S-263-2007
(Consultant)

MEMORANDUM

TO: Allan Frank, P.E.
Division of Structural Design

FROM: William Broyles, P.E.
Geotechnical Branch Manager

BY: Bart Asher, P.E., P.L.S.
Geotechnical Branch

DATE: May 31, 2007

SUBJECT: **Jefferson County**
1200 056
Mars # 6554101D
New Bridge at I-65 over Market Street
S0450 (B65-9)
Ohio River Bridges Project
Kennedy Interchange – Section 1
Item No. 5-118.18 & .19

The geotechnical engineering report for this structure has been completed by K.S. Ware and Associates, L.L.C. We have reviewed and concur with the recommendations as presented in this report.

A copy of the report is attached. If you have any questions, please contact this office at 502-564-2374.

Attachment:

cc: J. Callihan
R. Harris
N. Stroop
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John Godfrey (K.S. Ware) (w/o attachment)

REPORT OF GEOTECHNICAL EXPLORATION

New Bridge at I-65 over Market St. (B65-9)

KTA Structure Number S0450
Item Number 5-118.18 and .19
Louisville, Kentucky
KSWA Project No. 500-05-0001.16

Prepared For:
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Prepared By:
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April 17, 2007

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April 17, 2007

Mr. Glen Kelly
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Louisville, Kentucky 40202

Subject: **Report of Geotechnical Exploration**
New Bridge at I-65 over Market St. (B65-9)
KTA Structure Number S0450
Item Number 5-118.18 & .19
KSWA Project No. 500-05-0001.016

Dear Mr. Kelly:

K. S. Ware and Associates, L.L.C. (KSWA) is pleased to submit this report which details the results of our geotechnical exploration for the referenced project. The exploration described in this report was performed in general accordance with the guidelines presented in the Kentucky Transportation Cabinet's Geotechnical Manual and the AASHTO LRFD Bridge Design Specifications.

KSWA has presented the results of the field exploration, laboratory data and our recommendations for the design and construction of the substructure elements proposed for the new bridge. We appreciate this opportunity to be of service to you on this project. Please contact us if you have any questions regarding this report.

Respectfully submitted,

K. S. Ware and Associates, L.L.C.

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Distribution: KYTC (3) + CD
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Report of Geotechnical Exploration
New Bridge at I-65 Over Market St. (B65-9) Item Number 5-118.18 and .19
Louisville, Kentucky

TABLE OF CONTENTS

1.0 LOCATION AND DESCRIPTION 1
2.0 SITE TOPOGRAPHY AND GEOLOGIC CONDITIONS 2
3.0 SUMMARY OF BORINGS 3
4.0 SOIL AND ROCK CONDITIONS 4
5.0 LABORATORY TESTING AND RESULTS 6
5.1 GENERAL 6
5.2 UNDISTURBED (SHELBY) TUBE TESTING 6
5.2.1 Engineering Classification Testing 6
5.2.2 Atterberg Limits Tests 6
5.2.3 #200 Wash 6
5.2.4 Unconfined Compression Testing 7
5.2.5 Consolidation Test 7
5.3 LABORATORY TESTING OF STANDARD PENETRATION TEST SAMPLES 7
5.3.1 Engineering Classification Testing 7
5.3.2 #200 Wash 8
6.0 ENGINEERING ANALYSIS 9
6.1 GENERAL 9
6.2 CORRECTION OF STANDARD PENETRATION TEST DATA 10
6.3 SETTLEMENT ANALYSIS 10
6.3.1 Abutment 2 at I-65 and Ramps 10 and 26 10
6.3.2 Abutment 1 at I-65 and Ramps 2, 3 and 4 11
6.4 LATERAL SQUEEZE POTENTIAL 12
6.5 GLOBAL STABILITY ANALYSIS 12
6.6 H-PILE ANALYSIS 12
6.6.1 Abutment 2 at I-65 and Ramps 10 and 26 13
6.6.2 Abutment 1 at I-65 and Ramps 2, 3 and 4 14
6.6.3 Negative Skin Friction 15
6.6.3.1 Abutment 2 at I-65 and Ramps 10 and 26 15
6.6.3.2 Abutment 1 at I-65 and Ramps 2, 3 and 4 16
6.6.4 Wave Equation Analysis (Drivability) 16
6.6.4.1 Abutment 2 at I-65 and Ramps 10 and 26 18
6.6.4.2 Abutment 1 at I-65 and Ramps 2, 3 and 4 18
6.7 DRILLED SHAFT ANALYSIS 19
6.7.1 Abutment 2 at I-65 and Ramps 10 and 26 20
6.7.2 Abutment 1 at I-65 and Ramps 2, 3 and 4 21
6.7.3 Negative Skin Friction 22

6.7.3.1 Abutment 2 at I-65 and Ramps 10 and 26 22
6.7.3.2 Abutment 1 at I-65 and Ramps 2, 3 and 4 23
7.0 SEISMIC SITE COEFFICIENT 24
8.0 LIQUEFACTION POTENTIAL 25
9.0 VIBRATION MONITORING 26
10.0 CONCLUSIONS AND RECOMMENDATIONS 27
10.1 FOUNDATION INSTALLATION CONSIDERATIONS 27
10.2 GENERAL FOUNDATION CONSIDERATIONS 27
10.3 H-PILE FOUNDATIONS 28
10.4 DRILLED SHAFT FOUNDATIONS 30
10.5 EXISTING FOUNDATIONS 32
11.0 ENVIRONMENTAL CONCERNS 33
12.0 CLOSING 34

TABLES

TABLE 1: BRIDGE SUBSTRUCTURE LOCATIONS 1
TABLE 2: SUMMARY OF BORINGS 3
TABLE 3: CONSOLIDATION RESULTS 7
TABLE 4: STP SAMPLE CLASSIFICATIONS 8
TABLE 5: SETTLEMENT SUMMARY – ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26 11
TABLE 6: LRFD RESISTANCE FACTORS FOR H-PILE CAPACITY 13
TABLE 7: SOIL PARAMETERS FOR DESIGN-ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26 13
TABLE 8: MAXIMUM FACTORED NOMINAL GEOTECHNICAL RESISTANCE AND ESTIMATED DEPTHS FOR RESISTANCE DEVELOPMENT – ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26 14
TABLE 9: SOIL PARAMETER FOR DESIGN – ABUTMENT 1 AT I-65 AND RAMPS 2, 3 AND 4 14
TABLE 10: MAXIMUM FACTORED NOMINAL GEOTECHNICAL RESISTANCE AND ESTIMATED DEPTHS FOR RESISTANCE DEVELOPMENT – ABUTMENT 1 AT I-65 AND RAMPS 2, 3 AND 4 15
TABLE 11: ESTIMATED MAXIMUM DOWNDRAG LOADS – ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26 16
TABLE 12: MAXIMUM DRIVABLE DEPTHS FOR VARIOUS HAMMER SIZES – ABUTMENT 2 AT I-65 AND RAMPS 10 & 26 18
TABLE 13: MAXIMUM DRIVABLE DEPTHS FOR VARIOUS HAMMER SIZES – ABUTMENT 1 AT I-65 AND RAMPS 2, 3 AND 4 19
TABLE 14: LRFD RESISTANCE FACTORS FOR DRILLED SHAFT CAPACITY 20
TABLE 15: SOIL PARAMETERS FOR DESIGN-ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26 20
TABLE 16: SUMMARY OF DRILLED SHAFT CAPACITIES – ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26 21
TABLE 17: SOIL PARAMETER FOR DESIGN – ABUTMENT 1 AT I-65 AND RAMPS 2, 3 AND 4 21
TABLE 18: SUMMARY OF DRILLED SHAFT CAPACITIES – ABUTMENT 1 AT I-65 AND RAMPS 2, 3 AND 4 22

TABLE 19: ESTIMATED MAXIMUM DOWNDRAG LOADS – ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26 23

APPENDICES

APPENDIX A: SITE LOCATION MAPS
APPENDIX B: CLIENT ADVANCED SITUATION DOCUMENTS
APPENDIX C: SUBSURFACE DATA SHEET
APPENDIX D: CORRELATION OF SPT DATA TO HAMMER EFFICIENCY AND OVERBURDEN PRESSURE
APPENDIX E: SOIL PROFILES
APPENDIX F: STABILITY SECTION
APPENDIX G: CAPACITY TABLES – ABUTMENT 2 AT I-65 AND RAMPS 10 AND26
APPENDIX H: CAPACITY TABLES – ABUTMENT 1 AT I-65 AND RAMPS 2, 3 AND 4
APPENDIX I: H-PILE DRIVING RESISTANCES
APPENDIX J: LABORATORY TESTING RESULTS
APPENDIX K: COORDINATE DATA SUBMISSION FORM
APPENDIX L: ENVIRONMENTAL SITES MAP

Report of Geotechnical Exploration
New Bridge at I-65 over Market St. (B65-9)
Item Number 5-118.18 and .19
Louisville, Kentucky

1.0 LOCATION AND DESCRIPTION

The Kentucky Transportation Cabinet (KYTC) is planning to replace the northbound and southbound bridges over Market Street in downtown Louisville, Kentucky, as part of the Louisville-Southern Indiana Ohio River Bridges Project (LSIORB). Original plans include replacement and widening of the existing bridge in multiple phases with the addition of Ramps 2 and 3 merging into Ramp 4 and Ramps 10 and 26 to alleviate traffic congestion. Each phase will divert traffic to existing and newly constructed structures as they are built so that the new structure can be constructed.

The length of the proposed bridge will be 126.05 feet along the centerline of I-65. The bridge abutments are skewed at an angle of 34 degrees 34 minutes left from the alignment of Market Street. Based on the advanced situation folder by KYTC the bridge begins at Station 659+97.53 and ends at Station 661+23.58.

Table 1: Bridge Substructure Locations

Element	I-65 Centerline Station
Abutment 1	659+99.409
Abutment 2	661+21.803

The typical section for the north and south bound lanes of I-65 consists of two 12 foot through lanes and 12 foot inside and outside shoulders. On the northbound side Ramps 2 and 3 have typical sections that consist of two pairs of split 12 foot lanes and then merge together into four 12 foot lanes with 12 foot inside and outside shoulders. On the southbound side Ramps 10 and 26 have typical sections with three interior 12 foot lanes with a fourth 15 foot lane that is separated by a varying width gore. There is a 12 foot interior should and an eight foot outside shoulder on this structure.

The proposed project structure, location, and details are illustrated in Appendix A. A plan and profile drawing which depicts the layout of the proposed substructure elements and the boring locations is included in Appendix C.

2.0 SITE TOPOGRAPHY AND GEOLOGIC CONDITIONS

The physiographic map of Kentucky indicates that this area is located on the southwestern border of the Outer Bluegrass Region. This region is located in the central portion of the state where Ordovician (and some Silurian and Devonian) age rocks are exposed at the surface. The Outer Bluegrass Region is characterized by deep valleys, with little flat land because the bedrock in this area is mostly composed of interbedded Ordovician limestones and shales that are more easily eroded than the limestones of the Inner Bluegrass Region.

The geologic map of parts of the Jeffersonville, New Albany and Charlestown quadrangles, Kentucky-Indiana, describes much of the local geologic conditions in Louisville. This map indicates that the native soils at this bridge are listed as Outwash. Outwash is alluvial deposits consisting of sand, gravel, silt and clay intermixed and interbedded. The sand is very fine to coarse. The gravel is light brown to light reddish brown, well to poorly sorted, sub angular to rounded and commonly cross bedded. The gravel includes pebbles and cobbles of limestone, siltstone, sandstone, dolomite, quartz, chert, quartzite, granite, gneiss, schist and finely crystalline igneous and metamorphic rocks. The silts and clays are typically gray to olive gray below the water table and yellowish brown above the water table.

The Outwash deposit thicknesses typically range from 75 to 125 feet in thickness. The Outwash plain generally lies between elevation 455 and 465 feet above sea level.

The geologic map also indicates artificial fill at the interstate location. The interstate was elevated from the surrounding natural ground level by approximately 25 feet. According to the project bridge elevations and the topographic quadrangle for Jeffersonville, IN-KY, the highest elevation in the vicinity is the artificial fill for the interstate at an elevation of approximately 485 feet above sea level while the lowest elevation is the south side gutter of East Market Street at approximately 460 feet above sea level.

3.0 SUMMARY OF BORINGS

Drilling and sampling operations were performed by Fuller, Mossbarger, Scott and May (FMSM) drillers and monitored by KSWA personnel. Initial borehole locations were located and then adjusted by FMSM based on utility proximity and local conditions. The drilling was performed on March 30 and April 19, 2006 and consisted of two boreholes labeled 1B-32 and 1B-34. Boring 1W-82 was scheduled to be a secondary boring to Structure S0450 and primary to Structure S9305, and is listed in an environmental phase. At the time of the completion of this report, Boring 1W-82 had not been drilled. Since activities on Boring 1W-82 had not been performed at the completion of this report, KSWA chose to add Boring 1W-80 due to its close proximity to the site. Boring 1W-80 is primary to Structure S9290. The borings were either backfilled or a monitoring well was installed by FMSM personnel. Table 2 details the borehole location and elevations. Appendix C describes the proposed layout of the new bridge, the borehole locations and the borehole profiles.

Table 2: Summary of Borings

Boring Number	Station/ Offset from Center Line	Surface Elevation	Top of Rock Elevation	Refusal/ Begin Core Elevation	Length of Core	Bottom of Boring Elevation	Approximate Water Elevation*
		(Feet)	(Feet)	(Feet)	(Feet)	(Feet)	(Feet)
1B-32	658+80, 99' LT	461.5	335.6	335.6	18.5	317.1	419.0
1B-34	660+42, 127' LT	461.3	*N/A*	*N/A*	*N/A*	381.3	417.4
1W-80	662+60 155 RT	461.9	*N/A*	*N/A*	*N/A*	381.9	419.5

**At time of drilling*
N/A – Not Applicable

Borings 1B-34 and 1W-80 were terminated at a depth of 80.0 feet and did not encounter rock. Boring 1B-32 was augered to a depth of 125.9 feet where rock was encountered. This boring was cored 18.5 feet into rock.

4.0 SOIL AND ROCK CONDITIONS

The results of the field exploration indicate that the near surface soils at Boring 1B-32 encountered probable fill material consisting of clay with trace amounts of construction debris at depths ranging from about 0.7 to 4.5 feet. Boring 1B-32 encountered 8 inches of topsoil. The near surface soils at Boring 1B-34 were overlain by 2 inches of asphalt and 8 inches of concrete and consisted of native sand with silt to a depth of about 8.5 feet. Boring 1W-80 encountered approximately 8 inches of topsoil underlain by clay soils to a depth of approximately 13 feet.

Soils encountered below the near surface soils were generally identified as poorly graded sand, fine to coarse grained, with trace amounts of sub angular to rounded river gravel at discreet depths. Below the probable fill material, the soils encountered at Boring 1B-32 were generally identified as a sandy silt at depths ranging from about 4.5 to 10 feet and poorly graded sand at a depth range of about 10 to 98.5 feet. Poorly graded gravel was encountered from about 98.5 feet to the auger refusal depth of 125.9 feet. At Boring 1B-34, poorly graded and well graded sand extends from a depth of about 8.5 feet to the termination depth of about 80.0 feet. Boring 1W-80 encountered poorly graded and well graded sand from a depth of about 13 feet to the termination depth of about 80 feet. The sand encountered varied in fineness and percentage of gravel from 0 to 43.6 percent. These soils are alluvial deposits from the Ohio River and its tributaries. The Ohio River is located approximately one half mile north of the subject site. The soils' natural moisture content was observed in the field to be generally moist above the water table and wet below the water table. The water table depth encountered at Boring 1B-32 was at about 42.5 feet and about 44 feet in Boring 1B-34. In boring 1W-80, the water table was measured at approximately 42 feet. Due to the proximity to the Ohio River, water table depths are expected to show limited fluctuation.

Boring 1B-32 N-values within the sands ranged from 6 to 56 with an average of approximately 30. Boring 1B-32 encountered loose sand at a depth range of about 10 to 25 feet, dense sand at a depth range of about 25 to 43 feet, medium dense sand with gravel and gravel from a depth of about 43 to 98.5 feet and dense to very dense gravel and sandy gravel from a depth of about 98.5 feet to the auger refusal depth at approximately 125.9 feet. Boring 1B-34 encountered very loose to loose sands at a depth range of about 0.7 to 33 feet and medium dense sand extending from a depth of about 33 to 80 feet. Boring 1W-80 encountered loose sands at depths ranging from about 13 to 28 feet underlain by a dense sand to the termination depth at approximately 80 feet. Boring 1B-32 encountered auger refusal at limestone bedrock and Boring 1B-34 and 1W-80was terminated in medium dense to dense sand at a depth of about 80 feet.

Rock cored at Boring 1B-32 consisted of predominately limestone with a few thin shale partings. The rock was light gray and crystalline grained. The limestone was massive to thick bedded. The Rock Quality Designation (RQD) was 77 and 95 percent and recovery was 99 and 100 percent, respectively.

Soil specimens were collected during the drilling by (Shelby) tube and split spoon methods. Rock samples were collected by coring. Specimens from the borings were returned to KSWA's laboratory for

engineer's observation and testing. Laboratory Testing included natural moisture content, #200 wash, gradations, Unified Soil Classification System (USCS) and American Association of State Highway Transportation Officials (AASHTO) soil classifications, unconfined compression tests and consolidation tests on selected samples. Test results are presented on the Subsurface Data Sheets included in Appendix C and discussed in Section 5 of this report.

5.0 LABORATORY TESTING AND RESULTS

5.1 GENERAL

Laboratory tests were performed in accordance with applicable AASHTO or Kentucky Methods of soil testing specifications. The results of the laboratory tests are depicted graphically on the Subsurface Data Sheets presented in Appendix C.

The test results were used to establish material properties and utilized in subsequent engineering analysis to evaluate foundation alternatives and their respective installation processes.

Undisturbed samples were generally collected in cohesive soils (silts and clays) at the beginning of the borings. Where a tube recovered less than 50 percent material or the material changed to a cohesionless material, split spoon sampling followed. Split spoon sampling continued in cohesionless material (sands and gravel). The testing presented is split into undisturbed and split spoon sampling

5.2 UNDISTURBED (SHELBY) TUBE TESTING

Undisturbed (Shelby) tube samples were obtained from the borings: one from Borings 1B-34 and 1W-80, both labeled ST-1, and two from Boring 1B-32, labeled ST-1 and ST-2. The four samples collected were extruded and contained high proportions of sand. Results are presented on Subsurface Data Sheets in Appendix C.

5.2.1 Engineering Classification Testing

Classification testing was performed on Shelby tube Sample ST-1 from Boring 1B-34. The sample was classified as a silty clayey sand (SC-SM) as defined by USCS and A-4 as defined by AASHTO.

5.2.2 Atterberg Limits Tests

Atterberg limits testing was performed on Sample ST-1 from Boring 1B-34. The samples collected contained a high proportion of sand and determined to be non-plastic.

5.2.3 #200 Wash

Three Shelby tube samples were washed over a #200 sieve to determine the amount of fine materials (silt or clay). Sample ST-1 from Boring 1B-32 was found to contain 35.0 percent fines while sample ST-1 from Boring 1B-34 was found to contain 33.2 percent fines. Sample ST-1 from Boring 1W-80 contained 19.8 percent fines. Visual observation indicated that the natural soil fines content decreased with depth to about 8 percent.

5.2.4 Unconfined Compression Testing

An unconfined compression test was attempted on Boring 1B-34, Sample ST-1. The material was a silty sand with some clay. Compression testing yielded an unconfined compressive strength of 1.1 ksf.

5.2.5 Consolidation Test

Two consolidation tests were performed: one on Boring 1B-32, Sample ST-1 and one on Boring 1B-34, Sample ST-1. The results are shown below:

Table 3: Consolidation Results

Sample Number	Initial Void Ratio	Compressibility Index	Recompression Index	Comments
	e_o	(C_c)	(C_r)	
1B-32 ST-1	0.571	0.1368	0.0110	Silty Sand
1B-34 ST-1	0.708	0.070	0.019	Silty Clayey Sand

5.3 LABORATORY TESTING OF STANDARD PENETRATION TEST SAMPLES

Standard Penetration Tests (SPT) were generally performed in sample borings where sand was encountered or the previous Shelby tube sample did not recover significant material. The split spoon samples collected generally encountered brown, poorly graded, fine to coarse grained sand, with trace amounts of river gravel.

A total of 40 split spoon samples were collected. Selected samples were tested for moisture content, classification, #200 wash and gradation. Results are presented on the Subsurface Data Sheets in Appendix C.

5.3.1 Engineering Classification Testing

Classification testing was performed on eight SPT samples from Boring 1B-32 and nine SPT samples from Boring 1B-34. The samples were classified according to the Unified Soil Classification System (USCS) and the American Association of State Highway and Transportation Officials (AASHTO) guidelines. The results are presented in Table 4 on the following page.

Table 4: STP Sample Classifications

Boring No.	Sample No.	Depth (ft)	USCS Classification	AASHTO Classification
1B-32	SS-1	2.5-4.0	CL	A-4
1B-32	SS-4	25.0-26.5	SP-SC	A-1-b
1B-32	SS-7	40.0-41.5	SP-SM	A-1-b
1B-32	SS-11	60.0-61.5	SP-SC	A-1-b
1B-32	SS-16	85.0-86.5	SP-SC	A-1-b
1B-32	SS-18	95.0-96.5	SP-SC	A-1-b
1B-32	SS-21	110.0-111.5	SP-SM	A-1-b
1B-32	SS-25	125.0-126.5	GP-GM	A-1-a
1B-34	SS-1	5.0-6.5	SM	A-4
1B-34	SS-2	10.0-11.5	SP-SC	A-3
1B-34	SS-4	20.0-21.5	SP-SC	A-1-b
1B-34	SS-7	35.0-36.5	SP	A-1-a
1B-34	SS-8	40.0-41.5	SW-SM	A-1-b
1B-34	SS-9	45.0-46.5	SW-SM	A-1-a
1B-34	SS-10	50.0-51.5	SP-SM	A-3
1B-34	SS-11	55.056.5	SP-SM	A-1-b
1B-34	SS-13	65.0-66.5	SP-SC	A-1-b

5.3.2 #200 Wash

One SPT samples from Boring 1B-34 and three samples from Boring 1W-80 were washed over a #200 sieve to determine the amount of fine materials (silt or clay). The results of the 200 wash of sample SS-6 from Boring 1B-34 indicated 4.2 percent passing. The results of the 200 wash of samples from Boring 1W-80 ranged from 4.6 to 11.2 percent passing.

6.0 ENGINEERING ANALYSIS

6.1 GENERAL

It is our understanding that the new structure will include Ramps 2 and 3 merging into Ramp 4 and Ramps 10 and 26. The structure will include two breastwall abutments. The proposed footings for the abutments and piers are to be founded on either driven steel H-piles or drilled shafts. The engineering analysis is based on this premise and the laboratory data presented.

Based on the Advanced Situation Folder for Structure S0450, the western end of Structure S0450 where Ramps 10, 26 and I-65 coincide, there will be approximately 20 to 30 feet of fill added above the existing grade. Approximately 30 feet of fill will be placed for the embankment at Abutments 1 and 2 of Ramps 10 and 26 and approximately 20 feet of a wedge fill will be placed for the embankment at Abutment 2 of I-65. The eastern end of Structure S0450 at Abutment 1 of I-65 and where Ramps 2 and 3 merge to make Ramp 4, it is expected that there will be little to no fill added to the site. We understand the new abutments will be set back from the location of the existing abutments at I-65 north and south. Existing friction piles at these locations will be used and additional piles will be driven where needed. This area where the current alignment for I-65 north and south exists will be the new bridge structure for new Ramps 2, 3 and 4 and I-65 northbound. We propose to provide two "idealized" soil profiles from the soil borings for each scenario. Instead the engineering analysis will vary depending on layers of soils encountered at the respective foundation locations. The engineering analyses shown are based on the laboratory test results presented.

KYTC has requested that the proposed project be designed using the AASHTO Load and Resistance Factor Design (LRFD). LRFD is "a reliability-based design methodology in which force effects caused by factored loads are not permitted to exceed the factored resistance of the components." LRFD utilizes load and resistance factors to account for unknowns in loads and load resistance of structural members in lieu of using a Factor of Safety to account for unknowns. The resistance factors of LRFD design were developed using either statistical analysis of load tests together with reliability theory, fitting to allowable stress design (ASD), or both.

From the Advanced Situation Folder for Structure S0450, we understand the existing abutment piles will be reused in locations where the proposed abutments coincide with new substructure units. It is estimated that the existing structure was constructed in the middle to late 60's. Therefore the structure would have been constructed using Allowable Stress Design (ASD) methodology. Based on the information available to KSWA, the type and length of pile used for the existing foundation system is unknown. However, it is our understanding that, as part of construction of the existing foundations, piles were "driven to refusal or to sustain a minimum load of 50 tons per pile." The design load of 50 tons per pile would be in reference to an ASD load. Therefore, it is reasonable to estimate the total nominal geotechnical axial resistance (ultimate capacity) as 50 tons times a factor-of safety equal to 3.0. This results in an ultimate capacity

equal to 150 tons as an estimate for the existing piles. For that reason, KSWA estimates a 50-ton ASD load for the existing structure can be roughly equated to a 70-ton LRFD load.

6.2 CORRECTION OF STANDARD PENETRATION TEST DATA

Split spoon samples were collected in cohesionless soils and in soils where undisturbed samples provided little recovery. Split spoon samples also provided blow counts (N-values per foot) through soils as a general indicator of the soil strengths. FMSM provided drill rig equipment for the borings which were equipped with automatic hammer samplers. The automatic hammers were tested and reported to be 80 percent efficient. The generally accepted efficiency of a rope and cathead sampler system on a drill rig is 60 percent.

The AASHTO LRFD Bridge Design Specifications (Section 10.4.6.2) required that the split spoon data be corrected for both the estimated efficiency of the sampler system and the presence of the overburden. KSWA has provided the corrected N values in the "Correlation of SPT Data to Hammer Efficiency and Overburden Pressure" in Appendix D of this report.

6.3 SETTLEMENT ANALYSIS

Based on the Advanced Situation Folder by the structural engineer (American) the addition of Ramps 10 and 26 will include up to approximately 30 feet new soil fill material. This will occur below the approach slabs of Abutments 1 and 2 at Ramps 10 and 26 tapering to approximately 20 feet of fill at Abutment 2 of I-65.

The classification and percent compaction of the current embankment material is not known. The bridge borings were performed at approximately the Market Street level elevation of approximately 461, feet generally indicate silty and clayey sands near the surface changing to poorly graded sands with trace fines. Our analysis included approximately 7 feet of silty clayey sands extending beneath the street level. We have estimated unit weights, initial void ratios and compressibility indices for the embankment materials. Settlements were calculated based on FHWA HI-88-009 procedures.

6.3.1 Abutment 2 at I-65 and Ramps 10 and 26

Settlement calculations at the proposed area under where Ramps 10 and 26 were performed at Abutment 2 as a result of the new embankment fill. Ramps 10 and 26 at Abutment 2, along with subsurface information coming from Boring 1B-34 was determined to be the "worst case" scenario for this particular structure. The time rate of settlement was also determined for the embankment to achieve 90 percent of total settlement. Based on our settlement analysis we conclude that the total settlement will be approximately 4 - 1/8 inches. The following table provides a summary of settlement analysis completed for the new bridge structure from the pile cap elevation.

Table 5: Settlement Summary – Abutment 2 at I-65 and Ramps 10 and 26

Location	Predicted Settlement			Approx. Time for 90% Consolidation	
	Silty Clayey Sands, (in.)	Loose, Medium Dense and Dense Sands, (in.)	Total, (in.)	Days	Weeks
Abutment 2	1 - 5/8	2 - ½	4 – 1/8	59	9

We expect that the majority of the settlement will occur during the construction phase of the bridge. If the embankment material unit weights, void ratios or compressibility indices are different from the typical values assigned to them, the amount of settlement could increase, or decrease. Construction considerations such as the amount of excavation and backfill operations will help to control any settlement issues in the new fill. To reduce settlement concerns, we recommend constructing the embankment fills first, prior to pile or drilled shaft installation. Typical sequencing would include 1) construct the embankment with the slope toe at the pile cap edge, 2) apply waiting time, 3) drive H-piles and construct breast wall and 4) backfill against breast wall with a clean graded granular stone, such as a number 67. The additional weight of the granular backfill wedge should not be significant to cause further downdrag or settlement concerns. Based on our settlement analysis we conclude that the total "wait time" after construction of the embankment, to neglect downdrag concerns, to be approximately 7 weeks.

The total predicted settlement should also be considered at Abutment 2 at I-65; although we do anticipate there will be a lesser amount of settlement due to the reduced embankment height and better soil conditions at that location. We expect that the majority of the settlement will occur during the construction phase of the bridge. If the embankment material unit weights, void ratios or compressibility indices are different from the typical values assigned to them, the amount of settlement could increase, or decrease. Construction considerations such as the amount of excavation and backfill operations will help to control any settlement issues in the new fill.

The designer should also be aware that settlement at the end bent locations will occur within the sand soils at the pile and drilled shaft tip elevations. This will result in settlement of the pile and drilled shaft group. We anticipate that any settlement of the pile and drilled shaft group will occur during the embankment construction. Pile and drilled shaft settlements are further discussed in the pile and drilled shaft sections of this report.

6.3.2 Abutment 1 at I-65 and Ramps 2, 3 and 4

Abutment 1 at I-65 and Abutment 1 of Ramps 2 and 3 and Abutment 2 of Ramp 4 are not expected to have any significant additional fill. Therefore, consolidation of the existing materials should not occur.

6.4 LATERAL SQUEEZE POTENTIAL

Bridge abutments supported on pile foundations driven through soft soils that are subject to unbalanced embankment fill loading can have a "lateral squeeze" scenario that produces horizontal movement of the abutment structure. These large horizontal movements can cause damage to the structure. The unbalanced embankment load, where soft soils are present, will displace the soil laterally. The lateral displacement may bend piles and cause the abutment to tilt toward or away from the fill.

FHWA guidelines predict that lateral squeeze can occur when the embankment stresses are greater than three times the shear strength of the soft soil zone. The maximum new fill height at this structure is about 30 feet. Based on an estimated new fill unit weight of 125 pounds per cubic feet (pcf), we can expect an embankment stress of approximately 3750 pounds per square feet (psf) at the natural ground surface. A review of the subsurface data from Boring 1B-34 indicates that an undrained shear strength of 300 psf was estimated for the softest layer. Based on the FHWA guidelines, the embankment stress of approximately 3750 psf is greater than three times the undrained shear strength (3 x 550 = 1650 psf), indicating there is a possibility of lateral squeeze at this bridge location. Based on the embankment height, horizontal movement can be estimated to be about ¾ of an inch. Abutment tilting can be reduced or eliminated by constructing the embankment fill to the limits of the pile cap or excavating the area for the pile cap after the embankment is constructed, allowing time for settlement to occur and then proceed with pile installation.

6.5 GLOBAL STABILITY ANALYSIS

The factor of safety against rotational failure for the bridge abutment was determined using the Simplified Bishop Method of the STABL for Windows computer software. The soil parameters input for this program were obtained from our laboratory testing. Global stability analysis was performed for drained and undrained conditions. The KYTC Geotechnical Manual recommends minimum factors of safety of 1.6 and 1.2 for long term and short term conditions, respectively. Our analysis indicated factors of safety against global rotational failure for long term and short term conditions of 2.4 and 2.1, respectively. These values meet or exceed the KYTC target values. Results of the slope stability analysis, including minimum factors of safety, predicted failure surfaces, and modeled groundwater table positions are present graphically in Appendix F.

6.6 H-PILE ANALYSIS

H-Pile analysis to determine the axial capacity of the piles at the end bents was performed using the "DRIVEN Version 1.2" program from the FHWA. The axial capacity estimates were determined for three different steel H-pile sizes: 12x53, 14x73 and 14x89, each grade 50 steel. The Kentucky Transportation Cabinet (KYTC) provided the recommended H-pile sizes and grade of steel. The DRIVEN program performs analysis utilizing soil parameters from lab testing and as estimated from our exploration data (i.e., correlating N values to soil shear strength). The Resistance Factors for LRFD

design were taken from the AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 10.5.5.2.3-1 and are summarized in the table on the next page.

Table 6: LRFD Resistance Factors for H-Pile Capacity

Loading Condition	Resistance Method	Analysis	Resistance Factor, φ
Nominal Resistance of Single Pile in Axial Compression – Static Analysis	Skin Friction and End Bearing – Clay and Mixed Soils	α - Method	0.35
	Skin Friction and End Bearing – Sand	Nordlund / Thurman Method	0.45
Uplift Resistance of Single Piles – Static Analysis	Side Resistance in Clay	α - Method	0.25
	Side Resistance in Sand	Nordlund Method	0.35

6.6.1 Abutment 2 at I-65 and Ramps 10 and 26

We have estimated the new fill parameters based on information obtained from existing old and new embankments. Soil parameters were compared from each boring at this structure and an "idealized" soil profile was developed for the pile analysis. The following idealized soil profile and representative design parameters was used for our analysis and should also be utilized for lateral analyses:

Table 7: Soil Parameters for Design-Abutment 2 at I-65 and Ramps 10 and 26

ELEVATION (ft)		SOIL PARAMETERS				COMMENTS
From	To	γ(pcf)	C(psf)	e_{50}	φ	
491	461	125	1400	0.007	0	Stiff Clay (New Fill)
461	454	115	550	--	28.1	Firm Silty Clayey Sand
454	428	115	0	--	28.9	Loose Sand
428	395	122	0	--	32.6	Medium Dense Sand
395	381	147	0	--	33.6	Dense Sand

Water table level at elevation 417 ft.

Appendix G contains a summary of depth below the pile cap versus nominal side resistance, nominal end bearing resistance and total nominal axial pile resistance. Both static and dynamic analysis methods are present in the capacity tables. A pile cap elevation of approximately 456 feet MSL was assumed in our calculations.

The KYTC Geotechnical Branch has recommended maximum factored nominal resistances for each of the three pile types. These loads are based on the factored resistances from the LRFD Bridge Design Specifications Table 10.5.5.2.3-1 for skin resistance and end bearing in clays, sands and mixed soils.

Table 8 on the next page includes the recommended maximum factored resistance for each pile type and the estimated depths for development of the resistances:

Table 8: Maximum Factored Nominal Geotechnical Resistance and Estimated Depths for Resistance Development – Abutment 2 at I-65 and Ramps 10 and 26

H-PILE	MAXIMUM FACTORED RESISTANCE	Depth*	Elevation**	Uplift Resistance
12 x 53	100 tons	86 ft.	370	116.6 tons
14 x 73	140 tons	87 ft.	369	159.6 tons
14 x 89	170 tons	92 ft.	364	192.2 tons

*Measured from bottom of the pile cap.
**Based on a bottom of pile of pile cap elevation of 456 ft.

6.6.2 Abutment 1 at I-65 and Ramps 2, 3 and 4

The abutment pile cap elevation will be at approximately 35 feet below the current ground elevation of about 491 feet. Soil parameters were compared from each boring at this structure and an "idealized" soil profile was developed for the pile analysis. The following idealized soil profile and representative design parameters was used for our analysis and should also be utilized for lateral analyses:

Table 9: Soil Parameter for Design – Abutment 1 at I-65 and Ramps 2, 3 and 4

ELEVATION (ft)		SOIL PARAMETERS				COMMENTS
From	To	γ(pcf)	C(psf)	e_{50}	φ	
462	449	105	300	.02	0	Soft Silty Clay
449	434	115	0	--	30.4	Loose Sand
434	382	127	0	--	37.0	Dense Sand

Water Table Elevation was 420 at time of drilling.

Appendix H contains a summary of depths below the pile cap versus nominal side resistance, nominal end bearing resistance and total nominal resistance for the piers. A pile cap elevation of approximately 456 feet MSL was assumed in our calculations (approximate pier pile cap elevation). The Resistance Factors for LRFD were taken from the AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 10.5.5.2.3-1.

As previously mentioned in Section 6.1, the designer is proposing the reuse of some of the existing friction piles for Abutment 1 of Ramps 2 and 3 and I-65 northbound and Abutment 2 of Ramp 4. A 70-ton maximum factored nominal geotechnical axial resistance is provided as an option for these locations.

The KYTC Geotechnical Branch has recommended maximum factored nominal resistances for each of the three pile types. These loads are based on the factored resistances from the LRFD Bridge Design

Specifications Table 10.5.5.2.3-1 for skin resistance and end bearing in clays, sands and mixed soils. Table 10 below includes the recommended maximum factored resistance for each pile type and the estimated depths for development of the resistances:

Table 10: Maximum Factored Nominal Geotechnical Resistance and Estimated Depths for Resistance Development – Abutment 1 at I-65 and Ramps 2, 3 and 4

H-PILE	MAXIMUM FACTORED RESISTANCE	Depth*	Elevation**	Uplift Resistance
12 x 53	100 tons	71 ft.	385	104.6 tons
	70 tons	57 ft.	399	73.0 tons
14 x 73	140 tons	73 ft.	383	147.6 tons
	70 tons	49 ft.	407	74.0 tons
14 x 89	170 tons	77 ft.	379	176.3 tons
	70 tons	47 ft.	409	74.7 tons

*Measured from bottom of the pile cap.
**Based on a bottom of pile of pile cap elevation of 456 Ft.

6.6.3 Negative Skin Friction

When piles are installed through a soil deposit undergoing consolidation, the resulting relative downward movement of the soil around piles induces "downdrag" forces on the piles. These "downdrag" forces are also called negative shaft resistance. Negative shaft resistance is the reverse of the usual positive shaft resistance developed along the pile surface. The downdrag force increases the axial load on the pile and can be especially significant on long piles driven through compressible soils. Therefore, the potential for negative shaft resistance must be considered in pile design.

Settlement computations were performed to determine the amount of settlement the soil surrounding the piles is expected to undergo after the piles are installed. The amount of relative settlement between soil and pile that is necessary to mobilize negative shaft resistance is about 10 to 12 mm (0.39 to 0.47 inches). At that movement, the maximum value of negative shaft resistance is equal to the soil-pile adhesion. The negative shaft resistance can not exceed this value because slip of the soil along the pile shaft occurs at this value. It is particularly important in the design of friction piles to determine the depth at which the pile will be unaffected by negative shaft resistance. Only below that depth can positive shaft resistance forces provide support to resist vertical loads. The calculations are based upon methods outlined in FHWA-HI-97-013 and FHWA-IF-99-025, which utilize soil strengths and effective stresses within the varying soil stratums.

6.6.3.1 Abutment 2 at I-65 and Ramps 10 and 26

As previously mentioned in Section 6.3, settlement calculations as a result of the new embankment fill loads indicate total settlement will be about 4 inches. The resulting settlement is predominately occurring within the silty clayey sand soil zone extending from the pile cap elevation to a depth of about 7 feet.

Therefore, the proposed deep foundations at this location will be subject to "downdrag" forces. If a construction sequencing is followed where as the embankment is constructed prior to driving the piles and an estimated waiting period of about 7 weeks is followed after embankment construction (see section 6.3.1) or about 5 feet of the silty clayey sand soil zone is excavated and replaced with a granular backfill prior to embankment construction, downdrag forces will not be an issue. Otherwise, the H-piles should be designed to resist an estimated "downdrag" force of at least the maximum "downdrag" load as shown below in Table 11. This "downdrag" force has been accounted for on the H-pile capacity tables in Appendix G.

Table 11: Estimated Maximum Downdrag Loads – Abutment 2 at I-65 and Ramps 10 and 26

H-pile	Total Factored Geotechnical Axial Resistance, (tons)	Estimated Tip Elevation*, (ft)	Estimated Pile Length Subject to Downdrag,** (ft)	Estimated Maximum Downdrag Load	
				Kips	Tons
12 x 53	100	370	10.6	19.1	9.5
14 x 73	140	369	10.6	25.1	12.5
14 x 89	170	364	10.6	27.2	13.6

* As outlined in Table 10
** Measured downward from the bottom of the pile cap

6.6.3.2 Abutment 1 at I-65 and Ramps 2, 3 and 4

These abutment locations will either utilize the existing friction piles and/or will be excavated back and new friction piles will be driven. We do not anticipate additional embankment loading in the area of these abutments. Therefore, we expect negative skin friction will not be engaged at these abutment locations.

6.6.4 Wave Equation Analysis (Drivability)

Piles can be damaged when stresses induced during pile driving exceed the structural capacity of the pile. Also, the efficiency of a driving system can vary significantly depending on the type and size of pile, stroke length, cushioning and helmet used. A wave equation analysis can be used during the design phase to estimate the pile driving stresses, the pile penetration per blow, and ultimate capacity of the pile. The Pile Dynamics, Inc. GRL WEAP program was used for this analysis. The GRL WEAP program simulates motions and forces in a pile when driven by either an impact hammer or a vibratory hammer. The program computes the following:

- The blow count of a pile under one or more assumed ultimate resistance values and other dynamic soil resistance parameters, given a hammer and driving system. For vibratory hammers, the equivalent result is the time required for a unit penetration.
- The axial stress in the pile, averaged over its cross section associated with the assumed capacity value(s).
- The energy transferred by the hammer to the pile for each capacity analyzed.

Based on these results the following can be indirectly determined:

- The pile's bearing capacity at the time of driving or re-striking, given its observed penetration resistance (blow count).
- The stresses during pile driving, given an observed blow count.
- The expected blow count if the static bearing capacity of the pile is known.

The KYTC Geotechnical Branch requested that the estimated depths for refusal conditions be determined for three separate hammer sizes (approximately 20 kips-ft., 40 kips-ft. and 60 kips-ft energies). The piles were analyzed using the idealized soil profile. Further the driving was analyzed under the assumption that there would be no interruptions in the driving of a pile, the pile would not "set" during driving, full hammer stroke was used to refusal and the hammer efficiency and diesel pressure did not change during the driving.

The typical design soil profiles for this project consist of occasional new fill zones, clayey sand layers and deeper sand and gravel layers. Results of significant research and literature in regard to pile drivability suggest that there are reductions in skin friction that occur during driving. The KYTC Geotechnical Branch suggests that reductions of 50 percent when penetrating clays and 25 percent when penetrating sands in skin friction or resistance be applied when estimating driving resistances with GRL WEAP.

Three H-piles, 12x53, 14x73 and 14x89, were analyzed as proposed by KYTC. KSWA analyzed the piles using three separate diesel hammers: an ICE 422 closed end diesel hammer with a ram weight of 4 kips and a potential energy of 23.12 kip-ft/kW; an ICE 640 closed end diesel hammer with a ram weight of 6 kips and a potential energy of 40.62 kip-ft/kW; and an ICE 60-S open end diesel hammer with a ram weight of 7 kips and a potential energy of 59.99 kip-ft/kW. These hammers were selected from a list of common available hammers to closely match the requested energies. Further, if driving conditions of the piles did not allow full recommended nominal resistance, an ICE 80-S open ended hammer with a ram weight of 8 kips and a potential energy of 80 kip-ft/KW was considered.

The AASHTO LRFD Bridge Design Specifications, 4th Edition, Commentary for Section 10.7.8 indicates that a blow count of over 10 to 15 blows per inch (120 to 180 blows per foot) "should be used with caution". The FHWA publication titled "Soils and Foundations Workshop Manual, Second Edition" defines a reasonable range of hammer blows to be between 30 and 144 blows per foot for a steel H-pile.

KSWA has assumed 144 blows per foot to constitute refusal conditions for any hammer and pile size combination.

6.6.4.1 Abutment 2 at I-65 and Ramps 10 and 26

Based on our drivability analysis, the following table represents the estimated limiting "drivable" depths for each size of pile and hammer energies at the abutment locations.

Table 12: Maximum Drivable Depths for Various Hammer Sizes – Abutment 2 at I-65 and Ramps 10 & 26

H-PILE SIZE	HAMMER TYPE AND SIZE			
	ICE 422 (23.12 kip-ft./kW)	ICE 640 (40.62 kip-ft./kW)	ICE 60-S (59.99 kip-ft./kW)	ICE 80-S (80.0) kip-ft/kW)
12 x 53	64 ft. (392)	70 ft. (386)	78 ft. (378)	86 ft. (370)**
14 x 73	62 ft. (394)	70 ft. (386)	80 ft. (376)	87 ft. (369)**
14 x 89	64 ft. (392)	72 ft. (384)	84 ft. (372)	92 ft. (364)**

*Pile Cap Elevation of 456 ft.
** Maximum Drivable Depths equal to the recommended driving depth to achieve recommended factored resistance (Table 8)

The ICE 422, ICE 640 and ICE 60-S hammers encountered refusal at a depth above the depth required to achieve the maximum factored nominal resistance. The ICE 80-S was able to drive the KTYC recommended piles to the depth required to achieve the maximum factored nominal resistance without developing damaging compressive or tensile stresses within the pile. Therefore, we recommend using the ICE 80-S or equivalent hammer for H-piles driven at Abutment 2 at I-65 and Abutments 1 and 2 at Ramps 10 and 26. Conversations with local pile driving contractors have indicated that typically they are able to drive to the recommended depths with smaller hammers in the Louisville area.

6.6.4.2 Abutment 1 at I-65 and Ramps 2, 3 and 4

Based on our drivability analysis, the Table 13 on the following page represents the estimated limiting "drivable" depths for each size of pile and hammer energies at the abutment locations.

Table 13: Maximum Drivable Depths for Various Hammer Sizes – Abutment 1 at I-65 and Ramps 2, 3 and 4

H-PILE SIZE	HAMMER TYPE AND SIZE		
	ICE 422 (23.12 kip-ft./kW)	ICE 640 (40.62 kip-ft./kW)	ICE 60-S (59.99 kip-ft./kW)
12 x 53	56 ft. (400)	64 ft. (392)	71 ft. (385)**
14 x 73	56 ft. (400)	62 ft. (394)	73 ft. (383)**
14 x 89	58 ft. (398)	66 ft. (390)	77 ft. (379)**

*Pile Cap Elevation of 456 ft.

** Maximum Drivable Depths equal to the recommended driving depth to achieve recommended factored resistance (Table 10)

The ICE 422 and ICE 640 hammers encountered refusal at a depth above the depth required to achieve the maximum factored nominal resistance. The ICE 60-S was able to drive the KTYC recommended piles to the depth required to achieve the maximum factored nominal resistance without developing damaging compressive or tensile stresses within the pile. Therefore, we recommend using the ICE 60-S or equivalent hammer for H-piles drived at Abutment 1 at I-65 and the abutments at Ramps 2, 3 and 4. Conversations with local pile driving contractors have indicated that typicall they are able to drive to the recommended depths with smaller hammers in the Louisville area.

6.7 DRILLED SHAFT ANALYSIS

Drilled shaft analysis was performed using the FB-Deep (formerly ShaftSpt) computer program developed by the Bridge Software Institute, Department of Civil Engineering, University of Florida. The methodology is based on FHWA reports, "Drilled Shafts: Construction Procedure and Design Methods", FHWA-IF-99-025, and "Load Transfer for Drilled Shafts in Intermediate Geomaterials", FHWA-RD-95-172. The capacity estimates were based on four different shaft sizes: 30-, 36-, 42- and 48-inch diameter. The Kentucky Transportation Cabinet (KYTC) provided the recommended shaft sizes for analysis. The soil types and strength characteristics for each were also input. The resistance factors used for LRFD were taken from the AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 10.5.5.2.4-1 and are summarized in the table on the next page.

Table 14: LRFD Resistance Factors for Drilled Shaft Capacity

Loading Condition	Resistance Method	Analysis	Resistance Factor, φ
Nominal Axial Compressive Resistance of Single Drilled Shafts	Side Resistance in Clay	α - Method	0.45
	End Bearing in Clay	Total Stress	0.40
	Side Resistance in Sand	β – Method	0.55
	End Bearing in Sand	SPT Method	0.50
Uplift Resistance of Single Drilled Shafts	Side Resistance in Clay	α - Method	0.35
	Side Resistance in Sand	β – Method	0.45

The results of our drilled shaft analysis are presented in the following report sections

6.7.1 Abutment 2 at I-65 and Ramps 10 and 26

The soil types and strength characteristics for the design boring profile at this location were analyzed. A pile cap elevation of approximately 456 feet MSL was assumed in our calculations. The following idealized soil profile and representative design parameters was used for our analysis and should also be utilized for lateral analyses:

Table 15: Soil Parameters for Design-Abutment 2 at I-65 and Ramps 10 and 26

ELEVATION (ft)		SOIL PARAMETERS				COMMENTS
From	To	γ(pcf)	C(psf)	e_{50}	φ	
491	461	125	1400	0.007	0	Stiff Clay (New Fill)
461	449	115	550	--	28.1	Firm Silty Clayey Sand
449	428	115	0	--	28.9	Loose Sand
428	395	122	0	--	32.6	Medium Dense Sand
395	381	147	0	--	33.6	Dense Sand

Water table level at elev. 417 ft.

Appendix G contains a summary of depth below the pile cap versus nominal side resistance, nominal end bearing resistance and total nominal axial resistance. A pile cap elevation of approximately 456 feet MSL was assumed in our calculations. Resistance factors used were 0.45 and 0.40 for side resistance and tip resistance, respectively, in clay and 0.55 and 0.50 for side resistance and tip resistance, respectively in sand. The Resistance Factors for LRFD were taken from the AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 10.5.5.2.3-1. Table 16 on the next page summarizes the estimated depths at which the drilled piers should bear to achieve the factored nominal geotechnical resistance.

Table 16: Summary of Drilled Shaft Capacities – Abutment 2 at I-65 and Ramps 10 and 26

Total Factored Axial Resistance (Tons)	Depth* (Ft)	Elevation (Ft)	Total Factored Uplift Resistance** (Tons)
30 Inch Diameter Drilled Shaft			
60	31	425	26.8
70	33	423	32.1
80	36	420	40.3
90	39	417	48.8
36 Inch Diameter Drilled Shaft			
60	26	430	20.5
70	30	426	29.1
80	32	424	35.4
90	34	422	41.8
42 Inch Diameter Drilled Shaft			
60	22	434	18.5
70	25	431	22.6
80	29	427	30.3
90	31	425	37.6
48 Inch Diameter Drilled Shaft			
60	21	435	19.7
70	22	434	21.1
80	25	431	25.8
90	28	428	30.6

*Depth and elevations based on the expected bottom of pile cap elevation of 456 ft.

**Uplift resistance based on drill depth to achieve desired factored axial resistance.

6.7.2 Abutment 1 at I-65 and Ramps 2, 3 and 4

The soil types and strength characteristics for each were also input. A pile cap elevation of approximately 456 feet MSL was assumed in our calculations. The following idealized soil profile and representative design parameters was used for our analysis and should also be utilized for lateral analyses:

Table 17: Soil Parameter for Design – Abutment 1 at I-65 and Ramps 2, 3 and 4

ELEVATION (ft)		SOIL PARAMETERS				COMMENTS
From	To	γ(pcf)	C(psf)	e_{50}	φ	
462	449	105	300	.02	0	Soft Silty Clay
449	434	115	0	--	30.4	Loose Sand
434	382	127	0	--	35.0	Dense Sand

Water table level at elev. 420 ft.

Appendix H contains a summary of depth below the pile cap versus nominal side resistance, nominal end bearing resistance and total nominal axial resistance. A pile cap elevation of approximately 456 feet MSL

was assumed in our calculations. Resistance factors used were 0.45 and 0.40 for side resistance and tip resistance, respectively, in clay and 0.55 and 0.50 for side resistance and tip resistance, respectively in sand. The Resistance Factors for LRFD were taken from the AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 10.5.5.2.3-1. Table 18 on the next page summarizes the estimated depths at which the drilled piers should bear to achieve the factored nominal geotechnical resistance.

Table 18: Summary of Drilled Shaft Capacities – Abutment 1 at I-65 and Ramps 2, 3 and 4

Total Factored Axial Resistance (Tons)	Depth* (Ft)	Elevation (Ft)	Total Factored Uplift Resistance** (Tons)
30 Inch Diameter Drilled Shaft			
60	24	432	17.5
70	27	429	24.7
80	30	426	32.3
90	33	423	40.2
36 Inch Diameter Drilled Shaft			
60	20	436	13.2
70	22	434	15.6
80	25	431	23.8
90	28	428	32.6
42 Inch Diameter Drilled Shaft			
60	17	439	11.4
70	19	437	14.0
80	22	434	18.2
90	24	432	24.5
48 Inch Diameter Drilled Shaft			
60	15	441	10.2
70	17	439	13.0
80	19	437	16.0
90	21	435	19.2

*Depth and elevations based on the expected bottom of pile cap elevation of 456 ft.

**Uplift resistance based on drill depth to achieve desired factored axial resistance.

6.7.3 Negative Skin Friction

6.7.3.1 Abutment 2 at I-65 and Ramps 10 and 26

As previously mentioned in Section 6.3, settlement calculations as a result of the new embankment fill loads indicate total settlement will be about 4 inches. The resulting settlement is predominately occurring within the firm silty clayey sand zone extending from the estimated pile cap elevation to a depth of about 7 feet. Therefore, KSWA expected the proposed deep foundations at this location will be subject to "downdrag" forces. If a construction sequencing is followed where as the embankment is constructed prior to construction of the drilled shafts and an estimated waiting period of about 7 weeks is followed after embankment construction; or if about 5 feet of the silty clayey sand soil zone is excavated and

replaced with a granular backfill prior to embankment construction, downdrag forces will not be an issue. The top 5 foot and a bottom length taken as one shaft diameter should not be considered to contribute to skin resistance or downdrag loads if located in cohesive soils. The following table provides estimates of the shaft length subject to downdrag and estimated maximum downdrag load.

Table 19: Estimated Maximum Downdrag Loads – Abutment 2 at I-65 and Ramps 10 and 26

Total Factored Geotechnical Axial Resistance, tons	Estimated Tip Elevation*, ft	Estimated Pile Length Subject to Downdrag,** ft	Estimated Maximum Downdrag Load	
			kips	Tons
30 Inch Diameter Drilled Shaft				
60	425	12	25.2	12.6
70	423	12	25.2	12.6
80	420	12	25.2	12.6
90	417	12	25.2	12.6
36 Inch Diameter Drilled Shaft				
60	430	12	28.4	14.2
70	426	12	28.4	14.2
80	424	12	28.4	14.2
90	422	12	28.4	14.2
42 Inch Diameter Drilled Shaft				
60	434	12	34.4	17.2
70	431	12	34.4	17.2
80	427	12	34.4	17.2
90	425	12	34.4	17.2
48 Inch Diameter Drilled Shaft				
60	435	12	39.2	19.6
70	434	12	39.2	19.6
80	431	12	39.2	19.6
90	428	12	39.2	19.6

***** As outlined in Table 4
** Measured downward from the bottom of the pile cap

6.7.3.2 Abutment 1 at I-65 and Ramps 2, 3 and 4

At these abutment locations, the existing embankment will be excavated back and new drilled shaft foundations will be constructed. We do not anticipate additional embankment loading in the area of these abutments. Therefore, negative skin friction will not be engaged at these abutment locations.

7.0 SEISMIC SITE COEFFICIENT

A review of the AASHTO LRFD Bridge Design Specifications, 4th Edition, Section 3.10 (Earthquake Loading) indicated the design value for the acceleration Coefficient for this site is 6.0 percent of gravity. Based on section 3.10.5.1, the site is a Soil Profile Type I and the Site Coefficient (S) would be 1.0.

8.0 LIQUEFACTION POTENTIAL

It is widely accepted that only recent sediments or fills of saturated, cohesionless soils at shallow depths will liquefy in a large magnitude earthquake. The liquefaction susceptibility of a specific deposit is affected by geologic history, confining pressure, density, and characteristics of the soil grains. An approximate assessment of liquefaction potential can be made on the basis of ground water levels and depositional history (i.e., type, age and depth of sediment). A typical soil profile susceptible to liquefaction consists of low density, poorly graded sands with a high groundwater table, near the ground surface. A study was further made concerning the probability of an earthquake with a magnitude of 6.0 or greater occurring in Louisville, Kentucky within 500 years. The study was made using the US Geological Survey PSHA Model which indicated a 0 to 0.1 probability of an earthquake greater than 6.0 magnitude occurring.

Our test borings indicated groundwater depths ranging from approximately 40 to 44 feet beneath the ground surface. The very loose to loose sands encountered at this bridge site, were encountered at depths above the water table and were unsaturated. Based on our analysis of the site Cyclic Stress Ratio (CSR) and empirical correlations relating Cyclic Resistance Ratio (CRR) to normalized SPT blow count (N_1), it is our opinion that no liquefaction will occur and an in-depth study of liquefaction potential is not warranted.

9.0 VIBRATION MONITORING

A vibration monitoring program should be executed during the construction sequence to monitor vibrations at nearby structures which may contain sensitive equipment. The vibrations from the installation of H-piles should be monitored by vibration instruments and knowledgeable personnel to document the level of vibrations. The monitoring program should include a pre-construction and post-construction survey of existing structures.

10.0 CONCLUSIONS AND RECOMMENDATIONS

10.1 FOUNDATION INSTALLATION CONSIDERATIONS

The installation of foundation elements at this site will encounter subsurface materials consisting of fill materials and native soils consisting of silty clays and silts with some debris, underlain by alluvial sands and gravelly sands, as described in Section 4 of this report. Based on plans and profiles provided as part of the Kennedy Interchange Bridge Project, we understand the new ramps will utilize either drilled or driven piles for abutment support in addition to new pier foundations for widening. We further understand that the designer may elect to use existing H-piles at Abutment 1 at I-65, Abutment 1 of Ramps 2 and 3 and Abutment 2 or Ramp 4. Currently, KSWA has no information on the construction of the existing pile foundations. However, the piles appear to be performing satisfactorily with the existing loads. There will be some risk which will have to be accepted by the designer and KYTC regarding the use of the existing foundation elements. This risk can be reduced if initial load testing and/or construction documents are provided for review by the geotechnical engineer.

The foundation elements are planned to be installed through foundation soils only, at the Market Street levels. Due to the unavailability of structure loading data at the time of this report, foundation capacity criterion was calculated verses depth for each foundation element. In sands, considerable penetration of the pile is typically required before the soil shearing resistance is fully mobilized, due to compression or cushioning by soil below the tip. This is particularly true of drilled and piers since the soil is not compressed by driving.

10.2 GENERAL FOUNDATION CONSIDERATIONS

Based upon review of the existing subsurface conditions, it is recommended that friction foundation systems be used on all bridge substructure elements. The foundation alternates which KSWA considers to be most practical include H-piles and drilled shafts. Structural and/or economic considerations may dictate which option is most preferable.

- Factored pile capacity should be evaluated based on the tables attached. Bearing elevations of selected foundation systems may vary at locations where borings were not performed.

- Based on the Advanced Situation Folder provided by the structural engineer (American), Structure S0450 will require approximately 30 feet of new fill placed at the north end of the structure for the abutment at Ramps 10 and 26 and about 20 feet of a wedge fill at Abutment 2 of I-65. At Abutment 1 of I-65 and Ramps 2, 3 and 4, it is expected that there will be no additional fill. Boring 1B-34 encountered about 7 feet of silty clayey sand, then, loose sand to a depth of 33 feet, underlain, by 33 feet of feet of medium dense sand, then dense sand to termination. Therefore, we expect that settlement would occur within the loose sand layers once the new embankment fill was placed. Settlement calculations as a result of the new embankment fill loads were performed at Abutment 2. The time rate of settlement was also determined for the

embankment to achieve 90 percent of total settlement. It is estimated that the abutments may experience total a settlement of about 4 inches, of which 1 – 5/8 inches is estimated to occur in the silty clayey sands and 2 – 1/2 inches is estimated to occur in the remainder of the sand layers. AASHTO specifications indicate as little as 0.4 inches of settlement is sufficient enough to mobilize negative skin friction. Therefore, we recommend that the design of the H-pile or drilled shaft foundations include the expected downdrag loads. The maximum downdrag estimates provided in sections 6.6.3 and 6.7.3 are for the maximum total factored geotechnical axial resistance, installed to the estimated elevations provided in Tables 8, 10, 16 and 18 only. If the designer requires different lengths or capacities, the designer should contact KSWA to re-evaluate the downdrag loads on the foundation supports.

- An estimated waiting time of about 7 weeks after embankment construction would be required to neglect downdrag forces. If the construction sequence will not allow a waiting period for settlement to occur before foundation elements are installed, one of the following alternatives should be followed to reduce the downdrag loads.

    1. Design foundation elements which will support the estimated downdrag forces.
    2. Design the structure to tolerate the total amount of settlement resulting from the downdrag and other loads.
    3. Coat piles with a bitumen slip layer to allow movement between the soil and the piles. We understand this method reduces downdrag as much as 90 percent.
    4. Predrill and provide a plastic jacket or sleeve for the pile to reduce downdrag.
    5. Construct the embankment with lightweight fill materials to reduce total settlement.
    6. Excavate all or a portion of the existing compressible silty clayey sand soils and replace with a compacted granular fill to reduce or eliminate downdrag forces.
    7. Construct the embankment and utilize full "wait time" prior to the installation of the piles.

    Should one of these alternatives be chosen, or if another option not shown above is desired, KSWA should be contacted to assist in further design.

- Prior to placement of any concrete or reinforcing steel in a foundation excavation, the excavation bottom should be clean, and all soft, wet or loose materials should be removed. In no case should concrete be placed upon compressible or water-softened materials.

- Foundation excavations should be properly braced/ shored to provide adequate safety to people working in or around the excavations. Bracing should be performed in accordance with applicable federal, state and local guidelines.

- A vibration monitoring program should be executed during the construction sequence to monitor vibrations at nearby structures which may contain sensitive equipment. The vibrations from the installation of H-piles should be monitored by vibration instruments and knowledgeable personnel to document the level of vibrations. The monitoring program should include a pre-construction and post-construction survey of existing structures.

10.3 H-PILE FOUNDATIONS

H-Pile foundation recommendations have been developed from our experience and the recommendations from the AASHTO LRFD Bridge Design Manual, 4th Edition. The sections are referenced in parenthesis.

- Center to Center pile spacing should not be less than 30 inches or 2.5 pile diameters (10.7.1.2).

- Top of piles should extent no less than 12 inches into the pile cap or 6 inches into the pile cap with embedded bars or strands (10.7.1.2).

- Where pile foundations are placed adjacent to existing structures, the influence of the existing structure on the behavior of the foundation, and the effect of the new foundation on the existing structures, including vibration effects due to pile installation shall be investigated (10.7.1.6.4).

- Single pile settlement should be less than 1.0 inches where pile tips are adequately embedded in dense granular soils.

- The pile group should be analyzed for settlement in accordance with section 10.7.2.3 in conjunction with pile embedment pile cap size and number of piles.

- Pile design should ensure that strength limit state considerations and satisfied before checking service limit state considerations.

- Use grade 50 steel H-piles as friction piles. The piles should be driven to the target elevation range and then allowed to set for a minimum of one day to allow for dissipation of excess pore pressures caused by the pile installation process. This should allow the soil to "set-up". After the one day waiting period, re-strike the piles to check if an adequate capacity has been achieved.

- Perform lateral load analysis using the geotechnical parameters provided in Section 6.6 in accordance with LRFD section 10.7.2.4. The AASHTO LRFD guidelines recommend a resistance factor for horizontal geotechnical resistance of a single pile or pile group of 1.0 for lateral capacity analysis.

- The efficiency factor (η) of a pile group should be 0.65 where the center to center spacing is 2.5 pile diameters where the cap is not in contact with the ground surface and cohesive soils are present at the ground surface; 1.0 where the center to center spacing is 6.0 pile diameters where the cap is, or is not, in contact with the ground surface and cohesive soils are present at the ground surface, and interpolated where spacing is between 2.5 and 6. For center to center spacing of 2.5 or 6.5 pile diameters and where cohesionless soils are present at the ground surface, a group efficiency factor of 1.0 may be used.

- Evaluate the factored axial and factored uplift capacities using the attached tables provided in Appendices G and H.

- Where load testing and/or dynamic analysis of the driven H-piles is performed, LRFD factors used to determine the factored axial capacity, Appendices G and H, for design purposes may be revised per Table 10.5.5.2.3-1 of the AASHTO LRFD Bridge Design Specifications, 4th Edition based on site variability and the number and type of tests performed. Lateral capacity requirements will need to be checked if the shaft lengths are changed based on load testing and/or dynamic analysis.

- Pile types, driving systems and installations should conform to current AASHTO Standard Specifications LRFD Bridge Design Specifications

- Drivability sturdiness was performed assuming continuous driving. If interruptions in driving individual piles should occur, difficulties in continuing the installation process will likely occur due to pile "set-up" characteristics.

- The recommended hammer energy presented in section 6.6.4 is based on the ultimate driving resistance that 12x53, 14x73 and 14x89 steel H-piles would experience during the installation of the piles.

- When selecting the pile size and length of the pile required to support the applied loads, the designer should select the minimum hammer energy required to drive the piles to the specified depths from the table presented in section 6.6.4. The designer should place a note on the drawing that states:

  A hammer system capable of delivering a minimum energy of ____ foot-kips will be necessary to drive the piles without encountering excessive blow counts and over-stressing the piles.

- The Contractor should submit appropriate pile driving systems to the Kentucky Transportation Cabinet for approval prior to the installation of the first pile. Approval of the pile driving system by the Engineer will be subject to satisfactory field performance of the pile driving procedures."

- Resistance factors for determining the structural capacity of steel H-piles should be determined per section 6.5.4.2 of the AASHTO LRFD Bridge Design Specifications, 4th Edition. The capacity of the steel H-piles should also consider the anticipated downdrag loads. AASHTO LRFD Bridge Design Specifications indicate that for friction piles subjected to downdrag loading, downdrag shall be considered at the service, strength and extreme limit states.

- KSWA estimates settlement to be less than 3 inches for the pile foundation option at abutment 2. The designer should be aware that settlement will occur in the sand foundation soils below the tip elevation of the piles, resulting in the settlement of the pile group. Based on our settlement analysis and anticipated length of the H-piles, KSWA estimates that pile grouple settlement will be less than ¼ inch.This settlement should occur during construction of the embankment. The contractor should be prepared to accommodate this settlement during construction.

- Dynamic testing of the piles shall be performed according to the procedures given in ASTM D4945 and with 10.7.3.8.3. The minimum number of piles that should be tested is as specified in Table 10.5.5.2.3-3. Restrike testing should be performed if setup or relaxation is anticipated.

- Static load tests used to determine the pile axial capacity should follow the procedures specified in ASTM D1143 and with 10.7.3.8.2.

10.4 DRILLED SHAFT FOUNDATIONS

Drilled Shaft foundation recommendations have been developed from our experience and the recommendations from the AASHTO LRFD Bridge Design Manual, 4th Edition. The sections are referenced in parenthesis.

- If the center-to-center spacing of the drilled shafts is less than 4.0 diameters, the interaction effects between adjacent shafts shall be evaluated. If the center-to-center spacing of the drilled

shafts is less than 6.0 diameters, the sequence of the construction should be specified in the contract documents (10.8.1.2).

- Do not locate the side of a drilled shaft within 12 inches of the edge of the pile cap (10.8.1.2).

- Perform lateral load analysis using the geotechnical parameters provided in Section 6.7. The AASHTO LRFD guidelines recommend a resistance factor for horizontal geotechnical resistance of a single shaft or shaft group of 1.0 for lateral capacity analysis.

- Embed the shafts to the plan tip elevation or to the elevation as directed by the engineer.

- The individual nominal resistance for cohesive soils of each shaft should be reduced by a factor η for an isolated shaft taken as: η equals 0.65 for center-to-center spacing of 2.5 diameters, η equals 0.8 for center-to-center spacing of 4.0 diameters and η equals 1.0 for center-to-center spacing of 6.0 diameters. The individual nominal resistance for non-cohesive soils of each shaft should be reduced by a factor η for an isolated shaft taken as: η equals 0.65 for center-to-center spacing of 2.5 diameters and η equals 1.0 for center-to-center spacing of 4.0 diameters. For intermediate spacing, the value of η can be interpolated (10.8.3.6.3).

- Evaluate the factored axial and factored uplift capacities using the attached Pile Capacity Tables provided in Appendices G and H. The Summary of Drilled Shaft Capacities is presented in section 6.7. Should more or less capacity be required, the designer should contact KSWA for additional analysis.

- The capacity of the steel H-piles should also consider the anticipated downdrag loads. AASHTO LRFD Bridge Design Specifications indicate that for friction piles subjected to downdrag loading, downdrag shall be considered at the service, strength and extreme limit states.

- Where load testing and/or dynamic analysis of the drilled shafts is performed, LRFD factors used to determine the factored axial capacity, Appendices G and H, for design purposes may be revised per Table 10.5.5.2.4-1 of the AASHTO LRFD Bridge Design Specifications, 4th Edition based on site variability and the number and type of tests performed. Lateral capacity requirements will need to be checked if the shaft lengths are changed based on load testing and/or dynamic analysis.

- An appropriate number (approximately 3) of Crosshole Sonic Logging (CSL) access tubes, consisting of 2-inch nominal diameter schedule 40 steel pipe, will be required. Show these tubes on the drilled shaft details. Include the following plan note on the Drilled Shaft Detail Sheet:

  Perform Nondestructive Drilled Shaft Integrity Testing on the Drilled Shafts using Crosshole Sonic Logging (CSL) in accordance with the "Special Note for Non-Destructive Testing of Drilled Shafts". The Department will pay for this testing and associated cost at the contract unit bid prices for "CSL Testing". This includes CSL Testing Mobilization and the CSL Testing. The access tubes are incidental to the shaft.

  Include the following plan quantities:

Bid Item	Unit	Quantity
CSL Testing	Each	##

- It is recommended that Class A Modified concrete with good workability, i.e., increased slump, in accordance with the current KYTC Special Note for Drilled Shafts be used in construction of drilled shafts. Once an excavation is complete, concrete should be "tremmied" to the bottom of the shaft. The drilling Contractor should either wait until concrete has been placed for the total length of an individual shaft before pulling temporary casing (if used), or the level of concrete being placed should be maintained at a distance above the bottom of the casing as the casing is being retrieved so as to reduce the possibility of soils collapsing into the excavation and detrimentally affecting the structural integrity of the drilled shaft. The level of concrete should be maintained above the water table (hydrostatic level) at all times as casing is retrieved.

- If slurry is used to conduct drilled shaft excavations, it should be designed to suspend the soil size particles encountered, and should not leave a thick coating of slurry, or "mud" on the sides and bottoms of the resulting excavations. In accordance with the current KYTC Special Note for Drilled Shafts, the Contractor should provide to the Kentucky Transportation Cabinet a detailed description of the slurry proposed for use and all the necessary equipment to properly install the shafts and maintain environmental standards.

- All drilled shaft construction, shall be performed in accordance with the current KYTC **"Special Note for Drilled Shafts".** A qualified geotechnical engineer should be present during drilled shaft excavations to verify suitable bearing conditions.

- KSWA estimates settlement to be less than 3 inches for the drilled shaft foundation option at the end bents. The designer should be aware that settlement will occur in the sand foundation soils below the tip elevation of the shafts, resulting in the settlement of the shaft group. Based on our settlement analysis and anticipated length of the drilled piers, KSWA estimates that this settlement will be less than ¾ inches. This settlement should occur during construction of the embankment. The contractor should be prepared to accommodate this settlement during construction.

- If used, load tests should follow the procedures specified in ASTM D1143 and 10.8.3.5.6.

10.5 EXISTING FOUNDATIONS

- We recommend that, at a minimum, one existing pile at every substructure element, which is to be used in the proposed bridge substructure, be subjected to non-destructive tests prior to construction of the new pile caps.

- At least one load test should be performed on an existing pile that will not be incorporated into the new bridge structure. It is recommended that the load test be performed in accordance with ASTM D1143, and under the supervision of an experienced geotechnical engineer. The testing will be to verify that the piles which will be reutilized in the new foundation can accommodate the original design load. The Designer should determine the current loading on the substructure elements to remain in place. In no case should the loading of the existing piles be in excess of the original design load. If additional capacity is needed, the Designer should consider the following: 1) add additional friction piles, 2) completely remove the existing pier, cut-off the existing piles, and design and construct a new pier.

11.0 ENVIRONMENTAL CONCERNS

As part of the Kennedy Interchange project, several bridges and retaining walls will be constructed within or near areas that are known or suspected to have environmental contaminates. The bridges covered as part of this report are located adjacent to several areas where a Phase II environmental site assessment is underway. At the time of this report, KSWA has not received information on the type or extent of contamination. Environmental Site 85 American S & W Stocks / Vermont America Corporation (formerly American Saw and Tool) is located approximately 200 feet to the north of the proposed structure. The Environmental Site A Slugger Field is located approximately 500 feet to the north of the proposed structure. Upon completion of the Phase II Environmental Site Assessments, the designer should review the subject environmental reports from the adjacent sites for a better determination of potential concerns relative to foundation construction and worker protection. The map provided in Appendix K illustrates the location of the bridges in relation to the identified environmental sites.

12.0 CLOSING

- General soil descriptions and indicated boundaries are based on an engineering interpretation of all available subsurface information and may not necessarily reflect the actual variation in subsurface conditions between borings and samples. Collected data and field interpretation of conditions encountered in individual borings are shown on the attached Subsurface Data Sheets.

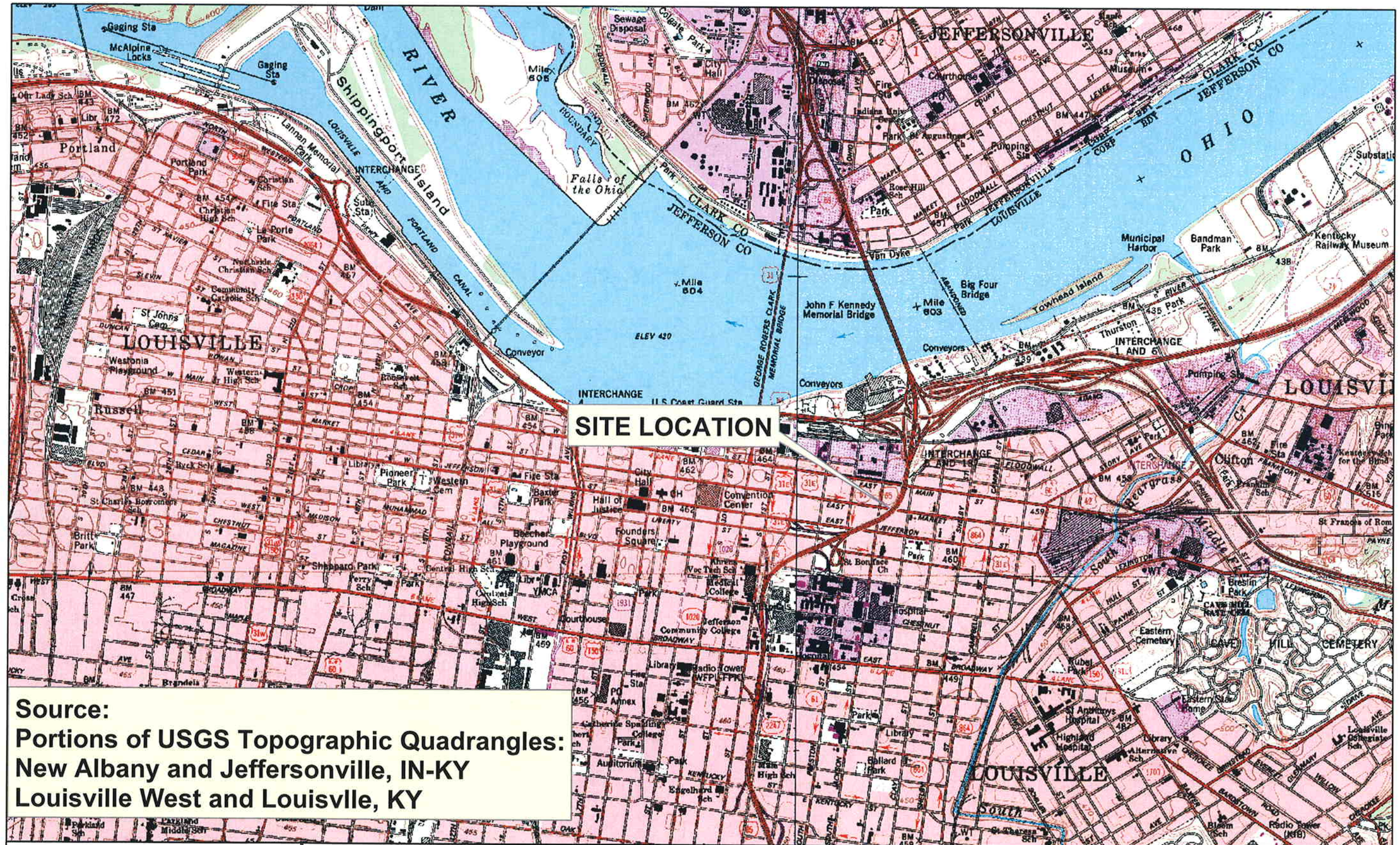
- The observed water levels and/or conditions indicated on the boring logs are as recorded at the time of exploration. These water levels and/or conditions may vary considerably, with time, according to the prevailing climate, rainfall or other factors and are otherwise dependent on the duration of and methods used in the exploration program

- Sound engineering judgment was exercised in preparing the subsurface information presented herein. This information was prepared and is intended for design and estimating purposes. Its presentation on the plans or elsewhere is for the purpose of providing intended users with access to the same information available to the KYTC. This subsurface information interpretation is presented in good faith and is not intended as a substitute for personal investigations, independent interpretations or judgments of the Contractor.

- All structure details shown herein are for illustrative purposes only and may not be indicative of the final design conditions shown in the contract plans.

APPENDIX A:

SITE LOCATION MAPS



KSWA
K.S. Ware & Associates, L.L.C.
Engineering, Environmental & Information Services

Site and Topographic Map

Site: Bridge 65-9
I-65 Bridge Over E. Market Street
KSWA Project No. 500-05-0001.016

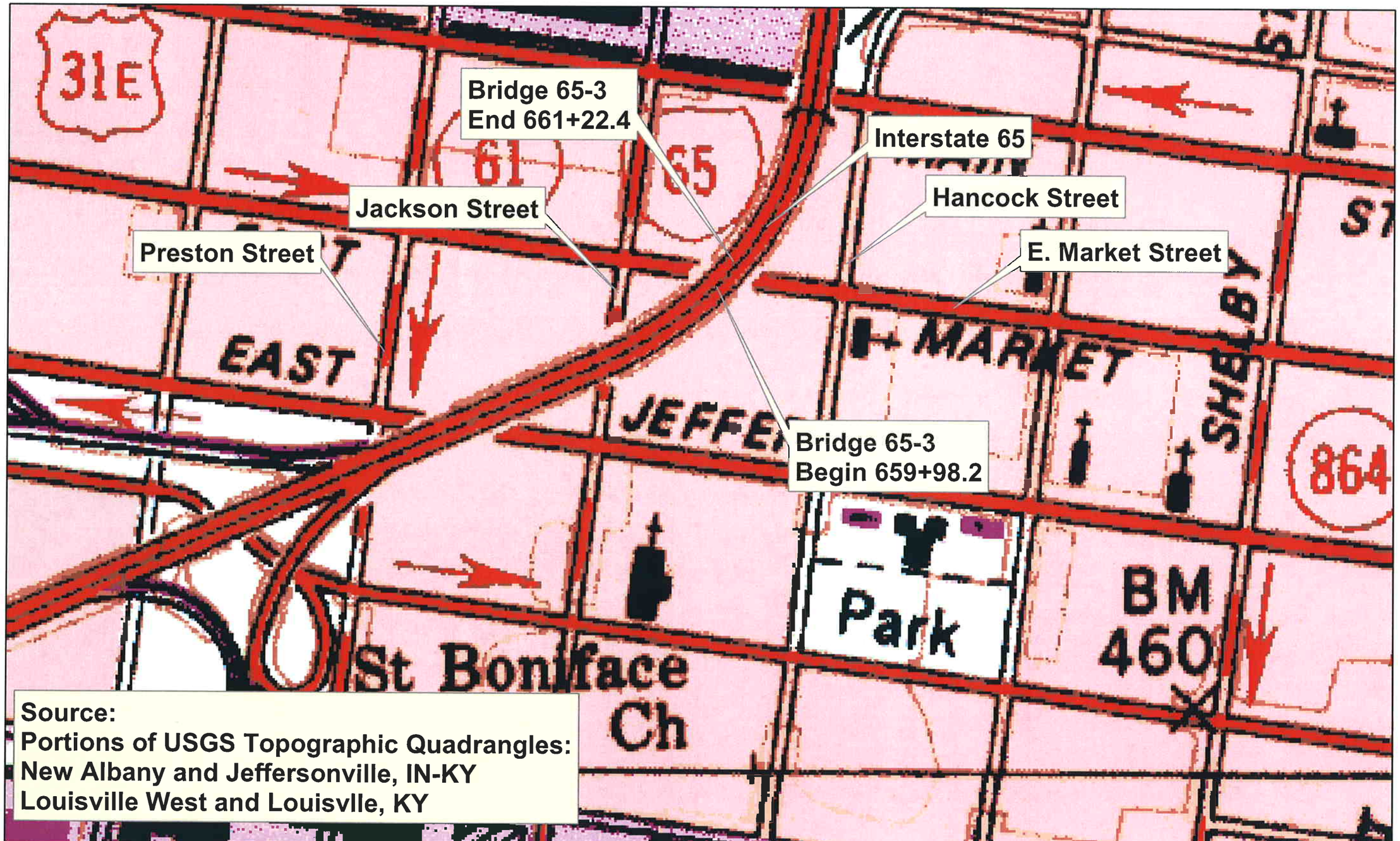
Item 5-118.18 and 19
KTC Project No. S0450

Prepared For: QK4

0 800 1,600 3,200
Feet

N W E S

Figure 1A



KSWA
K.S. Ware & Associates, L.L.C.
Engineering, Environmental & Information Services

Site and Topographic Map

Site: Bridge 65-9
I-65 Bridge Over E. Market Street
KSWA Project No. 500-05-0001.016

Item 5-118.18 and 19
KTC Project No. S0450

Prepared For: QK4

0 100 200 400
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N
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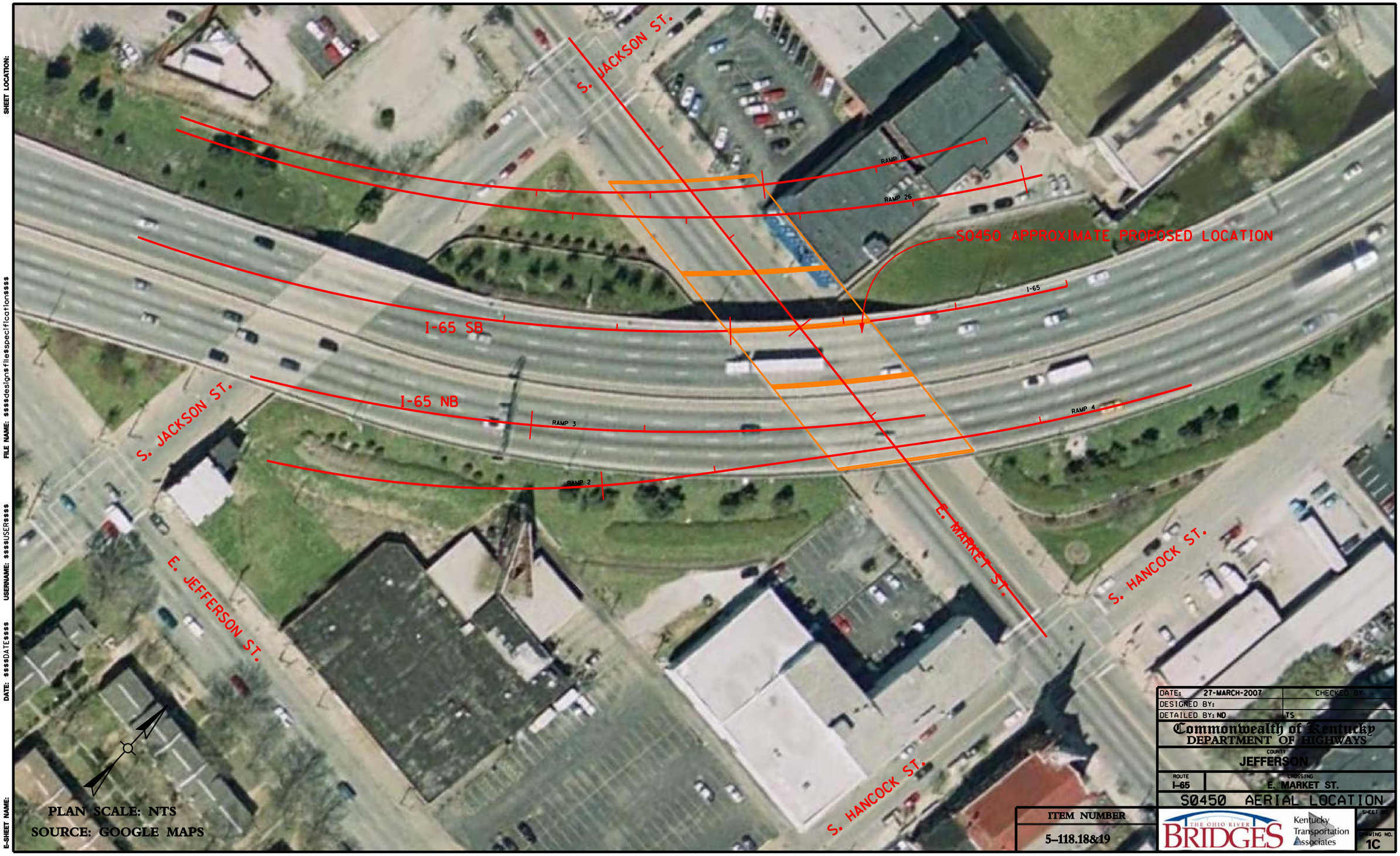
Figure
1B



DATE: 27-MARCH-2007	CHECKED BY
DESIGNED BY:	
DETAILED BY: ND	TS

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: JEFFERSON

ROUTE: I-65 | CROSSING: E. MARKET ST.

S0450 AERIAL LOCATION

ITEM NUMBER: 5-118.18&19

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

SHEET NO.

DRAWING NO. 1C

SHEET LOCATION:

FILE NAME: $$$$design$file$specification$$$$

USERNAME: $$$$USER$$$$

DATE: $$$$DATE$$$$

E-SHEET NAME:

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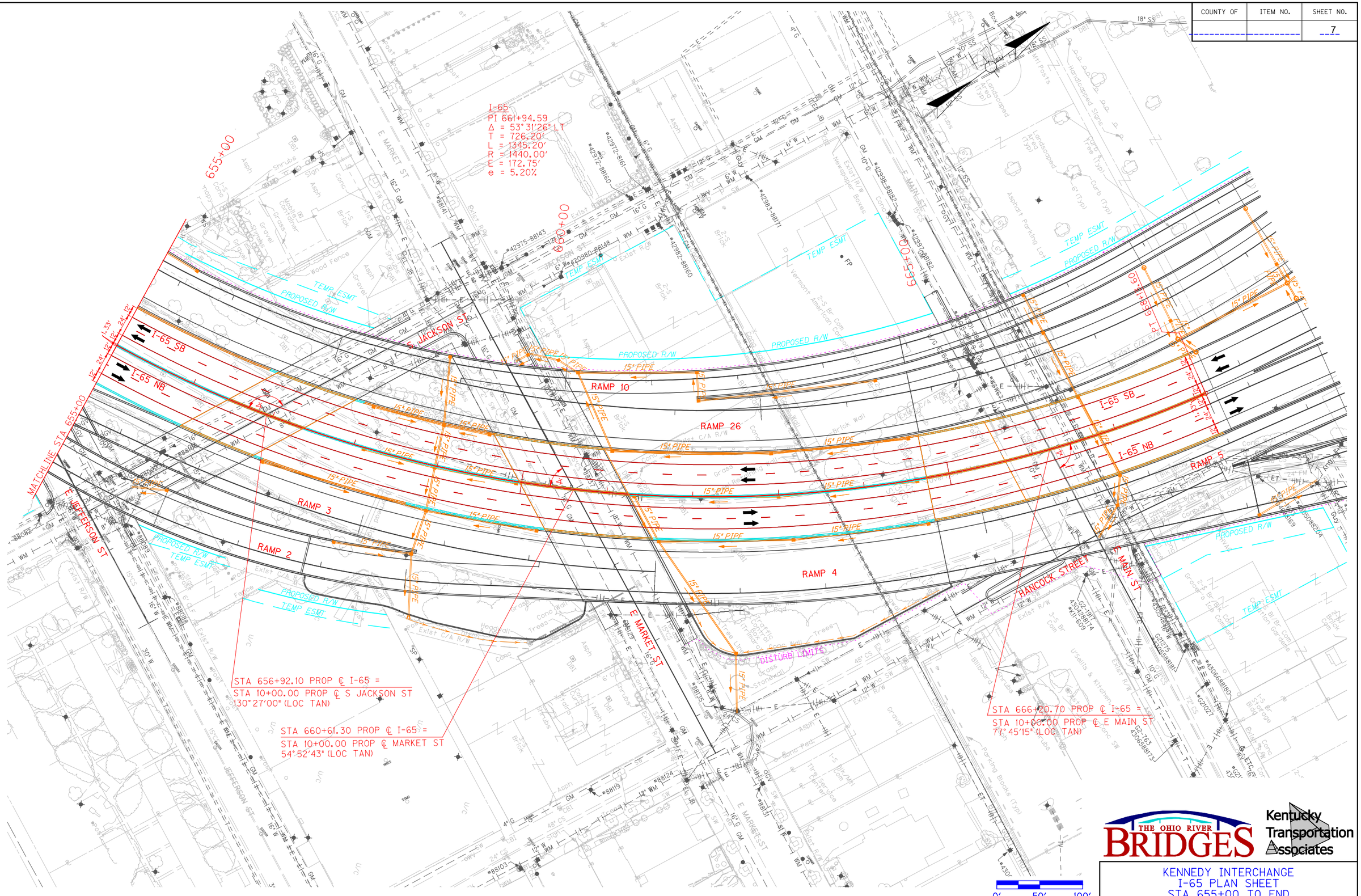
APPENDIX B:

CLIENT DRAWINGS FROM PROJECTWISE

COUNTY OF	ITEM NO.	SHEET NO.
		7



THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
I-65 PLAN SHEET
STA 655+00 TO END

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APPROVED BY ____ DATE ____

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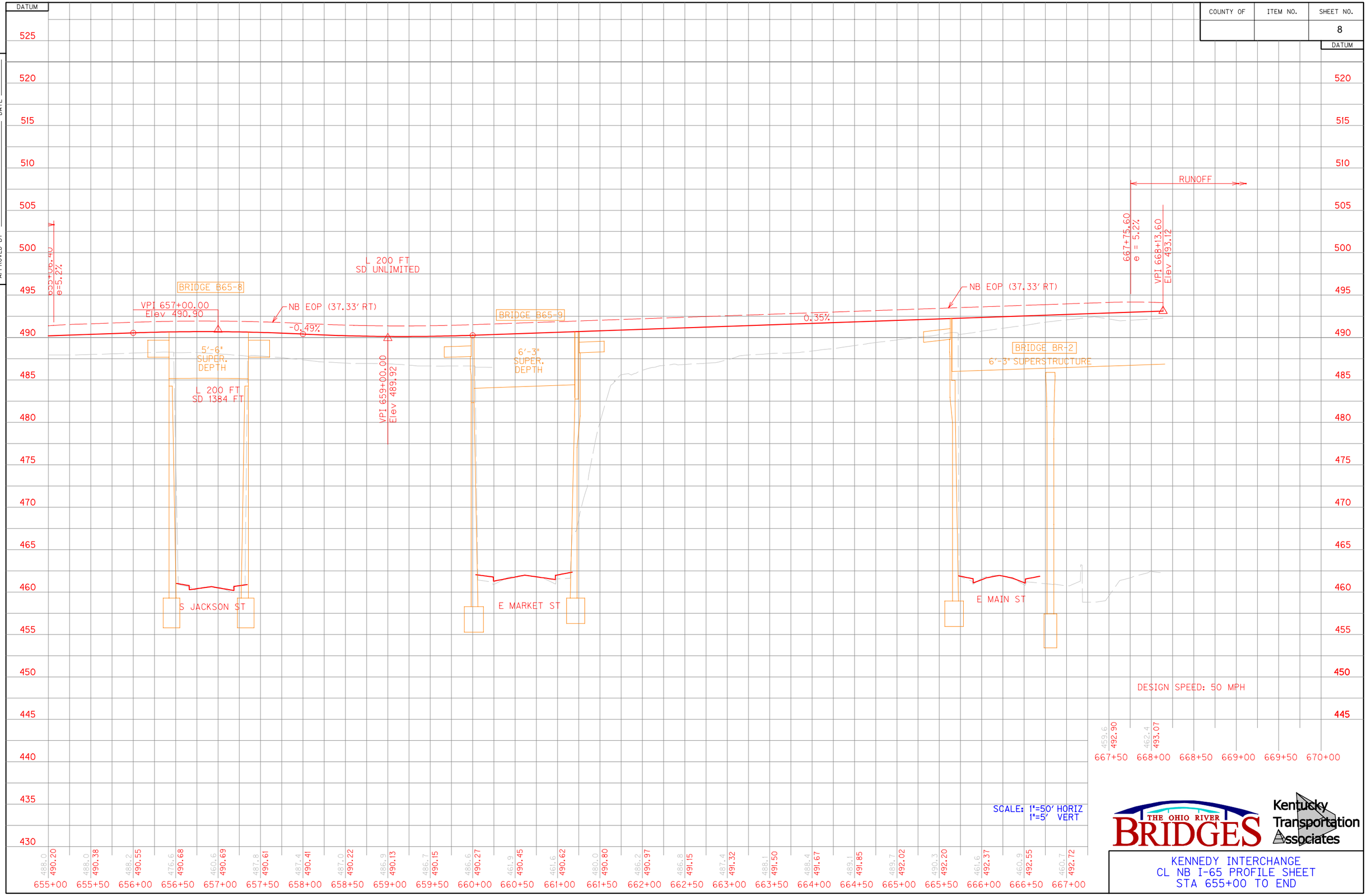

KENNEDY INTERCHANGE
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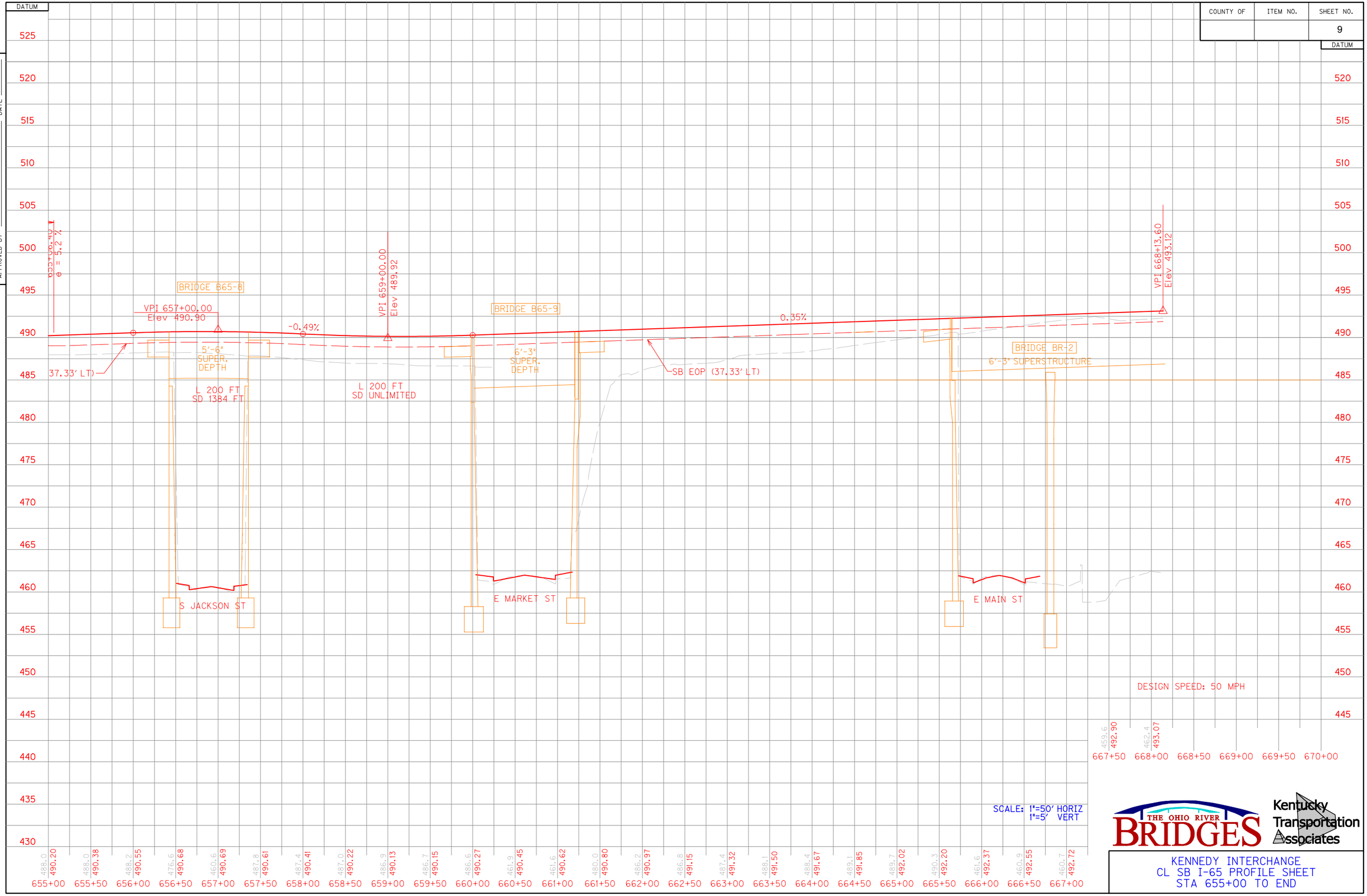

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THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
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I–65 TYPICAL SECTIONS

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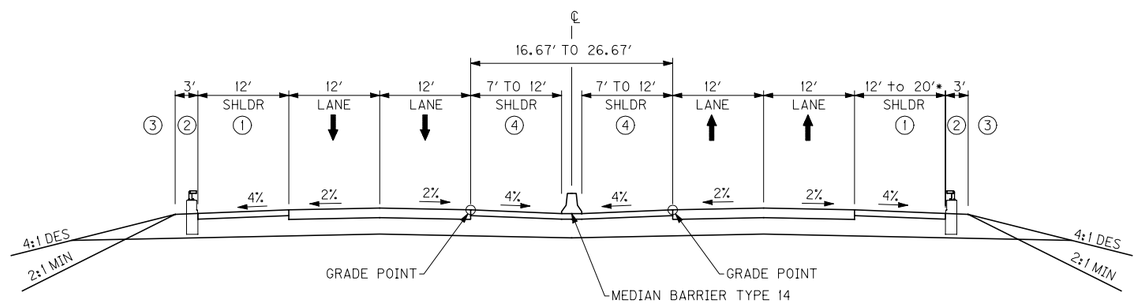
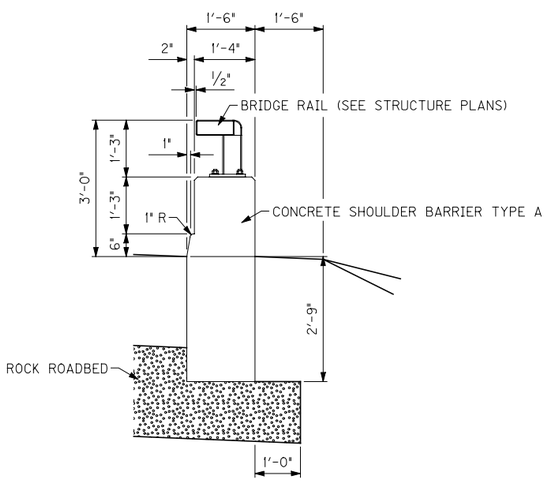


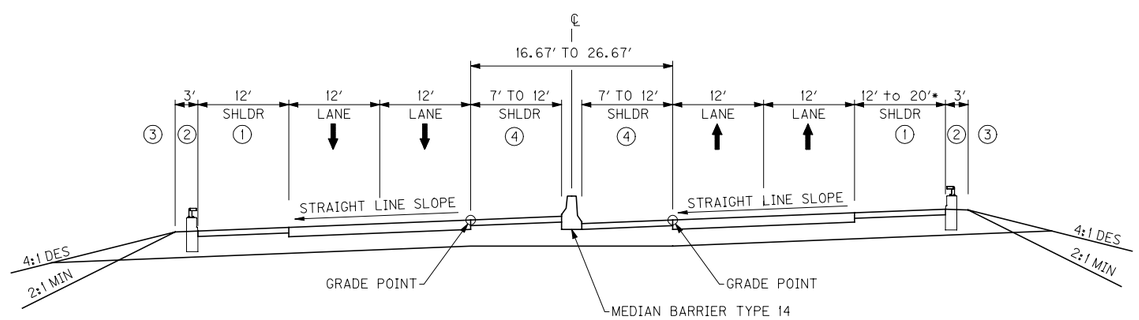
NORMAL SECTION

* SHOULDER WIDENED FOR M.O.T.



DETAIL B

NOT TO SCALE



SUPERELEVATED SECTION LEFT

1. SHOULDER PAVEMENT SHALL BE EXTENDED TO FACE OF GUARDRAIL/BARRIER WHERE GUARDRAIL/BARRIER IS TO BE INSTALLED.
2. SHOULDER SHALL BE WIDENED 3' WHERE GUARDRAIL/BARRIER IS TO BE INSTALLED.
3. SEE PLANS FOR SLOPES OUTSIDE THE SHOULDER.
4. SEE PLANS FOR LANE AND SHOULDER TRANSITIONS.

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

NOT TO SCALE

TYPICAL SECTIONS I 65

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APPROVED BY ____ DATE ____

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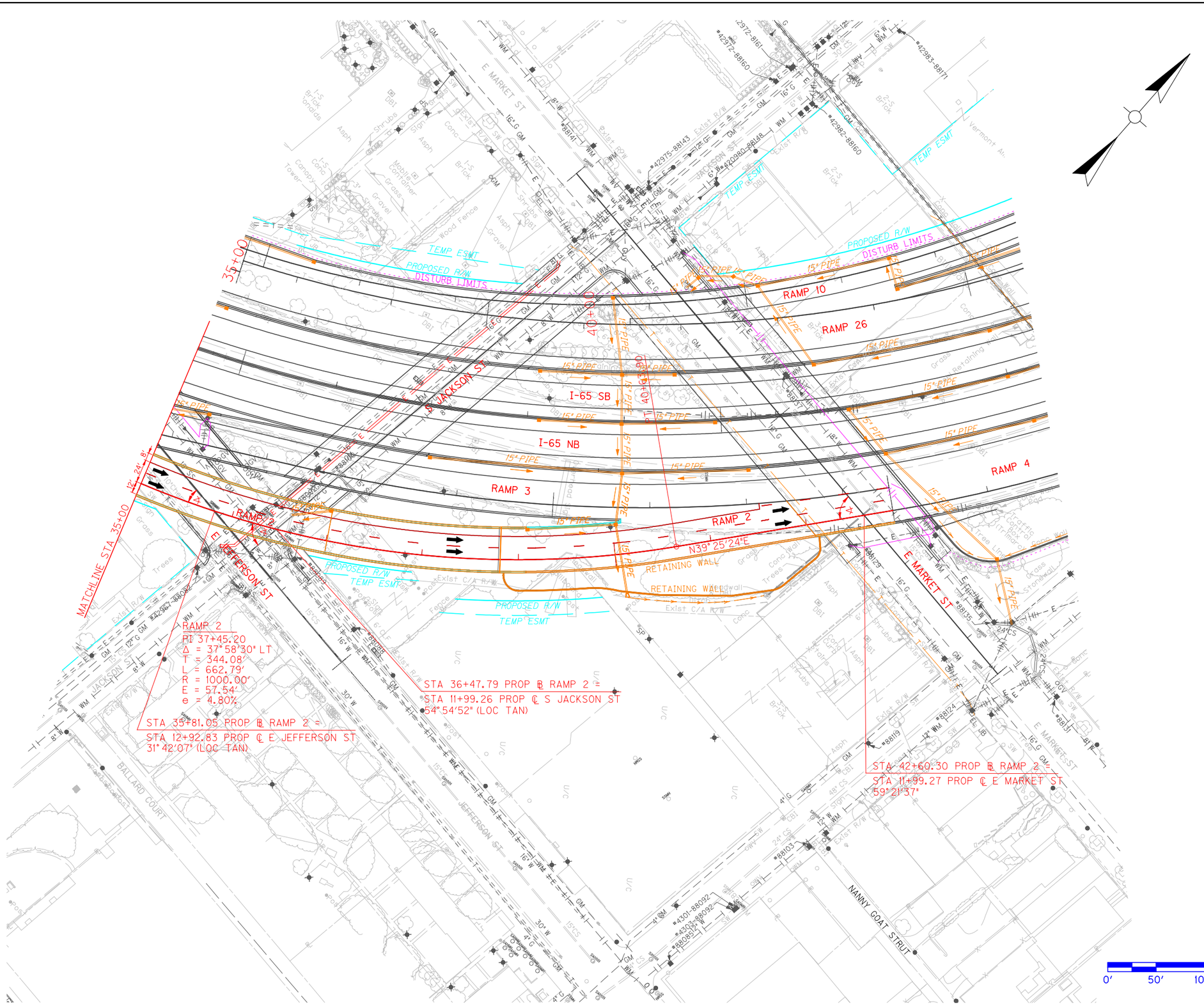
APPROVED BY _____ DATE _____



THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
RAMP 2 PLAN SHEET
STA 35+00 TO END

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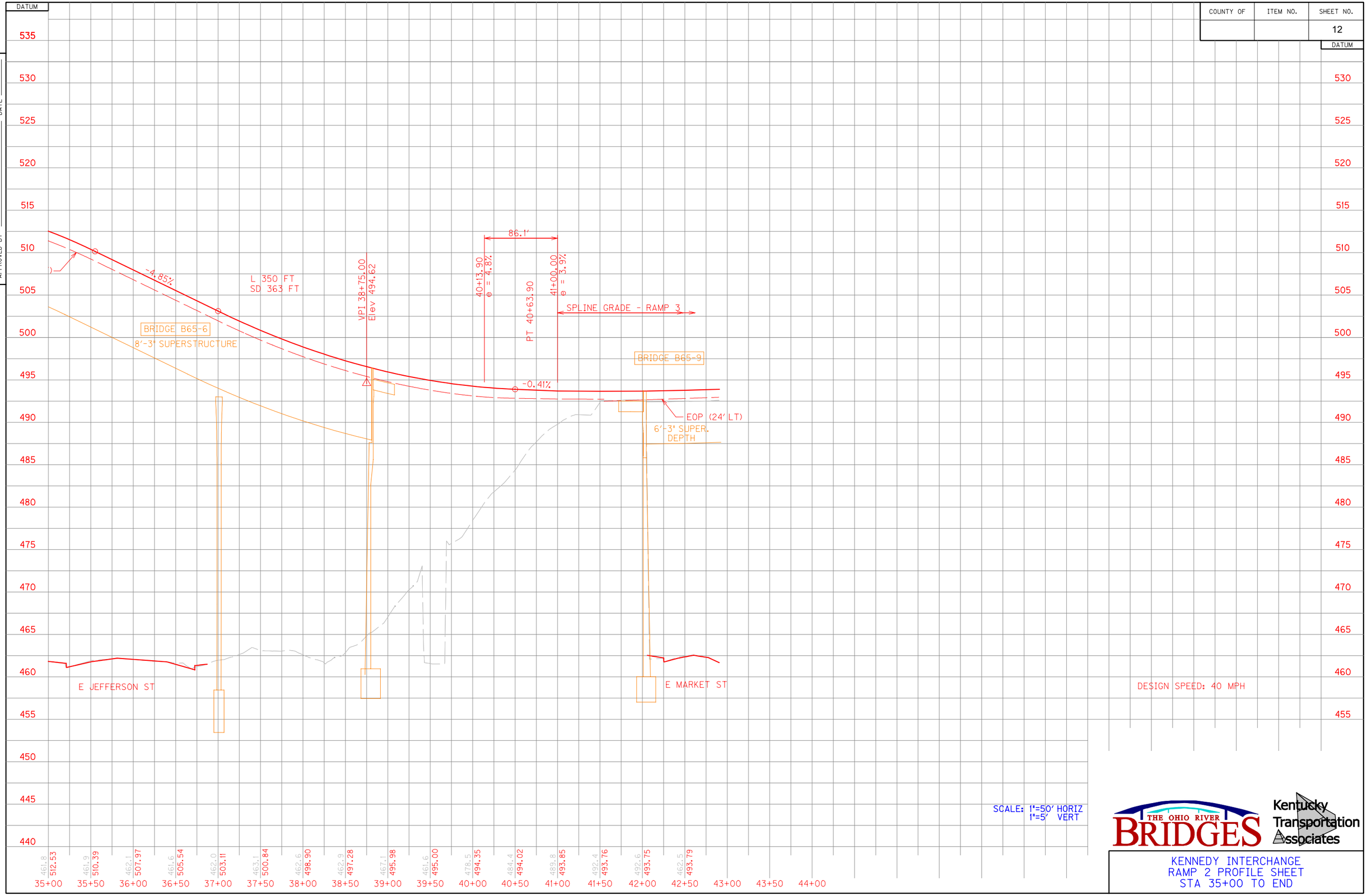

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APPROVED BY ____ DATE ____

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
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STA 35+00 TO END

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RAMP 2 TYPICAL SECTIONS

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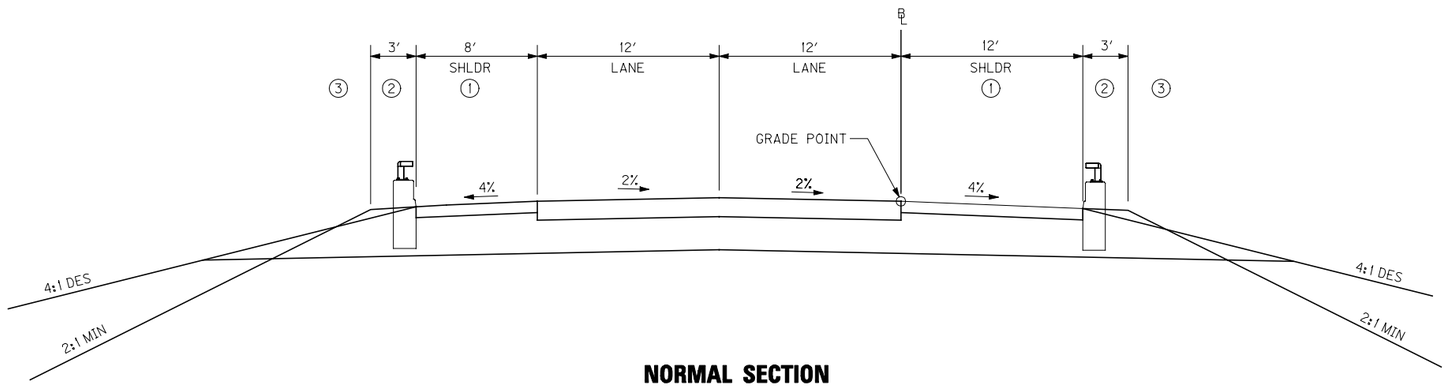
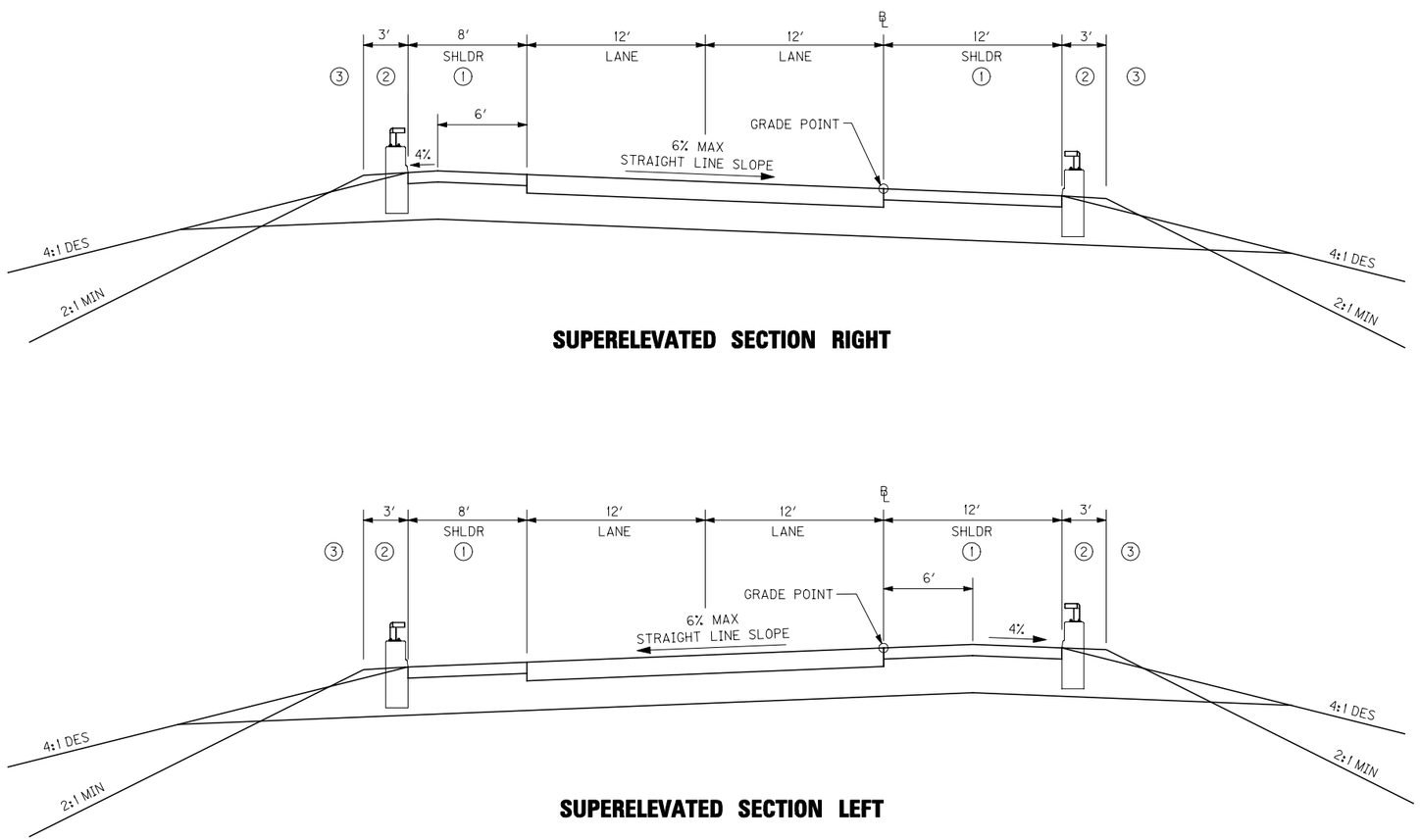
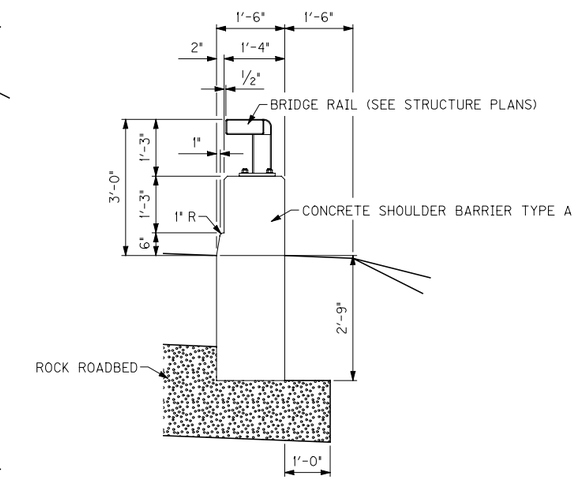


NORMAL SECTION

SUPERELEVATED SECTION RIGHT



SUPERELEVATED SECTION LEFT



DETAIL B

NOT TO SCALE

① SHOULDER PAVEMENT SHALL BE EXTENDED TO FACE OF GUARDRAIL/BARRIER WHERE GUARDRAIL/BARRIER IS TO BE INSTALLED.

② SHOULDER SHALL BE WIDENED 3′ WHERE GUARDRAIL/BARRIER IS TO BE INSTALLED.

③ SEE PLANS FOR SLOPES OUTSIDE THE SHOULDER.

④ SEE PLANS FOR LANE AND SHOULDER TRANSITIONS.

NOT TO SCALE

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

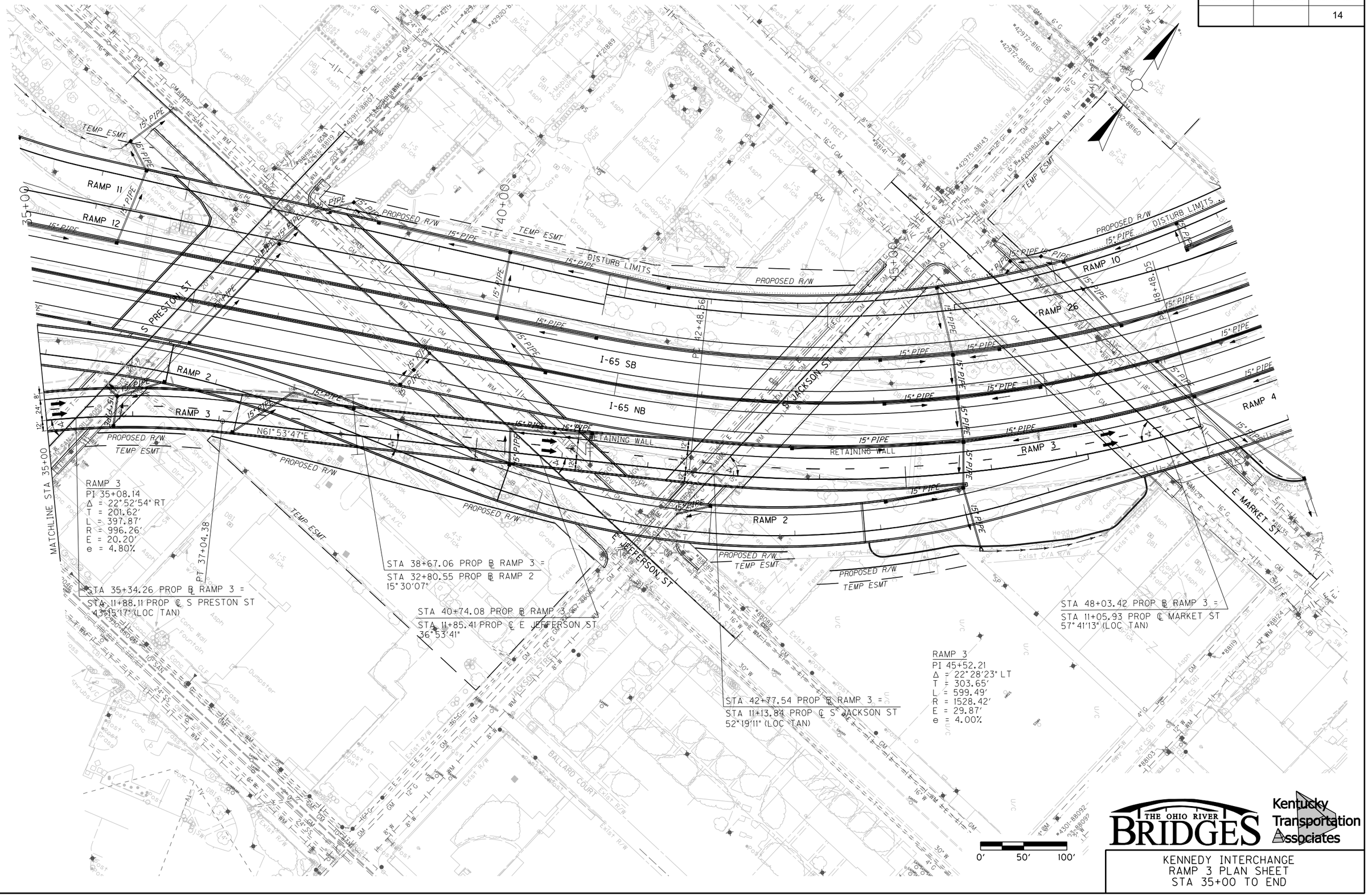
TYPICAL SECTIONS RAMP 2

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\mperry\dms01609\TS_R-02-1.dgn
E-SHEET NAME:

COUNTY OF	ITEM NO.	SHEET NO.
		14

PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____



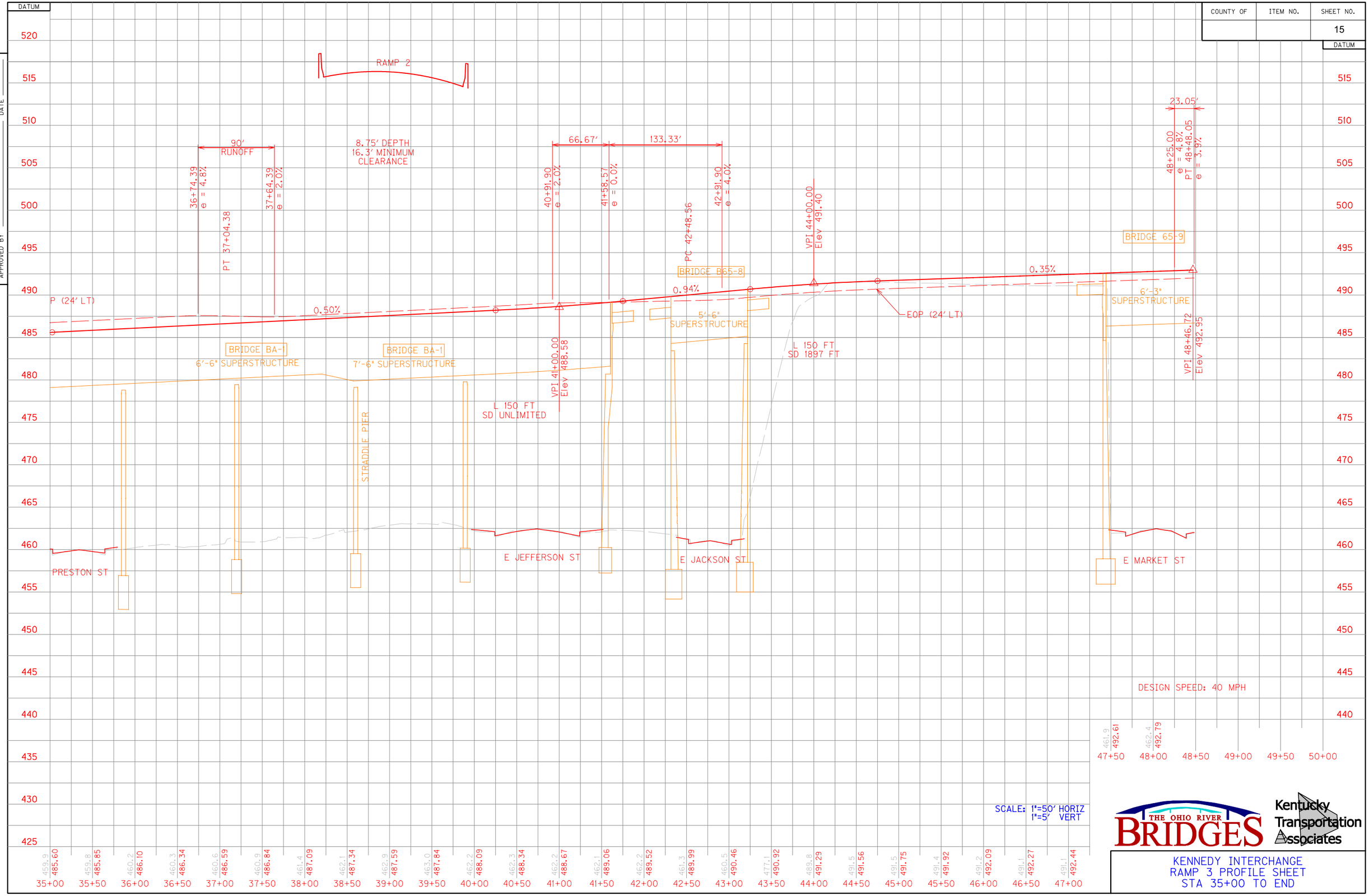
THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
RAMP 3 PLAN SHEET
STA 35+00 TO END

USER: cassandra-s
DATE: 04/26/2006
FILE NAME: ...\S0590_Approach_Slab_Cassie.dgn
E-SHEET NAME:

COUNTY OF	ITEM NO.	SHEET NO.
		15



KENNEDY INTERCHANGE
RAMP 3 PROFILE SHEET
STA 35+00 TO END

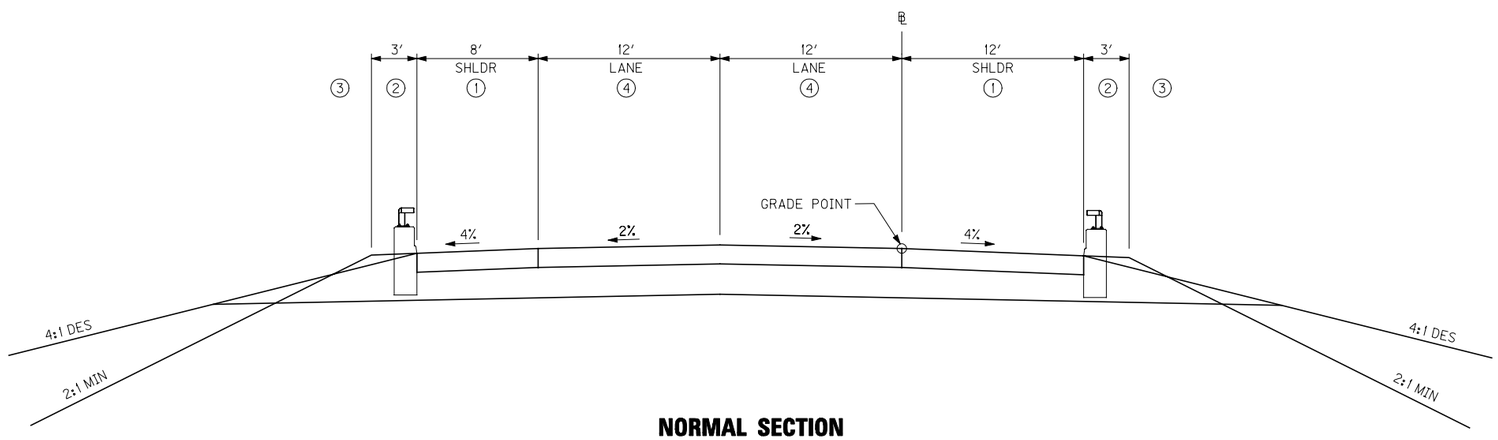
PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\dms01602\ramp03_pr3500.dgn
E-SHEET NAME:

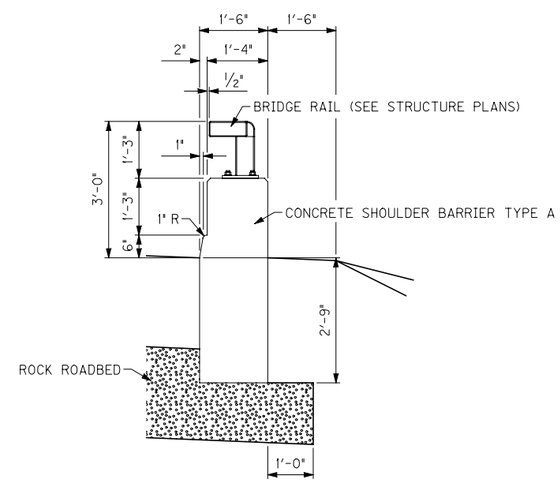
COUNTY OF	ITEM NO.	SHEET NO.
		16

RAMP 3 TYPICAL SECTIONS

STATION 32+50.00 TO STATION 48+48.05



NORMAL SECTION



DETAIL B

NOT TO SCALE

① SHOULDER PAVEMENT SHALL BE EXTENDED TO FACE OF GUARDRAIL/BARRIER WHERE GUARDRAIL/BARRIER IS TO BE INSTALLED.

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③ SEE PLANS FOR SLOPES OUTSIDE THE SHOULDER.

④ SEE PLANS FOR LANE AND SHOULDER TRANSITIONS.

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

NOT TO SCALE

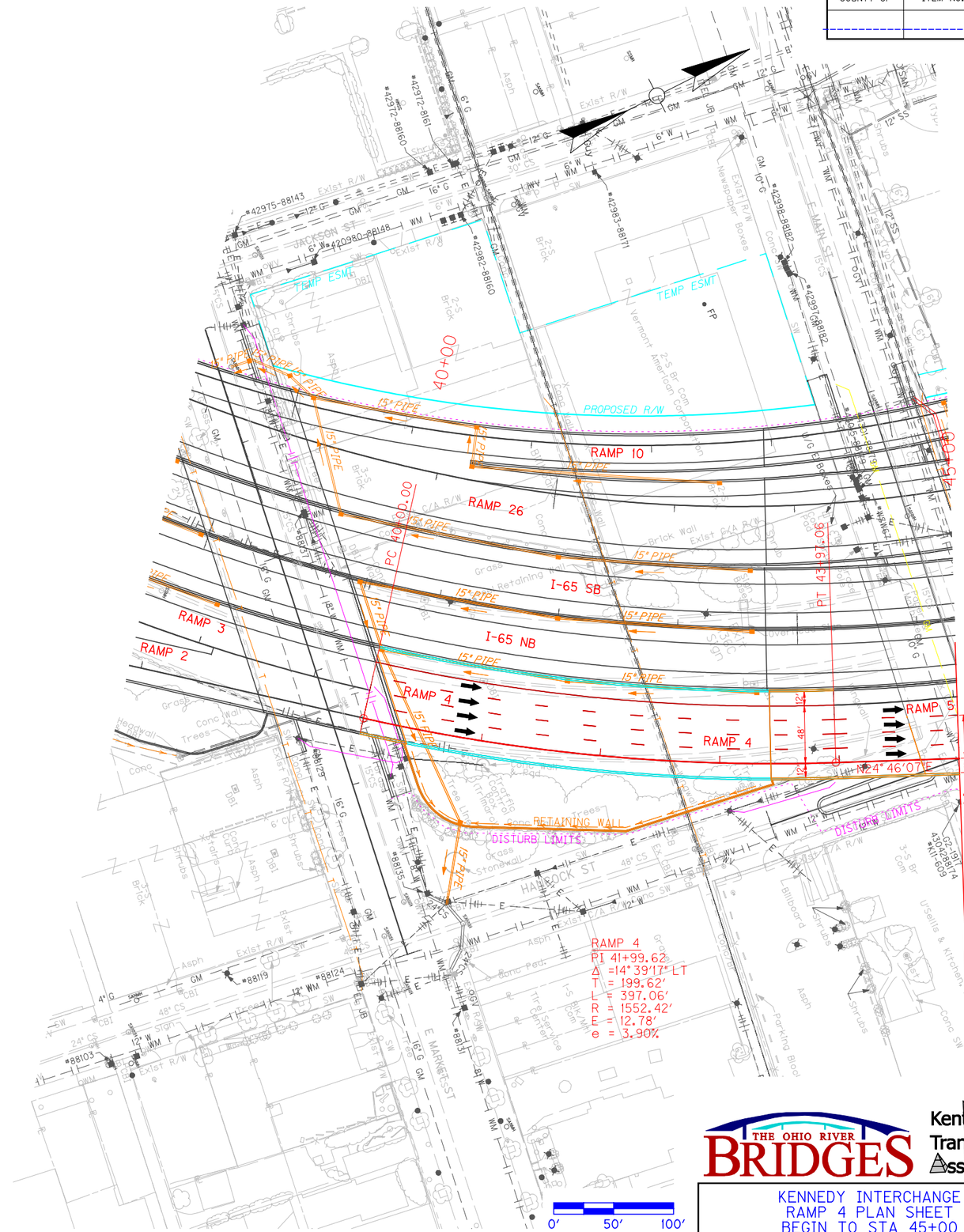
TYPICAL SECTIONS RAMP 3

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\mperry\dms01609\TS_R-03-3.dgn
E-SHEET NAME:

COUNTY OF	ITEM NO.	SHEET NO.
		17

PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____



THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
RAMP 4 PLAN SHEET
BEGIN TO STA 45+00

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\mperry\dms0160!r04_pl4000.dgn
E-SHEET NAME: _____

COUNTY OF	ITEM NO.	SHEET NO.
		18

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

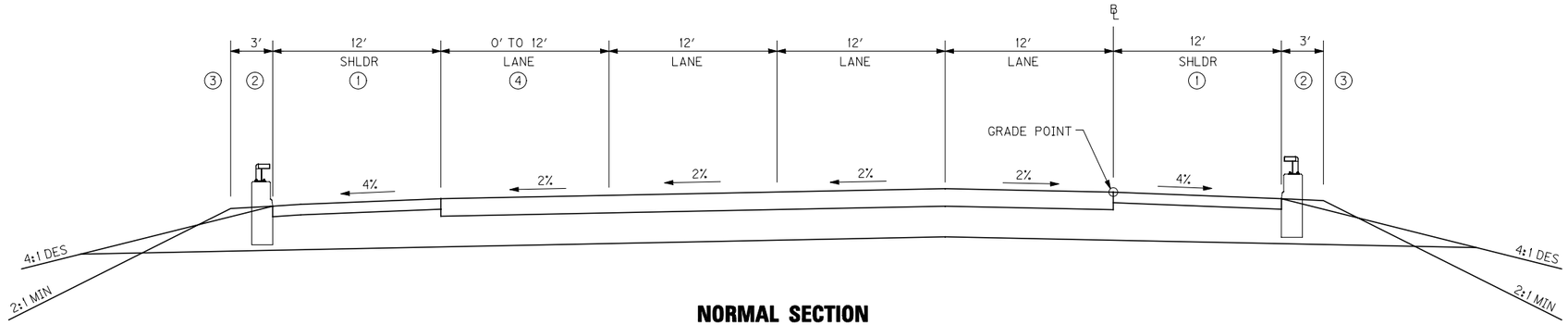
KENNEDY INTERCHANGE
RAMP 4 PROFILE SHEET
BEGIN TO STA 45+00

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\dms01602\ramp04_pr4000.dgn
E-SHEET NAME:

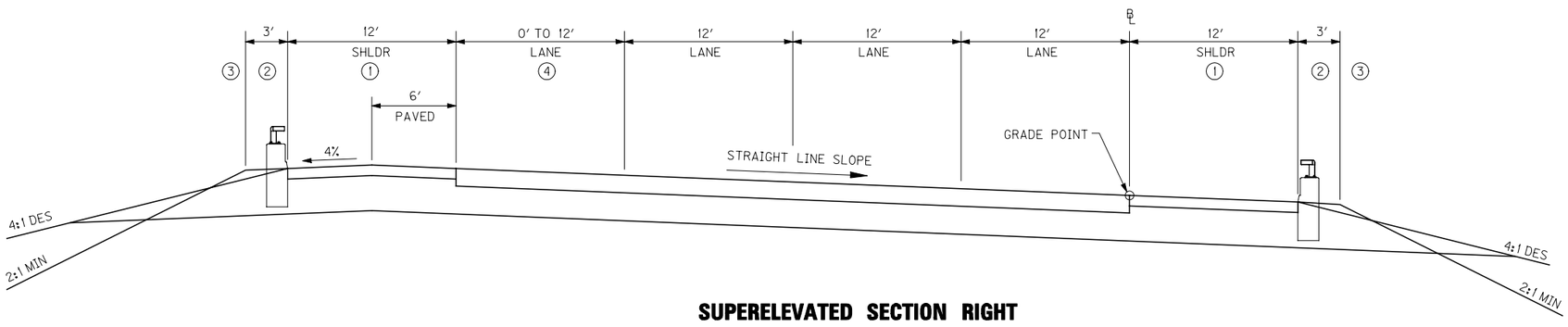
COUNTY OF	ITEM NO.	SHEET NO.
		19

RAMP 4 TYPICAL SECTIONS

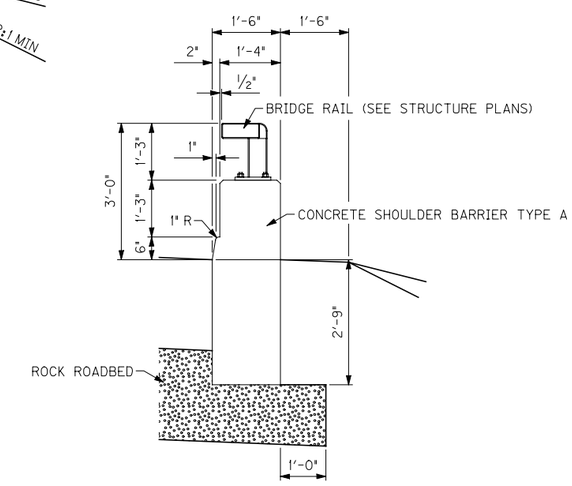
STATION 40+00.00 TO STATION 56+39.55



NORMAL SECTION

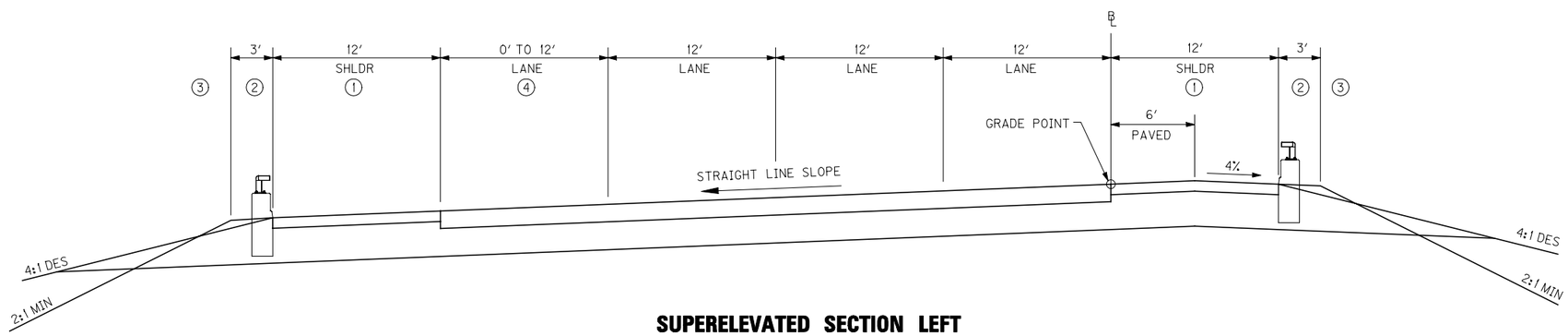


SUPERELEVATED SECTION RIGHT



DETAIL B

NOT TO SCALE



SUPERELEVATED SECTION LEFT

1. SHOULDER PAVEMENT SHALL BE EXTENDED TO FACE OF GUARDRAIL/BARRIER WHERE GUARDRAIL/BARRIER IS TO BE INSTALLED.
2. SHOULDER SHALL BE WIDENED 3' WHERE GUARDRAIL/BARRIER IS TO BE INSTALLED.
3. SEE PLANS FOR SLOPES OUTSIDE THE SHOULDER.
4. SEE PLANS FOR LANE AND SHOULDER TRANSITIONS.

NOT TO SCALE

THE OHIO RIVER BRIDGES

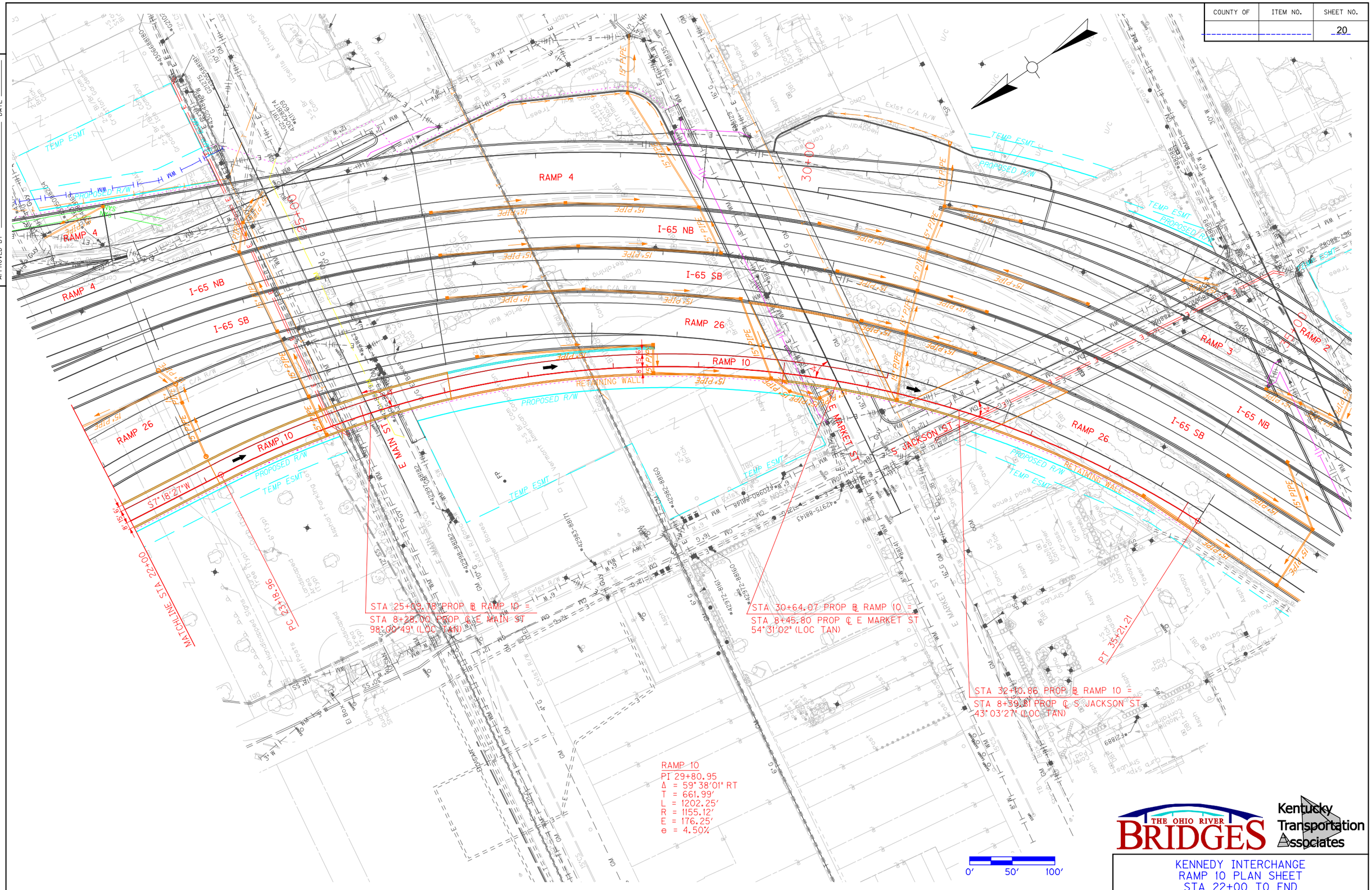
Kentucky Transportation Associates

TYPICAL SECTIONS RAMP 4

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\mperry\dms01609\TS_R-04-1.dgn
E-SHEET NAME:

COUNTY OF	ITEM NO.	SHEET NO.
		20



PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

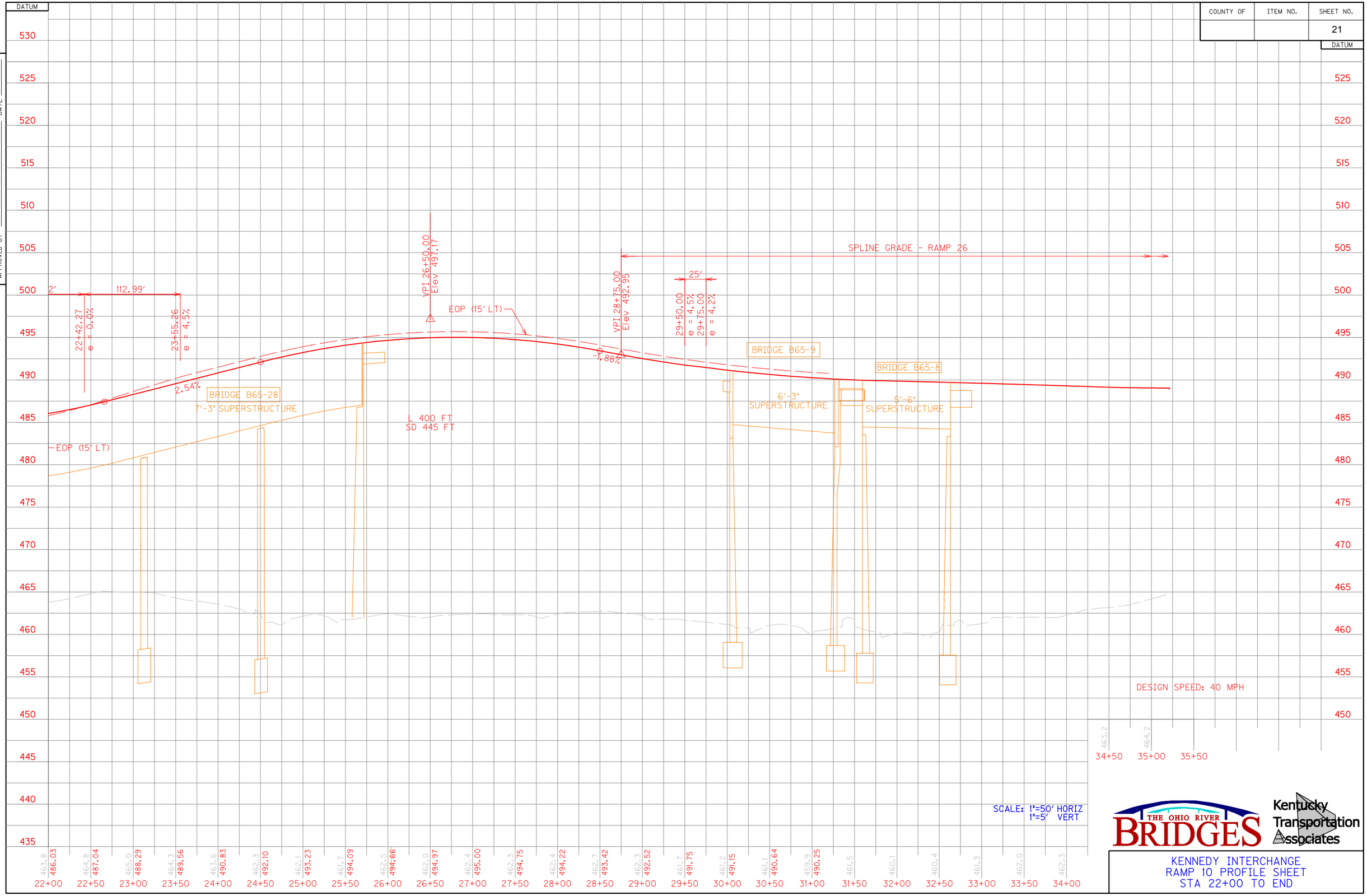
USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\mperry\dms01601\r10_pl2200.dgn
E-SHEET NAME: ----------

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
RAMP 10 PLAN SHEET
STA 22+00 TO END

COUNTY OF	ITEM NO.	SHEET NO.
		21



PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

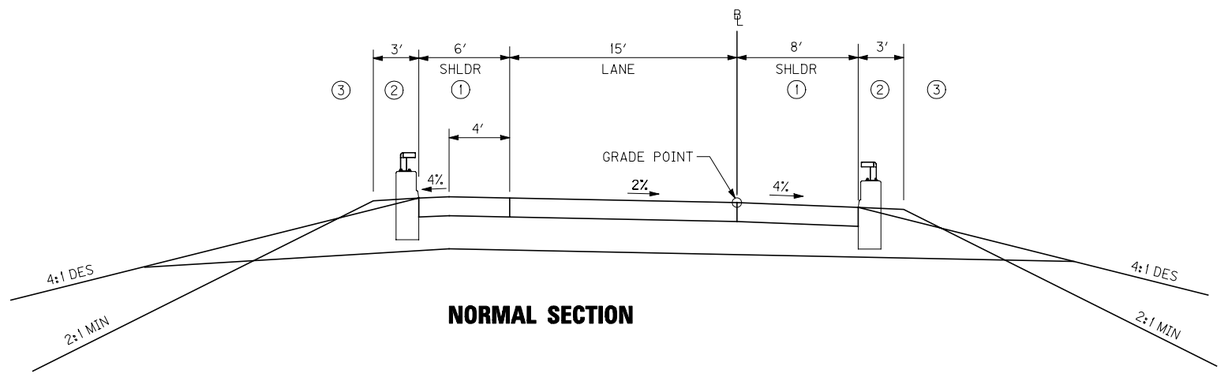
KENNEDY INTERCHANGE
RAMP 10 PROFILE SHEET
STA 22+00 TO END

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\dms01602\ramp10_pr2200.dgn
E-SHEET NAME:

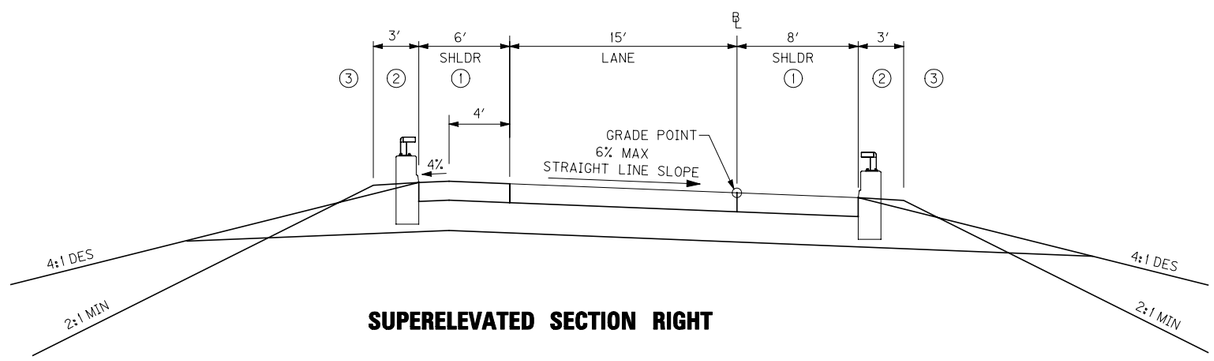
COUNTY OF	ITEM NO.	SHEET NO.
		22

RAMP 10 TYPICAL SECTIONS

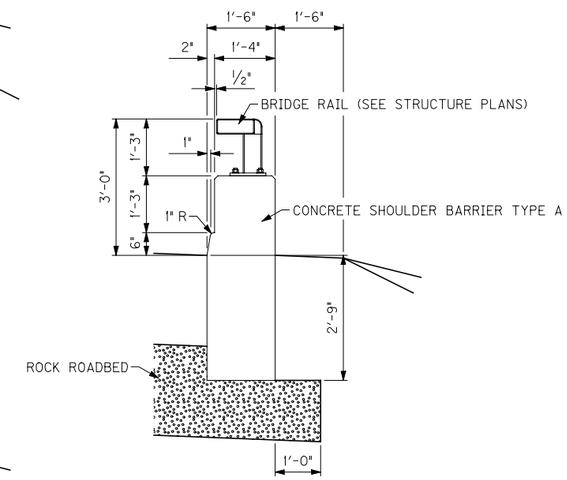
STATION 8+75.85 TO STATION 35+21.21



NORMAL SECTION

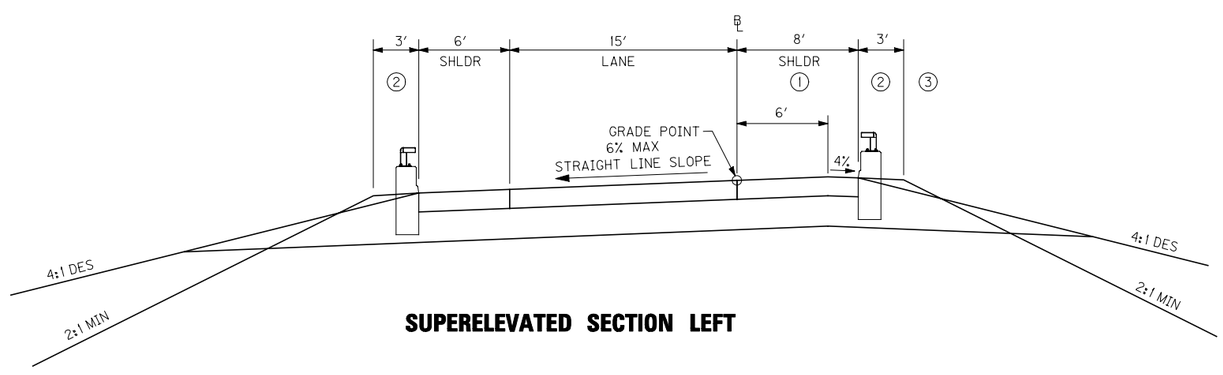


SUPERELEVATED SECTION RIGHT



DETAIL B

NOT TO SCALE



SUPERELEVATED SECTION LEFT

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NOT TO SCALE

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

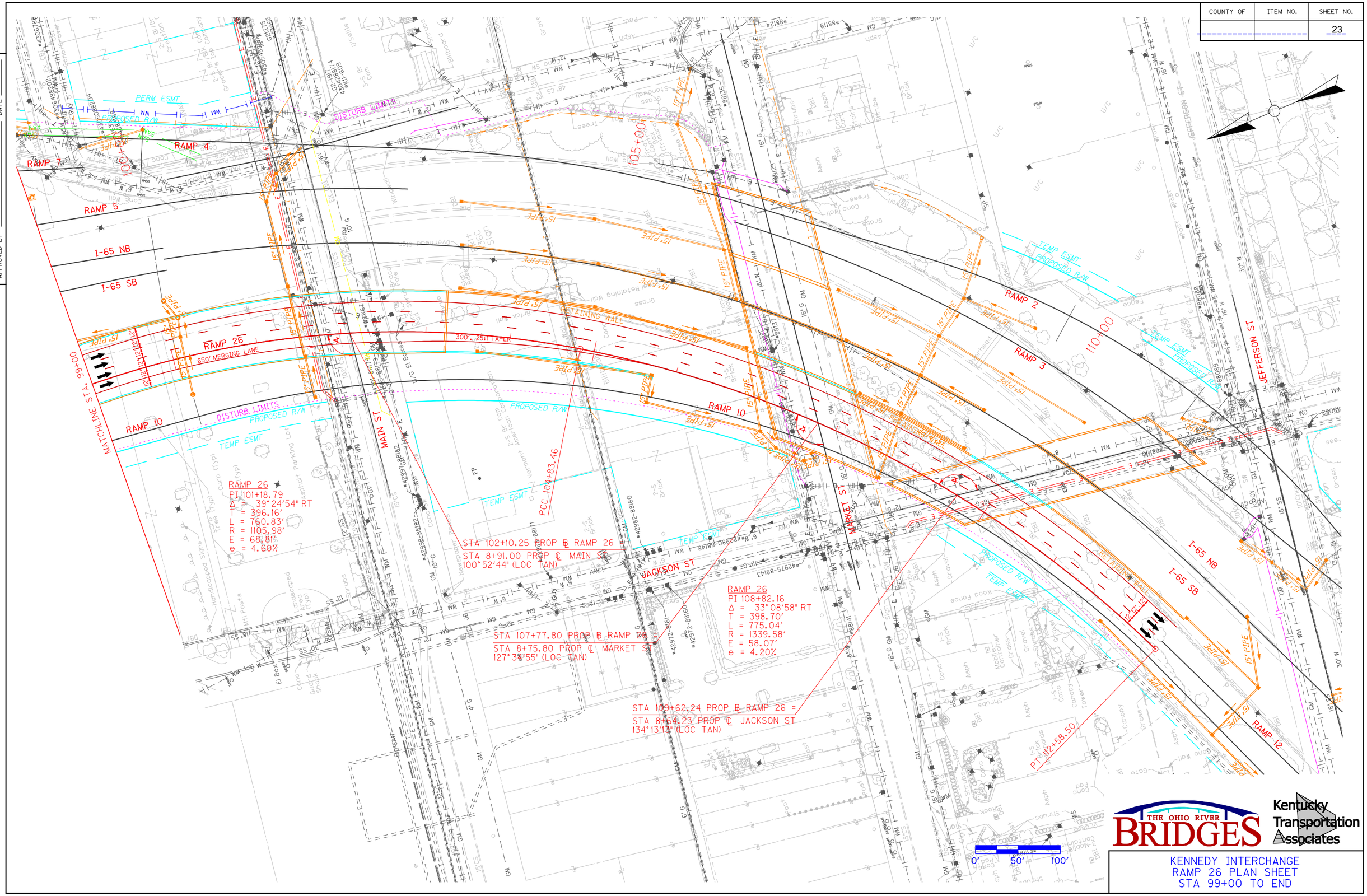
TYPICAL SECTIONS RAMP 10

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\mperry\dms01609\TS_R-10-1.dgn
E-SHEET NAME:

COUNTY OF	ITEM NO.	SHEET NO.
		23

PREPARED BY _____ DATE _____
CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____



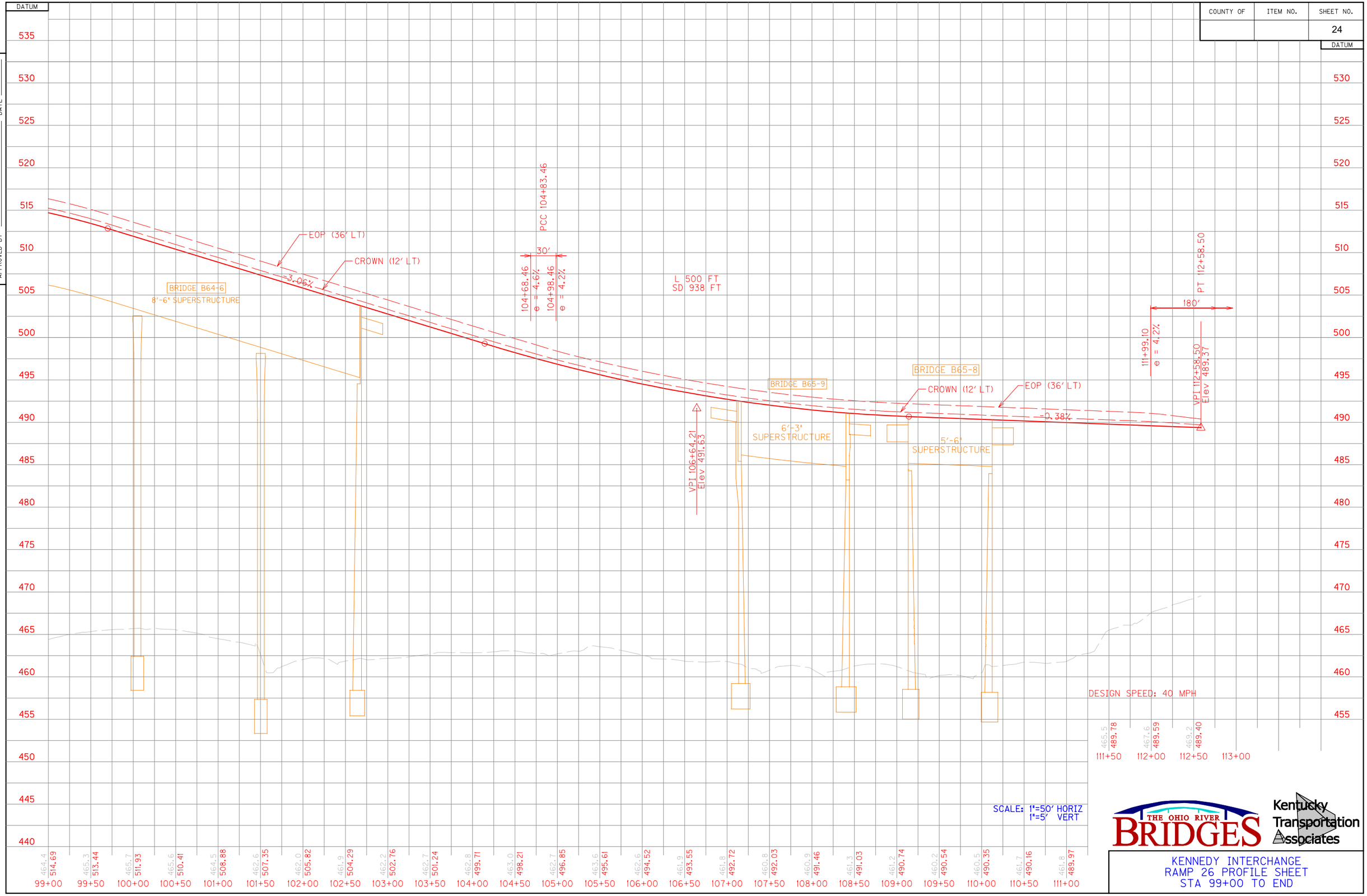
THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

KENNEDY INTERCHANGE
RAMP 26 PLAN SHEET
STA 99+00 TO END

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\dms01601\R26_PL09900.dgn
E-SHEET NAME: _____

COUNTY OF	ITEM NO.	SHEET NO.
		24



PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

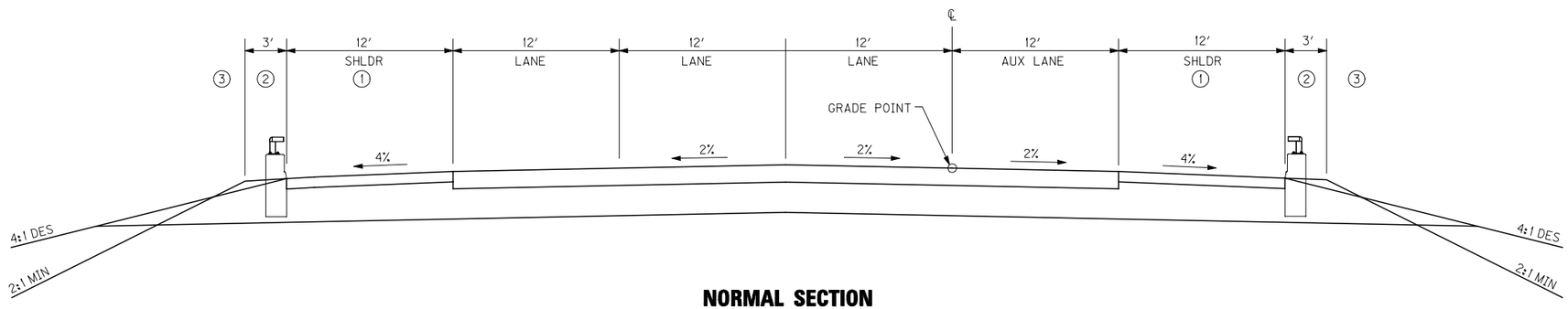
KENNEDY INTERCHANGE
RAMP 26 PROFILE SHEET
STA 99+00 TO END

USER: lperryym
DATE: 5/26/2006
FILE NAME: ...\dms01602\Ramp26PR09900.dgn
E-SHEET NAME:

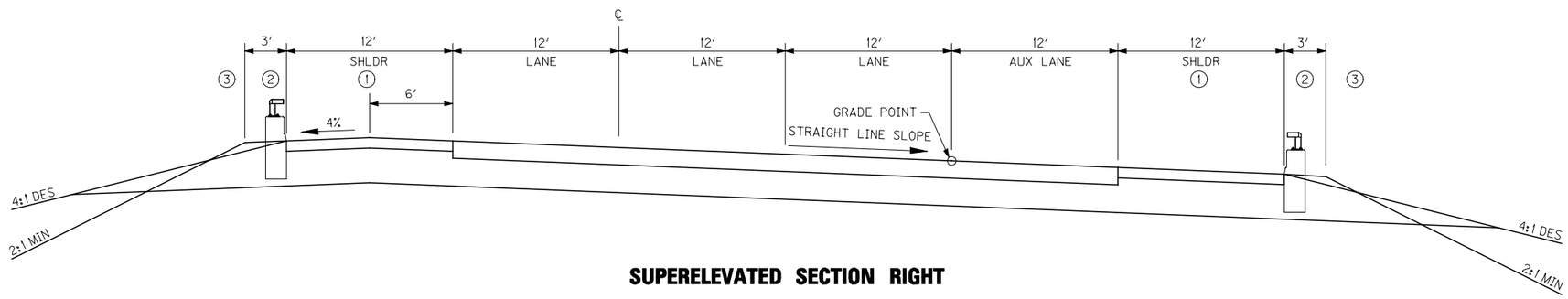
COUNTY OF	ITEM NO.	SHEET NO.
		25

RAMP 26 TYPICAL SECTIONS

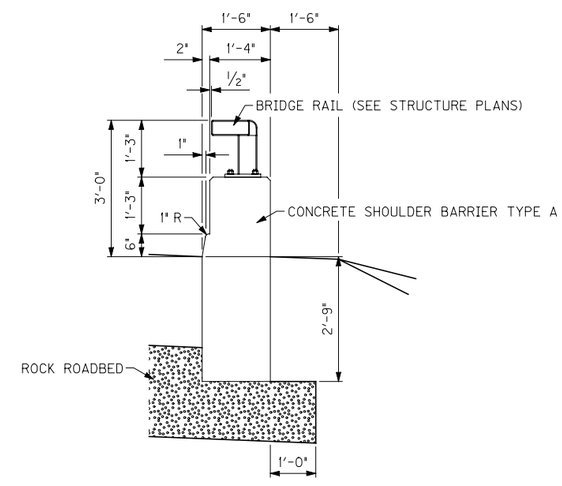
STATION 97+22.63 TO STATION 112+58.50



NORMAL SECTION



SUPERELEVATED SECTION RIGHT



DETAIL B

NOT TO SCALE

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NOT TO SCALE

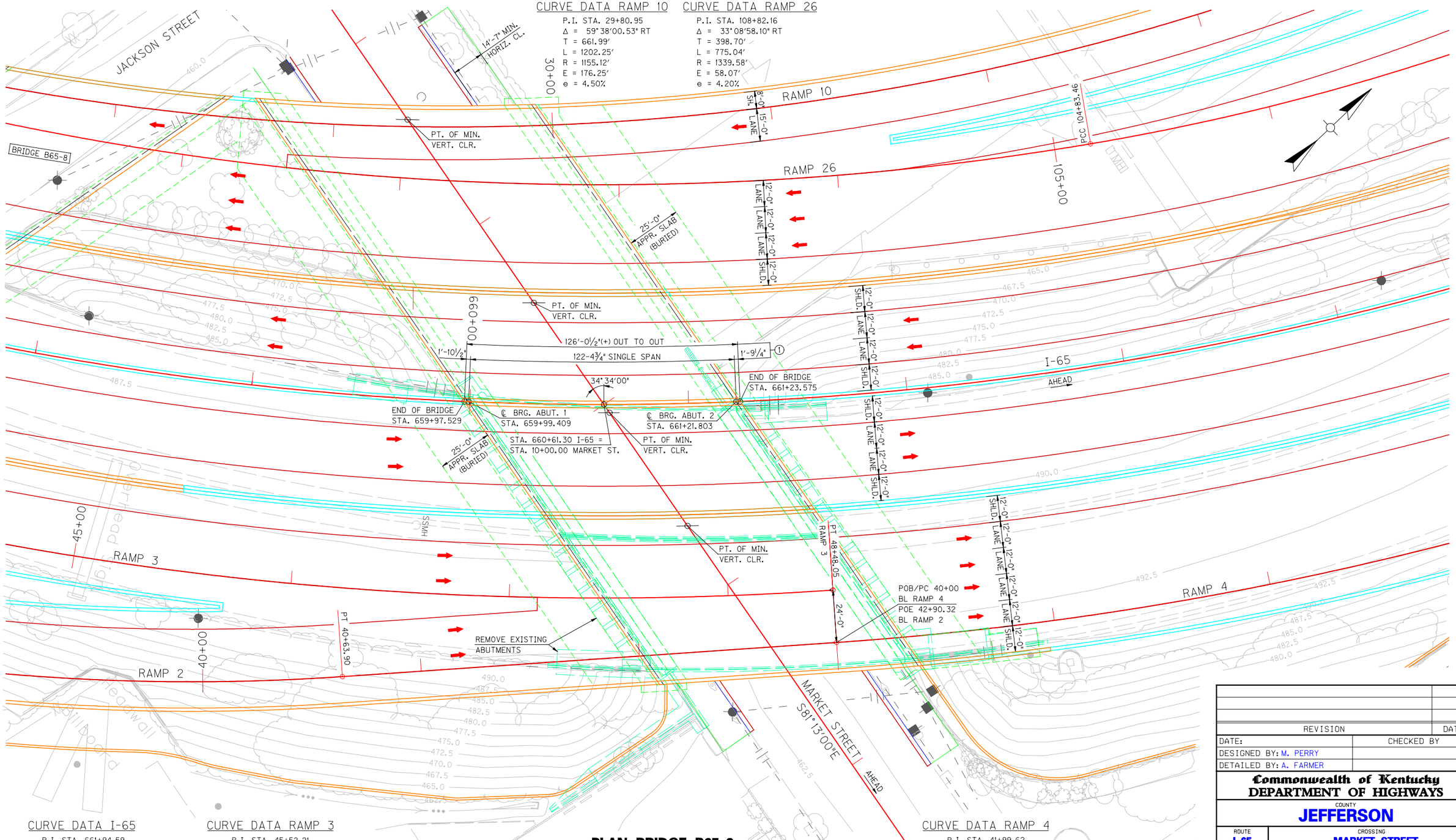
THE OHIO RIVER BRIDGES

Kentucky Transportation Associates

TYPICAL SECTIONS RAMP 26

PREPARED BY ____ DATE ____
CHECKED BY ____ DATE ____
APPROVED BY ____ DATE ____

USER: lperrym
DATE: 5/26/2006
FILE NAME: ...\mperry\dms01609\TS_R-26-4.dgn
E-SHEET NAME:



CURVE DATA I-65
P.I. STA. 661+94.59
Δ = 53°31'26" LT
T = 726.20'
L = 1345.20'
R = 1440.00'
E = 172.75'
e = 5.20%

CURVE DATA RAMP 3
P.I. STA. 45+52.21
Δ = 22°28'23" LT
T = 303.65'
L = 599.49'
R = 1528.42'
E = 29.87'
e = 4.00%

PLAN BRIDGE B65-9

122'-4¾" SINGLE SPAN - 60" STEEL TUB GIRDERS
34°34'00" SKEW LT., HS-25 ALTERNATE MILITARY LOADING
BRIDGE ROADWAY WIDTH VARIES
SHOULDER WIDTH VARIES AT BRIDGE

CURVE DATA RAMP 4
P.I. STA. 41+99.62
Δ = 14°39'16.50" LT
T = 199.62'
L = 397.06'
R = 1552.42'
E = 12.78'
e = 3.90%

① MEASURED ALONG I-65

REVISION	DATE

DATE:	CHECKED BY
DESIGNED BY: M. PERRY	
DETAILED BY: A. FARMER	

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: **JEFFERSON**

ROUTE: **I-65** | CROSSING: **MARKET STREET**

LAYOUT BRIDGE B65-9

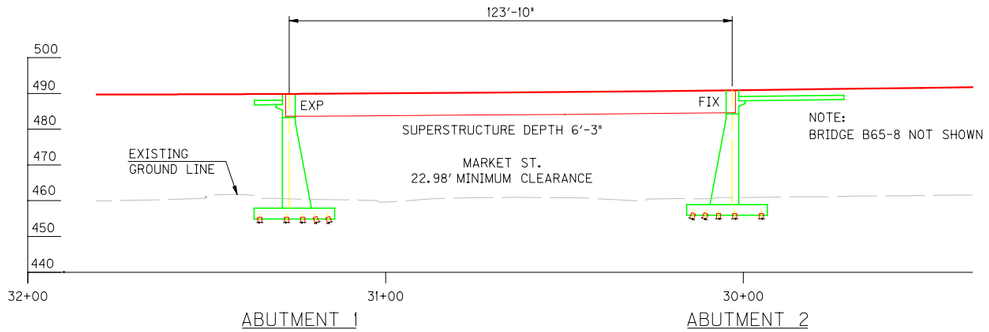
ITEM NUMBER
5-118.18 & 5-118.19

PREPARED BY: THE OHIO RIVER BRIDGES — Kentucky Transportation Associates

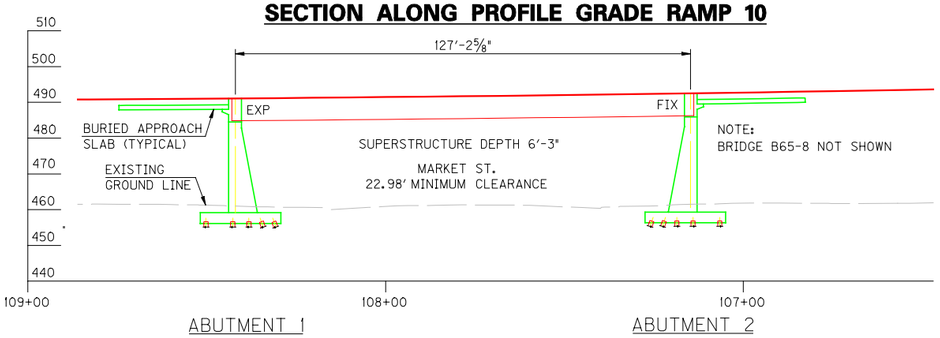
SHEET NO.

DRAWING NO.

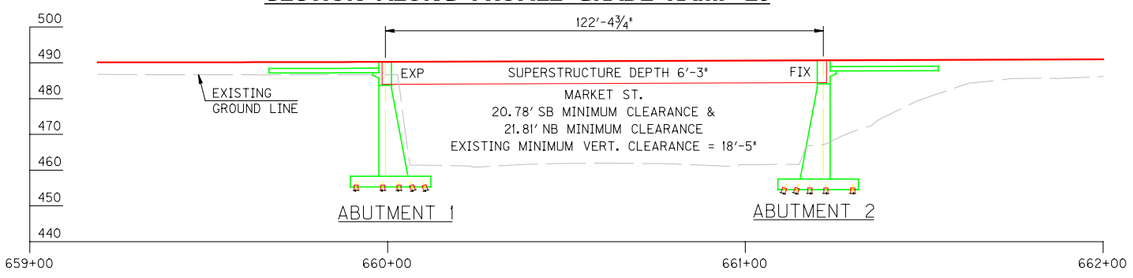
SHEET LOCATION:
FILE NAME: ...\dms02666\S0450_LAY01.DGN
USERNAME: ttrimbe
DATE: 6/6/2006
E-SHEET NAME:



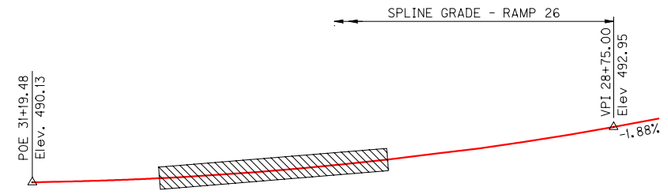
SECTION ALONG PROFILE GRADE RAMP 10



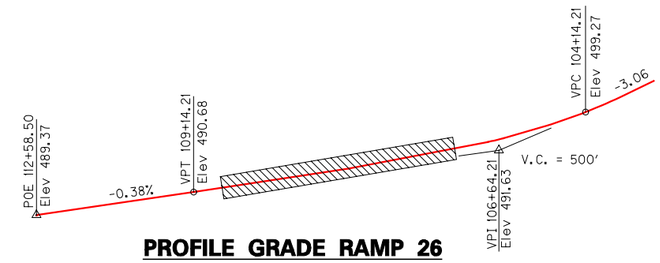
SECTION ALONG PROFILE GRADE RAMP 26



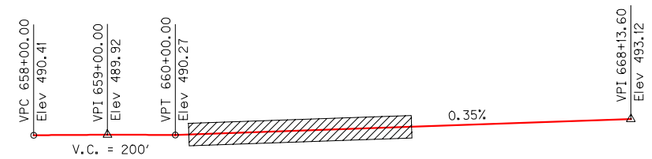
SECTION ALONG PROFILE GRADE I-65 NB / SB



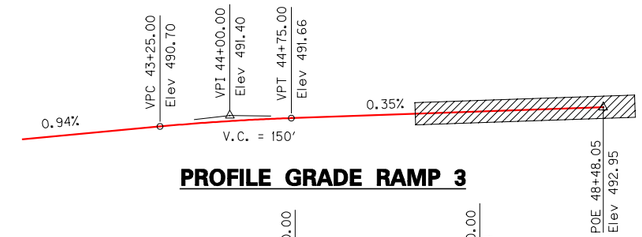
PROFILE GRADE RAMP 10



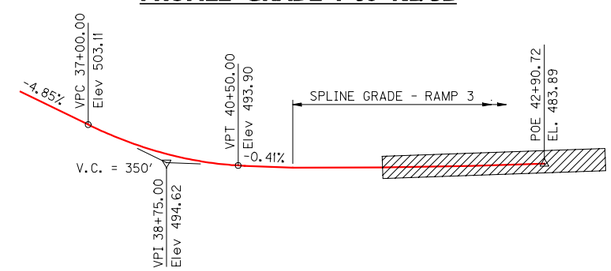
PROFILE GRADE RAMP 26



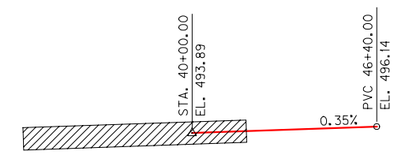
PROFILE GRADE I-65 NB/SB



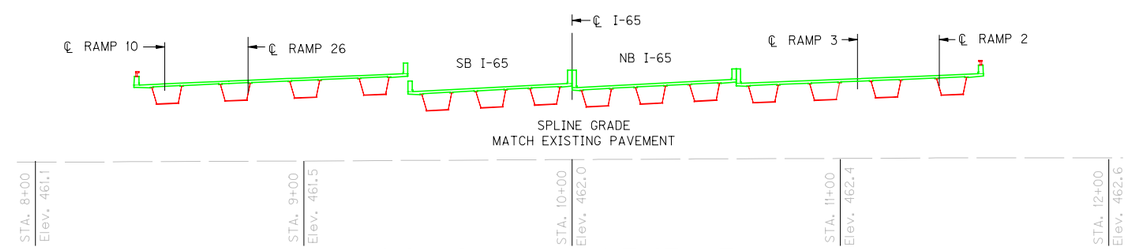
PROFILE GRADE RAMP 3



PROFILE GRADE RAMP 2

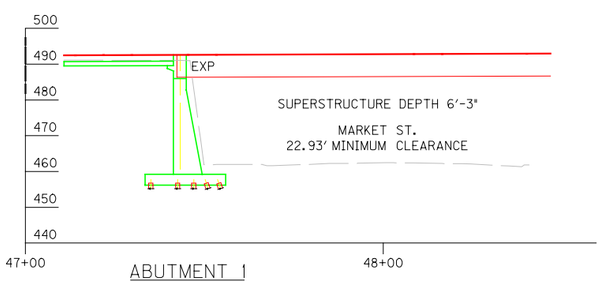


PROFILE GRADE RAMP 4

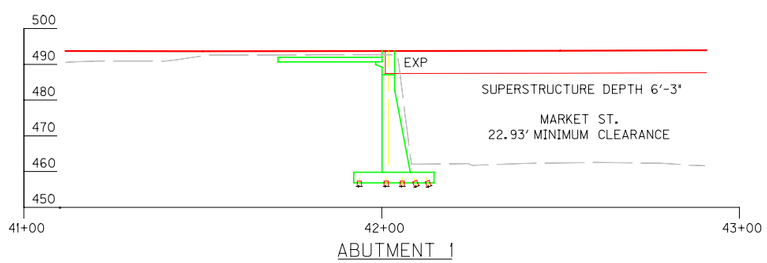


PROFILE GRADE MARKET STREET

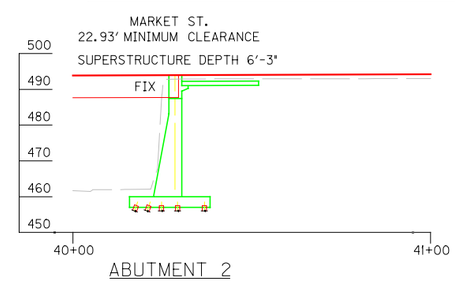
- DENOTES LIMITS OF STRUCTURE



SECTION ALONG PROFILE GRADE RAMP 3



SECTION ALONG PROFILE GRADE RAMP 2



SECTION ALONG PROFILE GRADE RAMP 4

REVISION	DATE

DATE:	CHECKED BY
DESIGNED BY: M. PERRY	
DETAILED BY: E. TRIMBLE	

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: JEFFERSON

ROUTE: I-65 | CROSSING: MARKET STREET

PROFILES BRIDGE B65-9

ITEM NUMBER: 5-118.18 & 5-118.19

PREPARED BY: THE OHIO RIVER BRIDGES — Kentucky Transportation Associates

SHEET NO.

DRAWING NO.

SHEET LOCATION:

FILE NAME: ...\dms02666\S0450_LAY02.dgn

USERNAME: ltrimbe

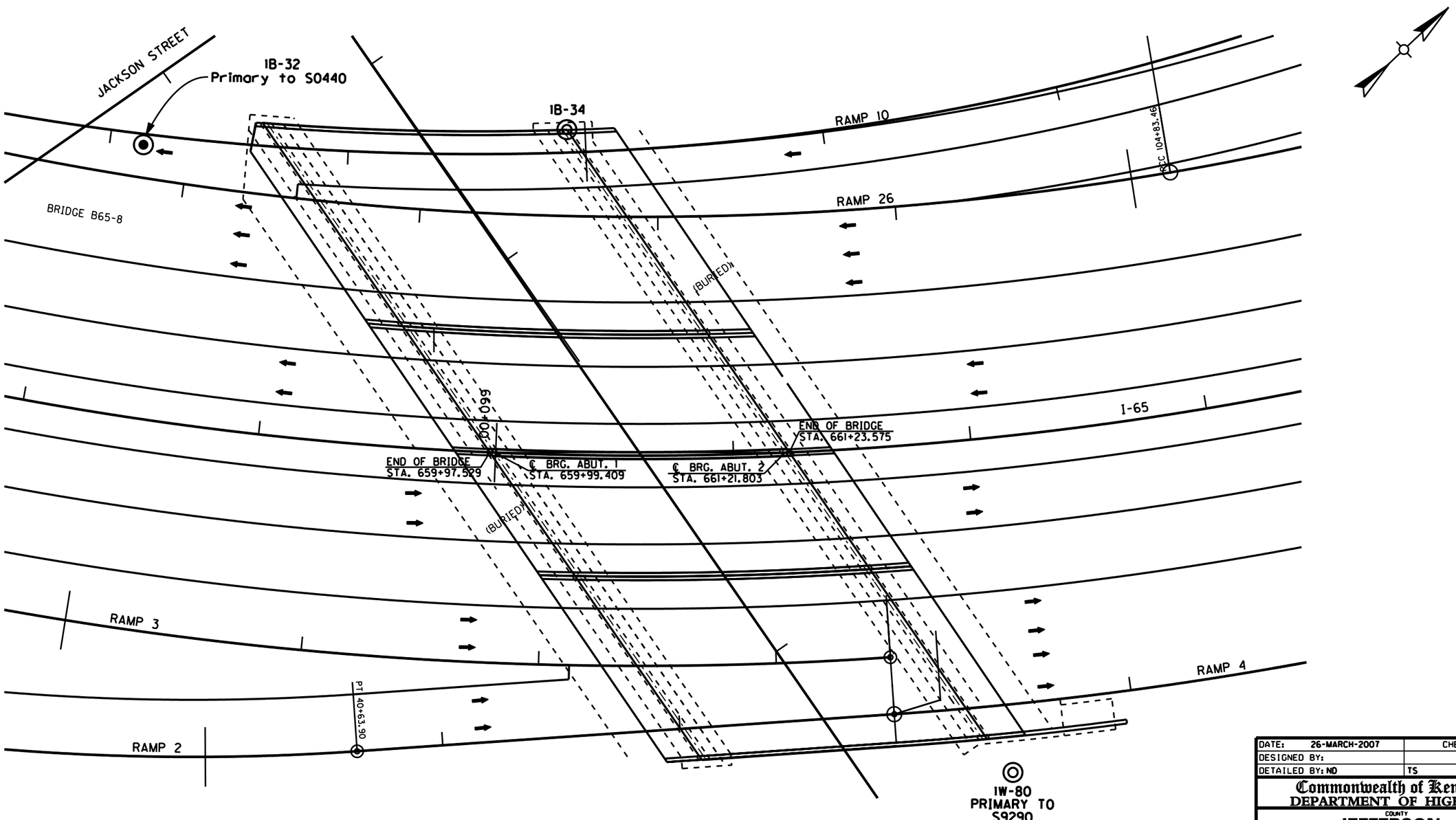
DATE: 6/6/2006

E-SHEET NAME:

APPENDIX C:

SUBSURFACE DATA SHEET

SUBSURFACE DATA



PLAN BRIDGE B65-9

Plan Scale 1" = 20'

DATE: 26-MARCH-2007	CHECKED BY
DESIGNED BY:	
DETAILED BY: ND	TS

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: JEFFERSON

ROUTE: I65 — CROSSING: Bridge over MARKET ST.

SUBSURFACE DATA

PREPARED BY: THE OHIO RIVER BRIDGES — Kentucky Transportation Associates

SHEET NO.

DRAWING NO. 0000

S0450

ITEM NUMBER: 5-118.18 & 19

Sheet 1 of 2

SHEET LOCATION:

FILE NAME: $$$$design$file$specification$$$$

USERNAME: $$$$USER$$$$

DATE: $$$$DATE$$$$

E-SHEET NAME:

...\S0450_Subsurface Data.dgn 4/9/2007 4:10:49 PM

SUBSURFACE DATA

Profile Scale:
Vertical 1" = 10'
Horizontal not to scale

APPROXIMATE ROADWAY GRADE ELEV. = 000.0

Hole No.
Station
Offset
Elev.
(Sea level datum)

END BENT ONE

IB-32
658+80
99' Lt.
461.5

200 Wash	Qu (ksf)	w%	LI		
		17.5	NP	N= 11	A-4; CL, S+C=53.4(34.4+19.0)
35.0	0	19.3			
		13.3	NP		A-2-4; SM, S+C=31.2(20.4+10.8)
	0	4.3			
		4.6		N= 7	
		4.8		N= 6	
		5.9			
		7.6	NP	N= 12	A-1-b; SP-SC, S+C=6.9(2.9+4.0)
		3.3		N= 42	
		3.1		N= 33	
		3.3	NP	N= 45	A-1-b; SP-SM, S+C=7.0(4.1+2.9)
		419.0		N= 37	
		12.8		N= 22	
		13.5		N= 24	
		16.6	NP	N= 28	A-1-b; SP-SC, S+C=8.1(2.7+5.4)
		14.5		N= 26	
		13.1		N= 35	
		17.7		N= 22	
		19.9		N= 28	
		19.3	NP	N= 24	A-1-b; SP-SC, S+C=8.5(3.6+4.9)
		23.4		N= 24	
		17.2	NP	N= 36	A-1-b; SP-SC, S+C=8.9(3.7+5.2)
		14.8		N= 56	
		20.7		N= 40	
		13.0	NP	N= 55.5	A-1-b; SP-SM, S+C=9.0(6.2+2.8)
		25.3		N= 32	
		25.4		N= 20	
		23.7		N= 35	
		24.3	NP	N= 50/3"	A-1-a; GP-GM, S+C=9.8(6.9+2.9)

Top of rock elev.= 334.9

KYROD	ROD	REC	
77	77	99	LIMESTONE: light gray, crystalline, few thin shale partings, dolomitic
95	95	100	LIMESTONE: light gray, crystalline, few thin shale partings, dolomitic

N.R.
(317.1)

PIER ONE

IB-34
660+42
127' Lt.
461.3

200 Wash	Qu (ksf)	w%	LI		
33.2	.0075	9.1	NP		A-4; SM, S+C=47.9(29.5+18.4)
		11.5	NP	N= 7	A-4; SM, S+C=41.9(34.3+7.6)
		2.2			
		2.9	NP	N= 5	A-3; SP-SC, S+C=8.5(2.6+5.9)
		3.0		N= 1	
		5.6			
		3.1	NP	N= 4	A-1-b; SP-SC, S+C=5.8(1.4+4.4)
		3.1		N= 6	
4.2		3.7		N=10	
		2.5	NP	N=31	A-1-a; SP, S+C=3.9(5.7+2.9)
		11.6	NP	N=10	A-1-b; SW-SM, S+C=8.6(5.7+2.9)
		417.4			
		14.6	NP	N=20	A-1-a; SW-SM, S+C=7.9(5.1+2.8)
		18.5	NP	N=23	A-3; SP-SM, S+C=9.3(5.1+4.2)
		16.4	NP	N=21	A-1-b; SP-SM, S+C=8.7(4.6+4.1)
		16.7		N=19	
		22.0	NP	N=20	A-1-b; SP-SC, S+C=8.1(2.7+5.4)
		23.9		N=25	
		17.8		N=33	

N.R.
(381.4)

WALL 80

IW-80
662+60
155' Rt.
461.9

200 Wash	Qu (ksf)	w%	LI		
19.8	0	15.1	NP		
11.2		8.8		N=WOH	
		23.2	NP	N=7	A-4; CL, S+C=88.0(46.0+42.0)
		12.7	NP	N=5	
4.6		7.3	NP	N=9	A-1-b, SP-SC, S+C=6.6(3.1+3.5)
		6.2		N=7	A-3, SP-SM, S+C=7.2(5.9+1.3)
7.4		3.6	NP	N=32	
		7.3		N=28	A-1-a, GP-GC, S+C=5.9(2.9+3.0)
		8.9	NP	N=25	
		12.4		N=30	A-1-b, SP-SM, S+C=11.97(8.97+3.0)
		13.1		N=27	
		11.3		N=31	
		11.7	NP	N=43	A-1-b, SW-SC, S+C=8.5(4.0+4.5)
		23.3		N=23	
		22.2		N=21	A-1-b, SP-SC, S+C=9.1(2.4+6.7)
		15.5		N=25	A-1-b, SP-SC, S+C=8.1(1.7+6.4)

N.R.
(381.9)

Datum

DATE: 26-MARCH-2007	CHECKED BY
DESIGNED BY:	
DETAILED BY: ND	TS

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: JEFFERSON

ROUTE: I-65 | CROSSING: Bridge over MARKET ST.

SUBSURFACE DATA

S0450
ITEM NUMBER
5-118.18 & 19

PREPARED BY: THE OHIO RIVER BRIDGES — Kentucky Transportation Associates

SHEET NO.

DRAWING NO. 0000

Sheet 2 of 2

SHEET LOCATION:
FILE NAME: $$$$design$file$specification$$$$
USERNAME: $$$$USER$$$$
DATE: $$$$DATE$$$$
E-SHEET NAME:

APPENDIX D:

CORRELATION OF SPT DATA TO HAMMER EFFICIENCY AND OVERBURDEN PRESSURE

KENNEDY INTERCHANGE
STRUCTURE S0450 BORING 1B-32, 1B-34, & 1W-80
CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS
FOR COARSE GRAINED SOILS

A	B	C	D	E	F	G	H	I	J	L	M	O
	Depth of Mid. Pt. of Sample	Assumed Estimated Unit Weight	Vertical Effective Stress	SPT N Value	SPT N Value	Corrected Factor	Corrected N-Value	Relative Density	Unified Soil Classification	Unit Weight Dry	Moisture content	Void Ratio
Soil No.	(ft)	(pcf) γ	(ksf) ó	N	N	C_N	$(N_1)_{60}$	(%)		(pcf)	(%) m	

NOTES:

C. This spreadsheet has been designed such that an initial "Assumed Estimated Unit Weight" is placed into Column C.

E. N_{80} is the blow count per foot as determined in the field using a automatic hammer.

F. $N_{60} = (E_{AH}/60)\ N_{AH}$ where: E_{AH} = autohammer efficiency (80%): N_{AH}=blowcount from the autohammer, as referenced in (1)
The autohammer efficiency is based on typical values of efficiencies (85-95) and actual testing preformed on FMSM hammers. SPT Analyze Pile Dynamics Inc. was used to conduct the testing. An autohammer is more energy efficient than a standard hammer.
Hammer efficiency is a means of comparing the energy transferred from the hammer to the drill string during sampling.

G. AASHTO LRFD Bridge Design Specification Section 10.4.6.2.4, CN= 0.77*Log10(40/ó) and CN,2.0

I. Relative Density based on Tokimatsu, K. and Seed, H.B. 1988. "Evaluation of Settlements in Sands Due to Earthquake Shaking" JGED, ASCE, Vol. 113, No. 8, pp. 861-878; as referenced in (2).

J. Classification based on field and laboratory data by KSWA.

L. Moisture content based on laboratory testing of SPT samples by KSWA.

KENNEDY INTERCHANGE
STRUCTURE S0450 BORING 1B-32
CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS
FOR COARSE GRAINED SOILS

Sample Interval			Depth of Mid. Pt. of Sample (ft)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ	SPT N Value N_{80}	SPT N Value N_{60}	Corrected Factor C_N	Corrected N-Value $(N_1)_{60}$	Unified Soil Classification	Moisture content (%) M
				Water Table =	43.5						
0	–	4	2	125	0.25	N/A	N/A	N/A	N/A	CL	N/A
4	–	12	8	115	0.92	N/A	N/A	N/A	N/A	SP	N/A
12	–	13.5	12.75	115	1.49	7	9	1.10	10	SP	4.6
15	–	16.5	15.75	115	1.83	6	8	1.03	8	SP	4.8
20	–	21.5	20.75	115	2.41	12	16	0.94	15	SP-SC	7.6
25	–	26.5	25.75	115	2.98	42	56	0.87	49	SP-SC	3.3
30	–	31.5	30.75	115	3.56	33	44	0.81	36	GP-GM	3.1
35	–	36.5	35.75	122	4.17	45	60	0.76	45	GP-GM	3.3
40	–	41.5	40.75	122	4.78	37	49	0.71	35	GP-GM	4.1
45	–	46.5	45.75	122	5.07	22	29	0.69	20	SP-SM	12.8
50	–	51.5	50.75	122	5.37	24	32	0.67	21	SP	13.5
55	–	56.5	55.75	122	5.67	28	37	0.65	24	SP-SC	16.6
60	–	61.5	60.75	122	5.97	26	35	0.64	22	SP-SC	14.5
65	–	66.5	65.75	122	6.27	35	47	0.62	29	SP-SC	13.1
70	–	71.5	70.75	127	6.59	22	29	0.60	17	SP-SC	17.7
75	–	76.5	75.75	127	6.91	28	37	0.59	22	SP-SC	19.9
80	–	81.5	80.75	127	7.24	24	32	0.57	18	SP-SC	19.3
85	–	86.5	85.75	127	7.56	24	32	0.56	18	SP-SC	23.4
90	–	91.5	90.75	127	7.88	36	48	0.54	26	SP-SC	17.2
95	–	96.5	95.75	127	8.20	56	75	0.53	40	SP-SC	14.8
100	–	101.5	100.75	127	8.53	40	53	0.52	27	GP-GM	20.7
105	–	106.5	105.75	127	8.85	105	140	0.50	50+	GP-GM	13.0
110	–	111.5	110.75	127	9.17	32	43	0.49	21	GP-GM	25.3
115	–	116.5	115.75	127	9.50	20	27	0.48	13	GP-GM	25.4
120	–	121.5	120.75	127	9.82	35	47	0.47	22	GP-GM	N/A
125	–	125.25	125.125	127	10.10	82	109	0.46	50+	GP-GM	N/A

KENNEDY INTERCHANGE
STRUCTURE S0450 BORING 1B-34
CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS
FOR COARSE GRAINED SOILS

Sample Interval			Depth of Mid. Pt. of Sample (ft)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ	SPT N Value N_{80}	SPT N Value N_{60}	Corrected Factor C_N	Corrected N-Value $(N_1)_{60}$	Unified Soil Classification	Moisture content (%) M
				Water Table =	44.0						
0	–	10	5	115	0.58	N/A	N/A	N/A	N/A	CL-ML	N/A
10	–	11.5	10.75	115	1.24	5	7	1.16	8	SP-SC	2.9
15	–	16.5	15.75	115	1.81	1	1	1.03	1	SP-SC	3.0
20	–	21.5	20.75	115	2.39	4	5	0.94	5	SP-SC	3.1
25	–	26.5	25.75	115	2.96	6	8	0.87	7	SP-SC	3.1
30	–	31.5	30.75	122	3.57	10	13	0.81	11	SP-SC	3.7
35	–	36.5	35.75	127	4.21	31	41	0.75	31	SP	2.5
40	–	41.5	40.75	122	4.82	10	13	0.71	9	SW-SM	11.6
45	–	46.5	45.75	122	5.11	20	27	0.69	19	SW-SM	14.6
50	–	51.5	50.75	122	5.41	23	31	0.67	21	SP-SM	18.5
55	–	56.5	55.75	122	5.71	21	28	0.65	18	SP-SM	16.4
60	–	61.5	60.75	122	6.01	19	25	0.63	16	SP-SM	16.7
65	–	66.5	65.75	122	6.31	20	27	0.62	17	SP-SC	22.0
70	–	71.5	70.75	122	6.60	25	33	0.60	20	SP-SC	23.9
75	–	76.5	75.75	127	6.93	33	44	0.59	26	SP-SC	17.8

KENNEDY INTERCHANGE
STRUCTURE S4050 BORING 1W-80
CORRELATION OF SPT DATA TO UNIT WEIGHTS AND SHEAR STRENGTHS
FOR COARSE GRAINED SOILS

Sample Interval			Depth of Mid. Pt. of Sample (ft)	Assumed Estimated Unit Weight (pcf) γ	Vertical Effective Stress (ksf) σ	SPT N Value N_{80}	SPT N Value N_{60}	Corrected Factor C_N	Corrected N-Value $(N_1)_{60}$	Unified Soil Classification	Moisture content (%) M
				Water Table =	42.0						
0	–	13	6.5	105	0.68	N/A	N/A	N/A	N/A	CL	N/A
15	–	16.5	15.75	115	1.75	5	7	1.05	7	SP-SC	12.7
20	–	21.5	20.75	115	2.32	9	12	0.95	11	SP-SC	7.3
25	–	26.5	25.75	115	2.90	7	9	0.88	8	SP-SM	6.2
30	–	31.5	30.75	127	3.53	32	43	0.81	35	GP-GC	3.6
35	–	36.5	35.75	127	4.17	28	37	0.76	28	GP-GC	7.3
40	–	41.5	40.75	127	4.80	25	33	0.71	23	GP-GC	8.9
45	–	46.5	45.75	127	5.12	30	40	0.69	27	SP-SM	12.4
50	–	51.5	50.75	127	5.45	27	36	0.67	24	SP-SM	13.1
55	–	56.5	55.75	127	5.77	31	41	0.65	27	SP-SM	11.3
60	–	61.5	60.75	127	6.09	43	57	0.63	36	SW-SC	11.7
65	–	66.5	65.75	127	6.42	23	31	0.61	19	SP-SC	23.3
70	–	71.5	70.75	127	6.74	21	28	0.60	17	SP-SC	22.2
75	–	76.5	75.75	127	7.06	25	33	0.58	19	SP-SC	15.5

APPENDIX E:

SOIL PROFILES

K.S. Ware & Associates, L.L.C.
Engineering, Environmental & Information Services

SUBSURFACE PROFILE

Kennedy Interchange
Bridge S0450

Boring Number 1B-32

Stratigraphy

Approximate Elevation (ft.)	Approximate Depth (ft.)	Description	Parameters
462.7	**0.0**	Stiff Clay (CL)	γ_t (lb/ft^3) = 125; C_u(tsf) = 0.19; E_{50} = 0.02; P-Y Curve Reference Number 3
452.7	**10.0**	Loose Sand (SP)	γ_t (lb/ft^3) = 115; Φ(°) = 31.1; P-Y Curve Reference Number 4
438.7	**24.0**	Dense Sand (SP-SC and GP-GM)	γ_t (lb/ft^3) = 127; Φ(°) = 35; P-Y Curve Reference Number 4
420.7	**42.0**	Dense Sand (SP-SC and GP-GM)	γ_t (lb/ft^3) = 127; γ_e (lb/ft^3) = 64.6; Φ(°) = 35; P-Y Curve Reference Number 4
318.7	**144.0**	**Refusal** **Boring Terminated**	

γ_t (lb/ft^3	=	Unit Density (Above Water Table)			
γ_e (lb/ft^3	=	Unit Density (Below Water Table)	C_u(tsf)	=	Undrained Shear Strength
Φ (°)	=	Friction Angle	E_{50}	=	Modulus of Elasticity of Soil (50%)

K.S. Ware & Associates, L.L.C.
Engineering, Environmental & Information Services

SUBSURFACE PROFILE

Kennedy Interchange
Bridge S0450

Boring Number 1B-34

Stratigraphy

Approximate Elevation (ft.)	Approximate Depth (ft.)	Description	Parameters
461.0	**0.0**	Firm Silty Clayey Sand (SC-SM)	γ_t (lb/ft^3) = 115; C_u(tsf) = 0.275; Φ(°) = 28.1; P-Y Curve Reference Number 5
454.0	**7.0**	Loose Sand (SP-SC)	γ_t (lb/ft^3) = 115; Φ(°) = 28.9; P-Y Curve Reference Number 4
428.0	**33.0**	Medium Dense Sand (SP-SM and SW-SM)	γ_t (lb/ft^3) = 122; Φ(°) = 32.6; P-Y Curve Reference Number 4
417.0	**44.0**	Medium Dense Sand (SP-SM and SW-SM)	γ_t (lb/ft^3) = 122; γ_e (lb/ft^3) = 59.6; Φ(°) = 32.6; P-Y Curve Reference Number 4
395.0	**66.0**	Dense Sand (SP-SC)	γ_t (lb/ft^3) = 127; γ_e (lb/ft^3) = 64.6; Φ(°) = 33.6; P-Y Curve Reference Number 4
381.0	**80.0**	**No Refusal** **Boring Terminated**	

γ_t (lb/ft^3	=	Unit Density (Above Water Table)			
γ_e (lb/ft	=	Unit Density (Below Water Table)	C_u(tsf)	=	Undrained Shear Strength
Φ (°)	=	Friction Angle	E_{50}	=	Modulus of Elasticity of Soil (50%)

K.S. Ware & Associates, L.L.C.
Engineering, Environmental & Information Services

SUBSURFACE PROFILE

Kennedy Interchange
Bridge S0450

Boring Number 1W-80

Stratigraphy

Approximate Elevation (ft.)	Approximate Depth (ft.)	Description	Parameters
462.0	**0.0**	Soft Silty Clay (CL)	γ_t (lb/ft^3) = 105; C_u(tsf) = 0.15; E_{50} = 0.02; P-Y Curve Reference Number 1
449.0	**13.0**	Loose Sand (SP-SC & SP-SM)	γ_t (lb/ft^3) = 115; $\Phi(°)$ = 30.4; P-Y Curve Reference Number 4
434.0	**28.0**	Dense Sand (GP-GC)	γ_t (lb/ft^3) = 127; $\Phi(°)$ = 37; P-Y Curve Reference Number 4
420.0	**42.0**	Dense Sand (SP-SM and SP-SC)	γ_t (lb/ft^3) = 127; γ_e (lb/ft^3) = 64.6; $\Phi(°)$ = 37; P-Y Curve Reference Number 4
382.0	**80.0**	**No Refusal** **Boring Terminated**	

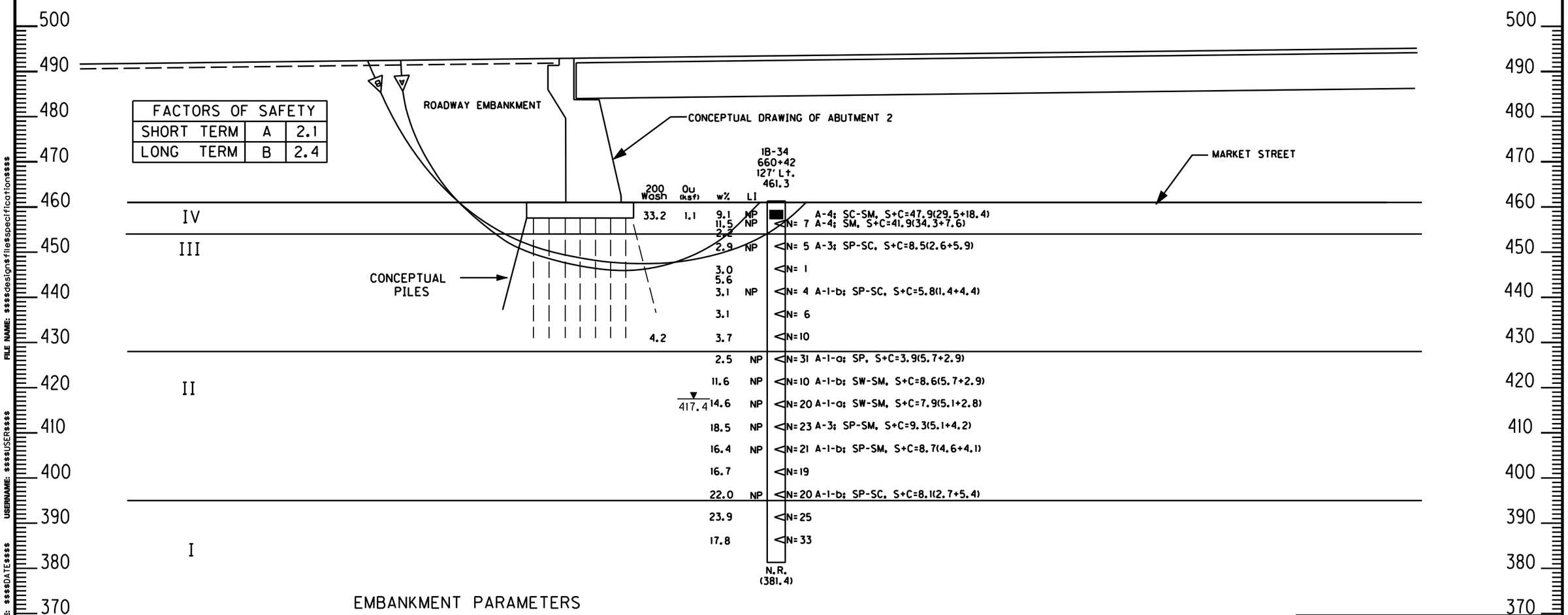
γ_t (lb/ft^3	=	Unit Density (Above Water Table)			
γ_e (lb/ft^3	=	Unit Density (Below Water Table)	C_u(tsf)	=	Undrained Shear Strength
Φ (°)	=	Friction Angle	E_{50}	=	Modulus of Elasticity of Soil (50%)

APPENDIX F:

STABILITY SECTION

STABILITY SECTION

Profile Scale:
Vertical 1" = 10'
Horizontal not to scale



FACTORS OF SAFETY		
SHORT TERM	A	2.1
LONG TERM	B	2.4

EMBANKMENT PARAMETERS

ASSUMED SOIL STRENGTH PARAMETERS					
SOIL	I	II	III	IV	ROADWAY EMBANKMENT
SHORT TERM	γ = 127 pcf c = 0 psf ϕ = 33.6	γ = 122 pcf c = 0 psf ϕ = 32.6	γ = 115 pcf c = 0 psf ϕ = 28.9	γ = 115 pcf c = 550 psf ϕ = 0	γ = 120 pcf c = 1000 psf ϕ = 0
LONG TERM	γ = 127 pcf $\bar{c}$ = 0 psf $\bar{\phi}$ = 33.6	γ = 122 pcf $\bar{c}$ = 0 psf $\bar{\phi}$ = 32.6	γ = 115 pcf $\bar{c}$ = 0 psf $\bar{\phi}$ = 28.9	γ = 115 pcf $\bar{c}$ = 0 psf $\bar{\phi}$ = 28.1	γ = 120 pcf $\bar{c}$ = 200 psf $\bar{\phi}$ = 23

SHEET 1 OF 1

ITEM NUMBER
5-118.18 & 19

DATE: 26- MARCH- 2007 | CHECKED BY
DESIGNED BY:
DETAILED BY: ND | TS

Commonwealth of Kentucky
DEPARTMENT OF HIGHWAYS

COUNTY: JEFFERSON

ROUTE: 165 | CROSSING: MARKET STREET

STABILITY SECTION

PREPARED BY: THE OHIO RIVER BRIDGES — Kentucky Transportation Associates

SHEET NO. 000
DRAWING NO. 000

SHEET LOCATION:
FILE NAME: $$$$designs$file$specification$$$$
USERNAME: $$$$USER$$$$
DATE: $$$$DATE$$$$
E-SHEET NAME:

...\S0450_GEOSUBS STAB.dgn 4/26/2007 8:54:09 AM

APPENDIX G:

CAPACITY TABLES

ABUTMENT 2 AT I-65 AND RAMPS 10 AND 26

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
12x53 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nonimal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65) (kips)	(tons)	ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35) (kips)	(tons)
0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	-1.02	0.00	-1.02	-0.5	-0.4	-0.2	-0.7	-0.3	0.3	0.1
2	-2.04	0.00	-2.04	-1.0	-0.7	-0.4	-1.3	-0.7	0.5	0.3
3	-3.07	0.00	-3.07	-1.5	-1.1	-0.5	-2.0	-1.0	0.8	0.4
4	-4.09	0.00	-4.09	-2.0	-1.4	-0.7	-2.7	-1.3	1.0	0.5
5	-5.11	0.00	-5.11	-2.6	-1.8	-0.9	-3.3	-1.7	1.3	0.6
@ 6' 6	-6.13	0.00	-6.13	-3.1	-2.1	-1.1	-4.0	-2.0	1.5	0.8
6	-6.15	0.00	-6.15	-3.1	-2.2	-1.1	-4.0	-2.0	1.5	0.8
Silts 7	-7.56	0.00	-7.56	-3.8	-2.6	-1.3	-4.9	-2.5	2.2	1.1
Sands 7	-7.58	1.43	-6.15	-3.1	-2.2	-1.1	-4.0	-2.0	2.9	1.5
8	-5.50	1.43	-4.07	-2.0	-1.4	-0.7	-2.6	-1.3	3.6	1.8
9	-3.42	1.43	-1.99	-1.0	-0.7	-0.3	-1.3	-0.6	4.3	2.2
10	-1.34	1.43	0.09	0.0	0.0	0.0	0.1	0.0	4.8	2.4
10.6	-0.10	1.43	1.33	0.7	0.5	0.2	0.9	0.4	5.1	2.5
11	0.73	1.43	2.16	1.1	0.8	0.4	1.4	0.7	6.0	3.0
12	2.81	1.43	4.24	2.1	1.8	0.9	2.8	1.4	7.0	3.5
13	4.89	1.43	6.32	3.2	2.7	1.4	4.1	2.1	8.0	4.0
14	6.97	1.43	8.40	4.2	3.6	1.8	5.5	2.7	9.0	4.5
15	9.05	1.43	10.48	5.2	4.6	2.3	6.8	3.4	10.0	5.0
16	11.13	1.43	12.56	6.3	5.5	2.8	8.2	4.1	11.0	5.5
17	13.21	1.43	14.64	7.3	6.5	3.2	9.5	4.8	11.9	6.0
18	15.28	1.43	16.71	8.4	7.4	3.7	10.9	5.4	12.9	6.5
19	17.36	1.43	18.79	9.4	8.3	4.2	12.2	6.1	13.9	7.0
20	19.44	1.43	20.87	10.4	9.3	4.6	13.6	6.8	14.9	7.4
21	21.52	1.43	22.95	11.5	10.2	5.1	14.9	7.5	15.9	7.9
22	23.60	1.43	25.03	12.5	11.1	5.6	16.3	8.1	16.9	8.4
23	25.68	1.43	27.11	13.6	12.1	6.0	17.6	8.8	17.8	8.9
24	27.76	1.43	29.19	14.6	13.0	6.5	19.0	9.5	18.8	9.4
25	29.83	1.43	31.26	15.6	13.9	7.0	20.3	10.2	19.8	9.9
26	31.91	1.43	33.34	16.7	14.9	7.4	21.7	10.8	20.8	10.4
27	33.99	1.43	35.42	17.7	15.8	7.9	23.0	11.5	21.8	10.9
28	36.07	1.43	37.50	18.8	16.7	8.4	24.4	12.2	21.8	10.9
28	36.14	4.30	40.44	20.2	18.1	9.0	26.3	13.1	24.1	12.1
29	40.24	4.30	44.54	22.3	19.9	10.0	28.9	14.5	26.5	13.2
30	44.34	4.30	48.64	24.3	21.8	10.9	31.6	15.8	28.8	14.4
31	48.43	4.30	52.73	26.4	23.6	11.8	34.3	17.1	31.1	15.6
32	52.53	4.30	56.83	28.4	25.4	12.7	36.9	18.5	33.5	16.7
33	56.63	4.30	60.93	30.5	27.3	13.6	39.6	19.8	35.8	17.9
34	60.73	4.30	65.03	32.5	29.1	14.6	42.3	21.1	38.1	19.1
35	64.83	4.30	69.13	34.6	31.0	15.5	44.9	22.5	40.5	20.2
36	68.93	4.30	73.23	36.6	32.8	16.4	47.6	23.8	42.8	21.4
37	73.02	4.30	77.32	38.7	34.7	17.3	50.3	25.1	45.1	22.6
38	77.12	4.30	81.42	40.7	36.5	18.3	52.9	26.5	47.4	23.7
39	81.22	4.30	85.52	42.8	38.4	19.2	55.6	27.8	47.5	23.7

Contributes to Downdrag

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
12x53 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)	(kips)	(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
39	81.31	4.30	85.61	42.8	38.4	19.2	55.6	27.8	50.5	25.3
40	86.88	4.30	91.18	45.6	40.9	20.4	59.3	29.6	53.5	26.8
41	92.45	4.30	96.75	48.4	43.4	21.7	62.9	31.4	56.6	28.3
42	98.02	4.30	102.32	51.2	45.9	23.0	66.5	33.3	59.6	29.8
43	103.58	4.30	107.88	53.9	48.4	24.2	70.1	35.1	62.6	31.3
44	109.15	4.30	113.45	56.7	50.9	25.5	73.7	36.9	65.6	32.8
45	114.72	4.30	119.02	59.5	53.4	26.7	77.4	38.7	68.7	34.3
46	120.29	4.30	124.59	62.3	55.9	28.0	81.0	40.5	71.7	35.8
47	125.86	4.30	130.16	65.1	58.4	29.2	84.6	42.3	74.7	37.4
48	131.43	4.30	135.73	67.9	60.9	30.5	88.2	44.1	77.7	38.9
49	137.00	4.30	141.30	70.6	63.5	31.7	91.8	45.9	80.8	40.4
50	142.57	4.30	146.87	73.4	66.0	33.0	95.5	47.7	83.8	41.9
51	148.13	4.30	152.43	76.2	68.5	34.2	99.1	49.5	86.8	43.4
52	153.70	4.30	158.00	79.0	71.0	35.5	102.7	51.4	89.8	44.9
53	159.27	4.30	163.57	81.8	73.5	36.7	106.3	53.2	92.9	46.4
54	164.84	4.30	169.14	84.6	76.0	38.0	109.9	55.0	95.9	47.9
55	170.41	4.30	174.71	87.4	78.5	39.2	113.6	56.8	98.9	49.5
56	175.98	4.30	180.28	90.1	81.0	40.5	117.2	58.6	101.9	51.0
57	181.55	4.30	185.85	92.9	83.5	41.7	120.8	60.4	104.9	52.5
58	187.11	4.30	191.41	95.7	86.0	43.0	124.4	62.2	108.0	54.0
59	192.68	4.30	196.98	98.5	88.5	44.3	128.0	64.0	111.0	55.5
60	198.25	4.30	202.55	101.3	91.0	45.5	131.7	65.8	114.0	57.0
61	203.82	4.30	208.12	104.1	93.5	46.8	135.3	67.6	114.1	57.0
61	203.95	6.65	210.60	105.3	94.6	47.3	136.9	68.4	118.7	59.3
62	213.68	6.65	220.33	110.2	99.0	49.5	143.2	71.6	123.2	61.6
63	223.40	6.65	230.05	115.0	103.4	51.7	149.5	74.8	127.8	63.9
64	233.13	6.65	239.78	119.9	107.8	53.9	155.9	77.9	132.4	66.2
65	242.85	6.65	249.50	124.8	112.1	56.1	162.2	81.1	137.0	68.5
66	252.58	6.65	259.23	129.6	116.5	58.3	168.5	84.2	141.6	70.8
67	262.30	6.65	268.95	134.5	120.9	60.4	174.8	87.4	146.1	73.1
68	272.03	6.65	278.68	139.3	125.3	62.6	181.1	90.6	150.7	75.4
69	281.75	6.65	288.40	144.2	129.6	64.8	187.5	93.7	155.3	77.6
70	291.48	6.65	298.13	149.1	134.0	67.0	193.8	96.9	159.9	79.9
71	301.20	6.65	307.85	153.9	138.4	69.2	200.1	100.1	164.4	82.2
72	310.93	6.65	317.58	158.8	142.8	71.4	206.4	103.2	169.0	84.5
73	320.65	6.65	327.30	163.7	147.2	73.6	212.7	106.4	173.6	86.8
74	330.38	6.65	337.03	168.5	151.5	75.8	219.1	109.5	178.2	89.1
75	340.10	6.65	346.75	173.4	155.9	78.0	225.4	112.7	182.8	91.4
76	349.83	6.65	356.48	178.2	160.3	80.1	231.7	115.9	187.3	93.7
77	359.55	6.65	366.20	183.1	164.7	82.3	238.0	119.0	191.9	96.0
78	369.28	6.65	375.93	188.0	169.0	84.5	244.4	122.2	196.5	98.2
79	379.01	6.65	385.66	192.8	173.4	86.7	250.7	125.3	201.1	100.5
80	388.73	6.65	395.38	197.7	177.8	88.9	257.0	128.5	205.6	102.8
81	398.46	6.65	405.11	202.6	182.2	91.1	263.3	131.7	210.2	105.1
82	408.18	6.65	414.83	207.4	186.5	93.3	269.6	134.8	214.8	107.4

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
12x53 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		**ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method**		**ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)**		**ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)**	
(ft)	(kips)	(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
83	417.91	6.65	424.56	212.3	190.9	95.5	276.0	138.0	219.4	109.7
84	427.63	6.65	434.28	217.1	195.3	97.6	282.3	141.1	224.0	112.0
85	437.36	6.65	444.01	222.0	199.7	99.8	288.6	144.3	228.5	114.3
86	447.08	6.65	453.73	226.9	204.0	102.0	294.9	147.5	233.1	116.6
87	456.81	6.65	463.46	231.7	208.4	104.2	301.2	150.6	237.7	118.8
88	466.53	6.65	473.18	236.6	212.8	106.4	307.6	153.8	242.3	121.1
89	476.26	6.65	482.91	241.5	217.2	108.6	313.9	156.9	246.8	123.4
90	485.98	6.65	492.63	246.3	221.6	110.8	320.2	160.1	251.4	125.7
91	495.71	6.65	502.36	251.2	225.9	113.0	326.5	163.3	256.0	128.0
92	505.43	6.65	512.08	256.0	230.3	115.2	332.9	166.4	260.6	130.3
93	515.16	6.65	521.81	260.9	234.7	117.3	339.2	169.6	265.2	132.6
94	524.89	6.65	531.54	265.8	239.1	119.5	345.5	172.7	269.7	134.9
95	534.61	6.65	541.26	270.6	243.4	121.7	351.8	175.9	274.3	137.2
96	544.34	6.65	550.99	275.5	247.8	123.9	358.1	179.1	278.9	139.4
97	554.06	6.65	560.71	280.4	252.2	126.1	364.5	182.2	283.5	141.7
98	563.79	6.65	570.44	285.2	256.6	128.3	370.8	185.4	288.0	144.0
99	573.51	6.65	580.16	290.1	260.9	130.5	377.1	188.6	292.6	146.3
100	583.24	6.65	589.89	294.9	265.3	132.7	383.4	191.7	297.2	148.6
101	592.96	6.65	599.61	299.8	269.7	134.8	389.7	194.9	301.8	150.9
102	602.69	6.65	609.34	304.7	274.1	137.0	396.1	198.0	306.3	153.2
103	612.41	6.65	619.06	309.5	278.4	139.2	402.4	201.2	310.9	155.5
104	622.14	6.65	628.79	314.4	282.8	141.4	408.7	204.4	315.5	157.8
105	631.86	6.65	638.51	319.3	287.2	143.6	415.0	207.5	320.1	160.0
106	641.59	6.65	648.24	324.1	291.6	145.8	421.4	210.7	324.7	162.3
107	651.31	6.65	657.96	329.0	296.0	148.0	427.7	213.8	329.2	164.6
108	661.04	6.65	667.69	333.8	300.3	150.2	434.0	217.0	333.8	166.9
109	670.76	6.65	677.41	338.7	304.7	152.4	440.3	220.2	338.4	169.2
110	680.49	6.65	687.14	343.6	309.1	154.5	446.6	223.3	343.0	171.5
111	690.22	6.65	696.87	348.4	313.5	156.7	453.0	226.5	347.5	173.8
112	699.94	6.65	706.59	353.3	317.8	158.9	459.3	229.6	352.1	176.1
113	709.67	6.65	716.32	358.2	322.2	161.1	465.6	232.8	356.7	178.4
114	719.39	6.65	726.04	363.0	326.6	163.3	471.9	236.0	361.3	180.6
115	729.12	6.65	735.77	367.9	331.0	165.5	478.2	239.1	365.9	182.9
116	738.84	6.65	745.49	372.7	335.3	167.7	484.6	242.3	370.4	185.2
117	748.57	6.65	755.22	377.6	339.7	169.9	490.9	245.4	375.0	187.5
118	758.29	6.65	764.94	382.5	344.1	172.0	497.2	248.6	379.6	189.8
119	768.02	6.65	774.67	387.3	348.5	174.2	503.5	251.8	384.2	192.1
120	777.74	6.65	784.39	392.2	352.8	176.4	509.9	254.9	388.7	194.4
121	787.47	6.65	794.12	397.1	357.2	178.6	516.2	258.1	393.3	196.7
122	797.19	6.65	803.84	401.9	361.6	180.8	522.5	261.2	397.9	199.0
123	806.92	6.65	813.57	406.8	366.0	183.0	528.8	264.4	402.5	201.2
124	816.64	6.65	823.29	411.6	370.3	185.2	535.1	267.6	407.1	203.5
125	826.37	6.65	833.02	416.5	374.7	187.4	541.5	270.7	-2.0	-1.0

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x73 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nonimal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65) (kips)	(tons)	ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35) (kips)	(tons)
0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	-1.34	0.00	-1.34	-0.7	-0.5	-0.2	-0.9	-0.4	0.3	0.2
2	-2.68	0.00	-2.68	-1.3	-0.9	-0.5	-1.7	-0.9	0.7	0.3
3	-4.03	0.00	-4.03	-2.0	-1.4	-0.7	-2.6	-1.3	1.0	0.5
4	-5.37	0.00	-5.37	-2.7	-1.9	-0.9	-3.5	-1.7	1.3	0.7
5	-6.71	0.00	-6.71	-3.4	-2.3	-1.2	-4.4	-2.2	1.7	0.8
@ 6' 6	-8.05	0.00	-8.05	-4.0	-2.8	-1.4	-5.2	-2.6	2.0	1.0
6	-8.09	0.00	-8.09	-4.0	-2.8	-1.4	-5.3	-2.6	2.0	1.0
Silts 7	-9.94	0.00	-9.94	-5.0	-3.5	-1.7	-6.5	-3.2	2.9	1.5
Sands 7	-9.96	1.98	-7.98	-4.0	-2.8	-1.4	-5.2	-2.6	3.9	1.9
8	-7.23	1.98	-5.25	-2.6	-1.8	-0.9	-3.4	-1.7	4.8	2.4
9	-4.50	1.98	-2.52	-1.3	-0.9	-0.4	-1.6	-0.8	5.7	2.9
10	-1.76	1.98	0.22	0.1	0.1	0.0	0.1	0.1	6.3	3.1
10.6	-0.12	1.98	1.86	0.9	0.6	0.3	1.2	0.6	6.6	3.3
11	0.97	1.98	2.95	1.5	1.1	0.6	1.9	1.0	7.9	4.0
12	3.70	1.98	5.68	2.8	2.4	1.2	3.7	1.8	9.2	4.6
13	6.43	1.98	8.41	4.2	3.6	1.8	5.5	2.7	10.5	5.3
14	9.17	1.98	11.15	5.6	4.8	2.4	7.2	3.6	11.8	5.9
15	11.90	1.98	13.88	6.9	6.1	3.0	9.0	4.5	13.1	6.6
16	14.63	1.98	16.61	8.3	7.3	3.6	10.8	5.4	14.4	7.2
17	17.36	1.98	19.34	9.7	8.5	4.3	12.6	6.3	15.7	7.8
18	20.10	1.98	22.08	11.0	9.7	4.9	14.3	7.2	17.0	8.5
19	22.83	1.98	24.81	12.4	11.0	5.5	16.1	8.1	18.3	9.1
20	25.56	1.98	27.54	13.8	12.2	6.1	17.9	9.0	19.6	9.8
21	28.29	1.98	30.27	15.1	13.4	6.7	19.7	9.8	20.9	10.4
22	31.03	1.98	33.01	16.5	14.7	7.3	21.5	10.7	22.2	11.1
23	33.76	1.98	35.74	17.9	15.9	7.9	23.2	11.6	23.5	11.7
24	36.49	1.98	38.47	19.2	17.1	8.6	25.0	12.5	24.7	12.4
25	39.22	1.98	41.20	20.6	18.4	9.2	26.8	13.4	26.0	13.0
26	41.96	1.98	43.94	22.0	19.6	9.8	28.6	14.3	27.3	13.7
27	44.69	1.98	46.67	23.3	20.8	10.4	30.3	15.2	28.6	14.3
28	47.42	1.98	49.40	24.7	22.0	11.0	32.1	16.1	28.7	14.3
28	47.50	5.93	53.43	26.7	23.9	11.9	34.7	17.4	31.8	15.9
29	53.00	5.93	58.93	29.5	26.3	13.2	38.3	19.2	34.9	17.5
30	58.49	5.93	64.42	32.2	28.8	14.4	41.9	20.9	38.0	19.0
31	63.99	5.93	69.92	35.0	31.3	15.6	45.4	22.7	41.2	20.6
32	69.49	5.93	75.42	37.7	33.8	16.9	49.0	24.5	44.3	22.1
33	74.98	5.93	80.91	40.5	36.2	18.1	52.6	26.3	47.4	23.7
34	80.48	5.93	86.41	43.2	38.7	19.3	56.2	28.1	50.5	25.3
35	85.97	5.93	91.90	46.0	41.2	20.6	59.7	29.9	53.7	26.8
36	91.47	5.93	97.40	48.7	43.6	21.8	63.3	31.7	56.8	28.4
37	96.97	5.93	102.90	51.4	46.1	23.1	66.9	33.4	59.9	30.0
38	102.46	5.93	108.39	54.2	48.6	24.3	70.5	35.2	63.0	31.5
39	107.96	5.93	113.89	56.9	51.1	25.5	74.0	37.0	63.1	31.6

Contributes to Downdrag

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x73 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)	(kips)	(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
39	108.09	5.93	114.02	57.0	51.1	25.6	74.1	37.1	67.2	33.6
40	115.56	5.93	121.49	60.7	54.5	27.2	79.0	39.5	71.2	35.6
41	123.03	5.93	128.96	64.5	57.8	28.9	83.8	41.9	75.3	37.6
42	130.50	5.93	136.43	68.2	61.2	30.6	88.7	44.3	79.3	39.7
43	137.96	5.93	143.89	71.9	64.6	32.3	93.5	46.8	83.4	41.7
44	145.43	5.93	151.36	75.7	67.9	34.0	98.4	49.2	87.5	43.7
45	152.90	5.93	158.83	79.4	71.3	35.6	103.2	51.6	91.5	45.8
46	160.37	5.93	166.30	83.2	74.6	37.3	108.1	54.0	95.6	47.8
47	167.84	5.93	173.77	86.9	78.0	39.0	112.9	56.5	99.6	49.8
48	175.31	5.93	181.24	90.6	81.4	40.7	117.8	58.9	103.7	51.8
49	182.78	5.93	188.71	94.4	84.7	42.4	122.7	61.3	107.7	53.9
50	190.25	5.93	196.18	98.1	88.1	44.0	127.5	63.8	111.8	55.9
51	197.71	5.93	203.64	101.8	91.5	45.7	132.4	66.2	115.8	57.9
52	205.18	5.93	211.11	105.6	94.8	47.4	137.2	68.6	119.9	59.9
53	212.65	5.93	218.58	109.3	98.2	49.1	142.1	71.0	124.0	62.0
54	220.12	5.93	226.05	113.0	101.5	50.8	146.9	73.5	128.0	64.0
55	227.59	5.93	233.52	116.8	104.9	52.4	151.8	75.9	132.1	66.0
56	235.06	5.93	240.99	120.5	108.3	54.1	156.6	78.3	136.1	68.1
57	242.53	5.93	248.46	124.2	111.6	55.8	161.5	80.7	140.2	70.1
58	249.99	5.93	255.92	128.0	115.0	57.5	166.4	83.2	144.2	72.1
59	257.46	5.93	263.39	131.7	118.3	59.2	171.2	85.6	148.3	74.1
60	264.93	5.93	270.86	135.4	121.7	60.9	176.1	88.0	152.3	76.2
61	272.40	5.93	278.33	139.2	125.1	62.5	180.9	90.5	152.4	76.2
61	272.59	9.18	281.77	140.9	126.6	63.3	183.2	91.6	158.6	79.3
62	285.71	9.18	294.89	147.4	132.5	66.3	191.7	95.8	164.8	82.4
63	298.83	9.18	308.01	154.0	138.4	69.2	200.2	100.1	171.0	85.5
64	311.95	9.18	321.13	160.6	144.3	72.2	208.7	104.4	177.1	88.6
65	325.07	9.18	334.25	167.1	150.2	75.1	217.3	108.6	183.3	91.7
66	338.19	9.18	347.37	173.7	156.1	78.1	225.8	112.9	189.5	94.7
67	351.31	9.18	360.49	180.2	162.0	81.0	234.3	117.2	195.7	97.8
68	364.43	9.18	373.61	186.8	167.9	84.0	242.8	121.4	201.8	100.9
69	377.55	9.18	386.73	193.4	173.8	86.9	251.4	125.7	208.0	104.0
70	390.67	9.18	399.85	199.9	179.7	89.9	259.9	130.0	214.2	107.1
71	403.79	9.18	412.97	206.5	185.7	92.8	268.4	134.2	220.4	110.2
72	416.91	9.18	426.09	213.0	191.6	95.8	277.0	138.5	226.5	113.3
73	430.03	9.18	439.21	219.6	197.5	98.7	285.5	142.7	232.7	116.4
74	443.16	9.18	452.34	226.2	203.4	101.7	294.0	147.0	238.9	119.5
75	456.28	9.18	465.46	232.7	209.3	104.6	302.5	151.3	245.1	122.5
76	469.40	9.18	478.58	239.3	215.2	107.6	311.1	155.5	251.3	125.6
77	482.52	9.18	491.70	245.8	221.1	110.5	319.6	159.8	257.4	128.7
78	495.64	9.18	504.82	252.4	227.0	113.5	328.1	164.1	263.6	131.8
79	508.76	9.18	517.94	259.0	232.9	116.4	336.7	168.3	269.8	134.9
80	521.88	9.18	531.06	265.5	238.8	119.4	345.2	172.6	276.0	138.0
81	535.00	9.18	544.18	272.1	244.7	122.3	353.7	176.9	282.1	141.1
82	548.12	9.18	557.30	278.6	250.6	125.3	362.2	181.1	288.3	144.2

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x73 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)	(kips)	(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
83	561.24	9.18	570.42	285.2	256.5	128.3	370.8	185.4	294.5	147.2
84	574.36	9.18	583.54	291.8	262.4	131.2	379.3	189.7	300.7	150.3
85	587.48	9.18	596.66	298.3	268.3	134.2	387.8	193.9	306.8	153.4
86	600.60	9.18	609.78	304.9	274.2	137.1	396.4	198.2	313.0	156.5
87	613.72	9.18	622.90	311.5	280.1	140.1	404.9	202.4	319.2	159.6
88	626.84	9.18	636.02	318.0	286.0	143.0	413.4	206.7	325.4	162.7
89	639.96	9.18	649.14	324.6	291.9	146.0	421.9	211.0	331.5	165.8
90	653.08	9.18	662.26	331.1	297.8	148.9	430.5	215.2	337.7	168.9
91	666.20	9.18	675.38	337.7	303.7	151.9	439.0	219.5	343.9	171.9
92	679.32	9.18	688.50	344.3	309.6	154.8	447.5	223.8	350.1	175.0
93	692.44	9.18	701.62	350.8	315.5	157.8	456.1	228.0	356.2	178.1
94	705.56	9.18	714.74	357.4	321.4	160.7	464.6	232.3	362.4	181.2
95	718.68	9.18	727.86	363.9	327.4	163.7	473.1	236.6	368.6	184.3
96	731.80	9.18	740.98	370.5	333.3	166.6	481.6	240.8	374.8	187.4
97	744.92	9.18	754.10	377.1	339.2	169.6	490.2	245.1	380.9	190.5
98	758.05	9.18	767.23	383.6	345.1	172.5	498.7	249.3	387.1	193.6
99	771.17	9.18	780.35	390.2	351.0	175.5	507.2	253.6	393.3	196.6
100	784.29	9.18	793.47	396.7	356.9	178.4	515.8	257.9	399.5	199.7
101	797.41	9.18	806.59	403.3	362.8	181.4	524.3	262.1	405.6	202.8
102	810.53	9.18	819.71	409.9	368.7	184.3	532.8	266.4	411.8	205.9
103	823.65	9.18	832.83	416.4	374.6	187.3	541.3	270.7	418.0	209.0
104	836.77	9.18	845.95	423.0	380.5	190.2	549.9	274.9	424.2	212.1
105	849.89	9.18	859.07	429.5	386.4	193.2	558.4	279.2	430.3	215.2
106	863.01	9.18	872.19	436.1	392.3	196.1	566.9	283.5	436.5	218.3
107	876.13	9.18	885.31	442.7	398.2	199.1	575.5	287.7	442.7	221.3
108	889.25	9.18	898.43	449.2	404.1	202.1	584.0	292.0	448.9	224.4
109	902.37	9.18	911.55	455.8	410.0	205.0	592.5	296.3	455.0	227.5
110	915.49	9.18	924.67	462.3	415.9	208.0	601.0	300.5	461.2	230.6
111	928.61	9.18	937.79	468.9	421.8	210.9	609.6	304.8	467.4	233.7
112	941.73	9.18	950.91	475.5	427.7	213.9	618.1	309.0	473.6	236.8
113	954.85	9.18	964.03	482.0	433.6	216.8	626.6	313.3	479.8	239.9
114	967.97	9.18	977.15	488.6	439.5	219.8	635.1	317.6	485.9	243.0
115	981.09	9.18	990.27	495.1	445.4	222.7	643.7	321.8	492.1	246.1
116	994.21	9.18	1003.39	501.7	451.3	225.7	652.2	326.1	498.3	249.1
117	1007.33	9.18	1016.51	508.3	457.2	228.6	660.7	330.4	504.5	252.2
118	1020.45	9.18	1029.63	514.8	463.1	231.6	669.3	334.6	510.6	255.3
119	1033.57	9.18	1042.75	521.4	469.1	234.5	677.8	338.9	516.8	258.4
120	1046.69	9.18	1055.87	527.9	475.0	237.5	686.3	343.2	523.0	261.5
121	1059.81	9.18	1068.99	534.5	480.9	240.4	694.8	347.4	529.2	264.6
122	1072.93	9.18	1082.11	541.1	486.8	243.4	703.4	351.7	535.3	267.7
123	1086.06	9.18	1095.24	547.6	492.7	246.3	711.9	356.0	541.5	270.8
124	1099.18	9.18	1108.36	554.2	498.6	249.3	720.4	360.2	547.7	273.8
125	1112.30	9.18	1121.48	560.7	504.5	252.2	729.0	364.5	-2.7	-1.3

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x89 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)		Nonimal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65) (kips)	(tons)	ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35) (kips)	(tons)
	0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	1	-1.46	0.00	-1.46	-0.7	-0.5	-0.3	-0.9	-0.5	0.4	0.2
	2	-2.91	0.00	-2.91	-1.5	-1.0	-0.5	-1.9	-0.9	0.7	0.4
	3	-4.37	0.00	-4.37	-2.2	-1.5	-0.8	-2.8	-1.4	1.1	0.5
	4	-5.82	0.00	-5.82	-2.9	-2.0	-1.0	-3.8	-1.9	1.5	0.7
	5	-7.28	0.00	-7.28	-3.6	-2.5	-1.3	-4.7	-2.4	1.8	0.9
@ 6'	6	-8.73	0.00	-8.73	-4.4	-3.1	-1.5	-5.7	-2.8	2.2	1.1
	6	-8.77	0.00	-8.77	-4.4	-3.1	-1.5	-5.7	-2.9	2.2	1.1
Silts	7	-10.78	0.00	-10.78	-5.4	-3.8	-1.9	-7.0	-3.5	3.2	1.6
Sands	7	-10.80	2.41	-8.39	-4.2	-2.9	-1.5	-5.5	-2.7	4.2	2.1
	8	-7.84	2.41	-5.43	-2.7	-1.9	-0.9	-3.5	-1.8	5.2	2.6
	9	-4.87	2.41	-2.46	-1.2	-0.9	-0.4	-1.6	-0.8	6.2	3.1
	10	-1.91	2.41	0.50	0.2	0.2	0.1	0.3	0.2	6.8	3.4
	10.6	-0.13	2.41	2.28	1.1	0.8	0.4	1.5	0.7	7.2	3.6
	11	1.05	2.41	3.46	1.7	1.3	0.7	2.2	1.1	8.6	4.3
	12	4.01	2.41	6.42	3.2	2.7	1.3	4.2	2.1	10.0	5.0
	13	6.98	2.41	9.39	4.7	4.0	2.0	6.1	3.1	11.4	5.7
	14	9.94	2.41	12.35	6.2	5.3	2.7	8.0	4.0	12.8	6.4
	15	12.90	2.41	15.31	7.7	6.7	3.3	10.0	5.0	14.2	7.1
	16	15.87	2.41	18.28	9.1	8.0	4.0	11.9	5.9	15.6	7.8
	17	18.83	2.41	21.24	10.6	9.3	4.7	13.8	6.9	17.0	8.5
	18	21.79	2.41	24.20	12.1	10.7	5.3	15.7	7.9	18.4	9.2
	19	24.75	2.41	27.16	13.6	12.0	6.0	17.7	8.8	19.8	9.9
	20	27.72	2.41	30.13	15.1	13.3	6.7	19.6	9.8	21.2	10.6
	21	30.68	2.41	33.09	16.5	14.7	7.3	21.5	10.8	22.6	11.3
	22	33.64	2.41	36.05	18.0	16.0	8.0	23.4	11.7	24.0	12.0
	23	36.61	2.41	39.02	19.5	17.3	8.7	25.4	12.7	25.4	12.7
	24	39.57	2.41	41.98	21.0	18.7	9.3	27.3	13.6	26.8	13.4
	25	42.53	2.41	44.94	22.5	20.0	10.0	29.2	14.6	28.2	14.1
	26	45.49	2.41	47.90	24.0	21.3	10.7	31.1	15.6	29.6	14.8
	27	48.46	2.41	50.87	25.4	22.7	11.3	33.1	16.5	31.0	15.5
	28	51.42	2.41	53.83	26.9	24.0	12.0	35.0	17.5	31.1	15.5
	28	51.51	7.24	58.75	29.4	26.2	13.1	38.2	19.1	34.5	17.3
	29	57.54	7.24	64.78	32.4	28.9	14.5	42.1	21.1	38.0	19.0
	30	63.57	7.24	70.81	35.4	31.6	15.8	46.0	23.0	41.4	20.7
	31	69.60	7.24	76.84	38.4	34.4	17.2	49.9	25.0	44.8	22.4
	32	75.63	7.24	82.87	41.4	37.1	18.5	53.9	26.9	48.2	24.1
	33	81.66	7.24	88.90	44.5	39.8	19.9	57.8	28.9	51.7	25.8
	34	87.70	7.24	94.94	47.5	42.5	21.2	61.7	30.9	55.1	27.5
	35	93.73	7.24	100.97	50.5	45.2	22.6	65.6	32.8	58.5	29.3
	36	99.76	7.24	107.00	53.5	47.9	24.0	69.5	34.8	61.9	31.0
	37	105.79	7.24	113.03	56.5	50.6	25.3	73.5	36.7	65.4	32.7
	38	111.82	7.24	119.06	59.5	53.3	26.7	77.4	38.7	68.8	34.4
	39	117.85	7.24	125.09	62.5	56.1	28.0	81.3	40.7	68.9	34.4

Contributes to Downdrag

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x89 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)	(kips)	(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
39	117.98	7.24	125.22	62.6	56.1	28.1	81.4	40.7	73.3	36.7
40	126.17	7.24	133.41	66.7	59.8	29.9	86.7	43.4	77.8	38.9
41	134.37	7.24	141.61	70.8	63.5	31.7	92.0	46.0	82.2	41.1
42	142.56	7.24	149.80	74.9	67.2	33.6	97.4	48.7	86.7	43.3
43	150.76	7.24	158.00	79.0	70.9	35.4	102.7	51.3	91.1	45.6
44	158.95	7.24	166.19	83.1	74.6	37.3	108.0	54.0	95.6	47.8
45	167.15	7.24	174.39	87.2	78.2	39.1	113.4	56.7	100.0	50.0
46	175.34	7.24	182.58	91.3	81.9	41.0	118.7	59.3	104.5	52.2
47	183.54	7.24	190.78	95.4	85.6	42.8	124.0	62.0	108.9	54.5
48	191.73	7.24	198.97	99.5	89.3	44.7	129.3	64.7	113.4	56.7
49	199.93	7.24	207.17	103.6	93.0	46.5	134.7	67.3	117.8	58.9
50	208.12	7.24	215.36	107.7	96.7	48.3	140.0	70.0	122.3	61.1
51	216.31	7.24	223.55	111.8	100.4	50.2	145.3	72.7	126.7	63.4
52	224.51	7.24	231.75	115.9	104.1	52.0	150.6	75.3	131.2	65.6
53	232.70	7.24	239.94	120.0	107.7	53.9	156.0	78.0	135.6	67.8
54	240.90	7.24	248.14	124.1	111.4	55.7	161.3	80.6	140.1	70.0
55	249.09	7.24	256.33	128.2	115.1	57.6	166.6	83.3	144.5	72.3
56	257.29	7.24	264.53	132.3	118.8	59.4	171.9	86.0	149.0	74.5
57	265.48	7.24	272.72	136.4	122.5	61.2	177.3	88.6	153.4	76.7
58	273.68	7.24	280.92	140.5	126.2	63.1	182.6	91.3	157.9	78.9
59	281.87	7.24	289.11	144.6	129.9	64.9	187.9	94.0	162.3	81.2
60	290.07	7.24	297.31	148.7	133.6	66.8	193.2	96.6	166.8	83.4
61	298.26	7.24	305.50	152.8	137.2	68.6	198.6	99.3	166.9	83.4
61	298.46	11.20	309.66	154.8	139.1	69.6	201.3	100.6	173.7	86.8
62	312.90	11.20	324.10	162.1	145.6	72.8	210.7	105.3	180.5	90.2
63	327.35	11.20	338.55	169.3	152.1	76.1	220.1	110.0	187.3	93.6
64	341.79	11.20	352.99	176.5	158.6	79.3	229.4	114.7	194.1	97.0
65	356.23	11.20	367.43	183.7	165.1	82.6	238.8	119.4	200.9	100.4
66	370.68	11.20	381.88	190.9	171.6	85.8	248.2	124.1	207.7	103.8
67	385.12	11.20	396.32	198.2	178.1	89.1	257.6	128.8	214.5	107.2
68	399.56	11.20	410.76	205.4	184.6	92.3	267.0	133.5	221.3	110.6
69	414.00	11.20	425.20	212.6	191.1	95.6	276.4	138.2	228.1	114.0
70	428.45	11.20	439.65	219.8	197.6	98.8	285.8	142.9	234.9	117.4
71	442.89	11.20	454.09	227.0	204.1	102.1	295.2	147.6	241.7	120.8
72	457.33	11.20	468.53	234.3	210.6	105.3	304.5	152.3	248.5	124.2
73	471.78	11.20	482.98	241.5	217.1	108.6	313.9	157.0	255.3	127.6
74	486.22	11.20	497.42	248.7	223.6	111.8	323.3	161.7	262.1	131.0
75	500.66	11.20	511.86	255.9	230.1	115.1	332.7	166.4	268.9	134.4
76	515.11	11.20	526.31	263.2	236.6	118.3	342.1	171.0	275.7	137.8
77	529.55	11.20	540.75	270.4	243.1	121.6	351.5	175.7	282.5	141.2
78	543.99	11.20	555.19	277.6	249.6	124.8	360.9	180.4	289.3	144.6
79	558.44	11.20	569.64	284.8	256.1	128.1	370.3	185.1	296.1	148.0
80	572.88	11.20	584.08	292.0	262.6	131.3	379.7	189.8	302.9	151.4
81	587.32	11.20	598.52	299.3	269.1	134.6	389.0	194.5	309.6	154.8
82	601.76	11.20	612.96	306.5	275.6	137.8	398.4	199.2	316.4	158.2

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x89 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)	(kips)	(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
83	616.21	11.20	627.41	313.7	282.1	141.1	407.8	203.9	323.2	161.6
84	630.65	11.20	641.85	320.9	288.6	144.3	417.2	208.6	330.0	165.0
85	645.09	11.20	656.29	328.1	295.1	147.6	426.6	213.3	336.8	168.4
86	659.54	11.20	670.74	335.4	301.6	150.8	436.0	218.0	343.6	171.8
87	673.98	11.20	685.18	342.6	308.1	154.1	445.4	222.7	350.4	175.2
88	688.42	11.20	699.62	349.8	314.6	157.3	454.8	227.4	357.2	178.6
89	702.87	11.20	714.07	357.0	321.1	160.6	464.1	232.1	364.0	182.0
90	717.31	11.20	728.51	364.3	327.6	163.8	473.5	236.8	370.8	185.4
91	731.75	11.20	742.95	371.5	334.1	167.1	482.9	241.5	377.6	188.8
92	746.19	11.20	757.39	378.7	340.6	170.3	492.3	246.2	384.4	192.2
93	760.64	11.20	771.84	385.9	347.1	173.5	501.7	250.8	391.2	195.6
94	775.08	11.20	786.28	393.1	353.6	176.8	511.1	255.5	398.0	199.0
95	789.52	11.20	800.72	400.4	360.1	180.0	520.5	260.2	404.8	202.4
96	803.97	11.20	815.17	407.6	366.6	183.3	529.9	264.9	411.6	205.8
97	818.41	11.20	829.61	414.8	373.1	186.5	539.2	269.6	418.4	209.2
98	832.85	11.20	844.05	422.0	379.6	189.8	548.6	274.3	425.2	212.6
99	847.30	11.20	858.50	429.2	386.1	193.0	558.0	279.0	432.0	216.0
100	861.74	11.20	872.94	436.5	392.6	196.3	567.4	283.7	438.8	219.4
101	876.18	11.20	887.38	443.7	399.1	199.5	576.8	288.4	445.6	222.8
102	890.63	11.20	901.83	450.9	405.6	202.8	586.2	293.1	452.4	226.2
103	905.07	11.20	916.27	458.1	412.1	206.0	595.6	297.8	459.2	229.6
104	919.51	11.20	930.71	465.4	418.6	209.3	605.0	302.5	466.0	233.0
105	933.95	11.20	945.15	472.6	425.1	212.5	614.4	307.2	472.8	236.4
106	948.40	11.20	959.60	479.8	431.6	215.8	623.7	311.9	479.6	239.8
107	962.84	11.20	974.04	487.0	438.1	219.0	633.1	316.6	486.4	243.2
108	977.28	11.20	988.48	494.2	444.6	222.3	642.5	321.3	493.2	246.6
109	991.73	11.20	1002.93	501.5	451.1	225.5	651.9	326.0	500.0	250.0
110	1006.17	11.20	1017.37	508.7	457.6	228.8	661.3	330.6	506.8	253.4
111	1020.61	11.20	1031.81	515.9	464.1	232.0	670.7	335.3	513.6	256.8
112	1035.06	11.20	1046.26	523.1	470.6	235.3	680.1	340.0	520.4	260.2
113	1049.50	11.20	1060.70	530.3	477.1	238.5	689.5	344.7	527.2	263.6
114	1063.94	11.20	1075.14	537.6	483.6	241.8	698.8	349.4	534.0	267.0
115	1078.39	11.20	1089.59	544.8	490.1	245.0	708.2	354.1	540.8	270.4
116	1092.83	11.20	1104.03	552.0	496.6	248.3	717.6	358.8	547.6	273.8
117	1107.27	11.20	1118.47	559.2	503.1	251.5	727.0	363.5	554.4	277.2
118	1121.71	11.20	1132.91	566.5	509.6	254.8	736.4	368.2	561.2	280.6
119	1136.16	11.20	1147.36	573.7	516.1	258.0	745.8	372.9	568.0	284.0
120	1150.60	11.20	1161.80	580.9	522.6	261.3	755.2	377.6	574.8	287.4
121	1165.04	11.20	1176.24	588.1	529.1	264.5	764.6	382.3	581.6	290.8
122	1179.49	11.20	1190.69	595.3	535.6	267.8	773.9	387.0	588.4	294.2
123	1193.93	11.20	1205.13	602.6	542.1	271.0	783.3	391.7	595.2	297.6
124	1208.37	11.20	1219.57	609.8	548.6	274.3	792.7	396.4	602.0	301.0
125	1222.82	11.20	1234.02	617.0	555.1	277.5	802.1	401.1	-2.9	-1.4

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
30" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)		Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
	1	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.1**	**0.0**
	2	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.3**	**0.1**
	3	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.7**	**0.3**
	4	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**1.2**	**0.6**
	5	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**1.9**	**0.9**
@ 6'	6	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**2.7**	**1.3**
Silts	7	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**3.5**	**1.8**
Sands	8	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**4.7**	**2.4**
	9	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**6.0**	**3.0**
	10	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**7.3**	**3.7**
	11	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**8.6**	**4.3**
	12	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**10.0**	**5.0**
	13	15.63	8.03	23.66	11.8	8.6	4.0	**12.6**	**6.3**	**11.5**	**5.8**
	14	19.02	16.71	35.73	17.9	10.5	8.4	**18.8**	**9.4**	**13.1**	**6.5**
	15	22.56	26.05	48.61	24.3	12.4	13.0	**25.4**	**12.7**	**14.7**	**7.3**
	16	25.96	36.05	62.01	31.0	14.3	18.0	**32.3**	**16.2**	**16.2**	**8.1**
	17	29.48	46.70	76.18	38.1	16.2	23.3	**39.6**	**19.8**	**17.8**	**8.9**
	18	33.10	58.00	91.11	45.6	18.2	29.0	**47.2**	**23.6**	**19.4**	**9.7**
	19	36.83	69.96	106.80	53.4	20.3	35.0	**55.2**	**27.6**	**21.1**	**10.5**
	20	40.67	82.58	123.25	61.6	22.4	41.3	**63.7**	**31.8**	**22.8**	**11.4**
	21	44.60	95.85	140.45	70.2	24.5	47.9	**72.5**	**36.2**	**24.6**	**12.3**
	22	48.62	109.78	158.40	79.2	26.7	54.9	**81.6**	**40.8**	**26.4**	**13.2**
	23	52.74	113.05	165.79	82.9	29.0	56.5	**85.5**	**42.8**	**28.2**	**14.1**
	24	56.95	116.25	173.20	86.6	31.3	58.1	**89.4**	**44.7**	**30.1**	**15.1**
	25	61.63	119.28	180.91	90.5	33.9	59.6	**93.5**	**46.8**	**32.2**	**16.1**
	26	66.01	122.15	188.17	94.1	36.3	61.1	**97.4**	**48.7**	**34.2**	**17.1**
	27	70.48	124.87	195.35	97.7	38.8	62.4	**101.2**	**50.6**	**36.2**	**18.1**
	28	75.02	127.42	202.44	101.2	41.3	63.7	**105.0**	**52.5**	**38.3**	**19.1**
	29	86.26	129.78	216.04	108.0	47.4	64.9	**112.3**	**56.2**	**43.3**	**21.7**
	30	97.67	131.93	229.60	114.8	53.7	66.0	**119.7**	**59.8**	**48.5**	**24.2**
	31	109.24	133.87	243.11	121.6	60.1	66.9	**127.0**	**63.5**	**53.7**	**26.8**
	32	120.98	135.60	256.58	128.3	66.5	67.8	**134.3**	**67.2**	**58.9**	**29.5**
	33	132.87	137.27	270.13	135.1	73.1	68.6	**141.7**	**70.9**	**64.3**	**32.1**
	34	144.84	138.93	283.77	141.9	79.7	69.5	**149.1**	**74.6**	**69.7**	**34.8**
	35	156.98	140.60	297.58	148.8	86.3	70.3	**156.6**	**78.3**	**75.1**	**37.6**
	36	169.24	142.27	311.51	155.8	93.1	71.1	**164.2**	**82.1**	**80.7**	**40.3**
	37	181.62	143.94	325.55	162.8	99.9	72.0	**171.9**	**85.9**	**86.2**	**43.1**
	38	194.10	145.60	339.71	169.9	106.8	72.8	**179.6**	**89.8**	**91.9**	**45.9**
	39	206.69	147.27	353.96	177.0	113.7	73.6	**187.3**	**93.7**	**97.5**	**48.8**
	40	219.37	148.94	368.31	184.2	120.7	74.5	**195.1**	**97.6**	**103.2**	**51.6**

Contributes to Downdrag

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
30" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	232.14	150.61	382.74	191.4	127.7	75.3	**203.0**	**101.5**	**109.0**	**54.5**
42	244.98	152.27	397.26	198.6	134.7	76.1	**210.9**	**105.4**	**114.8**	**57.4**
43	257.90	153.94	411.85	205.9	141.8	77.0	**218.8**	**109.4**	**120.6**	**60.3**
44	270.89	155.61	426.50	213.2	149.0	77.8	**226.8**	**113.4**	**126.4**	**63.2**
45	283.93	157.28	441.21	220.6	156.2	78.6	**234.8**	**117.4**	**132.3**	**66.1**
46	297.03	158.94	455.97	228.0	163.4	79.5	**242.8**	**121.4**	**138.2**	**69.1**
47	310.17	160.61	470.78	235.4	170.6	80.3	**250.9**	**125.5**	**144.1**	**72.0**
48	323.35	162.28	485.63	242.8	177.8	81.1	**259.0**	**129.5**	**150.0**	**75.0**
49	336.57	163.95	500.51	250.3	185.1	82.0	**267.1**	**133.5**	**156.0**	**78.0**
50	349.81	165.61	515.42	257.7	192.4	82.8	**275.2**	**137.6**	**161.9**	**81.0**
51	363.06	167.28	530.35	265.2	199.7	83.6	**283.3**	**141.7**	**167.9**	**83.9**
52	376.34	168.95	545.29	272.6	207.0	84.5	**291.5**	**145.7**	**173.9**	**86.9**
53	389.61	170.62	560.23	280.1	214.3	85.3	**299.6**	**149.8**	**179.8**	**89.9**
54	402.89	172.28	575.18	287.6	221.6	86.1	**307.7**	**153.9**	**185.8**	**92.9**
55	416.17	173.95	590.12	295.1	228.9	87.0	**315.9**	**157.9**	**191.8**	**95.9**
56	429.43	175.62	605.05	302.5	236.2	87.8	**324.0**	**162.0**	**197.8**	**98.9**
57	442.68	177.26	619.93	310.0	243.5	88.6	**332.1**	**166.0**	**203.7**	**101.9**
58	455.90	178.83	634.72	317.4	250.7	89.4	**340.2**	**170.1**	**209.7**	**104.8**
59	469.09	180.33	649.42	324.7	258.0	90.2	**348.2**	**174.1**	**215.6**	**107.8**
60	482.24	181.77	664.02	332.0	265.2	90.9	**356.1**	**178.1**	**221.5**	**110.8**
61	495.36	183.15	678.51	339.3	272.4	91.6	**364.0**	**182.0**	**227.4**	**113.7**
62	508.40	184.45	692.85	346.4	279.6	92.2	**371.8**	**185.9**	**233.3**	**116.6**
63	521.40	185.66	707.06	353.5	286.8	92.8	**379.6**	**189.8**	**239.1**	**119.6**
64	534.36	186.79	721.15	360.6	293.9	93.4	**387.3**	**193.6**	**245.0**	**122.5**
65	547.28	187.83	735.11	367.6	301.0	93.9	**394.9**	**197.5**	**250.8**	**125.4**
66	560.14	188.85	748.99	374.5	308.1	94.4	**402.5**	**201.3**	**256.6**	**128.3**
67	572.89	189.87	762.76	381.4	315.1	94.9	**410.0**	**205.0**	**262.3**	**131.2**
68	585.60	190.89	776.49	388.2	322.1	95.4	**417.5**	**208.8**	**268.0**	**134.0**
69	598.24	191.91	790.15	395.1	329.0	96.0	**425.0**	**212.5**	**273.7**	**136.9**
70	610.80	192.93	803.73	401.9	335.9	96.5	**432.4**	**216.2**	**279.4**	**139.7**
71	623.27	193.95	817.21	408.6	342.8	97.0	**439.8**	**219.9**	**285.0**	**142.5**
72	635.64	194.97	830.61	415.3	349.6	97.5	**447.1**	**223.5**	**290.5**	**145.3**
73	647.92	195.98	843.90	422.0	356.4	98.0	**454.3**	**227.2**	**296.1**	**148.0**
74	660.08	197.00	857.09	428.5	363.0	98.5	**461.5**	**230.8**	**301.5**	**150.8**
75	672.14	198.02	870.16	435.1	369.7	99.0	**468.7**	**234.3**	**307.0**	**153.5**
76	684.08	199.04	883.12	441.6	376.2	99.5	**475.8**	**237.9**	**312.3**	**156.2**
77	677.90	200.06	877.96	439.0	372.8	100.0	**472.9**	**236.4**	**309.6**	**154.8**
78	707.58	201.08	908.66	454.3	389.2	100.5	**489.7**	**244.9**	**322.9**	**161.5**
79	719.13	202.10	921.23	460.6	395.5	101.1	**496.6**	**248.3**	**328.1**	**164.1**
80	730.55	203.12	933.66	466.8	401.8	101.6	**503.4**	**251.7**	**333.3**	**166.6**

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
36" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
1	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.0**	**0.0**
2	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.4**	**0.2**
3	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.8**	**0.4**
4	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**1.4**	**0.7**
5	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**2.2**	**1.1**
6	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**3.2**	**1.6**
7	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**4.2**	**2.1**
8	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**5.7**	**2.8**
9	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**7.2**	**3.6**
10	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**8.8**	**4.4**
11	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**10.4**	**5.2**
12	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**12.0**	**6.0**
13	18.76	10.28	29.04	14.5	10.3	5.1	**15.5**	**7.7**	**13.8**	**6.9**
14	22.82	21.39	44.22	22.1	12.6	10.7	**23.2**	**11.6**	**15.7**	**7.8**
15	27.07	33.34	60.42	30.2	14.9	16.7	**31.6**	**15.8**	**17.6**	**8.8**
16	31.16	46.13	77.29	38.6	17.1	23.1	**40.2**	**20.1**	**19.4**	**9.7**
17	35.37	59.76	95.13	47.6	19.5	29.9	**49.3**	**24.7**	**21.3**	**10.7**
18	39.72	74.22	113.94	57.0	21.8	37.1	**59.0**	**29.5**	**23.3**	**11.6**
19	44.20	89.51	133.71	66.9	24.3	44.8	**69.1**	**34.5**	**25.3**	**12.6**
20	48.80	105.65	154.45	77.2	26.8	52.8	**79.7**	**39.8**	**27.4**	**13.7**
21	53.52	122.62	176.13	88.1	29.4	61.3	**90.7**	**45.4**	**29.5**	**14.7**
22	58.35	140.42	198.77	99.4	32.1	70.2	**102.3**	**51.2**	**31.7**	**15.8**
23	63.29	144.52	207.81	103.9	34.8	72.3	**107.1**	**53.5**	**33.9**	**16.9**
24	68.34	148.45	216.79	108.4	37.6	74.2	**111.8**	**55.9**	**36.2**	**18.1**
25	73.95	152.20	226.16	113.1	40.7	76.1	**116.8**	**58.4**	**38.7**	**19.3**
26	79.22	155.78	235.00	117.5	43.6	77.9	**121.5**	**60.7**	**41.1**	**20.5**
27	84.58	159.20	243.78	121.9	46.5	79.6	**126.1**	**63.1**	**43.5**	**21.7**
28	90.03	162.44	252.47	126.2	49.5	81.2	**130.7**	**65.4**	**45.9**	**23.0**
29	103.51	165.48	268.99	134.5	56.9	82.7	**139.7**	**69.8**	**52.0**	**26.0**
30	117.20	168.29	285.50	142.7	64.5	84.1	**148.6**	**74.3**	**58.2**	**29.1**
31	131.09	170.88	301.97	151.0	72.1	85.4	**157.5**	**78.8**	**64.4**	**32.2**
32	145.18	173.24	318.41	159.2	79.8	86.6	**166.5**	**83.2**	**70.7**	**35.4**
33	159.44	175.39	334.84	167.4	87.7	87.7	**175.4**	**87.7**	**77.2**	**38.6**
34	173.80	177.52	351.33	175.7	95.6	88.8	**184.4**	**92.2**	**83.6**	**41.8**
35	188.37	179.65	368.03	184.0	103.6	89.8	**193.4**	**96.7**	**90.2**	**45.1**
36	203.09	181.78	384.87	192.4	111.7	90.9	**202.6**	**101.3**	**96.8**	**48.4**
37	217.94	183.91	401.85	200.9	119.9	92.0	**211.8**	**105.9**	**103.5**	**51.7**
38	232.92	184.04	416.96	208.5	128.1	92.0	**220.1**	**110.1**	**110.2**	**55.1**
39	248.03	188.17	436.20	218.1	136.4	94.1	**230.5**	**115.2**	**117.0**	**58.5**
40	263.24	190.30	453.54	226.8	144.8	95.2	**239.9**	**120.0**	**123.9**	**61.9**

Contributes to Downdrag

@ 6'

Silts

Sands

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
36" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	278.56	192.43	470.99	235.5	153.2	96.2	**249.4**	**124.7**	**130.8**	**65.4**
42	293.98	194.56	488.54	244.3	161.7	97.3	**259.0**	**129.5**	**137.7**	**68.8**
43	309.48	196.69	506.17	253.1	170.2	98.3	**268.6**	**134.3**	**144.7**	**72.3**
44	325.07	198.82	523.88	261.9	178.8	99.4	**278.2**	**139.1**	**151.7**	**75.8**
45	340.72	200.95	541.67	270.8	187.4	100.5	**287.9**	**143.9**	**158.7**	**79.4**
46	356.44	203.07	559.51	279.8	196.0	101.5	**297.6**	**148.8**	**165.8**	**82.9**
47	372.21	205.20	577.41	288.7	204.7	102.6	**307.3**	**153.7**	**172.9**	**86.5**
48	388.02	207.33	595.36	297.7	213.4	103.7	**317.1**	**158.5**	**180.0**	**90.0**
49	403.88	209.46	613.34	306.7	222.1	104.7	**326.9**	**163.4**	**187.2**	**93.6**
50	419.77	211.59	631.36	315.7	230.9	105.8	**336.7**	**168.3**	**194.3**	**97.2**
51	435.68	213.72	649.40	324.7	239.6	106.9	**346.5**	**173.2**	**201.5**	**100.7**
52	451.60	215.85	667.45	333.7	248.4	107.9	**356.3**	**178.2**	**208.6**	**104.3**
53	467.54	217.98	685.52	342.8	257.1	109.0	**366.1**	**183.1**	**215.8**	**107.9**
54	483.47	220.11	703.58	351.8	265.9	110.1	**376.0**	**188.0**	**223.0**	**111.5**
55	499.40	222.24	721.64	360.8	274.7	111.1	**385.8**	**192.9**	**230.1**	**115.1**
56	515.32	224.33	739.65	369.8	283.4	112.2	**395.6**	**197.8**	**237.3**	**118.7**
57	531.21	226.36	757.57	378.8	292.2	113.2	**405.3**	**202.7**	**244.5**	**122.2**
58	547.08	228.31	775.39	387.7	300.9	114.2	**415.0**	**207.5**	**251.6**	**125.8**
59	562.91	230.20	793.11	396.6	309.6	115.1	**424.7**	**212.3**	**258.7**	**129.4**
60	578.69	232.02	810.72	405.4	318.3	116.0	**434.3**	**217.1**	**265.8**	**132.9**
61	594.43	233.77	828.20	414.1	326.9	116.9	**443.8**	**221.9**	**272.9**	**136.5**
62	610.08	235.44	845.52	422.8	335.5	117.7	**453.3**	**226.6**	**279.9**	**140.0**
63	625.68	237.02	862.70	431.3	344.1	118.5	**462.6**	**231.3**	**287.0**	**143.5**
64	641.24	238.50	879.74	439.9	352.7	119.3	**471.9**	**236.0**	**294.0**	**147.0**
65	656.73	239.90	896.63	448.3	361.2	119.9	**481.2**	**240.6**	**300.9**	**150.5**
66	672.17	241.21	913.38	456.7	369.7	120.6	**490.3**	**245.1**	**307.9**	**153.9**
67	687.47	242.51	929.98	465.0	378.1	121.3	**499.4**	**249.7**	**314.8**	**157.4**
68	702.73	243.81	946.54	473.3	386.5	121.9	**508.4**	**254.2**	**321.6**	**160.8**
69	717.89	245.11	963.00	481.5	394.8	122.6	**517.4**	**258.7**	**328.5**	**164.2**
70	732.96	246.41	979.37	489.7	403.1	123.2	**526.3**	**263.2**	**335.2**	**167.6**
71	747.92	247.71	995.64	497.8	411.4	123.9	**535.2**	**267.6**	**342.0**	**171.0**
72	762.77	249.02	1011.79	505.9	419.5	124.5	**544.0**	**272.0**	**348.7**	**174.3**
73	777.50	250.32	1027.82	513.9	427.6	125.2	**552.8**	**276.4**	**355.3**	**177.6**
74	792.10	251.62	1043.72	521.9	435.7	125.8	**561.5**	**280.7**	**361.9**	**180.9**
75	806.57	252.92	1059.49	529.7	443.6	126.5	**570.1**	**285.0**	**368.4**	**184.2**
76	820.90	254.22	1075.12	537.6	451.5	127.1	**578.6**	**289.3**	**374.8**	**187.4**
77	835.08	255.52	1090.60	545.3	459.3	127.8	**587.1**	**293.5**	**381.2**	**190.6**
78	849.10	256.82	1105.92	553.0	467.0	128.4	**595.4**	**297.7**	**387.5**	**193.8**
79	862.96	258.12	1121.09	560.5	474.6	129.1	**603.7**	**301.8**	**393.7**	**196.9**
80	876.66	259.43	1136.08	568.0	482.2	129.7	**611.9**	**305.9**	**399.9**	**200.0**

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
42" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
1	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**0.1**	**0.1**
2	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**0.4**	**0.2**
3	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**0.9**	**0.5**
4	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**1.7**	**0.8**
5	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**2.6**	**1.3**
6	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**3.7**	**1.9**
7	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**5.0**	**2.5**
8	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**6.6**	**3.3**
9	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**8.4**	**4.2**
10	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**10.3**	**5.1**
11	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**12.1**	**6.0**
12	0.00	0.00	0.00	0.00	0.0	0.0	**0.0**	**0.0**	**14.0**	**7.0**
13	21.88	12.57	34.45	17.22	12.0	6.3	**18.3**	**9.2**	**16.2**	**8.1**
14	26.63	26.15	52.78	26.39	14.6	13.1	**27.7**	**13.9**	**18.3**	**9.1**
15	31.58	40.76	72.34	36.17	17.4	20.4	**37.8**	**18.9**	**20.5**	**10.3**
16	36.35	56.39	92.73	46.37	20.0	28.2	**48.2**	**24.1**	**22.7**	**11.3**
17	41.27	73.03	114.30	57.15	22.7	36.5	**59.2**	**29.6**	**24.9**	**12.4**
18	46.34	90.70	137.04	68.52	25.5	45.4	**70.8**	**35.4**	**27.2**	**13.6**
19	51.57	109.39	160.95	80.48	28.4	54.7	**83.1**	**41.5**	**29.5**	**14.8**
20	56.93	129.09	186.03	93.01	31.3	64.5	**95.9**	**47.9**	**31.9**	**16.0**
21	62.44	149.82	212.26	106.13	34.3	74.9	**109.3**	**54.6**	**34.4**	**17.2**
22	68.07	171.48	239.55	119.78	37.4	85.7	**123.2**	**61.6**	**36.9**	**18.5**
23	73.84	176.31	250.15	125.08	40.6	88.2	**128.8**	**64.4**	**39.5**	**19.8**
24	79.73	180.97	260.70	130.35	43.9	90.5	**134.3**	**67.2**	**42.2**	**21.1**
25	86.28	185.44	271.72	135.86	47.5	92.7	**140.2**	**70.1**	**45.1**	**22.6**
26	92.42	189.74	282.16	141.08	50.8	94.9	**145.7**	**72.8**	**47.9**	**23.9**
27	98.67	193.85	292.53	146.26	54.3	96.9	**151.2**	**75.6**	**50.7**	**25.4**
28	105.03	197.79	302.82	151.41	57.8	98.9	**156.7**	**78.3**	**53.6**	**26.8**
29	120.76	201.52	322.28	161.14	66.4	100.8	**167.2**	**83.6**	**60.7**	**30.3**
30	136.74	205.01	341.75	170.87	75.2	102.5	**177.7**	**88.9**	**67.8**	**33.9**
31	152.94	208.26	361.21	180.60	84.1	104.1	**188.3**	**94.1**	**75.1**	**37.6**
32	169.37	211.28	380.65	190.32	93.2	105.6	**198.8**	**99.4**	**82.5**	**41.3**
33	186.02	214.05	400.07	200.04	102.3	107.0	**209.3**	**104.7**	**90.0**	**45.0**
34	202.77	216.66	419.43	209.71	111.5	108.3	**219.9**	**109.9**	**97.6**	**48.8**
35	219.76	219.25	439.02	219.51	120.9	109.6	**230.5**	**115.2**	**105.2**	**52.6**
36	236.93	221.85	458.78	229.39	130.3	110.9	**241.2**	**120.6**	**112.9**	**56.5**
37	254.26	224.45	478.71	239.35	139.8	112.2	**252.1**	**126.0**	**120.7**	**60.4**
38	271.74	227.04	498.79	249.39	149.5	113.5	**263.0**	**131.5**	**128.6**	**64.3**
39	289.36	229.64	519.00	259.50	159.1	114.8	**274.0**	**137.0**	**136.5**	**68.3**
40	307.12	232.24	539.35	269.68	168.9	116.1	**285.0**	**142.5**	**144.5**	**72.3**

Contributes to Downdrag

@ 6'

Silts

Sands

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
42" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	324.99	234.83	559.82	279.91	178.7	117.4	**296.2**	**148.1**	**152.6**	**76.3**
42	342.98	237.43	580.41	290.20	188.6	118.7	**307.4**	**153.7**	**160.6**	**80.3**
43	361.06	240.03	601.09	300.55	198.6	120.0	**318.6**	**159.3**	**168.8**	**84.4**
44	379.24	242.62	621.87	310.93	208.6	121.3	**329.9**	**164.9**	**177.0**	**88.5**
45	397.51	245.22	642.73	321.36	218.6	122.6	**341.2**	**170.6**	**185.2**	**92.6**
46	415.84	247.82	663.66	331.83	228.7	123.9	**352.6**	**176.3**	**193.4**	**96.7**
47	434.24	250.41	684.65	342.33	238.8	125.2	**364.0**	**182.0**	**201.7**	**100.9**
48	452.69	253.01	705.70	352.85	249.0	126.5	**375.5**	**187.7**	**210.0**	**105.0**
49	471.19	255.61	726.80	363.40	259.2	127.8	**387.0**	**193.5**	**218.3**	**109.2**
50	489.73	258.20	747.93	373.97	269.3	129.1	**398.5**	**199.2**	**226.7**	**113.3**
51	508.29	260.80	769.09	384.55	279.6	130.4	**410.0**	**205.0**	**235.0**	**117.5**
52	526.87	263.40	790.27	395.13	289.8	131.7	**421.5**	**210.7**	**243.4**	**121.7**
53	545.46	265.99	811.45	405.73	300.0	133.0	**433.0**	**216.5**	**251.8**	**125.9**
54	564.05	268.59	832.64	416.32	310.2	134.3	**444.5**	**222.3**	**260.1**	**130.1**
55	582.64	271.15	853.79	426.89	320.4	135.6	**456.0**	**228.0**	**268.5**	**134.2**
56	601.20	273.64	874.84	437.42	330.7	136.8	**467.5**	**233.7**	**276.9**	**138.4**
57	619.75	276.06	895.80	447.90	340.9	138.0	**478.9**	**239.4**	**285.2**	**142.6**
58	638.26	278.40	916.66	458.33	351.0	139.2	**490.2**	**245.1**	**293.5**	**146.8**
59	656.72	280.67	937.40	468.70	361.2	140.3	**501.5**	**250.8**	**301.8**	**150.9**
60	675.14	282.87	958.01	479.01	371.3	141.4	**512.8**	**256.4**	**310.1**	**155.1**
61	693.50	285.00	978.50	489.25	381.4	142.5	**523.9**	**262.0**	**318.4**	**159.2**
62	711.76	287.04	998.80	499.40	391.5	143.5	**535.0**	**267.5**	**326.6**	**163.3**
63	729.96	288.99	1018.95	509.48	401.5	144.5	**546.0**	**273.0**	**334.8**	**167.4**
64	748.11	290.84	1038.95	519.47	411.5	145.4	**556.9**	**278.4**	**343.0**	**171.5**
65	766.19	292.60	1058.78	529.39	421.4	146.3	**567.7**	**283.9**	**351.1**	**175.5**
66	784.19	294.26	1078.45	539.23	431.3	147.1	**578.4**	**289.2**	**359.2**	**179.6**
67	802.05	295.85	1097.89	548.95	441.1	147.9	**589.0**	**294.5**	**367.2**	**183.6**
68	819.85	297.43	1117.28	558.64	450.9	148.7	**599.6**	**299.8**	**375.2**	**187.6**
69	837.54	299.02	1136.56	568.28	460.6	149.5	**610.2**	**305.1**	**383.2**	**191.6**
70	855.12	300.61	1155.72	577.86	470.3	150.3	**620.6**	**310.3**	**391.1**	**195.6**
71	872.57	302.19	1174.77	587.38	479.9	151.1	**631.0**	**315.5**	**399.0**	**199.5**
72	889.90	303.78	1193.68	596.84	489.4	151.9	**641.3**	**320.7**	**406.8**	**203.4**
73	907.08	305.37	1212.45	606.22	498.9	152.7	**651.6**	**325.8**	**414.5**	**207.2**
74	924.12	906.95	1831.07	915.54	508.3	453.5	**961.7**	**480.9**	**422.2**	**211.1**
75	941.00	308.54	1249.54	624.77	517.5	154.3	**671.8**	**335.9**	**429.8**	**214.9**
76	957.71	310.13	1267.84	633.92	526.7	155.1	**681.8**	**340.9**	**437.3**	**218.6**
77	974.25	311.71	1285.97	642.98	535.8	155.9	**691.7**	**345.8**	**444.7**	**222.4**
78	990.61	313.30	1303.92	651.96	544.8	156.7	**701.5**	**350.7**	**452.1**	**226.0**
79	1006.79	314.89	1321.68	660.84	553.7	157.4	**711.2**	**355.6**	**459.4**	**229.7**
80	1022.76	316.48	1339.24	669.62	562.5	158.2	**720.8**	**360.4**	**466.6**	**233.3**

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
48" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)		Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
	1	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.1**	**0.1**
	2	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**0.5**	**0.2**
	3	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**1.1**	**0.5**
	4	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**1.9**	**0.9**
	5	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**3.0**	**1.5**
@ 6'	6	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**4.3**	**2.1**
Silts	7	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**5.7**	**2.8**
Sands	8	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**7.6**	**3.8**
	9	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**9.6**	**4.8**
	10	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**11.7**	**5.9**
	11	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**13.8**	**6.9**
	12	0.00	0.00	0.00	0.0	0.0	0.0	**0.0**	**0.0**	**16.0**	**8.0**
	13	25.01	14.89	39.90	20.0	13.8	7.4	**21.2**	**10.6**	**18.5**	**9.2**
	14	30.43	30.99	61.42	30.7	16.7	15.5	**32.2**	**16.1**	**20.9**	**10.5**
	15	36.10	48.30	84.39	42.2	19.9	24.1	**44.0**	**22.0**	**23.5**	**11.7**
	16	41.54	66.81	108.35	54.2	22.8	33.4	**56.3**	**28.1**	**25.9**	**13.0**
	17	47.17	86.52	133.69	66.8	25.9	43.3	**69.2**	**34.6**	**28.4**	**14.2**
	18	52.96	107.45	160.41	80.2	29.1	53.7	**82.9**	**41.4**	**31.0**	**15.5**
	19	58.93	129.58	188.51	94.3	32.4	64.8	**97.2**	**48.6**	**33.7**	**16.9**
	20	65.07	152.91	217.97	109.0	35.8	76.5	**112.2**	**56.1**	**36.5**	**18.2**
	21	71.36	177.37	248.72	124.4	39.2	88.7	**127.9**	**64.0**	**39.3**	**19.7**
	22	77.80	202.83	280.62	140.3	42.8	101.4	**144.2**	**72.1**	**42.2**	**21.1**
	23	84.39	208.39	292.78	146.4	46.4	104.2	**150.6**	**75.3**	**45.2**	**22.6**
	24	91.12	213.77	304.90	152.4	50.1	106.9	**157.0**	**78.5**	**48.2**	**24.1**
	25	98.60	218.97	317.58	158.8	54.2	109.5	**163.7**	**81.9**	**51.6**	**25.8**
	26	105.62	223.98	329.61	164.8	58.1	112.0	**170.1**	**85.0**	**54.7**	**27.4**
	27	112.77	228.81	341.58	170.8	62.0	114.4	**176.4**	**88.2**	**58.0**	**29.0**
	28	120.04	233.45	353.49	176.7	66.0	116.7	**182.7**	**91.4**	**61.2**	**30.6**
	29	138.02	237.88	375.90	187.9	75.9	118.9	**194.8**	**97.4**	**69.3**	**34.7**
	30	156.27	242.06	398.33	199.2	85.9	121.0	**207.0**	**103.5**	**77.5**	**38.8**
	31	174.79	245.99	420.78	210.4	96.1	123.0	**219.1**	**109.6**	**85.9**	**42.9**
	32	193.57	249.68	443.25	221.6	106.5	124.8	**231.3**	**115.7**	**94.3**	**47.2**
	33	212.59	253.12	465.71	232.9	116.9	126.6	**243.5**	**121.7**	**102.9**	**51.4**
	34	231.74	256.31	488.05	244.0	127.5	128.2	**255.6**	**127.8**	**111.5**	**55.7**
	35	251.16	259.38	510.54	255.3	138.1	129.7	**267.8**	**133.9**	**120.2**	**60.1**
	36	270.78	262.45	533.23	266.6	148.9	131.2	**280.2**	**140.1**	**129.1**	**64.5**
	37	290.58	265.52	556.10	278.1	159.8	132.8	**292.6**	**146.3**	**138.0**	**69.0**
	38	310.56	268.59	579.15	289.6	170.8	134.3	**305.1**	**152.6**	**147.0**	**73.5**
	39	330.70	271.66	602.36	301.2	181.9	135.8	**317.7**	**158.9**	**156.0**	**78.0**
	40	350.99	274.73	625.72	312.9	193.0	137.4	**330.4**	**165.2**	**165.2**	**82.6**

Contributes to Downdrag

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
48" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	371.42	277.80	649.22	324.6	204.3	138.9	**343.2**	**171.6**	**174.3**	**87.2**
42	391.97	280.87	672.84	336.4	215.6	140.4	**356.0**	**178.0**	**183.6**	**91.8**
43	412.65	283.94	696.58	348.3	227.0	142.0	**368.9**	**184.5**	**192.9**	**96.5**
44	433.42	287.01	720.43	360.2	238.4	143.5	**381.9**	**190.9**	**202.3**	**101.1**
45	434.29	290.08	724.37	362.2	238.9	145.0	**383.9**	**191.9**	**202.6**	**101.3**
46	475.25	293.15	768.39	384.2	261.4	146.6	**408.0**	**204.0**	**221.1**	**110.5**
47	496.27	296.22	792.49	396.2	273.0	148.1	**421.1**	**210.5**	**230.5**	**115.3**
48	517.36	299.28	816.65	408.3	284.5	149.6	**434.2**	**217.1**	**240.0**	**120.0**
49	538.51	302.35	840.86	420.4	296.2	151.2	**447.4**	**223.7**	**249.5**	**124.8**
50	559.69	305.42	865.11	432.6	307.8	152.7	**460.5**	**230.3**	**259.1**	**129.5**
51	580.90	308.49	889.40	444.7	319.5	154.2	**473.7**	**236.9**	**268.6**	**134.3**
52	602.14	311.56	913.70	456.9	331.2	155.8	**487.0**	**243.5**	**278.2**	**139.1**
53	623.38	314.63	938.02	469.0	342.9	157.3	**500.2**	**250.1**	**287.7**	**143.9**
54	644.63	317.66	962.30	481.1	354.5	158.8	**513.4**	**256.7**	**297.3**	**148.6**
55	665.87	320.62	986.49	493.2	366.2	160.3	**526.5**	**263.3**	**306.9**	**153.4**
56	687.09	323.51	1010.60	505.3	377.9	161.8	**539.7**	**269.8**	**316.4**	**158.2**
57	708.28	326.31	1034.60	517.3	389.6	163.2	**552.7**	**276.4**	**325.9**	**163.0**
58	729.44	329.05	1058.48	529.2	401.2	164.5	**565.7**	**282.9**	**335.5**	**167.7**
59	750.54	331.71	1082.25	541.1	412.8	165.9	**578.7**	**289.3**	**345.0**	**172.5**
60	771.59	334.29	1105.88	552.9	424.4	167.1	**591.5**	**295.8**	**354.4**	**177.2**
61	792.58	336.80	1129.38	564.7	435.9	168.4	**604.3**	**302.2**	**363.9**	**181.9**
62	813.44	339.22	1152.66	576.3	447.4	169.6	**617.0**	**308.5**	**373.3**	**186.6**
63	834.24	341.55	1175.79	587.9	458.8	170.8	**629.6**	**314.8**	**382.6**	**191.3**
64	854.98	343.77	1198.75	599.4	470.2	171.9	**642.1**	**321.1**	**392.0**	**196.0**
65	875.64	345.90	1221.54	610.8	481.6	172.9	**654.6**	**327.3**	**401.3**	**200.6**
66	896.22	347.92	1244.15	622.1	492.9	174.0	**666.9**	**333.4**	**410.5**	**205.3**
67	916.63	349.85	1266.47	633.2	504.1	174.9	**679.1**	**339.5**	**419.7**	**209.8**
68	936.97	351.72	1288.69	644.3	515.3	175.9	**691.2**	**345.6**	**428.8**	**214.4**
69	957.19	353.60	1310.79	655.4	526.5	176.8	**703.3**	**351.6**	**437.9**	**219.0**
70	977.28	355.48	1332.75	666.4	537.5	177.7	**715.2**	**357.6**	**447.0**	**223.5**
71	997.23	357.35	1354.58	677.3	548.5	178.7	**727.2**	**363.6**	**456.0**	**228.0**
72	1017.03	359.23	1376.25	688.1	559.4	179.6	**739.0**	**369.5**	**464.9**	**232.4**
73	1036.66	361.10	1397.77	698.9	570.2	180.6	**750.7**	**375.4**	**473.7**	**236.9**
74	1056.13	362.98	1419.11	709.6	580.9	181.5	**762.4**	**381.2**	**482.5**	**241.2**
75	1075.42	364.85	1440.28	720.1	591.5	182.4	**773.9**	**387.0**	**491.2**	**245.6**
76	1094.53	366.73	1461.26	730.6	602.0	183.4	**785.4**	**392.7**	**499.7**	**249.9**
77	1113.43	368.61	1482.04	741.0	612.4	184.3	**796.7**	**398.3**	**508.3**	**254.1**
78	1132.13	370.48	1502.61	751.3	622.7	185.2	**807.9**	**404.0**	**516.7**	**258.3**
79	1150.62	372.36	1522.97	761.5	632.8	186.2	**819.0**	**409.5**	**525.0**	**262.5**
80	1168.87	374.23	1543.11	771.6	642.9	187.1	**830.0**	**415.0**	**533.2**	**266.6**

APPENDIX H:

CAPACITY TABLES

ABUTMENT 1 AT I-65 AND RAMPS 2, 3 AND 4

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
12x53 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nonimal Side Resistance	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65) (kips)	(tons)	ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35) (kips)	(tons)
0	0.00	0.24	0.24	0.1	0.1	0.0	0.2	0.1	0.0	0.0
1	0.95	0.24	1.19	0.6	0.4	0.2	0.8	0.4	0.2	0.1
2	1.91	0.24	2.15	1.1	0.8	0.4	1.4	0.7	0.5	0.2
3	2.86	0.24	3.10	1.5	1.1	0.5	2.0	1.0	0.7	0.4
4	3.81	0.24	4.05	2.0	1.4	0.7	2.6	1.3	1.0	0.5
5	4.76	0.24	5.00	2.5	1.8	0.9	3.3	1.6	1.2	0.6
@ 6' 6	5.72	0.24	5.96	3.0	2.1	1.0	3.9	1.9	1.4	0.7
Clays 7	6.67	0.24	6.91	3.5	2.4	1.2	4.5	2.2	1.7	0.8
Sands 7	6.70	1.43	8.13	4.1	3.0	1.5	5.3	2.6	1.7	0.8
8	8.74	1.43	10.17	5.1	3.9	1.9	6.6	3.3	2.6	1.3
9	10.78	1.43	12.21	6.1	4.8	2.4	7.9	4.0	3.5	1.8
10	12.83	1.43	14.26	7.1	5.7	2.9	9.3	4.6	4.5	2.2
11	14.87	1.43	16.30	8.1	6.6	3.3	10.6	5.3	5.4	2.7
12	16.91	1.43	18.34	9.2	7.6	3.8	11.9	6.0	6.3	3.2
13	18.95	1.43	20.38	10.2	8.5	4.2	13.2	6.6	7.3	3.6
14	20.99	1.43	22.42	11.2	9.4	4.7	14.6	7.3	8.2	4.1
15	23.04	1.43	24.47	12.2	10.3	5.2	15.9	8.0	9.1	4.6
16	25.08	1.43	26.51	13.3	11.2	5.6	17.2	8.6	10.1	5.0
17	27.12	1.43	28.55	14.3	12.2	6.1	18.6	9.3	11.0	5.5
18	29.16	1.43	30.59	15.3	13.1	6.5	19.9	9.9	11.9	6.0
19	31.20	1.43	32.63	16.3	14.0	7.0	21.2	10.6	12.9	6.4
20	33.25	1.43	34.68	17.3	14.9	7.5	22.5	11.3	13.8	6.9
21	35.29	1.43	36.72	18.4	15.8	7.9	23.9	11.9	14.7	7.4
22	37.33	1.43	38.76	19.4	16.8	8.4	25.2	12.6	15.7	7.8
22	37.40	10.26	47.66	23.8	20.8	10.4	31.0	15.5	15.7	7.8
23	42.06	10.26	52.32	26.2	22.9	11.4	34.0	17.0	18.2	9.1
24	46.73	10.26	56.99	28.5	25.0	12.5	37.0	18.5	20.7	10.4
25	51.39	10.26	61.65	30.8	27.1	13.5	40.1	20.0	23.2	11.6
26	56.05	10.26	66.31	33.2	29.2	14.6	43.1	21.6	25.7	12.9
27	60.72	10.26	70.98	35.5	31.2	15.6	46.1	23.1	28.3	14.1
28	65.38	10.26	75.64	37.8	33.3	16.7	49.2	24.6	30.8	15.4
29	70.05	10.26	80.31	40.2	35.4	17.7	52.2	26.1	33.3	16.6
30	74.71	10.26	84.97	42.5	37.5	18.8	55.2	27.6	35.8	17.9
31	79.37	10.26	89.63	44.8	39.6	19.8	58.3	29.1	38.3	19.2
32	84.04	10.26	94.30	47.1	41.7	20.9	61.3	30.6	40.8	20.4
33	88.70	10.26	98.96	49.5	43.8	21.9	64.3	32.2	43.4	21.7
34	93.36	10.26	103.62	51.8	45.9	23.0	67.4	33.7	45.9	22.9
35	98.03	10.26	108.29	54.1	48.0	24.0	70.4	35.2	48.4	24.2
36	102.69	10.26	112.95	56.5	50.1	25.1	73.4	36.7	50.9	25.5
36	102.80	10.26	113.06	56.5	50.2	25.1	73.5	36.7	51.0	25.5

Downdrag is not an issue at this location.

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
12x53 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)		(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
37	112.42	10.26	122.68	61.3	54.5	27.3	79.7	39.9	55.5	27.8
38	122.05	10.26	132.31	66.2	58.8	29.4	86.0	43.0	60.0	30.0
39	131.67	10.26	141.93	71.0	63.2	31.6	92.3	46.1	64.5	32.3
40	141.29	10.26	151.55	75.8	67.5	33.8	98.5	49.3	69.1	34.5
41	150.91	10.26	161.17	80.6	71.8	35.9	104.8	52.4	73.6	36.8
42	160.54	10.26	170.80	85.4	76.2	38.1	111.0	55.5	78.1	39.1
43	170.16	10.26	180.42	90.2	80.5	40.2	117.3	58.6	82.6	41.3
44	179.78	10.26	190.04	95.0	84.8	42.4	123.5	61.8	87.2	43.6
45	189.40	10.26	199.66	99.8	89.2	44.6	129.8	64.9	91.7	45.8
46	199.03	10.26	209.29	104.6	93.5	46.7	136.0	68.0	96.2	48.1
47	208.65	10.26	218.91	109.5	97.8	48.9	142.3	71.1	100.7	50.4
48	218.27	10.26	228.53	114.3	102.1	51.1	148.5	74.3	105.3	52.6
49	227.90	10.26	238.16	119.1	106.5	53.2	154.8	77.4	109.8	54.9
50	237.52	10.26	247.78	123.9	110.8	55.4	161.1	80.5	114.3	57.2
51	247.14	10.26	257.40	128.7	115.1	57.6	167.3	83.7	118.8	59.4
52	256.76	10.26	267.02	133.5	119.5	59.7	173.6	86.8	123.3	61.7
53	266.39	10.26	276.65	138.3	123.8	61.9	179.8	89.9	127.9	63.9
54	276.01	10.26	286.27	143.1	128.1	64.1	186.1	93.0	132.4	66.2
55	285.63	10.26	295.89	147.9	132.5	66.2	192.3	96.2	136.9	68.5
56	295.25	10.26	305.51	152.8	136.8	68.4	198.6	99.3	141.4	70.7
57	304.88	10.26	315.14	157.6	141.1	70.6	204.8	102.4	146.0	73.0
58	314.50	10.26	324.76	162.4	145.5	72.7	211.1	105.5	150.5	75.2
59	324.12	10.26	334.38	167.2	149.8	74.9	217.3	108.7	155.0	77.5
60	333.75	10.26	344.01	172.0	154.1	77.1	223.6	111.8	159.5	79.8
61	343.37	10.26	353.63	176.8	158.4	79.2	229.9	114.9	164.1	82.0
62	352.99	10.26	363.25	181.6	162.8	81.4	236.1	118.1	168.6	84.3
63	362.61	10.26	372.87	186.4	167.1	83.6	242.4	121.2	173.1	86.5
64	372.24	10.26	382.50	191.2	171.4	85.7	248.6	124.3	177.6	88.8
65	381.86	10.26	392.12	196.1	175.8	87.9	254.9	127.4	182.1	91.1
66	391.48	10.26	401.74	200.9	180.1	90.0	261.1	130.6	186.7	93.3
67	401.10	10.26	411.36	205.7	184.4	92.2	267.4	133.7	191.2	95.6
68	410.73	10.26	420.99	210.5	188.8	94.4	273.6	136.8	195.7	97.9
69	420.35	10.26	430.61	215.3	193.1	96.5	279.9	139.9	200.2	100.1
70	429.97	10.26	440.23	220.1	197.4	98.7	286.2	143.1	204.8	102.4
71	439.60	10.26	449.86	224.9	201.7	100.9	292.4	146.2	209.3	104.6
72	449.22	10.26	459.48	229.7	206.1	103.0	298.7	149.3	213.8	106.9
73	458.84	10.26	469.10	234.6	210.4	105.2	304.9	152.5	218.3	109.2
74	468.46	10.26	478.72	239.4	214.7	107.4	311.2	155.6	222.9	111.4
75	478.09	10.26	488.35	244.2	219.1	109.5	317.4	158.7	227.4	113.7
76	487.71	10.26	497.97	249.0	223.4	111.7	323.7	161.8	231.9	115.9
77	497.33	10.26	507.59	253.8	227.7	113.9	329.9	165.0	236.4	118.2

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
12x53 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		**ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method**		**ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)**		**ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)**	
(ft)		(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
78	506.96	10.26	517.22	258.6	232.1	116.0	336.2	168.1	240.9	120.5
79	516.58	10.26	526.84	263.4	236.4	118.2	342.4	171.2	245.5	122.7
80	526.20	10.26	536.46	268.2	240.7	120.4	348.7	174.3	250.0	125.0
81	535.82	10.26	546.08	273.0	245.0	122.5	355.0	177.5	254.5	127.3
82	545.45	10.26	555.71	277.9	249.4	124.7	361.2	180.6	259.0	129.5
83	555.07	10.26	565.33	282.7	253.7	126.9	367.5	183.7	263.6	131.8
84	564.69	10.26	574.95	287.5	258.0	129.0	373.7	186.9	268.1	134.0
85	574.31	10.26	584.57	292.3	262.4	131.2	380.0	190.0	272.6	136.3
86	583.94	10.26	594.20	297.1	266.7	133.3	386.2	193.1	277.1	138.6
87	593.56	10.26	603.82	301.9	271.0	135.5	392.5	196.2	281.6	140.8
88	603.18	10.26	613.44	306.7	275.4	137.7	398.7	199.4	286.2	143.1
89	612.81	10.26	623.07	311.5	279.7	139.8	405.0	202.5	290.7	145.3
90	622.43	10.26	632.69	316.3	284.0	142.0	411.2	205.6	295.2	147.6
91	632.05	10.26	642.31	321.2	288.3	144.2	417.5	208.8	299.7	149.9
92	641.67	10.26	651.93	326.0	292.7	146.3	423.8	211.9	304.3	152.1
93	651.30	10.26	661.56	330.8	297.0	148.5	430.0	215.0	308.8	154.4
94	660.92	10.26	671.18	335.6	301.3	150.7	436.3	218.1	313.3	156.7
95	670.54	10.26	680.80	340.4	305.7	152.8	442.5	221.3	317.8	158.9
96	680.16	10.26	690.42	345.2	310.0	155.0	448.8	224.4	322.4	161.2
97	689.79	10.26	700.05	350.0	314.3	157.2	455.0	227.5	326.9	163.4
98	699.41	10.26	709.67	354.8	318.7	159.3	461.3	230.6	331.4	165.7
99	709.03	10.26	719.29	359.6	323.0	161.5	467.5	233.8	335.9	168.0
100	718.66	10.26	728.92	364.5	327.3	163.7	473.8	236.9	340.4	170.2
101	728.28	10.26	738.54	369.3	331.7	165.8	480.0	240.0	345.0	172.5
102	737.90	10.26	748.16	374.1	336.0	168.0	486.3	243.2	349.5	174.7
103	747.52	10.26	757.78	378.9	340.3	170.2	492.6	246.3	354.0	177.0
104	757.15	10.26	767.41	383.7	344.6	172.3	498.8	249.4	358.5	179.3
105	766.77	10.26	777.03	388.5	349.0	174.5	505.1	252.5	363.1	181.5
106	776.39	10.26	786.65	393.3	353.3	176.7	511.3	255.7	367.6	183.8
107	786.01	10.26	796.27	398.1	357.6	178.8	517.6	258.8	372.1	186.1
108	795.64	10.26	805.90	402.9	362.0	181.0	523.8	261.9	376.6	188.3
109	805.26	10.26	815.52	407.8	366.3	183.1	530.1	265.0	381.2	190.6
110	814.88	10.26	825.14	412.6	370.6	185.3	536.3	268.2	385.7	192.8
111	824.51	10.26	834.77	417.4	375.0	187.5	542.6	271.3	390.2	195.1
112	834.13	10.26	844.39	422.2	379.3	189.6	548.9	274.4	394.7	197.4
113	843.75	10.26	854.01	427.0	383.6	191.8	555.1	277.6	399.2	199.6
114	853.37	10.26	863.63	431.8	387.9	194.0	561.4	280.7	403.8	201.9
115	863.00	10.26	873.26	436.6	392.3	196.1	567.6	283.8	408.3	204.1

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x73 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nonimal Side Resistance	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65) (kips)	(tons)	ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35) (kips)	(tons)
0	0.00	0.33	0.33	0.2	0.1	0.1	0.2	0.1	0.0	0.0
1	1.13	0.33	1.46	0.7	0.5	0.3	0.9	0.5	0.3	0.1
2	2.25	0.33	2.58	1.3	0.9	0.5	1.7	0.8	0.6	0.3
3	3.38	0.33	3.71	1.9	1.3	0.6	2.4	1.2	0.8	0.4
4	4.51	0.33	4.84	2.4	1.7	0.8	3.1	1.6	1.1	0.6
5	5.64	0.33	5.97	3.0	2.1	1.0	3.9	1.9	1.4	0.7
@ 6' 6	6.76	0.33	7.09	3.5	2.5	1.2	4.6	2.3	1.7	0.8
Clays 7	7.89	0.33	8.22	4.1	2.9	1.4	5.3	2.7	2.0	1.0
Sands 7	7.93	1.98	9.91	5.0	3.6	1.8	6.4	3.2	2.0	1.0
8	10.62	1.98	12.60	6.3	4.8	2.4	8.2	4.1	3.2	1.6
9	13.31	1.98	15.29	7.6	6.1	3.0	9.9	5.0	4.4	2.2
10	16.01	1.98	17.99	9.0	7.3	3.6	11.7	5.8	5.7	2.8
11	18.70	1.98	20.68	10.3	8.5	4.2	13.4	6.7	6.9	3.4
12	21.39	1.98	23.37	11.7	9.7	4.8	15.2	7.6	8.1	4.1
13	24.08	1.98	26.06	13.0	10.9	5.5	16.9	8.5	9.4	4.7
14	26.77	1.98	28.75	14.4	12.1	6.1	18.7	9.3	10.6	5.3
15	29.47	1.98	31.45	15.7	13.3	6.7	20.4	10.2	11.8	5.9
16	32.16	1.98	34.14	17.1	14.5	7.3	22.2	11.1	13.0	6.5
17	34.85	1.98	36.83	18.4	15.8	7.9	23.9	12.0	14.3	7.1
18	37.54	1.98	39.52	19.8	17.0	8.5	25.7	12.8	15.5	7.7
19	40.23	1.98	42.21	21.1	18.2	9.1	27.4	13.7	16.7	8.4
20	42.93	1.98	44.91	22.5	19.4	9.7	29.2	14.6	18.0	9.0
21	45.62	1.98	47.60	23.8	20.6	10.3	30.9	15.5	19.2	9.6
22	48.31	1.98	50.29	25.1	21.8	10.9	32.7	16.3	20.4	10.2
22	48.40	14.16	62.56	31.3	27.3	13.7	40.7	20.3	20.5	10.2
23	54.72	14.16	68.88	34.4	30.2	15.1	44.8	22.4	23.9	11.9
24	61.05	14.16	75.21	37.6	33.0	16.5	48.9	24.4	27.3	13.6
25	67.37	14.16	81.53	40.8	35.9	17.9	53.0	26.5	30.7	15.3
26	73.70	14.16	87.86	43.9	38.7	19.4	57.1	28.6	34.1	17.1
27	80.02	14.16	94.18	47.1	41.6	20.8	61.2	30.6	37.5	18.8
28	86.35	14.16	100.51	50.3	44.4	22.2	65.3	32.7	40.9	20.5
29	92.67	14.16	106.83	53.4	47.3	23.6	69.4	34.7	44.3	22.2
30	98.99	14.16	113.15	56.6	50.1	25.0	73.6	36.8	47.8	23.9
31	105.32	14.16	119.48	59.7	52.9	26.5	77.7	38.8	51.2	25.6
32	111.64	14.16	125.80	62.9	55.8	27.9	81.8	40.9	54.6	27.3
33	117.97	14.16	132.13	66.1	58.6	29.3	85.9	42.9	58.0	29.0
34	124.29	14.16	138.45	69.2	61.5	30.7	90.0	45.0	61.4	30.7
35	130.62	14.16	144.78	72.4	64.3	32.2	94.1	47.1	64.8	32.4
36	136.94	14.16	151.10	75.6	67.2	33.6	98.2	49.1	68.2	34.1
36	137.09	14.16	151.25	75.6	67.2	33.6	98.3	49.2	68.3	34.2

Downdrag is not an issue at this location.

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x73 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		**ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method**		**ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)**		**ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)**	
(ft)		(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
37	150.14	14.16	164.30	82.1	73.1	36.6	106.8	53.4	74.4	37.2
38	163.19	14.16	177.35	88.7	79.0	39.5	115.3	57.6	80.6	40.3
39	176.24	14.16	190.40	95.2	84.9	42.4	123.8	61.9	86.7	43.4
40	189.29	14.16	203.45	101.7	90.7	45.4	132.2	66.1	92.8	46.4
41	202.33	14.16	216.49	108.2	96.6	48.3	140.7	70.4	99.0	49.5
42	215.38	14.16	229.54	114.8	102.5	51.2	149.2	74.6	105.1	52.6
43	228.43	14.16	242.59	121.3	108.3	54.2	157.7	78.8	111.2	55.6
44	241.48	14.16	255.64	127.8	114.2	57.1	166.2	83.1	117.4	58.7
45	254.53	14.16	268.69	134.3	120.1	60.0	174.6	87.3	123.5	61.8
46	267.58	14.16	281.74	140.9	126.0	63.0	183.1	91.6	129.6	64.8
47	280.63	14.16	294.79	147.4	131.8	65.9	191.6	95.8	135.8	67.9
48	293.68	14.16	307.84	153.9	137.7	68.9	200.1	100.0	141.9	71.0
49	306.72	14.16	320.88	160.4	143.6	71.8	208.6	104.3	148.0	74.0
50	319.77	14.16	333.93	167.0	149.4	74.7	217.1	108.5	154.2	77.1
51	332.82	14.16	346.98	173.5	155.3	77.7	225.5	112.8	160.3	80.2
52	345.87	14.16	360.03	180.0	161.2	80.6	234.0	117.0	166.4	83.2
53	358.92	14.16	373.08	186.5	167.1	83.5	242.5	121.3	172.6	86.3
54	371.97	14.16	386.13	193.1	172.9	86.5	251.0	125.5	178.7	89.4
55	385.02	14.16	399.18	199.6	178.8	89.4	259.5	129.7	184.8	92.4
56	398.07	14.16	412.23	206.1	184.7	92.3	267.9	134.0	191.0	95.5
57	411.11	14.16	425.27	212.6	190.6	95.3	276.4	138.2	197.1	98.6
58	424.16	14.16	438.32	219.2	196.4	98.2	284.9	142.5	203.2	101.6
59	437.21	14.16	451.37	225.7	202.3	101.1	293.4	146.7	209.4	104.7
60	450.26	14.16	464.42	232.2	208.2	104.1	301.9	150.9	215.5	107.8
61	463.31	14.16	477.47	238.7	214.0	107.0	310.4	155.2	221.6	110.8
62	476.36	14.16	490.52	245.3	219.9	110.0	318.8	159.4	227.8	113.9
63	489.41	14.16	503.57	251.8	225.8	112.9	327.3	163.7	233.9	117.0
64	502.46	14.16	516.62	258.3	231.7	115.8	335.8	167.9	240.0	120.0
65	515.50	14.16	529.66	264.8	237.5	118.8	344.3	172.1	246.2	123.1
66	528.55	14.16	542.71	271.4	243.4	121.7	352.8	176.4	252.3	126.2
67	541.60	14.16	555.76	277.9	249.3	124.6	361.2	180.6	258.4	129.2
68	554.65	14.16	568.81	284.4	255.1	127.6	369.7	184.9	264.6	132.3
69	567.70	14.16	581.86	290.9	261.0	130.5	378.2	189.1	270.7	135.4
70	580.75	14.16	594.91	297.5	266.9	133.4	386.7	193.3	276.8	138.4
71	593.80	14.16	607.96	304.0	272.8	136.4	395.2	197.6	283.0	141.5
72	606.85	14.16	621.01	310.5	278.6	139.3	403.7	201.8	289.1	144.6
73	619.89	14.16	634.05	317.0	284.5	142.3	412.1	206.1	295.2	147.6
74	632.94	14.16	647.10	323.6	290.4	145.2	420.6	210.3	301.4	150.7
75	645.99	14.16	660.15	330.1	296.2	148.1	429.1	214.5	307.5	153.8
76	659.04	14.16	673.20	336.6	302.1	151.1	437.6	218.8	313.6	156.8
77	672.09	14.16	686.25	343.1	308.0	154.0	446.1	223.0	319.8	159.9

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x73 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)		(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
78	685.14	14.16	699.30	349.6	313.9	156.9	454.5	227.3	325.9	163.0
79	698.19	14.16	712.35	356.2	319.7	159.9	463.0	231.5	332.0	166.0
80	711.24	14.16	725.40	362.7	325.6	162.8	471.5	235.8	338.2	169.1
81	724.28	14.16	738.44	369.2	331.5	165.7	480.0	240.0	344.3	172.2
82	737.33	14.16	751.49	375.7	337.3	168.7	488.5	244.2	350.4	175.2
83	750.38	14.16	764.54	382.3	343.2	171.6	497.0	248.5	356.6	178.3
84	763.43	14.16	777.59	388.8	349.1	174.5	505.4	252.7	362.7	181.4
85	776.48	14.16	790.64	395.3	355.0	177.5	513.9	257.0	368.8	184.4
86	789.53	14.16	803.69	401.8	360.8	180.4	522.4	261.2	375.0	187.5
87	802.58	14.16	816.74	408.4	366.7	183.4	530.9	265.4	381.1	190.6
88	815.63	14.16	829.79	414.9	372.6	186.3	539.4	269.7	387.2	193.6
89	828.67	14.16	842.83	421.4	378.5	189.2	547.8	273.9	393.4	196.7
90	841.72	14.16	855.88	427.9	384.3	192.2	556.3	278.2	399.5	199.8
91	854.77	14.16	868.93	434.5	390.2	195.1	564.8	282.4	405.6	202.8
92	867.82	14.16	881.98	441.0	396.1	198.0	573.3	286.6	411.8	205.9
93	880.87	14.16	895.03	447.5	401.9	201.0	581.8	290.9	417.9	209.0
94	893.92	14.16	908.08	454.0	407.8	203.9	590.3	295.1	424.0	212.0
95	906.97	14.16	921.13	460.6	413.7	206.8	598.7	299.4	430.2	215.1
96	920.02	14.16	934.18	467.1	419.6	209.8	607.2	303.6	436.3	218.2
97	933.06	14.16	947.22	473.6	425.4	212.7	615.7	307.8	442.4	221.2
98	946.11	14.16	960.27	480.1	431.3	215.7	624.2	312.1	448.6	224.3
99	959.16	14.16	973.32	486.7	437.2	218.6	632.7	316.3	454.7	227.4
100	972.21	14.16	986.37	493.2	443.0	221.5	641.1	320.6	460.8	230.4
101	985.26	14.16	999.42	499.7	448.9	224.5	649.6	324.8	467.0	233.5
102	998.31	14.16	1012.47	506.2	454.8	227.4	658.1	329.1	473.1	236.6
103	1011.36	14.16	1025.52	512.8	460.7	230.3	666.6	333.3	479.2	239.6
104	1024.41	14.16	1038.57	519.3	466.5	233.3	675.1	337.5	485.4	242.7
105	1037.45	14.16	1051.61	525.8	472.4	236.2	683.5	341.8	491.5	245.8
106	1050.50	14.16	1064.66	532.3	478.3	239.1	692.0	346.0	497.6	248.8
107	1063.55	14.16	1077.71	538.9	484.1	242.1	700.5	350.3	503.8	251.9
108	1076.60	14.16	1090.76	545.4	490.0	245.0	709.0	354.5	509.9	255.0
109	1089.65	14.16	1103.81	551.9	495.9	247.9	717.5	358.7	516.0	258.0
110	1102.70	14.16	1116.86	558.4	501.8	250.9	726.0	363.0	522.2	261.1
111	1115.75	14.16	1129.91	565.0	507.6	253.8	734.4	367.2	528.3	264.2
112	1128.80	14.16	1142.96	571.5	513.5	256.8	742.9	371.5	534.4	267.2
113	1141.85	14.16	1156.01	578.0	519.4	259.7	751.4	375.7	540.6	270.3
114	1154.89	14.16	1169.05	584.5	525.3	262.6	759.9	379.9	546.7	273.4
115	1167.94	14.16	1182.10	591.1	531.1	265.6	768.4	384.2	552.8	276.4

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x89 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nonimal Side Resistance	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method (kips)	(tons)	ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65) (kips)	(tons)	ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35) (kips)	(tons)
0	0.00	0.41	0.41	0.2	0.1	0.1	0.3	0.1	0.0	0.0
1	1.14	0.41	1.55	0.8	0.5	0.3	1.0	0.5	0.3	0.1
2	2.28	0.41	2.69	1.3	0.9	0.5	1.8	0.9	0.6	0.3
3	3.42	0.41	3.83	1.9	1.3	0.7	2.5	1.2	0.9	0.4
4	4.57	0.41	4.98	2.5	1.7	0.9	3.2	1.6	1.1	0.6
5	5.71	0.41	6.12	3.1	2.1	1.1	4.0	2.0	1.4	0.7
@ 6' 6	6.85	0.41	7.26	3.6	2.5	1.3	4.7	2.4	1.7	0.9
Clays 7	7.99	0.41	8.40	4.2	2.9	1.5	5.5	2.7	2.0	1.0
Sands 7	8.02	2.41	10.43	5.2	3.9	1.9	6.8	3.4	2.0	1.0
8	10.94	2.41	13.35	6.7	5.2	2.6	8.7	4.3	3.3	1.7
9	13.87	2.41	16.28	8.1	6.5	3.2	10.6	5.3	4.7	2.3
10	16.79	2.41	19.20	9.6	7.8	3.9	12.5	6.2	6.0	3.0
11	19.72	2.41	22.13	11.1	9.1	4.6	14.4	7.2	7.3	3.7
12	22.64	2.41	25.05	12.5	10.4	5.2	16.3	8.1	8.7	4.3
13	25.57	2.41	27.98	14.0	11.8	5.9	18.2	9.1	10.0	5.0
14	28.49	2.41	30.90	15.5	13.1	6.5	20.1	10.0	11.3	5.7
15	31.42	2.41	33.83	16.9	14.4	7.2	22.0	11.0	12.7	6.3
16	34.34	2.41	36.75	18.4	15.7	7.8	23.9	11.9	14.0	7.0
17	37.27	2.41	39.68	19.8	17.0	8.5	25.8	12.9	15.4	7.7
18	40.19	2.41	42.60	21.3	18.3	9.2	27.7	13.8	16.7	8.3
19	43.12	2.41	45.53	22.8	19.6	9.8	29.6	14.8	18.0	9.0
20	46.04	2.41	48.45	24.2	21.0	10.5	31.5	15.7	19.4	9.7
21	48.97	2.41	51.38	25.7	22.3	11.1	33.4	16.7	20.7	10.3
22	51.89	2.41	54.30	27.2	23.6	11.8	35.3	17.6	22.0	11.0
22	51.99	17.27	69.26	34.6	30.3	15.2	45.0	22.5	22.1	11.0
23	58.97	17.27	76.24	38.1	33.5	16.7	49.6	24.8	25.8	12.9
24	65.95	17.27	83.22	41.6	36.6	18.3	54.1	27.0	29.6	14.8
25	72.94	17.27	90.21	45.1	39.8	19.9	58.6	29.3	33.4	16.7
26	79.92	17.27	97.19	48.6	42.9	21.4	63.2	31.6	37.1	18.6
27	86.90	17.27	104.17	52.1	46.0	23.0	67.7	33.9	40.9	20.5
28	93.88	17.27	111.15	55.6	49.2	24.6	72.2	36.1	44.7	22.3
29	100.87	17.27	118.14	59.1	52.3	26.2	76.8	38.4	48.4	24.2
30	107.85	17.27	125.12	62.6	55.5	27.7	81.3	40.7	52.2	26.1
31	114.83	17.27	132.10	66.0	58.6	29.3	85.9	42.9	56.0	28.0
32	121.81	17.27	139.08	69.5	61.7	30.9	90.4	45.2	59.7	29.9
33	128.79	17.27	146.06	73.0	64.9	32.4	94.9	47.5	63.5	31.8
34	135.78	17.27	153.05	76.5	68.0	34.0	99.5	49.7	67.3	33.6
35	142.76	17.27	160.03	80.0	71.2	35.6	104.0	52.0	71.1	35.5
36	149.74	17.27	167.01	83.5	74.3	37.2	108.6	54.3	74.8	37.4
36	149.90	17.27	167.17	83.6	74.4	37.2	108.7	54.3	74.9	37.5

Downdrag is not an issue at this location.

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x89 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method		ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)		ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)	
(ft)		(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
37	164.31	17.27	181.58	90.8	80.9	40.4	118.0	59.0	81.7	40.8
38	178.71	17.27	195.98	98.0	87.4	43.7	127.4	63.7	88.5	44.2
39	193.12	17.27	210.39	105.2	93.8	46.9	136.8	68.4	95.2	47.6
40	207.52	17.27	224.79	112.4	100.3	50.2	146.1	73.1	102.0	51.0
41	221.93	17.27	239.20	119.6	106.8	53.4	155.5	77.7	108.8	54.4
42	236.34	17.27	253.61	126.8	113.3	56.6	164.8	82.4	115.5	57.8
43	250.74	17.27	268.01	134.0	119.8	59.9	174.2	87.1	122.3	61.2
44	265.15	17.27	282.42	141.2	126.2	63.1	183.6	91.8	129.1	64.5
45	279.56	17.27	296.83	148.4	132.7	66.4	192.9	96.5	135.9	67.9
46	293.96	17.27	311.23	155.6	139.2	69.6	202.3	101.2	142.6	71.3
47	308.37	17.27	325.64	162.8	145.7	72.8	211.7	105.8	149.4	74.7
48	322.77	17.27	340.04	170.0	152.2	76.1	221.0	110.5	156.2	78.1
49	337.18	17.27	354.45	177.2	158.7	79.3	230.4	115.2	162.9	81.5
50	351.59	17.27	368.86	184.4	165.1	82.6	239.8	119.9	169.7	84.9
51	365.99	17.27	383.26	191.6	171.6	85.8	249.1	124.6	176.5	88.2
52	380.40	17.27	397.67	198.8	178.1	89.1	258.5	129.2	183.2	91.6
53	394.80	17.27	412.07	206.0	184.6	92.3	267.8	133.9	190.0	95.0
54	409.21	17.27	426.48	213.2	191.1	95.5	277.2	138.6	196.8	98.4
55	423.62	17.27	440.89	220.4	197.6	98.8	286.6	143.3	203.6	101.8
56	438.02	17.27	455.29	227.6	204.0	102.0	295.9	148.0	210.3	105.2
57	452.43	17.27	469.70	234.8	210.5	105.3	305.3	152.7	217.1	108.6
58	466.84	17.27	484.11	242.1	217.0	108.5	314.7	157.3	223.9	111.9
59	481.24	17.27	498.51	249.3	223.5	111.7	324.0	162.0	230.6	115.3
60	495.65	17.27	512.92	256.5	230.0	115.0	333.4	166.7	237.4	118.7
61	510.05	17.27	527.32	263.7	236.5	118.2	342.8	171.4	244.2	122.1
62	524.46	17.27	541.73	270.9	242.9	121.5	352.1	176.1	251.0	125.5
63	538.87	17.27	556.14	278.1	249.4	124.7	361.5	180.7	257.7	128.9
64	553.27	17.27	570.54	285.3	255.9	128.0	370.9	185.4	264.5	132.3
65	567.68	17.27	584.95	292.5	262.4	131.2	380.2	190.1	271.3	135.6
66	582.08	17.27	599.35	299.7	268.9	134.4	389.6	194.8	278.0	139.0
67	596.49	17.27	613.76	306.9	275.4	137.7	398.9	199.5	284.8	142.4
68	610.90	17.27	628.17	314.1	281.8	140.9	408.3	204.2	291.6	145.8
69	625.30	17.27	642.57	321.3	288.3	144.2	417.7	208.8	298.4	149.2
70	639.71	17.27	656.98	328.5	294.8	147.4	427.0	213.5	305.1	152.6
71	654.12	17.27	671.39	335.7	301.3	150.6	436.4	218.2	311.9	156.0
72	668.52	17.27	685.79	342.9	307.8	153.9	445.8	222.9	318.7	159.3
73	682.93	17.27	700.20	350.1	314.2	157.1	455.1	227.6	325.4	162.7
74	697.33	17.27	714.60	357.3	320.7	160.4	464.5	232.2	332.2	166.1
75	711.74	17.27	729.01	364.5	327.2	163.6	473.9	236.9	339.0	169.5
76	726.15	17.27	743.42	371.7	333.7	166.8	483.2	241.6	345.8	172.9
77	740.55	17.27	757.82	378.9	340.2	170.1	492.6	246.3	352.5	176.3

Steel H-Pile Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x89 H-Pile (50ksi steel)

Depth Below Pile Cap	Nonimal Side Resistance	Nominal End Bearing	Rn Total Nominal Geotechnical Axial Resistance		**ΦRn Total Factored Geotechnical Axial Resistance Static Analysis Method**		**ΦRn Total Factored Geotechnical Axial Resistance Dynamic Analysis Method (Φ=0.65)**		**ΦRn Total Factored Geotechnical Uplift Resistance Static Analysis Method (Φ=0.35)**	
(ft)		(kips)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)	(kips)	(tons)
78	754.96	17.27	772.23	386.1	346.7	173.3	501.9	251.0	359.3	179.7
79	769.37	17.27	786.64	393.3	353.1	176.6	511.3	255.7	366.1	183.0
80	783.77	17.27	801.04	400.5	359.6	179.8	520.7	260.3	372.8	186.4
81	798.18	17.27	815.45	407.7	366.1	183.1	530.0	265.0	379.6	189.8
82	812.58	17.27	829.85	414.9	372.6	186.3	539.4	269.7	386.4	193.2
83	826.99	17.27	844.26	422.1	379.1	189.5	548.8	274.4	393.2	196.6
84	841.40	17.27	858.67	429.3	385.6	192.8	558.1	279.1	399.9	200.0
85	855.80	17.27	873.07	436.5	392.0	196.0	567.5	283.7	406.7	203.4
86	870.21	17.27	887.48	443.7	398.5	199.3	576.9	288.4	413.5	206.7
87	884.61	17.27	901.88	450.9	405.0	202.5	586.2	293.1	420.2	210.1
88	899.02	17.27	916.29	458.1	411.5	205.7	595.6	297.8	427.0	213.5
89	913.43	17.27	930.70	465.3	418.0	209.0	605.0	302.5	433.8	216.9
90	927.83	17.27	945.10	472.6	424.5	212.2	614.3	307.2	440.6	220.3
91	942.24	17.27	959.51	479.8	430.9	215.5	623.7	311.8	447.3	223.7
92	956.65	17.27	973.92	487.0	437.4	218.7	633.0	316.5	454.1	227.0
93	971.05	17.27	988.32	494.2	443.9	222.0	642.4	321.2	460.9	230.4
94	985.46	17.27	1002.73	501.4	450.4	225.2	651.8	325.9	467.6	233.8
95	999.86	17.27	1017.13	508.6	456.9	228.4	661.1	330.6	474.4	237.2
96	1014.27	17.27	1031.54	515.8	463.4	231.7	670.5	335.3	481.2	240.6
97	1028.68	17.27	1045.95	523.0	469.8	234.9	679.9	339.9	488.0	244.0
98	1043.08	17.27	1060.35	530.2	476.3	238.2	689.2	344.6	494.7	247.4
99	1057.49	17.27	1074.76	537.4	482.8	241.4	698.6	349.3	501.5	250.7
100	1071.89	17.27	1089.16	544.6	489.3	244.6	708.0	354.0	508.3	254.1
101	1086.30	17.27	1103.57	551.8	495.8	247.9	717.3	358.7	515.0	257.5
102	1100.71	17.27	1117.98	559.0	502.2	251.1	726.7	363.3	521.8	260.9
103	1115.11	17.27	1132.38	566.2	508.7	254.4	736.0	368.0	528.6	264.3
104	1129.52	17.27	1146.79	573.4	515.2	257.6	745.4	372.7	535.4	267.7
105	1143.93	17.27	1161.20	580.6	521.7	260.8	754.8	377.4	542.1	271.1
106	1158.33	17.27	1175.60	587.8	528.2	264.1	764.1	382.1	548.9	274.4
107	1172.74	17.27	1190.01	595.0	534.7	267.3	773.5	386.8	555.7	277.8
108	1187.14	17.27	1204.41	602.2	541.1	270.6	782.9	391.4	562.4	281.2
109	1201.55	17.27	1218.82	609.4	547.6	273.8	792.2	396.1	569.2	284.6
110	1215.96	17.27	1233.23	616.6	554.1	277.1	801.6	400.8	576.0	288.0
111	1230.36	17.27	1247.63	623.8	560.6	280.3	811.0	405.5	582.8	291.4
112	1244.77	17.27	1262.04	631.0	567.1	283.5	820.3	410.2	589.5	294.8
113	1259.17	17.27	1276.44	638.2	573.6	286.8	829.7	414.8	596.3	298.1
114	1273.58	17.27	1290.85	645.4	580.0	290.0	839.1	419.5	603.1	301.5
115	1287.99	17.27	1305.26	652.6	586.5	293.3	848.4	424.2	609.8	304.9

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
30" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
1	0.00	23.18	23.18	11.6	0.0	9.3	**9.3**	**4.6**	**0.0**	**0.0**
2	0.00	26.07	26.07	13.0	0.0	10.4	**10.4**	**5.2**	**0.0**	**0.0**
3	0.00	28.96	28.96	14.5	0.0	11.6	**11.6**	**5.8**	**0.0**	**0.0**
4	0.00	32.21	32.21	16.1	0.0	12.9	**12.9**	**6.4**	**0.0**	**0.0**
5	0.00	36.55	36.55	18.3	0.0	14.6	**14.6**	**7.3**	**0.0**	**0.0**
@ 6' 6	0.00	40.88	40.88	20.4	0.0	16.4	**16.4**	**8.2**	**0.0**	**0.0**
Clays 7	0.00	49.46	49.46	24.7	0.0	19.8	**19.8**	**9.9**	**0.0**	**0.0**
Sands 8	3.28	56.66	59.95	30.0	1.8	23.4	**25.2**	**12.6**	**1.5**	**0.7**
9	7.16	64.41	71.58	35.8	3.9	27.3	**31.2**	**15.6**	**3.2**	**1.6**
10	10.74	72.70	83.45	41.7	5.9	31.4	**37.3**	**18.7**	**4.8**	**2.4**
11	14.01	81.52	95.54	47.8	7.7	35.8	**43.5**	**21.8**	**6.3**	**3.2**
12	17.42	90.50	107.92	54.0	9.6	40.3	**49.9**	**24.9**	**7.8**	**3.9**
13	20.92	99.47	120.39	60.2	11.5	44.8	**56.3**	**28.1**	**9.4**	**4.7**
14	24.58	108.44	133.02	66.5	13.5	49.3	**62.8**	**31.4**	**11.1**	**5.5**
15	28.35	117.42	145.77	72.9	15.6	53.8	**69.4**	**34.7**	**12.8**	**6.4**
16	32.24	126.39	158.63	79.3	17.7	58.2	**76.0**	**38.0**	**14.5**	**7.3**
17	36.24	135.36	171.60	85.8	19.9	62.7	**82.7**	**41.3**	**16.3**	**8.2**
18	40.35	143.89	184.24	92.1	22.2	67.0	**89.2**	**44.6**	**18.2**	**9.1**
19	44.56	151.52	196.08	98.0	24.5	70.8	**95.3**	**47.7**	**20.1**	**10.0**
20	48.88	158.24	207.12	103.6	26.9	74.2	**101.1**	**50.5**	**22.0**	**11.0**
21	53.28	164.08	217.36	108.7	29.3	77.1	**106.4**	**53.2**	**24.0**	**12.0**
22	57.79	169.01	226.80	113.4	31.8	79.6	**111.3**	**55.7**	**26.0**	**13.0**
23	67.65	172.90	240.55	120.3	37.2	81.5	**118.7**	**59.4**	**30.4**	**15.2**
24	77.78	175.59	253.37	126.7	42.8	82.9	**125.6**	**62.8**	**35.0**	**17.5**
25	88.16	177.09	265.24	132.6	48.5	83.6	**132.1**	**66.0**	**39.7**	**19.8**
26	98.78	177.43	276.21	138.1	54.3	83.8	**138.1**	**69.0**	**44.5**	**22.2**
27	109.64	177.43	287.07	143.5	60.3	83.8	**144.1**	**72.0**	**49.3**	**24.7**
28	120.65	177.43	298.07	149.0	66.4	83.8	**150.1**	**75.1**	**54.3**	**27.1**
29	131.91	177.43	309.34	154.7	72.6	83.8	**156.3**	**78.2**	**59.4**	**29.7**
30	143.38	177.43	320.81	160.4	78.9	83.8	**162.6**	**81.3**	**64.5**	**32.3**
31	155.04	177.43	332.46	166.2	85.3	83.8	**169.0**	**84.5**	**69.8**	**34.9**
32	166.87	177.43	344.30	172.2	91.8	83.8	**175.5**	**87.8**	**75.1**	**37.5**
33	178.89	177.43	356.31	178.2	98.4	83.8	**182.2**	**91.1**	**80.5**	**40.2**
34	191.06	177.43	368.49	184.2	105.1	83.8	**188.9**	**94.4**	**86.0**	**43.0**
35	203.39	177.43	380.82	190.4	111.9	83.8	**195.6**	**97.8**	**91.5**	**45.8**
36	215.87	177.43	393.30	196.6	118.7	83.8	**202.5**	**101.2**	**97.1**	**48.6**
37	228.49	177.43	405.92	203.0	125.7	83.8	**209.4**	**104.7**	**102.8**	**51.4**
38	241.24	177.43	418.67	209.3	132.7	83.8	**216.4**	**108.2**	**108.6**	**54.3**
39	254.11	177.43	431.54	215.8	139.8	83.8	**223.5**	**111.8**	**114.4**	**57.2**
40	267.10	177.43	444.52	222.3	146.9	83.8	**230.7**	**115.3**	**120.2**	**60.1**

Downdrag is not an issue at this location.

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
30" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	280.19	177.43	457.62	228.8	154.1	83.8	**237.9**	**118.9**	**126.1**	**63.0**
42	293.39	177.43	470.81	235.4	161.4	83.8	**245.1**	**122.6**	**132.0**	**66.0**
43	306.67	177.43	484.10	242.0	168.7	83.8	**252.4**	**126.2**	**138.0**	**69.0**
44	320.04	177.43	497.46	248.7	176.0	83.8	**259.8**	**129.9**	**144.0**	**72.0**
45	333.48	177.43	510.91	255.5	183.4	83.8	**267.2**	**133.6**	**150.1**	**75.0**
46	347.00	177.43	524.42	262.2	190.8	83.8	**274.6**	**137.3**	**156.1**	**78.1**
47	360.57	177.43	538.00	269.0	198.3	83.8	**282.1**	**141.0**	**162.3**	**81.1**
48	374.20	177.43	551.63	275.8	205.8	83.8	**289.6**	**144.8**	**168.4**	**84.2**
49	387.88	177.43	565.30	282.7	213.3	83.8	**297.1**	**148.5**	**174.5**	**87.3**
50	401.59	177.43	579.02	289.5	220.9	83.8	**304.6**	**152.3**	**180.7**	**90.4**
51	415.34	177.43	592.77	296.4	228.4	83.8	**312.2**	**156.1**	**186.9**	**93.5**
52	429.12	177.43	606.54	303.3	236.0	83.8	**319.8**	**159.9**	**193.1**	**96.6**
53	442.91	177.43	620.34	310.2	243.6	83.8	**327.4**	**163.7**	**199.3**	**99.7**
54	456.72	177.43	634.14	317.1	251.2	83.8	**335.0**	**167.5**	**205.5**	**102.8**
55	470.53	177.43	647.96	324.0	258.8	83.8	**342.6**	**171.3**	**211.7**	**105.9**
56	484.34	177.43	661.77	330.9	266.4	83.8	**350.2**	**175.1**	**218.0**	**109.0**
57	498.14	177.43	675.57	337.8	274.0	83.8	**357.7**	**178.9**	**224.2**	**112.1**
58	511.93	177.43	689.35	344.7	281.6	83.8	**365.3**	**182.7**	**230.4**	**115.2**
59	525.69	177.43	703.12	351.6	289.1	83.8	**372.9**	**186.4**	**236.6**	**118.3**
60	539.43	177.43	716.86	358.4	296.7	83.8	**380.5**	**190.2**	**242.7**	**121.4**
61	553.14	177.43	730.56	365.3	304.2	83.8	**388.0**	**194.0**	**248.9**	**124.5**
62	566.80	177.43	744.23	372.1	311.7	83.8	**395.5**	**197.8**	**255.1**	**127.5**
63	580.36	177.43	757.78	378.9	319.2	83.8	**403.0**	**201.5**	**261.2**	**130.6**
64	593.86	177.43	771.28	385.6	326.6	83.8	**410.4**	**205.2**	**267.2**	**133.6**
65	607.30	177.43	784.73	392.4	334.0	83.8	**417.8**	**208.9**	**273.3**	**136.6**
66	620.68	177.43	798.10	399.1	341.4	83.8	**425.1**	**212.6**	**279.3**	**139.7**
67	633.99	177.43	811.42	405.7	348.7	83.8	**432.5**	**216.2**	**285.3**	**142.6**
68	647.17	177.43	824.60	412.3	355.9	83.8	**439.7**	**219.9**	**291.2**	**145.6**
69	660.30	177.43	837.73	418.9	363.2	83.8	**446.9**	**223.5**	**297.1**	**148.6**
70	673.34	177.43	850.76	425.4	370.3	83.8	**454.1**	**227.1**	**303.0**	**151.5**
71	686.28	177.43	863.70	431.9	377.5	83.8	**461.2**	**230.6**	**308.8**	**154.4**
72	699.11	177.43	876.53	438.3	384.5	83.8	**468.3**	**234.1**	**314.6**	**157.3**
73	711.83	177.43	889.26	444.6	391.5	83.8	**475.3**	**237.6**	**320.3**	**160.2**
74	724.44	177.43	901.86	450.9	398.4	83.8	**482.2**	**241.1**	**326.0**	**163.0**
75	736.92	177.43	914.35	457.2	405.3	83.8	**489.1**	**244.5**	**331.6**	**165.8**
76	749.28	177.43	926.71	463.4	412.1	83.8	**495.9**	**247.9**	**337.2**	**168.6**
77	761.51	177.43	938.93	469.5	418.8	83.8	**502.6**	**251.3**	**342.7**	**171.3**
78	773.59	177.43	951.02	475.5	425.5	83.8	**509.2**	**254.6**	**348.1**	**174.1**
79	785.53	177.43	962.96	481.5	432.0	83.8	**515.8**	**257.9**	**353.5**	**176.7**
80	797.32	177.43	974.75	487.4	438.5	83.8	**522.3**	**261.1**	**358.8**	**179.4**

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
36" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
1	0.00	32.37	32.37	16.2	0.0	12.9	**12.9**	**6.5**	**0.0**	**0.0**
2	0.00	36.40	36.40	18.2	0.0	14.6	**14.6**	**7.3**	**0.0**	**0.0**
3	0.00	40.44	40.44	20.2	0.0	16.2	**16.2**	**8.1**	**0.0**	**0.0**
4	0.00	44.48	44.48	22.2	0.0	17.8	**17.8**	**8.9**	**0.0**	**0.0**
5	0.00	49.52	49.52	24.8	0.0	19.8	**19.8**	**9.9**	**0.0**	**0.0**
@ 6' 6	0.00	55.57	55.57	27.8	0.0	22.2	**22.2**	**11.1**	**0.0**	**0.0**
Clays 7	0.00	64.81	64.81	32.4	0.0	25.9	**25.9**	**13.0**	**0.0**	**0.0**
Sands 8	3.40	73.94	77.34	38.7	1.9	30.5	**32.4**	**16.2**	**1.5**	**0.8**
9	8.06	83.65	91.71	45.9	4.4	35.3	**39.8**	**19.9**	**3.6**	**1.8**
10	12.89	93.95	106.84	53.4	7.1	40.5	**47.6**	**23.8**	**5.8**	**2.9**
11	16.81	104.82	121.63	60.8	9.2	45.9	**55.2**	**27.6**	**7.6**	**3.8**
12	20.91	116.20	137.10	68.6	11.5	51.6	**63.1**	**31.6**	**9.4**	**4.7**
13	25.11	127.65	152.76	76.4	13.8	57.3	**71.2**	**35.6**	**11.3**	**5.6**
14	29.49	139.10	168.59	84.3	16.2	63.1	**79.3**	**39.6**	**13.3**	**6.6**
15	34.02	150.55	184.57	92.3	18.7	68.8	**87.5**	**43.8**	**15.3**	**7.7**
16	38.87	162.00	200.87	100.4	21.4	74.5	**95.9**	**47.9**	**17.5**	**8.7**
17	43.49	172.97	216.46	108.2	23.9	80.0	**103.9**	**52.0**	**19.6**	**9.8**
18	48.42	182.99	231.41	115.7	26.6	85.0	**111.6**	**55.8**	**21.8**	**10.9**
19	53.47	192.06	245.53	122.8	29.4	89.5	**119.0**	**59.5**	**24.1**	**12.0**
20	58.65	200.17	258.82	129.4	32.3	93.6	**125.9**	**62.9**	**26.4**	**13.2**
21	63.94	207.32	271.27	135.6	35.2	97.2	**132.3**	**66.2**	**28.8**	**14.4**
22	69.34	217.53	286.87	143.4	38.1	102.3	**140.4**	**70.2**	**31.2**	**15.6**
23	81.18	218.61	299.80	149.9	44.7	102.8	**147.5**	**73.7**	**36.5**	**18.3**
24	93.33	222.43	315.77	157.9	51.3	104.7	**156.1**	**78.0**	**42.0**	**21.0**
25	105.79	224.98	330.76	165.4	58.2	106.0	**164.2**	**82.1**	**47.6**	**23.8**
26	118.54	226.41	344.94	172.5	65.2	106.7	**171.9**	**86.0**	**53.3**	**26.7**
27	131.57	226.41	357.98	179.0	72.4	106.7	**179.1**	**89.5**	**59.2**	**29.6**
28	144.78	226.41	371.19	185.6	79.6	106.7	**186.4**	**93.2**	**65.2**	**32.6**
29	158.30	226.41	384.70	192.4	87.1	106.7	**193.8**	**96.9**	**71.2**	**35.6**
30	172.06	226.41	398.46	199.2	94.6	106.7	**201.4**	**100.7**	**77.4**	**38.7**
31	186.04	226.41	412.45	206.2	102.3	106.7	**209.0**	**104.5**	**83.7**	**41.9**
32	200.25	226.41	426.66	213.3	110.1	106.7	**216.9**	**108.4**	**90.1**	**45.1**
33	214.66	226.41	441.07	220.5	118.1	106.7	**224.8**	**112.4**	**96.6**	**48.3**
34	229.27	226.41	455.68	227.8	126.1	106.7	**232.8**	**116.4**	**103.2**	**51.6**
35	244.07	226.41	470.48	235.2	134.2	106.7	**241.0**	**120.5**	**109.8**	**54.9**
36	259.05	226.41	485.45	242.7	142.5	106.7	**249.2**	**124.6**	**116.6**	**58.3**
37	274.19	226.41	500.60	250.3	150.8	106.7	**257.5**	**128.8**	**123.4**	**61.7**
38	289.49	226.41	515.90	257.9	159.2	106.7	**265.9**	**133.0**	**130.3**	**65.1**
39	304.93	226.41	531.34	265.7	167.7	106.7	**274.4**	**137.2**	**137.2**	**68.6**
40	320.52	226.41	546.93	273.5	176.3	106.7	**283.0**	**141.5**	**144.2**	**72.1**

Downdrag is not an issue at this location.

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
36" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	336.23	226.41	562.64	281.3	184.9	106.7	**291.7**	**145.8**	**151.3**	**75.7**
42	352.06	226.41	578.47	289.2	193.6	106.7	**300.4**	**150.2**	**158.4**	**79.2**
43	368.04	226.41	594.45	297.2	202.4	106.7	**309.1**	**154.6**	**165.6**	**82.8**
44	384.05	226.41	610.45	305.2	211.2	106.7	**317.9**	**159.0**	**172.8**	**86.4**
45	400.18	226.41	626.59	313.3	220.1	106.7	**326.8**	**163.4**	**180.1**	**90.0**
46	416.40	226.41	642.80	321.4	229.0	106.7	**335.7**	**167.9**	**187.4**	**93.7**
47	432.69	226.41	659.09	329.5	238.0	106.7	**344.7**	**172.4**	**194.7**	**97.4**
48	449.04	226.41	675.45	337.7	247.0	106.7	**353.7**	**176.8**	**202.1**	**101.0**
49	465.45	226.41	691.86	345.9	256.0	106.7	**362.7**	**181.4**	**209.5**	**104.7**
50	481.91	226.41	708.32	354.2	265.1	106.7	**371.8**	**185.9**	**216.9**	**108.4**
51	498.41	226.41	724.82	362.4	274.1	106.7	**380.8**	**190.4**	**224.3**	**112.1**
52	514.94	226.41	741.35	370.7	283.2	106.7	**389.9**	**195.0**	**231.7**	**115.9**
53	531.49	226.41	757.90	379.0	292.3	106.7	**399.0**	**199.5**	**239.2**	**119.6**
54	548.06	226.41	774.47	387.2	301.4	106.7	**408.2**	**204.1**	**246.6**	**123.3**
55	564.64	226.41	791.04	395.5	310.5	106.7	**417.3**	**208.6**	**254.1**	**127.0**
56	581.21	226.41	807.62	403.8	319.7	106.7	**426.4**	**213.2**	**261.5**	**130.8**
57	597.77	226.41	824.18	412.1	328.8	106.7	**435.5**	**217.7**	**269.0**	**134.5**
58	614.31	226.41	840.72	420.4	337.9	106.7	**444.6**	**222.3**	**276.4**	**138.2**
59	630.83	226.41	857.24	428.6	347.0	106.7	**453.7**	**226.8**	**283.9**	**141.9**
60	647.32	226.41	873.73	436.9	356.0	106.7	**462.7**	**231.4**	**291.3**	**145.6**
61	663.76	226.41	890.17	445.1	365.1	106.7	**471.8**	**235.9**	**298.7**	**149.3**
62	680.16	226.41	906.57	453.3	374.1	106.7	**480.8**	**240.4**	**306.1**	**153.0**
63	696.43	226.41	922.83	461.4	383.0	106.7	**489.8**	**244.9**	**313.4**	**156.7**
64	712.63	226.41	939.04	469.5	391.9	106.7	**498.7**	**249.3**	**320.7**	**160.3**
65	728.76	226.41	955.17	477.6	400.8	106.7	**507.5**	**253.8**	**327.9**	**164.0**
66	744.81	226.41	971.22	485.6	409.6	106.7	**516.4**	**258.2**	**335.2**	**167.6**
67	760.79	226.41	987.20	493.6	418.4	106.7	**525.2**	**262.6**	**342.4**	**171.2**
68	776.61	226.41	1003.02	501.5	427.1	106.7	**533.9**	**266.9**	**349.5**	**174.7**
69	792.36	226.41	1018.77	509.4	435.8	106.7	**542.5**	**271.3**	**356.6**	**178.3**
70	808.01	226.41	1034.41	517.2	444.4	106.7	**551.1**	**275.6**	**363.6**	**181.8**
71	823.53	226.41	1049.94	525.0	452.9	106.7	**559.7**	**279.8**	**370.6**	**185.3**
72	838.93	226.41	1065.34	532.7	461.4	106.7	**568.1**	**284.1**	**377.5**	**188.8**
73	854.20	226.41	1080.61	540.3	469.8	106.7	**576.5**	**288.3**	**384.4**	**192.2**
74	869.33	226.41	1095.73	547.9	478.1	106.7	**584.9**	**292.4**	**391.2**	**195.6**
75	884.31	226.41	1110.72	555.4	486.4	106.7	**593.1**	**296.5**	**397.9**	**199.0**
76	899.14	226.41	1125.55	562.8	494.5	106.7	**601.2**	**300.6**	**404.6**	**202.3**
77	913.81	226.41	1140.22	570.1	502.6	106.7	**609.3**	**304.7**	**411.2**	**205.6**
78	928.31	226.41	1154.72	577.4	510.6	106.7	**617.3**	**308.6**	**417.7**	**208.9**
79	942.64	226.41	1169.05	584.5	518.5	106.7	**625.2**	**312.6**	**424.2**	**212.1**
80	956.79	226.41	1183.20	591.6	526.2	106.7	**633.0**	**316.5**	**430.6**	**215.3**

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
42" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
1	0.00	42.39	42.39	21.20	0.0	17.0	**17.0**	**8.5**	**0.0**	**0.0**
2	0.00	47.67	47.67	23.84	0.0	19.1	**19.1**	**9.5**	**0.0**	**0.0**
3	0.00	52.96	52.96	26.48	0.0	21.2	**21.2**	**10.6**	**0.0**	**0.0**
4	0.00	58.24	58.24	29.12	0.0	23.3	**23.3**	**11.6**	**0.0**	**0.0**
5	0.00	63.53	63.53	31.77	0.0	25.4	**25.4**	**12.7**	**0.0**	**0.0**
@ 6' 6	0.00	70.80	70.80	35.40	0.0	28.3	**28.3**	**14.2**	**0.0**	**0.0**
Clays 7	0.00	81.10	81.10	40.55	0.0	32.4	**32.4**	**16.2**	**0.0**	**0.0**
Sands 8	3.96	92.19	96.15	48.08	2.2	38.0	**40.2**	**20.1**	**1.8**	**0.9**
9	8.77	103.88	112.65	56.33	4.8	43.8	**48.7**	**24.3**	**3.9**	**2.0**
10	14.41	116.18	130.59	65.30	7.9	50.0	**57.9**	**29.0**	**6.5**	**3.2**
11	19.62	129.09	148.70	74.35	10.8	56.4	**67.2**	**33.6**	**8.8**	**4.4**
12	24.39	142.60	166.99	83.49	13.4	63.2	**76.6**	**38.3**	**11.0**	**5.5**
13	29.29	156.54	185.84	92.92	16.1	70.2	**86.3**	**43.1**	**13.2**	**6.6**
14	34.41	170.51	204.91	102.46	18.9	77.1	**96.1**	**48.0**	**15.5**	**7.7**
15	39.69	184.47	224.16	112.08	21.8	84.1	**106.0**	**53.0**	**17.9**	**8.9**
16	45.13	197.94	243.07	121.54	24.8	90.9	**115.7**	**57.8**	**20.3**	**10.2**
17	50.74	210.40	261.14	130.57	27.9	97.1	**125.0**	**62.5**	**22.8**	**11.4**
18	56.49	221.87	278.36	139.18	31.1	102.8	**133.9**	**66.9**	**25.4**	**12.7**
19	62.39	232.35	294.73	147.37	34.3	108.1	**142.4**	**71.2**	**28.1**	**14.0**
20	68.43	241.98	310.41	155.20	37.6	112.9	**150.5**	**75.3**	**30.8**	**15.4**
21	74.60	250.30	324.90	162.45	41.0	117.0	**158.1**	**79.0**	**33.6**	**16.8**
22	80.90	257.78	338.68	169.34	44.5	120.8	**165.3**	**82.6**	**36.4**	**18.2**
23	94.71	264.10	358.81	179.41	52.1	123.9	**176.0**	**88.0**	**42.6**	**21.3**
24	108.89	269.09	377.97	188.99	59.9	126.4	**186.3**	**93.2**	**49.0**	**24.5**
25	123.42	272.74	396.16	198.08	67.9	128.3	**196.1**	**98.1**	**55.5**	**27.8**
26	138.29	275.07	413.36	206.68	76.1	129.4	**205.5**	**102.7**	**62.2**	**31.1**
27	153.50	276.07	429.57	214.78	84.4	129.9	**214.3**	**107.2**	**69.1**	**34.5**
28	168.91	276.11	445.02	222.51	92.9	129.9	**222.8**	**111.4**	**76.0**	**38.0**
29	184.68	276.11	460.79	230.40	101.6	129.9	**231.5**	**115.8**	**83.1**	**41.6**
30	200.73	276.11	476.84	238.42	110.4	129.9	**240.3**	**120.2**	**90.3**	**45.2**
31	217.05	276.11	493.16	246.58	119.4	129.9	**249.3**	**124.7**	**97.7**	**48.8**
32	233.62	276.11	509.73	254.87	128.5	129.9	**258.4**	**129.2**	**105.1**	**52.6**
33	250.44	276.11	526.55	263.28	137.7	129.9	**267.7**	**133.8**	**112.7**	**56.3**
34	267.49	276.11	543.60	271.80	147.1	129.9	**277.1**	**138.5**	**120.4**	**60.2**
35	284.75	276.11	560.86	280.43	156.6	129.9	**286.6**	**143.3**	**128.1**	**64.1**
36	302.22	276.11	578.33	289.17	166.2	129.9	**296.2**	**148.1**	**136.0**	**68.0**
37	319.89	276.11	596.00	298.00	175.9	129.9	**305.9**	**152.9**	**143.9**	**72.0**
38	337.74	276.11	613.85	306.92	185.8	129.9	**315.7**	**157.8**	**152.0**	**76.0**
39	355.76	276.11	631.87	315.93	195.7	129.9	**325.6**	**162.8**	**160.1**	**80.0**
40	373.94	276.11	650.05	325.02	205.7	129.9	**335.6**	**167.8**	**168.3**	**84.1**

Downdrag is not an issue at this location.

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
42" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	392.27	276.11	668.38	334.19	215.7	129.9	**345.7**	**172.8**	**176.5**	**88.3**
42	410.74	276.11	686.85	343.43	225.9	129.9	**355.9**	**177.9**	**184.8**	**92.4**
43	429.34	276.11	705.45	352.72	236.1	129.9	**366.1**	**183.0**	**193.2**	**96.6**
44	448.05	276.11	724.16	362.08	246.4	129.9	**376.4**	**188.2**	**201.6**	**100.8**
45	466.88	276.11	742.99	371.49	256.8	129.9	**386.7**	**193.4**	**210.1**	**105.0**
46	485.80	276.11	761.91	380.95	267.2	129.9	**397.1**	**198.6**	**218.6**	**109.3**
47	504.80	276.11	780.91	390.46	277.6	129.9	**407.6**	**203.8**	**227.2**	**113.6**
48	523.88	276.11	799.99	400.00	288.1	129.9	**418.1**	**209.0**	**235.7**	**117.9**
49	543.03	276.11	819.14	409.57	298.7	129.9	**428.6**	**214.3**	**244.4**	**122.2**
50	562.23	276.11	838.34	419.17	309.2	129.9	**439.2**	**219.6**	**253.0**	**126.5**
51	581.48	276.11	857.59	428.80	319.8	129.9	**449.8**	**224.9**	**261.7**	**130.8**
52	600.76	276.11	876.87	438.44	330.4	129.9	**460.4**	**230.2**	**270.3**	**135.2**
53	620.08	276.11	896.19	448.09	341.0	129.9	**471.0**	**235.5**	**279.0**	**139.5**
54	639.41	276.11	915.52	457.76	351.7	129.9	**481.6**	**240.8**	**287.7**	**143.9**
55	658.74	276.11	934.85	467.43	362.3	129.9	**492.3**	**246.1**	**296.4**	**148.2**
56	678.07	276.11	954.18	477.09	372.9	129.9	**502.9**	**251.4**	**305.1**	**152.6**
57	697.40	276.11	973.51	486.75	383.6	129.9	**513.5**	**256.8**	**313.8**	**156.9**
58	716.70	276.11	992.81	496.41	394.2	129.9	**524.1**	**262.1**	**322.5**	**161.3**
59	735.97	276.11	1012.08	506.04	404.8	129.9	**534.7**	**267.4**	**331.2**	**165.6**
60	755.21	276.11	1031.32	515.66	415.4	129.9	**545.3**	**272.7**	**339.8**	**169.9**
61	774.39	276.11	1050.50	525.25	425.9	129.9	**555.9**	**277.9**	**348.5**	**174.2**
62	793.52	276.11	1069.63	534.82	436.4	129.9	**566.4**	**283.2**	**357.1**	**178.5**
63	812.50	276.11	1088.61	544.30	446.9	129.9	**576.8**	**288.4**	**365.6**	**182.8**
64	831.40	276.11	1107.51	553.76	457.3	129.9	**587.2**	**293.6**	**374.1**	**187.1**
65	850.22	276.11	1126.33	563.17	467.6	129.9	**597.6**	**298.8**	**382.6**	**191.3**
66	868.95	276.11	1145.06	572.53	477.9	129.9	**607.9**	**303.9**	**391.0**	**195.5**
67	887.59	276.11	1163.70	581.85	488.2	129.9	**618.1**	**309.1**	**399.4**	**199.7**
68	906.04	276.11	1182.15	591.08	498.3	129.9	**628.3**	**314.1**	**407.7**	**203.9**
69	924.42	276.11	1200.53	600.27	508.4	129.9	**638.4**	**319.2**	**416.0**	**208.0**
70	942.67	276.11	1218.78	609.39	518.5	129.9	**648.4**	**324.2**	**424.2**	**212.1**
71	960.79	276.11	1236.90	618.45	528.4	129.9	**658.4**	**329.2**	**432.4**	**216.2**
72	978.75	276.11	1254.86	627.43	538.3	129.9	**668.3**	**334.1**	**440.4**	**220.2**
73	996.56	276.11	1272.67	636.34	548.1	129.9	**678.1**	**339.0**	**448.5**	**224.2**
74	1014.21	276.11	1290.32	645.16	557.8	129.9	**687.8**	**343.9**	**456.4**	**228.2**
75	1031.69	276.11	1307.80	653.90	567.4	129.9	**697.4**	**348.7**	**464.3**	**232.1**
76	1048.99	276.11	1325.10	662.55	576.9	129.9	**706.9**	**353.4**	**472.0**	**236.0**
77	1066.11	276.11	1342.22	671.11	586.4	129.9	**716.3**	**358.2**	**479.7**	**239.9**
78	1083.03	276.11	1359.14	679.57	595.7	129.9	**725.6**	**362.8**	**487.4**	**243.7**
79	1099.75	276.11	1375.86	687.93	604.9	129.9	**734.8**	**367.4**	**494.9**	**247.4**
80	1116.25	276.11	1392.36	696.18	613.9	129.9	**743.9**	**371.9**	**502.3**	**251.2**

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
48" Diameter

Estimated Base of Pile Cap Elevation = 456 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
1	0.00	53.01	53.01	26.5	0.0	21.2	**21.2**	**10.6**	**0.0**	**0.0**
2	0.00	59.62	59.62	29.8	0.0	23.8	**23.8**	**11.9**	**0.0**	**0.0**
3	0.00	66.23	66.23	33.1	0.0	26.5	**26.5**	**13.2**	**0.0**	**0.0**
4	0.00	72.84	72.84	36.4	0.0	29.1	**29.1**	**14.6**	**0.0**	**0.0**
5	0.00	79.45	79.45	39.7	0.0	31.8	**31.8**	**15.9**	**0.0**	**0.0**
@ 6' 6	0.00	86.06	86.06	43.0	0.0	34.4	**34.4**	**17.2**	**0.0**	**0.0**
Clays 7	0.00	98.31	98.31	49.2	0.0	39.3	**39.3**	**19.7**	**0.0**	**0.0**
Sands 8	4.53	111.37	115.91	58.0	2.5	45.9	**48.3**	**24.2**	**2.0**	**1.0**
9	9.30	125.06	134.37	67.2	5.1	52.7	**57.8**	**28.9**	**4.2**	**2.1**
10	15.75	139.38	155.13	77.6	8.7	59.9	**68.5**	**34.3**	**7.1**	**3.5**
11	22.42	154.32	176.74	88.4	12.3	67.3	**79.7**	**39.8**	**10.1**	**5.0**
12	27.87	169.89	197.76	98.9	15.3	75.1	**90.4**	**45.2**	**12.5**	**6.3**
13	33.48	186.09	219.56	109.8	18.4	83.2	**101.6**	**50.8**	**15.1**	**7.5**
14	39.32	202.59	241.91	121.0	21.6	91.5	**113.1**	**56.5**	**17.7**	**8.8**
15	45.36	218.58	263.94	132.0	24.9	99.5	**124.4**	**62.2**	**20.4**	**10.2**
16	51.58	233.54	285.13	142.6	28.4	106.9	**135.3**	**67.7**	**23.2**	**11.6**
17	57.98	247.47	305.46	152.7	31.9	113.9	**145.8**	**72.9**	**26.1**	**13.0**
18	64.56	260.37	324.93	162.5	35.5	120.4	**155.9**	**77.9**	**29.1**	**14.5**
19	71.30	272.23	343.53	171.8	39.2	126.3	**165.5**	**82.8**	**32.1**	**16.0**
20	78.20	283.07	361.27	180.6	43.0	131.7	**174.7**	**87.4**	**35.2**	**17.6**
21	85.26	292.87	378.12	189.1	46.9	136.6	**183.5**	**91.7**	**38.4**	**19.2**
22	92.46	301.64	394.10	197.0	50.9	141.0	**191.8**	**95.9**	**41.6**	**20.8**
23	108.24	309.20	417.45	208.7	59.5	144.8	**204.3**	**102.2**	**48.7**	**24.4**
24	124.44	315.39	439.84	219.9	68.4	147.9	**216.3**	**108.2**	**56.0**	**28.0**
25	141.05	320.21	461.26	230.6	77.6	150.3	**227.9**	**113.9**	**63.5**	**31.7**
26	158.05	323.65	481.70	240.8	86.9	152.0	**238.9**	**119.5**	**71.1**	**35.6**
27	175.43	325.71	501.14	250.6	96.5	153.0	**249.5**	**124.8**	**78.9**	**39.5**
28	193.04	326.40	519.44	259.7	106.2	153.4	**259.5**	**129.8**	**86.9**	**43.4**
29	211.06	326.40	537.46	268.7	116.1	153.4	**269.5**	**134.7**	**95.0**	**47.5**
30	229.41	326.40	555.81	277.9	126.2	153.4	**279.5**	**139.8**	**103.2**	**51.6**
31	248.06	326.40	574.46	287.2	136.4	153.4	**289.8**	**144.9**	**111.6**	**55.8**
32	267.00	326.40	593.40	296.7	146.8	153.4	**300.2**	**150.1**	**120.1**	**60.1**
33	286.22	326.40	612.62	306.3	157.4	153.4	**310.8**	**155.4**	**128.8**	**64.4**
34	305.70	326.40	632.10	316.0	168.1	153.4	**321.5**	**160.8**	**137.6**	**68.8**
35	325.43	326.40	651.83	325.9	179.0	153.4	**332.4**	**166.2**	**146.4**	**73.2**
36	345.40	326.40	671.80	335.9	190.0	153.4	**343.3**	**171.7**	**155.4**	**77.7**
37	365.59	326.40	691.99	346.0	201.1	153.4	**354.4**	**177.2**	**164.5**	**82.3**
38	385.98	326.40	712.38	356.2	212.3	153.4	**365.7**	**182.8**	**173.7**	**86.8**
39	406.58	326.40	732.98	366.5	223.6	153.4	**377.0**	**188.5**	**183.0**	**91.5**
40	427.36	326.40	753.76	376.9	235.0	153.4	**388.4**	**194.2**	**192.3**	**96.2**

Downdrag is not an issue at this location.

Drilled Shaft Capacities
Kennedy Interchange S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
48" Diameter

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	Rn Total Nominal Geotechnical Axial Resistance (kips)	(tons)	Factored Nominal Side Resistance (kips)	Factored Nominal End Bearing (kips)	**ΦRn Total Factored Geotechnical Axial Resistance (kips)**	**(tons)**	**ΦRn Total Factored Geotechnical Uplift Resistance (kips)**	**(tons)**
41	448.31	326.40	774.71	387.4	246.6	153.4	**399.9**	**200.0**	**201.7**	**100.9**
42	469.42	326.40	795.82	397.9	258.2	153.4	**411.5**	**205.8**	**211.2**	**105.6**
43	490.67	326.40	817.07	408.5	269.9	153.4	**423.2**	**211.6**	**220.8**	**110.4**
44	512.06	326.40	838.46	419.2	281.6	153.4	**435.0**	**217.5**	**230.4**	**115.2**
45	533.57	326.40	859.97	430.0	293.5	153.4	**446.8**	**223.4**	**240.1**	**120.1**
46	555.19	326.40	881.59	440.8	305.4	153.4	**458.7**	**229.4**	**249.8**	**124.9**
47	576.91	326.40	903.31	451.7	317.3	153.4	**470.7**	**235.3**	**259.6**	**129.8**
48	598.72	326.40	925.12	462.6	329.3	153.4	**482.7**	**241.3**	**269.4**	**134.7**
49	620.60	326.40	947.00	473.5	341.3	153.4	**494.7**	**247.4**	**279.3**	**139.6**
50	642.55	326.40	968.95	484.5	353.4	153.4	**506.8**	**253.4**	**289.1**	**144.6**
51	664.55	326.40	990.95	495.5	365.5	153.4	**518.9**	**259.4**	**299.0**	**149.5**
52	686.59	326.40	1012.99	506.5	377.6	153.4	**531.0**	**265.5**	**309.0**	**154.5**
53	708.66	326.40	1035.06	517.5	389.8	153.4	**543.1**	**271.6**	**318.9**	**159.4**
54	730.75	326.40	1057.15	528.6	401.9	153.4	**555.3**	**277.6**	**328.8**	**164.4**
55	752.85	326.40	1079.25	539.6	414.1	153.4	**567.4**	**283.7**	**338.8**	**169.4**
56	774.94	326.40	1101.34	550.7	426.2	153.4	**579.6**	**289.8**	**348.7**	**174.4**
57	797.03	326.40	1123.43	561.7	438.4	153.4	**591.7**	**295.9**	**358.7**	**179.3**
58	819.09	326.40	1145.49	572.7	450.5	153.4	**603.9**	**301.9**	**368.6**	**184.3**
59	841.11	326.40	1167.51	583.8	462.6	153.4	**616.0**	**308.0**	**378.5**	**189.2**
60	863.09	326.40	1189.49	594.7	474.7	153.4	**628.1**	**314.0**	**388.4**	**194.2**
61	885.02	326.40	1211.42	605.7	486.8	153.4	**640.1**	**320.1**	**398.3**	**199.1**
62	906.88	326.40	1233.28	616.6	498.8	153.4	**652.2**	**326.1**	**408.1**	**204.0**
63	928.57	326.40	1254.97	627.5	510.7	153.4	**664.1**	**332.0**	**417.9**	**208.9**
64	950.17	326.40	1276.57	638.3	522.6	153.4	**676.0**	**338.0**	**427.6**	**213.8**
65	971.68	326.40	1298.08	649.0	534.4	153.4	**687.8**	**343.9**	**437.3**	**218.6**
66	993.09	326.40	1319.49	659.7	546.2	153.4	**699.6**	**349.8**	**446.9**	**223.4**
67	1014.38	326.40	1340.78	670.4	557.9	153.4	**711.3**	**355.6**	**456.5**	**228.2**
68	1035.48	326.40	1361.88	680.9	569.5	153.4	**722.9**	**361.4**	**466.0**	**233.0**
69	1056.48	326.40	1382.88	691.4	581.1	153.4	**734.4**	**367.2**	**475.4**	**237.7**
70	1077.34	326.40	1403.74	701.9	592.5	153.4	**745.9**	**373.0**	**484.8**	**242.4**
71	1098.04	326.40	1424.44	712.2	603.9	153.4	**757.3**	**378.6**	**494.1**	**247.1**
72	1118.57	326.40	1444.97	722.5	615.2	153.4	**768.6**	**384.3**	**503.4**	**251.7**
73	1138.93	326.40	1465.33	732.7	626.4	153.4	**779.8**	**389.9**	**512.5**	**256.3**
74	1159.10	326.40	1485.50	742.8	637.5	153.4	**790.9**	**395.4**	**521.6**	**260.8**
75	1179.08	326.40	1505.48	752.7	648.5	153.4	**801.9**	**400.9**	**530.6**	**265.3**
76	1198.85	326.40	1525.25	762.6	659.4	153.4	**812.7**	**406.4**	**539.5**	**269.7**
77	1218.41	326.40	1544.81	772.4	670.1	153.4	**823.5**	**411.7**	**548.3**	**274.1**
78	1237.75	326.40	1564.15	782.1	680.8	153.4	**834.1**	**417.1**	**557.0**	**278.5**
79	1256.85	326.40	1583.25	791.6	691.3	153.4	**844.6**	**422.3**	**565.6**	**282.8**
80	1275.72	326.40	1602.12	801.1	701.6	153.4	**855.0**	**427.5**	**574.1**	**287.0**

APPENDIX I:

H-PILE DRIVING RESISTANCE TABLES

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
12x53 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 418 ft.

	Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
Contributes to Downdrag	1	1.02	1.43	1.94	1.0
	2	2.04	1.43	2.45	1.2
	3	3.07	1.43	2.96	1.5
	4	4.09	1.43	3.47	1.7
	5	5.11	1.43	3.98	2.0
	6	6.13	1.43	4.50	2.2
	6	6.15	1.43	4.51	2.3
Silts	7	8.96	1.43	6.61	3.3
Sands	8	11.77	1.43	8.72	4.4
	9	14.59	1.43	10.83	5.4
	10	17.40	1.43	12.94	6.5
	10.6	19.08	1.43	14.21	7.1
	11	20.21	1.43	15.05	7.5
	12	23.02	1.43	17.16	8.6
	13	25.83	1.43	19.27	9.6
	14	28.64	1.43	21.38	10.7
	15	31.46	1.43	23.48	11.7
	16	34.27	1.43	25.59	12.8
	17	37.08	1.43	27.70	13.9
	18	39.89	1.43	29.81	14.9
	19	42.70	1.43	31.92	16.0
	20	45.52	1.43	34.03	17.0
	21	48.33	1.43	36.14	18.1
	22	51.14	1.43	38.25	19.1
	23	53.95	1.43	40.36	20.2
	24	56.76	1.43	42.46	21.2
	25	59.57	1.43	44.57	22.3
	26	62.39	1.43	46.68	23.3
	27	65.20	1.43	48.79	24.4
	28	68.01	1.43	50.90	25.5
	28	68.11	4.30	53.85	26.9
	29	74.76	4.30	58.84	29.4
	30	81.42	4.30	63.83	31.9
	31	88.07	4.30	68.82	34.4
	32	94.73	4.30	73.81	36.9
	33	101.38	4.30	78.80	39.4
	34	108.04	4.30	83.79	41.9
	35	114.69	4.30	88.78	44.4
	36	121.35	4.30	93.77	46.9
	37	128.00	4.30	98.76	49.4

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
38	134.66	4.30	103.75	51.9
@ 39 ' 39	141.31	4.30	108.75	54.4
39	141.47	4.30	108.87	54.4
40	150.11	4.30	115.35	57.7
41	158.75	4.30	121.83	60.9
42	167.39	4.30	128.31	64.2
43	176.03	4.30	134.79	67.4
44	184.67	4.30	141.27	70.6
45	193.31	4.30	147.75	73.9
46	201.95	4.30	154.23	77.1
47	210.59	4.30	160.71	80.4
48	219.23	4.30	167.19	83.6
49	227.87	4.30	173.67	86.8
50	236.51	4.30	180.15	90.1
51	245.15	4.30	186.63	93.3
52	253.79	4.30	193.11	96.6
53	262.43	4.30	199.59	99.8
54	271.07	4.30	206.07	103.0
55	279.71	4.30	212.55	106.3
56	288.35	4.30	219.03	109.5
57	296.99	4.30	225.51	112.8
58	305.63	4.30	231.99	116.0
59	314.27	4.30	238.47	119.2
60	322.91	4.30	244.95	122.5
61	331.55	4.30	251.43	125.7
61	331.75	6.65	253.93	127.0
62	344.83	6.65	263.73	131.9
63	357.91	6.65	273.54	136.8
64	370.99	6.65	283.35	141.7
65	384.07	6.65	293.16	146.6
66	397.14	6.65	302.97	151.5
67	410.22	6.65	312.78	156.4
68	423.30	6.65	322.59	161.3
69	436.38	6.65	332.40	166.2
70	449.46	6.65	342.21	171.1
71	462.54	6.65	352.02	176.0
72	475.62	6.65	361.82	180.9
73	488.70	6.65	371.63	185.8
74	501.77	6.65	381.44	190.7
75	514.85	6.65	391.25	195.6

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
12x53 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 418 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
76	527.93	6.65	401.06	200.5
77	541.01	6.65	410.87	205.4
78	554.09	6.65	420.68	210.3
79	567.17	6.65	430.49	215.2
80	580.25	6.65	440.30	220.1
81	593.33	6.65	450.11	225.1
82	606.40	6.65	459.92	230.0
83	619.48	6.65	469.72	234.9
84	632.56	6.65	479.53	239.8
85	645.64	6.65	489.34	244.7
86	658.72	6.65	499.15	249.6
87	671.80	6.65	508.96	254.5
88	684.88	6.65	518.77	259.4
89	697.96	6.65	528.58	264.3
90	711.03	6.65	538.39	269.2
91	724.11	6.65	548.20	274.1
92	737.19	6.65	558.01	279.0
93	750.27	6.65	567.82	283.9
94	763.35	6.65	577.62	288.8
95	776.43	6.65	587.43	293.7
96	789.51	6.65	597.24	298.6
97	802.59	6.65	607.05	303.5
98	815.66	6.65	616.86	308.4
99	828.74	6.65	626.67	313.3
100	841.82	6.65	636.48	318.2
101	854.90	6.65	646.29	323.1
102	867.98	6.65	656.10	328.0
103	881.06	6.65	665.91	333.0
104	894.14	6.65	675.72	337.9
105	907.22	6.65	685.52	342.8
106	920.29	6.65	695.33	347.7
107	933.37	6.65	705.14	352.6
108	946.45	6.65	714.95	357.5
109	959.53	6.65	724.76	362.4
110	972.61	6.65	734.57	367.3
111	985.69	6.65	744.38	372.2
112	998.77	6.65	754.19	377.1
113	1011.85	6.65	764.00	382.0
114	1024.93	6.65	773.81	386.9
115	1038.00	6.65	783.62	391.8

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x73 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 418 ft.

	Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	H-Pile Driving Resistance (tons)
Contributes to Downdrag	1	1.34	1.98	2.65	1.3
	2	2.68	1.98	3.32	1.7
	3	4.03	1.98	3.99	2.0
	4	5.37	1.98	4.66	2.3
	5	6.71	1.98	5.33	2.7
	6	8.05	1.98	6.01	3.0
	6	8.09	1.98	6.03	3.0
Silts	7	11.79	1.98	8.80	4.4
Sands	8	15.48	1.98	11.57	5.8
	9	19.18	1.98	14.34	7.2
	10	22.87	1.98	17.11	8.6
	10.6	25.09	1.98	18.77	9.4
	11	26.57	1.98	19.88	9.9
	12	30.26	1.98	22.65	11.3
	13	33.96	1.98	25.43	12.7
	14	37.65	1.98	28.20	14.1
	15	41.35	1.98	30.97	15.5
	16	45.04	1.98	33.74	16.9
	17	48.74	1.98	36.51	18.3
	18	52.44	1.98	39.28	19.6
	19	56.13	1.98	42.06	21.0
	20	59.83	1.98	44.83	22.4
	21	63.52	1.98	47.60	23.8
	22	67.22	1.98	50.37	25.2
	23	70.91	1.98	53.14	26.6
	24	74.61	1.98	55.91	28.0
	25	78.30	1.98	58.69	29.3
	26	82.00	1.98	61.46	30.7
	27	85.69	1.98	64.23	32.1
	28	89.39	1.98	67.00	33.5
	28	89.52	5.93	71.05	35.5
	29	98.45	5.93	77.74	38.9
	30	107.37	5.93	84.44	42.2
	31	116.30	5.93	91.13	45.6
	32	125.23	5.93	97.83	48.9
	33	134.15	5.93	104.52	52.3
	34	143.08	5.93	111.22	55.6
	35	152.00	5.93	117.91	59.0
	36	160.93	5.93	124.61	62.3
	37	169.86	5.93	131.30	65.7

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	H-Pile Driving Resistance (tons)
38	178.78	5.93	138.00	69.0
@ 39 ' 39	187.71	5.93	144.69	72.3
39	187.92	5.93	144.85	72.4
40	199.51	5.93	153.54	76.8
41	211.10	5.93	162.23	81.1
42	222.69	5.93	170.92	85.5
43	234.27	5.93	179.61	89.8
44	245.86	5.93	188.30	94.2
45	257.45	5.93	197.00	98.5
46	269.04	5.93	205.69	102.8
47	280.63	5.93	214.38	107.2
48	292.22	5.93	223.07	111.5
49	303.81	5.93	231.76	115.9
50	315.40	5.93	240.45	120.2
51	326.98	5.93	249.15	124.6
52	338.57	5.93	257.84	128.9
53	350.16	5.93	266.53	133.3
54	361.75	5.93	275.22	137.6
55	373.34	5.93	283.91	142.0
56	384.93	5.93	292.60	146.3
57	396.52	5.93	301.29	150.6
58	408.10	5.93	309.99	155.0
59	419.69	5.93	318.68	159.3
60	431.28	5.93	327.37	163.7
61	442.87	5.93	336.06	168.0
61	443.14	9.18	339.51	169.8
62	460.78	9.18	352.75	176.4
63	478.43	9.18	365.98	183.0
64	496.07	9.18	379.21	189.6
65	513.72	9.18	392.45	196.2
66	531.36	9.18	405.68	202.8
67	549.01	9.18	418.91	209.5
68	566.65	9.18	432.15	216.1
69	584.30	9.18	445.38	222.7
70	601.94	9.18	458.61	229.3
71	619.59	9.18	471.85	235.9
72	637.23	9.18	485.08	242.5
73	654.88	9.18	498.31	249.2
74	672.52	9.18	511.55	255.8
75	690.17	9.18	524.78	262.4

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x73 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 418 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
76	707.81	9.18	538.02	269.0
77	725.46	9.18	551.25	275.6
78	743.10	9.18	564.48	282.2
79	760.74	9.18	577.72	288.9
80	778.39	9.18	590.95	295.5
81	796.03	9.18	604.18	302.1
82	813.68	9.18	617.42	308.7
83	831.32	9.18	630.65	315.3
84	848.97	9.18	643.88	321.9
85	866.61	9.18	657.12	328.6
86	884.26	9.18	670.35	335.2
87	901.90	9.18	683.58	341.8
88	919.55	9.18	696.82	348.4
89	937.19	9.18	710.05	355.0
90	954.84	9.18	723.28	361.6
91	972.48	9.18	736.52	368.3
92	990.13	9.18	749.75	374.9
93	1007.77	9.18	762.99	381.5
94	1025.41	9.18	776.22	388.1
95	1043.06	9.18	789.45	394.7
96	1060.70	9.18	802.69	401.3
97	1078.35	9.18	815.92	408.0
98	1095.99	9.18	829.15	414.6
99	1113.64	9.18	842.39	421.2
100	1131.28	9.18	855.62	427.8
101	1148.93	9.18	868.85	434.4
102	1166.57	9.18	882.09	441.0
103	1184.22	9.18	895.32	447.7
104	1201.86	9.18	908.55	454.3
105	1219.51	9.18	921.79	460.9
106	1237.15	9.18	935.02	467.5
107	1254.80	9.18	948.25	474.1
108	1272.44	9.18	961.49	480.7
109	1290.09	9.18	974.72	487.4
110	1307.73	9.18	987.96	494.0
111	1325.37	9.18	1,001.19	500.6
112	1343.02	9.18	1,014.42	507.2
113	1360.66	9.18	1,027.66	513.8
114	1378.31	9.18	1,040.89	520.4
115	1395.95	9.18	1,054.12	527.1

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x89 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 418 ft.

	Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	H-Pile Driving Resistance (tons)
Contributes to Downdrag	1	1.46	2.41	3.14	1.6
	2	2.91	2.41	3.87	1.9
	3	4.37	2.41	4.59	2.3
	4	5.82	2.41	5.32	2.7
	5	7.28	2.41	6.05	3.0
	6	8.73	2.41	6.78	3.4
	6	8.77	2.41	6.80	3.4
Silts	7	12.78	2.41	9.80	4.9
Sands	8	16.79	2.41	12.81	6.4
	9	20.79	2.41	15.81	7.9
	10	24.80	2.41	18.82	9.4
	10.6	27.21	2.41	20.62	10.3
	11	28.81	2.41	21.82	10.9
	12	32.82	2.41	24.83	12.4
	13	36.82	2.41	27.84	13.9
	14	40.83	2.41	30.84	15.4
	15	44.84	2.41	33.85	16.9
	16	48.85	2.41	36.85	18.4
	17	52.86	2.41	39.86	19.9
	18	56.86	2.41	42.86	21.4
	19	60.87	2.41	45.87	22.9
	20	64.88	2.41	48.88	24.4
	21	68.89	2.41	51.88	25.9
	22	72.89	2.41	54.89	27.4
	23	76.90	2.41	57.89	28.9
	24	80.91	2.41	60.90	30.4
	25	84.92	2.41	63.91	32.0
	26	88.92	2.41	66.91	33.5
	27	92.93	2.41	69.92	35.0
	28	96.94	2.41	72.92	36.5
	28	97.08	7.24	77.86	38.9
	29	106.87	7.24	85.20	42.6
	30	116.67	7.24	92.55	46.3
	31	126.46	7.24	99.89	49.9
	32	136.25	7.24	107.24	53.6
	33	146.05	7.24	114.58	57.3
	34	155.84	7.24	121.93	61.0
	35	165.64	7.24	129.27	64.6
	36	175.43	7.24	136.62	68.3
	37	185.22	7.24	143.96	72.0

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	H-Pile Driving Resistance (tons)
38	195.02	7.24	151.31	75.7
@ 39 ' 39	204.81	7.24	158.66	79.3
39	205	7	159	79
40	217.75	7.24	168.36	84.2
41	230.47	7.24	177.90	88.9
42	243.18	7.24	187.43	93.7
43	255.90	7.24	196.97	98.5
44	268.61	7.24	206.51	103.3
45	281.32	7.24	216.04	108.0
46	294.04	7.24	225.58	112.8
47	306.75	7.24	235.11	117.6
48	319.47	7.24	244.65	122.3
49	332.18	7.24	254.18	127.1
50	344.90	7.24	263.72	131.9
51	357.61	7.24	273.25	136.6
52	370.32	7.24	282.79	141.4
53	383.04	7.24	292.33	146.2
54	395.75	7.24	301.86	150.9
55	408.47	7.24	311.40	155.7
56	421.18	7.24	320.93	160.5
57	433.89	7.24	330.47	165.2
58	446.61	7.24	340.00	170.0
59	459.32	7.24	349.54	174.8
60	472.04	7.24	359.07	179.5
61	484.75	7.24	368.61	184.3
61	485.05	11.20	372.80	186.4
62	504.47	11.20	387.36	193.7
63	523.90	11.20	401.93	201.0
64	543.32	11.20	416.50	208.2
65	562.74	11.20	431.07	215.5
66	582.17	11.20	445.63	222.8
67	601.59	11.20	460.20	230.1
68	621.01	11.20	474.77	237.4
69	640.44	11.20	489.34	244.7
70	659.86	11.20	503.90	252.0
71	679.28	11.20	518.47	259.2
72	698.71	11.20	533.04	266.5
73	718.13	11.20	547.61	273.8
74	737.56	11.20	562.17	281.1
75	756.98	11.20	576.74	288.4

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 2 at I-65 and Ramps 10 and 26
14x89 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 418 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
76	776.40	11.20	591.31	295.7
77	795.83	11.20	605.88	302.9
78	815.25	11.20	620.44	310.2
79	834.67	11.20	635.01	317.5
80	854.10	11.20	649.58	324.8
81	873.52	11.20	664.15	332.1
82	892.94	11.20	678.71	339.4
83	912.37	11.20	693.28	346.6
84	931.79	11.20	707.85	353.9
85	951.21	11.20	722.42	361.2
86	970.64	11.20	736.99	368.5
87	990.06	11.20	751.55	375.8
88	1009.48	11.20	766.12	383.1
89	1028.91	11.20	780.69	390.3
90	1048.33	11.20	795.26	397.6
91	1067.75	11.20	809.82	404.9
92	1087.18	11.20	824.39	412.2
93	1106.60	11.20	838.96	419.5
94	1126.02	11.20	853.53	426.8
95	1145.45	11.20	868.09	434.0
96	1164.87	11.20	882.66	441.3
97	1184.29	11.20	897.23	448.6
98	1203.72	11.20	911.80	455.9
99	1223.14	11.20	926.36	463.2
100	1242.57	11.20	940.93	470.5
101	1261.99	11.20	955.50	477.7
102	1281.41	11.20	970.07	485.0
103	1300.84	11.20	984.63	492.3
104	1320.26	11.20	999.20	499.6
105	1339.68	11.20	1,013.77	506.9
106	1359.11	11.20	1,028.34	514.2
107	1378.53	11.20	1,042.90	521.5
108	1397.95	11.20	1,057.47	528.7
109	1417.38	11.20	1,072.04	536.0
110	1436.80	11.20	1,086.61	543.3
111	1456.22	11.20	1,101.18	550.6
112	1475.65	11.20	1,115.74	557.9
113	1495.07	11.20	1,130.31	565.2
114	1514.49	11.20	1,144.88	572.4
115	1533.92	11.20	1,159.45	579.7

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
12x53 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 420 ft.

	Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
	1	0.95	0.24	0.72	0.4
	2	1.91	0.24	1.19	0.6
	3	2.86	0.24	1.67	0.8
	4	3.81	0.24	2.15	1.1
	5	4.76	0.24	2.62	1.3
	6	5.72	0.24	3.10	1.5
Clays	7	6.67	0.24	3.58	1.8
Sands	7	6.70	1.43	4.79	2.4
	8	9.36	1.43	6.78	3.4
	9	12.02	1.43	8.78	4.4
	10	14.68	1.43	10.78	5.4
	11	17.35	1.43	12.77	6.4
	12	20.01	1.43	14.77	7.4
	13	22.67	1.43	16.76	8.4
	14	25.33	1.43	18.76	9.4
	15	27.99	1.43	20.76	10.4
	16	30.65	1.43	22.75	11.4
	17	33.31	1.43	24.75	12.4
	18	35.97	1.43	26.74	13.4
	19	38.64	1.43	28.74	14.4
	20	41.30	1.43	30.74	15.4
	21	43.96	1.43	32.73	16.4
	22	46.62	1.43	34.73	17.4
	22	46.71	10.26	43.63	21.8
	23	53.90	10.26	49.02	24.5
	24	61.09	10.26	54.41	27.2
	25	68.28	10.26	59.80	29.9
	26	75.47	10.26	65.20	32.6
	27	82.66	10.26	70.59	35.3
	28	89.85	10.26	75.98	38.0
	29	97.05	10.26	81.38	40.7
	30	104.24	10.26	86.77	43.4
	31	111.43	10.26	92.16	46.1
	32	118.62	10.26	97.56	48.8
	33	125.81	10.26	102.95	51.5
	34	133.00	10.26	108.34	54.2
	35	140.19	10.26	113.73	56.9
@ 3 6'	36	147.38	10.26	119.13	59.6
	36	147.56	10.26	119.26	59.6
	37	160.48	10.26	128.95	64.5

Downdrag is not an issue at this location.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
38	173.41	10.26	138.65	69.3
39	186.33	10.26	148.34	74.2
40	199.25	10.26	158.03	79.0
41	212.17	10.26	167.72	83.9
42	225.10	10.26	177.41	88.7
43	238.02	10.26	187.11	93.6
44	250.94	10.26	196.80	98.4
45	263.86	10.26	206.49	103.2
46	276.79	10.26	216.18	108.1
47	289.71	10.26	225.88	112.9
48	302.63	10.26	235.57	117.8
49	315.56	10.26	245.26	122.6
50	328.48	10.26	254.95	127.5
51	341.40	10.26	264.64	132.3
52	354.32	10.26	274.34	137.2
53	367.25	10.26	284.03	142.0
54	380.17	10.26	293.72	146.9
55	393.09	10.26	303.41	151.7
56	406.01	10.26	313.10	156.6
57	418.94	10.26	322.80	161.4
58	431.86	10.26	332.49	166.2
59	444.78	10.26	342.18	171.1
60	457.71	10.26	351.87	175.9
61	470.63	10.26	361.56	180.8
62	483.55	10.26	371.26	185.6
63	496.47	10.26	380.95	190.5
64	509.40	10.26	390.64	195.3
65	522.32	10.26	400.33	200.2
66	535.24	10.26	410.02	205.0
67	548.16	10.26	419.72	209.9
68	561.09	10.26	429.41	214.7
69	574.01	10.26	439.10	219.6
70	586.93	10.26	448.79	224.4
71	599.86	10.26	458.48	229.2
72	612.78	10.26	468.18	234.1
73	625.70	10.26	477.87	238.9
74	638.62	10.26	487.56	243.8
75	651.55	10.26	497.25	248.6
76	664.47	10.26	506.94	253.5
77	677.39	10.26	516.64	258.3

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
12x53 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 420 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
78	690.32	10.26	526.33	263.2
79	703.24	10.26	536.02	268.0
80	716.16	10.26	545.71	272.9
81	729.08	10.26	555.40	277.7
82	742.01	10.26	565.10	282.5
83	754.93	10.26	574.79	287.4
84	767.85	10.26	584.48	292.2
85	780.77	10.26	594.17	297.1
86	793.70	10.26	603.87	301.9
87	806.62	10.26	613.56	306.8
88	819.54	10.26	623.25	311.6
89	832.47	10.26	632.94	316.5
90	845.39	10.26	642.63	321.3
91	858.31	10.26	652.33	326.2
92	871.23	10.26	662.02	331.0
93	884.16	10.26	671.71	335.9
94	897.08	10.26	681.40	340.7
95	910.00	10.26	691.09	345.5
96	922.92	10.26	700.79	350.4
97	935.85	10.26	710.48	355.2
98	948.77	10.26	720.17	360.1
99	961.69	10.26	729.86	364.9
100	974.62	10.26	739.55	369.8
101	987.54	10.26	749.25	374.6
102	1000.46	10.26	758.94	379.5
103	1013.38	10.26	768.63	384.3
104	1026.31	10.26	778.32	389.2
105	1039.23	10.26	788.01	394.0
106	1052.15	10.26	797.71	398.9
107	1065.07	10.26	807.40	403.7
108	1078.00	10.26	817.09	408.5
109	1090.92	10.26	826.78	413.4
110	1103.84	10.26	836.47	418.2
111	1116.77	10.26	846.17	423.1
112	1129.69	10.26	855.86	427.9
113	1142.61	10.26	865.55	432.8
114	1155.53	10.26	875.24	437.6
115	1168.46	10.26	884.93	442.5

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x73 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 420 ft.

	Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	H-Pile Driving Resistance (tons)
	1	1.13	0.33	0.89	0.4
	2	2.25	0.33	1.46	0.7
	3	3.38	0.33	2.02	1.0
	4	4.51	0.33	2.58	1.3
	5	5.64	0.33	3.15	1.6
	6	6.76	0.33	3.71	1.9
Clays	7	7.89	0.33	4.28	2.1
Sands	7	7.93	1.98	5.96	3.0
	8	11.44	1.98	8.59	4.3
	9	14.95	1.98	11.22	5.6
	10	18.46	1.98	13.85	6.9
	11	21.96	1.98	16.48	8.2
	12	25.47	1.98	19.11	9.6
	13	28.98	1.98	21.74	10.9
	14	32.49	1.98	24.38	12.2
	15	36.00	1.98	27.01	13.5
	16	39.51	1.98	29.64	14.8
	17	43.02	1.98	32.27	16.1
	18	46.53	1.98	34.90	17.5
	19	50.03	1.98	37.53	18.8
	20	53.54	1.98	40.16	20.1
	21	57.05	1.98	42.80	21.4
	22	60.56	1.98	45.43	22.7
	22	60.69	14.16	57.71	28.9
	23	70.44	14.16	65.02	32.5
	24	80.19	14.16	72.33	36.2
	25	89.94	14.16	79.64	39.8
	26	99.69	14.16	86.96	43.5
	27	109.44	14.16	94.27	47.1
	28	119.19	14.16	101.58	50.8
	29	128.95	14.16	108.90	54.4
	30	138.70	14.16	116.21	58.1
	31	148.45	14.16	123.52	61.8
	32	158.20	14.16	130.84	65.4
	33	167.95	14.16	138.15	69.1
	34	177.70	14.16	145.46	72.7
	35	187.45	14.16	152.77	76.4
@	36	197.20	14.16	160.09	80.0
	36	197.44	14.16	160.27	80.1
	37	214.96	14.16	173.41	86.7

Downdrag is not an issue at this location.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	H-Pile Driving Resistance (tons)
38	232.49	14.16	186.55	93.3
39	250.01	14.16	199.70	99.8
40	267.53	14.16	212.84	106.4
41	285.06	14.16	225.98	113.0
42	302.58	14.16	239.12	119.6
43	320.10	14.16	252.27	126.1
44	337.63	14.16	265.41	132.7
45	355.15	14.16	278.55	139.3
46	372.67	14.16	291.69	145.8
47	390.20	14.16	304.84	152.4
48	407.72	14.16	317.98	159.0
49	425.24	14.16	331.12	165.6
50	442.77	14.16	344.26	172.1
51	460.29	14.16	357.41	178.7
52	477.81	14.16	370.55	185.3
53	495.34	14.16	383.69	191.8
54	512.86	14.16	396.83	198.4
55	530.39	14.16	409.98	205.0
56	547.91	14.16	423.12	211.6
57	565.43	14.16	436.26	218.1
58	582.96	14.16	449.40	224.7
59	600.48	14.16	462.55	231.3
60	618.00	14.16	475.69	237.8
61	635.53	14.16	488.83	244.4
62	653.05	14.16	501.97	251.0
63	670.57	14.16	515.12	257.6
64	688.10	14.16	528.26	264.1
65	705.62	14.16	541.40	270.7
66	723.14	14.16	554.54	277.3
67	740.67	14.16	567.69	283.8
68	758.19	14.16	580.83	290.4
69	775.71	14.16	593.97	297.0
70	793.24	14.16	607.11	303.6
71	810.76	14.16	620.26	310.1
72	828.28	14.16	633.40	316.7
73	845.81	14.16	646.54	323.3
74	863.33	14.16	659.69	329.8
75	880.85	14.16	672.83	336.4
76	898.38	14.16	685.97	343.0
77	915.90	14.16	699.11	349.6

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x73 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 420 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
78	933.42	14.16	712.26	356.1
79	950.95	14.16	725.40	362.7
80	968.47	14.16	738.54	369.3
81	985.99	14.16	751.68	375.8
82	1003.52	14.16	764.83	382.4
83	1021.04	14.16	777.97	389.0
84	1038.56	14.16	791.11	395.6
85	1056.09	14.16	804.25	402.1
86	1073.61	14.16	817.40	408.7
87	1091.13	14.16	830.54	415.3
88	1108.66	14.16	843.68	421.8
89	1126.18	14.16	856.82	428.4
90	1143.70	14.16	869.97	435.0
91	1161.23	14.16	883.11	441.6
92	1178.75	14.16	896.25	448.1
93	1196.28	14.16	909.39	454.7
94	1213.80	14.16	922.54	461.3
95	1231.32	14.16	935.68	467.8
96	1248.85	14.16	948.82	474.4
97	1266.37	14.16	961.96	481.0
98	1283.89	14.16	975.11	487.6
99	1301.42	14.16	988.25	494.1
100	1318.94	14.16	1,001.39	500.7
101	1336.46	14.16	1,014.53	507.3
102	1353.99	14.16	1,027.68	513.8
103	1371.51	14.16	1,040.82	520.4
104	1389.03	14.16	1,053.96	527.0
105	1406.56	14.16	1,067.10	533.6
106	1424.08	14.16	1,080.25	540.1
107	1441.60	14.16	1,093.39	546.7
108	1459.13	14.16	1,106.53	553.3
109	1476.65	14.16	1,119.68	559.8
110	1494.17	14.16	1,132.82	566.4
111	1511.70	14.16	1,145.96	573.0
112	1529.22	14.16	1,159.10	579.6
113	1546.74	14.16	1,172.25	586.1
114	1564.27	14.16	1,185.39	592.7
115	1581.79	14.16	1,198.53	599.3

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x89 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 420 ft.

	Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
	1	1.14	0.41	0.98	0.5
	2	2.28	0.41	1.55	0.8
	3	3.42	0.41	2.12	1.1
	4	4.57	0.41	2.69	1.3
	5	5.71	0.41	3.26	1.6
	6	6.85	0.41	3.83	1.9
Clays	7	7.99	0.41	4.41	2.2
Sands	7	8.02	2.41	6.43	3.2
	8	11.83	2.41	9.29	4.6
	9	15.64	2.41	12.15	6.1
	10	19.46	2.41	15.00	7.5
	11	23.27	2.41	17.86	8.9
	12	27.08	2.41	20.72	10.4
	13	30.89	2.41	23.58	11.8
	14	34.70	2.41	26.44	13.2
	15	38.52	2.41	29.30	14.6
	16	42.33	2.41	32.16	16.1
	17	46.14	2.41	35.02	17.5
	18	49.95	2.41	37.88	18.9
	19	53.76	2.41	40.74	20.4
	20	57.58	2.41	43.59	21.8
	21	61.39	2.41	46.45	23.2
	22	65.20	2.41	49.31	24.7
	22	65.33	17.27	64.27	32.1
	23	76.10	17.27	72.34	36.2
	24	86.86	17.27	80.42	40.2
	25	97.63	17.27	88.49	44.2
	26	108.39	17.27	96.57	48.3
	27	119.16	17.27	104.64	52.3
	28	129.92	17.27	112.72	56.4
	29	140.69	17.27	120.79	60.4
	30	151.46	17.27	128.86	64.4
	31	162.22	17.27	136.94	68.5
	32	172.99	17.27	145.01	72.5
	33	183.75	17.27	153.09	76.5
	34	194.52	17.27	161.16	80.6
	35	205.28	17.27	169.24	84.6
@ 36'	36	216.05	17.27	177.31	88.7
	36	216.31	17.27	177.51	88.8
	37	235.66	17.27	192.01	96.0

Downdrag is not an issue at this location.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
38	255.00	17.27	206.52	103.3
39	274.35	17.27	221.03	110.5
40	293.70	17.27	235.54	117.8
41	313.04	17.27	250.05	125.0
42	332.39	17.27	264.56	132.3
43	351.74	17.27	279.07	139.5
44	371.08	17.27	293.58	146.8
45	390.43	17.27	308.09	154.0
46	409.77	17.27	322.60	161.3
47	429.12	17.27	337.11	168.6
48	448.47	17.27	351.62	175.8
49	467.81	17.27	366.13	183.1
50	487.16	17.27	380.64	190.3
51	506.51	17.27	395.15	197.6
52	525.85	17.27	409.66	204.8
53	545.20	17.27	424.17	212.1
54	564.55	17.27	438.68	219.3
55	583.89	17.27	453.19	226.6
56	603.24	17.27	467.70	233.9
57	622.59	17.27	482.21	241.1
58	641.93	17.27	496.72	248.4
59	661.28	17.27	511.23	255.6
60	680.62	17.27	525.74	262.9
61	699.97	17.27	540.25	270.1
62	719.32	17.27	554.76	277.4
63	738.66	17.27	569.27	284.6
64	758.01	17.27	583.78	291.9
65	777.36	17.27	598.29	299.1
66	796.70	17.27	612.80	306.4
67	816.05	17.27	627.31	313.7
68	835.40	17.27	641.82	320.9
69	854.74	17.27	656.33	328.2
70	874.09	17.27	670.84	335.4
71	893.44	17.27	685.35	342.7
72	912.78	17.27	699.86	349.9
73	932.13	17.27	714.37	357.2
74	951.47	17.27	728.88	364.4
75	970.82	17.27	743.39	371.7
76	990.17	17.27	757.90	378.9
77	1009.51	17.27	772.41	386.2

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

H-Pile Driving Resistances
Kennedy Interchanges S0450 (B65-9) Bridge
Abutment 1 at I-65 and Ramps 2, 3 and 4
14x89 H-Pile (50ksi steel)

Estimated Base of Pile Cap Elevation = 456 ft.
Water table at normal pool = 420 ft.

Depth Below Pile Cap (ft)	Nominal Side Resistance (kips)	Nominal End Bearing (kips)	H-Pile Driving Resistance (kips)	(tons)
78	1028.86	17.27	786.92	393.5
79	1048.21	17.27	801.43	400.7
80	1067.55	17.27	815.94	408.0
81	1086.90	17.27	830.45	415.2
82	1106.25	17.27	844.96	422.5
83	1125.59	17.27	859.47	429.7
84	1144.94	17.27	873.98	437.0
85	1164.29	17.27	888.49	444.2
86	1183.63	17.27	903.00	451.5
87	1202.98	17.27	917.51	458.8
88	1222.32	17.27	932.02	466.0
89	1241.67	17.27	946.53	473.3
90	1261.02	17.27	961.04	480.5
91	1280.36	17.27	975.55	487.8
92	1299.71	17.27	990.06	495.0
93	1319.06	17.27	1,004.57	502.3
94	1338.40	17.27	1,019.08	509.5
95	1357.75	17.27	1,033.58	516.8
96	1377.10	17.27	1,048.09	524.0
97	1396.44	17.27	1,062.60	531.3
98	1415.79	17.27	1,077.11	538.6
99	1435.14	17.27	1,091.62	545.8
100	1454.48	17.27	1,106.13	553.1
101	1473.83	17.27	1,120.64	560.3
102	1493.17	17.27	1,135.15	567.6
103	1512.52	17.27	1,149.66	574.8
104	1531.87	17.27	1,164.17	582.1
105	1551.21	17.27	1,178.68	589.3
106	1570.56	17.27	1,193.19	596.6
107	1589.91	17.27	1,207.70	603.9
108	1609.25	17.27	1,222.21	611.1
109	1628.60	17.27	1,236.72	618.4
110	1647.95	17.27	1,251.23	625.6
111	1667.29	17.27	1,265.74	632.9
112	1686.64	17.27	1,280.25	640.1
113	1705.99	17.27	1,294.76	647.4
114	1725.33	17.27	1,309.27	654.6
115	1744.68	17.27	1,323.78	661.9

*Refer to capacity tables and/or construction drawings for required depth/capacities that incorporate other loads that have been accounted for in the design of these piles.

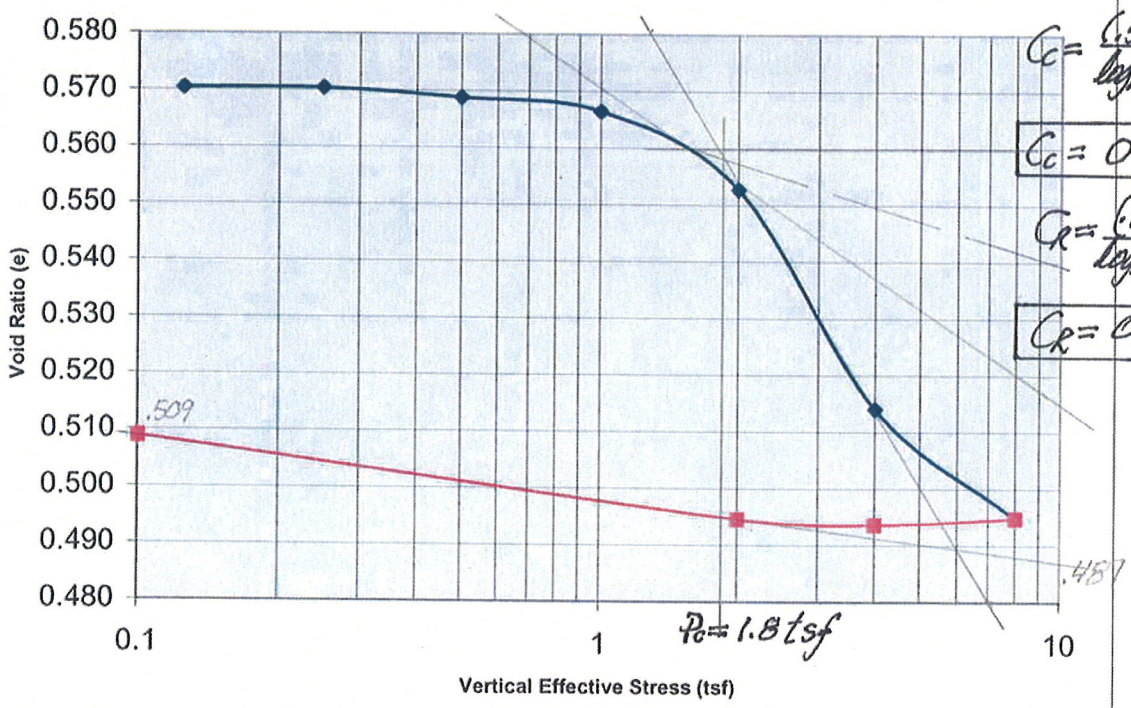
APPENDIX J:

LABORATORY TESTING RESULTS

KSWA

ASTM D 2435 / AASHTO T 216
One-Dimensional Consolidation of Soils

Job Name:	Kennedy Interchange	**Job number:**	500-05-0001.15
Location:	S0440 **Boring #** 1B-32	**Depth:**	ST-1
Specimen Type:	Undisturbed		
Sample Description:	Brown Sandy Silt		
Equipment:	Consol-1, Dial 3		

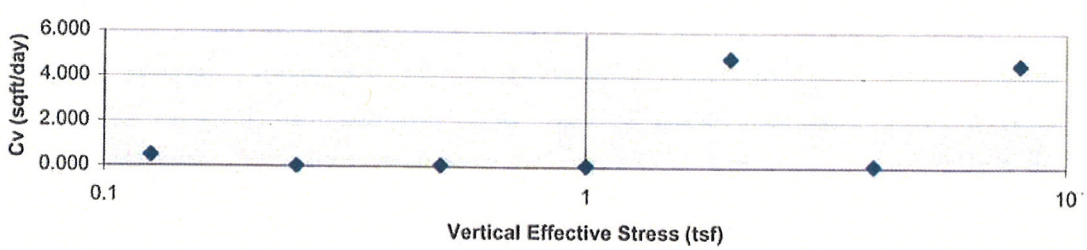


$C_c = \frac{(.580-.480)}{\log_{10}\left(\frac{7.0}{1.3}\right)}$

$C_c = 0.1368$

$C_R = \frac{(.509-.487)}{\log_{10}\left(\frac{1.0}{0.1}\right)}$

$C_R = 0.0110$



Submitted By: ALL Date: 8/22/06
Reviewed By: TDS Date: 8/22/06

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54 Lindsley Avenue
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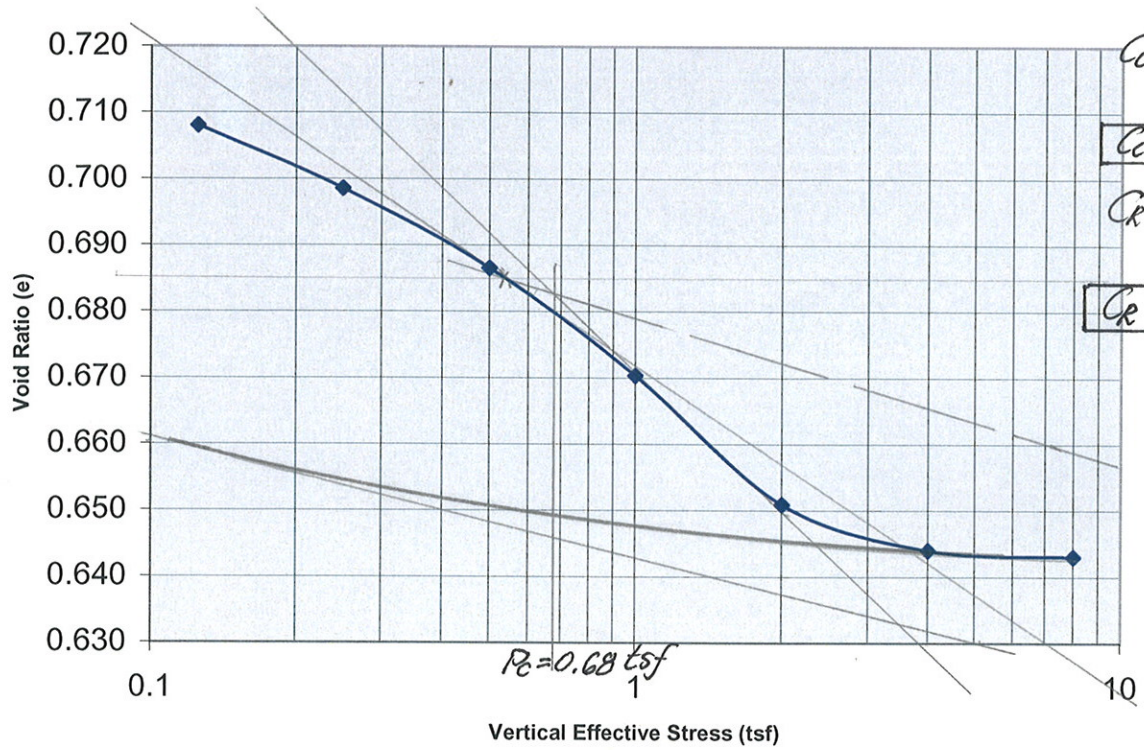
Fax (615) 256-5873

KSWA

ASTM D 2435 / AASHTO T 216
One-Dimensional Consolidation of Soils

Job Name:	Kennedy Interchange	**Job number:**	500-05-0001.34
Location:	S0450 **Boring #** 1B-34	**Depth:**	ST-1 0.5-2.5
Specimen Type:	Undisturbed		
Sample Description:	Brown Silty Sand		
Equipment:	Consol-1, Dial 3		

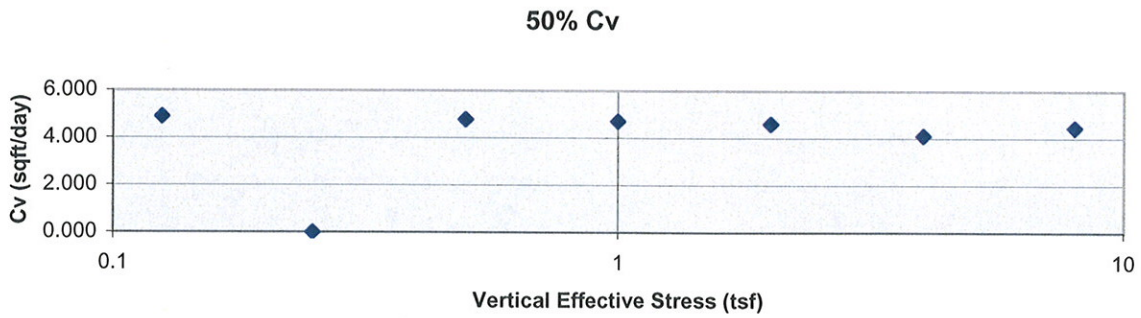


$C_c = \frac{(.720-.650)}{\log_{10}(\frac{2}{.2})}$

$C_c = 0.070$

$C_R = \frac{(.662-.680)}{\log_{10}(\frac{.5}{.1})}$

$C_R = 0.019$



Submitted By: TPS Date: 8/8/06
Reviewed By: gr Date: 8/8/06

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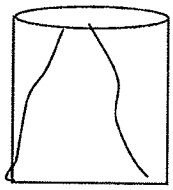
KSWA

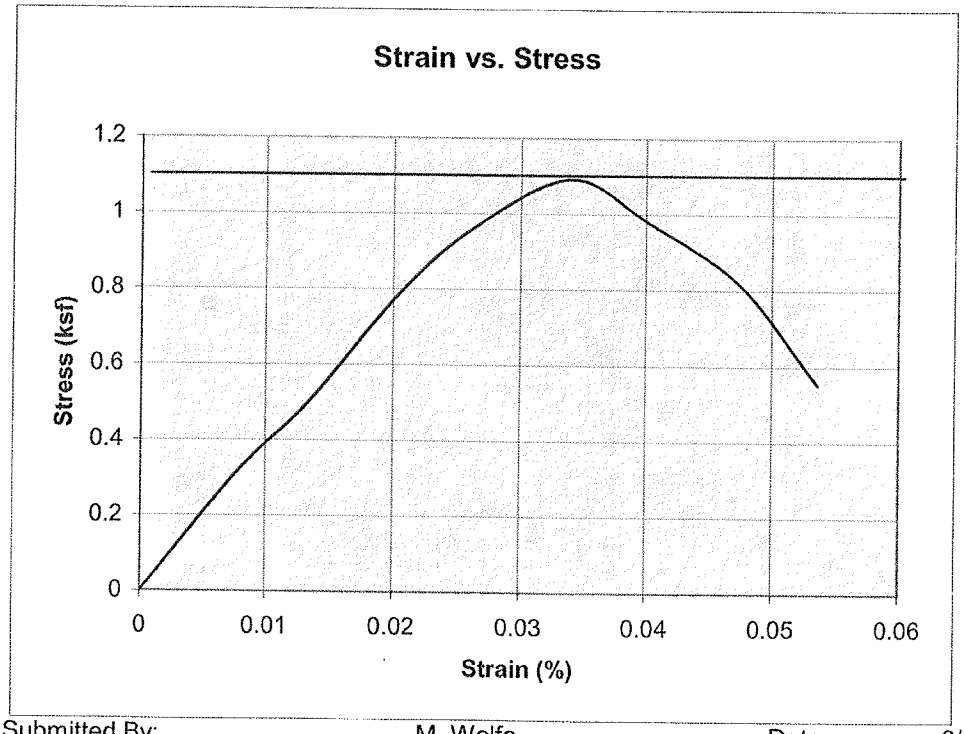
Unconfined Compression Test
AASHTO T-208

Job Name:	Kennedy Interchange	**Job number:**	500-05-0001
Location: S0450	**Boring #** 1B-34 ST-1	**Depth:**	2-4'
Date Tested:	7/14/2006		
Specimen Type:	Shelby Tube		
Sample Description:	Light Brown Sand with Silt		

Testing apparatus: Proving Ring # N205598 UTM Serial # 2147

Wet Density:	N/A		
Dry Density:	N/A	**Initial Height:**	5.76
Moisture Content:	12.8%	**Initial Diameter:**	2.82
Deg of Sat.:		**Specific Gravity:**	





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Submitted By: M. Wolfe Date: 6/5/2006
Reviewed By: Date: 10/18/06

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APPENDIX K:

COORDINATE DATA SUBMISSION FORM

COORDINATE DATA SUBMISSION FORM
KYTC DIVISION OF STRUCTURAL DESIGN -- GEOTECHNICAL BRANCH

County	Jefferson	Date	3/30/2007
Road Number	I-65 over Market St. (B65-9)		
Survey Crew / Consultant	K. S. Ware & Associates, LLC	Notes:	
Contact Person	Timothy D. Smith, P.E.	All coordinates should be NAD-83 Latitude,	
Item #	5-118.18	Longitude in Decimal Degrees	
MARS #	C-04224166		
Project #	S0450		

(Please Mark one)

Elevation Datum **Sea Level** Assumed

HOLE NUMBER	STATION	OFFSET	ELEVATION (ft)	LATITUDE	LONGITUDE
1B-32	658+80	99' LT	461.5	38.253453	85.74433
1B-34	660+42	127' LT	461.3	38.253619	85.743909
1W-80	662+60	155' RT	461.9	38.253787	85.742504
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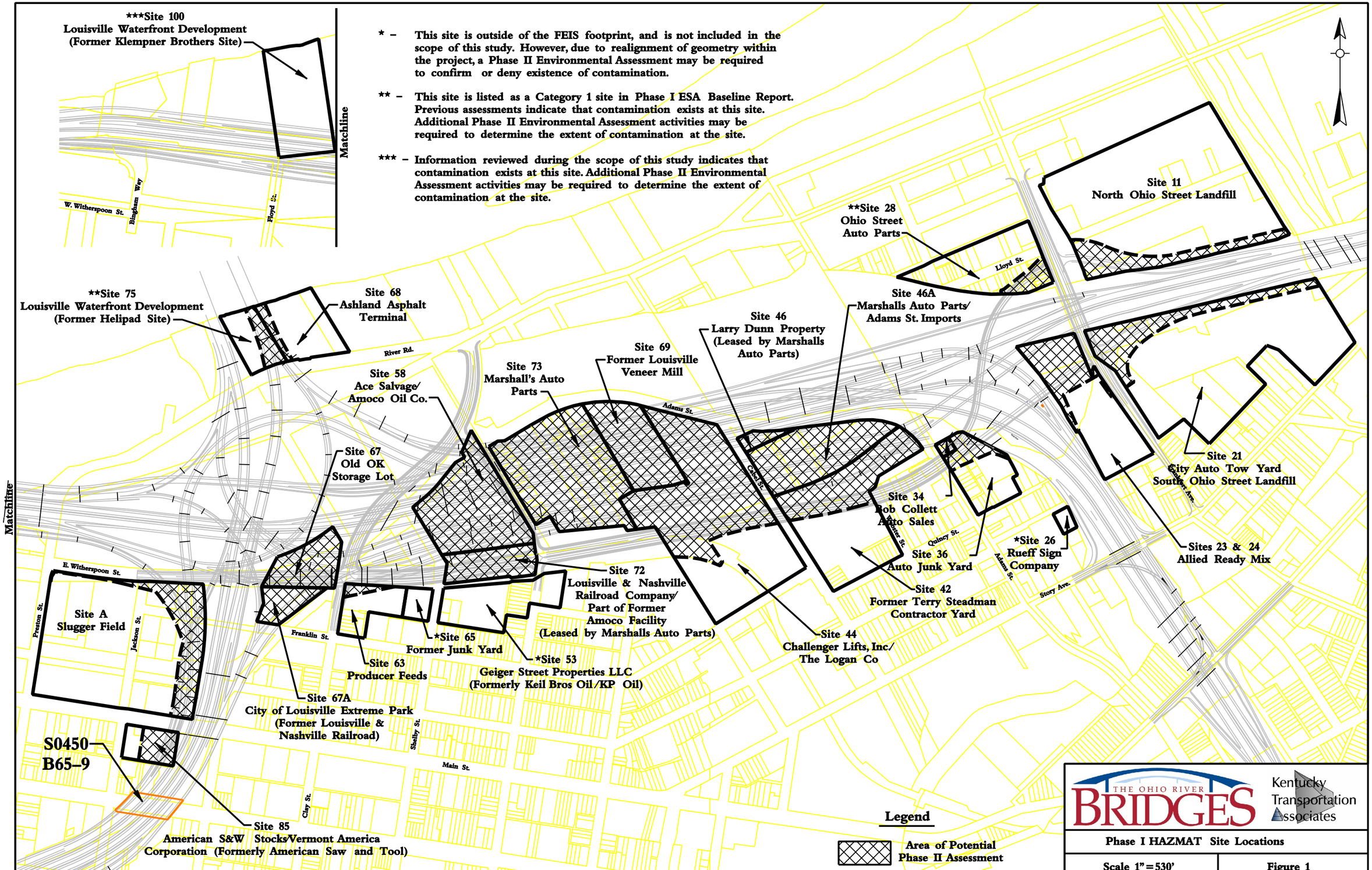
APPENDIX L:

ENVIRONMENTAL SITES MAP



...\HAZMAT-Sites-Locations-Map.dgn 4/9/2007 4:04:54 PM