STRUCTURE GEOTECHNICAL REPORT

BRIDGE REPLACEMENT
IL Route 141 over Tributary to Cane Creek

FAP Route 877 (IL 141)
Section 101B-2
White County, Illinois
Job No. D-99-017-10
Contract No. 78162
PTB 148/33 Work Order #6
Existing Structure No. 097-0036
Proposed Structure No. 097-0077

Prepared by:

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November 2010

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1.0 PROJECT DESCRIPTION AND PROPOSED STRUCTURE INFORMATION

1.1 Introduction

The geotechnical study summarized in this report was performed for the proposed bridge on IL 141 over a Tributary to Cane Creek in White County, Illinois. The purpose of this report is to present geotechnical design and construction recommendations for the proposed structure.

1.2 Project Description

The project entails complete replacement of the existing bridge (S.N. 097-0036) located at IL Route 141 over a Tributary to Cane Creek in White County, Illinois. The project is located about 6600 ft. due north of Omaha, Illinois. The general location of the bridge is shown on a USGS Topographic Location Map, Exhibit A. The site lies within the limits of the Third Principal Meridian, (T. 7S, R. 8E, Section 15) in the Mt. Vernon Hill Country Physiographic region.

1.3 Proposed Bridge Information

The proposed single span structure (S.N. 097-0077) will be built on a 90 degree skew at centerline Sta. 7+32.00. The overall length of the structure will be 83 ft. as measured from back to back abutments, with a total deck width of 35 ft.-2 in. The proposed substructure will consist of integral abutments supported by driven pile. See attached Type, Size and Location Plan (TS&L) with Boring Locations, Exhibit B, as provided by HLR. The project will be completed using staged construction to maintain one lane of traffic at all times.

2.0 EXISTING BRIDGE INFORMATION

The original structure (SN 097-0036) was constructed in 1933 as SBI Route 141 Section 101BR-1. In 1974, the bridge was reconstructed with a new precast, pre-stressed concrete deck beam superstructure on a widened substructure cap. The existing structure is supported on reinforced concrete closed abutments on untreated timber pile supported footings. The existing structure is built at Sta. 7+32 on an 11 degree skew and measures 43 ft.-5/8 in. from back to back abutments with a total deck width of 33 ft. out to out superstructure.

The approved Bridge Condition Report, dated August 11, 2009, recommends complete replacement of the existing structure.

3.0 SITE INVESTIGATION, SUBSURFACE EXPLORATION AND GENERALIZED SUBSURFACE CONDITIONS

The site investigation plan was determined and conducted by the Illinois Department of Transportation (IDOT). A site visit by a representative of Kaskaskia Engineering Group, LLC (KEG) to observe all or part of the borings, or to make site observations, was not included in the scope of services. Therefore, no on-site observations have been made relative to existing conditions of the structure, stream, or roadway or of subsurface sample conditions by KEG personnel.

Two standard penetration test (SPT) borings, designated 1-S and 2-S, were drilled near the proposed east and west abutments on October 28 and 29, 2009. Boring 1-S was located near the east abutment at Sta. 7+77, 7 ft. right of the centerline. Boring 2-S was located near the west abutment at Sta. 6+87, 7 ft. left of the centerline. Both borings commenced at El. 376.2 and were extended to shale. Detailed information regarding the nature and thickness of the soils and rock encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs, Exhibit C. The boring locations are shown on the Provided Type, Size and Location Plan (TS&L) with Boring Locations, Exhibit B.

Generally the top 2 ft. of the profile consisted of asphalt pavement, overlying concrete pavement, with a crushed rock subbase. Below the subbase, the general lithology encountered is summarized below in sequential order:

a) Soft to stiff silty clay loam to clay loam
b) Silty clay to clay
c) Clay shale

The following is a general description of each layer and the characteristics of the soils encountered:

a) Soft to stiff silty clay loam to clay loam – These soils ranged from El. 374.7 to El. 346.7 with blow counts ranging from weight of hammer to N-values of 8. Moisture contents ranged from 19 to 30 percent, and average unconfined compressive strengths were 750 pounds per square foot (psf).
b) Silty clay to clay – These soils ranged from El. 359.2 to El. 284.2 with N-values ranging from 0 to 19 bpf. Moisture contents ranged from 20 to 36 percent, and average unconfined compressive strengths were 1600 psf.
c) Clay Shale – This hard, dry, gray shale commenced between El. 287.2 and El. 284.2 with N-values exceeding 50 blows per inch.

The only discrepancy to this general lithology was found in Boring 2-S from El. 346.7 to

El. 344.2 where a layer of loose, wet, grey, sand was encountered with a weight of hammer blow count and moisture content of 27 percent.

Table 3.1 shows the top of shale elevations for Borings 1-S and 2-S.

Table 3.1 - Shale Elevation

Boring	Shale Elevation
1-S	284.2
2-S	267.2

Groundwater elevations, encountered during drilling, ranged from approximate El. 353 to El. 360. At Boring 1-S, groundwater was measured at completion at El. 357.7. The surface water elevation was recorded as 360.5 on the boring logs.

It should be noted that the groundwater level is subject to seasonal and climatic variations and other factors and may be present at different depths in the future. In addition, without extended periods of observation, measurement of the true groundwater levels may not be possible.

4.0 GEOTECHNICAL EVALUATIONS

4.1 Settlement

Settlement should not be a concern at this structure. Ultimately, the additional pressure of the fill to be placed on the end-slopes will be less than what is currently applied by the existing reinforced concrete closed abutments that rest on untreated timber pile supported footings.

4.2 Slope Stability

The proposed construction does not result in significant changes in roadway embankment sideslopes, but does result in new 2:1 endslopes at the abutments. No problems with the sideslopes are reflected in the documentation of existing conditions. Currently, the abutments are closed concrete abutments. When these abutments are replaced by open abutments supported by deep pile foundations, the existing vertical concrete wall face will be replaced with 2:1 (H:V) endslopes.

Slope stability was checked for the proposed endslopes using STABL for Windows 3.0, the soil properties at the site, and the geometrics of the embankments. Three conditions were modeled: end-of-construction, long-term stability, and a design seismic event. A critical factor of safety (FOS) was determined for each condition. According to current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability and 1.0 for a design seismic event.

In order to model the end of construction condition, full cohesion was used with no friction angle assumed. Nominal values for cohesion were used to model the long term and seismic conditions to analyze the theoretical condition where pore water pressure has dissipated. Friction angles ranged from 12 to 28 degrees.
The Bishop Circular Method, which generates circular-shaped failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis are shown in Table 4.1 for the more critical of the two proposed endslopes. STABL program output from this analysis can be found in Slope Stability Analysis, Exhibit D.

Table 4.1 – Slope Stability Critical FOS

	Calculated Critical FOS		
	End of Construction	**Long Term**	**Seismic**
East Abutment Endslope (critical slope)	5.2	2.0	1.0

4.3 Seismic Considerations

The determination of the Seismic Site Class was based on the method described by IDOT AGMU Memo 09.1 - Seismic Site Class Definition and the IDOT-provided spreadsheet titled Seismic Site Class Determination. Using these resources, the controlling global site class for this project is Site Class D.

Additional seismic parameters were determined for use in design of the structure and evaluation of liquefaction potential. The USGS published information and mapping (http://earthquake.usgs.gov/), including software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to determine the parameters for the project site location. The values, based on a 1000 Year Return Period with a Probability of Exceedance (PE) of 7% in 75 years and the Site Class previously determined, are summarized below.

Table 4.2 – Summary of Seismic Parameters

Parameter	Value
Soil Site Class	D
Spectral Acceleration Coefficient at Period of 0.2 Sec, Ss	0.545g (Site Class B)
Spectral Acceleration Coefficient at Period of 1.0 Sec, S1	0.141g (Site Class B)
Site Factor, Zero Period, Fpga	1.23g (Site Class D)
Site Factor, Short Period, Fa	1.36g (Site Class D)

Site Factor, Long Period, Fv	2.24g (Site Class D)
Spectral Response Acceleration, 0.2 Sec, S_{DS}	0.741g(Site Class D)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.315 g (Site Class D)
Seismic Performance Zone	3

As indicated in the table above, the Seismic Performance Zone is 3, based on S_{D1} and Table 3.15.2-1 in the IDOT Bridge Manual, as well as the Soil Site Class D and Figure 2.3.10-3 in the IDOT Bridge Manual.

4.4 Scour

The existing bridge shows evidence of channel degradation and local abutment scour. The poor alignment of the bridge and channel has created a scour hole and exposed the top of the abutment footing at the upstream, northeast corner of the bridge.

The proposed structure will increase the waterway opening for the 100 year event compared to the existing condition. The predicted channel contraction scour is 0 ft., reduced due to the larger waterway opening. The skew of the proposed bridge has been changed to provide better alignment.

Scour countermeasures proposed include protecting the abutment slopes with stone riprap and driving piles to accommodate the predicted scour. As shown on the Provided Type, Size and Location Plan (TS&L) with Boring Locations, Exhibit B, the integral abutments proposed for the bridge are positioned behind a 2:1 (H:V) embankment and lined with Class A4 stone riprap. This is considered an armored embankment and is considered to be an adequate level of scour protection according to the Bridge Manual. The bridge condition report states that the proposed structure is expected to be stable for scour with countermeasures in place.

Table 4.3 shows the design scour elevations. No reduction in the scour elevations was applied. The near surface soil profile anticipated silty clay to clay material, which would not be considered more scour prone than the default properties assumed in the hydraulic analysis.

Table 4.3 - Design Scour Elevations

	West Abutment	**East Abutment**
Design Scour Elevation (ft.)	370.3	369.7

4.5 Mining Activity

According to the Illinois State Geological Survey (ISGS) website, coal mining has occurred in White County. According to the County Coal Map Series, White County dated August 17, 2009, which was obtained from the Illinois State Geological Survey (ISGS) website (http://www.isgs.illinois.edu/maps-data-pub/coal-maps.shtml), the project site was not undermined.

The listed disclaimer indicates locations of some features on the mine map may be offset by 500 or more feet due to errors in the original source maps, the compilation process, digitizing, or a combination of these factors. The location of this bridge is approximately 3 miles away from the closest mining area shown on the map.

4.6 Lateral Pile/Pier Response

Generally, the geotechnical engineer provides soil parameters to the structural engineer so that an L-Pile program or other approved program can be used for the lateral or displacement analysis of the foundations. Therefore, Table 4.4 has been included showing the soil parameters needed to perform a displacement or lateral pile analysis, if deemed necessary by the structural engineer.

Table 4.4 – Soil Parameters for Lateral Pile Load Analysis

	Elev. at Bottom of Layer	γ (pcf)	Φ (degrees)	*k* or k_{rm} (pci)	N	% fines < #200	c (psf)	ε50
Boring 1-S East Abut	359.2	120	28	100	3	80	750	0.010
	284.2	115	23	200	7	70	1600	0.006
	271.2	135	12	.0005	100	10	0	N/A
Boring 2-S West Abut	359.2	120	28	100	4	80	600	0.010
	346.7	126	23	100	3	80	700	0.010
	344.2	115	30	20	0	60	0	N/A
	287.2	126	26	300	13	85	1800	0.006
	286.2	135	12	.0005	100	10	0	N/A

4.7 Liquefaction

A liquefaction analysis was performed using the liquefaction worksheet provided by IDOT BBS Central Geotechnical Unit (Mod. 5/24/2010). The Peak Horizontal Ground Surface Acceleration value in the spreadsheet was set equivalent to the PGA (.162 for NMSZ and .216 for CEUS), as determined based on deaggregation information from the

USGS website and the liquefaction worksheet. The PGA was calculated for both GMPE models. The Design Earthquake Mean Magnitudes (7.7 for NMSZ and 5.4 for CEUS) were determined using the USGS data and deaggregation methods provided at http://earthquake.usgs.gov/. The soil profiles for Borings 1-S and 2-S were analyzed.

The results for the soil profile encountered in both borings indicated no concerns for liquefaction. However, Atterburg limit testing results were not available on the boring logs provided by the Department. Plasticity index and liquid limit are now required input fields in the liquefaction spreadsheet. See the liquefaction analysis spreadsheets, included in Liquefaction Analysis, Exhibit E. The liquefaction analysis performed by the Department is also included in Liquefaction Analysis, Exhibit E. The Department found that Boring 2-S indicated the presence of liquefiable soils. The tool used to calculate liquefaction potential at that time was also a spreadsheet created by the BBS Foundations Unit modified August 25, 2001. If the Department's analyses are used, the liquefiable layer was found at El. 346. The potentially liquefiable layer shown is confined by competent non-liquefiable layers.

Minimal vertical ground settlement should be expected to occur following liquefaction. This condition results in an added negative skin friction downdrag load. The liquefaction and downdrag losses are not to be assumed at the strength limit state group loading. At the time of writing this SGR, the information for the Extreme Event I loading (the loading that would occur during a seismic event) was not available. However, it is not expected that the seismic case will control the design for this structure. Liquefaction was not considered as a reduction for the pile design capacity or other foundation considerations included herein. Liquefaction analysis results can be found in Liquefaction Analysis, Exhibit E.

5.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

5.1 General Feasibility

The TS&L indicates use of integral abutments. For an 83 ft. structure with integral abutments, H-piles, 12 in. metal shell piles, and 14 in. metal shell piles are permitted for foundation support. These pile types were analyzed using the Modified IDOT Static Method of Estimating Pile Length spreadsheet (Rev. May 3, 2010) provided by IDOT BBS Foundations and Geotechnical Unit.

The pile design analysis revealed that metal shell piles would develop significant frictional resistance and end bearing before reaching the shale. H-piles would also be feasible for design as well and would reach maximum required bearing in the shale.

5.2 Pile Supported Foundations

The foundations supporting the proposed bridge must provide sufficient support to resist dead and live loads, including seismic loadings. Based on the encountered subsurface conditions, the Modified IDOT Static Method of Estimating Pile Length (Rev. May 3, 2010) provided by IDOT BBS Foundations and Geotechnical Unit, and the information available to date, we recommend using metal shell pile. H-piles are also a feasible foundation type for this structure. The Modified IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths. Table 5.1 shows the calculated pile lengths and corresponding pile tip elevations, based on the pile top elevations as provided by HLR, at the abutments. The full pile design analysis is included in Modified IDOT Pile Length Tables, Exhibit F.

The factored design load, as provided by HLR, is 1020 kips at the abutments. HLR requested, in addition to the typically required pile design data that is included in Table 5.1, KEG provide pile types and lengths for 85%, 100%, 115%, and 130% of the factored loads. This additional information can be found in Estimated Pile Types and Lengths for Modified Factored Load Conditions, Exhibit G.

The Estimated Pile Lengths for the pile types being considered are shown in Table 5.1, LRFD Pile Design. The Nominal Required Bearing (R_N) represents the resistance the pile will experience during driving as well as to assist the contractor in selecting a proper hammer size. The Factored Resistance Available (R_F) documents the net long term axial factored pile capacity available at the top of pile to support factored structure loadings.

At the abutments, the pile cutoff elevation was estimated at El. 371.8 for the east abutment and 371.9 at the west abutment, based on the TS&L provided by HLR. These pile cutoff elevations were used to determine the estimated pile lengths as shown in Table 5.1.

Settlement of the existing soils at the locations of the proposed west and east abutment backslopes are not anticipated. As discussed in Section 4.7, downdrag forces due to liquefaction should be analyzed further when the Extreme Event I loadings are known. Downdrag due to liquefaction values were not applied to the strength limit state loadings to obtain the R_F. Scour elevations were applied during the pile design analysis to account for scour at the abutments, although the scour elevations are not below the pile caps since an armored embankment is being proposed.

The R_F was determined by multiplying the Maximum Nominal Required Bearing ($R_{N\ MAX}$) of the pile type being considered by the Geotechnical Resistance Factor (Φ_G) of 0.55. The estimated pile lengths and pile tip elevations for applicable metal shell sections and H-Piles that will develop end bearing in the shale are shown in Table 5.1.

Table 5.1— LRFD Pile Design

	Pile Designation	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Total Factored Load (kips)	Estimated Pile Length (ft)	Pile Tip El.
East Abutment (Boring 1-S)	Metal Shell 12” w .179” walls	251	138	1020	62	310
	Metal Shell 14” w .25” walls	388	213	1020	77	295
	HP 10X57	454	250	1020	87	285
	HP 12X74	589	324	1020	87	285
	HP 12X84	664	365	1020	87	285
	HP 14X89	705	388	1020	87	285
West Abutment (Boring 2-S)	Metal Shell 12” w .179” walls	221	122	1020	57	315
	Metal Shell 14” w .25” walls	363	200	1020	77	295
	HP 10X57	454	250	1020	85	287
	HP 12X74	589	324	1020	85	287
	HP 12X84	664	365	1020	85	287
	HP 14X89	705	388	1020	85	287

Although all of the above pile types are considerable options for foundation support, the structural engineer is responsible to determine what pile best suits the design. Some of the pile options may not be suitable alternatives due to spacing requirements or constructability concerns. It is recommended that if an H-pile is recommended for construction and the elevation noted above is within driving distance to shale, piles be driven 2 to 6 ft. into the shale.

One test pile is recommended at the west abutment. A test pile is performed prior to production driving so that actual, on-site, field data can be gathered to determine pile driving requirements for the project. This is the manner in which the contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Construction Activities

The construction activities should be performed in accordance with the current *IDOT Standard Specifications for Road and Bridge Construction* and any pertinent Special *Provisions or policies.*

6.2 Temporary Sheeting and Soil Retention

Temporary shoring will be required at the abutments during construction, as staged construction is anticipated for this project. The native soils indicate adequate unconfined compressive strengths and densities below approximate El. 358 at all substructure locations. If retained height is less than 15 ft. and temporary shoring depths meet or exceed this elevation, IDOT temporary sheet piling design charts should be feasible at this location.

If the temporary shoring is designed to terminate prior to El. 358, low strength native soils with average unconfined compressive strengths of less than 0.5 tsf will be encountered. Therefore, if the retained height is greater than 15 ft., the IDOT Temporary Sheet Piling Design Guide and Charts show that a Cantilevered Sheet Piling System would not be feasible and a Temporary Soil Retention System will be required. An Illinois-licensed structural engineer is required to seal the design of the temporary soil retention system, if deemed necessary.

6.3 Site and Soil Conditions

Should any bridge or embankment design considerations assumed by either IDOT or KEG change, KEG should be contacted to determine if the recommendations stated in this report still apply.

Soils with high moisture content could complicate construction activities. Soft or disturbed areas should be undercut (typically 1 to 2 ft.) and crushed rock, such as CA-6, can be used to provide a working platform.

6.4 Foundation Construction

Conventional pile driving equipment and methodologies should be assumed. The preliminary proposed locations of the west and east abutments coincide closely with the existing foundations. Conflicts in locations (i.e., new piles encountering existing piles that will remain in place) could result in damage to the new unit, especially for the case of metal shell piles. If H-piles are used, damage would be less severe, but the bearing conditions could be significantly compromised (and would likely not be apparent during driving). Therefore, coring through the existing concrete foundations to avoid any pile damage during driving or offsetting the proposed abutments to allow a reasonable separation distance is recommended.

The TSL does not indicate any buried utilities near the area of the structure replacement; however, a nearby overhead utility was noted on the north side of the existing structure in the BCR. A JULIE locate is required prior to the start of construction activities. The owner should be notified immediately if a utility is anticipated to cause conflicts with construction.

7.0 COMPUTATIONS

Computations and analyses for special circumstances, if any, are included as exhibits. Please refer to each section of the report for reference to the exhibit containing any such calculations or analysis used.

8.0 GEOTECHNICAL DATA

Soil borings can be found in Boring Logs, Exhibit C.

9.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of HLR and IDOT. They are specific only to the project described and are based on the subsurface information obtained at two boring locations within the bridge area in 2009, KEG's understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. KEG should be contacted if conditions encountered during construction are not consistent with those described.

Exhibit A
Location Map
IL Route 141 over Cane Creek
White County, Illinois

Designed By:CHA
Drawn By: TDW
Checked By: MGM
Date: 8/19/10
Project #: 08-0060.06

Kaskaskia
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Belleville, Illinois 62220
618.233.5877 phone
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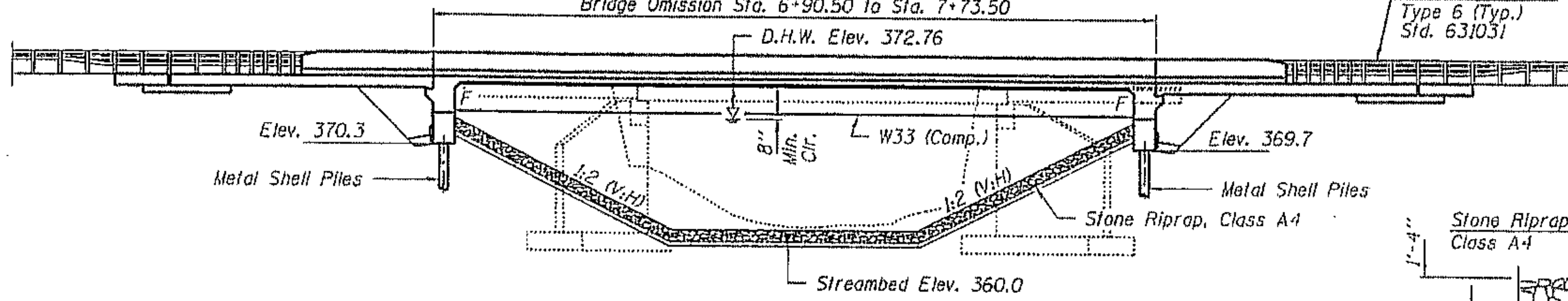
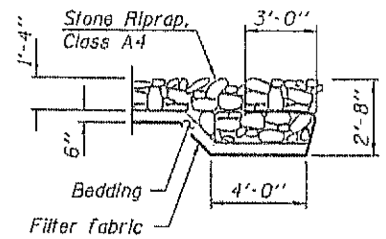
BENCHMARK: BM#54 - Chiseled "□" on SW corner SN 097-0036, 18' Rt., Sta. 7+10, Elev. 373.96

EXISTING STRUCTURE: SN 097-0036 was originally constructed in 1933 as a single span RC T-girder on closed abutments. In 1974 the bridge was reconstructed with a new single span PPC deck beam superstructure on widened existing abutments. The bridge is 43'-0⅝" bk.-bk. abuts. and 33'-0" o.-o. Structure to be removed and replaced using staged construction to maintain one lane of traffic at all times.

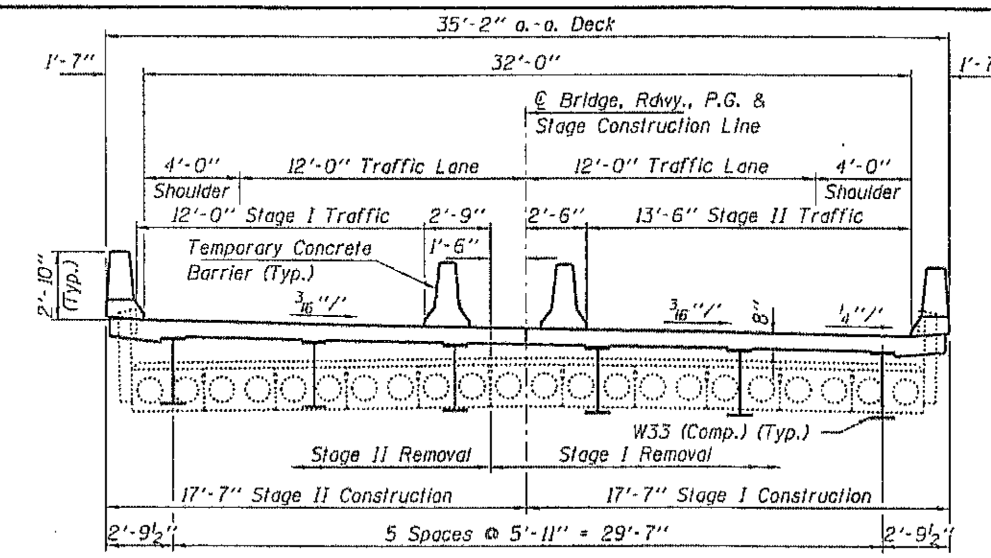
Salvage: None



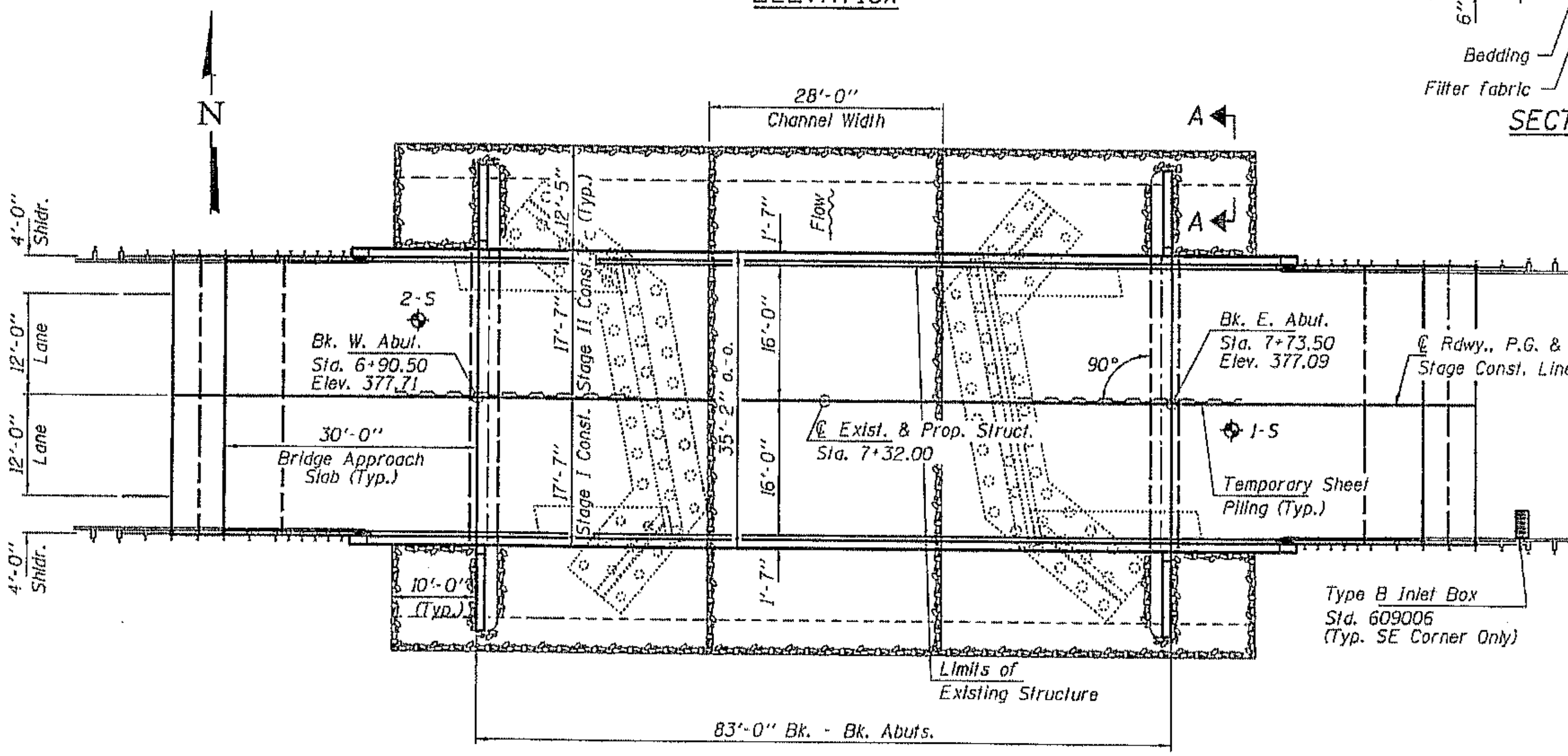
ELEVATION



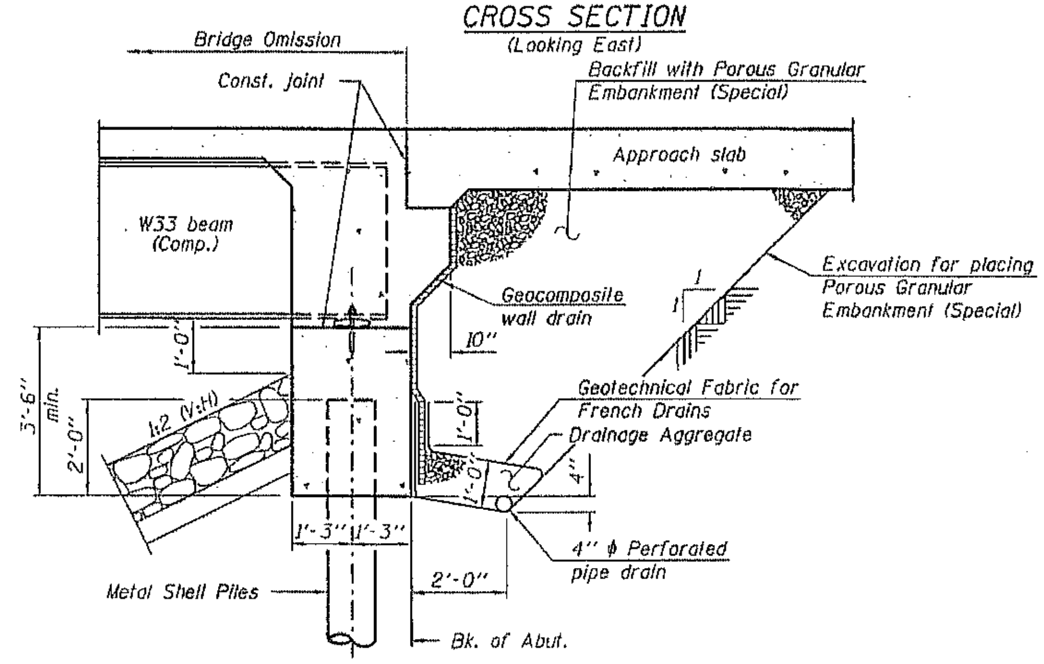
SECTION A-A



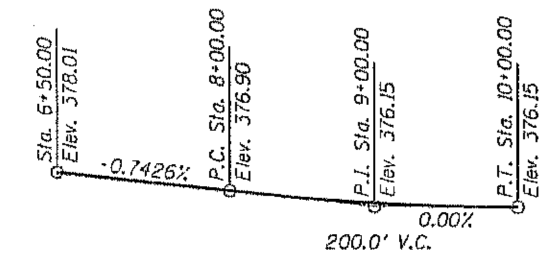
CROSS SECTION
(Looking East)



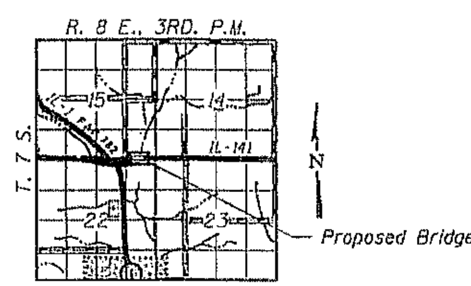
PLAN



SECTION THRU INTEGRAL ABUTMENT



PROFILE GRADE
(along ℄ roadway)



LOCATION SKETCH

Note:
The condition of the existing deck beams for Stage I Traffic should be verified during final design. If their condition changes, the proposed staging sequence shall be re-evaluated. If a beam replacement or beam support contract is required, the designer shall provide the necessary plans.

DESIGN SPECIFICATIONS

2010 AASHTO LRFD Bridge Design Specifications

LOADING HL-93

Allow 50#/sq. ft. for future wearing surface.

DESIGN STRESSES

f'c = 3,500 psi
fy = 60,000 psi (Reinf.)
fy = 50,000 psi (Structural Steel) (M270 GR. 50W)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.315 g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.741 g
Soil Site Class = D

HIGHWAY CLASSIFICATION

FAP Route 877 - IL 141
Functional Class: minor arterial - rural
ADT: 2150 (2007) / 3500 (2023)
ADTT: 366 / 595 (17%)
DHV: 350 (2023)
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-way Traffic
Directional Distribution: 50% / 50%

DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	W. Abut.	E. Abut.
	370.3	369.7

WATERWAY INFORMATION

Drainage Area = 6.95 Sq. Mi. Proposed Low Grade Elev. 376.10 @ Sta. 11+50

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Natural H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	1930	270	500	370.31	0.22	0.07	370.53	370.38
Design	50	3150	360	680	372.76	0.42	0.09	373.18	372.85
Base	100	3700	380	720	373.22	1.20	0.15	374.42	373.37
Max. Calc.	500	5130	400	730	373.96	1.74	0.19	375.70	374.15

Sta. Equation: Sta. 154+48.58 (bk) = Sta. 6+43.64 (ah)

P.I. Sta. 151+99.22
Δ = 10°00'00" (Rt.)
D = 2°00'00"
R = 2,864.79'
T = 250.64'
L = 500.00'
E = 10.94'
e = 3.2%
T.R. = 190
S.E. Run = 40
P.C. Sta. 149+48.58
P.T. Sta. 154+48.58
S.E. Transition Sta. 153+76.25 to Sta. 6+54.50
Sta. 8+09.50 to Sta. 9+56.32

GENERAL PLAN
IL ROUTE 141
OVER TRIB. CANE CREEK
FAP ROUTE 877 - SECTION 101B-2
WHITE COUNTY
STATION 7+32.00
STRUCTURE NO. 097-0077

FILE NAME = 0970036-sht-bridge.dgn	USER NAME =	DESIGNED - M.D.C.	REVISED -
		CHECKED - D.W.T.	REVISED -
	PLOT SCALE =	DRAWN - D.A.B.	REVISED -
	PLOT DATE = 8/24/2010	CHECKED - M.D.C.	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

HLR

GENERAL PLAN
STRUCTURE NO. 097-0077
SHEET NO. 1 OF 1 SHEETS

F.A.P.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
877	101B-2	WHITE		
IL 141 OVER TRIB. TO CANE CR.		CONTRACT NO. 78162		
		ILLINOIS FED. AID PROJECT		

Illinois Department of Transportation

Memorandum

To:	Carrie Nelsen	Attn: Dave Piche
From:	Greg Smothers	By: Rob Graeff
Subject:	*Boring Logs & Liquefaction Analysis	
Date:	December 10, 2009	

FAP 877 (IL 141) over Tributary to Cane Creek
Structure 097-0036(E)
White County

Foundation boring logs have been obtained for the above listed structure and are attached.

Liquefaction Analysis

Liquefaction calculations indicate the presence of liquefiable soils at this structure location in Boring 2-S only.

Slope Stability

At the time of this report, a preliminary TSL is not available. Therefore, we are unable to provide any slope stability calculations for the proposed endslope configuration. This office should be contacted to complete the slope stability calculations when a proposed endslope configuration is determined.

Structure Geotechnical Report

Due to a current shortage of staffing, the District Nine Geotechnical Unit is unable to complete the required Structure Geotechnical Report. Any additional foundation recommendations should be evaluated by a competent consultant.

Attachments
RG:rg

cc: Soils File

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 877 (IL 141) Over Trib Cane Creek

Route: FAP 877 (IL 141 **Structure Number:** 097-0036 **Date:** 10/28/2009

Section 101BR-1 **Bored By:** R Moberly

County: White **Location:** 0.25 mile East Jct. IL Rte 1 **Checked By:** Rob Graeff

Boring No 1-S
Station 7+77
Offset 7' Rt CL
Ground Surface 376.2 Ft

Surf Wat Elev: 360.5
Ground Water Elevation
when Drilling 352.7
At Completion 357.7
At: Hrs:

Description	DEPTH	BLOWS	Qu tsf	W%
Asphalt, Concrete & crushed aggregate				
374.2				
Medium, very moist, brown, Silty Clay to Silty Clay Loam A-6		1		
		2	0.8B	20
		2		
371.7				
Stiff, moist, grey, Silty Clay Loam A-4	5.0	1		
		4	1.1S	21
		4		
369.2				
Soft, very moist, grey, Silty Clay Loam A-4		WH		
		WH	0.4B	30
		WH		
366.7				
Medium to soft, very moist, grey, Silty Clay Loam A-6	10.0	WH		
		1	0.6B	28
		WH		
		1		
		1	0.3B	23
		1		
361.7				
Stiff, moist to very moist, grey mottled brown, Silty Clay Loam A-6	15.0	1		
		1	1.1B	24
		1		
359.2				
Medium to stiff, moist, brown mottled grey, Silty Clay to Clay A7-6		1		
		1	1.0B	31
		2		
	20.0	1		
		1	0.9B	30
		2		
354.2				
Soft, very moist, grey, Silty Clay to Clay A7-6 with Sandy seams		WH		
		1	0.4B	24
		WH		
351.7				
	25.0	1		

Description	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, grey mottled brown, Clay to Silty Clay A7-6		1	1.1B	20
		2		
349.2				
Soft to medium , very moist, grey and brown, Clay to Silty Clay A7-6		WH		
		WH	0.4B	28
		WH		
	30.0	WH		
		1	0.7B	24
		WH		
		WH		
		WH	0.6B	21
		WH		
341.7				
Stiff, moist, grey, Clay A7-6	35.0	1		
		3	1.6B	24
		4		
339.2				
Very stiff, moist, grey, Clay A7-6		2		
		4	2.3B	22
		7		
	40.0	2		
		4	2.3B	29
		7		
331.7				
Stiff, moist, grey, Clay A7-6	45.0	1		
		3	1.2B	32
		3		
	50.0	3		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 877 (IL 141) **Date:** 10/28/2009

Section: 101BR-1

County: White

Boring No: 1-S
Station: 7+77
Offset: 7' Rt CL
Ground Surface: 376.2 Ft

Description	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, grey, Clay A7-6		5	1.6B	27
		7		
321.7				
Very stiff, moist, grey, Clay to Silty Clay A7-6	55.0	3		
		6	2.3B	26
		9		
	60.0	2		
		5	2.3B	27
		8		
311.7				
Stiff, moist, grey, Silty Clay to Clay A7-6	65.0	1		
		3	1.2B	25
		3		
306.7				
Very stiff, moist, grey, Clay A7-6	70.0	2		
		5	2.3B	27
		8		
301.7				
Medium, very moist, grey, Clay	75.0	1		

Description	DEPTH	BLOWS	Qu tsf	W%
A7-6		2	0.8B	25
		3		
296.7				
Very stiff, moist, grey, Clay A7-6	80.0	1		
		4	2.1B	23
		7		
	85.0			
	90.0	2		
		5	2.7B	26
		12		
284.2				
Hard, dry, grey, Clay Shale				
	95.0	100/2"		
	100.0	100/2"		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 877 (IL 141)
Date: 10/28/2009
Section: 101BR-1
County: White

Boring No: 1-S
Station: 7+77
Offset: 7' Rt CL
Ground Surface: 376.2 Ft

Description	DEPTH	BLOWS	Qu tsf	W%		DEPTH	BLOWS	Qu tsf	W%
Hard, dry, grey, Clay Shale									
271.2	105.0	100/1"				130.0			
Bottom of hole = 104.6 feet Free water observed at 23.5 feet Elevation referenced to BM @ SW wingwall; Elev.= 374.0 feet Note: To convert "N" values to "N60" multiply by 1.25	110.0					135.0			
	115.0					140.0			
	120.0					145.0			
	125.0					150.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation
Boring Log

FAP 877 (IL 141) Over Trib Cane Creek

Route: FAP 877 (IL 141 **Structure Number:** 097-0036 **Date:** 10/29/2009

Section 101BR-1 **Bored By:** R Moberly

County: White **Location:** 0.25 mile East Jct. IL Rte 1 **Checked By:** Rob Graeff

Boring No 2-S
Station 6+87
Offset 7' Lt CL
Ground Surface 376.2 Ft

Surf Wat Elev: 360.5
Ground Water Elevation
when Drilling 360.2
At Completion
At: **Hrs:**

Description	DEPTH	BLOWS	Qu tsf	W%
Asphalt, concrete and crushed aggregate				
374.7				
Medium to stiff, moist, brown, Silty Clay Loam A-4		1		
		4	1.0S	19
		3		
	5.0	1		
		2	0.8B	21
		2		
369.2				
Medium, very moist, grey, Silty Clay Loam A-6		1		
		2	0.6B	22
		2		
	10.0	1		
		2	0.7B	24
		2		
		1		
		2	0.7B	27
		2		
361.7				
Very soft, very moist, brown, Clay Loam A-6 with some gravel	15.0	WH		
		1	0.2B	27
		1		
359.2				
Medium, very moist, brown mottled grey, Clay A7-6		WH		
		WH	0.6B	24
		WH		
	20.0	1		
		2	0.9B	20
		2		
		1		
		2	0.9B	24
		2		
351.7				
	25.0	1		

Description	DEPTH	BLOWS	Qu tsf	W%
Medium, very moist, grey, Clay to Clay Loam A-6		1	0.7B	22
		2		
349.2				
Soft, very moist, grey, Clay Loam to Clay A-6		1		
		1	0.4B	22
		4		
346.7				
Very loose, wet, grey, Sand	30.0	WH		
87% Sand		WH		27
10% Silt		WH		
3% Clay				
344.2				
Stiff, moist, grey, Clay A7-6		1		
		3	1.7B	36
		3		
	35.0	2		
		4	1.5B	22
		7		
339.2				
Very stiff to stiff, moist, grey, Clay A7-6		3		
		7	2.1B	25
		10		
	40.0	2		
		5	1.5B	27
		7		
	45.0	2		
		3	1.2B	30
		4		
326.7				
	50.0	3		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 877 (IL 141) **Date:** 10/29/2009

Section: 101BR-1

County: White

Boring No: 2-S
Station: 6+87
Offset: 7' Lt CL
Ground Surface: 376.2 Ft

Description	DEPTH	BLOWS	Qu tsf	W%
Very stiff to stiff, moist, grey, Clay A7-6 with Sand layers		7	1.5B	27
		10		
	55.0	2		
		6	2.1B	26
		8		
316.7				
Very stiff to stiff, moist, grey, Clay A7-6	60.0	3		
		7	2.5B	31
		10		
	65.0	3		
		7	2.5B	25
		9		
	70.0	4		
		8	3.3B	26
		11		
	75.0	2		

Description	DEPTH	BLOWS	Qu tsf	W%
Very stiff to stiff, moist, grey, Clay A7-6		6	1.5B	24
		9		
296.7				
Soft, very moist, grey, Clay A7-6	80.0	1		
		2	0.4B	22
		3		
	85.0			
287.2				
Hard, damp, grey, Clay Shale				
286.2	90.0	100/6"		
Bottom of hole = 90.0 feet				
Free water observed at 16.0 feet				
Elevation referenced to BM @ SW wingwall; Elev. = 374.0 feet				
Note: To convert "N" values to "N60" multiply by 1.25	95.0			
	100.0			

N-Std Pentr Test: 2" OD Sampler, 140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

LIQUEFACTION POTENTIAL ANALYSIS

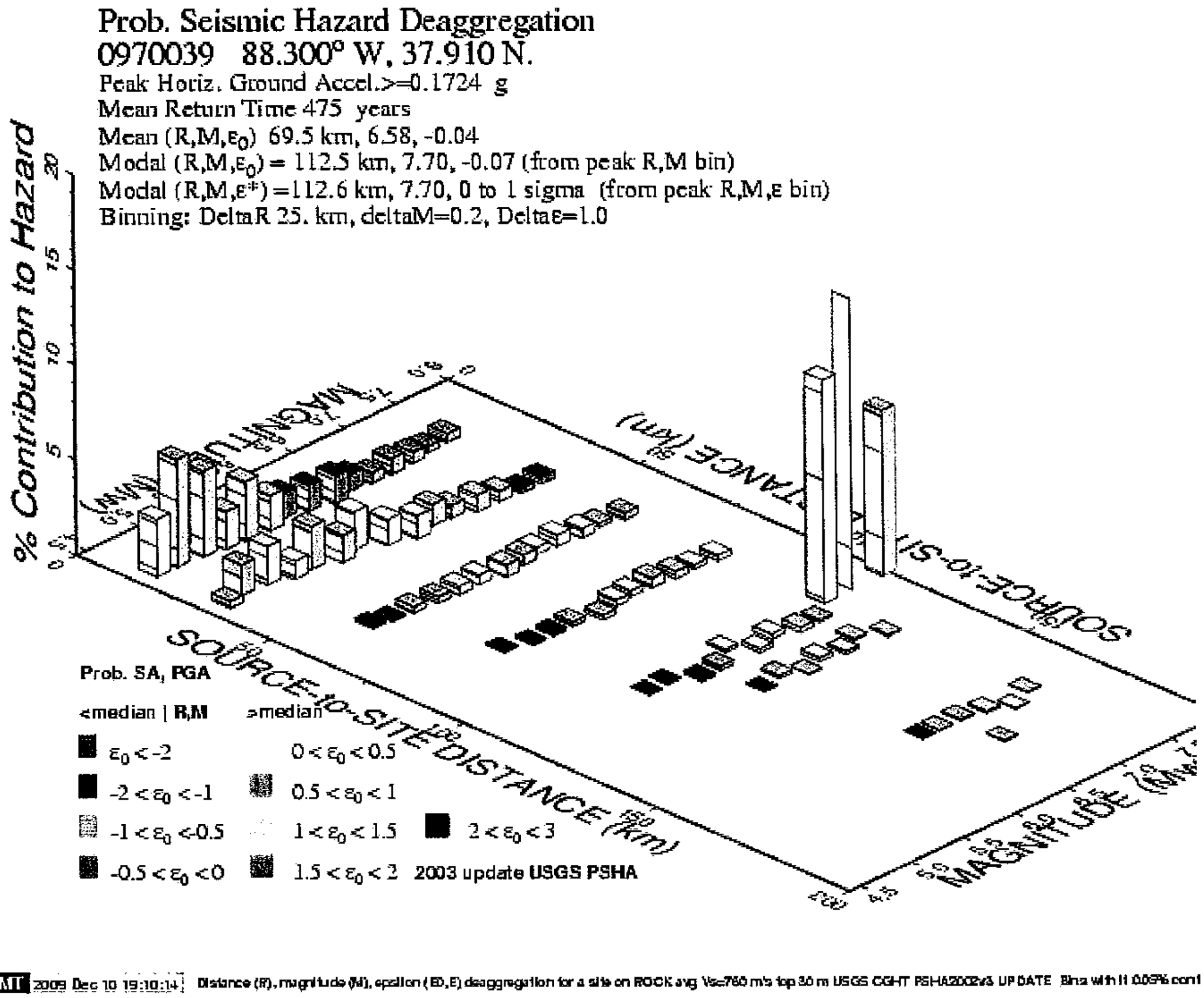
BUREAU OF BRIDGES AND STRUCTURES FOUNDATIONS UNIT wmk 8/25/01

REFERENCE BORING NUMBER================================	2-S	
STRUCTURE NUMBER=======================================	097-0036	
ELEVATION OF BORING GROUND SURFACE=====================	376	Feet
DEPTH TO GROUNDWATER DURING DRILLING===================	16	Feet (Below Boring Ground Surface)
DEPTH TO GROUNDWATER DURING EARTHQUAKE=================	16	Feet (Below Finished Grade Cut or Fill Surface)
MAX. HORZ. GROUND SURFACE ACCELERATION=================	0.1724	Coefficient of Gravity
DESIGN EARTHQUAKE MEAN MAGNITUDE=======================	6.58	Moment Magnetude Scale
FINISHED GRADE FILL OR CUT FROM BORING SURFACE=========	0	Ft. Which is 0 ksf Effect.Surch.Fill Press.
ADJUST DIST. #9 N VALUES TO 60% ENERGY TRANSFER========	1	(1=Yes OR 2=No)

Sloped Ground Shear Stress Correct. Factor ($K\alpha$)	1.00
Earthquake Magnitude Scaling Factor (MSF)=	1.397

	Boring Data			Conditions During Drilling					Conditions During Earthquake							
Elev. of Sample (Feet)	Boring Sample Depth (Feet)	S.P.T. N Value (Blows)	% Fines < #200 (%)	Effect. Unit Weight (KCF.)	Effect. Vertical Stress (KSF.)	Overburd. & Drillrod Corrected (Ni)60	Fines Content Corrected (Ni)60cs	CSR Resisting Mag 7.5 CRR(7.5)	Effect. Unit Weight (KCF.)	Effect. Vertical Stress (KSF.)	Total Vertical Stress (KSF.)	Confining, Sloping & Mag. Correct. ($K\sigma$)($K\alpha$)(MSF)	Corrected CRR(7.5) Resisting CRR	Stress Reduct. Factor (rd)	Earth Quake Induced CSR	FACTOR OF SAFETY CRR/CSR
373.5	2.5	7	nl	0.117	0.292	13.514	21.217	0.230	0.117	0.292	0.292	1.566	**0.361**	0.994	**0.111**	**ABO. WAT.**
371	5	4	nl	0.111	0.576	7.406	13.887	0.150	0.111	0.569	0.569	1.547	**0.232**	0.988	**0.111**	**ABO. WAT.**
368.5	7.5	4	nl	0.111	0.853	6.257	12.509	0.135	0.111	0.830	0.830	1.534	**0.208**	0.981	**0.110**	**ABO. WAT.**
366	10	4	nl	0.111	1.130	5.585	11.702	0.127	0.111	1.107	1.107	1.527	**0.193**	0.975	**0.109**	**ABO. WAT.**
363.5	12.5	4	nl	0.111	1.406	5.138	11.166	0.121	0.111	1.384	1.384	1.525	**0.184**	0.969	**0.109**	**ABO. WAT.**
361	15	2	nl	0.104	1.674	2.415	7.898	0.088	0.104	1.608	1.608	1.528	**0.134**	0.963	**0.108**	**ABO. WAT.**
358.5	17.5	1	nl	0.044	1.859	1.175	6.410	0.075	0.044	1.294	1.388	1.525	**0.114**	0.956	**0.115**	**NL**
356	20	4	nl	0.055	1.983	4.662	10.594	0.115	0.055	0.994	1.243	1.529	**0.176**	0.950	**0.133**	**NL**
353.5	22.5	4	nl	0.055	2.121	4.616	10.539	0.114	0.055	1.240	1.646	1.525	**0.174**	0.944	**0.140**	**NL**
351	25	3	nl	0.053	2.256	3.436	9.123	0.100	0.053	1.349	1.910	1.525	**0.152**	0.938	**0.149**	**NL**
348.5	27.5	5	nl	0.057	2.393	5.687	11.824	0.128	0.057	1.509	2.227	1.526	**0.195**	0.931	**0.154**	**NL**
346	30	1	13	0.044	2.520	1.133	3.063	0.056	0.044	1.518	2.392	1.526	**0.085**	0.928	**0.164**	**0.518**
343.5	32.5	6	nl	0.059	2.648	6.777	13.133	0.142	0.059	1.670	2.699	1.530	**0.217**	0.908	**0.164**	**NL**
341	35	11	nl	0.064	2.801	12.340	19.808	0.214	0.064	2.139	3.325	1.551	**0.332**	0.887	**0.154**	**NL**
338.5	37.5	17	nl	0.068	2.965	18.924	27.709	0.336	0.068	2.464	3.805	1.576	**0.529**	0.867	**0.150**	**NL**
336	40	12	nl	0.065	3.130	13.268	20.921	0.227	0.065	2.643	4.141	1.593	**0.362**	0.846	**0.149**	**NL**
	*	*	*													

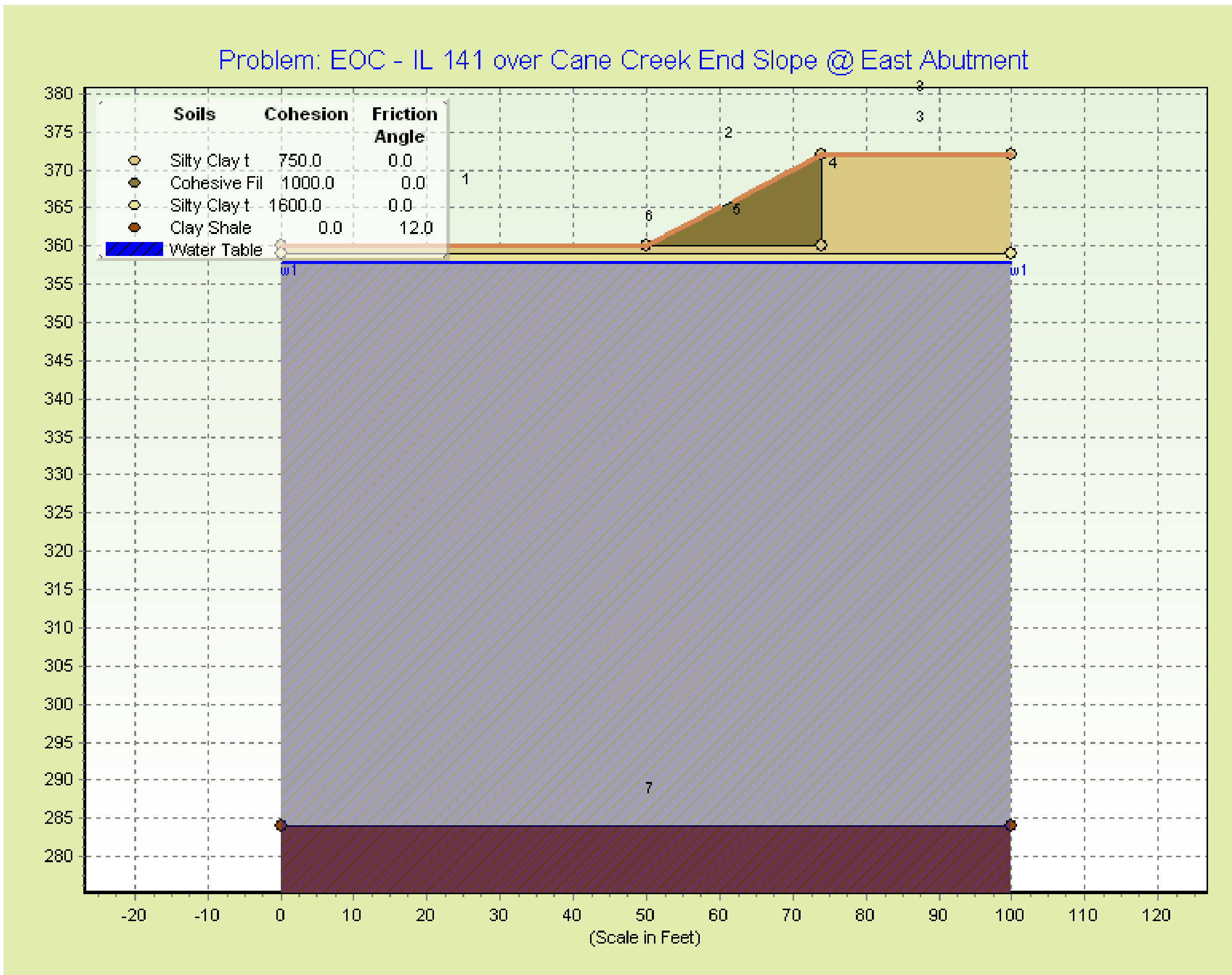
* ALL COHESIVE TO END OF BORING



PGA = 0.1724 g

M_w = 6.58

================== DATA SUMMARY ====================



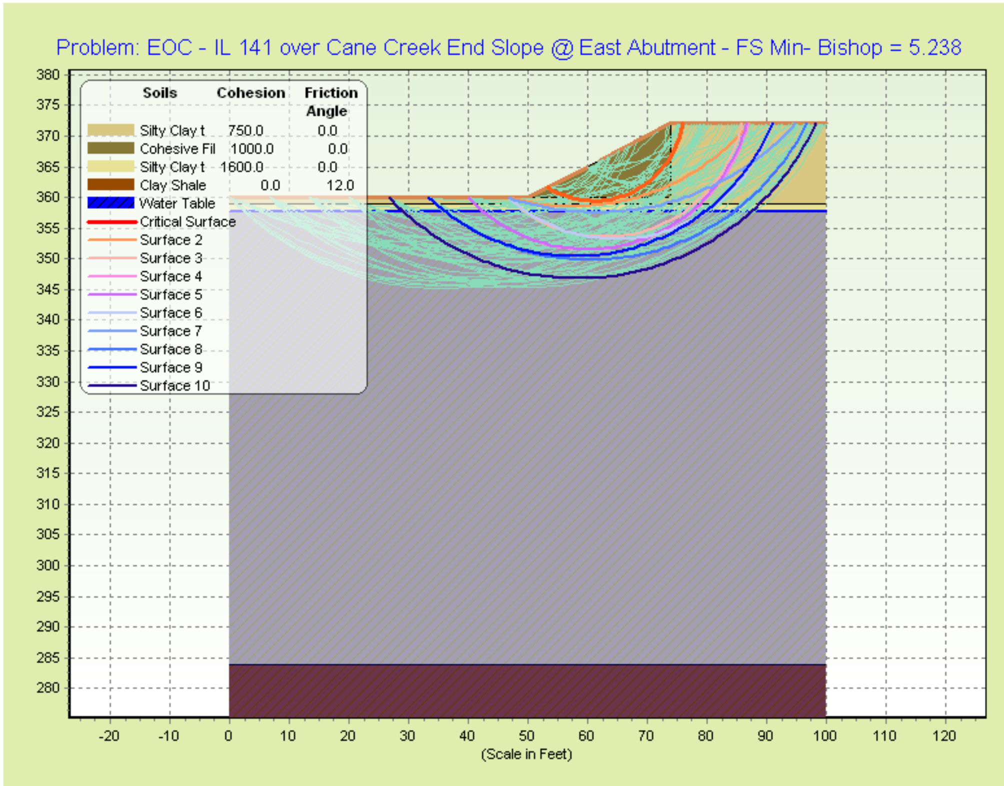
Profile Data

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	360	50	360	2
2	50	360	74	372	1
3	74	372	100	372	2
4	74	372	74	360	2
5	50	360	74	360	2
6	0	359	100	359	3
7	0	284	100	284	4

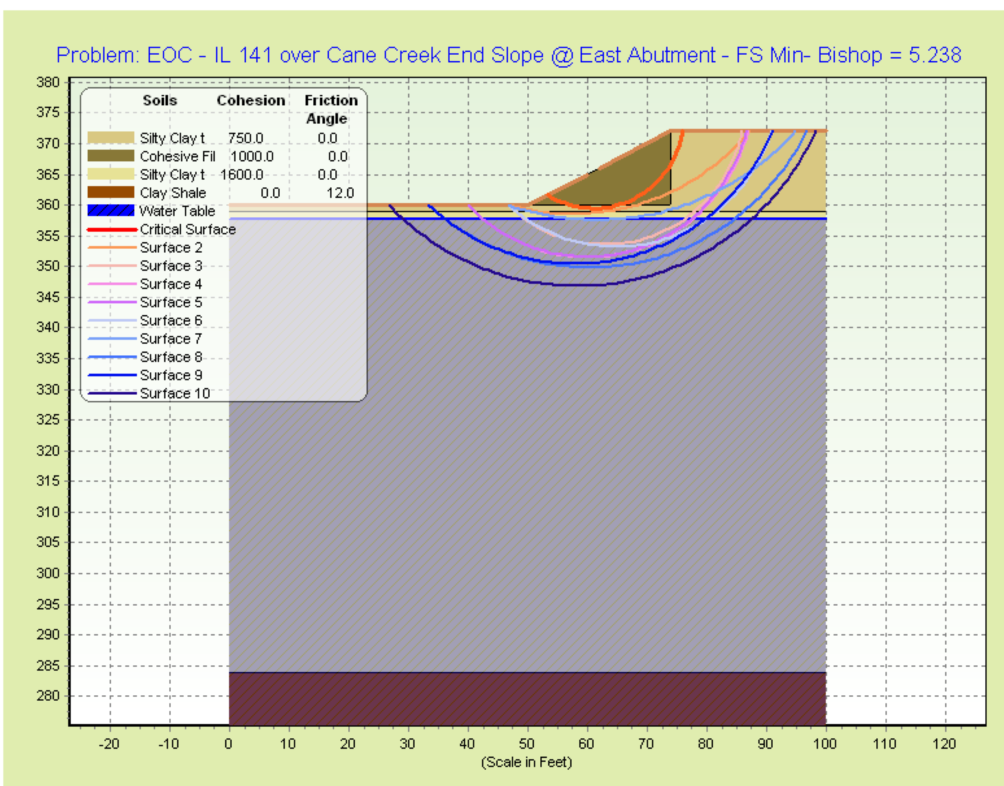
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	125	125	1000	0	0	0	1	Cohesive Fill
2	120	120	750	0	0	0	1	Silty Clay to
3	115	115	1600	0	0	0	1	Silty Clay to
4	135	135	0	12	0	0	1	Clay Shale

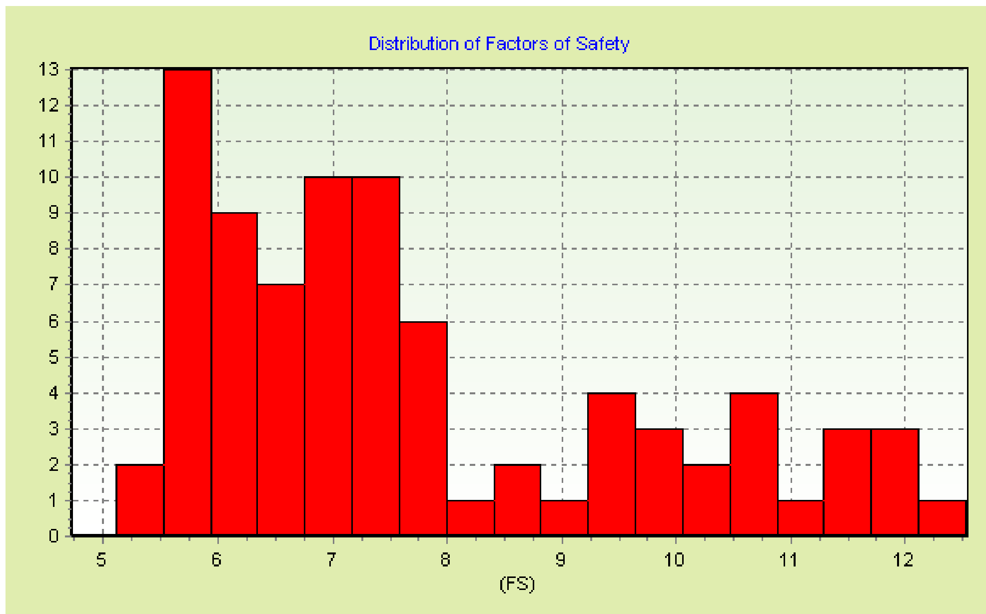
=============== All Surfaces Generated =============



=============== 10 Most Critical Surfaces ===============



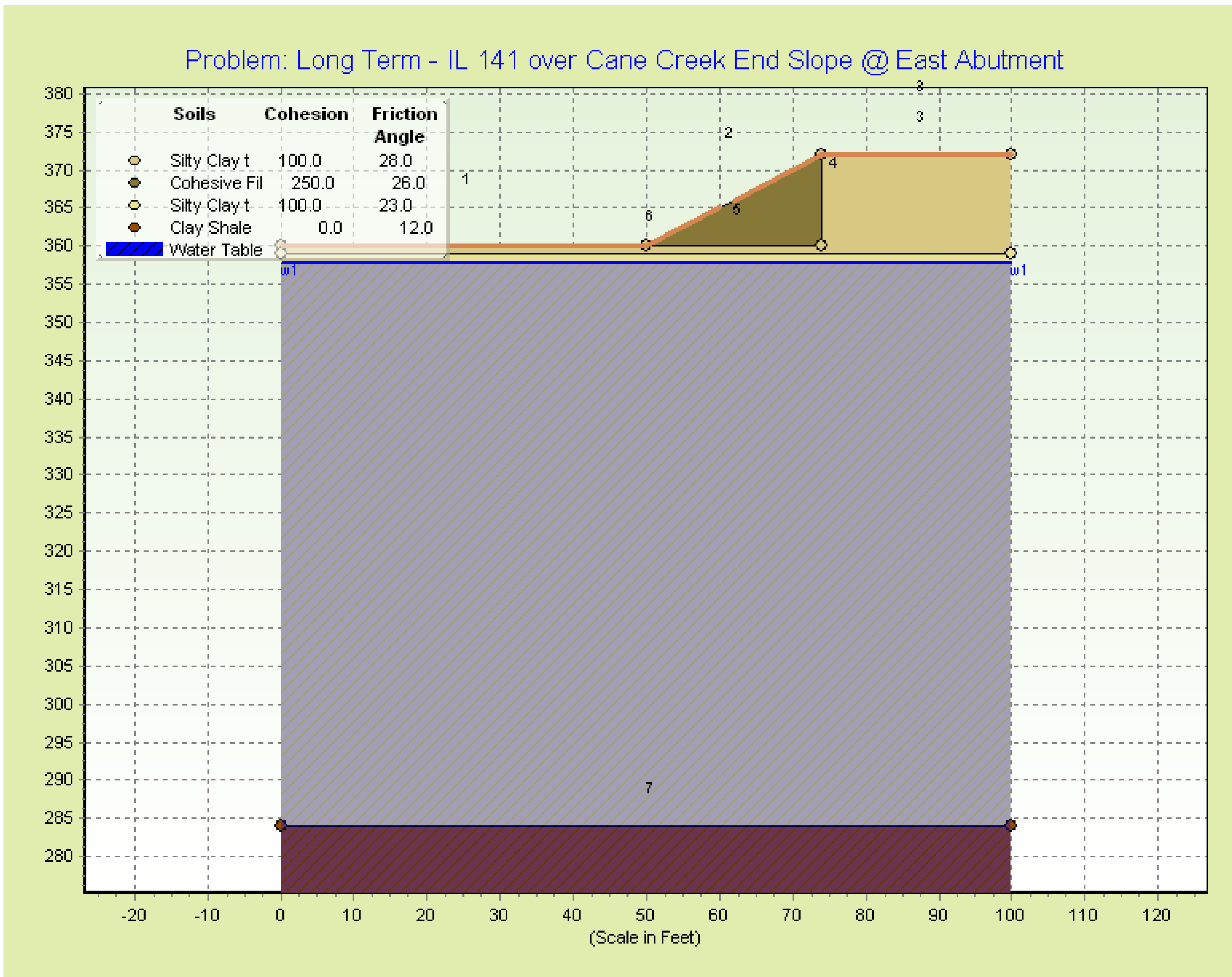
============= Factor of Safety Histogram ============



======== Factors of Safety of 10 Most Critical Surfaces =======

Surface Number	Factor of Safety
1	5.238
2	5.395
3	5.694
4	5.706
5	5.711
6	5.765
7	5.801
8	5.838
9	5.843
10	5.88

================== DATA SUMMARY ====================



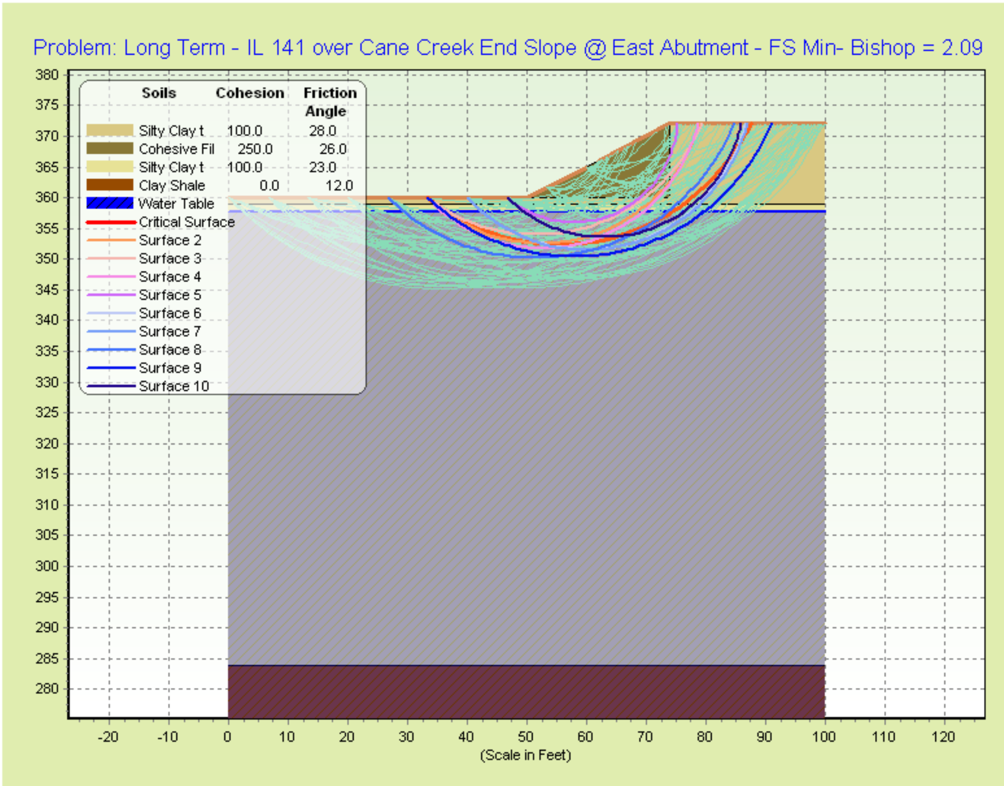
Profile Data

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
1	0	360	50	360	2
2	50	360	74	372	1
3	74	372	100	372	2
4	74	372	74	360	2
5	50	360	74	360	2
6	0	359	100	359	3
7	0	284	100	284	4

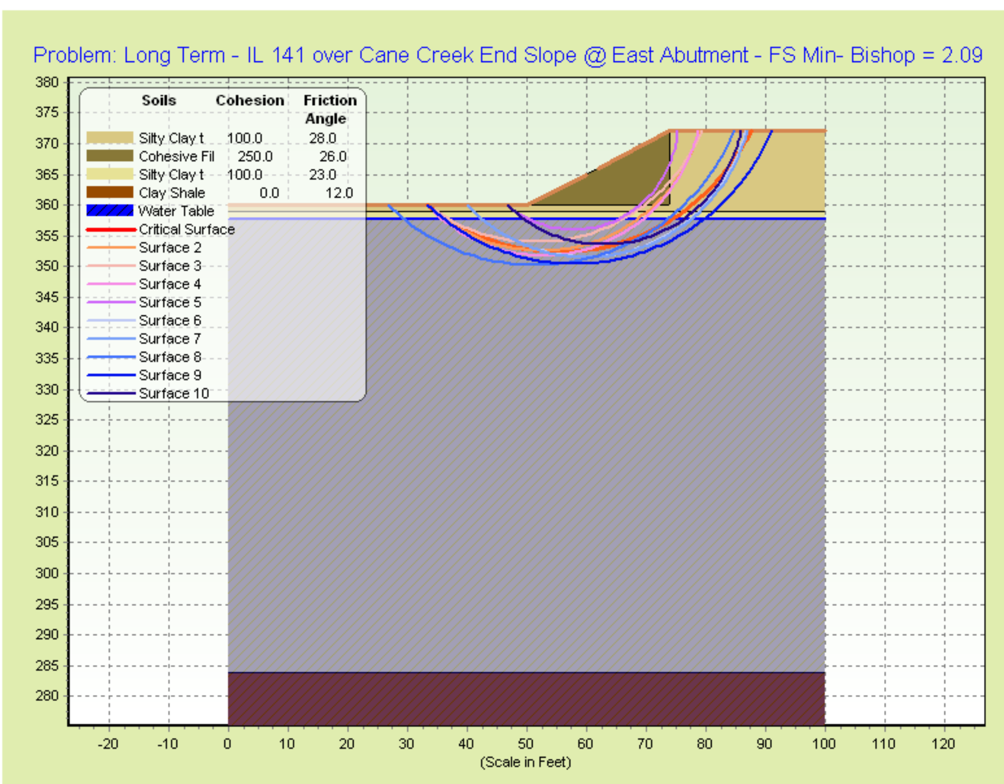
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	125	125	250	26	0	0	1	Cohesive Fill
2	120	120	100	28	0	0	1	Silty Clay to
3	115	115	100	23	0	0	1	Silty Clay to
4	135	135	0	12	0	0	1	Clay Shale

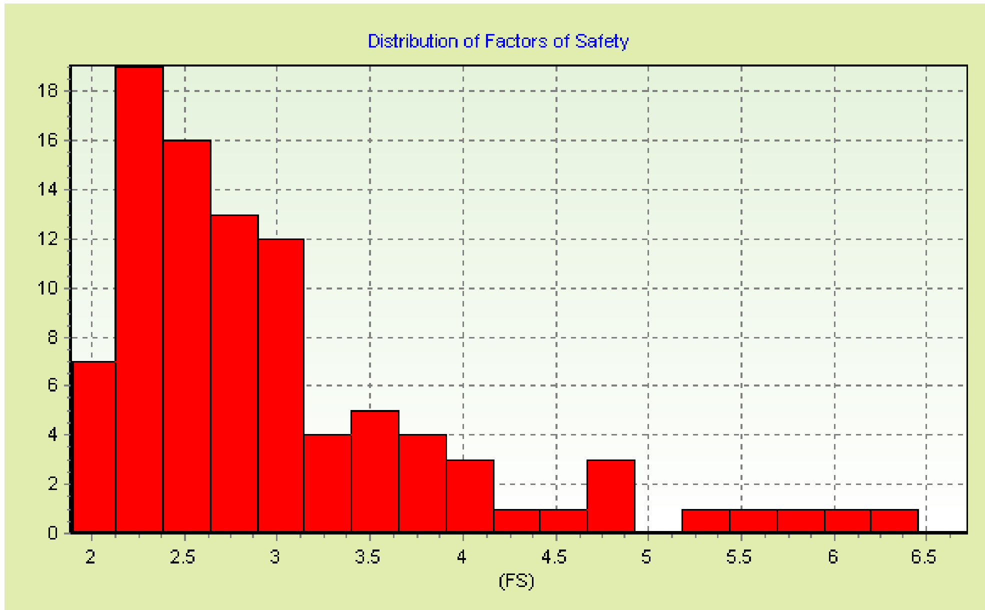
=============== All Surfaces Generated =============



=============== 10 Most Critical Surfaces ===============



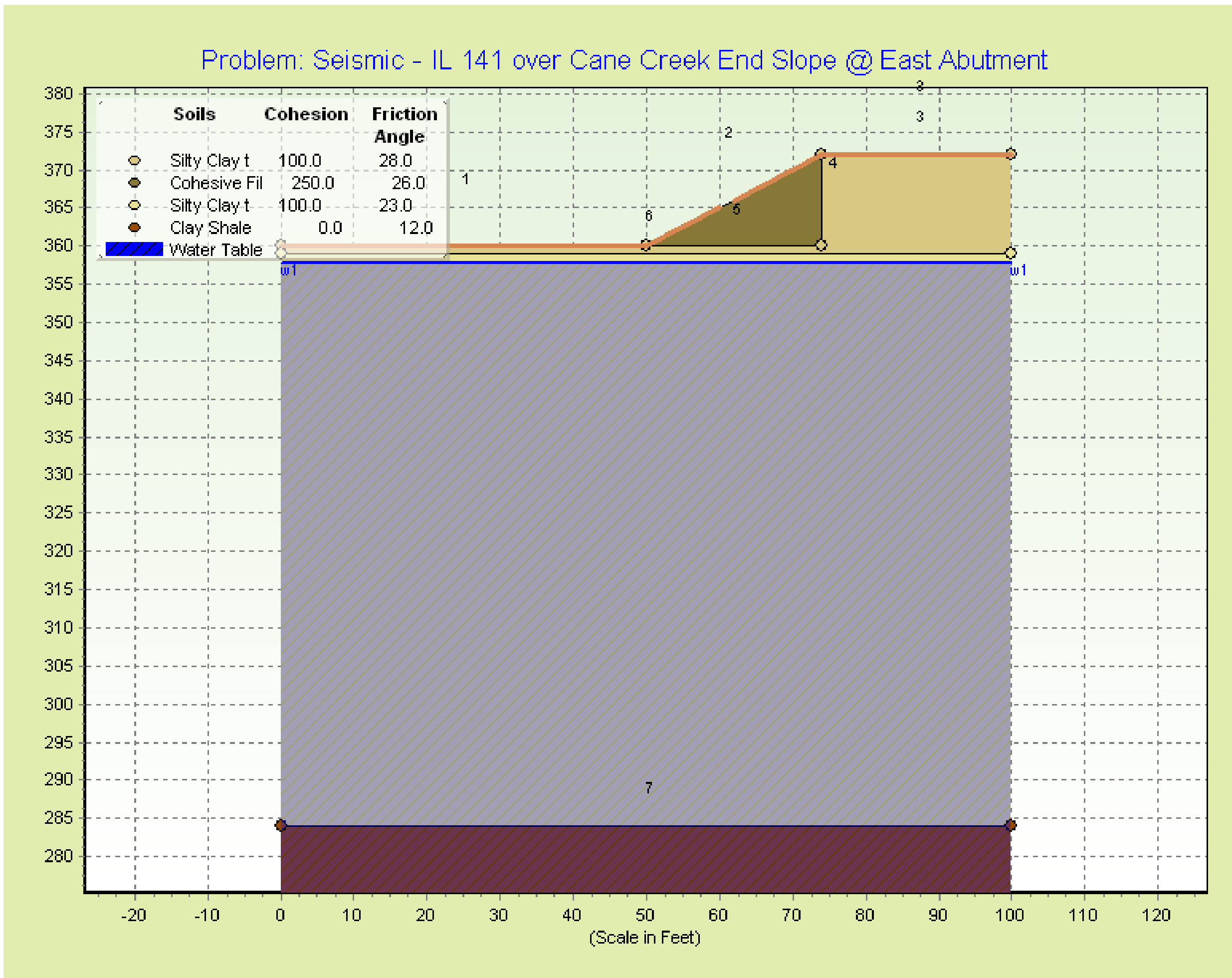
============= Factor of Safety Histogram ============



======== Factors of Safety of 10 Most Critical Surfaces =======

Surface Number	Factor of Safety
1	2.09
2	2.1
3	2.114
4	2.12
5	2.12
6	2.124
7	2.132
8	2.171
9	2.173
10	2.234

================== DATA SUMMARY ====================



Profile Data

Segment Number	Left Extreme X	Left Extreme Y	Right Extreme X	Right Extreme Y	Soil Under Segment
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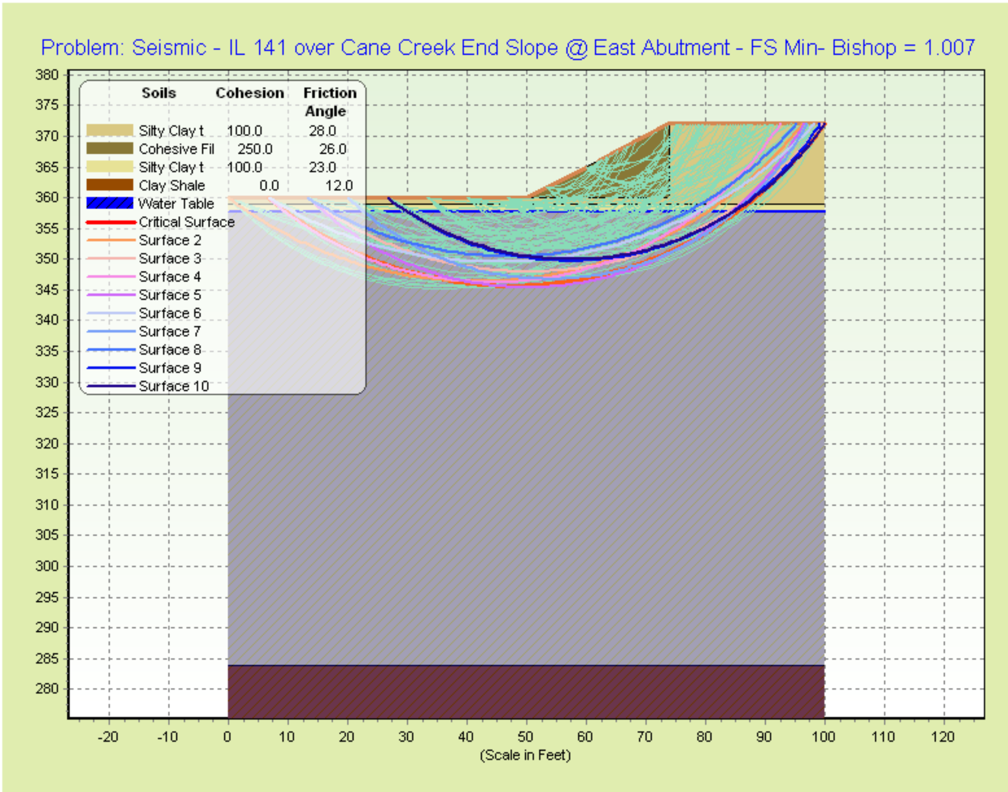
3	74	372	100	372	2
4	74	372	74	360	2
5	50	360	74	360	2
6	0	359	100	359	3
7	0	284	100	284	4

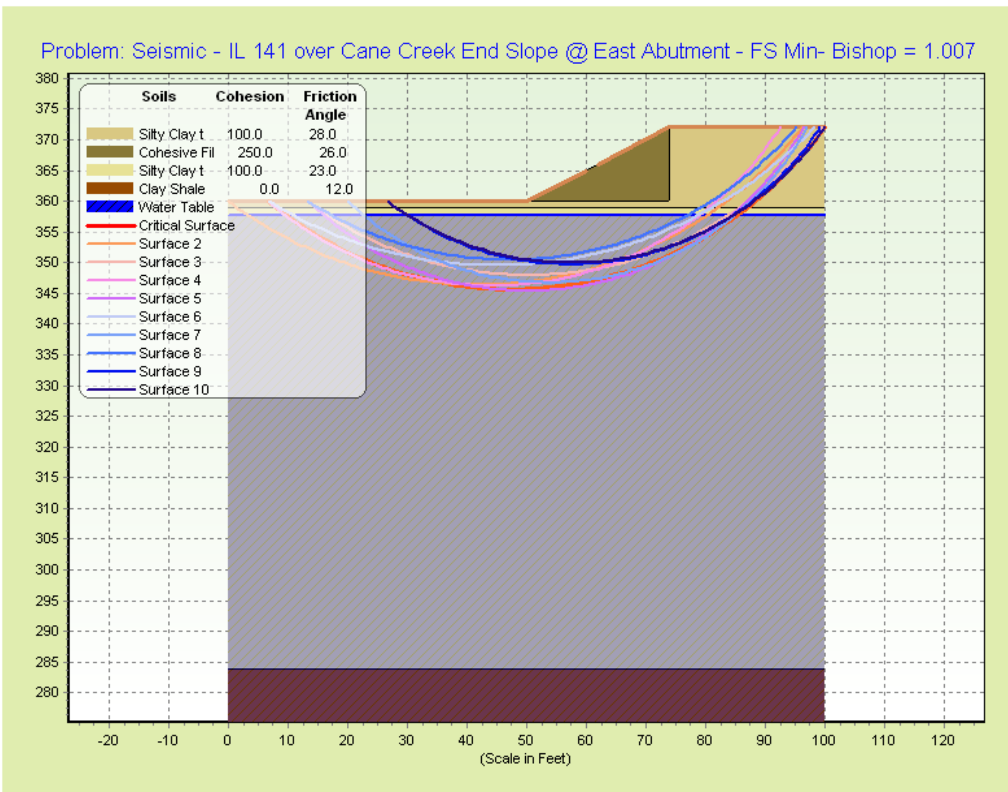
Soil Properties

Soil Number	Wet Unit Weight	Saturated Unit Weight	Cohesive Intercept	Friction Angle	Ru	Pressure Head	Water Table	Soil Name
1	125	125	250	26	0	0	1	Cohesive Fill
2	120	120	100	28	0	0	1	Silty Clay to
3	115	115	100	23	0	0	1	Silty Clay to
4	135	135	0	12	0	0	1	Clay Shale

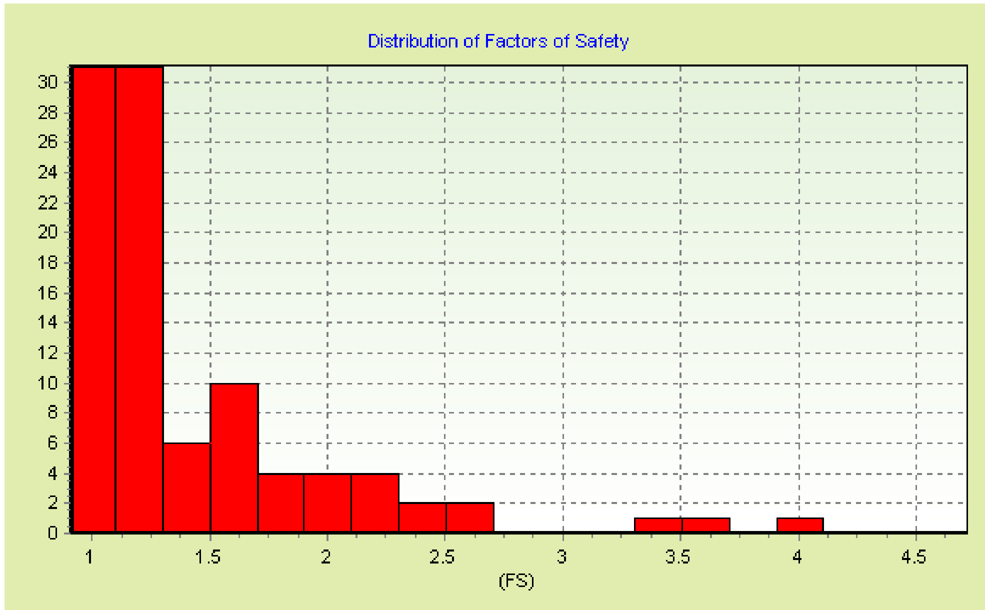
=============== All Surfaces Generated =============



=============== 10 Most Critical Surfaces ===============



============= Factor of Safety Histogram ============



======== Factors of Safety of 10 Most Critical Surfaces =======

Surface Number	Factor of Safety
1	1.007
2	1.013
3	1.014
4	1.024
5	1.026
6	1.031
7	1.034
8	1.034
9	1.04
10	1.041

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/24/10

REFERENCE BORING NUMBER ====================================== 1-S
ELEVATION OF BORING GROUND SURFACE ========================== 376.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ====================== 23.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE =================== 18.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ====== 0.216
EARTHQUAKE MOMENT MAGNITUDE =============================== 5.4
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== -6.40 FT. (Cut Depth)
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 6 IN.
SAMPLING METHOD== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.081**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **#DIV/0!** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.4
Source-To-Site Distance, R (km) = 16.3
Ground Motion Prediction Equations = CEUS
PGA = **0.216**

IF(P22="","",IF(B22>=(K$7+K$12-K$9),"N.L. (1)",IF(OR(G22>=12,AND(H22>0,I22>0,I22/MA

DATA REQUIRED

BORING DATA								CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE								
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR	
372.7	3.5	4	0.8	80			20	0.119	0.417	6.642	12.970	0.140									
370.2	6	8	1.1	80			21	0.123	0.724	12.188	19.626	0.211									
367.7	8.5	0	0.4	80			30	0.111	1.002	0.000	5.000	0.072	0.111	0.233	0.233	1.500	**0.225**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
365.2	11	1	0.6	80			28	0.116	1.292	1.426	6.711	0.085	0.116	0.523	0.523	1.343	**0.239**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
362.7	13.5	2	0.3	80			23	0.108	1.562	2.792	8.350	0.099	0.108	0.793	0.793	1.243	**0.256**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
360.2	16	2	1.1	80			24	0.123	1.869	2.684	8.221	0.098	0.123	1.101	1.101	1.155	**0.235**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
357.7	18.5	3	1	70			31	0.122	2.174	3.854	9.625	0.110	0.122	1.406	1.406	1.099	**0.251**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
355.2	21	3	0.9	70			30	0.120	2.474	3.684	9.420	0.108	0.120	1.706	1.706	1.051	**0.236**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
352.7	23.5	1	0.4	70			24	0.111	2.752	1.177	6.412	0.083	0.111	1.983	1.983	1.014	**0.175**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
350.2	26	3	1.1	70			20	0.060	2.902	3.462	9.154	0.106	0.060	2.133	2.233	0.999	**0.220**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
347.7	28.5	0	0.4	70			28	0.049	3.024	0.000	5.000	0.072	0.049	2.256	2.511	0.988	**0.148**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
345.2	31	1	0.7	70			24	0.055	3.162	1.113	6.336	0.082	0.055	2.393	2.805	0.975	**0.167**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
342.7	33.5	0	0.6	70			21	0.053	3.294	0.000	5.000	0.072	0.053	2.526	3.093	0.966	**0.145**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
340.2	36	7	1.6	70			24	0.065	3.457	7.465	13.958	0.150	0.065	2.688	3.412	0.941	**0.293**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
337.7	38.5	11	2.3	70			22	0.069	3.629	11.438	18.726	0.200	0.069	2.861	3.740	0.918	**0.382**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
335.2	41	11	2.3	70			29	0.069	3.802	11.161	18.393	0.196	0.069	3.033	4.069	0.903	**0.369**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
330.2	46	6	1.2	70			32	0.061	4.107	5.840	12.008	0.131	0.061	3.338	4.686	0.895	**0.244**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
325.2	51	12	1.6	70			27	0.065	4.432	11.187	18.424	0.197	0.065	3.663	5.323	0.856	**0.350**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
320.2	56	15	2.3	70			26	0.069	4.777	13.367	21.040	0.229	0.069	4.008	5.980	0.826	**0.393**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(D)**
315.2	61	13	2.3	70			27	0.069	5.122	11.081	18.297	0.195	0.069	4.353	6.637	0.816	**0.331**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
310.2	66	6	1.2	70			25	0.061	5.427	4.921	10.905	0.121	0.061	4.658	7.254	0.830	**0.209**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
305.2	71	13	2.3	70			27	0.069	5.772	10.221	17.265	0.184	0.069	5.003	7.911	0.788	**0.301**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
300.2	76	6	0.8	70			25	0.057	6.057	4.565	10.478	0.117	0.057	5.288	8.508	0.807	**0.197**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
295.2	81	11	2.1	70			23	0.068	6.397	8.064	14.677	0.157	0.068	5.628	9.160	0.775	**0.253**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
285.2	91	17	2.7	70			26	0.071	7.107	11.545	18.855	0.202	0.071	6.338	10.494	0.730	**0.306**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
281.2	95	100		10				0.083	7.439	77.593	80.140	0.567	0.083	6.670	11.076	0.632	**0.746**	#DIV/0!	**#DIV/0!**	**N.L. (3)**	
276.2	100	100		10				0.083	7.854	73.020	75.468	0.530	0.083	7.085	11.803	0.617	**0.681**	#DIV/0!	**#DIV/0!**	**N.L. (3)**	
271.2	105	100		10				0.083	8.269	66.551	68.860	0.476	0.083	7.500	12.530	0.603	**0.598**	#DIV/0!	**#DIV/0!**	**N.L. (3)**	

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI ≥ 12 OR w_c/LL ≤ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

L I Q U E F A C T I O N   A N A L Y S I S

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/24/10

REFERENCE BORING NUMBER ===================================== 1-S
ELEVATION OF BORING GROUND SURFACE ========================== 376.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ======================= 23.50 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE =================== 18.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ====== 0.162
EARTHQUAKE MOMENT MAGNITUDE ================================ 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE =============== -6.40 FT. (Cut Depth)
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 6 IN.
SAMPLING METHOD== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **#DIV/0!** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 109.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.162**

IF(P22="","",IF(B22>=(K$7+K$12-K$9),"N.L. (1)",IF(OR(G22>=12,AND(H22>0,I22>0,I22/MA

DATA REQUIRED

ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	Drilling: EFFECTIVE UNIT WT. (KCF.)	Drilling: EFFECTIVE VERT. STRESS (KSF.)	Drilling: CORR. SPT N VALUE $(N_1)_{60}$	Drilling: EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	Drilling: CRR RESIST. MAG 7.5 $CRR_{7.5}$	Earthquake: EFFECTIVE UNIT WT. (KCF.)	Earthquake: EFFECTIVE VERT. STRESS (KSF.)	Earthquake: TOTAL VERT. STRESS (KSF.)	Earthquake: OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR	
372.7	3.5	4	0.8	80			20	0.119	0.417	6.642	12.970	0.140									
370.2	6	8	1.1	80			21	0.123	0.724	12.188	19.626	0.211									
367.7	8.5	0	0.4	80			30	0.111	1.002	0.000	5.000	0.072	0.111	0.233	0.233	1.500	**0.103**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
365.2	11	1	0.6	80			28	0.116	1.292	1.426	6.711	0.085	0.116	0.523	0.523	1.343	**0.109**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
362.7	13.5	2	0.3	80			23	0.108	1.562	2.792	8.350	0.099	0.108	0.793	0.793	1.243	**0.117**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
360.2	16	2	1.1	80			24	0.123	1.869	2.684	8.221	0.098	0.123	1.101	1.101	1.155	**0.107**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
357.7	18.5	3	1	70			31	0.122	2.174	3.854	9.625	0.110	0.122	1.406	1.406	1.099	**0.114**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
355.2	21	3	0.9	70			30	0.120	2.474	3.684	9.420	0.108	0.120	1.706	1.706	1.051	**0.108**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
352.7	23.5	1	0.4	70			24	0.111	2.752	1.177	6.412	0.083	0.111	1.983	1.983	1.014	**0.080**	#DIV/0!	**#DIV/0!**	**N.L. (1)**	
350.2	26	3	1.1	70			20	0.060	2.902	3.462	9.154	0.106	0.060	2.133	2.233	0.999	**0.100**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
347.7	28.5	0	0.4	70			28	0.049	3.024	0.000	5.000	0.072	0.049	2.256	2.511	0.988	**0.067**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
345.2	31	1	0.7	70			24	0.055	3.162	1.113	6.336	0.082	0.055	2.393	2.805	0.975	**0.076**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
342.7	33.5	0	0.6	70			21	0.053	3.294	0.000	5.000	0.072	0.053	2.526	3.093	0.966	**0.066**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
340.2	36	7	1.6	70			24	0.065	3.457	7.465	13.958	0.150	0.065	2.688	3.412	0.941	**0.134**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
337.7	38.5	11	2.3	70			22	0.069	3.629	11.438	18.726	0.200	0.069	2.861	3.740	0.918	**0.174**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
335.2	41	11	2.3	70			29	0.069	3.802	11.161	18.393	0.196	0.069	3.033	4.069	0.903	**0.168**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
330.2	46	6	1.2	70			32	0.061	4.107	5.840	12.008	0.131	0.061	3.338	4.686	0.895	**0.111**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
325.2	51	12	1.6	70			27	0.065	4.432	11.187	18.424	0.197	0.065	3.663	5.323	0.856	**0.160**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
320.2	56	15	2.3	70			26	0.069	4.777	13.367	21.040	0.229	0.069	4.008	5.980	0.826	**0.179**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(D)**
315.2	61	13	2.3	70			27	0.069	5.122	11.081	18.297	0.195	0.069	4.353	6.637	0.816	**0.151**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
310.2	66	6	1.2	70			25	0.061	5.427	4.921	10.905	0.121	0.061	4.658	7.254	0.830	**0.095**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
305.2	71	13	2.3	70			27	0.069	5.772	10.221	17.265	0.184	0.069	5.003	7.911	0.788	**0.137**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
300.2	76	6	0.8	70			25	0.057	6.057	4.565	10.478	0.117	0.057	5.288	8.508	0.807	**0.090**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
295.2	81	11	2.1	70			23	0.068	6.397	8.064	14.677	0.157	0.068	5.628	9.160	0.775	**0.115**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
285.2	91	17	2.7	70			26	0.071	7.107	11.545	18.855	0.202	0.071	6.338	10.494	0.730	**0.140**	#DIV/0!	**#DIV/0!**	**#DIV/0!**	**(C)**
281.2	95	100		10				0.083	7.439	77.593	80.140	0.567	0.083	6.670	11.076	0.632	**0.340**	#DIV/0!	**#DIV/0!**	**N.L. (3)**	
276.2	100	100		10				0.083	7.854	73.020	75.468	0.530	0.083	7.085	11.803	0.617	**0.310**	#DIV/0!	**#DIV/0!**	**N.L. (3)**	
271.2	105	100		10				0.083	8.269	66.551	68.860	0.476	0.083	7.500	12.530	0.603	**0.273**	#DIV/0!	**#DIV/0!**	**N.L. (3)**	

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI ≥ 12 OR w_c/LL ≤ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

LIQUEFACTION ANALYSIS

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/24/10

REFERENCE BORING NUMBER ==================================== 2-S
ELEVATION OF BORING GROUND SURFACE ========================= 376.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ====================== 16.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ================== 10.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.216
EARTHQUAKE MOMENT MAGNITUDE ============================== 5.4
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ============== -6.40 FT. (Cut Depth)
HAMMER EFFICIENCY== 73 %
BOREHOLE DIAMETER== 6 IN.
SAMPLING METHOD== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **2.081**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^*_{s,40'}$ = **#DIV/0!** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 5.4
Source-To-Site Distance, R (km) = 16.3
Ground Motion Prediction Equations = CEUS
PGA = **0.216**

DATA REQUIRED

IF(P22="","",IF(B22>=(K$7+K$12-K$9),"N.L. (1)",IF(OR(G22>=12,AND(H22>0,I22>(

BORING DATA								CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	EFFECTIVE VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
372.7	3.5	7	1	80			19	0.122	0.427	11.686	19.023	0.204								
370.2	6	4	0.8	80			21	0.119	0.725	6.016	12.219	0.133								
367.7	8.5	4	0.6	80			22	0.116	1.015	5.754	11.904	0.130	0.116	0.244	0.244	1.500	**0.407**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
365.2	11	4	0.7	80			24	0.117	1.307	5.682	11.818	0.129	0.117	0.536	0.536	1.396	**0.376**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
362.7	13.5	4	0.7	80			27	0.117	1.600	5.533	11.639	0.128	0.117	0.829	0.829	1.255	**0.334**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
360.2	16	2	0.2	80			27	0.104	1.860	2.690	8.228	0.098	0.104	1.089	1.089	1.158	**0.236**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
357.7	18.5	0	0.6	80			24	0.053	1.992	0.000	5.000	0.072	0.053	1.221	1.352	1.117	**0.167**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
355.2	21	4	0.9	80			20	0.058	2.137	5.265	11.318	0.125	0.058	1.366	1.653	1.111	**0.289**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
352.7	23.5	4	0.9	80			24	0.058	2.282	5.166	11.199	0.124	0.058	1.511	1.954	1.084	**0.279**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
350.2	26	3	0.7	80			22	0.055	2.420	3.798	9.558	0.109	0.055	1.649	2.248	1.059	**0.241**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
347.7	28.5	5	0.4	80			22	0.049	2.542	6.216	12.459	0.135	0.049	1.771	2.526	1.045	**0.295**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
345.2	31	0		60			27	-0.062	2.387	0.000	5.000	0.072	-0.062	1.616	2.527	1.056	**0.158**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
342.7	33.5	6	1.7	85			36	0.065	2.550	7.512	14.014	0.150	0.065	1.779	2.846	1.046	**0.327**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
340.2	36	11	1.5	85			22	0.064	2.710	13.398	21.078	0.229	0.064	1.939	3.162	1.027	**0.490**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
337.7	38.5	17	2.1	85			25	0.068	2.880	20.966	30.159	0.479	0.068	2.109	3.488	1.002	**0.999**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
335.2	41	12	1.5	85			27	0.064	3.040	13.840	21.608	0.236	0.064	2.269	3.804	0.980	**0.482**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
330.2	46	7	1.2	85			30	0.061	3.345	7.695	14.235	0.152	0.061	2.574	4.421	0.951	**0.302**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
325.2	51	17	1.5	85			27	0.064	3.665	18.255	26.906	0.336	0.064	2.894	5.053	0.900	**0.629**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
320.2	56	14	2.1	85			26	0.068	4.005	13.946	21.735	0.238	0.068	3.234	5.705	0.879	**0.436**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
315.2	61	17	2.5	85			31	0.070	4.355	16.320	24.584	0.284	0.070	3.584	6.367	0.844	**0.499**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
310.2	66	16	2.5	85			25	0.070	4.705	14.468	22.362	0.247	0.070	3.934	7.029	0.826	**0.425**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
305.2	71	19	3.3	85			26	0.074	5.075	16.547	24.857	0.289	0.074	4.304	7.711	0.795	**0.478**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
300.2	76	15	1.5	85			24	0.064	5.395	12.363	19.836	0.213	0.064	4.624	8.343	0.796	**0.353**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
295.2	81	5	0.4	85			22	0.049	5.640	4.004	9.805	0.111	0.049	4.869	8.900	0.826	**0.191**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
286.2	90	100		10				0.083	6.387	86.734	89.478	0.640	0.083	5.616	10.208	0.677	**0.902**	#DIV/0!	**#DIV/0!**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

L I Q U E F A C T I O N   A N A L Y S I S

I.D.O.T. Bureau of Bridges and Structures FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/24/10

REFERENCE BORING NUMBER ==================================== 2-S
ELEVATION OF BORING GROUND SURFACE ========================= 376.20 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ====================== 16.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ================== 10.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.162
EARTHQUAKE MOMENT MAGNITUDE =============================== 7.7
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ============== -6.40 FT. (Cut Depth)
HAMMER EFFICIENCY=== 73 %
BOREHOLE DIAMETER=== 6 IN.
SAMPLING METHOD=== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = **0.948**

AVG. SHEAR WAVE VELOCITY (top 40')
$V^{*}_{s,40'}$ = **#DIV/0!** FT./SEC.

PGA CALCULATOR
Earthquake Moment Magnitude = 7.7
Source-To-Site Distance, R (km) = 109.3
Ground Motion Prediction Equations = NMSZ
PGA = **0.162**

DATA REQUIRED

IF(P22="","",IF(B22>=(K$7+K$12-K$9),"N.L. (1)",IF(OR(G22>=12,AND(H22>0,I22>(

BORING DATA								CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE								
ELEV. OF SAMPLE (FT.)	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	CORR. SPT N VALUE $(N_1)_{60}$	EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$	CRR RESIST. MAG 7.5 $CRR_{7.5}$	EFFECTIVE UNIT WT. (KCF.)	VERT. STRESS (KSF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. $CRR_{7.5}$ CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR
372.7	3.5	7	1	80			19	0.122	0.427	11.686	19.023	0.204								
370.2	6	4	0.8	80			21	0.119	0.725	6.016	12.219	0.133								
367.7	8.5	4	0.6	80			22	0.116	1.015	5.754	11.904	0.130	0.116	0.244	0.244	1.500	**0.185**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
365.2	11	4	0.7	80			24	0.117	1.307	5.682	11.818	0.129	0.117	0.536	0.536	1.396	**0.171**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
362.7	13.5	4	0.7	80			27	0.117	1.600	5.533	11.639	0.128	0.117	0.829	0.829	1.255	**0.152**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
360.2	16	2	0.2	80			27	0.104	1.860	2.690	8.228	0.098	0.104	1.089	1.089	1.158	**0.107**	#DIV/0!	**#DIV/0!**	**N.L. (1)**
357.7	18.5	0	0.6	80			24	0.053	1.992	0.000	5.000	0.072	0.053	1.221	1.352	1.117	**0.076**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
355.2	21	4	0.9	80			20	0.058	2.137	5.265	11.318	0.125	0.058	1.366	1.653	1.111	**0.132**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
352.7	23.5	4	0.9	80			24	0.058	2.282	5.166	11.199	0.124	0.058	1.511	1.954	1.084	**0.127**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
350.2	26	3	0.7	80			22	0.055	2.420	3.798	9.558	0.109	0.055	1.649	2.248	1.059	**0.110**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
347.7	28.5	5	0.4	80			22	0.049	2.542	6.216	12.459	0.135	0.049	1.771	2.526	1.045	**0.134**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
345.2	31	0		60			27	-0.062	2.387	0.000	5.000	0.072	-0.062	1.616	2.527	1.056	**0.072**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
342.7	33.5	6	1.7	85			36	0.065	2.550	7.512	14.014	0.150	0.065	1.779	2.846	1.046	**0.149**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
340.2	36	11	1.5	85			22	0.064	2.710	13.398	21.078	0.229	0.064	1.939	3.162	1.027	**0.223**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
337.7	38.5	17	2.1	85			25	0.068	2.880	20.966	30.159	0.479	0.068	2.109	3.488	1.002	**0.455**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
335.2	41	12	1.5	85			27	0.064	3.040	13.840	21.608	0.236	0.064	2.269	3.804	0.980	**0.220**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
330.2	46	7	1.2	85			30	0.061	3.345	7.695	14.235	0.152	0.061	2.574	4.421	0.951	**0.138**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
325.2	51	17	1.5	85			27	0.064	3.665	18.255	26.906	0.336	0.064	2.894	5.053	0.900	**0.287**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
320.2	56	14	2.1	85			26	0.068	4.005	13.946	21.735	0.238	0.068	3.234	5.705	0.879	**0.199**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
315.2	61	17	2.5	85			31	0.070	4.355	16.320	24.584	0.284	0.070	3.584	6.367	0.844	**0.227**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
310.2	66	16	2.5	85			25	0.070	4.705	14.468	22.362	0.247	0.070	3.934	7.029	0.826	**0.194**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
305.2	71	19	3.3	85			26	0.074	5.075	16.547	24.857	0.289	0.074	4.304	7.711	0.795	**0.218**	#DIV/0!	**#DIV/0!**	**#DIV/0! (D)**
300.2	76	15	1.5	85			24	0.064	5.395	12.363	19.836	0.213	0.064	4.624	8.343	0.796	**0.161**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
295.2	81	5	0.4	85			22	0.049	5.640	4.004	9.805	0.111	0.049	4.869	8.900	0.826	**0.087**	#DIV/0!	**#DIV/0!**	**#DIV/0! (C)**
286.2	90	100		10				0.083	6.387	86.734	89.478	0.640	0.083	5.616	10.208	0.677	**0.411**	#DIV/0!	**#DIV/0!**	**N.L. (3)**

* FACTOR OF SAFETY DESCRIPTIONS
N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR w_c/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60}$ > 25
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

M O D I F I E D I D O T S T A T I C M E T H O D O F E S T I M A T I N G P I L E L E N G T H

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/3/2010

SUBSTRUCTURE================================ East Abutment
REFERENCE BORING ============================ 1-S
GROUND SURFACE ELEV. AT BORING ============== 376.20 FT.
PILE CUTOFF ELEV. ============================ 371.80 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRIV 366.80 FT.
GROUND WATER ELEVATION===================== 352.70 FT.
HAMMER EFFICIENCY============================ 73 %
LRFD or ASD or SEISMIC ========================= LRFD

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1020 KIPS
TOTAL WIDTH OF SUBSTRUCTURE ================ 35.16 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE == 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 232.08 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 87.03 KIPS

PILE TYPE AND SIZE ========== Metal Shell 12"Φ w/.179" walls
Pile Perimeter================= 3.142 FT.
Pile End Bearing Area============= 0.785 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 369.70 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 0.00 FT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
254 KIPS	**251** KIPS	**138** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
365.20	1.60	0.60	1		3.6		5.8	6	0	0	3	7
362.70	2.50	0.30	2		3.0	2.2	14.7	15	0	0	8	9
360.20	2.50	1.10	2		9.4	8.1	23.4	23	0	0	13	12
357.70	2.50	1.00	3		8.8	7.4	31.4	31	0	0	17	14
355.20	2.50	0.90	3		8.0	6.6	35.8	36	0	0	20	17
352.70	2.50	0.40	1		3.9	2.9	44.8	45	0	0	25	19
350.20	2.50	1.10	3		9.4	8.1	49.1	49	0	0	27	22
347.70	2.50	0.40	0		3.9	2.9	55.2	55	0	0	30	24
345.20	2.50	0.70	1		6.5	5.1	61.0	61	0	0	34	27
342.70	2.50	0.60	0		5.7	4.4	74.0	74	0	0	41	29
340.20	2.50	1.60	7		12.4	11.8	91.5	92	0	0	50	32
337.70	2.50	2.30	11		15.7	16.9	107.2	107	0	0	59	34
335.20	2.50	2.30	11		15.7	16.9	114.8	115	0	0	63	37
330.20	5.00	1.20	6		20.2	8.8	137.9	138	0	0	76	42
325.20	5.00	1.60	12		24.8	11.8	167.8	168	0	0	92	47
320.20	5.00	2.30	15		31.4	16.9	199.2	199	0	0	110	52
315.20	5.00	2.30	13		31.4	16.9	222.5	223	0	0	122	57
310.20	5.00	1.20	6		20.2	8.8	250.8	251	0	0	138	62
305.20	5.00	2.30	13		31.4	16.9	271.1	~~271~~	~~0~~	~~0~~	~~149~~	~~67~~
300.20	5.00	0.80	6		14.5	5.9	295.2	~~295~~	~~0~~	~~0~~	~~162~~	~~72~~
295.20	5.00	2.10	11		29.6	15.4	329.2	~~329~~	~~0~~	~~0~~	~~181~~	~~77~~
285.20	10.00	2.70	17		70.0	19.8	627.0	~~627~~	~~0~~	~~0~~	~~345~~	~~87~~
284.20	1.00			Shale		247.7						

Pile Design Table for East Abutment utilizing Boring #1-S

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	138	76	42
	168	92	47
	199	110	52
	223	122	57
	251	138	62
Metal Shell 12"Φ w/.25" walls			
	138	76	42
	168	92	47
	199	110	52
	223	122	57
	251	138	62
	271	149	67
	295	162	72
	329	181	77
Metal Shell 14"Φ w/.25" walls			
	136	75	37
	163	90	42
	199	110	47
	236	130	52
	261	144	57
	296	163	62
	317	175	67
	347	191	72
	388	213	77
Metal Shell 14"Φ w/.312" walls			
	136	75	37
	163	90	42
	199	110	47
	236	130	52
	261	144	57
	296	163	62
	317	175	67
	347	191	72
	388	213	77
Steel HP 8 X 36			
	145	80	42
	175	96	47
	210	115	52
	239	132	57
	266	146	62
Steel HP 10 X 42			
	150	82	37
	180	99	42
	217	119	47
	259	143	52
	294	162	57
	329	181	62

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57			
	153	84	37
	183	101	42
	222	122	47
	265	146	52
	300	165	57
	335	184	62
	368	203	67
	397	218	72
	441	243	77
	454	250	87
Steel HP 12 X 53			
	142	78	32
	167	92	34
	182	100	37
	218	120	42
	265	146	47
	315	173	52
	356	196	57
	398	219	62
Steel HP 12 X 63			
	143	79	32
	168	93	34
	184	101	37
	220	121	42
	267	147	47
	318	175	52
	359	197	57
	402	221	62
	439	241	67
	475	261	72
Steel HP 12 X 74			
	145	80	32
	171	94	34
	186	102	37
	223	123	42
	271	149	47
	322	177	52
	363	200	57
	407	224	62
	445	245	67
	481	265	72
	535	295	77
	589	324	87
Steel HP 12 X 84			
	147	81	32
	173	95	34
	189	104	37
	226	124	42
	274	151	47
	327	180	52
	368	202	57
	413	227	62
	450	248	67
	487	268	72
	542	298	77
	664	365	87

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	140	77	29
	172	95	32
	202	111	34
	218	120	37
	262	144	42
	318	175	47
	378	208	52
	424	233	57
	477	262	62
	517	285	67
	562	309	72
Steel HP 14 X 89			
	141	78	29
	174	96	32
	205	113	34
	221	121	37
	265	146	42
	322	177	47
	383	210	52
	429	236	57
	482	265	62
	523	288	67
	568	313	72
	633	348	77
	705	388	87
Steel HP 14 X 102			
	143	79	29
	177	97	32
	207	114	34
	223	123	37
	268	147	42
	326	179	47
	387	213	52
	433	238	57
	488	268	62
	529	291	67
	574	316	72
	640	352	77
	810	445	87
Steel HP 14 X 117			
	145	80	29
	179	98	32
	210	115	34
	226	124	37
	271	149	42
	329	181	47
	391	215	52
	438	241	57
	493	271	62
	534	294	67
	581	319	72
	647	356	77
	929	511	87
Precast 14"x 14"			
	140	77	32
	163	90	34
	173	95	37
	208	114	42
	254	139	47
Timber Pile			
	130	72	42

M O D I F I E D I D O T S T A T I C M E T H O D O F E S T I M A T I N G P I L E L E N G T H

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/3/2010

SUBSTRUCTURE================================ West Abutment
REFERENCE BORING =========================== 2-S
GROUND SURFACE ELEV. AT BORING ============= 376.20 FT.
PILE CUTOFF ELEV. ============================ 371.90 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRIV 366.90 FT.
GROUND WATER ELEVATION===================== 360.20 FT.
HAMMER EFFICIENCY=========================== 73 %
LRFD or ASD or SEISMIC ======================== LRFD

TOTAL FACTORED SUBSTRUCTURE LOAD ========= 1020 KIPS
TOTAL WIDTH OF SUBSTRUCTURE =============== 35.16 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE == 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 232.08 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 87.03 KIPS

PILE TYPE AND SIZE ========== Metal Shell 12"Φ w/.179" walls
Pile Perimeter================= 3.142 FT.
Pile End Bearing Area============= 0.785 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 370.30 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 0.00 FT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Factored Resistance Available in Boring	Maximum Pile Driveable Length in Boring
254 KIPS	**221** KIPS	**122** KIPS	**57** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
365.20	1.70	0.70	4		4.4		9.6	10	0	0	5	7
362.70	2.50	0.70	4		6.5	5.1	12.4	12	0	0	7	9
360.20	2.50	0.20	2		2.0	1.5	17.3	17	0	0	10	12
357.70	2.50	0.60	0		5.7	4.4	25.2	25	0	0	14	14
355.20	2.50	0.90	4		8.0	6.6	33.2	33	0	0	18	17
352.70	2.50	0.90	4		8.0	6.6	39.8	40	0	0	22	19
350.20	2.50	0.70	3		6.5	5.1	44.1	44	0	0	24	22
347.70	2.50	0.40	5		3.9	2.9	45.0	45	0	0	25	24
345.20	2.50	0.00	0	Medium Sand	0.0	0.0	57.5	58	0	0	32	27
342.70	2.50	1.70	6		12.9	12.5	69.0	69	0	0	38	29
340.20	2.50	1.50	11		11.8	11.0	85.2	85	0	0	47	32
337.70	2.50	2.10	17		14.8	15.4	95.6	96	0	0	53	34
335.20	2.50	1.50	12		11.8	11.0	105.2	105	0	0	58	37
330.20	5.00	1.20	7		20.2	8.8	127.6	128	0	0	70	42
325.20	5.00	1.50	17		23.7	11.0	155.7	156	0	0	86	47
320.20	5.00	2.10	14		29.6	15.4	188.2	188	0	0	104	52
315.20	5.00	2.50	17		33.2	18.4	221.4	221	0	0	122	57
310.20	5.00	2.50	16		33.2	18.4	260.5	~~260~~	~~0~~	~~0~~	~~143~~	~~62~~
305.20	5.00	3.30	19		40.4	24.3	287.6	~~288~~	~~0~~	~~0~~	~~158~~	~~67~~
300.20	5.00	1.50	15		23.7	11.0	303.2	~~303~~	~~0~~	~~0~~	~~167~~	~~72~~
295.20	5.00	0.40	5		7.8	2.9	311.1	~~311~~	~~0~~	~~0~~	~~171~~	~~77~~
287.20	8.00	0.40	5		12.5	2.9	568.3	~~568~~	~~0~~	~~0~~	~~313~~	~~85~~
286.20	1.00			Shale	99.1	247.7	667.3	~~667~~	~~0~~	~~0~~	~~367~~	~~85.7~~
285.20	1.00			Shale	99.1	247.7	766.4	~~766~~	~~0~~	~~0~~	~~422~~	~~86.7~~
284.20	1.00			Shale	99.1	247.7	865.5	~~865~~	~~0~~	~~0~~	~~476~~	~~87.7~~
283.20	1.00			Shale	99.1	247.7	964.5	~~965~~	~~0~~	~~0~~	~~530~~	~~88.7~~
282.20	1.00			Shale	99.1	247.7	1063.6	~~1064~~	~~0~~	~~0~~	~~585~~	~~89.7~~
281.20	1.00			Shale	99.1	247.7	1162.7	~~1163~~	~~0~~	~~0~~	~~639~~	~~90.7~~
280.20	1.00			Shale	99.1	247.7	1261.7	~~1262~~	~~0~~	~~0~~	~~694~~	~~91.7~~
279.20	1.00			Shale	99.1	247.7	1360.8	~~1361~~	~~0~~	~~0~~	~~748~~	~~92.7~~
278.20	1.00			Shale	99.1	247.7	1459.9	~~1460~~	~~0~~	~~0~~	~~803~~	~~93.7~~
277.20	1.00			Shale	99.1	247.7	1558.9	~~1559~~	~~0~~	~~0~~	~~857~~	~~94.7~~
276.20	1.00			Shale		247.7						

Pile Design Table for West Abutment utilizing Boring #2-S

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	156	86	47
	188	104	52
	221	122	57
Metal Shell 12"Φ w/.25" walls			
	156	86	47
	188	104	52
	221	122	57
	260	143	62
	288	158	67
	303	167	72
	311	171	77
Metal Shell 14"Φ w/.25" walls			
	151	83	42
	185	102	47
	223	123	52
	262	144	57
	309	170	62
	338	186	67
	354	195	72
	363	200	77
Metal Shell 14"Φ w/.312" walls			
	151	83	42
	185	102	47
	223	123	52
	262	144	57
	309	170	62
	338	186	67
	354	195	72
	363	200	77
Steel HP 8 X 36			
	134	74	42
	163	89	47
	197	108	52
	233	128	57
	273	150	62
Steel HP 10 X 42			
	137	75	37
	166	91	42
	202	111	47
	244	134	52
	288	159	57

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57			
	140	77	37
	169	93	42
	206	113	47
	249	137	52
	294	162	57
	345	190	62
	388	214	67
	414	227	72
	424	233	77
	454	250	85
Steel HP 12 X 53			
	150	83	34
	167	92	37
	202	111	42
	246	135	47
	297	163	52
	351	193	57
	411	226	62
Steel HP 12 X 63			
	152	83	34
	168	92	37
	204	112	42
	248	136	47
	300	165	52
	354	195	57
	415	228	62
	464	255	67
	492	271	72
Steel HP 12 X 74			
	154	85	34
	170	94	37
	206	114	42
	251	138	47
	304	167	52
	358	197	57
	421	231	62
	470	258	67
	498	274	72
	511	281	77
	589	324	85
Steel HP 12 X 84			
	156	86	34
	173	95	37
	209	115	42
	255	140	47
	308	169	52
	363	200	57
	426	234	62
	476	262	67
	505	278	72
	518	285	77
	664	365	85

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	130	72	29
	160	88	32
	181	100	34
	200	110	37
	242	133	42
	295	162	47
	357	196	52
	420	231	57
	494	272	62
	548	301	67
Steel HP 14 X 89			
	132	72	29
	162	89	32
	183	101	34
	202	111	37
	245	135	42
	299	164	47
	361	199	52
	425	234	57
	500	275	62
	554	305	67
	585	322	72
	601	330	77
	705	388	85
Steel HP 14 X 102			
	133	73	29
	164	90	32
	185	102	34
	204	112	37
	248	136	42
	302	166	47
	365	201	52
	430	237	57
	506	278	62
	560	308	67
	592	325	72
	607	334	77
	805	443	85
	810	445	86
Steel HP 14 X 117			
	135	74	29
	167	92	32
	187	103	34
	207	114	37
	251	138	42
	306	168	47
	369	203	52
	435	239	57
	511	281	62
	566	311	67
	598	329	72
	613	337	77
	816	449	85
	929	511	87
Precast 14"x 14"			
	145	80	34
	158	87	37
	192	106	42
	235	129	47
Timber Pile			
	146	80	47

MODIFIED IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/3/2010

SUBSTRUCTURE================================ West Abutment
REFERENCE BORING =========================== 2-S
GROUND SURFACE ELEV. AT BORING ============= 376.20 FT.
PILE CUTOFF ELEV. ============================ 371.90 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRIV 366.90 FT.
GROUND WATER ELEVATION===================== 360.20 FT.
HAMMER EFFICIENCY=========================== 73 %
LRFD or ASD or SEISMIC ========================SEISMIC

TOTAL SEISMIC SUBSTRUCTURE LOAD =========== 1020 KIPS
TOTAL WIDTH OF SUBSTRUCTURE ================ 35.16 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE == 1

Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts 232.08 KIPS
Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts 87.03 KIPS

PILE TYPE AND SIZE ========== Metal Shell 12"Φ w/.179" walls

Pile Perimeter================= 3.142 FT.
Pile End Bearing Area============= 0.785 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 370.30 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 0.00 FT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Seismic Resistance Available in Boring	Maximum Pile Driveable Length in Boring
254 KIPS	**221** KIPS	**221** KIPS	**57** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE SIDE RESIST. (KIPS)	ULTIMATE END BRG. RESIST. (KIPS)	ULTIMATE TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	NOMINAL GEOTECH. LOSS FROM LIQUEF. & DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	SEISMIC RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
365.20	1.70	0.70	4		4.4		9.6	10	0	0	10	7
362.70	2.50	0.70	4		6.5	5.1	12.4	12	0	0	12	9
360.20	2.50	0.20	2		2.0	1.5	17.3	17	0	0	17	12
357.70	2.50	0.60	0		5.7	4.4	25.2	25	0	0	25	14
355.20	2.50	0.90	4		8.0	6.6	33.2	33	0	0	33	17
352.70	2.50	0.90	4		8.0	6.6	39.8	40	0	0	40	19
350.20	2.50	0.70	3		6.5	5.1	44.1	44	0	0	44	22
347.70	2.50	0.40	5		3.9	2.9	45.0	45	0	0	45	24
345.20	2.50	0.00	0	Medium Sand	0.0	0.0	57.5	58	0	0	58	27
342.70	2.50	1.70	6		12.9	12.5	69.0	69	0	0	69	29
340.20	2.50	1.50	11		11.8	11.0	85.2	85	0	0	85	32
337.70	2.50	2.10	17		14.8	15.4	95.6	96	0	0	96	34
335.20	2.50	1.50	12		11.8	11.0	105.2	105	0	0	105	37
330.20	5.00	1.20	7		20.2	8.8	127.6	128	0	0	128	42
325.20	5.00	1.50	17		23.7	11.0	155.7	156	0	0	156	47
320.20	5.00	2.10	14		29.6	15.4	188.2	188	0	0	188	52
315.20	5.00	2.50	17		33.2	18.4	221.4	221	0	0	221	57
310.20	5.00	2.50	16		33.2	18.4	260.5	~~260~~	~~0~~	~~0~~	~~260~~	~~62~~
305.20	5.00	3.30	19		40.4	24.3	287.6	~~288~~	~~0~~	~~0~~	~~288~~	~~67~~
300.20	5.00	1.50	15		23.7	11.0	303.2	~~303~~	~~0~~	~~0~~	~~303~~	~~72~~
295.20	5.00	0.40	5		7.8	2.9	311.1	~~311~~	~~0~~	~~0~~	~~311~~	~~77~~
287.20	8.00	0.40	5		12.5	2.9	568.3	~~568~~	~~0~~	~~0~~	~~568~~	~~85~~
286.20	1.00			Shale	99.1	247.7	667.3	~~667~~	~~0~~	~~0~~	~~667~~	~~85.7~~
285.20	1.00			Shale	99.1	247.7	766.4	~~766~~	~~0~~	~~0~~	~~766~~	~~86.7~~
284.20	1.00			Shale	99.1	247.7	865.5	~~865~~	~~0~~	~~0~~	~~865~~	~~87.7~~
283.20	1.00			Shale	99.1	247.7	964.5	~~965~~	~~0~~	~~0~~	~~965~~	~~88.7~~
282.20	1.00			Shale	99.1	247.7	1063.6	~~1064~~	~~0~~	~~0~~	~~1064~~	~~89.7~~
281.20	1.00			Shale	99.1	247.7	1162.7	~~1163~~	~~0~~	~~0~~	~~1163~~	~~90.7~~
280.20	1.00			Shale	99.1	247.7	1261.7	~~1262~~	~~0~~	~~0~~	~~1262~~	~~91.7~~
279.20	1.00			Shale	99.1	247.7	1360.8	~~1361~~	~~0~~	~~0~~	~~1361~~	~~92.7~~
278.20	1.00			Shale	99.1	247.7	1459.9	~~1460~~	~~0~~	~~0~~	~~1460~~	~~93.7~~
277.20	1.00			Shale	99.1	247.7	1558.9	~~1559~~	~~0~~	~~0~~	~~1559~~	~~94.7~~
276.20	1.00			Shale		247.7						

Pile Design Table for West Abutment utilizing Boring #2-S

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	85	85	32
	96	96	34
	105	105	37
	128	128	42
	156	156	47
	188	188	52
	221	221	57
Metal Shell 12"Φ w/.25" walls			
	85	85	32
	96	96	34
	105	105	37
	128	128	42
	156	156	47
	188	188	52
	221	221	57
	260	260	62
	288	288	67
	303	303	72
	311	311	77
Metal Shell 14"Φ w/.25" walls			
	83	83	29
	102	102	32
	114	114	34
	124	124	37
	151	151	42
	185	185	47
	223	223	52
	262	262	57
	309	309	62
	338	338	67
	354	354	72
	363	363	77
Metal Shell 14"Φ w/.312" walls			
	83	83	29
	102	102	32
	114	114	34
	124	124	37
	151	151	42
	185	185	47
	223	223	52
	262	262	57
	309	309	62
	338	338	67
	354	354	72
	363	363	77
Steel HP 8 X 36			
	85	85	32
	99	99	34
	111	111	37
	134	134	42
	163	163	47
	197	197	52
	233	233	57
	273	273	62
Steel HP 10 X 42			
	71	71	27
	87	87	29
	107	107	32
	123	123	34
	137	137	37
	166	166	42
	202	202	47
	244	244	52
	288	288	57

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57			
	73	73	27
	89	89	29
	109	109	32
	126	126	34
	140	140	37
	169	169	42
	206	206	47
	249	249	52
	294	294	57
	345	345	62
	388	388	67
	414	414	72
	424	424	77
	454	454	85
Steel HP 12 X 53			
	73	73	24
	88	88	27
	107	107	29
	132	132	32
	150	150	34
	167	167	37
	202	202	42
	246	246	47
	297	297	52
	351	351	57
	411	411	62
Steel HP 12 X 63			
	73	73	24
	89	89	27
	108	108	29
	133	133	32
	152	152	34
	168	168	37
	204	204	42
	248	248	47
	300	300	52
	354	354	57
	415	415	62
	464	464	67
	492	492	72
Steel HP 12 X 74			
	74	74	24
	90	90	27
	110	110	29
	135	135	32
	154	154	34
	170	170	37
	206	206	42
	251	251	47
	304	304	52
	358	358	57
	421	421	62
	470	470	67
	498	498	72
	511	511	77
	589	589	85
Steel HP 12 X 84			
	75	75	24
	92	92	27
	111	111	29
	137	137	32
	156	156	34
	173	173	37
	209	209	42
	255	255	47
	308	308	52
	363	363	57
	426	426	62
	476	476	67
	505	505	72
	518	518	77
	664	664	85

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	86	86	24
	108	108	27
	130	130	29
	160	160	32
	181	181	34
	200	200	37
	242	242	42
	295	295	47
	357	357	52
	420	420	57
	494	494	62
	548	548	67
Steel HP 14 X 89			
	87	87	24
	109	109	27
	132	132	29
	162	162	32
	183	183	34
	202	202	37
	245	245	42
	299	299	47
	361	361	52
	425	425	57
	500	500	62
	554	554	67
	585	585	72
	601	601	77
	705	705	85
Steel HP 14 X 102			
	86	86	22
	88	88	24
	111	111	27
	133	133	29
	164	164	32
	185	185	34
	204	204	37
	248	248	42
	302	302	47
	365	365	52
	430	430	57
	506	506	62
	560	560	67
	592	592	72
	607	607	77
	805	805	85
	810	810	86
Steel HP 14 X 117			
	87	87	22
	89	89	24
	112	112	27
	135	135	29
	167	167	32
	187	187	34
	207	207	37
	251	251	42
	306	306	47
	369	369	52
	435	435	57
	511	511	62
	566	566	67
	598	598	72
	613	613	77
	816	816	85
	929	929	87
Precast 14"x 14"			
	67	67	24
	89	89	27
	105	105	29
	130	130	32
	145	145	34
	158	158	37
	192	192	42
	235	235	47
Timber Pile			
	75	75	32
	88	88	34
	99	99	37
	120	120	42
	146	146	47

M O D I F I E D   I D O T   S T A T I C   M E T H O D   O F   E S T I M A T I N G   P I L E   L E N G T H

I.D.O.T. BBS FOUNDATIONS AND GEOTECHNICAL UNIT

Modified 5/3/2010

SUBSTRUCTURE================================ East Abutment
REFERENCE BORING =========================== 1-S
GROUND SURFACE ELEV. AT BORING ============= 376.20 FT.
PILE CUTOFF ELEV. ============================ 371.80 FT.
GROUND SURFACE ELEV. AGAINST PILE DURING DRIV 366.80 FT.
GROUND WATER ELEVATION===================== 352.70 FT.
HAMMER EFFICIENCY=========================== 73 %
LRFD or ASD or SEISMIC ======================== SEISMIC

TOTAL SEISMIC SUBSTRUCTURE LOAD =========== 1020 KIPS
TOTAL WIDTH OF SUBSTRUCTURE ================ 35.16 FT.
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE == 1
Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts 232.08 KIPS
Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts 87.03 KIPS

PILE TYPE AND SIZE ========== Metal Shell 12"Φ w/.179" walls
Pile Perimeter================= 3.142 FT.
Pile End Bearing Area============= 0.785 SQFT.

GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) = None
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========= 369.70 FT.
TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 0.00 FT.

MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses

Maximum Nominal Req'd Bearing of Pile	Maximum Nominal Req.d Bearing of Boring	Maximum Seismic Resistance Available in Boring	Maximum Pile Driveable Length in Boring
254 KIPS	**251** KIPS	**251** KIPS	**62** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE SIDE RESIST. (KIPS)	ULTIMATE END BRG. RESIST. (KIPS)	ULTIMATE TOTAL RESIST. (KIPS)	NOMINAL REQ'D BEARING (KIPS)	NOMINAL GEOTECH. LOSS FROM LIQUEF. & DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	SEISMIC RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
365.20	1.60	0.60	1		3.6		5.8	6	0	0	6	7
362.70	2.50	0.30	2		3.0	2.2	14.7	15	0	0	15	9
360.20	2.50	1.10	2		9.4	8.1	23.4	23	0	0	23	12
357.70	2.50	1.00	3		8.8	7.4	31.4	31	0	0	31	14
355.20	2.50	0.90	3		8.0	6.6	35.8	36	0	0	36	17
352.70	2.50	0.40	1		3.9	2.9	44.8	45	0	0	45	19
350.20	2.50	1.10	3		9.4	8.1	49.1	49	0	0	49	22
347.70	2.50	0.40	0		3.9	2.9	55.2	55	0	0	55	24
345.20	2.50	0.70	1		6.5	5.1	61.0	61	0	0	61	27
342.70	2.50	0.60	0		5.7	4.4	74.0	74	0	0	74	29
340.20	2.50	1.60	7		12.4	11.8	91.5	92	0	0	92	32
337.70	2.50	2.30	11		15.7	16.9	107.2	107	0	0	107	34
335.20	2.50	2.30	11		15.7	16.9	114.8	115	0	0	115	37
330.20	5.00	1.20	6		20.2	8.8	137.9	138	0	0	138	42
325.20	5.00	1.60	12		24.8	11.8	167.8	168	0	0	168	47
320.20	5.00	2.30	15		31.4	16.9	199.2	199	0	0	199	52
315.20	5.00	2.30	13		31.4	16.9	222.5	223	0	0	223	57
310.20	5.00	1.20	6		20.2	8.8	250.8	251	0	0	251	62
305.20	5.00	2.30	13		31.4	16.9	271.1	~~271~~	~~0~~	~~0~~	~~271~~	~~67~~
300.20	5.00	0.80	6		14.5	5.9	295.2	~~295~~	~~0~~	~~0~~	~~295~~	~~72~~
295.20	5.00	2.10	11		29.6	15.4	329.2	~~329~~	~~0~~	~~0~~	~~329~~	~~77~~
285.20	10.00	2.70	17		70.0	19.8	627.0	~~627~~	~~0~~	~~0~~	~~627~~	~~87~~
284.20	1.00			Shale		247.7						

Pile Design Table for East Abutment utilizing Boring #1-S

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	74	74	29
	92	92	32
	107	107	34
	115	115	37
	138	138	42
	168	168	47
	199	199	52
	223	223	57
	251	251	62
Metal Shell 12"Φ w/.25" walls			
	74	74	29
	92	92	32
	107	107	34
	115	115	37
	138	138	42
	168	168	47
	199	199	52
	223	223	57
	251	251	62
	271	271	67
	295	295	72
	329	329	77
Metal Shell 14"Φ w/.25" walls			
	72	72	27
	89	89	29
	110	110	32
	128	128	34
	136	136	37
	163	163	42
	199	199	47
	236	236	52
	261	261	57
	296	296	62
	317	317	67
	347	347	72
	388	388	77
Metal Shell 14"Φ w/.312" walls			
	72	72	27
	89	89	29
	110	110	32
	128	128	34
	136	136	37
	163	163	42
	199	199	47
	236	236	52
	261	261	57
	296	296	62
	317	317	67
	347	347	72
	388	388	77
Steel HP 8 X 36			
	75	75	29
	92	92	32
	109	109	34
	121	121	37
	145	145	42
	175	175	47
	210	210	52
	239	239	57
	266	266	62
Steel HP 10 X 42			
	80	80	27
	94	94	29
	115	115	32
	136	136	34
	150	150	37
	180	180	42
	217	217	47
	259	259	52
	294	294	57
	329	329	62

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 10 X 57			
	81	81	27
	96	96	29
	117	117	32
	139	139	34
	153	153	37
	183	183	42
	222	222	47
	265	265	52
	300	300	57
	335	335	62
	368	368	67
	397	397	72
	441	441	77
	454	454	87
Steel HP 12 X 53			
	78	78	22
	87	87	24
	97	97	27
	115	115	29
	142	142	32
	167	167	34
	182	182	37
	218	218	42
	265	265	47
	315	315	52
	356	356	57
	398	398	62
Steel HP 12 X 63			
	79	79	22
	88	88	24
	98	98	27
	116	116	29
	143	143	32
	168	168	34
	184	184	37
	220	220	42
	267	267	47
	318	318	52
	359	359	57
	402	402	62
	439	439	67
	475	475	72
Steel HP 12 X 74			
	80	80	22
	89	89	24
	99	99	27
	118	118	29
	145	145	32
	171	171	34
	186	186	37
	223	223	42
	271	271	47
	322	322	52
	363	363	57
	407	407	62
	445	445	67
	481	481	72
	535	535	77
	589	589	87
Steel HP 12 X 84			
	81	81	22
	90	90	24
	100	100	27
	119	119	29
	147	147	32
	173	173	34
	189	189	37
	226	226	42
	274	274	47
	327	327	52
	368	368	57
	413	413	62
	450	450	67
	487	487	72
	542	542	77
	664	664	87

	Nominal Required Bearing (Kips)	Seismic Resistance Available (Kips)	Estimated Pile Length (Ft.)
Steel HP 14 X 73			
	84	84	19
	93	93	22
	105	105	24
	116	116	27
	140	140	29
	172	172	32
	202	202	34
	218	218	37
	262	262	42
	318	318	47
	378	378	52
	424	424	57
	477	477	62
	517	517	67
	562	562	72
Steel HP 14 X 89			
	85	85	19
	94	94	22
	106	106	24
	117	117	27
	141	141	29
	174	174	32
	205	205	34
	221	221	37
	265	265	42
	322	322	47
	383	383	52
	429	429	57
	482	482	62
	523	523	67
	568	568	72
	633	633	77
	705	705	87
Steel HP 14 X 102			
	87	87	19
	96	96	22
	107	107	24
	119	119	27
	143	143	29
	177	177	32
	207	207	34
	223	223	37
	268	268	42
	326	326	47
	387	387	52
	433	433	57
	488	488	62
	529	529	67
	574	574	72
	640	640	77
	810	810	87
Steel HP 14 X 117			
	70	70	17
	88	88	19
	97	97	22
	108	108	24
	120	120	27
	145	145	29
	179	179	32
	210	210	34
	226	226	37
	271	271	42
	329	329	47
	391	391	52
	438	438	57
	493	493	62
	534	534	67
	581	581	72
	647	647	77
	929	929	87
Precast 14"x 14"			
	83	83	24
	92	92	27
	113	113	29
	140	140	32
	163	163	34
	173	173	37
	208	208	42
	254	254	47
Timber Pile			
	80	80	32
	96	96	34
	109	109	37
	130	130	42

Exhibit G - Estimated Pile Types and Lengths for Modified Factored Load Conditions

	Pile Designation	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Modified Load Condition (%)	Total Factored Load (kips)	Estimated Pile Length (ft)	Pile Tip Elevation
East Abutment (Boring 1-S)	**Metal Shell 12" w .179" walls**	251	138	85%	867	62	310
				100%	1020	62	310
				115%	1173	62	310
				130%	1326	62	310
	Metal Shell 14" w .25" walls	388	213	85%	867	77	295
				100%	1020	77	295
				115%	1173	77	295
				130%	1326	77	295
	HP 10x57	454	250	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285
	HP 12X74	589	324	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285
	HP 12X84	664	365	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285
	HP 14X89	705	388	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285

Exhibit G - Estimated Pile Types and Lengths for Modified Factored Load Conditions

	Pile Designation	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Modified Load Condition (%)	Total Factored Load (kips)	Estimated Pile Length (ft)	Pile Tip Elevation
West Abutment (Boring 2-S)	**Metal Shell 12" w .179" walls**	221	122	85%	867	57	315
				100%	1020	57	315
				115%	1173	57	315
				130%	1326	57	315
	Metal Shell 14" w .25" walls	363	200	85%	867	77	295
				100%	1020	77	295
				115%	1173	77	295
				130%	1326	77	295
	HP 10x57	454	250	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287
	HP 12X74	589	324	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287
	HP 12X84	664	365	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287
	HP 14X89	705	388	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287

Illinois Department of Transportation

Memorandum

To:	Carrie Nelsen	Attn: Dave Piche
From:	Greg Smothers	By: Rob Graeff
Subject:	*Boring Logs & Liquefaction Analysis	
Date:	December 10, 2009	

FAP 877 (IL 141) over Tributary to Cane Creek
Structure 097-0036(E)
White County

Foundation boring logs have been obtained for the above listed structure and are attached.

Liquefaction Analysis

Liquefaction calculations indicate the presence of liquefiable soils at this structure location in Boring 2-S only.

Slope Stability

At the time of this report, a preliminary TSL is not available. Therefore, we are unable to provide any slope stability calculations for the proposed endslope configuration. This office should be contacted to complete the slope stability calculations when a proposed endslope configuration is determined.

Structure Geotechnical Report

Due to a current shortage of staffing, the District Nine Geotechnical Unit is unable to complete the required Structure Geotechnical Report. Any additional foundation recommendations should be evaluated by a competent consultant.

Attachments
RG:rg

cc: Soils File

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 877 (IL 141) Over Trib Cane Creek

Route: FAP 877 (IL 141 Structure Number: 097-0036 Date: 10/28/2009

Section 101BR-1 Bored By: R Moberly

County: White Location: 0.25 mile East Jct. IL Rte 1 Checked By: Rob Graeff

Boring No 1-S
Station 7+77
Offset 7' Rt CL
Ground Surface 376.2 Ft

Surf Wat Elev: 360.5
Ground Water Elevation
when Drilling 352.7
At Completion 357.7
At: Hrs:

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
Asphalt, Concrete & crushed aggregate	374.2				
Medium, very moist, brown, Silty Clay to Silty Clay Loam A-6	371.7		1 / 2 / 2	0.8B	20
Stiff, moist, grey, Silty Clay Loam A-4	369.2	5.0	1 / 4 / 4	1.1S	21
Soft, very moist, grey, Silty Clay Loam A-4	366.7		WH / WH / WH	0.4B	30
Medium to soft, very moist, grey, Silty Clay Loam A-6		10.0	WH / 1 / WH	0.6B	28
	361.7		1 / 1 / 1	0.3B	23
Stiff, moist to very moist, grey mottled brown, Silty Clay Loam A-6	359.2	15.0	1 / 1 / 1	1.1B	24
Medium to stiff, moist, brown mottled grey, Silty Clay to Clay A7-6			1 / 1 / 2	1.0B	31
	354.2	20.0	1 / 1 / 2	0.9B	30
Soft, very moist, grey, Silty Clay to Clay A7-6 with Sandy seams	351.7		WH / 1 / WH	0.4B	24
		25.0	1		

Description	Elev.	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, grey mottled brown, Clay to Silty Clay A7-6	349.2		1 / 2	1.1B	20
Soft to medium , very moist, grey and brown, Clay to Silty Clay A7-6			WH / WH / WH	0.4B	28
		30.0	WH / 1 / WH	0.7B	24
	341.7		WH / WH / WH	0.6B	21
Stiff, moist, grey, Clay A7-6	339.2	35.0	1 / 3 / 4	1.6B	24
Very stiff, moist, grey, Clay A7-6			2 / 4 / 7	2.3B	22
	331.7	40.0	2 / 4 / 7	2.3B	29
Stiff, moist, grey, Clay A7-6		45.0	1 / 3 / 3	1.2B	32
		50.0	3		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 877 (IL 141) **Date:** 10/28/2009

Section: 101BR-1

County: White

Boring No: 1-S
Station: 7+77
Offset: 7' Rt CL
Ground Surface: 376.2 Ft

Description	DEPTH	BLOWS	Qu tsf	W%	Description	DEPTH	BLOWS	Qu tsf	W%
Stiff, moist, grey, Clay A7-6		5	1.6B	27	A7-6		2	0.8B	25
		7					3		
321.7					296.7				
Very stiff, moist, grey, Clay to Silty Clay A7-6	55.0	3			Very stiff, moist, grey, Clay A7-6	80.0	1		
		6	2.3B	26			4	2.1B	23
		9					7		
	60.0	2				85.0			
		5	2.3B	27					
		8							
311.7									
Stiff, moist, grey, Silty Clay to Clay A7-6	65.0	1				90.0	2		
		3	1.2B	25			5	2.7B	26
		3					12		
					284.2				
					Hard, dry, grey, Clay Shale				
306.7									
Very stiff, moist, grey, Clay A7-6	70.0	2				95.0	100/2"		
		5	2.3B	27					
		8							
301.7									
Medium, very moist, grey, Clay	75.0	1				100.0	100/2"		

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 877 (IL 141)
Date: 10/28/2009
Section: 101BR-1
County: White

Boring No: 1-S
Station: 7+77
Offset: 7' Rt CL
Ground Surface: 376.2 Ft

	DEPTH	BLOWS	Qu tsf	W%		DEPTH	BLOWS	Qu tsf	W%
Hard, dry, grey, Clay Shale									
271.2	105.0	100/1"				130.0			
Bottom of hole = 104.6 feet									
Free water observed at 23.5 feet									
Elevation referenced to BM @ SW wingwall; Elev.= 374.0 feet									
Note: To convert "N" values to "N60" multiply by 1.25	110.0					135.0			
	115.0					140.0			
	120.0					145.0			
	125.0					150.0			

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation Boring Log

FAP 877 (IL 141) Over Trib Cane Creek

Route: FAP 877 (IL 141   Structure Number: 097-0036   Date: 10/29/2009

Section 101BR-1   Bored By: R Moberly

County: White   Location: 0.25 mile East Jct. IL Rte 1   Checked By: Rob Graeff

Boring No 2-S
Station 6+87
Offset 7' Lt CL
Ground Surface 376.2 Ft

Surf Wat Elev: 360.5
Ground Water Elevation when Drilling 360.2
At Completion
At: Hrs:

Description	Depth	Blows	Qu tsf	W%
Asphalt, concrete and crushed aggregate				
374.7				
Medium to stiff, moist, brown, Silty Clay Loam A-4		1		
		4	1.0S	19
		3		
	5.0	1		
		2	0.8B	21
		2		
369.2				
Medium, very moist, grey, Silty Clay Loam A-6		1		
		2	0.6B	22
		2		
	10.0	1		
		2	0.7B	24
		2		
		1		
		2	0.7B	27
		2		
361.7				
Very soft, very moist, brown, Clay Loam A-6 with some gravel	15.0	WH		
		1	0.2B	27
		1		
359.2				
Medium, very moist, brown mottled grey, Clay A7-6		WH		
		WH	0.6B	24
		WH		
	20.0	1		
		2	0.9B	20
		2		
		1		
		2	0.9B	24
		2		
351.7				
	25.0	1		

Description	Depth	Blows	Qu tsf	W%
Medium, very moist, grey, Clay to Clay Loam A-6		1	0.7B	22
		2		
349.2				
Soft, very moist, grey, Clay Loam to Clay A-6		1		
		1	0.4B	22
		4		
346.7				
Very loose, wet, grey, Sand	30.0	WH		
87% Sand		WH		27
10% Silt		WH		
3% Clay				
344.2				
Stiff, moist, grey, Clay A7-6		1		
		3	1.7B	36
		3		
	35.0	2		
		4	1.5B	22
		7		
339.2				
Very stiff to stiff, moist, grey, Clay A7-6		3		
		7	2.1B	25
		10		
	40.0	2		
		5	1.5B	27
		7		
	45.0	2		
		3	1.2B	30
		4		
326.7				
	50.0	3		

N-Std Pentr Test: 2" OD Sampler, 140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

Route: FAP 877 (IL 141) **Date:** 10/29/2009

Section: 101BR-1

County: White

Boring No: 2-S
Station: 6+87
Offset: 7' Lt CL
Ground Surface: 376.2 Ft

Description	DEPTH	BLOWS	Qu tsf	W%
Very stiff to stiff, moist, grey, Clay A7-6 with Sand layers		7	1.5B	27
		10		
	55.0	2		
		6	2.1B	26
		8		
316.7				
Very stiff to stiff, moist, grey, Clay A7-6	60.0	3		
		7	2.5B	31
		10		
	65.0	3		
		7	2.5B	25
		9		
	70.0	4		
		8	3.3B	26
		11		
	75.0	2		

Description	DEPTH	BLOWS	Qu tsf	W%
Very stiff to stiff, moist, grey, Clay A7-6		6	1.5B	24
		9		
296.7				
Soft, very moist, grey, Clay A7-6	80.0	1		
		2	0.4B	22
		3		
	85.0			
287.2				
Hard, damp, grey, Clay Shale				
286.2	90.0	100/6"		
	95.0			
	100.0			

Bottom of hole = 90.0 feet

Free water observed at 16.0 feet

Elevation referenced to BM @ SW wingwall; Elev. = 374.0 feet

Note: To convert "N" values to "N60" multiply by 1.25

N-Std Pentr Test: 2" OD Sampler,140# Hammer, 30" Fall (Type Fail. B-Bulge S-Shear E-Estimated P-Penetrometer)

LIQUEFACTION POTENTIAL ANALYSIS

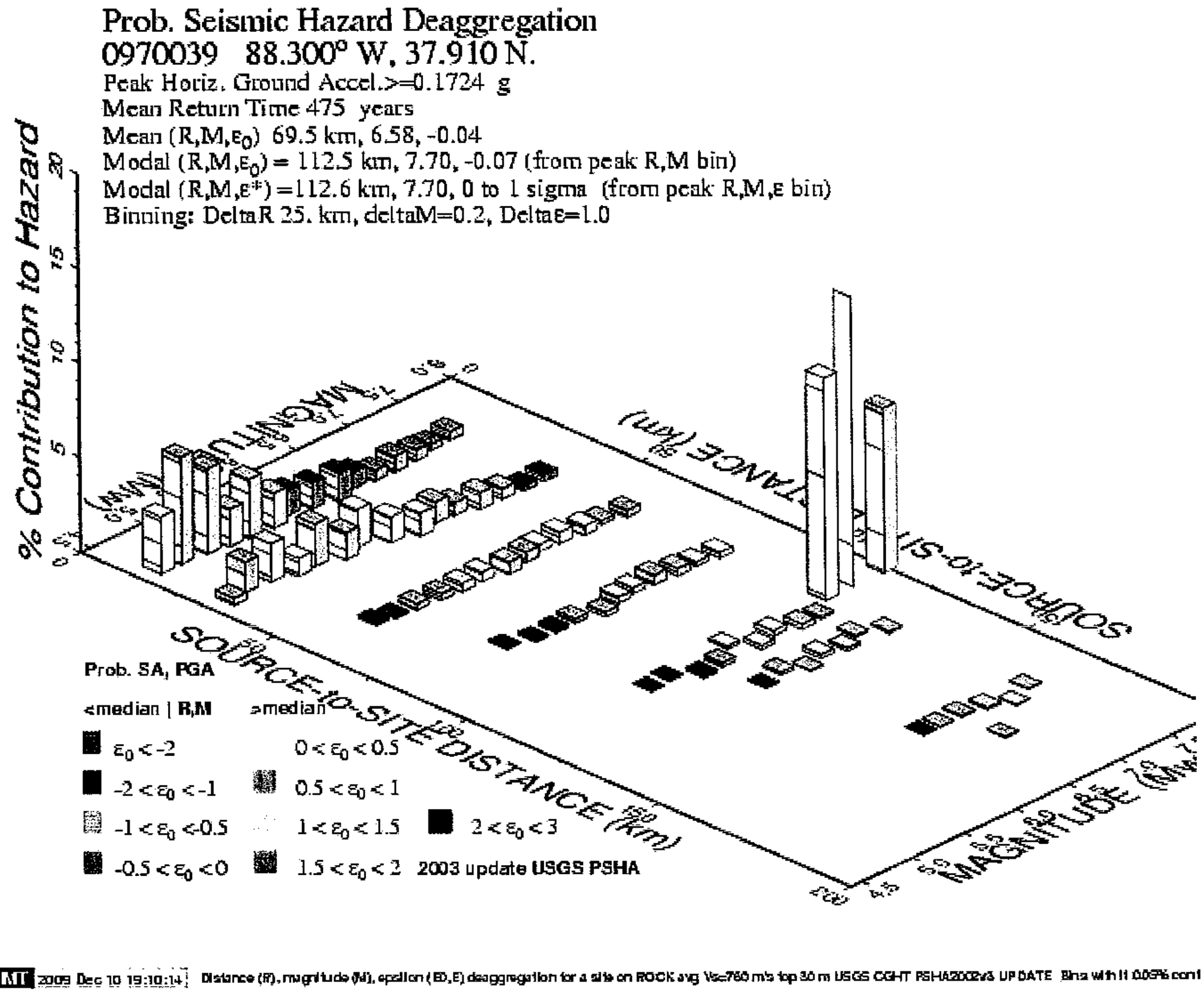
BUREAU OF BRIDGES AND STRUCTURES FOUNDATIONS UNIT wmk 8/25/01

REFERENCE BORING NUMBER================================	2-S	
STRUCTURE NUMBER======================================	097-0036	
ELEVATION OF BORING GROUND SURFACE=====================	376	Feet
DEPTH TO GROUNDWATER DURING DRILLING===================	16	Feet (Below Boring Ground Surface)
DEPTH TO GROUNDWATER DURING EARTHQUAKE=================	16	Feet (Below Finished Grade Cut or Fill Surface)
MAX. HORZ. GROUND SURFACE ACCELERATION=================	0.1724	Coefficient of Gravity
DESIGN EARTHQUAKE MEAN MAGNITUDE=======================	6.58	Moment Magnetude Scale
FINISHED GRADE FILL OR CUT FROM BORING SURFACE===========	0	Ft. Which is 0 ksf Effect.Surch.Fill Press.
ADJUST DIST. #9 N VALUES TO 60% ENERGY TRANSFER==========	1	(1=Yes OR 2=No)

Sloped Ground Shear Stress Correct. Factor ($K\alpha$)	1.00
Earthquake Magnitude Scaling Factor (MSF)=	1.397

	Boring Data			Conditions During Drilling					Conditions During Earthquake							
Elev. of Sample (Feet)	Boring Sample Depth (Feet)	S.P.T. N Value (Blows)	% Fines < #200 (%)	Effect. Unit Weight (KCF.)	Effect. Vertical Stress (KSF.)	Overburd. & Drillrod Corrected (Ni)60	Fines Content Corrected (Ni)60cs	CSR Resisting Mag 7.5 CRR(7.5)	Effect. Unit Weight (KCF.)	Effect. Vertical Stress (KSF.)	Total Vertical Stress (KSF.)	Confining, Sloping & Mag. Correct. ($K\sigma$)($K\alpha$)(MSF)	**Corrected CRR(7.5) Resisting CRR**	Stress Reduct. Factor (rd)	**Earth Quake Induced CSR**	FACTOR OF SAFETY CRR/CSR
373.5	2.5	7	nl	0.117	0.292	13.514	21.217	0.230	0.117	0.292	0.292	1.566	**0.361**	0.994	**0.111**	**ABO. WAT.**
371	5	4	nl	0.111	0.576	7.406	13.887	0.150	0.111	0.569	0.569	1.547	**0.232**	0.988	**0.111**	**ABO. WAT.**
368.5	7.5	4	nl	0.111	0.853	6.257	12.509	0.135	0.111	0.830	0.830	1.534	**0.208**	0.981	**0.110**	**ABO. WAT.**
366	10	4	nl	0.111	1.130	5.585	11.702	0.127	0.111	1.107	1.107	1.527	**0.193**	0.975	**0.109**	**ABO. WAT.**
363.5	12.5	4	nl	0.111	1.406	5.138	11.166	0.121	0.111	1.384	1.384	1.525	**0.184**	0.969	**0.109**	**ABO. WAT.**
361	15	2	nl	0.104	1.674	2.415	7.898	0.088	0.104	1.608	1.608	1.528	**0.134**	0.963	**0.108**	**ABO. WAT.**
358.5	17.5	1	nl	0.044	1.859	1.175	6.410	0.075	0.044	1.294	1.388	1.525	**0.114**	0.956	**0.115**	**NL**
356	20	4	nl	0.055	1.983	4.662	10.594	0.115	0.055	0.994	1.243	1.529	**0.176**	0.950	**0.133**	**NL**
353.5	22.5	4	nl	0.055	2.121	4.616	10.539	0.114	0.055	1.240	1.646	1.525	**0.174**	0.944	**0.140**	**NL**
351	25	3	nl	0.053	2.256	3.436	9.123	0.100	0.053	1.349	1.910	1.525	**0.152**	0.938	**0.149**	**NL**
348.5	27.5	5	nl	0.057	2.393	5.687	11.824	0.128	0.057	1.509	2.227	1.526	**0.195**	0.931	**0.154**	**NL**
346	30	1	13	0.044	2.520	1.133	3.063	0.056	0.044	1.518	2.392	1.526	**0.085**	0.928	**0.164**	**0.518**
343.5	32.5	6	nl	0.059	2.648	6.777	13.133	0.142	0.059	1.670	2.699	1.530	**0.217**	0.908	**0.164**	**NL**
341	35	11	nl	0.064	2.801	12.340	19.808	0.214	0.064	2.139	3.325	1.551	**0.332**	0.887	**0.154**	**NL**
338.5	37.5	17	nl	0.068	2.965	18.924	27.709	0.336	0.068	2.464	3.805	1.576	**0.529**	0.867	**0.150**	**NL**
336	40	12	nl	0.065	3.130	13.268	20.921	0.227	0.065	2.643	4.141	1.593	**0.362**	0.846	**0.149**	**NL**
	*	*	*													

* ALL COHESIVE TO END OF BORING



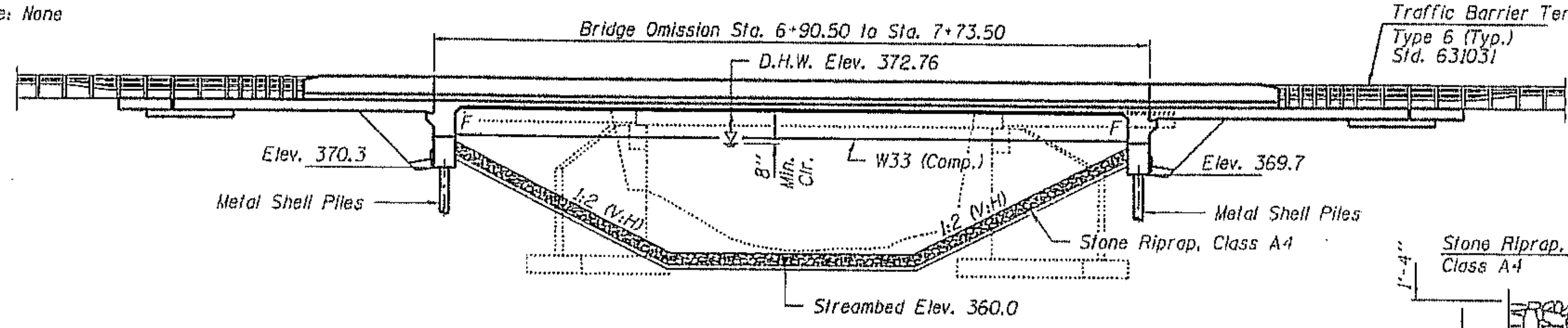
PGA = 0.1724 g

M_w = 6.58

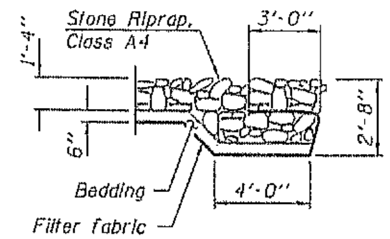
BENCHMARK: BM#54 - Chiseled "□" on SW corner SN 097-0036, 18' Rt., Sta. 7+10, Elev. 373.96

EXISTING STRUCTURE: SN 097-0036 was originally constructed in 1933 as a single span RC T-girder on closed abutments. In 1974 the bridge was reconstructed with a new single span PPC deck beam superstructure on widened existing abutments. The bridge is 43'-0⅝" bk.-bk. abuts. and 33'-0" o.-o. Structure to be removed and replaced using staged construction to maintain one lane of traffic at all times.

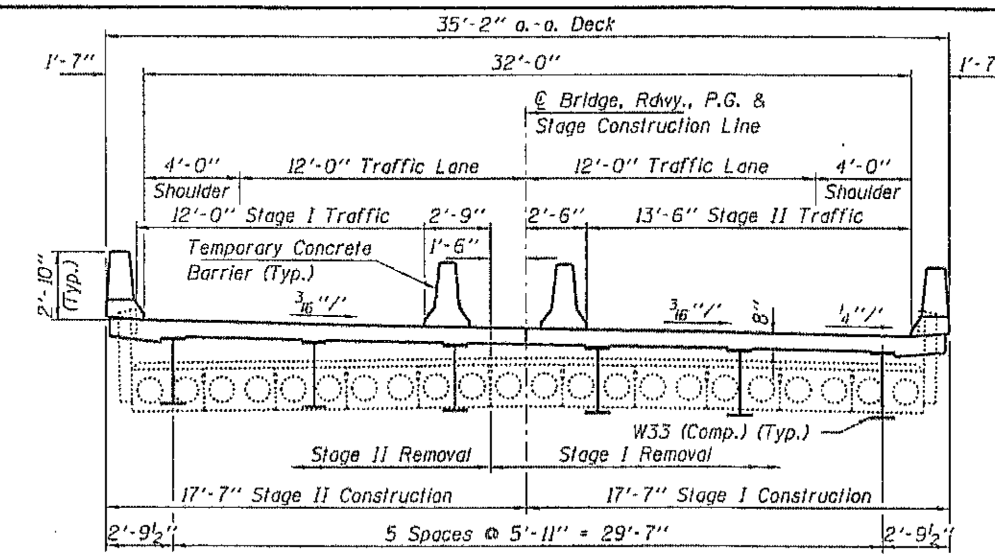
Salvage: None



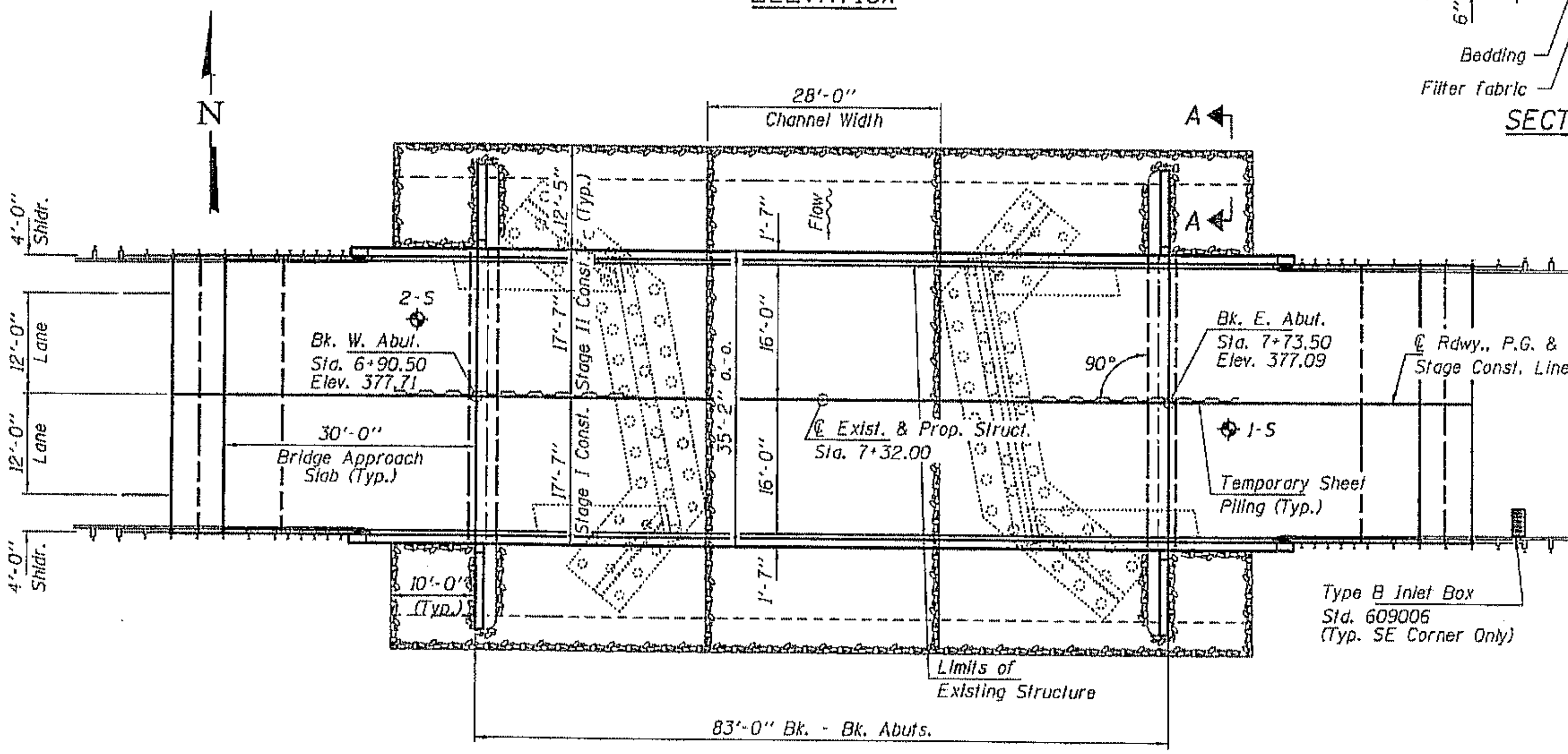
ELEVATION



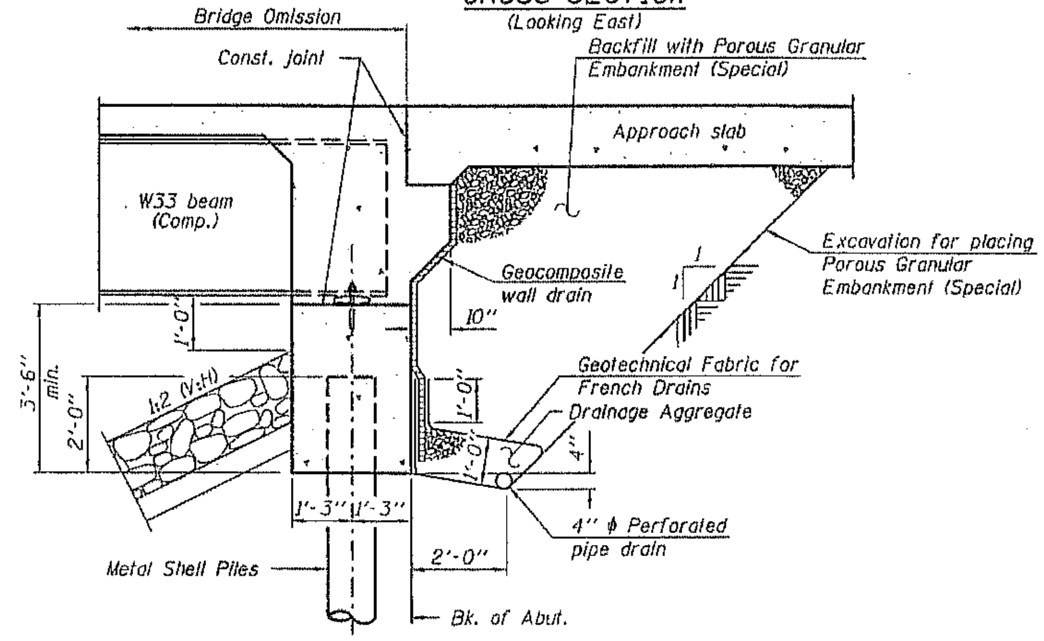
SECTION A-A



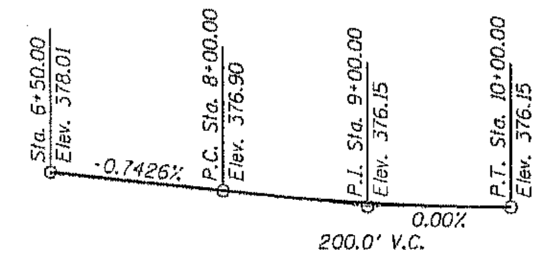
CROSS SECTION
(Looking East)



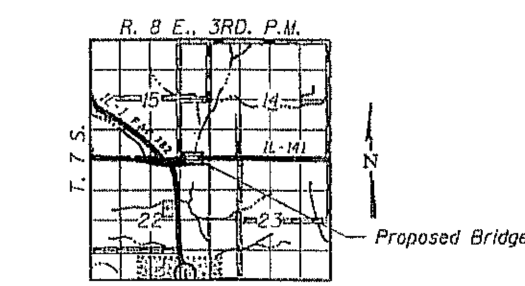
PLAN



SECTION THRU INTEGRAL ABUTMENT



PROFILE GRADE
(along ℄ roadway)



LOCATION SKETCH

Note:
The condition of the existing deck beams for Stage I Traffic should be verified during final design. If their condition changes, the proposed staging sequence shall be re-evaluated. If a beam replacement or beam support contract is required, the designer shall provide the necessary plans.

DESIGN SPECIFICATIONS

2010 AASHTO LRFD Bridge Design Specifications

LOADING HL-93

Allow 50#/sq. ft. for future wearing surface.

DESIGN STRESSES

f'c = 3,500 psi
fy = 60,000 psi (Reinf.)
fy = 50,000 psi (Structural Steel) (M270 GR. 50W)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.315 g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.741 g
Soil Site Class = D

HIGHWAY CLASSIFICATION

FAP Route 877 - IL 141
Functional Class: minor arterial - rural
ADT: 2150 (2007) / 3500 (2023)
ADTT: 366 / 595 (17%)
DHV: 350 (2023)
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
Two-way Traffic
Directional Distribution: 50% / 50%

DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	W. Abut.	E. Abut.
	370.3	369.7

WATERWAY INFORMATION

Drainage Area = 6.95 Sq. Mi. Proposed Low Grade Elev. 376.10 @ Sta. 11+50

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Natural H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	1930	270	500	370.31	0.22	0.07	370.53	370.38
Design	50	3150	360	680	372.76	0.42	0.09	373.18	372.85
Base	100	3700	380	720	373.22	1.20	0.15	374.42	373.37
Max. Calc.	500	5130	400	730	373.96	1.74	0.19	375.70	374.15

Sta. Equation: Sta. 154+48.58 (bk) = Sta. 6+43.64 (ah)

P.I. Sta. 151+99.22
Δ = 10°00'00" (Rt.)
D = 2°00'00"
R = 2,864.79'
T = 250.64'
L = 500.00'
E = 10.94'
e = 3.2%
T.R. = 190
S.E. Run = 40
P.C. Sta. 149+48.58
P.T. Sta. 154+48.58
S.E. Transition Sta. 153+76.25 to Sta. 6+54.50
Sta. 8+09.50 to Sta. 9+56.32

GENERAL PLAN
IL ROUTE 141
OVER TRIB. CANE CREEK
FAP ROUTE 877 - SECTION 101B-2
WHITE COUNTY
STATION 7+32.00
STRUCTURE NO. 097-0077

FILE NAME = 0970036-sht-bridge.dgn	USER NAME =	DESIGNED - M.D.C.	REVISED -
		CHECKED - D.W.T.	REVISED -
	PLOT SCALE =	DRAWN - D.A.B.	REVISED -
	PLOT DATE = 8/24/2010	CHECKED - M.D.C.	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

HLR

GENERAL PLAN
STRUCTURE NO. 097-0077
SHEET NO. 1 OF 1 SHEETS

F.A.P.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
877	101B-2	WHITE		
IL 141 OVER TRIB. TO CANE CR.		CONTRACT NO. 78162		
		ILLINOIS FED. AID PROJECT		

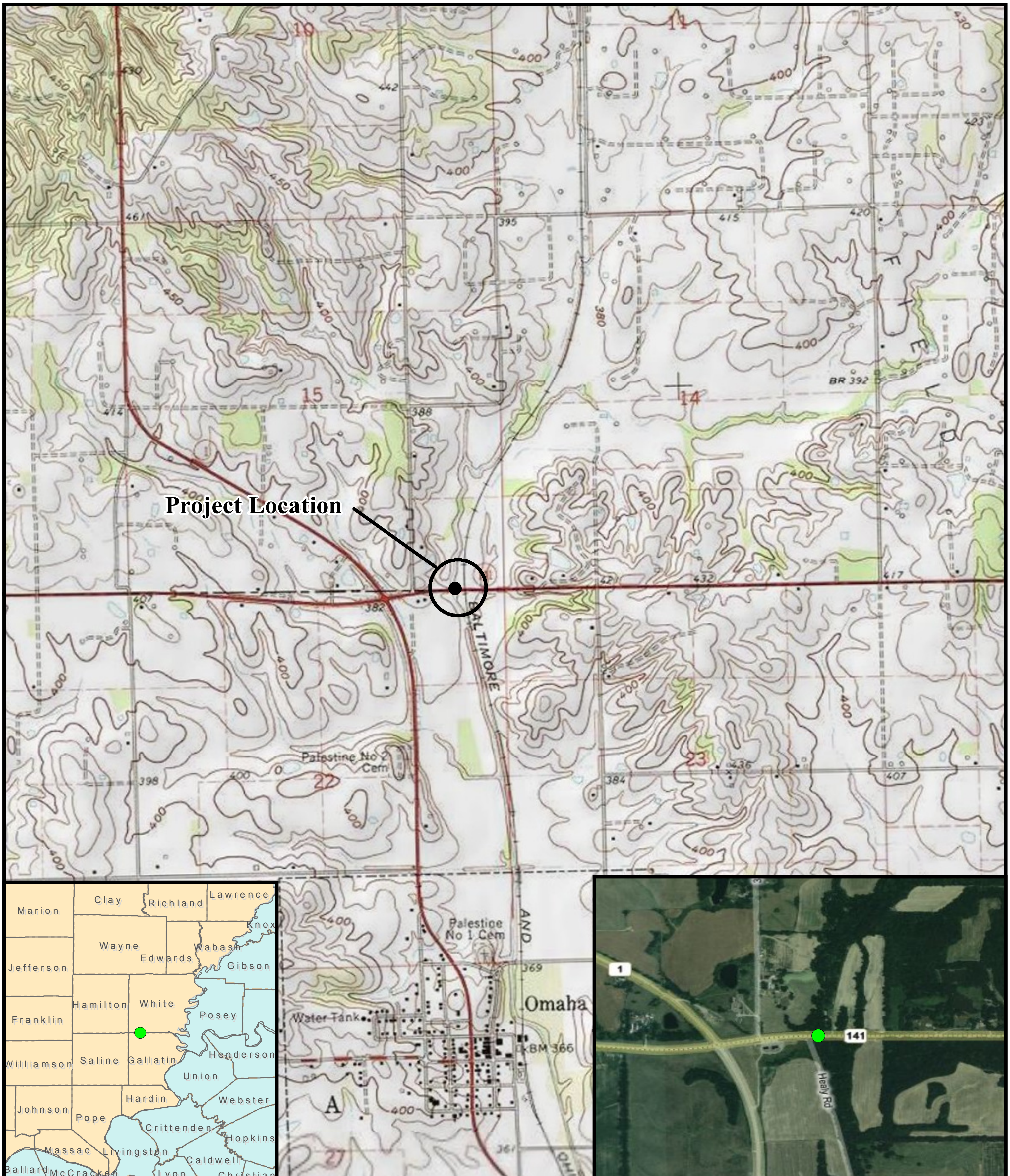


Exhibit A
Location Map
IL Route 141 over Cane Creek
White County, Illinois

N

0 400 800
Feet

Designed By:CHA
Drawn By: TDW
Checked By: MGM
Date: 8/19/10
Project #: 08-0060.06

Kaskaskia
Engineering Group, LLC
23 Public Square Suite 404
Belleville, Illinois 62220
618.233.5877 phone
618.233.5977 fax
www.kaskaskiaeng.com

Exhibit G - Estimated Pile Types and Lengths for Modified Factored Load Conditions

	Pile Designation	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Modified Load Condition (%)	Total Factored Load (kips)	Estimated Pile Length (ft)	Pile Tip Elevation
East Abutment (Boring 1-S)	**Metal Shell 12" w .179" walls**	251	138	85%	867	62	310
				100%	1020	62	310
				115%	1173	62	310
				130%	1326	62	310
	Metal Shell 14" w .25" walls	388	213	85%	867	77	295
				100%	1020	77	295
				115%	1173	77	295
				130%	1326	77	295
	HP 10x57	454	250	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285
	HP 12X74	589	324	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285
	HP 12X84	664	365	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285
	HP 14X89	705	388	85%	867	87	285
				100%	1020	87	285
				115%	1173	87	285
				130%	1326	87	285

Exhibit G - Estimated Pile Types and Lengths for Modified Factored Load Conditions

	Pile Designation	R_n Nominal Required Bearing (kips)	R_F Factored Resistance Available (kips)	Modified Load Condition (%)	Total Factored Load (kips)	Estimated Pile Length (ft)	Pile Tip Elevation
West Abutment (Boring 2-S)	**Metal Shell 12" w .179" walls**	221	122	85%	867	57	315
				100%	1020	57	315
				115%	1173	57	315
				130%	1326	57	315
	Metal Shell 14" w .25" walls	363	200	85%	867	77	295
				100%	1020	77	295
				115%	1173	77	295
				130%	1326	77	295
	HP 10x57	454	250	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287
	HP 12X74	589	324	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287
	HP 12X84	664	365	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287
	HP 14X89	705	388	85%	867	85	287
				100%	1020	85	287
				115%	1173	85	287
				130%	1326	85	287