SCI-823-0.00

PID No. 19415

S.R. 823 over Portsmouth-Minford Road (S.R. 139)

Structure Type Study Submittal

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

July 15, 2005

Prepared by:

TranSystems Corporation

TABLE OF CONTENTS

Table of Contents — *Page No.*

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 existing Portsmouth-Minford Road (SR 139). As requested by the Scope of Services, a Bridge Type Study report is to be submitted before any plan development. The purpose of this report is to investigate various span arrangements and superstructure and substructure types in order to determine the most appropriate and economical structure type that will meet the project requirements.

2. Design Criteria

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

3. Subsurface Conditions and Foundation Recommendation

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

In summary, five (5) test borings (TR-15, TR-16, TR-17, TR-18 and TR-19) were drilled which all encountered sandstone bedrock between approximately 7 and 9 feet below the existing ground surface. Additionally, generally cohesive soils were encountered below the 0"-12" topsoil layer, to the top of bedrock. The cohesive soils ranged from loose to very dense silt (A-4b) to clay (A-6a), and were generally soft to very stiff.

Based on the alternatives considered for this study, two foundation types were considered applicable for substructure elements, one type for the abutments and one type for the piers:

Two different foundation types are utilized for this structure. Per phone discussion with DLZ Ohio, Inc. on 7/06/05, an addendum will be submitted during the TS&L stage stating that substructures located in areas of new embankment construction should be founded on H-piles. Thus, for the abutments which are founded on fill, HP14x73 piles with a maximum design load of 95 tons should be used.

For each alternative, the depth from the proposed abutment foundation to the top of rock is from 41' to 48', a majority of which is embankment fill. Subsequently, it is recommended that the piles not be driven until the majority of primary consolidation settlement of both the in-situ soil, which may be compressible, and the embankment fill has occurred. This will avoid having high down-drag forces that could significantly reduce the load-carrying capacity of the piles. Additionally the piles could be sleeved to prevent any possible down-drag forces. Finally, since the piles will be driven to refusal onto hard bedrock, the feasibility of using steel points will be investigated as required by Section 202.2.3.2.a of the ODOT Bridge Design Manual.

For the piers, which will be founded below existing grade, spread footings will be utilized as recommended in the Foundation Report. As stated above, the bedrock is relatively shallow, thus the piers will not require deep foundations to reach the allowable bearing pressure of 15 tons per square foot.

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 structure and similar and will consist of two 12'-0" travel lanes with 6'-0" median shoulders and 12'-0" outside shoulders. Including a 1'-6" inside median parapet and a 1'-6" outside straight face deflector parapet yields a structure deck width of 45'-0" out to out.

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

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

In accordance with the ODOT L&D manual, Volume 1, for the twin structures at Portsmouth-Minford Road, a 10'-0" horizontal offset from edge of pavement will be maintained below the proposed SR 823.

The existing Portsmouth-Minford Road will remain on its current horizontal and vertical alignment. The cross section will remain unchanged.

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

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

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

5. Proposed Structure Configurations

Alignment & Profile: The proposed horizontal geometry is along a curved alignment across the entire length of both the left and right structures. The proposed mainline profile grade line is located on the inside edge of pavement for both bridges and is along a constant sloping grade of -1.34%. The horizontal and vertical geometry for all alternatives considered are the same. Embankment slopes will be a maximum of 2:1 in order to minimize right-of-way impacts.

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

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

STRUCTURE TYPE ALTERNATIVE TABLE			
Structure Type Alternative	**1**	**2**	**3**
Superstructure Type Description	Dog-legged, 84"web, continuous steel plate girders A709 Grade 50W	Prestressed Concrete Girders 54" AASHTO Type 4 beams	Dog-legged, W36 rolled steel beams A709 Grade 50W
Proposed Beam Spacing	4 Spaces @ 9'-9"	4 Spaces @ 9'-9"	4 Spaces @ 9'-9"
No. of Spans	2	4	4
Abutment Type	Stub Type abutments with 2:1 spill-through slopes (Semi Integral Type)	Stub Type abutments with 2:1 spill-through slopes (Semi Integral Type)	Stub Type abutments with 2:1 spill-through slopes (Semi Integral Type)
No. of Piers	1	3	3
Pier Type	T-Type Pier	T-Type Piers	T-Type Piers
Substructure Orientation	19°00'00"	19°00'00"	19°00'00"
Approximate Bridge Length	340'	340'	340'
<u>Approximate Structure Depth</u>			
Slab	8.75"	8.5"	8.75"
Haunch	2"	2"	2"
Beam	88.0"	54"	36"
Total	98.75" (8.229')	64.5" (5.375')	46.75" (3.896')

TranSystems Corporation

Alternatives Discussion:

As stated above, various span configurations were investigated and were refined to the layouts discussed below. The location of the Long Run creek and Portsmouth-Minford Road dictated that either a 2-span or 4-span bridge would be most economical, with horizontal clearances to the roadway and Long Run affecting the locations of the piers and abutments. The proposed vertical profile was not a determining factor in comparing the alternatives, as all they all utilize the same embankment fills and abutments. The different alternatives discussed below modify the location and the number of piers, as well as the type of superstructure.

Alternative 1

Span configuration: This alternative is comprised of a 2-span structure with span lengths of 170'-0" and 170'-0", for an overall bridge length of 340'-0" from centerline bearings at abutments, for both the left and right structures. The abutments and pier are oriented with a 19°00'00" skew with respect to the chord from intersection of centerline of construction and abutment bearing centerlines. Embankment slopes of 2:1 are used for both abutments.

Substructure:

I. *Abutments:* Both the forward and rear abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal. The details of the abutments will follow ODOT Standard Construction drawings.

II. *Pier:* The single pier will consist of a T-type pier supported on a single spread footing founded on bedrock, with a design capacity of 15 tsf.

Superstructure: The preliminary design of this alternative indicates that 5 - 88" deep Grade 50W plate girders, spaced at 9'-9" with 3'-0" minimum and 4'-0" maximum overhangs, would be required to accommodate the HS25 design loading. The girders will be dog-legged to accommodate the large radius curve, and will maintain the overhang requirement of 4'-0" maximum. Both the left and right bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0".

Alternative 2

Span configuration: This alternative is comprised of a 4-span structure with span lengths of 70'-0", 100'-0", 100'-0" and 70'-0", for an overall bridge length of 340'-0" from centerline bearings at abutments, for both the left and right structures. The abutments and piers are oriented with a 19°00'00" skew with respect to the chord from intersection of centerline of construction and abutment bearing centerlines. Embankment slopes of 2:1 are used for both abutments.

Substructure:

I. *Abutments:* Both the forward and rear abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal. The details of the abutments will follow ODOT Standard Construction drawings.

II. *Piers:* The three piers will consist of a T-type piers, each supported on a single spread footing founded on bedrock, with a design capacity of 15 tsf.

Superstructure: The preliminary design of this alternative indicates that 5-AASHTO Type 4 prestressed beams, spaced at 9'-9" with 3'-0" minimum and 4'-0" maximum overhangs, would be required to accommodate the HS25 design loading. The structures will be simple span for non-composite dead loads and continuous for superimposed and live loads. Both the left and right bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0".

Alternative 3

Span configuration: This alternative is similar to Alternative 2, and is comprised of a 4-span structure with span lengths of 70'-0", 100'-0", 100'-0" and 70'-0", for an overall bridge length of 340'-0" from centerline bearings at abutments, for both the left and right structures. The abutments and piers are oriented with a 19°00'00" skew with respect to the chord from intersection of centerline of construction and abutment bearing centerlines. Embankment slopes of 2:1 are used for both abutments.

Substructure:

I. *Abutments:* Both the forward and rear abutments will be semi-integral type supported on H-piles as they are located in new embankment fill. The piles shall be HP14x73 with a design capacity of 95-tons per pile, driven to refusal. The details of the abutments will follow ODOT Standard Construction drawings.

II. *Piers:* The three piers will consist of a T-type piers, each supported on a single spread footing founded on bedrock, with a design capacity of 15 tsf.

Superstructure: The preliminary design of this alternative indicates that a 5-W36 Grade 50W rolled beams, spaced at 9'-9" with 3'-0" minimum and 4'-0" maximum overhangs, would be required to accommodate the HS25 design loading. The girders will be dog-legged to accommodate the large radius curve, and will maintain the overhang requirement of 4'-0" maximum. Both the left and right bridge width will be 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0".

6. Preliminary Probable Bridge Construction Cost:

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

7. Summary:

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

SUMMARY OF ALTERNATIVES AND RECOMMENDATIONS

STRUCTURE TYPE ALTERNATIVE	STRUCTURE TYPE	PROBABLE BRIDGE CONSTRUCTION COST	RATING	ADVANTAGES/ DISADVANTAGES
1	2-span continuous dog-legged plate girders, A709 Grade 50W with a composite reinforced concrete deck slab, supported by semi-integral abutments on HP piles with 2:1 slopes, and a T-Type pier on a spread foundation	**Structure Cost:** **$4,288,000** **Additional Life Cycle Cost:** **$1,413,000** **Total Relative Ownership Cost:** **$5,701,000**	3	***Advantages:*** • Long span bridge provides more open line of sight for roadway underneath • Most aesthetically pleasing • Weathering steel provides for lower life cycle cost and ease of maintenance for high structure ***Disadvantages:*** • Most expensive alternative • Long plate girder lengths may have trouble with transportation and construction • Construction lead time for deep plate girders may cause delays • Heavy girder erection may be an issue
2	4-span continuous for live load 54" AASHTO Type 4 Prestressed Concrete Beams with a composite reinforced concrete deck slab, supported by semi-integral abutments on HP piles with 2:1 slopes, and T-Type piers on spread foundations	**Structure Cost:** **$3,931,000** **Additional Life Cycle Cost:** **$1,497,000** **Total Relative Ownership Cost:** **$5,428,000**	2	***Advantages:*** • In general, prestressed beams require less life cycle maintenance costs ***Disadvantages:*** • Construction lead time for Prestressed beams may cause construction delays
3	4-span continuous dog-legged W36 Grade 50W beams with a composite reinforced concrete deck slab, supported by semi-integral abutments on HP piles with 2:1 slopes, and T-Type piers on spread foundations	**Structure Cost:** **$3,743,000** **Additional Life Cycle Cost:** **$1,413,000** **Total Relative Ownership Cost:** **$5,156,000**	1	***Advantages:*** • Weathering steel provides for lower life cycle cost and ease of maintenance for high structure ***Disadvantages:*** • Painting of structural steel could be a problem for high bridge if weathering steel not utilized

8. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 3,** which consists of 4-span W36 A709 Grade 50W weathering steel beams with semi-integral abutments, 2:1 slopes and T-Type piers, for both the left and right structures. (See Appendix B for the Site Plan and Structure Details).

Our recommendation for Alternative 3 is based on the following items:

- This Alternative appears to be the most economical when utilizing weathering steel and considering life cycle costs
- Due to the height of the structure, erection of shorter span steel beams appears to be less difficult than concrete or long span steel girders
- If prestressed beams were used, future sealing requirements would be difficult with the relatively high piers

APPENDIX A

TRANSYSTEMS CORPORATION

SCI-823-0.00

SR 823 Over Portsmouth-Minford Rd

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\11-SR139(PrtsmthMinford)\Estimates\[Portsmouth-Minford Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/25/2005
Checked: ELK Date: 6/30/2005

COST COMPARISON SUMMARY

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Total Initial Superstructure Cost	Total Initial Construction Cost
1	4	170.00	170.00	0.00	0.00	340.00	5 ~ Steel Plate Girders	84" Web - Grade 50W	$2,570,000	$4,288,000
2	4	70.00	100.00	100.00	70.00	340.00	5 ~ P.S. Concrete I-Beams	AASHTO Type 4	$1,906,000	$3,931,000
3	4	70.00	100.00	100.00	70.00	340.00	5 ~ Rolled Beams	W36 Grade 50W	$1,798,000	$3,743,000

SCI-823-0.00

SR 823 Over Portsmouth-Minford Rd

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\11-SR139(PrtsmthMinford)\Estimates\[Portsmouth-Minford Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/25/2005
Checked: ELK Date: 6/30/2005

ALTERNATIVE COST SUMMARY

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Subtotal Superstructure Cost	Subtotal Substructure Cost	Approach Roadway Length (1)	Approach Roadway Cost (2, 3)	Structure Incidental Cost (16%)	Structure Contingency Cost (20%)	Total Initial Construction Cost
1	2	170.00	170.00	0.00	0.00	340.00	5 ~ Steel Plate Girders	84" Web - Grade 50W	$2,570,000	$510,000	0.0	$0	$493,000	$715,000	$4,288,000
2	4	70.00	100.00	100.00	70.00	340.00	5 ~ P.S. Concrete I-Beams	AASHTO Type 4	$1,906,000	$918,000	0.0	$0	$452,000	$655,000	$3,931,000
3	4	70.00	100.00	100.00	70.00	340.00	5 ~ Rolled Beams	W36 Grade 50W	$1,798,000	$891,000	0.0	$0	$430,000	$624,000	$3,743,000

NOTES:

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

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

   Pavement Widths:

Alternative	Left Bridge Rear Appr.	Left Bridge Fwd Appr.	Right Bridge Rear Appr.	Right Bridge Fwd Appr.	Average Rear Approach	Average Fwd. Approach	Combined Average
Alt. 1	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.
Alt. 2	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.
Alt. 3	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.	45.00 ft.

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

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

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

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

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

SCI-823-0.00
SR 823 Over Portsmouth-Minford Rd
STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\11-SR139(PrtsmthMinford)\Estimates\[Portsmouth-Minford Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/27/2005
Checked: ELK Date: 6/30/2005

SUPERSTRUCTURE

Alternative No.	No. Spans	Span 1	Span 2	Span 3	Span 4	Total Span Length (ft.)	Deck Length (ft.)	Deck Area (sq. ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Stringer Section	Structural Steel Weight (pounds)	Structural Steel Cost	Prestressed Girder Cost	Initial Superstructure Cost
1	2	170.00	170.00	0.00	0.00	340.00	684.00	30,800	1,130	$668,000	$283,500	$82,500	5 ~ Steel Plate Girders	84" Web - Grade 50W	1274378.4	$1,535,500	$0	$2,570,000
2	4	70.00	100.00	100.00	70.00	340.00	684.00	30,800	1,104	$652,500	$276,900	$82,500	5 ~ P.S. Concrete I-Beams	AASHTO Type 4	0.0	$0	$894,500	$1,906,000
3	4	70.00	100.00	100.00	70.00	340.00	684.00	30,800	1,130	$668,000	$283,500	$82,500	5 ~ Rolled Beams	W36 Grade 50W	899640.0	$763,900	$0	$1,798,000

(Span 1–Span 4 under heading "Span Arrangement")

Deck Cross-Sectional Area:

Parapets:

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

Slab:

	T (ft.)	Ave. W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Alt. 1	0.73	45.00	32.8	3.3	44.6
Alt. 2	0.71	45.00	31.9	3.2	43.6
Alt. 3	0.73	45.00	32.8	3.3	44.6

Number of structures = 2

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

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

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$591.00

Based on parapet and slab percentages of total concrete area

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

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

Prestressed Concrete Girders
Unit Costs:

	Year 2004		Annual Escalation	Year 2008		No. Required
Alt. 2						
AASHTO Type IV						
Type 4 I-Beams	$16,000	ea.	3.5%	$18,360	ea.	40
Pier Diaphragms	$1,800	ea.	3.5%	$2,070	ea.	24
Abutment Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	16
Intermediate Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	64

Structural Steel
Unit Costs ($/lb.):

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

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

	Year 2008		Quantity Per Beam		No. Required	Total	
Alt. 1							
Plate Girder							
84" Web - Plate Girder - Grade 50	$1.20	/lb	117,998	lb/e	10	1,179,980	
Crossframes (10% of beam weight	$1.20	/lb	11,800	lb/e	8	94,398	
Total			129,798	lb/ea		1,274,378	
Alt. 3							
W36x245							
Rolled Beam - Grade 50	$0.85	/lb	83,300	lb/e	10	833,000	lbs
Crossframes (10% of beam weight	$0.85	/lb	8,330	lb/e	8	66,640	lbs
Total			91,630	lb/ea		899,640	lbs

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft. Average Width = 45.00 ft
Area = 125 sq. yd.

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

SCI-823-0.00

SR 823 Over Portsmouth-Minford Rd

STRUCTURE TYPE STUDY - Alternate 1 - Substructure Quantity Calculations

By: JDH
Checked: ELK

Date: 6/27/2005
Date: 6/30/2005

Pier Quantities (T-Type Pier Cap on Spread Foundation)

Pier Location	Length	Pier Cap				Single Rectangular Column					Footing						Total Volume
		Width	Depth	Area	Volume	Width	Height	Depth	Column	Volume	Width	Height	Area	Depth	# Footing	Volume	
Pier 1 Left	45.5	4	8	303	1213	15.17	40.83	3	1	1858	30.33	4	121.3	13	1	1577	4648
Pier 1 Right	45.5	4	8	303	1213	15.17	40.83	3	1	1858	30.33	4	121.3	13	1	1577	4648
Total (Cu.Ft.)					2427					3716						3155	9297
Total (Cu.Yd.)					90					138						117	344

Semi-Integral Abutment Quantities

Abut Location	Length	Backwall				Beam Seat				Footing					Total Volume
		Width	Depth	Area	Volume	Width	Height	Area	Volume	Width	Depth	Area	# Footing	Volume	
Rear Abutment															
Left	47.6	3	6.17	18.51	881	3	3	9.00	428	6	3	18	1	857	2166
Right	47.6	3	6.17	18.51	881	3	3	9.00	428	6	3	18	1	857	2166
Total															*4333*
Fwd Abutment															
Left	47.6	3	6.17	18.51	881	3	3	9.00	428	6	3	18	1	857	2166
Right	47.6	3	6.17	18.51	881	3	3	9.00	428	6	3	18	1	857	2166
Total															*4333*
Total (Cu.Ft.)					3524				1714					3427	8665
Total (Cu.Yd.)					131				63					127	321

MSE Abutment Wall Quantities

Abutment Location	Wall			
	Height	Return	Length	Area
Rear Abutment				
Left	0	0	48	0
Right	0	0	48	0
Fwd Abutment				
Left	0	0	48	0
Right	0	0	48	0
Total (Sq.Ft.)				0

HP 14x73 Pile Quantities/Per Bridge

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles (Spacing)	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut	113	93	206	5	1030	325	190	7	14	1	*14*	674.3	630	46.0	*644*
Pier 1	410	199	609	5	3045	697	Spread footings at Piers								
Fwd. Abut	113	93	206	5	1030	325	190	7	14	1	*14*	669.9	625	47.0	*658*
TotaL	636	385	1021	15	5105	1347		14			28				1302

piles per row at abutments = 2 since semi integral abutment

SCI-823-0.00

SR 823 Over Portsmouth-Minford Rd

STRUCTURE TYPE STUDY - Alternate 2 - Substructure Quantity Calculations

By: JDH
Checked: ELK

Date: 6/27/2005
Date: 6/30/2005

Pier Quantities (T-Type Pier Cap on Spread Foundation)

Pier Location	Length	Pier Cap				Single Rectangular Column					Footing						Total Volume
		Width	Depth	Area	Volume	Width	Height	Depth	Column	Volume	Width	Height	Area	Depth	# Footing	Volume	
Pier 1 Left	45.5	4	8	303	1213	15.17	41.33	3	1	1881	30.33	4	121.3	13	1	1577	4671
Pier 1 Right	45.5	4	8	303	1213	15.17	41.33	3	1	1881	30.33	4	121.3	13	1	1577	4671
Pier 2 Left	45.5	4	8	303	1213	15.17	43.08	3	1	1960	30.33	4	121.3	13	1	1577	4751
Pier 2 Right	45.5	4	8	303	1213	15.17	43.08	3	1	1960	30.33	4	121.3	13	1	1577	4751
Pier 3 Left	45.5	4	8	303	1213	15.17	39.73	3	1	1808	30.33	4	121.3	13	1	1577	4598
Pier 3 Right	45.5	4	8	303	1213	15.17	39.73	3	1	1808	30.33	4	121.3	13	1	1577	4598
Total (Cu.Ft.)					7280					11297						9464	28041
Total (Cu.Yd.)					270					418						351	1039

Semi-Integral Abutment Quantities

Abut Location		Backwall				Beam Seat					Footing						Total Volume
	Length	Width	Depth	Area	Volume	Width	Height		Area	Volume	Width	Depth		Area	# Footing	Volume	
Rear Abutment																	
Left	47.6	3	5.5	16.5	785	3	3		9.00	428	6	3		18	1	857	2071
Right	47.6	3	5.5	16.5	785	3	3		9.00	428	6	3		18	1	857	2071
Total																	*4141*
Fwd Abutment																	
Left	47.6	3	5.5	16.5	785	3	3		9.00	428	6	3		18	1	857	2071
Right	47.6	3	5.5	16.5	785	3	3		9.00	428	6	3		18	1	857	2071
Total																	*4141*
Total (Cu.Ft.)					3142					1714						3427	8282
Total (Cu.Yd.)					116					63						127	307

MSE Abutment Wall Quantities

Abutment Location	Wall			
	Height	Return	Length	Area
Rear Abutment				
Left	0	0	48	0
Right	0	0	48	0
Fwd Abutment				
Left	0	0	48	0
Right	0	0	48	0
Total (Sq.Ft.)				0

HP 14x73 Pile Quantities/Per Bridge

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles (Spacing)	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut	88	84	172	5	860	311	190	6	14	1	*14*	676.2	630	48.0	*672*
Pier 1	311	248	559	5	2795	701	Spread footings at Piers								
Pier 2	360	259	619	5	3095	713	Spread footings at Piers								
Pier 3	311	248	559	5	2795	690	Spread footings at Piers								
Fwd. Abut	88	84	172	5	860	311	190	6	14	1	*14*	671.8	625	49.0	*686*
TotaL	1158	923	2081	25	10405	2724		12			28				1358

piles per row at abutments = 2 since semi integral abutment

SCI-823-0.00

SR 823 Over Portsmouth-Minford Rd

STRUCTURE TYPE STUDY - Alternate 3 - Substructure Quantity Calculations

By: JDH
Checked: ELK

Date: 6/27/2005
Date: 6/30/2005

Pier Quantities (T-Type Pier Cap on Spread Foundation)

Pier Location	Length	Pier Cap				Single Rectangular Column					Footing						Total Volume
		Width	Depth	Area	Volume	Width	Height	Depth	Column	Volume	Width	Height	Area	Depth	# Footing	Volume	
Pier 1 Left	45.5	4	8	303	1213	15.17	42.79	3	1	1947	30.33	4	121.3	13	1	1577	4738
Pier 1 Right	45.5	4	8	303	1213	15.17	42.79	3	1	1947	30.33	4	121.3	13	1	1577	4738
Pier 2 Left	45.5	4	8	303	1213	15.17	44.54	3	1	2027	30.33	4	121.3	13	1	1577	4817
Pier 2 Right	45.5	4	8	303	1213	15.17	44.54	3	1	2027	30.33	4	121.3	13	1	1577	4817
Pier 3 Left	45.5	4	8	303	1213	15.17	41.19	3	1	1874	30.33	4	121.3	13	1	1577	4665
Pier 3 Right	45.5	4	8	303	1213	15.17	41.19	3	1	1874	30.33	4	121.3	13	1	1577	4665
Total (Cu.Ft.)					7280					11695						9464	28439
Total (Cu.Yd.)					270					433						351	1053

Semi-Integral Abutment Quantities

Abut Location	Length	Backwall				Beam Seat					Footing						Total Volume
		Width	Depth	Area	Volume	Width	Height		Area	Volume	Width	Depth		Area	# Footing	Volume	
Rear Abutment																	
Left	47.6	3	2.5	7.5	357	3	3		9.00	428	6	3		18	1	857	1642
Right	47.6	3	2.5	7.5	357	3	3		9.00	428	6	3		18	1	857	1642
Total																	*3284*
Fwd Abutment																	
Left	47.6	3	2.5	7.5	357	3	3		9.00	428	6	3		18	1	857	1642
Right	47.6	3	2.5	7.5	357	3	3		9.00	428	6	3		18	1	857	1642
Total																	*3284*
Total (Cu.Ft.)					1428					1714						3427	6569
Total (Cu.Yd.)					53					63						127	243

MSE Abutment Wall Quantities

Abutment Location	Wall			
	Height	Return	Length	Area
Rear Abutment				
Left	0	0	48	0
Right	0	0	48	0
Fwd Abutment				
Left	0	0	48	0
Right	0	0	48	0
Total (Sq.Ft.)				0

HP 14x73 Pile Quantities/Per Bridge

Location	Load/ girder (Kips)			# Girders	Total Girder Load	Subst Wt (kips)	Pile Cap. (Kips)	Min No. Piles (Capacity)	Min no. piles (Spacing)	Increase Factor	Total Piles	Top Elev.	Bot Elev.	Pile Length	Total Pile Length (Feet)
	DL	LL + I	Total												
Rear Abut	48	84	132	5	660	246	190	5	14	1	*14*	677.6	630	50.0	*700*
Pier 1	175	117	292	5	1460	711	Spread footings at Piers								
Pier 2	188	122	310	5	1550	723	Spread footings at Piers								
Pier 3	175	117	292	5	1460	700	Spread footings at Piers								
Fwd. Abut	48	84	132	5	660	246	190	5	14	1	*14*	673.2	625	50.0	*700*
TotaL	634	524	1158	25	5790	2626		10			28				1400

piles per row at abutments = 2 since semi integral abutment

SCI-823-0.00

SR 823 Over Portsmouth-Minford Rd

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\11-SR139(PrtsmthMinford)\Estimates\[Portsmouth-Minford Structure Cost Comparison.xls]Life Cycle Cost

By: JDH Date: 6/28/2005
Checked: ELK Date: 6/30/2005

SUBSTRUCTURE

Alternative No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Pier Concrete Cost	Pier Reinforcing Cost	Abutment Concrete Cost	Abutment Reinforcing Cost	Pile Foundation Cost	MSE Abutment Wall Cost	Temporary Shoring Cost	Initial Substructure Cost
1	2	170.00	170.00	0.00	0.00	340.00	5 ~ Steel Plate Girders	84" Web - Grade 50W	$166,300	$37,900	$170,600	$28,000	$107,500	$0	$0	$510,000
2	4	70.00	100.00	100.00	70.00	340.00	5 ~ P.S. Concrete I-Beams	AASHTO Type 4	$501,600	$114,200	$163,000	$26,700	$112,200	$0	$0	$918,000
3	4	70.00	100.00	100.00	70.00	340.00	5 ~ Rolled Beams	W36 Grade 50W	$508,800	$115,900	$129,400	$21,200	$115,600	$0	$0	$891,000

Pier QC/QA Concrete, Class QSC1 Cost:

Alternate 1

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost	
Cap	89.9	$421.00	3.5%	$483.00	$43,410	
Columns	137.6	$421.00	3.5%	$483.00	$66,470	
Footings	116.8	$421.00	3.5%	$483.00	$56,430	
Total Pier Cost					$166,300	All Piers

Alternate 2

Component	Volume	Year 2004	Annual Escalation	Year 2008	Total Cost	
Cap	269.6	$421.00	3.5%	$483.00	$130,230	
Columns	418.4	$421.00	3.5%	$483.00	$202,090	
Footings	350.5	$421.00	3.5%	$483.00	$169,300	
Total Pier Cost					$501,600	All Piers

Alternate 3

Component	Volume	Year 2004	Annual Escalation	Year 2008	Total Cost	
Cap	269.6	$421.00	3.5%	$483.00	$130,230	
Columns	433.2	$421.00	3.5%	$483.00	$209,220	
Footings	350.5	$421.00	3.5%	$483.00	$169,300	
Total Pier Cost					$508,800	All Piers

Abutment QC/QA Concrete, Class QSC1 Cost:

Alternate 1

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	160.5	$421.00	3.5%	$483.00	$77,500
Forward	160.5	$421.00	3.5%	$483.00	$77,500
Wingwalls					
Rear	16.0	$421.00	3.5%	$483.00	$7,800
Forward	16.0	$421.00	3.5%	$483.00	$7,800

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

Alternate 2

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	153.4	$421.00	3.5%	$483.00	$74,100
Forward	153.4	$421.00	3.5%	$483.00	$74,100
Wingwalls					
Rear	15.3	$421.00	3.5%	$483.00	$7,400
Forward	15.3	$421.00	3.5%	$483.00	$7,400

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

Alternate 3

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment					
Rear	121.6	$421.00	3.5%	$483.00	$58,800
Forward	121.6	$421.00	3.5%	$483.00	$58,800
Wingwalls					
Rear	12.2	$421.00	3.5%	$483.00	$5,900
Forward	12.2	$421.00	3.5%	$483.00	$5,900

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

Pile Foundation Unit Cost ($/ft.):
HP14 x 73 Steel Piles, Furnished & Driven
Abutment and Pier Piles

	Number	Total Pile Length	Total Cost
Alt. 1	56	2,604	$107,500
Alt. 2	56	2,716	$112,200
Alt. 3	56	2,800	$115,600

HP14 x 73 Steel Piles, Furnished & Driven

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

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

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

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

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

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

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

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

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

SCI-823-0.00

SR 823 Over Portsmouth-Minford Rd

STRUCTURE TYPE STUDY

Filename: G:\CO03\0064\Bridge\BTS\11-SR139(PrtsmthMinford)\Estimates\[Portsmouth-Minford Structure Cost Comparison.xls]Life Cycle Cost
By: JDH Date: 6/25/2005
Checked: ELK Date: 6/30/2005

LIFE CYCLE MAINTENANCE COST

Alt. No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Total Span Length (ft.)	Framing Alternative	Structural Steel Painting: Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost	Superstructure Sealing: Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost	Approach Pavement Resurfacing: Cost Per Cycle	Number of Maintenance Cycles	Total Life Cycle Cost
1	2	170	170	0	0	340	5 ~ Steel Plate Girders	$757,300	0	$0	$0	0	$0	$0	7	$0
2	4	70	100	100	70	340	5 ~ P.S. Concrete I-Beams	$0	0	$0	$53,100	2	$106,200	$0	7	$0
3	4	70	100	100	70	340	5 ~ Rolled Beams	$385,200	0	$0	$0	0	$0	$0	0	$0

Alt. No.	No. Spans	Span Arrangement Span 1	Span 2	Span 3	Span 4	Total Span Length (ft.)	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	2	170	170	0	0	340	5 ~ Steel Plate Girders	$93,400	$113,200	n/a	1	$206,600	$668,000	$283,500	n/a	$255,000	1	$1,206,500	$1,413,000	$4,288,000	$5,701,000
2	4	70	100	100	70	340	5 ~ P.S. Concrete I-Beams	$93,400	$113,200	n/a	1	$206,600	$652,500	$276,900	n/a	$255,000	1	$1,184,400	$1,497,000	$3,931,000	$5,428,000
3	4	70	100	100	70	340	5 ~ Rolled Beams	$93,400	$113,200	n/a	1	$206,600	$668,000	$283,500	n/a	$255,000	1	$1,206,500	$1,413,000	$3,743,000	$5,156,000

Structural Steel Painting:
Structural Steel Area:

Alternate	Web Depth (in.)	No. Stringers	Total Span Length (ft.)	Assumed Ave. Bot. Flange Width (in.)	Nominal Exposed Girder Area (sq. ft.)	Secondary Member Allowance	Total Exposed Steel Area (sq. ft.)
1	84	10	340.00	18.00	62,900	20%	75,500
3	34	10	340.00	15.00	32,017	20%	38,400

Painting Cost per sq. ft.:

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

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

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

PS Concrete Area:

	No. Stringers	Total Span Length (ft.)	Nominal Exposed Beam Area (sq. ft.)	Secondary Member Allowance	Total Exposed Concrete Area (sq. yd.)
Alt. 2	10	340.00	39,086	10%	4,780

Sealing Cost per sq. yd.:

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

Bridge Redecking:
Bridge Deck Joint Cost per foot:

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

	Bridge Width	No. Joints
Alt. 1	45.00	0
Alt. 2	45.00	0
Alt. 3	45.00	0

Bridge Deck Removal Cost:

	Deck Area (3) (sq. ft.)	Year 2008	Deck Removal Cost
Alt. 1	30,800	$8.28	$255,000
Alt. 2	30,800	$8.28	$255,000
Alt. 3	30,800	$8.28	$255,000

Bridge Deck Overlay (Item 848):
Bridge Deck MSC Overlay Cost per sq. yd.:

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

Bridge Deck MSC Overlay Cost per cu. yd.:

	Year 2004	Annual Escalation	Year 2008
Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only	$144.00	3.5%	$165.24

	Deck Area (3) (sq. ft.)	Deck Area (sq. yd.)	Hand Chipping (sq. yd.)	Variable Thickness Repair (cu. yd.)
Alt. 1	30,800	3,422	86	77
Alt. 2	30,800	3,422	86	77
Alt. 3	30,800	3,422	86	77

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

Bridge Deck Joint Gland Replacement Cost per foot:

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

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

NOTES:

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

Approach Pavement Resurfacing:
Resurface Perpetual Asphalt Pavement:
Resurfacing Units Costs:

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

Asphalt Resurfacing Costs:

	Approach Roadway Length (ft.) (4)	Approach Roadway Width (ft.)	Resurfacing Area (sq. yd.)	Wearing Course Thickness (in.)	Wearing Course Volume (cu. yd.)
Alt. 1	0.0	45.0	0	1.50	0.0
Alt. 2	0.0	45.0	0	1.50	0.0
Alt. 3	0.0	45.0	0	1.50	0.0

APPENDIX B

TRANSYSTEMS CORPORATION

2 site plans

40'-45' MSE walls — what About STREAM? WJK

undercut

Turned back

40'-45' Leveling PAd — Coping

T-Type piers

40 scale

H + V.

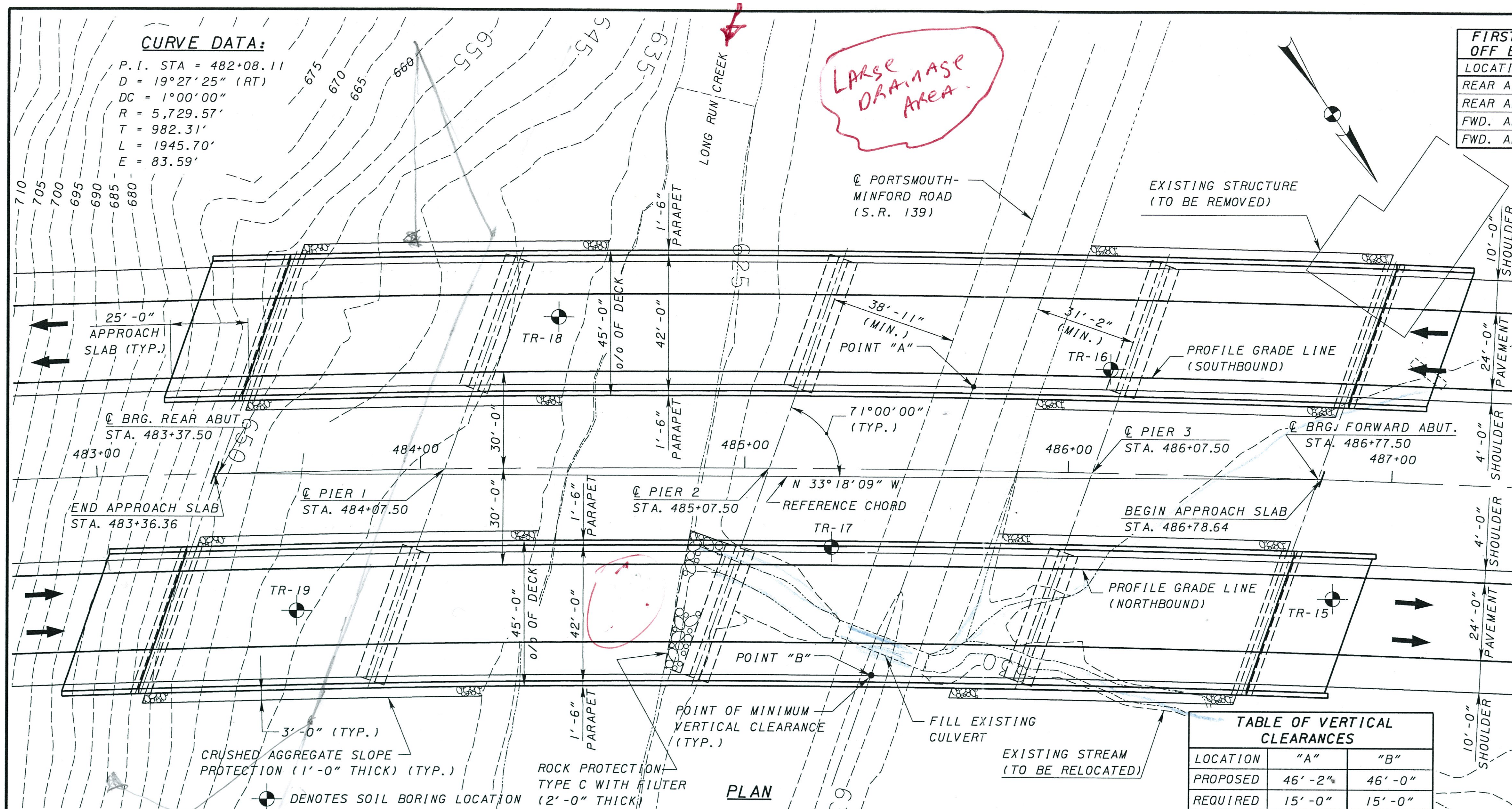
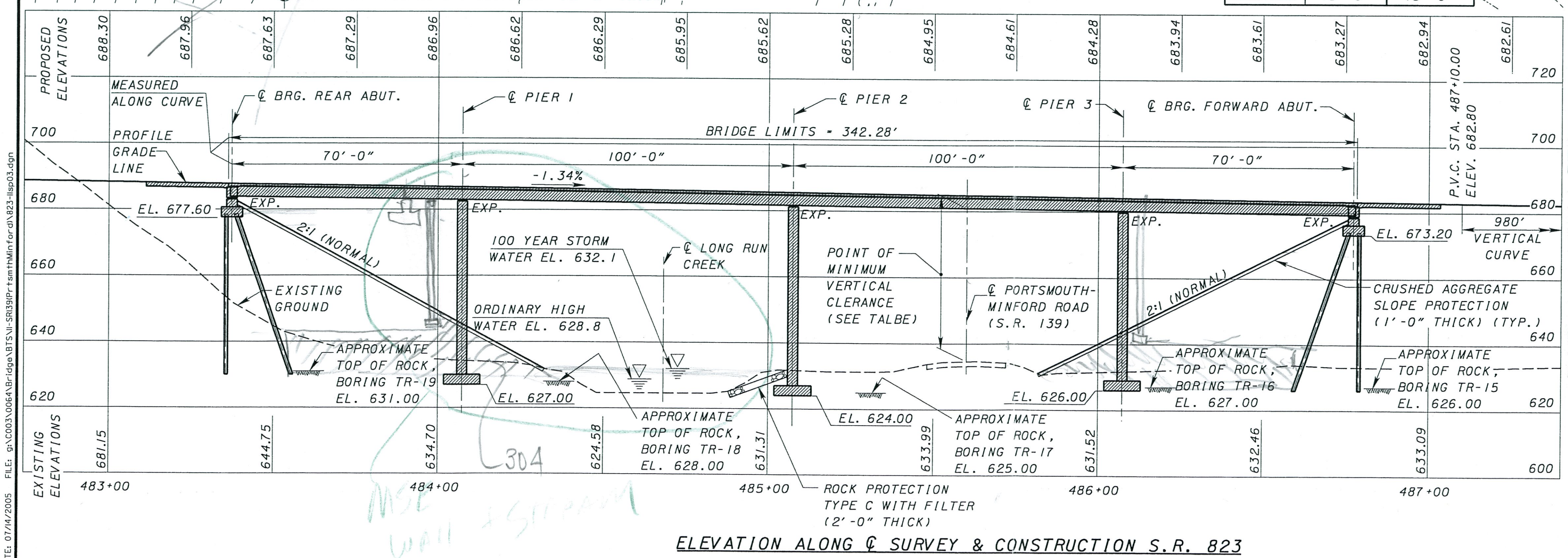


TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	46'-2"	46'-0"
REQUIRED	15'-0"	15'-0"



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-15	486+82.23	36.94' RT.
TR-16	486+12.38	32.33' LT.
TR-17	485+26.88	24.34' RT.
TR-18	484+42.66	46.98' LT.
TR-19	483+60.89	42.99' RT.

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

TRAFFIC DATA

(SR 823)
CURRENT YEAR ADT (2010) = 19,800
DESIGN YEAR ADT (2010) = 26,000
CURRENT YEAR ADTT (2030) = 2770
DESIGN YEAR ADTT (2030) = 3640

PROPOSED STRUCTURE

TYPE: 4-SPAN CONTINUOUS STEEL ROLLED BEAM A709 GRADE 50W WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE SUBSTRUCTURE UNITS.

SPANS: 70'-0", 100'-0", 100'-0", 70'-0" C/C BEARINGS. (MEASURED ALONG CURVE)

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

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

SKEW: 19°00'00" WITH RESPECT TO REF. CHORD.

CROWN: NORMAL 0.016 FT./FT.

ALIGNMENT: 1°00'00" CURVE.

WEARING SURFACE: 1" MONOLITHIC CONCRETE.

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

LATITUDE:

LONGITUDE:

STRUCTURE FILE NO.:

HYDRAULIC DATA

DRAINAGE AREA = 13.424 sq.mi. = 8591 acres

Q_{50} = 2230 cfs	Q_{100} = 2572 cfs
V_{50} = 6.8 fps	V_{100} = 7.1 fps
EL_{50} = 631.7	EL_{100} = 632.1

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. SPREAD FOOTINGS SHALL HAVE AN ALLOWABLE BEARING CAPACITY OF 15 TSF.

UTILITIES:

UTILITIES DISPOSITION WILL BE ADDRESSED DURING TS&L SUBMITTAL.

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

DATE 7/9/05 | STRUCTURE FILE NUMBER
REVIEWED NFF
DRAWN MLR | REVISED
DESIGNED JDH | CHECKED RER

SCIOTO COUNTY
STA. 483+36.36
STA. 486+78.64

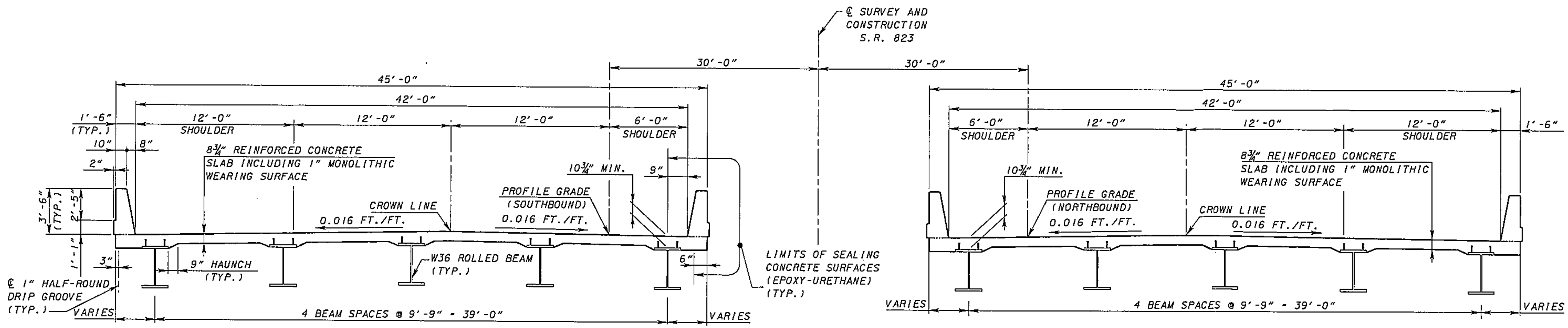
PRELIMINARY SITE PLAN - ALTERNATIVE 3
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER PORTSMOUTH-MINFORD RD (S.R. 139)

SCI-823-0.00
PID 19415

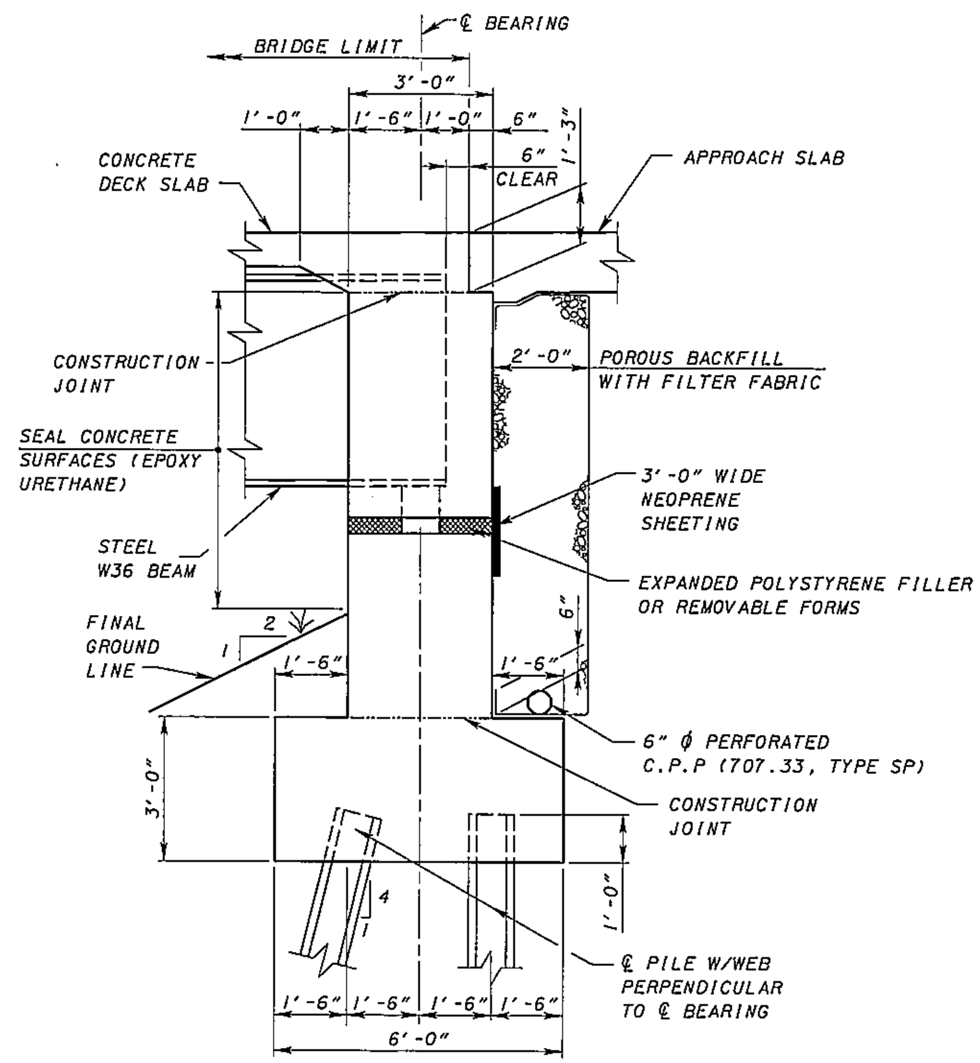
1 / 2

$XXX
$YYY

DATE: 07/14/2005 FILE: g:\C003\0064\Bridge\BTS\I-SR139\PrtsmthMinford\823-llsp03.dgn



PROPOSED TRANSVERSE SECTION



TYPICAL ABUTMENT SECTION

SUPERSTRUCTURE DEPTH	
ITEM	W36 BEAM
SLAB (INCLUDING WEARING SURFACE)	8¾"
HAUNCH (BOTTOM OF SLAB TO TOP OF FLANGE)	2"
BEAM DEPTH	36"
TOP OF WEARING SURFACE TO BOTTOM OF BEAM (INCHES)	46.75"
TOP OF WEARING SURFACE TO BOTTOM OF BEAM (FEET)	3.89'

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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	7/9/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

TRANSVERSE SECTION - ALTERNATIVE 3
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER PORTSMOUTH-MINFOLD ROAD (S.R. 139)

SCI-823-0.00
PID 19415

2/2

$XXX
$YYY

DATE: 07/14/2005 FILE: g:\C003\0064\Bridge\BTSW-SR139Prtsmth-Minford\823-tr.dgn

APPENDIX C

TRANSYSTEMS CORPORATION

TranSystems Corporation

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

VERTICAL CLEARANCE CALCULATIONS

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

Alternative 2 - 5 AASHTO Type IV Beams — ***Point Location:*** ***A***

Adjstment for Cross Slope

Comment	Grade		Offset		
PGL to Beam CL:	-0.016	x	5.5	=	-0.09
			Total Adjustment	=	**-0.09**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	36	3
	46.5	3.88

Total Superstructure Depth (ft) = **3.88**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**485+71.75**	
Offset Location @ Critical Point	=	**25.5 '**	**Left**
Profile Grade Elevation at Critical Point	=	684.65	
Adjustment for Cross Slopes to Beam CL	=	-0.09	
Top of Deck Elevation @ Critical Point	=	**684.56**	
Total Superstructure Depth	=	-3.88	
Bottom of Beam Elevation @ Critical Point	=	**680.68**	
Approximate Top of Existing Ground @ Critical Point	=	**634.50**	
Actual Vertical Clearance	=	***46.18***	
Preferred Vertical Clearance	=	*17.0*	
Required Vertical Clearance	=	*15.0*	

TRANSYSTEMS CORPORATION

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

VERTICAL CLEARANCE CALCULATIONS

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

Alternative 2 - 5 AASHTO Type IV Beams — ***Point Location:*** ***B***

Adjstment for Cross Slope

Comment	Grade		Offset		
1 Lanes:	0.016	x	12	=	0.19
1 Lanes:	-0.016	x	12	=	-0.19
Shoulder to Beam CL:	-0.016	x	9.5	=	-0.15
			Total Adjustment	=	**-0.15**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.5	0.71
Haunch:	2	0.17
Girder or Beam Depth:	36	3
	46.5	3.88

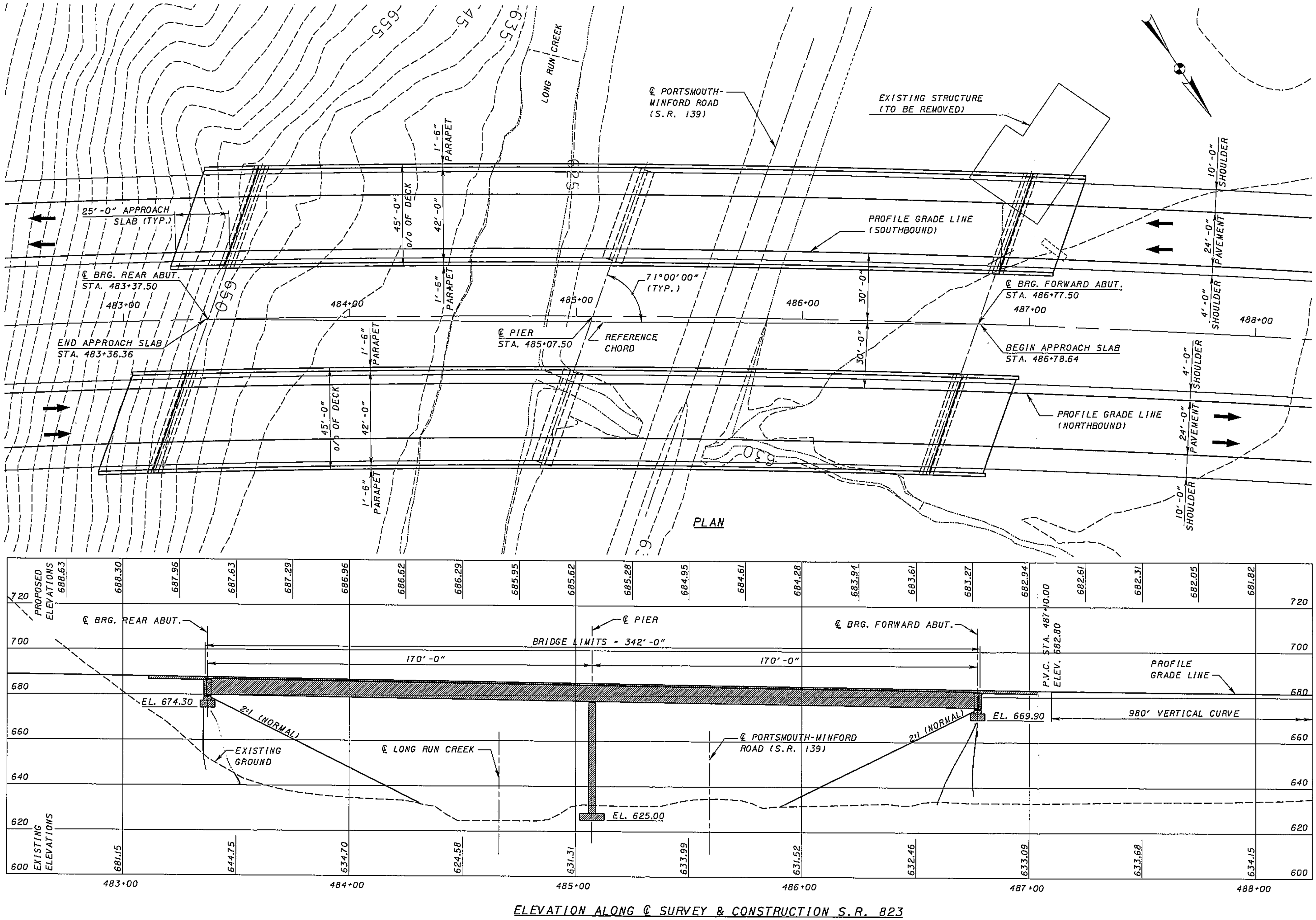
Total Superstructure Depth (ft) = **3.88**

Vertical Clearance at Critical Point

Station @ Critical Point	**=**	**485+41.10**	
Offset Location @ Critical Point	**=**	**64. '**	**Right**
Profile Grade Elevation at Critical Point	=	685.06	
Adjustment for Cross Slopes to Beam CL	=	-0.15	
Top of Deck Elevation @ Critical Point	**=**	**684.91**	
Total Superstructure Depth	=	-3.88	
Bottom of Beam Elevation @ Critical Point	**=**	**681.03**	
Approximate Top of Existing Ground @ Critical Point	**=**	**635.00**	
Actual Vertical Clearance	**=**	***46.03***	
Preferred Vertical Clearance	=	*17.0*	
Required Vertical Clearance	=	*15.0*	

APPENDIX D

TRANSYSTEMS CORPORATION



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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	7/9/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	

SCIOTO COUNTY
STA. 483+36.36
STA. 486+78.64

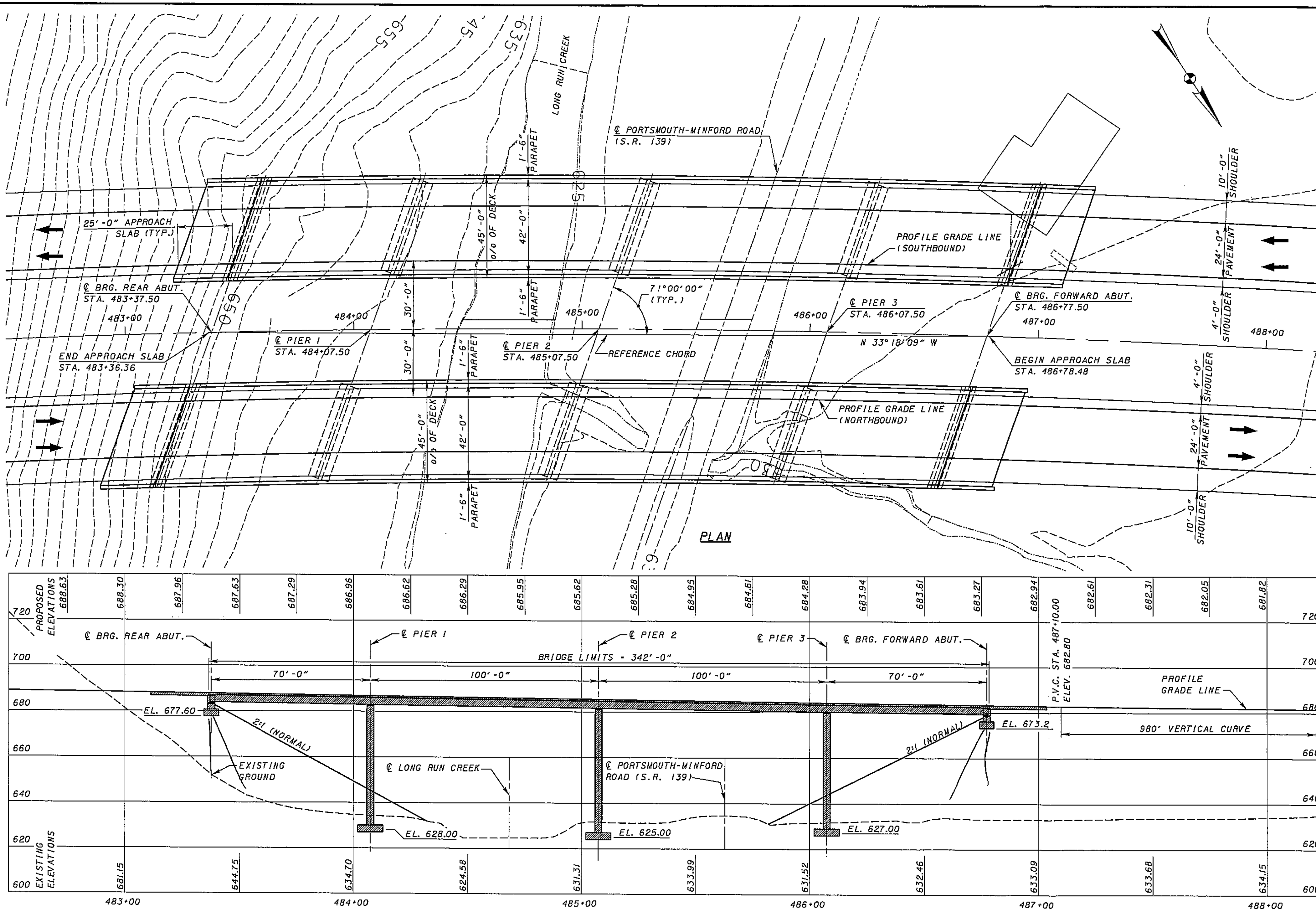
PRELIMINARY SITE PLAN - ALTERNATIVE I
BRIDGE NO. SCI-823-XXXX
SR 823 OVER PORTSMOUTH-MINFORD RD (SR 139)

SCI-823-0.00
PID 19415

1/1

XXX
YYY

DATE: 07/14/2005 FILE: g:\C003\0064\Bridge\BTSVII-SR139PrtsmthMinford\823-0sp01.dgn



ELEVATION ALONG ℄ SURVEY & CONSTRUCTION S.R. 823

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

DESIGNED	DRAWN	REVIEWED	DATE
JDH	MLR	NFF	7/9/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	

SCIOTO COUNTY
STA. 483+36.36
STA. 486+78.64

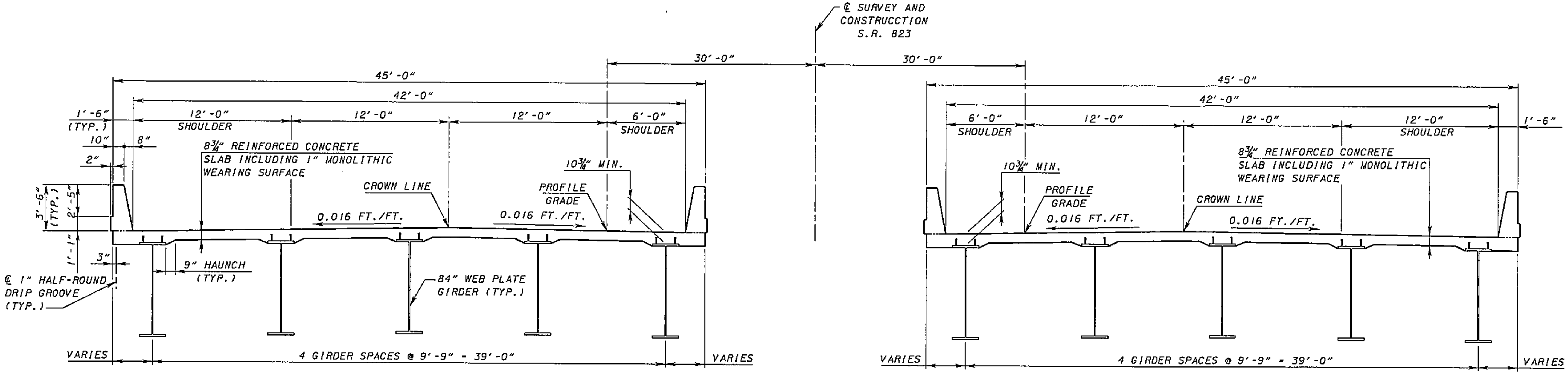
PRELIMINARY SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER PORTSMOUTH-MINFORD RD (S.R. 139)

PID

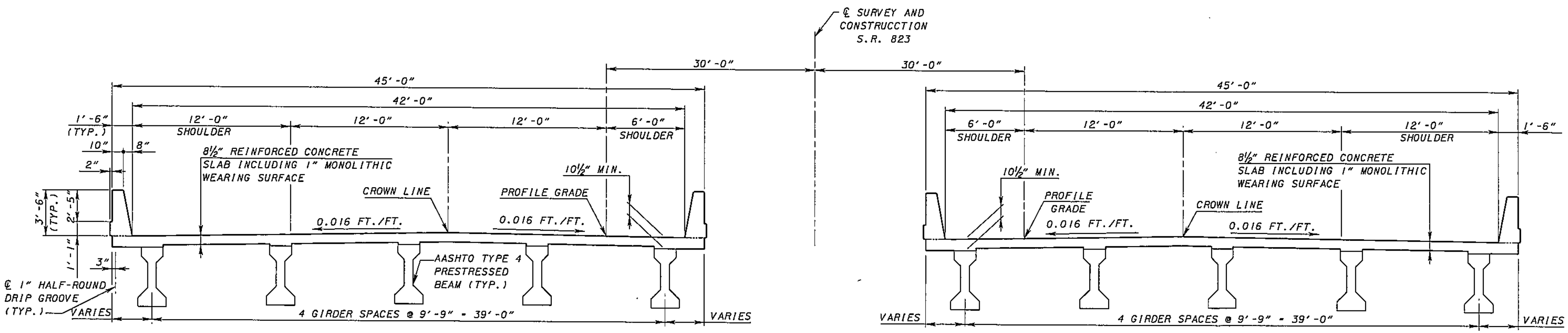
1 / 1

$XXX
$YYY

DATE: 07/14/2005 FILE: g:\C003\0064\Bridge\BTS\Vi-SR0139\PrtsmthMinford\823-lbsp02.dgn



ALTERNATIVE 1



ALTERNATIVE 2

DESIGN AGENCY
TRANSYSTEMS CORPORATION

DESIGNED	CHECKED	DRAWN	REVISED	REVIEWED	DATE
NFF	JDH	MLR		NFF	7/9/05

STRUCTURE FILE NUMBER

TRANSVERSE SECTION-ALTERNATIVES 1 AND 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER PORTSMOUTH-MINFORD ROAD (S.R. 139)

SCI-823-0.00
PID 19415

1/1

DATE: 7/13/2005

APPENDIX E

TRANSYSTEMS CORPORATION

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

March 31, 2005

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

Re: **SCI-823-0.00 over Portsmouth-Minford Rd (SR 139)**
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 on SCI-823-0.00 over Portsmouth-Minford Rd. (SR 139). It is anticipated that the proposed structure will be a four-span, elevated bridge with embankment fills for both abutments. At the present time, it is understood that the forward abutment will be founded on an embankment with a maximum height of 46 feet. The grade at the proposed location of the rear abutment varies along the cross section. The embankment fill is understood to vary from 0 feet to the far left of centerline and up to 35 feet to the right of centerline. It is anticipated that the piers for the structure will be located at elevations similar to those existing at State Route 139 and will be generally 45 feet in height. Currently Portsmouth-Minford Rd. (SR 139) is located along the north side of Long Run.

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.

2162 Front Street • Cuyahoga Falls, Ohio 44221-3288 • (330) 923-0401 • FAX (330) 928-1029
With Offices Throughout The Midwest
www.dlz.com

Field Exploration

A total of five borings, TR-15 through TR-19, were drilled at the proposed structure between July 9, 2004 and February 23, 2005. The borings were drilled to depths from 18.0 to 27.0 feet. The borings were extended into bedrock, which was verified by rock coring. Boring Logs and information concerning the drilling procedures are attached.

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

Findings

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

The borings generally encountered 2 to 12 inches of topsoil at the surface. Boring TR-16 did not encounter topsoil. Underlying the surficial materials, the borings encountered loose to very dense silt (A-4b) and gravel with sand and silt (A-2-4) and medium stiff to very stiff sandy silt (A-4a) and silt and clay (A-6a) to depths between 6.0 and 8.7 feet where bedrock was encountered.

The bedrock encountered at the proposed structure location was composed primarily of medium hard to hard sandstone and siltstone that was generally slightly fractured to intact. Recovery of the core samples ranged from 83 to 100% and RQD values ranged from 57 to 97% with an average RQD of 83%.

Seepage was encountered in borings TR-15, TR-16, and TR-17 between depths of 6.0 and 7.0 feet. The remaining borings did not encounter seepage. At completion of drilling, water levels ranged from 1.6 to 16.3 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 should be expected to correspond with the level of Long Run.

Conclusions and Recommendations

Based on existing proposed cross section plans, it would appear that deep foundations would be necessary for the abutments and shallow foundations would be appropriate for the pier foundations. The following is a brief discussion of the recommendations for the substructures.

Due to the large amount of embankment fill, it appears that drilled shafts bearing on bedrock will be the best-suited foundation type for the support of the proposed structural abutments. If high lateral or uplift loads are anticipated, deeper rock sockets may be needed. The actual design lengths or rock sockets will need to be designed based upon actual loading conditions.

Competent bedrock was encountered at shallow depths at the expected pier locations. Therefore, the use of spread footings on rock should be the best-suited foundation type for support of the proposed structure's piers. The footings should be embedded into the bedrock. If an alternative foundation type is required due to lateral or uplift loads, drilled shafts with rock sockets can be utilized.

The following table summarizes the site conditions and foundation recommendations.

Boring Number	Structural Element	Existing Ground Surface Elevation* (Feet)	Approximate Bearing Elevation* (Feet)	Recommended Foundation Type	Allowable Bearing Capacity
TR-15	Forward Abutment	637	630	Drilled Shafts	15 TSF
TR-16	Pier	636	627	Spread Footing	15 TSF
TR-17	Pier	631	625	Spread Footing	15 TSF
TR-18	Pier	635	628	Spread Footing	15 TSF
TR-19	Rear Abutment	644	635	Drilled Shafts	15 TSF

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

DLZ

ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

Grain-size analyses were performed for scour analysis since the proposed structure location is located perpendicular to Long Run. The following table outlines the D85 and D50 particle sizes from the grain-size analysis. The laboratory data sheets for the grain-size analyses are attached.

Boring	Sample	Depth	Grain Size	
			D_{85}	D_{50}
TR-18	S-1	1.0' – 2.5'	1.23 mm	0.0297 mm
TR-18	S-2	3.5' – 5.0'	0.207 mm	0.0574 mm
TR-18	S-3	6.0' – 7.5'	1.24 mm	0.13 mm

Closing

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

Sincerely,

DLZ OHIO, INC.

Richard Hessler
Geotechnical Engineer

Arthur (Pete) Nix, P.E.
Senior Geotechnical Engineer

DLZ

ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

Attachments: General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Site Plan
Boring Logs TR-15, TR-16, TR-17, TR-18, TR-19
Particle Size Distribution Test Reports

cc: File

S:\Dept\Geotech\Projects\0121\307003 Portsmouth Structures\SR139 letter.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 soils 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.

S:\Dept\Geotech\Misc\Legends\Geninfo.eng

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:

<u>Granular Soils - Compactness</u>

Terms	Blows/Foot Standard Penetration
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	over 50

<u>Cohesive Soils - Consistency</u>

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 - 1.00	4 - 8	Penetrated by thumb w/ moderate effort
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 ODOT Classification System. Soil particle size definitions are as follows:

Description	Size	Description	Size
Boulders	Larger than 8"	Sand-Coarse	2.00 mm. to 0.42 mm.
Cobbles	8" to 3"	-Fine	0.42 mm. to 0.074 mm.
Gravel-Coarse	3" to 3/4"	Silt	0.074 mm. to 0.005 mm.
-Fine	3/4" to 2.00" 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. 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

g. 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

10. Rock hardness and rock quality description.

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

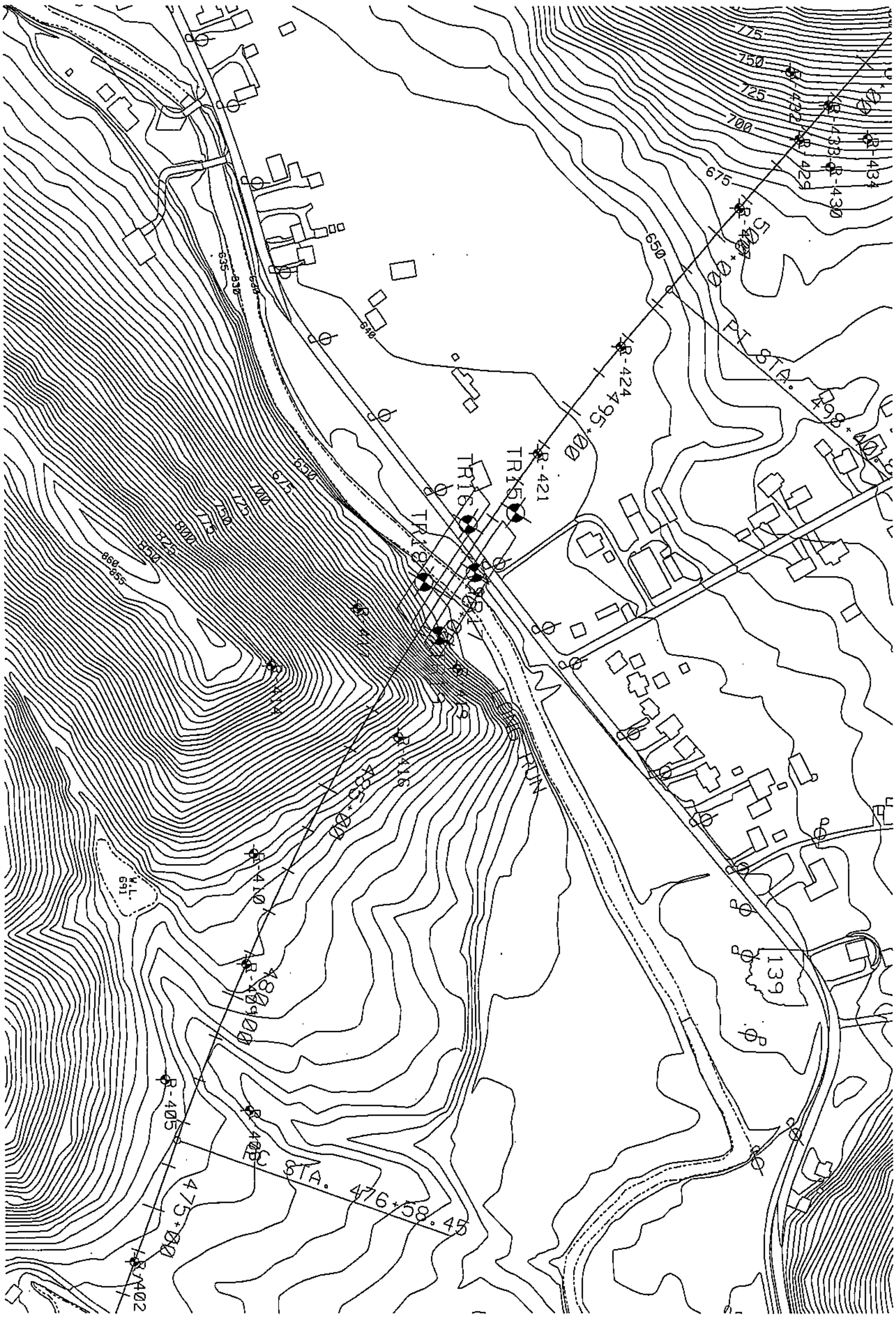
Term	Description
Very Soft	Difficult to indent with thumb nails; resembles hard soil but has rock structure
Soft	Resists indentation with thumb nail but can be abraded and pierced to a shallow depth by a pencil point.
Medium Hard	Resists pencil point, but can be scratched with a knife blade.
Hard	Can be deformed or broken by light to moderate hammer blows.
Very Hard	Can be broken only by heavy blows, and in some rocks, by 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.



1/1	SCI-823-0.00	SITE PLAN SCI-823-0.00 OVER PORTSMOUTH- MINFORD RD (SR 139)	DRAWN BY RJH CHECKED PPP	0 50 100 200 HORIZONTAL SCALE IN FEET

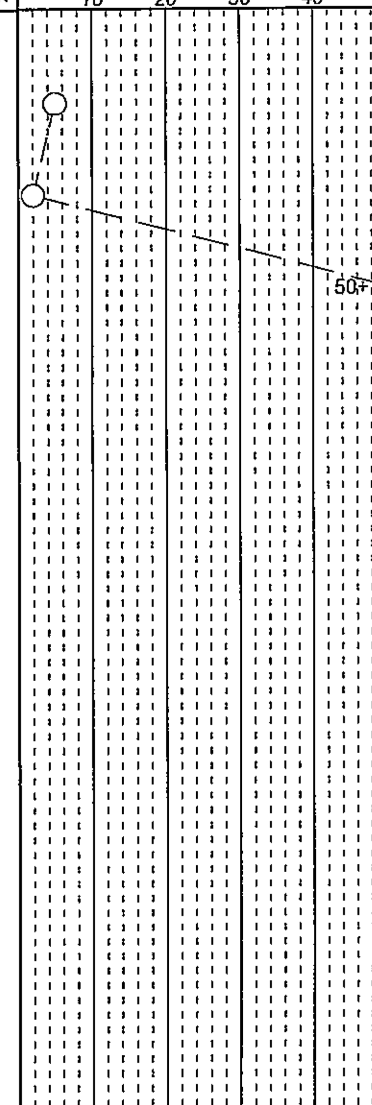
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-15 | Location: Station 492+40, 35' Right | Date Drilled: 7/9/04

WATER OBSERVATIONS: Water seepage at: 6.0'
Water level at completion: 18'

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
0.2	637.0 / 636.8						Topsoil-2"						
		4 2 3	14	1		1.0	Stiff to very stiff brown SANDY SILT (A-4a), trace gravel; moist.						
5		2 1 1	13	2		<0.25	@3.5' - 5.0', very soft.						
7.0	630.0	3 20 50/2	13	3A 3B		3.25	Severely weathered brownish-gray SILTSTONE fragments.						
8.0	629.0	Core 120"	Rec 99"	RQD 70%	R-1		Hard gray SANDSTONE; fine grained, contains occasional rust stains. @8.0' - 9.0', probable core loss. @13.0' - 14.0', argilllacious.						
14.0	623.0						Medium hard to hard gray SILTSTONE; arenaceous, slightly micaceous.						
18.0	619.0						Bottom of Boring - 18.0'						



FILE: 0121-3 [3/31/2005 12:32 PM]

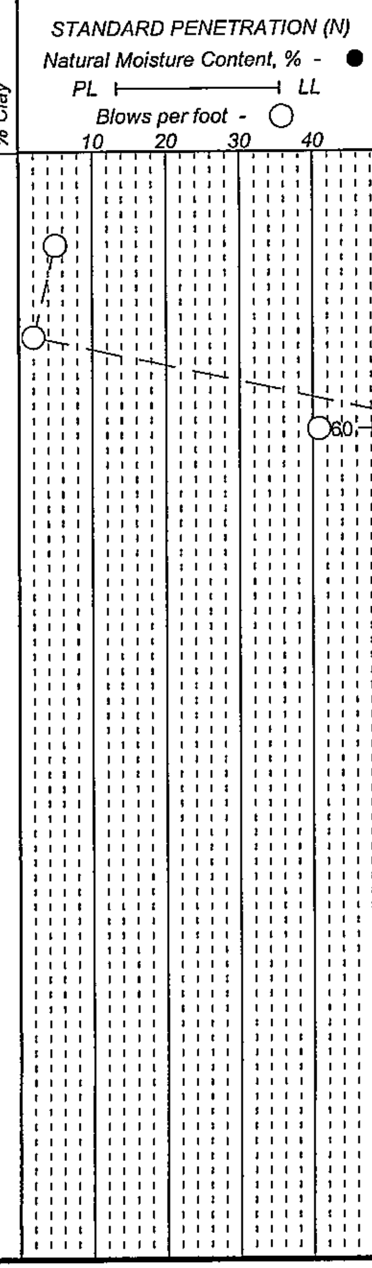
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-16 | *Location:* Station 491+60, 35' Left | *Date Drilled:* 7/9/04

WATER OBSERVATIONS: Water seepage at: 6.0' Water level at completion: 6.5'

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	636.0						Medium stiff to stiff brown SANDY SILT (A-4a); moist.						
		2 3 2	16	1		1.0							
		1 1 1	15	2		0.75							
		4 10 50/5	12	3		--	@ 6.0'-7.4', contains rock fragments.						
8.5	627.5						Medium hard to hard gray SILTSTONE. @8.9'-9.2', possible clay seam, washed out.						
9.2	626.8	Core 120"	Rec 118"	RQD 85%	R-1		Hard gray SANDSTONE; fine grained.						
17.0	619.0						Medium hard to hard gray SILTSTONE; arenaceous.						
18.5	617.5						Bottom of Boring - 18.5'						



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-17

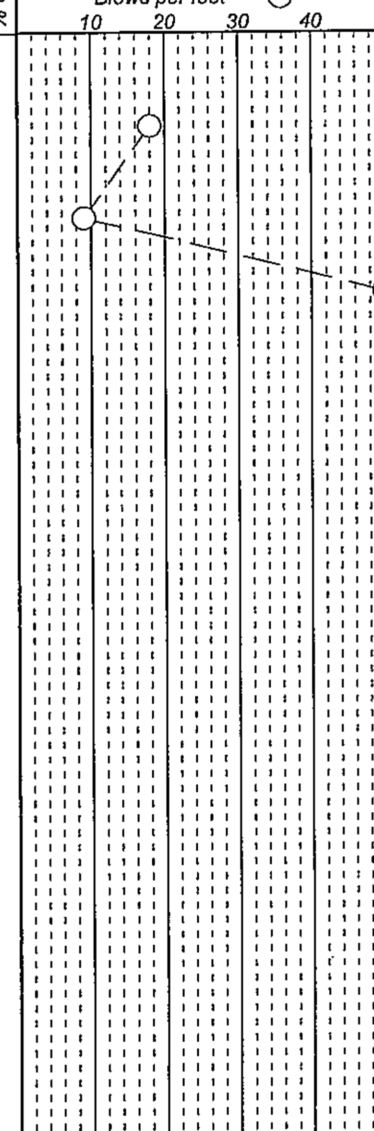
Location: Station 490+80, 35' Right **Date Drilled:** 2/23/05

WATER OBSERVATIONS:
Water seepage at: 6.3' - 7.0'
Water level at completion: 1.6' (inside hollowstem augers after coring)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	631.0												
0.4	630.6						Topsoil - 5"						
		6 8 10	18	1			Medium dense brown SILT (A-4b), little fine to coarse sand, trace clay; damp.						
3.0	628.0	6 4 5	18	2			Loose brown GRAVEL WITH SAND AND SILT (A-2-4); damp.						
5.5	625.5						Very dense brown SANDY SILT (A-4a); wet.						
6.3	624.7	3 50/5	11	3A 3B			Weathered SILTSTONE, gray.						
7.0	624.0	Core 120"	Rec 120"	RQD 83%	R-1		Medium hard brown and gray SANDSTONE; fine grained, moderately weathered, slightly micaceous, slightly fractured. @ 7.3'-7.4', very soft, highly weathered. @ 8.5', irregular fracture. @ 8.7', gray. @ 16.0', 1" soft, weathered zone.						
17.0	614.0	Core 120"	Rec 120"	RQD 97%	R-2		Hard brown and gray SANDSTONE; fine grained, slightly weathered, slightly micaceous, slightly fractured. @ 22.8'-23.0', very soft, highly weathered siltstone seam. @ 23.0'-23.2', siltstone seam.						
27.0	604.0						Bottom of Boring - 27.0'						

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

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



FILE: 0121-31 [3/31/2005 12:32 PM]

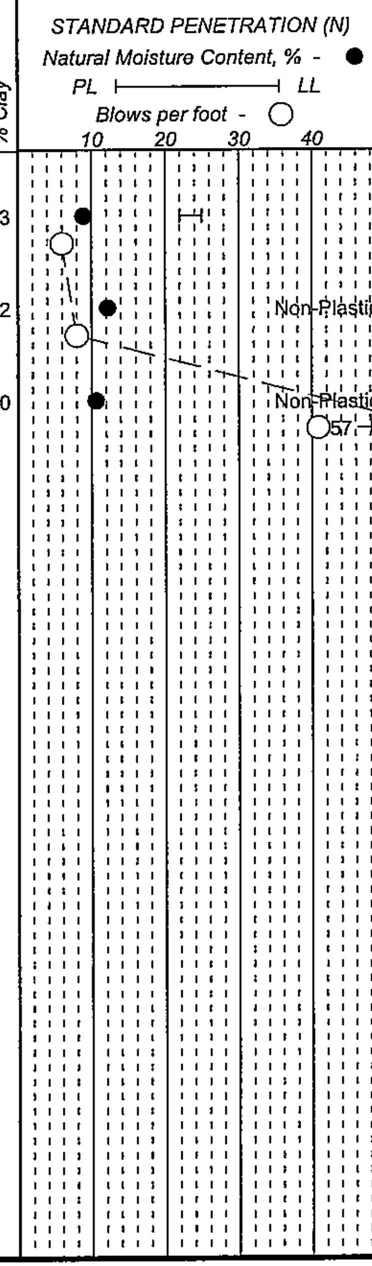
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-18 | Location: Station 490+00, 35' Left | Date Drilled: 8/17/04

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 9.4'

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	635.0						Topsoil - 12"						
1.0	634.0	2 3 3	18	1			Loose brown SILT (A-4b), some fine sand; dry. S-1 contains roots.	13	7	--	9	58	13
		3 4 4	18	2				0	3	--	40	45	12
6.0	629.0	6 7 50/3	12	3			Severely weathered brown and gray SILTSTONE fragments, rust stains.	11	20	--	28	31	10
7.3	627.7	Core 84"	Rec 84"	RQD 95%	R-1		Hard gray SANDSTONE; fine grained, slightly micaceous. @ 7.3'-7.8',8.0',8.6'-8.8', brown rust-stained. @ 7.3' - 7.6'; vertical fracture.						
17.5	617.5	Core 72"	Rec 72"	RQD 94%	R-2		Hard dark gray SILTSTONE; fine grained, slightly micaceous, arenaceous.						
20.3	614.7						Bottom of Boring - 20.3'						



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

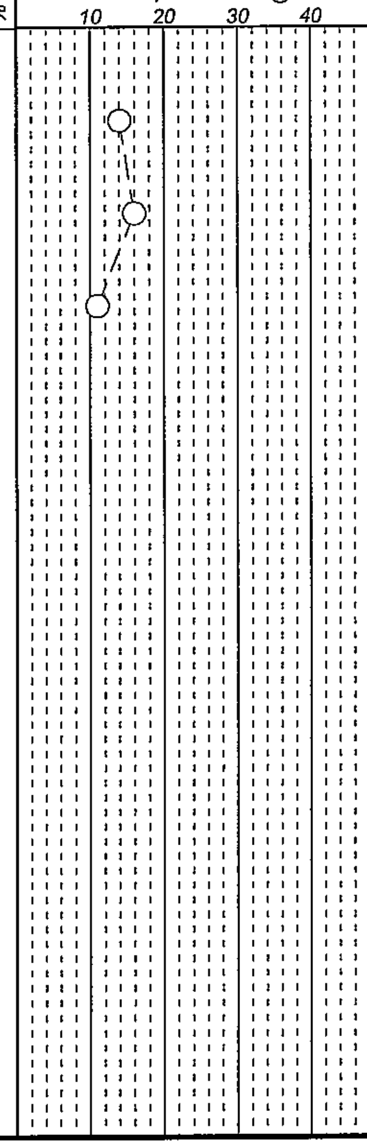
Client: TranSystems, Inc. | *Project:* SCI-823-0.00 | *Job No.* 0121-3070.03

LOG OF: Boring TR-19 | *Location:* Station 489+10, 35' Right | *Date Drilled:* 8/16/04 to 8/17/04

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 16.3'

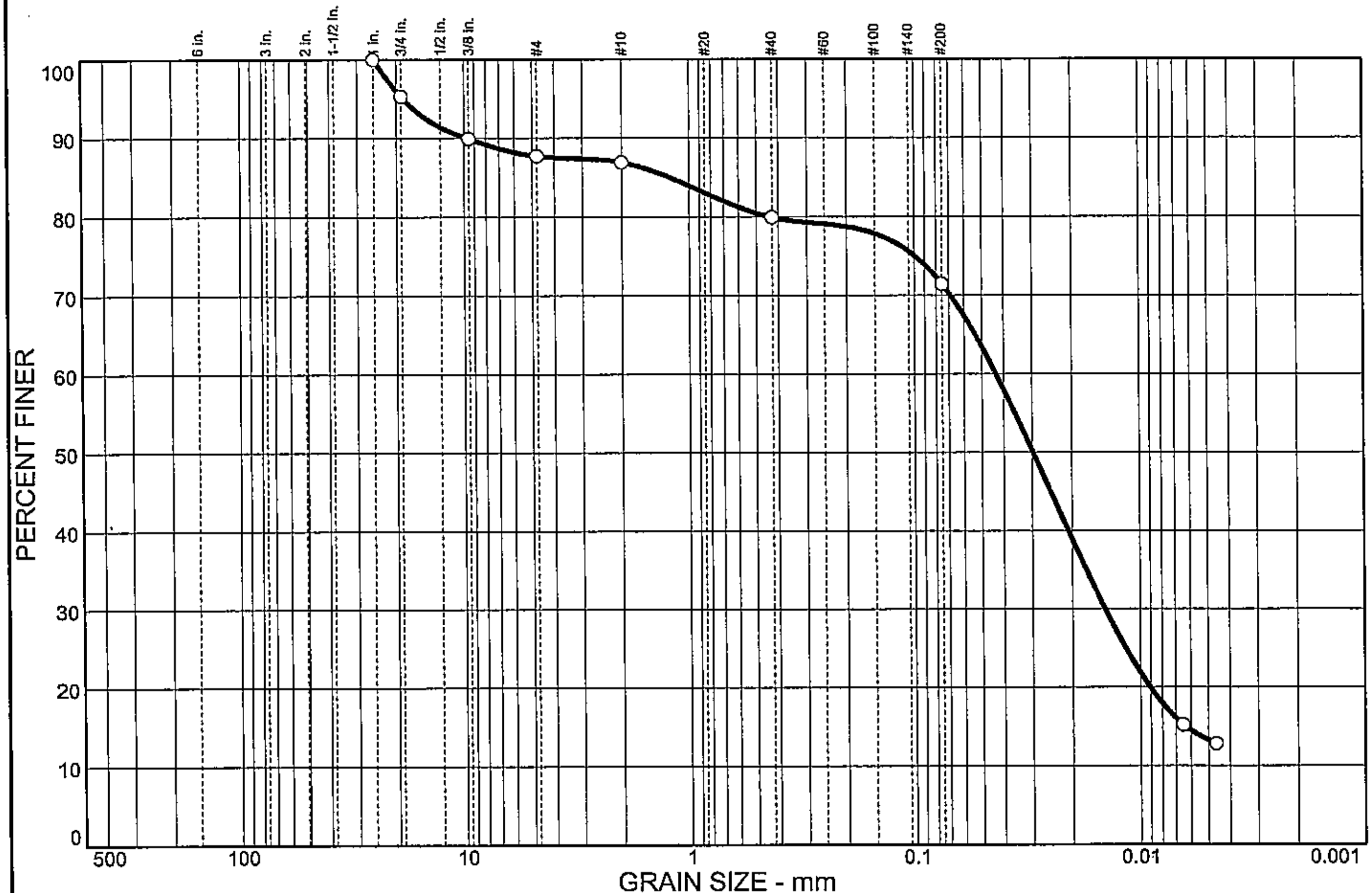
Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay
0	644.0						Topsoil-12"						
1.0	643.0	3 7 7	18	1		–	Stiff to very stiff brown SILT AND CLAY (A-6a), little fine to coarse sand; damp.						
		4 7 9	18	2		–	@ 3.5'; trace gravel.						
6.0	638.0	4 5 6	18	3			Medium dense brown SILT (A-4b), some fine to coarse sand; damp. @ 8.5'; contains siltstone/shale fragments.						
8.7	635.3	50/2	2	4									
		Core 30"	Rec 30"	RQD 57%	R-1		Hard gray SANDSTONE; fine grained, slightly micaceous, occasional black lamination. @ 8.8'-9.0',9.2'-9.4', brown rust-stained. @ 13.1'-13.3', 45 degree fracture.						
13.7	630.3	Core 108"	Rec 108"	RQD 70%	R-2		Medium hard to hard gray SILTSTONE; fine grained, slightly micaceous, arenaceous. @ 13.9'-14.0', 45 degree fracture. @ 14.7'-15.5', broken zone. @ 14.8'-15.0', sandstone seam. @ 15.4'-15.5', clay seam.						
20.0	624.0						Bottom of Boring - 20.0'						

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



FILE: 0121-3₁ [3/31/2005 12:32 PM]

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	4.7	7.6	0.8	7.0	8.5	58.1	13.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 in.	100.0		
.75 in.	95.3		
3/8 in.	89.9		
#4	87.7		
#10	86.9		
#40	79.9		
#200	71.4		

* (no specification provided)

Soil Description

Atterberg Limits

PL= 22 LL= 25 PI= 3

Coefficients

D_{85}= 1.23 D_{60}= 0.0433 D_{50}= 0.0297
D_{30}= 0.0143 D_{15}= 0.0063 D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(1)

Remarks

Moisture Content= 8.9%

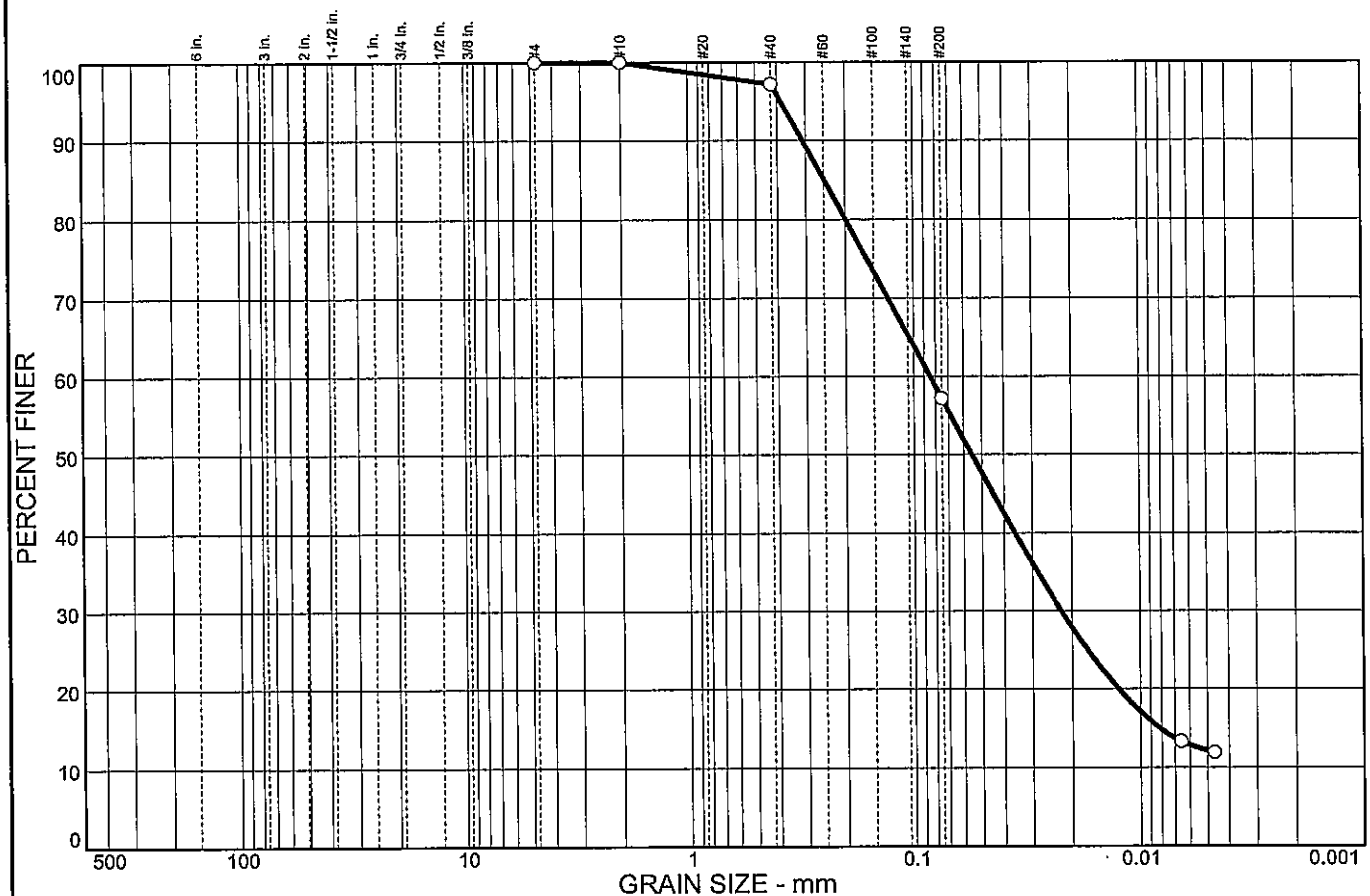
Sample No.: 1 **Source of Sample:** TR-18 **Date:** 3/24/05
Location: **Elev./Depth:** 1.0

DLZ

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

Project No: 0121-3070.03 **Figure**

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	2.8	40.0	45.1	12.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#40	97.2		
#200	57.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 0.249 D_{60}= 0.0845 D_{50}= 0.0553
D_{30}= 0.0223 D_{15}= 0.0082 D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

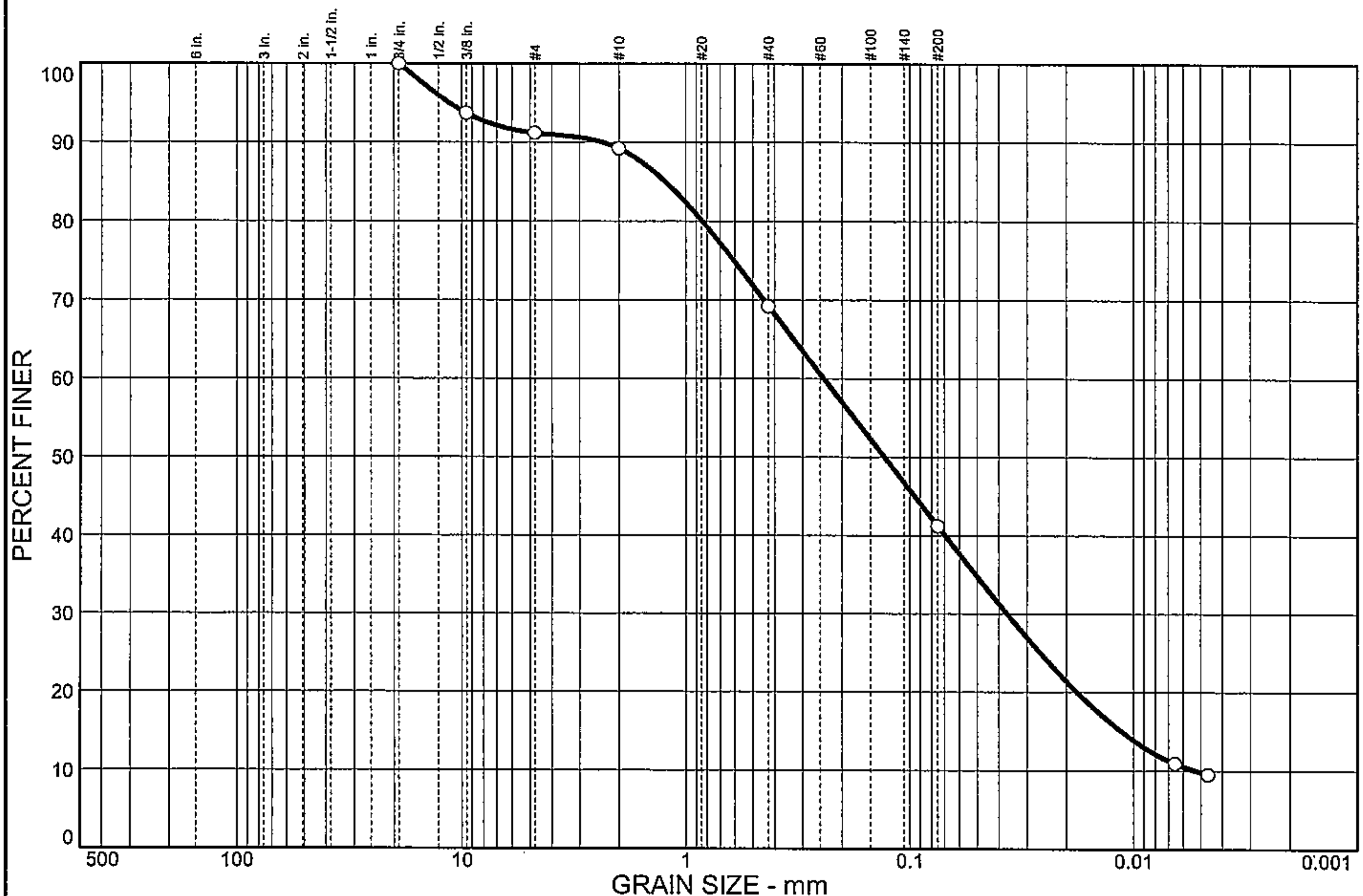
Moisture Content= 12.2%

Sample No.: 2 **Source of Sample:** TR-18 **Date:** 3/24/05
Location: **Elev./Depth:** 3.5

DLZ

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

PARTICLE SIZE DISTRIBUTION TEST REPORT



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	8.8	2.0	20.0	28.0	31.4	9.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75 in.	100.0		
.375 in.	93.7		
#4	91.2		
#10	89.2		
#40	69.2		
#200	41.2		

* (no specification provided)

Soil Description

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{85}= 1.24 D_{60}= 0.241 D_{50}= 0.130
D_{30}= 0.0368 D_{15}= 0.0114 D_{10}= 0.0053
C_u= 45.38 C_c= 1.06

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Moisture Content= 10.6%

Sample No.: 3 **Source of Sample:** TR-18 **Date:** 3/24/05
Location: **Elev./Depth:** 6

DLZ

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