SCI-823-0.00

PID No. 19415

S.R. 823 over Slocum Avenue (T.R. 248)

Structure Type Study Submittal

Prepared for:
Ohio Department of Transportation
District 9
650 Eastern Ave.
Chillicothe, Ohio 45601

September 6, 2006

STRUCTURAL ENGINEERING
SEP 1 1 2006
WJK ☐ SM ☐ TJK ☐ JEM ☐
JAC ☐ RZ ☐ AW ☐ ☐
MT ☐ DAG ☐ JCR ☐ ☐
AD ☐ SS ☐ JS ☐ FILE ☐

Prepared by:
TranSystems®

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BRIDGE TYPE STUDY NARRATIVE

1. Introduction

TranSystems Corporation is providing engineering services to the Ohio Department of Transportation for the design of new left and right overpass structures that will carry the proposed S.R. 823 bypass over Slocum Avenue. As requested by the Scope of Services, a Structure 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. An initial Structure Type Study report dated 7/15/2005 was submitted to the Department and comments, dated 9/8/2005, were in turn received by Transystems Corporation. However, since these dates, the entire project has experienced a change in profile – the original project profile presented in the Preferred Alternative Verification Report (PAVR) submitted July 2005 has been altered in order to reduce the fill heights over culverts and to rebalance the cut and fill earthwork along the entire project length. This revised project profile was approved 2/15/2006 by the Department and the revised profile at the proposed bridge site involves a change to the vertical curvature of S.R. 823. The revised profile raises the elevations of the proposed S.R. 823 Mainline over Slocum Avenue from the elevations specified in the July 2005 PAVR. In addition to the change in profile for the mainline the intersection of Slocum and Pershing Avenues has been relocated so that the intersection is no longer below the structure. The proposed intersection maintains the location of Slocum Avenue and relocates Pershing Avenue to either side of the mainline embankment in an offset-t arrangement. The offset-t intersection was presented to the District and approved on 8/14/06. The re-designed intersection will affect the placement of substructure units and thus alter span lengths from those originally proposed in July 2005. Combining this with the change in mainline profile warrants a reevaluation of bridge types for the proposed S.R. 823 Mainline over Slocum Avenue. This follow-up Structure Type Study presents the results of these reevaluations as well as alternative bridge types that are investigated in accordance with the 9/8/2005 ODOT comments. As a result, three (3) alternatives for construction of the proposed S.R. 823 Mainline over Slocum Avenue are evaluated in this study and are designated as Alternatives 1, 2 and 3. Each of these alternatives is evaluated with regard to estimated construction cost, projected maintenance costs, horizontal and vertical clearances, constructability and maintenance of traffic. Discussion of these alternatives is presented later in this report.

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, 17th Edition. Horizontal clearances (clear zone width and horizontal sight distance) are based on the Ohio Department of Transportation Location and Design Manual, Volume One – Roadway Design.

3. Subsurface Conditions and Foundation Recommendation

DLZ Ohio, Inc. performed the subsurface exploration for the proposed bridge and prepared the Preliminary Bridge Foundation Recommendations which were presented in Section 3 and Appendix E of the original 7/15/2005 Structure Type Study report. Updated boring logs for the three test borings (TR-36, TR-37 and TR-38) and preliminary MSE wall evaluations – performed by DLZ Ohio, Inc. – accompany this modified/updated Structure Type Study Report. The SSI found 73 to 80 feet of generally cohesive soils with intermittent granular soils above bedrock. The preliminary evaluations by DLZ reveal that MSE wall stability is marginal. The use of wick drains and monitoring of pore water pressures is recommended to maintain a drained condition under the MSE embankments. DLZ also recommends the MSE wall be built in stages to maintain stability of the embankment. Refer to the preliminary MSE wall evaluation report, dated 8/18/2006, for more details and information. In lieu of

MSE walls to support the roadway embankment 2:1 spill through slopes can be used. The stability of the spill through slopes is included in the attached MSE wall evaluation. Wick drains are also recommended for the spill through slope to reduce the settlement time. Please refer to the previously submitted DLZ report *Proposed Highland Bend Embankments*, June 8, 2006, for information regarding time rate of consolidation and possible wick drain spacing for the embankments.

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 left and right structures are similar and will consist of two 12'-0" travel lanes with 6'-0" median shoulders and 12'-0" outside shoulders. Each bridge deck will be 44'-11½" out-to-out with a 1'-6" outside straight face deflector parapet (SBR-1-99) and a 1'-5 ½" inside straight face deflector parapet (similar to a Type A1 barrier from Roadway Standard Construction Drawing RM-4.3 but using a base width of 1'-5 ½" and top width of 6 5/8"). The left and right structures will be separated by a 1" longitudinal joint. Horizontal and vertical sight distances are in accordance with the design standards, for all alternatives considered. The profile grade line for both bridge sections will be located at the inside edge of pavement, which is 7'-6" from the centerline of survey and construction of S.R. 823. Noise Barriers are required on the structures in compliance with the noise analysis and environmental documentation.

Slocum Avenue will remain on its current geometry and Pershing Avenue will be relocated to each side of SR 823 using an offset-t intersection.

Vertical and Horizontal Clearances – The vertical alignment of these mainline structures is dictated by the overall vertical design of the new bypass profile. According to the ODOT Location and Design Manual, Volume One – Roadway Design, Figure 302-1E, a preferred vertical clearance of 15'-0" (minimum of 14'-6") must be provided over Slocum Avenue which is positioned directly below the S.R. 823 mainline structures at this site. Each alternative considered provides more than the preferred 15'-0" clearance. The 15'-0" clear zone from edge of traveled way is based on Figure 600-1E of the ODOT L&D Manual, Volume One. The information input into Figure 600-1E is as follows:

1. existing Slocum Ave. may be classified as a Urban Local Road and the *posted speed is 50 mph*;
2. from phone conversations with Scioto County Engineers Office the most recent ADT of Slocum Avenue is 1,897 at the Corporation Limits and is similar to the traffic data presented on the plans for existing Slocum Ave. over the Little Scioto River.
3. proposed Slocum Avenue will have open drainage and ditch slopes of 4:1 are assumed

Using the identified parameters of items 1) through 3) in Figure 600-1E results in the minimum horizontal clear zone width of 15'-0".

Pavement Drainage - The collection of storm water runoff will be addressed off of the bridge, thus scuppers will not be required. Catch Basins will be provided near the rear abutment to direct pavement drainage away from the bridge. The type of drainage system will be investigated as part of the preliminary design.

MSE straps

TranSystems

Utilities - No utilities will be placed on the bridge. However, lighting and ITS conduits will be provided as necessary. Field survey and utility data collection is ongoing at this time and utility dispositions will be addressed at TS&L. The potential utility impacts of the structures are considered the same for all alternatives under consideration.

Maintenance of Traffic – While the new bridges are under construction, traffic will be maintained on both existing Slocum and Pershing Avenues. It is anticipated that there will be limited closures during construction for beam setting.

5. Proposed Structure Configurations

Alignment & Profile: The proposed horizontal geometry of SR 823 is along a tangent for the entire length of both the left and right structures. The cross section is a normal crown. The proposed mainline profile grade line is located on the inside edge of pavement for both bridges. A 1700' vertical curve begins at station 122+50 with a PVI = 578.23, G1= -4.10%, G2=5.00%. The horizontal and vertical geometry for all alternatives considered are the same. Spill through embankment slopes will be a maximum of 2:1 in order to minimize bridge length and the roadway slopes shall be 2.5:1 to satisfy stability.

Structure Types: As per the Scope of Services, we investigated several bridge types and alternatives as part of this type study. Various span configurations were investigated and were refined to the layouts discussed below. Considering the horizontal clear zones on either side of the intersection a single span bridge and 3-span arrangements were considered for this study. The different alternatives discussed below modify the location and the number of piers as well as the type of superstructure.

A preliminary bridge construction cost has been prepared for the three (3) Alternatives (See Appendix A). The unit prices were based on ODOT's Summary of Contracts Awarded Year 2004 and were inflated 3.5% each year to the 2008 sale date, unless different unit prices were recommended by ODOT in August 2005. These estimates were used as a guide to select the most economical alternative. Maintenance costs such as painting, overlays and re-decking were included for each Alternative.

The structure types that were considered are outlined in the Structure Type Alternative Table below:

STRUCTURE TYPE ALTERNATIVE TABLE			
Structure Type Alternative	**1**	**2**	**3**
Superstructure Type Description	Prestressed Concrete Girders 72" Modified AASHTO Type 4 beams	60" Web steel plate girders A709 Grade 50 W	Prestressed Concrete Girders 54" AASHTO Type 4 beams
Proposed Beam Spacing	4 Spaces @ 9'-6"	4 Spaces @ 9'-6"	4 Spaces @ 9'-6"
No. of Spans	3 (97.5'-125'-97.5')	3 (97.5'-125'-97.5')	1 (81')
Abutment Type	Stub Type abutments on 2:1 spill-through embankments (Semi-Integral)	Stub Type abutments on 2:1 spill-through embankments(Semi-Integral)	Stub Type abutments on MSE wall supported embankments(Semi-Integral)
No. of Piers	2	2	None
Pier Type	T-type	T-type	N/A
Substructure Orientation	38°33'37" LF	38°33'37" LF	38°33'37" LF
Approximate Bridge Length	320'	320'	81'
<u>Approximate Structure Depth</u>			
Slab	8.5"	8.75"	8.5"
Haunch	2"	2"	2"
Beam	72.0"	68.0"	54.0"
Total	82.5" (6.875')	78.75" (6.5625')	64.5" (5.575')

Alternatives Discussion:

Alternative 1

This alternative is comprised of a 3-span structure with span lengths of 97'-6", 125'-0" and 97'-6" for an overall bridge length of 320'-0" from centerline bearings at abutments. The abutments and pier are oriented parallel to Slocum Avenue with a skew of 38°33'37". This span arrangement is similar to one presented in the initial types study but with shorter end spans in response to the comments received. Embankment slopes of 2:1 are used for both abutments. A retaining wall is required along Pershing Avenue to prevent the embankment from encroaching upon the road. The maximum height of the wall is approximately 30' and MSE wall construction is proposed due to their use in other areas on the project. The embankments are set to begin at the 15'-0" clear zone allowing for a traversable roadway ditch within that zone.

Both the forward and rear abutments will be semi-integral supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal on bedrock. The details of the abutments will follow ODOT Standard Construction drawings. An integral or fixed abutment was considered due to the 4% (approx.) grade that the structure will be built to except the 38° skew is in excess of the limits set forth in section 205.8 of the BDM.

The piers will consist of T-type piers, each supported on a HP14x73 H-piles, with a design capacity of 95 tons. It is recommended that one of the piers be a fixed design (i.e. fixed bearings) in order to resolve reactions associated with constructing the structure on a 4% (approx.) grade. The pier would also need to be designed for a proportional amount of the thermal movement in accordance with BDM section 205.9. The pier dimensions were assumed in order to estimate quantities and will need to be established in final design.

The preliminary design of this alternative consists of 5- 72" AASHTO Type 4 Modified prestressed beams, spaced at 9'-6" with 3'-5 3/4" overhangs. The design loading applied was HS-25 with Alternate Military Loading and a future wearing surface of 60 psf. The structures will be simple span for non-composite dead loads and continuous for superimposed and live loads. In accordance with the BDM the beams are also checked for a simply supported condition under all loads except the future wearing surface. This analysis indicates that concrete strengths of 6000 psi at release and 8000 psi final are required. Discussions with Ohio Prestressers Association indicate concrete strength and shipping feasibility were not of particular concern or reason for additional cost (please refer to the attached documentation). Both the left and right bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 44'-11 1/2". Deck thickness, including a 1" monolithic wearing surface, is 8 1/2". As an alternate to the beam design requiring 8000 psi concrete, a girder line could be added. The additional girder line would add approximately $50,000 to the cost of the superstructure. The cost of the substructure would be nominally increased due to the increased dead load and the life cycle costs also increased due to the greater surface area to be sealed.

The initial bridge construction cost for Alternative 1 is estimated to be $5,970,000 in year 2008 dollars. The present value life cycle maintenance costs for this alternative are estimated to be $1,489,000, resulting in a total estimated ownership cost of $7,459,000 in year 2008 dollars.

Alternative 2

Alternative 2 is similar to Alternative 1 except with a steel superstructure. The preliminary design of this alternative consists of 5 – 68" web Grade 50W plate girders, spaced at 9'-6" with 3'-5 3/4" deck overhangs. The design loading applied was HS-25 (Case I fatigue) with Alternate Military Loading and a future wearing surface of 60 psf. The differential deflections due to the total slab weight were investigated in accordance with section 302.2.7 of the BDM. The preliminary analysis indicates that a girder design that satisfies the strength requirements is stiff enough to minimize differential deflections between girders to less than ½". The preliminary analysis only considered the weight of the concrete applied to the whole structure and not the pour sequence, which could cause higher deflections. Hybrid girders were not considered due to the stiffness requirements. Both the left and right bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 44'-11 1/2". Deck thickness, including a 1" monolithic wearing surface, is 8 ¾".

The initial bridge construction cost for Alternative 2 is estimated to be $5,330,000 in year 2008 dollars. The present value life cycle maintenance costs for this alternative are estimated to be $2,889,000, resulting in a total estimated ownership cost of $8,219,000 in year 2008 dollars.

Alternative 3

This alternative is comprised of a single span structure with a span length of 81'-0" from centerline bearings at abutments. The abutments are oriented with a 38°33'37" skew. The skew and span length was selected to attain the15'-0" clear zone from Slocum Ave. while minimizing the span length.

Embankment slopes are supported by MSE walls approximately 55'-60' in height. The MSE walls will be turned back 45° except at the north east quadrant of the bridge where the wall must protect relocated Pershing Avenue.

The abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal on bedrock. The details of the abutments will follow ODOT Standard Construction drawings. Piles will need to be sleeved through the MSE wall embankment zone in accordance with the MSE wall Specifications. The structure will be constructed on a 4% (approx.) grade and the horizontal reaction should be resolved through the bearings and included in loadings given for the MSE wall. Intergral design was considered to create a "fixed" abutment; however, this would require movements within the reinforced soil and are appropriately prohibited in ODOT BDM 204.6.2.1. Due to calculated stability safety factors it is recommended the MSE walls be built in stages (see Appendix E), and to reduce primary consolidation time, wick drains should be used within the embankment area.

The preliminary design of this alternative consists of 5- 54" Type 4 prestressed beams, spaced at 9'-6" with 3'-5 3/4" overhangs. The design loading applied was HS-25 with Alternate Military Loading and a future wearing surface of 60 psf. Discussions with Ohio Prestressers Association indicate shipping feasibility is not of particular concern. Both the left and right bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 44'-11 1/2". Deck thickness, including a 1" monolithic wearing surface, is 8 1/2".

The initial bridge construction cost for Alternative 3 is estimated to be $6,750,000 in year 2008 dollars. The present value life cycle maintenance costs for this alternative are estimated to be $416,000, resulting in a total estimated ownership cost of $7,166,000 in year 2008 dollars.

6. Recommendations:

The attached cost analysis indicates that Alternative 3 has the lowest ownership cost and Alternative 2 has the lowest construction cost. Alternative 1 has a slightly higher total ownership cost than Alternative Three. However, in discussions with OSE staff, the costs to construct MSE walls of the height proposed may be underestimated. Additionally, the life cycle costs that have been calculated incorporate mostly superstructure costs. The life cycle costs for the substructures would likely be lower for conventional reinforced concrete substructures than for tall MSE walls. We are not aware of any specific life cycle costs for the substructures, particularly for newer MSE wall construction. Due to the lower initial construction cost presented, the anticipated higher maintenance on the MSE wall, as well as recent performance issues with tall MSE walls, Alternative 1 is recommended for further development. Based upon the above information and discussions, we recommend for both the left and right structures **Structure Type Alternative 1**, which consists of a three span with 72" AASHTO Type 4 Modified prestressed beams supported on semi-integral abutments and T-type piers. (See Appendix B for the Site Plan and Structure Details).

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

A. Traditional construction methods with spill through slopes.

B. Low total ownership costs (lowest of alternates not using MSE walls).

APPENDIX A

Cost Comparison Summary

S.R. 823 over Slocum Avenue L&R

STRUCTURE TYPE STUDY

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

ALTERNATIVE COST SUMMARY

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Subtotal Superstructure Cost	Subtotal Substructure Cost	Structure Incidental Cost (16%)	Structure Contingency Cost (20%)	Total Alternative Const. Cost	Life Cycle Maintenance Cost	Total Relative Ownership Cost
1	3	97.5'-125'-97.5'	320.00	5 Prestressed Concrete Girders /per BRIDGE	Modified AASHTO Type 4 (72")	$2,167,000	$2,122,000	$686,200	$995,000	$5,970,000	$1,489,000	$7,459,000
2	3	97.5'-125'-97.5'	320.00	5 Steel Girders /per BRIDGE	68" Web Grade 50W	$2,017,000	$1,815,000	$613,100	$889,000	$5,330,000	$2,889,000	$8,219,000
3	1	81'	81.00	5 Prestressed Concrete Girders /per BRIDGE	AASHTO Type 4 (54")	$918,000	$3,931,000	$775,800	$1,125,000	$6,750,000	$416,000	$7,166,000

NOTES:

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

2. Estimated construction cost does not include existing structure removal (if any), which should be quantified seperately, if required.

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STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 1 - SUPERSTRUCTURE

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Approach Roadway Cost	Framing Alternative	Proposed Girder Section	Prestressed Concrete Cost	Subtotal Superstructure Cost
1	3	97.5'-125'-97.5'	320.00	322	1051	$622,200	$263,600	$113,400	$0	5 Prestressed Concrete Girders /per BRIDGE	Modified AASHTO Type 4 (72")	$1,168,000	**$2,167,000**

COST SUPPORT CALCULATIONS

Deck Cross-Sectional Area:

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Parapets	1	4.26	4.26
Parapets	1	4.77	4.77

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.71	44.96	31.8	3.2	44.1
Right Bridge	0.71	44.96	31.8	3.2	44.1

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

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

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$592.00

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

See estimating web site

Prestressed Concrete Girders
Unit Costs:

AASHTO Type IV Beams	Year 2005		Annual Escalation	Year 2008		No. Required	
Pier Diaphragms	$1,800	ea.	3.5%	$2,000	ea.	20	$40,000
Abutment Diaphragms	$1,200	ea.	3.5%	$1,330	ea.	0	$0
Intermediate Diaphragms	$905	ea.	3.5%	$1,000	ea.	72	$72,000
Modified Type 4 I-Beams (72")	$295	per ft.	3.5%	$330	ea.	3200	$1,056,000
							$1,168,000

Construction Complexity Factor
Percent of Superstructure = 0% Due to Deck forming, Screed and Varying Girder Spaces

Reinforced Concrete Approach Slabs (T=17")
Unit Cost ($/sq. yd.):
Length = 30 ft. Width = 90 ft
Area = 600 sq. yd.

	Year 2004	Annual Escalation	Year 2008
Approach Slabs	$165.00	3.5%	$189.00

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

	Cost Ratio	Year 2004	Annual Escalation	Year 2008
Strip Seal Expansion Joints	1.00	$250	3.5%	$318

Approach Roadway

			Year 2005	Annual Escalation	Year 2008
Embankment fill	0.00	cu.yd.	$4.00	3.5%	$4.43
Wick Drains	0.00	ft.	$1.00	3.5%	$1.11
Roadway incl. base	0.00	sq.yd.	$26.00	3.5%	$28.83
Barrier (single faced)	0	ft.	$50.00	3.5%	$55.44
Barrier (dble faced)	0	ft.	$80.00	3.5%	$88.70

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STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 1 - SUBSTRUCTURE

By: PJP
Checked: MSL

Date: 8/31/2006
Date: 9/5/2006

SUBSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Wall Cost	Additional Crane Cost	Earthwork Cost	Subtotal Substructure Cost
1	3	97.5'-125'-97.5'	5 Prestressed Concrete Girders /per BRIDGE	Modified AASHTO Type 4 (72")	$479,100	$109,100	$221,200	$36,300	$859,200	$172,800	$75,000	$169,500	**$2,122,000**

COST SUPPORT CALCULATIONS

Pier QC/QA Concrete, Class QSC1 Cost: (Spread Footing)

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Cap	310	$421.00	3.5%	$483.00	$149,730
Stem	416	$421.00	3.5%	$483.00	$200,930
Footings	266	$421.00	3.5%	$483.00	$128,480
Total	992				$479,100

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

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

Abutment QC/QA Concrete, Class QSC1 Cost:

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	398	$421.00	3.5%	$483.00	$192,200
Wingwalls	60	$421.00	3.5%	$483.00	$29,000

Note: 15% of abutment volume allowed for wingwalls.

Excavation and Embankment Costs:

Component	Quantity	Year 2005	Annual Escalation	Year 2008	Total Cost
Embankment	34231	$2.00	3.5%	$2.00	$68,500
Rock Excavation	0	$6.00	3.5%	$6.65	$0
Wick Drains	91000	$1.00	3.5%	$1.11	$101,000

Note: Structure Excavation included in contingency esimates.

Epoxy Coated Reinforcing Steel
Unit Cost ($/lb):
Assume 125 lbs of reinforcing steel per cubic yard of pier concrete.
Assume 90 lbs of reinforcing steel per cubic yard of abutment concrete.

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

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

	Total Area (sq. ft.)	Year 2005 Unit Cost	Annual Escalation	Year 2008
Alt. 1	3,120	$50.00	3.5%	$55.40

Pile Foundation Unit Cost ($/ft.): *HP 14X73 Piles, Furnished & Driven*

Number of Piles		Total Pile Length
224	SEE QUANTITY CALCULATIONS	21,480

Pile Foundation Unit Cost ($/ft.):

	Year 2005 Unit Cost	Annual Escalation	Year 2008
Furnished	$26.47	3.5%	$29.30
Driven	$9.62	3.5%	$10.70
Total			$40.00

Shaft Foundation Unit Cost ($/ft.): 36" Drilled Shaft

	Number of Shafts		Total Shaft Length
Alt. 1	0	SEE QUANTITY CALCULATIONS	0

Shaft Foundation Unit Cost ($/ft.):

Unit Cost	Escalation	2008
$300.00	3.5%	$344.00

Cost of Shafts: $ -

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

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

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

Additional Crane Cost

$ 75,000

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STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 1 - QUANTITY CALCULATIONS

By: PJP
Checked: MSL

Date: 8/31/2006
Date: 9/5/2006

Pier Quantities

Pier Location	Length	Cap				Stem					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Length*		*Volume*	*Width*	*Depth*	*Length*		*Volume*	
Pier 1 (Piles)	51.76	5	8.1	40.50	2096	3	32	26.00		2496	15	4	30.00		1800	6392
Pier 2 (Piles)	51.76	5	8.1	40.50	2096	3	40	26.00		3120	15	4	30.00		1800	7016
Pier 3																0
Pier 4																0
Pier 5																0
Pier 6																0
Pier 7																0
Total (Cu.Ft.)					**4193**					**5616**					**3600**	**13409**
Total (Cu.Yd.)					**155**					**208**					**133**	**497**
			Qty x 2 (L/R)		**310**					**416**					**266**	**994**

Pile Quantities

Location	Load/girder (Kips)	# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
Rear Abut.	0	0	0	0	140	0	1	*20*	605.0	480.0	125.0	*2500*
Pier 1	0	0	0	0	140	0	1	*36*	562.5	477	90.0	*3240*
Pier 2	0	0	0	0	140	0	1	*36*	550.5	477	75.0	*2700*
Pier 3	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 4	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 5	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 6	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 7	0	0	0	0	140	0	1	*0*	0	0.0	0.0	*0*
Fwd. Abut.	0	0	0	0	140	0	1	*20*	592.7	481.0	115.0	*2300*
TotaL								**112**				**10740**
							Qty x 2 (L/R)	**224**				**21480**

Abutment Quantities

Abut Location	Length (feet)	Backwall				Beam Seat					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*		*Volume*	*Width*	*Depth*	*Area*	*# Footi*	*Volume*	
Rear Abut	56.81	3	6.75	20.25	1150	3	3	9.00		511	6	3	18	1	1023	2684
Fwd. Abut	56.81	3	6.75	20.25	1150	3	3	9.00		511	6	3	18	1	1023	2684
Total (Cu.Ft.)					**2301**					**1023**					**2045**	**5369**
Total (Cu.Yd.)					**85**					**38**					**76**	**199**
			Qty x 2 (L/R)		**170**					**76**					**152**	**398**

36" Drilled Shafts for Piers

Location	Load/girder (Kips)	# Girders	Total Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Pile Length	Total Shaft Length (Feet)
Rear Abut.	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 1	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 2	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 3	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 4	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 5	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 6	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 7	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Fwd. Abut.	0	10	0	0	0	0	1	*0*	0	0	0.0	*0*
Total								**0**				**0**

MSE Abutment Wall Quantities

Abut Location		Wall			
		Height	*Length*	*Area*	*Volume*
Rear Abut		0		0.0	
RA Wing (L)				0.0	
RA Wing (R)				0.0	
Fwd Abut		16	195	3120.0	
FA Wing (L)				0.0	
FA Wing (R)				0.0	
Total (Sq.Ft.)				**3120**	

Superstructure P/S Concrete Quantities

Location	Type of girder	# Girders	Span Length (ft.)	Total Length (ft.)	Spacing Int. diaphragm	No. of Int in span	Number of Int Diap. 1 location	Total No. in Span
Span 1	MOD TYPE 4 72	10	97.5	975	24.38	8	3	24
Span 2		10	125.0	1250	31.25	8	3	24
Span 3		10	97.5	975	24.38	8	3	24
Span 4		0	0.0	0	0.00			0
Span 5		0	0.0	0	0.00			0
Span 6		0	0.0	0	0.00			0
Span 7		0	0.0	0	0.00			0
Span 8		0	0.0	0	0.00			0
Span 9		0	0.0	0	**Total**			72
Total	**MOD TYPE 4 72**	**8**		**3200**				

SCI-823-0.00 - PORTSMOUTH BYPASS
S.R. 823 over Slocum Avenue L&R
STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 2 - SUPERSTRUCTURE

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Approach Roadway Cost	Framing Alternative	Proposed Stringer Section	Structural Steel Weight (pounds)	Structural Steel Cost	Subtotal Superstructure Cost
2	3	97.5'-125'-97.5'	320	322	1076	$636,800	$269,800	$113,400	$0	5 Steel Girders /per BRIDGE	68" Web Grade 50W	836,394	$996,900	**$2,017,000**

COST SUPPORT CALCULATIONS

Deck Cross-Sectional Area:

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Parapets	1	4.26	4.26
Parapets	1	4.77	4.77

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.73	44.96	32.8	3.3	45.1
Right Bridge	0.73	44.96	32.8	3.3	45.1

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

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

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$592.00

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

Structural Steel
Unit Costs ($/lb.):

	Cost Ratio	Year 2005	Annual Escalation	Year 2008	
Rolled Beams - Grade 50	n/a	$0.74	3.5%	$0.82	
Level 4 Plate Girders - Grade 50W	n/a	$1.08	3.5%	$1.19	Straight Girders
Level 5 Plate Girders - Grade 50W	n/a	$1.20	3.5%	$1.33	Curved Girders

Reinforced Concrete Approach Slabs (T=17")
Unit Cost ($/sq. yd.):
Length = 30 ft. Width = 90 ft
Area = 600 sq. yd.

	Year 2004	Annual Escalation	Year 2008
Approach Slabs	$165.00	3.5%	$189.00

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

	Cost Ratio	Year 2003	Annual Escalation	Year 2008
Strip Seal Expansion Joints	1.00	$250.00	3.5%	$318.07

Approach Roadway

	Quantity	Year 2005	Annual Escalation	Year 2008
Embankment fill	0.00 cu.yd.	$4.00	3.5%	$4.43
Wick Drains	0.00 ft.	$1.00	3.5%	$1.11
Roadway incl. base	0.00 sq.yd.	$26.00	3.5%	$28.83
Barrier (single faced)	0 ft.	$50.00	3.5%	$55.44
Barrier (dble faced)	0 ft.	$80.00	3.5%	$88.70

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S.R. 823 over Slocum Avenue L&R

STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 2 - SUBSTRUCTURE

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

SUBSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Wall Cost	Additional Crane Cost	Earthwork Cost	Subtotal Substructure Cost
2	3	97.5'-125'-97.5'	5 Steel Girders /per BRIDGE	68" Web Grade 50W	$409,600	$93,300	$221,200	$36,300	$781,200	$172,800	$0	$101,000	**$1,815,000**

COST SUPPORT CALCULATIONS

Pier QC/QA Concrete, Class QSC1 Cost: (Spread Footing)

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Alt 1 Total Cost
Cap	182	$421.00	3.5%	$483.00	$87,910
Stem	400	$421.00	3.5%	$483.00	$193,200
Footings	266	$421.00	3.5%	$483.00	$128,480
Total Cost	848				$409,600

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

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

Abutment QC/QA Concrete, Class QSC1 Cost:

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	398	$421.00	3.5%	$483.00	$192,200
Wingwalls	60	$421.00	3.5%	$483.00	$29,000

Note: 15% of abutment volume allowed for wingwalls.

Excavation and Embankment Costs:

Component	Quantity	Year 2005	Annual Escalation	Year 2008	Total Cost
Embankment	34231	$2.00	3.5%	$2.00	$68,500
Rock Excavation	0	$6.00	3.5%	$6.65	$0
Wick Drains	91000	$1.00	3.5%	$1.11	$101,000

Note: Structure Excavation included in contingency esimates.

Epoxy Coated Reinforcing Steel
Unit Cost ($/lb):
Assume 125 lbs of reinforcing steel per cubic yard of pier concrete.
Assume 90 lbs of reinforcing steel per cubic yard of abutment concrete.

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

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

	Total Area (sq. ft.)	Year 2005 Unit Cost	Annual Escalation	Year 2008
Alt. 2	3,120	$50.00	3.5%	$55.40

Pile Foundation Unit Cost ($/ft.): *HP 14X73 Piles, Furnished & Driven*

Number of Piles		Total Pile Length
204	SEE QUANTITY CALCULATIONS	19,530

Pile Foundation Unit Cost ($/ft.):

	Year 2005 Unit Cost	Annual Escalation	Year 2008
Furnished	$26.47	3.5%	$29.30
Driven	$9.62	3.5%	$10.70
Total			$40.00

Shaft Foundation Unit Cost ($/ft.): 36" Drilled Shaft

	Number of Shafts		Total Shaft Length
Alt. 2	0	SEE QUANTITY CALCULATIONS	0

Shaft Foundation Unit Cost ($/ft.):

Unit Cost	Escalation	2008
$300.00	3.5%	$344.00

Cost of Shafts: $ -

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

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

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

Additional Crane Cost

$ -

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S.R. 823 over Slocum Avenue L&R

STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 2 - QUANTITY CALCULATIONS

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

Pier Quantities

Pier Location	Length	Cap				Stem					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Length*		*Volume*	*Width*	*Depth*	*Length*		*Volume*	
Pier 1 (Pile)	50.50	3	8.1	24.30	1227	3	32	25.00		2400	15	4	30.00		1800	5427
Pier 2 (Pile)	50.50	3	8.1	24.30	1227	3	40	25.00		3000	15	4	30.00		1800	6027
Pier 3																0
Pier 4																0
Pier 5																0
Pier 6																0
Pier 7																0
Total (Cu.Ft.)					**2454**					**5400**					**3600**	**11454**
Total (Cu.Yd.)					**91**					**200**					**133**	**424**
			Qty x 2 (L/R)		**182**					**400**					**266**	**848**

Abutment Quantities

Abut Location	Length (feet)	Backwall				Beam Seat					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*		*Volume*	*Width*	*Depth*	*Area*	*# Footin*	*Volume*	
Rear Abut	56.81	3	6.75	20.25	1150	3	3	9.00		511	6	3	18	1	1023	2684
Fwd. Abut	56.81	3	6.75	20.25	1150	3	3	9.00		511	6	3	18	1	1023	2684
Total (Cu.Ft.)					**2301**					**1023**					**2045**	**5369**
Total (Cu.Yd.)					**85**					**38**					**76**	**199**
			Qty x 2 (L/R)		**170**					**76**					**152**	**398**

MSE Abutment Wall Quantities

Abut Location		Wall			
		Height	*Length*	*Area*	*Volume*
Rear Abut		0	0	0.0	
RA Wing (L)		0	0	0.0	
RA Wing (R)		0	0	0.0	
Fwd Abut		16	195	3120.0	
FA Wing (L)		0	0	0.0	
FA Wing (R)		0	0	0.0	
Total (Sq.Ft.)				3120	

Pile Quantities

Location	Load/girder (Kips)	# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
Rear Abut.	0	0	0	0	140	0	1	*18*	605.0	480.0	125.0	*2250*
Pier 1	0	0	0	0	140	0	1	*33*	562.5	477	90.0	*2970*
Pier 2	0	0	0	0	140	0	1	*33*	550.5	477	75.0	*2475*
Pier 3	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 4	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 5	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 6	0	0	0	0	140	0	1	*0*	0	0	0.0	*0*
Pier 7	0	0	0	0	140	0	1	*0*	0	0.0	0.0	*0*
Fwd. Abut.	0	0	0	0	140	0	1	*18*	592.7	481.0	115.0	*2070*
Total								**102**				**9765**
							Qty x 2 (L/R)	**204**				**19530**

Includes 5' of additional length into rock

36" Drilled Shafts for Piers

Location	Load/girder (Kips)	# Girders	Total Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Pile Length	Total Shaft Length (Feet)
Rear Abut.	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 1	0	0	0	0	0	0	1	*0*	0	0	2.0	*0*
Pier 2	0	0	0	0	0	0	1	*0*	0	0	2.0	*0*
Pier 3	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 4	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 5	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 6	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 7	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Fwd. Abut.	0	10	0	0	0	0	1	*0*	0	0	0.0	*0*
Total								**0**				**0**

Superstructure Steel Quantities

Location	Wt.of girder (lb)/ft	# Girders	Span Length	Total Weight
Span 1	261	10	97.5	254839
Span 2	261	10	125.0	326716
Span 3	261	10	97.5	254839
Span 4	0	0	0	0
Span 5	0	0	0	0
Span 6	0	0	0	0
Span 7	0	0	0	0
Span 8	0	0	0	0
Total				836394

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S.R. 823 over Slocum Avenue L&R
STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 3 - SUPERSTRUCTURE

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Approach Roadway Cost	Framing Alternative	Proposed Stringer Section	Prestressed Concrete Cost	Subtotal Superstructure Cost
3	1	81'	81	83	271	$160,400	$67,900	$113,400	$350,000	5 Prestressed Concrete Girders /per BRIDGE	AASHTO Type 4 (54")	$226,500	**$918,000**

COST SUPPORT CALCULATIONS

Deck Cross-Sectional Area:

Parapets:

	No.	Individual Area (sq. ft.)	Parapet Area (sq. ft.)
Parapets	1	4.26	4.26
Parapets	1	4.77	4.77

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.71	44.96	31.8	3.2	44.1
Right Bridge	0.71	44.96	31.8	3.2	44.1

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

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

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$592.00

Based on parapet and slab percentages
of total concrete area

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

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

Prestressed Concrete Girders
Unit Costs:

	Year 2005		Annual Escalation	Year 2008		No. Required	
AASHTO Type IV Beams							
Pier Diaphragms	$1,800	ea.	3.5%	$2,000	ea.	0	$0
Abutment Diaphragms	$1,200	ea.	3.5%	$1,330	ea.	0	$0
Intermediate Diaphragms	$905	ea.	3.5%	$1,000	ea.	24	$24,000
Type 4 I-Beams (54")	$225	per ft.	3.5%	$250	ea.	810	$202,500
							$226,500

Reinforced Concrete Approach Slabs (T=17")
Unit Cost ($/sq. yd.):
Length = 30 ft. Width = 90 ft
Area = 600 sq. yd.

	Year 2004	Annual Escalation	Year 2008
Approach Slabs	$165.00	3.5%	$189.00

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

	Cost Ratio	Year 2005	Annual Escalation	Year 2008
Strip Seal Expansion Joints	1.00	$250.00	3.5%	$277.18

Strip Seal Expansion Joints Length 0 ft.

Approach Roadway

	Quantity	Unit	Year 2005	Annual Escalation	Year 2008
Embankment fill	75,500	cu.yd.	$2.00	3.5%	$2.22
Wick Drains	64,750	ft.	$1.00	3.5%	$1.11
Roadway incl. base	2,178	sq.yd.	$26.00	3.5%	$28.83
Barrier (single faced)	478	ft.	$50.00	3.5%	$55.44
Barrier (dble faced)	239	ft.	$80.00	3.5%	$88.70

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S.R. 823 over Slocum Avenue L&R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 3 - SUBSTRUCTURE

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

SUBSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Abutment & Wingwall Cost	Additional Crane Cost	Earthwork Cost	Subtotal Substructure Cost
3	1	81'	5 Prestressed Concrete Girders /per BRIDGE	AASHTO Type 4 (54")	$0	$0	$180,000	$29,500	$429,300	$3,153,581	$75,000	$63,900	**$3,931,000**

COST SUPPORT CALCULATIONS

Pier QC/QA Concrete, Class QSC1 Cost: (Spread Footing)

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

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

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

Abutment QC/QA Concrete, Class QSC1 Cost:

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	324	$421.00	3.5%	$483.00	$156,500
Wingwalls	49	$421.00	3.5%	$483.00	$23,500

Note: 15% of abutment volume allowed for wingwalls.

Excavation and Embankment Costs:

Component	Quantity	Year 2005	Annual Escalation	Year 2008	Total Cost
Embankment	0	$4.00	3.5%	$4.00	$0
Rock Excavation	0	$6.00	3.5%	$6.65	$0
Wick Drains	57540	$1.00	3.5%	$1.11	$63,900

Note: Structure Excavation included in contingency esimates.

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

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

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

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

	Total Area (sq. ft.)	Year 2005 Unit Cost	Annual Escalation	Year 2008
Alt. 3	33,478	$85.00	3.5%	$94.20

Pile Foundation Unit Cost ($/ft.): *HP 14X73 Piles, Furnished & Driven*

	Number of Piles		Total Pile Length
Alt. 3	72	SEE QUANTITY CALCULATIONS	9,000

Pile Foundation Unit Cost ($/ft.):

	Year 2005 Unit Cost	Annual Escalation	Year 2008
Furnished	$31.00	3.5%	$34.40
Driven	$12.00	3.5%	$13.30
Total			$47.70

Shaft Foundation Unit Cost ($/ft.): 36" Drilled Shaft

	Number of Shafts		Total Shaft Length
Alt. 3	0	SEE QUANTITY CALCULATIONS	0

Shaft Foundation Unit Cost ($/ft.):

Unit Cost	Escalation	2008
$300.00	4.5%	$358.00

Cost of Shafts: $ -

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

	Temp. Shoring Area (sq. ft.)	Temp. Girder Support (lump sum)
Alt. 3	0	$ -

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

Additional Crane Cost

$ 75,000

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Slocum Avenue L&R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 3 - QUANTITY CALCULATIONS

By: PJP
Checked: MSL

Date: 8/31/2006
Date: 9/5/2006

Pier Quantities

Pier Location	Length	Cap				Stem					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Length*		*Volume*	*Width*	*Depth*	*Length*		*Volume*	
Pier 1	0	0	0	0.00	0	0	0	19.00		0	0	0	0.00		0	0
Pier 2	0	0	0	0.00	0	0	0	19.00		0	0	0	0.00		0	0
Pier 3	0	0	0	0.00	0	0	0	19.00		0	0	0	0.00		0	0
Pier 4																0
Pier 5																0
Pier 6																0
Pier 7																0
Total (Cu.Ft.)					**0**					**0**					**0**	**0**
Total (Cu.Yd.)					**0**					**0**					**0**	**0**
		Qty x 2 (L/R)			**0**					**0**					**0**	**0**

Abutment Quantities

Abut Location	Length (feet)	Backwall				Beam Seat					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Area*		*Volume*	*Width*	*Depth*	*Area*	*# Footin*	*Volume*	
Rear Abut	56.81	3	5.3	15.90	903	3	1.5	4.50		256	6	3	18	1	1023	2182
Fwd. Abut	56.81	3	5.3	15.90	903	3	1.5	4.50		256	6	3	18	1	1023	2182
Total (Cu.Ft.)					**1807**					**511**					**2045**	**4363**
Total (Cu.Yd.)					**67**					**19**					**76**	**162**
		Qty x 2 (L/R)			**134**					**38**					**152**	**324**

MSE Abutment Wall Quantities

Abut Location		Wall			
		Height	*Length*	*Area*	*Volume*
Rear Abut		53	130	6890	
RA Wing (L)		48	90	4320	
RA Wing (R)		43	120	5160	
Fwd Abut		51	140	7140	
FA Wing (L)		40	120	4800	
FA Wing (R)		26.5	195	5168	
Total (Sq.Ft.)				33478	

Pile Quantities

Location	Load/girder (Kips)	# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
Rear Abut.	0	0	0	0	140	0	1	*18*	599.6	477.0	125.0	*2250*
Pier 1	0	0	0	0	140	0	1	*0*	0	0	2.0	*0*
Pier 2	0	0	0	0	140	0	1	*0*	0	0	2.0	*0*
Pier 3	0	0	0	0	140	0	1	*0*	0	0	2.0	*0*
Pier 4	0	0	0	0	140	0	1	*0*	0	0	2.0	*0*
Pier 5	0	0	0	0	140	0	1	*0*	0	0	2.0	*0*
Pier 6	0	0	0	0	140	0	1	*0*	0	0	2.0	*0*
Pier 7	0	0	0	0	140	0	1	*0*	0	0	2.0	*0*
Fwd. Abut.	0	0	0	0	140	0	1	*18*	602.8	481	125.0	*2250*
Total								**36**				**4500**
							Qty x 2 (L/R)	**72**				**9000**

36" Drilled Shafts for Piers

Location	Load/girder (Kips)	# Girders	Total Load	Subst Wt (kips)	Pile Cap.(Kips	No. Piles	Increase Factor	Total Shafts	Top Elev.	Bot Elev.	Pile Length	Total Shaft Length (Feet)
Rear Abut.	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 1	0	0	0	0	0	0	1	*0*	0	0	2.0	*0*
Pier 2	0	0	0	0	0	0	1	*0*	0	0	2.0	*0*
Pier 3	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 4	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 5	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 6	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Pier 7	0	0	0	0	0	0	1	*0*	0	0	0.0	*0*
Fwd. Abut.	0	10	0	0	0	0	1	*0*	0	0	0.0	*0*
Total								**0**				**0**

Superstructure P/S Concrete Quantities

Location	Type of girder	# Girders	Span Length (ft.)	Total Length (ft.)	Spacing Int. diaphragm	No. of Int in span	Number of Int Diap. 1 location	Total No. in Span
Span 1	TYPE 4 54	10	81.0	810	20.25	8	3	24
Span 2		0	0.0	0	0.00			0
Span 3		0	0.0	0	0.00			0
Span 4		0	0.0	0	0.00			0
Span 5		0	0.0	0	0.00			0
Span 6		0	0.0	0	0.00			0
Span 7		0	0.0	0	0.00			0
Span 8		0	0.0	0	0.00			0
Span 9		0	0.0	0	**Total**			24
Total	**TYPE 4 54**	**8**		**810**				

By: PJP Date: 8/31/2006
Checked: MSL Date: 9/5/2006

LIFE CYCLE MAINTENANCE COST

Alt. No.	Span Arrangement No. Spans	Lengths	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	320.00	Prestressed Concrete Girders /per BRIDGE	$0	0	$0	$85,900	2	$171,800	$0	10	$0
2	3	320.00	5 Steel Girders /per BRIDGE	$775,390	2	$1,550,780	$0	0	$0	$0	10	$0
3	1	81.00	Prestressed Concrete Girders /per BRIDGE	$0	0	$0	$16,100	2	$32,200	$4,600	10	$46,000

Alt. No.	Span Arrangement No. Spans	Lengths	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	3	320	Prestressed Concrete Girders /per BRIDGE	$87,200	$105,800	n/a	1	$193,000	$622,200	$263,600	n/a	$238,200	1	$1,124,000	**$1,489,000**	**$5,970,000**	**$7,459,000**
2	3	320	5 Steel Girders /per BRIDGE	$87,200	$105,800	n/a	1	$193,000	$636,800	$269,800	n/a	$238,200	1	$1,144,800	**$2,889,000**	**$5,330,000**	**$8,219,000**
3	1	81	Prestressed Concrete Girders /per BRIDGE	$22,100	$26,800	$12,819	1	$48,900	$160,400	$67,900	$0	$60,300	1	$288,600	**$416,000**	**$6,750,000**	**$7,166,000**

Structural Steel Painting:

Structural Steel Area:

	Web Depth (in.)	No. Stringers	Total Span Length (ft.)	Est. Ave. Bot. Flange Width (in.)	Nominal Exposed Girder Area (sq. ft.)	Secondary Member Allowance	Total Exposed Steel Area (sq. ft.)
Alt. 2	68	10	320.00	15.40	48,585	20%	58,300

Painting Cost per sq. ft.:

	Year 2005	Annual Escalation	Year 2008
Prep.	$6.75	3.5%	$7.48
Prime	$1.75	3.5%	$1.94
Intermed.	$1.75	3.5%	$1.94
Finish	$1.75	3.5%	$1.94
Total	$12.00		$13.30

Superstructure Sealing:

PS Concrete I-Beam Area:

72" Modified AASHTO Type 4

	H	V	Diag.	No.	Total
Bot. Flange	26			1	26.00
		8		2	16.00
Lower Fillets	9	9	12.73	2	25.46
Web		46		2	92.00
Upper Fillets	3	3	4.24	2	8.49
	11	2	11.18	2	22.36
Top Flange		4		2	8.00
Total Exposed Perimeter					198.30 in.

54" AASHTO Type 4

	H	V	Diag.	No.	Total
Bot. Flange	26			1	26.00
		8		2	16.00
Lower Fillets	9	9	12.73	2	25.46
Web		23		2	46.00
Upper Fillet	6	6	8.49	2	16.97
Top Flange		8		2	16.00 in.
Total Exposed Perimeter					146.43

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. 1	10	320.00	52,880	10%	6,460
Alt. 3	10	81.00	9,884	10%	1,210

Sealing Cost per sq. yd.:

	Year 2005	Annual Escalation	Year 2008
Epoxy-Urethane Sealer	$12.00	3.5%	$13.30

Bridge Redecking:

Bridge Deck Joint Cost per foot:

	Year 2005	Annual Escalation	Year 2008
Structural Expansion Joint Including Elastomeric Strip Seal	$250.00	3.5%	$277.18

	Bridge Width	No. Joints
Alt. 1	113.44	0
Alt. 2	113.44	0
Alt. 3	113.44	0

Bridge Deck Removal Cost:

	Deck Area (3) (sq. ft.)	Year 2008	Deck Removal Cost
Alt. 1	28,773	$8.28	$238,200
Alt. 2	28,773	$8.28	$238,200
Alt. 3	7,283	$8.28	$60,300

Bridge Deck Overlay (Item 848):

Bridge Deck MSC Overlay Cost per sq. yd.:

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

Bridge Deck MSC Overlay Cost per cu. yd.:

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

	Deck Area (3) (sq. ft.)	Deck Area (sq. yd.)	Hand Chipping (sq. yd.)	Variable Thickness Repair (cu. yd.)
Alt. 1	28,773	3,197	80	72
Alt. 2	28,773	3,197	80	72
Alt. 3	7,283	809	20	18

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 2005	Annual Escalation	Year 2008
Elastomeric Strip Seal Gland	$62.50	3.5%	$69.29

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 except for Alt. 3.
3. See Superstructure Cost sheet.
4. See Alternative Cost Summary sheet.
5. Assume bridge deck overlay at Year 25 and bridge deck replacement at Year 50. Assume superstructures are painted or sealed on a 25-year recurrence interval. Assume complete bridge replacement at Year 75.
6. Life cycle maintenance cost differences are assumed to be predominately a function of superstructure maintenance costs. Consequently, substructure lifecycle maintenance costs are not included in this analysis.

Approach Pavement Resurfacing:

Resurface Perpetual Asphalt Pavement:

Resurfacing Units Costs:

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

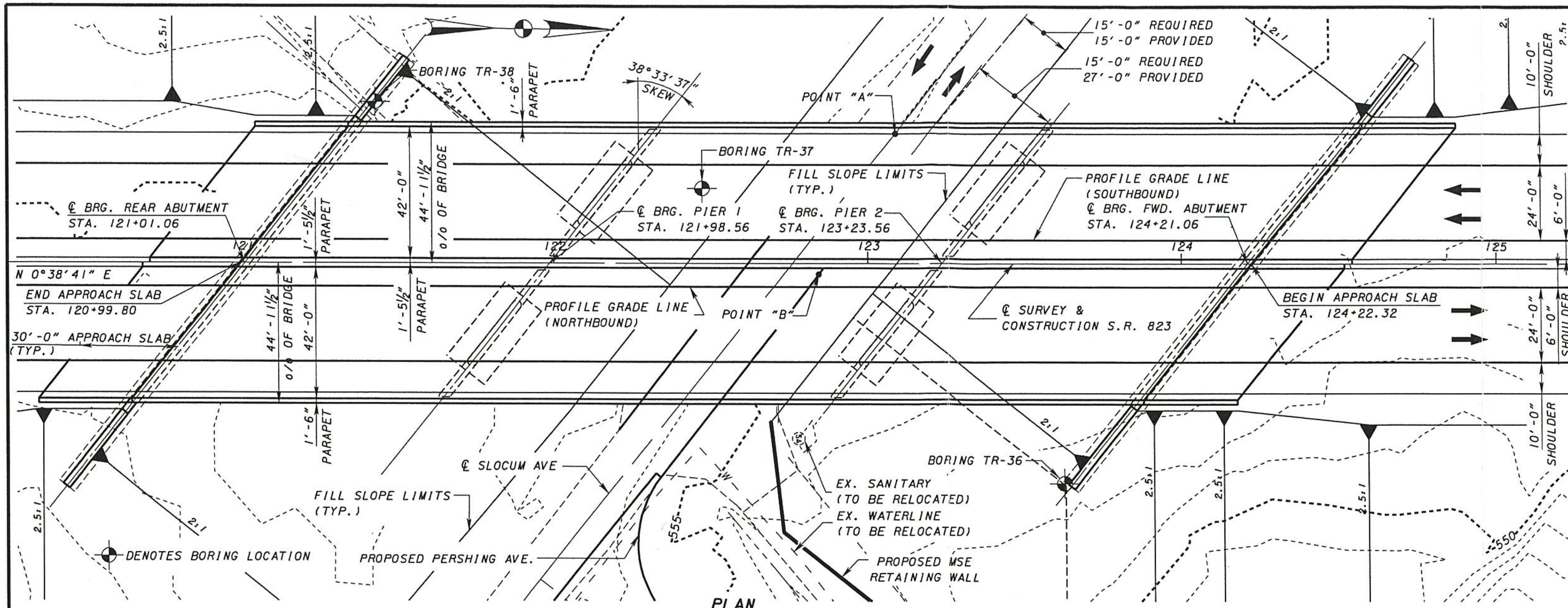
Asphalt Resurfacing Costs:

	Approach Roadway Length (ft.) (4)	Approach Roadway Width (ft.)	Resurfacing Area (sq. yd.)	Wearing Course Thickness (in.)	Wearing Course Volume (cu. yd.)
Alt. 1	0.0	38.0	0	1.50	0.0
Alt. 2	0.0	38.0	0	1.50	0.0
Alt. 3	239.0	38.0	1,009	1.50	42.0

APPENDIX B

Preferred Alternative Site Plan and Details

TranSystems



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-36	123+62.19	70.37' RT.
TR-37	122+47.30	23.87' LT.
TR-38	121+30.05	51.68' LT.
TR-38A	120+14.58	4.84' RT.

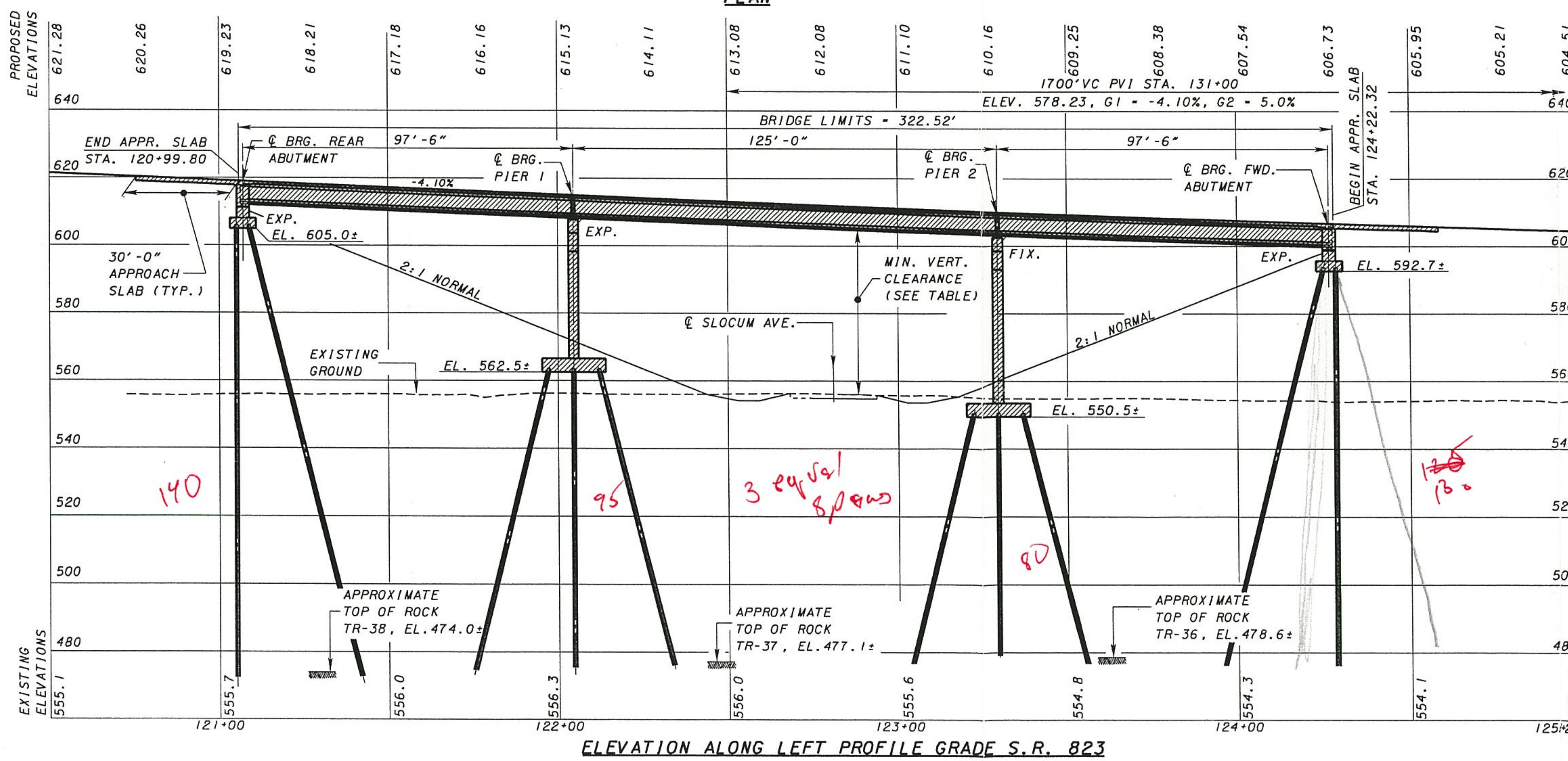
TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	47.35'	48.92'
PREFFERED	15.0'	15.0'

NOTES:

1. ALL SHEETS WITH PLAN DIMENSIONS ARE SHOWN HORIZONTAL.
2. EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS..

FOUNDATION DATA:

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



ELEVATION ALONG LEFT PROFILE GRADE S.R. 823

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

TRAFFIC DATA

S.R. 823
CURRENT YEAR ADT (2010) = 21,200
DESIGN YEAR ADT (2030) = 31,200
CURRENT YEAR ADTT (2010) = 2,968
DESIGN YEAR ADTT (2030) = 4,368

PROPOSED STRUCTURE

TYPE: 3 SPAN 72" TYPE 4 (MOD.) PRESTRESSED CONCRETE I-BEAM WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE T-TYPE PIERS AND SEMI-INTEGRAL ABUTMENTS.

SPANS: 97'-6" - 125' - 97'-6" C/C BRGS

ROADWAY: 2 - 42'-0" T/T OF PARAPETS

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

SKEW: 38°33'37" LF

CROWN: NORMAL 0.016 FT/FT

ALIGNMENT: TANGENT

WEARING SURFACE: MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (30' LONG)

LATITUDE:

LONGITUDE:

SITE PLAN - ALTERNATIVE 1

BRIDGE NO. SCI-823-XXXX (T.R. 248)

S.R. 823 OVER SLOCUM AVENUE

SCIOTO COUNTY

STA. 120+99.80

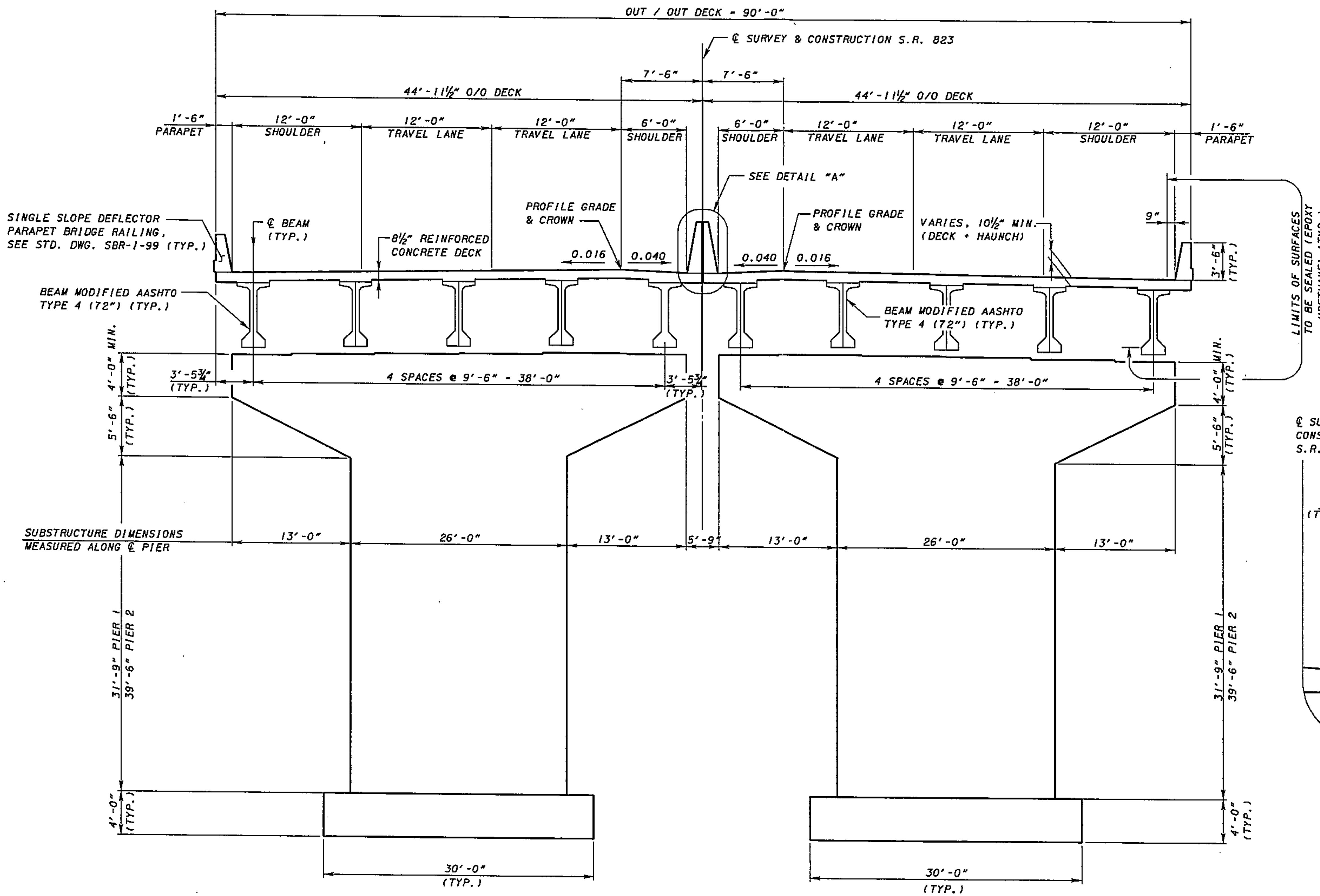
STA. 124+22.32

SCI-823-823-0.0

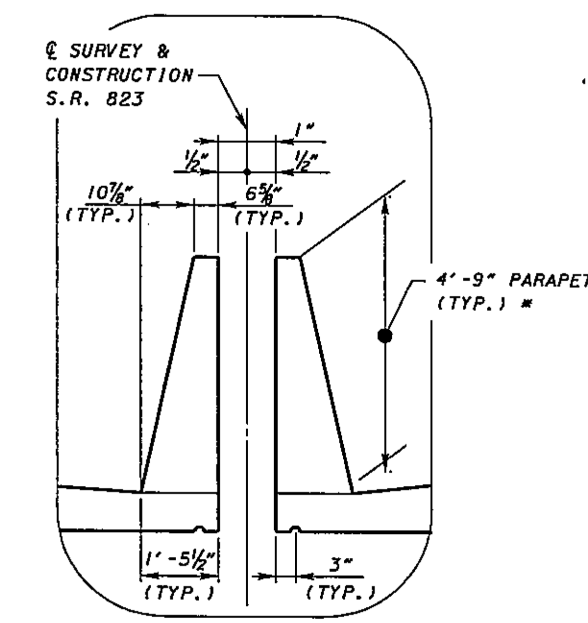
PIDI9415

DESIGN AGENCY: TranSystems

DESIGNED PJP | CHECKED MSL | DRAWN AWB | REVIEWED JRC | DATE 09/01/06 | REVISED | STRUCTURE FILE NUMBER



TYPICAL TRANSVERSE SECTION



DETAIL "A"
(NOT SHOWN TO SCALE)

* PARAPETS ARE SIMILAR TO TYPE A1 BARRIER FROM ROADWAY STANDARD DRAWING RM-4.3

DESIGN AGENCY: TranSystems

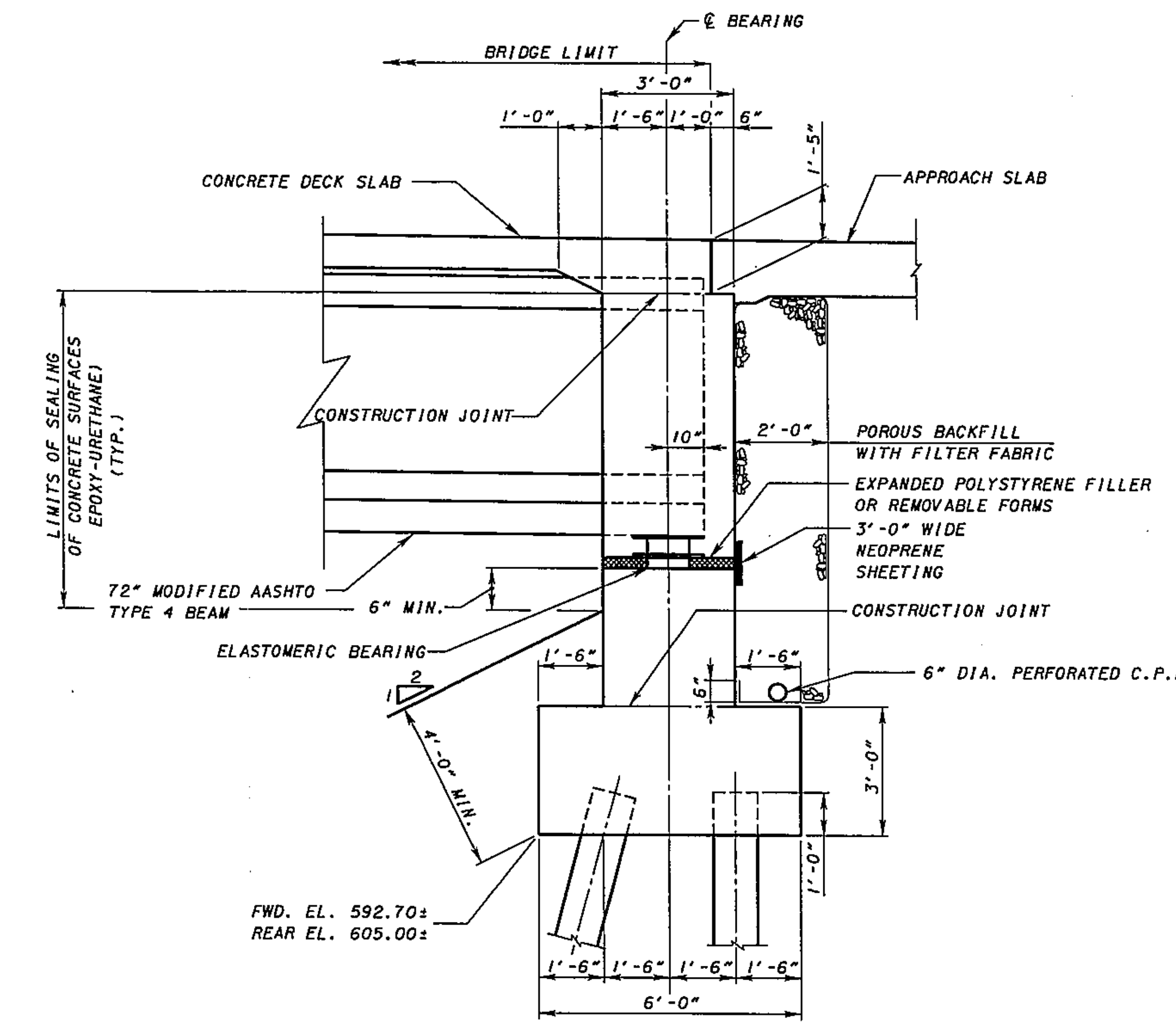
DESIGNED	DRAWN	REVIEWED	DATE
PJP	CAS	JRC	08/31/06
CHECKED	REVISED	STRUCTURE FILE NUMBER	
WSL			

TRANSVERSE SECTION - ALTERNATIVE 1
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SLOCUM AVENUE (T.R. 248)

SCI-823-0.00
PID 19415

2 / 3

SUPERSTRUCTURE DEPTH	
ITEM	72" MODIFIED AASHTO TYPE 4 BEAM
SLAB (INCLUDING WEARING SURFACE)	8.5"
HAUNCH (BOTTOM OF SLAB TO TOP OF FLANGE)	2"
GIRDER DEPTH	72"
TOP OF WEARING SURFACE TO BOTTOM OF GIRDER FLANGE (INCH)	82.5"
TOP OF WEARING SURFACE TO BOTTOM OF GIRDER FLANGE (FEET)	6.875'



ABUTMENT SECTION

DESIGN AGENCY
TranSystems
DESIGNED PJP | DRAWN CAS | REVIEWED JRC | DATE 08/31/06
CHECKED MSL | REVISED | STRUCTURE FILE NUMBER

TYPICAL ABUTMENT SECTION ALTERNATIVE 1
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SLOCUM AVENUE (T.R. 248)

SCI-823-0.00
PID 19415

3 / 3

Ohio Prestressers Association

51 Mallard Point Hebron Ohio 43025-9688 Phone: 614-456-3012 Email: mekllc@columbus.rr.com

April 18, 2006

Patrick Plews, EI
TranSystems Corporation
720 E. Pete Rose Way
Suite 360
Cincinnati Ohio 45202

Re: Portsmouth Bypass, AASHTO Modified Type 4 I-beams 72"

Dear Patrick:

Thank you for the opportunity to provide input for your prestressed concrete bridge design.

Pursuant to Email correspondence, and review of the information you sent to Prestress Services Industries, LLC, and United Precast, Inc., on behalf of those member producers, I offer the following:

1. Producing 72" AASHTO Modified Type 4 Prestressed Concrete I-Beams is no problem for either member producer at lengths of 150'-0".

2. Release strength of 6,000 psi and final strength of 8,000 psi is not a problem for either producer and will not add additional cost to the beams.

3. It is highly recommended that a 4' top flange is used to add stability for shipping.

4. The producers do not anticipate any unusual problems shipping beams to the site. PSI scouted the route and can deliver, but only from the East side taking US23 to 728 East which becomes Lucasville/Minford Rd. They will continue east to CR 46/High Street (Minford) south to project area.

5. Budget pricing for your beams ranges from $258/lf to $300/lf furnished and erected. Budget pricing is developed from actual historical bridges sold by ODOT over the past 2 years.

Both Ohio Prestressers Association members are looking forward to competing on this project when it comes to sale. If you need any additional information, please call.

Sincerely,
Ohio Prestressers Association

Mary Ellen Kimberlin
Executive Director

APPENDIX C

Vertical Clearance Calculations

TranSystems

TranSystems

Made By	PJP	Date	08/30/06	Job No.	P403030064
Checked By	MTN	Date	08/30/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

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

Description S.R. 823 OVER SLOCUM AVENUE **PID #** 19415

Alternative 1 - 5-72" Type 4 Modified Concrete I-Beams, Three Span — ***Point Location:*** ***A***

Adjstment for Cross Slope

Comment	Grade		Offset	
Profile grade line to critical pt.:	-0.016	x	34	-0.544
			Total Adjustment =	**-0.54**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	72	6
	82.5	6.88

Total Superstructure Depth (ft) = **6.88**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**123+08.86**
Offset Location @ Critical Point	=	**41.5' LEFT**
Profile Grade Elevation at Critical Point	=	610.76
Adjustment for Cross Slopes to Beam CL	=	-0.54
Top of Deck Elevation @ Critical Point	=	**610.22**
Total Superstructure Depth	=	-6.88
Bottom of Beam Elevation @ Critical Point	=	**603.34**
Approximate Top of Existing Ground @ Critical Point	=	**555.99**
Actual Vertical Clearance	=	***47.35***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

TranSystems

Made By PJP	**Date** 08/30/06	**Job No.** P403030064	
Checked By MTN	**Date** 08/30/06	**Sheet No.**	

VERTICAL CLEARANCE CALCULATIONS

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

Description S.R. 823 OVER SLOCUM AVENUE **PID #** 19415

Alternative 1 - 5-72" Type 4 Modified Concrete I-Beams, Three Span — ***Point Location:*** ***B***

Adjstment for Cross Slope

Comment	Grade		Offset		
Shoulder:	-0.04	x	4	=	-0.16
				=	0.00
					0
			Total Adjustment	=	**-0.16**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	72	6
	82.5	6.88

Total Superstructure Depth (ft) = **6.88**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**122+84.19**
Offset Location @ Critical Point	=	**3.5 Rt.**
Profile Grade Elevation at Critical Point	=	611.71
Adjustment for Cross Slopes to Beam CL	=	-0.16
Top of Deck Elevation @ Critical Point	=	**611.55**
Total Superstructure Depth	=	-6.88
Bottom of Beam Elevation @ Critical Point	=	**604.67**
Approximate Top of Existing Ground @ Critical Point	=	**555.75**
Actual Vertical Clearance	=	***48.92***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

TranSystems

Made By	PJP	Date	08/30/06	Job No.	P403030064
Checked By	MTN	Date	08/30/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

Job Name: SCI-823-0.00 Structure:

Description: S.R. 823 OVER SLOCUM AVENUE PID #: 19415

Alternative 2 - 5-68" Web Steel Plate Girders, Three Span — ***Point Location:*** ***A***

Adjstment for Cross Slope

Comment	Grade		Offset	
Profile grade line to critical pt.:	-0.016	x	34	-0.544
			Total Adjustment =	**-0.54**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	71	5.92
	81.5	6.8

Total Superstructure Depth (ft) = **6.80**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**123+08.86**
Offset Location @ Critical Point	=	**41.5' LEFT**
Profile Grade Elevation at Critical Point	=	610.76
Adjustment for Cross Slopes to Beam CL	=	-0.54
Top of Deck Elevation @ Critical Point	=	**610.22**
Total Superstructure Depth	=	-6.80
Bottom of Beam Elevation @ Critical Point	=	**603.42**
Approximate Top of Existing Ground @ Critical Point	=	**555.99**
Actual Vertical Clearance	=	***47.43***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

TranSystems

Made By	PJP	**Date**	08/30/06	**Job No.**	P403030064
Checked By	MTN	**Date**	08/30/06	**Sheet No.**	

VERTICAL CLEARANCE CALCULATIONS

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

Description S.R. 823 OVER SLOCUM AVENUE **PID #** 19415

Alternative 2 - 5-68" Web Steel Plate Girders, Three Span — ***Point Location:*** ***B***

Adjstment for Cross Slope

Comment	Grade		Offset		
Shoulder:	-0.04	x	4	=	-0.16
				=	0.00
					0
			Total Adjustment	=	**-0.16**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	71	5.92
	81.5	6.8

Total Superstructure Depth (ft) = **6.80**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**122+84.19**
Offset Location @ Critical Point	=	**3.5 Rt.**
Profile Grade Elevation at Critical Point	=	611.71
Adjustment for Cross Slopes to Beam CL	=	-0.16
Top of Deck Elevation @ Critical Point	=	**611.55**
Total Superstructure Depth	=	-6.80
Bottom of Beam Elevation @ Critical Point	=	**604.75**
Approximate Top of Existing Ground @ Critical Point	=	**555.75**
Actual Vertical Clearance	=	***49.00***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

TranSystems

Made By	PJP	Date	08/30/06	Job No.	P403030064
Checked By	MTN	Date	08/30/06	Sheet No.	

VERTICAL CLEARANCE CALCULATIONS

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

Description S.R. 823 OVER SLOCUM AVENUE **PID #** 19415

Alternative 3 - 5-54" AASHTO Type 4 Concrete Beams, Single Span — ***Point Location: A***

Adjstment for Cross Slope

Comment	Grade		Offset	
Profile grade line to critical pt.:	-0.016	x	34	-0.544
			Total Adjustment =	**-0.54**

Superstructure Depth

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

Vertical Clearance at Critical Point

Station @ Critical Point	=	**123+08.86**
Offset Location @ Critical Point	=	**41.5' LEFT**
Profile Grade Elevation at Critical Point	=	610.76
Adjustment for Cross Slopes to Beam CL	=	-0.54
Top of Deck Elevation @ Critical Point	=	**610.22**
Total Superstructure Depth	=	-5.38
Bottom of Beam Elevation @ Critical Point	=	**604.84**
Approximate Top of Existing Ground @ Critical Point	=	**555.99**
Actual Vertical Clearance	=	***48.85***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

TranSystems

Made By	PJP	**Date**	08/30/06	**Job No.**	P403030064
Checked By	MTN	**Date**	08/30/06	**Sheet No.**	

VERTICAL CLEARANCE CALCULATIONS

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

Description S.R. 823 OVER SLOCUM AVENUE **PID #** 19415

Alternative 3 - 5-54" AASHTO Type 4 Concrete Beams, Single Span — ***Point Location: B***

Adjstment for Cross Slope

Comment	Grade		Offset		
Shoulder:	-0.04	x	4	=	-0.16
				=	0.00
					0
			Total Adjustment	=	**-0.16**

Superstructure Depth

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

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

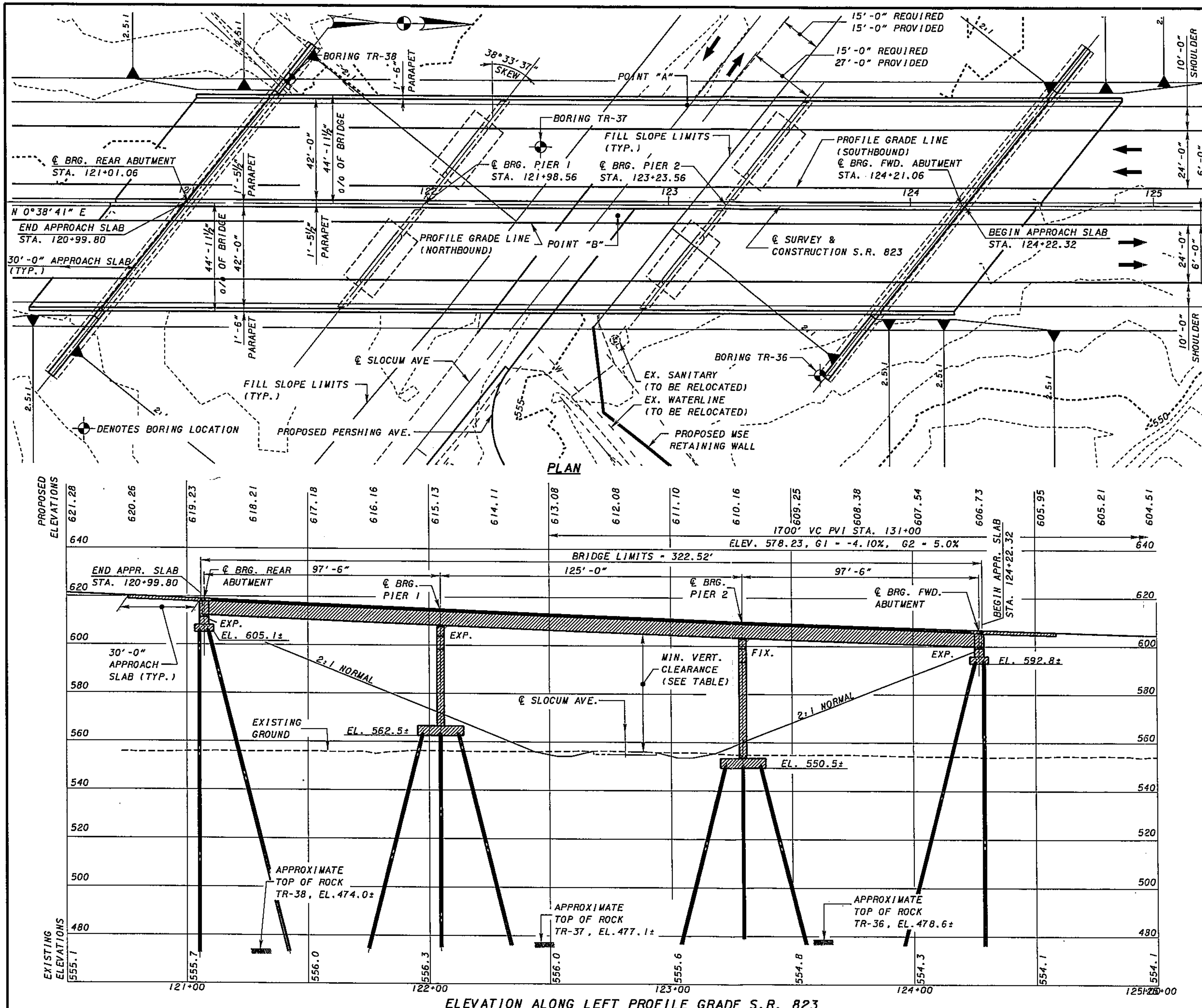
Vertical Clearance at Critical Point

Station @ Critical Point	=	**122+84.19**
Offset Location @ Critical Point	=	**3.5 Rt.**
Profile Grade Elevation at Critical Point	=	611.71
Adjustment for Cross Slopes to Beam CL	=	-0.16
Top of Deck Elevation @ Critical Point	=	**611.55**
Total Superstructure Depth	=	-5.38
Bottom of Beam Elevation @ Critical Point	=	**606.17**
Approximate Top of Existing Ground @ Critical Point	=	**555.75**
Actual Vertical Clearance	=	***50.42***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

APPENDIX D

Preliminary Structure Site Plan

TranSystems



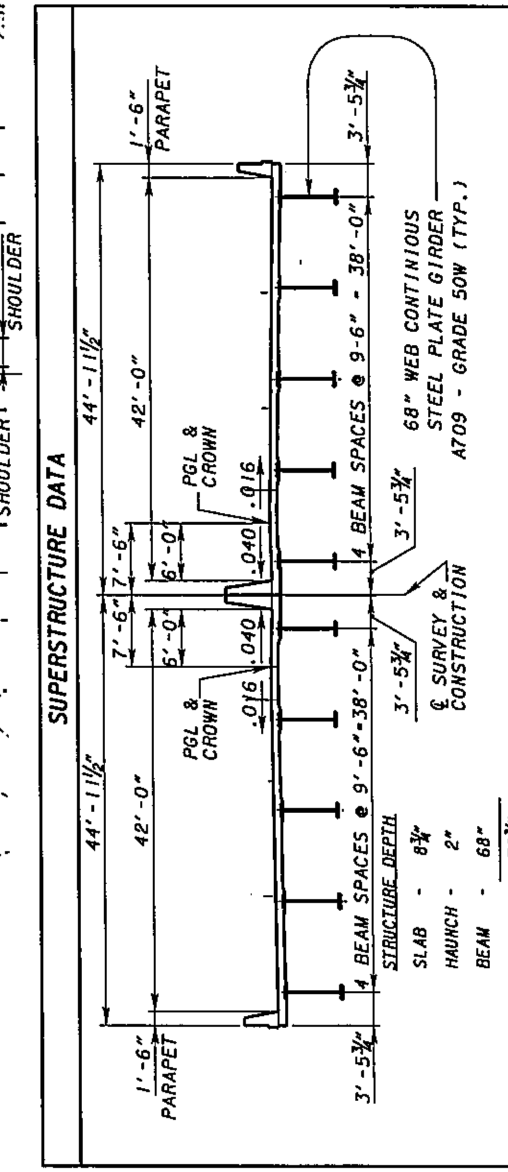


TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	47.43'	49.00'
PREFERRED	15.0'	15.0'

PROPOSED STRUCTURE

TYPE: 3 SPAN CONTINOUS STEEL PLATE GIRDERS (68" WEB A709-GRADE 50W) WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED ON REINFORCED CONCRETE T-TYPE PIERS AND SEMI-INTEGRAL ABUTMENTS.

SPANS: 97'-6" - 125' - 97'-6" C/C BRGS

ROADWAY: 2 - 42'-0" T/T OF PARAPETS

LOADING: HS-25 (CASE 1) AND ALTERNATE MILITARY LOADING, FWS=60 PSF

SKEW: 38°33'37" LF

CROWN: NORMAL 0.016 FT/FT

ALIGNMENT: TANGENT

WEARING SURFACE: MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (30' LONG)

LATITUDE:

LONGITUDE:

DESIGN AGENCY: TranSystems

DESIGNED PJP | CHECKED MSL | DRAWN AWB | REVISED | REVIEWED JRC | DATE 09/01/06 | STRUCTURE FILE NUMBER

SCIOTO COUNTY
STA. 120+99.80
STA. 124+22.32

SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SLOCUM AVENUE (T.R. 248)

SCI-823-0.00
PID19415

1 / 1

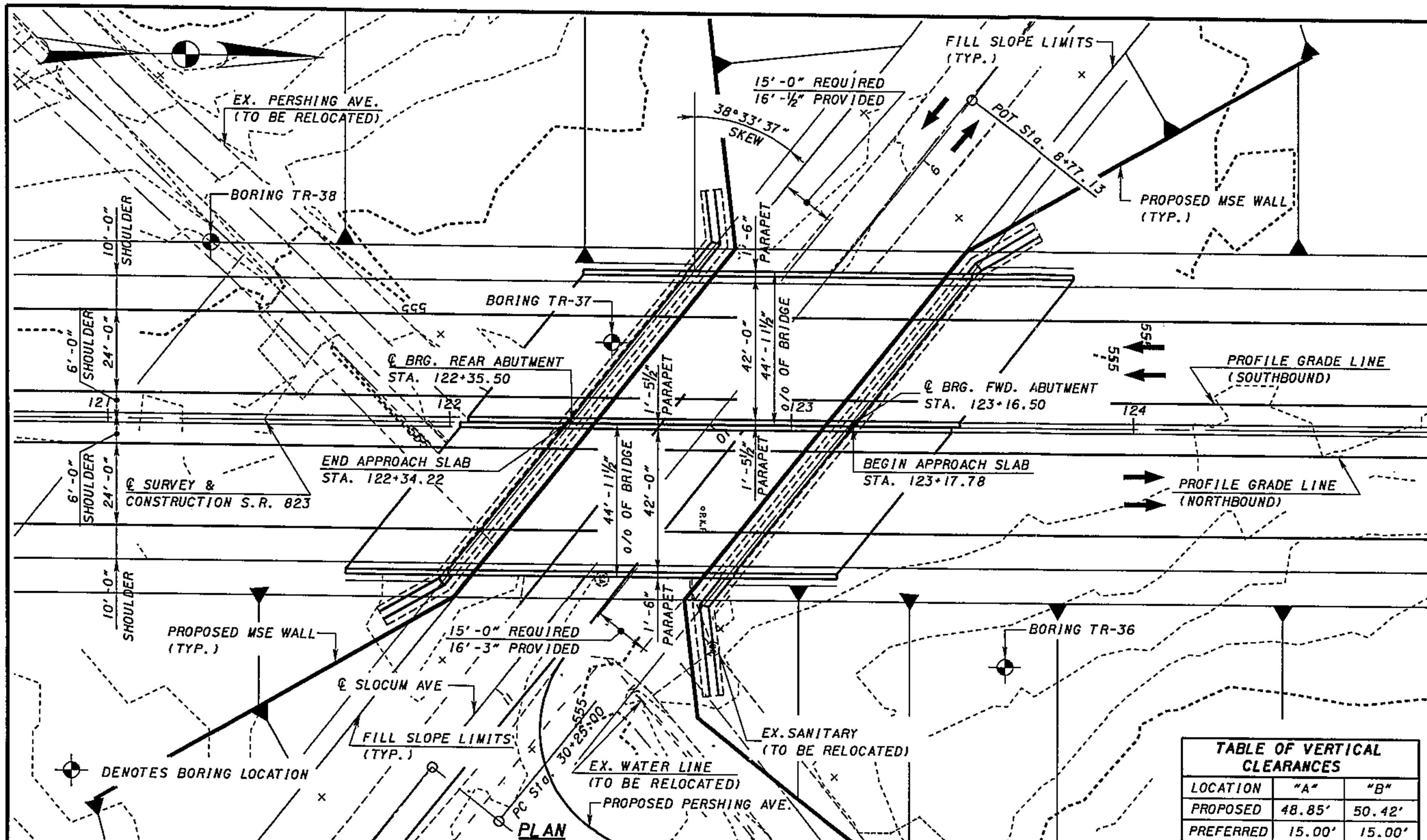
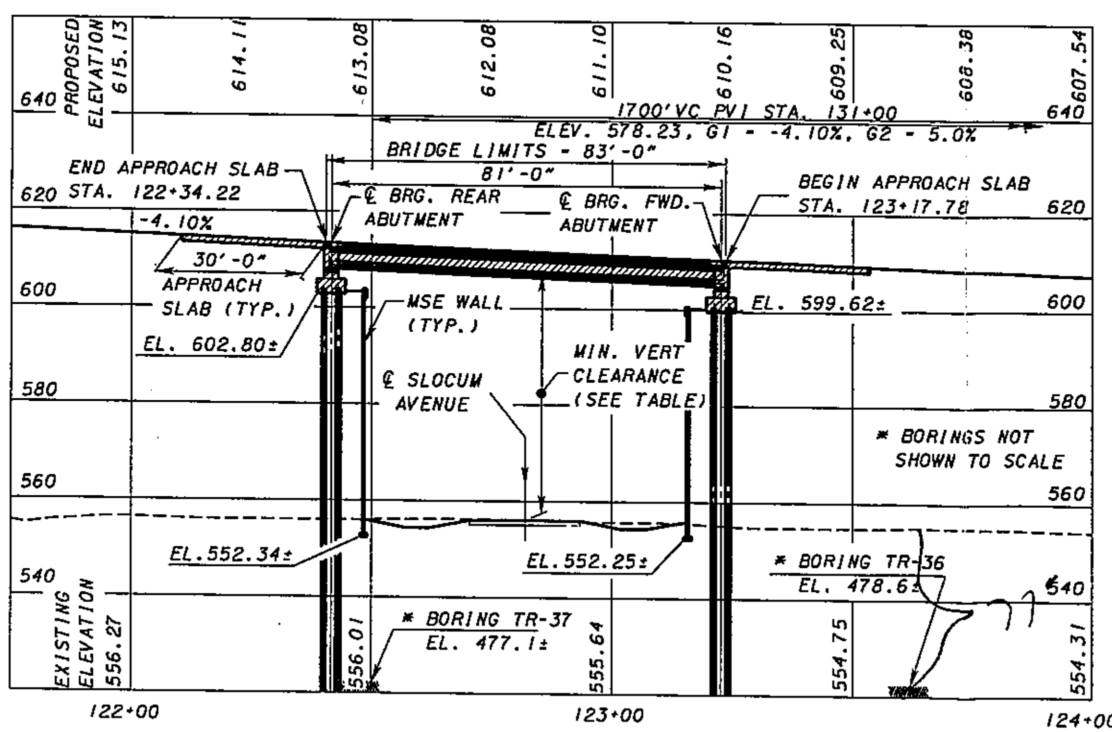
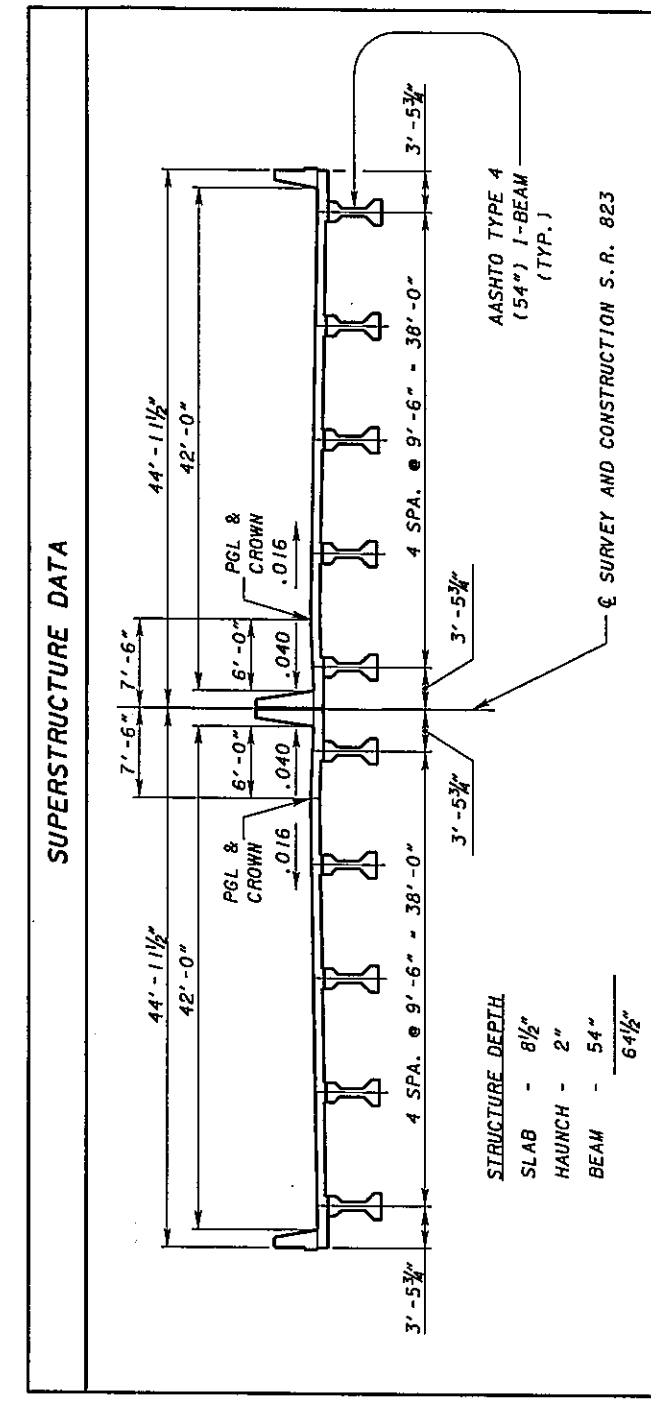


TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	48.85'	50.42'
PREFERRED	15.00'	15.00'



ELEVATIONS ALONG LEFT PROFILE GRADE S.R. 823



PROPOSED STRUCTURE

TYPE: SINGLE SPAN 54" TYPE 4 PRESTRESSED CONCRETE I-BEAM WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY SEMI-INTEGRAL ABUTMENTS ON PILES WITH MSE WALLS

SPANS: 81'-0" C/C BEARINGS

ROADWAY: 2 - 42'-0" T/T PARAPETS

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

SKEW: 38°33'37" LF

CROWN: NORMAL 0.016 FT/FT

ALIGNMENT: TANGENT

WEARING SURFACE: MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (30' LONG)

LATITUDE:

LONGITUDE:

DESIGN AGENCY: Burgess & Niple / Systems

DESIGNED PJP | CHECKED WSL | DRAWN CAS | REVISED | REVIEWED JRC | DATE 09/01/06 | STRUCTURE FILE NUMBER

SCIOTO COUNTY
STA. 122+34.22
STA. 123+17.78

SITE PLAN - ALTERNATIVE 3
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SLOCUM AVENUE (T.R. 248)

SCI-823-0.00
PID 19415

APPENDIX E

Preliminary Geotechnical Report
& Preliminary MSE Wall Evaluation

TranSystems

DLZ

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PLANNERS • SURVEYORS

August 18, 2006

Michael D. Weeks, P.E., P.S.
TranSystems Corporation
5747 Perimeter Drive, Suite 240
Dublin, OH 43017

Re: **Preliminary MSE Wall Evaluations - Revised**
Slocum Avenue (Highland Bend)
SCI-823-0.00 Portsmouth Bypass
DLZ Job No.: 0121-3070.03
Document # 0026

Dear Mr. Weeks:

This letter includes the revised findings of preliminary evaluations of mechanically stabilized earth (MSE) retaining walls on the above-referenced project. The previous evaluation of these structures was revised to incorporate changes suggested in comments received for other MSE walls in the Portsmouth Bypass project. All previous correspondence pertaining to these MSE walls should be disregarded. The findings included in this letter pertain to the MSE walls at the intersection of proposed SR 823 and Slocum Avenue. The findings of other preliminary MSE wall evaluations will be submitted in separate documents at a later date.

It should be noted that the results of these evaluations are based upon the findings of four preliminary structural borings and two roadway borings. Boring logs for borings TR-36, TR-37, TR-38, TR-38A, R-64, and R-64A are attached. Also, see attached boring plan. After the bridge design is finalized, it may be necessary to drill additional borings in the area of the proposed MSE walls in accordance with ODOT's Specifications for Subsurface Investigations in order to finalize the MSE wall evaluations.

An MSE retaining wall essentially consists of good quality backfill material with layers of metal or plastic reinforcing that are attached to concrete facing panels. The MSE wall and associated backfill should be constructed in accordance with the specifications of the manufacturer of the MSE wall.

At the time this letter was prepared, it was understood that the plan location of the bridge structure for proposed SR 823 over Slocum Avenue is similar to the location shown on the plan and profile drawings dated July 11, 2005. See attached plan and profile drawing. It is understood that the planned structure is being modified as follows: placing MSE walls at approximately stations 122+02 and 123+47 to contain the abutments and hold back the roadway embankment, thus shortening the bridge structure. Furthermore, it is understood from updated profile information that the height of the MSE wall at station 122+02 (Rear Abutment) will be

A preliminary global stability analysis and preliminary bearing capacity analysis were performed for the MSE walls at this bridge location in accordance with ODOT and AASHTO guidelines. The MSE walls were also analyzed for sliding and overturning. At the time this letter was prepared, it was assumed that deep foundations would be used to support the structures at this location. However, the use of MSE walls at this site does not preclude the use of most common foundation types. Once a foundation type has been selected, DLZ should be informed so that the analyses may be revised as necessary.

Preliminary calculations for bearing capacity, sliding, and overturning, as well as the results of the global stability analyses are attached. Other external and internal stability analyses are required for the design of an MSE wall, but are considered outside the scope of this report. The parameters required to perform the stability analyses are presented below.

In accordance with ODOT guidelines, a unit weight of 120 pcf and a friction angle of 34 degrees were selected for the backfill material in the reinforced zone. Similarly, the fill material used to construct the roadway embankments is assumed to have a unit weight of 120 pcf and a friction angle of 30 degrees. If the embankment fill material or backfill material for the reinforcing zone has properties significantly different from these values, DLZ should be informed so that the analyses may be revised as necessary.

Preliminary calculations for bearing capacity, sliding, overturning, and settlement were performed for the MSE wall at the rear abutment location. The MSE wall at the rear abutment is slightly higher than the MSE wall at the forward abutment, and thus the more critical location. Due to similarities in soil profiles and strengths, the analyses at the rear abutment are considered representative of both wall locations.

MSE Wall Evaluation at Station 122+02 (Rear Abutment) and Station 123+47 (Forward Abutment)

In the area of this proposed MSE wall, boring TR-37 encountered three inches of topsoil at the surface. Below the topsoil layer, primarily very stiff to hard clay (A-7-6) and silty clay (A-6b) was encountered to a depth of 10.5 feet below ground surface. Below 10.5 feet, primarily very stiff silt (A-4b) was encountered to a depth of approximately 32.0 feet below ground surface. Below 32.0 feet, primarily hard silty clay (A-6b) and clay (A-7-6) was encountered to a depth of approximately 62.0 feet below ground surface. Below 62.0 feet, primarily medium dense silt (A-4b) was encountered to a depth of approximately 72.0 feet below ground surface. Below 72.0 feet, primarily loose gravel with sand and silt (A-2-4) was encountered to a depth of approximately 79.0 feet below ground surface, at the top of bedrock. Underlying the soil, this boring encountered medium hard to hard, moderately weathered sandstone to the bottom of the boring, at a depth of 99.0 feet.

It is understood that the MSE wall at the rear abutment will be approximately 59.7 feet high, as measured from the existing ground surface to the proposed profile grade. Similarly, it is understood that the MSE wall at the forward abutment is 56.5 feet high. A minimum required embedment depth of 3.0 feet was assumed for the analyses.

Preliminary analyses yielded factors of safety for drained global stability, drained bearing capacity, drained sliding, and overturning that were adequate. However, undrained global stability, undrained sliding, and undrained bearing capacity factors of safety were below recommended minimum values. An undercutting option was considered but did not yield satisfactory results. Results of these analyses indicate that if MSE walls are to be used at this location, a drained condition must be maintained throughout the construction process.

Based upon the traditional Terzaghi bearing capacity equations, the allowable undrained bearing capacity is equal to approximately 30 feet of fill. Next, UTEXAS3 was utilized to evaluate the bearing capacity of the MSE wall. UTEXAS3 is a computer program that can be used to evaluate several types of global stability failure modes. If the problem is modeled so the failure surface passes through the TOE of the MSE wall volume, this analysis can be said to be analyzing a global stability failure mode that is essentially a bearing capacity failure. Using this type of model for the MSE walls at SR 823 over Slocum Avenue, the factor of safety for undrained bearing capacity of the full height wall was calculated to be 1.2. Additionally, an analysis was performed to determine the maximum allowable staged construction height to achieve a minimum factor of safety for undrained bearing capacity of 2.5. This analysis resulted in a maximum allowable staged height of 30 feet. This value is in good agreement with the value determined from the undrained bearing capacity calculation. Consequently, it is recommended that the MSE walls be built in 30-foot stages. The required waiting period between stages will be determined by the selection of wick drain spacing. Several wick drain spacing options are presented for the roadway embankments in our report; *Proposed Highland Bend Embankments* dated June 8, 2006. The ninety percent consolidation periods for the various spacing options range from 30 to 95 days. The waiting period will allow excess pore water pressures to dissipate enough to accommodate the additional loading of the embankment fill while maintaining a factor of safety of 2.5.

For stability, preliminary calculations indicate that a minimum reinforcement length of 0.9 times the total height plus the embedment depth is required. This corresponds to 56.4 and 53.6 feet for the rear and forward abutments, respectively.

The total maximum settlement of the MSE wall volumes at this location was estimated to be approximately 21 inches at the centerline of the wall. Settlement was calculated using the computer program EMBANK, using the "end of fill" option to model the non-

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continuous embankment loading. Differential settlement at this location was estimated to be approximately 0.8%. MSE retaining walls are able to withstand relatively large amounts of differential settlement, typically up to 100 millimeters per 10 meters of wall length (1/100). The estimated amount of differential settlement at this site is less than the typical recommended maximum value of 1/100.

In lieu of MSE walls, spill through slopes have been evaluated to construct the embankments at the abutment locations. Global stability analyses indicate that 2H:1V or flatter slopes may be used to construct the spill through slopes near the rear and forward abutments. It should be noted that due to higher fills or more critical soil profiles, the roadway embankments in this area require the use of 2.5H:1V or flatter slopes. (Embankment analyses are contained in the report, *Proposed Highland Bend Embankments*, dated June 8, 2006) The use of 2H:1V slopes pertains to the spill through slopes for the Slocum and Pershing Avenue structure location only.

Calculations for bearing capacity, overturning, sliding, and settlement are attached. A drawing showing the results of the global stability analyses is also attached.

A summary of soil properties, summary of the results of calculations, and results of global stability analyses are attached.

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

Respectfully submitted,
DLZ OHIO, INC.

Steven J. Riedy
Geotechnical Engineer

Dorothy A. Adams

Dorothy A. Adams, M.S.C.E., P.E.
Senior Geotechnical Engineer

Encl: As noted

cc: file

M:\proj\0121\3070.03\Stability Analyses\Documents\MSE Wall letters\08 Slocum Ave (Highland Bend)\Preliminary - Revised\MSE Wall Findings - Slocum Avenue 08-18-06 SJR.doc

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.

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

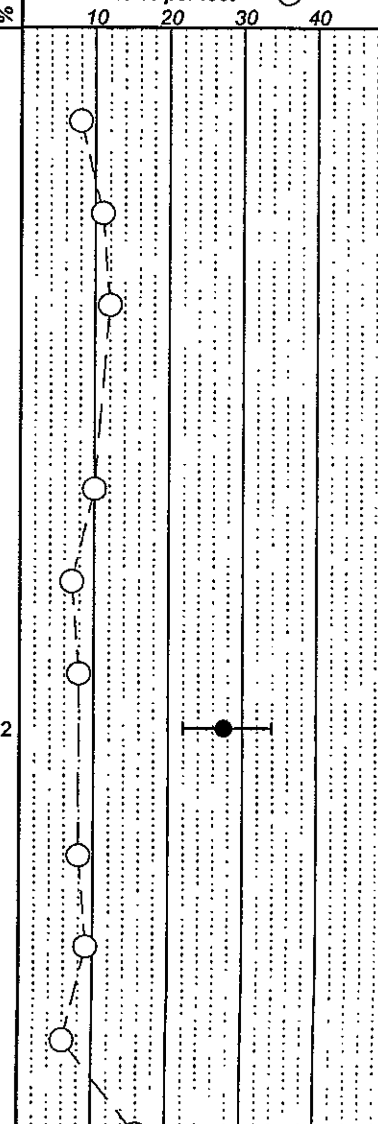
LOG OF: Boring R-64 | Location: approx. 20' SE of marking | Date Drilled: 05/16/05 to 05/17/05

WATER OBSERVATIONS: Water seepage at: 63.5'
Water level at completion: 65.5' (prior to coring)
2.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	551.6												
0.3	551.3						Topsoil - 3"						
		4 4 4	11	1		4.5	Very stiff to hard brown SILT AND CLAY (A-6a), little fine to coarse sand; damp.						
		2 4 7	15	2		4.25							
		4 5 7	17	3		3.0							
					P1								
		3 4 6	18	4		3.75							
		1 3 4	17	5		3.0	@ 13.5', Very stiff, trace fine to coarse sand, moist to wet.						
		2 4 4	18	6		2.5							
					P2			0	5	–	2	51	42
		3 4 4	18	7		3.0	@ 21.0', Little fine to coarse sand, moist to wet.						
23.5	528.1												
		3 4 5	18	8		1.75	Stiff brown and gray SILT (A-4b), little fine sand, little clay; moist.						
		2 2 4	18	9		1.75							
		3 6 10	18	10		4.5+							

DRAFT

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



FILE: 0121-3070-03 [8/18/2006 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 R-64 | Location: approx. 20' SE of marking | Date Drilled: 05/16/05 to 05/17/05

WATER OBSERVATIONS: Water seepage at: 63.5'
Water level at completion: 65.5' (prior to coring)
2.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30.0	521.6						Very stiff to hard gray CLAY (A-7-6); damp.						
35		5 9 12	16	11		4.5+							
40		3 7 11	18	12		4.5		0	0	--	0	23	77
45		4 8 12	16	13		4.5+							
50		3 7 9	18	14		4.5							
55		5 7 10	18	15		3.5							
57.0	494.6						Hard gray SILTY CLAY (A-6b), some fine to coarse sand, trace gravel; damp.						
60		3 7 7	18	16		4.25							

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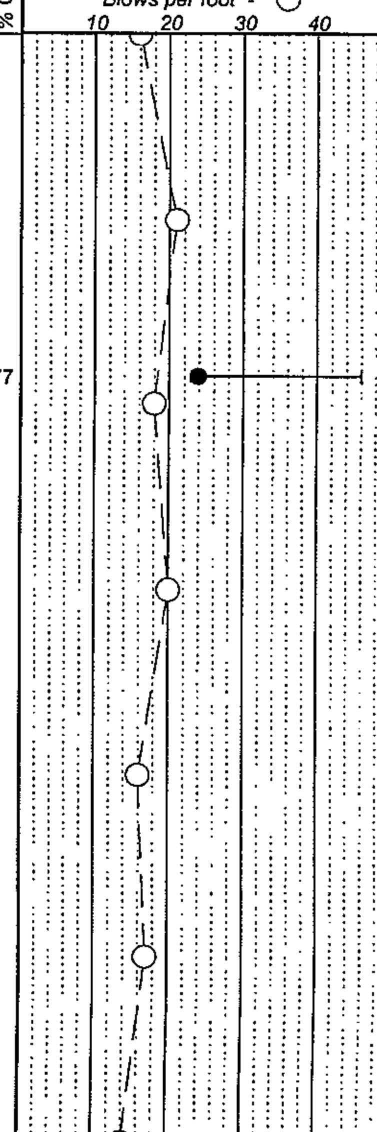
STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢—⊣ LL
Blows per foot - ○



FILE: 0121-3070-03 [8/18/2006 8:52 AM]

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

LOG OF: Boring R-64 **Location:** approx. 20' SE of marking **Date Drilled:** 05/16/05 to 05/17/05

WATER OBSERVATIONS: Water seepage at: 63.5'
Water level at completion: 65.5' (prior to coring)
2.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60.0	491.6						Loose to medium dense gray COARSE AND FINE SAND (A-3a), some silt, little gravel; wet.						
65		5 6 8	14	17									
70		WOH 1 7	18	18									
73.5	478.1	50/5	5	19			Severely weathered gray SANDSTONE, argillaceous.						
75.5	476.1	Core 65"	Rec 65"	RQD 83%	R-1		Medium hard to hard gray to dark gray SANDSTONE; fine grained, slightly weathered, argillaceous, thickly bedded, highly fractured, clay seam from 79.4' to 79.5'.						
80.9	470.7						Bottom of Boring - 80.9'						

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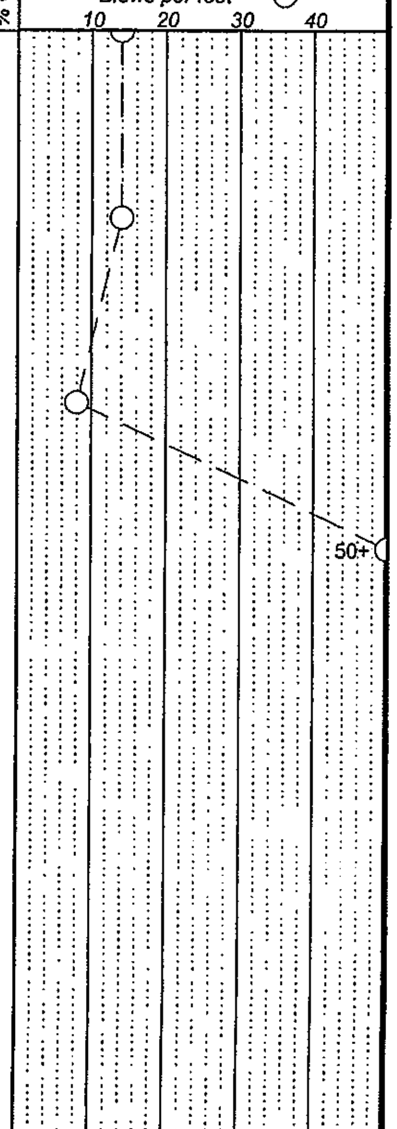
STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



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

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

LOG OF: Boring R-64A | Location: Highland Bend | Date Drilled: 1/11/06

WATER OBSERVATIONS: Water seepage at: 68.5' - 70.0'
Water level at completion: 64.8' (prior to coring)
13.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	552.0												
0.3	551.7						Topsoil - 4"						
		2 2 5	13	1		2.25	Very stiff brown SILTY CLAY (A-6b), trace fine to coarse sand; damp.	0	1	--	5	43	51
		4 5 8	18	2		4.5+	@ 3.0'-7.5', Hard, trace organic soil.						
5.0	547.0				P1A	2.0 / 0	Stiff to very stiff brown CLAY (A-7-6), "and" silt, trace fine to coarse sand; damp to moist.	0	1	--	2	49	48
5.9	546.1				P1B		Very stiff brown SILT AND CLAY (A-6a), trace fine sand; damp.	0	1	--	1	48	50
10		3 3 6	18	3		2.5		0	0	--	1	47	52
		4 4 6	18	4		2.5							
15		2 5 5	18	5		2.5							
15.8	536.2				P2A	0.5 / 2.0		0	0	--	1	52	47
					P2B		Soft to medium stiff brown SILT (A-4b), some to "and" clay, trace fine sand; moist.	0	0	--	2	67	31
20		2 5 6	18	6		0.5		0	0	--	1	70	29
		3 3 6	18	7		0.25	@ 21.0', little clay.	0	0	--	1	81	18
23.0	529.0						Medium stiff brownish gray CLAY (A-7-6), "and" silt, trace fine to coarse sand; damp.						
25		2 3 4	18	8		0.75		0	1	--	2	43	54
		4 6 8	16	9		2.5	@ 25.0', Very stiff.						
30		4 5 9	18	10		2.5	@ 28.5', little silt.	0	0	--	1	17	82

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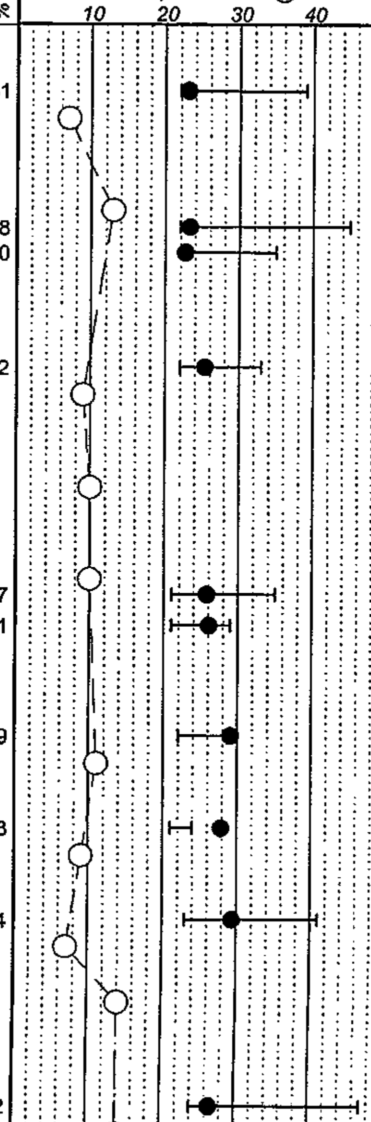
STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├─┤ LL
Blows per foot - ○



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

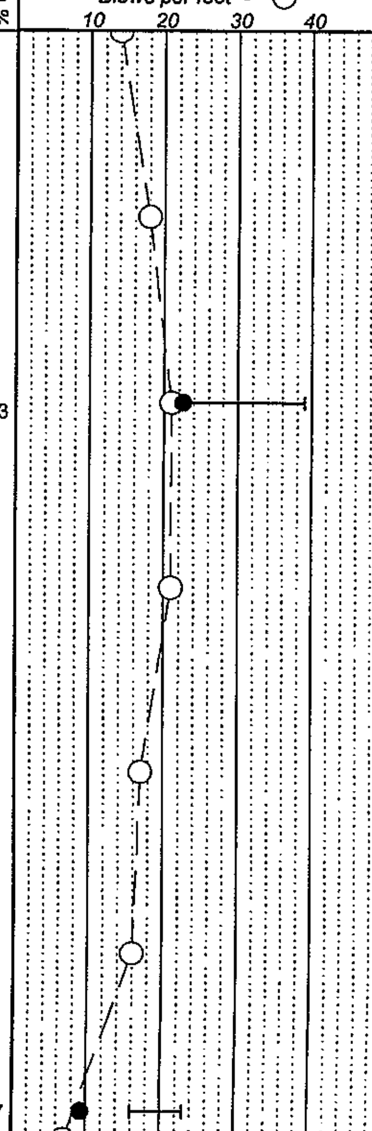
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring R-64A | Location: Highland Bend | Date Drilled: 1/11/06

WATER OBSERVATIONS: Water seepage at: 68.5' - 70.0'
Water level at completion: 64.8' (prior to coring)
13.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	522.0						Very stiff to hard gray CLAY (A-7-6), little silt, trace coarse sand; damp.						
35		5 7 11	18	11		4.5+							
37.0	515.0						Hard gray SILTY CLAY (A-6b), some silt, trace silt; damp to moist.						
40		6 10 11	18	12		4.5+							
					P4	4.0		0	0	--	1	26	73
45		6 9 12	18	13		4.5+							
							@ 47.0', Trace organic clay.						
50		5 7 10	18	14		4.0							
55		4 7 9	18	15		2.5							
57.0	495.0						Medium stiff to stiff gray SILT (A-4b), some clay, little fine to coarse sand; damp to moist.						
60		WOH 2 5	18	16		1.0		0	1	--	14	58	27

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



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FILE: 0121-3070-03 [8/16/2006 3:23 PM]

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

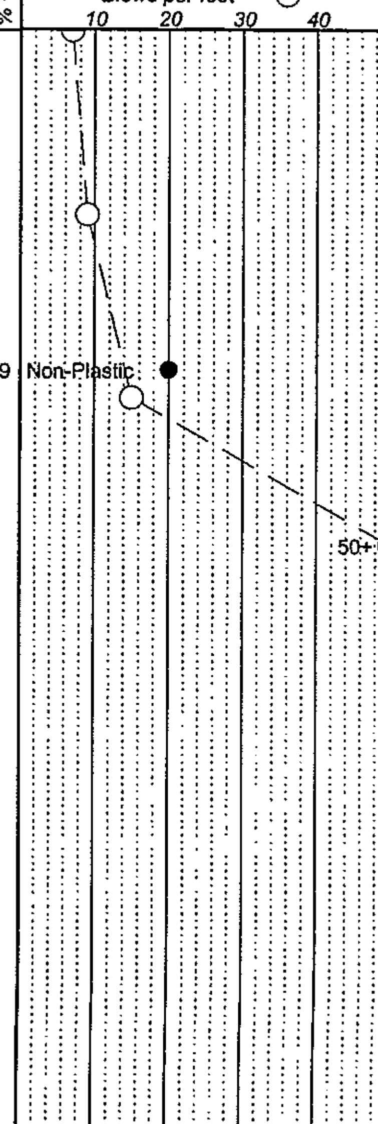
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring R-64A | Location: Highland Bend | Date Drilled: 1/11/06

WATER OBSERVATIONS: Water seepage at: 68.5' - 70.0'
Water level at completion: 64.8' (prior to coring)
13.9' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60	492.0												
60.0–67.0		3 4 5	18	17		1.0	@ 62.5', Little to some fine to coarse sand, trace to little gravel, trace to little clay, moist to wet.						
67.0–72.0	485.0	3 6 9	18	18			Medium dense gray SANDY SILT (A-4a), trace clay, trace gravel; moist to wet.	1	6	--	53	31	9
72.0–75.0	480.0	50/5	4	19			Severely weathered gray SANDSTONE argillaceous, micaceous.						
75.0–80.0	477.0	Core 60"	Rec 60"	RQD 100%	R-1		Medium hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, thickly bedded, slightly fractured. @ 78.8' to 79.3', very fine grained interbed, soft.						
80.0	472.0						Bottom of Boring - 80.0'						
85													
90													

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



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FILE: 0121-3070-03 [8/16/2006 3:23 PM]

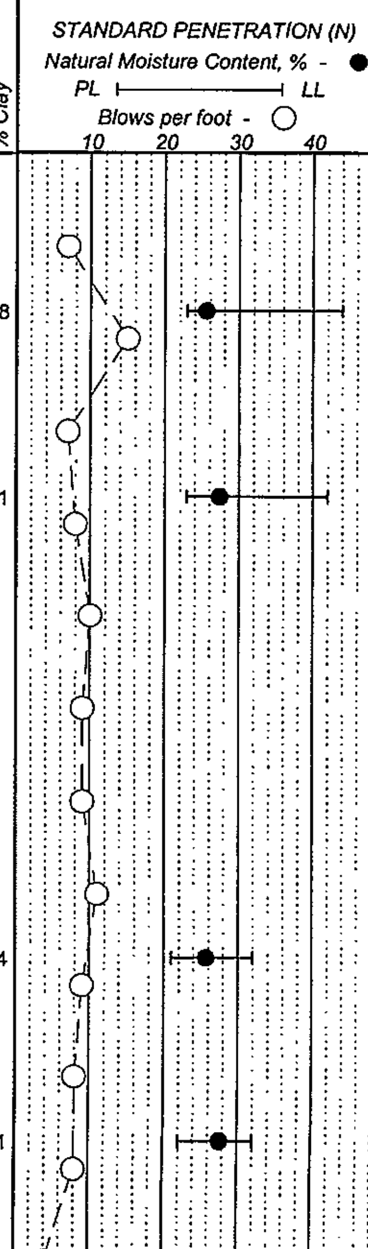
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-36 | Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	552.6												
0.3	552.3						Topsoil - 4"						
		2 3 4	17	1		2.0	Very stiff brown and gray CLAY (A-7-6), trace fine sand; moist. @ 0.0'-1.8', contains root fragments.						
5		6 7 8	16	2		3.0		0	0	--	1	31	68
5.5	547.1						Very stiff brown CLAY (A-7-6), trace fine sand; varved; moist.						
		3 3 4	18	3		3.0							
10		2 3 5	16	4		3.0		0	0	--	1	38	61
		3 4 6	18	5		2.5							
15		2 4 5	18	6		3.25							
		3 4 5	18	7		3.0							
20		4 5 6	18	8		3.0							
20.5	532.1						Very stiff brown SILT AND CLAY (A-6a); varved; moist.						
		3 4 5	18	9		3.25		0	0	--	1	65	34
25		3 4 4	18	10		3.0							
26.0	526.6						Very stiff brown SILT (A-4b); varved; moist.						
		2 4 4	18	11		3.5		0	0	--	2	67	31
28.5	524.1						Very stiff gray CLAY (A-7-6); varved; wet.						
30		2 2 2	18	12		2.75							



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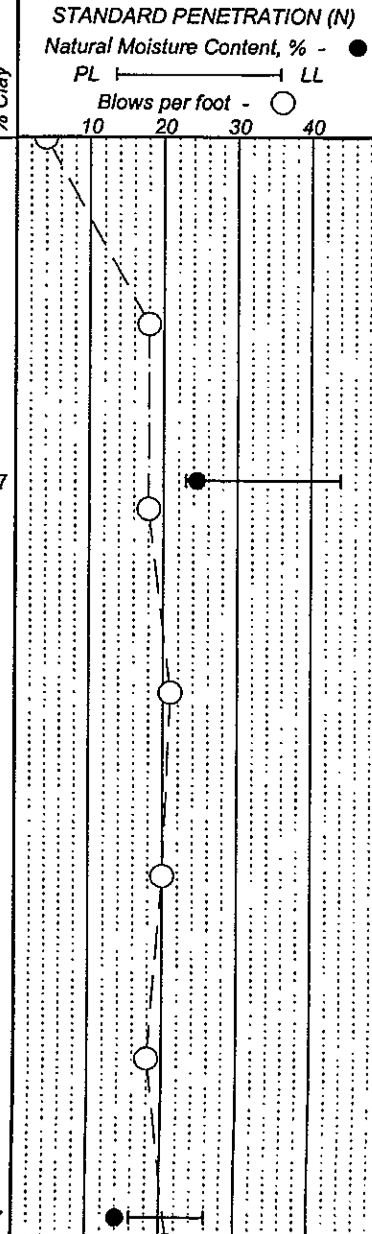
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-36 | Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	522.6						Very stiff gray CLAY (A-7-6); varved; damp to moist.						
35		5 8 10	11	13		3.75							
40		7 8 10	18	14		3.75	@ 38.0', brownish gray.	0	0	–	0	33	67
							@ 42.0' to 47.0', hard.						
45		4 9 12	18	15		4.5+							
							@ 47.0', gray, damp to moist.						
50		7 10 10	18	16		2.75							
55		5 9 9	18	17		3.0							
57.0	495.6						Hard gray SILT (A-4b); damp.						
60		5 10 11	18	18		4.5+		0	1	–	9	53	37



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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-36 | Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N)
60	492.6						Hard gray SILT (A-4b); damp.							
62.0	490.6						Very loose gray SANDY SILT (A-4a); wet.							
65		5 1 2	18	19										
70		0 4 7	18	20			@ 69.0', medium dense.	0	1	--	60	31	8	Non-Plastic
72.0	480.6						Severely weathered gray SANDSTONE argillaceous.							
74.0	478.6	50/1	1	21			Hard light gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, massively bedded, slightly fractured. @ 76.0', 76.3', low angle fractures. @ 77.6',77.7', low angle fracture.							
75–85		Core 120"	Rec 116"	RQD 70%	R-1		@ 83.4' to 84.9', medium hard, very fine grained.							
85–90		Core 120"	Rec 119"	RQD 93%	R-2									

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

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FILE: 0121-3070-03 [8/18/2006 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-36 | Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press /Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N)
90.0	462.6						Hard light gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, massively bedded, slightly fractured. @ 90.2' to 90.5', calcareous layer. @ 92.6' to 97.1', calcareous.							
94.0	458.6						Bottom of Boring - 94.0'							

Depth scale: 95, 100, 105, 110, 115, 120

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

DRAFT

FILE: 0121-3070-03 [8/18/2006 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-37 | Location: Pier 1 SCI-823.00 over Slocum Ave | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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	556.1												
0.3	555.8						Topsoil - 3"						
		2 3 3	14	1		2.25	Very stiff brown CLAY (A-7-6); trace fine to coarse sand; moist.	0	1	--	4	41	54
		3 4 5	18	2		2.0	@ 3.0', brown and gray.						
5													
5.5	550.6												
		3 4 5	18	3		1.5	Hard brown SILT CLAY (A-6b), trace fine to coarse sand; damp.	0	1	--	6	38	55
		3 6 8	17	4		4.5+	@ 8.0', hard; damp.						
10													
10.5	545.6												
		3 4 5	10	5		2.25	Very stiff brown SILT (A-4b), "and" clay, trace fine sand; varved; damp to moist.						
		2 3 5	18	6		3.0		0	0	--	1	61	38
15													
		2 4 4	18	7		0.5	@ 16.0'-18.0', soft; wet.						
		3 4 5	18	8		2.0							
20													
		2 3 5	18	9		2.25							
		2 4 5	18	10		2.0							
25													
25.5	530.6												
		3 5 5	18	11		—	Medium dense brown SILT (A-4b), some clay, trace fine sand; moist.	0	0	--	0	79	21
30		3 4 6	18	12				0	0	--	2	77	21

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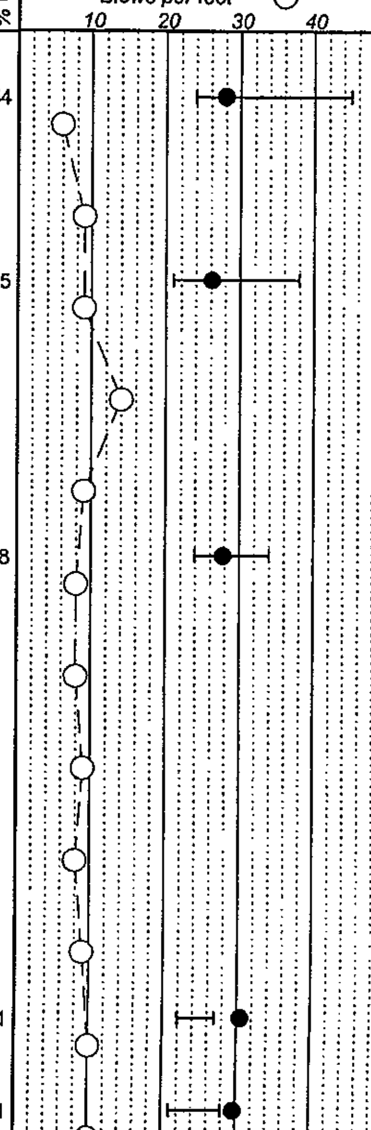
STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ├──┤ LL
Blows per foot - ○



FILE: 0121-3070-03 [8/16/2006 3:23 PM]

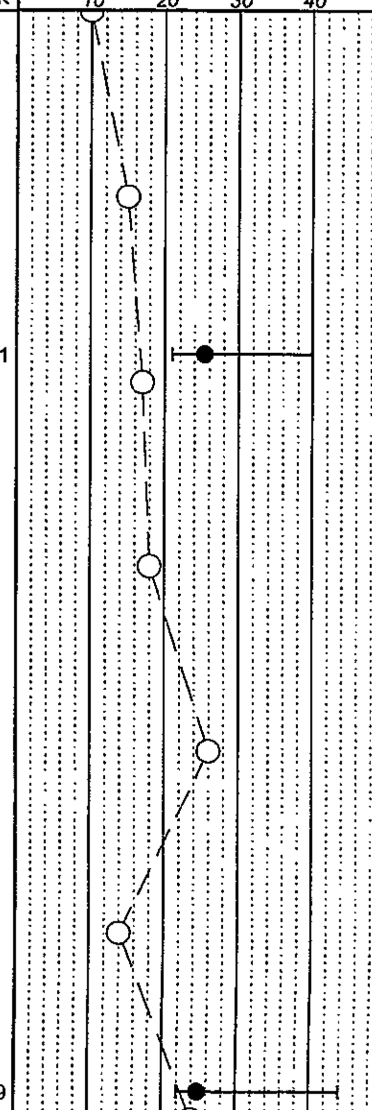
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-37 | Location: Pier 1 SCI-823.00 over Slocum Ave | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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	526.1						Medium dense brown SILT (A-4b); moist.						
32.0	524.1						Hard brownish gray SILTY CLAY (A-6b), trace fine sand; moist.						
		4 6 9	18	13		4.5+							
		6 8 9	18	14		4.25		0	0	–	1	38	61
42.0	514.1						Hard gray CLAY (A-7-6); damp to moist.						
		4 7 11	18	15		4.25							
		8 13 13	18	16		4.5+							
		4 7 7	18	17		4.0							
60		8 12 12	18	18		4.5+		0	0	–	0	21	79



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FILE: 0121-3070-03 (8/16/2006 3:23 PM)

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

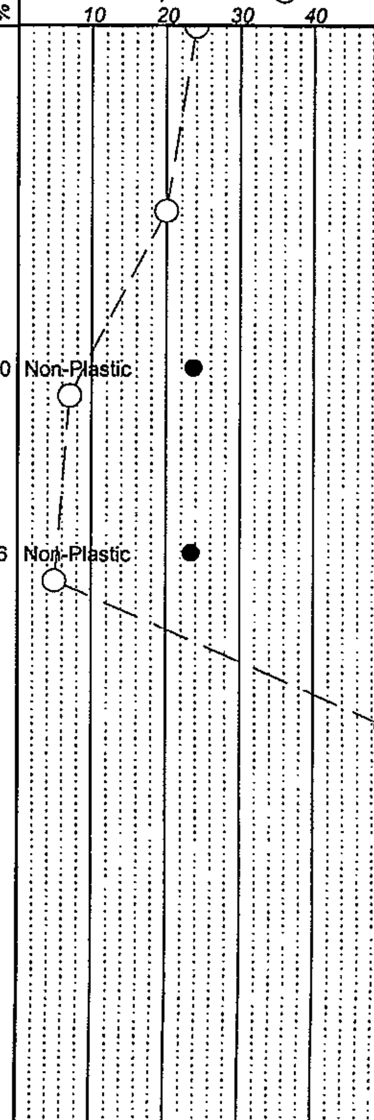
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-37 | Location: Pier 1 SCI-823.00 over Slocum Ave | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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)
60	496.1						Hard gray CLAY (A-7-6); damp to moist.							
62.0	494.1						Medium dense light gray SILT (A-4b), some fine to coarse sand, little clay, trace gravel; moist.							
65		7 10 10	18	19										
							@ 68.0', loose, wet.							
70		3 3 4	18	20				1	2	–	30	57	10	Non-Plastic
72.0	484.1						Loose gray GRAVEL WITH SAND AND SILT (A-2-4), trace clay; wet.							
75		0 1 4	18	21				17	3	–	53	21	6	Non-Plastic
							Severely weathered gray SANDSTONE argillaceous.							
79.0	477.1	50/2	1	22			@ 79.0' to 80.2', broken.							
80							Medium hard to hard gray SANDSTONE; very fine to fine grained, moderately weathered, argillaceous, thinly bedded to thickly bedded, slightly fractured. @ 79.3' to 79.4' and 79.8' to 80.1', iron stained bands. @ 80.8', low angle fracture.							
85		Core 120"	Rec 117"	RQD 74%	R-1									
							@ 86.0', low angle fracture. @ 87.5' to 89.2', contains moderate argillaceous laminations. @ 88.3' to 88.6', decomposed argillaceous band.							
90														

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



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FILE: 0121-3070-03 [8/16/2006 3:23 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-37 | **Location:** Pier 1 SCI-823.00 over Slocum Ave | **Date Drilled:** 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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
90	466.1	Core 120"	Rec 119"	RQD 99%	R-2		@ 91.9' to 92.0', calcareous. @ 94.4' to 94.7', calcareous. @ 96.9' to 97.4', calcareous layer.							
99.0	457.1						Bottom of Boring - 99.0'							

Depth scale: 90, 95, 100, 105, 110, 115, 120

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FILE: 0121-3070-03 [8/16/2006 3:23 PM]

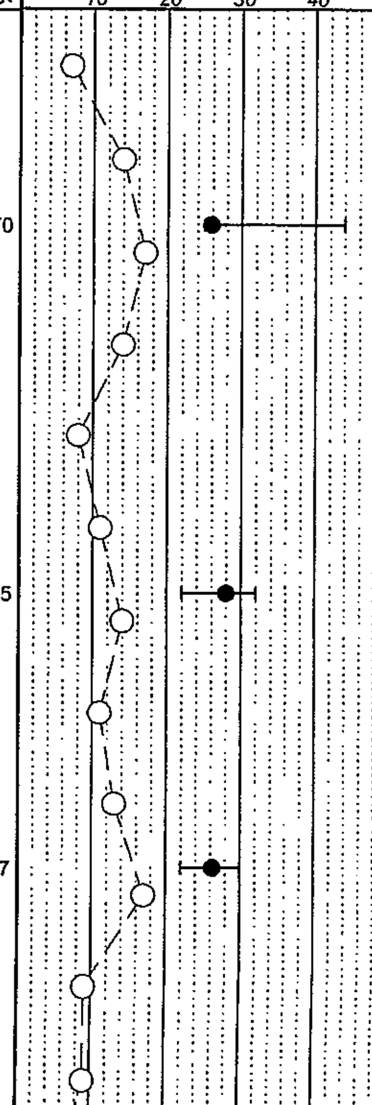
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-38 | Location: Rear Abutment SCI-823.00 over Slocum Ave | Date Drilled: 02/09/05 to 02/10/05

WATER OBSERVATIONS: Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' *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 / 0.3	554.0 / 553.7	WOH 3 4	18	1		2.5	Topsoil - 4" / Very stiff CLAY (A-7-6), brown , trace fine sand; damp.						
		3 5 9	18	2		3.25							
5		4 6 11	18	3		3.5		0	0	--	1	29	70
		4 6 8	18	4		2.0							
10.0	544.0	2 3 5	18	5		1.5	Stiff brown SILT (A-4b), little clay, trace fine to coarse sand; moist.						
		3 5 6	18	6		1.5							
15		3 5 9	18	7		1.25		0	1	--	2	63	35
		2 5 6	18	8		1.25							
20		3 5 8	18	9		1.5							
		4 8 9	16	10		1.5		0	0	--	1	72	27
25.0	529.0	2 4 5	18	11		1.5	Stiff brown SILT (A-4b), some clay, trace fine sand, contains silt laminae; moist.						
		3 4 5	18	12		1.0							
30													



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FILE: 0121-3070-03 [8/18/2006 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-38 | Location: Rear Abutment SCI-823.00 over Slocum Ave | Date Drilled: 02/09/05 to 02/10/05

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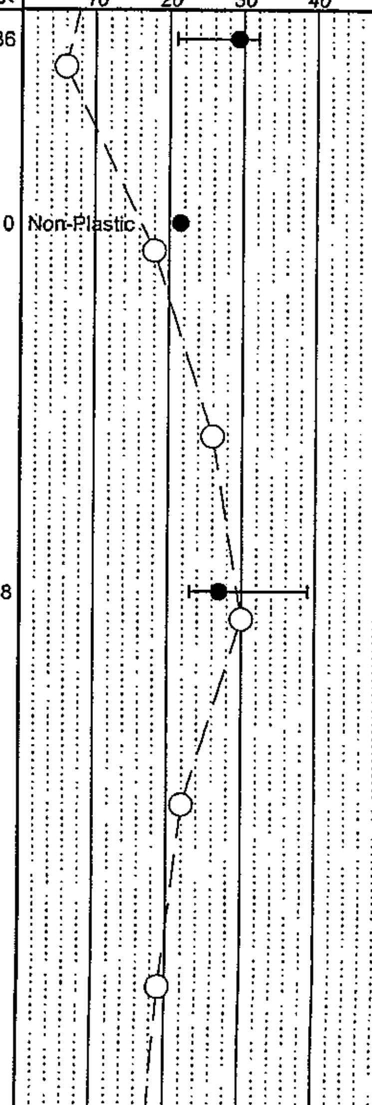
7.3' *Including drilling water)

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
30	524.0	3 2 4	16	13		1.0	Stiff brown SILT AND CLAY (A-6a), little fine sand; moist.	0	0	--	5	59	36
33.0	521.0						Medium dense gray COARSE AND FINE SAND (A-3a); moist.						
35		4 7 11	18	14				0	21	--	50	20	10
38.0	516.0						Very stiff gray SILTY CLAY (A-6b), little fine sand; damp to moist.						
40		7 12 14	18	15		3.5							
45		10 13 17	18	16		3.0		0	0	--	1	32	68
50		5 9 13	18	17		4.0							
55.0	499.0	7 9 10	18	18		3.5	Very stiff gray SILT (A-4b), little fine sand, little silty clay; moist.						
60													



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FILE: 0121-3070-03 [8/18/2006 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

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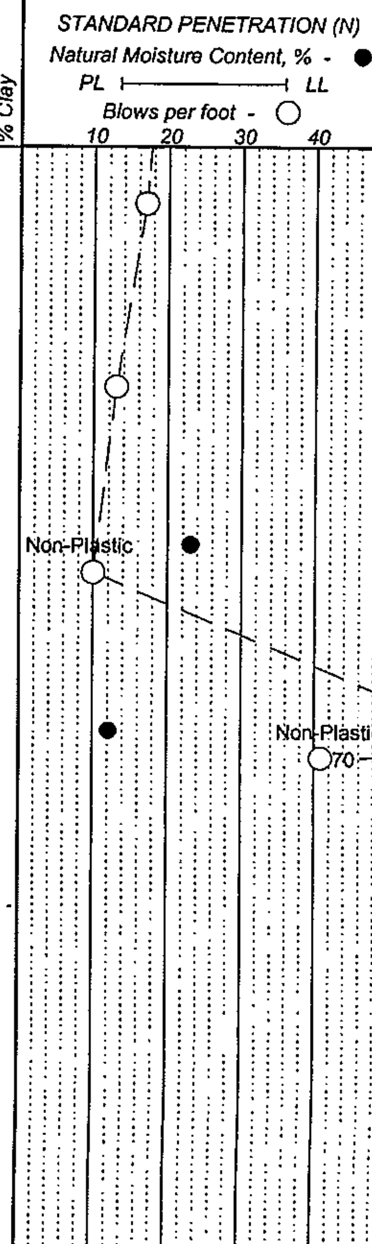
Water level at completion: 9.8' (Prior to coring)
7.3' *Including drilling water)

DRAFT

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
60.0	494.0	4 8 9	18	19			Medium dense gray COARSE AND FINE SAND (A-3a), some silt, little clay; moist.						
65		6 6 7	18	20			@ 65.0', wet.						
68.0	486.0	WOH 5 5	15	21			Loose gray SANDY SILT (A-4a); wet.	0	1	–	54	45	
73.0	481.0	9 20 50/3	13	22			Very dense gray GRAVEL WITH SAND (A-1-b); wet.	50	19	–	12	20	
80.0	474.0	Core 60"	Rec 60"	RQD 90%	R-1		Medium hard to hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, arenaceous, thinly bedded to thickly bedded. @ 80.0' to 80.2', argillaceous zone, broken.						
85		Core 60"	Rec 60"	RQD 80%	R-2		@ 85.9',86.2',86.7', low angle clay filled fractures.						
90													



FILE: 0121-3070-03 [8/18/2006 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-38 **Location:** Rear Abutment SCI-823.00 over Slocum Ave **Date Drilled:** 02/09/05 to 02/10/05

WATER OBSERVATIONS: Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' *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) Natural Moisture Content, % - ● PL ├──┤ LL Blows per foot - ○ 10 20 30 40
90	464.0	Core 60"	Rec 33"	RQD 55%	R-3		Medium hard to hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, arenaceous, massively bedded, slightly fractured.							
95		Core 60"	Rec 0"	RQD 0%	R-4		@ 92.8' to 100.0', lost recovery; unknown reason.							
100.0	454.0						Bottom of Boring - 100.0'							
105														
110														
115														
120														

DRAFT

FILE: 0121-3070-03 [8/18/2006 8:52 AM]

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

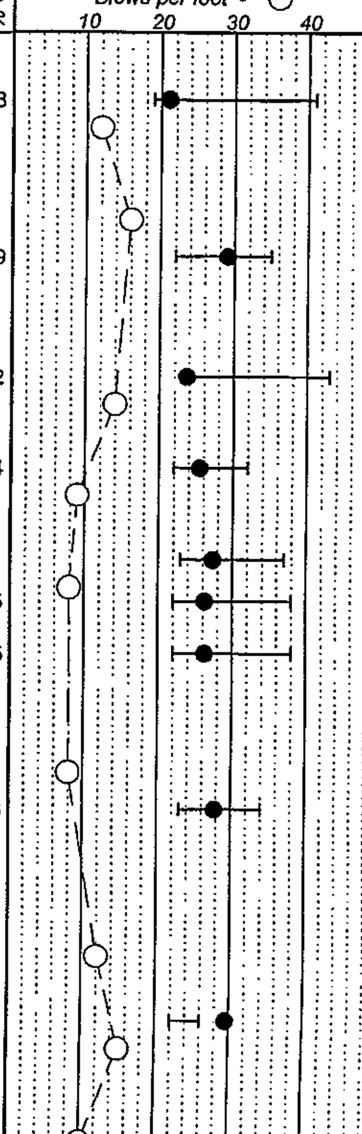
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-38A | *Location:* Highland Bend | *Date Drilled:* 1/9/06 to 1/10/06

WATER OBSERVATIONS: Water seepage at: 43.5', 73.5'
Water level at completion: 43.0' (prior to coring)
13.6' (includes drilling water) 41.5' (after 15 hours)

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	554.0												
0.8	553.2						Topsoil - 9"						
		2 4 8	13	1		4.5+	Hard mottled brown and gray CLAY (A-7-6), some to "and" silt, trace fine sand; damp to moist.	0	0	–	4	42	53
		6 7 9	18	2		2.75	@ 3.5', Very stiff.						
5.0	549.0				P-1	2.0	Stiff to very stiff mottled brown and gray SILT AND CLAY (A-6a), trace fine sand; moist.	0	0	–	4	47	49
7.5	546.5	4 6 8	16	3		4.0	Hard brown CLAY (A-7-6), trace fine sand, some silt; damp to moist.	0	0	–	1	27	72
10.5	543.5	3 4 5	18	4		1.25	Stiff brown SILT (A-4b), "and" clay, trace fine sand; moist.	0	0	–	3	54	44
13.0	541.0	3 3 5	18	5		2.0	Stiff to very stiff brown SILT AND CLAY (A-6a), trace fine sand; moist.	0	0	–	1	48	51
15.0	539.0				P-2	1.5 / 1.0	Medium stiff to stiff brown SILTY CLAY (A-6b), trace fine sand; moist.	0	0	–	1	44	55
								0	0	–	1	74	25
		3 4 4	18	6		1.75							
20.0	534.0				P-3	1.0	Medium stiff brown SILT AND CLAY (A-6a), trace to little fine to coarse sand; moist.	0	7	--	4	53	36
		3 5 7	18	7		2.0							
25.5	528.5	5 6 9	18	8		0.75	Medium stiff brown SILT (A-4b), little clay; wet.	0	0	–	0	82	18
		3 4 6	18	9		0.75							
30													

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



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FILE: 0121-3070-03 [8/18/2006 8:52 AM]

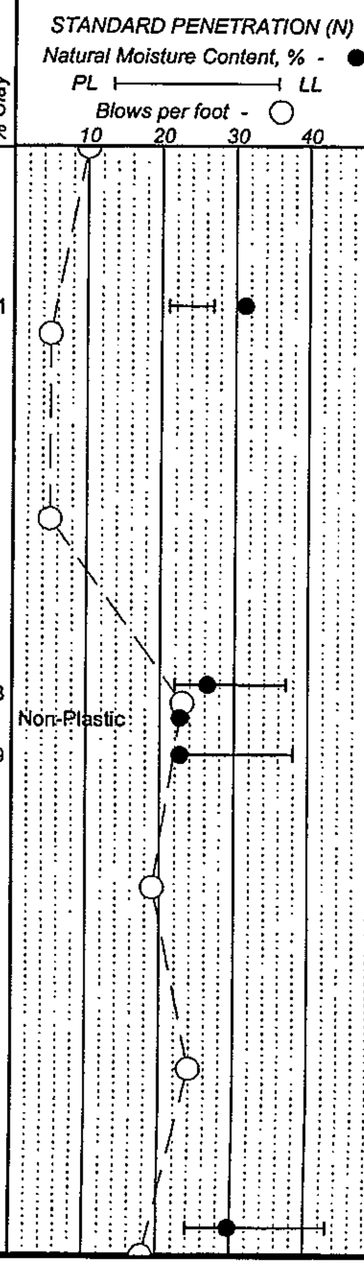
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-38A | Location: Highland Bend | Date Drilled: 1/9/06 to 1/10/06

WATER OBSERVATIONS: Water seepage at: 43.5', 73.5'
Water level at completion: 43.0' (prior to coring)
13.6' (includes drilling water) 41.5' (after [illegible] hours)

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	524.0												
35		WOH 2 3	18	10		0.75		0	0	–	0	69	31
40		1 1 4	18	11		0.75							
42.0	512.0						Loose to medium dense brown FINE SAND (A-3), trace silty clay, trace coarse sand; wet.						
44.5	509.5	4 10 13	18	12a				0	0	–	3	24	73
45.0	509.0			12b		2.75	Very stiff brownish gray SILT AND CLAY (A-6a), little to some silt, trace fine sand; moist.	0	0	–	91	9	
45.8	508.2				P-4	NC / 4.5+	Poorly graded sand with silt	0	0	–	1	31	69
							Loose to medium dense brown FINE SAND (A-3), trace silty clay; wet.						
50		5 8 11	18	13		4.0	Very stiff to hard dark brown SILTY CLAY (A-6b), some silt, trace fine sand; damp to moist.						
							@ 52.0', Very stiff.						
55		7 10 14	15	14		2.75							
57.0	497.0						Stiff dark brown CLAY (A-7-6), little to some silt, trace fine sand; moist.						
60		6 8 10	18	15		1.5		0	0	–	1	23	76



DRAFT

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-38A | Location: Highland Bend | Date Drilled: 1/9/06 to 1/10/06

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Water level at completion: 43.0' (prior to coring)
13.6' (includes drilling water) 41.5' (after 15 hours)

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	494.0												
62.0	492.0	4 7 6	18	16		0.5	Soft to medium stiff blue-gray SANDY SILT (A-4a), some fine sand, little to some clay; moist to wet.	0	0	–	29	48	23
67.0	487.0	2 4 4	12	17			Loose gray SILT (A-4b), trace to little fine sand, trace clay; moist to wet.						
72.0	482.0	2 6 3	18	18			Loose to medium dense brown COARSE AND FINE SAND (A-3a), little silty clay, trace gravel; moist to wet.						
77.0	477.0	50/3	2	19		4.0	Hard gray SILT AND CLAY (A-6a), trace to little fine sand; damp.						
81.0	473.0	Core 60"	Rec 60"	RQD 65%	R-1		Medium hard gray SANDSTONE; very fine to fine grained, moderately to highly weathered, argillaceous, micaceous, medium bedded, moderately to highly fractured. @ 91.4', 91.9', 92.2', low angle fractures.						
86.0	468.0						Bottom of Boring - 86.0'						

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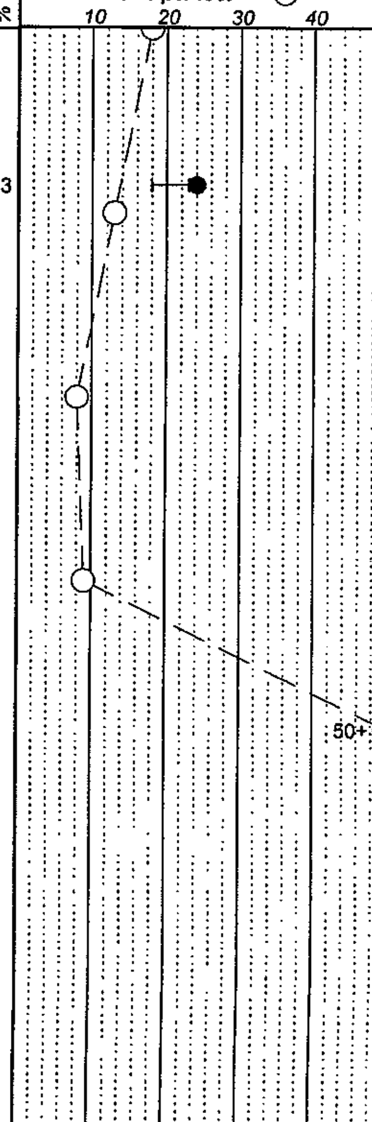
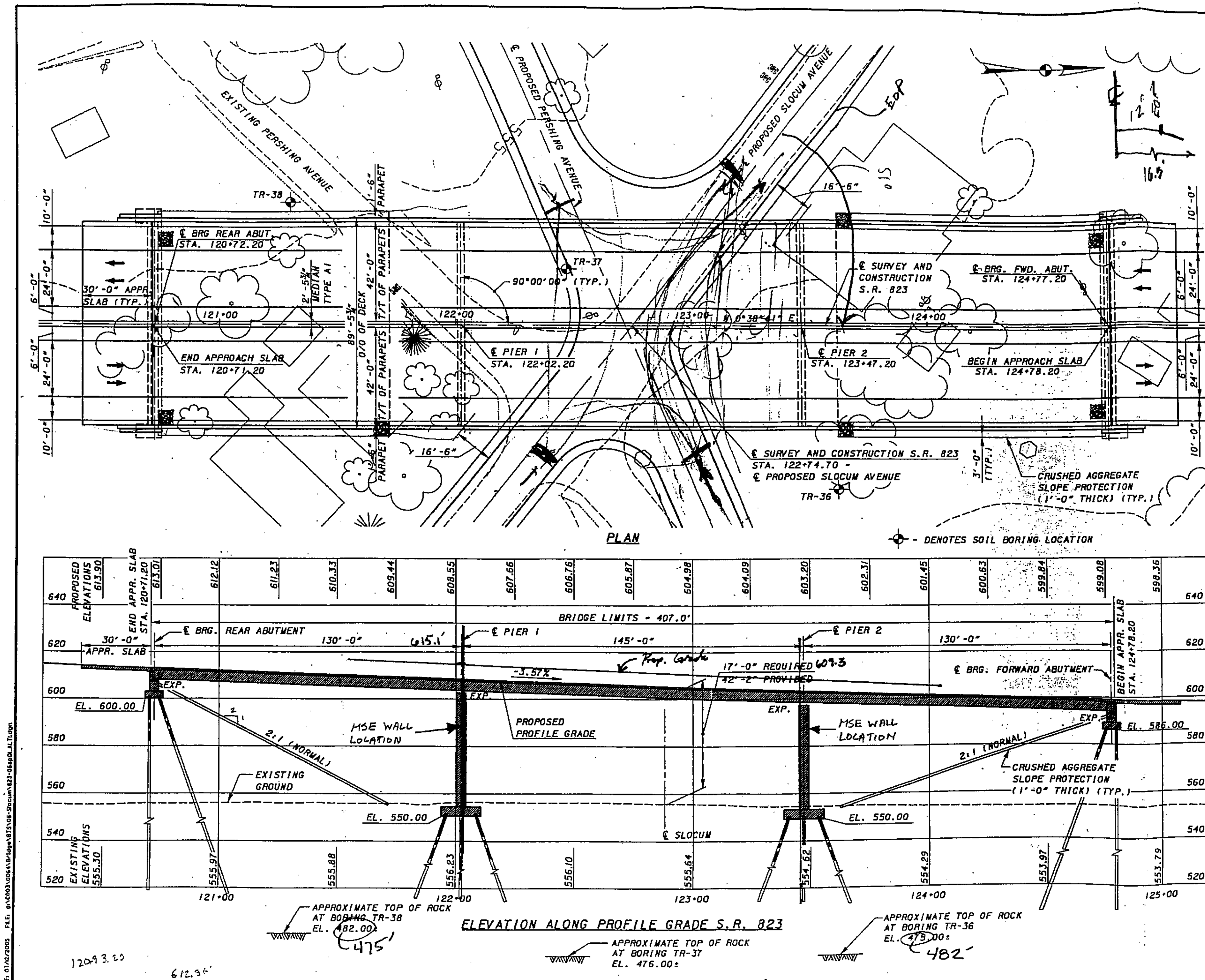
STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢—⊣ LL
Blows per foot - ○



FILE: 0121-3070-03 [8/18/2006 8:52 AM]



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-36	123+62.19	70.37' RT.
TR-37	122+47.30	23.87' LT.
TR-38	121+30.05	51.68' LT.

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

TRAFFIC DATA

(SR 823)

CURRENT YEAR ADT (2010) - 21,200
CURRENT YEAR ADT (2030) - 31,200
DESIGN YEAR ADTT (2010) - 2,968
DESIGN YEAR ADTT (2030) - 4,368

PROPOSED STRUCTURE

TYPE: 3 SPAN CONTINUOUS STEEL PLATE GIRDER A 709 GRADE 50W WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BT REINFORCED CONCRETE SUBSTRUCTURES ON PILES.

SPANS: 130'-145'-130' C/C BEARINGS

ROADWAY: 2-42'-0" T/T OF PARAPETS

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

SKEW: NONE

CROWN: NORMAL 0.016 FT./FT.

ALIGNMENT: TANGENT

WEARING SURFACE: 1" MONOLITHIC CONCRETE

APPROACH SLABS: AS-1-81 (30'-0" LONG)

LATITUDE:

LONGITUDE:

STRUCTURE FILE NO.:

NOTES:

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

FOUNDATION DATA:

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

UTILITIES:

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

TranSystems Corporation

DATE 7/11/05 | DESIGNED HFF | DRAWN GHD | REVIEWED RER | CHECKED BTA

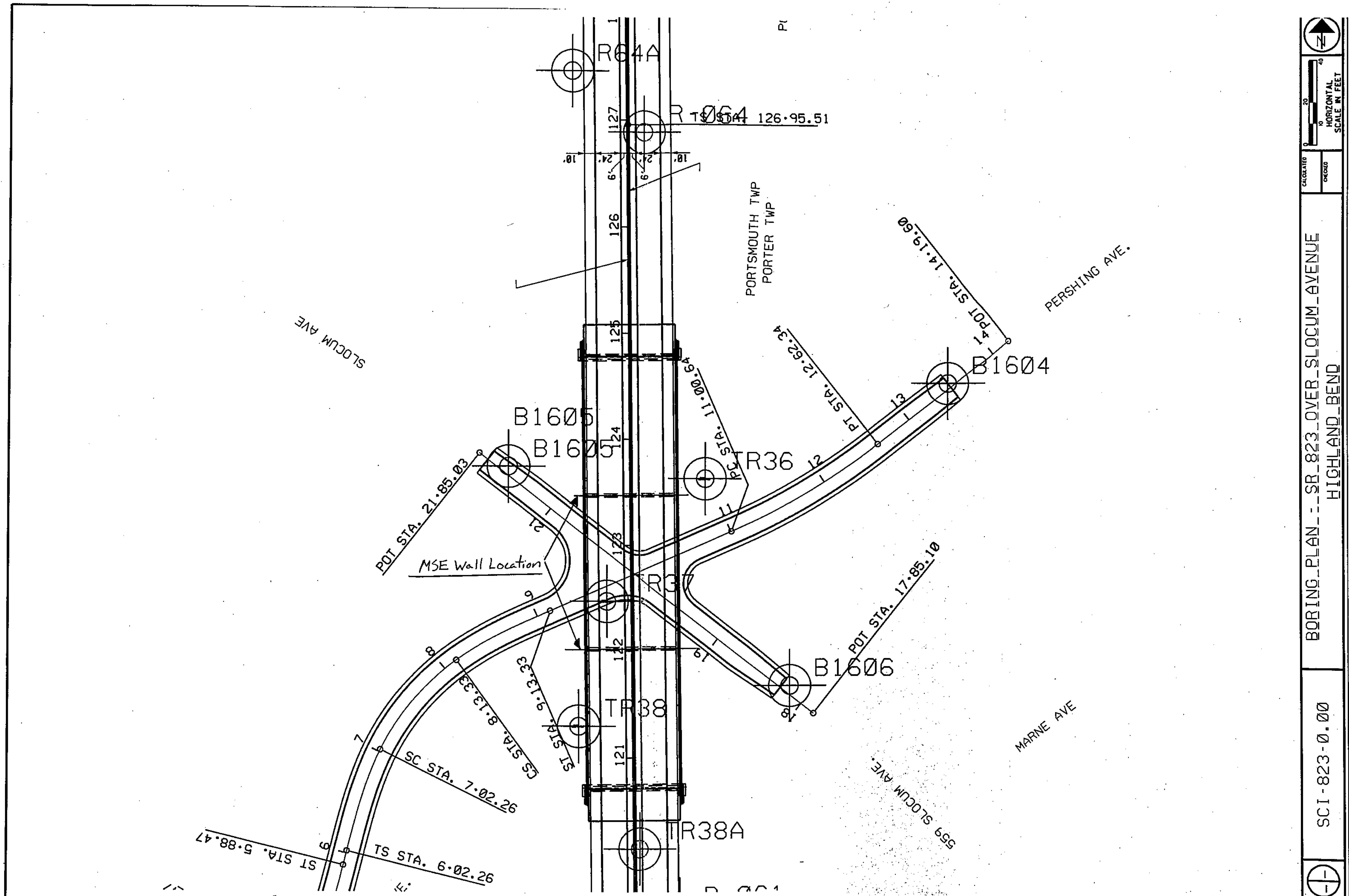
[redacted] COUNTY +71.20 +78.20

PRELIMINARY SITE PLAN - ALTERNATIVE I
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SLOCUM AVENUE

SCI-823-0.00
PID 19415

1 / 2

DATE: 07/12/2005


BORING PLAN - SR 823 OVER SLOCUM AVENUE
HIGHLAND BEND
SCI-823-0.00
HORIZONTAL SCALE IN FEET
0
10
20
40
CALCULATED
CHECKED
R64A
R064
TS STA. 126+95.51
127
126
125
124
123
122
121
10'
24'
6'
PORTSMOUTH TWP
PORTER TWP
POT STA. 14+19.60
PERSHING AVE.
PT STA. 12+62.34
B1604
B1605
TR36
PC STA. 11+00.64
POT STA. 21+85.03
MSE Wall Location
TR37
POT STA. 17+85.10
B1606
TR38
TR38A
SLOCUM AVE
MARNE AVE
559 SLOCUM AVE.
CS STA. 8+13.33
ST STA. 9+13.33
SC STA. 7+02.26
TS STA. 6+02.26
ST STA. 5+88.47
6
7
8
9
11
12
13
14
18
19
21

Soil Parameters Used in MSE Wall Stability Analyses
Slocum Avenue

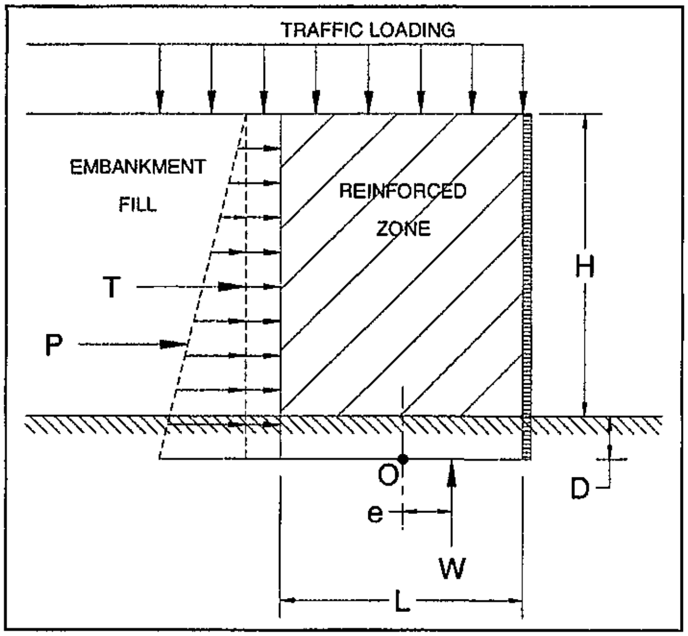
Zone	Soil Type	Unit Weight (pcf)	Strength Parameters			
			Undrained		Drained	
			c	ϕ	c'	ϕ'
Embankment	Compacted Embankment Fill	120	0	30	0	30
Foundation Soil (Rear Abutment) (Boring TR-37&38)	Very Stiff Clay	125	1700	0	0	29
Foundation Soil (Forward Abutment) (Boring TR-36&37)	Very Stiff Clay	125	1700	0	0	29

MSE Retaining Wall Parameters and Analyses Results
Slocum Avenue (Rear & Forward Abutment)

Retained Soil (New Embankment) Unit Weight = 120 pcf Coefficient of Active Earth Pressure (K_a) = 0.33 (Based on $\phi = 30°$)
Sliding along base of MSE wall Sliding Coefficient $(\mu)(0.67) = \tan 29° (0.67) = 0.37$ Use $(\mu)(0.67)$ Use $(\mu)(0.67)$ =0.35 as a maximum value as per AASHTO, BDM,303.4.1.1
Allowable Bearing Capacity – Undrained Condition q_{all} = 3,564 psf For MSE wall with minimum 56-foot long reinforcing
Allowable Bearing Capacity – Drained Condition q_{all} = 11,895 psf For MSE wall with minimum 56-foot long reinforcing
Global Stability **Factor of Safety – Undrained Condition = 1.2** Factor of Safety – Drained Condition = 1.5 Factor of Safety – Seismic Condition = 1.4 For MSE wall with 56-foot long reinforcing
Estimated Settlement of MSE volume Total settlement = 21 inches Differential settlement = 0.8% < 1/100
Full Height of MSE Wall = 59.7 feet Minimum Embedment Depth = 3.0 feet Minimum Length of Reinforcement for External Stability = 0.90*(H+D)=56 feet Maximum Construction Stage = 30 feet

BEARING CAPACITY OF A MSE WALL

Ref: {AASHTO; STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, 17th Edition, 2002}



Soil Properties

γ_{EMB}	=	120	pcf	Unit weight	Embankment fill
ϕ'_{EMB}	=	30	deg.	Friction ang.	Embankment fill
γ_{FDN}	=	125	pcf	Unit weight	Foundation soil
c	=	1700	psf	Cohesion	Foundation soil
ϕ	=	0	deg.	Friction ang.	Foundation soil
c'	=	0	psf	Cohesion	Foundation soil
ϕ'	=	29	deg.	Friction ang.	Foundation soil

Loads and Parameters

ω_t	=	240	psf	Traffic loading
L=B	=	56.43	ft	Length of MSE reinforcement
L factor	=	0.9		Length factor-range (0.7 - 1.0)
D	=	3	ft	Embedment depth
Dw	=	0	ft	Groundwater depth
H+D	=	62.7	ft	
H	=	59.7	ft	Height of wall
Ka	=	0.33		
Γ Pa	=	20.9	ft	Moment arm
Γ Wt	=	31.35	ft	Moment arm
B'	=	48.29	ft	
γ'	=	57.6	pcf	
W_t		13,543	lb/ft of wall	Weight from traffic
W_{mse}	=	424,579	lb/ft of wall	Weight from MSE wall

Effective Bearing Pressure

$$\sigma_v = \frac{W_t + W_{MSE}}{L - 2e}$$

σ_v = 9,073 psf

Ultimate undrained bearing capacity, q_{ult}

$$q_{ULT} = cN_c + \sigma'_D N_q + \frac{1}{2}\gamma B N_\gamma$$

q_{ULT} = 8,911 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 3,564 psf

Factor of Safety = **0.98** **No Good**

Ultimate drained bearing capacity, q_{ult}

$$q_{ULT} = c'N_c + \sigma'_D N_q + \frac{1}{2}\gamma' B N_\gamma$$

q_{ULT} = 29,738 psf

$$q_{ALL} = \frac{q_{ULT}}{FS}$$

q_{ALL} = 11,895 psf

Factor of Safety = **3.28** **OK**

Bearing Capacity Factors for Equations

Undrained		Drained	
N_c	5.14	N_c	27.86
N_q	1.00	N_q	16.44
N_γ	0.00	N_γ	19.34

Eccentricity of Resultant Force

e = 4.07 ft

Kern

e < L/6 = 9.41 ft

STABILITY OF MSE WALL

Assumptions:

1. Estimated height of embankment; H=59.7'
2. It is assumed that the bridge is supported on piles
3. Ground water; Dw=0.0'
4. Traffic loading is neglacted in resisting forces
5. Sliding FS is undrained. See attached sheet for drained

Wall Properties

H+D	=	62.7	feet
γ_{mse}	=	120	pcf
L	=	56.43	feet
L factor	=	0.90	
ϕ	=	30	deg

Foundational Soil Properties

c	=	1700	psf	Cohesion
ϕ'	=	29	deg	Friction angle
ω_T	=	240	psf	Traffic loading

Length factor-range (0.7 - 1.0)

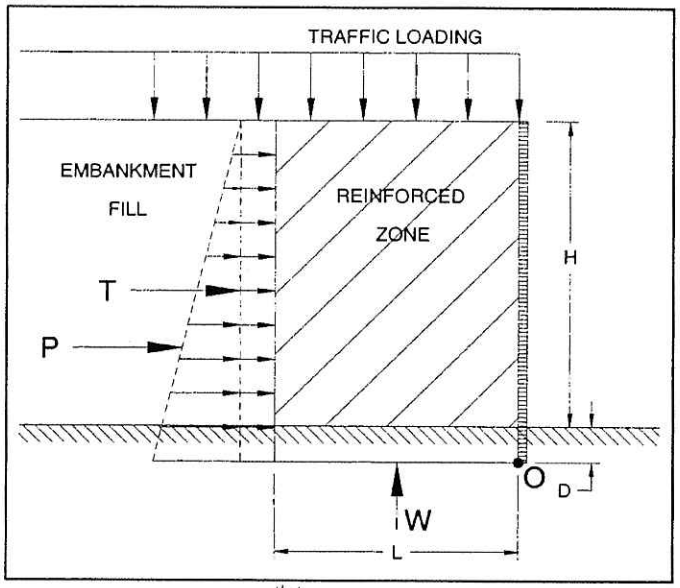
Friction Angle of Embankment Fill

RESISTANCE AGAINST SLIDING ALONG BASE

Thrust: $P_a = K_a\left[\frac{1}{2}\gamma H^2 + \omega_T H\right]$

where; $K_a = \tan^2(45 - \frac{\phi}{2})$ K_a = 0.33

P_a = 82,805 lbs per foot of wall



Resistance: $P_r = W(0.67)(\mu)$ (Drained)

where; $\mu = \tan(\phi)$ 0.67μ = 0.37

0.67μ Max. = 0.35 {AASHTO, Bridge Design Manual, 303.4.1.1}

P_r = 148,603 lbs per foot of wall

Use Undrained Value

$P_r = L(c)$ (Undrained)

P_r = 95,931 lbs per foot of wall

USE THIS VALUE

Drained FS = $\frac{148,603 \text{ lb/ft.}}{82,805 \text{ lb/ft}}$ = 1.79 > 1.50 ✓ OK

$FS = \frac{P_r}{P_a}$

	Calculated	Required
	FS = **1.16**	FS = 1.50

Resistance Against Sliding is **No Good** ← Undrained

RESISTANCE AGAINST OVERTURNING

* Summation of Moments about point "O" (base of wall).

* Traffic loading is neglected in resisting forces

$\Sigma M_{resisting}$ = 11,979,506 lb-ft

$$\Sigma M_{resisting} = \gamma H L\left(\frac{L}{2}\right)$$

$\Sigma M_{overturning}$ = 1,782,526 lb-ft

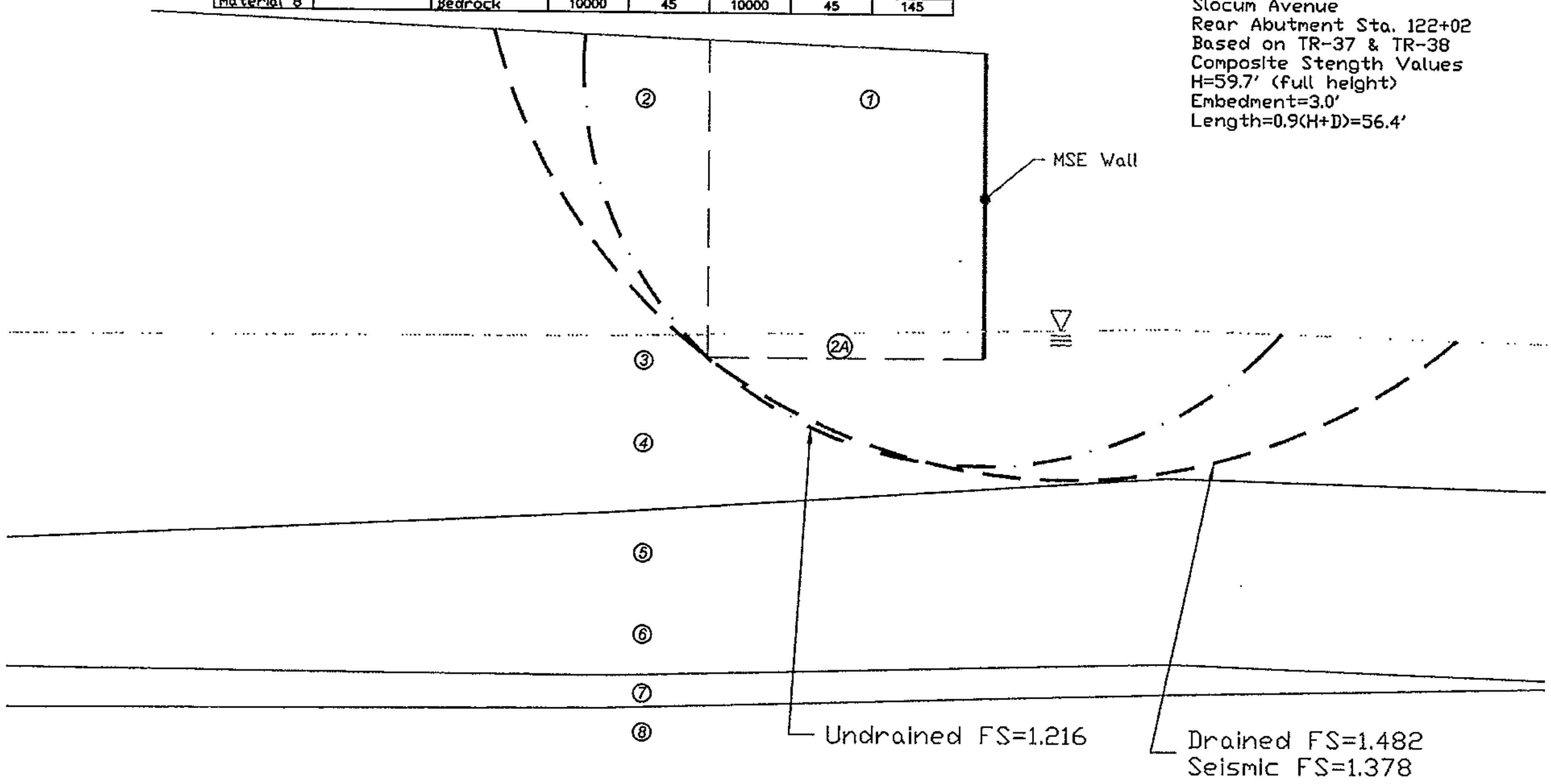
$$\Sigma M_{overturnig} = K_a\left[\frac{1}{2}\gamma H^2\left(\frac{H}{3}\right) + \omega_T H\left(\frac{H}{2}\right)\right]$$

$$FS = \frac{\Sigma M_{resisting}}{\Sigma M_{overturnin\,g}}$$

	Calculated	Required
	FS = **6.72**	FS = 2.00

Resistance Against Overturning is **OK**

Material	Consistency	Soil Type	Undrained C (psf)	Undrained ϕ (deg)	Drained C' (psf)	Drained ϕ' (deg)	γ (pcf)
Material 1	Compacted	MSE Fill	0	34	0	34	120
Material 2	Compacted	Emb. Fill	0	30	0	30	120
Material 2A	Compacted	Gran. Fill	0	34	0	34	120
Material 3	M. Stiff	Clay	1700	0	0	29	125
Material 4	M. Stiff	Silt	1800	0	0	28	122
Material 5	V. Stiff	Silty Clay	3750	0	0	29	125
Material 6	M. Dense	Silt	0	28	0	28	122
Material 7	Dense	Sand & Grvl	0	36	0	36	125
Material 8		Bedrock	10000	45	10000	45	145



823 OVER PERSHING-SLOCUM
DRAINED & UNDRAINED ANALYSIS
BASED ON BORING TR-37 & TR-38

MSE WALL STABILITY ANALYSIS

SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: SJR	DATE 8/15/06

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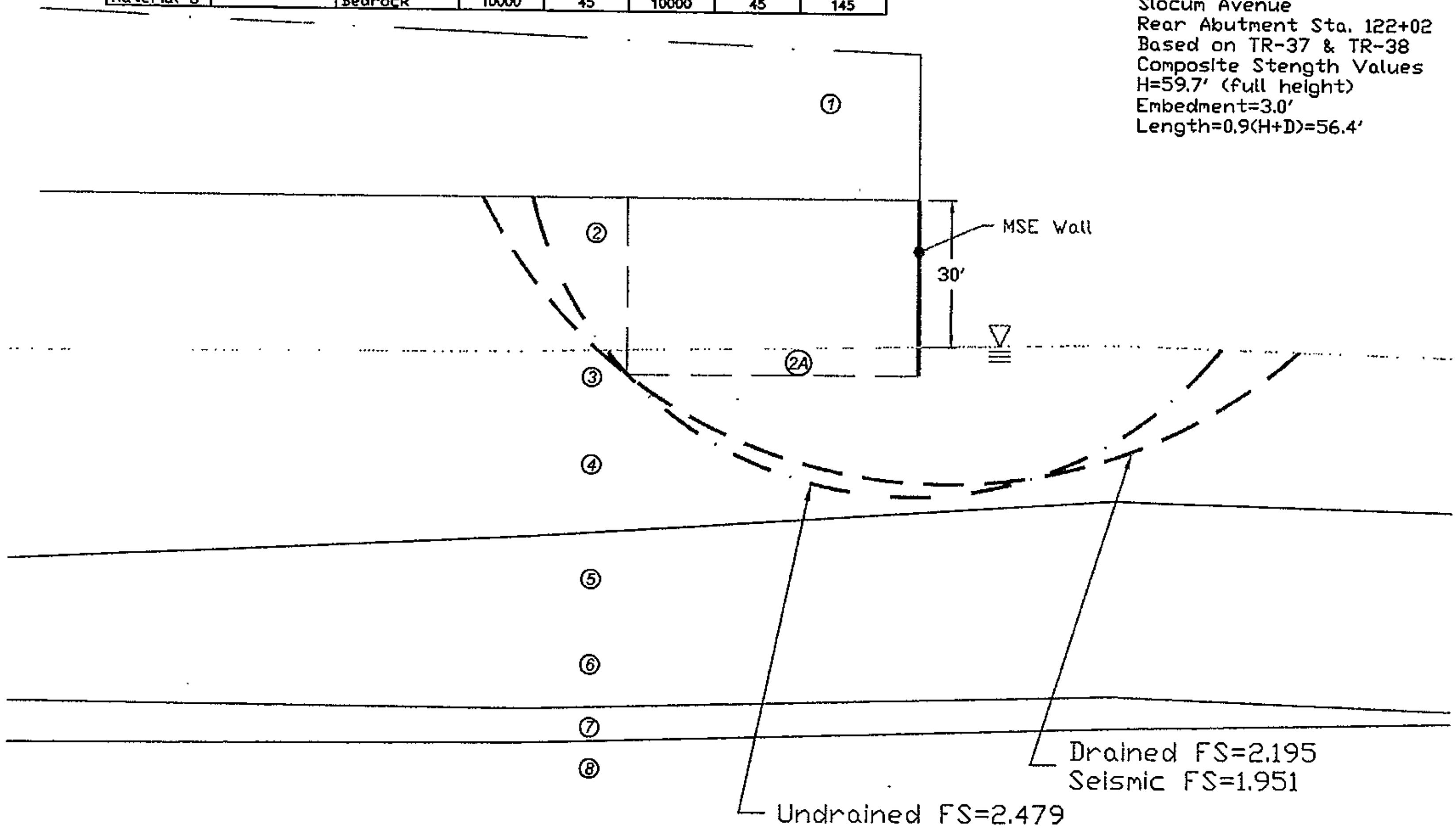
Material	Consistency	Soil Type	Undrained C (psf)	Undrained Φ (deg)	Drained C' (psf)	Drained Φ' (deg)	γ (pcf)
Material 1	Compacted	MSE Fill	0	34	0	34	120
Material 2	Compacted	Emb. Fill	0	30	0	30	120
Material 2A	Compacted	Gran. Fill	0	34	0	34	120
Material 3	M. Stiff	Clay	1700	0	0	29	125
Material 4	M. Stiff	Silt	1800	0	0	28	122
Material 5	V. Stiff	Silty Clay	3750	0	0	29	125
Material 6	M. Dense	Silt	0	28	0	28	122
Material 7	Dense	Sand & Grvl	0	36	0	36	125
Material 8		Bedrock	10000	45	10000	45	145

MSE Wall Stability
Slocum Avenue
Rear Abutment Sta. 122+02
Based on TR-37 & TR-38
Composite Stength Values
H=59.7' (full height)
Embedment=3.0'
Length=0.9(H+D)=56.4'



SLOCUM AVENUE (HIGHLAND BEND)
REAR ABUTMENT STA: 122+02

MSE WALL STABILITY ANALYSIS
STAGED CONSTRUCTION ANALYSIS
SCI-823-0. 00

PROJECT NO. 0121-3070. 03 | CALC: SJR | DATE 8-15-06

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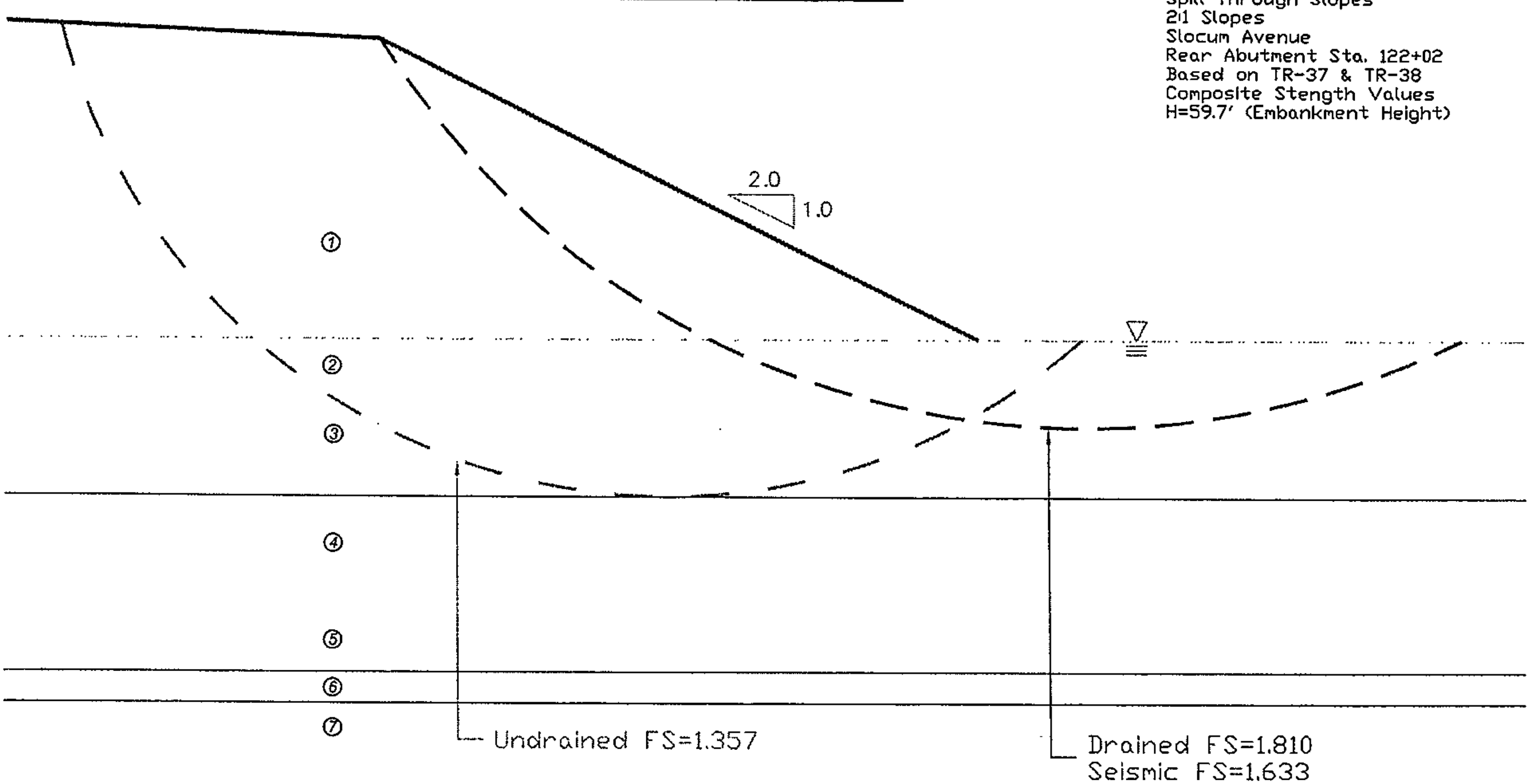
Material	Consistency	Soil Type	Undrained C (psf)	Undrained Φ (deg)	Drained C' (psf)	Drained Φ' (deg)	γ (pcf)
Material 1	Compacted	Emb. Fill	0	30	0	30	120
Material 2	M. Stiff	Clay	1700	0	0	29	125
Material 3	M. Stiff	Silt	1800	0	0	28	122
Material 4	V. Stiff	Silty Clay	3750	0	0	29	125
Material 5	M. Dense	Silt	0	28	0	28	122
Material 6	Dense	Sand & Grvl	0	36	0	36	125
Material 7		Bedrock	10000	45	10000	45	145

Spill Through Slopes
2:1 Slopes
Slocum Avenue
Rear Abutment Sta. 122+02
Based on TR-37 & TR-38
Composite Stength Values
H=59.7' (Embankment Height)



823 OVER PERSHING-SLOCUM
DRAINED & UNDRAINED ANALYSIS
BASED ON BORING TR-37 & TR-38

SPILL THROUGH SLOPE STABILITY ANALYSIS

SCI-823-0.00

PROJECT NO. 0121-3070.03	CALC: SJR	DATE 8/16/06

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CLIENT Tran Systems / ODOT D-9
PROJECT SCI-823 Portsmouth Bypass
SUBJECT Consolidation Parameters
MSE Wall - 823 over Pershing / Slocum

PROJECT NO. 0121-3070.03
SHEET NO. 1 OF 4
COMP. BY SJK DATE 8-16-0
CHECKED BY ______ DATE ______

C_c and C_r values were determined from Consolidation Test Results

The following borings had consolidation testing performed.
For tests see "Proposed Highland Bend Embankments", dated June 8, 2006.

Boring	Depth	Soil	C_c	C_r	P_c
R-61	6.0'	A-7-6	0.21	0.05	6,000 psf
TR-38A	15.7'	A-6b	0.18	0.04	9,000
TR-38A	45.8'	A-6a	0.19	0.07	3,000
TR-35A	12.4'	A-4b	0.10	0.01	4,000
TR-35A	27.0'	A-4b	0.27	0.08	3,000
TR-35A	66.9'	A-4b	0.10	0.01	2,000
R-64	18.0'	A-6a	0.24	0.04	6,000

* Layers at similar elevations and having similar Atterburg Limits were also assigned the same Consolidation parameters.

Layer	Thickness	Soil	C_c	C_r	P_c	e_o	γ
Layer 1	3.0'	Gran. Fill	0	0	0	—	120
Layer 2	7.0'	A-7-6	0.21	0.05	6,000	0.76	125
Layer 3	24.0'	A-4b	0.24	0.04	6,000	0.78	122
Layer 4	25.0'	A-6b	0.22	0.06	4,000	0.68	125
Layer 5	13.0'	A-4b	0.24	0.04	4,000	0.70	122
Layer 6	7.0	Sand & Gravel		0	0	—	125

SLOCUM MSE - Settlement Analysis

ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿

INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION

Project Name	: SCI-823	Client	: TranSystems
File Name	: Slocum MSE	Project Manager	: Nix
Date	: 8/15/10	Computed by	: SJR

Settlement for X-Direction

Embank. slope, x direc. =	150.00 (ft)	Height of fill H =	60.00 (ft)
y direc. =	150.00 (ft)	Unit weight of fill =	120.00 (pcf)
Embankment top width =	100.00 (ft)	p load/unit area =	7200.00 (psf)
Embankment bottom width =	400.00 (ft)	Foundation Elev. =	555.00 (ft)
Ground Surface Elev. =	555.00 (ft)		
Water table Elev. =	550.00 (ft)	Unit weight of Wat. =	62.40 (pcf)

N§.	LAYER TYPE	THICK. (ft)	COEFFICIENT COMP.	RECOMP.	SWELL.	UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO
1	INCOMP.	3.0	-----	-----	-----	120.00	----	----
2	COMP.	7.0	0.210	0.050	0.000	125.00	2.65	0.76
3	COMP.	24.0	0.240	0.040	0.000	122.00	2.65	0.78
4	COMP.	25.0	0.220	0.060	0.000	125.00	2.65	0.68
5	COMP.	13.0	0.240	0.040	0.000	122.00	2.65	0.70
6	INCOMP.	7.0	-----	-----	-----	125.00	----	----

N§.	SUBLAYER THICK. (ft)	ELEV. (ft)	SOIL STRESSES INITIAL (psf)	MAX.PAST PRESS. (psf)
1	INCOMP.			
2	7.00	548.50	703.90	6000.00
3	12.00	539.00	1280.60	6000.00
4	12.00	527.00	1995.80	6000.00
5	12.50	514.75	2744.65	4000.00
6	12.50	502.25	3527.15	4000.00
7	13.00	489.50	4305.80	4000.00
8	INCOMP.			

Layer	X = 0.00 Stress (psf)	Sett. (in.)	X = 25.00 Stress (psf)	Sett. (in.)	X = 50.00 Stress (psf)	Sett. (in.)	X = 75.00 Stress (psf)	Sett. (in.)
1	INCOMP.	INCOMP.	INCOMP.	INCOMP.				
2	27.75	0.04	637.86	0.67	1193.60	1.03	1826.39	1.33
3	112.04	0.12	617.29	0.55	1209.58	0.93	1810.41	1.24
4	206.28	0.14	649.90	0.40	1216.81	0.67	1804.73	0.91
5	295.87	0.24	701.54	0.53	1233.29	0.86	1800.41	1.97
6	381.91	0.24	760.98	0.89	1256.31	1.82	1794.98	2.73
7	463.65	1.68	821.69	2.38	1282.10	3.20	1787.47	4.03
8	INCOMP.	INCOMP.	INCOMP.	INCOMP.				
		------ 2.46		------ 5.41		------ 8.51		------ 12.19

X = 100.00 X = 125.00 X = 150.00 X = 175.00

SLOCUM MSE - Settlement Analysis

Layer	Stress (psf)	Sett. (in.)	Stress (psf)	Sett. (in.)	Stress (psf)	Sett. (in.)	Stress (psf)	Sett. (in.)
1	INCOMP.	INCOMP.	INCOMP.	INCOMP.				
2	2456.91	1.56	3007.45	1.72	3607.71	1.88	3634.17	1.88
3	2410.40	1.49	3000.22	1.70	3501.90	1.85	3600.27	1.88
4	2392.02	1.11	2956.98	1.28	3397.53	1.40	3550.38	1.44
5	2366.68	2.97	2895.73	3.81	3296.31	4.39	3477.22	4.64
6	2332.29	3.55	2823.16	4.24	3193.21	4.72	3385.81	4.96
7	2290.68	4.78	2743.97	5.42	3087.50	5.88	3281.40	6.12
8	INCOMP.	INCOMP.	INCOMP.	INCOMP.				
		------		------		------		------
		15.45		18.16		20.11		20.93

X = 200.00

Layer	Stress (psf)	Sett. (in.)
1	INCOMP.	
2	3634.75	1.88
3	3607.12	1.88
4	3573.68	1.44
5	3517.66	4.70
6	3438.20	5.02
7	3339.92	6.20
8	INCOMP.	

		21.13

ÄÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ

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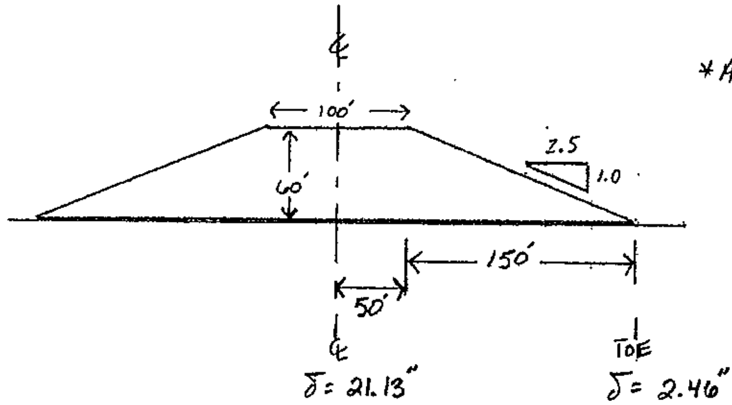
CLIENT	TranSystems / ODOT D-9	PROJECT NO.	0121-3070.03
PROJECT	SCI-823 Portsmouth Bypass	SHEET NO.	4 OF 4
SUBJECT	Differential Settlement	COMP. BY	SJR DATE 8-16-06
	MSE Wall - 823 over Pershing and Slocum	CHECKED BY	DA DATE 8-17-06

*Assuming 2.5:1.0 Embankment Slopes.



$$\text{Differential Settlement} = \frac{(21.13'' - 2.46'')(1'/12'')}{(150' + 50')} = 0.008 < \frac{1}{100}$$

$$= 0.8\% < 1.0\% \quad \checkmark \quad \boxed{OK}$$

CN-Patrick J. Plews

From: Steven Riedy [sriedy@dlzcorp.com]
Sent: Wednesday, August 23, 2006 7:39 AM
To: CN-Patrick J. Plews
Cc: Pete Nix
Subject: Strucural Foundation Review - SR 823 over Slocum Avenue

Patrick,
At the request of TranSystems we have reviewed the foundation recommendations for the structure at proposed SR 823 over Slocum Avenue. Based upon the current information, it is anticipated that HP 14x73, 95 ton driven piles will be founded on bedrock. It is my understanding that the original preliminary structural foundation recommendations have been modified as per conversations between DLZ and TranSystems. It appears that the concern was a clay layer first encountered at approximately elevation 520. It is possible that the piles may be founded in this clay layer. However, if this layer does not have sufficient strength, it is anticipated that the piles will likely be founded on bedrock. To better estimate the pile lengths, it is recommended that the contractor drive test piles at each structure location *prior to ordering piling for this project.* Estimated pile tip elevations are included below. All updated recommendations will be included in the final structural recommendations for this structure.

Boring Number	Structural Element	Existing Ground Surface Elev* (Feet)	Top of Rock Elev* (Feet)	Estimated HP 14x73, 95 ton pile Tip Elev* (Feet)
TR-36	North Abutment	552.6	480.6	481
TR-37	Pier	556.1	477.1	477
TR-38	South Abutment	554.0	474.0	480

** Elevations have been established based upon as-drilled survey information.*

Please feel free to contact me if you need any additional information.
Thanks,
Steven

Steven J. Riedy
Geotechnical Engineer

Telephone: (614) 888-0040
Cellular Phone: 614-332-9146
FAX: (614)848-6712
e-mail: sriedy@dlz.com

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6121 Huntley Road • Columbus, Ohio 43229-1003

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CN-Patrick J. Plews

From: Steven Riedy [sriedy@dlzcorp.com]
Sent: Friday, August 18, 2006 3:26 PM
To: CN-Patrick J. Plews
Subject: SCI-823 Slocum Spill Through Slopes

Patrick,
As per our earlier conversation; For the spill through slopes, the factor of safety of 1.3 for global stability is used when assuming deep foundations for the structures. Settlement was not evaluated specifically for the spill through slopes in the MSE wall letter. Settlement and consolidation periods were evaluated in our report *Proposed Highland Bend Embankments*, dated June 8, 2006. The settlement was evaluated for the roadway embankment from station 116+00 to 122+00. The maximum settlement for the full height embankment was estimated to be approximately 38 inches. The stability calculations indicate that the spill through slopes are stable in the undrained condition. However, due to more critical soil profiles, higher embankments, and given short length of this embankment (approx. 600 feet), the staged construction and consolidation estimates calculated for the roadway embankment should apply here. The estimated time of 90 percent consolidation for this embankment is approximately 3287 days without wick drains. Wick drain spacings and time-rate estimates are provided for each embankment in the highland bend area.
For more detailed information pertaining to the embankments, please refer to the above mentioned report.
Let me know if you need anything else.
Thanks,
Steven

--
Steven J. Riedy
Geotechnical Engineer

Telephone: (614) 888-0040
Cellular Phone: 614-332-9146
FAX: (614) 848-6712
e-mail: sriedy@dlz.com

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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 Slocum Ave. (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 Slocum Ave within the Highland Bend area. It is anticipated that the proposed structure will be a two-span, elevated bridge with embankment fills at both abutments. The existing grade at the proposed new bridge location is relatively flat with an elevation around 555. It is anticipated that the SCI-823-0.00 mainline will require an embankment constructed to approximate heights of 40 to 70 feet. The existing Highland Bend area is located within the Little Scioto River valley with the overburden being primarily composed of glacial and alluvial deposits.

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

Field Exploration

A total of three borings, TR-36 through TR-38, were drilled at the proposed structure between January 27, 2005 and February 10, 2005. The borings were drilled to depths between 94 and 100 feet. The borings were extended into bedrock, which was verified by rock coring. Boring Logs and information concerning the drilling procedures are attached.

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

Findings

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

At the ground surface, topsoil was encountered to depths of 3 to 4 inches. Beneath the topsoil, generally cohesive soils were encountered to the top of bedrock with intermittent layers of granular soil. The cohesive soils encountered ranged from sandy silt (A-4a) to silt and clay (A-6a), and were generally stiff to very stiff. The granular soils ranged from sandy silt (A-4a) to fine sand (A-3). The granular soils were generally very loose to medium dense. Boring TR-36 encountered thicker granular layers than TR-37 or TR-38.

Bedrock was encountered between 73 and 80 feet below the ground surface, which generally was a medium hard to hard sandstone that was slightly broken to intact. Borings TR-36 and TR-37 encountered a siltstone layer ranging in thickness from 1.5 to 1.7 feet within the sandstone. Recovery of the core samples ranged from 0 to 100%, and RQD values ranged from 0 to 99% with an average RQD of 74%.

Seepage was detected in all of the borings ranging in depth from 10 to 80 feet below the ground surface. Seepage was generally detected within granular layers. Water levels recorded at completion of drilling ranged from 3.0 to 12.0 feet. However, the final water levels include drilling water and may not be representative of the actual groundwater conditions. Groundwater levels may vary seasonally, and may be influenced by the level of the Little Scioto River.

Conclusions and Recommendations

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

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Boring Number	Structural Element	Existing Ground Surface Elevation* (Feet)	Top of Rock Elevation* (Feet)	Estimated H-pile Tip Elevation* (HP 14X73 95 Ton capacity)	Estimated Drilled Shaft Tip Elevation*	Allowable Bearing Capacity for Drilled Shafts (TSF)
TR-36	North Abutment	555	482	~~502~~ 482	476	20
TR-37	Pier	555	476	~~509~~ 476	472	20
TR-38	South Abutment	555	475	~~498~~ 475	472	20

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

† AS PER DISCUSSION WITH PAUL PAINTER ON 6/20/05 "NEED TO DRIVE TO BEDROCK".

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, and/or an additional load added to the design loads to account for negative skin friction associated with the embankment settlement.

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

Spread footings could be considered, but differential settlement concerns would need to be addressed. Recommendations can be presented if the spread footing option is considered. Pre-loading or other techniques may be necessary if footings are used.

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

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

Closing

If you have any questions or wish to schedule an opportunity to discuss the recommendations presented, please contact our office.

Sincerely,

DLZ OHIO, INC.

P. Paul Painter

P. Paul Painter
Engineering Geologist

Dorothy A. Adams for

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

Attachments: General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Boring Location Plan
Boring Logs TR-36, TR-37, TR-38

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.**

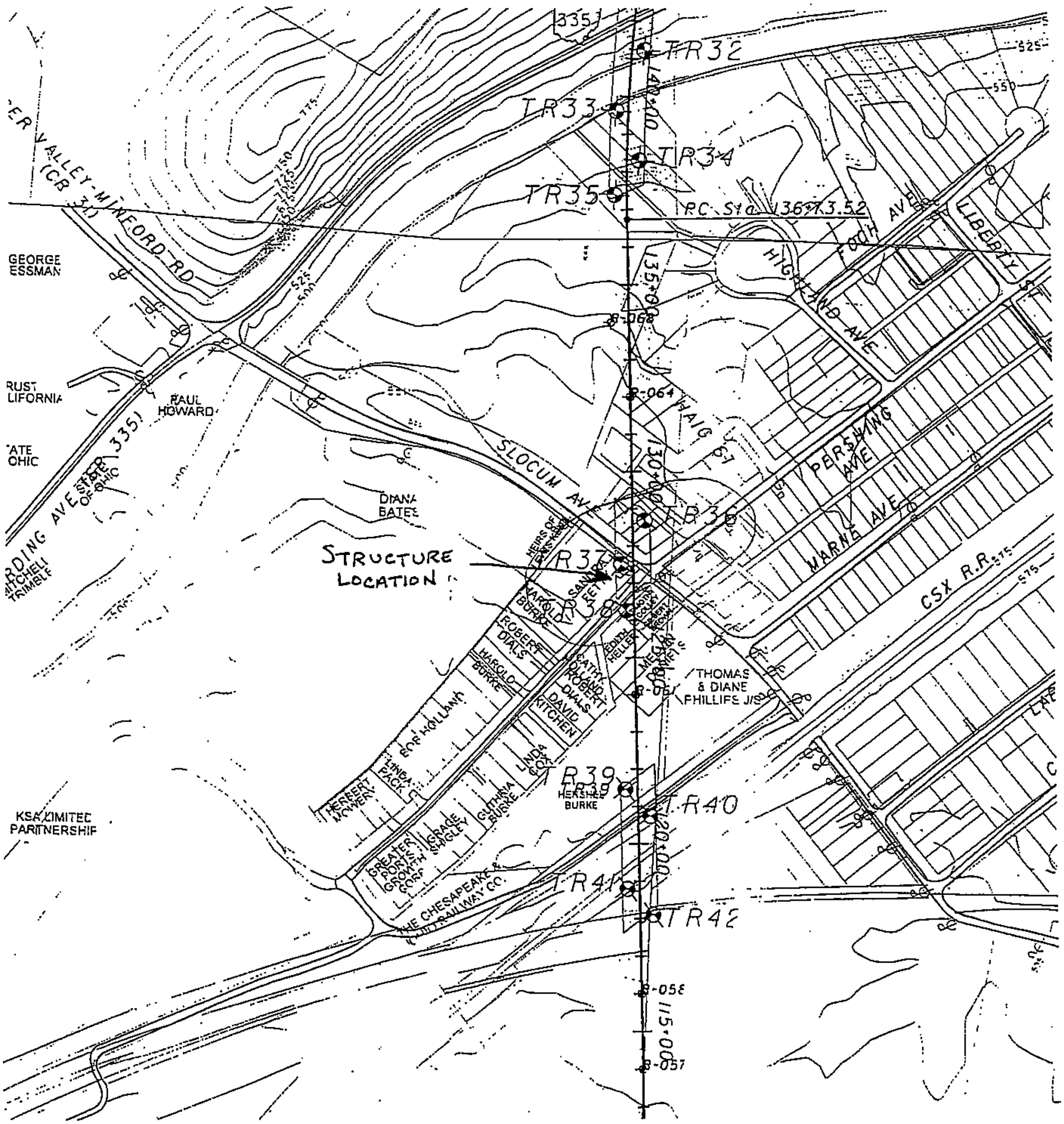
Term	Description
Very Soft	Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb)
Soft	Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed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

Slocum Avenue

SCI-823 over Slocum Ave.

SCI-823-0.00

FIGURE 1.

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

Job No. 0121-3070.03

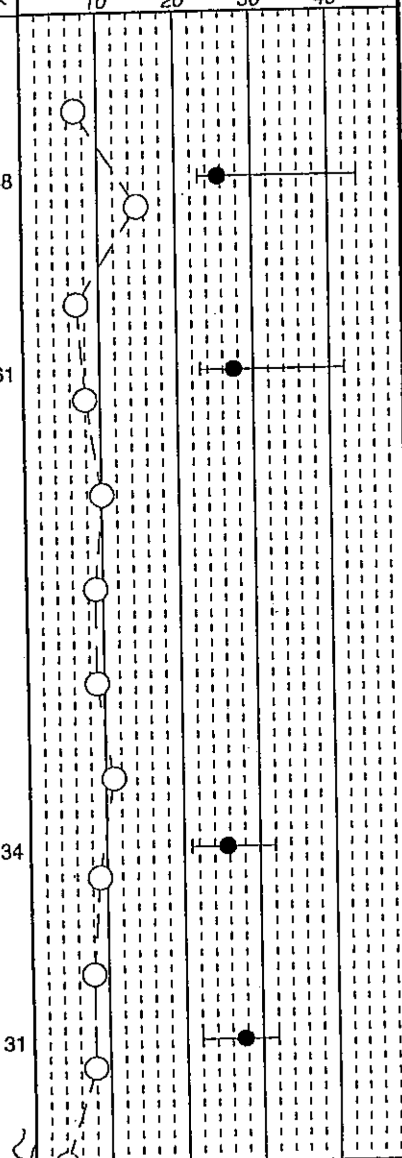
Client: TranSystems, Inc. | Project: SCI-823-0.00

LOG OF: Boring TR-36

Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetro-meter (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0.3	555.0 / 554.7						Topsoil - 4"						
		2 3 4	17	1		2.0	Very stiff brown and gray CLAY (A-7-6), trace fine sand; moist. @ 0.3'-1.8', contains root fragments.						
5		6 7 8	16	2		3.0		0	0	--	1	31	68
5.5	549.5	3 3 4	18	3		3.0	Very stiff brown CLAY (A-7-6), trace fine sand; varved; moist.						
		2 3 5	16	4		3.0		0	0	--	1	38	61
10		3 4 6	18	5		2.5							
		2 4 5	18	6		3.25							
15		3 4 5	18	7		3.0	@ 16.0', brown and brownish gray.						
		4 5 6	18	8		3.0							
20 / 20.5	534.5	3 4 5	18	9		3.25	Very stiff brown SILT (A-4b); varved; moist.		0	--	1	66	34
		3 4 4	18	10		3.0							
25		2 4 4	18	11		3.5		0	0	--	2	67	31
30		2 2 2	18	12		2.75	@ 28.0', gray, moist.						



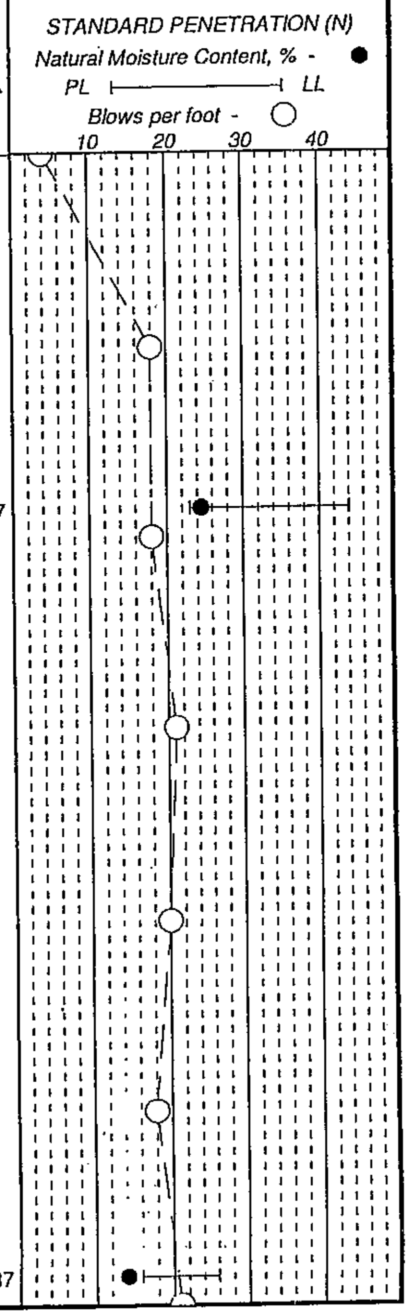
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-36 | Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
30	525.0						Loose brown SILT (A-4b), little fine to coarse sand; varved; damp to moist.						
32.0	523.0						Very stiff gray CLAY (A-7-6); varved; damp to moist.						
35		5 8 10	11	13		3.75							
40		7 8 10	18	14		3.75	@ 38.0', brownish gray.		0	--	0	33	67
45		4 9 12	18	15		4.0-4.5+	@ 42.0'-47.0', hard.						
50		7 10 10	18	16		2.75	@ 47.0', gray, damp to moist.						
55		5 9 9	18	17		3.0							
57.0	498.0						Hard gray SILT (A-4b); damp.						
60		5 10 11	18	18		4.5+		0	1	--	9	53	37



FILE: 0121-3070-03 [3/28/2005 9:06 AM]

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

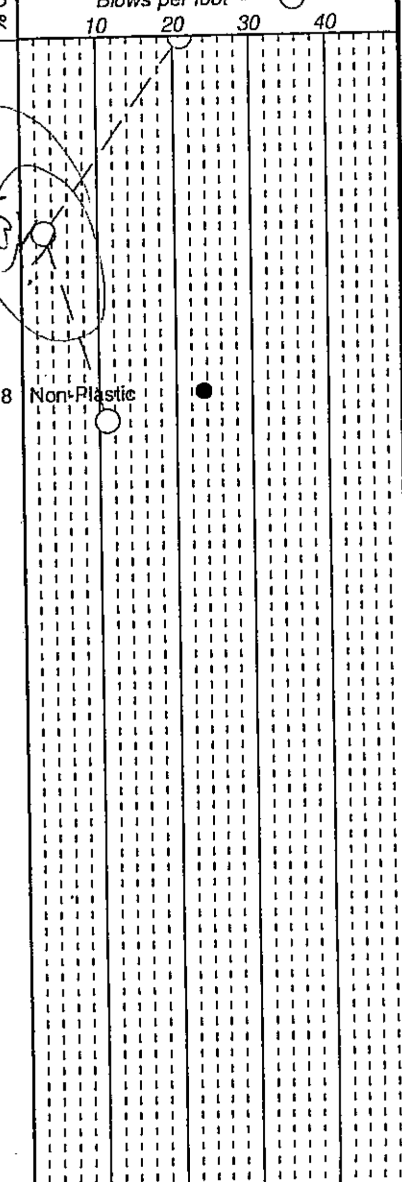
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-36 | Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
60	495.0						Hard gray SILT (A-4b); damp.						
62.0	493.0						Very loose gray SANDY SILT (A-4a); wet.						
		5 1 2	18	19									
65													
		0 4 7	18	20			@ 69.0', medium dense.	0	1	--	60	31	8
70													
73.0	482.0	50/1	1	21			Hard light gray SANDSTONE; very fine to fine grained, moderately weathered, argillaceous, thinly bedded to medium bedded, contains argillacous clasts.						
75							@ 74.4'-75.7', very broken.						
							@ 76.0',76.3', low angle fracture.						
							@ 77.6',77.7', low angle fracture.						
		Core 120"	Rec 116"	RQD 70%	R-1		@ 79.6', low angle fracture.						
80							@ 81.0'-81.4', high angle thin shale burrow.						
							@ 81.7',82.1', low angle fracture.						
83.4	471.6						Medium hard dark gray SILTSTONE; moderately weathered, thinly bedded, broken.						
84.9	470.1						Hard light gray SANDSTONE; very fine to fine grained, moderately weathered, argillaceous, thinly bedded to medium bedded, contains argillacous clasts.						
		Core 120"	Rec 119"	RQD 93%	R-2								
90													

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-36 | Location: Forward Abutment SCI-823.00 over Slocum Ave | Date Drilled: 01/31/05 to 02/01/05

WATER OBSERVATIONS: Water seepage at: 62'-73'
Water level at completion: 12.0' (Prior to coring)
12.0' (includes drilling water)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ⊢—⊣ LL Blows per foot - ○ 10 20 30 40
90	465.0						Hard light gray SANDSTONE; very fine to fine grained, moderately weathered, argillaceous, thinly bedded to medium bedded, contains argillacous clasts. @ 90.2'-90.5', limestone layer. @ 92.6'-97.1', calcareous.							
94.0	461.0						Bottom of Boring - 94.0'							
95														
100														
105														
110														
115														
120														

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

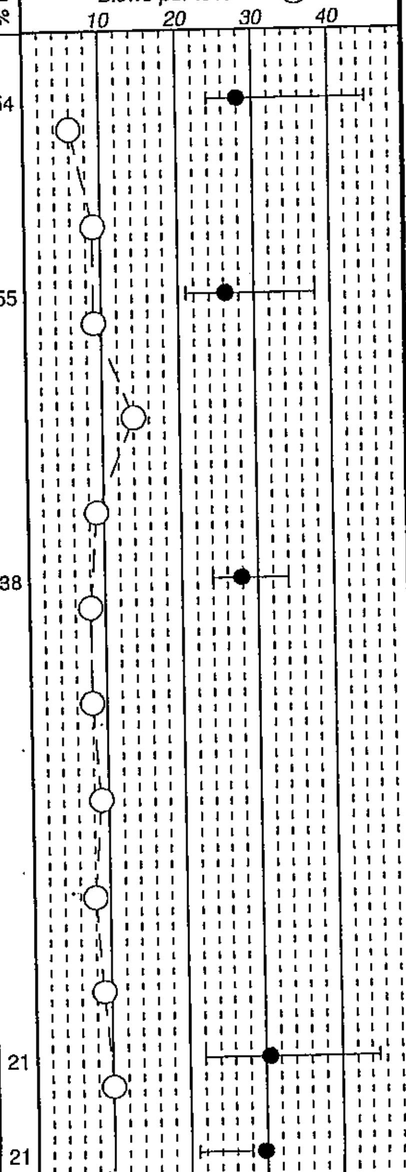
LOG OF: Boring TR-37

Location: Pier 1 SCI-823.00 over Slocum Ave | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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	555.0												
0.3	554.7						Topsoil - 3"						
		2 3 3	14	1		2.25	Very stiff brown CLAY (A-7-6); trace fine to coarse sand; moist.	0	1	--	4	41	54
		3 4 5	18	2		2.0	@ 3.0', brown and gray.						
5.5	549.5	3 4 5	18	3		1.5	Hard brown SILT CLAY (A-6b), trace fine to coarse sand; damp.	0	1	--	6	38	55
		3 6 8	17	4		4.5+	@ 8.0', hard; damp.						
10.5	544.5	3 4 5	10	5		2.25	Very stiff brown SILT (A-4b), little fine to coarse sand; varved; damp to moist.						
		2 3 5	18	6		3.0		0	0	--	1	61	38
		2 4 4	18	7		---	@ 16.0'-18.0', stiff, moist to wet.						
		3 4 5	18	8		2.0							
		2 3 5	18	9		2.25							
		2 4 5	18	10		2.0							
25.5	529.5	3 5 5	18	11		---	Stiff to very stiff brown CLAY (A-7-6); moist.	0	0	--	0	78	21
28.0	527.0	3 4 6	18	12			Medium dense brown SILT (A-4b); moist.	0	0	--	2	77	21
30													

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



FILE: 0121-3070-03 | 3/28/2005 9:06 AM

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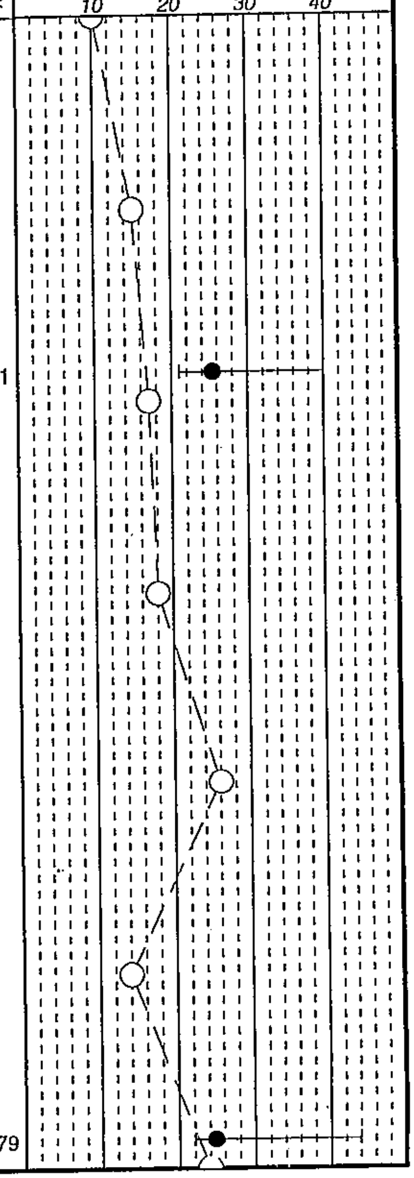
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-37 | Location: Pier 1 SCI-823.00 over Slocum Ave | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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	525.0						Medium dense brown SILT (A-4b); moist.						
32.0	523.0						Hard brownish gray SILTY CLAY (A-6b), trace fine sand; moist.						
		4 6 9	18	13		4.5+							
35													
		6 8 9	18	14		4.25		0	0	--	1	38	61
40													
		4 7 11	18	15		4.25							
45													
		8 13 13	18	16		4.5+							
50													
		4 7 7	18	17		4.0							
55													
57.0	498.0						Hard gray CLAY (A-7-6); damp to moist.						
		8 12 12	18	18		4.5+		0	0	--	0	21	79
60													



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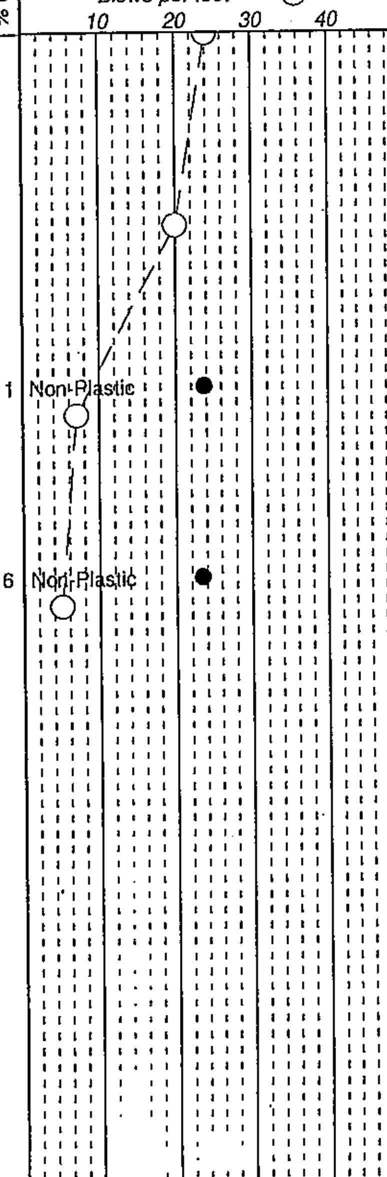
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-37 | Location: Pier 1 SCI-823.00 over Slocum Ave | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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	495.0						Hard gray CLAY (A-7-6); damp to moist.						
62.0	493.0						Medium dense light gray SILT (A-4b); contains organic material; damp.						
63.5–65		7 10 10	18	19									
68.5–70		3 3 4	18	20			@ 68.0', loose, wet.	1	2	--	30	57	11
72.0	483.0						Loose gray GRAVEL WITH SAND AND SILT (A-2-4); wet.						
73.5–75		0 1 4	18	21				17	3	--	53	21	6
78.6	476.4	50/2	1	22			Hard gray SANDSTONE; very fine to fine grained, moderately weathered, argillaceous, thinly bedded to medium bedded, contains argillacous clasts. @ 79.0'-80.2', broken. @ 80.8', low angle fracture. @ 86.0', low angle fracture.						
78.8–88.8		Core 120"	Rec 117"	RQD 74%	R-1								
87.5	467.5						Medium hard dark gray SILTSTONE; moderately weathered, thinly bedded, broken.						
89.2	465.8						Hard gray SANDSTONE; very fine to fine grained, moderately						
90													

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



FILE: 0121-3070-03 [3/28/2005 9:06 AM]

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

LOG OF: Boring TR-37 | Location: Pier 1 SCI-823.00 over Slocum Ave | Date Drilled: 01/27/05 to 01/31/05

WATER OBSERVATIONS: Water seepage at: 16.0'-18.0', 37'-37.5', 68'
Water level at completion: Not Recorded

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	465.0	Core 120"	Rec 119"	RQD 99%	R-2		weathered, argillaceous, thinly bedded to medium bedded, contains argillacous clasts. @ 91.9'-92.0', calcareous. @ 94.4'-94.7', calcareous. @ 96.9'-97.4', limestone layer.							
99.0	456.0						Bottom of Boring - 99.0'							

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

Depth scale: 90, 95, 100, 105, 110, 115, 120

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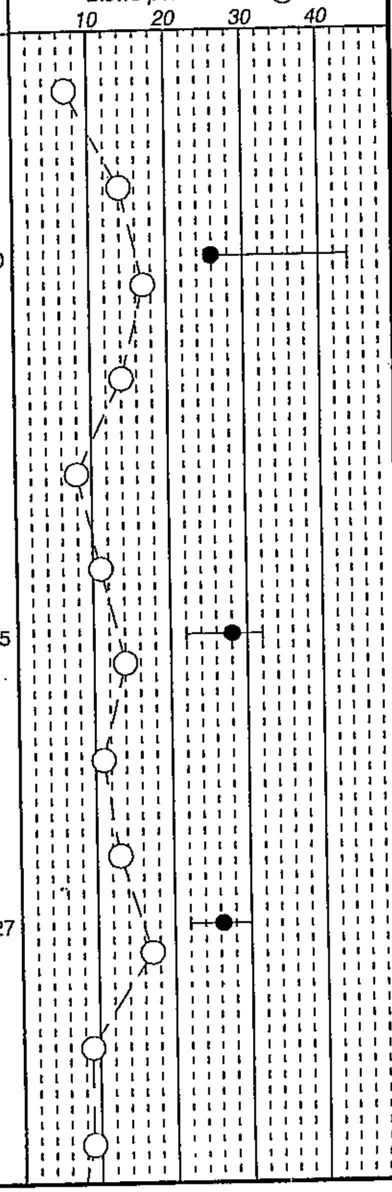
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-38 | Location: Rear Abutment SCI-823.00 over Slocum Ave | Date Drilled: 02/09/05 to 02/10/05

WATER OBSERVATIONS: Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' *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
	555.0												
0.3	554.7	WOH 3 4	18	1		2.5	Topsoil - 4" Very stiff CLAY (A-7-6), brown , trace fine sand; damp.						
		3 5 9	18	2		3.25							
5		4 6 11	18	3		3.5		0	0	--	1	29	70
		4 6 8	18	4		2.0							
10.0	545.0	2 3 5	18	5		1.5	Stiff brown SILT (A-4b), little clay, trace fine to coarse sand; moist.						
		3 5 6	18	6		1.5							
15		3 5 9	18	7		1.25		0	1	--	2	63	35
		2 5 6	18	8		1.25							
20		3 5 8	18	9		1.5							
		4 8 9	16	10		1.5		0	0	--	1	72	27
25.0	530.0	2 4 5	18	11		1.5	Stiff brown SILT AND CLAY (A-6a); little fine sand; contains silt laminae; moist.						
		3 4 5	18	12		1.0							
30													

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



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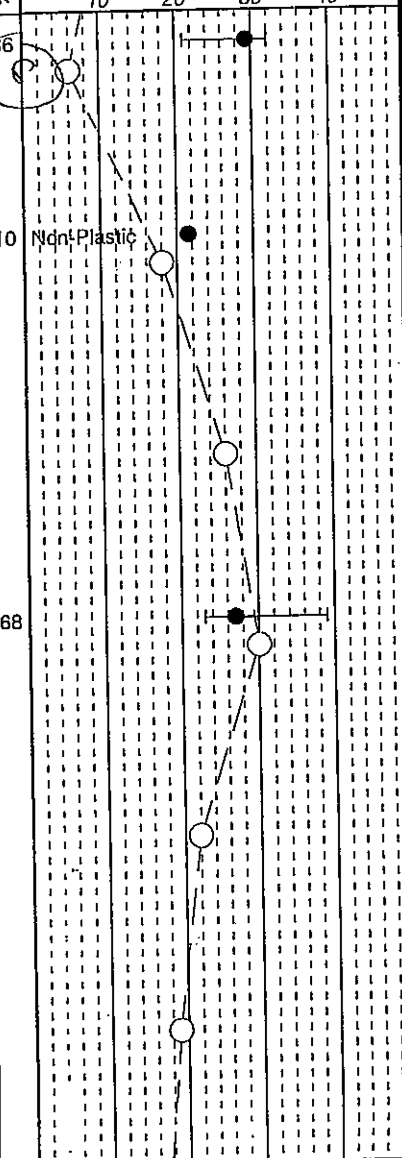
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-38 | Location: Rear Abutment SCI-823.00 over Slocum Ave | Date Drilled: 02/09/05 to 02/10/05

WATER OBSERVATIONS: Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' *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
30	525.0	3 2 4	16	13		1.0	Stiff brown SILT AND CLAY (A-6a), little fine sand; moist.	0	0	--	5	59	36
33.0	522.0						Medium dense gray GRAVEL WITH SAND AND SILT (A-2-4); moist.						
35		4 7 11	18	14				0	21	--	50	20	10
38.0	517.0						Very stiff gray SILTY CLAY (A-6b), little fine sand; damp to moist.						
40		7 12 14	18	15		3.5							
45		10 13 17	18	16		3.0		0	0	--	1	32	68
50		5 9 13	18	17		4.0							
55.0	500.0	7 9 10	18	18		3.5	Very stiff gray SILT (A-4b), little fine sand, little silty clay; moist.						
60													



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

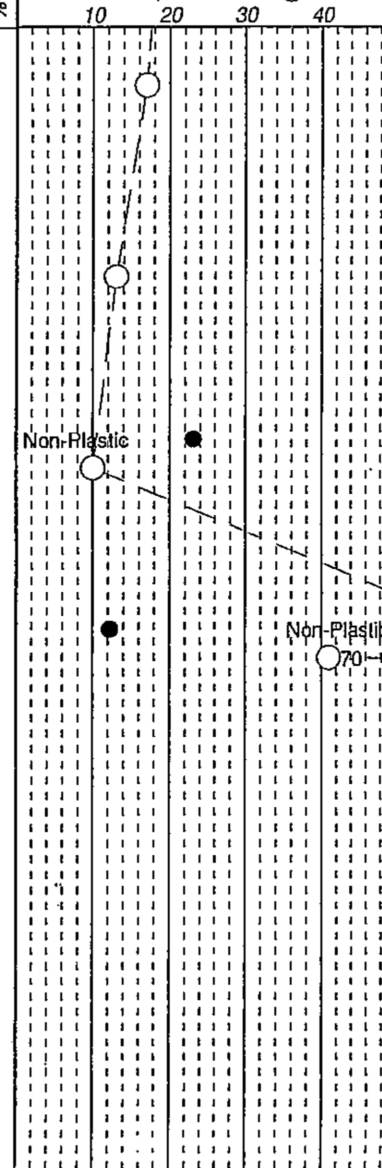
Client: TranSystems, Inc. | **Project:** SCI-823-0.00 | **Job No.** 0121-3070.03

LOG OF: Boring TR-38 | **Location:** Rear Abutment SCI-823.00 over Slocum Ave | **Date Drilled:** 02/09/05 to 02/10/05

WATER OBSERVATIONS:
Water seepage at: 10.0'-21.5' 33.0'-38.5', 65.0'-80.0'
Water level at completion: 9.8' (Prior to coring)
7.3' *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
60.0	495.0	4 8 9	18	19		2.5	Medium dense gray COARSE AND FINE SAND (A-3a), some silt, little clay; moist.						
65		6 6 7	18	20			@ 65.0', wet.						
68.0	487.0						Loose gray SANDY SILT (A-4a); wet.						
70		WOH 5 5	15	21				0	1	--	54	45	
73.0	482.0						Very dense gray GRAVEL WITH SAND (A-1-b); wet.						
75		9 20 50/3	13	22				50	19	--	12	20	
80.0	475.0	Core 60"	Rec 60"	RQD 90%	R-1		Medium hard to hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, arenaceous, thinly bedded to thickly bedded.						
85		Core 60"	Rec 60"	RQD 80%	R-2		@ 80.0'-80.2',84.0'-84.2', broken zones. @ 85.9',86.2',86.7', low angle clay filled fractures.						
90													

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



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