FINAL REPORT
STRUCTURE FOUNDATION EXPLORATION
BRIDGE – FRA-71-0308 (L&R) OVER US ROUTE 62
FRA-71-0.00 IMPROVEMENTS
FRANKLIN COUNTY, OHIO
PID#: 93496

For:

Mead & Hunt, Inc.
5900 Wilcox Place
Dublin, OH 43016

Submitted by:

NEAS Inc.
National Engineering & Architectural Services Inc.

2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF PHOTOGRAPHS

LIST OF EXHIBITS

LIST OF APPENDICES

FINAL REPORT
STRUCTURE FOUNDATION EXPLORATION
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EXECUTIVE SUMMARY

This report presents the results of a structure foundation exploration for widening twin, four-span structures comprising Bridge FRA-71-0308 (L&R) carrying Interstate 71 (IR-71) over US Route 62 (US-62) in southwestern Franklin County. The bridge widening is a component of the larger IR-70 widening program, FRA-71-0.00, that includes ~6 miles of roadway and widening of two additional bridges.

The upgrade to Bridge FRA-71-0296 will be designed using the Load Factor Design (LFD) method as set forth in the American Association of State Highway and Transportation Officials (AASHTO) Publication *AASHTO Standard Specifications for Highway Bridges 7th Edition (with 2015 Interim Revisions)* (AASHTO, 2014) and ODOT *Bridge Design Manual*, [ODOT, 2007 (revised 2014)].

The proposed work for FRA-71-0308 will consist of widening the bridges ~30 feet (ft) to the inside, and supporting the extended abutments and piers on deep foundations using Cast In Place (CIP) piles.

The site is located in the Darby Plain portion of the Southern Ohio Loamy Till Plain, which is part of the Central Lowlands, which is characterized by hummocky ground moraine of moderate relief and poorly drained swales, which previously held wet prairies/meadows, and a few large streams. Bedrock is mapped as Devonian-age Columbus Limestone mapped at a depth of ~100 ft.

Subsurface conditions were characterized on the basis of 6 historical boring logs and the results of 5 new borings drilled to depths between 25 and 34.3 ft. The geotechnical conditions at the bridge site are good with a competent horizon encountered at relatively shallow depth.

The widened bridge elements will be supported on deep foundations consisting of 12-inch diameter CIP piles driven into the hard glacial till horizon at an elevation of about 850 ft.

1. INTRODUCTION

1.1. General

This report presents the results of a structure foundation exploration for widening Bridge FRA-71-0308 (L&R) carrying IR-71 over US-62 in southwestern Franklin County. The bridge widening is a component of the larger IR-70 widening program, FRA-71-0.00, that includes ~6 miles of roadway and widening of two additional bridges.

The exploration was conducted in general accordance with National Engineering & Architectural Services, Inc.'s (NEAS)[1] proposal to Mead & Hunt, Inc. dated October 9, 2013, and ODOT *Specifications for Geotechnical Explorations, 2013* (ODOT, 2013). The upgrade will be designed in accordance with the LRFD method as set forth in AASHTO's Publication *Bridge Design Specifications, 7th Edition (with 2015 Interim Revisions)* (AASHTO, 2014) and ODOT *Bridge Design Manual*, [ODOT, 2007 (revised 2014)].

1.2. Proposed Construction

The existing FRA-71-0308 structures are twin, four-span, continuous steel beam bridge with spill-thru abutments as shown on the original construction drawings (FALCON, 2013). The existing piers are supported on 12" diameter, CIP reinforced concrete piles driven to a minimum bearing capacity of 40 tons per pile and the existing abutments are on spread footings designed for a maximum bearing pressure of 1.7 tons per sq ft.

The proposed improvements at FRA-71-0308 will consist of widening both structures ~30 ft to the inside, and supporting the extended abutments and piers on deep foundations using 12-inch diameter CIP piles.

2. GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1. Geology and Physiology

The site is located in the Darby Plain portion of the Southern Ohio Loamy Till Plain, which is part of the Central Lowlands (Brockman, 1998). The area is characterized by hummocky ground moraine of moderate relief and poorly drained swales, which previously held wet prairies/meadows, and a few large streams.

The terrain at the bridge site and to the east is flat at about elevation 870-875 ft (US Department of the Interior, 1966). To the west the land dips to 780 ft at Big Darby Creek approximately 1.5 miles away.

[1] On October 19, 2014 Barr & Prevost Inc. (B&P) separated into two entities; Barr Engineering Inc. (BEI), the predecessor company to B&P, and Barr & Prevost, a JMT Division. BEI has retained the geotechnical exploration services for the FRA-71-0.00 project as a subcontractor to Barr & Prevost/JMT. On November 23, 2016, BEI was renamed to National Engineering & Architectures, Inc (NEAS).

The surficial geology is mapped as 40 feet of Wisconsinan Loam Till, with high carbonate content, overlying up to 130 feet (ft) of undifferentiated till of indeterminate age characterized primarily by it high density. Bedrock consists of Devonian-age Columbus Limestone mapped at a depth of ~100 ft. [Brockman et. al., 2005 and Shrake, 1994) at the bridge site.

2.2. Soils

Soils along the IR-71 corridor have been mapped by the Natural Resources Conservation Service (U.S. Department of Agriculture, 2013) as Udorthents-Urban land complex because of the presence of embankment fill and are not rated. Soils immediately adjacent to the corridor are mapped as Crosby silt loam 0 to 2 percent, which are all rated as very limited for local road and street construction because of flooding, frost susceptibility, and low strength.

2.3. Seismicity

Earthquake hazard analysis in this part of the country is dominated by proximity to the New Madrid Fault Zone (NMFZ) approximately 400 miles to the southwest. Possible future movements along this fault could generate earthquakes of magnitude 7.0-8.0 with a recurrence period of 500-1,500 years (USGS, 2008). The resulting ground motion would be experienced over a wide area, with the Harrisburg area located within the possible zone of influence. In addition, earthquake epicenters of lesser magnitude (< ~ magnitude 5) occurred in southern Fairfield County (~30 miles southeast) in 1848/1870 and 1967, which indicate other potential earthquake sources that are contributory to seismic risk (ODNR, 2012 and 2013[(1)]).

2.4. Hydrogeology

Surface water drainage in the area is dominated by the south flowing Big Darby Creek, a tributary to the Scioto River, located approximately 1.5 miles west. The creek is at an elevation of about 780 ft at this location and likely represents the regional ground water elevation.

2.5. Mining and Oil/Gas Production

No abandoned mines are noted on ODNR's Abandoned Underground Mine Locator in the vicinity of the bridge site (ODNR, 2013[(2)]).

No oil or gas wells are noted within the immediate vicinity of the bridge site (ODNR, 2013[(3)]).

2.6. Site Reconnaissance

A preliminary site reconnaissance was conducted Feb 4, 2014 during field operation planning and borehole staking at which time the ground was partially snow covered. A second inspection of the area was performed May 24, 2014.

Immediately east are the infields for the exit and entrance ramps to IR-71 at US-62. West land use includes a golf cart manufacturer, an active gasoline station and an abandoned gasoline station. The embankments are vegetated with bushes, grass and a few trees. US 62 (Harrisburg Pike) parallels the CSX railroad approximately 600 ft to the west. The area between the track and the Pike has been developed with predominantly light commercial facilities; the area to the east is agricultural farmland and light rural residential development.

The twin bridges are configured for separate northbound and southbound lanes, but presently span only a single, two-lane road between Piers 1 and 2 (Photographs 1 and 2). The area between Piers 2 and 3 is grass covered.

Photograph 1: FRA-71-0308 NB Piers 1 and 2.

Photograph 2: FRA-71-0308 NB Piers 2 and 3.

No evidence of distress or poor performance was observed at the supports that could be attributed to geotechnical factors. The bridge parapet lines appear to be straight and true which is interpreted to indicate absence of significant differential settlement (Photographs 1 and 2). Spill through slopes appear to be stable and are generally well maintained with crushed rock (Photograph 3). Surface drainage appears to be adequate.

Photograph 3: FRA-71-0308 NB Pier 3 and Forward Spill Through

Widening will take place in the area between the two existing structures (Photograph 4).

Photograph 4: FRA-71-0308 NB to be Widened.

3. EXPLORATION

3.1. Historical Boring Programs

Original design drawings prepared by Barrett, Cargo, Withers & Associates, Ltd., (prepared in 1962), the Soil Profile for the roadway PIC-1-3.06/FRA-1-0.00 (1962), and the report of the geotechnical exploration for the existing bridge were reviewed. A structure foundation investigation was conducted for the existing bridge in 1962 by The H. C. Nutting Company [*Report of Foundation Investigation, Interstate I-71, Bridge No. FRA-1-0308 R & L*]. Six borings were drilled and sampled at the bridge site. Copies of the original boring logs are provided in Appendix A and drilling information is summarized in Table 1 below. The boring locations are shown on Exhibit 1.

Table 1: Historical Boring Summary

Boring Number	Surface Elevation NGVD 29[1] (ft)	Station/ Offset	Depth (ft)	Bottom of Hole Elevation (ft)	Depth Bedrock Encountered (ft)	Structure
B-001-U-62	873.5	30+41, 55' L	56.5	817.0	NE	rear abutment L
B-004-U-62	873.8	30+54, 73' R	51.5	822.3	NE	pier 3 L
B-005-U-62	874.6	31+33, 97' R	56.5	818.1	NE	forward abutment L
B-006-U-62	871.0	28+56, 55' L	56.5	814.5	NE	rear abutment R

B-007-U-62	873.5	29+33, 21' L	56.5	817.0	NE	pier 1 R
B-010-U-62	873.2	29+34, 97' R	56.5	816.7	NE	forward abutment R

(1) NGVD 29 - 0.607=NAVD 88
NE – not encountered.

H.C. Nutting reported the following:

> "The subsurface profile consists of a relatively deep deposit of glacial till extending to the end of the borings, elevation 814.5."

Key findings of the geotechnical exploration were:

- The glacial till is stratified. A ~6 ft thick surficial layer of stiff clay and silty clay (A-6a / A-6b / A-7-6) overlies stiff sandy silt (A-4a) and silty clay (A-6a) for a further ~ 15 ft.
- At about elevation 845-850 ft the till becomes hard sandy silt (A-4a) with relatively rare lenses of dense outwash sand and gravel (A-1-b, A-2-4).
- Groundwater was encountered at an elevation of ~862-868 ft.

Two roadway borings for IR-71 were drilled near the rear abutment (station 1003+00 CL) to a depth of 21 ft and rear Pier 2 (station 1005+00 CL) to a depth of 16 ft. The findings were similar to those of the structure borings.

3.2. Field Exploration

Subsurface drilling was conducted by Central Star Drilling and Stock Drilling under subcontract to BEI between March 29 and April 11, 2014 and consisted of 5 borings drilled between 25.0 and 34.3 ft below ground surface. All drilling was supervised and logged by a BEI representative. The locations of these borings are provided on Exhibit 1 and summarized below in Table 2. The Logs of Borings are provided in Appendix A.

Table 2: Boring Summary

Boring Number	Boring Location (Lat/Long)	NAVD 88 Surface Elevation (ft)	Depth (ft)	Bottom of Hole Elevation (ft)	Depth to Groundwater (ft)	Depth to Bedrock (ft)	Structure
B-042-1-14	39.824847370, -83.141437220	894.0	25.0	869.0	NE	NE	rear abutment L&R
B-042-2-14	39.824572890, -83.141259020	874.0	30.0	844.0	NE	NE	pier 2 R
B-042-3-14	39.824890620, -83.141140180	874.0	31.5	842.5	NE	NE	pier 1 L
B-042-4-14	39.824751990, -83.140971610	873.0	31.5	841.5	NE	NE	pier 3 R
B-042-5-14	39.825072650, -83.140844960	875.0	34.3	840.7	13.5	NE	pier 2 L

NE – not encountered.

The bridge borings were drilled using either a truck-mounted CME 55 Automatic rig with 2.25-inch diameter hollow stem augers (HAS) or CME 750X with 2.25-inch HAS. Soil samples were recovered at 2.5-ft intervals using a split spoon sampler (AASHTO T-206 “Standard Method for Penetration Test and Split Barrel Sampling of Soils”).

The standard penetration test (SPT) was conducted during sampling using an auto-hammer that was calibrated June 12, 2012 as 75% efficient (CME 55) or calibrated March 1, 2013 as 79% efficient (CME 750X). Field boring logs were prepared by the B&P field supervisor, including lithological description and standard penetration test results, recorded as blows per 6-inch increment of penetration. Groundwater observations were recorded during the investigation. Hand penetrometer testing was conducted on a majority of SPT samples prior to removal from the sampler. Each boring was backfilled with soil cuttings.

3.3. Laboratory Testing Program

The laboratory testing program consisted primarily of classification testing and moisture content determinations. Data from the laboratory-testing program were incorporated onto the logs of borings (Appendix A). Soil samples are retained at the laboratory for 60 days following report submittal, after which time they will be discarded.

3.3.1. Classification Testing

Natural moisture content tests were performed on all soil samples. Representative soil samples were selected for index property (Atterberg Limits) and gradation testing for classification purposes. The results are presented on the log of the boring. Mechanical soil classification (Plastic Limit, Liquid Limit and gradation testing) was conducted on 43% of the recovered samples enabling identification and testing of all significant soil units.

Final classification of soil strata in accordance with AASHTO M-145 “Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes,” as modified by ODOT “Classification of Soils” was made once laboratory test results became available. Samples that were not tested were classified visually on the basis of comparison to those that were.

3.3.2. Standard Penetration Test Results

Standard Penetration Tests (SPT) and split-barrel (commonly known as split-spoon) sampling of soils was performed at 2.5-foot intervals in all borings using a calibrated auto-hammer. The resulting N-values must then be adjusted to account for the high efficiency of the hammer, compared to those used historically when many of the correlations of N-value with engineering properties of soils were developed. Manual hammers used in the past are considered to have been approximately 60% efficient and so the field measured N-values are adjusted by a factor equal to the calibrated efficiency/60. The resulting N_{60} values are shown on the log of borings.

4. FINDINGS

The following interpretation of the subsurface conditions is based on results of the two field explorations, laboratory testing, and consideration of the geological history of the site.

4.1. General

The stratigraphy at the bridge site is generally consistent with the geological model discussed above, over 50 ft of glacial till overburden to the depth explored. Bedrock was not encountered in any of the borings and is estimated to be on the order of 100 ft deep.

4.2. Overburden

Three distinct overburden formations have been described, each of which is glacially derived till, but with differing depositional histories and properties.

4.2.1. Embankment

The rear approach embankment was explored (B-042-1-14) and found to consist of reworked glacial till comprised primarily of hard sandy silt (A-4a) with lesser amounts of silt and clay (A-6a, A-6b, A-7-6) near the base of the embankment. The sample driving energy (N) averaged 31 blows per foot (bpf) and the hand penetrometer readings were consistently greater than 4.5 tsf except in the more clayey soils where they were in the range 3.25 - 4.5+ tsf. The original ground elevation at the historical boring locations was 871 - 874 ft and is taken to be the base of the freeway embankment.

4.2.2. Glacial Till (1)

Below the embankment is a layer of intact glacial till that is almost exclusively sandy silt (A-4a). It is generally logged as medium stiff to stiff with an average blow count of 19 bpf. This material frequently includes a surface mantled layer of clay up to 8 ft thick (A-7-6, A-6a, A-6b).

In B-042-3-14 and B-042-2-14 this stratum was less strong with blow counts averaging 9 bpf and hand penetrometer values of 1.0-2.75 tsf.

4.2.3. Glacial Till (2)

At elevation 844 - 845 ft a much harder till was encountered, again consisting primarily of sandy silt (A-4a), but with a blow count in the range 32-89 and an average of 61 bpf. This material was present in each of the five historical borings to the depths explored. This is a remarkably uniform material based on liquid limit and plasticity index. Till (2) is interpreted to be an Illinoian deposit and Till (1) more recent Wisconsinan.

4.3. Groundwater

Groundwater was encountered in the borings as summarized below in Table 3.

Table 3: Groundwater Summary

Boring Number	**Surface Elevation (ft)**	**Depth (ft)**	**Depth to Groundwater During Drilling (ft)**	**Elevation of Groundwater (ft)**	**Depth to Groundwater After 24 hrs (ft)**	**Elevation of Groundwater (ft)**
B-004-U-62	873.8	51.5	12.5	861.3	6.0	867.8
B-005-U-62	874.6	56.5	7.5	867.1	10.5	864.1
B-006-U-62	871.0	56.5	7.5	863.5	8.5	862.5
B-007-U-62	873.5	56.5	25.0	848.5	10.5	863.0
B-010-U-62	873.2	56.5	-	-	9.5	863.7
B-042-5-14	875.0	34.3	13.5	861.5	-	-

Water was encountered in only one project boring (B-042-5-14).

4.4. Soil Properties for Analysis

Generalized material profiles and physical properties for analysis have been developed. These are based primarily on published engineering correlations with index properties and consistency data as indicated by SPT results and hand penetrometer readings. The soil properties are shown in Table 4.

Table 4: Geotechnical Soil Properties

Soil Type	Description	Property	Value	Source
	894	N_{60}	31	Appendix A
		WC	11%	Appendix A
1	Embankment (A-4a)	S_u	4,000 psf	Appendix A
		c'	400 psf	GB 6
	873	Φ'	32º	GB 6
	873	N_{60}	9	Appendix A
		WC	18%	Appendix A
2	Glacial Till (1) (A-4a, A-7-6, A-6a)	S_u	1,500 psf	Appendix A
		c'	100 psf	GB 6/Estimate
	851	Φ'	29º	GB 6/Estimate
	851	N_{60}	59	Appendix A
		WC	10%	Appendix A
3	Glacial Till (2) (A-4c)	S_u	11,000 psf	N_{60} correlations
		c'	400 psf	GB 6/Estimate
	817	Φ'	32º	GB 6/ Estimate

The strength properties of the glacially derived materials deserve further mention. The existing pier piles were ordered to a length of 30 ft. A pile cap elevation of 868 ft would place the tip of the piles in the range of 847 - 837 ft (accounting for the method of establishing the pile order length), a depth that places them within the top of the hard Till (2) below 851 ft. Strength properties for Till (1) and (2) have been estimated using field test results and published correlations with various indicator parameters including N_{60} (blow counts).

Undrained shear strength has been correlated with N_{60} values for a variety of basal tills (ICE, 2012). The results of laboratory testing suggest a factor of 4.1-7.0 x N_{60} (measured in kPa: 1 kPa = 21 psf), although it is claimed that experience in the field justifies a higher value, and a factor of 9 is recommended for foundation design. This method yields shear strength values of 1,700 psf (the weaker zone of Till 1) and 11,000 psf (Till 2) based on N_{60} values of 9 and 59.

Unconfined compression tests on samples of Till 1 performed by H.C. Nutting suggest that a value of 1,500 psf is a reasonably conservative undrained shear strength estimate for use in design - see Table 5.

Table 5: Soil Properties – Glacial Till (H.C. Nutting, 1962)

Boring	**Depth (ft)**	**Soil**	**Dry Density (pcf)**	**Moisture Content (%)**	**Unconfined Compressive Strength (kg/cm^2)**	**Undrained Shear Strength (psf)**
B-004-U-62	5 - 6.5	A-4a	120.3	14.0	2.44	2500
B-004-U-62	8.5-10	A-4a	126.9	12.5	1.26	1290
B-005-U-62	7-8.5	A-4a	130.8	10.9	2.54	2601
B-007-U-62	5-6.5	A-7-6	106.6	20.5	2.08	2130
B-007-7-62	13.5-15	A-4a	129.2	12.6	0.96	983

The average undrained shear strength for the A-4a soil component of Till 1 is 1,843 psf.

5. ANALYSIS AND RECOMMENDATIONS

5.1. Global Stability

The existing spill through slopes extend the full distance between the parallel structures and have been in place for about 50 years. They appear to be performing well and no significant modification to the slopes is planned as part of these improvements. The global stability of the abutments should, therefore, remain adequate.

5.2. Settlement

No significant additional fill or other loading of the approach embankments is anticipated and settlement will not therefore be a factor in design.

5.3. Deep Foundations

The widened structure will be supported on deep foundations that derive resistance primarily from the hard glacial till encountered beneath the site. The existing abutments are founded on shallow spread foundations bearing on the approach embankment fills. Extensions to the abutments will be supported on deep foundations to reduce the potential for differential settlement between the two phases of construction.

Driven piling will, theoretically rely on friction to provide resistance since it will not be driven to refusal at bedrock. However, pier piles driven for the existing structure foundations appear to have been designed to terminate near the top of the hard glacial till layer suggesting that they are functioning primarily as end bearing piles. The most efficient foundation system will be obtained by driving the piles into the hard glacial till layer below elevation ~ 851 ft. The load bearing capacity of such piles was evaluated using the software solution DRIVEN v1.2, and the input/output are provided in Appendix B.

Based on the results, the estimated pile lengths have been established for the service design loads provided by the designers (Table 6). Ultimate bearing values equal to twice the service design load was used to establish the pile lengths.

Table 6: Estimated Pile Lengths-12-inch Diameter CIP Piles

Location	Service Design Load (kips)	Pile Cap Elevation (ft)	Top of Hard Till Elevation (ft)	Pile Tip Elevation (ft)	Estimate Length(1) (ft)
Rear Abutment L&R	70	882	849	847	35
Piers 1 & 3 L&R	90	867	849	845	25
Pier 2 L&R	70	867	849	847	20
Forward Abutment L&R	70	881	849	847	35

(1) Assumes 1 ft embedment in pile cap, rounded up to the next 5 ft increment.

5.4. Driveability

The driving resistance of CIP-piles through the hard glacial till is expected to be high and pile points are recommended to facilitate driving. Driveability is difficult to assess quantitatively as the SPT values tend to be very high. Experience in similar formations suggest that the piles may be driven with a Pileco 25/32 or Pileco 25/26 without over-stressing them or requiring unreasonably high numbers of blows. The contractor should provide an analysis to demonstrate that the equipment planned for use is capable of performing without over-stressing the piles.

5.5. Groundwater

Groundwater was encountered in the historical borings at elevations that are above the foundation level of the pier pile caps. Given the fine grained soil types, the amount of ground water flow is not expected to be large unless zones of porous soil (sand and / or gravel) are encountered. For the same reason storm water will pond readily and may be slow to drain. Contractor operations should include provision for dewatering excavations by pumping, and for protecting them from storm water inflow.

5.6. Seismic Design

ODOT has determined that the whole state lies within Seismic Zone 1. Based on the results of the subsurface exploration, the laboratory test data, and our review of the AASHTO Site Class Definition, we recommend a project site classification of C (very dense soil and rock with N>=50 or s_u >= 2ksf).

6. QUALIFICATIONS

This investigation was performed in accordance with accepted geotechnical engineering practice for the purpose of characterizing the subsurface conditions at the site of Bridge FRA-71-0308 (L&R), performing geotechnical engineering analyses, and providing recommendations for the design and construction of the foundations only. The analyses and recommendations submitted in this report are based upon data obtained from borings drilled at the locations shown on Exhibit 1 and as presented on the Logs of Borings (Appendix A). This report does not reflect any variations that may occur between the borings or elsewhere on the site, or variations whose nature and extent may not become evident until a later stage of construction. In the event that any changes in the nature, design or location of the proposed wall is made, the conclusions and recommendations contained in this report should not be considered valid until they are reviewed, and have been modified or verified in writing by a geotechnical engineer.

It has been a pleasure to be of service to Mead & Hunt, Inc. performing this geotechnical exploration for Bridge FRA-71-0308 for the FRA-71-0.00 project.

Respectfully Submitted,

NEAS, Inc.

3/27/17

Enoch Chipukaizer	Chunmei (Melinda) He, P.E.
Principal	Geotechnical Engineer

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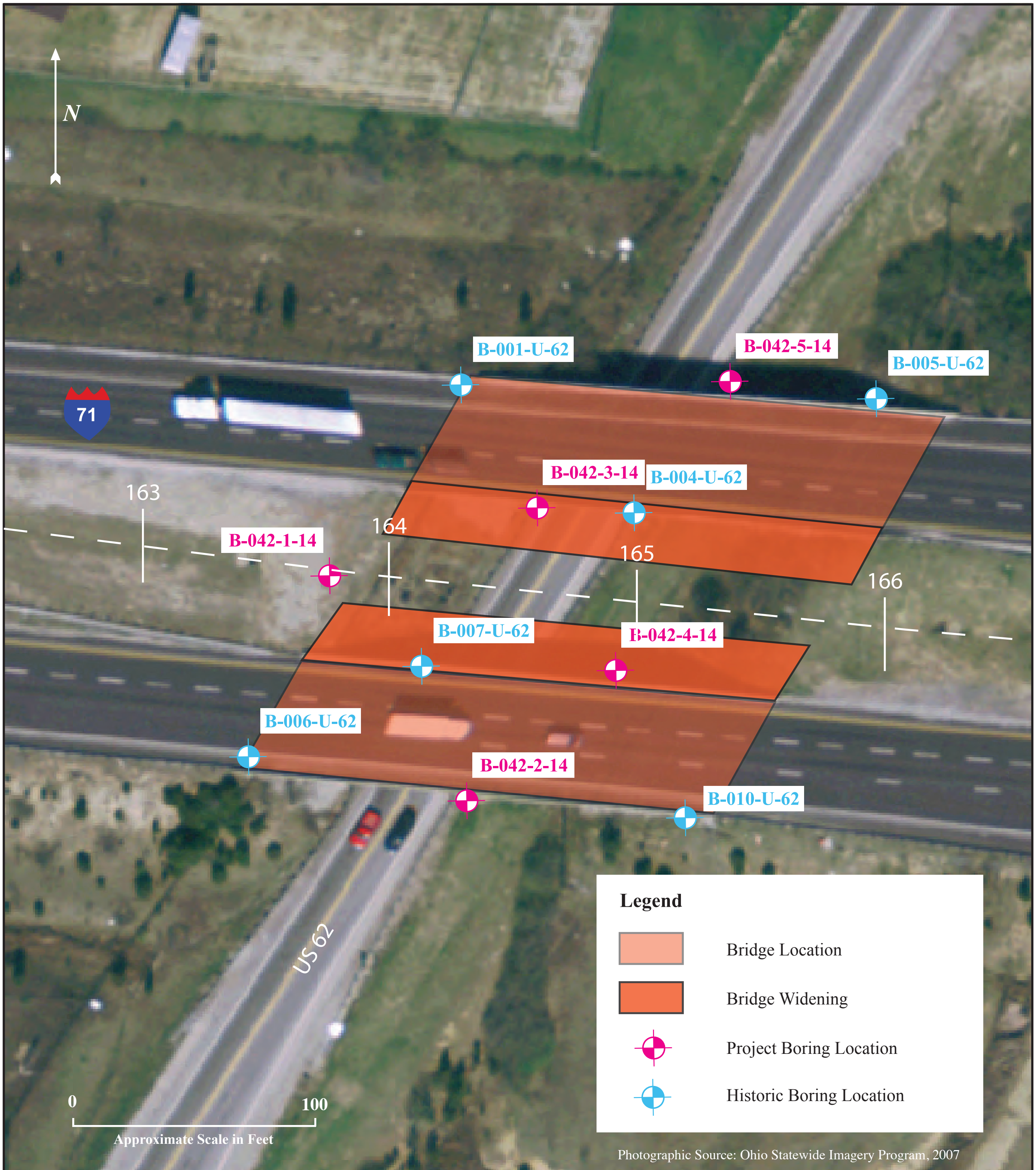


Area of Detail

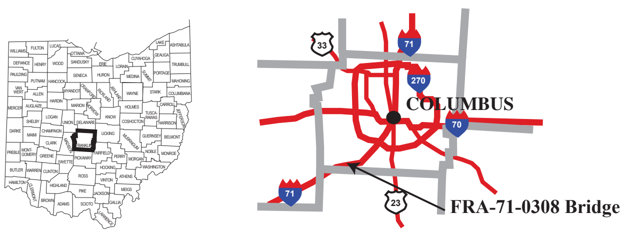


Exhibit 1

BARR ENGINEERING, INC.

Boring Locations
FRA-71-0308 L&R
Bridge over US 62

FRA-71-0.00 Improvements
PID#: 93496

APPENDIX A

LOGS OF BORINGS AND LABORATORY TESTING RESULTS

NEAS Inc.
National Engineering & Architectural Services Inc.

LEGEND

SYMBOL	DESCRIPTION	ODOT CLASSIFICATION
	Gravel and/or Stone Fragments	A-1-a
	Gravel and/or Stone Fragments with Sand	A-1-b
FS	Fine Sand	A-3
	Coarse and Fine Sand	A-3a
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4 A-2-5
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6 A-2-7
	Sandy Silt	A-4a
	Silt	A-4b
	Elastic Silt and Clay	A-5
	Silt and Clay	A-6a
	Silty Clay	A-6b
	Elastic Clay	A-7-5
	Clay	A-7-6
	Organic Silt	A-8a
	Organic Clay	A-8b

SYMBOL	DESCRIPTION	ODOT CLASSIFICATION
	Shale	Visual
	Weathered Shale	Visual
	Sandstone	Visual

GRADATION (%)

GR Gravel
CS Coarse Sand
MS Medium Sand
FS Fine Sand
SI Silt
CL Clay (<5 micron)

SAMPLER SYMBOLS

Shelby Tube

Rock Core

Split Spoon Sample (SS)

* Indicates a Sample Taken Within 3 ft of Proposed Grade

ABBREVIATIONS

LL	LIQUID LIMIT (%)	HP	HAND PENETROMETER
PI	PLASTIC INDEX (%0	PID	PHOTOIONIZATION DETECTOR
WC	MOISTURE CONTENT (%)	UC	UNCONFINED COMPRESSION
SPT	STANDARD PENETRATION TEST	ppm	PARTS PER MILLION
NP	NON PLASTIC	w	WATER FIRST ENCOUNTERED
-200	PERCENT PASSING NO. 200 SIEVE	▼	WATER LEVEL UPON COMPLETION
N_{60}	ADJUSTED SPT RESULT		
EOB	END OF BORING		

MATERIAL CLASSIFIED BY VISUAL INSPECTION

Sod and Topsoil
Pavement or Base
Concrete

Uncontrolled Fill (Describe)

Bouldery Zone

Peat, S-Sedimentary W-Woody F-Fibrous L-Loamy & etc

PROJECT: FRA-71-00.00	DRILLING FIRM / OPERATOR: CENTRAL STAR / MJ	DRILL RIG: CME 55 (CS)	STATION / OFFSET: 163+56, 1 RT	EXPLORATION ID B-042-1-14
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: B&P / Z. JEWELL	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. IR 71	
PID: 93496 BR ID: FRA-71-0308	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 6/12/12	ELEVATION: 894.0 (MSL) EOB: 25.0 ft.	PAGE 1 OF 1
START: 3/29/14 END: 3/29/14	SAMPLING METHOD: SPT	ENERGY RATIO (%): 74.9	LAT / LONG: 39.824847370, -83.141437220	

MATERIAL DESCRIPTION AND NOTES	ELEV. 894.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
12.0", **TOPSOIL**	893.0																	
HARD, GRAYISH BROWN, **SANDY SILT**, SOME CLAY, TRACE TO LITTLE GRAVEL, DAMP			6 10 14	30	61	SS-1	4.5+	8	13	17	35	27	23	15	8	14	A-4a (5)	
@3.5'; SS-2 BECOMES BROWN MOTTLED WITH GRAY			10 12 12	30	39	SS-2	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
@6.0'; SS-3 BECOMES GRAY			10 11 9	25	44	SS-3	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
@8.5'; SS-4 BECOMES GRAY MOTTLED WITH BROWN, CONTAINS ONE PIECE OF COARSE GRAVEL			14 20 12	40	67	SS-4	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	
@11.0'; SS-5 BECOMES BROWN MOTTLED WITH GRAY	881.0		11 12 17	36	61	SS-5	4.5+	19	10	14	35	22	22	14	8	8	A-4a (4)	
HARD, BROWN MOTTLED WITH GRAY AND ORANGISH BROWN, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, DAMP	878.5		10 12 14	32	44	SS-6	4.5+	6	9	12	35	38	34	18	16	15	A-6b (10)	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP	876.0		12 15 15	37	61	SS-7	4.5+	-	-	-	-	-	-	-	-	10	A-6a (V)	
VERY STIFF TO HARD, BROWN MOTTLED WITH GRAY, **CLAY**, "AND" SILT, LITTLE SAND, TRACE GRAVEL, DAMP	873.5		7 8 10	22	72	SS-8	3.25 - 4.5+	4	5	11	38	42	44	19	25	19	A-7-6 (15)	
HARD, BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP	871.0		7 9 12	26	100	SS-9	4.5+	7	10	13	37	33	28	16	12	14	A-6a (8)	
VERY STIFF, GRAY MOTTLED WITH BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP TO MOIST	869.0	EOB 25	5 7 9	20	100	SS-10	3.0 - 3.5	-	-	-	-	-	-	-	-	21	A-6b (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 10.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: FRA-71-00.00	DRILLING FIRM / OPERATOR: CENTRAL STAR / MJ	DRILL RIG: CME 55 (CS)	STATION / OFFSET: 164+14, 96 RT	EXPLORATION ID B-042-2-14
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: B&P / Z. JEWELL	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. IR 71	
PID: 93496 BR ID: FRA-71-0308	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 6/12/12	ELEVATION: 874.0 (MSL) EOB: 30.0 ft.	PAGE 1 OF 1
START: 3/29/14 END: 3/29/14	SAMPLING METHOD: SPT	ENERGY RATIO (%): 74.9	LAT / LONG: 39.824572890, -83.141259020	

MATERIAL DESCRIPTION AND NOTES	ELEV. 874.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
12.0", **TOPSOIL**	873.0																	
HARD, BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, SOME SAND, LITTLE TO SOME GRAVEL, DAMP		1 - 2.5	7 7 7	17	100	SS-1	4.5+	23	12	12	28	25	28	16	12	10	A-6a (4)	
		3.5 - 5	4 7 9	20	94	SS-2	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	
@6.0'; SS-3 BECOMES STIFF TO VERY STIFF	866.0	6 - 7.5	4 7 7	17	100	SS-3	1.1 - 2.1	13	7	12	36	32	31	17	14	17	A-6a (8)	
VERY STIFF, GRAYISH BROWN, **SANDY SILT**, LITTLE TO SOME CLAY, TRACE TO LITTLE GRAVEL, DAMP		8.5 - 10	4 6 13	24	100	SS-4	2.25	10	18	21	32	19	18	13	5	12	A-4a (3)	
@11.0'; SS-5 BECOMES DENSE		11 - 12.5	10 12 20	40	100	SS-5	-	16	17	22	33	12	NP	NP	NP	11	A-4a (2)	
@13.5'; SS-6 TO SS-7 SOFT TO STIFF		13.5 - 15	4 5 5	12	100	SS-6	1.25 - 2.5	12	12	15	38	23	21	15	6	12	A-4a (5)	
		16 - 17.5	5 8 11	24	100	SS-7	.5 - 1.5	-	-	-	-	-	-	-	-	13	A-4a (V)	
@18.5'; SS-8 BECOMES HARD		18.5 - 20	12 20 21	51	50	SS-8	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	
@21.0'; SS-9 BECOMES GRAY		21 - 22.5	8 13 12	31	61	SS-9	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
		23.5 - 25	12 15 20	44	50	SS-10	4.5+	18	10	13	32	27	24	15	9	10	A-4a (5)	
	844.0	28.5 - 30 EOB	14 15 15	37	67	SS-11	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

PROJECT: FRA-71-00.00	DRILLING FIRM / OPERATOR: STOCK / AUSTIN	DRILL RIG: CME 750X (STOCK)	STATION / OFFSET: 164+37, 23 LT	EXPLORATION ID B-042-3-14
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: B&P / Z. JEWELL	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. IR 71	
PID: 93496 BR ID: FRA-71-0308	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 3/1/13	ELEVATION: 874.0 (MSL) EOB: 31.5 ft.	
START: 4/11/14 END: 4/11/14	SAMPLING METHOD: SPT	ENERGY RATIO (%): 78.6	LAT / LONG: 39.824890620, -83.141140180	

MATERIAL DESCRIPTION AND NOTES	ELEV. 874.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
12.0", **ASPHALT**	873.0																	
6.0", **GRANULAR BASE**	872.5	1																
STIFF TO VERY STIFF, GRAY, **CLAY**, "AND" SILT, TRACE SAND, TRACE GRAVEL, MOIST		2																
	869.5	3, 4	2-2-3	7	83	SS-1	1.5 - 2.25	1	3	7	38	51	45	19	26	25	A-7-6 (15)	
STIFF TO VERY STIFF, BROWN MOTTLED WITH GRAY AND ORANGISH BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		5, 6, 7	4-3-4	9	56	SS-2	2.0 - 2.25	-	-	-	-	-	-	-	-	26	A-6b (V)	
	864.5	8, 9	4-4-4	10	67	SS-3	2.0 - 2.25	-	-	-	-	-	-	-	-	18	A-6b (V)	
VERY SOFT TO SOFT, GRAYISH BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP TO MOIST		10, 11, 12	2-3-4	9	100	SS-4	.5 - .75	13	14	18	34	21	21	14	7	15	A-4a (4)	
		13, 14	1-2-4	8	44	SS-5	.25 - .5	-	-	-	-	-	-	-	-	14	A-4a (V)	
@15.0'; SS-6 STIFF		15, 16, 17	2-3-3	8	100	SS-6	1.0 - 1.25	-	-	-	-	-	-	-	-	12	A-4a (V)	
@17.5'; BECOME HARD		18, 19	5-6-8	18	100	SS-7	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		20, 21, 22	7-9-7	21	94	SS-8	4.5+	14	10	15	34	27	22	14	8	10	A-4a (5)	
		23, 24	4-5-5	13	72	SS-9	4.5+	-	-	-	-	-	-	-	-	12	A-4a (V)	
		25, 26, 27	5-6-11	22	78	SS-10	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
@27.5'; SS-11 NO RECOVERY		28, 29	14-24-16	52	0	SS-11	-	-	-	-	-	-	-	-	-	-		

PID: 93496	BR ID: FRA-71-0308	PROJECT: FRA-71-00.00	STATION / OFFSET: 164+37, 23 LT	START: 4/11/14	END: 4/11/14	PG 2 OF 2	B-042-3-14

MATERIAL DESCRIPTION AND NOTES	ELEV. 844.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY SOFT TO SOFT, GRAYISH BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP TO MOIST *(continued)*	842.5	EOB 31	13 15 16	41	-	SS-12	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/15/17 12:22 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE\ARCHIVE BY YEAR\2015 ARCHIVE\FRA-71-0.00 2014-15\COMBINE

PROJECT: FRA-71-00.00	DRILLING FIRM / OPERATOR: STOCK / AUSTIN	DRILL RIG: CME 750X (STOCK)	STATION / OFFSET: 164+89, 23 RT
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: B&P / Z. JEWELL	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. IR 71
PID: 93496 BR ID: FRA-71-0308	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 3/1/13	ELEVATION: 873.0 (MSL) EOB: 31.5 ft.
START: 4/10/14 END: 4/10/14	SAMPLING METHOD: SPT	ENERGY RATIO (%): 78.6	LAT / LONG: 39.824751990, -83.140971610

EXPLORATION ID B-042-4-14

MATERIAL DESCRIPTION AND NOTES	ELEV. 873.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		1	1 1 3	5	72	SS-1	1.75 - 2.0	7	7	12	34	40	36	17	19	21	A-6b (11)	
		2																
@2.5'; SS-2 BECOMES BROWN MOTTLED WITH DARK GRAY, CONTAINS ROOTS		3	2 2 2	5	44	SS-2	1.0 - 2.75	-	-	-	-	-	-	-	-	17	A-6b (V)	
	868.5	4																
STIFF, BROWN MOTTLED WITH GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		5 - 6	3 5 3	10	50	SS-3	1.0 - 2.0	10	8	11	37	34	33	18	15	21	A-6a (9)	
		7																
@7.5'; SS-4 BECOMES VERY STIFF, BROWN		8	3 3 5	10	100	SS-4	2.5 - 2.75	-	-	-	-	-	-	-	-	19	A-6a (V)	
	863.5	9																
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE TO LITTLE GRAVEL, DAMP		10 - 11	3 9 6	20	44	SS-5	1.0 - 3.75	17	10	16	36	21	21	14	7	12	A-4a (4)	
		12																
		13	3 3 4	9	67	SS-6	1.25 - 3.25	-	-	-	-	-	-	-	-	12	A-4a (V)	
		14																
		15 - 16	1 3 4	9	61	SS-7	1.0 - 1.75	-	-	-	-	-	-	-	-	12	A-4a (V)	
		17																
@17.5'; SS-8 TO SS-12 BECOMES VERY STIFF TO HARD		18	10 11 14	33	72	SS-8	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		19																
		20 - 21	8 10 9	25	78	SS-9	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
		22																
		23	4 15 17	42	44	SS-10	2.5 - 2.75	7	6	10	47	30	26	18	8	17	A-4a (8)	
		24																
		25 - 26	7 11 16	35	94	SS-11	4.5+	12	12	19	33	24	23	14	9	10	A-4a (4)	
		27																
		28																
		29																

PID: 93496	BR ID: FRA-71-0308	PROJECT: FRA-71-00.00	STATION / OFFSET: 164+89, 23 RT	START: 4/10/14	END: 4/10/14	PG 2 OF 2	B-042-4-14

MATERIAL DESCRIPTION AND NOTES	ELEV. 843.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
STIFF TO VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE TO LITTLE GRAVEL, DAMP *(continued)* @30.0'; SS-12 BECOMES GRAY	841.5	31 EOB	15 22 37	77	83	SS-12	4.5+	6	8	17	42	27	22	14	8	8	A-4a (7)	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. CAVE DEPTH 29.5'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 2/15/17 12:22 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\1ARCHIVE\ARCHIVE BY YEAR\2015 ARCHIVE\FRA-71-0.00 2014-15\COMBINE

PROJECT: FRA-71-00.00	DRILLING FIRM / OPERATOR: CENTRAL STAR / MJ	DRILL RIG: CME 55 (CS)	STATION / OFFSET: 165+14, 96 LT	EXPLORATION ID B-042-5-14
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: B&P / Z. JEWELL	HAMMER: CME AUTOMATIC	ALIGNMENT: CL CONST. IR 71	
PID: 93496 BR ID: FRA-71-0308	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 6/12/12	ELEVATION: 875.0 (MSL) EOB: 34.3 ft.	PAGE 1 OF 2
START: 3/29/14 END: 3/29/14	SAMPLING METHOD: SPT	ENERGY RATIO (%): 74.9	LAT / LONG: 39.825072650, -83.140844960	

MATERIAL DESCRIPTION AND NOTES	ELEV. 875.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
12.0", **TOPSOIL**	874.0																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME GRAVEL, LITTLE SAND, DAMP	872.0		5 7 7	17	50	SS-1	2.5 - 3.5	27	8	11	29	25	28	17	11	12	A-6a (4)	
VERY STIFF, BROWN MOTTLED WITH GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, SS-2 CONTAINS IRON STAINING, MOIST			5 7 11	22	100	SS-2	2.75 - 3.0	8	7	10	34	41	36	16	20	18	A-6b (12)	
	867.0		4 7 9	20	72	SS-3	2.0 - 3.0	-	-	-	-	-	-	-	-	16	A-6b (V)	
STIFF, BROWN MOTTLED WITH GRAY, **SANDY SILT**, LITTLE TO SOME CLAY, TRACE TO LITTLE GRAVEL, DAMP TO MOIST			6 6 7	16	89	SS-4	1.75 - 2.0	12	12	16	36	24	21	15	6	13	A-4a (5)	
@11.0'; SS-5 BECOMES BROWN			3 6 10	20	100	SS-5	1.0 - 2.0	-	-	-	-	-	-	-	-	13	A-4a (V)	
@13.5'; SS-6 BECOMES GRAYISH BROWN		W	5 6 8	17	28	SS-6	1.0 - 1.5	-	-	-	-	-	-	-	-	15	A-4a (V)	
@16.0'; SS-7 BECOMES HARD			9 9 12	26	89	SS-7	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	
@18.5'; SS-8 ONE PIECE COARSE GRAVEL	854.5		24 31 20	64	11	SS-8	-	-	-	-	-	-	-	-	-	-		
HARD, GRAYISH BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP			14 16 17	41	17	SS-9	-	-	-	-	-	-	-	-	-	12	A-6a (V)	
	849.5		10 15 25	50	56	SS-10	4.5+	6	9	15	39	31	27	15	12	12	A-6a (8)	
VERY DENSE, GRAYISH BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP			20 40 41	101	100	SS-11	-	-	-	-	-	-	-	-	-	11	A-4a (V)	
@28.5'; SS-12 BECOMES HARD			28 33 47	100	100	SS-12	4.5+	11	9	19	37	24	23	14	9	8	A-4a (5)	

PID: 93496	BR ID: FRA-71-0308	PROJECT: FRA-71-00.00	STATION / OFFSET: 165+14, 96 LT	START: 3/29/14	END: 3/29/14	PG 2 OF 2	B-042-5-14

MATERIAL DESCRIPTION AND NOTES	ELEV. 845.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY DENSE, GRAYISH BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP *(continued)*		31																
		32																
		33																
	840.7	EOB 34	30 50/3"	-	100	SS-13	4.5+	-	-	-	-	-	-	-	-	7	A-4a (V)	

NOTES: GROUNDWATER ENCOUNTERED AT 13.5' DURING DRILLING. CAVE DEPTH 8.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

APPENDIX B

CALCULATIONS

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: Z:\Users\stu\FRA70u62_abut_tot.dvn
Project Name: FRA-71-0296 US62 Project Date: 05/25/2014
Project Client: ODOT MH
Computed By: se
Project Manager: jep

PILE INFORMATION

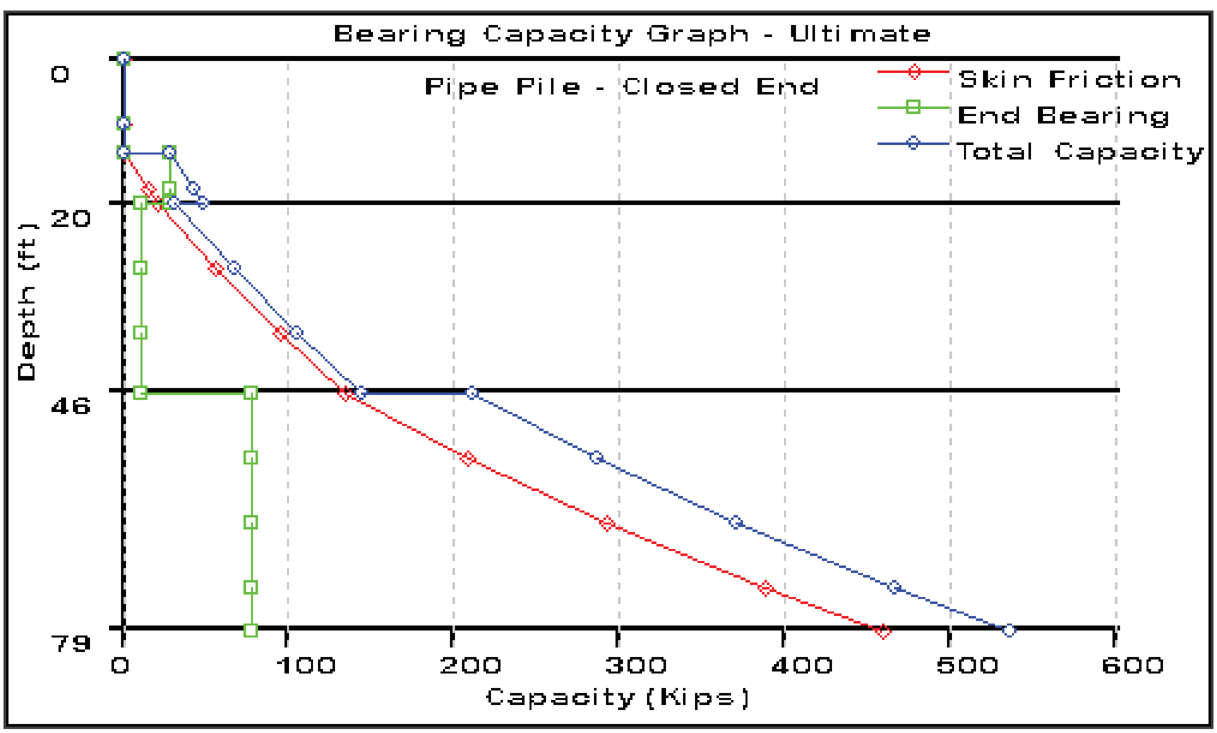
Pile Type: Pipe Pile - Closed End
Top of Pile: 13.00 ft
Diameter of Pile: 12.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	29.00 ft
	- Driving/Restrike	29.00 ft
	- Ultimate:	29.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	20.00 ft	0.00%	130.00 pcf	4000.00 psf	T-80 Same
2	Cohesive	26.00 ft	0.00%	125.00 pcf	1500.00 psf	T-80 Same
3	Cohesive	33.00 ft	0.00%	130.00 pcf	11000.00 psf	T-80 Same



ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
9.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
12.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
13.00 ft	0.00 Kips	28.27 Kips	28.27 Kips
18.01 ft	14.98 Kips	28.27 Kips	43.26 Kips
19.99 ft	20.91 Kips	28.27 Kips	49.18 Kips
20.01 ft	20.97 Kips	10.60 Kips	31.58 Kips
29.01 ft	56.12 Kips	10.60 Kips	66.72 Kips
38.01 ft	95.15 Kips	10.60 Kips	105.75 Kips
45.99 ft	133.61 Kips	10.60 Kips	144.21 Kips
46.01 ft	133.74 Kips	77.75 Kips	211.50 Kips
55.01 ft	207.76 Kips	77.75 Kips	285.52 Kips
64.01 ft	291.92 Kips	77.75 Kips	369.68 Kips
73.01 ft	388.09 Kips	77.75 Kips	465.85 Kips
78.99 ft	458.29 Kips	77.75 Kips	536.04 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: Z:\Users\stu\FRA70u62_pier_tot.dvn
Project Name: FRA-71-0296 US62 Project Date: 05/25/2014
Project Client: ODOT MH
Computed By: se
Project Manager: jep

PILE INFORMATION

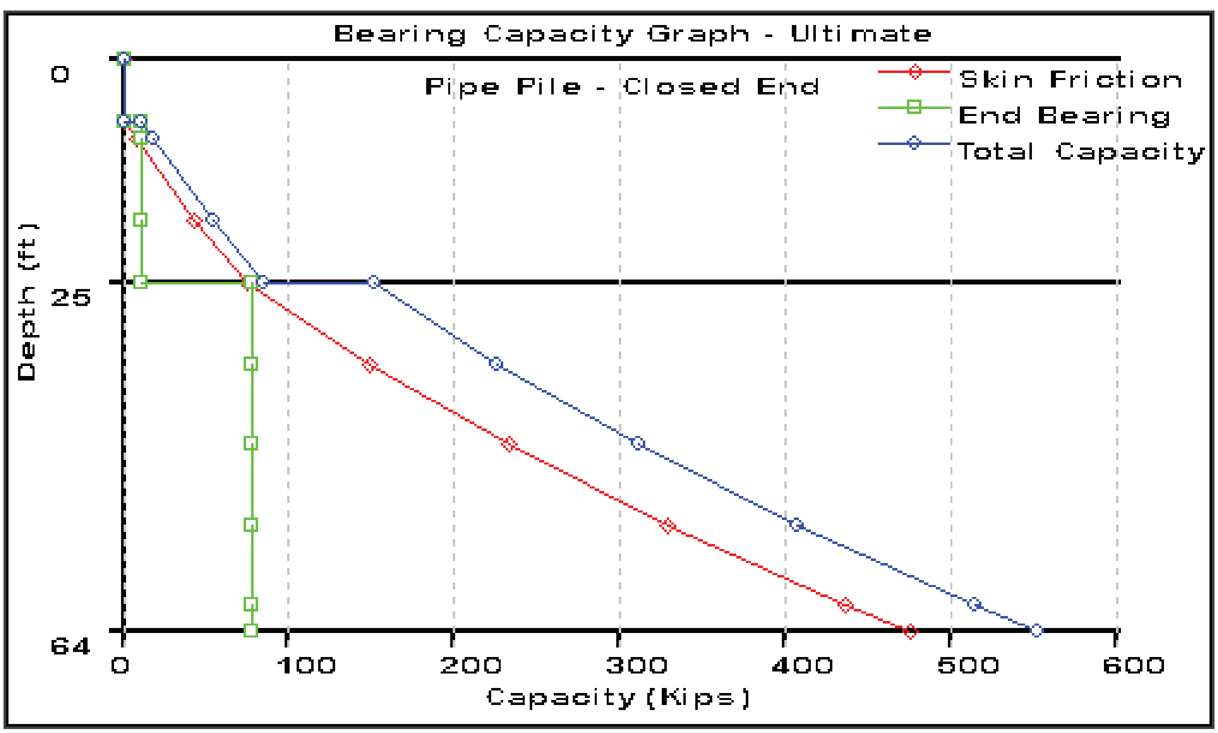
Pile Type: Pipe Pile - Closed End
Top of Pile: 7.00 ft
Diameter of Pile: 12.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	9.00 ft
	- Driving/Restrike	9.00 ft
	- Ultimate:	9.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	25.00 ft	0.00%	130.00 pcf	1500.00 psf	T-80 Same
2	Cohesive	39.00 ft	0.00%	130.00 pcf	11000.00 psf	T-80 Same



ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
6.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
7.00 ft	0.00 Kips	10.60 Kips	10.60 Kips
9.01 ft	7.85 Kips	10.60 Kips	18.45 Kips
18.01 ft	43.29 Kips	10.60 Kips	53.90 Kips
24.99 ft	74.12 Kips	10.60 Kips	84.72 Kips
25.01 ft	74.25 Kips	77.75 Kips	152.00 Kips
34.01 ft	148.27 Kips	77.75 Kips	226.02 Kips
43.01 ft	232.43 Kips	77.75 Kips	310.18 Kips
52.01 ft	328.60 Kips	77.75 Kips	406.35 Kips
61.01 ft	436.15 Kips	77.75 Kips	513.90 Kips
63.99 ft	474.27 Kips	77.75 Kips	552.02 Kips