STRUCTURAL ENGINEERING

JUL 19 2005

WJK ☐ SM ☐ TJK ☐ JEM ☐
JAC ☐ RZ ☐ AW ☐ ☐
MT ☐ DAG ☐ JCR ☐ ☐
AD ☐ SS ☐ JS ☐ FILE ☐

# SCI-823-0.00

## PID NO. 19415

## S.R. 823 OVER WEBSTER ST. (S.R. 140)

## 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.*** |
|---|---|
| 1. Introduction | 1 |
| 2. Design Criteria | 1 |
| 3. Subsurface Conditions and Foundation Recommendation | 1 |
| 4. Roadway | 1 |
| 5. Proposed Structure Configurations | 2 |
| 6. Preliminary Probable Bridge Construction Cost | 5 |
| 7. Summary | 5 |
| 8. Recommendations | 7 |
| APPENDIX A<br>• Preliminary Probable Construction Cost | 12 Sheets |
| APPENDIX B<br>• Preliminary Site Plan – Alternative 1 (Sheet 1 of 2)<br>• Transverse Section – Alternative 1 (Sheets 2 of 2) | 2 Sheets |
| APPENDIX C<br>• Preliminary Vertical Clearance Calculations | 1 Sheet |
| APPENDIX D<br>• Preliminary Site Plan – Alternative 2 (Sheet 1 of 1)<br>• Preliminary Site Plan – Alternative 3 (Sheet 1 of 1) | 2 Sheets |
| APPENDIX E<br>• Preliminary Geotechnical Report | |

# BRIDGE TYPE STUDY NARRATIVE

## 1. Introduction

TranSystems Corporation is providing engineering services to the Ohio Department of Transportation for the design of new overpass structure that will carry the proposed S.R. 823 bypass over S.R. 140 (Webster Street). As requested by the Scope of Services, a Bridge Type Study report is to be submitted before any plan development. The purpose of this report is to investigate various span arrangements and superstructure and substructure types in order to determine the most appropriate and economical structure type that will meet the project requirements.

## 2. Design Criteria

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

## 3. Subsurface Conditions and Foundation Recommendation

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

In summary, three test borings (TR-43, TR-44 and TR-45) were drilled and all of them encountered sandstone bedrock between 5 and 15 feet below the existing ground surface. Two of the three borings also encountered a few shallow layers of stiff brown SILT AND CLAY (A-6a), very stiff brown SILTY CLAY (A-6b), hard brown and gray SILT (A-4b) and loose brown SANDY SILT (A-4a). For a more detailed description of the material encountered, refer to the subsurface investigation report.

Based on the alternatives considered for this study, three 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. 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. It is also recommended that the piles not be driven until the majority of primary consolidation settlement has occurred in order 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. The proposed bridge section will consist of four 12'-0" travel lanes (two lanes northbound, two southbound lanes) with 6'-0" median shoulders and 12'-0" outside shoulders. With a 2'-5¾" inside median Type A1 parapet and a 1'-6" outside straight face deflector parapets, the bridge deck width will be 89'-5¾" out to out. Horizontal and vertical sight distances, in accordance with the design standards, have been provided over the bridge for all alternatives considered. The existing S.R. 140 (Webster Street) 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 17'-0" of preferred vertical clearance could be provided for all the alternatives considered for this study. In accordance with the L&D manual, Volume 1, a 14'-0" horizontal offset with a Type D barrier will be maintained beneath the structure along the north side S.R. 140. An existing guardrail, which parallels an existing creek, will be maintained on the south side of S.R. 140.

**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 alternates as part of the type study.

Three alternatives have been evaluated in this Structure Type Study, and are designated as Alternative 1, 2 and 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** | Tangent, continuous rolled steel beams A709 Grade 50W | Tangent Prestressed Concrete Girders 60" AASHTO Type 4 | Tangent Prestressed Concrete Girders 54" Modified AASHTO Type 4 |
| **Proposed Beam Spacing** | 10 Spaces @ 8'-3" | 10 Spaces @ 8'-3" | 9 Spaces @ 9'-3" |
| **No. of Spans** | 3 | 1 | 3 |
| **Abutment Type** | Semi Integral Type with spill-through slopes | Semi Integral Type with MSE wall | Semi Integral Type with spill-through slopes |
| **No. of Piers** | 2 | none | 2 |
| **Pier Type** | Cap & Column | N/A | Cap & Column |
| **Substructure Orientation** | 22°00'00" (RF) | 22°00'00" (RF) | 22°00'00" (RF) |
| **Approximate Bridge Length** | 234' | 101' | 234' |
| **Approximate Structure Depth** | | | |
| **Slab** | 8.5" | 8.5" | 8.5" |
| **Haunch** | 2" | 2" | 2" |
| **Beam** | 33" | 60" | 54" |
| **Total** | 43.5"(3.625') | 70.5"(5.875') | 64.5"(5.375') |

## Alternative Discussion:

### *Alternative 1*

**Span configuration:** Various span configurations were investigated and they were refined to the 3-span layout configuration. Horizontal Clearance requirements and adjacent creek dictated the locations of the piers for the required middle span length. Embankment slopes will be a maximum 2:1 in order to minimize right-of-way impacts. The bridge overall length is 232' from centerline of bearing to centerline of bearing.

**Substructure:** This alternative is comprised of three spans (70'-92'-70') with a span ratio of 0.76. The abutments and piers were both located at a 22°00'00" (RF) skew to the roadway alignment.

I. *Abutments:* The rear abutment will be a semi-integral type abutment supported on a spread footing founded in bedrock. The forward abutment will also be a semi-integral type abutment but contrarily will be founded on H-piles since it located in new embankment construction. 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.

II. *Piers:* The piers will consist of cap & column type piers supported on drilled shafts with sockets into bedrock

**Superstructure:** The preliminary design of this alternative indicates that 11 -W33 continuous rolled steel beams spaced at 8'-3" would be required for the structure to accommodate the HS25 design loading requirements.

### *Alternative 2*

**Span configuration:** This alternative has a similar horizontal layout as Alternative 1, except that the bridge is comprised of a simple span type structure supported on prestressed concrete beams and semi-integral type abutments with MSE walls. The bridge overall length is 101' from centerline of bearing to centerline of bearing.

**Substructure:** The abutment and turn-back type MSE walls are at a 22°00'00" (RF) skew to the roadway alignment, and the face of the forward abutment MSE wall is located behind the Type D barrier outside the 14'-0" 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 abutments will consist of semi-integral type abutments 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:* N/A

**Superstructure:** The preliminary design of this alternative indicates that a 11 - 60" Prestressed Modified AASHTO Type 4 beam spaced at 8'-3" would be required to accommodate the HS25 design loading requirements.

### *Alternative 3*

**Span configuration:** This alternative also has a similar horizontal and span layout as Alternative 1, except that the bridge is comprised of prestressed concrete beams and stub type semi-integral abutments. The bridge overall length is 232' from centerline of bearing to centerline of bearing.

**Substructure:** This alternative is comprised of three spans (70'-92'-70') with a span ratio of 0.76. The abutments and piers were both located at a 22°00'00" (RF) skew to the roadway alignment.

I. *Abutments:* The rear abutment will be a semi-integral type abutment supported on a spread footing founded in bedrock. The forward abutment will also be a semi-integral type abutment but contrarily will be founded on H-piles since it located in new embankment construction. 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.

II. *Piers:* The piers will consist of cap & column type piers supported on drilled shafts with sockets into bedrock

**Superstructure:** The preliminary design of this alternative indicates that a 10 - 54" Prestressed AASHTO Type 4 beam spaced at 9'-3" would be required to accommodate the HS25 design loading requirements.

## 6. Preliminary Probable Bridge Construction Cost:

A preliminary probable bridge construction cost has been prepared for Alternatives 1, 2, and 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.

## 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** | 3-span continuous tangent rolled steel beams, A709 Grade 50W with a composite reinforced concrete deck slab supported by reinforced concrete semi-integral abutments and cap & columns piers on various foundations | **Structure Cost:**<br>**$2,160,000**<br>**Additional Life Cycle Cost:**<br>**$941,000**<br>**Total Relative Ownership Cost:**<br>**$3,101,000** | 1 | ***Advantages:***<br>• This alternative is the least expensive to construct.<br>• Scour will be less of concern around pier 1.<br>• Beams lighter to erect<br>***Disadvantages:***<br>• Uncertainty with Steel Prices. |
| **2** | 1-simple span tangent 60" Modified AASHTO Type 4 Prestressed Concrete Beams with a composite reinforced concrete deck slab supported by reinforced concrete semi-integral abutments on piles and MSE walls. | **Structure Cost:**<br>**$2,280,000**<br>**Additional Life Cycle Cost:**<br>**$501,000**<br>**Total Relative Ownership Cost:**<br>**$2,781,000** | 2 | ***Advantages:***<br>• This alternative will reduce the number of spans of Alternative 1 to a single span layout.<br>***Disadvantages:***<br>• Increased the structure depth.<br>• Heavy beams might present construction delivery and issues with beam setting.<br>• Scour potential risk is greater by rear abutment MSE Wall. |
| **3** | 3-span continuous 54" AASHTO Type 4 Prestressed Concrete Beams with a composite reinforced concrete deck slab supported by reinforced concrete semi-integral abutments and cap & columns piers on various foundations | **Structure Cost:**<br>**$2,650,000**<br>**Additional Life Cycle Cost:**<br>**$1,018,000**<br>**Total Relative Ownership Cost:**<br>**$3,668,000** | 3 | ***Advantages:***<br>• Potentially less maintenance then steel Alternative 1.<br>***Disadvantages:***<br>• Most expensive alternative to construct. |

## 8. Recommendations:

Based upon the above information and discussions, we recommend **Structure Type Alternative 1 (Three Span, rolled steel beams with semi-integral abutments and cap & column piers)** for the Bridge. (See Appendix B for the Site Plan and Structure Details).

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

- This Alternative appears to be the most economical from a construction standpoint.
- Scour potential from the nearby creek around pier 1 will be less likely with the drilled shaft foundations set in bedrock.
- Transport and erection of shorter steel pieces during construction will be easier than long prestressed girders.

# APPENDIX A

TRANSYSTEMS CORPORATION

# SCI-823-0.00 - PORTSMOUTH BYPASS

## S.R. 823 over S.R. 140 (Webster St.) L/R

### STRUCTURE TYPE STUDY

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

## 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 | 3 | 70' - 92' - 70' | 232.00 | 11 Rolled Beams | W33 Grade 50 W | $1,234,000 | $316,000 | $248,000 | $359,600 | $2,160,000 | $941,000 | $3,101,000 |
| 2 | 1 | 101' - MSE Wall Type Abutment | 101.00 | 11 Prestressed I-Girders | 60" Modified AASHTO Type 4 | $763,000 | $876,000 | $262,200 | $380,200 | $2,280,000 | $501,000 | $2,781,000 |
| 3 | 3 | 70' - 92' - 70' | 232.00 | 11 Prestressed I-Girders | 54" AASHTO Type 4 | $1,451,000 | $453,000 | $304,600 | $441,700 | $2,650,000 | $1,018,000 | $3,668,000 |

**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.

# SCI-823-0.00 - PORTSMOUTH BYPASS

## S.R. 823 over S.R. 140 (Webster St.) L/R

## STRUCTURE TYPE STUDY - ROLLED BEAM ALTERNATIVE 1 - SUPERSTRUCTURE

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 70' - 92' - 70' | 232 | 236 | 749 | $441,800 | $187,800 | $82,500 | 11 Rolled Beams | W33 Grade 50 W | 615,032 | $522,300 | $1,234,000 |

## COST SUPPORT CALCULATIONS

**Deck Cross-Sectional Area:**

Parapets:

| | No. | Individual Area (sq. ft.) | Parapet Area (sq. ft.) |
|---|---|---|---|
| Parapets | 2 | 4.26 | 8.52 |
| Split Median Barriers | 1 | 7.47 | 7.47 |

Slab:

| | T (ft.) | W (ft.) | Slab Area | Haunch & Overhang Area | Total Concrete Area (sq. ft.) |
|---|---|---|---|---|---|
| Bridge | 0.71 | 89.48 | 63.4 | 6.3 | 85.7 |

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 S.R. 140 (Webster St.) L/R

## STRUCTURE TYPE STUDY - ROLLED BEAM ALTERNATIVE 1 - SUBSTRUCTURE

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

## SUBSTRUCTURE

| Alternative No. | Span Arrangement No. Spans | Span Arrangement Lengths | Framing Alternative | Proposed Stringer Section | Pier Concrete Cost | Pier Reinforcing Cost | Abutment Concrete Cost | Abutment Reinforcing Cost | Pile Foundation Cost | Drilled Shaft Foundation Cost | Subtotal Substructure Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 70' - 92' - 70' | 11 Rolled Beams | W33 Grade 50 W | $81,500 | $18,600 | $159,800 | $26,200 | $18,400 | $11,500 | $316,000 |

## COST SUPPORT CALCULATIONS

**Pier QC/QA Concrete, Class QSC1 Cost: (HP-Pile)**

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

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

| Component | Volume (cu. yd.) | Year 2004 | Annual Escalation | Year 2008 | Alt 1 Total Cost |
|---|---|---|---|---|---|
| Cap | 69 | $421.00 | 3.5% | $483.00 | $33,490 |
| Columns | 99 | $421.00 | 3.5% | $483.00 | $48,030 |
| Footings | 0 | $421.00 | 3.5% | $483.00 | $0 |
| Total Cost | | | | | $81,500 |

**Abutment QC/QA Concrete, Class QSC1 Cost:**

Alternate 1

| Component | Volume (cu. yd.) | Year 2004 | Annual Escalation | Year 2008 | Total Cost |
|---|---|---|---|---|---|
| Abutment | 301 | $421.00 | 3.5% | $483.00 | $145,300 |
| Wingwalls | 30 | $421.00 | 3.5% | $483.00 | $14,500 |

**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 | | $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 |
|---|---|---|---|
| Alt. 1 | 26 | SEE QUANTITY CALCULATIONS | 546 |

**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 | 16 | SEE QUANTITY CALCULATIONS | 32 |

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

| Unit Cost | Escalation | 2008 |
|---|---|---|
| $300.00 | 4.5% | $358.00 |

Cost of Shafts: $ 11,500

**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 S.R. 140 (Webster St.) L/R

### STRUCTURE TYPE STUDY - ROLLED BEAM ALTERNATIVE 1 - QUANTITY CALCULATIONS

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

**Pier Quantities (Drilled Shaft Type Foundation)**

| Pier Location | Length | Cap | | | | Column | | | | | Footing | | | | | Total Volume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Width | Depth | Area | Volume | Dia | Height | Area | # Column | Volume | Width | Depth | Area | # Footing | Volume | |
| Pier 1 (D Shaft) | 96 | 3 | 3.25 | 9.75 | 936 | 3 | 24 | 7.07 | 8 | 1356 | | | | | | 2292 |
| Pier 2 (D Shaft) | 96 | 3 | 3.25 | 9.75 | 936 | 3 | 23.5 | 7.07 | 8 | 1328 | | | | | | 2264 |
| Pier 3 | | | | | | | | | | | | | | | | 0 |
| Pier 4 | | | | | | | | | | | | | | | | 0 |
| Pier 5 | | | | | | | | | | | | | | | | 0 |
| Pier 6 | | | | | | | | | | | | | | | | 0 |
| Pier 7 | | | | | | | | | | | | | | | | 0 |
| Total (Cu.Ft.) | | | | | 1872 | | | | | 2685 | | | | | 0 | 4557 |
| Total (Cu.Yd.) | | | | | 69 | | | | | 99 | | | | | 0 | 169 |

**Abutment Quantities**

| Abut Location | Length (feet) | Backwall | | | | Beam Seat | | | | | Footing | | | | | Total Volume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Width | Depth | Area | Volume | Width | Height | Area | | Volume | Width | Depth | Area | # Footing | Volume | |
| Rear Abut | 96 | 3 | 4.5 | 13.50 | 1296 | 3 | 3.68 | 11.04 | | 1060 | 6 | 3 | 18 | 1 | 1728 | 4084 |
| Fwd. Abut | 96 | 3 | 4.5 | 13.50 | 1296 | 3 | 3.52 | 10.56 | | 1014 | 6 | 3 | 18 | 1 | 1728 | 4038 |
| Total (Cu.Ft.) | | | | | 2592 | | | | | 2074 | | | | | 3456 | 8122 |
| Total (Cu.Yd.) | | | | | 96 | | | | | 77 | | | | | 128 | 301 |

**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 | 1.1 | 0 | 0.0 | 0.0 | 2.0 | 0 |
| Pier 1 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | 0 | 0 | 0 | 2.0 | 0 |
| Pier 2 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | 0 | 0 | 0 | 2.0 | 0 |
| Pier 3 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | 0 | 0 | 0 | 2.0 | 0 |
| Pier 4 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | 0 | 0 | 0 | 2.0 | 0 |
| Pier 5 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | 0 | 0 | 0 | 2.0 | 0 |
| Pier 6 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | 0 | 0 | 0 | 2.0 | 0 |
| Pier 7 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | 0 | 0 | 0 | 2.0 | 0 |
| Fwd. Abut. | 120 | 10 | 1200 | 606 | 140 | ~~14~~ | 1.5 | 26 | 574 | 555 | 21.0 | 546 |
| TotaL | | | | | | | | 26 | | | | 546 |

14 Front Pile
8 Back Piles
4 Wingwalls

**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 | 8 | 1 | 8 | 554.6 | 555 | 2.0 | 16 |
| Pier 2 | 0 | 0 | 0 | 0 | 0 | 8 | 1 | 8 | 554.64 | 555 | 2.0 | 16 |
| 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 | | | | | | | | 16 | | | | 32 |

**Superstructure Steel Quantities**

| Location | Wt.of girder (lb)/ft | # Girders | Span Length | Total Weight |
|---|---|---|---|---|
| Span 1 | 241 | 11 | 70 | 185570 |
| Span 2 | 241 | 11 | 92 | 243892 |
| Span 3 | 241 | 11 | 70 | 185570 |
| 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 | | | | 615032 |

| | |
|---|---|
| total steel weight per girder (lb.) = | 16870 |
| Total Span length (ft.)= | 232.00 |
| Weight Per ft. = | 73 |

# SCI-823-0.00 - PORTSMOUTH BYPASS

## S.R. 823 over S.R. 140 (Webster St.) L/R

### STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 2 - SUPERSTRUCTURE

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 101' - MSE Wall Type Abutment | 101.00 | 105.00 | 333 | $196,600 | $83,600 | $82,500 | 11 Prestressed I-Girders | 60" Modified AASHTO Type 4 | $400,000 | $763,000 | 0% | $763,000 |

## COST SUPPORT CALCULATIONS

**Deck Cross-Sectional Area:**

Parapets:

| | No. | Individual Area (sq. ft.) | Parapet Area (sq. ft.) |
|---|---|---|---|
| Parapets | 2 | 4.26 | 8.52 |
| Split Median Barriers | 1 | 7.47 | 7.47 |

Slab:

| | T (ft.) | W (ft.) | Slab Area | Haunch & Overhang Area | Total Concrete Area (sq. ft.) |
|---|---|---|---|---|---|
| Bridge | 0.71 | 89.48 | 63.4 | 6.3 | 85.7 |

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 |

**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 | ft. | 0 | $0 |
| Pier Diaphragms | $1,800 | ea. | 3.5% | $2,070 | ea. | 0 | $0 |
| Abutment Diaphragms | $1,200 | ea. | 3.5% | $1,380 | ea. | 22 | $30,360 |
| Intermediate Diaphragms | $1,200 | ea. | 3.5% | $1,380 | ea. | 30 | $41,400 |
| Modified Type 4 I-Beams (60") | $26,000 | ea. | 3.5% | $29,840 | ft. | 11 | $328,240 |
| | | | | | | TOTAL = | $400,000 |

**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.
Area = 250 sq. yd.
Width = 90 ft

| | 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 S.R. 140 (Webster St.) L/R

## STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 2 - SUBSTRUCTURE

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

## SUBSTRUCTURE

| Alternative No. | Span Arrangement No. Spans | Span Arrangement Lengths | Framing Alternative | Proposed Stringer Section | Pier Concrete Cost | Pier Reinforcing Cost | Abutment Concrete Cost | Abutment Reinforcing Cost | Pile Foundation Cost | MSE Abutment & Wingwall Cost | Additional Crane Cost | Subtotal Substructure Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 1 | 101.00 | 11 Prestressed I-Girders | 60" Modified AASHTO Type 4 | $0 | $0 | $152,800 | $25,100 | $60,400 | $562,200 | $75,000 | **$876,000** |

## COST SUPPORT CALCULATIONS

**Pier QC/QA Concrete, Class QSC1 Cost: (HP-Pile)**

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

**Abutment QC/QA Concrete, Class QSC1 Cost:**

| Component | Volume (cu. yd.) | Year 2004 | Annual Escalation | Year 2008 | Total Cost |
|---|---|---|---|---|---|
| Abutment | 316.4 | $421.00 | 3.5% | $483.00 | $152,800 |
| Wingwalls | | $421.00 | 3.5% | $483.00 | $0 |

**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 |

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

| Number of Piles | | Total Pile Length |
|---|---|---|
| 56 | SEE QUANTITY CALCULATION | 1,792 |

**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 |

**Additional Crane Cost**

**$ 75,000**

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

| Total Area (sq. ft.) | Year 2004 Unit Cost | Annual Escalation | Year 2008 |
|---|---|---|---|
| 9,068 | $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.

# SCI-823-0.00 - PORTSMOUTH BYPASS

## S.R. 823 over S.R. 140 (Webster St.) L/R

## STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE ALTERNATIVE 2 - QUANTITY CALCULATIONS

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

**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 Abut | 96 | 3 | 6.75 | 20.25 | 1944 | 3 | 2.08 | 6.24 | 599 | | 6 | 3 | 18 | 1 | 1728 | 4271 |
| Fwd. Abut | 96 | 3 | 6.75 | 20.25 | 1944 | 3 | 2.08 | 6.24 | 599 | | 6 | 3 | 18 | 1 | 1728 | 4271 |
| Total (Cu.Ft.) | | | | | 3888 | | | | 1198 | | | | | | 3456 | 8542 |
| Total (Cu.Yd.) | | | | | 144 | | | | 44 | | | | | | 128 | 316 |

**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 | 28 | 1 | 28 | 574.0 | 544.0 | 32.0 | 896 |
| 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 | 28 | 1 | 28 | 573.5 | 544 | 32.0 | 896 |
| TotaL | | | | | | | | 56 | | | | 1792 |

**MSE Abutment Wall Quantities**

| Abut Location | | Wall | | | |
|---|---|---|---|---|---|
| | | *Height* | *Length* | *Area* | *Volume* |
| Rear Abut | | 23 | 101 | 2323.0 | |
| RA Wing ( L ) | 0.5 | 33.25 | 66.5 | 1105.6 | |
| RA Wing ( R ) | 0.5 | 33.25 | 66.5 | 1105.6 | |
| Fwd. Abut | | 23 | 101 | 2323.0 | |
| FA Wing ( L ) | 0.5 | 33.25 | 66.5 | 1105.6 | |
| FA Wing ( R ) | 0.5 | 33.25 | 66.5 | 1105.6 | |
| Total (Sq.Ft.) | | | | 9068 | |

**Superstructure P/S Concrete Quantities**

| Location | Type of girder | # Girders | Span Length (ft.) | Total Length (ft.) | Spacing Int. diaphragm | No. of Int in span | Number of Int Diap. 1 location | Total No. in Span |
|---|---|---|---|---|---|---|---|---|
| Span 1 | MOD. AASHTO | 11 | 101 | 1111 | 33.67 | 3 | 10 | 30 |
| Span 2 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 3 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 4 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 5 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 6 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 7 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 8 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 9 | MOD. AASHTO | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| | | | | | **Total** | | | 30 |
| TotaL | MOD. AASHTO | 11 | | 1111 | | | | |

# SCI-823-0.00 - PORTSMOUTH BYPASS

## S.R. 823 over S.R. 140 (Webster St.) L/R

## STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 3 - SUPERSTRUCTURE

By: BTA
Checked: ELK

Date: 6/21/2005
Date: 7/1/2005

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 70' - 92' - 70' | 232.00 | 236.00 | 749 | $441,800 | $187,800 | $82,500 | 11 Prestressed I-Girders | 54" AASHTO Type 4 | $738,500 | $1,451,000 | 0% | $1,451,000 |

## COST SUPPORT CALCULATIONS

**Deck Cross-Sectional Area:**

Parapets:

| | No. | Individual Area (sq. ft.) | Parapet Area (sq. ft.) |
|---|---|---|---|
| Parapets | 2 | 4.26 | 8.52 |
| Split Median Barriers | 1 | 7.47 | 7.47 |

Slab:

| | T (ft.) | W (ft.) | Slab Area | Haunch & Overhang Area | Total Concrete Area (sq. ft.) |
|---|---|---|---|---|---|
| Bridge | 0.71 | 89.48 | 63.4 | 6.3 | 85.7 |

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 |

**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. | 30 | $550,800 |
| Pier Diaphragms | $1,800 | ea. | 3.5% | $2,070 | ea. | 22 | $45,540 |
| Abutment Diaphragms | $1,200 | ea. | 3.5% | $1,380 | ea. | 22 | $30,360 |
| Intermediate Diaphragms | $1,200 | ea. | 3.5% | $1,380 | ea. | 81 | $111,780 |
| Modified Type 4 I-Beams (60") | $26,000 | ea. | 3.5% | $29,840 | ea. | 0 | $0 |
| | | | | | | TOTAL = | $738,480 |

**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.
Area = 250 sq. yd.
Width = 90 ft

| | 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 S.R. 140 (Webster St.) L/R

## STRUCTURE TYPE STUDY - PRESTRESSED CONCRETE GIRDER ALTERNATIVE 3 - SUBSTRUCTURE

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

## SUBSTRUCTURE

| Alternative No. | Span Arrangement No. Spans | Span Arrangement Lengths | Framing Alternative | Proposed Stringer Section | Pier Concrete Cost | Pier Reinforcing Cost | Abutment Concrete Cost | Abutment Reinforcing Cost | Pile Foundation Cost | Drilled Shaft Foundation Cost | Additional Crane Cost | Subtotal Substructure Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3 | 70' - 92' - 70' | 11 Prestressed I-Girders | 54" AASHTO Type 4 | $122,600 | $27,900 | $171,200 | $28,100 | $16,600 | $11,500 | $75,000 | $453,000 |

## COST SUPPORT CALCULATIONS

**Pier QC/QA Concrete, Class QSC1 Cost: (HP-Pile)**

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

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

| Component | Volume (cu. yd.) | Year 2004 | Annual Escalation | Year 2008 | Total Cost |
|---|---|---|---|---|---|
| Cap | 168 | $421.00 | 3.5% | $483.00 | $81,140 |
| Columns | 86 | $421.00 | 3.5% | $483.00 | $41,450 |
| Footings | 0 | $421.00 | 3.5% | $483.00 | $0 |
| Total Cost | | | | | $122,600 |

**Abutment QC/QA Concrete, Class QSC1 Cost:**

| Component | Volume (cu. yd.) | Year 2004 | Annual Escalation | Year 2008 | Total Cost |
|---|---|---|---|---|---|
| Abutment | 322 | $421.00 | 3.5% | $483.00 | $155,600 |
| 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 |
|---|---|---|
| 26 | SEE QUANTITY CALCULATIONS | 494 |

**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 | 16 | SEE QUANTITY CALCULATIONS | 32 |

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

| Unit Cost | Escalation | 2007 |
|---|---|---|
| $300.00 | 4.5% | $358.00 |

Cost of Shafts: $ 11,500

**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 S.R. 140 (Webster St.) L/R

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

By: BTA
Checked: ELK

Date: 6/20/2005
Date: 7/1/2005

**Pier Quantities (Drilled Shaft Type Foundation)**

| Pier Location | Length | Cap | | | | Column | | | | | Footing | | | | | Total Volume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Width* | *Depth* | *Area* | *Volume* | *Dia* | *Height* | *Area* | *# Column* | *Volume* | *Width* | *Depth* | *Area* | *# Footing* | *Volume* | |
| Pier 1 (D Shaft) | 96 | 4.5 | 5.25 | 23.63 | 2268 | 3 | 21 | 7.07 | 8 | 1187 | | | | | | 3455 |
| Pier 2 (D Shaft) | 96 | 4.5 | 5.25 | 23.63 | 2268 | 3 | 20 | 7.07 | 8 | 1130 | | | | | | 3398 |
| Pier 3 | | | | | | | | | | | | | | | | 0 |
| Pier 4 | | | | | | | | | | | | | | | | 0 |
| Pier 5 | | | | | | | | | | | | | | | | 0 |
| Pier 6 | | | | | | | | | | | | | | | | 0 |
| Pier 7 | | | | | | | | | | | | | | | | 0 |
| Total (Cu.Ft.) | | | | | 4536 | | | | | 2317 | | | | | 0 | 6853 |
| Total (Cu.Yd.) | | | | | 168 | | | | | 86 | | | | | 0 | 254 |

**Abutment Quantities**

| Abut Location | Length (feet) | Backwall | | | | Beam Seat | | | | | Footing | | | | | Total Volume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Width* | *Depth* | *Area* | *Volume* | *Width* | *Height* | *Area* | | *Volume* | *Width* | *Depth* | *Area* | *# Footing* | *Volume* | |
| Rear Abut | 96 | 3 | 6.25 | 18.75 | 1800 | 3 | 3.93 | 11.79 | | 1132 | 5 | 3 | 15 | 1 | 1440 | 4372 |
| Fwd. Abut | 96 | 3 | 6.25 | 18.75 | 1800 | 3 | 3.77 | 11.31 | | 1086 | 5 | 3 | 15 | 1 | 1440 | 4326 |
| Total (Cu.Ft.) | | | | | 3600 | | | | | 2218 | | | | | 2880 | 8698 |
| Total (Cu.Yd.) | | | | | 133 | | | | | 82 | | | | | 107 | 322 |

**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 | 1.1 | *0* | 0.0 | 0.0 | 2.0 | *0* |
| Pier 1 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | *0* | 0 | 0 | 2.0 | *0* |
| Pier 2 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | *0* | 0 | 0 | 2.0 | *0* |
| Pier 3 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | *0* | 0 | 0 | 2.0 | *0* |
| Pier 4 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | *0* | 0 | 0 | 2.0 | *0* |
| Pier 5 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | *0* | 0 | 0 | 2.0 | *0* |
| Pier 6 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | *0* | 0 | 0 | 2.0 | *0* |
| Pier 7 | 0 | 0 | 0 | 0 | 140 | 0 | 1.25 | *0* | 0 | 0 | 2.0 | *0* |
| Fwd. Abut. | 120 | 10 | 1200 | 649 | 140 | 14 | 1.5 | *26* | 572 | 555 | 19.0 | *494* |
| TotaL | | | | | | | | **26** | | | | **494** |

14 Front Pile
8 Back Piles
4 Wingwalls

**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 | 8 | 1 | *8* | 554.6 | 555 | 2.0 | *16* |
| Pier 2 | 0 | 0 | 0 | 0 | 0 | 8 | 1 | *8* | 554.64 | 555 | 2.0 | *16* |
| 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 | | | | | | | | **16** | | | | **32** |

**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 | 10 | 70 | 700 | 23.33 | 3 | 9 | 27 |
| Span 2 | AASHTO TYPE 4 | 10 | 92 | 920 | 30.67 | 3 | 9 | 27 |
| Span 3 | AASHTO TYPE 4 | 10 | 70 | 700 | 23.33 | 3 | 9 | 27 |
| Span 4 | AASHTO TYPE 4 | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 5 | AASHTO TYPE 4 | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 6 | AASHTO TYPE 4 | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 7 | AASHTO TYPE 4 | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 8 | AASHTO TYPE 4 | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| Span 9 | AASHTO TYPE 4 | 0 | 0 | 0 | 0.00 | 3 | 0 | 0 |
| | | | | | Total | | | 81 |
| TotaL | AASHTO TYPE 4 | 30 | | 2320 | | | | |

# SCI-823-0.00 - PORTSMOUTH BYPASS

## S.R. 823 over S.R. 140 (Webster St.) L/R

### STRUCTURE TYPE STUDY - LIFE CYCLE COSTS

By: BTA
Checked: ELK

Date: 6/23/2005
Date: 7/1/2005

## LIFE CYCLE MAINTENANCE COST

| | | | | Structural Steel Painting * | | | Superstructure Sealing | | | Approach Pavement Resurfacing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alt. No. | Span Arrangement No. Spans | Lengths | Framing Alternative | Cost Per Cycle | Number of Maintenance Cycles | Total Life Cycle Cost | Cost Per Cycle | Number of Maintenance Cycles | Total Life Cycle Cost | Cost Per Cycle | Number of Maintenance Cycles | Total Life Cycle Cost |
| 1 | 3 | 232.00 | 11 Rolled Beams | $283,800 | 0 | $0 | $0 | 0 | $0 | $0 | 0 | $0 |
| 2 | 1 | 101.00 | 11 Prestressed I-Girders | $0 | 0 | $0 | $21,900 | 2 | $43,800 | $5,900 | 7 | $41,300 |
| 3 | 3 | 232.00 | 11 Prestressed I-Girders | $0 | 0 | $0 | $38,400 | 2 | $76,800 | $0 | 0 | $0 |

* - A709 Weathering Steel; assume no painting

| | | | | Bridge Deck Overlay (5) | | | | | Bridge Redecking (5) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Alt. No. | Span Arrangement No. Spans | Lengths | Framing Alternative | Deck Demo & Chipping | Deck Overlay | Deck Joint Gland (2) | Number of Maintenance Cycles | Total Life Cycle Cost | Deck Concrete Cost (3) | Deck Reinforcing Cost (3) | Deck Joint Cost (2) | Deck Removal Cost | Number of Maintenance Cycles | Total Life Cycle Cost | Superstructure Life Cycle Maintenance Cost (1) | Total Initial Construction Cost | Total Relative Ownership Cost |
| 1 | 3 | 232 | 11 Rolled Beams | $62,900 | $76,300 | n/a | 1 | $139,200 | $441,800 | $187,800 | n/a | $171,900 | 1 | $801,500 | **$941,000** | **$2,160,000** | **$3,101,000** |
| 2 | 1 | 101 | 11 Prestressed I-Girders | $27,400 | $33,200 | n/a | 1 | $60,600 | $196,600 | $83,600 | n/a | $74,800 | 1 | $355,000 | **$501,000** | **$2,280,000** | **$2,781,000** |
| 3 | 3 | 232 | 11 Prestressed I-Girders | $62,900 | $76,300 | n/a | 1 | $139,200 | $441,800 | $187,800 | n/a | $171,900 | 1 | $801,500 | **$1,018,000** | **$2,650,000** | **$3,668,000** |

**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. 1 | 33 | 11 | 232.00 | 15.00 | 23,606 | 20% | 28,300 |

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:
60" 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 | | 34 | | 2 | 68.00 |
| 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 | | | | | 174.30 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. 2 | 11 | 101.00 | 16,137 | 10% | 1,970 |
| Alt. 3 | 10 | 232.00 | 28,309 | 10% | 3,460 |

Sealing Cost per sq. yd.:

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

**Bridge Redecking:**
Bridge Deck Joint Cost per foot:

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

| | Bridge Width | No. Joints |
|---|---|---|
| Alt. 1 | 89.48 | 0 |
| Alt. 2 | 89.48 | 0 |
| Alt. 3 | 89.48 | 0 |

Bridge Deck Removal Cost:

| | Deck Area (3) (sq. ft.) | Year 2008 | Deck Removal Cost |
|---|---|---|---|
| Alt. 1 | 20,759 | $8.28 | $171,900 |
| Alt. 2 | 9,037 | $8.28 | $74,800 |
| Alt. 3 | 20,759 | $8.28 | $171,900 |

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

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

Bridge Deck MSC Overlay Cost per cu. yd.:

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

| | Deck Area (3) (sq. ft.) | Deck Area (sq. yd.) | Hand Chipping (sq. yd.) | Variable Thickness Repair (cu. yd.) |
|---|---|---|---|---|
| Alt. 1 | 20,759 | 2,307 | 58 | 52 |
| Alt. 2 | 9,037 | 1,004 | 25 | 23 |
| Alt. 3 | 20,759 | 2,307 | 58 | 52 |

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:

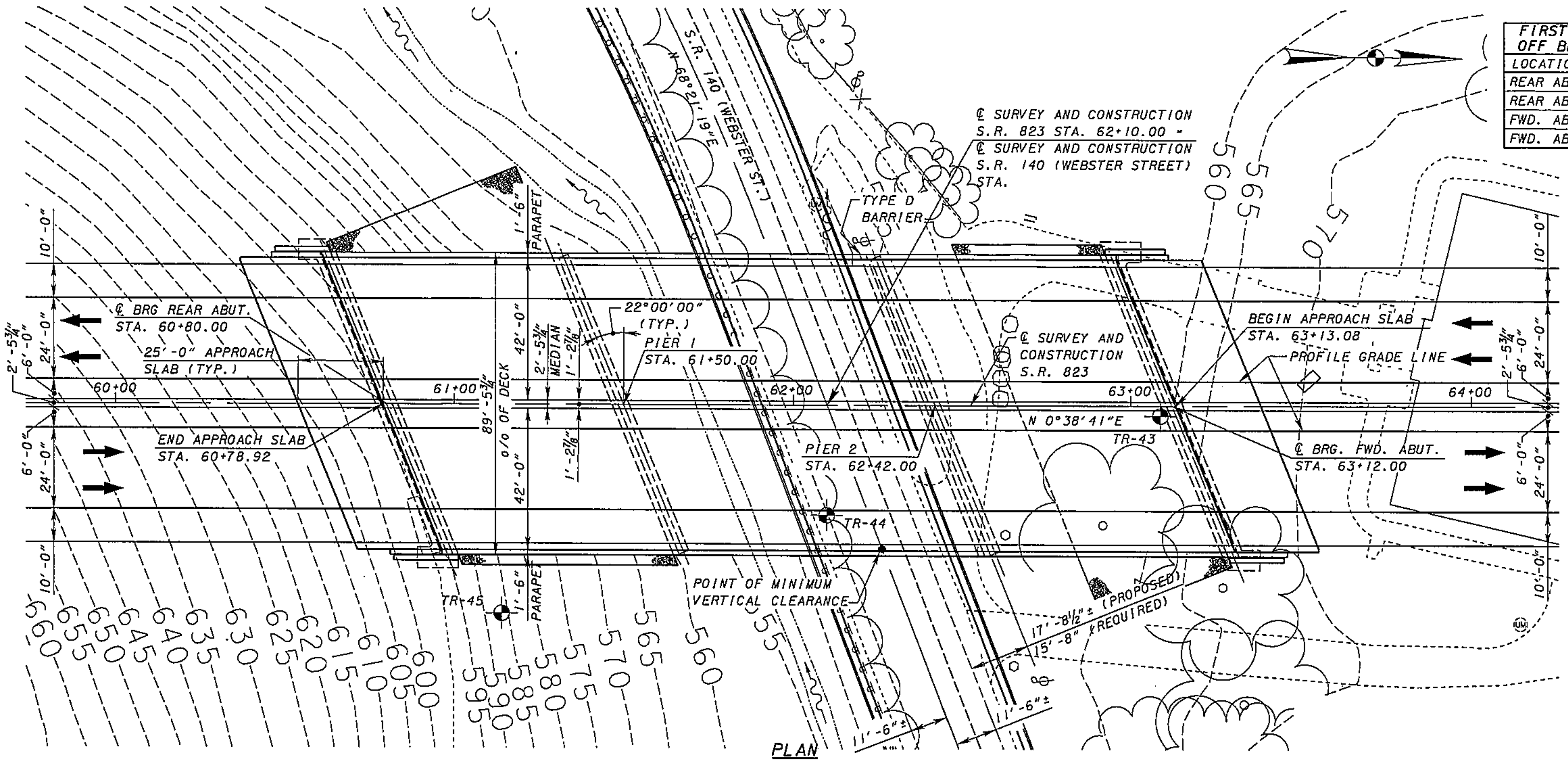
| | Year 2004 | Annual Escalation | Year 2008 |
|---|---|---|---|
| Pavement Planing, Asphalt Concrete, per sq. yd. (Item 254) | $0.98 | 3.5% | $1.12 |
| Asphalt Concrete Surface Course, per cu. yd. | $72.00 | 3.5% | $82.62 |

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 | 0.0 | 33.0 | 0 | 1.50 | 0.0 |
| Alt. 2 | 131.0 | 89.5 | 1,302 | 1.50 | 54.3 |
| Alt. 3 | 0.0 | 33.0 | 0 | 1.50 | 0.0 |

# 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-43 | 61+14.03 | 61.98' RT. |
| TR-44 | 62+09.92 | 32.69' RT. |
| TR-45 | 63+08.57 | 2.95' RT. |

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

**TRAFFIC DATA**

(SR 823)
CURRENT YEAR ADT (2010) = 13,400
CURRENT YEAR ADTT (2030) = 1,876
DESIGN YEAR ADT (2010) = 21,000
DESIGN YEAR ADTT (2030) = 2,940

**PROPOSED STRUCTURE**

TYPE: 3 - SPAN CONTINUOUS ROLLED STEEL BEAM A709 GRADE 50W WITH COMPOSITE REINFORCED CONCRETE DECK SUPPORTED BY REINFORCED CONCRETE SUBSTRUCTURE UNITS

SPANS: 70'-0", 92'-0", 70'-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: 22°00'00" RIGHT FORWARD

CROWN: 0.016 FT./FT.

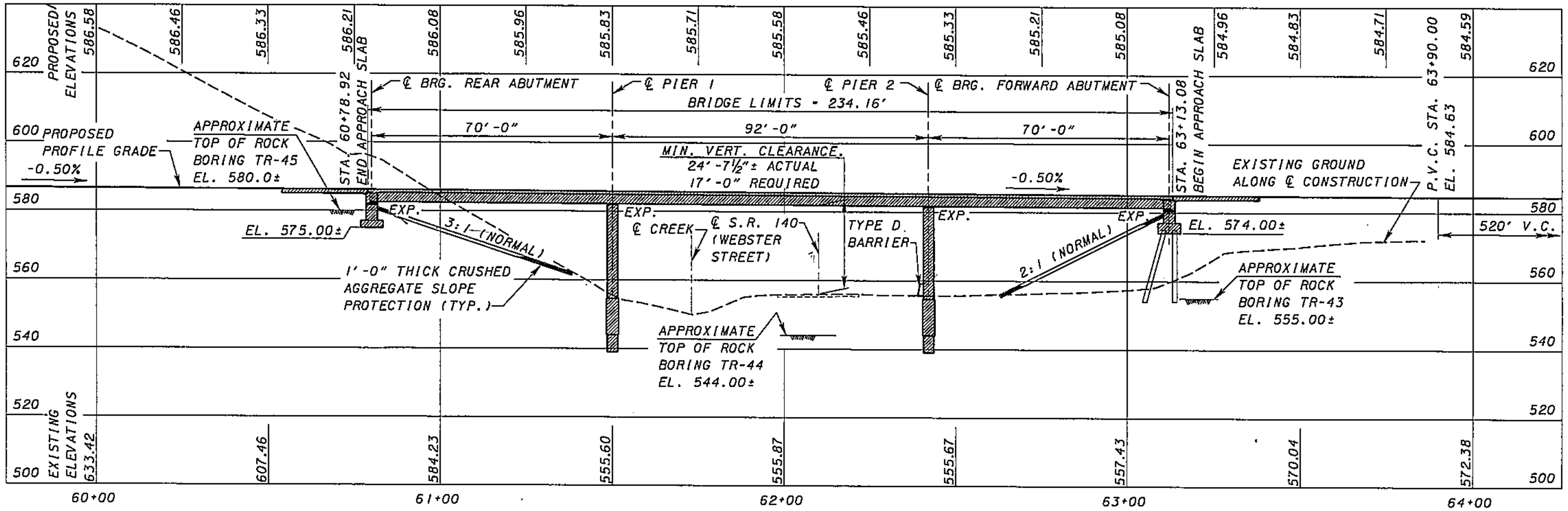
ALIGNMENT: TANGENT

WEARING SURFACE: 1" MONOLITHIC CONCRETE

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

LATITUDE:
LONGITUDE:

⊕ DENOTES SOIL BORING LOCATION



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.

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

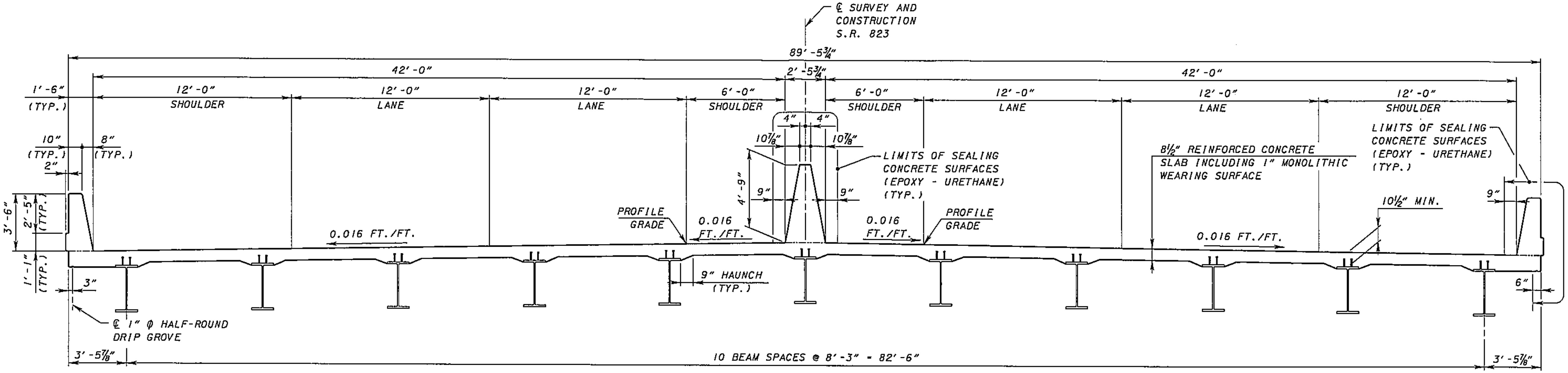
SCIOTO COUNTY
STA. 60+78.92
STA. 63+13.08

PRELIMINARY SITE PLAN - ALTERNATIVE 1
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R. 140 (WEBSTER ST.)

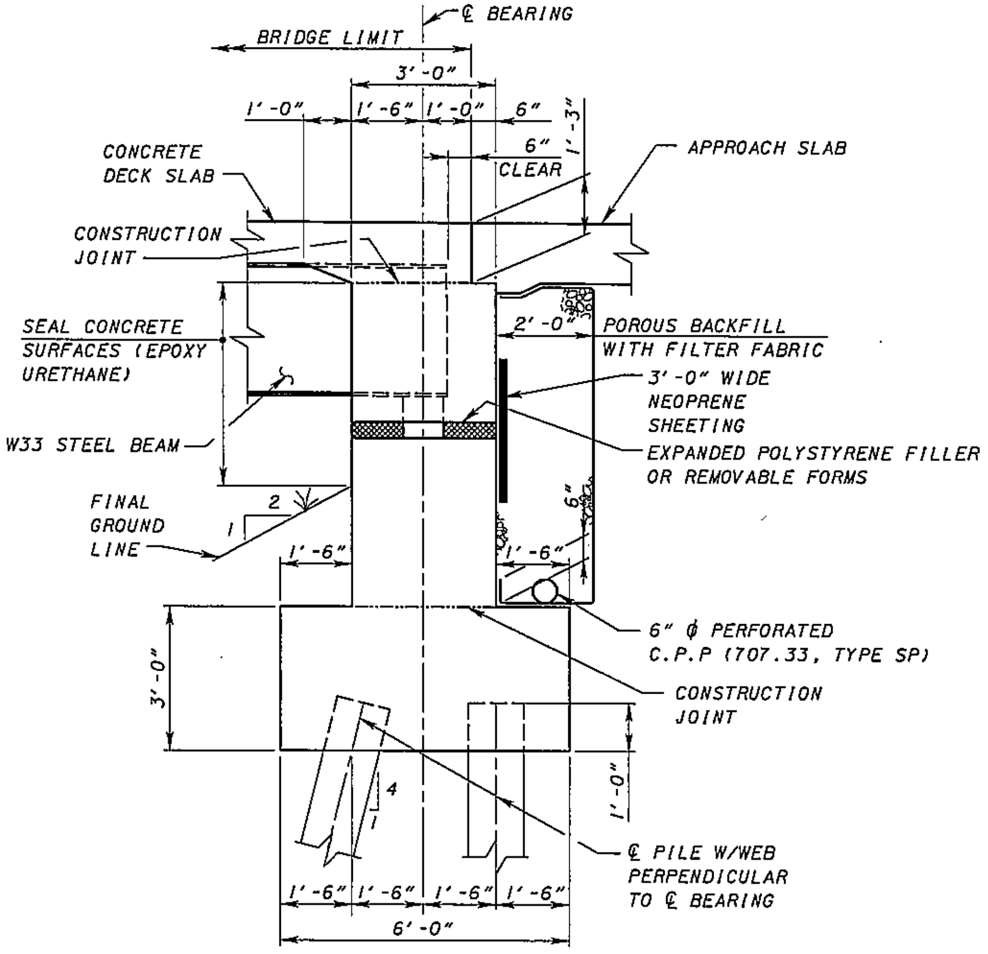
SCI-823-0.00
PID 19415

1/2

DATE: 7/13/2005 FILE: g:\C003\0064\Bridge\BTS\04-SR140(Webster)\823-04sp01_ALT1.dgn



| SUPERSTRUCTURE DEPTH | |
|---|---|
| ITEM | STEEL BEAM |
| | W33 |
| SLAB (INCLUDING WEARING SURFACE) | 8½" |
| HAUNCH (BOTTOM OF SLAB TO TOP OF FLANGE) | 2" |
| BEAM DEPTH | 33" |
| TOP OF WEARING SURFACE TO BOTTOM OF BEAM FLANGE (INCH) | 43.5" |
| TOP OF WEARING SURFACE TO BOTTOM OF BEAM FLANGE (FEET) | 3.625' |



TYPICAL ABUTMENT SECTION

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 | | | |

TRANSVERSE SECTION - ALTERNATIVE 1
BRIDGE NO. SCI-823-XXXX
S.R. 823 OVER S.R. 140 (WEBSTER ST.)

SCI-823-0.00
PID 19415

2/2

DATE: 07/12/2005 FILE: g:\C003\C064\Bridge\BTS\04-SR140Webster\823-04ts01_ALT1.dgn

# APPENDIX C

TRANSYSTEMS CORPORATION

| | | | | | |
|---|---|---|---|---|---|
| **Made By** | BTA | **Date** | 06/23/05 | **Job No.** | P403030064 |
| **Checked By** | | **Date** | | **Sheet No.** | |

# VERTICAL CLEARANCE CALCULATIONS

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

**Description** S.R. 823 OVER S.R.140 (WEBSTER ST.) **PID #** 19415

***Alternative 1 - 6 Rolled Steel Beams, 3 Span*** ***Point Location:* A**

## *Adjstment for Cross Slope*

| Comment | Grade | | Offset | | |
|---|---|---|---|---|---|
| 2 Lanes: | -0.016 | x | 24 | = | -0.38 |
| Shoulder to Beam CL: | -0.016 | x | 11 | = | -0.18 |

Total Adjustment = **-0.56**

## *Superstructure Depth*

| Comment | Depth (in) | Depth (ft) |
|---|---|---|
| Deck Thickness: | 8.5 | 0.71 |
| Haunch: | 2 | 0.17 |
| Girder or Beam Depth: | 33 | 2.75 |
| | 43.5 | 3.63 |

Total Superstructure Depth (ft) = **3.63**

## *Vertical Clearance at Critical Point*

**Station @ Critical Point = 62+26.34**

**Offset Location @ Critical Point = 42.24' Right**

Profile Grade Elevation at Critical Point = 585.45

Adjustment for Cross Slopes to Beam CL = -0.56

**Top of Deck Elevation @ Critical Point = 584.89**

Total Superstructure Depth = -3.63

**Bottom of Beam Elevation @ Critical Point = 581.26**

**Approximate Top of Existing Ground @ Critical Point = 556.63**

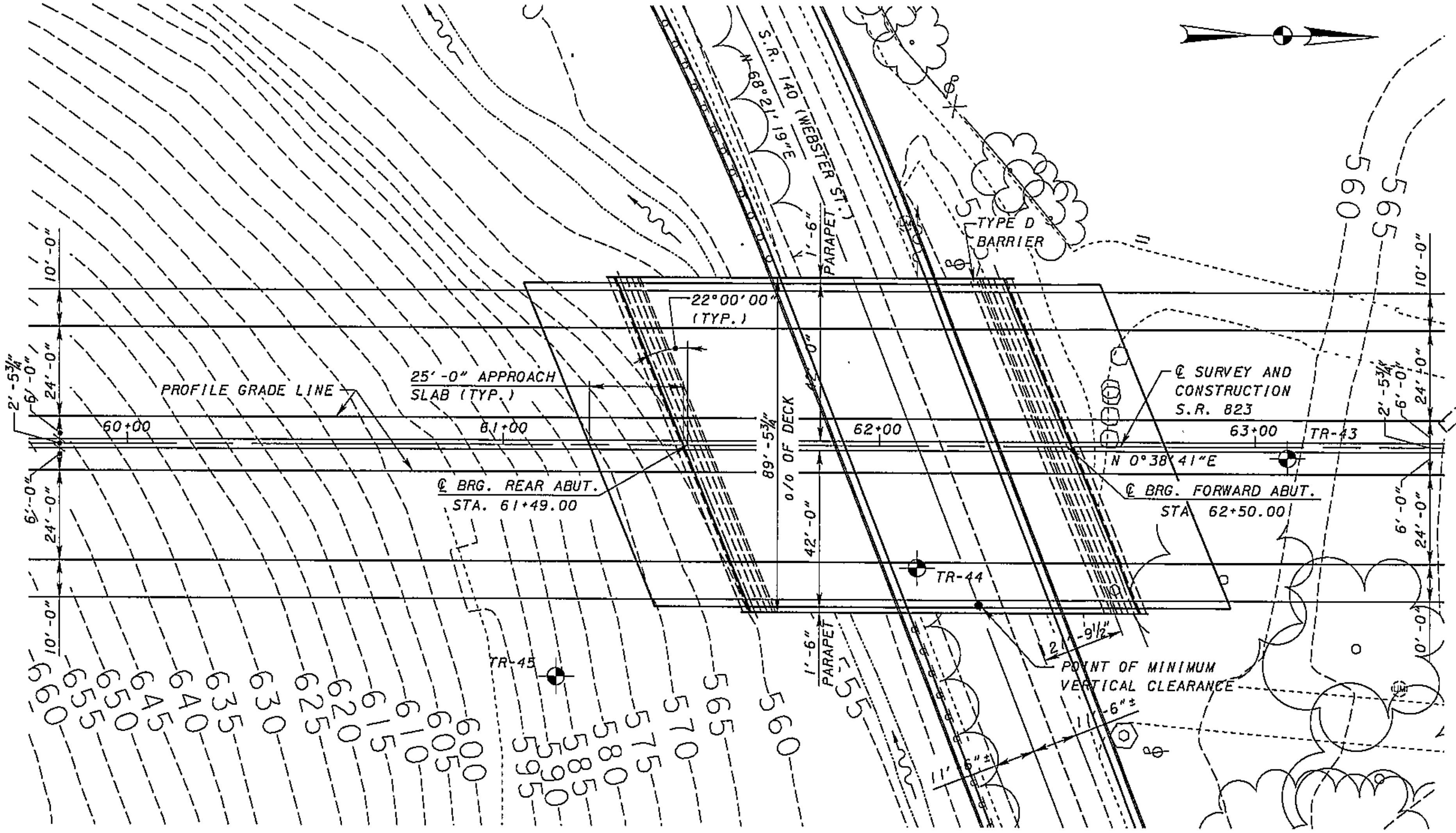
***Actual Vertical Clearance = 24.63***

*Preferred Vertical Clearance = 17.0*

*Required Vertical Clearance = 16.5*

# APPENDIX D

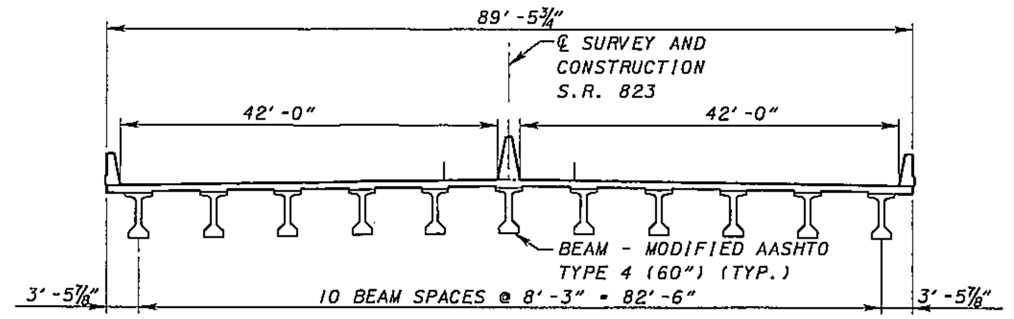
TRANSYSTEMS
CORPORATION



PLAN

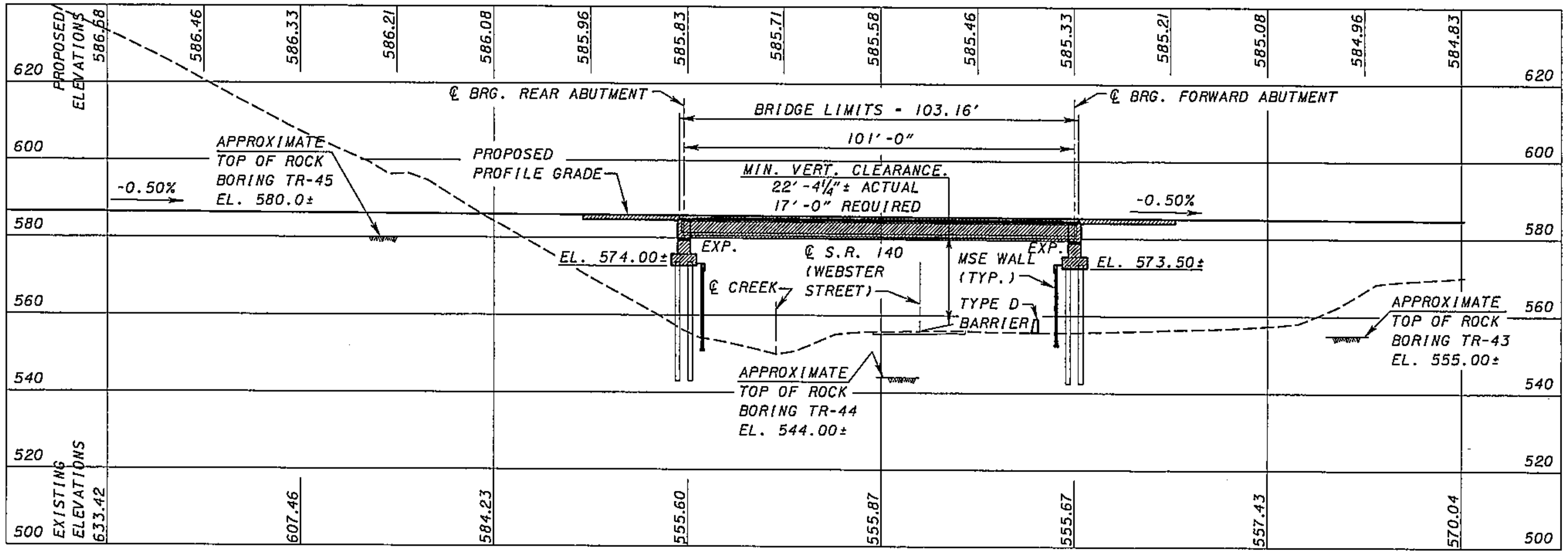
⊕ DENOTES SOIL BORING LOCATION

## SUPERSTRUCTURE DATA



STRUCTURE DEPTH

| | | |
|---|---|---|
| SLAB | - | 8½" |
| HAUNCH | - | 2" |
| BEAM | - | 5'-0" |
| | | 5'-10½" |



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 | | | |

STA.
STA.

PRELIMINARY SITE PLAN - ALTERNATIVE 2
S.R. 823 OVER S.R. 140 (WEBSTER ST.)

SCI-823-0.00
PID 19415

1/1

DATE: 07/12/2005 FILE: g:\C003\0064\Bridges\BTS\04-SR140Webster\823-04sp01_ALT2.dgn

# APPENDIX E

TRANSYSTEMS
CORPORATION

DLZ
ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

March 30, 2005

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

Re: **SCI-823-0.00 over Webster Street (S.R. 140)**
**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 for SCI-823-0.00 over Webster Street (S.R. 140). It is anticipated that the proposed structure will be a two-span elevated bridge. The existing grade at the proposed new bridge location is at approximate elevations 585 and 570 feet at the south and north abutments, respectively. It is anticipated that the SCI-823-0.00 mainline will be located in fill sections on either side of the proposed bridge. Approximately 5 feet and 20 feet of new fill are anticipated at the rear (south) and forward (north) abutments, respectively. It is anticipated that the center pier will be approximately 36 feet in height. A stream is located along the south side of Webster Street. Weathered bedrock is present in the stream bed.

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

## Field Exploration

A total of three borings, TR-43, TR-44 and TR-45, were drilled at the proposed structure between February 2 and 24, 2005. The borings were drilled to depths ranging from 25 to 35 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. Borings TR-43, TR-44 and TR-45 are located approximately at Stations 68+00, 67+00 and 66+00, respectively. Ground surface elevations at the boring locations and the boring locations were estimated from the established topographic mapping for the project and are presented on the attached Boring Logs.

## Findings

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

At the ground surface Borings TR-44 and TR-45 encountered 12 inches of asphalt pavement and 2 inches of topsoil, respectively. Beneath the asphalt pavement in Boring TR-44, 2 feet of silt (A-4b) was encountered overlying 2.5 feet of sandy silt (A-4a). Beneath the sandy silt in Boring TR-44 and at the surface of Boring TR-43, silt and clay (A-6a) was encountered to depths of 2.5 feet and 5.5 feet, respectively. Boring TR-43 encountered 6.1 feet of silty clay (A-6b) beneath the silt and clay (A-6a). Underlying the topsoil in Boring TR-45 and the residual soils in Borings TR-43 and TR-44, highly weathered to decomposed very soft sandstone was encountered ranging in thickness from 3 to 5 feet.

Bedrock was encountered between 5 and 15 feet below the ground surface, and generally consisted of a medium hard to hard sandstone that was slightly broken to intact. Recovery of the core samples ranged from 97 to 100%, and RQD values ranged from 73 to 100% with an average RQD of 87%.

Water seepage was not detected in any of the borings prior to coring operations. At the completion of drilling, water levels ranged from 2.0 to 6.7 feet. The final water levels include drilling water and likely are not representative of actual groundwater conditions. Groundwater levels may vary seasonably.

## Conclusions and Recommendations

Based on the subsurface materials encountered in the borings, either spread footing or drilled shaft foundations are best suited for support of the proposed structure. Competent bedrock was encountered at a shallow depth at the pier and rear (south) abutment locations. Additional fill will be placed at the abutment locations, resulting in an estimated depth to bedrock of 35 feet below the proposed grade at the forward (north) abutment. Bedrock will be shallower at the rear (south) abutment, possibly only 10 to 15 feet with the new fill. If an alternative foundation type is required due to lateral or uplift loads, a pile-type foundation can be used. H-piles can be used if pre-bored sockets into bedrock are utilized.

If spread footings are used to support the abutments, it is anticipated that they will be bearing in new fill. However, the rear (south) abutment may be bearing in bedrock, depending on how much fill is placed. Spread footings bearing in embankment fill may be designed for an allowable bearing capacity of 3000 psf.

If spread footings are used to support the pier or the rear (south) abutment is bearing on bedrock, the footings should be embedded into the bedrock. Additionally, drilled shafts socketed into rock can also be used. The depth of the spread footing embedment or the sockets will need to be designed based upon actual loading conditions. The following table summarizes the site conditions and bearing capacity recommendations for foundations on rock.

Foundation Recommendations

| Boring Number | Structural Element | Existing Ground Surface Elevation* (Feet) | Top of Competent Rock Elevation* (Feet) | Allowable Bearing Capacity |
|---|---|---|---|---|
| TR-43 | Forward (North) Abutment | 570 | 555 | 15 TSF |
| TR-44 | Pier | 555 | 544 | 15 TSF |
| TR-45 | Rear (South) Abutment | 585 | 580 | 15 TSF |

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

Grain size analyses of the overburden in Boring TR-44 were performed for scour analysis since the proposed structure location is located along a stream. The following table presents the $D_{50}$ and $D_{85}$ for each respective soil type encountered in the boring. In addition, grain size data sheets are attached to this report.

Data for Scour Analysis

| Boring Number | Existing Ground Surface Elevation* (Feet) | Sample Depth (Feet) | ODOT Classification | $D_{50}$ (mm) | $D_{85}$ (mm) |
|---|---|---|---|---|---|
| TR-44 | 555.0 | 1.0-2.5 | A-4b | 0.0145 | 0.0526 |
| TR-44 | 555.0 | 3.5-5.0 | A-4a | 0.0576 | 7.75 |
| TR-44 | 555.0 | 6.0-7.5 | A-6a | 0.0103 | 0.0478 |
| TR-44 | 555.0 | 8.5-9.3 | Weathered Rock | 0.0168 | 0.0519 |

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

## Closing

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

Sincerely,

**DLZ OHIO, INC.**

P. Paul Painter for
Edward R. Hood, P.E.
Geotechnical Engineer

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

Attachments: General Information – Drilling Procedures and Logs of Borings
Legend – Boring Log Terminology
Site Plan
Boring Logs TR-43, TR-44, TR-45
Grain Size Analysis

cc: File

M:\proj\0121\3070.03\Structure Memos\SR 140 lt05-30-05.doc

## GENERAL INFORMATION
## DRILLING PROCEDURES AND LOGS OF BORINGS

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standardized methods of investigation of subsurface conditions concerning geotechnical engineering considerations. Borings were drilled with either a truck-mounted or ATV-mounted drill rig.

Drive split-barrel sampling was performed in 1.5 foot increments at intervals not exceeding 5 feet. In the event the sampler encountered resistance to penetration of 6 inches or less after 50 blows of the drop hammer, the sampling increment was discontinued. Standard penetration data were recorded and one or more representative samples were preserved from each sampling increment.

In borings where rock was cored, NXM or NQ size diamond coring tools were used.

In the laboratory all samples were visually classified by a geotechnical engineer. Moisture contents of representative fine-grained soil samples were determined. A limited number of samples, considered representative of foundation materials present, were selected for performance of grain-size analyses and plasticity characteristics tests. The results of these tests are shown on the boring logs.

The boring logs included in the Appendix have been prepared on the basis of the field record of drilling and sampling, and the results of the laboratory examination and testing of samples. Stratification lines on the boring logs indicating changes in soil stratigraphy represent depths of changes approximated by the driller, by sampling effort and recovery, and by laboratory test results. Actual depths to changes may differ somewhat from the estimated depths, or transitions may occur gradually and not be sharply defined. The boring logs presented in this report therefore contain both factual and interpretative information and are not an exact copy of the field log.

Although it is considered that the borings have disclosed information generally representative of site conditions, it should be expected that between borings conditions may occur which are not precisely represented by any one of the borings. Soil deposition processes and natural geologic forces are such that soil and rock types and conditions may change in short vertical intervals and horizontal distances.

Soil/rock samples will be stored at our laboratory for a period of six months. After this period of time, they will be discarded, unless notified to the contrary by the client.

# LEGEND – BORING LOG TERMINOLOGY

Explanation of each column, progressing from left to right

1. Depth (in feet) – refers to distance below the ground surface.

2. Elevation (in feet) – is referenced to mean sea level, unless otherwise noted.

3. Standard Penetration (N) – the number of blows required to drive a 2-inch O.D., 1-3/8 inch I.D., split-barrel sampler, using a 140-pound hammer with a 30-inch free fall. The blows are recorded in 6-inch drive increments. Standard penetration resistance is determined from the total number of blows required for one foot of penetration by summing the second and third 6-inch increments of an 18-inch drive.

   50/n – indicates number of blows (50) to drive a split-barrel sampler a certain number of inches (n) other than the normal 6-inch increment.

4. The length of the sampler drive is indicated graphically by horizontal lines across the "Standard Penetration" and "Recovery" columns.

5. Sample recovery from each drive is indicated numerically in the column headed "Recovery".

6. The drive sample location is designated by the heavy vertical bar in the "Sample No., Drive" column.

7. The length of hydraulically pressed "Undisturbed" samples is indicated graphically by horizontal lines across the "Press" column.

8. Sample numbers are designated consecutively, increasing in depth.

9. Soil Description

   a. The following terms are used to describe the relative compactness and consistency of soils:

**Granular Soils** – Compactness

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

**Cohesive Soils** – Consistency

| Term | Unconfined Compression tons/sq.ft. | Blows/Foot Standard Penetration | Hand Manipulation |
|---|---|---|---|
| Very Soft | less than 0.25 | below 2 | Easily penetrated by fist |
| Soft | 0.25 – 0.50 | 2 – 4 | Easily penetrated by thumb |
| Medium Stiff | 0.50 – 1.0 | 4 – 8 | Penetrated by thumb with moderate pressure |
| Stiff | 1.0 – 2.0 | 8 – 15 | Readily indented by thumb but not penetrated |
| Very Stiff | 2.0 – 4.0 | 15 – 30 | Readily indented by thumb nail |
| Hard | over 4.0 | over 30 | Indented with difficulty by thumb nail |

   b. Color – If a soil is a uniform color throughout, the term is single, modified by such adjective as light and dark. If the predominant color is shaded by a secondary color, the secondary color precedes the primary color. If two major and distinct colors are swirled throughout the soil, the colors are modified by the term "mottled".

   c. Texture is based on the Ohio Department of Transportation Classification System. Soil particle size definitions are as follows:

| Description | | Size | Description | | Size |
|---|---|---|---|---|---|
| Boulders | | Larger than 8" | Sand | – Coarse | 2.0 mm to 0.42 mm |
| Cobbles | | 8" to 3" | | – Fine | 0.42 mm to 0.074 mm |
| Gravel | – Coarse | 3" to ¾" | Silt | | 0.074 mm to 0.005 mm |
| | – Fine | ¾" to 2.0 mm | Clay | | smaller than 0.005 mm |

d. The main soil component is listed first. The minor components are listed in order of decreasing percentage of particle size.

e. Modifiers to main soil descriptions are indicated as a percentage by weight of particle sizes.

| | |
|---|---|
| trace | 0 to 10% |
| little | 10 to 20% |
| some | 20 to 35% |
| "and" | 35 to 50% |

f. Moisture content of **cohesionless soils** (sands and gravels) is described as follows:

| Term | Relative Moisture or Appearance |
|---|---|
| Dry | No moisture present |
| Damp | Internal moisture, but none to little surface moisture |
| Moist | Free water on surface |
| Wet | Voids filled with free water |

g. The moisture content of **cohesive soils** (silts and clays) is expressed relative to plastic properties.

| Term | Relative Moisture or Appearance |
|---|---|
| Dry | Powdery |
| Damp | Moisture content slightly below plastic limit |
| Moist | Moisture content above plastic limit but below liquid limit |
| Wet | Moisture content above liquid limit |

10. Rock Hardness and Rock Quality Designation

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

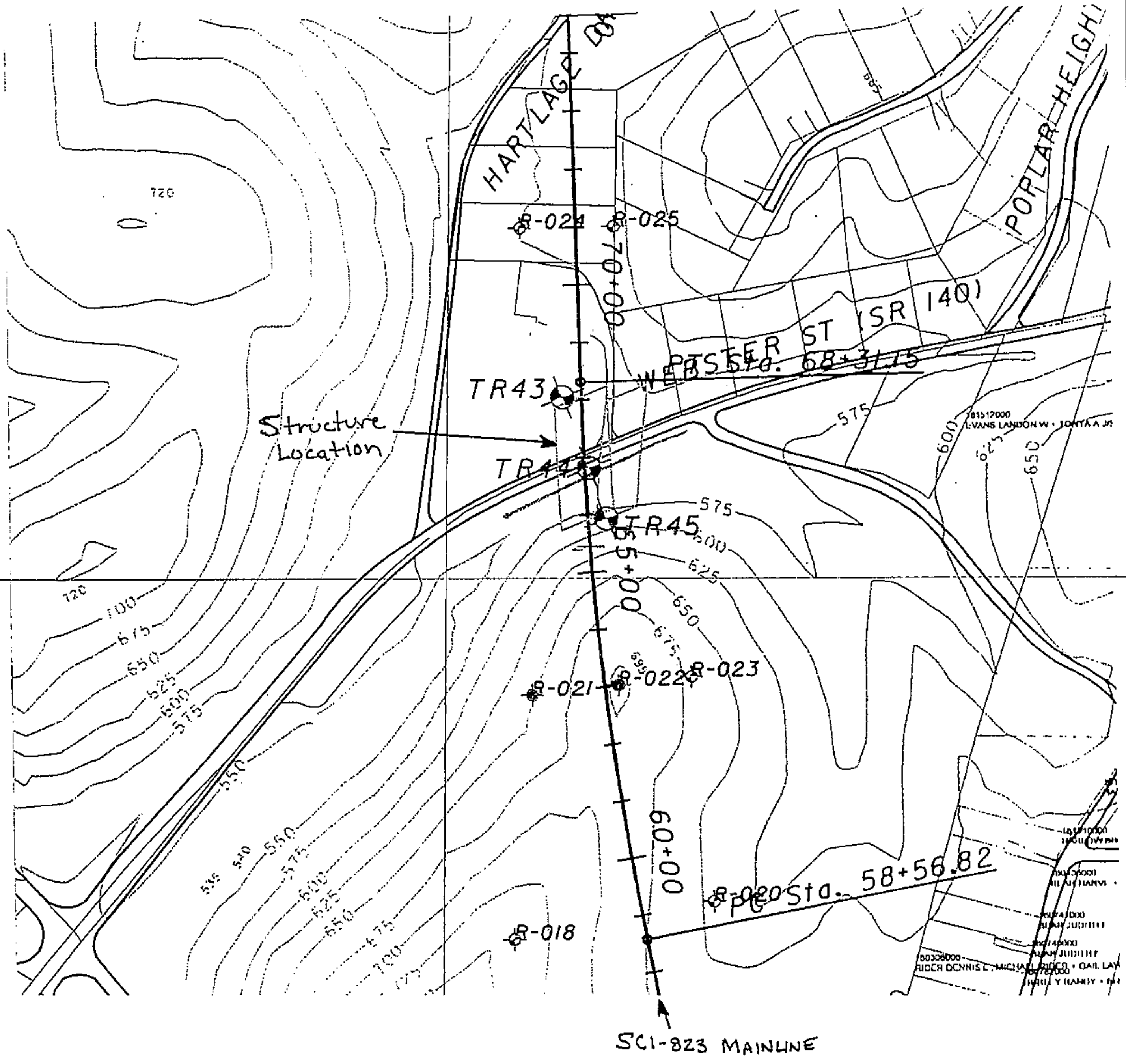
| Term | Description |
|---|---|
| Very Soft | Permits denting by moderate pressure of the fingers. Resembles hard soil but has rock structure. (Crushes under pressure of fingers and/or thumb) |
| Soft | Resists denting by fingers, but can be abraded and pierced to shallow depth by a pencil point. (Crushes under pressure of pressed hammer) |
| Medium Hard | Resists pencil point, but can be scratched with a knife blade. (Breaks easily under single hammer blow, but with crumbly edges.) |
| Hard | Can be deformed or broken by light to moderate hammer blows. (Breaks under one or two strong hammer blow, but with resistant sharp edges.) |
| Very Hard | Can be broken only by heavy and in some rocks repeated hammer blows. |

b. Rock Quality Designation, RQD – This value is expressed in percent and is an indirect measure of rock soundness. It is obtained by summing the total length of all core pieces which are at least four inches long, and then dividing this sum by the total length of the core run.

11. Gradation – when tests are performed, the percentage of each particle size is listed in the appropriate column (defined in Item 9c).

12. When a test is performed to determine the natural moisture content, liquid limit moisture content, or plastic limit moisture content, the moisture content is indicated graphically.

13. The standard penetration (N) value in blows per foot is indicated graphically.



Source: Topographic Mapping provided by TranSystems Corporation, Dated 2004

NORTH

DLZ
ENGINEERS * ARCHITECTS * SCIENTISTS

## SITE PLAN

Webster Street - SR 140
SCI-823 over SR 140
SCI-823-0.00

FIGURE 1.

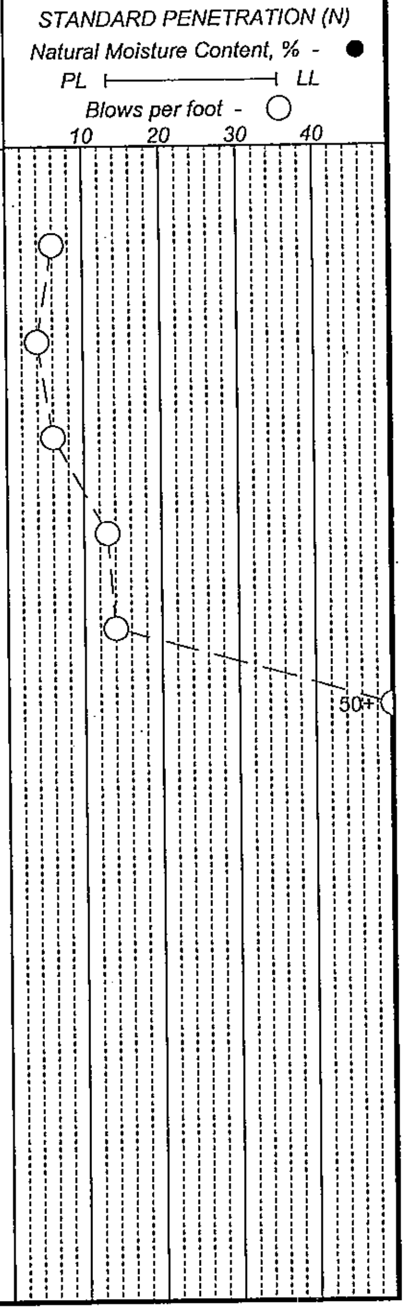
DLZ OHIO INC. * 6121 HUNTLEY ROAD, COLUMBUS, OHIO 43229 * (614)888-0040

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

**LOG OF: Boring TR-43**
Location: SCI-823-0.00 over Webster St. (Forward Abutment)
Date Drilled: 02/03/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 2.0' (includes drill water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetro-meter (tsf) | DESCRIPTION | % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 570.0 | | | | | | Very stiff brown SILT AND CLAY (A-6a), trace fine sand; damp to moist. | | | | | | |
| | | 2 3 3 | 15 | 1 | | 2.25 | | | | | | | |
| | | 2 2 2 | 16 | 2 | | 1.75 - 2.25 | @ 3.5-5.5', stiff to very stiff, brown and gray. | | | | | | |
| 5.5 | 564.5 | | | | | | Stiff to very stiff brown and gray SILTY CLAY (A-6b), little fine sand, trace fine gravel; moist. | | | | | | |
| | | 2 3 3 | 17 | 3 | | 2.0 | | | | | | | |
| | | 3 5 8 | 18 | 4 | | 1.75 | | | | | | | |
| 11.6 | 558.4 | 5 8 6 | 14 | 5 | | | Very soft brown SANDSTONE, very fine grained, decomposed argillaceous, broken. | | | | | | |
| | | 15 50/5 | 10 | 6 | | 4.5+ | | | | | | | |
| 15.0 | 555.0 | Core 120" | Rec 120" | RQD 78% | R-1 | | Medium hard gray SANDSTONE; very fine grained, highly weathered, argillaceous, micaceous, thinly bedded, highly fractured, with typical low and high angle clay filled and rust stained fractures. | | | | | | |
| 21.0 | 549.0 | | | | | | Medium hard to hard gray SANDSTONE; very fine grained, slightly weathered, argillaceous, micaceous, thinly bedded, slightly fractured. | | | | | | |
| 30 | | Core 120" | Rec 120" | RQD 100% | R-2 | | | | | | | | |



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-43**
Location: SCI-823-0.00 over Webster St. (Forward Abutment)
Date Drilled: 02/03/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 2.0' (includes drill water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. |  | Hand Penetrometer (tsf) | DESCRIPTION | GRADATION |  |  |  |  |  | STANDARD PENETRATION (N)<br>Natural Moisture Content, % - ●<br>PL ├──┤ LL<br>Blows per foot - ○<br>10 20 30 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  | Drive | Press / Core |  |  | % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |  |
| 30 | 540.0 |  |  |  |  |  | Medium hard to hard gray SANDSTONE; very fine grained, slightly weathered, argillaceous, micaceous, thinly bedded, slightly fractured. |  |  |  |  |  |  |  |
| 35.0 | 535.0 |  |  |  |  |  | Bottom of Boring - 35.0' |  |  |  |  |  |  |  |
| 40 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 45 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 55 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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

Client: TranSystems, Inc.

Project: SCI-823-0.00

Job No. 0121-3070.03

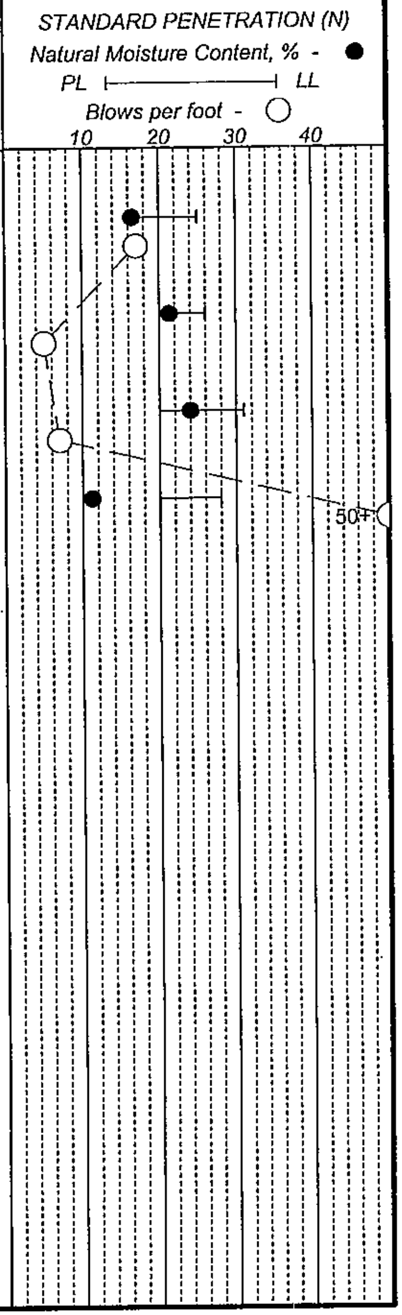
**LOG OF: Boring TR-44**

Location: SCI-823.0.00 over Webster St. (Pier)

Date Drilled: 02/02/05

WATER OBSERVATIONS:
Water seepage at: None
Water level at completion: 5.0' (includes drill water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetro-meter (tsf) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 555.0 | | | | | | Asphalt Concrete Pavement - 12" | | | | | | |
| 1.0 | 554.0 | 9<br>8<br>9 | 16 | 1 | | 4.0 | Hard brown and gray SILT (A-4b), some clay, trace fine to coarse sand; damp. | 1 | 2 | -- | 6 | 62 | 29 |
| 3.0 | 552.0 | 3<br>2<br>3 | 13 | 2 | | | Loose brown SANDY SILT (A-4a), some gravel, little clay; damp. | 22 | 12 | -- | 12 | 44 | 10 |
| 5<br>5.5 | 549.5 | 3<br>3<br>4 | 14 | 3 | | 2.25 | Very stiff brown and gray SILT AND CLAY (A-6a), trace fine sand; moist. | 0 | 3 | -- | 6 | 61 | 30 |
| 8.0 | 547.0 | 26<br>50/3 | 8 | 4 | | | Soft to medium hard gray and brown SANDSTONE; highly weathered to decomposed. | 0 | 1 | -- | 6 | 70 | 23 |
| 10 | | | | | | | | | | | | | |
| 11.0 | 544.0 | | | | | | Medium hard gray SANDSTONE; very fine grained, highly weathered, argillaceous, micaceous, thinly bedded, highly fractured, with typical low angle rust stained fractures. | | | | | | |
| 15 | | Core 108" | Rec 108" | RQD 73% | R-1 | | | | | | | | |
| | | | | | | | @ 17.7'-18.0', broken zone, clay filled.<br>@ 19.0'-20.0', high angle fractures. | | | | | | |
| 20.0 | 535.0 | | | | | | Medium hard to hard gray SANDSTONE; very fine grained, slightly weathered, argillaceous, micaceous, thinly bedded, slightly fractured. | | | | | | |
| 25 | | Core 120" | Rec 116" | RQD 92% | R-2 | | | | | | | | |
| 30.0 | 525.0 | | | | | | Bottom of Boring - 30.0' | | | | | | |



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-45**
Location: SCI-823-0.00 over Webster St. (Rear Abutment)
Date Drilled: 02/24/05

WATER OBSERVATIONS: Water seepage at: None
Water level at completion: 6.7' measured inside augers

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. | | Hand Penetrometer (tsf) | DESCRIPTION | GRADATION | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Drive | Press / Core | | | % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
| | 585.0 | | | | | | | | | | | | |
| 0.1 | 584.9 | | | | | | Topsoil - 2" | | | | | | |
| | | 15<br>50/4 | 10 | 1 | | | Very soft brown SANDSTONE; very fine grained, decomposed, argillaceous, broken. | | | | | | |
| | | 50/3 | 3 | 2 | | | | | | | | | |
| 5.0 | 580.0 | Core 120" | Rec 120" | RQD 79% | R-1 | | Soft to medium hard brownish gray SANDSTONE; very fine grained, highly weathered to decomposed, argillaceous, micaceous, thinly bedded, highly fractured, with typical low angle rust stained and clay filled fractures.<br>@ 5.0'-5.1', broken zones.<br>@ 7.4'-7.6', broken zones.<br>@ 9.3'-9.6', high angle rust stained fracture.<br>@ 11.1'- 11.4', broken zones.<br>@ 14.2'-14.5', high angle rust stained fracture. | | | | | | |
| 15.4 | 569.6 | Core 120" | Rec 120" | RQD 100% | R-2 | | Medium hard to hard gray SANDSTONE; very fine grained, slightly weathered, argillaceous, micaceous, thinly bedded, slightly fractured.<br>@ 16.1'-16.3', rust stained zone.<br>@ 17.3', low angle clay filled fracture.<br>@ 20.2', low angle clay filled fracture. | | | | | | |
| 25.0 | 560.0 | | | | | | Bottom of Boring - 25.0' | | | | | | |

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