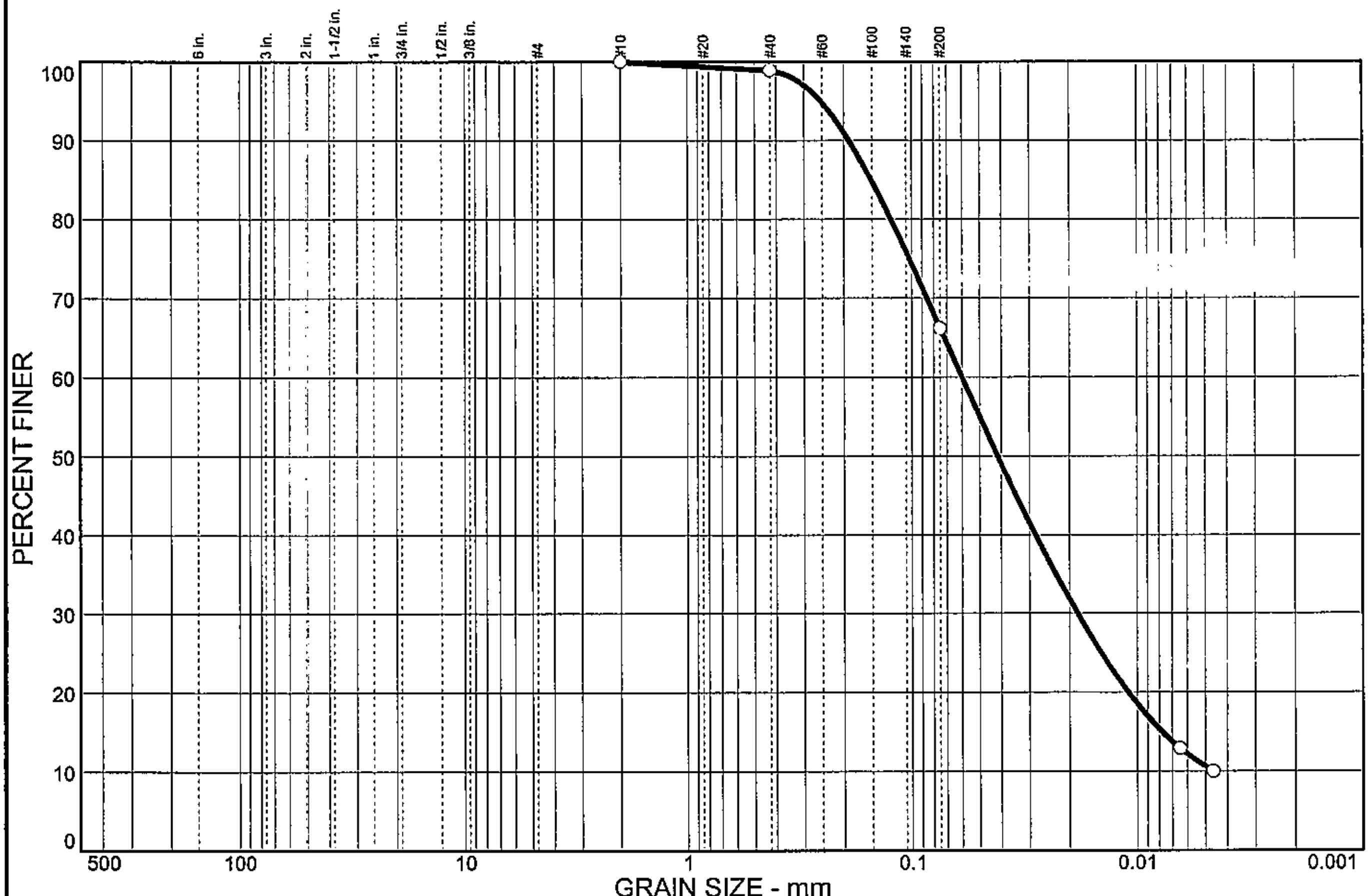
Moisture Content= 15.6%

Sample No.: 11 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 25

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	1.1	32.7	55.5	10.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	98.9		
#200	66.2		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.152 D_{60}= 0.0601 D_{50}= 0.0416
D_{30}= 0.0184 D_{15}= 0.0078 D_{10}= 0.0046
C_u= 13.06 C_c= 1.22

Classification

USCS= ML AASHTO= A-4(0)

Remarks

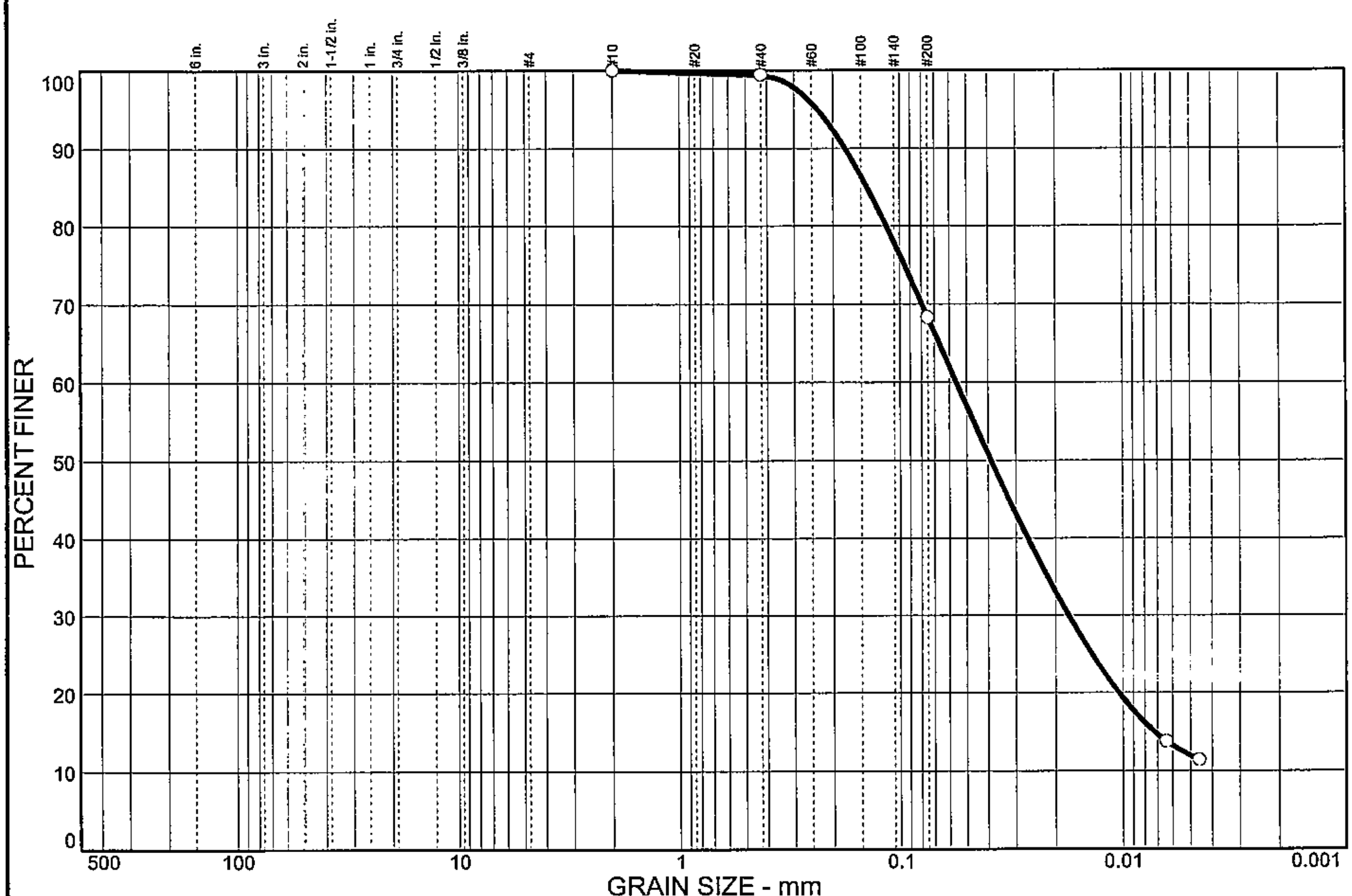
Moisture Content= 24.2%

Sample No.: 12 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 27.5

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.6	31.1	56.3	12.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.4		
#200	68.3		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.141 D_{60}= 0.0558 D_{50}= 0.0389
D_{30}= 0.0175 D_{15}= 0.0072 D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Moisture Content= 24.9%

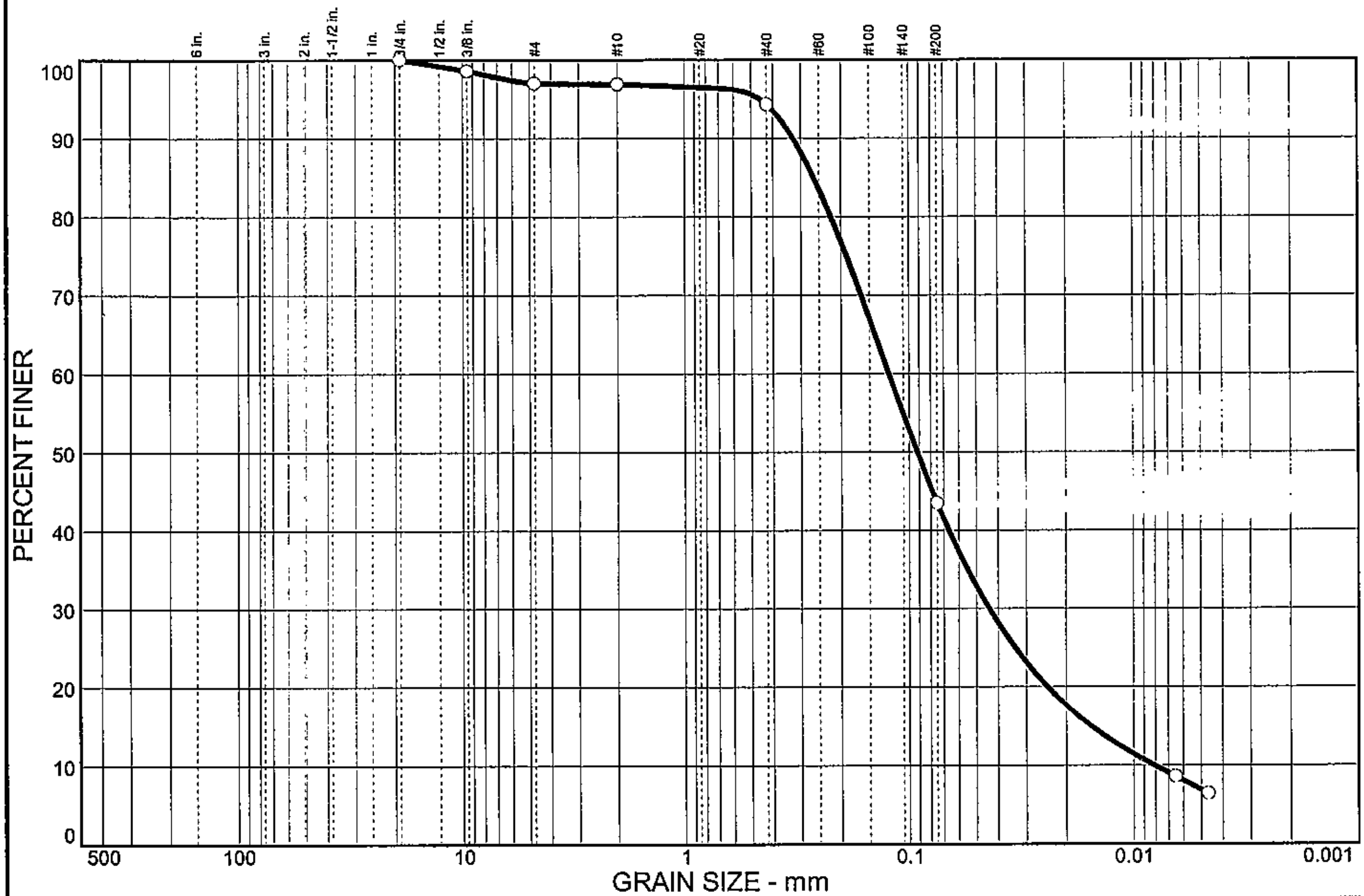
Sample No.: 13 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 30

DLZ

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

Project No: 0121-3070.03 **Figure**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	3.0	0.1	2.6	50.8	36.6	6.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	98.6		
#4	97.0		
#10	96.9		
#40	94.3		
#200	43.5		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.264 D_{60}= 0.123 D_{50}= 0.0921
D_{30}= 0.0439 D_{15}= 0.0154 D_{10}= 0.0081
C_u= 15.24 C_c= 1.94

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Moisture Content= 24.6%

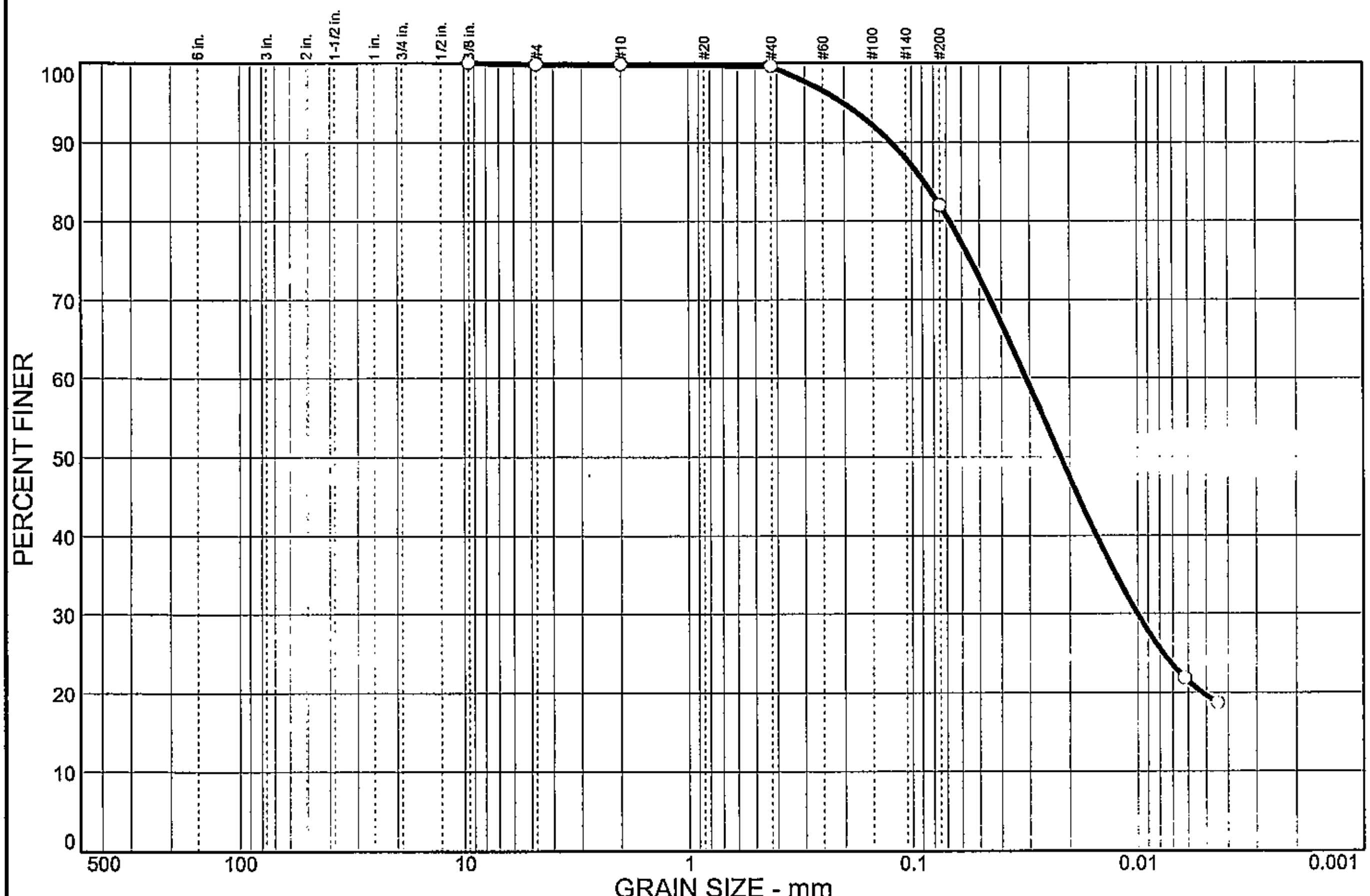
Sample No.: 14 **Source of Sample:** TR-32 **Date:** 3/25/05
Location: **Elev./Depth:** 35

DLZ

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

Project No: 0121-3070.03 **Figure**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.2	0.0	0.2	17.6	62.3	19.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.8		
#10	99.8		
#40	99.6		
#200	82.0		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 21 LL= 29 PI= 8

Coefficients

D_{85}= 0.0882 D_{60}= 0.0312 D_{50}= 0.0219
D_{30}= 0.0100 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-4(5)

Remarks

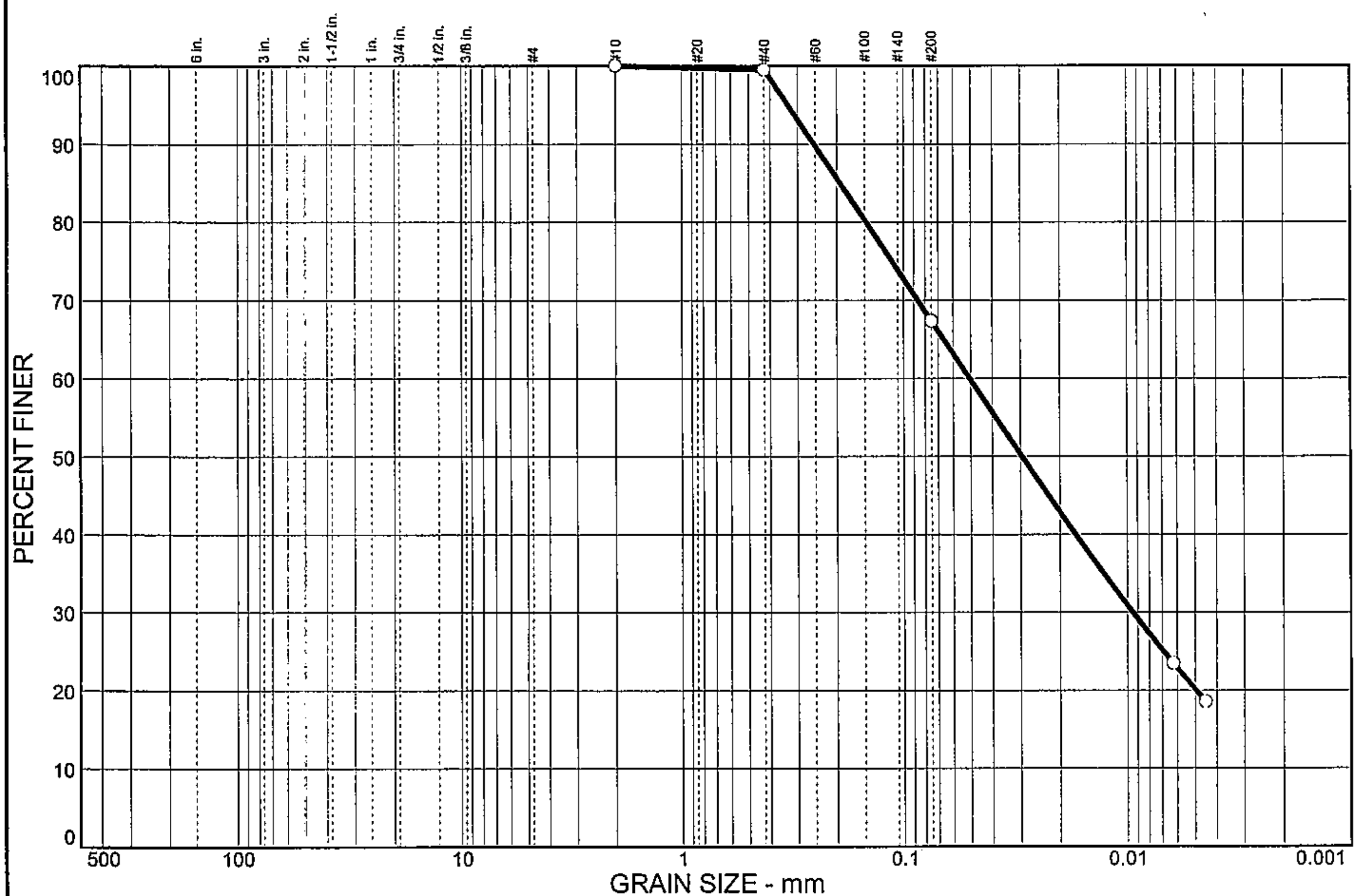
Moisture Content= 30.2%

Sample No.: 1 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 1.5

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.5	32.1	47.2	20.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.5		
#200	67.4		

* (no specification provided)

Soil Description

Sandy silty clay

Atterberg Limits

PL= 18 LL= 23 PI= 5

Coefficients

D_{85}= 0.193 D_{60}= 0.0505 D_{50}= 0.0295
D_{30}= 0.0094 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(1)

Remarks

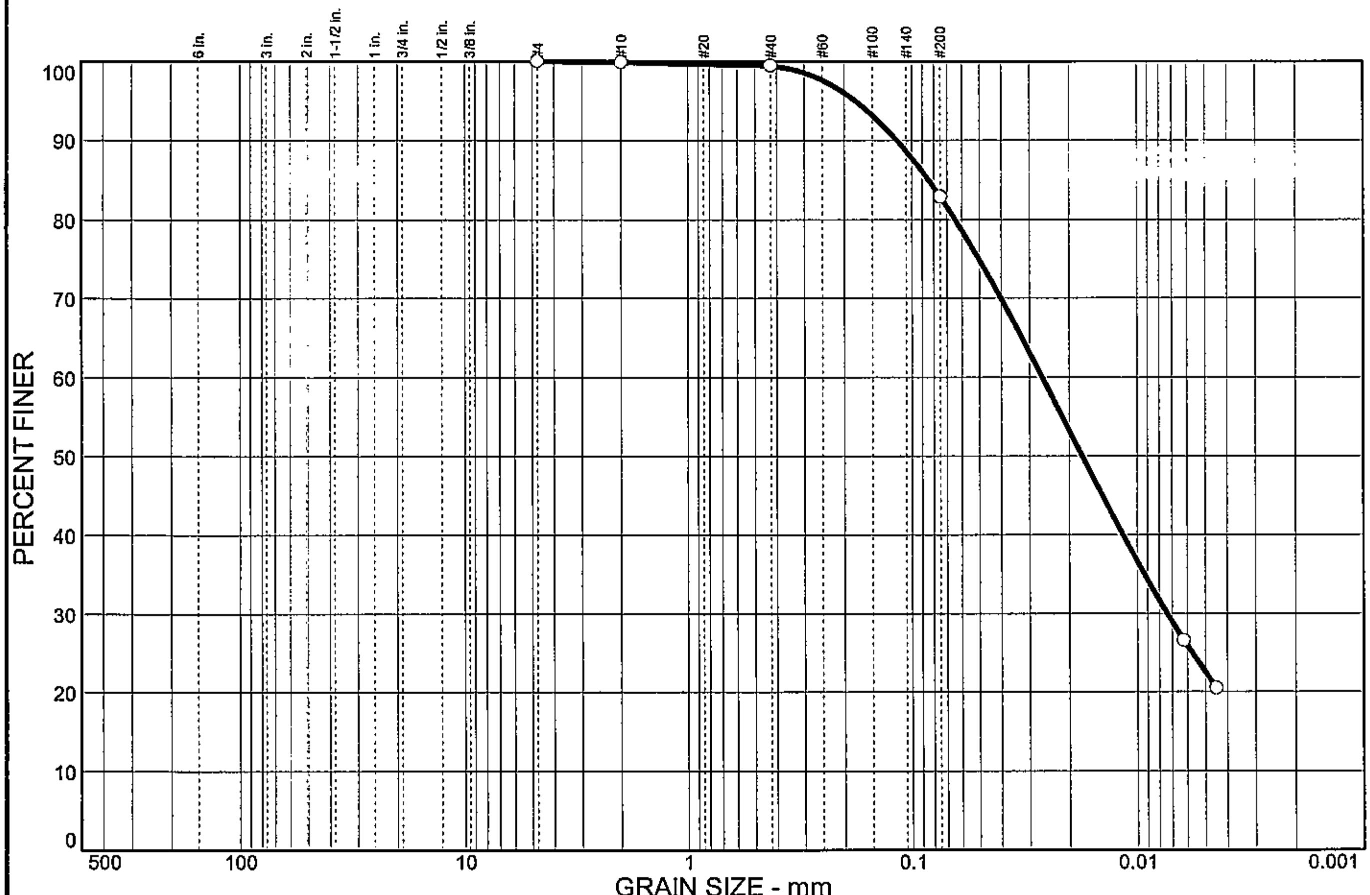
Moisture Content= 26.1%

Sample No.: 2 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 4.0

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.1	0.4	16.6	60.4	22.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.9		
#40	99.5		
#200	82.9		

* (no specification provided)

Soil Description

Silty clay with sand

Atterberg Limits

PL= 19 LL= 25 PI= 6

Coefficients

D_{85}= 0.0845 D_{60}= 0.0264 D_{50}= 0.0175
D_{30}= 0.0074 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(3)

Remarks

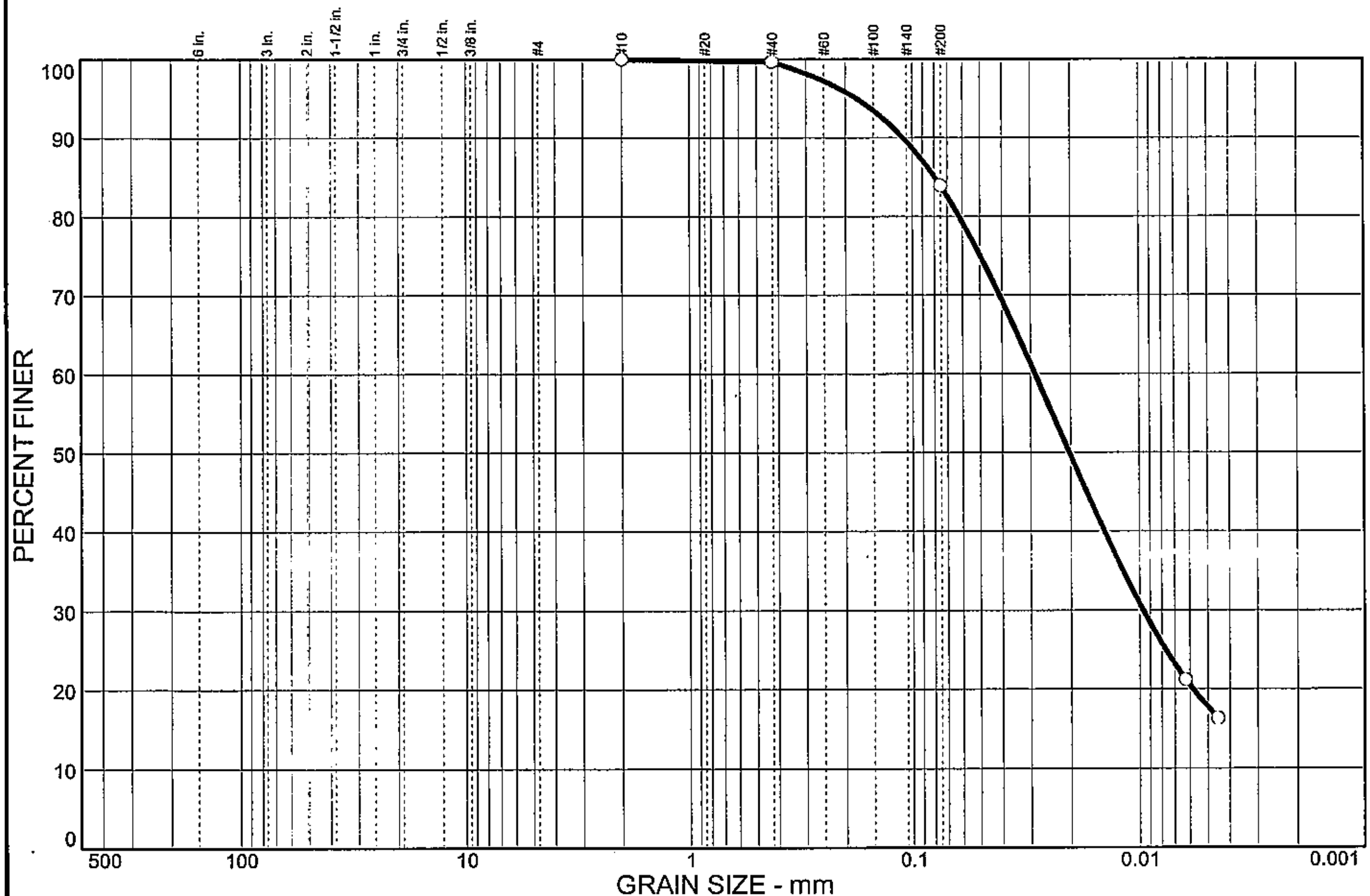
Moisture Content= 27.3%

Sample No.: 3 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 6.5

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.3	15.8	66.1	17.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.7		
#200	83.9		

* (no specification provided)

Soil Description

Silt with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.0796 D_{60}= 0.0287 D_{50}= 0.0203
D_{30}= 0.0096 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

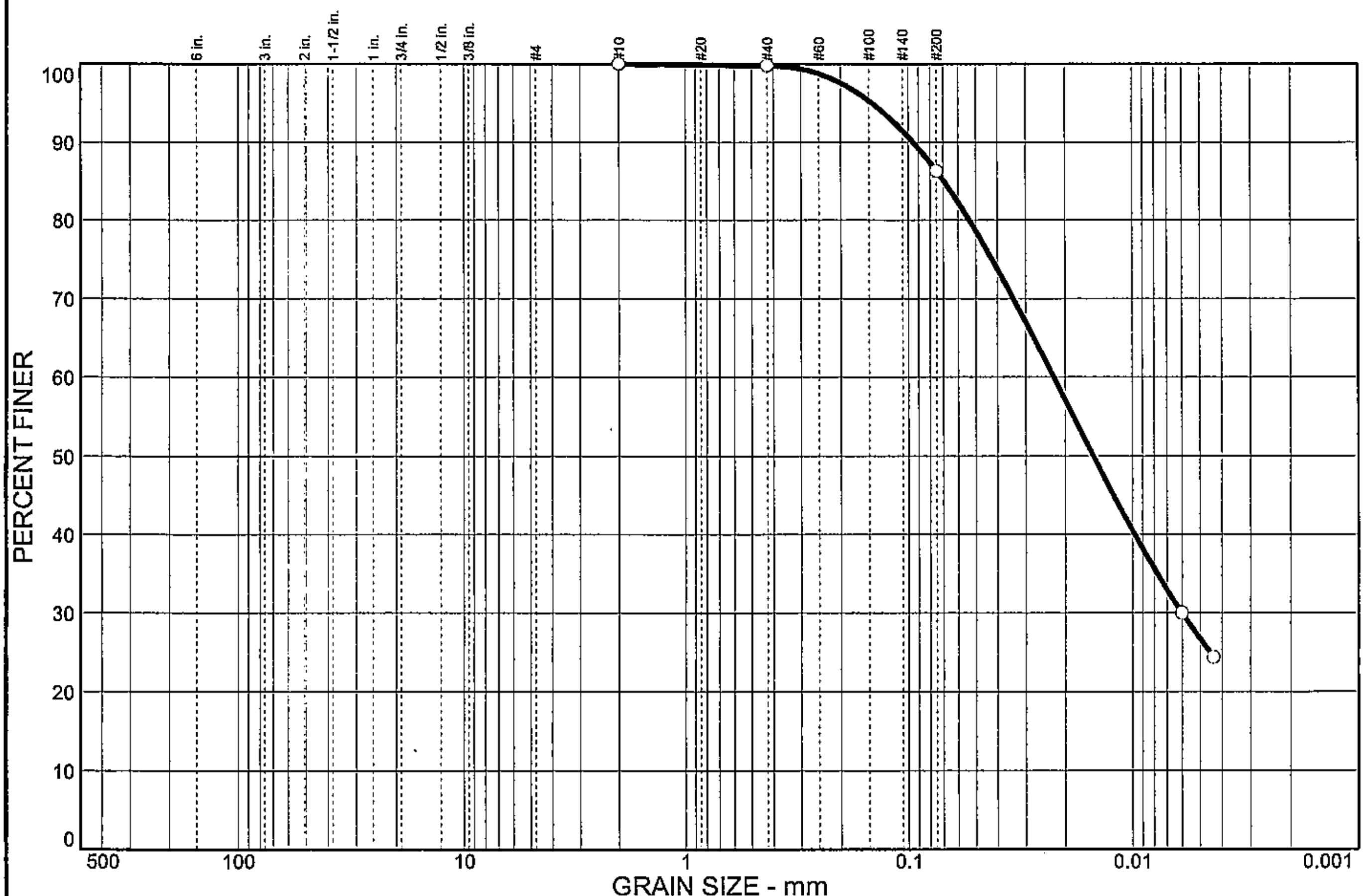
Moisture Content= 32.3%

Sample No.: 4 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 9

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	13.5	59.6	26.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.8		
#200	86.3		

* (no specification provided)

Soil Description

Lean clay

Atterberg Limits

PL= 20 LL= 28 PI= 8

Coefficients

D_{85}= 0.0696 D_{60}= 0.0225 D_{50}= 0.0150
D_{30}= 0.0060 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-4(6)

Remarks

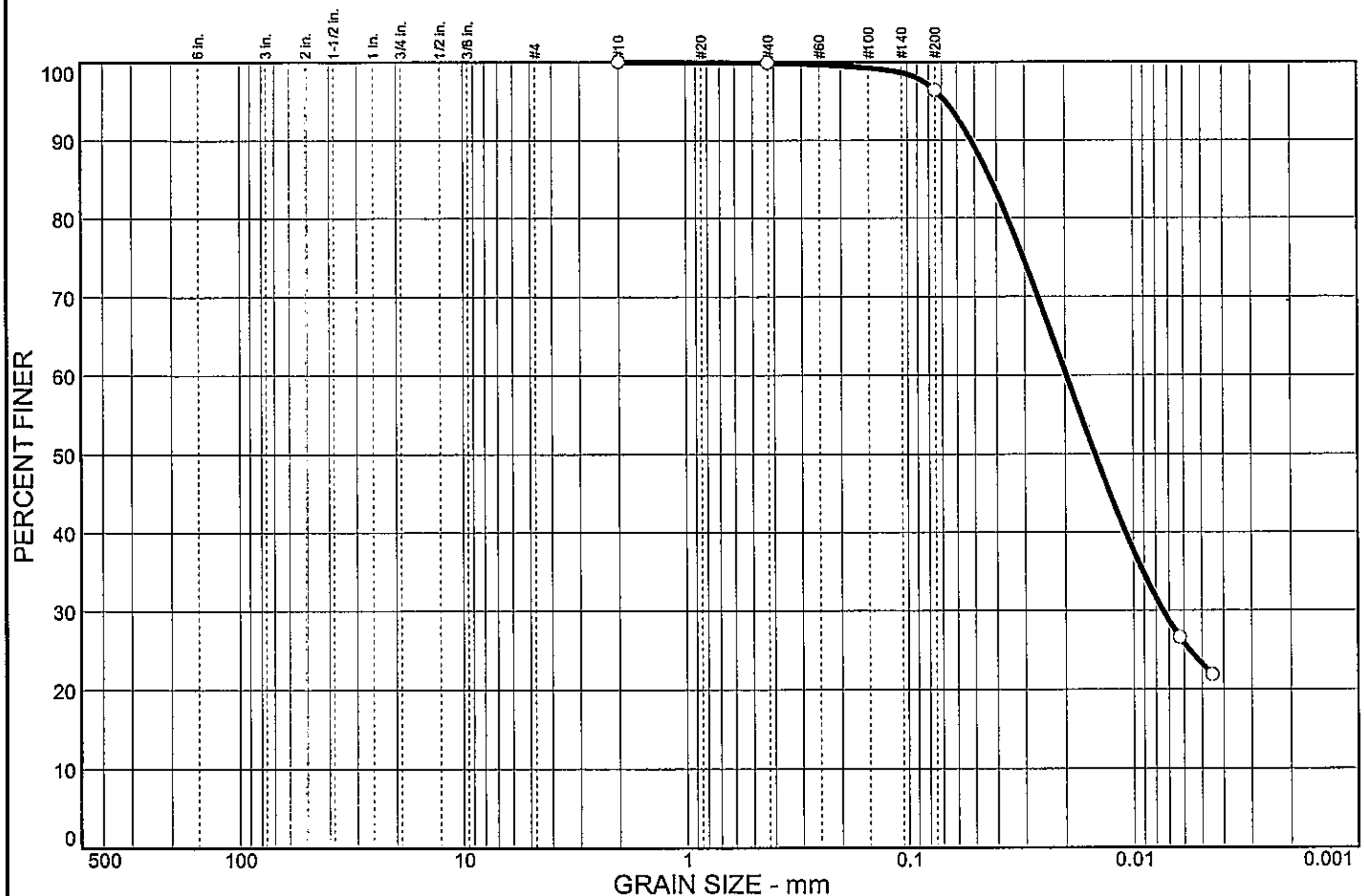
Moisture Content= 32.8%

Sample No.: 5 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 11.5

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	3.5	73.2	23.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.9		
#200	96.4		

* (no specification provided)

Soil Description

Silty clay

Atterberg Limits

PL= 21 LL= 28 PI= 7

Coefficients

D_{85}= 0.0425 D_{60}= 0.0197 D_{50}= 0.0148
D_{30}= 0.0074 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(6)

Remarks

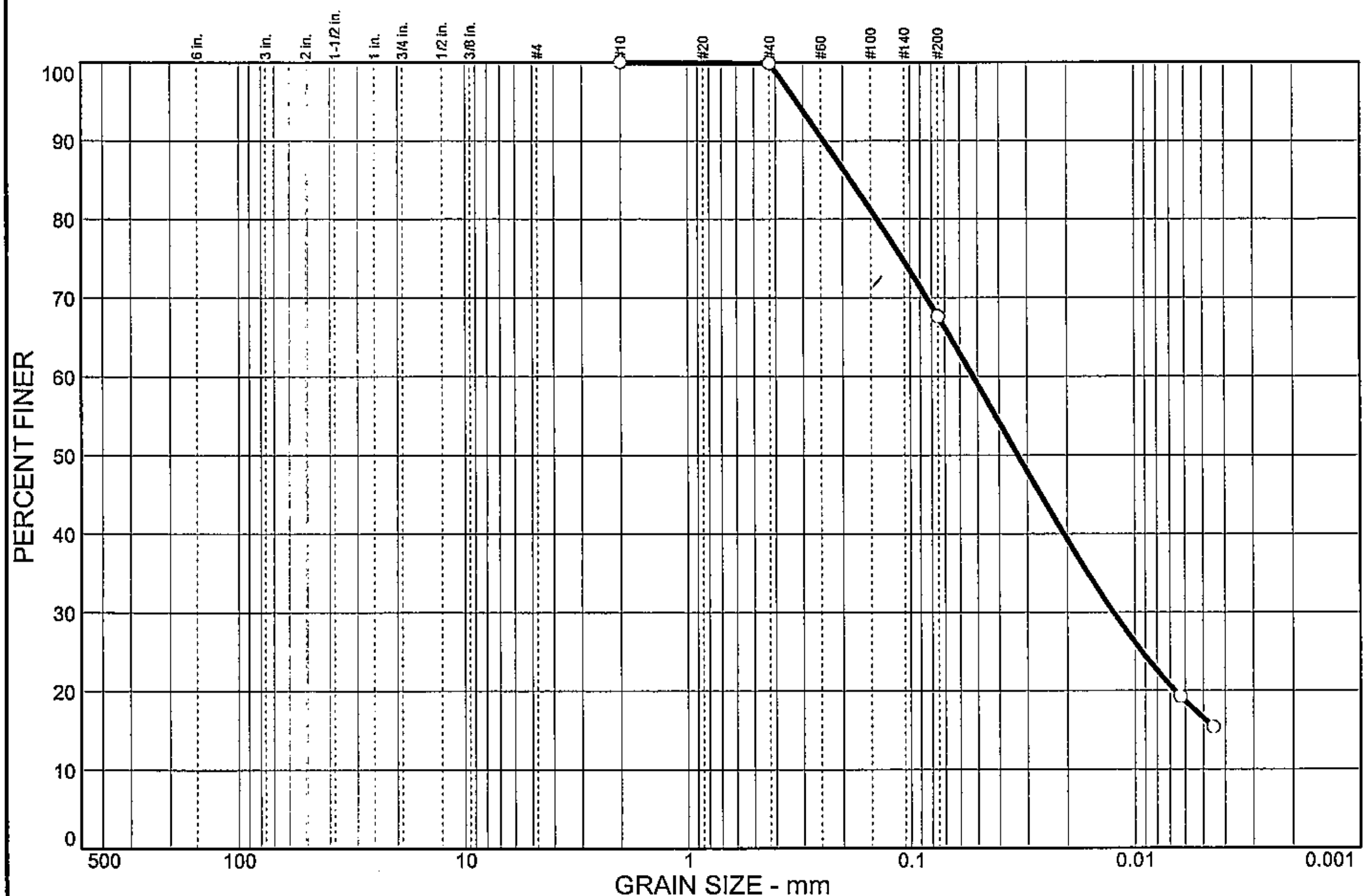
Moisture Content= 34.3%

Sample No.: 6 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 14

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	32.3	51.0	16.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.9		
#200	67.6		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= 18 LL= 20 PI= 2

Coefficients

D_{85}= 0.184 D_{60}= 0.0524 D_{50}= 0.0331
D_{30}= 0.0124 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

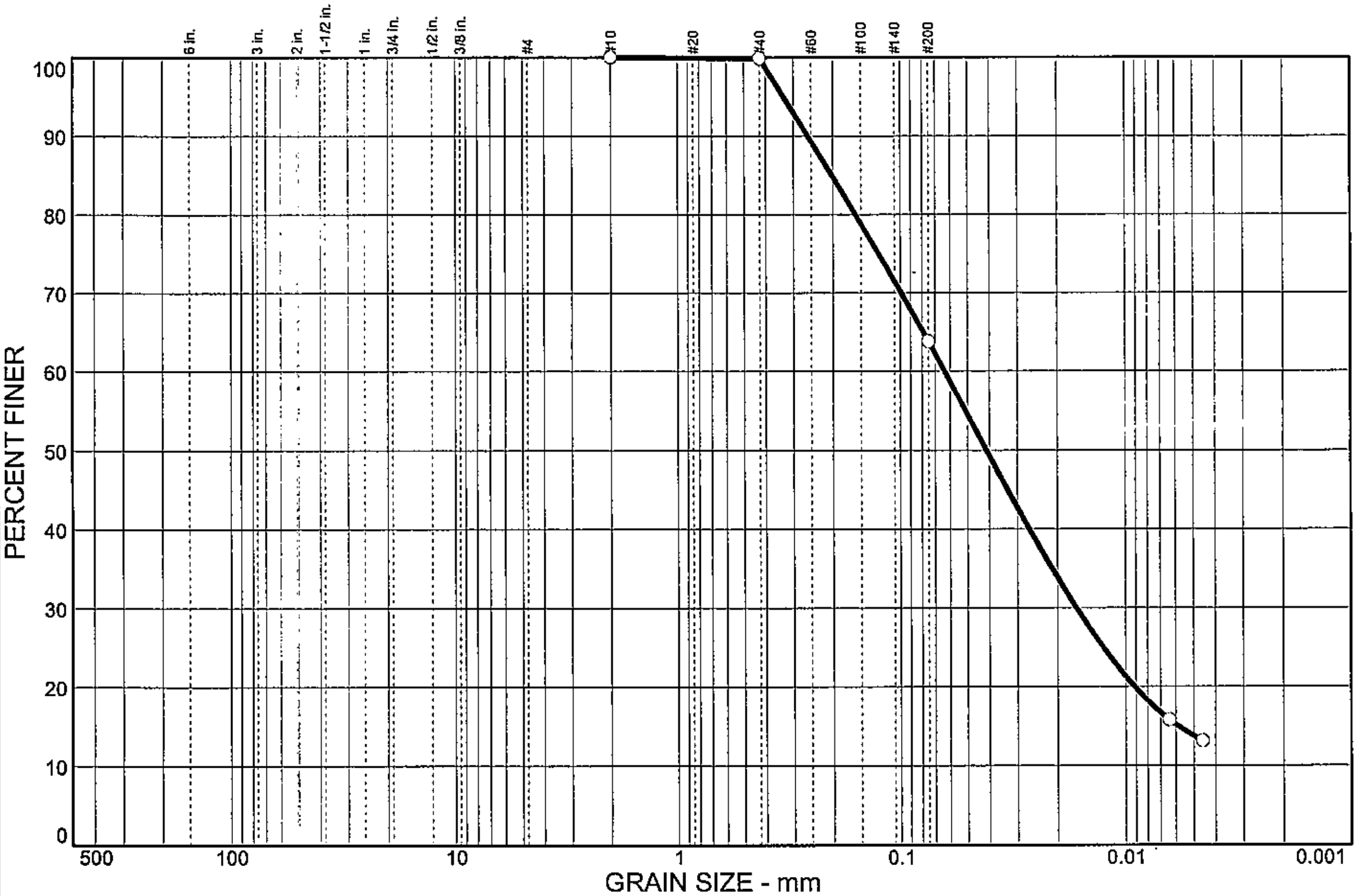
Moisture Content= 29.4%

Sample No.: 7 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 16.5

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	36.1	50.0	13.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	99.9		
#200	63.8		

* (no specification provided)

Soil Description

Sandy silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.202 D_{60}= 0.0635 D_{50}= 0.0413
D_{30}= 0.0165 D_{15}= 0.0058 D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

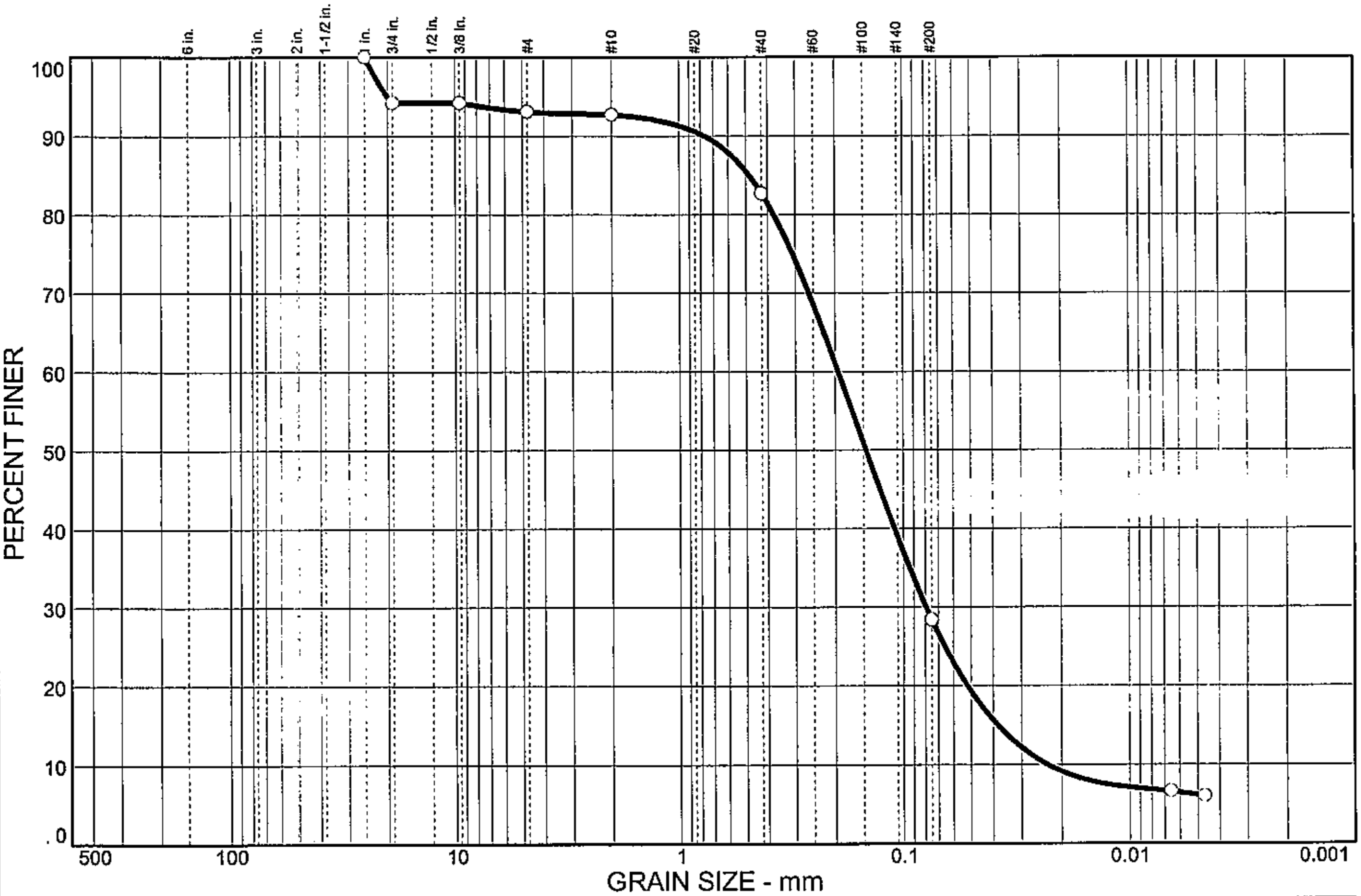
Moisture Content= 28.4%

Sample No.: 8 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 19.0

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	5.8	1.1	0.4	10.0	54.3	22.3	6.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.00 in.	100.0		
0.75 in.	94.2		
0.375 in.	94.2		
#4	93.1		
#10	92.7		
#40	82.7		
#200	28.4		

* (no specification provided)

Soil Description

Silty sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.483 D_{60}= 0.194 D_{50}= 0.146
D_{30}= 0.0795 D_{15}= 0.0381 D_{10}= 0.0230
C_u= 8.44 C_c= 1.41

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Moisture Content= 21.8%

Sample No.: 9 **Source of Sample:** TR-33 **Date:** 3/21/05
Location: **Elev./Depth:** 21.5

DLZ

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