FILE

*Revised Structure Type Study*

# SR-823 Over Norfolk Southern Tracks and US-23
## SCI-823-1601

# SCI-823-10.13
# PID No. 19415

Prepared for

**Ohio Department of Transportation**

May 2007

CH2MHILL

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## 1. Introduction

On July 14, 2005, CH2M HILL submitted the Structure Type Study for the SR-823 Bridge over Norfolk Southern Corporation tracks and US-23 located at the proposed US-23/SR-823 Interchange. This structure was originally recommended to have a semi-integral rear abutment supported on steel H-piles behind a 2:1 spill-through slope, and a semi-integral forward abutment supported on steel H-piles behind a Mechanically Stabilized Embankment (MSE) wall. Subsequent ODOT review comments of the Structure Type Study on September 28, 2005 recognized the economic benefit of recommending a MSE Wall forward abutment; however, ODOT Office of Structural Engineering (OSE) commented that *"The Design Consultant shall first determine that MSE wall supported abutments can be utilized at the proposed location prior to making any MSE wall recommendations during the Structure Type Study. Subsurface soil conditions are to be evaluated for expected settlements, differential settlements, allowable bearing capacities and global stability of the proposed MSE walls prior to submitting Structure Type Study to our office."*

All retaining wall justification and wall type studies were to be conducted by another consultant and coordinated with CH2M HILL. Since a Wall Type Study was not submitted, the SR-823 Bridge over Norfolk Southern tracks and US-23 has not been approved by OSE to-date.

In October 2006, the project's geotechnical consultant, DLZ, submitted a revised *"Subsurface Exploration and MSE Wall and Embankment Evaluations for Proposed US 23/SR 823 Interchange"* report, which included the design calculations requested by ODOT OSE. The report concluded that *"MSE walls can be safely constructed using staged construction and ground modification techniques at this interchange. However, due to the relatively poor subsurface conditions, the risk of detrimental differential settlement is greater when constructing MSE walls using staged construction."* Due to concerns over the existing soil conditions at the proposed interchange location, additional ground improvement and/or wall alternatives were investigated in a Wall Type Study in conjunction with revised Structure Type Studies for the three proposed bridges at Fairground Road; these reports were submitted to ODOT OSE in April 2007.

After reviewing DLZ's revised *"Subsurface Exploration and MSE Wall and Embankment Evaluations for Proposed US 23/SR 823 Interchange"* report, ODOT provided comments via a memorandum from Peter Narsavage dated April 23, 2007. One of the comments read, *"From the report, we understand that undrained bearing capacity and differential settlement of the ramp MSE walls are of concern. The other stability checks, such as global stability, sliding, and drained bearing capacity result in acceptable safety factors. We believe that MSE walls could be built in two stages, without any surcharging or ground improvement. Wick drains could be considered to decrease the amount of time required for consolidation of the foundation soil. Where the height of the MSE wall was high enough to cause concern about differential settlement, slip joints can be provided at regular intervals. The top row of facing panels would not be fabricated until after settlement was substantially complete."* A subsequent follow-up call with Mr. Narsavage on April 26, 2007 resulted in ODOT directing CH2M HILL not to perform any further Wall Type Studies at the interchange location, and to assume that MSE walls will be built in two stages without surcharging or ground improvements. This assumption will be re-evaluated after final borings have been completed and testing completed.

## 2. Major Developments

The following is a summary of the changes made to the previous SR-823 Bridge over Norfolk Southern tracks and US-23 Structure Type Study submission.

- Discussions between Norfolk Southern and ODOT District 9 in March 2006 indicated that Norfolk Southern has plans to add two additional tracks at the interchange location as part of the 'Heartland Corridor' project. Norfolk Southern has not indicated when the two future tracks will be constructed. As a result, the bridge abutments/piers adjacent to the railroad must be situated to accommodate for two future tracks that will be located outside of the two existing tracks.
- Three (3) bridge alternatives were considered to determine the most economical, combined structural system:
    2. Three span bridge behind MSE Walls;
    3. Two span bridge behind MSE Walls; and
    4. Three span bridge behind 2:1 spill-through slopes

Each bridge alternative was evaluated with regard to estimated construction cost, projected maintenance costs, horizontal and vertical clearances, aesthetics, constructability, and maintenance of traffic. Based on these evaluations, one alternative is recommended for further design development in the Bridge Preliminary Design Report stage.

- All proposed pier types were revised from a double hammerhead configuration to a single cap and column pier.
- An MSE wall at the rear abutment was investigated for the proposed structure.
- The proposed forward abutment location provides a clear zone distance that eliminates the need for concrete barrier protection.
- New pricing information for several structural items in 2006 dollars was used in this Structure Type Study re-submittal.
- The foundation and wall recommendations were revised and is included in Appendix E.

## 3. Design Criteria

All proposed structure types are in accordance with the most current version of the Ohio Department of Transportation Bridge Design Manual and the 2002 AASHTO Standard Specifications for Highway Bridges, 17th edition. Railroad clearances conform to Norfolk Southern Corporation's publication, "Overhead Grade Separation Design Criteria" and the 2005 AREMA Manual for Railway Engineering.

## 4. Bridge Transverse Section and Alignment

At the proposed bridge location, SR-823 follows a tangent horizontal alignment. The proposed eastbound section consists of one 16-foot lane, a 6'-1 1/8" right shoulder, and an 8-foot left shoulder. The proposed westbound section also consists of one 16-foot lane, a 6'-1 1/8" left shoulder, and an 8-foot right shoulder. With two 1'-6" wide single slope outside

deflector parapets and a 2'-9 ¾" wide single slope Type B1 median barrier, the out-to-out deck width is a constant 66'-0" for all alternatives. In addition, the bridge deck will have a 1.6% cross slope.

The proposed SR-823 vertical alignment over the Norfolk Southern tracks and US-23 consists of a -3.00 percent slope for the entire length of the proposed bridge structure.

The existing railroad section consists of two tracks on approximately 26'-6" centers, proceeding north on an approximate 0.3% downgrade. SR-823 crosses the existing tracks at a skew angle of approximately 22°36'. No modifications to the existing railroad are anticipated as part of the project, however, apparent settlement of the tracks may require the railroad to realign the vertical profile in the future. Calculations show that realignment may reduce the proposed vertical clearance by 6 ½" at the existing west track and 5 1/8" at the existing east track; therefore, 23'-6 ½" of vertical clearance shall be provided as a minimum. Allowing for this realignment is required per Norfolk Southern Corporation's publication, "Overhead Grade Separation Design Criteria". In addition, the bridge span over the railroad must be designed to accommodate for two future tracks that will added to the outside of the two existing tracks. It is assumed that the vertical alignment of the proposed tracks will match the alignment of the adjacent existing track and will be located 14'-0" from the each existing track per conversations with the Norfolk Southern Corporation.

The existing US-23 section consists of approximately two 12-foot lanes in each direction (northbound and southbound), with 8-foot outside shoulders and 4-foot inside shoulders. The depressed median measures approximately 40 feet from inside edge-of-pavement to inside edge-of-pavement. SR-823 crosses US-23 at an approximate skew angle of 22°40'. The proposed US-23 section consists of the existing section described above, with the addition of a southbound, 12-foot acceleration lane (with an 8-foot shoulder) for traffic exiting westbound SR-823 and merging onto southbound US-23. The design speed for this acceleration lane is 60 mph. The forward abutment along US-23, for all alternatives, is located outside the minimum preferred horizontal clear zone width of 30'-0".

## 5. Proposed Maintenance of Traffic Solution

The proposed SR-823 alignment will carry traffic exiting southbound US-23 onto eastbound SR-823 and exiting westbound SR-823 onto southbound US-23. Because SR-823 is new construction, maintenance of highway traffic during construction of the SR-823 bridge will be minimal. With the exception of limited US-23 closures for superstructure beam setting, existing culvert replacement, and US-23 acceleration lane construction, as well as traffic safety precautions throughout bridge construction, no additional maintenance of traffic solutions will need to be investigated.

Coordination with railway traffic below the proposed bridge will be required during construction. All features have been located such that permanent and temporary works will be located outside the permanent or temporary clear zones as applicable. Appropriate railroad flagging and insurance will be required throughout construction.

## 6. Evaluation of Structure Alternatives

### Common Considerations

Construction costs for each alternative have been developed for an identical length of improvement, equal to the out-to-out length of the longest alternative. Estimated construction costs for each alternative include all proposed work between these limits. The roadway profile for SR-823 in the interchange is controlled by the vertical clearances at both Ramp B and Ramp C over the railroad. As a result, vertical clearance for the SR-823 Bridge over Norfolk Southern tracks and US-23 exceeds the 23'-0" and 17'-0" required clearances, respectively, and no additional costs associated with profile adjustments are necessary. Costs to relocate utilities, and costs for services or construction to be provided by the Norfolk Southern Corporation are not included in this document. It is reasonable to assume that these costs will be similar for all alternatives, and would not influence the selection of the preferred alternative.

Railroad horizontal clearance is a primary consideration in determining the possible span arrangements. The following minimum horizontal clearances to the centerline of the adjacent future track were maintained for all alternatives:

- MSE wall abutments or cap and column piers: 25'-0"
- Pier footings: 17'-0" (to allow for temporary shoring)

These horizontal clearances allow adequate room to maintain existing railroad drainage. Some minor ditch modifications will be required due to the future new tracks, but these are not anticipated to impact the railway roadbed nor decrease the capacity of the existing ditches. The piers adjacent to the railroad have been situated to accommodate two future tracks to be placed on the outside of each of the two existing tracks. Roadway horizontal clearances were discussed previously in Section 4.

The horizontal clearance constraints imposed by the railroad and by US-23 restrict the range of possible pier locations, and limit the number of feasible span arrangements. Since most of the span arrangements include span lengths in excess of 125 feet, only steel beams superstructures were considered for this type study. In addition, unpainted weathering steel is selected in lieu of coated steel, to minimize initial construction and future lifecycle maintenance costs; this is consistent with the Department's recommendation to use weathering steel over railways. The use of weathering steel is also consistent with the proposed adjacent bridges carrying Ramp B and Ramp C – please refer to separate Structure Type Study submittals for these two ramp structures.

Currently, an open channel maintains flow from the outlet of an existing culvert under the railroad to the inlet of an existing culvert under US-23. The proposed interchange geometry requires that the culvert under US-23 be relocated to the south. However, the railroad culvert is expected to serve adequately in its current location. Preservation of the existing railroad culvert is desirable, because of the considerable costs associated with potential relocation of this drainage structure. As a result, either a concrete, flat bottom or grass ditch will be required to re-direct the water flow from the existing railroad culvert to the

proposed culvert under US-23. The location of proposed cap and column piers for all alternatives avoids conflict with this ditch.

Due to poor soil conditions at the interchange location, geotechnical calculations and analysis have concluded that MSE wall construction near the existing railroad tracks may cause the tracks to settle. A track settlement vs. distance of wall from the railroad track graph was prepared and discussed with Norfolk Southern Corporation representatives on May 2, 2007 at ODOT Central Office. At the meeting, Norfolk Southern representatives stated that the proposed tracks will not be constructed prior to construction of the proposed interchange. As a result, the proposed rear abutment MSE wall in Alternatives 1 and 2 will be constructed approximately 40'-0" from the existing adjacent railroad tracks. The graph shows a calculated settlement value of 0.25" may occur at the railroad track during and after construction of the rear abutment MSE wall. Norfolk Southern representatives concluded that they would be okay with this calculated 0.25" settlement of the adjacent tracks.

Spill-through type and retained-fill type abutments placed outside of the preferred 25'-0" minimum horizontal clearances are considered feasible for both the rear and forward abutments. Specifically at the rear abutment location, MSE abutment walls placed less than 25'-0" but more than 22'-0" from the future track centerline would require a cast-in-place concrete crash wall. The significant expense of building such a wall is not likely to be overcome by the cost savings realized with a nominally shorter superstructure. Therefore, MSE abutment walls and piers within 25'-0" of the future track centerlines are not considered in this study.

As previously mentioned in the original Structure Type Study, a FEMA study estimates the 100-year flood at elevation 543 feet, due to backwater from the Scioto River. Pier 2 and the forward abutment would be inundated in this event. It is anticipated that the MSE wall at the forward abutment may require specialized fill material, rip-rap, or other means to protect against scour. The Department should consider authorizing both a Hydraulic Analysis and Scour Analysis to aid in selection of pier foundation details, MSE wall details, and foundation details at the forward abutment.

### Alternative 1

Alternative 1 consists of a 122'-0", 146'-0", 103'-0" three span bridge with rear and forward abutments on steel H-piles behind MSE abutment breastwalls constructed outside the minimum preferred railroad and US-23 horizontal clearances. Both abutment faces are straight and approximately parallel to the railroad tracks and US-23. The cap and column piers are founded on steel H-pile supported footings. All piles will be driven to bedrock. The superstructure will consist of eight 60"-deep Grade 50 weathering steel plate girders, spaced at 8'-6" on center.

The initial bridge construction cost for Alternative 1 is estimated to be $4,932,000 in year 2006 dollars. The present value life cycle maintenance costs for this alternative are estimated to be $2,559,000, resulting in a total estimated bridge ownership cost of $7,491,000 in year 2006 dollars.

### Alternative 2

Alternative 2 consists of a 183'-0" and 183'-0" two span bridge with rear and forward abutments on steel H-piles behind MSE abutment breastwalls constructed outside the minimum preferred railroad and US-23 horizontal clearances. Both abutment faces are straight and approximately parallel to the railroad tracks and US-23. The cap and column pier is founded on steel H-pile supported footings. All piles will be driven to bedrock. The superstructure will consist of eight 78"-deep Grade 50 weathering steel plate girders, spaced at 8'-6" on center.

The initial bridge construction cost for Alternative 2 is estimated to be $4,836,000 in year 2006 dollars. The present value life cycle maintenance costs for this alternative are estimated to be $2,836,000, resulting in a total estimated bridge ownership cost of $7,672,000 in year 2006 dollars.

### Alternative 3

Alternative 3 consists of a 176'-0", 146'-0", 146'-0" three span bridge with rear and forward abutments on steel H-piles behind 2:1 spill-through slopes constructed outside the minimum preferred railroad and US-23 horizontal clearances. Both abutment faces are straight and approximately parallel to the railroad tracks and US-23. The cap and column piers are founded on steel H-pile supported footings. All piles will be driven to bedrock. The superstructure will consist of eight 75"-deep Grade 50 weathering steel plate girders, spaced at 8'-6" on center.

The initial bridge construction cost for Alternative 3 is estimated to be $4,696,000 in year 2006 dollars. The present value life cycle maintenance costs for this alternative are estimated to be $3,601,000, resulting in a total estimated bridge ownership cost of $8,297,000 in year 2006 dollars.

## 7. Recommended Alternative

Three (3) structural solutions for the construction of the proposed SR-823 Bridge over Norfolk Southern tracks and US-23 have been evaluated in this revised Structure Type Study. All alternatives provide comparable operational characteristics and meet minimum horizontal and vertical clearance requirements. Due to the fact that the roadway profile for SR-823 in the interchange is controlled by the vertical clearances at both Ramp B and Ramp C over the railroad, no differential costs associated with profile adjustments have been considered in the aforementioned alternatives.

When comparing the three bridge layouts, Alternative 1 offers the following desirable attributes:

- Shallowest superstructure depth, should Ramp B or Ramp C require a lower vertical profile
- Initial construction cost within 5% of the other alternatives
- Lowest total ownership costs

Based on the foregoing advantages, **CH2M HILL recommends that the three-span bridge of ALTERNATIVE 1 be constructed for the bridge carrying SR-823 over Norfolk Southern tracks and US-23.**

## 8. Subsurface Conditions and Foundation Recommendation

Subsurface investigations for the SCI-823-10.13 project will be conducted in two or possibly three phases. The first phase is complete, and included all of the proposed pavement and embankment borings, and a limited number of bridge borings. The second phase will include the remaining bridge borings (if necessary), and the majority of the proposed MSE retaining wall borings. If required, a third phase will target specific boring locations or in-situ testing recommended in the bridge and retaining wall Preliminary Design Report submissions.

Nine borings at the SR-823 Bridge over Norfolk Southern tracks and US-23 were taken during the first phase. Based on these initial borings, preliminary foundation recommendations have been made. A copy of the preliminary report is included with this submission.

The recommended alternative, Alternative 1, consists of semi-integral rear and forward abutments, behind an MSE wall, supported by HP 10x42 H-piles driven to bedrock. The final pile arrangement should consider avoiding potential conflicts with typical MSE reinforcing strap patterns. Each pier is supported by HP 12x53 piles driven to bedrock. Pier piles will be battered to resist horizontal loads.

It is anticipated that most of the piles will be driven to refusal on sandstone. While weathered shale bedrock is present at the top of rock near the rear abutment, the shale layer is thin and it is possible that some piles could be driven through the shale to refusal on the sandstone. Therefore, it is recommended that reinforced pile points be used to protect all the proposed piles while driving.

Final foundation size, capacity, and possible pile length recommendations will be made upon completion of the remaining bridge and retaining wall borings, and will be included with the bridge Preliminary Design Report submission.

# APPENDIX A

# SCI-823-10.13

## SCI-823 Over Norfolk Southern Tracks & US-23

### STRUCTURE TYPE STUDY

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[823_RR_Structure Cost Comparison.xls]Alternative Summary

By: DGS Date: 4/9/2007

Checked: JTC Date: 4/20/2007

## ALTERNATIVE COST SUMMARY

| Alternative No. | Span Arrangement No. Spans | Lengths | Total Span Length (ft.) | Framing Alternative | Proposed Stringer Section | Subtotal Superstructure Cost | Subtotal Substructure Cost | Approach Roadway Length (Note 1) | Approach Roadway Cost (Notes 2 & 3) | Structure Incidental Cost (16%) (Note 4) | Structure Contingency Cost (20%) | Roadway Incidental & Contingency Cost (30%) (Note 5) | Total Initial Construction Cost | Superstructure Life Cycle Maintenance Cost | Total Relative Ownership Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 122.00 - 146.00 - 103.00 | 371.00 | 8 ~ Steel Plate Girders | 60" Steel Plate Girder | $2,206,000 | $1,285,000 | 97.0 | $55,000 | $559,000 | $810,000 | $17,000 | $4,932,000 | $2,559,000 | $7,491,000 |
| 2 | 2 | 183.00 - 183.00 | 366.00 | 8 ~ Steel Plate Girders | 78" Steel Plate Girder | $2,179,000 | $1,242,000 | 102.0 | $57,000 | $547,000 | $794,000 | $17,000 | $4,836,000 | $2,836,000 | $7,672,000 |
| 3 | 3 | 176.00 - 146.00 - 146.00 | 468.00 | 8 ~ Steel Plate Girders | 75" Steel Plate Girder | $2,756,000 | $617,000 | 0.0 | $0 | $540,000 | $783,000 | $0 | $4,696,000 | $3,601,000 | $8,297,000 |

**NOTES:**

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

2. Use 2006 pavement cost = $46.00 /sq. yd.

   Pavement Widths:

| Alternative | Average Rear Approach | Average Fwd. Approach | Combined Average |
|---|---|---|---|
| Alt. 1 | 66.00 ft. | 66.00 ft. | 66.00 ft. |
| Alt. 2 | 66.00 ft. | 66.00 ft. | 66.00 ft. |
| Alt. 3 | 66.00 ft. | 66.00 ft. | 66.00 ft. |

3. Use 2006 Concrete Barrier, Single Slope Median, Type B1 cost = $64.00 /ft.
   Use 2006 Concrete Barrier, Single Slope, Type D cost = $81.00 /ft.

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

5. Roadway incidental cost allowance includes provision for drainage, maintenance of traffic, and traffic control costs.

6. No profile adjustment costs associated with raising the SCI-823 profiles have been considered, since all alternatives satisfy the minimum required vertical clearance of 23'-6 1/2" over the railroad west track, 23'-5 1/8" over the railroad east track, and 17'-0" over US-23.

| Alternative | Vertical Clearance Provided @ East NS RR (ft.) | Vertical Clearance Provided @ West NS RR (ft.) | Vertical Clearance Provided @ US-23 (ft.) | Profile Adjustment Required (ft.) |
|---|---|---|---|---|
| Alt. 1 | 26.19' | 26.18' | 27.78' | 0.00' |
| Alt. 2 | 24.65' | 24.81' | 26.24' | 0.00' |
| Alt. 3 | 24.90' | 24.89' | 26.49' | 0.00' |

# SCI-823-10.13

## SCI-823 Over Norfolk Southern Tracks & US-23

**STRUCTURE TYPE STUDY**

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[823_RR_Structure Cost Comparison.xls]Alternative Summary

By: DGS Date: 4/9/2007

Checked: JTC Date: 4/20/2007

## SUPERSTRUCTURE

| Alternative No. | Span Arrangement No. Spans | Lengths | Total Span Length (ft.) | Deck Length (ft.) | Deck Area (sq. ft.) | Deck Volume (cu. yd.) | Deck Concrete Cost | Deck Reinforcing Cost | Approach Slab Cost | Framing Alternative | Proposed Stringer Section | Structural Steel Weight (pounds) | Structural Steel Cost | Prestressed Beam Cost | Initial Superstructure Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 3 | 122.00 - 146.00 - 103.00 | 371.00 | 373.00 | 24,600 | 956 | $468,700 | $220,800 | $90,600 | 8 ~ Steel Plate Girders | 60" Steel Plate Girder | 1107000 | $1,425,800 | $0 | **$2,206,000** |
| **2** | 2 | 183.00 - 183.00 | 366.00 | 368.00 | 24,300 | 944 | $462,400 | $217,800 | $90,600 | 8 ~ Steel Plate Girders | 78" Steel Plate Girder | 1093500 | $1,408,400 | $0 | **$2,179,000** |
| **3** | 3 | 176.00 - 146.00 - 146.00 | 468.00 | 470.00 | 31,000 | 1,205 | $590,500 | $278,200 | $90,600 | 8 ~ Steel Plate Girders | 75" Steel Plate Girder | 1395000 | $1,796,800 | $0 | **$2,756,000** |

**Deck Cross-Sectional Area:**

Parapets:

| | No. | Individual Area (sq. ft.) | Parapet Area (sq. ft.) |
|---|---|---|---|
| Parapets | 2 | 4.26 | 8.52 |
| Median | 1 | 9.29 | 9.29 |

Slab:

| | T (ft.) | Ave. W (ft.) | Slab Area | Haunch & Overhang Area | Total Concrete Area (sq. ft.) |
|---|---|---|---|---|---|
| Alt. 1 | 0.71 | 66.00 | 46.7 | 4.7 | 69.2 |
| Alt. 2 | 0.71 | 66.00 | 46.7 | 4.7 | 69.2 |
| Alt. 3 | 0.71 | 66.00 | 46.7 | 4.7 | 69.2 |

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

**QC/QA Concrete, Class QSC2**

**Unit Cost ($/cu. yd):**

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Deck | $512.91 | 3.0% | $528.00 |
| Parapets | $370.36 | 3.0% | $381.00 |
| Weighted Average (Alt. 1 - Alt. 3) = | | | $490.00 |

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 for concrete or steel girder bridges

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Deck Reinforcing | $0.79 | 3.0% | $0.81 |

**Structural Steel**

**Unit Costs ($/lb.):**

| | Cost Ratio | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|---|
| Rolled Beams - Grade 50 (level 2) | n/a | $0.95 | 12.0% | $1.06 |
| Plate Girders - Grade 50 (level 4) | n/a | $1.15 | 12.0% | $1.29 |
| Hybrid Plate Girders - Grade 50/70W | 1.10 | $1.27 | 12.0% | $1.42 |

Note - all structural steel weight will be estimated at 65 pounds per each square foot of bridge deck area for long simple span tangent girders.
45 pounds per each square foot of bridge deck area for short simple span or long continuous span tangent girders.

**Reinforced Concrete Approach Slabs (T=17")**

**Unit Cost ($/sq. yd.):**

*Alt. 1 - 3*

Length = 30 ft. Width = 66.00 ft

Area = 220 sq. yd.

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Approach Slabs | $199.78 | 3.0% | $206.00 |

# SCI-823-10.13

## SCI-823 Over Norfolk Southern Tracks & US-23

**STRUCTURE TYPE STUDY**

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[823_RR_Structure Cost Comparison.xls]Alternative Summary
By: DGS Date: 4/9/2007
Checked: JTC Date: 4/20/2007

## 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 | Approach Embankment Cost | Initial Substructure Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 3 | 122.00 - 146.00 - 103.00 | 8 ~ Steel Plate Girders | 60" Steel Plate Girder | $108,700 | $22,500 | $125,200 | $23,000 | $106,900 | $794,800 | $103,700 | **$1,285,000** |
| **2** | 2 | 183.00 - 183.00 | 8 ~ Steel Plate Girders | 78" Steel Plate Girder | $58,500 | $12,300 | $142,200 | $26,200 | $119,400 | $764,000 | $119,100 | **$1,242,000** |
| **3** | 3 | 176.00 - 146.00 - 146.00 | 8 ~ Steel Plate Girders | 75" Steel Plate Girder | $120,600 | $25,300 | $151,400 | $27,900 | $111,300 | $0 | $180,900 | **$617,000** |

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

*Alt 1; Pier 1*

| | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|
| Cap | 34.2 | $555.68 | 3.0% | $572.00 | $19,600 |
| Columns | 46.1 | $555.68 | 3.0% | $572.00 | $26,400 |
| Footings | 35.6 | $300.31 | 3.0% | $309.00 | $11,000 |
| Total Pier 1 Cost | | | | | $57,000 |

*Alt 1; Pier 2*

| | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|
| Cap | 31.8 | $555.68 | 3.0% | $572.00 | $18,200 |
| Columns | 39.4 | $555.68 | 3.0% | $572.00 | $22,500 |
| Footings | 35.6 | $300.31 | 3.0% | $309.00 | $11,000 |
| Total Pier 2 Cost | | | | | $51,700 |

*Alt 2; Pier 1*

| | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|
| Cap | 31.8 | $555.68 | 3.0% | $572.00 | $18,200 |
| Columns | 47.4 | $555.68 | 3.0% | $572.00 | $27,100 |
| Footings | 42.7 | $300.31 | 3.0% | $309.00 | $13,200 |
| Total Pier 1 Cost | | | | | $58,500 |

*Alt 3; Pier 1*

| | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|
| Cap | 34.2 | $555.68 | 3.0% | $572.00 | $19,600 |
| Columns | 53.2 | $555.68 | 3.0% | $572.00 | $30,400 |
| Footings | 42.7 | $300.31 | 3.0% | $309.00 | $13,200 |
| Total Pier 1 Cost | | | | | $63,200 |

*Alt 3; Pier 2*

| | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|
| Cap | 31.8 | $555.68 | 3.0% | $572.00 | $18,200 |
| Columns | 45.4 | $555.68 | 3.0% | $572.00 | $26,000 |
| Footings | 42.7 | $300.31 | 3.0% | $309.00 | $13,200 |
| Total Pier 2 Cost | | | | | $57,400 |

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

Pier Piles:

| | Number Pier 1 | Number Pier 2 | Top Elevation Pier 1 | Top Elevation Pier 2 | Bottom Elevation Pier 1 | Bottom Elevation Pier 2 | Length Per Pier 1 Pile | Length Per Pier 2 Pile | Total Pile Length | Total Cost | Pile Size |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alt. 1 | 20 | 20 | 534.0 | 534.6 | 517.0 | 511.8 | 25 | 30 | 1,100 | $32,900 | HP12 x 53 |
| Alt. 2 | 24 | 0 | 535.6 | 0.0 | 511.8 | 0.0 | 30 | 0 | 720 | $26,100 | HP14 x 73 |
| Alt. 3 | 24 | 24 | 534.0 | 534.6 | 517.0 | 511.8 | 25 | 30 | 1,320 | $39,500 | HP12 x 53 |

Abutment Piles:

| | Number Rear | Number Forward | Top Elevation Rear | Top Elevation Forward | Bottom Elevation Rear | Bottom Elevation Fwd. | Length Per Rear Pile | Length Per Forward Pile | Total Pile Length | Total Cost | Pile Size |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Alt. 1 | 20 | 20 | 573.8 | 562.7 | 523.0 | 503.1 | 60 | 65 | 2,500 | $74,000 | HP10 x 42 |
| Alt. 2 | 26 | 26 | 572.3 | 561.3 | 523.0 | 503.1 | 55 | 65 | 3,120 | $93,300 | HP12 x 53 |
| Alt. 3 | 20 | 20 | 571.7 | 559.6 | 523.0 | 503.1 | 55 | 65 | 2,400 | $71,800 | HP12 x 53 |

| HP10 x 42 Steel Piles, Furnished & Driven | Year 2005 Unit Cost | Annual Escalation | Year 2006 |
|---|---|---|---|
| Furnished | $17.50 | 6.0% | $18.60 |
| Driven | $10.69 | 3.0% | $11.00 |
| Total | | | $29.60 |

| HP12 x 53 Steel Piles, Furnished & Driven | Year 2005 Unit Cost | Annual Escalation | Year 2006 |
|---|---|---|---|
| Furnished | $19.02 | 6.0% | $20.20 |
| Driven | $9.38 | 3.0% | $9.70 |
| Total | | | $29.90 |

| HP14 x 73 Steel Piles, Furnished & Driven | Year 2005 Unit Cost | Annual Escalation | Year 2006 |
|---|---|---|---|
| Furnished | $27.30 | 6.0% | $28.90 |
| Driven | $7.19 | 3.0% | $7.40 |
| Total | | | $36.30 |

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

*Alt. 1*

| Component | | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|---|
| Abutment | | | | | | |
| | Rear | 122.2 | $384.26 | 3.0% | $396.00 | $48,400 |
| | Fwd | 122.2 | $384.26 | 3.0% | $396.00 | $48,400 |
| Wingwalls | | | | | | |
| | Rear | 35.8 | $384.26 | 3.0% | $396.00 | $14,200 |
| | Fwd | 35.8 | $384.26 | 3.0% | $396.00 | $14,200 |
| Total Abutment Cost | | | | | | $125,200 |

*Alt. 2*

| Component | | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|---|
| Abutment | | | | | | |
| | Rear | 134.1 | $384.26 | 3.0% | $396.00 | $53,100 |
| | Fwd | 134.1 | $384.26 | 3.0% | $396.00 | $53,100 |
| Wingwalls | | | | | | |
| | Rear | 45.5 | $384.26 | 3.0% | $396.00 | $18,000 |
| | Fwd | 45.5 | $384.26 | 3.0% | $396.00 | $18,000 |
| Total Abutment Cost | | | | | | $142,200 |

*Alt. 3*

| Component | | Volume (cu. yd.) | Year 2005 | Annual Escalation | Year 2006 | Total Cost |
|---|---|---|---|---|---|---|
| Abutment | | | | | | |
| | Rear | 144.0 | $384.26 | 3.0% | $396.00 | $57,000 |
| | Fwd | 144.0 | $384.26 | 3.0% | $396.00 | $57,000 |
| Wingwalls | | | | | | |
| | Rear | 47.2 | $384.26 | 3.0% | $396.00 | $18,700 |
| | Fwd | 47.2 | $384.26 | 3.0% | $396.00 | $18,700 |
| Total Abutment Cost | | | | | | $151,400 |

**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 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Pier | $0.79 | 3.0% | $0.81 |
| Abutment | $0.79 | 3.0% | $0.81 |

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

| | Area (sq. ft.) Rear | Area (sq. ft.) Forward | Total Area (sq. ft.) | Year 2006 |
|---|---|---|---|---|
| Alt. 1 | 4924 | 4427 | 9351 | $85.00 |
| Alt. 2 | 4746 | 4242 | 8988 | |
| Alt. 3 | 0 | 0 | 0 | |

**Embankment Unit Cost ($/sq. ft.):**

| | Volume (cu. yd.) Rear | Volume (cu. yd.) Forward | Total Volume (cu. yd.) | Year 2006 |
|---|---|---|---|---|
| Alt. 1 | 3681 | 4962 | 8643 | $12.00 |
| Alt. 2 | 3681 | 6248 | 9929 | |
| Alt. 3 | 5128 | 9946 | 15074 | |

Note: Limits of non-retaining wall embankment are set by the limits of the approach slab for the longest bridge alternative (Alternative 3) and by the limits of the embankment included in cost of the retaining walls. For limits of embankment included with the retaining walls, see attached wall section. See attached section cuts for embankment volume calculations.

# SCI-823-10.13

## SCI-823 Over Norfolk Southern Tracks & US-23

**STRUCTURE TYPE STUDY**

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[823_RR_Structure Cost Comparison.xls]Alternative Summary

By: DGS Date: 4/9/2007

Checked: JTC Date: 4/20/2007

## LIFE CYCLE MAINTENANCE COST

| Alt. No. | Span Arrangement No. Spans | Lengths | Framing Alternative | Structural Steel Painting (5) Cost Per Cycle | Number of Maintenance Cycles | Total Life Cycle Cost | Superstructure Sealing (5) Cost Per Cycle | Number of Maintenance Cycles | Total Life Cycle Cost | Approach Pavement Resurfacing (7) Cost Per Cycle | Number of Maintenance Cycles | Total Life Cycle Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 122.00 - 146.00 - 103.00 | 8 ~ Steel Plate Girders | $630,200 | 2 | $1,260,400 | $0 | 4 | $0 | $3,100 | 7 | $21,700 |
| 2 | 2 | 183.00 - 183.00 | 8 ~ Steel Plate Girders | $776,700 | 2 | $1,553,400 | $0 | 4 | $0 | $3,200 | 7 | $22,400 |
| 3 | 3 | 176.00 - 146.00 - 146.00 | 8 ~ Steel Plate Girders | $964,900 | 2 | $1,929,800 | $0 | 4 | $0 | $0 | 7 | $0 |

| Alt. No. | Span Arrangement No. Spans | Lengths | Framing Alternative | Bridge Deck Overlay (5) Deck Demo & Chipping | Deck Overlay | Deck Joint Gland (2) | Number of Maintenance Cycles | Total Life Cycle Cost | Bridge Redecking (5) Deck Concrete Cost (3) | Deck Reinforcing Cost (3) | Deck Joint Cost (2) | Deck Removal Cost | Number of Maintenance Cycles | Total Life Cycle Cost | Superstructure Life Cycle Maintenance Cost (1) | Total Initial Construction Cost | Total Relative Ownership Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 122.00 - 146.00 - 103.00 | 8 ~ Steel Plate Girders | $79,000 | $91,800 | $0 | 2 | $341,600 | $468,700 | $220,800 | $0 | $246,000 | 1 | $935,500 | **$2,559,000** | **$4,932,000** | **$7,491,000** |
| 2 | 2 | 183.00 - 183.00 | 8 ~ Steel Plate Girders | $78,100 | $90,600 | $0 | 2 | $337,400 | $462,400 | $217,800 | $0 | $243,000 | 1 | $923,200 | **$2,836,000** | **$4,836,000** | **$7,672,000** |
| 3 | 3 | 176.00 - 146.00 - 146.00 | 8 ~ Steel Plate Girders | $99,600 | $115,600 | $10,400 | 2 | $451,200 | $590,500 | $278,200 | $41,500 | $310,000 | 1 | $1,220,200 | **$3,601,000** | **$4,696,000** | **$8,297,000** |

**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 | 60 | 8 | 371.0 | 16.00 | 41,552 | 20% | 49,900 |
| Alt. 2 | 78 | 8 | 366.0 | 18.00 | 51,240 | 20% | 61,500 |
| Alt. 3 | 75 | 8 | 468.0 | 18.00 | 63,648 | 20% | 76,400 |

Painting Cost per sq. ft.:

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Prep. | $6.88 | 3.0% | $7.09 |
| Prime | $1.62 | 3.0% | $1.67 |
| Intermed. | $1.89 | 3.0% | $1.95 |
| Finish | $1.86 | 3.0% | $1.92 |
| Total | | | $12.63 |

**Superstructure Sealing:**

PS Concrete I-Beam Area:

54" AASHTO Type 4

| | H | V | Diag. | No. | Total |
|---|---|---|---|---|---|
| Bot. Flange | 26 | | | 1 | 26.00 |
| | | 8 | | 2 | 16.00 |
| Lower Fillets | 9 | 9 | 12.73 | 2 | 25.46 |
| Web | | 23 | | 2 | 46.00 |
| Upper 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 | 0 | 371.00 | 0 | 10% | 0 |
| Alt. 2 | 0 | 366.00 | 0 | 10% | 0 |
| Alt. 3 | 0 | 468.00 | 0 | 10% | 0 |

Sealing Cost per sq. yd.:

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Epoxy-Urethane Sealer | $10.44 | 3.0% | $10.75 |

**Bridge Redecking:**

Bridge Deck Joint Cost per foot:

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Structural Expansion Joint Including Elastomeric Strip Seal | $305.46 | 3.0% | $314.62 |

| | Bridge Width (ft.) | No. Joints |
|---|---|---|
| Alt. 1 | 66.00 | 0 |
| Alt. 2 | 66.00 | 0 |
| Alt. 3 | 66.00 | 2 |

Bridge Deck Removal Cost:

| | Deck Area (3) (sq. ft.) | Year 2006 | Deck Removal Cost |
|---|---|---|---|
| Alt. 1 | 24,600 | $10.00 | $246,000 |
| Alt. 2 | 24,300 | $10.00 | $243,000 |
| Alt. 3 | 31,000 | $10.00 | $310,000 |

**Bridge Deck Overlay (Item 848):**

Bridge Deck MSC Overlay Cost per sq. yd.:

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Micro Silica Modified Concrete Overlay Using Hydrodemolition (1.25" thick) | $29.57 | 3.0% | $30.46 |
| Surface Preparation Using Hydrodemolition | $25.93 | 3.0% | $26.71 |
| Hand Chipping (10% of deck area) | $85.66 | 3.0% | $88.23 |

Bridge Deck MSC Overlay Cost per cu. yd.:

| | | | |
|---|---|---|---|
| Micro Silica Modified Concrete Overlay (Variable Thickness), Material Only | $145.00 | 3.0% | $149.35 |

| | Deck Area (3) (sq. ft.) | Deck Area (sq. yd.) | Hand Chipping (sq. yd.) | Variable Thickness Repair (cu. yd.) |
|---|---|---|---|---|
| Alt. 1 | 24,600 | 2,733 | 68 | 57 |
| Alt. 2 | 24,300 | 2,700 | 68 | 56 |
| Alt. 3 | 31,000 | 3,444 | 86 | 72 |

Assume 25% of deck area requires removal to depth of 4.5" (3.00" additional removal).

Bridge Deck Joint Gland Replacement Cost per foot:

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Elastomeric Strip Seal Gland | $76.37 | 3.0% | $78.66 |

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 (2006) dollars.
2. Bridge Alternatives 1 and 2 are to have semi-integral abutments. Alternative 3 is longer than is allowed for semi-integral abutments; therefore, strip seal deck joints are included with this option.
3. See Superstructure Cost sheet.
4. See Alternative Cost Summary sheet.
5. Assume bridge deck overlay at Year 20 & Year 60 and bridge deck replacement at Year 40.
   Assume steel superstructures are painted at Year 25, then on a 25-year recurrence interval
   Assume concrete superstructures are sealed on a 15-year 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.
7. Assume approach pavement resurfacing on a 10-year recurrence interval.

**Approach Pavement Resurfacing:**

Resurfacing Units Costs:

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Pavement Planing, Asphalt Concrete, per sq. yd. (Item 254) | $0.95 | 3.0% | $0.98 |

| | Year 2005 | Annual Escalation | Year 2006 |
|---|---|---|---|
| Asphalt Concrete Surface Course, per cu. yd. | $78.03 | 3.0% | $80.37 |

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 | 970 | 66.0 | 711 | 1.50 | 29.6 |
| Alt. 2 | 1020 | 66.0 | 748 | 1.50 | 31.2 |
| Alt. 3 | 0 | 66.0 | 0 | 1.50 | 0.0 |

# SCI-823-10.13

## SCI-823 Over Norfolk Southern Tracks & US-23

**STRUCTURE TYPE STUDY**

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[823_RR_Structure Cost Comparison.xls]Alternative Summary

By: DGS Date: 4/9/2007

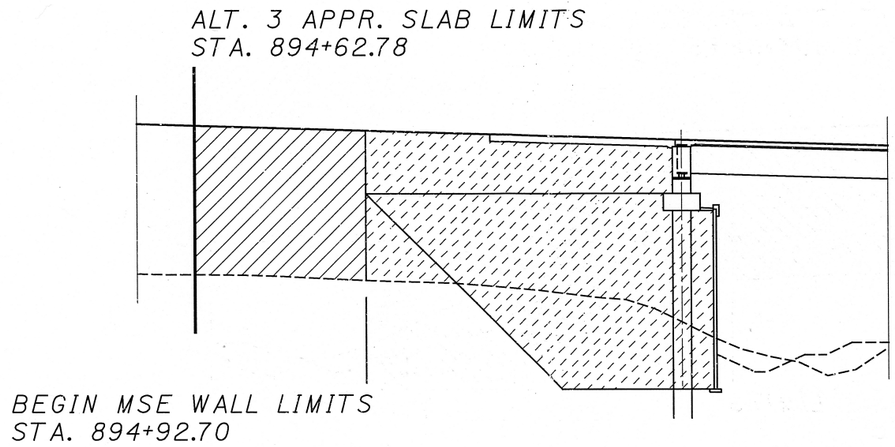
Checked: JTC Date: 4/20/2007

## COST COMPARISON SUMMARY

| Alternative No. | Span Arrangement No. Spans | Lengths | Framing Alternative | Proposed Stringer Section | Total Initial Superstructure Cost | Total Initial Substructure Cost | Total Initial Construction Cost | Superstructure Life Cycle Maintenance Cost | Total Relative Ownership Cost |
|---|---|---|---|---|---|---|---|---|---|
| **1** | 3 | 122.00 - 146.00 - 103.00 | 8 ~ Steel Plate Girders | 60" Steel Plate Girder | $2,206,000 | $1,285,000 | $4,932,000 | $2,559,000 | **$7,491,000** |
| **2** | 2 | 183.00 - 183.00 | 8 ~ Steel Plate Girders | 78" Steel Plate Girder | $2,179,000 | $1,242,000 | $4,836,000 | $2,836,000 | **$7,672,000** |
| **3** | 3 | 176.00 - 146.00 - 146.00 | 8 ~ Steel Plate Girders | 75" Steel Plate Girder | $2,756,000 | $617,000 | $4,696,000 | $3,601,000 | **$8,297,000** |

# MSE WALL & EMBANKMENT PAYMENT LIMITS
# SR-823 BRIDGE OVER NS TRACKS & US-23

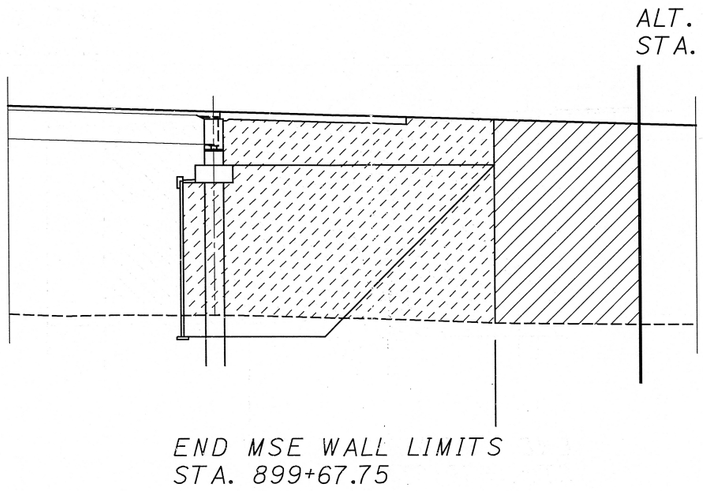
REAR ABUTMENT




EMBANKMENT PAYMENT LIMITS

MSE WALL PAYMENT LIMITS

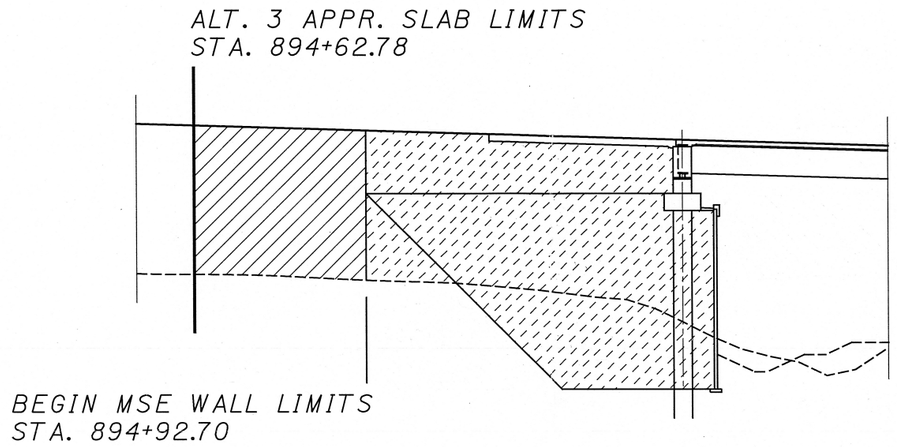
FORWARD ABUTMENT

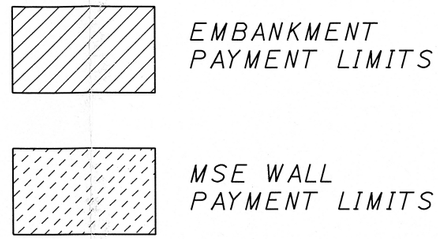



## ALTERNATIVE 1

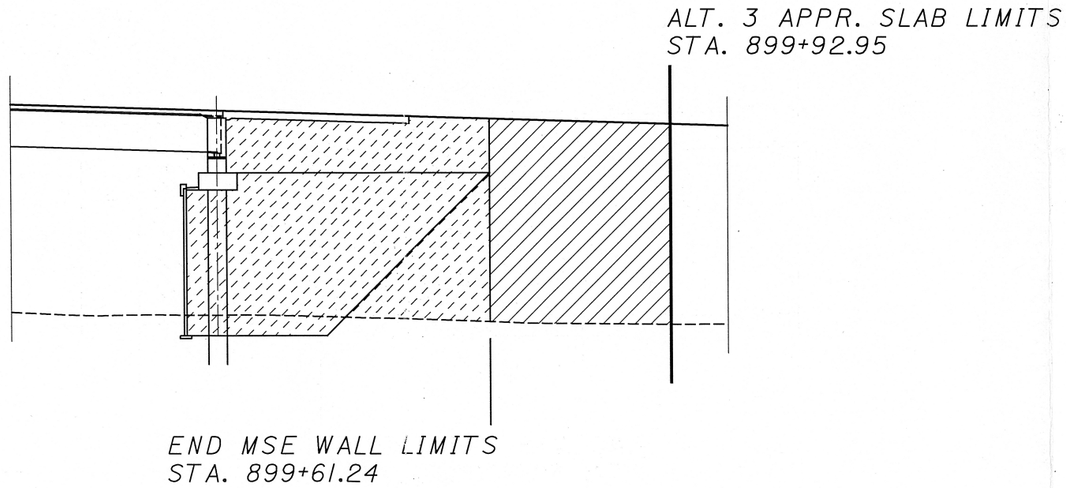
# MSE WALL & EMBANKMENT PAYMENT LIMITS
# SR-823 BRIDGE OVER NS TRACKS & US-23

REAR ABUTMENT



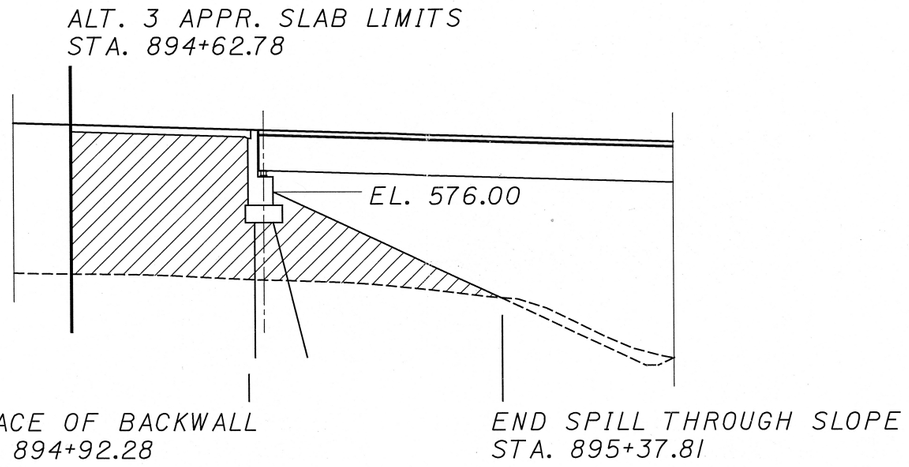

FORWARD ABUTMENT

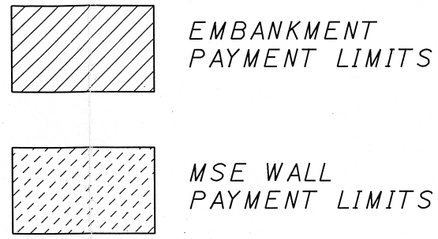



# ALTERNATIVE 2

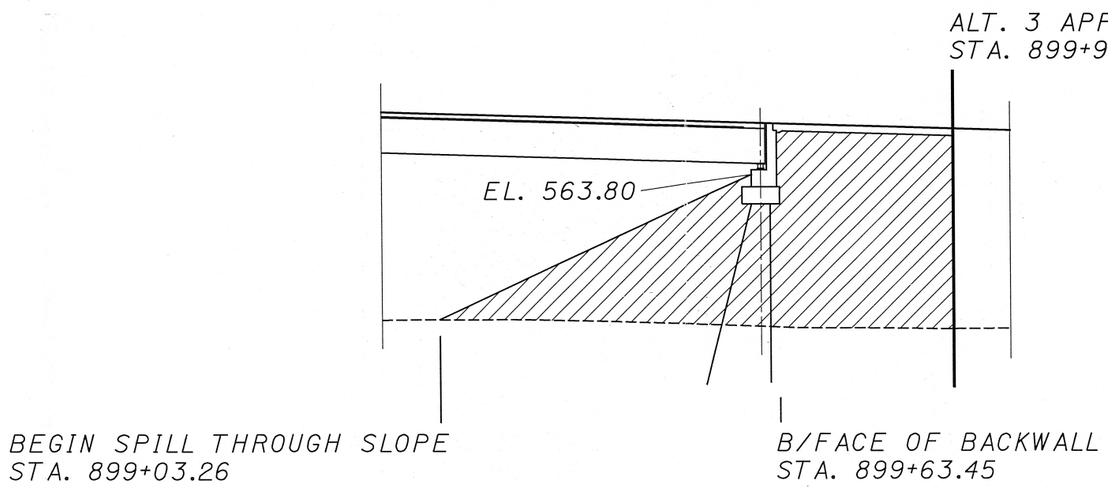
# MSE WALL & EMBANKMENT PAYMENT LIMITS
# SR-823 BRIDGE OVER NS TRACKS & US-23

## REAR ABUTMENT




## FORWARD ABUTMENT

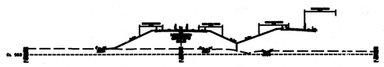



# ALTERNATIVE 3

# EMBANKMENT QUANTITIES FOR SR-823 BRIDGE OVER NS TRACKS & US-23

91' FROM FACE OF MSE WALL TO PAY LIMIT

REAR ABUTMENT

| | | END AREA | SR-823 STA. | VOLUME |
|---|---|---|---|---|
| ALT. 3 APPR. SLAB LIMITS | | 3292 SF | 894+62.78 | |
| | | | | 3681 CY |
| BEGIN MSE WALL LIMITS |  | 3351 SF | 894+92.70 | |

80' FROM FACE OF MSE WALL TO PAY LIMIT

FORWARD ABUTMENT

| | | END AREA | SR-823 STA. | VOLUME |
|---|---|---|---|---|
| END MSE WALL LIMITS | | 5375 SF | 899+67.75 | |
| | | | | 4962 CY |
| ALT. 3 APPR. SLAB LIMITS | | 5257 SF | 899+92.95 | |

## ALTERNATIVE I

8643 CY GRAND TOTAL

# EMBANKMENT QUANTITIES FOR SR-823 BRIDGE OVER NS TRACKS & US-23

91' FROM FACE OF MSE WALL TO PAY LIMIT

REAR ABUTMENT

| | | END AREA | SR-823 STA. | VOLUME |
|---|---|---|---|---|
| ALT. 3 APPR. SLAB LIMITS | | 3292 SF | 894+62.78 | |
| | | | | 3681 CY |
| BEGIN MSE WALL LIMITS | | 3351 SF | 894+92.70 | |

85' FROM FACE OF MSE WALL TO PAY LIMIT

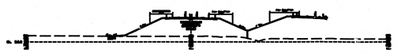
FORWARD ABUTMENT

| | | END AREA | SR-823 STA. | VOLUME |
|---|---|---|---|---|
| END MSE WALL LIMITS | | 5382 SF | 899+61.24 | |
| | | | | 6248 CY |
| ALT. 3 APPR. SLAB LIMITS | | 5257 SF | 899+92.95 | |

## ALTERNATIVE 2

9929 CY GRAND TOTAL

# EMBANKMENT QUANTITIES FOR SR-823 BRIDGE OVER NS TRACKS & US-23

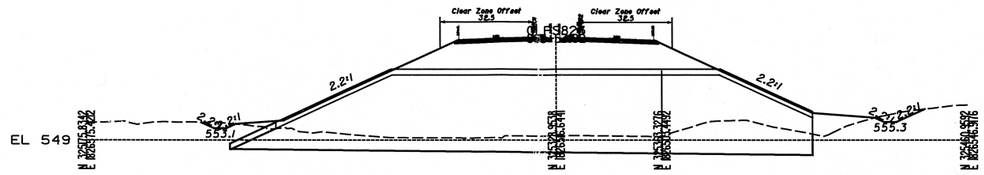
| | | END AREA | SR-823 STA. | VOLUME |
|---|---|---|---|---|
| REAR ABUTMENT | | | | |
| ALT. 3 APPR. SLAB LIMITS | | 3292 SF | 894+62.78 | |
| | | | | 3634 CY |
| B/FACE OF BACKWALL |  | 3360 SF | 894+92.28 | |
| B/FACE OF BACKWALL | | 1772 SF | 894+92.28 | |
| | | | | 1494 CY |
| END SPILL THROUGH SLOPE | | 0 SF | 895+37.81 | |
| FORWARD ABUTMENT | | | | |
| BEGIN SPILL THROUGH SLOPE | | 0 SF | 899+03.26 | |
| | | | | 4134 CY |
| B/FACE OF BACKWALL | | 3709 SF | 899+63.45 | |
| B/FACE OF BACKWALL | | 5382 SF | 899+63.45 | |
| | | | | 5812 CY |
| ALT. 3 APPR. SLAB LIMITS | | 5257 SF | 899+92.95 | |

## ALTERNATIVE 3

15074 CY GRAND TOTAL

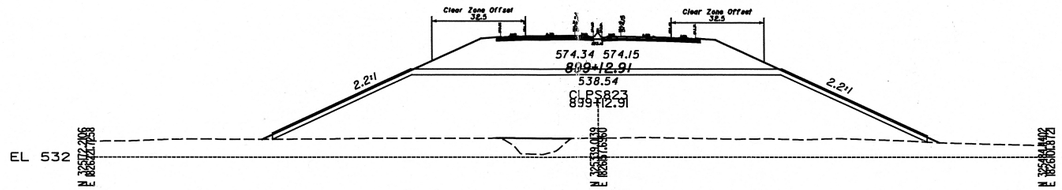
# MSE WALLS
# SR-823 BRIDGE OVER NS TRACKS & US-23

## REAR ABUTMENT




EXPOSED AREA = 4924 SQ FT.

## FORWARD ABUTMENT

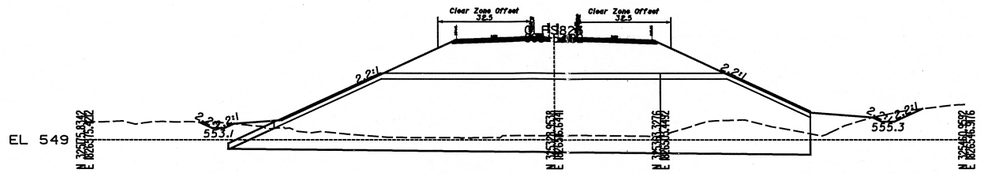



EXPOSED AREA = 4427 SQ FT.

# ALTERNATIVE I

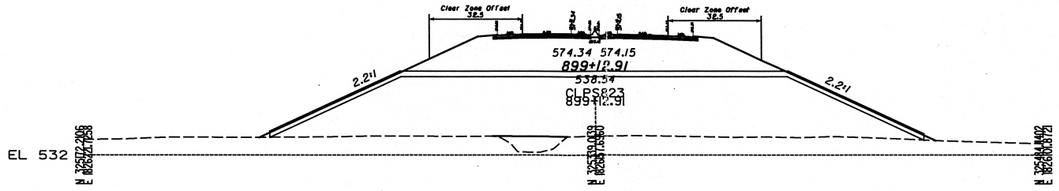
# MSE WALLS
# SR-823 BRIDGE OVER NS TRACKS & US-23

## REAR ABUTMENT




EXPOSED AREA = 4746 SQ FT.

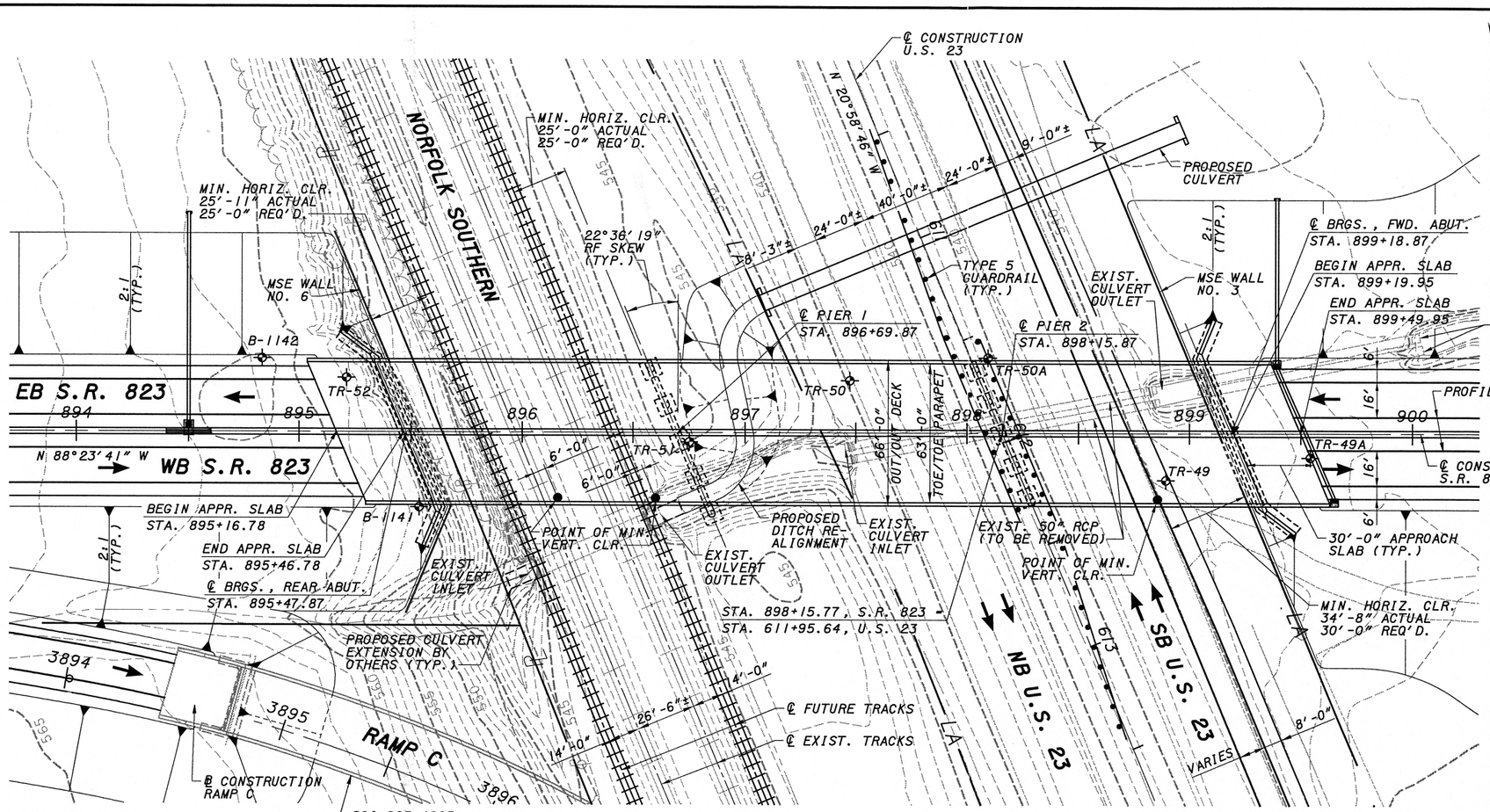
## FORWARD ABUTMENT



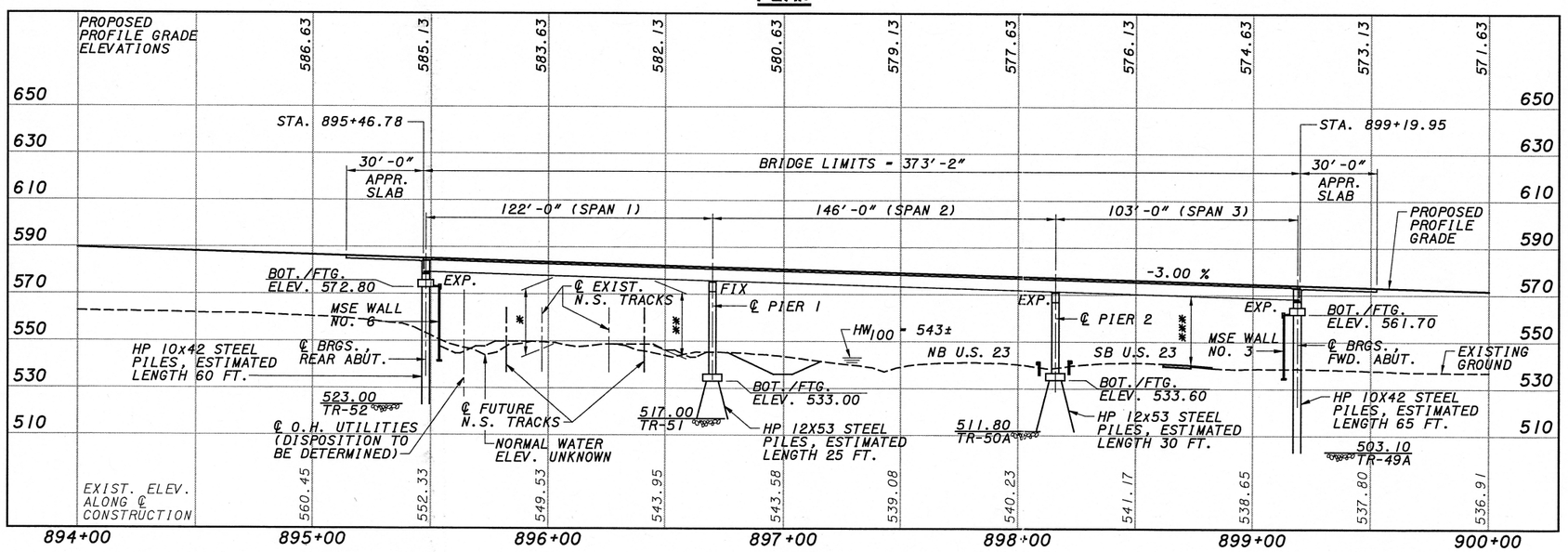

EXPOSED AREA = 4242 SQ FT.

# ALTERNATIVE 2

# APPENDIX B




## PLAN




* MIN. VERT. CLR. 26'-2" ACTUAL 23'-5⅛" REQ'D.
** MIN. VERT. CLR. 26'-2" ACTUAL 23'-6½" REQ'D.
*** MIN. VERT. CLR. 27'-9" ACTUAL 17'-0" REQ'D.

## PROFILE ALONG PROFILE GRADE LINE, S.R. 823

## BENCHMARKS

## TRAFFIC DATA

CURRENT ADT (2010) = 8900
DESIGN ADT (2030) = 13000
DESIGN ADTT = 1820

## LEGEND

INDICATES BORING LOCATION

## NOTE

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

## PROPOSED STRUCTURE

**TYPE:** THREE-SPAN COMPOSITE STEEL PLATE GIRDERS (WEATHERED ASTM A709, GR 50W) WITH REINFORCED CONCRETE DECK ON SEMI-INTEGRAL ABUTMENTS BEHIND MSE WALLS WITH CAP AND COLUMN PIERS

**LENGTH OF SPAN:** 122'-0", 146'-0", 103'-0" C-C BEARINGS, MEASURED ALONG ℄ CONSTRUCTION

**ROADWAY:** 30'-1⅛" TOE/TOE BARRIERS (RB)
30'-1⅛" TOE/TOE BARRIERS (LB)

**SIDEWALK:** NONE

**DESIGN LOADING:** HS25 (CASE II) AND THE ALTERNATE MILITARY LOADING, FWS = 60 LB/FT²

**SKEW:** 22°36'19" RIGHT FORWARD

**WEARING SURFACE:** MONOLITHIC CONCRETE

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

**ALIGNMENT:** TANGENT

**CROWN:** 0.016 FT/FT

**LATITUDE:** N 38°53'32"

**LONGITUDE:** W 82°59'58"

DESIGN AGENCY
CH2MHILL
5775 Perimeter Drive, Suite 190
Dublin, Ohio 43017

DESIGNED DGS | DRAWN JBA | REVIEWED SCJ | DATE 05/07
CHECKED SKT | REVISED | STRUCTURE FILE NUMBER

SITE PLAN
BRIDGE NO. SCI-823-1601
S.R. 823 OVER NORFOLK SOUTHERN & U.S. 23 - ALT. I
SCIOTO COUNTY
STA. 895+46.78 TO STA. 899+19.95
SCI-823-10.13
PID 19415
1 / 3

5/17/2007 8:58:55 AM
SCI823_COL_Scioto.plt
baukerma
...\823_160\cosp001_ch.dgn

66′-0″
OUT/OUT DECK

℄ CONSTRUCTION
S.R. 823

LIMITS OF SEALING
OF CONCRETE SURFACES
(EPOXY-URETHANE) (TYP.)

1′-6″ PARAPET | 8′-0″ SHOULDER | 16′-0″ TRAVEL LANE | 15′-0″ MEDIAN | 16′-0″ TRAVEL LANE | 8′-0″ SHOULDER | 1′-6″ PARAPET

6′-1⅛″ SHOULDER | 6′-1⅛″ SHOULDER

ROADWAY BARRIER, TYPE B1

VARIES, 10½″ MIN. (DECK + HAUNCH)

9″ (TYP.)

SINGLE SLOPE DEFLECTOR PARAPET BRIDGE RAILING, SEE STD. DWG. SBR-1-99

8½″ REINFORCED CONCRETE DECK

PROFILE GRADE

0.016 | 0.040 | 0.040 | 0.016

PROFILE GRADE

℄ GIRDER (TYP.)

3′-6″ (TYP.)

60″ STEEL PLATE GIRDER (TYP.)

6″

1½″ (TYP.)

3′-3″ | 3′-3″

4′-0″ MIN. (TYP.)

SUPERSTRUCTURE DIMENSIONS MEASURED PERPENDICULAR TO CENTERLINE OF CONSTRUCTION

7 GIRDER SPACES @ 8′-6″ = 59′-6″

2″ EXP. JT.

SUBSTRUCTURE DIMENSIONS MEASURED ALONG ℄ PIER

4′-6″ | 17′-9″ | 4′-4½″ | 13′-2½″ | 17′-9″ | 17′-9″ | 1′-6″
4′-6″ | 15′-6¾″ | 7′-9″ | 7′-9¾″ | 15′-6¾″ | 15′-6¾″ | 4′-6″

PIER 1
PIER 2

EXISTING GROUND

3′-0″ (TYP.)

ELEV. 533.00 PIER 1
ELEV. 533.60 PIER 2

8′-0″ (TYP.)

HP 12X53 PILES (TYP.)

## TYPICAL TRANSVERSE SECTION

DESIGN AGENCY
**CH2MHILL**
5775 Perimeter Drive, Suite 190
Dublin, Ohio 43017

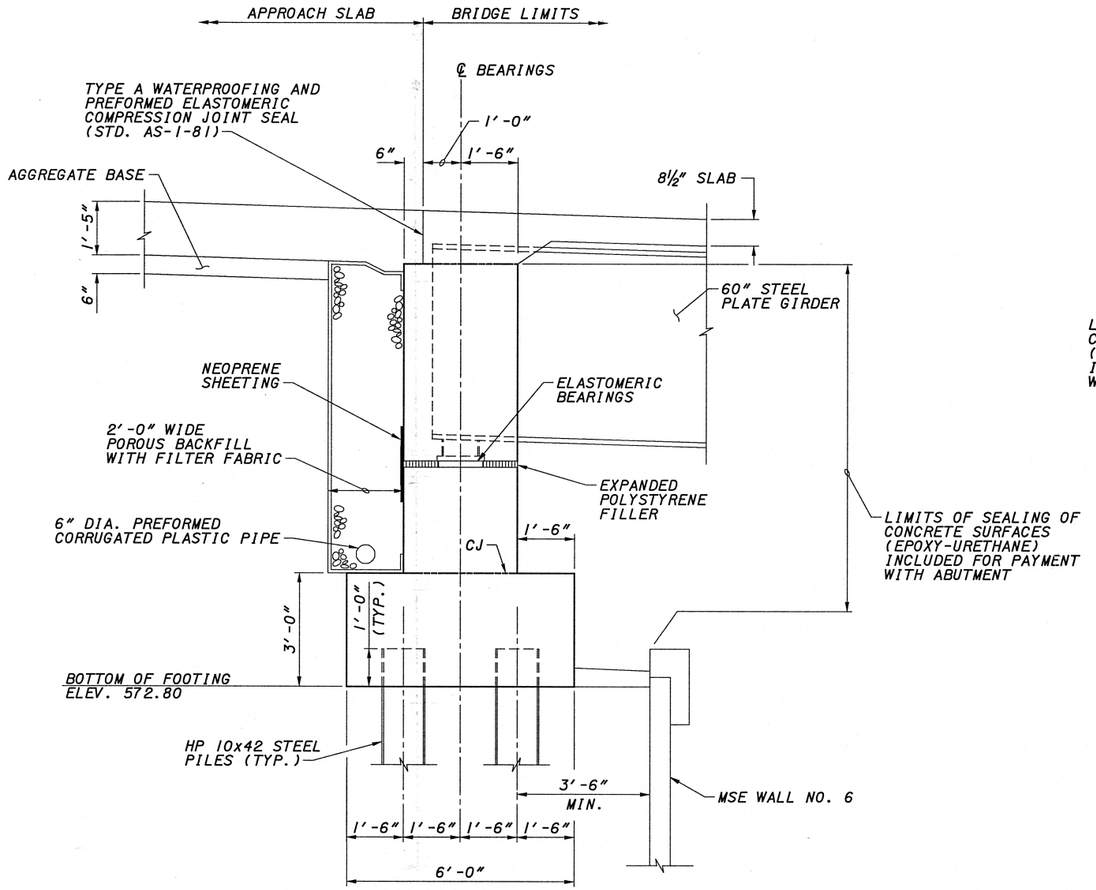
| DESIGNED | DRAWN | REVIEWED | DATE |
|---|---|---|---|
| DGS | JBA | SCJ | 05/07 |
| CHECKED | REVISED | STRUCTURE FILE NUMBER | |
| SKT | | | |

TYPICAL TRANSVERSE SECTION
BRIDGE NO. SCI-823-16.01
S.R. 823 OVER NORFOLK SOUTHERN & U.S. 23 - ALT. I

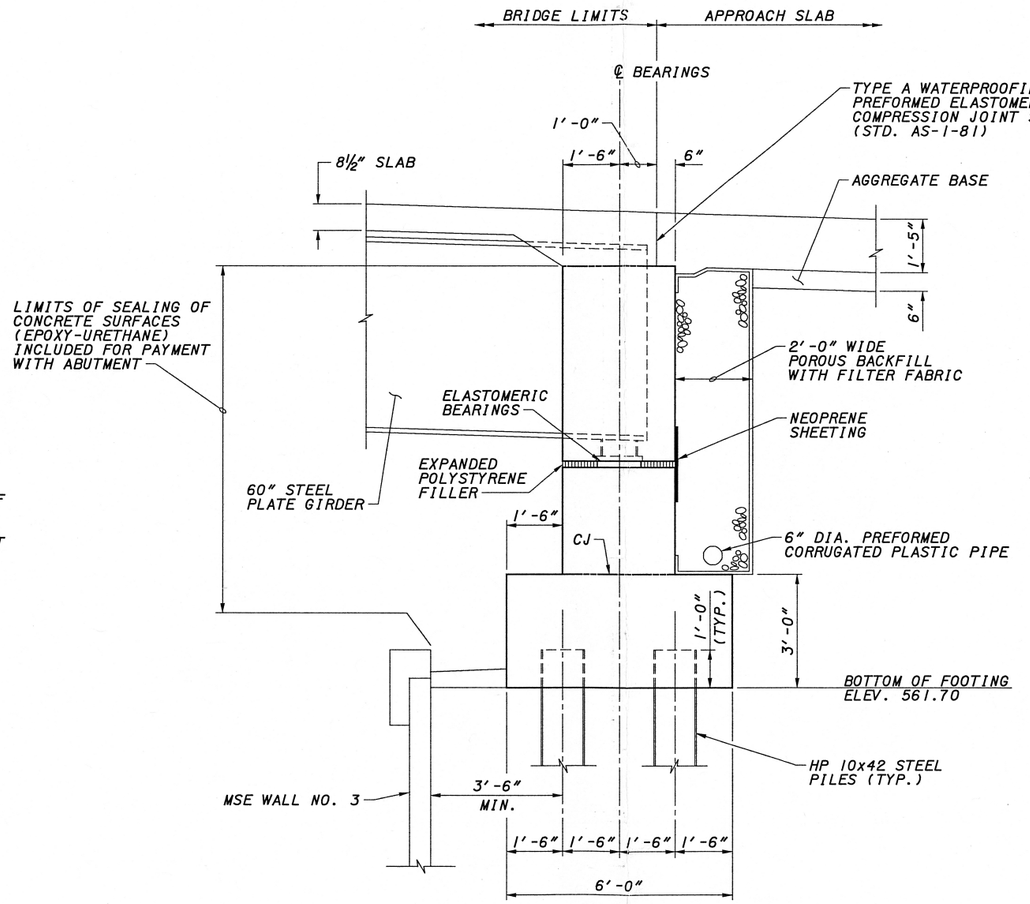
SCI-823-10.13
PID 19415

2 / 3

baukerma
...\823_16\cts001_ch.dgn
5/17/2007
8:58:55 AM
SCI823_COL_Scioto.plt




**REAR ABUTMENT SECTION**




**FORWARD ABUTMENT SECTION**

DESIGN AGENCY
**CH2MHILL**
5775 Perimeter Drive, Suite 190
Dublin, Ohio 43017

| DESIGNED | DRAWN | REVIEWED | DATE |
|---|---|---|---|
| DGS | JBA | SCJ | 05/07 |
| CHECKED | REVISED | STRUCTURE FILE NUMBER | |
| SKT | | | |

# ABUTMENT SECTION

BRIDGE NO. SCI-823-16.01
S.R. 823 OVER NORFOLK SOUTHERN & U.S. 23 - ALT. I

SCI-823-10.13
PID 19415

3 / 3

baukerma
...\823_16\dgn\car001_ch.dgn
5/17/2007
8:58:55 AM
SCI823_COL_Scioto.plt

# APPENDIX C

# SCI-823-10.13

## SR 823 MAINLINE OVER NORFOLK SOUTHERN RAILWAY AND US-23 / RAMP D

### VERTICAL CLEARANCES

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[SR823_RR_Vert_Clr.xls]Alternative 3

By: DGS Date: 4/10/2007

Checked: JTC Date: 4/19/2007

LEGEND:

User Input - Not Critical

User Input - Critical to Output

## Alternative 1 - 60" Steel Plate Girder

**PROFILE DATA - NORFOLK SOUTHERN RAILWAY**

*Use existing top of high rail elevations, as profile adjustments to the railroad are not anticipated in this project.*

| POINT | RAILROAD LOCATION | | RAILROAD STATION | RAILROAD - EXISTING ELEV. @ POINT |
|---|---|---|---|---|
| 1 | Top of Rail | East | n/a | 550.44 |
| 2 | Top of Rail | West | n/a | 548.96 |

**PROFILE DATA - RAMP D**

| POINT | RAMP D LOCATION | EXISTING ELEV. @ US-23 EDGE OF PVMT. | DISTANCE ACROSS TAPER | PAVEMENT X-SLOPE | DISTANCE ACROSS SHLDR. | SHOULDER X-SLOPE | RAMP D - FINISHED GRADE @ POINT |
|---|---|---|---|---|---|---|---|
| 3 | RT. EDGE OF PVMT | 540.91 | 10.12 | -1.6% | | -4.0% | 540.75 |
| 4 | RT. EDGE OF SHLDR. | 540.91 | 10.18 | -1.6% | 8.00 | -4.0% | 540.43 |

**PROFILE DATA - SR 823 MAINLINE**

Linear:

PVT Sta. 870+00.00 PVC Sta. 904+10.82

PVT Elev. 661.63 PVC Elev. 559.31

g -3.00%

Superelevation Data:

| Station | Pavement |
|---|---|
| 875+00.00 | -1.6% |
| 904+00.00 | -1.6% |

| POINT | SR 823 MAINLINE LOCATION DESCRIPTION | STA. | OFF.* | SR 823 PG ELEV. | PAVEMENT X-SLOPE | SR 823 - FINISHED GRADE @ POINT |
|---|---|---|---|---|---|---|
| 1 | RT. FASCIA GIRDER | 896+15.98 | 22.25 | 583.15 | -1.6% | 582.80 |
| 2 | RT. FASCIA GIRDER | 896+60.03 | 22.25 | 581.83 | -1.6% | 581.48 |
| 3 | RT. FASCIA GIRDER | 898+86.11 | 22.25 | 575.05 | -1.6% | 574.69 |
| 4 | RT. FASCIA GIRDER | 898+94.86 | 22.25 | 574.79 | -1.6% | 574.43 |

* - Offset from Profile Grade Line

**STRUCTURE DEPTH**

Haunch + Max. Top Flange = 3.5 in

| POINT | BEAM DESCRIPTION | Slab | Haunch | Top Flange | Web | Bot. Flange | Splice | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 60" Steel Plate Girder | 8.50 | 2.00 | 1.5 | 60 | 2.0 | - | 74.00 in |
| 2 | 60" Steel Plate Girder | 8.50 | 2.00 | 1.5 | 60 | 2.0 | 2.0 | 76.00 in |
| 3 | 60" Steel Plate Girder | 8.50 | 2.00 | 1.5 | 60 | 2.0 | - | 74.00 in |
| 4 | 60" Steel Plate Girder | 8.50 | 2.00 | 1.5 | 60 | 2.0 | - | 74.00 in |

### VERTICAL CLEARANCE - SR 823 MAINLINE OVER NORFOLK SOUTHERN RAILWAY AND US-23 / RAMP D

| POINT | LOCATION | SR 823 MAINLINE - FINISHED GRADE @ POINT | STRUCTURE DEPTH (in.) | BOT. GIRDER ELEVATION | RR / RAMP D - FINISHED GRADE @ POINT | VERTICAL CLEARANCE (ft.) | | MINIMUM VERT. CLR = |
|---|---|---|---|---|---|---|---|---|
| 1 | RT. FASCIA GIRDER | 582.80 | 74.000 | 576.63 | 550.44 | **26.19** | OK | 23'-5 1/8" |
| 2 | RT. FASCIA GIRDER | 581.48 | 76.000 | 575.14 | 548.96 | **26.18** | OK | 23'-6 1/2" |
| 3 | RT. FASCIA GIRDER | 574.69 | 74.000 | 568.53 | 540.75 | **27.78** | OK | MINIMUM VERT. |
| 4 | RT. FASCIA GIRDER | 574.43 | 74.000 | 568.27 | 540.43 | **27.84** | OK | CLR = 17'-0" |

# SCI-823-10.13

## SR 823 MAINLINE OVER NORFOLK SOUTHERN RAILWAY AND US-23 / RAMP D

### VERTICAL CLEARANCES

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[SR823_RR_Vert_Clr.xls]Alternative 3

By: DGS Date: 4/10/2007

Checked: JTC Date: 4/19/2007

LEGEND:

User Input - Not Critical

User Input - Critical to Output

**Alternative 2 - 78" Steel Plate Girder**

**PROFILE DATA - NORFOLK SOUTHERN RAILWAY**

*Use existing top of high rail elevations, as profile adjustments to the railroad are not anticipated in this project.*

| POINT | RAILROAD LOCATION | | RAILROAD STATION | RAILROAD - EXISTING ELEV. @ POINT |
|---|---|---|---|---|
| 1 | Top of Rail | East | n/a | 550.44 |
| 2 | Top of Rail | West | n/a | 548.96 |

**PROFILE DATA - RAMP D**

| POINT | RAMP D LOCATION | EXISTING ELEV. @ US-23 EDGE OF PVMT. | DISTANCE ACROSS TAPER | PAVEMENT X-SLOPE | DISTANCE ACROSS SHLDR. | SHOULDER X-SLOPE | RAMP D - FINISHED GRADE @ POINT |
|---|---|---|---|---|---|---|---|
| 3 | RT. EDGE OF PVMT | 540.91 | 10.12 | -1.6% | | -4.0% | 540.75 |
| 4 | RT. EDGE OF SHLDR. | 540.91 | 10.18 | -1.6% | 8.00 | -4.0% | 540.43 |

**PROFILE DATA - SR 823 MAINLINE**

Linear:

| | | | |
|---|---|---|---|
| PVT Sta. | 870+00.00 | PVC Sta. | 904+10.82 |
| PVT Elev. | 661.63 | PVC Elev. | 559.31 |
| g | -3.00% | | |

Superelevation Data:

| Station | Pavement |
|---|---|
| 875+00.00 | -1.6% |
| 904+00.00 | -1.6% |

| POINT | SR 823 MAINLINE LOCATION DESCRIPTION | STA. | OFF.* | SR 823 PG ELEV. | PAVEMENT X-SLOPE | SR 823 - FINISHED GRADE @ POINT |
|---|---|---|---|---|---|---|
| 1 | RT. FASCIA GIRDER | 896+15.98 | 22.25 | 583.15 | -1.6% | 582.80 |
| 2 | RT. FASCIA GIRDER | 896+60.03 | 22.25 | 581.83 | -1.6% | 581.48 |
| 3 | RT. FASCIA GIRDER | 898+86.11 | 22.25 | 575.05 | -1.6% | 574.69 |
| 4 | RT. FASCIA GIRDER | 898+94.86 | 22.25 | 574.79 | -1.6% | 574.43 |

* - Offset from Profile Grade Line

**STRUCTURE DEPTH**

Haunch + Max. Top Flange = 4.0 in

| POINT | BEAM DESCRIPTION | Slab | Haunch | Top Flange | Web | Bot. Flange | Splice | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 78" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 78 | 2.0 | - | 92.50 in |
| 2 | 78" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 78 | 2.0 | - | 92.50 in |
| 3 | 78" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 78 | 2.0 | - | 92.50 in |
| 4 | 78" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 78 | 2.0 | - | 92.50 in |

### VERTICAL CLEARANCE - SR 823 MAINLINE OVER NORFOLK SOUTHERN RAILWAY AND US-23 / RAMP D

| POINT | LOCATION | SR 823 MAINLINE - FINISHED GRADE @ POINT | STRUCTURE DEPTH (in.) | BOT. GIRDER ELEVATION | RR / RAMP D - FINISHED GRADE @ POINT | VERTICAL CLEARANCE (ft.) | | MINIMUM VERT. CLR = |
|---|---|---|---|---|---|---|---|---|
| 1 | RT. FASCIA GIRDER | 582.80 | 92.500 | 575.09 | 550.44 | **24.65** | OK | 23'-5 1/8" |
| 2 | RT. FASCIA GIRDER | 581.48 | 92.500 | 573.77 | 548.96 | **24.81** | OK | 23'-6 1/2" |
| 3 | RT. FASCIA GIRDER | 574.69 | 92.500 | 566.99 | 540.75 | **26.24** | OK | MINIMUM VERT. |
| 4 | RT. FASCIA GIRDER | 574.43 | 92.500 | 566.72 | 540.43 | **26.30** | OK | CLR = 17'-0" |

# SCI-823-10.13

## SR 823 MAINLINE OVER NORFOLK SOUTHERN RAILWAY AND US-23 / RAMP D

### VERTICAL CLEARANCES

Filename: P:\TranSystems\319861\19415\structures\Documents\Step 7 - Type Study\Bridge Type Study\Bridge SCI823-1601C 823 over Railroad_US23\[SR823_RR_Vert_Clr.xls]Alternative 3

By: DGS Date: 4/10/2007

Checked: JTC Date: 4/19/2007

LEGEND:

User Input - Not Critical

User Input - Critical to Output

**Alternative 3 - 75" Steel Plate Girder**

**PROFILE DATA - NORFOLK SOUTHERN RAILWAY**

*Use existing top of high rail elevations, as profile adjustments to the railroad are not anticipated in this project.*

| POINT | RAILROAD LOCATION | | RAILROAD STATION | RAILROAD - EXISTING ELEV. @ POINT |
|---|---|---|---|---|
| 1 | Top of Rail | East | n/a | 550.44 |
| 2 | Top of Rail | West | n/a | 548.96 |

**PROFILE DATA - RAMP D**

| POINT | RAMP D LOCATION | EXISTING ELEV. @ US-23 EDGE OF PVMT. | DISTANCE ACROSS TAPER | PAVEMENT X-SLOPE | DISTANCE ACROSS SHLDR. | SHOULDER X-SLOPE | RAMP D - FINISHED GRADE @ POINT |
|---|---|---|---|---|---|---|---|
| 3 | RT. EDGE OF PVMT | 540.91 | 10.12 | -1.6% | | -4.0% | 540.75 |
| 4 | RT. EDGE OF SHLDR. | 540.91 | 10.18 | -1.6% | 8.00 | -4.0% | 540.43 |

**PROFILE DATA - SR 823 MAINLINE**

Linear:

PVT Sta. 870+00.00 PVC Sta. 904+10.82

PVT Elev. 661.63 PVC Elev. 559.31

g -3.00%

Superelevation Data:

| Station | Pavement |
|---|---|
| 875+00.00 | -1.6% |
| 904+00.00 | -1.6% |

| POINT | SR 823 MAINLINE LOCATION DESCRIPTION | STA. | OFF.* | SR 823 PG ELEV. | PAVEMENT X-SLOPE | SR 823 - FINISHED GRADE @ POINT |
|---|---|---|---|---|---|---|
| 1 | RT. FASCIA GIRDER | 896+15.98 | 22.25 | 583.15 | -1.6% | 582.80 |
| 2 | RT. FASCIA GIRDER | 896+60.03 | 22.25 | 581.83 | -1.6% | 581.48 |
| 3 | RT. FASCIA GIRDER | 898+86.11 | 22.25 | 575.05 | -1.6% | 574.69 |
| 4 | RT. FASCIA GIRDER | 898+94.86 | 22.25 | 574.79 | -1.6% | 574.43 |

* - Offset from Profile Grade Line

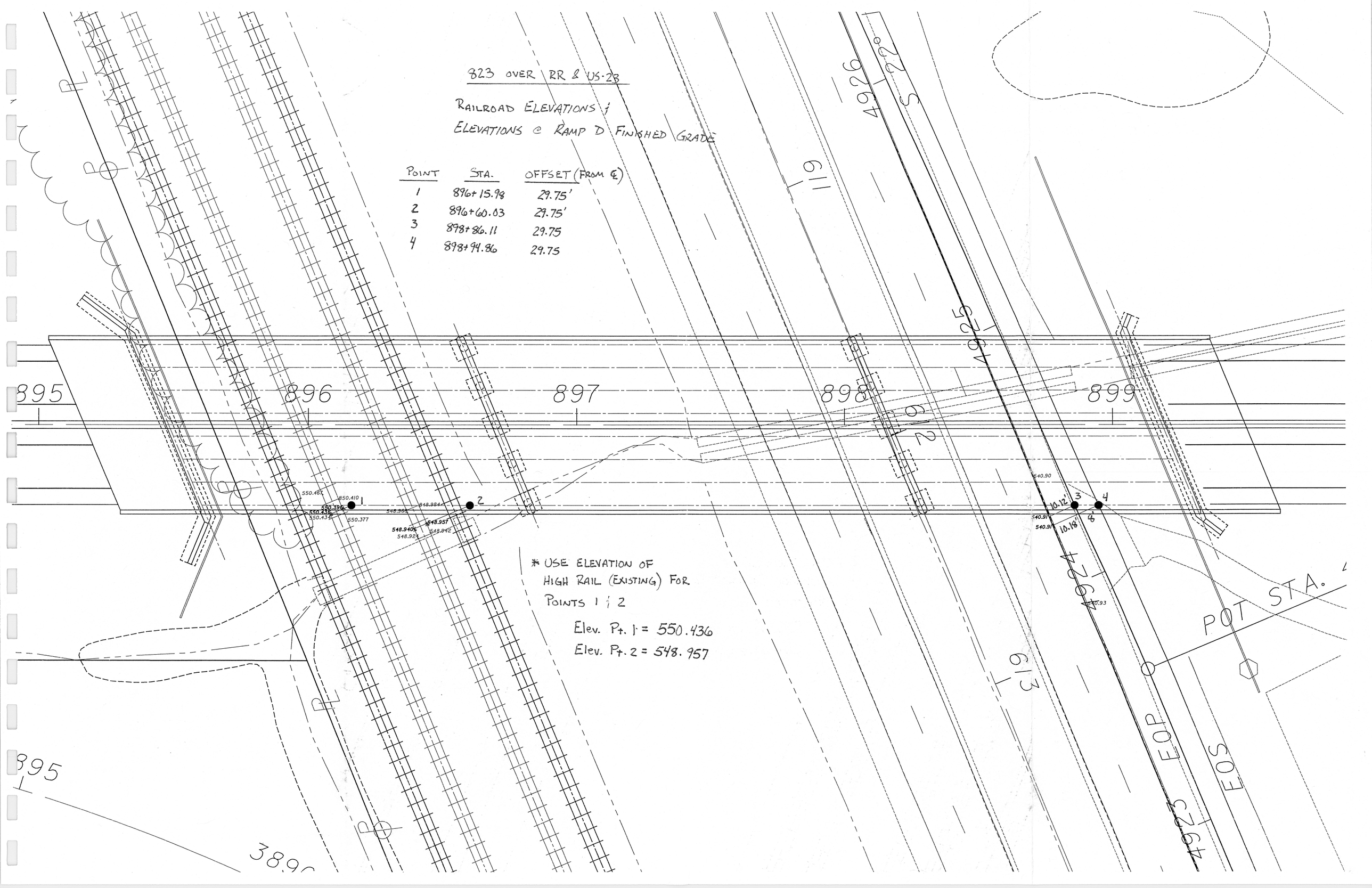
**STRUCTURE DEPTH**

Haunch + Max. Top Flange = 4.0 in

| POINT | BEAM DESCRIPTION | Slab | Haunch | Top Flange | Web | Bot. Flange | Splice | Total |
|---|---|---|---|---|---|---|---|---|
| 1 | 75" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 75 | 2.0 | - | 89.50 in |
| 2 | 75" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 75 | 2.0 | 2.0 | 91.50 in |
| 3 | 75" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 75 | 2.0 | - | 89.50 in |
| 4 | 75" Steel Plate Girder | 8.50 | 2.00 | 2.0 | 75 | 2.0 | - | 89.50 in |

**VERTICAL CLEARANCE - SR 823 MAINLINE OVER NORFOLK SOUTHERN RAILWAY AND US-23 / RAMP D**

| POINT | LOCATION | SR 823 MAINLINE - FINISHED GRADE @ POINT | STRUCTURE DEPTH (in.) | BOT. GIRDER ELEVATION | RR / RAMP D - FINISHED GRADE @ POINT | VERTICAL CLEARANCE (ft.) | | MINIMUM VERT. CLR = |
|---|---|---|---|---|---|---|---|---|
| 1 | RT. FASCIA GIRDER | 582.80 | 89.500 | 575.34 | 550.44 | **24.90** | OK | 23'-5 1/8" |
| 2 | RT. FASCIA GIRDER | 581.48 | 91.500 | 573.85 | 548.96 | **24.89** | OK | 23'-6 1/2" |
| 3 | RT. FASCIA GIRDER | 574.69 | 89.500 | 567.24 | 540.75 | **26.49** | OK | MINIMUM VERT. |
| 4 | RT. FASCIA GIRDER | 574.43 | 89.500 | 566.97 | 540.43 | **26.55** | OK | CLR = 17'-0" |




823 OVER RR & US-23

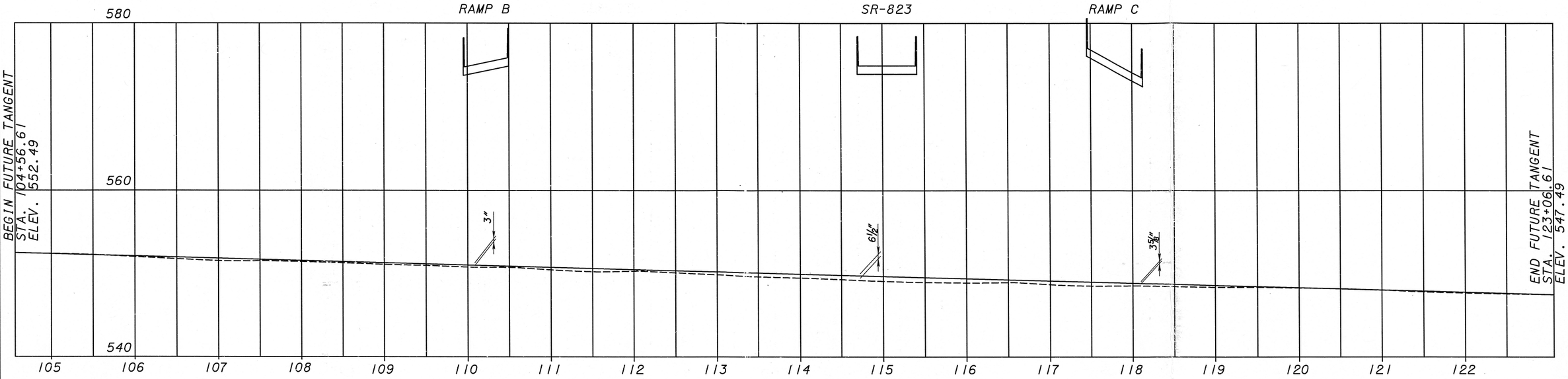
RAILROAD ELEVATIONS &
ELEVATIONS @ RAMP D FINISHED GRADE

| POINT | STA. | OFFSET (FROM ℄) |
|---|---|---|
| 1 | 896+15.98 | 29.75' |
| 2 | 896+60.03 | 29.75' |
| 3 | 898+86.11 | 29.75 |
| 4 | 898+94.86 | 29.75 |

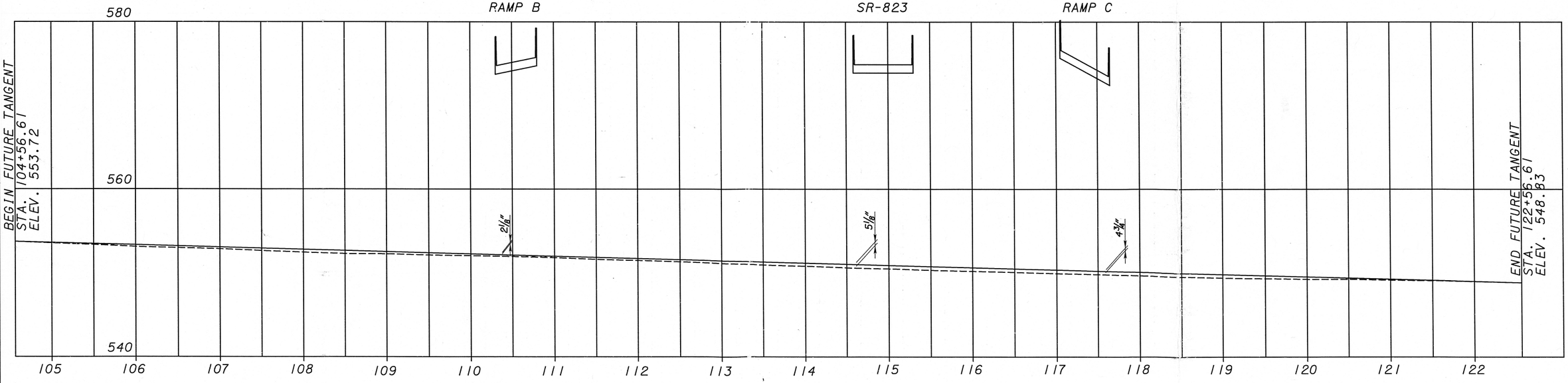
* USE ELEVATION OF HIGH RAIL (EXISTING) FOR POINTS 1 & 2

Elev. Pt. 1 = 550.436

Elev. Pt. 2 = 548.957




WEST TRACK - LEFT RAIL PROFILE




EAST TRACK - RIGHT RAIL PROFILE

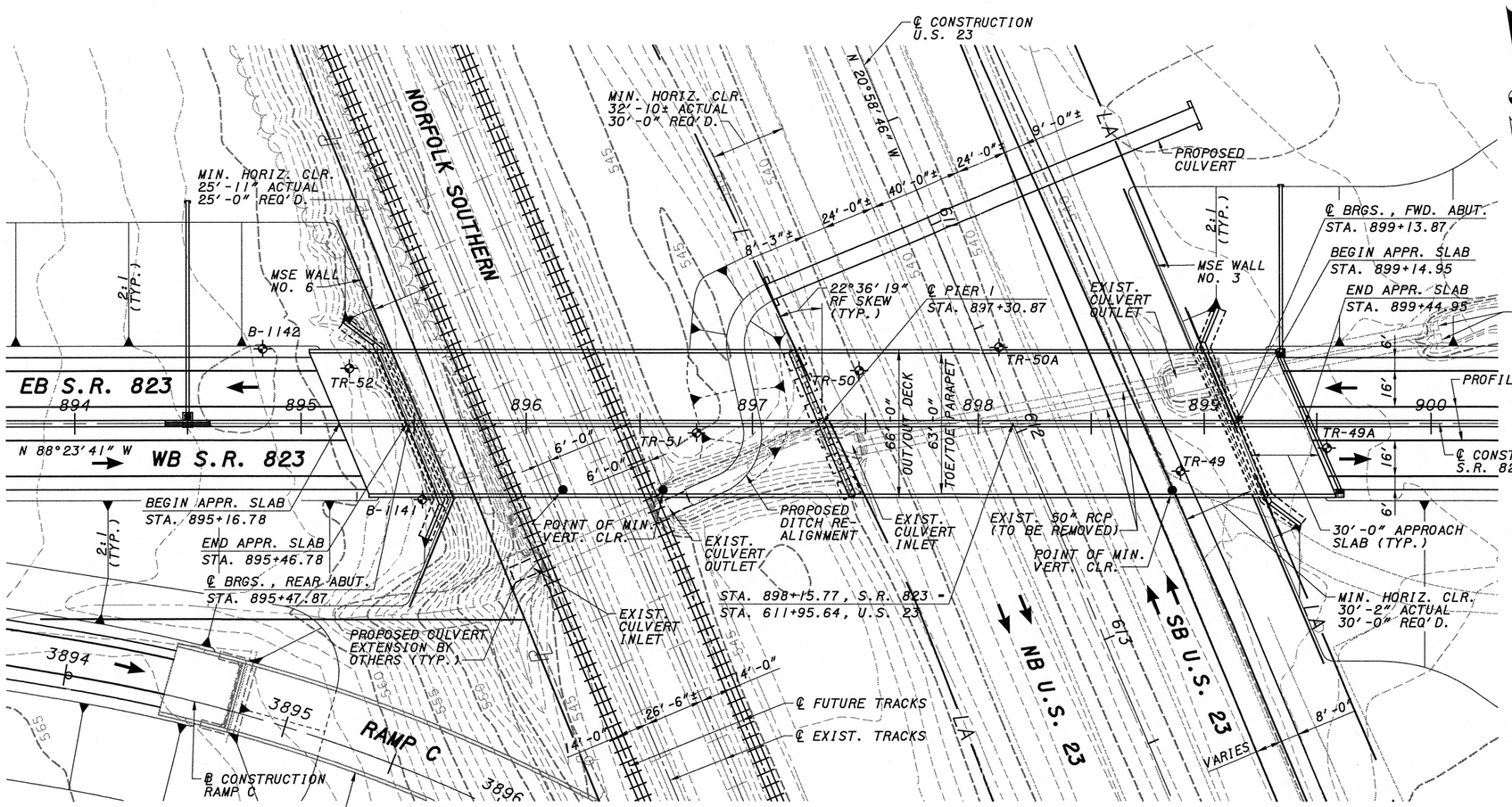
------ EXISTING RAIL SURVEY POINTS

——— POTENTIAL TRACK ALIGNMENT

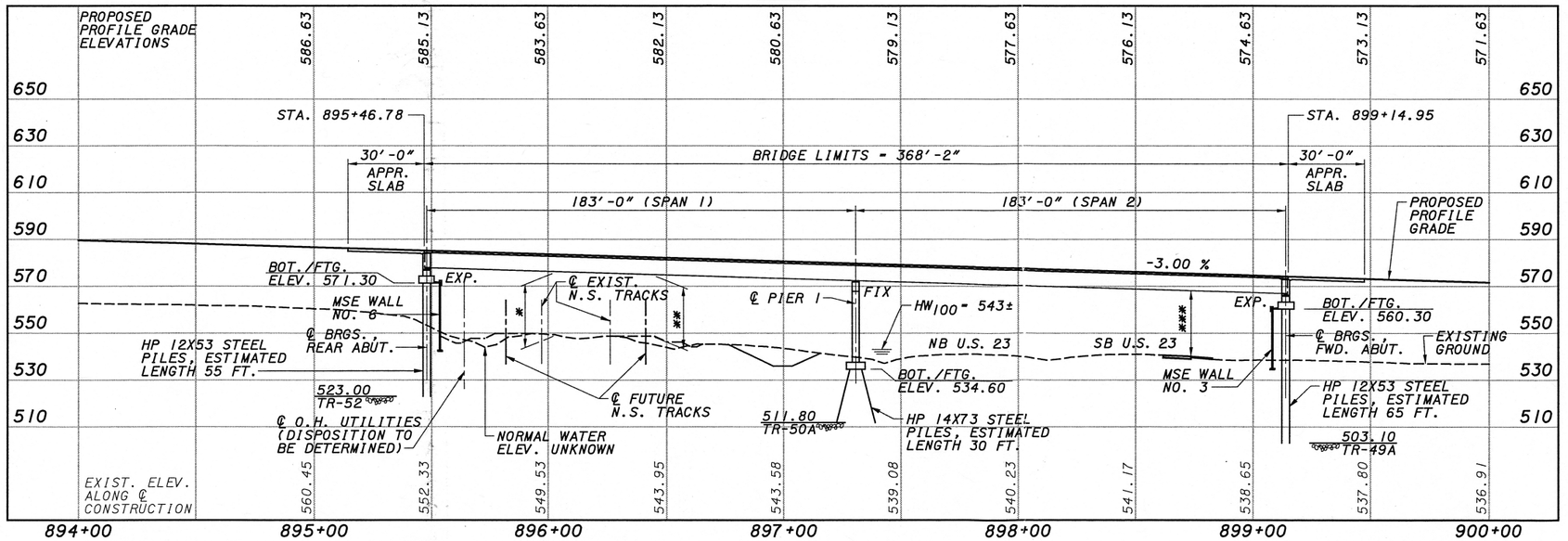
PORTSMOUTH BYPASS
SR-823 / US-23 INTERCHANGE
PROFILE OF NS CORP. TRACKS
CH2M HILL, MAY 2007

baukerma
...\Rail Profile_Work.dgn
5/17/2007
10:25:03 AM
SCI823_COL_darbycreek.plt

# APPENDIX D




## PLAN



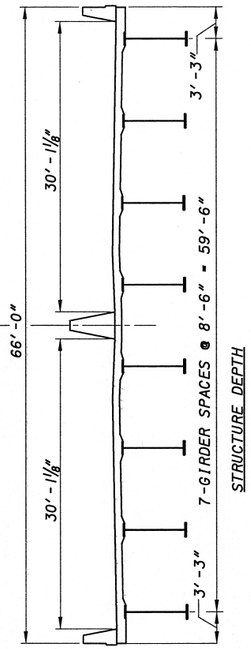

* MIN. VERT. CLR. 24'-7" ACTUAL 23'-5⅛" REQ'D.

** MIN. VERT. CLR. 24'-9" ACTUAL 23'-6½" REQ'D.

*** MIN. VERT. CLR. 26'-2" ACTUAL 17'-0" REQ'D.

## PROFILE ALONG PROFILE GRADE LINE, S.R. 823

## SUPERSTRUCTURE DATA




## LEGEND

INDICATES BORING LOCATION

## NOTE

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

## PROPOSED STRUCTURE

**TYPE:** TWO-SPAN COMPOSITE STEEL PLATE GIRDERS (WEATHERED ASTM A709, GR 50W) WITH REINFORCED CONCRETE DECK ON SEMI-INTEGRAL ABUTMENTS BEHIND MSE WALLS WITH CAP AND COLUMN PIER

**LENGTH OF SPAN:** 183'-0" & 183'-0" C-C BEARINGS, MEASURED ALONG ℄ CONSTRUCTION

**ROADWAY:** 30'-1⅛" TOE/TOE BARRIERS (RB) 30'-1⅛" TOE/TOE BARRIERS (LB)

**SIDEWALK:** NONE

**DESIGN LOADING:** HS25 (CASE II) AND THE ALTERNATE MILITARY LOADING, FWS = 60 LB/FT²

**SKEW:** 22°36'19" RIGHT FORWARD

**WEARING SURFACE:** MONOLITHIC CONCRETE

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

**ALIGNMENT:** TANGENT

**CROWN:** 0.016 FT/FT

**LATITUDE:** N 38°53'32"

**LONGITUDE:** W 82°59'58"

DESIGN AGENCY
**CH2MHILL**
5775 Perimeter Drive, Suite 190
Dublin, Ohio 43017

| REVIEWED | DATE |
|---|---|
| SCJ | 05/07 |
| STRUCTURE FILE NUMBER | |
| DRAWN | DESIGNED |
| JBA | DGS |
| REVISED | CHECKED |
| | SKT |

SCIOTO COUNTY
STA. 895+46.78 TO STA. 899+14.95

# SITE PLAN

BRIDGE NO. SCI-823-1601
S.R. 823 OVER NORFOLK SOUTHERN & U.S. 23 - ALT. 2

SCI-823-10.13
PID 19415

- / -

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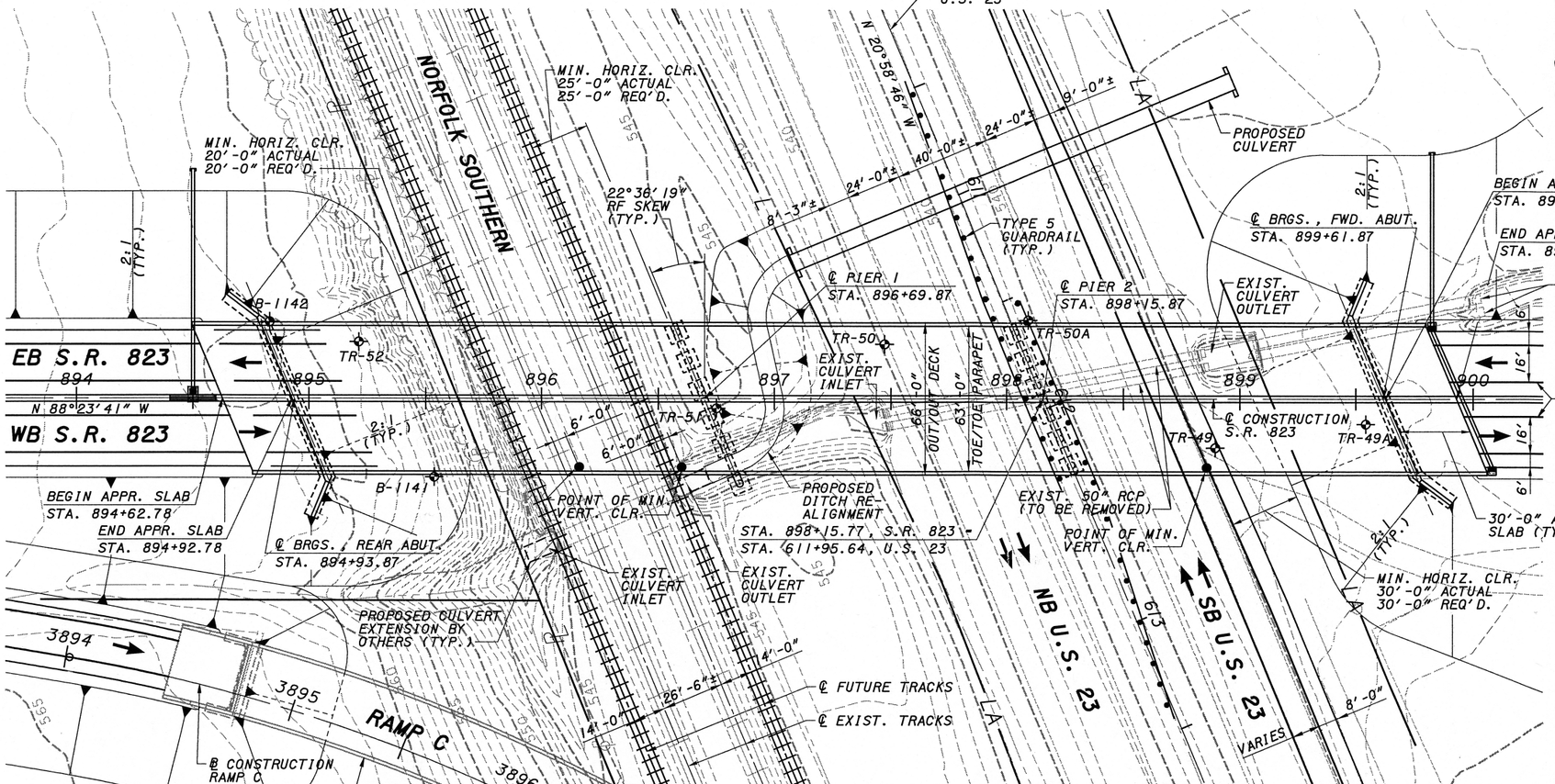
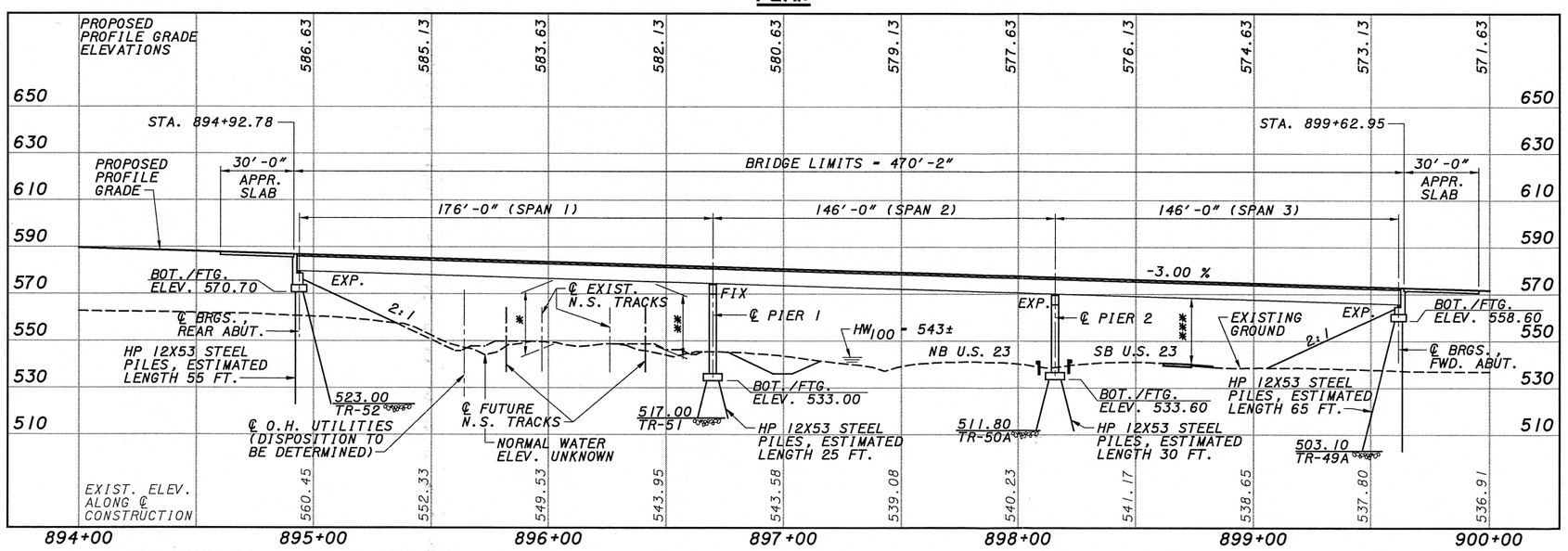



## PLAN



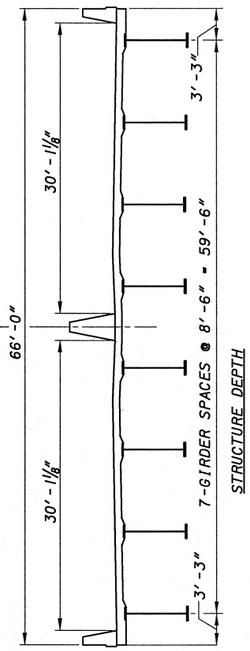

* MIN. VERT. CLR. 24'-10" ACTUAL 23'-5⅛" REQ'D.

** MIN. VERT. CLR. 24'-10" ACTUAL 23'-6½" REQ'D.

*** MIN. VERT. CLR. 26'-5" ACTUAL 17'-0" REQ'D.

## PROFILE ALONG PROFILE GRADE LINE, S.R. 823

### SUPERSTRUCTURE DATA




### LEGEND

⊕ INDICATES BORING LOCATION

### NOTE

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

### PROPOSED STRUCTURE

**TYPE:** THREE-SPAN COMPOSITE STEEL PLATE GIRDERS (WEATHERED ASTM A709, GR 50W) WITH REINFORCED CONCRETE DECK ON JOINTED STUB ABUTMENTS BEHIND 2:1 SLOPES WITH CAP AND COLUMN PIERS

**LENGTH OF SPAN:** 176'-0", 146'-0", 146'-0" C-C BEARINGS, MEASURED ALONG ℄ CONSTRUCTION

**ROADWAY:** 30'-1⅛" TOE/TOE BARRIERS (RB) 30'-1⅛" TOE/TOE BARRIERS (LB)

**SIDEWALK:** NONE

**DESIGN LOADING:** HS25 (CASE II) AND THE ALTERNATE MILITARY LOADING, FWS = 60 LB/FT²

**SKEW:** 22°36'19" RIGHT FORWARD

**WEARING SURFACE:** MONOLITHIC CONCRETE

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

**ALIGNMENT:** TANGENT

**CROWN:** 0.016 FT/FT

**LATITUDE:** N 38°53'32"

**LONGITUDE:** W 82°59'58"

DESIGN AGENCY
**CH2MHILL**
5775 Perimeter Drive, Suite 190
Dublin, Ohio 43017

| DESIGNED | DRAWN | REVIEWED | DATE |
|---|---|---|---|
| DGS | JBA | SCJ | 05/07 |
| CHECKED | REVISED | STRUCTURE FILE NUMBER | |
| SKT | | | |

SCIOTO COUNTY
STA. 894+92.78 TO STA. 899+62.95

SITE PLAN
BRIDGE NO. SCI-823-1601
S.R. 823 OVER NORFOLK SOUTHERN & U.S. 23 - ALT. 3

SCI-823-10.13
PID 19415

- / -

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# APPENDIX E

DLZ

ENGINEERS • ARCHITECTS • SCIENTISTS
PLANNERS • SURVEYORS

May 11, 2007

Mr. Rob Miller, AICP
Project Manager
CH2M Hill
5775 Perimeter Drive Suite 190
Dublin, Ohio 43017

Re: **SR 823 and US 23 Interchange – Mainline over N-S Railroad and US 23**
**Preliminary Bridge Foundation Recommendations**
**Project SCI-823-0.00**
**DLZ Job No.: 0121-3070.03**

Dear Mr. Miller:

This letter reports additional preliminary recommendations for the proposed bridge foundations at the SR 823 over the Norfolk Southern Railroad and US 23 site. The information contained in this document supercedes our report of Preliminary Structural Foundation Recommendations, dated May 2, 2005. Additional recommendations for other structures at the interchange will be presented in separate documents.

It is anticipated that one bridge will carry proposed SR 823 over the Norfolk Southern railroad and US 23. Several configurations have been presented for the proposed structure. This document will detail foundation options for Alternatives 1 through 3. It is understood that MSE retaining walls will be used to contain the roadway embankment at the abutment locations.

The findings and recommendations presented in this document should be considered preliminary. Additional borings will be necessary to finalize the recommendations for the "approved" bridge and retaining wall configurations.

**Preliminary Bridge Foundation Recommendations**

In the area of the proposed structures, borings generally encountered bedrock at depths ranging from 17.2 to 34.5 feet below the ground surface. Bedrock encountered in the borings generally consisted of soft to medium hard shale and sandstone, which was highly to moderately weathered and moderately fractured.

It is recommended that driven H-piles be used to support the proposed structure. Pile tip elevations have been estimated for HP 12x53, 70-ton piles driven to refusal on bedrock. Other

H-piles could also be considered to support the bridge abutments. For preliminary purposes, the pile tip elevations provided for the HP 12x53 piles are also considered to be representative of HP 10x42 and HP 14x73 piles. At the rear abutment, it is anticipated that the piles will penetrate two to four feet into the severely weathered shale bedrock. Because of the tendency of some shales to relax, it is recommended that the contractor restrike the piles (rear abutment only) 24 hours after installation to ensure the allowable bearing capacity of the pile is met.

It is anticipated that most of the piles will be driven to refusal on sandstone. While weathered shale bedrock is present at the top of rock near the rear abutment, the shale layer is thin and it is possible that some piles could be driven through the shale to refusal on the sandstone. Therefore, it is recommended that reinforced pile points be used to protect the piles while driving.

A table summarizing the site conditions and foundation recommendations is presented in the following table.

***Summary of Foundation Recommendations, HP-12x53, 70 ton Driven Piles****

| Structure | Element | Boring Number | Existing Ground Surface Elevation (Feet) | Estimated Pile Tip Elevation (Feet) |
|---|---|---|---|---|
| SR 823 over N-S Railroad and US 23 Alt. 1 | Rear Abutment | TR-52 | 558.0 | 521.0 |
| | Pier 1 | TR-51 | 544.5 | 516.0 |
| | Pier 2 | TR-50A | 539.3 | 511.8 |
| | Forward Abutment | TR-49A | 538.1 | 503.1 |
| SR 823 over N-S Railroad and US 23 Alt. 2 | Rear Abutment | TR-52 | 558.0 | 521.0 |
| | Pier | TR-50 | 540.5 | 515.3 |
| | Forward Abutment | TR-49A | 538.1 | 503.1 |
| SR 823 over N-S Railroad and US 23 Alt. 3 | Rear Abutment | B-1141 | 556.2 | 521.2 |
| | Pier 1 | TR-51 | 544.5 | 516.0 |
| | Pier 2 | TR-50A | 539.3 | 511.8 |
| | Forward Abutment | TR-49A | 538.1 | 503.1 |

** Cited pile tip elevations are considered representative of all H-piles being considered.*

It is understood that uplift or significant lateral loading is not anticipated with the currently proposed design. However, if changes in the preliminary design produce lateral loading or uplift, consideration could be given to using drilled shafts to support the abutments. If significant uplift or lateral loading of the structure foundation is anticipated, DLZ should be notified so that we may revise our recommendations as necessary.

Due to the multiple-span configurations, spread footings are not being considered to support the abutments. If the configuration should change, DLZ should be notified so that we may revise our recommendations as necessary.

**Closing**

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

Sincerely,

**DLZ OHIO, INC.**

Steven J. Riedy
Geotechnical Engineer

Dorothy A. Adams

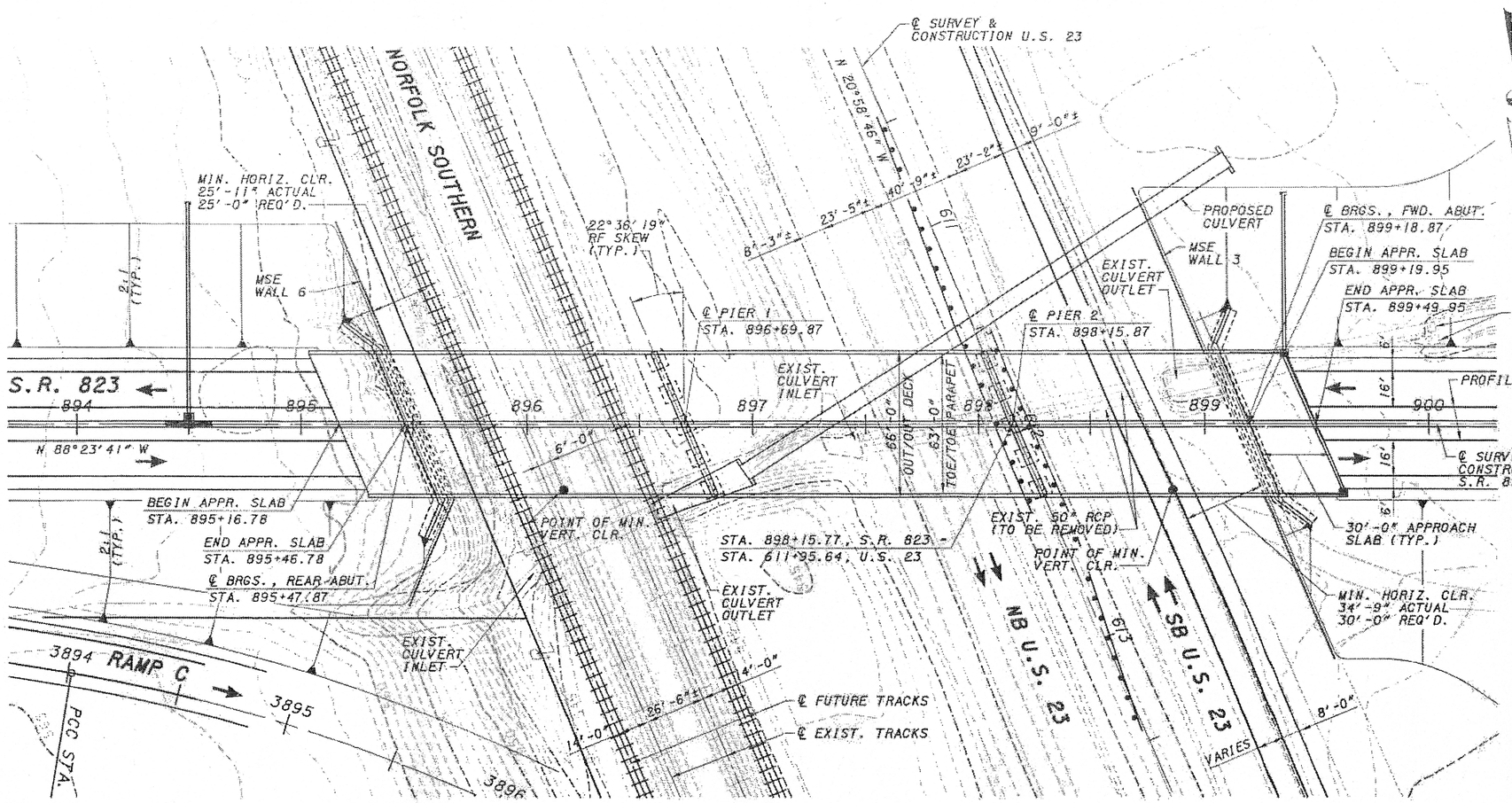
Dorothy A. Adams, P.E.
Senior Geotechnical Engineer

Attachments: Plan and Profile Drawing with Boring Locations (Alt.1 through Alt. 3)
Boring Logs

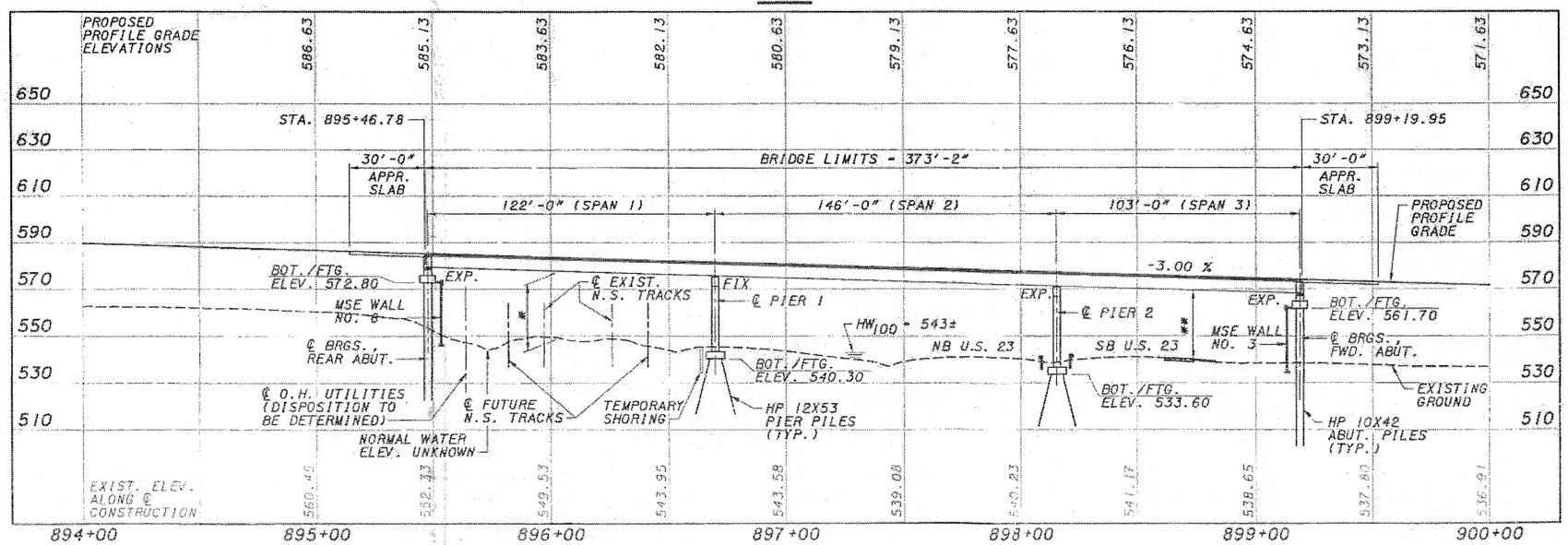
cc: File

sjr

M:\proj\0121\3070.03\Interchanges\US 23\Correspondence with CH2\Technical Memos\Mainline Structure Preliminary_Foundation Only 5-11-07.doc




## PLAN

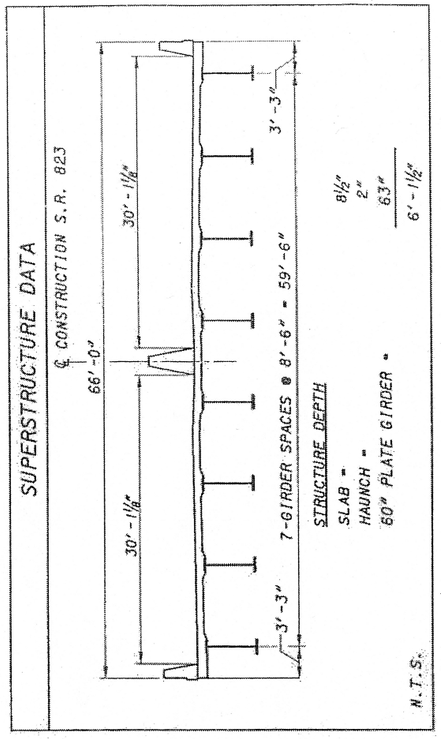



## PROFILE ALONG PROFILE GRADE LINE, S.R. 823

* MIN. VERT. CLR. XX'-XX" ACTUAL 23'-0" REQ'D.

** MIN. VERT. CLR. XX'-XX" ACTUAL 17'-0" REQ'D.

## SUPERSTRUCTURE DATA




## LEGEND

INDICATES BORING LOCATION

## NOTE

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

## PROPOSED STRUCTURE

**TYPE:** THREE-SPAN COMPOSITE STEEL PLATE GIRDERS (WEATHERED ASTM A709, GR 50W) WITH REINFORCED CONCRETE DECK ON SEMI-INTEGRAL ABUTMENTS BEHIND MSE WALLS WITH CAP AND COLUMN PIERS

**LENGTH OF SPAN:** 122'-0", 146'-0", 103'-0" C-C BEARINGS, MEASURED ALONG ℄ SURVEY & CONSTRUCTION

**ROADWAY:** 30'-1⅛" TOE/TOE PARAPETS (RB)
30'-1⅛" TOE/TOE PARAPETS (LB)

**SIDEWALK:** NONE

**DESIGN LOADING:** HS25 (CASE II) AND THE ALTERNATE MILITARY LOADING, FWS = 60 LB/FT²

**SKEW:** 22°36'19" RIGHT FORWARD

**WEARING SURFACE:** MONOLITHIC CONCRETE

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

**ALIGNMENT:** TANGENT

**CROWN:** 0.016 FT/FT

**LATITUDE:** N 38°53'32"

**LONGITUDE:** W 82°59'58"

# SITE PLAN

BRIDGE NO. SCI-823-1601
S.R. 823 OVER NORFOLK SOUTHERN R.R. 23.82 - ALT. 1

SCI-823-0.00
PID 19415

1 / 1

DESIGN AGENCY
CH2MHILL
6775 Perimeter Drive, Suite 190
Dublin, Ohio 43017

| DESIGNED | DRAWN | REVIEWED | DATE |
|---|---|---|---|
| DGS | JBA | SCJ | 04/07 |
| CHECKED | REVISED | STRUCTURE FILE NUMBER | |
| CKT | | | |

SCIOTO COUNTY
STA. 895+46.78 TO STA. 899+19.95

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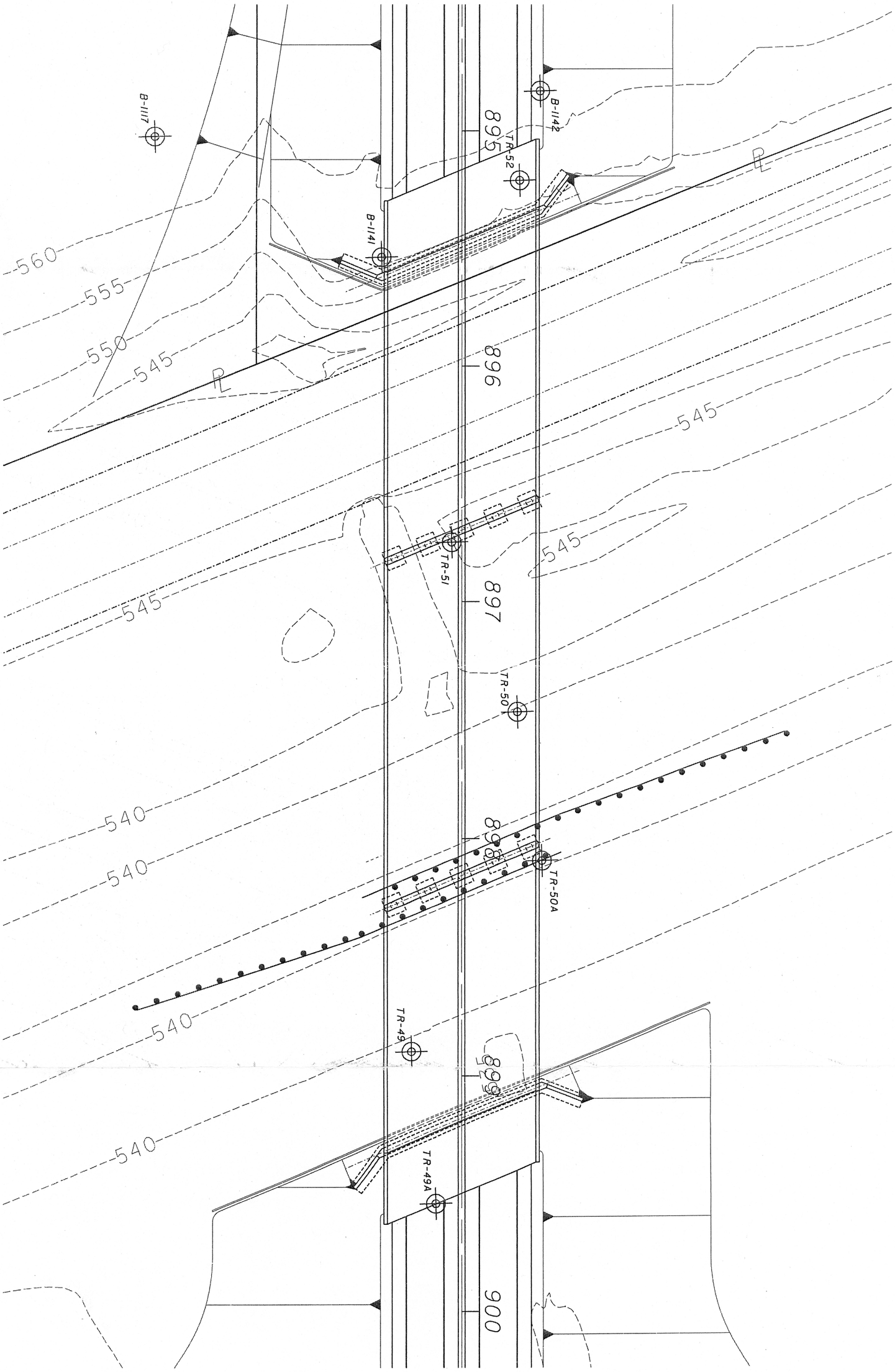


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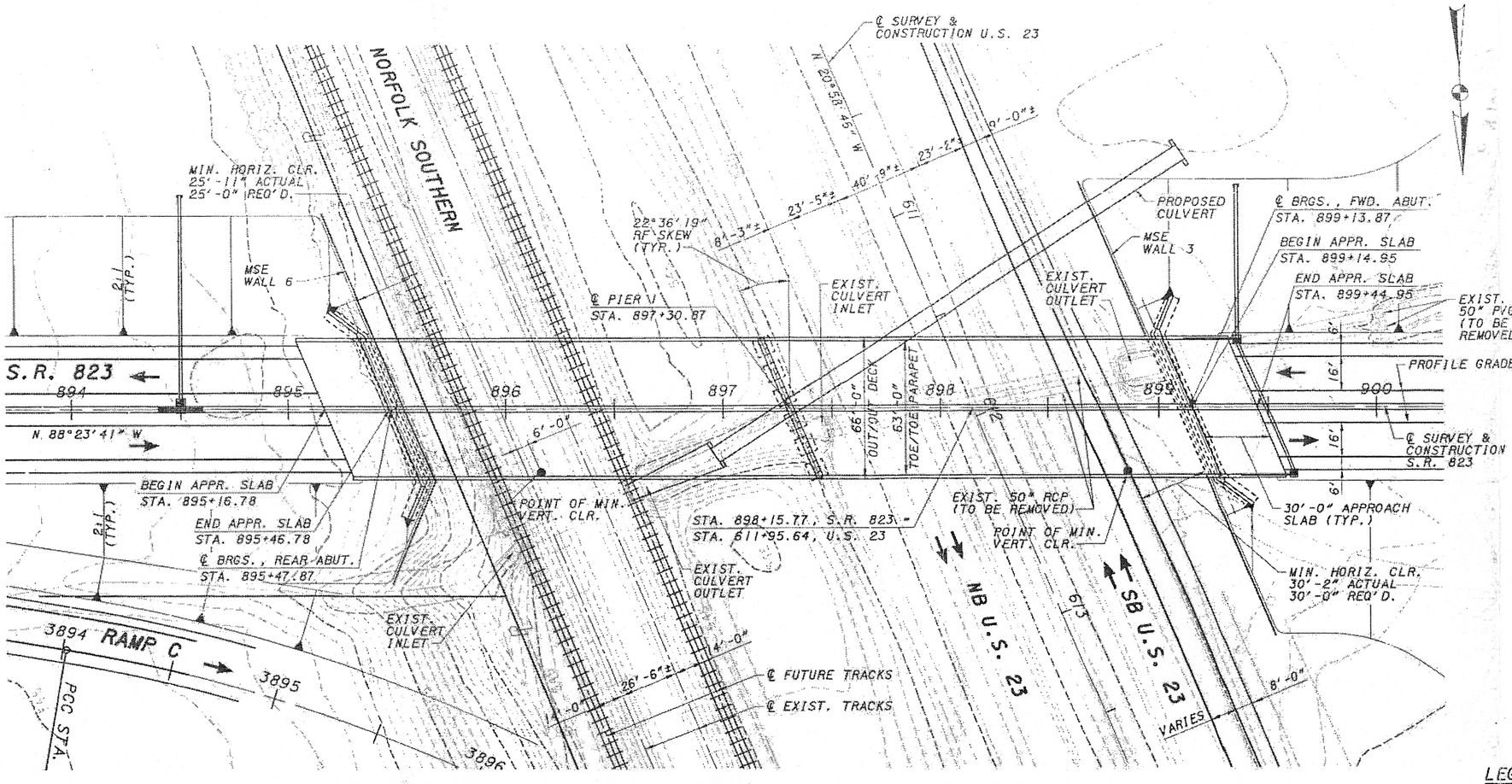
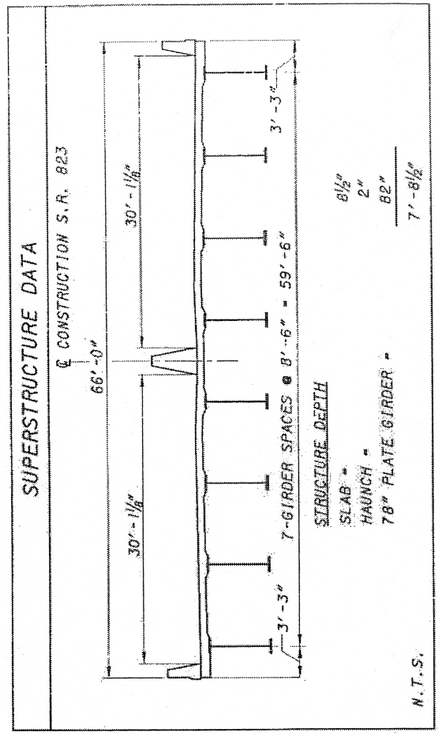
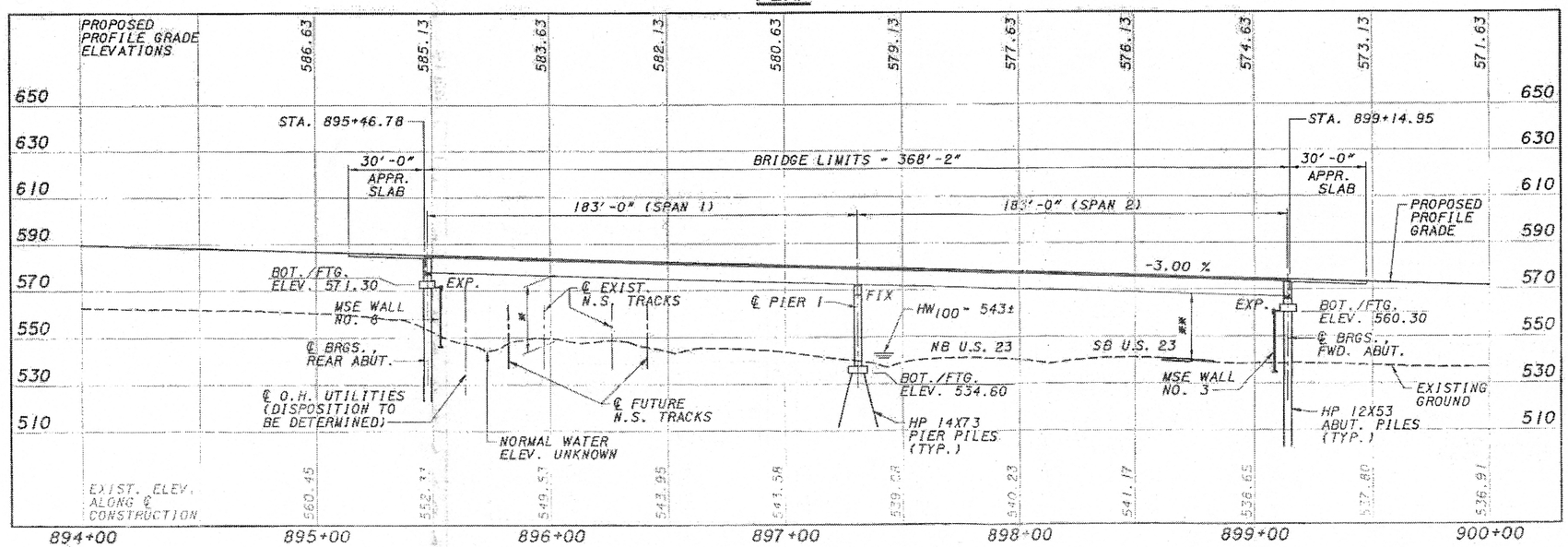



## PLAN




PROFILE ALONG PROFILE GRADE LINE, S.R. 823

* MIN. VERT. CLR. XX'-XX" ACTUAL 23'-0" REQ'D.

** MIN. VERT. CLR. XX'-XX" ACTUAL 17'-0" REQ'D.

## LEGEND

INDICATES BORING LOCATION

## NOTE

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

## PROPOSED STRUCTURE

**TYPE:** TWO-SPAN COMPOSITE STEEL PLATE GIRDERS (WEATHERED ASTM A709, GR 50W) WITH REINFORCED CONCRETE DECK ON SEMI-INTEGRAL ABUTMENTS BEHIND MSE WALLS WITH CAP AND COLUMN PIER

**LENGTH OF SPAN:** 183'-0", 183'-0", C-C BEARINGS, MEASURED ALONG ℄ SURVEY & CONSTRUCTION

**ROADWAY:** 30'-1⅛" TOE/TOE PARAPETS (RB)
30'-1⅛" TOE/TOE PARAPETS (LB)

**SIDEWALK:** NONE

**DESIGN LOADING:** HS25 (CASE II) AND THE ALTERNATE MILITARY LOADING, FWS = 60 LB/FT²

**SKEW:** 22°36'19" RIGHT FORWARD

**WEARING SURFACE:** MONOLITHIC CONCRETE

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

**ALIGNMENT:** TANGENT

**CROWN:** 0.016 FT/FT

**LATITUDE:** N 38°53'32"

**LONGITUDE:** W 82°59'58"

# SITE PLAN

BRIDGE NO. SCI-823-1601
S.R. 823 OVER NORFOLK SOUTHERN & U.S. 23 - ALT. 2

SCIOTO COUNTY
STA. 895+46.78 TO STA. 899+19.95

DESIGNED DGS | DRAWN JBA | REVIEWED SCJ | DATE 04/07
CHECKED SKT | REVISED | STRUCTURE FILE NUMBER

DESIGN AGENCY
CH2MHILL
5775 Perimeter Drive, Suite 180
Dublin, Ohio 43017

SCI-823-0.00
PID 19415

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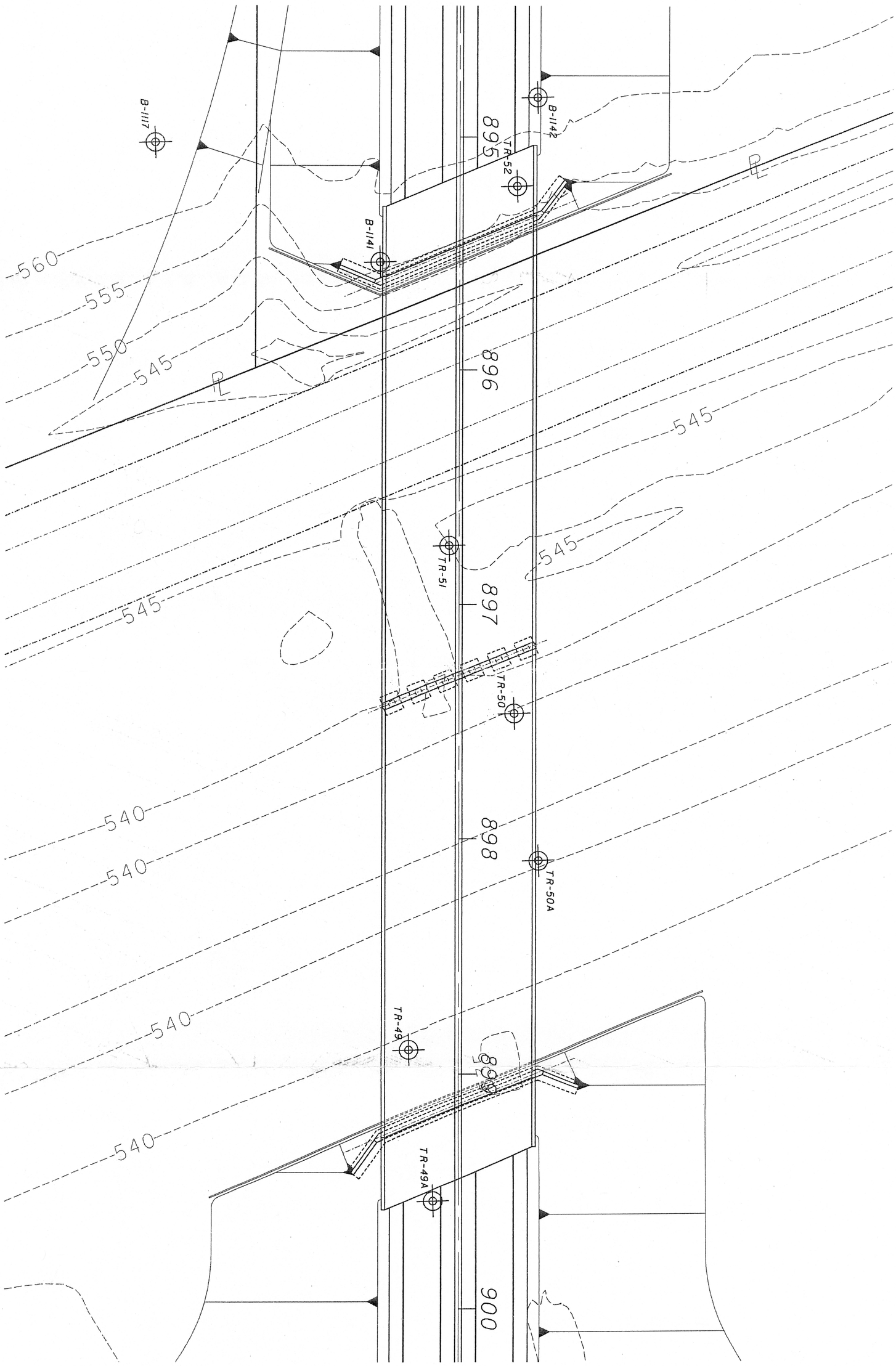


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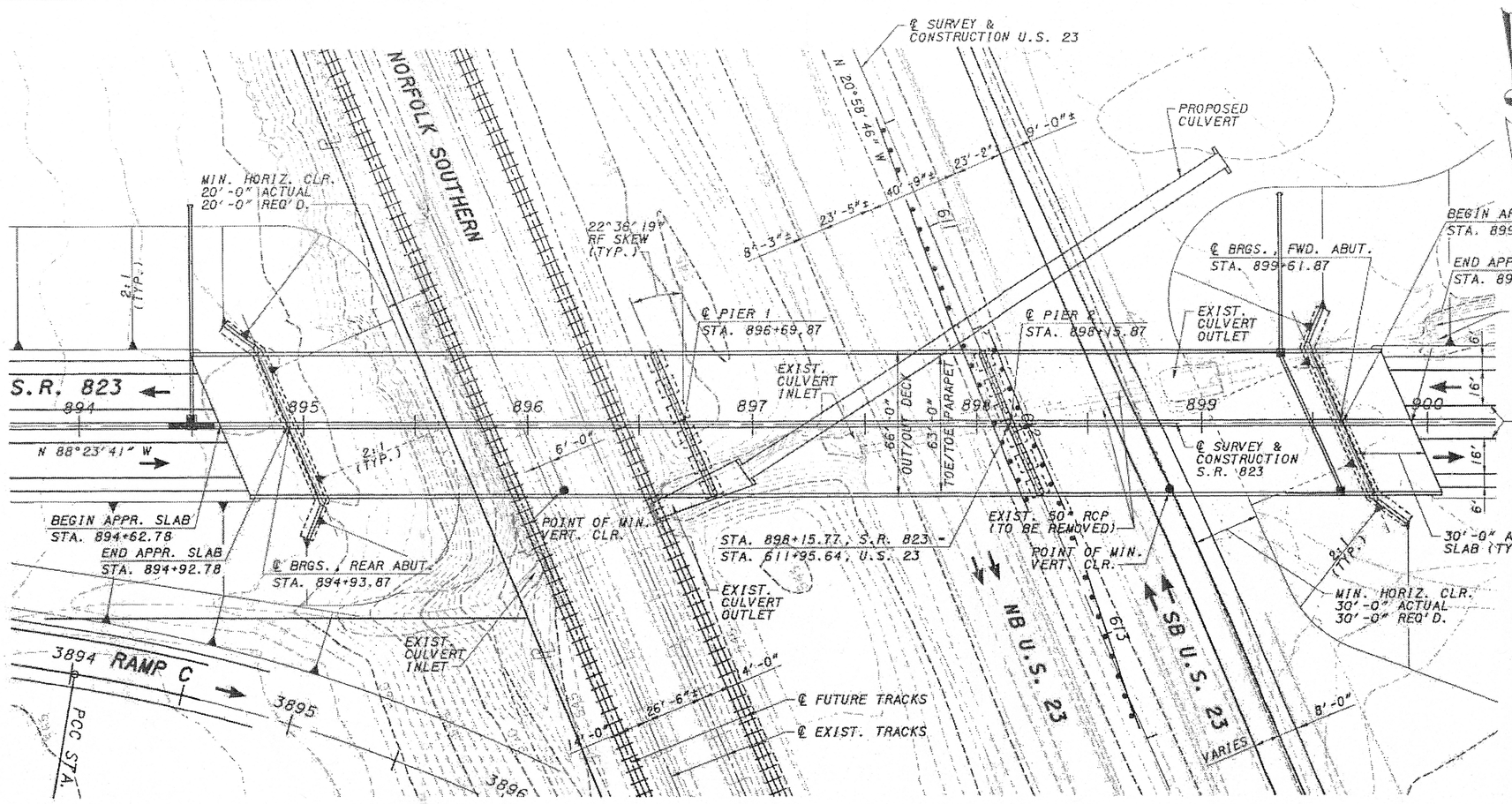
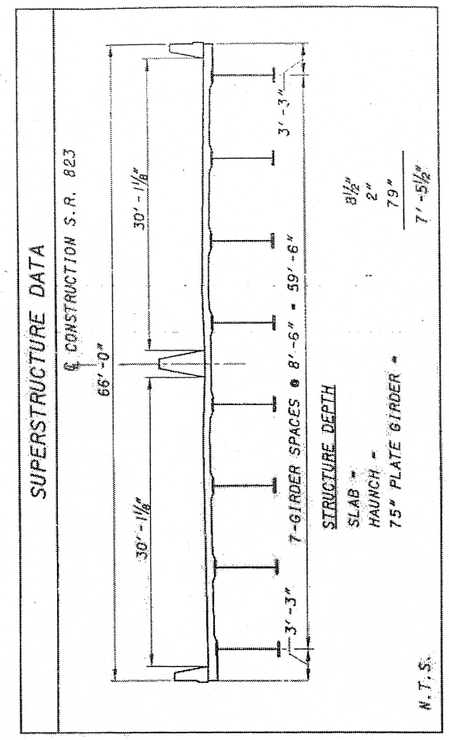
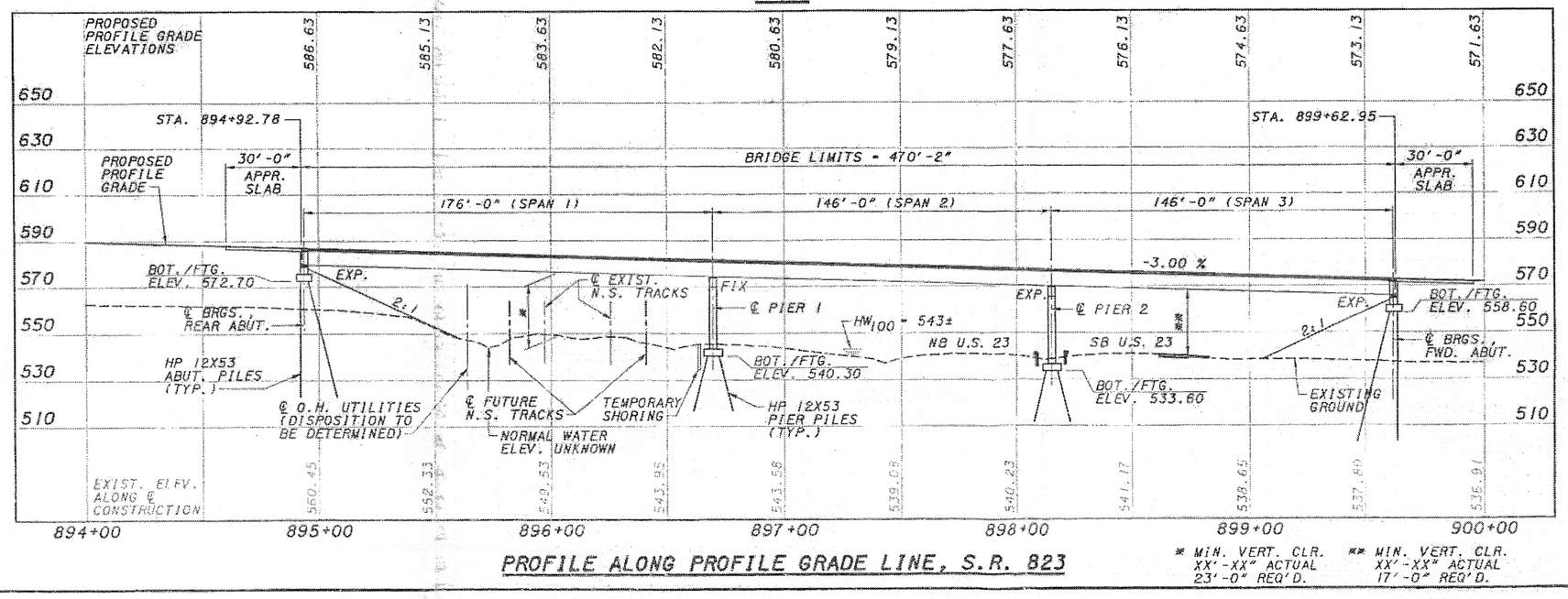



## PLAN




PROFILE ALONG PROFILE GRADE LINE, S.R. 823

* MIN. VERT. CLR. XX'-XX" ACTUAL 23'-0" REQ'D.

** MIN. VERT. CLR. XX'-XX" ACTUAL 17'-0" REQ'D.

### LEGEND

INDICATES BORING LOCATION

### NOTE

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

### PROPOSED STRUCTURE

TYPE: THREE-SPAN COMPOSITE STEEL PLATE GIRDERS (WEATHERED ASTM A709, GR 50W) WITH REINFORCED CONCRETE DECK ON SEMI-INTEGRAL ABUTMENTS BEHIND 2:1 SLOPES WITH CAP AND COLUMN PIERS

LENGTH OF SPAN: 176'-0", 146'-0", 146'-0" C-C BEARINGS, MEASURED ALONG ℄ SURVEY & CONSTRUCTION

ROADWAY: 30'-11⅛" TOE/TOE PARAPETS (RB) 30'-11⅛" TOE/TOE PARAPETS (LB)

SIDEWALK: NONE

DESIGN LOADING: HS25 (CASE II) AND THE ALTERNATE MILITARY LOADING, FWS = 60 LB/FT²

SKEW: 22°36'19" RIGHT FORWARD

WEARING SURFACE: MONOLITHIC CONCRETE

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

ALIGNMENT: TANGENT

CROWN: 0.016 FT/FT

LATITUDE: N 38°53'32"

LONGITUDE: W 82°59'58"

DESIGN AGENCY
CH2MHILL
3775 Perimeter Drive, Suite 190
Dublin, Ohio 43017

| DESIGNED | DRAWN | REVIEWED | DATE |
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| DGS | JBA | SCJ | 04/07 |
| CHECKED | REVISED | STRUCTURE FILE NUMBER | |
| SKT | | | |

SCIOTO COUNTY
STA. 894+92.78 TO STA. 899+62.95

23 - ALT. 3

# SITE PLAN

BRIDGE NO. SCI-823-1601
S.R. 823 OVER NORFOLK SOUTHERN & U.S. 23 - A

SCI-823-0.00
PID 19415

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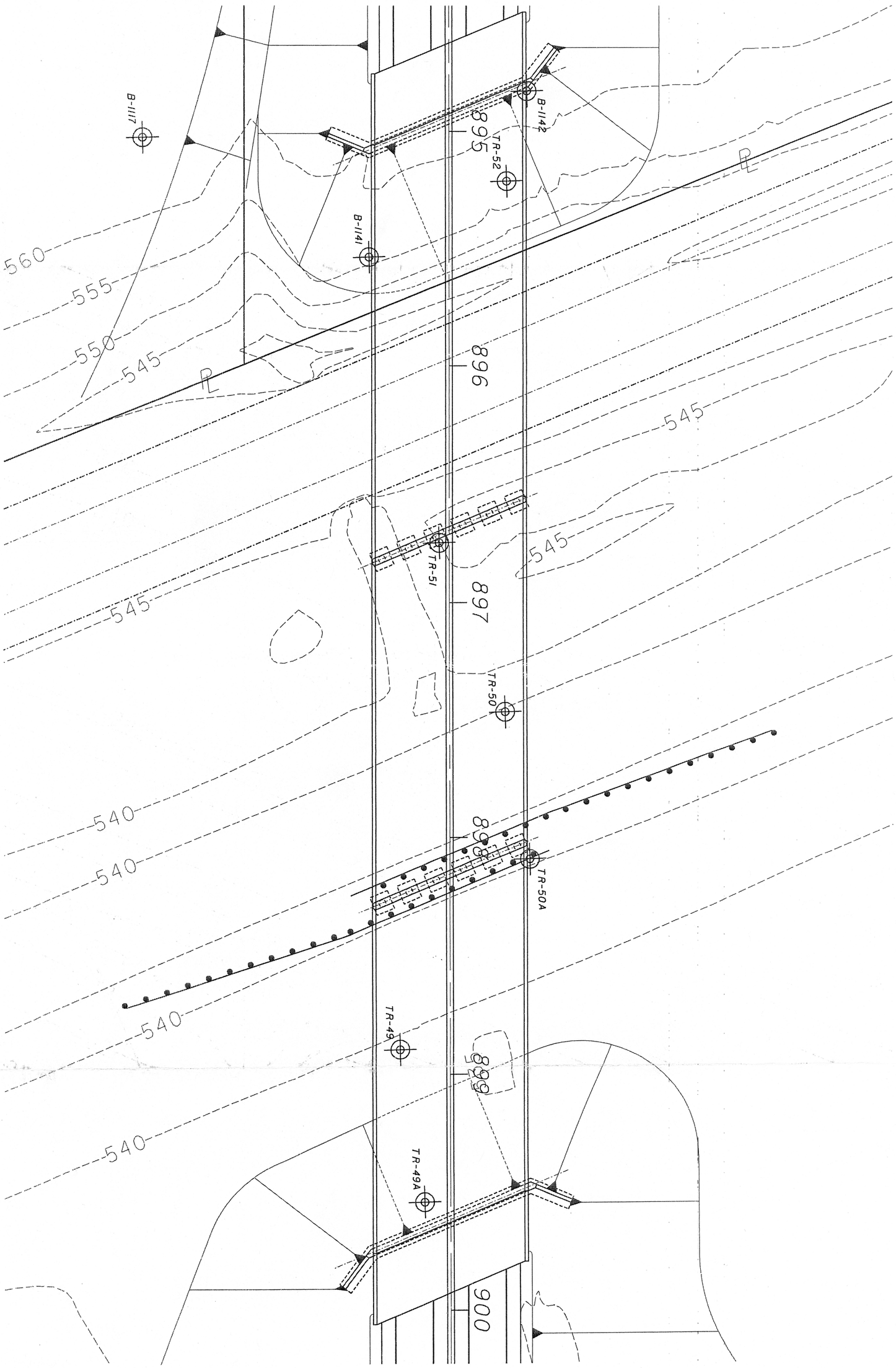



SCI-823-0.00
PID 19415

**BORING LOCATION PLAN**
**SR 823 OVER NORFOLK SOUTHERN & US 23 - ALT 3**

0 20
10 40
HORIZONTAL SCALE IN FEET

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

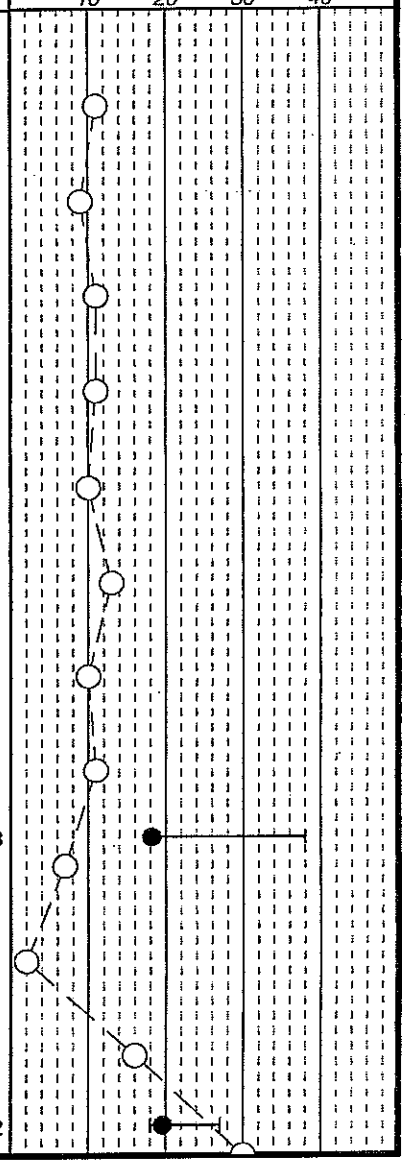
Client: TranSystems, Inc. | Project: SCI-823-0.00 | Job No. 0121-3070.03

**LOG OF: Boring B-1141** | Location: Sta. 895+53.5, 34.0 ft. RT of SR 823 CL | Date Drilled: 10/12/05

WATER OBSERVATIONS: Water seepage at: 21.0'-30.0'
Water level at completion: 31.0' (prior to coring)
7.7' (inside hollowstem augers)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2 | 556.2 | | | | | | Topsoil - 2" | | | | | | |
| | 556.0 | 5 5 6 | 18 | 1 | | | FILL: Loose to medium dense gray SANDY SILT (A-4a), trace clay, trace gravel; contains shale fragments; damp to moist. | | | | | | |
| | | 4 4 5 | 18 | 2 | | | | | | | | | |
| 5 | | 2 6 5 | 6 | 3 | | | | | | | | | |
| | | 4 8 3 | 8 | 4 | | | | | | | | | |
| 10 | | 15 7 3 | 5 | 5 | | | @ 11.0', contains wood fragments. | | | | | | |
| | | 4 5 8 | 3 | 6 | | | | | | | | | |
| 15 | | | | | | | | | | | | | |
| 15.5 | 540.7 | 3 5 5 | 0 | 7 | | | FILL: Loose to medium dense brown and gray GRAVEL WITH SAND, SILT, AND CLAY (A-2-6); moist to wet. @ 16.0'-20.0', contains wood fragments. | | | | | | |
| | | 5 5 6 | 3 | 8 | | | | | | | | | |
| 20 | | 3 4 3 | 14 | 9 | | | @ 21.0', brown. | 57 | 15 | -- | 7 | 8 | 13 |
| | | 2 1 1 | 18 | 10 | | | @ 23.5'-25.0', very loose. | | | | | | |
| 25 | | 1 1 15 | 5 | 11 | | | | | | | | | |
| 28.0 | 528.2 | | | | | | | | | | | | |
| | | 10 15 15 | 8 | 12 | | 1.5 | Stiff brown SANDY SILT (A-4a), some clay, little gravel; wet. | 11 | 8 | -- | 27 | 32 | 22 |
| 30 | | | | | | | | | | | | | |

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



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 B-1141** | Location: Sta. 895+53.5, 34.0 ft. RT of SR 823 CL | Date Drilled: 10/12/05

WATER OBSERVATIONS: Water seepage at: 21.0'-30.0'
Water level at completion: 31.0' (prior to coring)
7.7' (inside hollowstem augers)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 526.2 | | | | | | Stiff brown SANDY SILT (A-4a), some clay, little gravel; wet. | | | | | | |
| 33.0 | 523.2 | Core 120" | Rec 120" | RQD 78% | R1 | | Medium hard to hard black SHALE; moderately to highly weathered, carbonaceous, thinly laminated to laminated, highly fractured. @ 33.3', 33.4', 33.5', 33.9', 34.7'-34.8', 35.1', 35.3', 35.4', 36.0', 37.2', 37.4'- 37.6', 38.0', 38.3', 38.8', 39.2', 39.3', 39.9', 40.1', 40.8', 41.1', low angle fractures. | | | | | | |
| 42.6 | 513.6 | | | | | | | | | | | | |
| 43.0 | 513.2 | | | | | | Hard gray SANDSTONE; fine grained, slightly weathered, micaceous, medium bedded, unfractured. | | | | | | |
| | | | | | | | Bottom of Boring - 43.0' | | | | | | |

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

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-49A** | Location: Sta. 899+54.2, 10.9 ft. RT of SR 823 CL | Date Drilled: 3/21/05

WATER OBSERVATIONS: Water seepage at: 18.0'-28.0'
Water level at completion: 14.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 538.1 | | | | | | | | | | | | |
| | | 4 5 7 | 17 | 1 | | 4.5+ | No Topsoil<br>Hard brown SANDY SILT (A-4a), some clay, some gravel; contains sandstone fragments; damp. | | | | | | |
| | | 3 4 4 | 16 | 2 | | 4.0 | | | | | | | |
| 5 | | 3 5 5 | 16 | 3 | | 1.5 | @ 6.0', stiff, moist. | | | | | | |
| | | 2 2 3 | 17 | 4 | | 1.0 | | | | | | | |
| 10 | | 3 4 5 | 18 | 5 | | 1.5 | @ 11.0', little gravel. | 23 | 16 | -- | 9 | 30 | 22 |
| 13.0 | 525.1 | | | | | | | | | | | | |
| | | WOH 2 2 | 18 | 6 | | <0.25 | Very soft brown SILT AND CLAY (A-6a), trace to little fine to coarse sand; wet. | 0 | 5 | -- | 16 | 54 | 25 |
| 15 | | 1 2 3 | 18 | 7 | | <0.25 | | 0 | 0 | -- | 1 | 67 | 32 |
| 18.0 | 520.1 | | | | | | | | | | | | |
| | | W O H | 3 | 8 | | | Loose to medium dense brown GRAVEL (A-1-a), some to "and" fine to coarse sand, little clay; wet.<br>@ 18.5'-20.0', very loose. | | | | | | |
| 20 | | 5 9 18 | 12 | 9 | | | | 62 | 16 | -- | 8 | 14 | |
| | | 2 2 6 | 18 | 10 | | | | | | | | | |
| 25 | | 6 5 8 | 13 | 11 | | | | | | | | | |
| | | 10 43 50/4 | 16 | 12 | | | @ 28.5'-30.0', very dense. | | | | | | |
| 30 | | | | | | | | | | | | | |

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

Non-Plastic

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-49A** | Location: Sta. 899+54.2, 10.9 ft. RT of SR 823 CL | Date Drilled: 3/21/05

WATER OBSERVATIONS: Water seepage at: 18.0'-28.0'
Water level at completion: 14.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay | STANDARD PENETRATION (N) Natural Moisture Content, % - ● PL ⊢—⊣ LL Blows per foot - ○ 10 20 30 40 50+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30.0 | 508.1 | | | | | | | | | | | | | |
| | 508.1 | | | | | | Severely weathered gray SANDSTONE | | | | | | | |
| | | 50/2 | 1 | 13 | | | | | | | | | | |
| 35.0 | 503.1 | | | | | | Medium hard to hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, massive, highly fractured to broken. | | | | | | | |
| 40 | | Core 120" | Rec 84" | RQD 13% | R1 | | | | | | | | | |
| 45.0 | 493.1 | | | | | | Bottom of Boring - 45.0' | | | | | | | |
| 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-50** | Location: Sta. 897+47.1, 23.7 ft. LT of SR 823 CL | Date Drilled: 7/7/04

WATER OBSERVATIONS: Water seepage at: 13.5', 16.0'
Water level at completion: 14.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 540.5 | | | | | | | | | | | | |
| 0.3 | 540.2 | | | | | | Topsoil - 3" | | | | | | |
| | | 3 3 4 | 16 | 1 | | 4.5+ | Very stiff to hard brown SILT AND CLAY (A-6a), little fine to coarse sand, trace gravel; damp to moist. | | | | | | |
| | | 1 2 3 | 14 | 2 | | 2.0 | | | | | | | |
| 5 | | 2 3 3 | 13 | 3 | | 3.25 | | | | | | | |
| | | 2 3 3 | 16 | 4 | | 2.5 | | | | | | | |
| 10 | | 2 3 4 | 13 | 5 | | 2.75 | | | | | | | |
| | | W O H | 6 | 6 | | 1.0 | @ 13.5'-17.2', stiff, contains interbedded sand seams. | | | | | | |
| 15 | | 6 7 31 | 16 | 7a<br>7b | | 1.0<br>1.25 | | | | | | | |
| 17.2 | 523.3 | | | | | | Severely weathered brown and gray SANDSTONE fragments. | | | | | | |
| | | 10 15 32 | 4 | 8 | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
| 21.0 | 519.5 | Core 42" | Rec 19" | RQD 0% | R-1 | | Soft to medium hard gray SANDSTONE; decomposed, argillaceous, broken.<br>@ 24.4'-24.5', dark gray carbonaceous shale. | | | | | | |
| 25.2 | 515.3 | Core 78" | Rec 70" | RQD 53% | R-2 | | Hard gray SANDSTONE; very fine to fine grained, micaceous, argillaceous, massive, slightly to highly fractured.<br>@ 25.3'-25.7', 25.8'-25.9', 27.5'-27.8', 30.3'-30.3', high angle fractures.<br>@ 26.1',28.3',29.6', thin clay seams. | | | | | | |
| 30 | | | | | | | | | | | | | |

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

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-50** | Location: Sta. 897+47.1, 23.7 ft. LT of SR 823 CL | Date Drilled: 7/7/04

WATER OBSERVATIONS: Water seepage at: 13.5', 16.0'
Water level at completion: 14.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 510.5 | | | | | | Hard gray SANDSTONE; very fine to fine grained, micaceous, argillaceous, massive, slightly to highly fractured. | | | | | | |
| | | Core 42" | Rec 42" | RQD 100% | R-3 | | | | | | | | |
| 34.5 | 506.0 | | | | | | Bottom of Boring - 34.5' | | | | | | |
| 35 | | | | | | | | | | | | | |
| 40 | | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | |

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

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-50A** | Location: Sta. 898+09.3, 34.1 ft. LT of SR 823 CL | Date Drilled: 3/22/05

WATER OBSERVATIONS: Water seepage at: 18.0'-25.0'
Water level at completion: 18.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 539.3 | | | | | | | | | | | | |
| 0.1 | 539.2 | | | | | | Topsoil - 1" | | | | | | |
| | | 3 2 3 | 10 | 1 | | | FILL: Loose dark brown SANDY SILT (A-4a), trace gravel; contains roots; damp. | | | | | | |
| 3.0 | 536.3 | | | | | | | | | | | | |
| | | 2 1 2 | 8 | 2 | | 1.0 | Stiff brown SILT AND CLAY (A-6a), trace to little fine to coarse sand, trace gravel; moist. | | | | | | |
| 5 | | | | | | | | | | | | | |
| | | 2 3 3 | 13 | 3 | | 2.0 | | | | | | | |
| | | 1 2 3 | 16 | 4 | | 1.5 | | 1 | 4 | -- | 6 | 56 | 33 |
| 10 | | | | | | | | | | | | | |
| 10.5 | 528.8 | | | | | | | | | | | | |
| | | 1 2 3 | 18 | 5 | | 1.25 | Stiff brown SILTY CLAY (A-6b), some gravel, some fine to coarse sand; moist. | 32 | 20 | -- | 12 | 18 | 18 |
| | | WOH 2 3 | 18 | 6 | | 1.5 | | | | | | | |
| 15 | | | | | | | | | | | | | |
| | | 1 1 2 | 18 | 7 | | 1.25 | | | | | | | |
| 18.0 | 521.3 | | | | | | | | | | | | |
| | | WOH 1 3 | 16 | 8 | | | Very loose brown GRAVEL WITH SAND (A-1-b), little to some clay; wet. | 16 | 40 | -- | 23 | 21 | |
| 20 | | | | | | | | | | | | | |
| | | 2 5 11 | 16 | 9 | | | @ 21.0', medium dense. | 42 | 24 | -- | 20 | 14 | |
| | | 2 7 50 | 18 | 10 | | | | | | | | | |
| 24.5 | 514.8 | | | | | | Severely weathered brownish gray SANDSTONE. | | | | | | |
| 25 | | | | | | | | | | | | | |
| | | 25 37 50/4 | 10 | 11 | | | | | | | | | |
| 27.5 | 511.8 | | | | | | Hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, medium bedded, moderately fractured. | | | | | | |
| 30 | | | | | | | | | | | | | |

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

Non-Plastic
Non-Plastic
57
87

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-50A** | Location: Sta. 898+09.3, 34.1 ft. LT of SR 823 CL | Date Drilled: 3/22/05

WATER OBSERVATIONS: Water seepage at: 18.0'-25.0'
Water level at completion: 18.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 509.3 | Core 120" | Rec 117" | RQD 68% | R1 | | Hard gray SANDSTONE; very fine to fine grained, slightly to moderately weathered, argillaceous, micaceous, medium bedded, moderately fractured.<br>@ 28.1',-28.7', 29.0'-29.1', filled fractures.<br>@ 33.3', 34.3'-34.4', 36.2', 37.2', clay-filled fractures. | | | | | | |
| 35 | | | | | | | | | | | | | |
| 37.5 | 501.8 | | | | | | Bottom of Boring - 37.5' | | | | | | |
| 40 | | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | |

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

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-51** | Location: Sta. 896+74.9, 4.3 ft. RT of SR 823 CL | Date Drilled: 03/17/05

WATER OBSERVATIONS: Water seepage at: 13.0'-18.0'
Water level at completion: 21.0' (prior to coring)
13.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay | STANDARD PENETRATION (N) / Natural Moisture Content, % / Blows per foot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 544.5 | | | | | | | | | | | | | |
| 0.1 | 544.4 | | | | | | Topsoil - 2" | | | | | | | |
| | | 1 2 1 | 7 | 1 | | 2.0 | Stiff dark brown SILT AND CLAY (A-6a), little fine to coarse sand, trace fine to coarse gravel; damp to moist. | | | | | | | |
| | | 1 2 3 | 13 | 2 | | 1.0 | | | | | | | | |
| 5 | | | | | | | | | | | | | | |
| 5.5 | 539.0 | | | | | | Very stiff brown SILTY CLAY (A-6b), trace fine to coarse sand, trace fine to coarse gravel; damp. | | | | | | | |
| | | 2 3 6 | 8 | 3 | | 3.5 | | | | | | | | |
| 8.0 | 536.5 | | | | | | Very loose to loose brown GRAVEL WITH SAND (A-1-b), little clay, trace silt; damp. | | | | | | | |
| | | 3 3 4 | 10 | 4 | | | | | | | | | | |
| 10 | | | | | | | @ 11.0', moist. | | | | | | | |
| | | 1 1 1 | 7 | 5 | | | | 43 | 28 | -- | 11 | 7 | 11 | Non-Plastic |
| 13.0 | 531.5 | | | | | | Very loose brown COARSE AND FINE SAND (A-3a), little gravel, trace clay; wet. | | | | | | | |
| | | W O H | 18 | 6 | | | | 12 | 28 | -- | 45 | 15 | | Non-Plastic |
| 15 | | | | | | | | | | | | | | |
| | | W O H | 18 | 7 | | | | | | | | | | |
| 18.0 | 526.5 | | | | | | Medium dense reddish brown GRAVEL WITH SAND AND SILT (A-2-4), trace clay; contains sandstone fragments; damp to moist. | | | | | | | |
| | | 16 7 8 | 18 | 8 | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | |
| | | 7 14 11 | 14 | 9 | | | | 19 | 19 | -- | 30 | 24 | 8 | Non-Plastic |
| 23.0 | 521.5 | | | | | | Stiff gray CLAY (A-7-6), trace fine sand; moist. | | | | | | | |
| | | 1 3 5 | 11 | 10 | | 1.5 | | 0 | 0 | -- | 1 | 43 | 56 | |
| 25 | | | | | | | | | | | | | | |
| 25.5 | 519.0 | | | | | | Severely weathered black SHALE carbonaceous. | | | | | | | |
| | | 20 50/3 | 8 | 11 | | | | | | | | | | 50+ |
| 27.5 | 517.0 | | | | | | Medium hard black SHALE; moderately weathered, pyritic, laminated, broken. @ 28.1'-28.2', gray. | | | | | | | |
| 30 | | | | | | | | | | | | | | |

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-51** | Location: Sta. 896+74.9, 4.3 ft. RT of SR 823 CL | Date Drilled: 03/17/05

WATER OBSERVATIONS: Water seepage at: 13.0'-18.0'
Water level at completion: 21.0' (prior to coring)
13.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 514.5 | Core 120" | Rec 116" | RQD 71% | R1 | | Hard gray SANDSTONE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thickly bedded, moderately fractured.<br>@ 28.7'-28.8', pyritic.<br>@ 31.8', very thin clay seam.<br>@ 33.1'-33.3', clay and gravel infilled fracture.<br>@ 34.5', very thin clay infilled fracture.<br>@ 35.5'-36.2', broken zone with clay infilling.<br>@ 36.6'-36.8', highly weathered. | | | | | | |
| 37.5 | 507.0 | | | | | | Bottom of Boring - 37.5' | | | | | | |
| 40 | | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | |

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

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-52** | Location: Sta. 895+21.1, 24.8 ft. LT of SR 823 CL | Date Drilled: 03/15/05

WATER OBSERVATIONS: Water seepage at: 23.0'-30.0'
Water level at completion: 27.0' (prior to coring)
6.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 558.0 | | | | | | | | | | | | |
| 0.1 | 557.9 | | | | | | Topsoil - 1" | | | | | | |
| | | 2 2 3 | 4 | 1 | | 4.5+ | Hard gray SILTY CLAY (A-6b), trace to little fine to coarse sand; contains shale fragments; damp. | | | | | | |
| | | 3 5 7 | 10 | 2 | | 4.5+ | | | | | | | |
| 5 | | 10 7 4 | 9 | 3 | | 4.5+ | | | | | | | |
| | | 1 2 3 | 8 | 4 | | 4.5+ | | | | | | | |
| 10 | | | | | | | | | | | | | |
| 10.5 | 547.5 | | | | | | Loose gray GRAVEL WITH SAND AND SILT (A-2-4), trace to little clay; damp. | 66 | 4 | -- | 2 | 18 | 10 |
| | | 2 2 3 | 7 | 5 | | | | | | | | | |
| 13.0 | 545.0 | | | | | | Very stiff gray SILT AND CLAY (A-6a), trace fine to coarse sand, trace fine to coarse gravel; moist. | | | | | | |
| 15 | | 2 3 3 | 16 | 6 | | 3.75 | | | | | | | |
| | | 3 5 6 | 16 | 7 | | 4.0 | @ 16.0', brown. | | | | | | |
| | | 2 2 2 | 18 | 8 | | 1.0 | @ 18.5'-20.0', stiff, moist to wet. | | | | | | |
| 20 | | | | | | | | | | | | | |
| 20.5 | 537.5 | | | | | | Loose brown GRAVEL WITH SAND, SILT, AND CLAY (A-2-6); damp. | 35 | 20 | -- | 17 | 14 | 14 |
| | | 2 4 4 | 12 | 9 | | | | | | | | | |
| 23.0 | 535.0 | | | | | | Very soft brown CLAY (A-7-6), trace fine sand; wet. | | | | | | |
| | | WOH WOH 1 | 18 | 10 | | <0.25 | | | | | | | |
| 25 | | | | | | | | | | | | | |
| 25.5 | 532.5 | | | | | | Very loose brown GRAVEL WITH SAND, SILT, AND CLAY (A-2-6); wet. | | | | | | |
| | | W O H | 18 | 11 | | | @ 28.5-30.0', medium dense. | | | | | | |
| | | 13 15 5 | 17 | 12 | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

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

Non-Plastic

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-52** | Location: Sta. 895+21.1, 24.8 ft. LT of SR 823 CL | Date Drilled: 03/15/05

WATER OBSERVATIONS: Water seepage at: 23.0'-30.0'
Water level at completion: 27.0' (prior to coring)
6.0' (includes drilling water)

| Depth (ft) | Elev. (ft) | Blows per 6" | Recovery (in) | Sample No. Drive | Sample No. Press / Core | Hand Penetrometer (tsf) / * Point-Load Strength (psi) | DESCRIPTION | GRADATION % Aggregate | % C. Sand | % M. Sand | % F. Sand | % Silt | % Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30 | 528.0 | | | | | | Medium dense brown GRAVEL WITH SAND, SILT, AND CLAY (A-2-6); wet. | | | | | | |
| 32.0 | 526.0 | | | | | | Severely weathered black SHALE. | | | | | | |
| | | 22<br>50/5 | 10 | 13 | | | | | | | | | |
| 35.0 | 523.0 | | | | | | Medium hard black SHALE; moderately weathered, carbonaceous, laminated, broken to moderately fractured. | | | | | | |
| 40 | | Core<br>120" | Rec<br>120" | RQD<br>35% | R1 | | | | | | | | |
| 40.4 | 517.6 | | | | | | Hard gray SANDSTONE; very fine to fine grained, slightly weathered, argillaceous, micaceous, thickly bedded, slightly fractured. | | | | | | |
| 45.0 | 513.0 | | | | | | Bottom of Boring - 45.0' | | | | | | |
| 50 | | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | | |

STANDARD PENETRATION (N)
Natural Moisture Content, % - ●
PL ⊢——⊣ LL
Blows per foot - ○
10 20 30 40
50+

# APPENDIX F

# Meeting Agenda:
# Structures - Outstanding Issues at Norfolk Southern RR Portsmouth Bypass Project

**Attendees:** ODOT OSE, Norfolk Southern, TranSystems, CH2M HILL, DLZ

**FROM:** Shawn Thompson – CH2M HILL

**DATE** May 2, 2007

ODOT Office of Structural Engineering (OSE), Norfolk Southern, TranSystems, CH2M HILL, and DLZ are scheduled to meet on Wednesday, May 2, 2007 to discuss outstanding Structures and Geotechnical issues on the Portsmouth Bypass Project, particularly the proposed structures adjacent to the Norfolk Southern Railway. The agenda is to include, but is not limited to, the following:

1. *Bridge Issues:*

   CH2M HILL to discuss the 3 bridges over the Norfolk Southern RR, and what elements are driving the geometry.

Goals: 1.) Norfolk Southern concurrence on clear zone requirements (NS was generally in concurrence with our clear zone requirements provided)

2.) Norfolk Southern concurrence on potential ditch relocation to reduce Ramp C spans (NS was okay with the potential relocation of the ditch to reduce the Ramp C bridge spans, as long as the existing drainage capacity was not affected)

3.) Discuss boring a new pipe under the tracks (NS was okay with the idea of jacking and boring a new pipe under the existing tracks, as long as railway service was not interrupted)

4.) Discuss temporary work (falsework bent) between two existing tracks (NS stated that all temporary falsework would need to be at a minimum 10'-0" from the centerline of existing track)

2. *Geotechnical Issues:*

   DLZ and ODOT OSE to discuss existing track settlement with Norfolk Southern RR, due to the construction of MSE wall abutments adjacent to the tracks.

Goals: 1.) Reach agreement on what amount of calculated settlement is acceptable (NS was okay with the calculated 0.25" of settlement if an MSE wall is constructed approximately 40'-0" from the existing tracks)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3. *Other Outstanding Issues?* (None)

Norfolk Southern confirmed that a pier could not be placed between the two existing tracks.


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## Thompson, Shawn/COL

**From:** Thompson, Shawn/COL
**Sent:** Friday, April 13, 2007 4:01 PM
**To:** Wyatt, Dave
**Cc:** Jirschele, Steve/COL; jrcox@transystems.com; mdweeks@transystems.com; Miller, Robert/CLE; Richard Behrendt
**Subject:** RR Minimum Clearances - Portsmouth Bypass Project, OH

**Attachments:** Document.pdf

Document.pdf (185 KB)

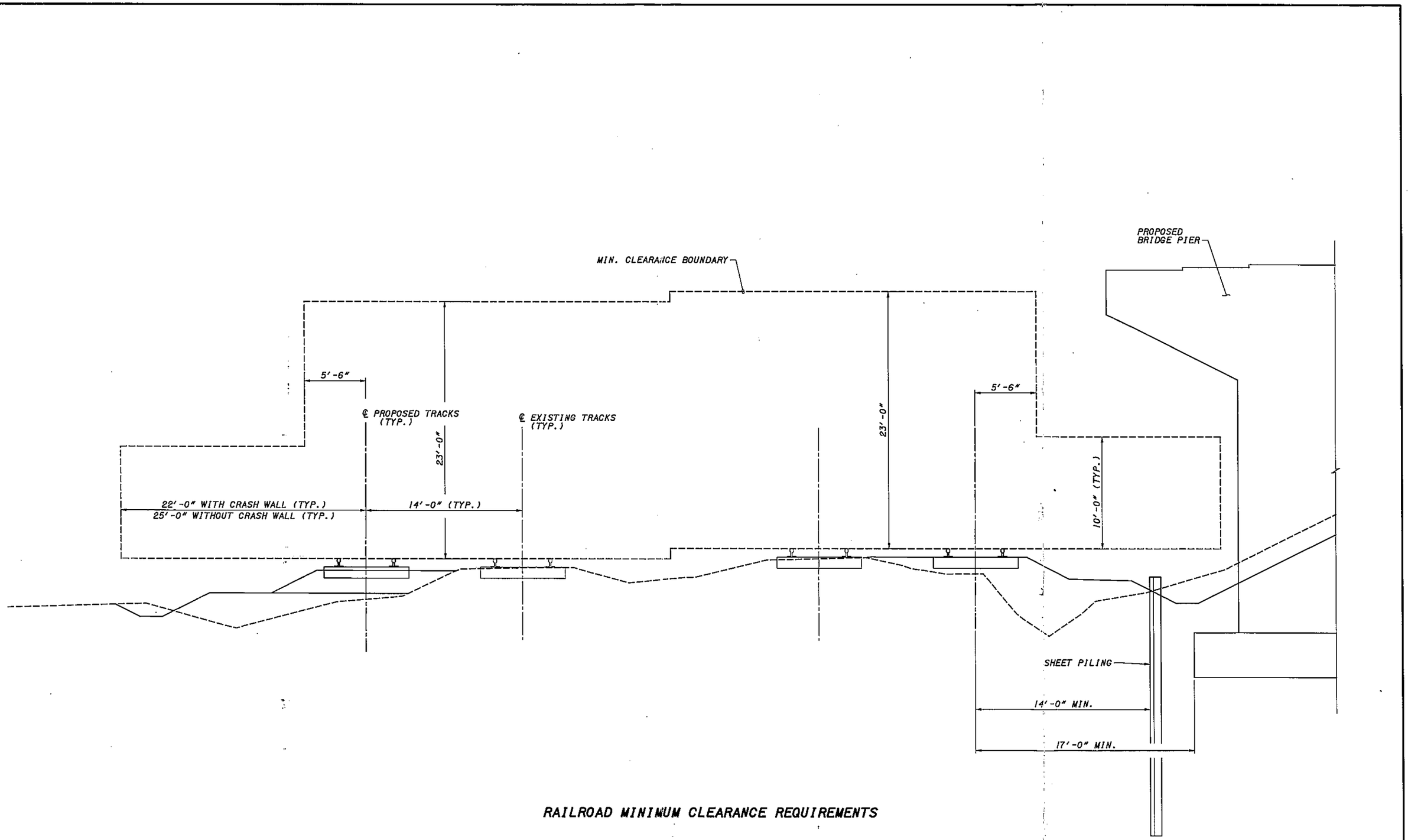
David,

Good afternoon. I hope you are doing well. Attached is a .pdf drawing showing our interpretation of your criteria for clearances at the US-23/SR-823 Interchange, as we understand them. Both Norfolk Southern and ODOT have clearance requirements. We will use the most conservative requirement, in the event of conflicts or differences between the two agencies.

One thing of note is the location of the T-type pier. Our understanding is that as long as the pier stem is a minimum of 22'-0" from the centerline of the track and 10'-0" high, the pier cap can extend inside of the 22'-0" clearance envelope. Again, due to the two new tracks and the curvature of the ramps, our goal is to shorten the span lengths as much as possible.

At your earliest convenience, please provide a response re: acceptance of our clearance understanding.

Thanks David. Have a great weekend.
Shawn




RAILROAD MINIMUM CLEARANCE REQUIREMENTS

FOR NORFOLK SOUTHERN CORP. APPROVAL
CH2M HILL, APRIL 13, 2007
SCI-823-0.00 PID 19415

baukerma
..\RR_CLR.dgn
5/17/2007
11:09:10 AM
SCI823_COL_darbycreek.plt

## Thompson, Shawn/COL

**From:** Wyatt, Dave [dave.wyatt@nscorp.com]
**Sent:** Wednesday, April 04, 2007 8:12 AM
**To:** Thompson, Shawn/COL
**Cc:** Richard Behrendt; ramoore1@nscorp.com; Jirschele, Steve/COL
**Subject:** FW: Norfolk Southern technical questions - Portsmouth Bypass ProjectinOhio
**Attachments:** Portsmouth_Bypass.pdf; 04032007_Phone_Conv.doc

Shawn:

Thanks for the layout view. I have added my comments in red to the attached Phone conversation Word Document.

Thanks

David Wyatt
System Engineer Public Improvements
Norfolk Southern Corporation
1200 Peachtree Street, N.E.
Atlanta, Georgia 30309

telephone: 404/529-1641
cell phone: 404/245-2596
fax: 404/527-2769

---

**From:** Shawn.Thompson@CH2M.com [mailto:Shawn.Thompson@CH2M.com]
**Sent:** Wednesday, April 04, 2007 7:12 AM
**To:** Wyatt, Dave
**Cc:** Richard.Behrendt@dot.state.oh.us; ramoore1@nscorp.com; Steve.Jirschele@CH2M.com
**Subject:** RE: Norfolk Southern technical questions - Portsmouth Bypass Projectin Ohio

David,
Good morning. I hope things are going well for you. I tried calling you yesterday, but I understand that you are on vacation this week and will return next Monday - I hope you had a great vacation.

I would like to thank you for your responses to my questions regarding the Portsmouth Bypass project in Ohio for ODOT. Per your request to Question #2 below, I have attached a .pdf file that contains the overall plan view of the project, as well as a zoomed-in plan view of the Ramp C bridge over Norfolk Southern RR (please note the yellow in the zoomed-in plan view indicates existing communication poles). As you can see from the curvature of Ramp C, coupled with the additional two future railway tracks, the challenge will be to shorten our bridge span lengths as much as possible from a constructability standpoint.

In any case, I have attached a Word file of some additional questions we were planning on asking you yesterday via phone. Your responses will continue to assist us in developing the most economical bridge structure at this location, while satisfying Norfolk Southern requirements and minimizing/eliminating RR impacts.

At your earliest convenience, we could either discuss over the phone our additional questions, or you may simply type out your responses and e-mail them back - whatever's easiest for you.

Thanks again for all your assistance on this project. Have a good day.

Shawn
614-734-7144 ext. 17

**From:** Wyatt, Dave [mailto:dave.wyatt@nscorp.com]
**Sent:** Thu 3/22/2007 6:48 PM
**To:** Thompson, Shawn/COL
**Cc:** Richard Behrendt; ramoore1@nscorp.com
**Subject:** FW: Norfolk Southern technical questions - Portsmouth Bypass Projectin Ohio

Shawn:

1.) Although we heard that the two new tracks are to be 14'-0" from the centerline of the existing tracks, could you confirm this 14'-0" offset? The future tracks will be located 14'-0" form center line of existing tracks – one future track each side.

2.) As you can see from the plan views, our pier locations accommodate the 20'-0" minimum distance from centerline of track to allow a roadbed profile with open ditches, but the pier stems/caps are cantilevered towards the tracks. We currently show a minimum distance of 13'-0" from the centerline of track to these cantilevered pier stems/caps. Is this acceptable, or do you have an acceptable minimum horizontal clear distance for this case? We did not get a plan view of the bridge layout, we only received a profile view. I am not sure of the skew of the cap relative to the track – please provide a plan view of the bent layouts relative to the centerline of tracks.

3.) In order to keep the span lengths as small as possible, we are not allowing for a maintenance roadway. Is this acceptable to both ODOT and Norfolk Southern? If you provide a minimum of 26'-0" from the centerline of future track to face of pier we can get a roadway in in conjunction with a standard 2'-0" flat bottom ditch; however, the picture that you attached indicates an existing ditch that exceed the 2'-0" flat bottom –your design should accommodate the exsitng drainage ditch..

4.) We are assuming that the 23'-0" vertical clearance is acceptable to Norfolk Southern to accommodate double-stacking. (you mentioned yesterday that this 23'-0" dimension is measured from a spot 5'-6" perpendicular from the top/rail) The 23'0" min. vertical clearance ATR is measured at a point 5'-6" each side form from center line of trac.k

5.) We are assuming that pier footings located no closer than 11'-0" from the centerline of the track is adequate in order to provide enough room for temporary shoring? Your assumption is correct.

6.) Per ODOT bridge design guidelines and NS guidelines, we are following the standard that all piers and MSE retaining walls located 25'-0" from the centerline of the tracks do not require crashwall protection. Correct – However, you previously mentions a severe skew, how does this impact the crash zone?

David Wyatt
System Engineer Public Improvements
Norfolk Southern Corporation
1200 Peachtree Street, N.E.
Atlanta, Georgia 30309

telephone: 404/529-1641
cell phone: 404/245-2596
fax: 404/527-2769

---

**From:** Shawn.Thompson@CH2M.com [mailto:Shawn.Thompson@CH2M.com]
**Sent:** Thursday, March 08, 2007 10:12 AM
**To:** tdwyatt@nscorp.com
**Cc:** Richard.Behrendt@dot.state.oh.us; jrcox@transystems.com; robert.miller@ch2m.com; steve.jirschele@ch2m.com

**Subject:** Norfolk Southern technical questions - Portsmouth Bypass Project in Ohio
**Importance:** High

David,
Good morning. I hope you are doing well. If you recall, I sent you some questions a few weeks ago concerning our bridge structures on the Portsmouth Bypass project in Ohio for ODOT. Please see the original e-mail below. I was curious if you'd had a chance to review my questions? Unfortunately, my work is starting to get onto the critical path, and your responses would greatly assist me in starting to lay out these structures in conformance to Norfolk Southern standards. Would you happen to know when I can expect to receive a response regarding this?

In addition, please read the below e-mail from Steve Jirschele, another structural engineer with my company. Apparently, there are communication line poles that run parallel to the existing tracks on the east side. See attached picture and profile of the proposed mainline bridge that shows this existing line (on the left side of the attached profile, this communication line is labeled "centerline Utilities). With the future tracks, this line may need to be relocated. My question regarding this communication line is as followed:

- What is the standard distance from centerline track to the communication line and the preferred distance from centerline pole to face of pier or MSE wall?

Also, could we get track plans or utility plans from Norfolk Southern? I just want to make sure that as we lay out these structures, we don't run into any other utilities that we're not aware of.

Thanks David. Have a great day.

Shawn

---

**From:** Jirschele, Steve/COL
**Sent:** Friday, February 23, 2007 12:01 PM
**To:** Thompson, Shawn/COL
**Subject:** RE: Norfolk Southern technical questions - Portsmouth Bypass Project in Ohio

Shawn,

As you recall there is the communication line (poles) that runs parallel to the tracks. Does the communication line have to be moved for the future track? When you talk to David - ask him the standard distance from centerline track to the communication line and the preferred distance from centerline pole to face of pier or MSE wall.

Did we ever get tracks plans or utility plans from the NS. For instance is there buried fiber optic cable or anything else that we should know about.

Steve Jirschele

---

**From:** Thompson, Shawn/COL
**Sent:** Friday, February 23, 2007 11:53 AM
**To:** tdwyatt@nscorp.com
**Cc:** richard.behrendt@dot.state.oh.us
**Subject:** Norfolk Southern technical questions - Portsmouth Bypass Project in Ohio

David,
Good morning. It was nice talking to you yesterday in regards to our Portsmouth Bypass project in southern Ohio. Again, Richard Behrendt, ODOT State Rail Coordinator, recommended that I contact you about several issues. I have attached two .pdf documents for your use in kindly assisting us. First, you will find plan views of our proposed interchange configuration, as well as detailed plan views of two horizontally curved ramp bridges (Ramp B and Ramp C) that need to span over the existing two tracks AND the proposed two new tracks. For

these ramp bridges, I looked at single span and 3-span alternatives from a constructability perspective. Second, I have attached a narrative that outlines the bridge impacts from adding the two new tracks.

A quick history of the project is that our original preliminary bridge designs in 2005 only accommodated the existing two tracks. We received notification from Norfolk Southern in early 2006 that two new tracks at 14' centers were to be added in the future. Therefore, this changes our bridge layouts. Because of the heavy geometric curvatures of Ramps B&C, we need to shorten our span lengths over the RR as much as possible, which hence leads to my technical questions/assumptions for you and Norfolk Southern:

1.) Although we heard that the two new tracks are to be 14'-0" from the centerline of the existing tracks, could you confirm this 14'-0" offset?

2.) As you can see from the plan views, our pier locations accommodate the 20'-0" minimum distance from centerline of track to allow a roadbed profile with open ditches, but the pier stems/caps are cantilevered towards the tracks. We currently show a minimum distance of 13'-0" from the centerline of track to these cantilevered pier stems/caps. Is this acceptable, or do you have an acceptable minimum horizontal clear distance for this case?

3.) In order to keep the span lengths as small as possible, we are not allowing for a maintenance roadway. Is this acceptable to both ODOT and Norfolk Southern?

4.) We are assuming that the 23'-0" vertical clearance is acceptable to Norfolk Southern to accommodate double-stacking. (you mentioned yesterday that this 23'-0" dimension is measured from a spot 5'-6" perpendicular from the top/rail)

5.) We are assuming that pier footings located no closer than 11'-0" from the centerline of the track is adequate in order to provide enough room for temporary shoring?

6.) Per ODOT bridge design guidelines and NS guidelines, we are following the standard that all piers and MSE retaining walls located 25'-0" from the centerline of the tracks do not require crashwall protection.

Again, thank you David for your time in assisting us on this challenging, yet exciting project. If you could provide me with your written responses at your earliest convenience, I would greatly appreciate it. Please do not hesitate to contact me should you have any questions to what was written above.

Thanks. Have a great weekend.

Shawn

Shawn K. Thompson, P.E.
CH2M HILL
Bridge Engineer
Operations Leader
5775 Perimeter Drive
Suite 190
Dublin, OH 43017
614-734-7144 ext. 17
shawn.thompson@ch2m.com

# CH2MHILL TELEPHONE CONVERSATION RECORD

**Call To:** Norfolk Southern Corp.

**Phone No.:** **Date:** April 03, 2007

**Call From:** Steve Jirschele, Shawn Thompson **Time:**

**Message Taken By:** Steve Jirschele

**Subject:** Portsmouth Bypass - Railroad Design Criteria

1. What is the minimum horizontal clearance that we're allowed? (I'm thinking about a drilled shaft that wouldn't have a footing.) **Minimum horizontal clearances are indicated in our Design Criteria see www.nscorp.com from the eight options across the top select "Doing Business" from the drop down options select "Publications" from the drop down options select "Design of Grade Separation Structures". 22'-0**

2. The clearance between the existing tracks is ±26.6'. Can we build a drilled shaft pier between the tracks? **NO**

3. Discuss the concept of an integral pier cap with the RR since it may require less than 22' of clearance during construction for formwork. **From the layout the pier is to located a minimum of 25'-0" from the future track; therefore, unless the future track is installed prior to your construction, I do not see a conflict. However, to elimiantethis potential conflict, I suggest that you consider locating the piers (that are adjacent to the railroad) parallel to the railroad, this will eliminate the need to consider crash wall protection for the piers.**

4. Is any additional clearance required for the communication lines? **All railroad comminucations lines will be relocated via the force account agreement prior to construction.**

5. Are there any buried RR utilities on site? **If so and if they are in conflict with the construction they will be relocated via the force account agreement prior to construction. Upon receipt of the TSL plans we will distribute to all our involved departments (Signal & Electrical, Communications, T-Cubed (fiber optics)) to determine if their facilities will be impacted and, if so, request an estmate for relocating.**

6. What is the allowable settlement or heave of the tracks due to construction? (DLZ says that the track could settle 0.3" if we build an MSE wall 20' from the tracks. Is that acceptable to the RR?) **0.00"**

## Thompson, Shawn/COL

**From:** Wyatt, Dave [dave.wyatt@nscorp.com]
**Sent:** Thursday, March 22, 2007 8:49 PM
**To:** Thompson, Shawn/COL
**Cc:** Richard Behrendt; ramoore1@nscorp.com
**Subject:** FW: Norfolk Southern technical questions - Portsmouth Bypass Projectin Ohio
**Importance:** High
**Attachments:** 16-riprap from CMP culvert.JPG; Document.pdf

Shawn:

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Norfolk Southern Corporation
1200 Peachtree Street, N.E.
Atlanta, Georgia 30309

telephone: 404/529-1641
cell phone: 404/245-2596
fax: 404/527-2769

---

**From:** Shawn.Thompson@CH2M.com [mailto:Shawn.Thompson@CH2M.com]

5/16/2007

**Sent:** Thursday, March 08, 2007 10:12 AM
**To:** tdwyatt@nscorp.com
**Cc:** Richard.Behrendt@dot.state.oh.us; jrcox@transystems.com; robert.miller@ch2m.com; steve.jirschele@ch2m.com
**Subject:** Norfolk Southern technical questions - Portsmouth Bypass Project in Ohio
**Importance:** High

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**Sent:** Friday, February 23, 2007 12:01 PM
**To:** Thompson, Shawn/COL
**Subject:** RE: Norfolk Southern technical questions - Portsmouth Bypass Project in Ohio

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Steve Jirschele

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**From:** Thompson, Shawn/COL
**Sent:** Friday, February 23, 2007 11:53 AM
**To:** tdwyatt@nscorp.com
**Cc:** richard.behrendt@dot.state.oh.us
**Subject:** Norfolk Southern technical questions - Portsmouth Bypass Project in Ohio

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Ohio. Again, Richard Behrendt, ODOT State Rail Coordinator, recommended that I contact you about several issues. I have attached two .pdf documents for your use in kindly assisting us. First, you will find plan views of our proposed interchange configuration, as well as detailed plan views of two horizontally curved ramp bridges (Ramp B and Ramp C) that need to span over the existing two tracks AND the proposed two new tracks. For these ramp bridges, I looked at single span and 3-span alternatives from a constructability perspective. Second, I have attached a narrative that outlines the bridge impacts from adding the two new tracks.

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6.) Per ODOT bridge design guidelines and NS guidelines, we are following the standard that all piers and MSE retaining walls located 25'-0" from the centerline of the tracks do not require crashwall protection.

Again, thank you David for your time in assisting us on this challenging, yet exciting project. If you could provide me with your written responses at your earliest convenience, I would greatly appreciate it. Please do not hesitate to contact me should you have any questions to what was written above.

Thanks. Have a great weekend.

Shawn

Shawn K. Thompson, P.E.
CH2M HILL
Bridge Engineer
Operations Leader
5775 Perimeter Drive
Suite 190
Dublin, OH 43017
614-734-7144 ext. 17
shawn.thompson@ch2m.com

## Thompson, Shawn/COL

**From:** mdweeks@transystems.com
**Sent:** Friday, May 05, 2006 9:56 AM
**To:** Miller, Robert/COL; Thompson, Shawn/COL
**Cc:** jrcox@transystems.com; jgbrown@transystems.com; rnunna@transystems.com
**Subject:** FW: SCI-823 NS RR involvement (3)

Rob and Shawn,

District 9 has given the go ahead to proceed with the Bridge Type Study based on your recent analysis (see below). Let me know if you need anything.

Thanks,
Mike

---

**From:** David.Norris@dot.state.oh.us [mailto:David.Norris@dot.state.oh.us]
**Sent:** Friday, May 05, 2006 9:39 AM
**To:** CO-Michael Weeks
**Subject:** RE: SCI-823 NS RR involvement (3)

Mike,

I haven't heard anything from OSE. Please proceed with the bridge type studies.

--
David A. Norris, PE
ODOT District 9 DDD Engineering Assistant
PO Box 467 Chillicothe, OH 45601
Toll Free: (888) 819-8501
Direct Phone: (740)-774-9061

**<mdweeks@transystems.com>**

05/05/2006 09:37 AM

To <David.Norris@dot.state.oh.us>
cc
Subject RE: SCI-823 NS RR involvement (3)

Dave,

Has OSE indicated anything regarding? Please let me know if we can proceed with the resubmission of the Bridge Type Study.

Thanks,
Mike

---

**From:** David.Norris@dot.state.oh.us [mailto:David.Norris@dot.state.oh.us]
**Sent:** Thursday, April 27, 2006 1:37 PM
**To:** CO-Michael Weeks
**Subject:** RE: SCI-823 NS RR involvement (3)

Mike,

I forwarded your info to Tim Keller, Ananda Dharma & Rich Behrendt.
Tim is out of the office til May 5, and haven't heard from Ananda (he reviewed the first submission).

I talked to Rich, and he feels pretty good about the 3-span bridge option, from the RR view.
I also talked to Larry Wills, in our office, and he thinks your proposal will work. There will be several details to work out, like crash walls, temporary supports, etc.

Unless I hear from OSE in the next couple of days, I think that you should go ahead with the Type Study submission.

--
David A. Norris, PE
ODOT District 9 DDD Engineering Assistant
PO Box 467 Chillicothe, OH 45601
Toll Free: (888) 819-8501
Direct Phone: (740)-774-9061
**<mdweeks@transystems.com>**

04/26/2006 04:31 PM

To <David.Norris@dot.state.oh.us>
cc
Subject RE: SCI-823 NS RR involvement (3)

Dave,

As we discussed, I have attached CH2M's Railroad Impact Analysis for your consideration. The intent of the analysis was to confirm that the existing geometric configuration of the interchange can accommodate the two additional RR tracks. A two-span option (as well as other alternatives) may also work – this will be addressed in the resubmission of the bridge type studies.

Let me know if you think we need to meet with OSE and others to discuss before we finalize the bridge type studies.

Mike

---

**From:** David.Norris@dot.state.oh.us [mailto:David.Norris@dot.state.oh.us]
**Sent:** Wednesday, April 26, 2006 2:57 PM
**To:** CO-Michael Weeks
**Subject:** Fw: SCI-823 NS RR involvement (3)

Mike,

I just left a message on your phone.

I mentioned at today's J&P meeting that you were trying to schedule a meeting with OSE, ORES and Rich Behrendt to discuss the NS RR bridges.
Please let me know when you get one scheduled.

Thanks,
--
David A. Norris, PE
ODOT District 9 DDD Engineering Assistant
PO Box 467 Chillicothe, OH 45601
Toll Free: (888) 819-8501
Direct Phone: (740)-774-9061

---- Forwarded by David Norris/Administration/D09/ODOT on 04/26/2006 02:53 PM ----

**Richard Behrendt/RealEstate/CEN/ODOT**

04/26/2006 02:43 PM

To David Norris/Administration/D09/ODOT@ODOT

cc Gary Cochenour/Production/D09/ODOT@ODOT, Jim Viau/RealEstate/CEN/ODOT@ODOT, Ray Lorello/RealEstate/CEN/ODOT@ODOT, Cash Misel/Director/CEN/ODOT@ODOT, Tim McDonald/ProductionMgmt/CEN/ODOT@ODOT

Subject Re: SCI-823 NS RR involvement (3) Link

Dave,
J.Viau noted to me that this project was discussed at today's J&P meeting, and was advised that a possible meeting is being attempted to be scheduled w/NS - Please ensure that I am included on the invitation list for this meeting.

Searching through my emails, I see that I did not provide a followup to your request that I discuss this project w/Chris Bennett - I did in fact talk w/him about this when he was in Columbus a couple of weeks ago, and his position is that NS will require accomodation of two (2) additional future tracks in addition to the two (2) existing tracks already in place as a requirement to execution of an Agreement.

This rail corridor is the subject of an intense study by NS to determine the cost to do clearance work in West Virginia & Ohio in order to provide for the movement of double-stack intermodal traffic over this route. When complete, this will provide a fast inland route from the Mid-Atlantic seaports in Virginia to Chicago and points west, and is anticipated to become a premier high-speed corridor for NS in the years to come.

As I stated in my email below from 3/13, the plans should be adjusted to account for NS current and future tracks...

Rich Behrendt
Program Mgr./State Rail Coordinator
Ohio Department of Transportation
1980 West Broad St.
Columbus, Ohio 43223
Phone: 614-387-3097
FAX: 614-466-0158
email: richard.behrendt@dot.state.oh.us

**Richard Behrendt/RealEstate/CEN/ODOT**

03/13/2006 11:29 AM

To David Norris/Administration/D09/ODOT
cc Ray Lorello/RealEstate/CEN/ODOT@ODOT, Jim Viau/RealEstate/CEN/ODOT@ODOT, Gary Cochenour/Production/D09/ODOT@ODOT
Subject Re: SCI-823 NS RR involvement Link

Dave,

Looking at the plan (and assuming the PL indication is NS's ROW line) , NS obviously has a wide ROW along US23 at the SR 823 area, and regardless of the other infrastructure/civil/physical issues that NS would need to amend if/when future tracks are constructed, putting new piers on their ROW w/o accomodating future tracks and dimensionally restricting them to the current layout to 2 tracks with the current design will invariably delay this project if we attempt to challenge this request.

Additionally, some of the new piers on Ramp B & C , as well as the bridge piers carrying SR 823 overhead look to be closer than 25' from centerline of existing track, which NS mandates should be accomodated w/crashwalls if less than 25' as per the NS design criteria: www.nscorp.com/nscorphtml/engineering/pdf/SEC1_OHB3.pdf

I'll talk w/Chris, but if he has already indicated that the design needs to accomodate 2 additional future tracks, the design should have accomodated that request - When was this info. conveyed this to Chris?

I realize that, depending upon how far along design is, to alter the design will increase cost; but in my opinion, it is highly unlikely that NS will approve of the design (or signing off on a RR Agreembased) based on the current layout if this is not corrected...

Rich Behrendt
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Phone: 614-387-3097
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email: richard.behrendt@dot.state.oh.us

**David Norris/Administration/D09/ODOT**

03/13/2006 09:56 AM

To Richard Behrendt/RealEstate/CEN/ODOT@ODOT
cc
Subject SCI-823 NS RR involvement

Rich,

Attached are 8 scanned files of pertinent sheets of the July 2005 PAVR submittal from TranSystems
These plan sheets were sent to NS previously, and in their response, they indicated that they would probably

request clearance for 2 additional tracks(one on each side) in the Lucasville/US 23 area.
I feel that this would cause considerable impact on the design & cost of our 3 proposed bridges, particularly the 2 curved ramp bridges.

I would appreciate you checking with Mr. Chris Bennett to see how serious they are about this.

Thanks,
--
David A. Norris, PE
ODOT District 9 DDD Engineering Assistant
PO Box 467 Chillicothe, OH 45601
Toll Free: (888) 819-8501
Direct Phone: (740)-774-9061 [attachment "RR_Impacts_Vert. Clr..pdf" deleted by David Norris/Administration/D09/ODOT] [attachment "RR_Impacts_Ramps B&C Calcs.pdf" deleted by David Norris/Administration/D09/ODOT] [attachment "RR_Impacts_Ramps B&C Plan Views.pdf" deleted by David Norris/Administration/D09/ODOT] [attachment "RR_Impacts_Report & Tele. Conversation.pdf" deleted by David Norris/Administration/D09/ODOT]

## Thompson, Shawn/COL

**From:** Jirschele, Steve/COL
**Sent:** Tuesday, April 11, 2006 12:20 PM
**To:** Miller, Robert/COL; Thompson, Shawn/COL
**Subject:** Conversation Record with Norfolk Southern
**Attachments:** 04112006_Bennett_Phone_Conv.doc

# CH2MHILL TELEPHONE CONVERSATION RECORD

**Call To:** Chris Bennett

**Phone No.:** 404-529-1256 **Date:** April 11, 2006

**Call From:** Steve Jirschele **Time:** 08:27 AM

**Message Taken By:** Steve Jirschele

**Subject:** Portsmouth Bypass

**Copies:** Shawn Thompson, Rob Miller

I called Chirs Bennett to discuss the Norfolk Southerns requirements in regard to adding two more tracks to their existing trackage. We discussed:

1. The new track centerline will be 14' off the centerline of the existing track.

2. For design purposes we can assume that the profile of the new tracks will match the profile of the existing tracks.

3. The two existing tracks at the site are on ±26' centers. I asked if they would be realigned to 14' centers when the new tracks were built. He was surprised that they were that far apart, but he offered the following observations:

    a. If the tracks are that far apart, there has to be a physical reason for it. Before a commitment could be made to move the tracks closer, they would have to know why they're that far apart now.

    b. ODOT would have to pay all realignment costs.

    c. Chris said that, based upon his past experience, ODOT cannot (or will not) comitt to funding a future realignment project that may or may not occur. He said without a funding commitment, the railroad will not comit to realigning the track.

    d. The other possibility is that ODOT fund the realignment now. However, that would still require an investigation as to why the tracks are ±26' apart now. If the tracks are that far apart, there is probably a good reason for it so the possibility of realigning the tracks to be closer together is probably slim.

Chris suggested that we assume the existing tracks cannot be realigned and proceed with preliminary design on that basis. If that results in a conclusion that it is impossible to build the bridges then ODOT, Norfolk Southern, and us (with TranSystems) could have a meeting to discuss other alternatives.

## Thompson, Shawn/COL

**From:** Jirschele, Steve/COL
**Sent:** Tuesday, March 21, 2006 5:35 PM
**To:** jrcox@transystems.com; Thompson, Shawn/COL
**Cc:** mdweeks@transystems.com; Miller, Robert/COL; Wolpert, Andy/COL
**Subject:** RE: Norfolk Southern RR Coordination

Thanks Jon. I called Chris Bennett at NS. He said ODOT has been forwarded all the information on their requirements for the Portsmouth location and said we need to get the information from them. He did say that the required clearances will be per the information on their website. 23' vertical clearance is sufficient for their double stack operations. Based upon previous e-mails, it is our understanding that one new track will be added on each side of the existing tracks. The only information we don't have is profile and centerline information for the new track. Below is the design criteria that we currently have or are asking you (or ODOT) to provide so the Bridge Type Studies can be revised:

1. Clearance to conform to requirements on the NS website: http://www.nscorp.com/nscorp/application?pageid=Legacy&page=http%3A//www.nscorp.com/nscorphtml/engineering/structure_design.html

2. Two new tracks to be added. One to the east and one to the west of the existing tracks. ODOT/TranSystems to provide the distance from the new track centerline to the existing track centerline.

3. ODOT/TranSystems to provide guidance on the profile of the new track since the new track will likely be the point of minimum vertical clearance. Should we match the existing rail profile or make an allowance for the new rail to be slightly higher than the existing?

Thanks for your help Jon, but now I think its up to ODOT to get us some more information.

Steve Jirschele

---

**From:** jrcox@transystems.com [mailto:jrcox@transystems.com]
**Sent:** Tuesday, March 21, 2006 12:24 PM
**To:** Jirschele, Steve/COL; Thompson, Shawn/COL
**Cc:** mdweeks@transystems.com
**Subject:** Norfolk Southern RR Coordination

Gentlemen,

As Steve and I discussed earlier, the contact person at Norfolk Southern is Chris Bennett, Engineer of Public Works, at 404-529-1256 about the minimum vertical clearance for double stacking.

**Jon R. Cox**
National Bridge Leader
TranSystems Corporation
720 E. Pete Rose Way
Suite 360
Cincinnati, OH 45202

Office: (513) 621-1981
Cell: (513) 226-3765
Fax: (513) 621-2901

## Thompson, Shawn/COL

**From:** mdweeks@transystems.com
**Sent:** Tuesday, March 14, 2006 7:14 PM
**To:** Miller, Robert/COL
**Cc:** Thompson, Shawn/COL; Jirschele, Steve/COL; jrcox@transystems.com
**Subject:** FW: SCI-823 NS RR involvement (2)

Guys,

See below for ongoing coordination with D-9 and Central Office regarding the Norfolk Southern future rails. Your team needs to assess the impacts to the designs and verify clearances with NS RR if needed.

Mike

---

**From:** Richard Behrendt [mailto:Richard.Behrendt@dot.state.oh.us]
**Sent:** Monday, March 13, 2006 2:07 PM
**To:** David Norris
**Cc:** Gary Cochenour; jcox@transystems.com; Jim Viau; CO-Michael Weeks; Ray Lorello
**Subject:** Re: SCI-823 NS RR involvement (2)

Dave,
Thanks for the added info.

I don't believe this is just a random comment on NS's part...As you may know, this rail corridor is currently a major route from the midwest down to the deep-water ports in Virginia and to the southeast part of the country, as well as being a major coal-hauling route from WV to the Great Lakes ports in the midwest and northeast. This line is currently under serious expansion review by NS as part of the 'Hearland Corridor' project, which will look at existing structures/clearances to determine costs for undercutting tunnels and removing other obstructions that will then permit operation of double-stack container/intermodal service and will no doubt run in the hundreds of millions of dollars. Together w/the new intermodal facility being constructed at Rickenbacker Airport here in Columbus, this line is projected to increase tonnage substantially, which is probably why NS is requesting added track potential on this route as existing capacity will soon be max'ed out if traffic develops as anticipated....

Rich Behrendt
Program Mgr./State Rail Coordinator
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FAX: 614-466-0158
email: richard.behrendt@dot.state.oh.us

**David Norris/Administration/D09/ODOT**

03/13/2006 01:16 PM

To Richard Behrendt/RealEstate/CEN/ODOT@ODOT
cc Gary Cochenour/Production/D09/ODOT@ODOT, Jim Viau/RealEstate/CEN/ODOT@ODOT, Ray Lorello/RealEstate/CEN/ODOT@ODOT, mdweeks@transystems.com, jcox@transystems.com
Subject Re: SCI-823 NS RR involvement Link

Rich,

The preliminary plans were sent to NS RR on 7/29/05. I received the email from Mr. Bennett on 01/13/06.

Part of the PAVR submission was the bridge type studies for all 21 bridges.
I don't have the bridge type studies in electronic format, that's why I sent the plan view sheets. If you would like to see the studies, Jawdat Siddiqi should have them in the Office of Structural Engineering.

The mainline bridge over NS had 8 alternatives proposed (3, 4, 5, 6 spans for steel beam & concrete beam).
Ramps B & C had 2 alternatives proposed (1, 2 span steel curved girder) each.
No selection has been made yet, as the consultant is incorporating review comments, and will resubmit. I asked Mr. Weeks to proceed with evaluating what NS RR requested, to see how it will affect our bridges.

I'm not saying that we should challenge their request, I'd just like more confidence that their expansion will really occur, instead of perhaps being a pipe dream.
This could cause us to reconfigure the whole interchange.

Thanks,
--
David A. Norris, PE
ODOT District 9 DDD Engineering Assistant
PO Box 467 Chillicothe, OH 45601
Toll Free: (888) 819-8501
Direct Phone: (740)-774-9061

**Richard Behrendt/RealEstate/CEN/ODOT**

03/13/2006 11:29 AM

To David Norris/Administration/D09/ODOT@ODOT
cc Ray Lorello/RealEstate/CEN/ODOT@ODOT, Jim Viau/RealEstate/CEN/ODOT@ODOT, Gary Cochenour/Production/D09/ODOT@ODOT
Subject Re: SCI-823 NS RR involvement Link

Dave,

Looking at the plan (and assuming the PL indication is NS's ROW line) , NS obviously has a wide ROW along US23 at the SR 823 area, and regardless of the other infrastructure/civil/physical issues that NS would need to amend if/when future tracks are constructed, putting new piers on their ROW w/o accomodating future tracks and dimensionally restricting them to the current layout to 2 tracks with the current design will invariably delay this project if we attempt to challenge this request.

Additionally, some of the new piers on Ramp B & C , as well as the bridge piers carrying SR 823 overhead look to be closer than 25' from centerline of existing track, which NS mandates should be accomodated w/crashwalls if less than 25' as per the NS design criteria: www.nscorp.com/nscorphtml/engineering/pdf/SEC1_OHB3.pdf

I'll talk w/Chris, but if he has already indicated that the design needs to accomodate 2 additional future tracks, the design should have accomodated that request - When was this info. conveyed this to Chris?

I realize that, depending upon how far along design is, to alter the design will increase cost; but in my opinion, it is

highly unlikely that NS will approve of the design (or signing off on a RR Agreement) based on the current layout if this is not corrected...

Rich Behrendt
Program Mgr./State Rail Coordinator
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Phone: 614-387-3097
FAX: 614-466-0158
email: richard.behrendt@dot.state.oh.us

**David Norris/Administration/D09/ODOT**

03/13/2006 09:56 AM

To Richard Behrendt/RealEstate/CEN/ODOT@ODOT

cc

Subject SCI-823 NS RR involvement

Rich,

Attached are 8 scanned files of pertinent sheets of the July 2005 PAVR submittal from TranSystems
These plan sheets were sent to NS previously, and in their response, they indicated that they would probably request clearance for 2 additional tracks(one on each side) in the Lucasville/US 23 area.
I feel that this would cause considerable impact on the design & cost of our 3 proposed bridges, particularly the 2 curved ramp bridges.

I would appreciate you checking with Mr. Chris Bennett to see how serious they are about this.

[attachment "339.tif" deleted by David Norris/Administration/D09/ODOT] [attachment "253.tif" deleted by David Norris/Administration/D09/ODOT] [attachment "331.tif" deleted by David Norris/Administration/D09/ODOT] [attachment "252.tif" deleted by David Norris/Administration/D09/ODOT] [attachment "325.tif" deleted by David Norris/Administration/D09/ODOT] [attachment "018.tif" deleted by David Norris/Administration/D09/ODOT] [attachment "002.tif" deleted by David Norris/Administration/D09/ODOT] [attachment "001.tif" deleted by David Norris/Administration/D09/ODOT]

Thanks,
--
David A. Norris, PE
ODOT District 9 DDD Engineering Assistant
PO Box 467 Chillicothe, OH 45601
Toll Free: (888) 819-8501
Direct Phone: (740)-774-9061

# APPENDIX G

# inter-office communication

**to:** Harry Fry, District 9 Deputy Director **date:** September 28, 2005

**from:** Tim Keller, Administrator, Office of Structural Engineering By: Jeff Crace, P. E.

**subject:** SCI-823-XXXX Norfolk Southern Railroad; PID 19415; Preliminary Design Submittal

We have performed a cursory review of the information furnished in the Preliminary Design Submittal by **CH2M**HILL Incorporated for the subject bridge as submitted and offer the following comments:

1. Due to the Departments long term experience and information that the Department has received concerning weathering steel, we have modified our anticipated long term maintenance of weathering steel to include the following. Initial painting of the beams is not required however the paint cycle should be initiated when required by the inspection process (for cost estimating purposes 25 - 30 and repeated as needed, every 25 - 30).

2. We recommend utilizing cap and column piers at locations that do not require T-type piers due to the required railroad horizontal clearance (25').

3. Was an MSE wall investigated for the proposed structure at the rear abutment?

4. If an MSE wall is feasible at the rear abutment, then investigate an alternate similar to Alternate number 1 but with an MSE will at the rear abutment.

   Can the proposed culvert be realigned, such that the footing for pier 2 in not located directly on the culvert, for this option?

   This option would also allow cap and column piers to be used which would also allow 7 beams to by utilized.

5. If "pertinent characteristics of the adjacent bridges" is referring to aesthetics, our office does not necessarily agree that all structures should be the same beam type (steel or concrete). Contact the District for further direction concerning aesthetics.

6. Show the horizontal clearance from the edge of Northbound lanes to the face of the pier 3.

7. For all alternates, the forward span (over southbound U. S. 23) should provide the clearzone clearance (30') from the to the face of the forward MSE wall/pier. Railing protecting the wall/pier located within the clearzone is considered a hazard.

8. If a substructure unit (pier) is fixed and integral/semi-integral abutments are utilized the fixed substructure unit shall be analyzed and designed to resist any forces/movements transmitted to it from the superstructure.

9. We recommend that semi-integral abutments not be utilized for this structure.

10. The Department has experienced problems (superstructure sliding down grade) with relatively long structures on profile grades greater than 3%.

11. The Design Consultant shall first determine that MSE wall supported abutments can be utilized at the proposed location prior to making any MSE wall recommendations during the Structure Type Study. Subsurface soil conditions are to be evaluated for expected settlements, differential settlements, allowable bearing capacities and global stability of the proposed MSE walls prior to submitting Structure Type Study to our office. The determination of utilizing a spread footing abutment placed directly on the reinforced soil mass can only be made after the above mentioned analysis have been performed as a minimum. Please refer to Section 204.6 of the 2004 Ohio Bridge Design Manual for additional design guidelines on MSE walls and L&D Manual, Volume 3, Section 1403.5.3 for submittal requirements.

12. The cost of structural steel and prestressed concrete beams have fluctuated and the following costs are the most recent available. The Consultant should look over their cost calculations and revise the cost comparison as appropriate utilizing the following costs:

**Structural Steel**

grade 50

| | |
|---|---|
| rolled beams | $0.90-1.00 |
| plate girders | $1.00-1.15 level 4 |
| | $1.15-1.30 level 5 |

grade 70 add $0.10-0.15 per pound

**Prestressed Concrete I-Beams**

| | |
|---|---|
| 45" | $190-200/LF |
| 54" | $215-225/LF |
| 60" | $240-255/LF |
| 66" | $265-280/LF |
| 72" | $295-310/LF |
| **Paint** | $12.00/SF |

13. On the final Site Plan in the Proposed Structure data block:

    a. Describe the Roadway width as "toe to toe barrier".

    b. Show the top of bedrock in the profile view by providing the following description: "Top of bedrock elevation ± ___ at Boring B-__ ."

Along with addressing the above review comments in writing, please furnish us a copy of the revised site plan for further review.

TK:JS:JC

c: District 9 - Tom Barnitz
District 9 -Dave Norris, Project Manager
District 9 -Doug Buskirk
File

CH2MHILL

***DESIGNER RESPONSE TO REVIEW COMMENTS***

BY: JTC/SKT DATE: 5/8/2007

# Bridge SCI-823-1601: SR-823 over Norfolk Southern Railway & US 23

PROJECT: SCI-823-10.13: Portsmouth Bypass PROJ. NO: 319861.08.02

REVIEWER: ODOT OSE – Jeff Crace, P.E. PHASE: Type Study

| Reference Page/Sheet No. | Review Comment | Designer Response |
|---|---|---|
| | ODOT Comments | |
| General | 1. Due to the Departments long term experience and information that the Department has received concerning weathering steel, we have modified our anticipated long term maintenance of weathering steel to include the following. Initial painting of the beams is not required however the paint cycle should be initiated when required by the inspection process (for cost estimating purposes 25 - 30 and repeated as needed, every 25 - 30). | Will comply. |
| General | 2. We recommend utilizing cap and column piers at locations that do not require T-type piers due to the required railroad horizontal clearance (25'). | Will comply. |
| General | 3. Was an MSE wall investigated for the proposed structure at the rear abutment? | Will comply and investigate an MSE wall at the rear abutment. However, during the initial Type Study development, the recommended Ramp B and Ramp C structures over the Norfolk Southern Railway utilized spill-through abutment types east of the tracks; since it is aesthetically consistent to use an abutment type similar to the adjacent ramp brides, an MSE wall was not originally investigated at the rear abutment. |

CH2MHILL

***DESIGNER RESPONSE TO REVIEW COMMENTS***

BY: JTC/SKT DATE: 5/8/2007

# Bridge SCI-823-1601: SR-823 over Norfolk Southern Railway & US 23

PROJECT: **SCI-823-10.13: Portsmouth Bypass** PROJ. NO: 319861.08.02

REVIEWER: ODOT OSE – Jeff Crace, P.E. PHASE: Type Study

| | | |
|---|---|---|
| Site Plan (1/3) | 4. If an MSE wall is feasible at the rear abutment, then investigate an alternate similar to Alternate number 1 but with an MSE at the rear abutment.<br><br>Can the proposed culvert be realigned, such that the footing for pier 2 in not located directly on the culvert, for this option?<br><br>This option would also allow cap and column piers to be used which would also allow 7 beams to be utilized. | Will comply.<br><br>Proposed culvert will be realigned to avoid conflict with proposed pier footing.<br><br>Will comply. Cap and Column pier type will be investigated; resulting beam spacing analysis will be performed during the Preliminary Design Report in order to determine the most economical/optimized structure. |
| General | 5. If "pertinent characteristics of the adjacent bridges" is referring to aesthetics, our office does not necessarily agree that all structures should be the same beam type (steel or concrete). Contact the District for further direction concerning aesthetics. | Will comply. |
| Site Plan (1/3) | 6. Show the horizontal clearance from the edge of Northbound lanes to the face of the pier 3. | Will comply. |
| Site Plan (1/3) | 7. For all alternates, the forward span (over southbound U. S. 23) should provide the clearzone clearance (30') from the *edge of pavement* to the face of the forward MSE wall/pier. Railing protecting the wall/pier located within the clearzone is considered a hazard. | Will comply. |

CH2MHILL

***DESIGNER RESPONSE TO REVIEW COMMENTS***

BY: JTC/SKT DATE: 5/8/2007

# Bridge SCI-823-1601: SR-823 over Norfolk Southern Railway & US 23

PROJECT: **SCI-823-10.13: Portsmouth Bypass** PROJ. NO: 319861.08.02

REVIEWER: ODOT OSE – Jeff Crace, P.E. PHASE: Type Study

| | | |
|---|---|---|
| General | 8. If a substructure unit (pier) is fixed and integral/semi-integral abutments are utilized the fixed substructure unit shall be analyzed and designed to resist any forces/movements transmitted to it from the superstructure. | Will comply. |
| General | 9. We recommend that semi-integral abutments not be utilized for this structure. | Where the bridge skew is less than 30 degrees and the total bridge length is less than 400 feet, semi-integral abutments will be investigated. All other alternatives will include conventional, jointed stub abutments. |
| General | 10. The Department has experienced problems (superstructure sliding down grade) with relatively long structures on profile grades greater than 3%. | Will consider ways to fix the superstructure at substructure locations to eliminate this sliding effect. Attached is an email from ODOT District 9 approving our geometric design of the interchange. Also attached is the Technical Memorandum explaining our geometric design of the interchange, which ODOT District 9 was provided. |

CH2MHILL

***DESIGNER RESPONSE TO REVIEW COMMENTS***

BY: JTC/SKT DATE: 5/8/2007

# Bridge SCI-823-1601: SR-823 over Norfolk Southern Railway & US 23

PROJECT: **SCI-823-10.13: Portsmouth Bypass** PROJ. NO: 319861.08.02

REVIEWER: ODOT OSE – Jeff Crace, P.E. PHASE: Type Study

| | | |
|---|---|---|
| General | 11. The Design Consultant shall first determine that MSE wall supported abutments can be utilized at the proposed location prior to making any MSE wall recommendations during the Structure Type Study. Subsurface soil conditions are to be evaluated for expected settlements, differential settlements, allowable bearing capacities and global stability of the proposed MSE walls prior to submitting Structure Type Study to our office. The determination of utilizing a spread footing abutment placed directly on the reinforced soil mass can only be made after the above mentioned analysis has been performed as a minimum. Please refer to Section 204.6 of the 2004 Ohio Bridge Design Manual for additional design guidelines on MSE walls and L&D Manual, Volume 3, Section 1403.5.3 for submittal requirements. | On October 4, 2006, DLZ submitted an updated "Subsurface Exploration and MSE Wall and Embankment Evaluations for Proposed US 23 / SR 823 Interchange" report, in response to ODOT concerns with the existing subsurface soil conditions at the site.<br><br>Per the ODOT Review of MSE Wall and Embankment Evaluation Report IOC from Peter Narsavage, dated April 23, 2007, *"From the report, we understand that undrained bearing capacity and differential settlement of the ramp MSE walls are of concern. The other stability checks, such as global stability, sliding, and drained bearing capacity result in acceptable safety factors. We believe that MSE walls could be built in two stages, without any surcharging or ground improvement. Wick drains could be considered to decrease the amount of time required for consolidation of the foundation soil. Where the height of the MSE wall was high enough to cause concern about differential settlement, slip joints can be provided at regular intervals. The top row of facing panels would not be fabricated until after settlement was substantially complete."* |

CH2MHILL

***DESIGNER RESPONSE TO REVIEW COMMENTS***

BY: JTC/SKT DATE: 5/8/2007

# Bridge SCI-823-1601: SR-823 over Norfolk Southern Railway & US 23

PROJECT: SCI-823-10.13: Portsmouth Bypass PROJ. NO: 319861.08.02

REVIEWER: ODOT OSE – Jeff Crace, P.E. PHASE: Type Study

| | | |
|---|---|---|
| General | 12. The cost of structural steel and prestressed concrete beams have fluctuated and the following costs are the most recent available. The Consultant should look over their cost calculations and revise the cost comparison as appropriate utilizing the following costs:<br><br>Structural Steel:<br><br>Grade 50 Rolled Beams: $0.90 - $1.00 per pound;<br>Grade 50 Plate Girders: $1.00 - $1.15 per pound (Level 4) and $1.15 - $1.30 per pound (Level 5);<br>For Grade 70, add $0.10 - $0.15 per pound<br><br>Prestressed Concrete I-Beams:<br><br>AASHTO Type 3: $190-$200/LF<br>AASHTO Type 4 (54"): $215-$225/LF<br>AASHTO Type 4 (60"): $240-$255/LF<br>AASHTO Type 4 (66"): $265-$280/LF<br>AASHTO Type 4 (72"): $295-$310/LF<br><br>Paint: $12/SF<br><br>MSE Walls: $45-$50/SF | Will comply. In September 2006, we contacted the ODOT Office of Estimating regarding another ODOT project for pricing information. We received new pricing information for several structural items in 2006 dollars, which will be used on this Structure Type Study re-submittal. |
| Site Plan (1/3) | 13. On the final Site Plan in the Proposed Structure data block:<br><br>a. Describe the Roadway width as "toe to toe barrier".<br><br>b. Show the top of bedrock in the profile view by providing the following description: "Top of bedrock elevation ± __ at Boring B-__ ." | a. Will comply.<br><br>b. Will comply. |