SCI-823-0.00

PID NO. 19415

S.R. 823 OVER SWAUGER VALLEY - MINFORD ROAD

STRUCTURE TYPE STUDY SUBMITTAL

Prepared for:
OHIO DEPARTMENT OF TRANSPORTATION
DISTRICT 9
650 EASTERN AVE.
CHILLICOTHE, OHIO 45601

JULY 15, 2005

Prepared by:

TRANSYSTEMS CORPORATION

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BRIDGE TYPE STUDY NARRATIVE

1. Introduction

TranSystems Corporation is providing engineering services to the Ohio Department of Transportation for the design of new left and right overpass structures that will carry the proposed S.R. 823 bypass over Swauger Valley – Minford Road. 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, four test borings (TR-20, TR-21, TR-22 and TR-23) were drilled and all of them encountered weathered gray sandstone between 3.5 and 7 feet below the existing ground surface. All of the borings also encountered some layers of soft to hard sandy SANDY SILT (A-4a), very dense SANDY SILT (A-4a) and hard SILT AND CLAY (A-6a) at various depths. For a more defined description of the material encountered, refer to the subsurface investigation report.

Based on the alternatives considered for this study, two different foundation conditions were considered applicable for various substructure elements. As such, it is recommended that in locations where proposed substructures are to be constructed in or near bedrock, either a spread footing with minimum rock embedment or drilled shafts with rock sockets should be used. Per phone discussion with DLZ Ohio, Inc. on 7/12/05, an addendum will be submitted during the TS&L stage stating that substructures located in areas of new embankment construction shall be founded on H-piles. It will be necessary to sleeve the H-piles through the approach embankment fill material. In addition, it is also recommended that the piles not be driven until the majority of primary consolidation settlement has occurred in order to avoid having high down-drag forces that could significantly reduce the load-carrying capacity of the piles.

HP12x53 piles with a maximum design load of 70 tons are assumed for this Bridge Type Study. 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.

4. Roadway

The purpose of this project is to construct a new bypass state route around the town of Portsmouth Ohio. The proposed alignment will carry two lanes of traffic, 15 plus miles in either direction, from an interchange with US 52 just east of the town to another interchange with US 23 north of the town in Valley Township. Each of the proposed bridge sections will consist of two 12'-0" travel lanes with 6'-

0" median shoulders and 12'-0" outside shoulders. Each bridge deck width will be 45'-0" out to out with 1'-6" inside and outside straight face deflector parapets. Horizontal and vertical sight distances, in accordance with the design standards, have been provided over the bridge for all alternatives considered. The existing Swauger Valley – Minford Road will remain on its current horizontal and vertical alignment.

Vertical and Horizontal Design - Since this structure's vertical alignment was dictated by the overall vertical design of the new bypass profile, clearance was not a critical issue. More than 15'-0" of preferred vertical clearance could be provided for all the alternatives considered for this study. All of the substructure layouts, for all of the alternatives, exceeded the minimum lateral clearance, therefore Type-D barrier will not be provided. An existing creek ditch, which parallels the road, will be also be maintained on the west side of the Swauger Valley – Minford Run.

Drainage Design - The collection of storm water runoff will be addressed off the bridge. The type of drainage system will be investigated as part of the preliminary design.

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

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

5. Proposed Structure Configurations

Alignment & Profile: The proposed horizontal geometry is along a tangent alignment across the entire length of both the left and right structures. The proposed mainline profile is located on the inside edge of pavement for both bridges and is along a constant sloping grade of +0.5%. The horizontal and vertical geometry for all alternatives considered are the same. Embankment slopes will be a maximum 2:1 in order to minimize right-of-way impacts.

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

Four alternatives have been evaluated in this Structure Type Study, and are designated as Alternative 1, 2, 3 and 4. The appropriate structure types that were considered are outlined in the Structure Type Alternative Table:

STRUCTURE TYPE ALTERNATIVE TABLE				
Structure Type Alternative	1	2	3	4
Superstructure Type Description	Tangent Prestressed Concrete Girders Modified AASHTO Type 4 (72")	Tangent, continuous A709 Grade 50W Steel Plate Girders	Tangent, continuous A709 Grade 50W Steel Plate Girders	Tangent Prestressed Concrete Girders AASHTO Type 4 (54")
Proposed Beam Spacing	5 Spaces @ 8'-0" /per Bridge	4 Spaces @ 9'-6" /per Bridge	4 Spaces @ 9'-6" /per Bridge	5 Spaces @ 8'-0" /per Bridge
No. of Spans	2	2	4	4
Abutment Type	Semi Integral Type with MSE wall	Semi Integral Type with MSE wall	Semi Integral Type with spill-through slopes	Semi Integral Type with spill-through slopes
No. of Piers	1	1	3	3
Pier Type	T-type	T-type	T-type	T-type
Substructure Orientation	None	None	13°00'00" (RF)	13°00'00" (RF)
Approximate Bridge Length	260'	260'	386'	386'
Approximate Structure Depth **Slab** **Haunch** **Beam**	 8.50" 2" 72"	 8.75" 2" 53"	 8.75" 2" 44.25"	 8.50" 2" 54"
Total	82.5"(6.875')	63.75"(5.3125')	55"(4.583')	64.5"(5.375')

Alternative Discussion:

Alternative 1

Span configuration: This alternative is comprised of two equal 130' spans with semi-integral type abutments with MSE Walls. The bridge overall length is 260' from centerline of bearing to centerline of bearing.

Substructure: The abutment, piers and MSE walls are at a 90°00'00" skew to the roadway alignment, and the face of the rear abutment MSE wall is located outside of the minimum horizontal clearance envelope. The bridge will be designed using semi-integral type abutment since it does not exceed the limitations outlined in the Bridge Design Manual.

I. *Abutments:* The rear and forward abutments will both be a semi-integral type abutment supported on H-piles (HP 12x53) with a design capacity of 70-tons per pile driven to refusal. MSE walls will be provided in front of the stub abutment and they will maintain the requirement shown in the Bridge Design Manual.

II. *Piers:* Pier 1 will be a T-type pier supported on a spread footing founded on bedrock.

Superstructure: The preliminary design of this alternative indicates that 6 - Prestressed Modified AASHTO Type 4 (72") beams spaced at 8'-0" would be required to accommodate the HS25 design loading requirements. Each bridge width is 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0.

Alternative 2

Span configuration: This alternative is the exact same layout as Alternative 1, but the superstructure is modeled with steel plate girders supporting the bridge deck.

Substructure: The abutment, piers and MSE walls are at a 90°00'00" skew to the roadway alignment, and the face of the rear abutment MSE wall is located outside of the minimum horizontal clearance envelope. The bridge will be designed using semi-integral type abutment since it does not exceed the limitations outlined in the Bridge Design Manual.

I. *Abutments:* The rear and forward abutments will both be a semi-integral type abutment supported on H-piles (HP 12x53) with a design capacity of 70-tons per pile driven to refusal. MSE walls will be provided in front of the stub abutment and they will maintain the requirement shown in the Bridge Design Manual.

II. *Piers:* Pier 1 will be a T-type pier supported on a spread footing founded in bedrock.

Superstructure: The preliminary design of this alternative indicates that 5 – continuous welded steel plate girders (A709 Grade 50W) spaced at 9'-6"would be required for each structure to accommodate the HS25 design loading requirements. Each bridge width is similar to Alternative 1 with a distance of 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0.

Alternative 3

Span configuration: This alternative is comprised of 86'-107'-107'-86' layout with an end span ratio of 0.80. The location of Swauger Valley – Minford Road and adjacent stream controlled the location of the two middle spans. The end spans were then proportioned accordingly to equalize the positive moment in all spans as recommend in Section 205.6 of the Bridge Design Manual. Embankment slopes will be a maximum of 2:1 in order to minimize right-of-way impacts. The bridge overall length is 360' from centerline of bearing to centerline of bearing.

Substructure: The abutments and piers were all located at a 13°00'00" (RF) skew to the roadway alignment.

III. *Abutments:* The rear and forward abutments will both be a semi-integral type abutment supported on H-piles (HP 12x53) with a design capacity of 70-tons per pile driven to refusal. Straight or U-turned type wingwall will also be provided at each abutment. The details of the abutments and wingwalls will follow ODOT Standard Construction drawings.

IV. *Piers:* Piers 1 through 3 will be a T-type pier supported on a spread footing founded on bedrock.

The H-Pile type foundation for the substructure units will be further evaluated during the Preliminary Engineering Report submittal (TS&L Submittal). It may be necessary to provide drilled shafts type foundation due to the close proximity of rock surfaces to the bottom of the proposed footings.

Superstructure: The preliminary design of this alternative indicates that 5 – continuous welded steel plate girders (A709 Grade 50W) spaced at 9'-6"would be required for each structure to accommodate the HS25 design loading requirements. Each bridge width is similar to Alternative 1 with a distance of 42'-0" from toe to toe of parapets with an overall bridge deck width of 45'-0.

Alternative 4

Span configuration: This alternative is the exact same layout as Alternative 3, but the superstructure is modeled with prestressed I-girders supporting the bridge deck. The bridge overall length is 360' from centerline of bearing to centerline of bearing.

Substructure: The abutments and piers were all located at a 13°00'00" (RF) skew to the roadway alignment.

V. *Abutments:* The rear and forward abutments will both be a semi-integral type abutment supported on H-piles (HP 12x53) with a design capacity of 70-tons per pile driven to refusal. Straight or U-turned type wingwall will also be provided at each abutment. The details of the abutments and wingwalls will follow ODOT Standard Construction drawings.

VI. *Piers:* Piers 1 through 3 will be a T-type pier supported on a spread footing founded in bedrock.

Superstructure: The preliminary design of this alternative indicates that 6 - Prestressed AASHTO Type 4 (54") beams spaced at 8'-0" would be required to accommodate the HS25 design loading requirements. Each bridge width is similar to Alternative 1 with a distance of 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, 2, 3 and 4 (See Appendix A). The unit prices were based on ODOT's Summary of Contracts Awarded Year 2004 inflated 3.5% each year to the 2008 sale date. This estimate will be used as a comparison between alternatives and as a guide to select the most economical structure.

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 CONST. COST**	**RATING**	**ADVANTAGES/ DISADVANTAGES**
1	2 span tangent 72" Modified AASHTO Type 4 Prestressed Concrete Beams with a composite reinforced concrete deck slab supported by reinforced concrete semi-integral abutments and T-type piers on various foundations.	**Structure Cost: $4,360,000 Additional Life Cycle Cost: $1,227,000 Total Relative Ownership Cost: $5,587,000**	2	***Advantages:*** • This alternative has the lowest total relative ownership cost. • This alternative is one of the least expensive to construct ***Disadvantages:*** • Potential construction difficulties with long span heavy prestressed girder and high crane lifts.
2	2-span continuous tangent steel plate girders, A709 Grade 50W with a composite reinforced concrete deck slab supported by reinforced concrete semi-integral abutments and T-type piers on various foundations	**Structure Cost: $4,570,000 Additional Life Cycle Cost: $1,102,000 Total Relative Ownership Cost: $5,672,000**	3	***Advantages:*** • This alternative has the lowest total life cycle cost. ***Disadvantages:*** • Uncertainty with Steel Prices. • Potential delivery and construction difficulties with long span steel girders.
(*) Recommended **3**	4-span continuous tangent steel plate girders, A709 Grade 50W with a composite reinforced concrete deck slab supported by reinforced concrete semi-integral abutments and T-type piers on various foundations	**Structure Cost: $4,350,000 Additional Life Cycle Cost: $1,605,000 Total Relative Ownership Cost: $5,955,000**	1	***Advantages:*** • This alternative is one of the least expensive to construct. • Shorter girder lengths with field splices will facilitate easier transport and construction. ***Disadvantages:*** • Uncertainty with Steel Prices.
4	4 span tangent 54" AASHTO Type 4 Prestressed Concrete Beams with a composite reinforced concrete deck slab supported by reinforced concrete semi-integral abutments T-type piers on various foundations.	**Structure Cost: $4,450,000 Additional Life Cycle Cost: $1,736,000 Total Relative Ownership Cost: $6,186,000**	4	***Advantages:*** • ***Disadvantages:*** • This alternative has the highest life cycle and total ownership cost. • Potential construction difficulties with long span prestressed girder and high crane lifts

8. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 3 (Four Span, steel plate girders with semi-integral abutments and T-type piers)** for the Bridge. (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 from a construction standpoint.
- Transport and erection of shorter steel pieces during construction will be easier than long and heavy prestressed girders.

APPENDIX A

TRANSYSTEMS CORPORATION

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S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY

By: BTA Date: 7/8/2005
Checked: ELK Date: 7/13/2005

ALTERNATIVE COST SUMMARY

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Framing Alternative	Proposed Stringer Section	Subtotal Superstructure Cost	Subtotal Substructure Cost	Structure Incidental Cost (16%)	Structure Contingency Cost (20%)	Total Alternative Cost	Life Cycle Maintenance Cost	Total Relative Ownership Cost
1	2	130' - 130'	260.00	6 Prestressed I-Girders /per BRIDGE	Modified AASHTO Type 4 (72")	$1,687,000	$1,442,000	$500,600	$725,900	$4,360,000	$1,227,000	$5,587,000
2	2	130' - 130'	260.00	5 Steel Girders /per BRIDGE	48" Web Grade 50W	$1,913,000	$1,367,000	$524,800	$761,000	$4,570,000	$1,102,000	$5,672,000
3	4	86' - 107' - 107' - 88'	386.00	5 Steel Girders /per BRIDGE	40" Web Grade 50W	$2,302,000	$821,000	$499,700	$724,500	$4,350,000	$1,605,000	$5,955,000
4	4	86' - 107' - 107' - 88'	386.00	6 Prestressed I-Girders /per BRIDGE	AASHTO Type 4 (54")	$2,298,000	$901,000	$511,800	$742,200	$4,450,000	$1,736,000	$6,186,000

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: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Girder Section	Concrete Girder Cost	Subtotal Superstructure Cost	Construction Complexity Factor	Subtotal Superstructure Cost
1	2	130' - 130'	260.00	264.00	854	$504,700	$214,200	$82,500	6 Prestressed I-Girders /per BRIDGE	Modified AASHTO Type 4 (72")	$885,900	$1,687,000	0%	$1,687,000

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	4.26	4.26

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.71	45.00	32.0	3.2	43.7
Right Bridge	0.71	45.00	32.0	3.2	43.7

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

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

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$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	
AASHTO Type IV Beams							
Type 4 I-Beams	$16,000	ea.	3.5%	$18,360	ea.	0	$0
Pier Diaphragms	$1,800	ea.	3.5%	$2,070	ea.	10	$20,700
Abutment Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	20	$27,600
Intermediate Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	88	$121,440
Modified Type 4 I-Beams (72")	$26,000	ea.	3.5%	$29,840	ea.	24	$716,160
						TOTAL =	$885,900

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

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft. Width = 90 ft
Area = 250 sq. yd.

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

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

	Cost Ratio	Year 2004	Annual Escalation	Year 2008
Modular Expansion Joints (2001 Price)	1.00	$863.00	3.5%	$1,097.98

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S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 1 - SUBSTRUCTURE

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

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 Abutment & Wingwall Cost	Additional Crane Cost	Subtotal Substructure Cost
1	2	130' - 130'	6 Prestressed I-Girders /per BRIDGE	Modified AASHTO Type 4 (72")	$163,300	$37,200	$170,100	$27,900	$65,700	$902,400	$75,000	$1,442,000

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	80	$421.00	3.5%	$483.00	$38,640
Stem	124	$421.00	3.5%	$483.00	$59,890
Footings	134	$421.00	3.5%	$483.00	$64,720
Total Cost	338				$163,300

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 Cost					$0

Abutment QC/QA Concrete, Class QSC1 Cost:

Component	Volume (cu. yd.)	Year 2004	Annual Escalation	Year 2008	Total Cost
Abutment	320	$421.00	3.5%	$483.00	$154,600
Wingwalls	32	$421.00	3.5%	$483.00	$15,500

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

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

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

	Total Area (sq. ft.)	Year 2004 Unit Cost	Annual Escalation	Year 2008
Alt. 1	14,555	$54.00	3.5%	$62.00

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

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

Number of Piles		Total Pile Length
60	SEE QUANTITY CALCULATIONS	1,950

Pile Foundation Unit Cost ($/ft.):

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

Shaft Foundation Unit Cost ($/ft.): 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	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. 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 ALTERNATIVE 1 - QUANTITY CALCULATIONS

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

Pier Quantities

Pier Location	Length	Cap				Stem					Footing					Total Volume
		Width	Depth	Area	Volume	Width	Height	Length		Volume	Width	Depth	Length		Volume	
Pier 1 (Spr Ftg)	45	4.5	5.333	24.00	1080	3	37.41	15.00		1683	15	4	30.00		1800	4563
Pier 2																
Pier 3																0
Pier 4																0
Pier 5																0
Pier 6																0
Pier 7																0
Total (Cu.Ft.)					1080					1683					1800	4563
Total (Cu.Yd.)					40					62					67	169
			Qty x 2 (L/R)		80					124					134	338

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	15	674.0	654.0	27.0	405
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	15	675.25	644	38.0	570
TotaL								30				975
							Qty x 2 (L/R)	60				1950

Includes 5' of additional length into rock

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	45	3	7.75	23.25	1046	3	2.32	6.96		313	6	3	18	1	810	2169
Fwd. Abut	45	3	7.75	23.25	1046	3	2.17	6.51		293	6	3	18	1	810	2149
Total (Cu.Ft.)					2093					606					1620	4319
Total (Cu.Yd.)					78					22					60	160
			Qty x 2 (L/R)		156					44					120	320

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

MSE Abutment Wall Quantities

Abut Location		Wall			
		Height	Length	Area	Volume
Rear Abut		24.5	140	3430.0	
RA Wing (L)	0.5	28.5	58	826.5	
RA Wing (R)	0.5	28.5	58	826.5	
Fwd Abut		40	140	5600.0	
FA Wing (L)	0.5	44	88	1936.0	
FA Wing (R)	0.5	44	88	1936.0	
Total (Sq.Ft.)				14555	

Superstructure P/S Concrete Quantities

Location	Type of girder	# Girders	Span Length (ft.)	Total Length (ft.)	Spacing Int.	No. of Int in span	Number of Int Diap. 1 location	Total No. in Span
Span 1	MOD TYPE 4 72	12	130	1560	43.33	4	11	44
Span 2	MOD TYPE 4 72	12	130	1560	43.33	4	11	44
Span 3		0	0	0	0.00	3	0	0
Span 4		0	0	0	0.00	3	0	0
Span 5		0	0	0	0.00	3	0	0
Span 6		0	0	0	0.00	3	0	0
Span 7		0	0	0	0.00	3	0	0
Span 8		0	0	0	0.00	3	0	0
Span 9		0	0	0	0.00	3	0	0
					Total			88
TotaL	MOD TYPE 4 60	24		3120				

SCI-823-0.00 - PORTSMOUTH BYPASS
S.R. 823 over Swauger Valley - Minford Road L/R
STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 2 - SUPERSTRUCTURE

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Stringer Section	Structural Steel Weight (Pounds)	Structural Steel Cost	Subtotal Superstructure Cost
2	2	130' - 130'	260	264	873	$515,200	$219,000	$82,500	5 Steel Girders /per BRIDGE	48" Web Grade 50W	910,000	$1,096,500	$1,913,000

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	4.26	4.26

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.73	45.00	32.9	3.3	44.7
Right Bridge	0.73	45.00	32.9	3.3	44.7

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

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

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$590.00

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 2004	Annual Escalation	Year 2008	
Rolled Beams - Grade 50	n/a	$0.74	3.5%	$0.85	
Level 4 Plate Girders - Grade 50W	n/a	$1.05	3.5%	$1.20	Straight Girders
level 5 Plate Girders - Grade 50W	n/a	$1.20	3.5%	$1.38	Curved Girders

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft. Width = 90 ft
Area = 250 sq. yd.

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

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

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

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 2 - SUBSTRUCTURE

By: BTA Date: 7/8/2005
Checked: ELK Date: 7/13/2005

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 Abutment & Wingwall Cost	Subtotal Substructure Cost
2	2	130' - 130'	5 Steel Girders /per BRIDGE	48" Web Grade 50W	$153,600	$35,000	$150,900	$24,700	$69,800	$932,800	$1,367,000

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	54	$421.00	3.5%	$483.00	$26,080
Stem	130	$421.00	3.5%	$483.00	$62,790
Footings	134	$421.00	3.5%	$483.00	$64,720
Total Cost	318				$153,600

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	284	$421.00	3.5%	$483.00	$137,200
Wingwalls	28	$421.00	3.5%	$483.00	$13,700

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

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

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

	Total Area (sq. ft.)	Year 2004 Unit Cost	Annual Escalation	Year 2008
Alt. 1	15,045	$54.00	3.5%	$62.00

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

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

Number of Piles		Total Pile Length
60	SEE QUANTITY CALCULATIONS	2,070

Pile Foundation Unit Cost ($/ft.):

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

Shaft Foundation Unit Cost ($/ft.): 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	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. 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

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Swauger Valley - Minford Road L/R

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

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

Pier Quantities

Pier Location	Length	Cap				Stem					Footing					Total Volume
		Width	Depth	Area	Volume	Width	Height	Length		Volume	Width	Depth	Length		Volume	
Pier 1 (Spr Ftg)	45	3	5.333	16.00	720	3	39	15.00		1755	15	4	30.00		1800	4275
Pier 2																0
Pier 3																0
Pier 4																0
Pier 5																0
Pier 6																0
Pier 7																0
Total (Cu.Ft.)					720					1755					1800	4275
Total (Cu.Yd.)					27					65					67	158
		Qty x 2 (L/R)			54					130					134	316

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	45	3	6.17	18.51	833	3	2.15	6.45		290	6	3	18	1	810	1933
Fwd. Abut	45	3	6.17	18.51	833	3	2	6.00		270	6	3	18	1	810	1913
Total (Cu.Ft.)					1666					560					1620	3846
Total (Cu.Yd.)					62					21					60	142
		Qty x 2 (L/R)			124					42					120	284

MSE Abutment Wall Quantities

Abut Location		Wall			
		Height	Length	Area	Volume
Rear Abut		26.5	140	3710.0	
RA Wing (L)	0.5	28.5	58	826.5	
RA Wing (R)	0.5	28.5	58	826.5	
Fwd Abut		41.5	140	5810.0	
FA Wing (L)	0.5	44	88	1936.0	
FA Wing (R)	0.5	44	88	1936.0	
Total (Sq.Ft.)				15045	

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	15	675.8	654.0	29.0	435
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	15	677	644	40.0	600
TotaL								30				1035
							Qty x 2 (L/R)	60				2070

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	350	10	130	455000
Span 2	350	10	130	455000
Span 3	0	0	0	0
Span 4	0	0	0	0
Span 5	0	0	0	0
Span 6	0	0	0	0
Span 7	0	0	0	0
Span 8	0	0	0	0
TotaL				910000

total steel weight per girder (lb.) = 91000
Total Span length (ft.)= 260.00
Weight Per ft. = 350

SCI-823-0.00 - PORTSMOUTH BYPASS
S.R. 823 over Swauger Valley - Minford Road L/R
STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 3 - SUPERSTRUCTURE

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Stringer Section	Structural Steel Weight (Pounds)	Structural Steel Cost	Subtotal Superstructure Cost
3	4	86' - 107' - 107' - 88'	386	390	1290	$761,100	$323,500	$82,500	5 Steel Girders /per BRIDGE	40" Web Grade 50W	941,840	$1,134,800	**$2,302,000**

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	4.26	4.26

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.73	45.00	32.9	3.3	44.7
Right Bridge	0.73	45.00	32.9	3.3	44.7

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

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

	Year 2004	Annual Escalation	Year 2008
Deck	$491.00	3.5%	$563.00
Parapets	$615.00	3.5%	$706.00
Weighted Average =			$590.00

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 2004	Annual Escalation	Year 2008	
Rolled Beams - Grade 50	n/a	$0.74	3.5%	$0.85	
Level 4 Plate Girders - Grade 50W	n/a	$1.05	3.5%	$1.20	Straight Girders
level 5 Plate Girders - Grade 50W	n/a	$1.20	3.5%	$1.38	Curved Girders

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft. Width = 90 ft
Area = 250 sq. yd.

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

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

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

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 3 - SUBSTRUCTURE

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

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	Subtotal Substructure Cost
3	4	86' - 107' - 107' - 88'	5 Steel Girders /per BRIDGE	40" Web Grade 50W	$457,900	$104,300	$163,700	$26,800	$68,700	$821,000

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	164	$421.00	3.5%	$483.00	$79,210
Stem	374	$421.00	3.5%	$483.00	$180,640
Footings	410	$421.00	3.5%	$483.00	$198,030
Total Cost	948				$457,900

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	308	$421.00	3.5%	$483.00	$148,800
Wingwalls	31	$421.00	3.5%	$483.00	$14,900

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

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

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

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

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

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

Number of Piles		Total Pile Length
60	SEE QUANTITY CALCULATIONS	2,040

Pile Foundation Unit Cost ($/ft.):

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

Shaft Foundation Unit Cost ($/ft.): 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	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. 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

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY - STEEL PLATE GIRDER ALTERNATIVE 3 - QUANTITY CALCULATIONS

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

Pier Quantities

Pier Location	Length	Cap				Stem					Footing					Total Volume
		Width	Depth	Area	Volume	Width	Height	Length		Volume	Width	Depth	Length		Volume	
Pier 1 (Spr Ftg)	46.18	3	5.333	16.00	739	3	34.32	15.40		1586	15	4	30.78		1847	4171
Pier 2 (Spr Ftg)	46.18	3	5.333	16.00	739	3	40.86	15.40		1888	15	4	30.78		1847	4473
Pier 3 (Spr Ftg)	46.18	3	5.333	16.00	739	3	34.39	15.40		1589	15	4	30.78		1847	4174
Pier 4																0
Pier 5																0
Pier 6																0
Pier 7																0
Total (Cu.Ft.)					2217					5062					5540	12819
Total (Cu.Yd.)					82					187					205	475
		Qty x 2 (L/R)			164					374					410	950

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	46.18	3	5.46	16.38	756	3	3.6	10.80		499	6	3	18	1	831	2086
Fwd. Abut	46.18	3	5.46	16.38	756	3	3.53	10.59		489	6	3	18	1	831	2077
Total (Cu.Ft.)					1513					988					1662	4163
Total (Cu.Yd.)					56					37					62	154
		Qty x 2 (L/R)			112					74					124	308

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	15	674.8	654.0	28.0	420
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	15	676.75	644	40.0	600
TotaL								30				1020
						Qty x 2 (L/R)		60				2040

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	244	10	86	209840
Span 2	244	10	107	261080
Span 3	244	10	107	261080
Span 4	244	10	86	209840
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				941840

total steel weight per girder (lb.) = 20984
Total Span length (ft.)= 260.00
Weight Per ft. = 81

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 4 - SUPERSTRUCTURE

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

SUPERSTRUCTURE

Alternative No.	Span Arrangement No. Spans	Span Arrangement Lengths	Total Span Length (ft.)	Deck Length (ft.)	Deck Volume (cu. yd.)	Deck Concrete Cost	Deck Reinforcing Cost	Approach Slab Cost	Framing Alternative	Proposed Girder Section	Concrete Girder Cost	Subtotal Superstructure Cost	Construction Complexity Factor	Subtotal Superstructure Cost
4	4	86' - 107' - 107' - 88'	386.00	390.00	1261	$745,500	$316,400	$82,500	6 Prestressed I-Girders /per BRIDGE	AASHTO Type 4 (54")	$1,153,100	$2,298,000	0%	$2,298,000

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	4.26	4.26

Slab:

	T (ft.)	W (ft.)	Slab Area	Haunch & Overhang Area	Total Concrete Area (sq. ft.)
Left Bridge	0.71	45.00	32.0	3.2	43.7
Right Bridge	0.71	45.00	32.0	3.2	43.7

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

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

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

AASHTO Type IV Beams	Year 2004		Annual Escalation	Year 2008		No. Required	
Type 4 I-Beams	$16,000	ea.	3.5%	$18,360	ea.	48	$881,280
Pier Diaphragms	$1,800	ea.	3.5%	$2,070	ea.	30	$62,100
Abutment Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	20	$27,600
Intermediate Diaphragms	$1,200	ea.	3.5%	$1,380	ea.	132	$182,160
Modified Type 4 I-Beams (60")	$26,000	ea.	3.5%	$29,840	ea.	0	$0
						TOTAL =	$1,153,140

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

Reinforced Concrete Approach Slabs (T=15")
Unit Cost ($/sq. yd.):
Length = 25 ft. Width = 90 ft
Area = 250 sq. yd.

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

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

	Cost Ratio	Year 2004	Annual Escalation	Year 2008
Modular Expansion Joints (2001 Price)	1.00	$863.00	3.5%	$1,097.98

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 4 - SUBSTRUCTURE

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

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	Additional Crane Cost	Subtotal Substructure Cost
4	4	86' - 107' - 107' - 88'	6 Prestressed I-Girders /per BRIDGE	AASHTO Type 4 (54")	$454,000	$103,400	$172,100	$28,200	$68,700	$75,000	$901,000

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	164	$421.00	3.5%	$483.00	$79,210
Stem	366	$421.00	3.5%	$483.00	$176,780
Footings	410	$421.00	3.5%	$483.00	$198,030
Total Cost	940				$454,000

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 Cost					$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	32	$421.00	3.5%	$483.00	$15,600

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

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

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

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

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

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

Number of Piles		Total Pile Length
60	SEE QUANTITY CALCULATIONS	2,040

Pile Foundation Unit Cost ($/ft.):

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

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

Number of Shafts		Total Shaft Length
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. 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

SCI-823-0.00 - PORTSMOUTH BYPASS

S.R. 823 over Swauger Valley - Minford Road L/R

STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE ALTERNATIVE 4 - QUANTITY CALCULATIONS

By: BTA
Checked: ELK

Date: 7/8/2005
Date: 7/13/2005

Pier Quantities

Pier Location	Length	Cap				Stem					Footing					Total Volume
		Width	*Depth*	*Area*	*Volume*	*Width*	*Height*	*Length*		*Volume*	*Width*	*Depth*	*Length*		*Volume*	
Pier 1 (Spr Ftg)	46.18	3	5.333	16.00	739	3	33.53	15.40		1549	15	4	30.78		1847	4135
Pier 2 (Spr Ftg)	46.18	3	5.333	16.00	739	3	40.07	15.40		1851	15	4	30.78		1847	4437
Pier 3 (Spr Ftg)	46.18	3	5.333	16.00	739	3	33.6	15.40		1552	15	4	30.78		1847	4138
Pier 4																0
Pier 5																0
Pier 6																0
Pier 7																0
Total (Cu.Ft.)					2217					4953					5540	12710
Total (Cu.Yd.)					82					183					205	471
			Qty x 2 (L/R)		164					366					410	942

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	46.18	3	6.25	18.75	866	3	3.56	10.68		493	6	3	18	1	831	2190
Fwd. Abut	46.18	3	6.25	18.75	866	3	3.49	10.47		484	6	3	18	1	831	2181
Total (Cu.Ft.)					1732					977					1662	4371
Total (Cu.Yd.)					64					36					62	162
			Qty x 2 (L/R)		128					72					124	324

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	15	674.8	654.0	28.0	420
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	15	676.75	644	40.0	600
TotaL								30				1020
							Qty x 2 (L/R)	60				2040

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 P/S Concrete Quantities

Location	Type of girder	# Girders	Span Length (ft.)	Total Length (ft.)	Spacing Int.	No. of Int in span	Number of Int Diap. 1 location	Total No. in Span
Span 1	AASHTO TYPE 4	12	86	1032	28.67	3	11	33
Span 2	AASHTO TYPE 4	12	107	1284	35.67	3	11	33
Span 3	AASHTO TYPE 4	12	107	1284	35.67	3	11	33
Span 4	AASHTO TYPE 4	12	86	1032	28.67	3	11	33
Span 5		0	0	0	0.00	3	0	0
Span 6		0	0	0	0.00	3	0	0
Span 7		0	0	0	0.00	3	0	0
Span 8		0	0	0	0.00	3	0	0
Span 9		0	0	0	0.00	3	0	0
					Total			132
TotaL	MOD TYPE 4 60	48		4632				

SCI-823-0.00 - PORTSMOUTH BYPASS
S.R. 823 over Swauger Valley - Minford Road L/R
STRUCTURE TYPE STUDY - LIFE CYCLE COSTS

By: BTA
Checked:

Date: 7/8/2005
Date:

LIFE CYCLE MAINTENANCE COST

Alt. No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Structural Steel Painting * Cost Per Cycle	Structural Steel Painting * Number of Maintenance Cycles	Structural Steel Painting * Total Life Cycle Cost	Superstructure Sealing Cost Per Cycle	Superstructure Sealing Number of Maintenance Cycles	Superstructure Sealing Total Life Cycle Cost	Approach Pavement Resurfacing Cost Per Cycle	Approach Pavement Resurfacing Number of Maintenance Cycles	Approach Pavement Resurfacing Total Life Cycle Cost
1	2	260.00	6 Prestressed I-Girders /per BRIDGE	$0	0	$0	$70,000	2	$140,000	$2,500	7	$17,500
2	2	260.00	5 Steel Girders /per BRIDGE	$407,200	0	$0	$0	0	$0	$2,500	7	$17,500
3	4	386.00	5 Steel Girders /per BRIDGE	$518,600	0	$0	$0	0	$0	$0	0	$0
4	4	386.00	6 Prestressed I-Girders /per BRIDGE	$0	0	$0	$76,800	2	$153,600	$0	0	$0

* - A709 Weathering Steel; assume no painting

Alt. No.	Span Arrangement No. Spans	Span Arrangement Lengths	Framing Alternative	Bridge Deck Overlay (5) Deck Demo & Chipping	Bridge Deck Overlay (5) Deck Overlay	Bridge Deck Overlay (5) Deck Joint Gland (2)	Bridge Deck Overlay (5) Number of Maintenance Cycles	Bridge Deck Overlay (5) Total Life Cycle Cost	Bridge Redecking (5) Deck Concrete Cost (3)	Bridge Redecking (5) Deck Reinforcing Cost (3)	Bridge Redecking (5) Deck Joint Cost (2)	Bridge Redecking (5) Deck Removal Cost	Bridge Redecking (5) Number of Maintenance Cycles	Bridge Redecking (5) Total Life Cycle Cost	Superstructure Life Cycle Maintenance Cost (1)	Total Initial Construction Cost	Total Relative Ownership Cost
1	2	260	6 Prestressed I-Girders /per BRIDGE	$70,900	$86,000	n/a	1	$156,900	$504,700	$214,200	n/a	$193,800	1	$912,700	$1,227,000	$4,360,000	$5,587,000
2	2	260	5 Steel Girders /per BRIDGE	$70,900	$86,000	n/a	1	$156,900	$515,200	$219,000	n/a	$193,800	1	$928,000	$1,102,000	$4,570,000	$5,672,000
3	4	386	5 Steel Girders /per BRIDGE	$105,300	$127,700	n/a	1	$233,000	$761,100	$323,500	n/a	$287,600	1	$1,372,200	$1,605,000	$4,350,000	$5,955,000
4	4	386	6 Prestressed I-Girders /per BRIDGE	$105,300	$127,700	n/a	1	$233,000	$745,500	$316,400	n/a	$287,600	1	$1,349,500	$1,736,000	$4,450,000	$6,186,000

Structural Steel Painting:
Structural Steel Area:

	Web Depth (in.)	No. Stringers	Total Span Length (ft.)	Assumed Ave. Bot. Flange Width (in.)	Nominal Exposed Girder Area (sq. ft.)	Secondary Member Allowance	Total Exposed Steel Area (sq. ft.)
Alt. 2	48	10	260.00	20.00	33,800	20%	40,600
Alt. 3	40	10	386.00	18.00	43,103	20%	51,700

Painting Cost per sq. ft.:

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

Superstructure Sealing:
PS Concrete I-Beam Area:
72" Modified AASHTO Type 4

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

54" AASHTO Type 2

	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 Fillets	6	6	8.49	2	16.97
Top Flange		8		2	16.00
Total Exposed Perimeter					146.43 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. 1	12	260.00	51,558	10%	6,300
Alt. 4	12	386.00	56,521	10%	6,910

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	90.00	0
Alt. 2	90.00	0
Alt. 3	92.40	0
Alt. 4	92.40	0

Bridge Deck Removal Cost:

	Deck Area (3) (sq. ft.)	Year 2008	Deck Removal Cost
Alt. 1	23,400	$8.28	$193,800
Alt. 2	23,400	$8.28	$193,800
Alt. 3	34,740	$8.28	$287,600
Alt. 4	34,740	$8.28	$287,600

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	23,400	2,600	65	59
Alt. 2	23,400	2,600	65	59
Alt. 3	34,740	3,860	97	87
Alt. 4	34,740	3,860	97	87

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

Bridge Deck Joint Gland Replacement Cost per foot:

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

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

NOTES:

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

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

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

Asphalt Resurfacing Costs:

	Approach Roadway Length (ft.) (4)	Approach Roadway Width (ft.)	Resurfacing Area (sq. yd.)	Wearing Course Thickness (in.)	Wearing Course Volume (cu. yd.)
Alt. 1	130.0	38.0	549	1.50	22.9
Alt. 2	130.0	38.0	549	1.50	22.9

APPENDIX B

TRANSYSTEMS CORPORATION

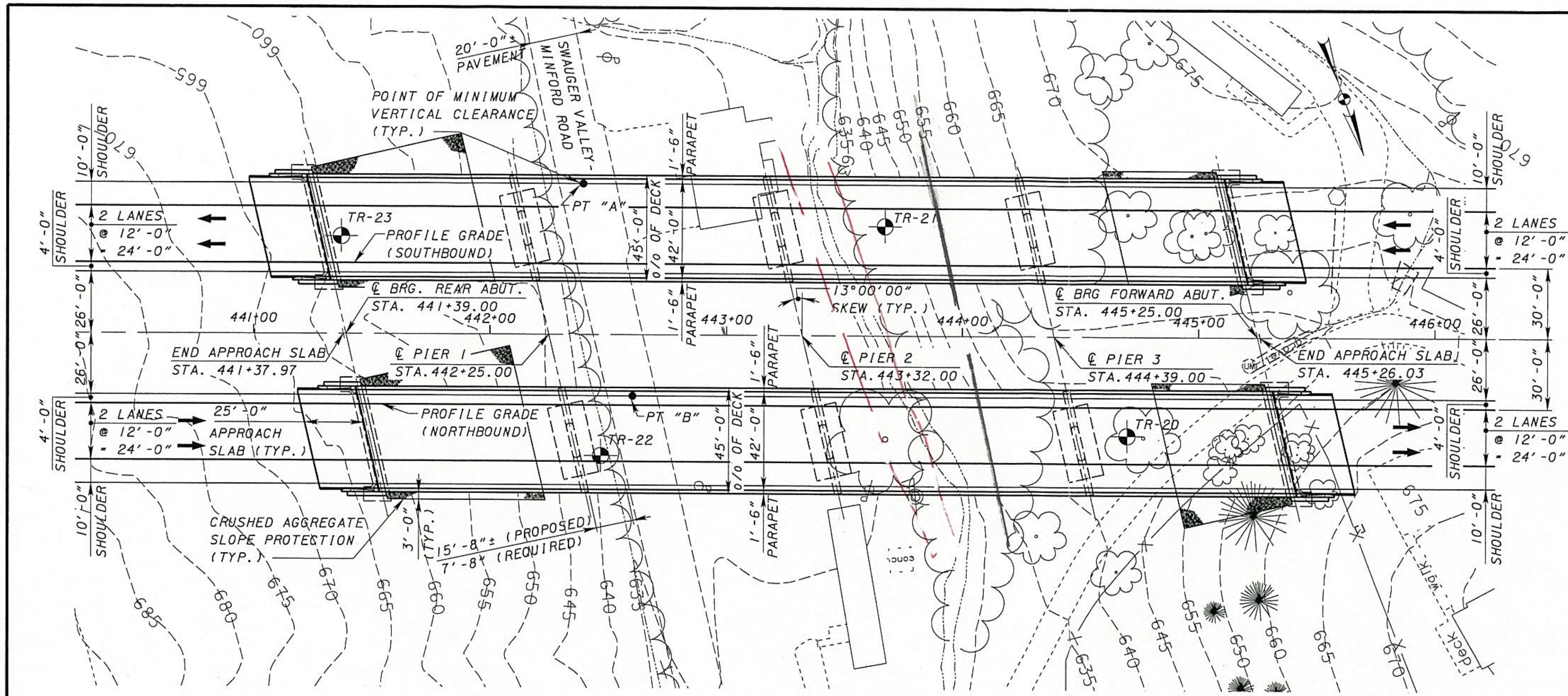
FIRST GUARDRAIL POST OFF BRIDGE LOCATIONS		
LOCATION	STATION	SIDE
REAR ABUT.	x	RT.
REAR ABUT.	x	LT.
FWD. ABUT.	x	RT.
FWD. ABUT.	x	LT.

BORING LOCATIONS		
BORING No.	STATION	OFFSET
TR-20	441+30.34	48.07' LT.
TR-21	442+46.93	51.45' RT.
TR-22	443+66.97	46.45' LT.
TR-23	444+69.73	42.09' RT.

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

TRAFFIC DATA

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



PLAN

DENOTES SOIL BORING LOCATION

60 Scale H+V

TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	40.7'±	44.7'±
REQUIRED	15.0'	15.0'

PROPOSED STRUCTURE

TYPE: 4 SPAN CONTINUOUS STEEL PLATE GIRDERS A709 GRADE 50W WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED ON REINFORCED CONCRETE SUBSTRUCTURE UNITS.

SPANS: 86'-0", 107'-0", 107'-0", 86'-0" c/c BEARINGS

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

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

SKEW: 13°00'00" (RIGHT FORWARD)

CROWN: 0.016 FT./FT.

ALIGNMENT: TANGENT

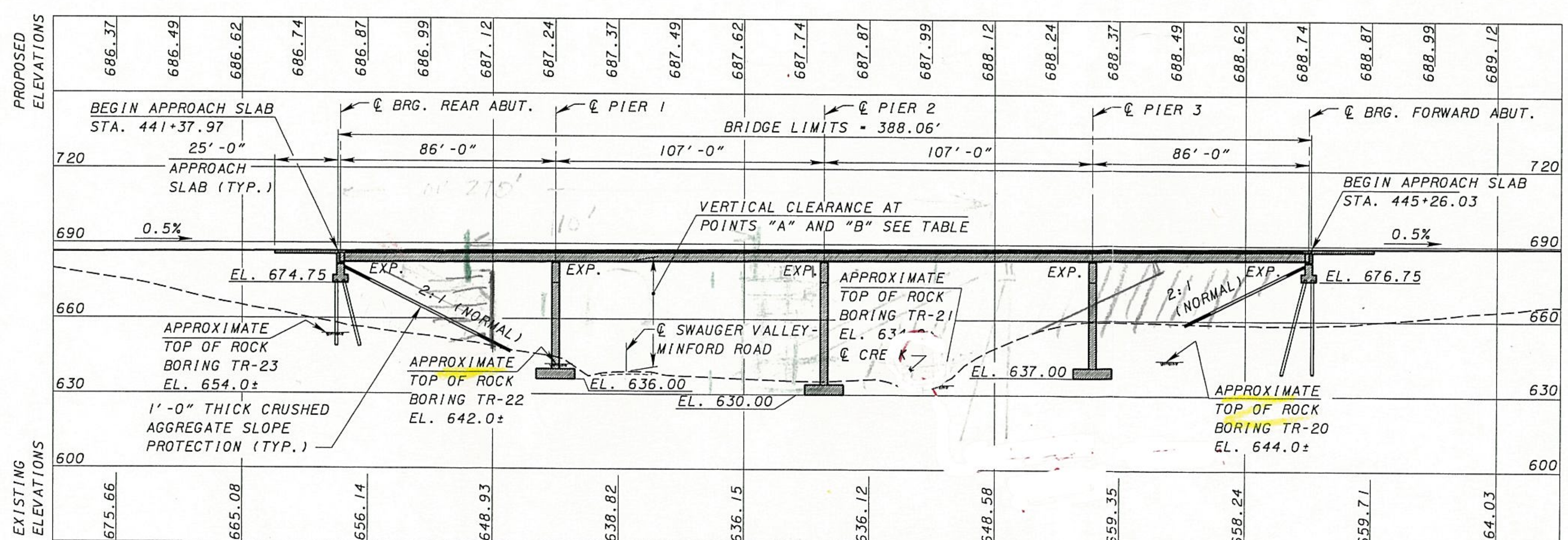
WEARING SURFACE: 1" MONOLITHIC CONCRETE

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

LATITUDE:

LONGITUDE:

STRUCTURE FILE NO. :



ELEVATION ALONG PROFILE GRADE S.R. 823

51.5'
≈45'

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 12x53 PILES AND HAVE A MAXIMUM CAPACITY OF 70 TONS PER PILE.

UTILITIES

UTILITIES DISPOSITION WILL BE ADDRESSED IN THE TS & L SUBMITTAL

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

DESIGNED BTA | CHECKED RER | DRAWN RCK | REVISED | REVIEWED NFF | DATE 07/12/05 | STRUCTURE FILE NUMBER

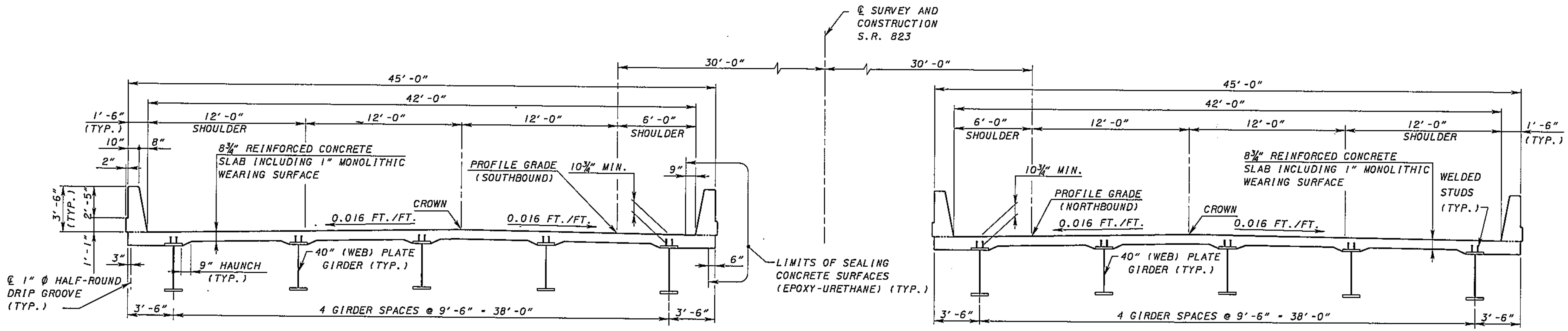
SCIOTO COUNTY
STA. 441+37.97
STA. 445+26.03

PRELIMINARY SITE PLAN - ALTERNATIVE 3
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SWAUGER VALLEY-MINFORD ROAD

SCI-823-0.00
PID 19415

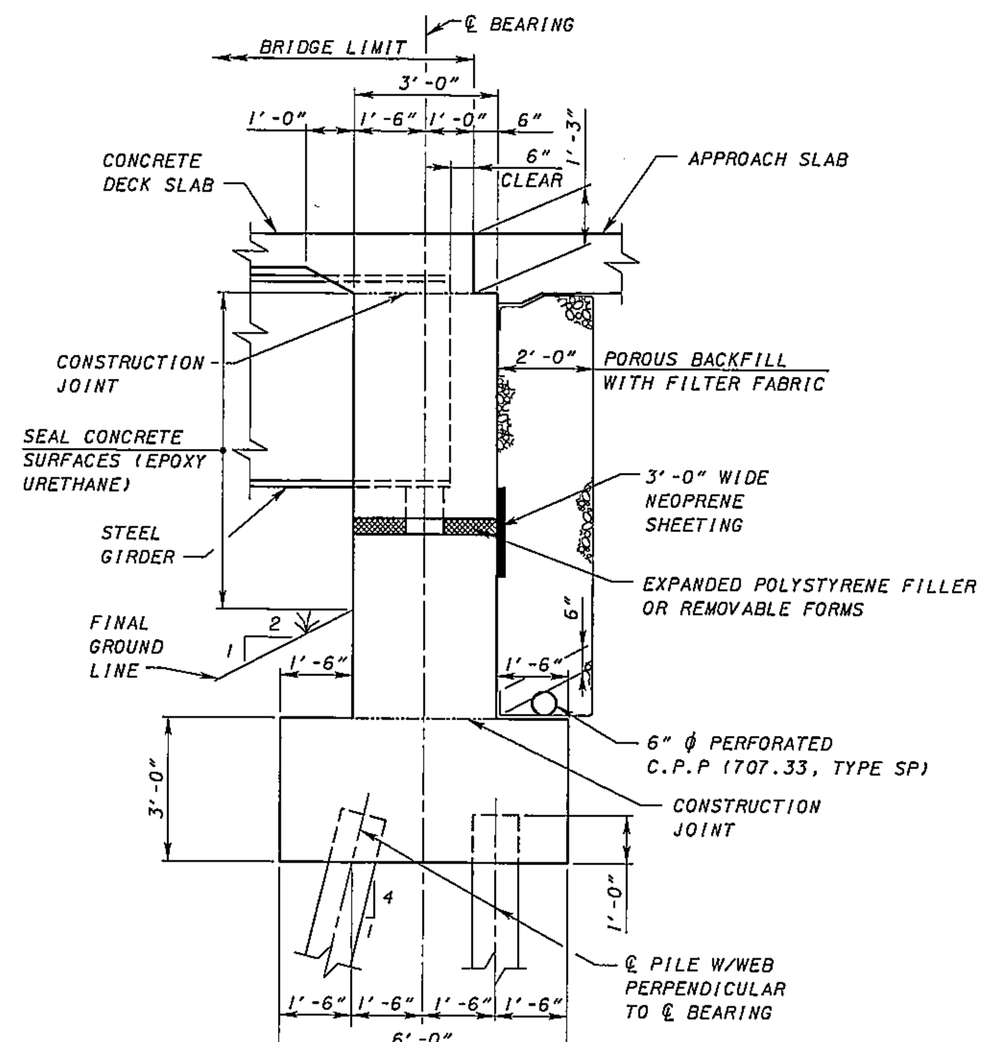
1/2

DATE: 07/13/2005 FILE: g:\C003\0064\Bridge\BTS\08-SwaugerValleyMinford\823-08sp01_alt3.dgn



PROPOSED TRANSVERSE SECTION

SUPERSTRUCTURE DEPTH	
ITEM	PLATE GIRDER 40" WEB
SLAB (INCLUDING WEARING SURFACE)	8¾"
HAUNCH (BOTTOM OF SLAB TO TOP OF FLANGE)	2"
GIRDER DEPTH	44.25"
TOP OF WEARING SURFACE TO BOTTOM OF GIRDER FLANGE (INCH)	55.00"
TOP OF WEARING SURFACE TO BOTTOM OF GIRDER FLANGE (FEET)	4.583'



TYPICAL ABUTMENT SECTION

DESIGN AGENCY: TRANSYSTEMS CORPORATION

DESIGNED	DRAWN	REVIEWED	DATE
BTA	RCK	NFF	7/9/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

TRANSVERSE SECTION - ALTERNATIVE 3
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SWAUGER VALLEY-MINFORD ROAD

SCI-823-0.00
PID 19415

2/2

DATE: 07/13/2005

APPENDIX C

TRANSYSTEMS CORPORATION

TRANSYSTEMS CORPORATION

Made By BTA Date 07/09/05 Job No. P403030064
Checked By Date Sheet No.

VERTICAL CLEARANCE CALCULATIONS

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

Alternative 3 - 5 Steel Plate Girders, 4 Span — *Point Location: A*

Adjstment for Cross Slope

Comment	Grade		Offset		
1 Lane:	0.016	x	12	=	0.19
1 Lane:	-0.016	x	12	=	-0.19
Shoulder to Beam CL:	-0.016	x	10		-0.16
			Total Adjustment	=	**-0.16**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.75	0.73
Haunch:	2	0.17
Girder or Beam Depth:	44.25	3.69
	55	4.59

Total Superstructure Depth (ft) = **4.59**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**442+40.68**
Offset Location @ Critical Point	=	**64.00' Left**
Profile Grade Elevation at Critical Point	=	687.32
Adjustment for Cross Slopes to Beam CL	=	-0.16
Top of Deck Elevation @ Critical Point	=	**687.16**
Total Superstructure Depth	=	-4.59
Bottom of Beam Elevation @ Critical Point	=	**682.57**
Approximate Top of Existing Ground @ Critical Point	=	**641.83**
Actual Vertical Clearance	=	***40.74***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

TRANSYSTEMS CORPORATION

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

VERTICAL CLEARANCE CALCULATIONS

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

Description S.R. 823 OVER SWAUGER VALLEY-MINFORD **PID #** 19415

Alternative 3 - 5 Steel Plate Girders, 4 Span — ***Point Location:*** *B*

Adjstment for Cross Slope

Comment	Grade		Offset		
Shoulder:	-0.016	x	4	=	-0.06
				=	0.00
					0
			Total Adjustment	=	**-0.06**

Superstructure Depth

Comment	Depth (in)	Depth (ft)
Deck Thickness:	8.75	0.73
Haunch:	2	0.17
Girder or Beam Depth:	44.25	3.69
	55	4.59

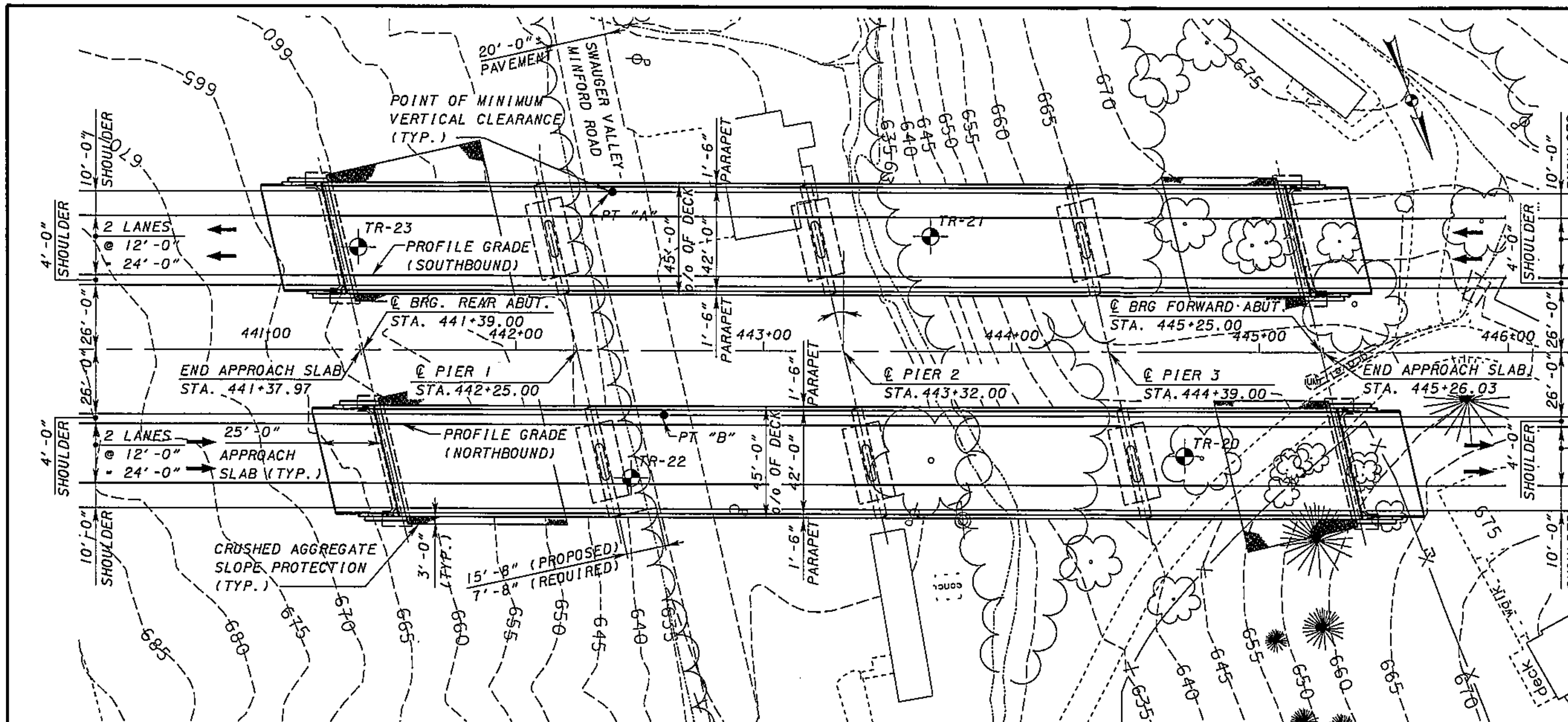
Total Superstructure Depth (ft) = **4.59**

Vertical Clearance at Critical Point

Station @ Critical Point	=	**442+60.08**
Offset Location @ Critical Point	=	**26.00' Right**
Profile Grade Elevation at Critical Point	=	687.42
Adjustment for Cross Slopes to Beam CL	=	-0.06
Top of Deck Elevation @ Critical Point	=	**687.36**
Total Superstructure Depth	=	-4.59
Bottom of Beam Elevation @ Critical Point	=	**682.77**
Approximate Top of Existing Ground @ Critical Point	=	**638.11**
Actual Vertical Clearance	=	***44.66***
Preferred Vertical Clearance	=	*15.0*
Required Vertical Clearance	=	*14.5*

APPENDIX D

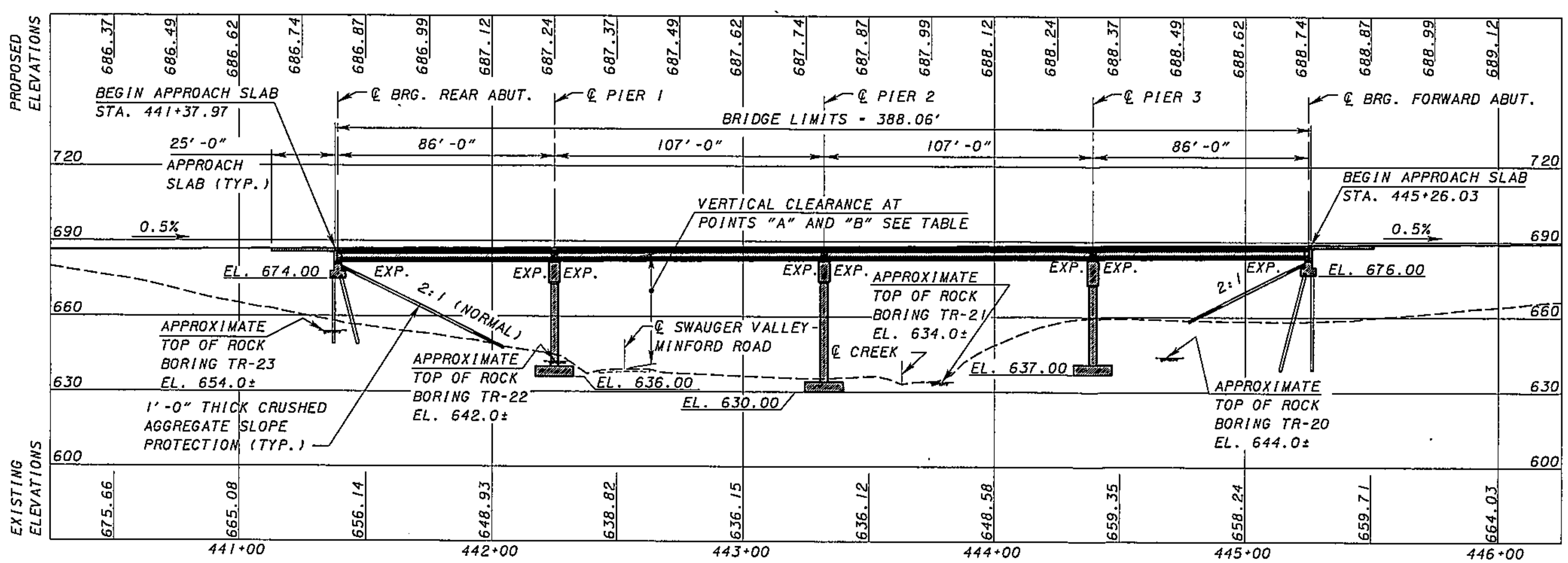
TRANSYSTEMS CORPORATION



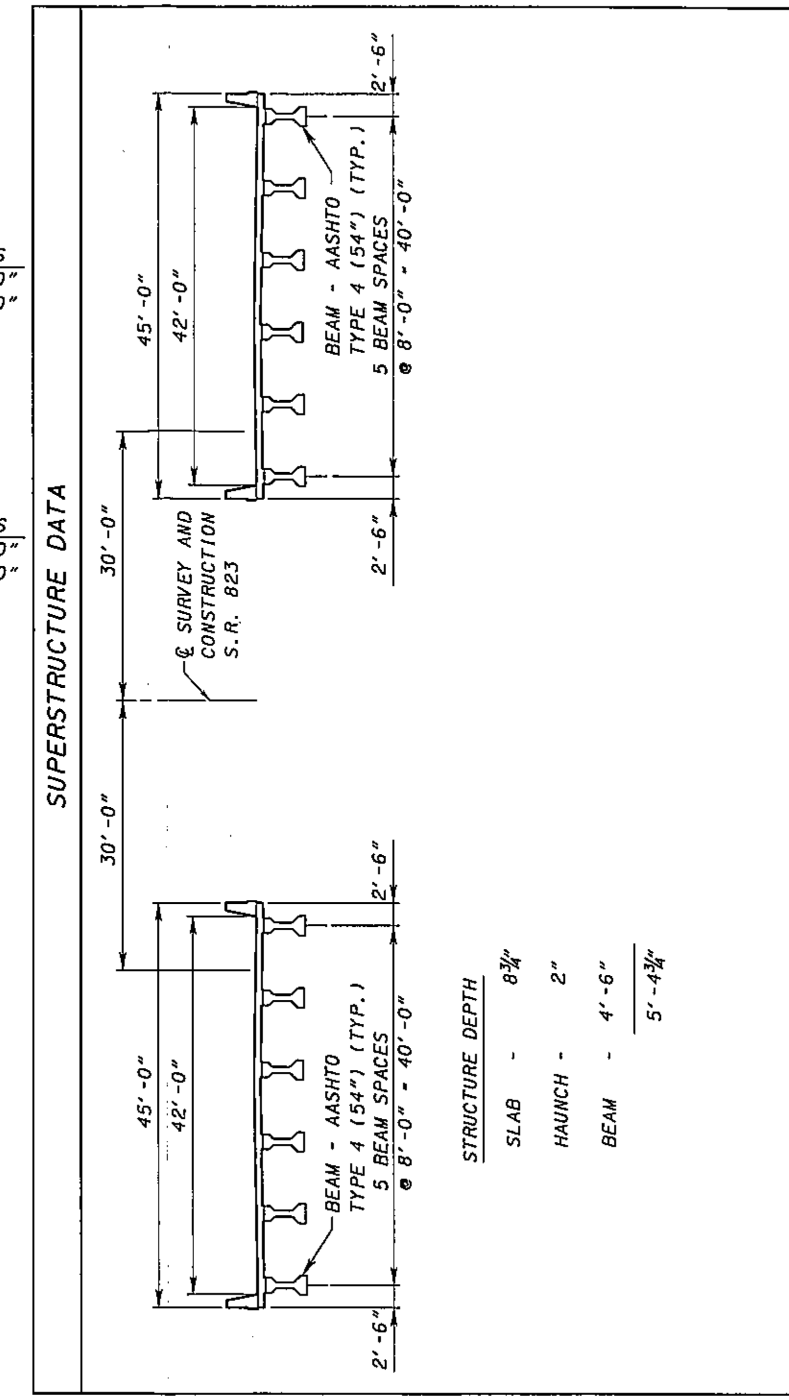
PLAN

DENOTES SOIL BORING LOCATION

TABLE OF VERTICAL CLEARANCES		
LOCATION	"A"	"B"
PROPOSED	40.0' ±	43.9' ±
REQUIRED	15.0'	15.0'



ELEVATION ALONG PROFILE GRADE S.R. 823



NOTES:

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

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 12x53 PILES AND HAVE A MAXIMUM CAPACITY OF 70 TONS PER PILE.

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

DESIGNED	DRAWN	REVIEWED	DATE
BTA	RCK	NFF	07/12/05
CHECKED	REVISED	STRUCTURE FILE NUMBER	
RER			

SCIOTO COUNTY
STA.
STA.

PRELIMINARY SITE PLAN - ALTERNATIVE 4
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SWAUGER VALLEY-MINFORD ROAD

SCI-823-0.00
PID 19415

1 / 1

DATE: 07/13/2005 FILE: g:\2003\0064\Bridges\BTS\08-Swauger Valley Minford\823-08sp0Lalt4.dgn

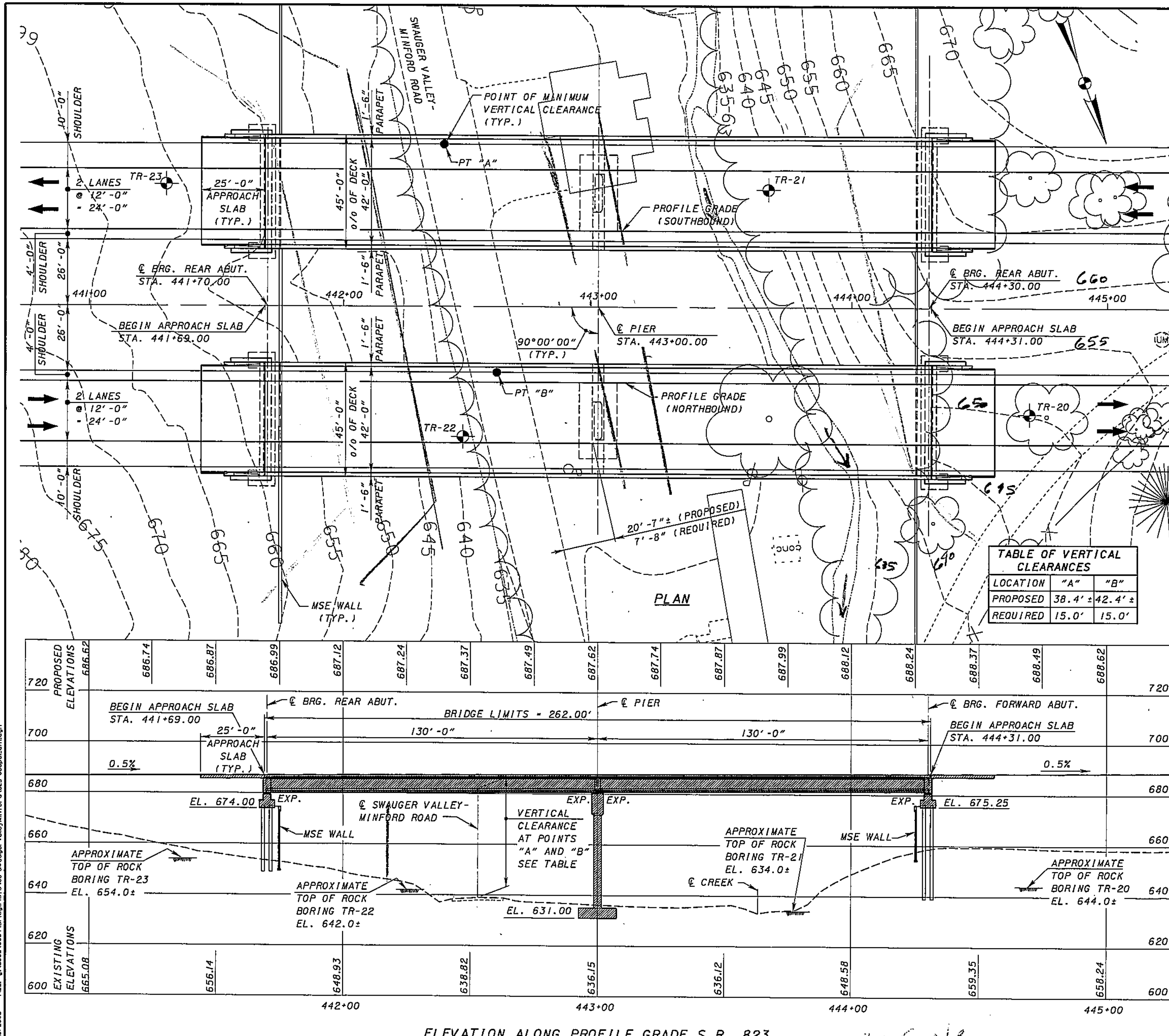
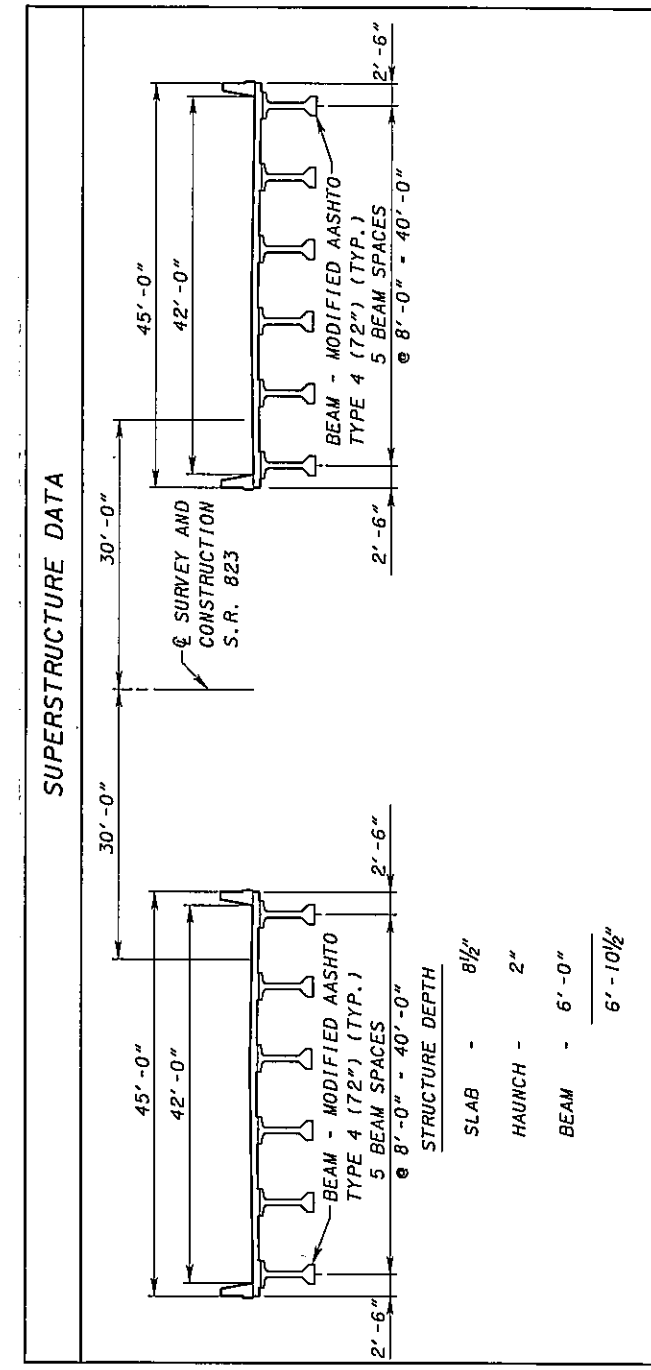


TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	38.4'±	42.4'±
REQUIRED	15.0'	15.0'

SUPERSTRUCTURE DATA



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 12x53 PILES AND HAVE A MAXIMUM CAPACITY OF 70 TONS PER PILE.

DESIGN AGENCY
TRANSYSTEMS CORPORATION

DESIGNED	DRAWN	REVIEWED	DATE
BTA	RCK	NFF	07/12/05
CHECKED RER	REVISED	STRUCTURE FILE NUMBER	

SCIOTO COUNTY
STA.
STA.

PRELIMINARY SITE PLAN - ALTERNATIVE I
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SWAUGER VALLEY-MINFORD ROAD

SCI-823-0.00
PID 19415

1/1

DATE: 7/13/2005

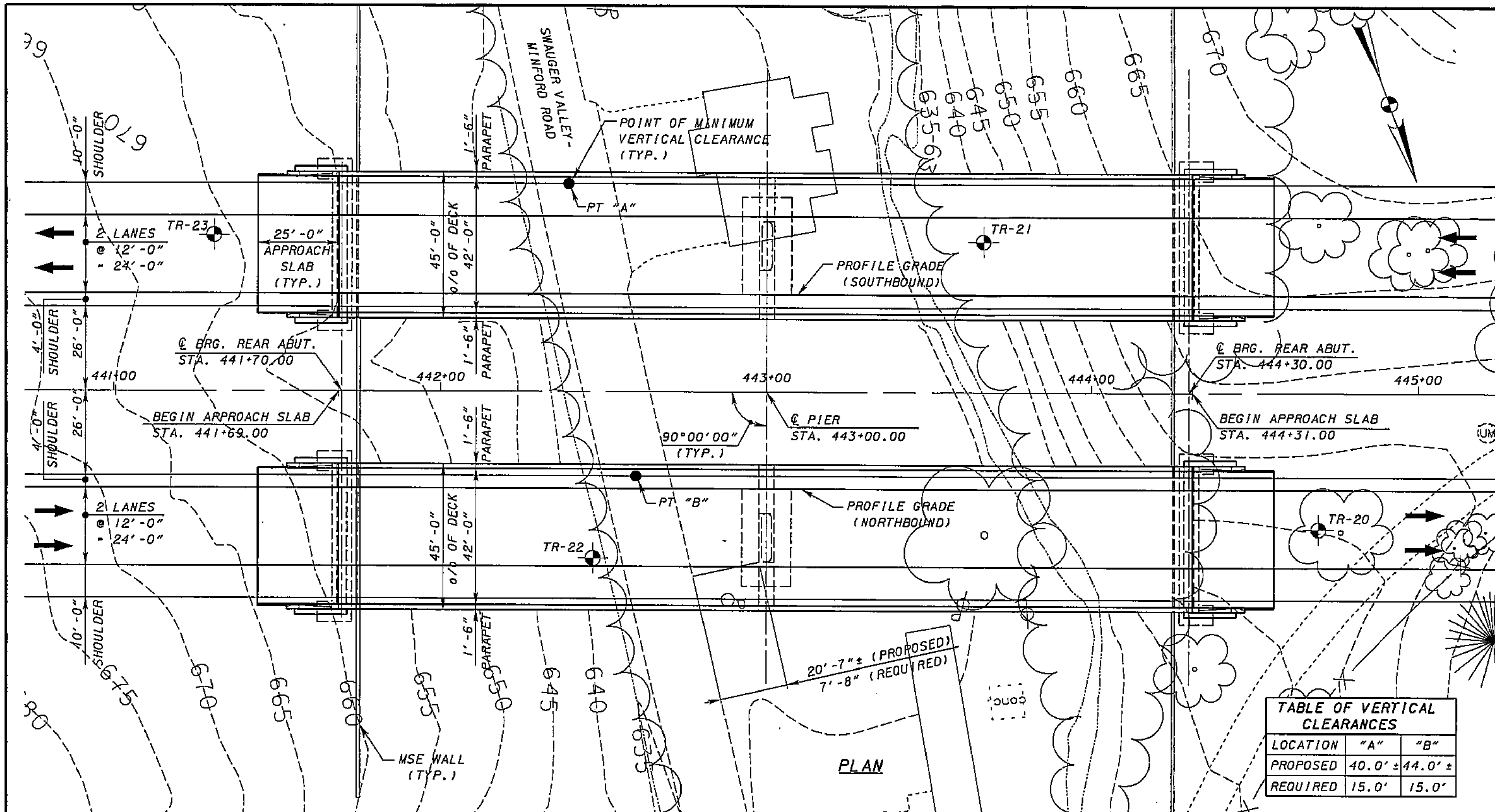
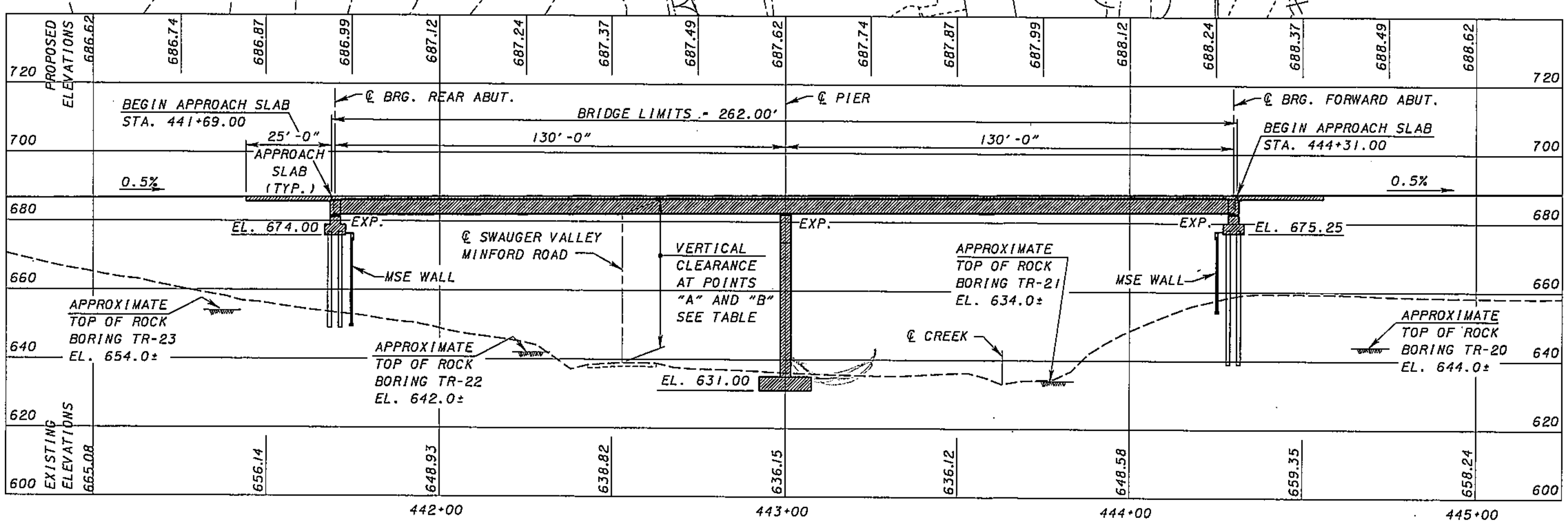
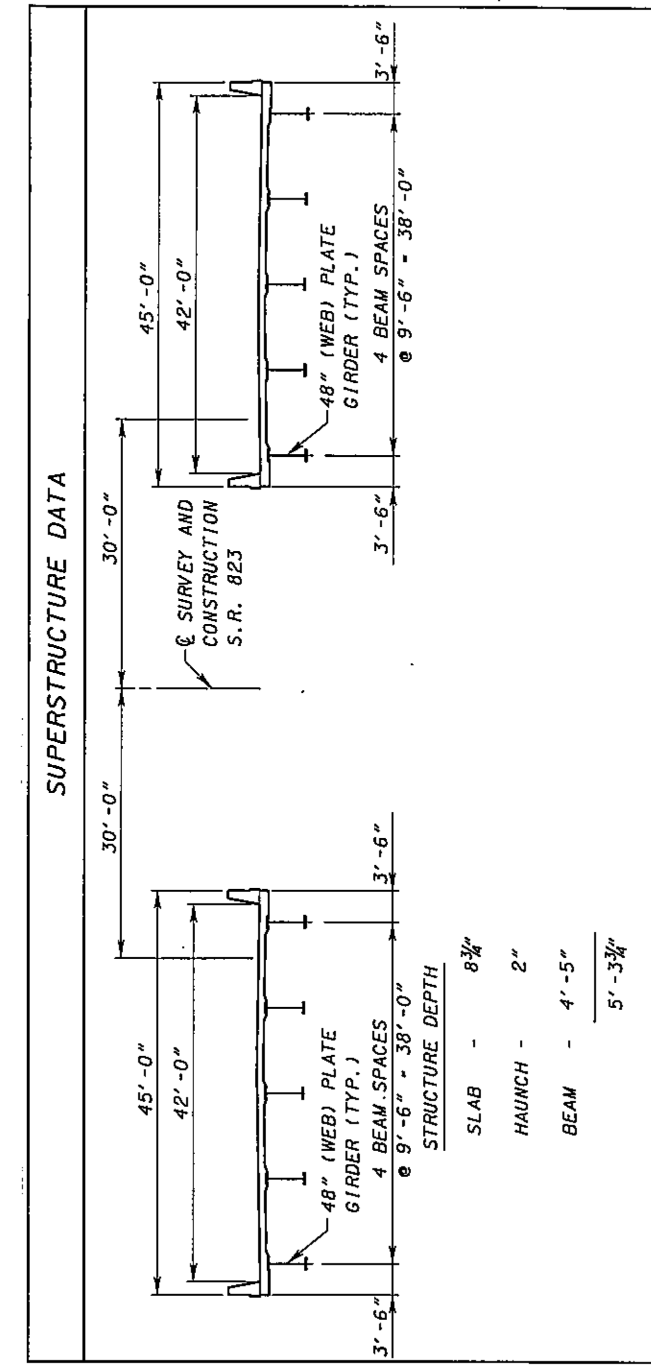


TABLE OF VERTICAL CLEARANCES

LOCATION	"A"	"B"
PROPOSED	40.0' ±	44.0' ±
REQUIRED	15.0'	15.0'



ELEVATION ALONG PROFILE GRADE S.R. 823



NOTES:

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

FOUNDATION DATA:

ALL NEW PILES SHALL BE HP 12x53 PILES AND HAVE A MAXIMUM CAPACITY OF 70 TONS PER PILE.

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

DESIGNED	CHECKED	DRAWN	REVISED	REVIEWED	DATE
BTA	RER	RCK		NFF	07/12/05

STRUCTURE FILE NUMBER

PRELIMINARY SITE PLAN - ALTERNATIVE 2
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER SWAUGER VALLEY-MINFORD ROAD

SCIOTO COUNTY
STA.
STA.

SCI-823-0.00
PID 19415

1/1

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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 Swauger Valley-Minford Road**
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 Swauger Valley-Minford Rd. It is anticipated that the proposed structure will be a three-span, elevated bridge with embankment fills at both abutment locations. The grade at the proposed locations for the forward and rear abutments varies along the cross section. The embankment fill at the forward abutment is understood to vary from 30 to 20 feet to the left and right of centerline, respectively, while the rear abutment fill embankment varies 20 to 40 feet from left and right of centerline, respectively. It is anticipated that the piers for the structure will be located at elevations similar to those existing at Swauger Valley-Minford Road and will generally be 50 feet in height. Currently, Swauger Valley-Minford Rd. is located along the east side of a stream. Bedrock exposures are evident along the streambed.

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 four borings, TR-20 through TR-23, were drilled at the proposed structure between August 3, 2004 and February 24, 2005. The borings were drilled to depths from 20.0 to 24.0 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.

Borings TR-20 and TR-22 encountered 2 and 8 inches of topsoil at the surface. Boring TR-21 was drilled in the stream and consequently encountered no topsoil. Underlying the surficial materials, the borings encountered soft to hard sandy silt (A-4a), very dense sandy silt, and hard silt and clay (A-6a) to depths generally between 3.5 and 7.5 feet where weathered bedrock was encountered. Boring TR-21 encountered bedrock at a depth of 1.5 feet.

Bedrock encountered at the proposed structure location was composed primarily of hard sandstone that was generally slightly fractured to intact. Recovery of the core samples ranged from 87 to 100% and RQD values ranged from 17 to 96% with an average RQD of 83%.

Seepage was not detected in any of the borings except TR-21, which was drilled in a stream. Water levels were not detected prior to coring except in boring TR-21. At completion of drilling, water levels ranged from 0.0 to 6.3 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 the adjacent stream.

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-20	Forward Abutment	649	644	Drilled Shafts	15 TSF
TR-21	Pier	636	634	Spread Footing	15 TSF
TR-22	Pier	646	642	Spread Footing	15 TSF
TR-23	Rear Abutment	662	654	Drilled Shafts	15 TSF

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

Additionally, since SCI-823-0.00 mainline at the proposed structure location will be founded on some fill, the slopes should be evaluated to ensure that adequate stability of the backslope is achieved. If the backslope should experience instability, then the abutments may also experience instability.

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

Attachments: General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Site Plan
Boring Logs TR-20, TR-21, TR-22, TR-23

cc: File

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.

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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

Terms	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 - 1.00	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.

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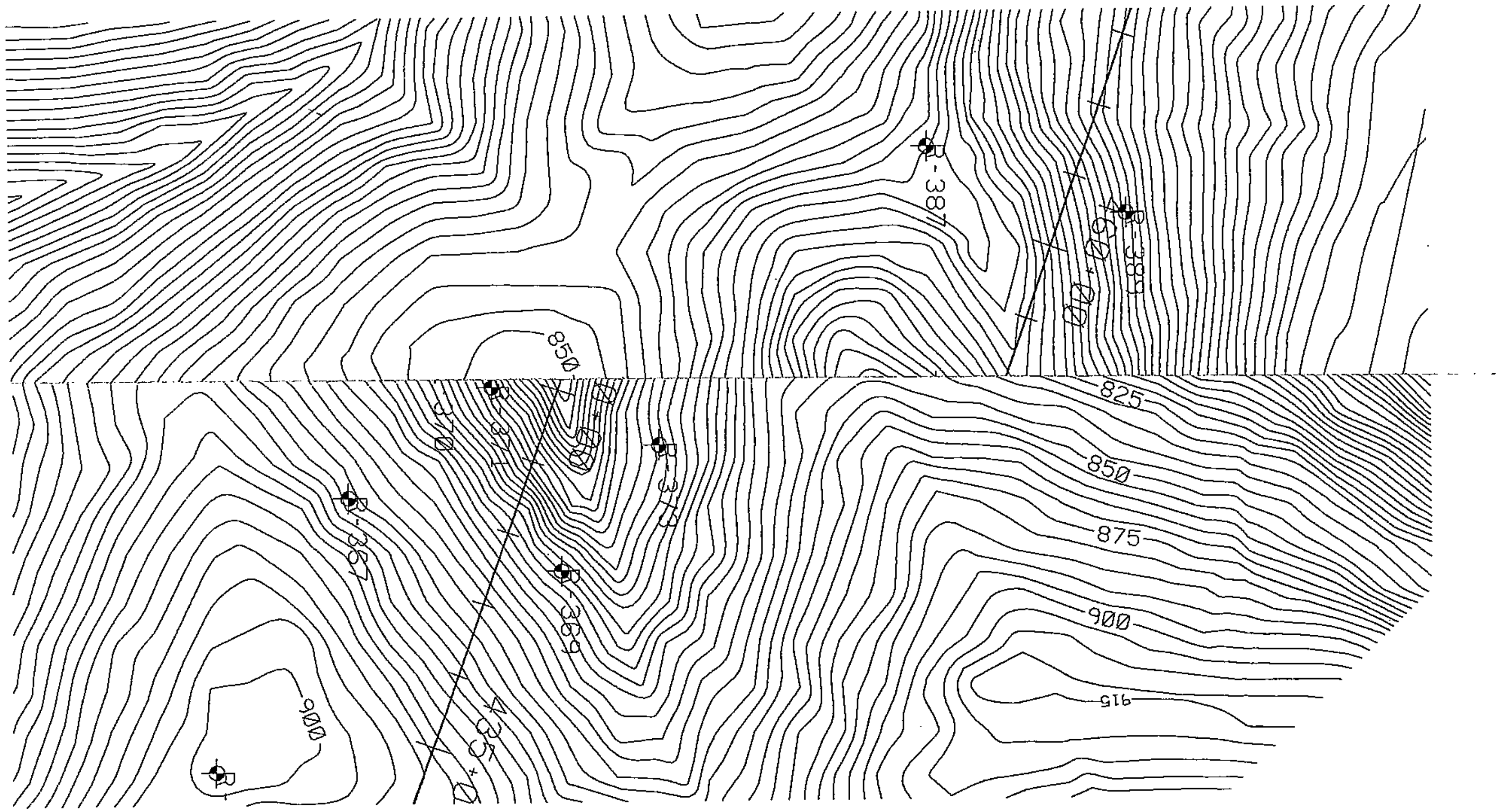


1/1	SCI-823-0.00	SITE PLAN SCI-823-0.00 OVER SWAUGER VALLEY-MINFORD RD	DRAWN BY RJH CHECKED PPP	

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

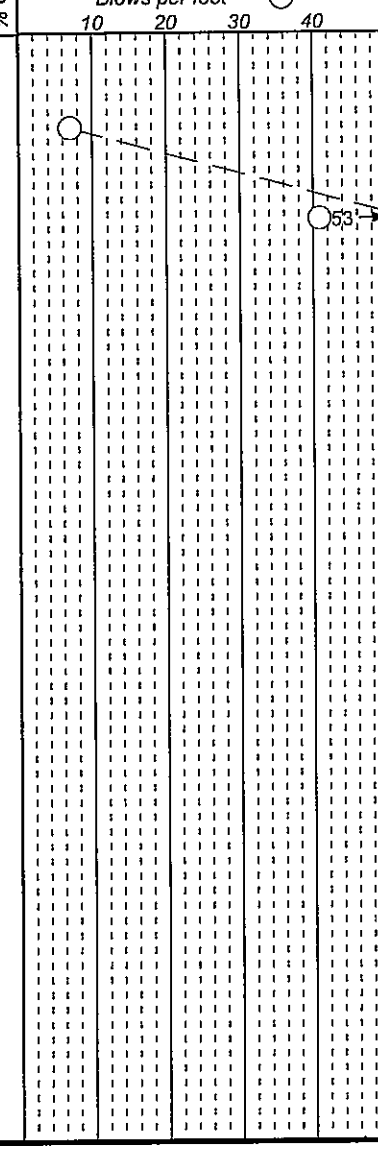
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

LOG OF: Boring TR-20 | Location: Station 450+20, 40' Right | Date Drilled: 8/4/04

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 6.3' (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
0.2	649.0 / 648.8						Topsoil - 2"						
		3 3 4	18	1		–	Soft to medium stiff brown and gray SILT AND CLAY (A-6a), some fine to coarse sand, little gravel; moist.						
4.5	644.5	1 3 50/3	15	2		–	Gray SANDSTONE fragments.						
5.0	644.0	Core 96"	Rec 91"	RQD 88%	R-1		Hard gray SANDSTONE; fine grained, slightly micaceous, occasional black lamination. @ 5.0' - 5.3'; broken. @ 9.3'-9.5', clay seam, possible core loss.						
		Core 84"	Rec 84"	RQD 86%	R-2		@ 13.9'; irregular vertical fracture.						
20.0	629.0						Bottom of Boring - 20.0'						

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



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

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

LOG OF: Boring TR-21 | Location: Station 449+20, 50' Left | Date Drilled: 8/3/04

WATER OBSERVATIONS: Water seepage at: 0.0' (2" Water above stream bed)
Water level at completion: 0.0' (2" Water above stream bed)

Depth (ft)	Elev. (ft)	Blows per 6"	Recovery (in)	Sample No. Drive	Sample No. Press / Core	Hand Penetrometer (tsf)	DESCRIPTION	% Aggregate	% C. Sand	% M. Sand	% F. Sand	% Silt	% Clay	STANDARD PENETRATION (N)
0	636.0						Gray GRAVEL (A-1-a); wet.							
1.5	634.5						Hard brown SANDSTONE; fine grained. @ 3.3'-3.4', clay seam.							
3.6	632.4	Core 114"	Rec 114"	RQD 70%	R-1		Hard gray SANDSTONE; fine grained, slightly micaceous, argillaceous, occasional black laminae.							
		Core 108"	Rec 108"	RQD 93%	R-2		@ 15.5'; interbedded siltstone and sandstone.							
16.3	619.7						Hard gray SILTSTONE; slightly micaceous, arenaceous.							
20.0	616.0						Bottom of Boring - 20.0'							

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

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

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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

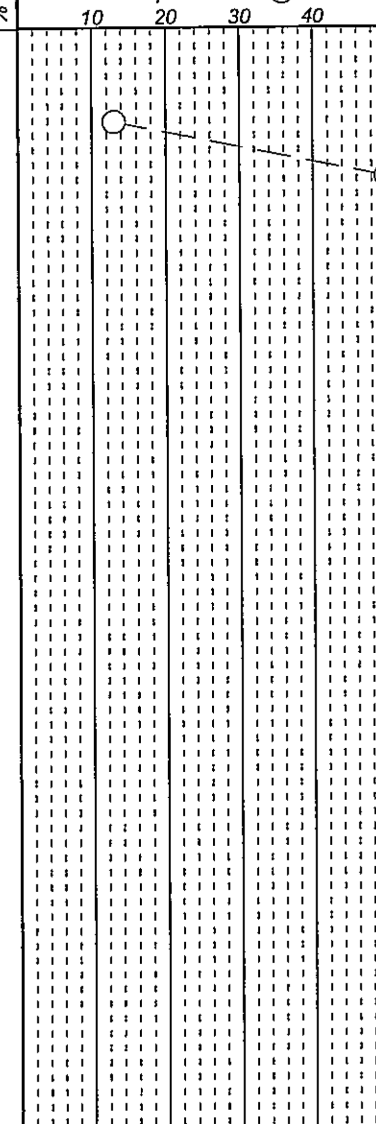
LOG OF: Boring TR-22 | Location: Station 447+90, 55' Right | Date Drilled: 2/24/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 4.5' (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	646.0						Topsoil - 8"						
0.8	645.2	3 6 7	18	1		1.25	Stiff brown SANDY SILT (A-4a), trace gravel; organic; moist.						
2.8	643.2	26 50/4	10	2A 2B			Very dense brown SANDY SILT (A-4a), trace gravel; organic; moist.						
3.5	642.5						Weathered SANDSTONE, brown.						
4.0	642.0	Core 120"	Rec 120"	RQD 84%	R-1		Soft brown SANDSTONE; fine grained, moderately weathered, slightly micaceous, moderately fractured. @ 5.2'-5.7',7.1'-7.3',8.7'-8.9' very soft, highly weathered. @ 6.1', gray, medium hard. @ 10.9'-11.0', iron stained horizontal fractures. @ 12.0' - 12.8', siltstone.						
14.0	632.0	Core 120"	Rec 120"	RQD 96%	R-2		Hard gray SANDSTONE; fine grained, slightly weathered, slightly micaceous, slightly fractured. @ 14.7'-15.3', very soft SILTSTONE, highly weathered, gray and brown. @ 19.3'-19.4', irregular vertical fracture. @ 19.6', 1/2" clay filled fracture. @ 23.2'-23.5', siltstone.						
24.0	622.0						Bottom of Boring - 24.0'						

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

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



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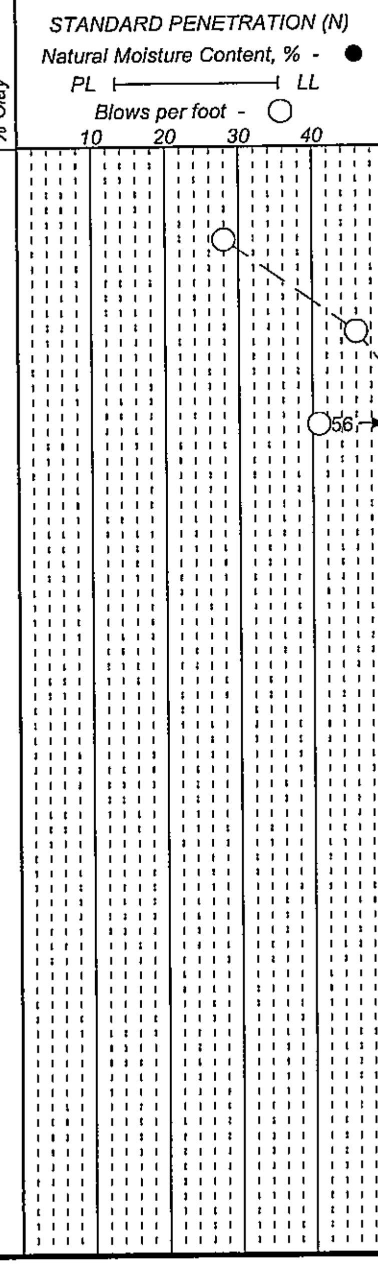
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

LOG OF: Boring TR-23 | Location: Station 446+90, 48' Left | Date Drilled: 8/9/04

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 2.0'

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	662.0						Hard brown SILT AND CLAY (A-6a), some fine to coarse sand, trace gravel; damp.						
		6 13 15	17	1		4.5+							
		11 26 20	17	2		4.5+							
5													
		11 16 40	16	3		4.5+	@ 6.0'; contains rust stains.						
7.5	654.5						Soft brown SANDSTONE; highly weathered.						
		Core 30"	Rec 26"	RQD 17%	R-1								
10.0	652.0						Hard gray SANDSTONE; slightly micaceous.						
							@ 12.9' - 13.6'; brown.						
15		Core 120"	Rec 120"	RQD 84%	R-2								
20.0	642.0						Bottom of Boring - 20.0'						
25													
30													



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