

STRUCTURE GEOTECHNICAL REPORT

Proposed SN 064-0047 (WB)
Proposed SN 064-0048 (EB)
Existing SNs 064-0017 & 064-0018

I-24 over Bear Creek
FAI Route 24
Section (64-1)B-2
Massac County

PTB 182 - Item 16
Contract No. 78685

Prepared By: Michael Haley, P.E., S.E.
Lin Engineering, Ltd.
3261 S. Meadowbrook Rd.,
Suite 500
Springfield, IL 62711
(217) 679-2928
mhaley@lineng.com

Prepared For: Eric Henkel, P.E., S.E.
ESCA Consultants, Inc.
2008 Linview Ave.
Urbana, IL 61801
(217) 384-0505, ext. 2
elh@escaconsultants.com

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Project Description and Scope

This project involves the complete replacement of dual bridges carrying I-24 over Bear Creek in Massac County. The project site is located in Section 22, Range 4E, Township 14S, in the 3rd Principal Meridian. A *Location Map* is presented in Exhibit A.

There are existing dual bridges at this location, SN 064-0017 and SN 064-0018, which were constructed in 1971. They are three span structures with rolled steel beam superstructures supported on concrete wall piers and stub abutments. The abutments are supported on concrete piles. The existing plans call for concrete piles driven to 35 Ton or 44 Ton capacity with estimated lengths of 55 to 59 feet at all four abutments. The piers utilize spread footings on untreated timber piles. The existing plans call for timber piles driven to 20 Ton capacity with estimated lengths of 44 to 47 feet at all four piers. Concrete slope walls are present from top to toe of slopes of both bridges. Both bridges measure 150'-10" back to back abutments and are 42'-0" out to out, with a 43° right ahead skew.

Per the preliminary Type, Size & Location Plan (TSL), the proposed dual structures are three span bridges with W30 rolled beams supported on integral abutments and pile bent piers with encasement wall. The proposed WB and EB structures will have back-to-back abutment lengths of 151'-0" and out-to-out widths of 44'-10", with a 43° right ahead skew. The roadway will be on vertical and horizontal tangent alignments. The proposed abutments will be constructed on existing embankments in roughly the same location as the existing abutments. The proposed profiles will be within a few inches of the existing profiles for both structures. Traffic will be maintained utilizing crossovers during construction. The new structures are to be designed following LRFD Bridge Design Specifications.

See *Preliminary TSL* attached in Exhibit B for further information about the proposed structures.

Field Exploration

Subsurface Exploration and Testing

The site is located about 1 mile south/southeast of the I-24/ Big Bay Road interchange surrounded by farmland outside the IDOT Right of Way, except for a wooded area just southwest of the bridges. The structures cross over Bear Creek, with a channel measuring between 15' to 22'. A grassy median separates the two structures. There are no utilities located near the structures.

The subsurface investigation consisted of two borings (1-S and 3-S) drilled by IDOT District 9 personnel in October of 2018. Additionally, four borings (1S thru 4S) from the original construction plans dated September 1968 were used to supplement the newer borings. 1-S was drilled between the east abutments, nearer to the EB structure; 3-S was drilled between the west abutments, nearer to the EB structure. The 1968 borings are located at the EB West Abutment (1S), the WB West Abutment (2S), the WB East Abutment (3S) and the EB Pier 2 (4S). Boring locations can be found in Exhibit B.

For the 2018 borings, standard penetration tests (SPT) were conducted every 2.5 feet below the ground surface according to AASHTO T 206, using a Hollow Stem Auger. The 2018 borings were drilled to depths exceeding 70 feet. No rock layers were encountered within the limits of the borings.

Subsurface Conditions

While drilling the 2018 borings, no free water was observed prior to beginning mud drilling around elevation 322. For the 1968 borings taken prior to the original construction, the groundwater level was observed at elevation 336.

The two borings taken in 2018 (1-S and 3-S) both encountered similar soil layers, with medium stiff to very stiff clay to silty clay layers starting at the ground surface and continuing to approximate elevation 322. Below this elevation is loose sand with clay layers followed by layers of dense sand. The four borings from 1968 (1S thru 4S) are very consistent with the newer borings.

Further descriptions of the soil conditions encountered in the borings are presented in the *Soil Borings* attached in Exhibit D and the *Subsurface Data Profile* in Exhibit C.

Geotechnical Evaluations

Settlement

Per the preliminary TSL, the proposed profiles will be within a few inches the existing. The proposed abutments will be located in roughly the same place as the existing abutments on existing embankments, resulting in calculated settlement of less than 0.4 inches. Since the settlement is negligible, downdrag forces are not significant and no pre-coring will be required.

Slope Stability

Preliminary stability analyses using Bishop's method were performed for both abutments on SN 064-0047 and SN 064-0048. According to AASHTO LRFD 11.6.2.3, the required resistance factor for slope stability is 0.65 which is equivalent to factor of safety of 1.54. The slope stability models rendered a worst-case factor of safety of 1.97. As per AASHTO LRFD 11.6.5.3, minimum required factor of safety under the effect of seismic loads is 1. The seismic slope stability yielded a worst-case factor of safety of 1.29. The horizontal coefficient was calculated according to FHWA-NHI-11-032. The horizontal coefficient for the west and east abutments is 0.26g. Slope stability analyses are presented in Exhibit G. No stability problems are expected.

Seismic Considerations

Based on the method described in the IDOT Design Guide LRFD Soil Site Class Definition, Soil Site Class E controls. The Design Spectral Acceleration at 1.0 sec (S_{D1}) is 0.783g and at 0.2 sec (S_{D5}) is 0.959g. These values are based on a 1000-year design return period earthquake. According to AASHTO LRFD 3.10.6 the Seismic Performance Zone is 4 based on the 1.0 second Design Spectral Acceleration.

Liquefaction analysis was performed using the IDOT Liquefaction Analysis spreadsheet for each boring at the proposed bridge locations. All boring locations were found to contain potentially liquefiable layers. Effects of liquefaction should be accounted for at all substructure locations. Liquefaction calculations are presented in Exhibit E.

Scour

With integral abutments protected by riprap, the design scour elevation is set at the bottom of the abutment cap per IDOT Bridge Manual 2.3.6.3.2. See table 1 for Scour Elevation Table.

Event/Limit State	Design Scour Elevations (ft)								
	SN 064-0047				SN 064-0048				
	W. Abut.	Pier 1	Pier 2	E. Abut.	W. Abut.	Pier 1	Pier 2	E. Abut.	Item 113
Q100	341.7	332.0	332.0	341.8	341.7	332.0	332.0	341.9	8
Q200	341.7	331.8	331.8	341.8	341.7	331.8	331.8	341.9	
Design	341.7	327.9	327.9	341.8	341.7	327.6	327.6	341.9	
Check	341.7	327.9	327.9	341.8	341.7	327.6	327.6	341.9	

Table 1

Foundation Recommendations

Following is the summary of preliminary factored vertical loads for the AASHTO LRFD Strength I load combination provided by ESCA Consultants, Inc., for both bridges. The Extreme Event I load combination was estimated to be 75% of Strength I.

Strength I Load Combination

Abutments	880 kips
Piers	1540 kips

Abutments

Due to IDOT's strong desire for a jointless structure, integral abutments will be provided for both of these bridges. Per IDOT ABD Memoranda 19.8, all pile types are permissible for an effective expansion length of 76.5' determined for westbound SN 064-0047, or for an effective expansion length of 80.3' determined for eastbound SN 064-0048. Unless the abutment type is changed, spread footings and drilled shafts are not allowed for integral abutments as per the IDOT Bridge Manual.

Driven pile foundation design includes seismic design, which accounts for the effects of liquefiable soil layers at each abutment. Analyses have been performed using the Modified IDOT Static Method for estimating nominal pile resistance. Pile size calculations are presented in Exhibit F and summarized in Tables 2 thru 9. The estimated lengths include a 2-foot embedment into the abutment cap and are based on top of pile elevations of 343.65 at the west abutment and 343.76 at the east abutment for SN 064-0047, and 343.73 at the west abutment and 343.88 at the east abutment for SN 064-0048. R_n values in tables represent the nominal required bearing. Due to the soil type and presence of liquefiable soils, the HP sections are not able to develop enough capacity as friction piles, therefore only metal shell piles are presented in the tables.

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
West Abutment SN 064-0047 Strength Limit State	MS 12" x 0.25"	78	43	27	316.65
		81	45	30	313.65
		162	89	35	308.65
		181	100	40	303.65
		205	113	45	298.65
		222	122	47	296.65
	MS 14" x 0.25"	392	216	55	288.65
		75	41	17	326.65
		83	46	20	323.65
		92	50	27	316.65
		95	52	30	313.65
		202	111	35	308.65
		220	121	40	303.65
		248	136	45	298.65
		270	148	47	296.65
		459	252	55	288.65
	MS 14" x 0.312"	75	41	17	326.65
		83	46	20	323.65
		92	50	27	316.65
		95	52	30	313.65
		202	111	35	308.65
		220	121	40	303.65
		248	136	45	298.65
		270	148	47	296.65
		310	171	55	288.65
		370	203	65	278.65
		447	246	67	276.65
		473	260	70	273.65
	MS 16" x 0.312"	570	314	75	268.65
		60	33	12	331.65
		80	44	15	328.65
		88	48	17	326.65
		97	53	20	323.65
		105	58	27	316.65
		109	60	30	313.65
		245	135	35	308.65
		262	144	40	303.65
		293	161	45	298.65
		320	176	47	296.65
		365	201	55	288.65
		428	235	65	278.65
		528	291	67	276.65
	654	360	75	268.65	
	MS 16" x 0.375"	60	33	12	331.65
		80	44	15	328.65
		88	48	17	326.65
		97	53	20	323.65
		105	58	27	316.65
		109	60	30	313.65
		245	135	35	308.65
262		144	40	303.65	
293		161	45	298.65	
320		176	47	296.65	
365		201	55	288.65	
428		235	65	278.65	
528		291	67	276.65	
558		307	75	268.65	
675		371	78	265.65	
699		385	81	262.65	
723		398	83	260.65	
748		411	86	257.65	
772	425	88	255.65		
782	430	89	254.65		

Table 2

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
West Abutment SN 064-0047 Extreme Event (Liquefaction)	MS 14" x 0.312"	447	26	67	276.65
		473	33	70	273.65
	MS 16" x 0.312"	528	47	67	276.65
		528	47	67	276.65
	MS 16" x 0.375"	675	116	78	265.65
		699	141	81	262.65
		723	165	83	260.65
		748	189	86	257.65
		772	213	88	255.65
		782	223	89	254.65

Table 3

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
East Abutment SN 064-0047 Strength Limit State	MS 12" x 0.25"	73	40	18	325.76
		85	47	20	323.76
		99	54	23	320.76
		106	58	30	313.76
		108	59	33	310.76
		177	98	35	308.76
		200	110	40	303.76
		206	113	43	300.76
		211	116	48	295.76
		287	158	55	288.76
	392	216	58	285.76	
	MS 14" x 0.25"	75	41	15	328.76
		88	48	18	325.76
		101	56	20	323.76
		118	65	23	320.76
		124	68	30	313.76
		126	69	33	310.76
		220	121	35	308.76
		247	136	40	303.76
		252	139	43	300.76
		255	140	48	295.76
	MS 14" x 0.312"	349	192	55	288.76
		459	252	58	285.76
		75	41	15	328.76
		88	48	18	325.76
		101	56	20	323.76
		118	65	23	320.76
		124	68	30	313.76
		126	69	33	310.76
		220	121	35	308.76
		247	136	40	303.76
	MS 16" x 0.312"	252	139	43	300.76
		255	140	48	295.76
		349	192	55	288.76
		363	199	58	285.76
		453	249	65	278.76
		472	260	68	275.76
		510	281	70	273.76
		528	290	72	271.76
		545	300	75	268.76
		563	310	77	266.76
	MS 16" x 0.312"	73	40	13	330.76
		88	49	15	328.76
		103	56	18	325.76
		118	65	20	323.76
		138	76	23	320.76
		142	78	30	313.76
		144	79	33	310.76
		267	147	35	308.76

Table 4

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
East Abutment SN 064-0047 Strength Limit State	MS 16" x 0.312"	298	164	40	303.76
		301	166	48	295.76
		415	228	55	288.76
		654	360	58	285.76
	MS 16" x 0.375"	73	40	13	330.76
		88	49	15	328.76
		103	56	18	325.76
		118	65	20	323.76
		138	76	23	320.76
		142	78	30	313.76
		144	79	33	310.76
		267	147	35	308.76
		298	164	40	303.76
		301	166	48	295.76
		415	228	55	288.76
		431	237	58	285.76
		533	293	65	278.76
		556	306	68	275.76
		604	332	70	273.76
		624	343	72	271.76
		644	354	75	268.76
		664	365	77	266.76
		684	376	80	263.76
		704	387	82	261.76
		724	398	85	258.76
		744	409	87	256.76
		764	420	90	253.76
		781	429	92	251.76

Table 4 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
East Abutment SN 064-0047 Extreme Event (Liquefaction)	MS 14" x 0.25"	363	7	58	285.76
	MS 14" x 0.312"	472	7	68	275.76
		510	34	70	273.76
		528	52	72	271.76
	MS 14" x 0.312"	545	69	75	268.76
		563	87	77	266.76
	MS 16" x 0.312"	431	25	58	285.76
		556	25	68	275.76
		604	60	70	273.76
		624	80	72	271.76
		644	100	75	268.76
		664	120	77	266.76
		684	140	80	263.76
		704	160	82	261.76
		724	180	85	258.76
		744	200	87	256.76
		764	220	90	253.76
		781	236	92	251.76

Table 5

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
West Abut. SN 064-0048 Strength Limit State	MS 12" x 0.25"	69	38	14	329.73
		83	45	16	327.73
		94	52	19	324.73
		99	55	21	322.73
		120	66	29	314.73

Table 6

Location	Pile Size	Rn Nominal Required Bearing (kips)	RF Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
West Abutment SN 064-0048 Strength Limit State	MS 12" x 0.25"	167	92	31	312.73
		193	106	36	307.73
		227	125	41	302.73
		270	148	46	297.73
		335	184	51	292.73
	MS 14" x 0.25"	392	215	56	287.73
		71	39	11	332.73
		82	45	14	329.73
		99	55	16	327.73
		112	62	19	324.73
		117	64	21	322.73
		143	79	29	314.73
		206	114	31	312.73
		239	131	36	307.73
		281	155	41	302.73
		335	184	46	297.73
	MS 14" x 0.312"	459	252	51	292.73
		71	39	11	332.73
		82	45	14	329.73
		99	55	16	327.73
		112	62	19	324.73
		117	64	21	322.73
		143	79	29	314.73
		206	114	31	312.73
		239	131	36	307.73
		281	155	41	302.73
		335	184	46	297.73
		418	230	51	292.73
		MS 16" x 0.312"	473	260	56
	570		314	61	282.73
	74		41	9	334.73
	84		46	11	332.73
	96		53	14	329.73
	116		64	16	327.73
	131		72	19	324.73
	135		74	21	322.73
	167		92	29	314.73
	249		137	31	312.73
	288		159	36	307.73
	340		187	41	302.73
	MS 16" x 0.375"		406	223	46
		508	279	51	292.73
		572	315	56	287.73
		653	359	61	282.73
		74	41	9	334.73
		84	46	11	332.73
		96	53	14	329.73
		116	64	16	327.73
		131	72	19	324.73
		135	74	21	322.73
167		92	29	314.73	
249		137	31	312.73	
288		159	36	307.73	
340	187	41	302.73		
406	223	46	297.73		
508	279	51	292.73		
572	315	56	287.73		
639	351	61	282.73		
739	406	68	275.73		
770	424	71	272.73		
777	427	71	272.73		

Table 6 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
West Abutment SN 064-0048 Extreme Event (Liquefaction)	MS 12" x 0.25"	227	29	41	302.73
		270	49	46	297.73
		335	114	51	292.73
		392	171	56	287.73
	MS 14" x 0.25"	239	30	36	307.73
		281	50	41	302.73
		335	77	46	297.73
		459	201	51	292.73
	MS 14" x 0.312"	239	30	36	307.73
		281	50	41	302.73
		335	77	46	297.73
		418	159	51	292.73
	MS 16" x 0.312"	473	214	56	287.73
		570	312	61	282.73
		249	32	31	312.73
		288	49	36	307.73
		340	76	41	302.73
		406	111	46	297.73
		508	213	51	292.73
		572	277	56	287.73
	MS 16" x 0.375"	655	359	61	282.73
		249	32	31	312.73
		288	49	36	307.73
		340	76	41	302.73
		406	111	46	297.73
		508	213	51	292.73
		572	277	56	287.73
		639	344	61	282.73
	739	443	68	275.73	
	770	475	71	272.73	
	777	482	71	272.73	

Table 7

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
East Abutment SN 064-0048 Strength Limit State	MS 12" x 0.25"	65	36	14	329.88
		81	44	16	327.88
		86	48	19	324.88
		89	49	21	322.88
		106	58	31	312.88
		141	77	34	309.88
		161	89	36	307.88
		178	98	42	301.88
		234	129	48	295.88
		352	194	54	289.88
		354	195	59	284.88
	MS 14" x 0.25"	392	216	64	279.88
		64	35	11	332.88
		78	43	14	329.88
		98	54	16	327.88
		102	56	19	324.88
		105	58	21	322.88
		124	68	31	312.88
		171	94	34	309.88
		197	109	36	307.88
		218	120	42	301.88
		291	160	48	295.88
	MS 14" x 0.312"	459	252	59	284.88
		64	35	11	332.88
		78	43	14	329.88
	98	54	16	327.88	

Table 8

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
East Abutment SN 064-0048 Strength Limit State	MS 14" x 0.312"	102	56	19	324.88
		105	58	21	322.88
		124	68	31	312.88
		171	94	34	309.88
		197	109	36	307.88
		218	120	42	301.88
		291	160	48	295.88
		435	239	59	284.88
		469	258	64	279.88
		570	314	69	274.88
	MS 16" x 0.312"	76	42	11	332.88
		93	51	14	329.88
		115	63	16	327.88
		119	65	19	324.88
		121	66	21	322.88
		142	78	31	312.88
		203	112	34	309.88
		237	130	36	307.88
		260	143	42	301.88
		352	194	48	295.88
		521	286	59	284.88
		559	307	64	279.88
		655	360	69	274.88
	MS 16" x 0.375"	76	42	11	332.88
		93	51	14	329.88
		115	63	16	327.88
		119	65	19	324.88
		121	66	21	322.88
		142	78	31	312.88
		203	112	34	309.88
		237	130	36	307.88
		260	143	42	301.88
		352	194	48	295.88
		521	286	59	284.88
		559	307	64	279.88
		620	341	69	274.88
		717	394	76	267.88
		744	409	78	265.88
		770	424	81	262.88
	781	430	82	261.88	

Table 8 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
East Abutment SN 064-0048 Extreme Event (Liquefaction)	MS 12" x 0.25"	178	16	42	301.88
		234	55	48	295.88
		352	139	54	289.88
		354	75	59	284.88
		392	78	64	279.88
	MS 14" x 0.25"	218	28	42	301.88
		291	82	48	295.88
		459	108	59	284.88
	MS 14" x 0.312"	218	28	42	301.88
		291	82	48	295.88
		435	108	59	284.88
		469	102	64	279.88
	MS 16" x 0.312"	570	115	69	274.88
		203	16	34	309.88
		237	43	36	307.88
		260	43	42	301.88
		352	113	48	295.88

Table 9

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
East Abutment SN 064-0048 Extreme Event (Liquefaction)	MS 16" x 0.312"	521	148	59	284.88
		559	139	64	279.88
		655	157	69	274.88
	MS 16" x 0.375"	203	16	34	309.88
		237	43	36	307.88
		260	43	42	301.88
		352	113	48	295.88
		521	148	59	284.88
		559	139	64	279.88
		620	157	69	274.88
		717	205	76	267.88
		744	232	78	265.88
		770	258	81	262.88
		781	269	82	261.88

Table 9 (Continued)

Piers

There are multiple options for the type of foundation at the piers: Spread footing bearing on soil, pile-supported foundation, or drilled shaft foundation.

Spread Footing on Soil: Due to the weaker soil layers with an unconfined compressive strength less than 2.0 tsf at the elevation of the pier footings, it is not recommended to utilize spread footings.

Pile Supported: Using a pile bent pier with a single line of piles is appropriate for the bridge size and type. Analyses have been performed using the Modified IDOT Static Method for estimating nominal pile resistance. Pile size calculations are presented in Exhibit F and summarized in Tables 10 thru 17. The estimated lengths include a 1-foot embedment into the pier cap and are based on top of pile elevations of 344.33 at Pier 1 and 344.38 and Pier 2 for SN 064-0047, and 344.42 at Pier 1 and 344.48 at Pier 2 for SN 064-0048. R_n values in tables represent the nominal required bearing. Due to the soil type and presence of liquefiable soils, the HP sections are not able to develop enough capacity as friction piles, therefore only metal shell piles are presented in the tables.

Drilled Shafts: With no rock layers indicated at the borings, drilled shafts would be uneconomical at this location.

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0047 Strength Limit State (Scour)	MS 12" x 0.25"	132	73	40	304.33
		156	86	45	299.33
		173	95	48	296.33
		208	115	55	289.33
		264	145	65	279.33
		321	176	67	277.33
		392	216	71	273.33
	MS 14" x 0.25"	38	21	30	314.33
		145	80	35	309.33
		163	90	40	304.33
		191	105	45	299.33
		212	117	48	296.33
		253	139	55	289.33
		312	172	65	279.33

Table 10

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0047 Strength Limit State (Scour)	MS 14" x 0.25"	390	214	67	277.33
		459	252	71	273.33
	MS 14" x 0.312"	38	21	30	314.33
		145	80	35	309.33
		163	90	40	304.33
		191	105	45	299.33
		212	117	48	296.33
		253	139	55	289.33
		312	172	65	279.33
		390	214	67	277.33
		415	228	71	273.33
		419	231	76	268.33
		511	281	79	265.33
		532	293	81	263.33
		570	314	84	260.33
	MS 16" x 0.312"	44	24	30	314.33
		180	99	35	309.33
		196	108	40	304.33
		228	125	45	299.33
		255	140	48	296.33
		300	165	55	289.33
		362	199	65	279.33
		463	255	67	277.33
	MS 16" x 0.375"	655	360	76	268.33
		44	24	30	314.33
		180	99	35	309.33
		196	108	40	304.33
		228	125	45	299.33
		255	140	48	296.33
		300	165	55	289.33
		362	199	65	279.33
		463	255	67	277.33
		492	271	76	268.33
		609	335	79	265.33
		634	349	81	263.33
		658	362	84	260.33
		682	375	86	258.33
		706	389	89	255.33
	731	402	91	253.33	
	755	415	94	250.33	
	779	429	96	248.33	

Table 10 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0047 Extreme Event (Liquefaction)	MS 12" x 0.25"	264	9	65	279.33
		321	63	67	277.33
		342	68	71	273.33
	MS 14" x 0.25"	145	69	35	309.33
		390	89	67	277.33
		415	96	71	273.33
	MS 14" x 0.312"	145	69	35	309.33
		390	89	67	277.33
		415	96	71	273.33
		419	62	76	268.33
		511	143	79	265.33
		532	164	81	263.33
	MS 16" x 0.312"	570	202	84	260.33
		180	93	35	309.33
		196	58	40	304.33
		228	58	45	299.33

Table 11

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0047 Extreme Event (Liquefaction)	MS 16" x 0.312"	255	76	48	296.33
		300	67	55	289.33
		463	120	67	277.33
		655	84	76	268.33
	MS 16" x 0.375"	180	93	35	309.33
		196	58	40	304.33
		228	58	45	299.33
		255	76	48	296.33
		300	67	55	289.33
		463	120	67	277.33
		492	84	76	268.33
		609	189	79	265.33
		634	213	81	263.33
		658	237	84	260.33
		682	261	86	258.33
		706	286	89	255.33
		731	310	91	253.33
		755	334	94	250.33
		779	359	96	248.33

Table 11 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0047 Strength Limit State (Scour)	MS 12" x 0.25"	124	68	36	308.38
		147	81	41	303.38
		153	84	44	300.38
		158	87	49	295.38
		234	128	56	288.38
		392	216	59	285.38
	MS 14" x 0.25"	64	35	34	310.38
		158	87	36	308.38
		185	102	41	303.38
		190	105	44	300.38
		193	106	49	295.38
		287	158	56	288.38
		459	252	59	285.38
		MS 14" x 0.312"	64	35	34
	158		87	36	308.38
	185		102	41	303.38
	190		105	44	300.38
	193		106	49	295.38
	287		158	56	288.38
	301		165	59	285.38
	391		215	66	278.38
	410		226	69	275.38
	448		247	71	273.38
	466		256	73	271.38
	484		266	76	268.38
	501		276	78	266.38
	519		285	81	263.38
	536	295	83	261.38	
	570	314	86	258.38	
	MS 16" x 0.312"	74	41	34	310.38
		196	108	36	308.38
		227	125	41	303.38
		231	127	49	295.38
		344	189	56	288.38
		360	198	59	285.38
		462	254	66	278.38
		486	267	69	275.38
		533	293	71	273.38
		553	304	73	271.38

Table 12

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0047 Strength Limit State (Scour)	MS 16" x 0.312"	573	315	76	268.38
		593	326	78	266.38
		614	337	81	263.38
		655	360	83	261.38
	MS 16" x 0.375"	74	41	34	310.38
		196	108	36	308.38
		227	125	41	303.38
		231	127	49	295.38
		344	189	56	288.38
		360	198	59	285.38
		462	254	66	278.38
		486	267	69	275.38
		533	293	71	273.38
		553	304	73	271.38
		573	315	76	268.38
		593	326	78	266.38
		614	337	81	263.38
		634	348	83	261.38
		654	359	86	258.38
		674	371	88	256.38
		694	382	91	253.38
		714	393	93	251.38
	734	404	96	248.38	
	754	415	98	246.38	
774	426	101	243.38		
782	430	102	242.38		

Table 12 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0047 Extreme Event (Liquefaction)	MS 12" x 0.25"	245	52	59	285.38
	MS 14" x 0.25"	158	69	36	308.38
		185	69	41	303.38
		190	62	44	300.38
		287	76	56	288.38
		301	76	59	285.38
	MS 14" x 0.312"	158	69	36	308.38
		185	69	41	303.38
		190	62	44	300.38
		287	76	56	288.38
		301	76	59	285.38
		391	69	66	278.38
		410	76	69	275.38
		448	103	71	273.38
		466	120	73	271.38
		484	138	76	268.38
		501	155	78	266.38
		519	173	81	263.38
		536	190	83	261.38
	570	224	86	258.38	
	MS 16" x 0.312"	196	94	36	308.38
		227	94	41	303.38
		344	103	56	288.38
		360	103	59	285.38
		462	94	66	278.38
		486	103	69	275.38
		533	138	71	273.38
		553	158	73	271.38
573	178	76	268.38		

Table 13

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0047 Extreme Event (Liquefaction)	MS 16" x 0.312"	593	198	78	266.38
		614	218	81	263.38
		655	260	83	261.38
	MS 16" x 0.375"	196	94	36	308.38
		227	94	41	303.38
		344	103	56	288.38
		360	103	59	285.38
		462	94	66	278.38
		486	103	69	275.38
		533	138	71	273.38
		553	158	73	271.38
		573	178	76	268.38
		593	198	78	266.38
		614	218	81	263.38
		634	238	83	261.38
		654	258	86	258.38
		674	278	88	256.38
		694	298	91	253.38
		714	318	93	251.38
		734	338	96	248.38
754	359	98	246.38		
774	379	101	243.38		
782	387	102	242.38		

Table 13 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0048 Strength Limit State (Scour)	MS 12" x 0.25"	118	65	44	300.42
		169	93	47	297.42
		171	94	54	290.42
		227	125	57	287.42
		253	139	62	282.42
		272	150	64	280.42
		311	171	69	275.42
		392	216	72	272.42
	MS 14" x 0.25"	121	66	37	307.42
		142	78	39	305.42
		145	80	44	300.42
		207	114	54	290.42
		282	155	57	287.42
		312	172	62	282.42
		334	184	64	280.42
		379	209	69	275.42
	MS 14" x 0.312"	459	252	72	272.42
		121	66	37	307.42
		142	78	39	305.42
		145	80	44	300.42
		207	114	54	290.42
		282	155	57	287.42
		312	172	62	282.42
		334	184	64	280.42
		379	209	69	275.42
		402	221	72	272.42
	MS 16" x 0.312"	458	252	75	269.42
		478	263	78	266.42
		499	274	80	264.42
		519	285	83	261.42
		539	297	85	259.42
		570	314	88	256.42
		69	38	34	310.42
		148	81	37	307.42

Table 14

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0048 Strength Limit State (Scour)	MS 16" x 0.312"	174	96	39	305.42
		175	96	44	300.42
		246	135	54	290.42
		342	188	57	287.42
		375	206	62	282.42
		402	221	64	280.42
		452	249	69	275.42
		479	263	72	272.42
		548	301	75	269.42
		571	314	78	266.42
		594	327	80	264.42
		617	339	83	261.42
		655	360	85	259.42
	MS 16" x 0.375"	69	38	34	310.42
		148	81	37	307.42
		174	96	39	305.42
		175	96	44	300.42
		246	135	54	290.42
		342	188	57	287.42
		375	206	62	282.42
		402	221	64	280.42
		452	249	69	275.42
		479	263	72	272.42
		548	301	75	269.42
		571	314	78	266.42
		594	327	80	264.42
		617	339	83	261.42
		640	352	85	259.42
		664	365	88	256.42
		687	378	90	254.42
	710	391	93	251.42	
	733	403	95	249.42	
	756	416	98	246.42	
	780	429	100	244.42	

Table 14 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0048 Extreme Event (Liquefaction)	MS 12" x 0.25"	171	9	54	290.42
		227	59	57	287.42
		272	59	64	280.42
		392	121	72	272.42
	MS 14" x 0.25"	207	19	54	290.42
		282	86	57	287.42
		312	79	62	282.42
		334	86	64	280.42
		379	79	69	275.42
		459	143	72	272.42
		MS 14" x 0.312"	207	19	54
	282		86	57	287.42
	312		79	62	282.42
	334		86	64	280.42
	379		79	69	275.42
	402		86	72	272.42
	458		142	75	269.42
	478		162	78	266.42
	499		183	80	264.42
	519		203	83	261.42
	539		223	85	259.42
	570	254	88	256.42	
	MS 16" x 0.312"	246	30	54	290.42

Table 15

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 1 SN 064-0048 Extreme Event (Liquefaction)	MS 16" x 0.312"	342	118	57	287.42
		375	109	62	282.42
		402	118	64	280.42
		452	109	69	275.42
		479	118	72	272.42
		548	187	75	269.42
		571	210	78	266.42
		594	233	80	264.42
	MS 16" x 0.375"	617	256	83	261.42
		655	294	85	259.42
		246	30	54	290.42
		342	118	57	287.42
		375	109	62	282.42
		402	118	64	280.42
		452	109	69	275.42
		479	118	72	272.42
		548	187	75	269.42
		571	210	78	266.42
		594	233	80	264.42
		617	256	83	261.42
		640	279	85	259.42
		664	303	88	256.42
		687	326	90	254.42
		710	349	93	251.42
		733	372	95	249.42
		756	395	98	246.42
		780	419	100	244.42

Table 15 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0048 Strength Limit State (Scour)	MS 12" x 0.25"	118	65	44	300.48
		169	93	47	297.48
		171	94	54	290.48
		227	125	57	287.48
		253	139	62	282.48
		272	150	64	280.48
		311	171	69	275.48
		392	216	72	272.48
	MS 14" x 0.25"	121	66	37	307.48
		142	78	39	305.48
		145	80	44	300.48
		207	114	54	290.48
		282	155	57	287.48
		312	172	62	282.48
		334	184	64	280.48
		379	209	69	275.48
	MS 14" x 0.312"	459	252	72	272.48
		121	66	37	307.48
		142	78	39	305.48
		145	80	44	300.48
		207	114	54	290.48
		282	155	57	287.48
		312	172	62	282.48
		334	184	64	280.48
		379	209	69	275.48
		402	221	72	272.48
	MS 14" x 0.375"	458	252	75	269.48
		478	263	78	266.48
		499	274	80	264.48
		519	285	83	261.48
		539	297	85	259.48
		570	314	88	256.48

Table 16

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0048 Strength Limit State (Scour)	MS 16" x 0.312"	69	38	34	310.48
		148	81	37	307.48
		174	96	39	305.48
		175	96	44	300.48
		246	135	54	290.48
		342	188	57	287.48
		375	206	62	282.48
		402	221	64	280.48
		452	249	69	275.48
		479	263	72	272.48
		548	301	75	269.48
		571	314	78	266.48
		594	327	80	264.48
		617	339	83	261.48
	655	360	85	259.48	
	MS 16" x 0.375"	69	38	34	310.48
		148	81	37	307.48
		174	96	39	305.48
		175	96	44	300.48
		246	135	54	290.48
		342	188	57	287.48
		375	206	62	282.48
		402	221	64	280.48
		452	249	69	275.48
		479	263	72	272.48
		548	301	75	269.48
		571	314	78	266.48
		594	327	80	264.48
		617	339	83	261.48
	640	352	85	259.48	
	664	365	88	256.48	
	687	378	90	254.48	
	710	391	93	251.48	
	733	403	95	249.48	
756	416	98	246.48		
780	429	100	244.48		

Table 16 (Continued)

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0048 Extreme Event (Liquefaction)	MS 12" x 0.25"	171	9	54	290.48
		227	59	57	287.48
		272	59	64	280.48
		392	121	72	272.48
	MS 14" x 0.25"	207	19	54	290.48
		282	86	57	287.48
		312	79	62	282.48
		334	86	64	280.48
		379	79	69	275.48
		459	143	72	272.48
		207	19	54	290.48
	MS 14" x 0.312"	282	86	57	287.48
		312	79	62	282.48
		334	86	64	280.48
		379	79	69	275.48
		402	86	72	272.48
		458	142	75	269.48
		478	162	78	266.48
		499	183	80	264.48
		519	203	83	261.48
		539	223	85	259.48
	570	254	88	256.48	

Table 17

Location	Pile Size	R _n Nominal Required Bearing (kips)	R _f Factored Resistance Available (kips)	Estimated Pile Length (ft)	Pile Tip Elev.
Pier 2 SN 064-0048 Extreme Event (Liquefaction)	MS 16" x 0.312"	246	30	54	290.48
		342	118	57	287.48
		375	109	62	282.48
		402	118	64	280.48
		452	109	69	275.48
		479	118	72	272.48
		548	187	75	269.48
		571	210	78	266.48
		594	233	80	264.48
		617	256	83	261.48
	655	294	85	259.48	
	MS 16" x 0.375"	246	30	54	290.48
		342	118	57	287.48
		375	109	62	282.48
		402	118	64	280.48
		452	109	69	275.48
		479	118	72	272.48
		548	187	75	269.48
		571	210	78	266.48
		594	233	80	264.48
		617	256	83	261.48
		640	279	85	259.48
		664	303	88	256.48
		687	326	90	254.48
		710	349	93	251.48
		733	372	95	249.48
		756	395	98	246.48
		780	419	100	244.48

Table 17 (Continued)

Lateral Loading Analysis

Tables 18 thru 25 provide soil parameters for the LPILE program (or other approved programs) for the structural engineer to perform the lateral analysis of the foundations.

Per Bridge Manual 3.10.1.10, if the lateral load on a pile exceeds 3 kips then a detailed soil structure interaction analysis shall be performed.

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Clay	321.5	0.034	-	500	7.0	0.007
Loose Sand	316.5	0.030	27.7	20	-	-
Soft Clay	311.5	0.027	-	30	2.1	0.020
Medium Sand	309.0	0.040	34.9	60	-	-
Dense to Loose Sand	291.5	0.037	33.0	60	-	-
Medium Sand	284.0	0.039	34.4	60	-	-
Dense to Loose Sand	271.0	0.038	33.4	60	-	-
Medium to Dense Sand	265.5	0.038	33.9	60	-	-

Table 18 – Westbound, West Abutment

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Clay	321.5	0.034	-	500	7.0	0.007
Loose Sand	316.5	0.030	27.7	20	-	-
Soft Clay	311.5	0.027	-	30	2.1	0.020
Medium Sand	309.0	0.040	34.9	60	-	-
Dense to Loose Sand	291.5	0.037	33.0	60	-	-
Medium Sand	284.0	0.039	34.4	60	-	-
Dense to Loose Sand	271.0	0.038	33.4	60	-	-
Medium to Dense Sand	265.5	0.038	33.9	60	-	-

Table 19 – Westbound, Pier 1

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Clay	320.8	0.036	-	500	8.5	0.007
Loose Sand	315.8	0.032	28.6	20	-	-
Medium Sand	313.3	0.038	33.8	60	-	-
Soft Clay	310.8	0.027	-	30	2.1	0.020
Very Soft Clay	308.3	0.024	-	30	1.4	0.020
Medium Sand	305.8	0.037	32.6	60	-	-
Medium to Loose Sand	293.3	0.037	32.9	60	-	-
Medium Sand	283.3	0.039	34.3	60	-	-
Dense Sand	274.8	0.040	35.3	125	-	-

Table 20 – Westbound Pier 2

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Clay	320.8	0.036	-	500	8.5	0.007
Loose Sand	315.8	0.032	28.6	20	-	-
Medium Sand	313.3	0.038	33.8	60	-	-
Soft Clay	310.8	0.027	-	30	2.1	0.020
Very Soft Clay	308.3	0.024	-	30	1.4	0.020
Medium Sand	305.8	0.037	32.6	60	-	-
Medium to Loose Sand	293.3	0.037	32.9	60	-	-
Medium Sand	283.3	0.039	34.3	60	-	-
Dense Sand	274.8	0.040	35.3	125	-	-

Table 21 – Westbound, East Abutment

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Medium Stiff Silt	342.3	0.069	-	100	5.6	0.010
Stiff Silt	339.8	0.074	-	500	11.1	0.007
Very Stiff Clay	337.3	0.042	-	1000	21.5	0.005
Stiff Silty Clay	334.8	0.035	-	500	7.6	0.007
Stiff Clay	332.3	0.037	-	500	10.4	0.007
Stiff Clay	322.3	0.040	-	500	9.2	0.007
Medium Stiff Clay	319.8	0.032	-	100	4.9	0.010
Very Loose Sand	312.3	0.030	28.0	20	-	-
Medium Dense Sand	297.3	0.037	32.7	60	-	-
Medium Dense Sand	277.3	0.040	35.7	60	-	-
Dense Sand	275.3	0.042	37.2	125	-	-

Table 22 – Eastbound, West Abutment

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Clay	325.6	0.034	-	500	7.1	0.007
Medium to Stiff Clay	320.6	0.035	-	500	7.6	0.007
Loose to Medium Sand	313.1	0.035	30.8	60	-	-
Very Soft Clay	308.1	0.024	-	30	1.4	0.020
Loose to Medium Sand	300.6	0.036	32.0	60	-	-
Loose to Dense Sand	269.6	0.038	33.7	60	-	-

Table 23 – Eastbound, Pier 1

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Clay	325.6	0.034	-	500	7.1	0.007
Medium to Stiff Clay	320.6	0.035	-	500	7.6	0.007
Loose to Medium Sand	313.1	0.035	30.8	60	-	-
Very Soft Clay	308.1	0.024	-	30	1.4	0.020
Loose to Medium Sand	300.6	0.036	32.0	60	-	-
Loose to Dense Sand	269.6	0.038	33.7	60	-	-

Table 24 – Eastbound, Pier 2

Soil Type	Elev. At Bottom of Layer	Effective Unit Wt. (pci)	Friction Angle (deg)	k (pci)	c (psi)	E50
Stiff Silty Loam	342.8	0.073	-	500	10.4	0.007
Stiff Silty Clay Loam	340.3	0.072	-	500	8.3	0.007
Very Stiff Silty Clay Loam	337.8	0.040	-	1000	16	0.005
Medium Stiff Clay	332.8	0.034	-	100	6.6	0.010
Stiff Clay	323.3	0.040	-	500	11.0	0.007
Medium Stiff Clay	320.3	0.030	-	100	3.5	0.010
Loose Sand	312.8	0.030	29.1	20	-	-
Soft Clay	310.3	0.028	-	30	2.8	0.020
Loose Sand	296.3	0.035	30.8	20	-	-
Medium Dense Sand	290.3	0.038	33.8	60	-	-
Dense Sand	285.3	0.042	37.2	125	-	-
Medium Dense Sand	268.1	0.040	34.9	60	-	-

Table 25 – Eastbound, East Abutment

Construction Considerations

Stage Construction

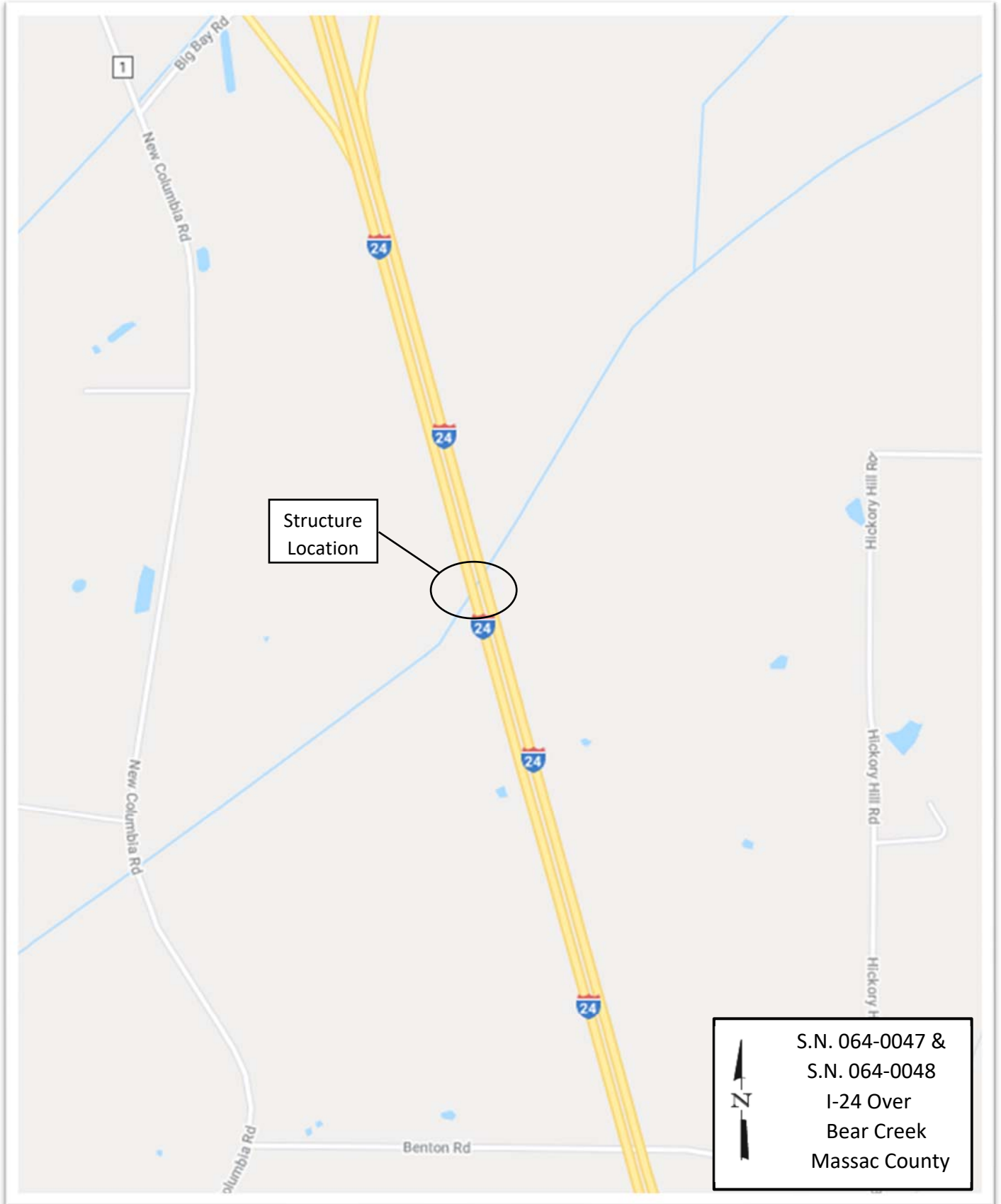
Traffic is expected to be maintained on I-24 utilizing cross overs for the construction of both structures. No temporary soil support system will be required for construction, as each of the proposed bridges will be constructed in a single stage and there is adequate space between the structures to excavate without cutting into the other structure. It has been determined that the soil will generally be adequate for a 1V:1H excavation slope. However, if the intermittent soft soil layers shown in the borings are encountered in the field, a 1V:1.5H excavation slope may be more appropriate.

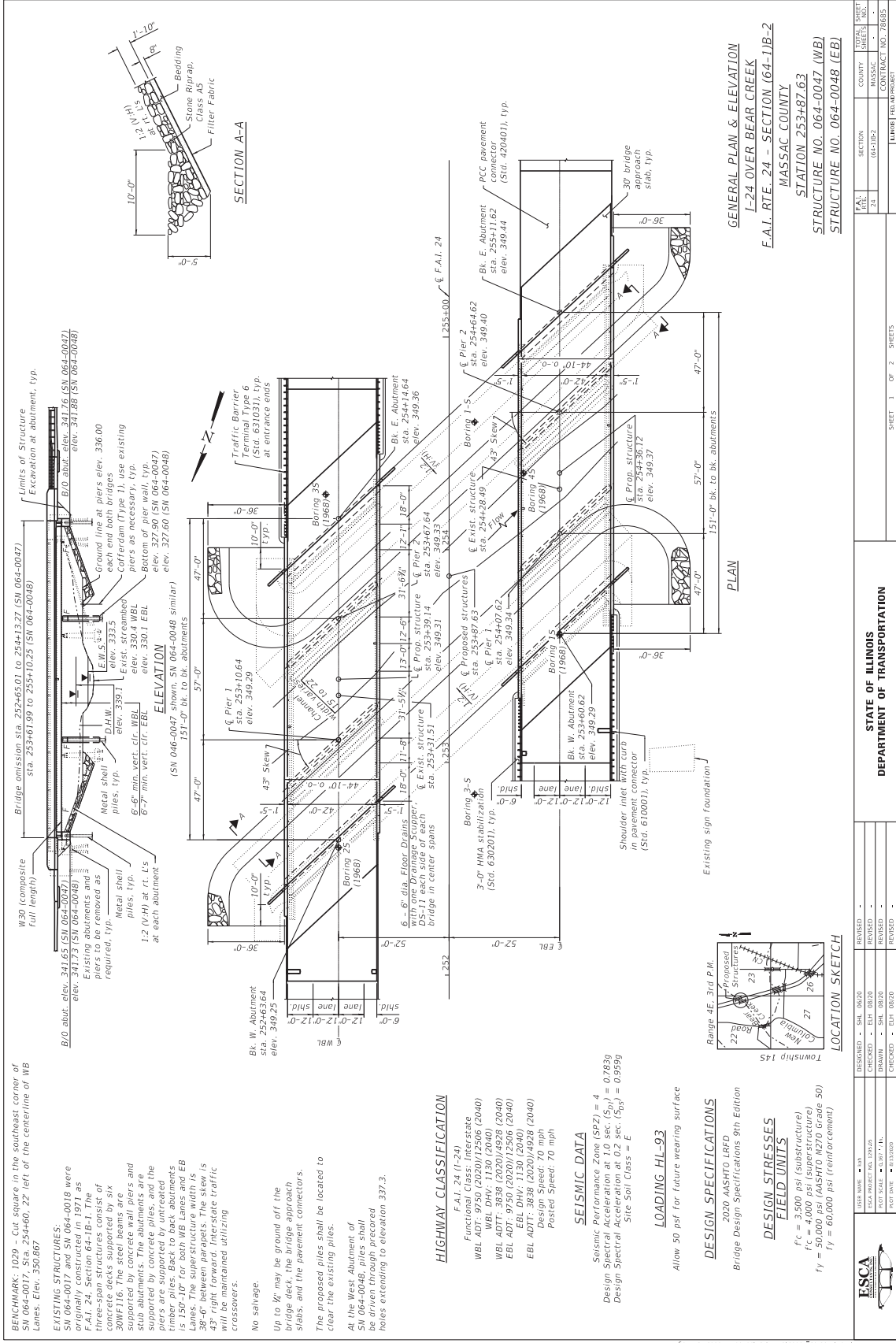
Foundation Construction

One test pile at each driven pile foundation should be provided due to the inconsistencies in the soil layers between the borings. Pile shoes are not required due to the absence of rock layers.

Limitations

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





BENCHMARK: 1029 - Cur square in the southeast corner of SN 064-0017, sta. 254+60.22' left of the centerline of WB Lane, Elev. 350.687

EXISTING STRUCTURES:
SN 064-0017 and SN 064-0018 were originally constructed in 1971 as Approach B to the 2-lane bridge. The existing concrete decks consist of six 30WF116. The steel beams are supported by concrete wall piers and stub abutments. The abutments are timber piles. Back to back abutments are supported by untreated timber piles. The superstructure width is 15'-0" between parapets. The skew is 38°-0" between parapets. The skew is to be maintained utilizing crossovers.

No salvage.
Up to 10' may be ground off the bridge deck to the approach slabs, and the pavement connectors.
The proposed piles shall be located to clear the existing piles.
At the West Abutment of SN 064-0048, piles shall be driven through pre-cored holes extending to elevation 337.3.

HIGHWAY CLASSIFICATION
F.A.I. 24 (I-24)
Functional Class: Interstate
WB Lane DHW: 1130 (2040)
WB Lane DHW: 1130 (2040)
EBL ADT: 3838 (2020)/4928 (2040)
EBL ADT: 9750 (2020)/12506 (2040)
EBL DHV: 1130 (2040)
EBL ADT: 3838 (2020)/4928 (2040)
Posted Speed: 70 mph

SEISMIC DATA
Seismic Performance Zone (SPZ) = 4
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.783g
Design Spectral Acceleration at 0.2 sec. ($S_{D0.2}$) = 0.959g
Site Soil Class = E

LOADING HL-93
Allow 50 psf for future wearing surface

DESIGN SPECIFICATIONS
2020 AASHTO LRFD
Bridge Design Specifications 9th Edition

DESIGN STRESSES FIELD UNITS
 $f_c = 3,500$ psi (substructure)
 $f_c = 4,000$ psi (superstructure)
 $f_y = 50,000$ psi (AASHTO M270 Grade 50)
 $f_y = 60,000$ psi (reinforcement)

LOCATION SKETCH
Range 4E, 3rd P.M.
Township 14S
Proposed Structures 23, 26, 27

GENERAL PLAN & ELEVATION
I-24 OVER BEAR CREEK
F.A.I. RTE. 24 - SECTION (64-1)B-2
MASSAC COUNTY
STATION 253+87.63
STRUCTURE NO. 064-0047 (WB)
STRUCTURE NO. 064-0048 (EB)

DESIGNED	•	SHL 0620	REVISED	•
CHECKED	•	EBL 0620	REVISED	•
APPROVED	•	ELR 0620	REVISED	•
CHECKED	•	ELR 0620	REVISED	•

DATE	BY	APP.
11/17/24	ELR	ELR
11/17/24	ELR	ELR
11/17/24	ELR	ELR

SCALE	SECTION	COUNTY	STATE
1"=20'	64-1)B2	MASSAC	ILLINOIS
24	24	MASSAC	ILLINOIS
24	24	MASSAC	ILLINOIS

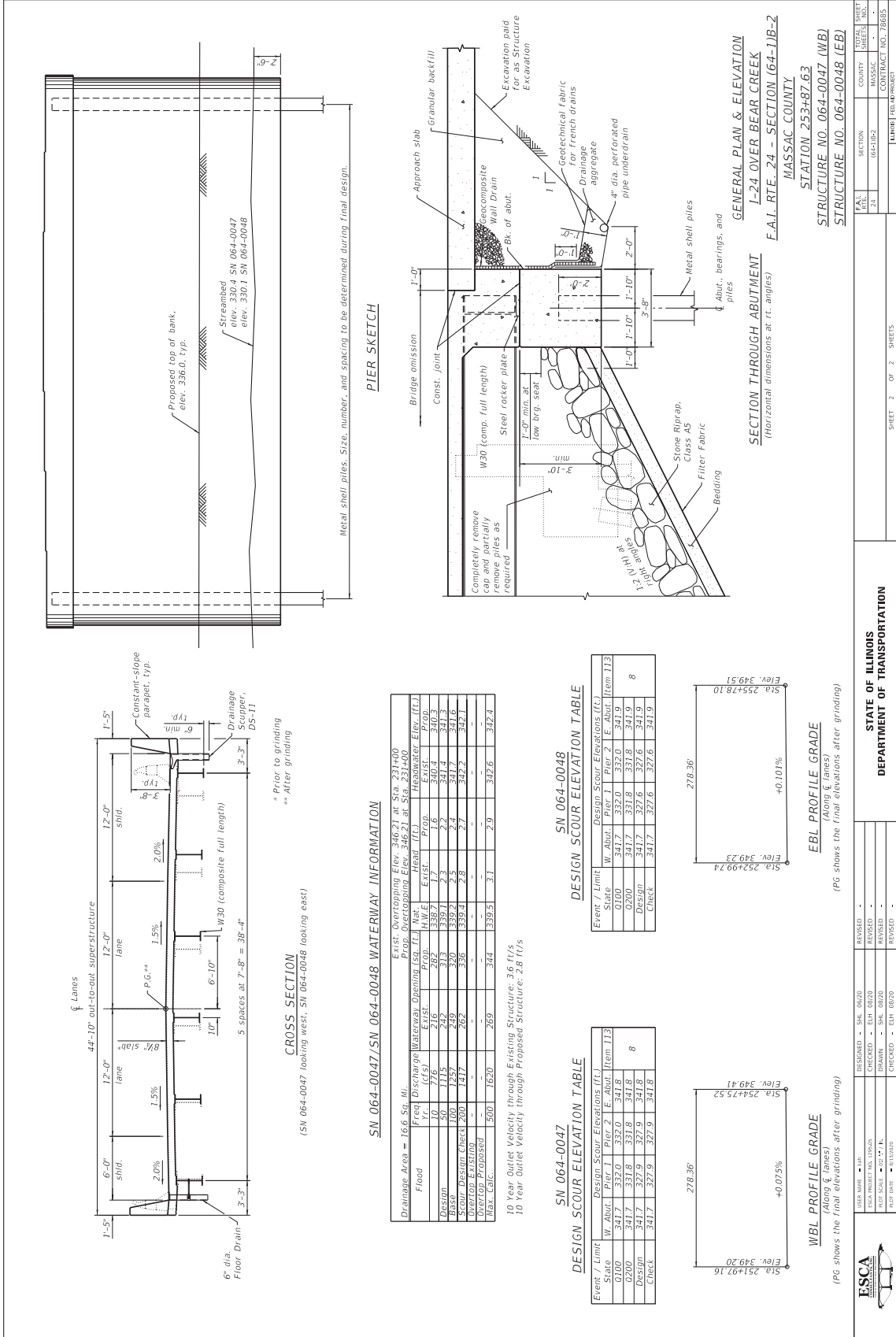
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DATE	11/23/2024
PROJECT NAME	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
PROJECT LOCATION	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
PROJECT SHEET NO.	87332000
PROJECT SHEET TOTAL	87332000

DESIGNED	•	SHL 0620	REVISED	•
CHECKED	•	EBL 0620	REVISED	•
APPROVED	•	ELR 0620	REVISED	•
CHECKED	•	ELR 0620	REVISED	•

DATE	BY	APP.
11/17/24	ELR	ELR
11/17/24	ELR	ELR
11/17/24	ELR	ELR

SCALE	SECTION	COUNTY	STATE
1"=20'	64-1)B2	MASSAC	ILLINOIS
24	24	MASSAC	ILLINOIS
24	24	MASSAC	ILLINOIS

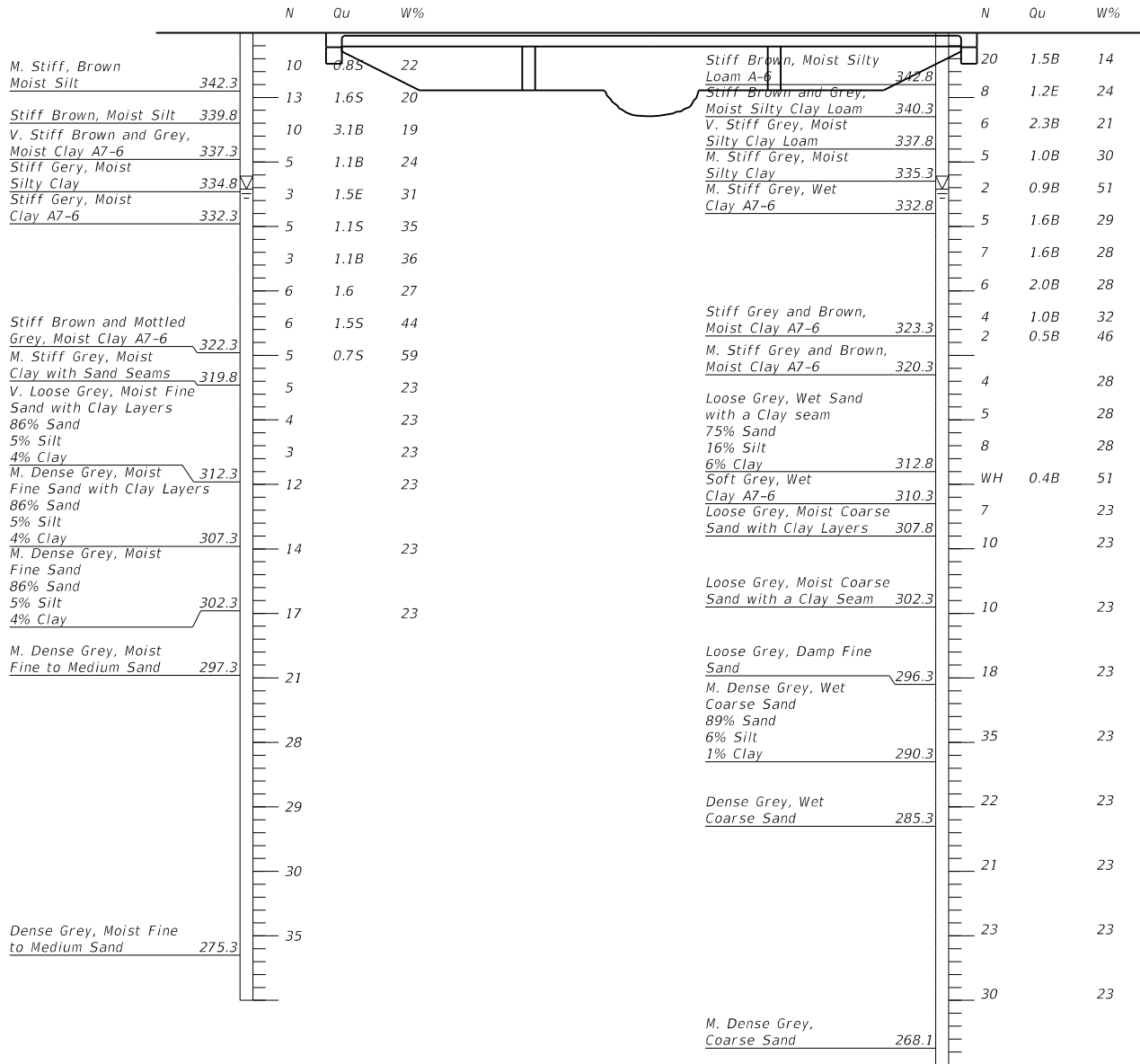
PROJECT NO.	87332000
DATE	11/23/2024
PROJECT NAME	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
PROJECT LOCATION	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
PROJECT SHEET NO.	87332000
PROJECT SHEET TOTAL	87332000



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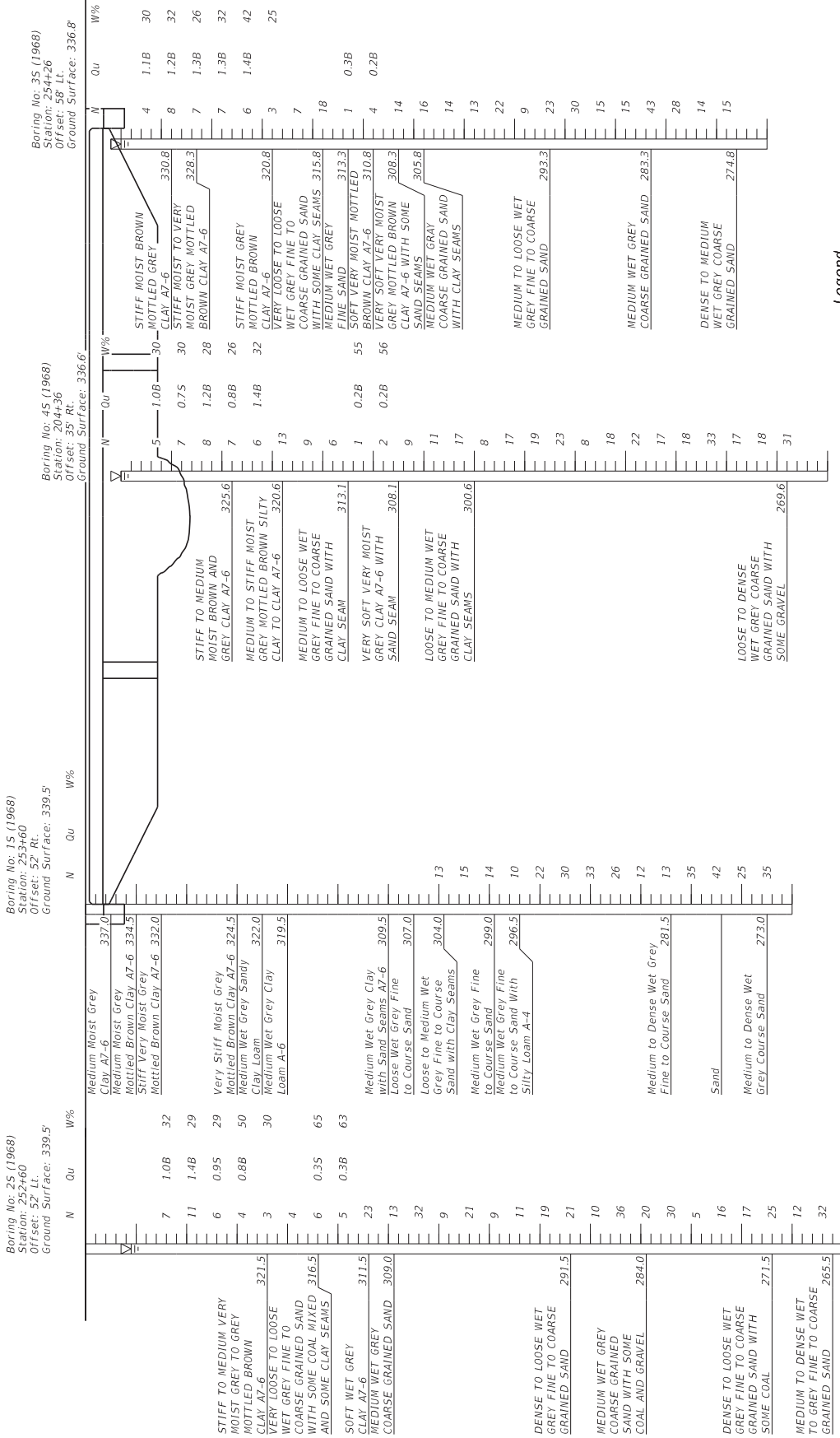
Boring No: 3-S
 Station: 252+85
 Offset: 40' LT CL of EB
 Ground Surface: 346.8'

Boring No: 1-S
 Station: 254+60
 Offset: 40' LT CL of EB
 Ground Surface: 346.8'



Legend

▽ Surface Water Elevation



Legend
▽ Surface Water Elevation

NOTE: The information above is from scans of 1968 Existing plans. Where data encountered was illegible, it has been interpreted in an attempt to be conservative.

ILLINOIS DEPARTMENT OF TRANSPORTATION
District Nine Materials

Bridge Foundation
Boring Log
Sheet 1 of 2

FAI-24 Over Bear Creek

Route: FAI-24

Structure Number: 064-0017/18

Date: 10/10/2018

Section (64-1)B-2

Bored By: L Estel

County: Massac

Location: 4.0 miles South of Johnson County

Checked By: A Hayes

Boring No 1-S

Station 254+60

Offset 40' LT of CL of EB

Ground Surface 346.8 Ft

DEPTH	B L O W S	Qu tsf	W%	Surf Wat Elev: 334.7	DEPTH	B L O W S	Qu tsf	W%
				Ground Water Elevation when Drilling				
				(Wash-type boring operation with bentonite drilling mud below Elev. 321.8) 320.3				
	3					3		
Stiff Brown, Moist SILTY LOAM A-6	10	1.5B	14	Loose Grey, Wet SAND with a CLAY seam		2		28
	10			75% Sand		2		
342.8				16% Silt				
				6% Clay				
Stiff Brown and Grey, Moist SILTY CLAY LOAM	5.0	4	1.2E	24		4		
	4				30.0	3		28
340.3						2		
V. Stiff Grey, Moist SILTY CLAY LOAM	2					5		
	3	2.3B	21			6		28
	3					2		
337.8					312.8			
M. Stiff Grey, Moist SILTY CLAY	10.0	2	1.0B	30		WH		
	3				35.0	WH	0.4B	51
335.3						WH		
					310.3			
M. Stiff Grey, Wet CLAY A7-6	WH					2		
	1	0.9B	51	Loose Grey, Moist Coarse SAND with CLAY layers		3		23
	1					4		
332.8					307.8			
Stiff Grey and Brown, Moist CLAY A7-6	15.0	2	1.6B	29		2		
	3				40.0	5		23
						5		
	1							
	3	1.6B	28					
	4							
	1				302.3			
	20.0	3	2.0B	28		7		
	3				45.0	5		23
						5		
	1							
	2	1.0B	32					
	2							
323.3								
M. Stiff Grey and Brown, Moist CLAY A7-6	WH							
	1	0.5B	46					
	1							
25.0					50.0			

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

Route: FAI-24
 Section: (64-1)B-2
 County: Massac

Boring No: 1-S
 Station: 254+60
 Offset: 40' LT of CL of EBLs
 Ground Surface: 346.8 Ft

	DEPTH	BLOWS	Qu tsf	W%		DEPTH	BLOWS	Qu tsf	W%
296.3									
M. Dense Grey, Wet Coarse SAND		9							
		8		23					
89% Sand		10					9		
6% Silt					M. Dense Grey, Coarse SAND		14		23
1% Clay							16		
	55.0					80.0			
290.3					Bottom of hole @ 78.7 feet				
Dense Grey, Wet Coarse SAND		9			Flowline @ Elev. 332.4				
		15		23	No free water observed prior to start of mud drilling @ Elev. 321.8				
		20							
					Elevation referenced to BM 1029 cut square in SE corner of SN 064-0017; Elev. = 350.87				
	60.0					85.0			
285.3					Borehole advanced with hollow stem auger (8" O.D., 3.25" I.D.) Elev. 346.8 to 321.8				
M. Dense Grey, Coarse SAND		8			To convert "N" values to "N60" multiply by 1.5				
		10		23					
		12							
	65.0					90.0			
		7							
		9		23					
		12							
	70.0					95.0			
		7							
		11		23					
		12							
	75.0					100.0			

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
Sheet 1 of 2

FAI-24 Over Bear Creek

Route: FAI-24

Structure Number: 064-0017/18

Date: 10/15/2018

Section (64-1)B-2

Bored By: L Estel

County: Massac

Location: 4.0 miles South of Johnson County

Checked By: A Hayes

Boring No 3-S

Station 252+85

Offset 40' LT of CL of EB

Ground Surface 346.8 Ft

	D E P T H	B L O W S	Qu tsf	W%	Surf Wat Elev: 334.7	D E P T H	B L O W S	Qu tsf	W%
					Ground Water Elevation when Drilling _____ At Completion _____ At: _____ Hrs: _____				
					M. Stiff Grey, Moist CLAY with SAND seams		2 3	0.7S	59
					319.8				
M. Stiff Brown, Moist SILT		1 3 7	0.8S	22	V. Loose Grey, Moist Fine SAND with CLAY layers		1 4		23
					86% Sand 5% Silt 4% Clay				
					342.3				
Stiff Brown, Moist SILT	5.0	3 6 7	1.6S	20		30.0	1 3 1		23
					339.8				
V. Stiff Brown and Grey, Moist CLAY A7-6		1 4 6	3.1B	19			1 2 1		23
					337.3				
Stiff Grey, Moist SILTY CLAY	10.0	1 2 3	1.1B	24	M. Dense Grey, Moist Fine SAND with CLAY layers	35.0	4 6 6		23
					86% Sand 5% Silt 4% Clay				
					334.8				
Stiff Grey, Moist CLAY A7-6		WH 1 2	1.5E	31					
					332.3				
Stiff Brown and Mottled Grey, Moist CLAY A7-6	15.0	1 2 3	1.1S	35	M. Dense Grey, Moist Fine SAND	40.0	4 6 8		23
					86% Sand 5% Silt 4% Clay				
					330.3				
					328.3				
					326.3				
					324.3				
(Wash-type boring operation with bentonite drilling mud below Elev. 322.3)		1 3 3	1.5S	44	M. Dense Grey, Moist Fine to Medium SAND	45.0	4 7 10		23
					322.3				
					320.3				
					318.3				
					316.3				
					314.3				
					312.3				
					310.3				
					308.3				
					306.3				
					304.3				
					302.3				
					300.3				
					298.3				
					296.3				
					294.3				
					292.3				
					290.3				
					288.3				
					286.3				
					284.3				
					282.3				
					280.3				
					278.3				
					276.3				
					274.3				
					272.3				
					270.3				
					268.3				
					266.3				
					264.3				
					262.3				
					260.3				
					258.3				
					256.3				
					254.3				
					252.3				
					250.3				

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

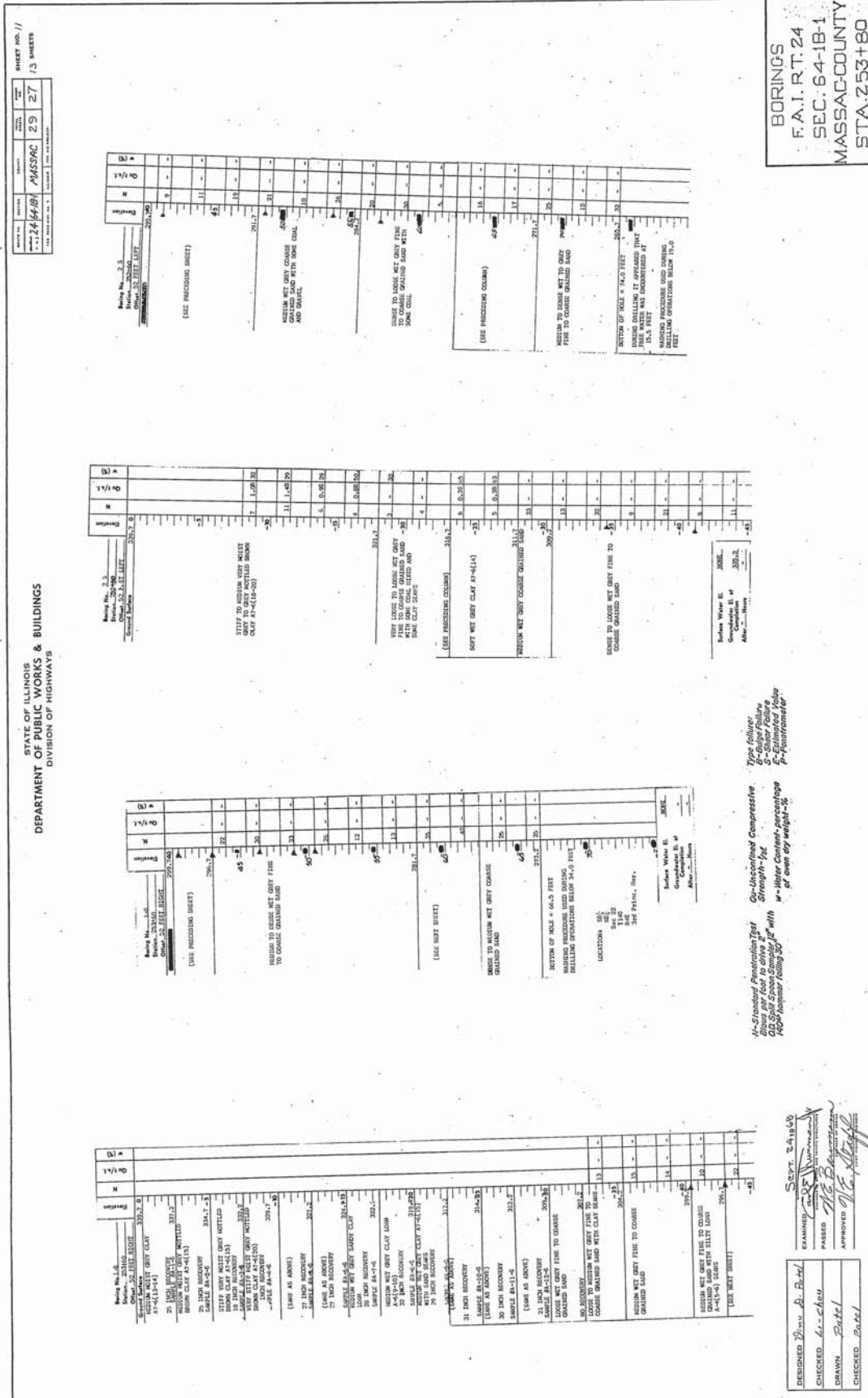
Route: FAI-24
Section: (64-1)B-2
County: Massac

Boring No: 3-S
Station: 252+85
Offset: 40' LT of CL of EBLs
Ground Surface: 346.8 Ft

	D E P T H	B L O W S			D E P T H	B L O W S		
			Qu tsf	W%			Qu tsf	W%
M. Dense Grey, Moist Fine to Medium SAND		10						
		11						
	55.0	9				80.0		
		14						
		14						
	60.0	9				85.0		
		13						
		16						
	65.0	7				90.0		
		12						
		18						
	70.0	11				95.0		
		16						
		19						
	75.0					100.0		

Bottom of hole @ 71.5 feet
No free water observed prior to start of water cap method @ Elev. 322.3
Flowline Elev. @ 332.4
Elevation referenced to BM 1029 cut square in SE corner of SN 064-0017; Elev. = 350.87
Borehole advanced with hollow stem auger (8" O.D, 3.25" I.D.) Elev. 346.8 to 322.3
To convert "N" values to "N60" multiply by 1.5

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



STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

PROJECT NO. 24-148(B) MASSAC 25 2B 13 SHEETS

DATE: 11/24/88
DRAWN: P. Patel
CHECKED: L. C. Chau
APPROVED: J. E. H. H. H.

DEPTH (ft)	DESCRIPTION	WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX	UNSATURATED WATER CONTENT (%)	SHRINKAGE (%)	STANDARD PENETRATION TEST (blows/ft)	SOIL CLASSIFICATION
0-1	TOP SOIL	25	45	20	15	1	10	ML
1-2	CLAY	45	75	30	25	2	15	CH
2-3	CLAY	45	75	30	25	2	15	CH
3-4	CLAY	45	75	30	25	2	15	CH
4-5	CLAY	45	75	30	25	2	15	CH
5-6	CLAY	45	75	30	25	2	15	CH
6-7	CLAY	45	75	30	25	2	15	CH
7-8	CLAY	45	75	30	25	2	15	CH
8-9	CLAY	45	75	30	25	2	15	CH
9-10	CLAY	45	75	30	25	2	15	CH
10-11	CLAY	45	75	30	25	2	15	CH
11-12	CLAY	45	75	30	25	2	15	CH
12-13	CLAY	45	75	30	25	2	15	CH
13-14	CLAY	45	75	30	25	2	15	CH
14-15	CLAY	45	75	30	25	2	15	CH
15-16	CLAY	45	75	30	25	2	15	CH
16-17	CLAY	45	75	30	25	2	15	CH
17-18	CLAY	45	75	30	25	2	15	CH
18-19	CLAY	45	75	30	25	2	15	CH
19-20	CLAY	45	75	30	25	2	15	CH
20-21	CLAY	45	75	30	25	2	15	CH
21-22	CLAY	45	75	30	25	2	15	CH
22-23	CLAY	45	75	30	25	2	15	CH
23-24	CLAY	45	75	30	25	2	15	CH
24-25	CLAY	45	75	30	25	2	15	CH
25-26	CLAY	45	75	30	25	2	15	CH
26-27	CLAY	45	75	30	25	2	15	CH
27-28	CLAY	45	75	30	25	2	15	CH
28-29	CLAY	45	75	30	25	2	15	CH
29-30	CLAY	45	75	30	25	2	15	CH
30-31	CLAY	45	75	30	25	2	15	CH
31-32	CLAY	45	75	30	25	2	15	CH
32-33	CLAY	45	75	30	25	2	15	CH
33-34	CLAY	45	75	30	25	2	15	CH
34-35	CLAY	45	75	30	25	2	15	CH
35-36	CLAY	45	75	30	25	2	15	CH
36-37	CLAY	45	75	30	25	2	15	CH
37-38	CLAY	45	75	30	25	2	15	CH
38-39	CLAY	45	75	30	25	2	15	CH
39-40	CLAY	45	75	30	25	2	15	CH
40-41	CLAY	45	75	30	25	2	15	CH
41-42	CLAY	45	75	30	25	2	15	CH
42-43	CLAY	45	75	30	25	2	15	CH
43-44	CLAY	45	75	30	25	2	15	CH
44-45	CLAY	45	75	30	25	2	15	CH
45-46	CLAY	45	75	30	25	2	15	CH
46-47	CLAY	45	75	30	25	2	15	CH
47-48	CLAY	45	75	30	25	2	15	CH
48-49	CLAY	45	75	30	25	2	15	CH
49-50	CLAY	45	75	30	25	2	15	CH
50-51	CLAY	45	75	30	25	2	15	CH
51-52	CLAY	45	75	30	25	2	15	CH
52-53	CLAY	45	75	30	25	2	15	CH
53-54	CLAY	45	75	30	25	2	15	CH
54-55	CLAY	45	75	30	25	2	15	CH
55-56	CLAY	45	75	30	25	2	15	CH
56-57	CLAY	45	75	30	25	2	15	CH
57-58	CLAY	45	75	30	25	2	15	CH
58-59	CLAY	45	75	30	25	2	15	CH
59-60	CLAY	45	75	30	25	2	15	CH
60-61	CLAY	45	75	30	25	2	15	CH
61-62	CLAY	45	75	30	25	2	15	CH
62-63	CLAY	45	75	30	25	2	15	CH
63-64	CLAY	45	75	30	25	2	15	CH
64-65	CLAY	45	75	30	25	2	15	CH
65-66	CLAY	45	75	30	25	2	15	CH
66-67	CLAY	45	75	30	25	2	15	CH
67-68	CLAY	45	75	30	25	2	15	CH
68-69	CLAY	45	75	30	25	2	15	CH
69-70	CLAY	45	75	30	25	2	15	CH
70-71	CLAY	45	75	30	25	2	15	CH
71-72	CLAY	45	75	30	25	2	15	CH
72-73	CLAY	45	75	30	25	2	15	CH
73-74	CLAY	45	75	30	25	2	15	CH
74-75	CLAY	45	75	30	25	2	15	CH
75-76	CLAY	45	75	30	25	2	15	CH
76-77	CLAY	45	75	30	25	2	15	CH
77-78	CLAY	45	75	30	25	2	15	CH
78-79	CLAY	45	75	30	25	2	15	CH
79-80	CLAY	45	75	30	25	2	15	CH
80-81	CLAY	45	75	30	25	2	15	CH
81-82	CLAY	45	75	30	25	2	15	CH
82-83	CLAY	45	75	30	25	2	15	CH
83-84	CLAY	45	75	30	25	2	15	CH
84-85	CLAY	45	75	30	25	2	15	CH
85-86	CLAY	45	75	30	25	2	15	CH
86-87	CLAY	45	75	30	25	2	15	CH
87-88	CLAY	45	75	30	25	2	15	CH
88-89	CLAY	45	75	30	25	2	15	CH
89-90	CLAY	45	75	30	25	2	15	CH
90-91	CLAY	45	75	30	25	2	15	CH
91-92	CLAY	45	75	30	25	2	15	CH
92-93	CLAY	45	75	30	25	2	15	CH
93-94	CLAY	45	75	30	25	2	15	CH
94-95	CLAY	45	75	30	25	2	15	CH
95-96	CLAY	45	75	30	25	2	15	CH
96-97	CLAY	45	75	30	25	2	15	CH
97-98	CLAY	45	75	30	25	2	15	CH
98-99	CLAY	45	75	30	25	2	15	CH
99-100	CLAY	45	75	30	25	2	15	CH

Soil description and test results for borings 1 through 100. Includes notes on soil types (CLAY, SAND, SILT) and test parameters (WATER CONTENT, LIQUID LIMIT, PLASTICITY INDEX, UNSATURATED WATER CONTENT, SHRINKAGE, STANDARD PENETRATION TEST).

Soil description and test results for borings 101 through 200. Includes notes on soil types and test parameters.

Soil description and test results for borings 201 through 300. Includes notes on soil types and test parameters.

Soil description and test results for borings 301 through 400. Includes notes on soil types and test parameters.

Soil description and test results for borings 401 through 500. Includes notes on soil types and test parameters.

Soil description and test results for borings 501 through 600. Includes notes on soil types and test parameters.

Soil description and test results for borings 601 through 700. Includes notes on soil types and test parameters.

Soil description and test results for borings 701 through 800. Includes notes on soil types and test parameters.

BORINGS
F.A.I. R.T. 24
SEC. 64-1B-1
MASSAC-COUNTY
STA. 253+80

Soil classification legend:
U - Unconsolidated
C - Consolidated
M - Macromass
S - Silty
ML - Silty clay
CL - Clay
MH - Silty macromass
CH - Clay
MS - Silty macromass
MC - Clay
MS - Silty macromass
MC - Clay
MS - Silty macromass
MC - Clay

DESIGNED: 10/24/88, S. Patel
CHECKED: L. C. Chau
DRAWN: Patel
CHECKED: Patel

EXAMINED: S. Patel
PASSED: L. C. Chau
APPROVED: J. E. H. H.



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== WB W Abut (2S)
 ELEVATION OF BORING GROUND SURFACE ===== 339.50 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== 0.40 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== 2.55 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== 2.15 FT. (Fill Height)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
V_{s,40'} = 468 FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING				CONDITIONS DURING EARTHQUAKE								
	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONFR. COMPR. STR., Q _u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w _c (%)	EFFECTIVE UNIT WT. (KCF.)	CORR. VERT. STRESS (KSF.)	SPT N VALUE (N ₁) _{60s}	EQUIV. CLN. SAND SPT N VALUE (N ₁) _{60cs}	CRR RESIST. MAG 7.5 CRR 7.5	EFFECTIVE UNIT WT. (KCF.)	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	
329	10.5	7	1		11	41	32	0.059	0.620	13.143	13.143	0.142	0.059	0.877	1.508	1.248	0.175	0.868	0.434	N.L. (2)
326.5	13	11	1.4		11	41	29	0.063	0.777	21.646	21.646	0.237	0.063	1.035	1.821	1.244	0.292	0.832	0.426	N.L. (2)
324	15.5	6	0.9		11	41	29	0.058	0.922	11.166	11.166	0.124	0.058	1.180	2.122	1.150	0.141	0.793	0.415	N.L. (2)
321.5	18	4	0.8		11	41	50	0.057	1.065	7.330	7.330	0.090	0.057	1.323	2.421	1.107	0.099	0.753	0.401	0.247 (C)
319	20.5	3					30	0.051	1.192	5.403	5.403	0.075	0.051	1.450	2.704	1.080	0.080	0.714	0.387	0.207 (C)
316.5	23	4						0.053	1.325	7.044	7.044	0.088	0.053	1.583	2.993	1.064	0.093	0.676	0.372	0.250 (C)
314	25.5	6	0.3		11	41	65	0.046	1.440	10.352	10.352	0.116	0.046	1.698	3.264	1.053	0.121	0.641	0.359	0.337 (C)
311.5	28	5	0.3		11	41	63	0.046	1.555	8.439	8.439	0.100	0.046	1.813	3.535	1.035	0.102	0.609	0.346	0.295 (C)
309	30.5	23						0.068	1.725	42.608	42.608	0.195	0.068	1.983	3.861	1.027	0.198	0.582	0.330	N.L. (3)
306.5	33	13						0.063	1.882	21.189	21.189	0.231	0.063	2.140	4.174	0.997	0.228	0.558	0.317	0.719 (D)
304	35.5	32						0.071	2.060	57.536	57.536	0.379	0.071	2.318	4.508	0.965	0.362	0.538	0.305	N.L. (3)
301.5	38	9						0.060	2.210	13.303	13.303	0.143	0.060	2.468	4.814	0.962	0.137	0.522	0.296	0.463 (D)
299	40.5	21						0.068	2.380	32.762	32.762	1.046	0.068	2.638	5.140	0.922	0.955	0.509	0.289	N.L. (3)
296.5	43	9						0.060	2.530	12.537	12.537	0.136	0.060	2.788	5.446	0.935	0.126	0.498	0.283	0.445 (D)
294	45.5	11						0.062	2.685	14.909	14.909	0.159	0.062	2.943	5.757	0.918	0.145	0.489	0.279	0.520 (D)
291.5	48	19						0.067	2.852	26.474	26.474	0.325	0.067	3.110	6.080	0.880	0.283	0.482	0.275	N.L. (3)
289	50.5	21						0.068	3.022	28.716	28.716	0.397	0.068	3.280	6.406	0.859	0.338	0.477	0.271	N.L. (3)
286.5	53	10						0.061	3.175	12.473	12.473	0.136	0.061	3.433	6.715	0.888	0.119	0.473	0.269	0.442 (D)
284	55.5	36						0.073	3.357	50.887	50.887	0.313	0.073	3.615	7.053	0.808	0.250	0.470	0.267	N.L. (3)
281.5	58	20						0.067	3.525	24.717	24.717	0.286	0.067	3.783	7.377	0.829	0.235	0.467	0.265	0.887 (D)
279	60.5	30						0.071	3.702	38.243	38.243	0.043	0.071	3.960	7.710	0.779	0.033	0.465	0.264	N.L. (3)
277	62.5	5						0.055	3.812	5.631	5.631	0.077	0.055	4.070	7.945	0.875	0.067	0.464	0.264	0.254 (C)
273.5	66	16						0.065	4.040	17.612	17.612	0.187	0.065	4.298	8.391	0.821	0.152	0.454	0.258	0.589 (D)
271	68.5	17						0.066	4.205	18.324	18.324	0.195	0.066	4.463	8.712	0.810	0.157	0.451	0.256	0.613 (D)
268.5	71	25						0.069	4.377	27.476	27.476	0.352	0.069	4.635	9.040	0.766	0.267	0.447	0.254	N.L. (3)
266	73.5	12						0.063	4.535	12.142	12.142	0.132	0.063	4.793	9.354	0.819	0.107	0.444	0.252	0.425 (C)
265.5	74	32						0.071	4.570	35.436	35.436	-0.438	0.071	4.828	9.421	0.725	-0.315	0.443	0.252	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_L/LL ≤ 0.85
 N.L. (3) = NOT LIQUEFIABLE, (N₁)₆₀ > 25
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== WB E Abut (3S)
 ELEVATION OF BORING GROUND SURFACE ===== 336.80 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== -2.30 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== 2.66 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== 4.96 FT. (Fill Height)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
V_{s,40'} = 417 FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
	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.)	CORR. VERT. STRESS (KSF.)	EQUIV. CLN. SPT N VALUE (N ₁) ₆₀	CRR MAG 7.5 CRR 7.5	EFFECTIVE UNIT WT. (KCF.)	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		
330.8	6	4	1.1		11	41	30	0.060	0.360	7.416	7.416	0.091	0.060	0.811	1.329	1.230	0.111	0.847	0.404	N.L. (2)
328.3	8.5	8	1.2		11	41	32	0.061	0.513	14.968	14.968	0.160	0.061	0.964	1.638	1.230	0.195	0.803	0.397	N.L. (2)
325.8	11	7	1.3		11	41	26	0.062	0.668	13.078	13.078	0.141	0.062	1.119	1.949	1.174	0.164	0.758	0.385	N.L. (2)
323.3	13.5	7	1.3		11	41	32	0.062	0.823	13.052	13.052	0.141	0.062	1.274	2.260	1.136	0.159	0.714	0.369	N.L. (2)
320.8	16	6	1.4		11	41	42	0.063	0.980	11.045	11.045	0.122	0.063	1.431	2.573	1.098	0.133	0.671	0.351	0.379 (D)
318.3	18.5	3					25	0.051	1.108	5.454	5.454	0.075	0.051	1.559	2.857	1.064	0.080	0.631	0.337	0.237 (C)
315.8	21	7						0.058	1.253	12.442	12.442	0.135	0.058	1.704	3.158	1.055	0.141	0.595	0.321	0.439 (D)
313.3	23.5	18						0.066	1.418	34.172	34.172	-5.557	0.066	1.869	3.479	1.049	-5.776	0.563	0.305	N.L. (3)
310.8	26	1	0.3		11	41	0	0.046	1.533	1.688	1.688	0.052	0.046	1.984	3.750	1.013	0.052	0.536	0.295	0.176 (C)
308.3	28.5	4	0.2		11	41	0	0.042	1.638	6.624	6.624	0.085	0.042	2.089	4.011	1.003	0.084	0.513	0.287	0.293 (C)
305.8	31	14						0.064	1.798	23.463	23.463	0.264	0.064	2.249	4.327	0.982	0.257	0.494	0.277	0.928 (D)
303.3	33.5	18						0.066	1.963	30.086	30.086	0.474	0.066	2.414	4.648	0.955	0.448	0.479	0.269	N.L. (3)
300.8	36	14						0.064	2.123	21.789	21.789	0.239	0.064	2.574	4.964	0.943	0.223	0.467	0.262	0.851 (D)
298.3	38.5	13						0.063	2.280	19.388	19.388	0.208	0.063	2.731	5.277	0.929	0.191	0.457	0.257	0.743 (D)
295.8	41	22						0.068	2.450	34.041	34.041	-23.851	0.068	2.901	5.603	0.887	-20.958	0.449	0.253	N.L. (3)
293.3	43.5	9						0.060	2.600	12.372	12.372	0.135	0.060	3.051	5.909	0.914	0.122	0.443	0.250	0.488 (D)
290.8	46	23						0.068	2.770	33.529	33.529	2.367	0.068	3.221	6.235	0.854	2.001	0.438	0.247	N.L. (3)
288.3	48.5	30						0.071	2.948	44.290	44.290	0.226	0.071	3.399	6.569	0.828	0.185	0.434	0.244	N.L. (3)
285.8	51	15						0.065	3.110	19.303	19.303	0.207	0.065	3.561	6.887	0.860	0.176	0.431	0.243	0.724 (D)
283.3	53.5	15						0.065	3.273	18.739	18.739	0.200	0.065	3.724	7.206	0.851	0.169	0.429	0.242	0.698 (D)
280.8	56	43						0.074	3.458	60.498	60.498	0.406	0.074	3.909	7.547	0.783	0.314	0.427	0.240	N.L. (3)
278.3	58.5	28						0.070	3.633	35.705	35.705	-0.327	0.070	4.084	7.878	0.773	-0.250	0.426	0.239	N.L. (3)
275.8	61	14						0.064	3.793	15.855	15.855	0.169	0.064	4.244	8.194	0.830	0.139	0.420	0.236	0.589 (D)
273.8	63	15						0.065	3.923	16.729	16.729	0.178	0.065	4.374	8.449	0.820	0.145	0.417	0.235	0.617 (D)

* FACTOR OF SAFETY DESCRIPTIONS
 N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
 N.L. (2) = NOT LIQUEFIABLE, PI ≥ 12 OR w_L/LL ≤ 0.85
 N.L. (3) = NOT LIQUEFIABLE, (N₁)₆₀ > 25
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== EB W Abut (3-S)
 ELEVATION OF BORING GROUND SURFACE ===== 346.80 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== 7.70 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== 2.63 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== -5.07 FT. (Cut Depth)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
 $V_{s,40'} = 425$ FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
	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.)	CORR. VERT. STRESS (KSF.)	EQUIV. CLN. SPT N VALUE ($N_{1,60}$)	CRR RESIST. MAG 7.5 CRR 7.5	EFFECTIVE UNIT WT. (KCF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. CRR 7.5 CRR	SOIL MASS FACTOR (r _s)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR		
342.3	4.5	10	0.8				22	0.119	0.536	18.300	18.300	0.195								
339.8	7	13	1.6				20	0.127	0.853	22.073	22.073	0.243	0.127	0.245	0.245	1.500	0.361	0.980	0.285	N.L. (1)
337.3	9.5	10	3.1		11	41	19	0.073	1.036	16.573	16.573	0.176	0.073	0.428	0.540	1.500	0.262	0.951	0.350	N.L. (2)
334.8	12	5	1.1		11	41	24	0.060	1.186	8.199	8.199	0.098	0.060	0.578	0.846	1.332	0.129	0.918	0.391	N.L. (2)
332.3	14.5	3	1.5		11	41	31	0.064	1.346	4.913	4.913	0.071	0.064	0.738	1.162	1.235	0.087	0.880	0.404	N.L. (2)
329.8	17	5	1.1		11	41	35	0.060	1.496	8.112	8.112	0.097	0.060	0.888	1.468	1.211	0.116	0.839	0.404	0.287 (C)
327.3	19.5	3	1.1		11	41	36	0.060	1.646	4.788	4.788	0.070	0.060	1.038	1.774	1.154	0.081	0.796	0.396	0.205 (C)
324.8	22	6	1.6		11	41	27	0.065	1.808	9.351	9.351	0.107	0.065	1.200	2.092	1.138	0.121	0.752	0.382	N.L. (2)
322.3	24.5	6	1.5		11	41	44	0.064	1.968	9.110	9.110	0.105	0.064	1.360	2.408	1.105	0.115	0.708	0.365	0.315 (C)
319.8	27	5	0.7		11	41	59	0.055	2.106	7.421	7.421	0.091	0.055	1.498	2.702	1.078	0.097	0.667	0.350	0.277 (C)
317.3	29.5	5					23	0.055	2.243	7.247	7.247	0.090	0.055	1.635	2.995	1.057	0.094	0.628	0.335	0.281 (C)
314.8	32	4					23	0.053	2.376	5.666	5.666	0.077	0.053	1.768	3.284	1.038	0.079	0.593	0.321	0.246 (C)
312.3	34.5	3					23	0.051	2.503	4.157	4.157	0.066	0.051	1.895	3.567	1.023	0.067	0.563	0.308	0.218 (C)
307.3	39.5	12					23	0.063	2.818	15.816	15.816	0.168	0.063	2.210	4.194	0.989	0.165	0.515	0.285	0.579 (D)
302.3	44.5	14					23	0.064	3.138	17.679	17.679	0.188	0.064	2.530	4.826	0.952	0.177	0.482	0.268	0.660 (D)
297.3	49.5	17					23	0.066	3.468	20.698	20.698	0.224	0.066	2.860	5.468	0.915	0.203	0.461	0.257	0.790 (D)
292.3	54.5	21					23	0.068	3.808	24.765	24.765	0.287	0.068	3.200	6.120	0.875	0.249	0.448	0.249	1.000 (D)
287.3	59.5	28					23	0.070	4.158	32.465	32.465	0.887	0.070	3.550	6.782	0.826	0.726	0.440	0.245	N.L. (3)
282.3	64.5	29					23	0.071	4.513	31.872	31.872	0.701	0.071	3.905	7.449	0.799	0.555	0.435	0.242	N.L. (3)
277.3	69.5	30					23	0.071	4.868	31.320	31.320	0.600	0.071	4.260	8.116	0.775	0.461	0.432	0.240	N.L. (3)
275.3	71.5	35					23	0.072	5.012	36.669	36.669	-0.108	0.072	4.404	8.385	0.747	-0.080	0.425	0.236	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 $w_p/LL \leq 0.85$
 N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== EB E Abut (1-S)
 ELEVATION OF BORING GROUND SURFACE ===== 346.80 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== 7.70 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== 2.78 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== -4.92 FT. (Cut Depth)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
V_{s,40'} = 359 FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING				CONDITIONS DURING EARTHQUAKE								
	BORING DEPTH (FT.)	SPT VALUE (BLOWS)	UNCONF. COMPR. STR., Q _u (TSF.)	% FINES < #200	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w _c (%)	EFFECTIVE UNIT WT. (KCF.)	CORR. STRESS (KSF.)	EQUIV. CLN. SPT N (N ₁) ₆₀	SAND SPT N VALUE (N ₁) _{60cs}	CRR RESIST. MAG 7.5 CRR _{7.5}	EFFECTIVE UNIT WT. (KCF.)	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	
342.8	4	20	1.5				14	0.126	0.504	41.749	41.749	0.175								
340.3	6.5	8	1.2				24	0.124	0.814	12.956	12.956	0.140	0.124	0.196	1.500	0.208	0.974	0.284	N.L. (1)	
337.8	9	6	2.3		11	41	21	0.069	0.987	9.674	9.674	0.110	0.069	0.368	0.450	1.494	0.163	0.929	0.330	N.L. (2)
335.3	11.5	5	1		11	41	30	0.059	1.134	8.232	8.232	0.098	0.059	0.516	0.753	1.366	0.132	0.881	0.374	N.L. (2)
332.8	14	2	0.9		11	41	51	0.058	1.279	3.309	3.309	0.060	0.058	0.661	1.054	1.263	0.075	0.829	0.385	0.195 (C)
330.3	16.5	5	1.6		11	41	29	0.065	1.442	8.182	8.182	0.097	0.065	0.823	1.373	1.231	0.119	0.776	0.377	N.L. (2)
327.8	19	7	1.6		11	41	28	0.065	1.604	11.246	11.246	0.124	0.065	0.986	1.691	1.201	0.148	0.724	0.361	N.L. (2)
325.3	21.5	6	2		11	41	28	0.067	1.772	9.407	9.407	0.108	0.067	1.153	2.015	1.149	0.123	0.674	0.343	N.L. (2)
323.3	23.5	4	1		11	41	32	0.059	1.890	6.159	6.159	0.081	0.059	1.271	2.257	1.112	0.089	0.636	0.329	N.L. (2)
320.3	26.5	2	0.5		11	41	46	0.051	2.043	3.005	3.005	0.058	0.051	1.424	2.598	1.083	0.063	0.585	0.311	0.203 (C)
317.8	29	4					28	0.053	2.175	5.876	5.876	0.079	0.053	1.557	2.886	1.066	0.083	0.549	0.296	0.280 (C)
315.3	31.5	5					28	0.055	2.313	7.169	7.169	0.089	0.055	1.694	3.180	1.049	0.093	0.517	0.283	0.329 (C)
312.8	34	8					28	0.059	2.460	11.174	11.174	0.124	0.059	1.842	3.483	1.034	0.127	0.491	0.270	0.470 (D)
310.3	36.5	1	0.4		11	41	51	0.049	2.583	1.368	1.368	0.050	0.049	1.964	3.762	1.015	0.051	0.469	0.261	0.195 (C)
307.8	39	7					23	0.058	2.728	9.341	9.341	0.107	0.058	2.109	4.063	1.001	0.106	0.451	0.253	0.419 (C)
302.3	44.5	10					23	0.061	3.063	12.625	12.625	0.137	0.061	2.445	4.741	0.965	0.131	0.423	0.239	0.548 (D)
296.3	50.5	10					23	0.061	3.429	11.919	11.919	0.130	0.061	2.811	5.482	0.934	0.121	0.406	0.230	0.526 (D)
290.3	56.5	18					23	0.066	3.825	20.781	20.781	0.225	0.066	3.207	6.252	0.884	0.197	0.396	0.225	0.876 (D)
285.3	61.5	35					23	0.072	4.185	42.051	42.051	0.183	0.072	3.567	6.924	0.812	0.147	0.391	0.221	N.L. (3)
280.3	66.5	22					23	0.068	4.525	23.197	23.197	0.260	0.068	3.907	7.576	0.825	0.213	0.389	0.219	0.973 (D)
275.3	71.5	21					23	0.068	4.865	20.891	20.891	0.227	0.068	4.247	8.228	0.812	0.182	0.382	0.216	0.843 (D)
270.3	76.5	23					23	0.068	5.205	22.016	22.016	0.242	0.068	4.587	8.880	0.789	0.189	0.375	0.212	0.892 (D)
268.1	78.7	30					23	0.071	5.361	29.126	29.126	0.416	0.071	4.743	9.174	0.754	0.311	0.372	0.210	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_p/LL ≤ 0.85
 N.L. (3) = NOT LIQUEFIABLE, (N₁)₆₀ > 25
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== WB Pier 1 (2S)
 ELEVATION OF BORING GROUND SURFACE ===== 339.50 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== 0.40 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== -3.10 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== -3.50 FT. (Cut Depth)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
V_{s,40'} = 480 FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING				CONDITIONS DURING EARTHQUAKE								
	BORING SAMPLE DEPTH (FT.)	SPT N VALUE (BLOWS)	UNCONFR. COMPR. STR., Q _u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w _c (%)	EFFECTIVE UNIT WT. (KCF.)	CORR. VERT. STRESS (KSF.)	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.)	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	
329	10.5	7	1		11	41	32	0.059	0.620	13.143	13.143	0.142	0.059	0.413	1.043	1.500	0.211	0.945	0.695	N.L. (2)
326.5	13	11	1.4		11	41	29	0.063	0.777	21.646	21.646	0.237	0.063	0.571	1.357	1.491	0.350	0.918	0.636	N.L. (2)
324	15.5	6	0.9		11	41	29	0.058	0.922	11.166	11.166	0.124	0.058	0.716	1.658	1.296	0.159	0.888	0.599	N.L. (2)
321.5	18	4	0.8		11	41	50	0.057	1.065	7.330	7.330	0.090	0.057	0.858	1.956	1.214	0.109	0.854	0.567	0.192 (C)
319	20.5	3					30	0.051	1.192	5.403	5.403	0.075	0.051	0.986	2.240	1.168	0.087	0.817	0.541	0.161 (C)
316.5	23	4						0.053	1.325	7.044	7.044	0.088	0.053	1.118	2.528	1.146	0.100	0.779	0.513	0.195 (C)
314	25.5	6	0.3		11	41	65	0.046	1.440	10.352	10.352	0.116	0.046	1.233	2.799	1.135	0.131	0.740	0.489	0.268 (D)
311.5	28	5	0.3		11	41	63	0.046	1.555	8.439	8.439	0.100	0.046	1.348	3.070	1.106	0.109	0.702	0.466	0.234 (C)
309	30.5	23						0.068	1.725	42.608	42.608	0.195	0.068	1.518	3.396	1.143	0.220	0.667	0.434	N.L. (3)
306.5	33	13						0.063	1.882	21.189	21.189	0.231	0.063	1.676	3.710	1.074	0.245	0.634	0.409	0.599 (D)
304	35.5	32						0.071	2.060	57.536	57.536	0.379	0.071	1.853	4.043	1.055	0.396	0.605	0.384	N.L. (3)
301.5	38	9						0.060	2.210	13.303	13.303	0.143	0.060	2.003	4.349	1.014	0.144	0.579	0.366	0.393 (D)
299	40.5	21						0.068	2.380	32.762	32.762	1.046	0.068	2.173	4.675	0.991	1.026	0.557	0.349	N.L. (3)
296.5	43	9						0.060	2.530	12.537	12.537	0.136	0.060	2.323	4.981	0.978	0.132	0.539	0.337	0.392 (D)
294	45.5	11						0.062	2.685	14.909	14.909	0.159	0.062	2.478	5.292	0.960	0.151	0.525	0.326	0.463 (D)
291.5	48	19						0.067	2.852	26.474	26.474	0.325	0.067	2.646	5.616	0.929	0.298	0.513	0.317	N.L. (3)
289	50.5	21						0.068	3.022	28.716	28.716	0.397	0.068	2.816	5.942	0.906	0.357	0.503	0.309	N.L. (3)
286.5	53	10						0.061	3.175	12.473	12.473	0.136	0.061	2.968	6.250	0.920	0.124	0.495	0.304	0.408 (D)
284	55.5	36						0.073	3.357	50.887	50.887	0.313	0.073	3.151	6.589	0.853	0.265	0.489	0.298	N.L. (3)
281.5	58	20						0.067	3.525	24.717	24.717	0.286	0.067	3.318	6.912	0.865	0.245	0.485	0.294	0.833 (D)
279	60.5	30						0.071	3.702	38.243	38.243	0.043	0.071	3.496	7.246	0.819	0.035	0.481	0.290	N.L. (3)
277	62.5	5						0.055	3.812	5.631	5.631	0.077	0.055	3.606	7.481	0.897	0.068	0.478	0.289	0.235 (C)
273.5	66	16						0.065	4.040	17.612	17.612	0.187	0.065	3.833	7.926	0.848	0.157	0.475	0.286	0.549 (D)
271	68.5	17						0.066	4.205	18.324	18.324	0.195	0.066	3.998	8.247	0.835	0.162	0.468	0.281	0.577 (D)
268.5	71	25						0.069	4.377	27.476	27.476	0.352	0.069	4.171	8.576	0.794	0.277	0.464	0.278	N.L. (3)
266	73.5	12						0.063	4.535	12.142	12.142	0.132	0.063	4.328	8.889	0.840	0.110	0.461	0.276	0.399 (C)
265.5	74	32						0.071	4.570	35.436	35.436	-0.438	0.071	4.364	8.956	0.754	-0.328	0.460	0.275	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_p/LL ≤ 0.85
 N.L. (3) = NOT LIQUEFIABLE, (N₁)₆₀ > 25
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== WB Pier 2 (3S)
 ELEVATION OF BORING GROUND SURFACE ===== 336.80 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== -2.30 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== -3.10 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== -0.80 FT. (Cut Depth)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
V_{s,40'} = 427 FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING				CONDITIONS DURING EARTHQUAKE								
	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.)	CORR. VERT. STRESS (KSF.)	EQUIV. CLN. SPT N VALUE (N ₁) ₆₀	CRR MAG 7.5 CRR 7.5	EFFECTIVE UNIT WT. (KCF.)	TOTAL VERT. STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. CRR 7.5 CRR	SOIL MASS PART. FACTOR (r _d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR		
330.8	6	4	1.1		11	41	30	0.060	0.360	7.416	7.416	0.091	0.060	0.312	0.830	1.500	0.135	0.942	0.730	N.L. (2)
328.3	8.5	8	1.2		11	41	32	0.061	0.513	14.968	14.968	0.160	0.061	0.464	1.138	1.490	0.236	0.908	0.648	N.L. (2)
325.8	11	7	1.3		11	41	26	0.062	0.668	13.078	13.078	0.141	0.062	0.619	1.449	1.361	0.191	0.870	0.593	N.L. (2)
323.3	13.5	7	1.3		11	41	32	0.062	0.823	13.052	13.052	0.141	0.062	0.774	1.760	1.287	0.180	0.828	0.548	N.L. (2)
320.8	16	6	1.4		11	41	42	0.063	0.980	11.045	11.045	0.122	0.063	0.932	2.074	1.216	0.147	0.785	0.509	0.289 (D)
318.3	18.5	3					25	0.051	1.108	5.454	5.454	0.075	0.051	1.060	2.357	1.151	0.086	0.741	0.480	0.179 (C)
315.8	21	7						0.058	1.253	12.442	12.442	0.135	0.058	1.205	2.658	1.150	0.154	0.698	0.449	0.343 (D)
313.3	23.5	18						0.066	1.418	34.172	34.172	-5.557	0.066	1.370	2.979	1.182	-6.506	0.657	0.416	N.L. (3)
310.8	26	1	0.3		11	41	0	0.046	1.533	1.688	1.688	0.052	0.046	1.485	3.250	1.074	0.055	0.620	0.395	0.139 (C)
308.3	28.5	4	0.2		11	41	0	0.042	1.638	6.624	6.624	0.085	0.042	1.590	3.511	1.062	0.089	0.586	0.377	0.236 (C)
305.8	31	14						0.064	1.798	23.463	23.463	0.264	0.064	1.750	3.827	1.063	0.278	0.557	0.355	0.783 (D)
303.3	33.5	18						0.066	1.963	30.086	30.086	0.474	0.066	1.915	4.148	1.037	0.487	0.532	0.336	N.L. (3)
300.8	36	14						0.064	2.123	21.789	21.789	0.239	0.064	2.075	4.464	1.007	0.238	0.511	0.320	0.744 (D)
298.3	38.5	13						0.063	2.280	19.388	19.388	0.208	0.063	2.232	4.778	0.985	0.203	0.494	0.308	0.659 (D)
295.8	41	22						0.068	2.450	34.041	34.041	-23.851	0.068	2.402	5.104	0.953	-22.525	0.480	0.297	N.L. (3)
293.3	43.5	9						0.060	2.600	12.372	12.372	0.135	0.060	2.552	5.410	0.955	0.127	0.469	0.290	0.438 (D)
290.8	46	23						0.068	2.770	33.529	33.529	2.367	0.068	2.722	5.736	0.910	2.133	0.460	0.283	N.L. (3)
288.3	48.5	30						0.071	2.948	44.290	44.290	0.226	0.071	2.900	6.069	0.882	0.198	0.454	0.276	N.L. (3)
285.8	51	15						0.065	3.110	19.303	19.303	0.207	0.065	3.062	6.388	0.899	0.184	0.448	0.272	0.676 (D)
283.3	53.5	15						0.065	3.273	18.739	18.739	0.200	0.065	3.225	6.706	0.887	0.176	0.444	0.269	0.654 (D)
280.8	56	43						0.074	3.458	60.498	60.498	0.406	0.074	3.410	7.047	0.827	0.332	0.440	0.265	N.L. (3)
278.3	58.5	28						0.070	3.633	35.705	35.705	-0.327	0.070	3.585	7.378	0.814	-0.263	0.438	0.262	N.L. (3)
275.8	61	14						0.064	3.793	15.855	15.855	0.169	0.064	3.745	7.694	0.859	0.144	0.436	0.261	0.552 (D)
273.8	63	15						0.065	3.923	16.729	16.729	0.178	0.065	3.875	7.949	0.848	0.149	0.434	0.260	0.573 (D)

* FACTOR OF SAFETY DESCRIPTIONS
 N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
 N.L. (2) = NOT LIQUEFIABLE, PI ≥ 12 OR w_L/LL ≤ 0.85
 N.L. (3) = NOT LIQUEFIABLE, (N₁)₆₀ > 25
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== EB Pier 1 (4S)
 ELEVATION OF BORING GROUND SURFACE ===== 336.60 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== -2.50 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== -3.10 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== -0.60 FT. (Cut Depth)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
 $V_{s,40'} = 411$ FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
	BORING DEPTH (FT.)	SPT VALUE (BLOWS)	UNCONF. COMPR. STR., Q_u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w_c (%)	EFFECTIVE UNIT WT. (KCF.)	CORR. STRESS (KSF.)	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.)	TOTAL STRESS (KSF.)	OVER-BURDEN CORR. FACT. (K_s)	CORR. CRR 7.5 CRR	SOIL MASS PART. FACTOR (r_d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR	
330.6	6	5	1		11	41	30	0.059	0.354	9.289	9.289	0.107	0.059	0.319	0.849	1.500	0.159	0.932	0.723	N.L. (2)
328.1	8.5	7	0.9		11	41	30	0.058	0.499	12.981	12.981	0.140	0.058	0.464	1.150	1.463	0.203	0.894	0.646	N.L. (2)
325.6	11	5	1.2		11	41	28	0.061	0.652	9.374	9.374	0.108	0.061	0.616	1.459	1.325	0.141	0.852	0.588	N.L. (2)
323.1	13.5	7	0.8		11	41	26	0.057	0.794	13.163	13.163	0.142	0.057	0.759	1.757	1.295	0.182	0.808	0.545	N.L. (2)
320.6	16	6	1.4		11	41	32	0.063	0.952	11.135	11.135	0.123	0.063	0.916	2.071	1.222	0.149	0.762	0.502	N.L. (2)
318.1	18.5	13						0.063	1.109	25.043	25.043	0.293	0.063	1.074	2.384	1.248	0.362	0.717	0.463	N.L. (3)
315.6	21	9						0.060	1.259	16.120	16.120	0.172	0.060	1.224	2.690	1.160	0.197	0.673	0.431	0.457 (D)
313.1	23.5	6						0.057	1.402	10.381	10.381	0.116	0.057	1.366	2.989	1.108	0.128	0.632	0.403	0.318 (D)
310.6	26	1	0.2		11	41	55	0.042	1.507	1.699	1.699	0.052	0.042	1.471	3.250	1.076	0.055	0.596	0.383	0.144 (C)
308.1	28.5	2	0.2		11	41	56	0.042	1.612	3.333	3.333	0.060	0.042	1.576	3.511	1.061	0.064	0.563	0.365	0.175 (C)
305.6	31	9						0.060	1.762	14.543	14.543	0.156	0.060	1.726	3.817	1.055	0.162	0.536	0.345	0.470 (D)
303.1	33.5	11						0.062	1.917	17.459	17.459	0.186	0.062	1.881	4.128	1.034	0.190	0.512	0.327	0.581 (D)
300.6	36	17						0.066	2.082	27.430	27.430	0.351	0.066	2.046	4.449	1.012	0.352	0.493	0.312	N.L. (3)
298.1	38.5	8						0.059	2.229	11.784	11.784	0.129	0.059	2.194	4.752	0.992	0.127	0.477	0.301	0.422 (D)
295.6	41	17						0.066	2.394	25.612	25.612	0.304	0.066	2.359	5.073	0.966	0.291	0.465	0.291	N.L. (3)
293.1	43.5	19						0.067	2.562	28.076	28.076	0.372	0.067	2.526	5.397	0.941	0.347	0.454	0.283	N.L. (3)
290.6	46	23						0.068	2.732	33.815	33.815	0.564	0.068	2.696	5.723	0.913	5.111	0.446	0.276	N.L. (3)
288.1	48.5	8						0.059	2.879	10.485	10.485	0.117	0.059	2.844	6.026	0.933	0.109	0.440	0.272	0.401 (C)
285.6	51	18						0.066	3.044	23.990	23.990	0.273	0.066	3.009	6.347	0.894	0.242	0.435	0.267	0.906 (D)
283.1	53.5	22						0.068	3.214	29.198	29.198	0.420	0.068	3.179	6.673	0.867	0.361	0.431	0.264	N.L. (3)
280.6	56	17						0.066	3.379	21.138	21.138	0.230	0.066	3.344	6.994	0.872	0.199	0.428	0.261	0.762 (D)
278.1	58.5	18						0.066	3.544	21.874	21.874	0.240	0.066	3.509	7.315	0.857	0.204	0.426	0.259	0.788 (D)
275.6	61	33						0.072	3.724	42.662	42.662	0.196	0.072	3.689	7.651	0.801	0.155	0.424	0.256	N.L. (3)
273.1	63.5	17						0.066	3.889	19.318	19.318	0.207	0.066	3.854	7.972	0.841	0.173	0.423	0.255	0.678 (D)
270.6	66	18						0.066	4.054	20.016	20.016	0.216	0.066	4.019	8.293	0.829	0.177	0.417	0.251	0.705 (D)
269.6	67	31						0.071	4.125	36.816	36.816	-0.087	0.071	4.090	8.426	0.769	-0.066	0.416	0.250	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 $w_p/LL \leq 0.85$
 N.L. (3) = NOT LIQUEFIABLE, $(N_{1,60}) > 25$
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ===== EB Pier 2 (4S)
 ELEVATION OF BORING GROUND SURFACE ===== 336.60 FT.
 DEPTH TO GROUNDWATER - DURING DRILLING ===== -2.50 FT. (Below Boring Ground Surface)
 DEPTH TO GROUNDWATER - DURING EARTHQUAKE ===== -3.10 FT. (Below Finished Grade Cut or Fill Surface)
 PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.448
 EARTHQUAKE MOMENT MAGNITUDE ===== 7.6
 FINISHED GRADE FILL OR CUT FROM BORING SURFACE ===== -0.60 FT. (Cut Depth)
 HAMMER EFFICIENCY ===== 73 %
 BOREHOLE DIAMETER ===== 8 IN.
 SAMPLING METHOD ===== Sampler w/out Liners

EQ MAGNITUDE SCALING FACTOR
(MSF) = 0.991

AVG. SHEAR WAVE VELOCITY (top 40')
V_{s,40'} = 411 FT./SEC.

PGA CALCULATOR
 Earthquake Moment Magnitude = 7.55
 Source-To-Site Distance, R (km) = 33.09
 Ground Motion Prediction Equations = NMSZ
 PGA = 0.498

ELEV. OF SAMPLE (FT.)	BORING DATA							CONDITIONS DURING DRILLING					CONDITIONS DURING EARTHQUAKE							
	BORING DEPTH (FT.)	SPT VALUE (BLOWS)	UNCONF. COMPR. STR., Q _u (TSF.)	% FINES < #200 (%)	PLAST. INDEX PI	LIQUID LIMIT LL	MOIST. CONTENT w _c (%)	EFFECTIVE UNIT WT. (KCF.)	CORR. STRESS (KSF.)	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.)	TOTAL STRESS (KSF.)	OVER-BURDEN CORR. FACT. (Ks)	CORR. RESIST. CRR 7.5	SOIL MASS PART. FACTOR (r _d)	EQ INDUCED CSR	FACTOR OF SAFETY * CRR/CSR	
330.6	6	5	1		11	41	30	0.059	0.354	9.289	9.289	0.107	0.059	0.319	0.849	1.500	0.159	0.932	0.723	N.L. (2)
328.1	8.5	7	0.9		11	41	30	0.058	0.499	12.981	12.981	0.140	0.058	0.464	1.150	1.463	0.203	0.894	0.646	N.L. (2)
325.6	11	5	1.2		11	41	28	0.061	0.652	9.374	9.374	0.108	0.061	0.616	1.459	1.325	0.141	0.852	0.588	N.L. (2)
323.1	13.5	7	0.8		11	41	26	0.057	0.794	13.163	13.163	0.142	0.057	0.759	1.757	1.295	0.182	0.808	0.545	N.L. (2)
320.6	16	6	1.4		11	41	32	0.063	0.952	11.135	11.135	0.123	0.063	0.916	2.071	1.222	0.149	0.762	0.502	N.L. (2)
318.1	18.5	13						0.063	1.109	25.043	25.043	0.293	0.063	1.074	2.384	1.248	0.362	0.717	0.463	N.L. (3)
315.6	21	9						0.060	1.259	16.120	16.120	0.172	0.060	1.224	2.690	1.160	0.197	0.673	0.431	0.457 (D)
313.1	23.5	6						0.057	1.402	10.381	10.381	0.116	0.057	1.366	2.989	1.108	0.128	0.632	0.403	0.318 (D)
310.6	26	1	0.2		11	41	55	0.042	1.507	1.699	1.699	0.052	0.042	1.471	3.250	1.076	0.055	0.596	0.383	0.144 (C)
308.1	28.5	2	0.2		11	41	56	0.042	1.612	3.333	3.333	0.060	0.042	1.576	3.511	1.061	0.064	0.563	0.365	0.175 (C)
305.6	31	9						0.060	1.762	14.543	14.543	0.156	0.060	1.726	3.817	1.055	0.162	0.536	0.345	0.470 (D)
303.1	33.5	11						0.062	1.917	17.459	17.459	0.186	0.062	1.881	4.128	1.034	0.190	0.512	0.327	0.581 (D)
300.6	36	17						0.066	2.082	27.430	27.430	0.351	0.066	2.046	4.449	1.012	0.352	0.493	0.312	N.L. (3)
298.1	38.5	8						0.059	2.229	11.784	11.784	0.129	0.059	2.194	4.752	0.992	0.127	0.477	0.301	0.422 (D)
295.6	41	17						0.066	2.394	25.612	25.612	0.304	0.066	2.359	5.073	0.966	0.291	0.465	0.291	N.L. (3)
293.1	43.5	19						0.067	2.562	28.076	28.076	0.372	0.067	2.526	5.397	0.941	0.347	0.454	0.283	N.L. (3)
290.6	46	23						0.068	2.732	33.815	33.815	0.564	0.068	2.696	5.723	0.913	5.111	0.446	0.276	N.L. (3)
288.1	48.5	8						0.059	2.879	10.485	10.485	0.117	0.059	2.844	6.026	0.933	0.109	0.440	0.272	0.401 (C)
285.6	51	18						0.066	3.044	23.990	23.990	0.273	0.066	3.009	6.347	0.894	0.242	0.435	0.267	0.906 (D)
283.1	53.5	22						0.068	3.214	29.198	29.198	0.420	0.068	3.179	6.673	0.867	0.361	0.431	0.264	N.L. (3)
280.6	56	17						0.066	3.379	21.138	21.138	0.230	0.066	3.344	6.994	0.872	0.199	0.428	0.261	0.762 (D)
278.1	58.5	18						0.066	3.544	21.874	21.874	0.240	0.066	3.509	7.315	0.857	0.204	0.426	0.259	0.788 (D)
275.6	61	33						0.072	3.724	42.662	42.662	0.196	0.072	3.689	7.651	0.801	0.155	0.424	0.256	N.L. (3)
273.1	63.5	17						0.066	3.889	19.318	19.318	0.207	0.066	3.854	7.972	0.841	0.173	0.423	0.255	0.678 (D)
270.6	66	18						0.066	4.054	20.016	20.016	0.216	0.066	4.019	8.293	0.829	0.177	0.417	0.251	0.705 (D)
269.6	67	31						0.071	4.125	36.816	36.816	-0.087	0.071	4.090	8.426	0.769	-0.066	0.416	0.250	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_p/LL ≤ 0.85
 N.L. (3) = NOT LIQUEFIABLE, (N₁)₆₀ > 25
 (C) = CONTRACTIVE SOIL TYPES
 (D) = DILATIVE SOIL TYPES



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) W Abutment
 REFERENCE BORING =====2S
 LRFD
 PILE CUTOFF ELEV. = 343.65 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.65 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 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
782 KIPS	782 KIPS	430 KIPS	89 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 880 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 114.84 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 43.07 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
338.00	3.65	1.00	7		17.0		32.3	32	0	0	18	6
335.00	3.00	1.00	7		14.0	15.3	46.3	46	0	0	25	9
332.00	3.00	1.00	7		14.0	15.3	60.3	60	0	0	33	12
329.00	3.00	1.00	7		14.0	15.3	80.4	80	0	0	44	15
326.50	2.50	1.40	11		15.0	21.4	87.8	88	0	0	48	17
324.00	2.50	0.90	6		10.7	13.8	96.9	97	0	0	53	20
321.50	2.50	0.80	4		9.7	12.3	120.7	121	0	0	66	22
319.00	2.50		3	Fine Sand	2.7	26.4	132.2	132	0	0	73	25
316.50	2.50		4	Fine Sand	3.6	35.2	105.3	105	0	0	58	27
314.00	2.50	0.30	6		4.0	4.6	109.2	109	0	0	60	30
311.50	2.50	0.30	5		4.0	4.6	310.8	311	0	0	171	32
309.00	2.50		23	Medium Sand	22.2	202.2	245.1	245	0	0	135	35
306.50	2.50		13	Clean Coarse Sand	13.7	114.3	425.8	426	0	0	234	37
304.00	2.50		32	Clean Coarse Sand	38.1	281.3	261.7	262	0	0	144	40
301.50	2.50		9	Clean Coarse Sand	9.5	79.1	376.7	377	0	0	207	42
299.00	2.50		21	Clean Coarse Sand	22.1	184.6	293.4	293	0	0	161	45
296.50	2.50		9	Clean Coarse Sand	9.5	79.1	320.4	320	0	0	176	47
294.00	2.50		11	Clean Coarse Sand	11.6	96.7	402.4	402	0	0	221	50
291.50	2.50		19	Clean Coarse Sand	20.0	167.0	440.0	440	0	0	242	52
289.00	2.50		21	Clean Coarse Sand	22.1	184.6	365.4	365	0	0	201	55
286.50	2.50		10	Clean Coarse Sand	10.5	87.9	604.5	605	0	0	332	57
284.00	2.50		36	Clean Coarse Sand	46.3	316.4	510.2	510	0	0	281	60
281.50	2.50		20	Medium Sand	19.3	175.8	617.4	617	0	0	340	62
279.00	2.50		30	Medium Sand	30.3	263.7	427.9	428	0	0	235	65
277.00	2.00		5	Medium Sand	3.9	43.9	528.5	528	0	0	291	67
273.50	3.50		16	Medium Sand	21.6	140.6	558.8	559	0	0	307	70
271.00	2.50		17	Medium Sand	16.4	149.4	645.5	646	0	0	355	73
268.50	2.50		25	Clean Coarse Sand	26.7	219.7	558.0	558	0	0	307	75
266.00	2.50		12	Clean Coarse Sand	12.7	105.5	746.4	746	0	0	411	78
265.50	0.50		32	Clean Coarse Sand	7.6	281.3	675.0	675	0	0	371	78
263.00	2.50		23	Clean Coarse Sand	24.3	202.2	699.2	699	0	0	385	81
260.50	2.50		23	Clean Coarse Sand	24.3	202.2	723.5	723	0	0	398	83
258.00	2.50		23	Clean Coarse Sand	24.3	202.2	747.7	748	0	0	411	86
255.50	2.50		23	Clean Coarse Sand	24.3	202.2	772.0	772	0	0	425	88
254.50	1.00		23	Clean Coarse Sand	9.7	202.2	781.7	782	0	0	430	89
254.00	0.50		23	Clean Coarse Sand	4.9	202.2	786.6	787	0	0	433	90
253.50	0.50		23	Clean Coarse Sand		202.2			0	0		



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) W Abutment
 REFERENCE BORING =====2S
 LRFD or ASD or SEISMIC =====SEISMIC
 PILE CUTOFF ELEV. =====343.65 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.65 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====266.00 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====324.00 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
782 KIPS	782 KIPS	223 KIPS	89 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD ===== 660 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts ===== 86.13 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts ===== 32.30 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
338.00	3.65	1.00	7		17.0		32.3	32	17	19	-3	6
335.00	3.00	1.00	7		14.0	15.3	46.3	46	31	34	-19	9
332.00	3.00	1.00	7		14.0	15.3	60.3	60	45	50	-34	12
329.00	3.00	1.00	7		14.0	15.3	80.4	80	59	65	-44	15
326.50	2.50	1.40	11		15.0	21.4	87.8	88	74	82	-68	17
324.00	2.50	0.90	6		10.7	13.8	96.9	97	85	93	-81	20
321.50	2.50	0.80	4		9.7	12.3	120.7	121	94	93	-67	22
319.00	2.50		3	Fine Sand	2.7	26.4	132.2	132	97	93	-58	25
316.50	2.50		4	Fine Sand	3.6	35.2	105.3	105	101	93	-89	27
314.00	2.50	0.30	6		4.0	4.6	109.2	109	105	93	-89	30
311.50	2.50	0.30	5		4.0	4.6	310.8	311	109	93	109	32
309.00	2.50		23	Medium Sand	22.2	202.2	245.1	245	131	93	21	35
306.50	2.50		13	Clean Coarse Sand	13.7	114.3	425.8	426	145	93	188	37
304.00	2.50		32	Clean Coarse Sand	38.1	281.3	261.7	262	183	93	-14	40
301.50	2.50		9	Clean Coarse Sand	9.5	79.1	376.7	377	192	93	91	42
299.00	2.50		21	Clean Coarse Sand	22.1	184.6	293.4	293	214	93	-14	45
296.50	2.50		9	Clean Coarse Sand	9.5	79.1	320.4	320	224	93	3	47
294.00	2.50		11	Clean Coarse Sand	11.6	96.7	402.4	402	235	93	74	50
291.50	2.50		19	Clean Coarse Sand	20.0	167.0	440.0	440	255	93	91	52
289.00	2.50		21	Clean Coarse Sand	22.1	184.6	365.4	365	278	93	-5	55
286.50	2.50		10	Clean Coarse Sand	10.5	87.9	604.5	605	288	93	223	57
284.00	2.50		36	Clean Coarse Sand	46.3	316.4	510.2	510	334	93	82	60
281.50	2.50		20	Medium Sand	19.3	175.8	617.4	617	354	93	170	62
279.00	2.50		30	Medium Sand	30.3	263.7	427.9	428	384	93	-49	65
277.00	2.00		5	Medium Sand	3.9	43.9	528.5	528	388	93	47	67
273.50	3.50		16	Medium Sand	21.6	140.6	558.8	559	409	93	56	70
271.00	2.50		17	Medium Sand	16.4	149.4	645.5	646	426	93	126	73
268.50	2.50		25	Clean Coarse Sand	26.7	219.7	558.0	558	453	93	12	75
266.00	2.50		12	Clean Coarse Sand	12.7	105.5	746.4	746	465	93	188	78
263.50	0.50		32	Clean Coarse Sand	7.6	281.3	675.0	675	465	93	116	78
263.00	2.50		23	Clean Coarse Sand	24.3	202.2	699.2	699	465	93	141	81
260.50	2.50		23	Clean Coarse Sand	24.3	202.2	723.5	723	465	93	165	83
258.00	2.50		23	Clean Coarse Sand	24.3	202.2	747.7	748	465	93	189	86
255.50	2.50		23	Clean Coarse Sand	24.3	202.2	772.0	772	465	93	213	88
254.50	1.00		23	Clean Coarse Sand	9.7	202.2	781.7	782	465	93	223	89
254.00	0.50		23	Clean Coarse Sand	4.9	202.2	786.6	787	465	93	228	90
253.50	0.50		23	Clean Coarse Sand		202.2						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) E Abutment
 REFERENCE BORING =====3S
 LRFD or ASD or SEISMIC ===== LRFD
 PILE CUTOFF ELEV. ===== 343.76 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.76 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 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
782 KIPS	781 KIPS	429 KIPS	92 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 880 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 114.84 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 43.07 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/ .375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMP. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
330.80	10.96	1.10	4		55.1		73.4	73	0	0	40	13
328.30	2.50	1.20	8		13.4	18.4	88.4	88	0	0	49	15
325.80	2.50	1.30	7		14.3	19.9	102.7	103	0	0	56	18
323.30	2.50	1.30	7		14.3	19.9	118.5	118	0	0	65	20
320.80	2.50	1.40	6		15.0	21.4	138.4	138	0	0	76	23
318.30	2.50		3	Fine Sand	2.7	26.4	176.3	176	0	0	97	25
315.80	2.50		7	Fine Sand	6.3	61.5	279.3	279	0	0	154	28
313.30	2.50		18	Fine Sand	16.3	158.2	142.0	142	0	0	78	30
310.80	2.50	0.30	1		4.0	4.6	144.5	144	0	0	79	33
308.30	2.50	0.20	4		2.7	3.1	267.1	267	0	0	147	35
305.80	2.50		14	Medium Sand	13.5	123.1	315.8	316	0	0	174	38
303.30	2.50		18	Medium Sand	17.4	158.2	298.0	298	0	0	164	40
300.80	2.50		14	Medium Sand	13.5	123.1	302.7	303	0	0	166	43
298.30	2.50		13	Medium Sand	12.5	114.3	394.3	394	0	0	217	45
295.80	2.50		22	Medium Sand	21.2	193.4	301.3	301	0	0	166	48
293.30	2.50		9	Medium Sand	8.7	79.1	433.0	433	0	0	238	50
290.80	2.50		23	Medium Sand	22.2	202.2	516.7	517	0	0	284	53
288.30	2.50		30	Medium Sand	30.3	263.7	415.2	415	0	0	228	55
285.80	2.50		15	Clean Coarse Sand	15.8	131.8	431.0	431	0	0	237	58
283.30	2.50		15	Clean Coarse Sand	15.8	131.8	692.9	693	0	0	381	60
280.80	2.50		43	Clean Coarse Sand	63.6	377.9	624.7	625	0	0	344	63
278.30	2.50		28	Clean Coarse Sand	31.1	246.1	532.8	533	0	0	293	65
275.80	2.50		14	Clean Coarse Sand	14.8	123.1	556.3	556	0	0	306	68
273.80	2.00		15	Clean Coarse Sand	12.7	131.8	604.2	604	0	0	332	70
271.30	2.50		19	Clean Coarse Sand	20.0	167.0	624.2	624	0	0	343	72
268.80	2.50		19	Clean Coarse Sand	20.0	167.0	644.2	644	0	0	354	75
266.30	2.50		19	Clean Coarse Sand	20.0	167.0	664.3	664	0	0	365	77
263.80	2.50		19	Clean Coarse Sand	20.0	167.0	684.3	684	0	0	376	80
261.30	2.50		19	Clean Coarse Sand	20.0	167.0	704.4	704	0	0	387	82
258.80	2.50		19	Clean Coarse Sand	20.0	167.0	724.4	724	0	0	398	85
256.30	2.50		19	Clean Coarse Sand	20.0	167.0	744.4	744	0	0	409	87
253.80	2.50		19	Clean Coarse Sand	20.0	167.0	764.5	764	0	0	420	90
251.80	2.00		19	Clean Coarse Sand	16.0	167.0	780.5	781	0	0	429	92
251.30	0.50		19	Clean Coarse Sand	4.0	167.0	784.5	785	0	0	434	92
250.80	0.50		19	Clean Coarse Sand	4.0	167.0	788.5	789	0	0	434	93
250.30	0.50		19	Clean Coarse Sand		167.0						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) E Abutment
 REFERENCE BORING =====3S
 LRFD or ASD or SEISMIC ===== SEISMIC
 PILE CUTOFF ELEV. ===== 343.76 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.76 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 273.80 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 323.30 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
782 KIPS	781 KIPS	236 KIPS	92 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD ===== 660 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts ===== 86.13 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts ===== 32.30 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/ .375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			NOMINAL REQ'D BEARING (KIPS)	NOMINAL LOSS FROM LIQUEF. & DD (KIPS)	FACTORED LOSS LOAD FROM DD (KIPS)	SEISMIC RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
330.80	10.96	1.10	4		55.1		73.4	73	55	61	-42	13
328.30	2.50	1.20	8		13.4	18.4	88.4	88	69	76	-56	15
325.80	2.50	1.30	7		14.3	19.9	102.7	103	83	91	-71	18
323.30	2.50	1.30	7		14.3	19.9	118.5	118	97	107	-86	20
320.80	2.50	1.40	6		15.0	21.4	138.4	138	112	107	-81	23
318.30	2.50		3	Fine Sand	2.7	26.4	176.3	176	115	107	-45	25
315.80	2.50		7	Fine Sand	6.3	61.5	279.3	279	121	107	51	28
313.30	2.50		18	Fine Sand	16.3	158.2	142.0	142	137	107	-102	30
310.80	2.50	0.30	1		4.0	4.6	144.5	144	141	107	-104	33
308.30	2.50	0.20	4		2.7	3.1	267.1	267	144	107	16	35
305.80	2.50		14	Medium Sand	13.5	123.1	315.8	316	158	107	51	38
303.30	2.50		18	Medium Sand	17.4	158.2	298.0	298	175	107	16	40
300.80	2.50		14	Medium Sand	13.5	123.1	302.7	303	188	107	7	43
298.30	2.50		13	Medium Sand	12.5	114.3	394.3	394	201	107	86	45
295.80	2.50		22	Medium Sand	21.2	193.4	301.3	301	222	107	-28	48
293.30	2.50		9	Medium Sand	8.7	79.1	433.0	433	231	107	95	50
290.80	2.50		23	Medium Sand	22.2	202.2	516.7	517	253	107	157	53
288.30	2.50		30	Medium Sand	30.3	263.7	415.2	415	283	107	25	55
285.80	2.50		15	Clean Coarse Sand	15.8	131.8	431.0	431	299	107	25	58
283.30	2.50		15	Clean Coarse Sand	15.8	131.8	692.9	693	315	107	271	60
280.80	2.50		43	Clean Coarse Sand	63.6	377.9	624.7	625	379	107	139	63
278.30	2.50		28	Clean Coarse Sand	31.1	246.1	532.8	533	410	107	16	65
275.80	2.50		14	Clean Coarse Sand	14.8	123.1	556.3	556	425	107	25	68
273.80	2.00		15	Clean Coarse Sand	12.7	131.8	604.2	604	437	107	60	70
271.30	2.50		19	Clean Coarse Sand	20.0	167.0	624.2	624	437	107	80	72
268.80	2.50		19	Clean Coarse Sand	20.0	167.0	644.2	644	437	107	100	75
266.30	2.50		19	Clean Coarse Sand	20.0	167.0	664.3	664	437	107	120	77
263.80	2.50		19	Clean Coarse Sand	20.0	167.0	684.3	684	437	107	140	80
261.30	2.50		19	Clean Coarse Sand	20.0	167.0	704.4	704	437	107	160	82
258.80	2.50		19	Clean Coarse Sand	20.0	167.0	724.4	724	437	107	180	85
256.30	2.50		19	Clean Coarse Sand	20.0	167.0	744.4	744	437	107	200	87
253.80	2.50		19	Clean Coarse Sand	20.0	167.0	764.5	764	437	107	220	90
251.80	2.00		19	Clean Coarse Sand	16.0	167.0	780.5	781	437	107	236	92
251.30	0.50		19	Clean Coarse Sand	4.0	167.0	784.5	785	437	107	240	92
250.80	0.50		19	Clean Coarse Sand	4.0	167.0	788.5	789	437	107	244	93
250.30	0.50		19	Clean Coarse Sand		167.0						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) W Abutment
 REFERENCE BORING =====3-S
 LRFD or ASD or SEISMIC ===== LRFD
 PILE CUTOFF ELEV. ===== 343.73 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.73 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 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
782 KIPS	777 KIPS	427 KIPS	71 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 880 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 114.84 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 43.07 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/ .375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
339.80	1.93	1.60	13		12.7		60.2	60	0	0	33	4
337.30	2.50	3.10	10		25.7	47.5	55.2	55	0	0	30	6
334.80	2.50	1.10	5		12.6	16.8	73.9	74	0	0	41	9
332.30	2.50	1.50	3		15.8	23.0	83.6	84	0	0	46	11
329.80	2.50	1.10	5		12.6	16.8	96.1	96	0	0	53	14
327.30	2.50	1.10	3		12.6	16.8	116.4	116	0	0	64	16
324.80	2.50	1.60	6		16.5	24.5	131.3	131	0	0	72	19
322.30	2.50	1.50	6		15.8	23.0	134.8	135	0	0	74	21
319.80	2.50	0.70	5		8.6	10.7	176.7	177	0	0	97	24
317.30	2.50		5	Fine Sand	4.5	43.9	172.4	172	0	0	95	26
314.80	2.50		4	Fine Sand	3.6	35.2	167.3	167	0	0	92	29
312.30	2.50		3	Fine Sand	2.7	26.4	249.1	249	0	0	137	31
307.30	5.00		12	Fine Sand	21.8	105.5	288.4	288	0	0	159	36
302.30	5.00		14	Fine Sand	25.4	123.1	340.2	340	0	0	187	41
297.30	5.00		17	Fine Sand	30.8	149.4	406.1	406	0	0	223	46
292.30	5.00		21	Medium Sand	40.5	184.6	508.2	508	0	0	279	51
287.30	5.00		28	Medium Sand	55.1	246.1	572.1	572	0	0	315	56
282.30	5.00		29	Medium Sand	57.8	254.9	638.7	639	0	0	351	61
277.30	5.00		30	Medium Sand	60.6	263.7	743.2	743	0	0	409	66
275.30	2.00		35	Medium Sand	30.6	307.6	738.6	739	0	0	406	68
272.80	2.50		31	Medium Sand	31.7	272.5	770.3	770	0	0	424	71
272.30	0.50		31	Medium Sand	6.3	272.5	776.7	777	0	0	427	71
271.80	0.50		31	Medium Sand	6.3	272.5	783.0	783	0	0	431	72
271.30	0.50		31	Medium Sand	6.3	272.5	789.4	789	0	0	434	72
270.80	0.50		31	Medium Sand		272.5			0	0		



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) W Abutment
 REFERENCE BORING =====3-S
 LRFD or ASD or SEISMIC ===== SEISMIC
 PILE CUTOFF ELEV. ===== 343.73 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.73 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 297.30 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 332.30 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
782 KIPS	777 KIPS	482 KIPS	71 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD ===== 660 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts ===== 86.13 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts ===== 32.30 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/ .375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			NOMINAL REQ'D BEARING (KIPS)	NOMINAL LOSS FROM LIQUEF. & DD (KIPS)	FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS)	SEISMIC RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)	
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)						
339.80	1.93	1.60	13		12.7		60.2	60	13	14	33	4	
337.30	2.50	3.10	10		25.7	47.5	55.2	55	38	42	-25	6	
334.80	2.50	1.10	5		12.6	16.8	73.9	74	51	56	-33	9	
332.30	2.50	1.50	3		15.8	23.0	83.6	84	67	74	-57	11	
329.80	2.50	1.10	5		12.6	16.8	96.1	96	79	74	-57	14	
327.30	2.50	1.10	3		12.6	16.8	116.4	116	92	74	-49	16	
324.80	2.50	1.60	6		16.5	24.5	131.3	131	108	74	-51	19	
322.30	2.50	1.50	6		15.8	23.0	134.8	135	124	74	-63	21	
319.80	2.50	0.70	5		8.6	10.7	176.7	177	133	74	-30	24	
317.30	2.50		5	Fine Sand	4.5	43.9	172.4	172	137	74	-38	26	
314.80	2.50		4	Fine Sand	3.6	35.2	167.3	167	141	74	-47	29	
312.30	2.50		3	Fine Sand	2.7	26.4	249.1	249	144	74	32	31	
307.30	5.00		12	Fine Sand	21.8	105.5	288.4	288	165	74	49	36	
302.30	5.00		14	Fine Sand	25.4	123.1	340.2	340	191	74	76	41	
297.30	5.00		17	Fine Sand	30.8	149.4	406.1	406	222	74	111	46	
292.30	5.00		21	Medium Sand	40.5	184.6	508.2	508	222	74	213	51	
287.30	5.00		28	Medium Sand	55.1	246.1	572.1	572	222	74	277	56	
282.30	5.00		29	Medium Sand	57.8	254.9	638.7	639	222	74	344	61	
277.30	5.00		30	Medium Sand	60.6	263.7	743.2	743	222	74	448	66	
275.30	2.00		35	Medium Sand	30.6	307.6	738.6	739	222	74	443	68	
272.80	2.50		31	Medium Sand	31.7	272.5	770.3	770	222	74	475	71	
272.30	0.50		31	Medium Sand	6.3	272.5	776.7	777	222	74	482	71	
271.80	0.50		31	Medium Sand	6.3	272.5	783.0	783	222	74	488	72	
271.30	0.50		31	Medium Sand	6.3	272.5	789.4	789	222	74	494	72	
270.80	0.50		31	Medium Sand		272.5							



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) E Abutment
 REFERENCE BORING =====1-S
 LRFD or ASD or SEISMIC ===== LRFD
 PILE CUTOFF ELEV. ===== 343.88 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.88 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== None
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 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
782 KIPS	781 KIPS	430 KIPS	82 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 880 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 114.84 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 43.07 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/ .375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
340.30	1.58	1.20	8		8.5		43.7	44	0	0	24	4
337.80	2.50	2.30	6		20.9	35.2	44.7	45	0	0	25	6
335.30	2.50	1.00	5		11.6	15.3	54.8	55	0	0	30	9
332.80	2.50	0.90	2		10.7	13.8	76.2	76	0	0	42	11
330.30	2.50	1.60	5		16.5	24.5	92.7	93	0	0	51	14
327.80	2.50	1.60	7		16.5	24.5	115.3	115	0	0	63	16
325.30	2.50	2.00	6		19.1	30.6	119.1	119	0	0	65	19
323.30	2.00	1.00	4		9.3	15.3	120.7	121	0	0	66	21
320.30	3.00	0.50	2		7.7	7.7	155.9	156	0	0	86	24
317.80	2.50		4	Fine Sand	3.6	35.2	168.3	168	0	0	93	26
315.30	2.50		5	Fine Sand	4.5	43.9	199.2	199	0	0	110	29
312.80	2.50		8	Fine Sand	7.3	70.3	142.3	142	0	0	78	31
310.30	2.50	0.40	1		5.2	6.1	202.9	203	0	0	112	34
307.80	2.50		7	Clean Coarse Sand	7.4	61.5	236.6	237	0	0	130	36
302.30	5.50		10	Clean Coarse Sand	23.2	87.9	259.8	260	0	0	143	42
296.30	6.00		10	Fine Sand	21.8	87.9	351.9	352	0	0	194	48
290.30	6.00		18	Clean Coarse Sand	45.6	158.2	546.9	547	0	0	301	54
285.30	5.00		35	Clean Coarse Sand	88.3	307.6	520.9	521	0	0	286	59
280.30	5.00		22	Clean Coarse Sand	46.4	193.4	558.5	559	0	0	307	64
275.30	5.00		21	Clean Coarse Sand	44.3	184.6	620.4	620	0	0	341	69
270.30	5.00		23	Clean Coarse Sand	48.5	202.2	730.4	730	0	0	402	74
268.10	2.20		30	Clean Coarse Sand	30.3	263.7	716.8	717	0	0	394	76
265.60	2.50		25	Clean Coarse Sand	26.7	219.7	743.6	744	0	0	409	78
263.10	2.50		25	Clean Coarse Sand	26.7	219.7	770.3	770	0	0	424	81
262.10	1.00		25	Clean Coarse Sand	10.7	219.7	781.0	781	0	0	430	82
261.60	0.50		25	Clean Coarse Sand	5.3	219.7	786.3	786	0	0	432	82
261.10	0.50		25	Clean Coarse Sand	5.3	219.7	791.6	792	0	0	436	83
260.60	0.50		25	Clean Coarse Sand		219.7						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) E Abutment
 REFERENCE BORING =====1-S
 LRFD or ASD or SEISMIC =====SEISMIC
 PILE CUTOFF ELEV. =====343.88 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 341.88 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====270.30 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====335.30 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
782 KIPS	781 KIPS	269 KIPS	82 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD =====660 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)=====61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE =====1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts =====86.13 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts =====32.30 KIPS

PILE TYPE AND SIZE =====Metal Shell 16"Φ w/ .375" walls
 Plugged Pile Perimeter=====4.189 FT.
 Plugged Pile End Bearing Area=====1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			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.)	
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)						
340.30	1.58	1.20	8		8.5		43.7	44	8	9	26	4	
337.80	2.50	2.30	6		20.9	35.2	44.7	45	29	32	-17	6	
335.30	2.50	1.00	5		11.6	15.3	54.8	55	41	45	-31	9	
332.80	2.50	0.90	2		10.7	13.8	76.2	76	52	45	-21	11	
330.30	2.50	1.60	5		16.5	24.5	92.7	93	68	45	-21	14	
327.80	2.50	1.60	7		16.5	24.5	115.3	115	85	45	-15	16	
325.30	2.50	2.00	6		19.1	30.6	119.1	119	104	45	-30	19	
323.30	2.00	1.00	4		9.3	15.3	120.7	121	113	45	-38	21	
320.30	3.00	0.50	2		7.7	7.7	155.9	156	121	45	-10	24	
317.80	2.50		4	Fine Sand	3.6	35.2	168.3	168	124	45	-1	26	
315.30	2.50		5	Fine Sand	4.5	43.9	199.2	199	129	45	25	29	
312.80	2.50		8	Fine Sand	7.3	70.3	142.3	142	136	45	-39	31	
310.30	2.50	0.40	1		5.2	6.1	202.9	203	141	45	16	34	
307.80	2.50		7	Clean Coarse Sand	7.4	61.5	236.6	237	149	45	43	36	
302.30	5.50		10	Clean Coarse Sand	23.2	87.9	259.8	260	172	45	43	42	
296.30	6.00		10	Fine Sand	21.8	87.9	351.9	352	194	45	113	48	
290.30	6.00		18	Clean Coarse Sand	45.6	158.2	546.9	547	239	45	262	54	
285.30	5.00		35	Clean Coarse Sand	88.3	307.6	520.9	521	328	45	148	59	
280.30	5.00		22	Clean Coarse Sand	46.4	193.4	558.5	559	374	45	139	64	
275.30	5.00		21	Clean Coarse Sand	44.3	184.6	620.4	620	418	45	157	69	
270.30	5.00		23	Clean Coarse Sand	48.5	202.2	730.4	730	467	45	218	74	
268.10	2.20		30	Clean Coarse Sand	30.3	263.7	716.8	717	467	45	205	76	
265.60	2.50		25	Clean Coarse Sand	26.7	219.7	743.6	744	467	45	232	78	
263.10	2.50		25	Clean Coarse Sand	26.7	219.7	770.3	770	467	45	258	81	
262.10	1.00		25	Clean Coarse Sand	10.7	219.7	781.0	781	467	45	269	82	
261.60	0.50		25	Clean Coarse Sand	5.3	219.7	786.3	786	467	45	274	82	
261.10	0.50		25	Clean Coarse Sand	5.3	219.7	791.6	792	467	45	280	83	
260.60	0.50		25	Clean Coarse Sand		219.7							



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) Pier 1
 REFERENCE BORING =====2S
 LRFD or ASD or SEISMIC =====LRFD
 PILE CUTOFF ELEV. =====344.33 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.90 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Scour
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====327.90 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====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
782 KIPS	779 KIPS	429 KIPS	96 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1540 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 200.97 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 75.37 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			NOMINAL REQ'D BEARING (KIPS)	FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS)	FACTORED GEOTECH. LOSS FROM DD (KIPS)	FACTORED RESISTANCE AVAILABLE (KIPS)	ESTIMATED PILE LENGTH (FT.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
326.50	1.40	1.40	11		8.4		22.2	22	0	0	12	18
324.00	2.50	0.90	6		10.7	13.8	31.4	31	0	0	17	20
321.50	2.50	0.80	4		9.7	12.3	48.9	49	0	0	27	23
319.00	2.50		3	Fine Sand	2.7	20.1	65.9	66	0	0	36	25
316.50	2.50		4	Fine Sand	3.6	34.4	39.7	40	0	0	22	28
314.00	2.50	0.30	6		4.0	4.6	43.7	44	0	0	24	30
311.50	2.50	0.30	5		4.0	4.6	245.2	245	0	0	135	33
309.00	2.50		23	Medium Sand	22.2	202.2	179.5	180	0	0	99	35
306.50	2.50		13	Clean Coarse Sand	13.7	114.3	360.2	360	0	0	198	38
304.00	2.50		32	Clean Coarse Sand	38.1	281.3	196.2	196	0	0	108	40
301.50	2.50		9	Clean Coarse Sand	9.5	79.1	311.1	311	0	0	171	43
299.00	2.50		21	Clean Coarse Sand	22.1	184.6	227.8	228	0	0	125	45
296.50	2.50		9	Clean Coarse Sand	9.5	79.1	254.9	255	0	0	140	48
294.00	2.50		11	Clean Coarse Sand	11.6	96.7	336.8	337	0	0	185	50
291.50	2.50		19	Clean Coarse Sand	20.0	167.0	374.4	374	0	0	206	53
289.00	2.50		21	Clean Coarse Sand	22.1	184.6	299.9	300	0	0	165	55
286.50	2.50		10	Clean Coarse Sand	10.5	87.9	539.0	539	0	0	296	58
284.00	2.50		36	Clean Coarse Sand	46.3	316.4	444.6	445	0	0	245	60
281.50	2.50		20	Medium Sand	19.3	175.8	551.8	552	0	0	304	63
279.00	2.50		30	Medium Sand	30.3	263.7	362.4	362	0	0	199	65
277.00	2.00		5	Medium Sand	3.9	43.9	462.9	463	0	0	255	67
273.50	3.50		16	Medium Sand	21.6	140.6	493.3	493	0	0	271	71
271.00	2.50		17	Medium Sand	16.4	149.4	580.0	580	0	0	319	73
268.50	2.50		25	Clean Coarse Sand	26.7	219.7	492.5	492	0	0	271	76
266.00	2.50		12	Clean Coarse Sand	12.7	105.5	680.9	681	0	0	374	78
263.50	0.50		32	Clean Coarse Sand	7.6	281.3	609.4	609	0	0	335	79
263.00	2.50		23	Clean Coarse Sand	24.3	202.2	633.7	634	0	0	349	81
260.50	2.50		23	Clean Coarse Sand	24.3	202.2	657.9	658	0	0	362	84
258.00	2.50		23	Clean Coarse Sand	24.3	202.2	682.2	682	0	0	375	86
255.50	2.50		23	Clean Coarse Sand	24.3	202.2	706.5	706	0	0	389	89
253.00	2.50		23	Clean Coarse Sand	24.3	202.2	730.7	731	0	0	402	91
250.50	2.50		23	Clean Coarse Sand	24.3	202.2	755.0	755	0	0	415	94
248.00	2.50		23	Clean Coarse Sand	24.3	202.2	779.2	779	0	0	429	96
245.50	2.50		23	Clean Coarse Sand	24.3	202.2	803.5	803	0	0	442	99
245.00	0.50		23	Clean Coarse Sand	4.9	202.2	808.3	808	0	0	445	99
244.50	0.50		23	Clean Coarse Sand		202.2			0	0		



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) Pier 1
 REFERENCE BORING =====2S
 LRFD or ASD or SEISMIC =====SEISMIC
 PILE CUTOFF ELEV. =====344.33 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.90 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====266.00 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====324.00 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
782 KIPS	779 KIPS	359 KIPS	96 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD ===== 1155 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts ===== 150.73 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts ===== 56.52 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			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.)		
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)							
326.50	1.40	1.40	11		8.4		22.2			22	8	9	5	18
324.00	2.50	0.90	6		10.7	13.8	31.4			31	19	21	-9	20
321.50	2.50	0.80	4		9.7	12.3	48.9			49	29	21	-1	23
319.00	2.50		3	Fine Sand	2.7	20.1	65.9			66	32	21	13	25
316.50	2.50		4	Fine Sand	3.6	34.4	39.7			40	35	21	-16	28
314.00	2.50	0.30	6		4.0	4.6	43.7			44	39	21	-16	30
311.50	2.50	0.30	5		4.0	4.6	245.2			245	43	21	181	33
309.00	2.50		23	Medium Sand	22.2		202.2			180	65	21	93	35
306.50	2.50		13	Clean Coarse Sand	13.7	114.3	360.2			360	79	21	260	38
304.00	2.50		32	Clean Coarse Sand	38.1	281.3	196.2			196	117	21	58	40
301.50	2.50		9	Clean Coarse Sand	9.5	79.1	311.1			311	127	21	164	43
299.00	2.50		21	Clean Coarse Sand	22.1	184.6	227.8			228	149	21	58	45
296.50	2.50		9	Clean Coarse Sand	9.5	79.1	254.9			255	158	21	76	48
294.00	2.50		11	Clean Coarse Sand	11.6	96.7	336.8			337	170	21	146	50
291.50	2.50		19	Clean Coarse Sand	20.0	167.0	374.4			374	190	21	164	53
289.00	2.50		21	Clean Coarse Sand	22.1	184.6	299.9			300	212	21	67	55
286.50	2.50		10	Clean Coarse Sand	10.5	87.9	539.0			539	223	21	295	58
284.00	2.50		36	Clean Coarse Sand	46.3	316.4	444.6			445	269	21	155	60
281.50	2.50		20	Medium Sand	19.3	175.8	551.8			552	288	21	243	63
279.00	2.50		30	Medium Sand	30.3	263.7	362.4			362	318	21	23	65
277.00	2.00		5	Medium Sand	3.9	43.9	462.9			463	322	21	120	67
273.50	3.50		16	Medium Sand	21.6	140.6	493.3			493	344	21	128	71
271.00	2.50		17	Medium Sand	16.4	149.4	580.0			580	360	21	199	73
268.50	2.50		25	Clean Coarse Sand	26.7	219.7	492.5			492	387	21	84	76
266.00	2.50		12	Clean Coarse Sand	12.7	105.5	680.9			681	400	21	260	78
265.50	0.50		32	Clean Coarse Sand	7.6	281.3	609.4			609	400	21	189	79
263.00	2.50		23	Clean Coarse Sand	24.3	202.2	633.7			634	400	21	213	81
260.50	2.50		23	Clean Coarse Sand	24.3	202.2	657.9			658	400	21	237	84
258.00	2.50		23	Clean Coarse Sand	24.3	202.2	682.2			682	400	21	261	86
255.50	2.50		23	Clean Coarse Sand	24.3	202.2	706.5			706	400	21	286	89
253.00	2.50		23	Clean Coarse Sand	24.3	202.2	730.7			731	400	21	310	91
250.50	2.50		23	Clean Coarse Sand	24.3	202.2	755.0			755	400	21	334	94
248.00	2.50		23	Clean Coarse Sand	24.3	202.2	779.2			779	400	21	359	96
247.50	0.50		23	Clean Coarse Sand	4.9	202.2	784.1			784	400	21	363	97
247.00	0.50		23	Clean Coarse Sand	4.9	202.2	788.9			789	400	21	368	97
246.50	0.50		23	Clean Coarse Sand		202.2								



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) Pier 2
 REFERENCE BORING =====3S
 LRFD
 PILE CUTOFF ELEV. = 344.38 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.90 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD = 327.90 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== 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
782 KIPS	782 KIPS	430 KIPS	102 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1540 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 200.97 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 75.37 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
325.80	2.10	1.30	7		12.0		31.9	32	0	0	18	19
323.30	2.50	1.30	7		14.3	19.9	47.7	48	0	0	26	21
320.80	2.50	1.40	6		15.0	21.4	63.0	63	0	0	35	24
318.30	2.50		3	Fine Sand	2.7	21.7	105.5	106	0	0	58	26
315.80	2.50		7	Fine Sand	6.3	61.5	208.5	209	0	0	115	29
313.30	2.50		18	Fine Sand	16.3	158.2	71.2	71	0	0	39	31
310.80	2.50	0.30	1		4.0	4.6	73.7	74	0	0	41	34
308.30	2.50	0.20	4		2.7	3.1	196.4	196	0	0	108	36
305.80	2.50		14	Medium Sand	13.5	123.1	245.0	245	0	0	135	39
303.30	2.50		18	Medium Sand	17.4	158.2	227.2	227	0	0	125	41
300.80	2.50		14	Medium Sand	13.5	123.1	231.9	232	0	0	128	44
298.30	2.50		13	Medium Sand	12.5	114.3	323.6	324	0	0	178	46
295.80	2.50		22	Medium Sand	21.2	193.4	230.5	231	0	0	127	49
293.30	2.50		9	Medium Sand	8.7	79.1	362.2	362	0	0	199	51
290.80	2.50		23	Medium Sand	22.2	202.2	445.9	446	0	0	245	54
288.30	2.50		30	Medium Sand	30.3	263.7	344.4	344	0	0	189	56
285.80	2.50		15	Clean Coarse Sand	15.8	131.8	360.2	360	0	0	198	59
283.30	2.50		15	Clean Coarse Sand	15.8	131.8	622.1	622	0	0	342	61
280.80	2.50		43	Clean Coarse Sand	63.6	377.9	553.9	554	0	0	305	64
278.30	2.50		28	Clean Coarse Sand	31.1	246.1	462.0	462	0	0	254	66
275.80	2.50		14	Clean Coarse Sand	14.8	123.1	485.6	486	0	0	267	69
273.30	2.00		15	Clean Coarse Sand	12.7	131.8	533.4	533	0	0	293	71
271.30	2.50		19	Clean Coarse Sand	20.0	167.0	553.4	553	0	0	304	73
268.80	2.50		19	Clean Coarse Sand	20.0	167.0	573.5	573	0	0	315	76
266.30	2.50		19	Clean Coarse Sand	20.0	167.0	593.5	593	0	0	326	78
263.80	2.50		19	Clean Coarse Sand	20.0	167.0	613.5	614	0	0	337	81
261.30	2.50		19	Clean Coarse Sand	20.0	167.0	633.6	634	0	0	348	83
258.80	2.50		19	Clean Coarse Sand	20.0	167.0	653.6	654	0	0	359	86
256.30	2.50		19	Clean Coarse Sand	20.0	167.0	673.7	674	0	0	371	88
253.80	2.50		19	Clean Coarse Sand	20.0	167.0	693.7	694	0	0	382	91
251.30	2.50		19	Clean Coarse Sand	20.0	167.0	713.7	714	0	0	393	93
248.80	2.50		19	Clean Coarse Sand	20.0	167.0	733.8	734	0	0	404	96
246.30	2.50		19	Clean Coarse Sand	20.0	167.0	753.8	754	0	0	415	98
243.80	2.50		19	Clean Coarse Sand	20.0	167.0	773.9	774	0	0	426	101
242.80	1.00		19	Clean Coarse Sand	8.0	167.0	781.9	782	0	0	430	102
242.30	0.50		19	Clean Coarse Sand	4.0	167.0	785.9	786	0	0	432	102
241.80	0.50		19	Clean Coarse Sand	4.0	167.0	789.9	790	0	0	434	103
241.30	0.50		19	Clean Coarse Sand		167.0			0	0		



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0047 (WB) Pier 2
 REFERENCE BORING =====3S
 LRFD or ASD or SEISMIC =====SEISMIC
 PILE CUTOFF ELEV. =====344.38 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.90 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====273.80 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====323.30 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
782 KIPS	782 KIPS	387 KIPS	102 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD =====1155 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)=====61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE =====1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts =====150.73 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts =====56.52 KIPS

PILE TYPE AND SIZE =====Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter=====4.189 FT.
 Plugged Pile End Bearing Area=====1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
325.80	2.10	1.30	7		12.0		31.9	32	12	13	7	19
323.30	2.50	1.30	7		14.3	19.9	47.7	48	26	29	-7	21
320.80	2.50	1.40	6		15.0	21.4	63.0	63	41	29	-7	24
318.30	2.50		3	Fine Sand	2.7	21.7	105.5	106	44	29	33	26
315.80	2.50		7	Fine Sand	6.3	61.5	208.5	209	50	29	129	29
313.30	2.50		18	Fine Sand	16.3	158.2	71.2	71	67	29	-24	31
310.80	2.50	0.30	1		4.0	4.6	73.7	74	71	29	-26	34
308.30	2.50	0.20	4		2.7	3.1	196.4	196	73	29	94	36
305.80	2.50		14	Medium Sand	13.5	123.1	245.0	245	87	29	129	39
303.30	2.50		18	Medium Sand	17.4	158.2	227.2	227	104	29	94	41
300.80	2.50		14	Medium Sand	13.5	123.1	231.9	232	118	29	85	44
298.30	2.50		13	Medium Sand	12.5	114.3	323.6	324	130	29	164	46
295.80	2.50		22	Medium Sand	21.2	193.4	230.5	231	151	29	50	49
293.30	2.50		9	Medium Sand	8.7	79.1	362.2	362	160	29	173	51
290.80	2.50		23	Medium Sand	22.2	202.2	445.9	446	182	29	235	54
288.30	2.50		30	Medium Sand	30.3	263.7	344.4	344	213	29	103	56
285.80	2.50		15	Clean Coarse Sand	15.8	131.8	360.2	360	228	29	103	59
283.30	2.50		15	Clean Coarse Sand	15.8	131.8	622.1	622	244	29	349	61
280.80	2.50		43	Clean Coarse Sand	63.6	377.9	553.9	554	308	29	217	64
278.30	2.50		28	Clean Coarse Sand	31.1	246.1	462.0	462	339	29	94	66
275.80	2.50		14	Clean Coarse Sand	14.8	123.1	485.6	486	354	29	103	69
273.80	2.00		15	Clean Coarse Sand	12.7	131.8	533.4	533	366	29	138	71
271.30	2.50		19	Clean Coarse Sand	20.0	167.0	553.4	553	366	29	158	73
268.80	2.50		19	Clean Coarse Sand	20.0	167.0	573.5	573	366	29	178	76
266.30	2.50		19	Clean Coarse Sand	20.0	167.0	593.5	593	366	29	198	78
263.80	2.50		19	Clean Coarse Sand	20.0	167.0	613.5	614	366	29	218	81
261.30	2.50		19	Clean Coarse Sand	20.0	167.0	633.6	634	366	29	238	83
258.80	2.50		19	Clean Coarse Sand	20.0	167.0	653.6	654	366	29	258	86
256.30	2.50		19	Clean Coarse Sand	20.0	167.0	673.7	674	366	29	278	88
253.80	2.50		19	Clean Coarse Sand	20.0	167.0	693.7	694	366	29	298	91
251.30	2.50		19	Clean Coarse Sand	20.0	167.0	713.7	714	366	29	318	93
248.80	2.50		19	Clean Coarse Sand	20.0	167.0	733.8	734	366	29	338	96
246.30	2.50		19	Clean Coarse Sand	20.0	167.0	753.8	754	366	29	359	98
243.80	2.50		19	Clean Coarse Sand	20.0	167.0	773.9	774	366	29	379	101
242.80	1.00		19	Clean Coarse Sand	8.0	167.0	781.9	782	366	29	387	102
242.30	0.50		19	Clean Coarse Sand	4.0	167.0	785.9	786	366	29	394	103
241.80	0.50		19	Clean Coarse Sand	4.0	167.0	789.9	790	366	29	396	103
241.30	0.50		19	Clean Coarse Sand		167.0						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) Pier 1
 REFERENCE BORING =====4S
 LRFD or ASD or SEISMIC =====LRFD
 PILE CUTOFF ELEV. = 344.42 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.60 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Scour
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD = 327.60 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====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
782 KIPS	780 KIPS	429 KIPS	100 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1540 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 200.97 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 75.37 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
325.40	2.20	1.20	5		11.8		24.1	24	0	0	13	19
322.90	2.50	0.80	7		9.7	12.3	42.9	43	0	0	24	22
320.40	2.50	1.40	6		15.0	21.4	131.5	132	0	0	72	24
317.90	2.50		13	Medium Sand	12.5	95.0	128.2	128	0	0	70	27
315.40	2.50		9	Medium Sand	8.7	79.1	110.5	110	0	0	61	29
312.90	2.50		6	Medium Sand	5.8	52.7	66.6	67	0	0	37	32
310.40	2.50	0.20	1		2.7	3.1	69.3	69	0	0	38	34
307.90	2.50	0.20	2		2.7	3.1	148.0	148	0	0	81	37
305.40	2.50		9	Medium Sand	8.7	79.1	174.3	174	0	0	96	39
302.90	2.50		11	Medium Sand	10.6	96.7	237.6	238	0	0	131	42
300.40	2.50		17	Medium Sand	16.4	149.4	174.9	175	0	0	96	44
297.90	2.50		8	Clean Coarse Sand	8.4	70.3	262.4	262	0	0	144	47
295.40	2.50		17	Clean Coarse Sand	17.9	149.4	298.0	298	0	0	164	49
292.90	2.50		19	Clean Coarse Sand	20.0	167.0	353.2	353	0	0	194	52
290.40	2.50		23	Clean Coarse Sand	24.3	202.2	245.6	246	0	0	135	54
287.90	2.50		8	Clean Coarse Sand	8.4	70.3	341.9	342	0	0	188	57
285.40	2.50		18	Clean Coarse Sand	19.0	158.2	396.0	396	0	0	218	59
282.90	2.50		22	Clean Coarse Sand	23.2	193.4	375.3	375	0	0	206	62
280.40	2.50		17	Clean Coarse Sand	17.9	149.4	402.0	402	0	0	221	64
277.90	2.50		18	Clean Coarse Sand	19.0	158.2	552.8	553	0	0	304	67
275.40	2.50		33	Clean Coarse Sand	40.0	290.1	452.3	452	0	0	249	69
272.90	2.50		17	Clean Coarse Sand	17.9	149.4	479.0	479	0	0	263	72
270.40	2.50		18	Clean Coarse Sand	19.0	158.2	612.2	612	0	0	337	74
269.40	1.00		31	Clean Coarse Sand	14.5	272.5	547.6	548	0	0	301	75
266.90	2.50		22	Clean Coarse Sand	23.2	193.4	570.8	571	0	0	314	78
264.40	2.50		22	Clean Coarse Sand	23.2	193.4	594.0	594	0	0	327	80
261.90	2.50		22	Clean Coarse Sand	23.2	193.4	617.2	617	0	0	339	83
259.40	2.50		22	Clean Coarse Sand	23.2	193.4	640.4	640	0	0	352	85
256.90	2.50		22	Clean Coarse Sand	23.2	193.4	663.6	664	0	0	365	88
254.40	2.50		22	Clean Coarse Sand	23.2	193.4	686.8	687	0	0	378	90
251.90	2.50		22	Clean Coarse Sand	23.2	193.4	710.1	710	0	0	391	93
249.40	2.50		22	Clean Coarse Sand	23.2	193.4	733.3	733	0	0	403	95
246.90	2.50		22	Clean Coarse Sand	23.2	193.4	756.5	756	0	0	416	98
244.40	2.50		22	Clean Coarse Sand	23.2	193.4	779.7	780	0	0	429	100
243.90	0.50		22	Clean Coarse Sand	4.6	193.4	784.3	784	0	0	434	101
243.40	0.50		22	Clean Coarse Sand	4.6	193.4	788.9	789	0	0	434	101
242.90	0.50		22	Clean Coarse Sand		193.4						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) Pier 1
 REFERENCE BORING =====4S
 LRFD or ASD or SEISMIC =====SEISMIC
 PILE CUTOFF ELEV. =====344.42 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.60 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====270.60 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====318.10 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
782 KIPS	780 KIPS	419 KIPS	100 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD ===== 1155 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts ===== 150.73 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts ===== 56.52 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
325.40	2.20	1.20	5		11.8		24.1	24	12	13	-1	19
322.90	2.50	0.80	7		9.7	12.3	42.9	43	22	24	-2	22
320.40	2.50	1.40	6		15.0	21.4	131.5	132	37	40	55	24
317.90	2.50		13	Medium Sand	12.5	95.0	128.2	128	49	40	39	27
315.40	2.50		9	Medium Sand	8.7	79.1	110.5	110	58	40	12	29
312.90	2.50		6	Medium Sand	5.8	52.7	66.6	67	64	40	-37	32
310.40	2.50	0.20	1		2.7	3.1	69.3	69	66	40	-37	34
307.90	2.50	0.20	2		2.7	3.1	148.0	148	69	40	39	37
305.40	2.50		9	Medium Sand	8.7	79.1	174.3	174	78	40	56	39
302.90	2.50		11	Medium Sand	10.6	96.7	237.6	238	88	40	109	42
300.40	2.50		17	Medium Sand	16.4	149.4	174.9	175	105	40	30	44
297.90	2.50		8	Clean Coarse Sand	8.4	70.3	262.4	262	113	40	109	47
295.40	2.50		17	Clean Coarse Sand	17.9	149.4	298.0	298	131	40	127	49
292.90	2.50		19	Clean Coarse Sand	20.0	167.0	353.2	353	151	40	162	52
290.40	2.50		23	Clean Coarse Sand	24.3	202.2	245.6	246	175	40	30	54
287.90	2.50		8	Clean Coarse Sand	8.4	70.3	341.9	342	184	40	118	57
285.40	2.50		18	Clean Coarse Sand	19.0	158.2	396.0	396	203	40	153	59
282.90	2.50		22	Clean Coarse Sand	23.2	193.4	375.3	375	226	40	109	62
280.40	2.50		17	Clean Coarse Sand	17.9	149.4	402.0	402	244	40	118	64
277.90	2.50		18	Clean Coarse Sand	19.0	158.2	552.8	553	263	40	250	67
275.40	2.50		33	Clean Coarse Sand	40.0	290.1	452.3	452	303	40	109	69
272.90	2.50		17	Clean Coarse Sand	17.9	149.4	479.0	479	321	40	118	72
270.40	2.50		18	Clean Coarse Sand	19.0	158.2	612.2	612	321	40	251	74
269.40	1.00		31	Clean Coarse Sand	14.5	272.5	547.6	548	321	40	187	75
266.90	2.50		22	Clean Coarse Sand	23.2	193.4	570.8	571	321	40	210	78
264.40	2.50		22	Clean Coarse Sand	23.2	193.4	594.0	594	321	40	233	80
261.90	2.50		22	Clean Coarse Sand	23.2	193.4	617.2	617	321	40	256	83
259.40	2.50		22	Clean Coarse Sand	23.2	193.4	640.4	640	321	40	279	85
256.90	2.50		22	Clean Coarse Sand	23.2	193.4	663.6	664	321	40	303	88
254.40	2.50		22	Clean Coarse Sand	23.2	193.4	686.8	687	321	40	326	90
251.90	2.50		22	Clean Coarse Sand	23.2	193.4	710.1	710	321	40	349	93
249.40	2.50		22	Clean Coarse Sand	23.2	193.4	733.3	733	321	40	372	95
246.90	2.50		22	Clean Coarse Sand	23.2	193.4	756.5	756	321	40	395	98
244.40	2.50		22	Clean Coarse Sand	23.2	193.4	779.7	780	321	40	419	100
243.90	0.50		22	Clean Coarse Sand	4.6	193.4	784.3	784	321	40	423	101
243.40	0.50		22	Clean Coarse Sand	4.6	193.4	788.9	789	321	40	428	101
242.90	0.50		22	Clean Coarse Sand		193.4						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) Pier 2
 REFERENCE BORING =====4S
 LRFD or ASD or SEISMIC =====LRFD
 PILE CUTOFF ELEV. = 344.48 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.60 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Scour
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD = 327.60 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====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
782 KIPS	780 KIPS	429 KIPS	100 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 1540 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 200.97 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 75.37 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
325.40	2.20	1.20	5		11.8		24.1	24	0	0	13	19
322.90	2.50	0.80	7		9.7	12.3	42.9	43	0	0	24	22
320.40	2.50	1.40	6		15.0	21.4	131.5	132	0	0	72	24
317.90	2.50		13	Medium Sand	12.5	95.0	128.2	128	0	0	70	27
315.40	2.50		9	Medium Sand	8.7	79.1	110.5	110	0	0	61	29
312.90	2.50		6	Medium Sand	5.8	52.7	66.6	67	0	0	37	32
310.40	2.50	0.20	1		2.7	3.1	69.3	69	0	0	38	34
307.90	2.50	0.20	2		2.7	3.1	148.0	148	0	0	81	37
305.40	2.50		9	Medium Sand	8.7	79.1	174.3	174	0	0	96	39
302.90	2.50		11	Medium Sand	10.6	96.7	237.6	238	0	0	131	42
300.40	2.50		17	Medium Sand	16.4	149.4	174.9	175	0	0	96	44
297.90	2.50		8	Clean Coarse Sand	8.4	70.3	262.4	262	0	0	144	47
295.40	2.50		17	Clean Coarse Sand	17.9	149.4	298.0	298	0	0	164	49
292.90	2.50		19	Clean Coarse Sand	20.0	167.0	353.2	353	0	0	194	52
290.40	2.50		23	Clean Coarse Sand	24.3	202.2	245.6	246	0	0	135	54
287.90	2.50		8	Clean Coarse Sand	8.4	70.3	341.9	342	0	0	188	57
285.40	2.50		18	Clean Coarse Sand	19.0	158.2	396.0	396	0	0	218	59
282.90	2.50		22	Clean Coarse Sand	23.2	193.4	375.3	375	0	0	206	62
280.40	2.50		17	Clean Coarse Sand	17.9	149.4	402.0	402	0	0	221	64
277.90	2.50		18	Clean Coarse Sand	19.0	158.2	552.8	553	0	0	304	67
275.40	2.50		33	Clean Coarse Sand	40.0	290.1	452.3	452	0	0	249	69
272.90	2.50		17	Clean Coarse Sand	17.9	149.4	479.0	479	0	0	263	72
270.40	2.50		18	Clean Coarse Sand	19.0	158.2	612.2	612	0	0	337	74
269.40	1.00		31	Clean Coarse Sand	14.5	272.5	547.6	548	0	0	301	75
266.90	2.50		22	Clean Coarse Sand	23.2	193.4	570.8	571	0	0	314	78
264.40	2.50		22	Clean Coarse Sand	23.2	193.4	594.0	594	0	0	327	80
261.90	2.50		22	Clean Coarse Sand	23.2	193.4	617.2	617	0	0	339	83
259.40	2.50		22	Clean Coarse Sand	23.2	193.4	640.4	640	0	0	352	85
256.90	2.50		22	Clean Coarse Sand	23.2	193.4	663.6	664	0	0	365	88
254.40	2.50		22	Clean Coarse Sand	23.2	193.4	686.8	687	0	0	378	90
251.90	2.50		22	Clean Coarse Sand	23.2	193.4	710.1	710	0	0	391	93
249.40	2.50		22	Clean Coarse Sand	23.2	193.4	733.3	733	0	0	403	95
246.90	2.50		22	Clean Coarse Sand	23.2	193.4	756.5	756	0	0	416	98
244.40	2.50		22	Clean Coarse Sand	23.2	193.4	779.7	780	0	0	429	100
243.90	0.50		22	Clean Coarse Sand	4.6	193.4	784.3	784	0	0	434	101
243.40	0.50		22	Clean Coarse Sand	4.6	193.4	788.9	789	0	0	434	101
242.90	0.50		22	Clean Coarse Sand		193.4						



IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE=====064-0048 (EB) Pier 2
 REFERENCE BORING =====4S
 LRFD or ASD or SEISMIC =====SEISMIC
 PILE CUTOFF ELEV. =====344.48 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 327.60 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Liquef.
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====270.60 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====318.10 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
782 KIPS	780 KIPS	419 KIPS	100 FT.

TOTAL SEISMIC SUBSTRUCTURE LOAD ===== 1155 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 61.30 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ===== 1
 Approx. Seismic Loading Applied per pile spaced at 8 ft. Cts ===== 150.73 KIPS
 Approx. Seismic Loading Applied per pile spaced at 3 ft. Cts ===== 56.52 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Plugged Pile Perimeter===== 4.189 FT.
 Plugged Pile End Bearing Area===== 1.396 SQFT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	ULTIMATE PLUGGED			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.)
					SIDE RESIST. (KIPS)	END BRG. RESIST. (KIPS)	TOTAL RESIST. (KIPS)					
325.40	2.20	1.20	5		11.8		24.1	24	12	13	-1	19
322.90	2.50	0.80	7		9.7	12.3	42.9	43	22	24	-2	22
320.40	2.50	1.40	6		15.0	21.4	131.5	132	37	40	55	24
317.90	2.50		13	Medium Sand	12.5	95.0	128.2	128	49	40	39	27
315.40	2.50		9	Medium Sand	8.7	79.1	110.5	110	58	40	12	29
312.90	2.50		6	Medium Sand	5.8	52.7	66.6	67	64	40	-37	32
310.40	2.50	0.20	1		2.7	3.1	69.3	69	66	40	-37	34
307.90	2.50	0.20	2		2.7	3.1	148.0	148	69	40	39	37
305.40	2.50		9	Medium Sand	8.7	79.1	174.3	174	78	40	56	39
302.90	2.50		11	Medium Sand	10.6	96.7	237.6	238	88	40	109	42
300.40	2.50		17	Medium Sand	16.4	149.4	174.9	175	105	40	30	44
297.90	2.50		8	Clean Coarse Sand	8.4	70.3	262.4	262	113	40	109	47
295.40	2.50		17	Clean Coarse Sand	17.9	149.4	298.0	298	131	40	127	49
292.90	2.50		19	Clean Coarse Sand	20.0	167.0	353.2	353	151	40	162	52
290.40	2.50		23	Clean Coarse Sand	24.3	202.2	245.6	246	175	40	30	54
287.90	2.50		8	Clean Coarse Sand	8.4	70.3	341.9	342	184	40	118	57
285.40	2.50		18	Clean Coarse Sand	19.0	158.2	396.0	396	203	40	153	59
282.90	2.50		22	Clean Coarse Sand	23.2	193.4	375.3	375	226	40	109	62
280.40	2.50		17	Clean Coarse Sand	17.9	149.4	402.0	402	244	40	118	64
277.90	2.50		18	Clean Coarse Sand	19.0	158.2	552.8	553	263	40	250	67
275.40	2.50		33	Clean Coarse Sand	40.0	290.1	452.3	452	303	40	109	69
272.90	2.50		17	Clean Coarse Sand	17.9	149.4	479.0	479	321	40	118	72
270.40	2.50		18	Clean Coarse Sand	19.0	158.2	612.2	612	321	40	251	74
269.40	1.00		31	Clean Coarse Sand	14.5	272.5	547.6	548	321	40	187	75
266.90	2.50		22	Clean Coarse Sand	23.2	193.4	570.8	571	321	40	210	78
264.40	2.50		22	Clean Coarse Sand	23.2	193.4	594.0	594	321	40	233	80
261.90	2.50		22	Clean Coarse Sand	23.2	193.4	617.2	617	321	40	256	83
259.40	2.50		22	Clean Coarse Sand	23.2	193.4	640.4	640	321	40	279	85
256.90	2.50		22	Clean Coarse Sand	23.2	193.4	663.6	664	321	40	303	88
254.40	2.50		22	Clean Coarse Sand	23.2	193.4	686.8	687	321	40	326	90
251.90	2.50		22	Clean Coarse Sand	23.2	193.4	710.1	710	321	40	349	93
249.40	2.50		22	Clean Coarse Sand	23.2	193.4	733.3	733	321	40	372	95
246.90	2.50		22	Clean Coarse Sand	23.2	193.4	756.5	756	321	40	395	98
244.40	2.50		22	Clean Coarse Sand	23.2	193.4	779.7	780	321	40	419	100
243.90	0.50		22	Clean Coarse Sand	4.6	193.4	784.3	784	321	40	423	101
243.40	0.50		22	Clean Coarse Sand	4.6	193.4	788.9	789	321	40	428	101
242.90	0.50		22	Clean Coarse Sand		193.4						

Slope Stability Soil Parameters SN 064-0047

Westbound, West Abutment (LRFD)				
Bottom Elev.	Layer Number	Unit Weight (lbs/ft ³)	Cohesion (lbs/ft ²)	Friction Angle (deg.)
321.5	1	121.2	1014	-
316.5	2	114.5		27.70
311.5	3	108.4	300	-
309.0	4	130.8		34.90
291.5	5	126.8		33.00
284.0	6	129.4		34.40
271.0	7	127.2		33.40
268.5	8	131.5		35.40
266.0	9	124.9		32.00
265.5	10	133.8		36.70

Westbound, West Abutment 2S (1968)

PGL @ Back/Abut: 349.25 X Y
 Approach Slab Thickness: 1.25 Bottom of Slope Coordinates: 60.00 331.00
 Bottom of Approach Slab: 348 Top of Slope Coordinates: 94.00 348
 Ditch at Bottom of Slope: 331.00 Bottom Initiation Pt Range (X): 26.00 60
 Slope Height: 17.00 Top Termination Pt Range (X): 94.00 128.00
 Horizontal Slope Length: 34

Westbound, East Abutment (LRFD)				
Bottom Elev.	Layer Number	Unit Weight (lbs/ft ³)	Cohesion (lbs/ft ²)	Friction Angle (deg.)
320.8	1	124.2	1225	-
315.8	2	116.9		28.60
313.3	3	128.5		33.80
310.8	4	108.4	300	-
308.3	5	104.3	200	-
305.8	6	126.3		32.60
293.3	7	126.7		32.90
290.8	8	130.8		34.90
288.3	9	133.2		36.30
283.3	10	126.9		32.90
274.8	11	130.6		35.00

Westbound, East Abutment 3S (1968)

PGL @ Back/Abut: 349.36 X Y
 Approach Slab Thickness: 1.25 Bottom of Slope Coordinates: 60.00 331.00
 Bottom of Approach Slab: 348.11 Top of Slope Coordinates: 94.22 348.11
 Ditch at Bottom of Slope: 331.00 Bottom Initiation Pt Range (X): 25.8 60
 Slope Height: 17.11 Top Termination Pt Range (X): 94.22 128.44
 Horizontal Slope Length: 34.22

Slope Stability Soil Parameters SN 064-0048

Eastbound, West Abutment (Seismic)				
Bottom Elev.	Layer Number	Unit Weight (lbs/ft ³)	Cohesion (lbs/ft ²)	Friction Angle (deg.)
342.3	1	119.0	800	-
339.8	2	127.0	1600	-
337.3	3	135.3	3100	-
334.8	4	122.6	1100	-
332.3	5	126.3	1500	-
322.3	6	131.5	397.50	-
319.8	7	117.5	210.00	-
312.3	8	114.2		8.40
307.3	9	124.9		9.60
302.3	10	126.3		9.78
297.3	11	128.0		10.05
277.3	12	131.5		35.70
275.3	13	134.7		37.20

Eastbound, West Abutment 3-S (2019)

PGL @ Back/Abut: 349.29 X Y

Approach Slab Thickness: 1.25 Bottom of Slope Coordinates: 60.00 336.00

Bottom of Approach Slab: 348.04 Top of Slope Coordinates: 84.08 348.04

Ditch at Bottom of Slope: 336.00 Bottom Initiation Pt Range (X): 35.92 60

Slope Height: 12.04 Top Termination Pt Range (X): 84.08 108.16

Horizontal Slope Length: 24.08

Eastbound, East Abutment (Seismic)				
Bottom Elev.	Layer Number	Unit Weight (lbs/ft ³)	Cohesion (lbs/ft ²)	Friction Angle (deg.)
342.8	1	126.3	1500	-
340.3	2	123.6	1200	-
337.8	3	131.5	2300	-
335.3	4	121.5	1000	-
332.8	5	120.3	270	-
323.3	6	131.5	1578	-
320.3	7	113.8	150.00	-
312.8	8	114.2		8.73
310.3	9	111.4	120.00	-
307.8	10	120.3		8.97
296.3	11	123.4		9.36
290.3	12	128.5		10.14
285.3	13	134.7		37.20
270.3	14	130.4		10.41
268.1	15	133.2		36.30

Eastbound, East Abutment 1-S (2019)

PGL @ Back/Abut: 349.44 X Y

Approach Slab Thickness: 1.25 Bottom of Slope Coordinates: 60.00 336.00

Bottom of Approach Slab: 348.19 Top of Slope Coordinates: 84.38 348.19

Ditch at Bottom of Slope: 336.00 Bottom Initiation Pt Range (X): 35.62 60

Slope Height: 12.19 Top Termination Pt Range (X): 84.38 108.76

Horizontal Slope Length: 24.38

