

Short, Michael A

Subject: FW: 006-0187, Contract 66A19, IL 26 over Big Bureau Creek Abutment Piling

From: Short, Michael A
Sent: Friday, December 16, 2016 1:14 PM
To: Alexander, David S; Ferguson, Steven P
Cc: Phillips, Wayne L; Sell, Nathan R
Subject: 006-0187, Contract 66A19, IL 26 over Big Bureau Creek Abutment Piling

Dave and Steve,

I have serious concerns about using the HP 14X73 piles at the abutments:

1. 14X0.312 metal shell piles are used at the piers. Having different pile types and sizes at the same structure increases costs to the Department as the pile hammer must be modified for the different pile types and cutoffs from the abutment piles cannot be used to provide additional pile length at the piers.
2. At the north abutment, the estimated pile length is 107 feet. This is an exceptionally long pile.
3. At the north abutment, the estimated pile tip elevation is 525.4 feet. The nearest soil borings at the north abutment extended to only elevation 570.0 feet. This means that approximately 45 feet of the pile length will be installed in unknown soils. This presents an unacceptably high level of risk to the Department during the construction process.
4. At the south abutment, the estimated pile length is 60 feet.
5. At the south abutment, the estimated pile tip elevation is 571.4 feet. The nearest soil borings at the south abutment extended to elevation 569.0 feet. This means that if the pile drives deeper than expected, it will be in unknown soils.

Since the time the SGR was approved, the Bureau of Bridges and Structures has re-evaluated the criteria for pile selection using integral abutments. Under the previous policy, metal shell piles were not permitted for the combination of skew and effective expansion length of this structure. The proposed revised policy (which is expected to be released very soon) would allow 14 inch metal shell piles on this structure. Based on the expected revisions to the integral abutment policy, it is recommended to consider the use of 14X0.312 metal shell piles at the integral abutments. This would allow the pile type and size to be the same at all of the substructure units on the structure. Additionally, the estimated length of the piles would be substantially shorter, as shown in the table. The number of MS 14X0.312 piles was determined by assuming the nominal required bearing of the MS piles would be 400 kips.

Substructure Unit	Number of HP 14X73 Piles	Estimated Length of each HP 14X73	Estimated Total Length of all HP 14X73 Piles	Number MS 14X0.312 Piles	Estimated Length of each MS 14X0.312	Estimated Total Length of all MS 14X0.312 Piles
North Abutment	8	107 feet	856 feet	10	43 feet	430 feet
South Abutment	8	60 feet	480 feet	10	42 feet	420 feet

In addition to simplifying construction by having shorter piles and a consistent pile type throughout all substructure units, an economic advantage will be realized as there will be substantial decrease in the quantity of piling needed at the abutments. Based on a preliminary calculation assuming a cost of \$65/foot of pile, the savings is approximately \$30,000.

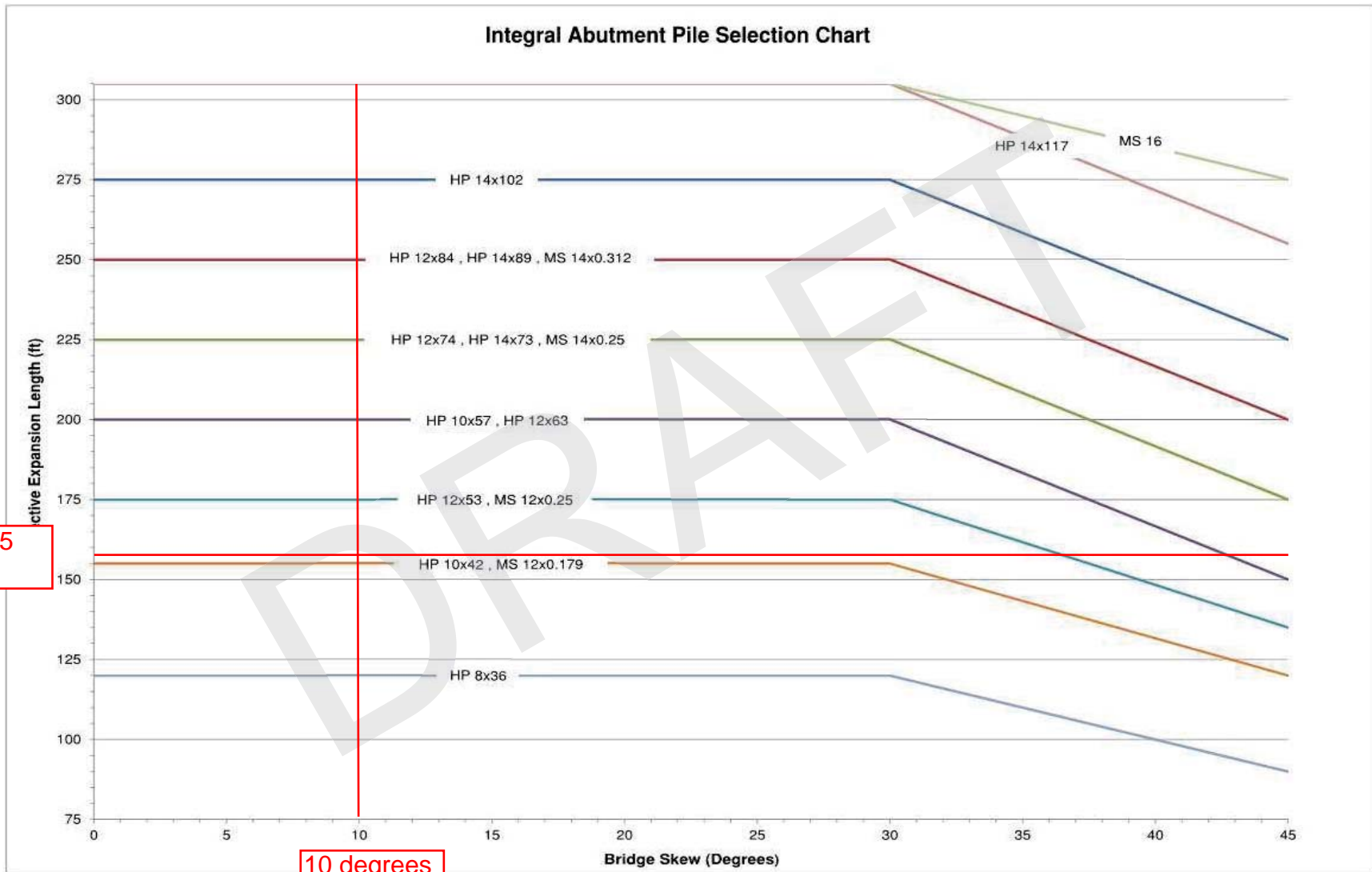
It is recommended that we discuss this issue with the Bureau of Bridges and Structures and the design consultant to determine if revisions to the abutment pile design are feasible.

Thanks,
Mike

SN 006-0187 Proposed Integral Abutment Policy Pile Selection Chart

Structure Skew = 10 degrees

Effective Expansion Length = 157.15 feet



Allowable pile sizes:

- MS 12X0.25, MS 14X0.25, MS 14X0.312, MS 16
- HP 10X57, HP 12X53, HP 12X63, HP 12X74, HP 12X84
- HP 14X73, HP 14X89, HP 14X102, HP 14X117

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE===== **NORTH ABUTMENT**
 REFERENCE BORING ===== **2**
 LRFD or ASD or SEISMIC ===== **LRFD**
 PILE CUTOFF ELEV. ===== **632.36** ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DR **630.36** 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
588 KIPS	464 KIPS	255 KIPS	43 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== **1822** kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== **43.20** ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = **1**
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 337.41 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 126.53 KIPS

PILE TYPE AND SIZE ===== **Metal Shell 16"Φ w/.312" walls**
 Pile Perimeter===== 4.189 FT.
 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			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)					
628.95	1.41		6	Medium Sand	3.3		23.9	24	0	0	13	3
626.45	2.50		8	Medium Sand	7.7	20.6	27.9	28	0	0	15	6
623.95	2.50		4	Medium Sand	3.9	16.9	48.1	48	0	0	26	8
621.95	2.00		6	Clean Coarse Sand	5.1	33.3	63.0	63	0	0	35	10
619.45	2.50		6	Clean Coarse Sand	6.3	43.2	158.1	158	0	0	87	13
616.95	2.50		15	Sandy Gravel	18.5	131.8	176.6	177	0	0	97	15
613.95	3.00		15	Sandy Gravel	22.2	131.8	129.8	130	0	0	71	18
611.45	2.50	4.10	16		31.7	62.8	164.5	165	0	0	91	21
608.95	2.50	4.30	19		32.9	65.9	197.4	197	0	0	109	23
606.45	2.50	4.30	19		32.9	65.9	230.3	230	0	0	127	26
603.95	2.50	4.30	20		32.9	65.9	273.9	274	0	0	151	28
601.45	2.50	5.00	25		34.1	76.6	311.0	311	0	0	171	31
598.95	2.50	5.20	28		34.1	79.6	345.1	345	0	0	190	33
596.95	2.00	5.20	27		27.3	79.6	521.3	521	0	0	287	35
594.45	2.50		26	Medium Sand	25.1	228.5	572.8	573	0	0	315	38
591.95	2.50		29	Medium Sand	28.9	254.9	429.5	429	0	0	236	40
589.45	2.50	5.40	29		34.1	82.7	463.5	464	0	0	255	43
586.95	2.50	5.40	29		34.1	82.7	658.8	659	0	0	362	45
584.45	2.50		37	Hard Till	21.9	243.9	680.8	681	0	0	374	48
581.95	2.50		37	Hard Till	21.9	243.9	676.4	676	0	0	372	50
579.45	2.50		33	Hard Till	19.1	217.5	695.5	695	0	0	383	53
576.95	2.50		33	Hard Till	19.1	217.5	760.7	761	0	0	418	55
574.45	2.50		40	Hard Till	24.3	263.7	785.0	785	0	0	432	58
571.95	2.50		40	Hard Till	24.3	263.7	789.6	790	0	0	434	60
569.95	2.00		37	Hard Till	17.6	243.9	807.1	807	0	0	444	62
564.95	5.00		37	Hard Till	43.9	243.9	851.0	851	0	0	468	67
559.95	5.00		37	Hard Till	43.9	243.9	894.9	895	0	0	492	72
554.95	5.00		37	Hard Till	43.9	243.9	938.8	939	0	0	516	77
549.95	5.00		37	Hard Till	43.9	243.9	982.7	983	0	0	540	82
544.95	5.00		37	Hard Till	43.9	243.9	1026.6	1027	0	0	565	87
539.95	5.00		37	Hard Till	43.9	243.9	1070.5	1070	0	0	589	92
534.95	5.00		37	Hard Till	43.9	243.9	1114.4	1114	0	0	613	97
529.95	5.00		37	Hard Till	43.9	243.9	1158.3	1158	0	0	637	102
524.95	5.00		37	Hard Till	43.9	243.9	1202.2	1202	0	0	661	107
519.95	5.00		37	Hard Till	43.9	243.9	1246.1	1246	0	0	685	112
514.95	5.00		37	Hard Till	43.9	243.9	1290.0	1290	0	0	709	117
509.95	5.00		37	Hard Till	43.9	243.9	1333.8	1334	0	0	734	122
504.95	5.00		37	Hard Till		243.9						

Attachment 3 North Abutment

Pile Design Table for NORTH ABUTMENT utilizing Boring #2

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls				Steel HP 10 X 57				Steel HP 14 X 73			
197	109	23		224	123	53		208	114	31	
230	127	26		236	130	55		244	134	33	
274	151	28		240	132	60		266	146	35	
311	171	31		243	133	62		281	155	38	
345	190	33		250	137	67		291	160	40	
429	236	40		257	141	72		317	175	43	
464	255	43		263	145	77		332	183	50	
Metal Shell 16"Φ w/.375" walls				270	149	82		337	185	53	
197	109	23		277	153	87		359	197	55	
230	127	26		284	156	92		362	199	60	
274	151	28		291	160	97		366	201	62	
311	171	31		298	164	102		376	207	67	
345	190	33		305	168	107		385	212	72	
429	236	40		312	172	112		395	217	77	
464	255	43		319	176	117		405	223	82	
659	362	45		326	179	122		415	228	87	
676	372	50		Steel HP 12 X 53				424	233	92	
695	383	53		225	124	38		434	239	97	
Metal Shell 14"Φ w/.25" walls				234	129	40		444	244	102	
194	107	26		254	140	43		453	249	107	
231	127	28		268	148	45		463	255	112	
263	145	31		269	148	50		473	260	117	
293	161	33		273	150	53		483	265	122	
Metal Shell 14"Φ w/.312" walls				289	159	55		Steel HP 14 X 89			
194	107	26		293	161	60		212	116	31	
231	127	28		296	163	62		248	137	33	
263	145	31		304	167	67		270	148	35	
293	161	33		313	172	72		286	157	38	
367	202	40		321	176	77		296	163	40	
397	218	43		329	181	82		322	177	43	
Steel HP 8 X 36				337	186	87		337	185	50	
226	124	97		346	190	92		341	188	53	
231	127	102		354	195	97		364	200	55	
237	130	107		362	199	102		367	202	60	
242	133	112		370	204	107		371	204	62	
248	136	117		378	208	112		381	209	67	
254	139	122		387	213	117		390	215	72	
Steel HP 10 X 42				395	217	122		400	220	77	
219	120	53		Steel HP 12 X 63				410	226	82	
230	127	55		227	125	38		420	231	87	
234	129	60		236	130	40		430	236	92	
237	130	62		257	141	43		440	242	97	
244	134	67		271	149	45		450	247	102	
251	138	72		272	150	50		459	253	107	
257	142	77		276	152	53		469	258	112	
264	145	82		292	161	55		479	263	117	
271	149	87		296	163	60		489	269	122	
278	153	92		299	165	62		Steel HP 14 X 102			
285	157	97		308	169	67		214	118	31	
292	160	102		316	174	72		251	138	33	
299	164	107		324	178	77		274	151	35	
305	168	112		332	183	82		289	159	38	
312	172	117		341	187	87		299	165	40	
319	175	122		349	192	92		327	180	43	
				357	197	97		341	188	50	
				366	201	102		346	190	53	
				374	206	107		369	203	55	
				382	210	112		372	204	60	
				391	215	117		376	207	62	
				399	219	122		386	212	67	
				Steel HP 12 X 74				396	218	72	
				219	120	35		406	223	77	
				231	127	38		415	229	82	
				240	132	40		425	234	87	
				261	144	43		435	239	92	
				276	152	45		445	245	97	
				276	152	50		455	250	102	
				280	154	53		465	256	107	
				297	163	55		475	261	112	
				301	165	60		485	267	117	
				304	167	62		495	272	122	
				312	172	67		Steel HP 14 X 117			
				321	176	72		218	120	31	
				329	181	77		255	140	33	
				338	186	82		277	153	35	
				346	190	87		293	161	38	
				354	195	92		304	167	40	
				363	199	97		331	182	43	
				371	204	102		346	190	50	
				379	209	107		350	193	53	
				388	213	112		374	206	55	
				396	218	117		377	207	60	
				405	223	122		381	209	62	
				Steel HP 12 X 84				391	215	67	
				222	122	35		401	220	72	
				235	129	38		411	226	77	
				244	134	40		421	231	82	
				265	146	43		431	237	87	
				280	154	45		441	243	92	
				280	154	50		451	248	97	
				284	156	53		461	254	102	
				302	166	55		471	259	107	
				305	168	60		481	265	112	
				309	170	62		491	270	117	
				317	174	67		501	276	122	
				326	179	72		Precast 14"x 14"			
				334	184	77		211	116	23	
				343	188	82		247	136	26	
				351	193	87		Timber Pile			
				360	198	92		144	79	23	
				368	202	97					
				377	207	102					
				385	212	107					
				394	216	112					
				402	221	117					
				411	226	122					

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE===== Pier 1
 REFERENCE BORING ===== B-4
 LRFD or ASD or SEISMIC ===== LRFD
 PILE CUTOFF ELEV. ===== 632.00 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== 614.50 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===== 609.00 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) ===== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ===== 2548 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)===== 43.20 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = 1

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
704 KIPS	697 KIPS	354 KIPS	66 FT.

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 471.85 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 176.94 KIPS

PILE TYPE AND SIZE ===== Metal Shell 16"Φ w/.375" walls
 Pile Perimeter===== 4.189 FT.
 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			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)					
612.00	2.50	3.80	24		29.9		74.3	74	16	0	24	20
609.50	2.50	2.90	17		24.5	44.4	112.6	113	30	0	32	23
607.00	2.50	3.80	26		29.9	58.2	145.5	145	30	0	50	25
604.50	2.50	4.00	29		31.1	61.3	175.0	175	30	0	66	28
602.00	2.50	3.90	27		30.5	59.7	200.9	201	30	0	81	30
599.50	2.50	3.60	22		28.7	55.1	243.4	243	30	0	104	33
597.00	2.50	4.50	30		34.1	68.9	412.9	413	30	0	197	35
594.50	2.50		31	Hard Till	17.8	204.4	430.7	431	30	0	207	38
592.00	2.50		31	Hard Till	17.8	204.4	455.1	455	30	0	220	40
589.50	2.50		32	Hard Till	18.4	211.0	506.5	507	30	0	249	43
587.00	2.50		37	Hard Till	21.9	243.9	535.1	535	30	0	264	45
584.50	2.50		38	Hard Till	22.7	250.5	544.6	545	30	0	270	48
583.50	1.00		36	Hard Till	8.5	237.3	553.1	553	30	0	274	49
582.50	1.00		36	Hard Till	8.5	237.3	561.6	562	30	0	279	50
581.50	1.00		36	Hard Till	8.5	237.3	570.0	570	30	0	284	51
580.50	1.00		36	Hard Till	8.5	237.3	578.5	579	30	0	288	52
579.50	1.00		36	Hard Till	8.5	237.3	587.0	587	30	0	293	53
578.50	1.00		36	Hard Till	8.5	237.3	595.5	595	30	0	298	54
577.50	1.00		36	Hard Till	8.5	237.3	604.0	604	30	0	302	55
576.50	1.00		36	Hard Till	8.5	237.3	612.5	612	30	0	307	56
575.50	1.00		36	Hard Till	8.5	237.3	620.9	621	30	0	312	57
574.50	1.00		36	Hard Till	8.5	237.3	629.4	629	30	0	316	58
572.50	2.00		36	Hard Till	17.0	237.3	646.4	646	30	0	326	60
570.50	2.00		36	Hard Till	17.0	237.3	663.3	663	30	0	335	62
569.50	1.00		36	Hard Till	8.5	237.3	671.8	672	30	0	340	63
568.50	1.00		36	Hard Till	8.5	237.3	680.3	680	30	0	344	64
567.50	1.00		36	Hard Till	8.5	237.3	688.8	689	30	0	349	65
566.50	1.00		36	Hard Till	8.5	237.3	697.3	697	30	0	354	66
565.50	1.00		36	Hard Till	8.5	237.3	705.7	706	-30	0	358	67
564.50	1.00		36	Hard Till	8.5	237.3	714.2	714	-30	0	363	68
563.50	1.00		36	Hard Till	8.5	237.3	722.7	723	-30	0	368	69
558.50	5.00		36	Hard Till	42.4	237.3	765.1	765	-30	0	394	74
553.50	5.00		36	Hard Till	42.4	237.3	807.5	808	-30	0	444	79
548.50	5.00		36	Hard Till	42.4	237.3	849.9	850	-30	0	438	84
543.50	5.00		36	Hard Till	42.4	237.3	892.3	892	-30	0	464	89
538.50	5.00		36	Hard Till	42.4	237.3	934.7	935	-30	0	484	94
533.50	5.00		36	Hard Till	42.4	237.3	977.1	977	-30	0	508	99
528.50	5.00		36	Hard Till		237.3						

Attachment 3 Pier 1

Pile Design Table for Pier 1 utilizing Boring #B-4

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls			Steel HP 10 X 57			Steel HP 14 X 73		
243	104	33	239	116	99	360	177	99
413	197	35	Steel HP 12 X 53			Steel HP 14 X 89		
431	207	38	292	142	99	356	174	94
455	220	40	Steel HP 12 X 63			365 179 99		
507	249	43	295	144	99	Steel HP 14 X 102		
535	264	45	Steel HP 12 X 74			360 176 94		
545	270	48	299	146	99	370 182 99		
553	274	49	Steel HP 12 X 84			Steel HP 14 X 117		
562	279	50	304	148	99	355 173 89		
570	284	51						
579	288	52						
587	293	53						
Metal Shell 16"Φ w/.375" walls								
243	104	33						
413	197	35						
431	207	38						
455	220	40						
507	249	43						
535	264	45						
545	270	48						
553	274	49						
562	279	50						
570	284	51						
579	288	52						
587	293	53						
595	298	54						
604	302	55						
612	307	56						
621	312	57						
629	316	58						
646	326	60						
663	335	62						
672	340	63						
680	344	64						
689	349	65						
697	354	66						
Metal Shell 14"Φ w/.25" walls								
355	169	38						
375	180	40						
Metal Shell 14"Φ w/.312" walls								
355	169	38						
375	180	40						
417	203	43						
441	216	45						
451	222	48						
458	226	49						
465	230	50						
473	234	51						
480	238	52						
488	242	53						
495	246	54						
502	250	55						
510	254	56						
Steel HP 8 X 36								
184	89	99						
Steel HP 10 X 42								
234	113	99						
						Precast 14"x 14" 262 111 33 Timber Pile 127 40 28		

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE=====PIER 2
 REFERENCE BORING =====B-2
 LRFD or ASD or SEISMIC =====LRFD
 PILE CUTOFF ELEV. =====632.00 ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DR =====614.50 ft
 GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) =====Scour
 BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =====609.00 ft
 TOP ELEV. OF LIQUEF. (so layers above apply DD) =====ft

TOTAL FACTORED SUBSTRUCTURE LOAD =====2548 kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)=====43.16 ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE : 1

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
704 KIPS	686 KIPS	347 KIPS	42 FT.

Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 472.29 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 177.11 KIPS

PILE TYPE AND SIZE =====Metal Shell 16"Φ w/.375" walls
 Pile Perimeter===== 4.189 FT.
 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			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)					
612.50	2.00	4.00	25		24.9		86.1	86	14	0	34	20
610.00	2.50	4.00	25		31.1	61.3	121.8	122	31	0	36	22
607.50	2.50	4.30	27		32.9	65.9	153.1	153	31	0	53	25
605.00	2.50	4.20	28		32.3	64.3	187.0	187	31	0	72	27
602.50	2.50	4.30	29		32.9	65.9	364.9	365	31	0	170	30
600.00	2.50		32	Hard Till	18.4	211.0	396.6	397	31	0	187	32
597.50	2.50		34	Hard Till	19.8	224.1	409.7	410	31	0	195	35
595.00	2.50		33	Hard Till	19.1	217.5	540.9	541	31	0	267	37
592.50	2.50		50	Hard Till	33.7	329.6	607.5	608	31	0	303	40
590.00	2.50		55	Hard Till	39.2	362.6	686.3	686	31	0	347	42
587.50	2.50		61	Hard Till	46.5	402.1	772.4	772	34	0	394	45
585.00	2.50		67	Hard Till	54.7	441.7	886.4	886	34	0	457	47
582.50	2.50		76	Hard Till	68.5	501.0	1113.1	1113	34	0	581	50
580.00	2.50		100	Hard Till	114.1	659.2	864.6	865	34	0	445	52
577.50	2.50		45	Hard Till	28.7	296.7	853.8	854	34	0	439	55
575.00	2.50		39	Hard Till	23.5	257.1	824.6	825	34	0	423	57
572.50	2.50		31	Hard Till	17.8	204.4	696.2	696	31	0	352	60
570.00	2.50	3.80	26		29.9	58.2	726.1	726	34	0	369	62
567.50	2.50	3.80	26		29.9	58.2	902.1	902	34	0	465	65
565.50	2.00		31	Hard Till	14.3	204.4	916.4	916	34	0	473	67
563.50	2.00		31	Hard Till	14.3	204.4	930.6	931	34	0	481	69
561.50	2.00		31	Hard Till	14.3	204.4	944.9	945	34	0	489	71
559.50	2.00		31	Hard Till	14.3	204.4	959.1	959	34	0	497	73
557.50	2.00		31	Hard Till	14.3	204.4	973.4	973	34	0	505	75
555.50	2.00		31	Hard Till	14.3	204.4	987.6	988	34	0	512	77
550.50	5.00		31	Hard Till	35.6	204.4	1023.3	1023	34	0	532	82
545.50	5.00		31	Hard Till	35.6	204.4	1058.9	1059	34	0	552	87
540.50	5.00		31	Hard Till	35.6	204.4	1094.5	1095	34	0	571	92
535.50	5.00		31	Hard Till	35.6	204.4	1130.1	1130	34	0	591	97
530.50	5.00		31	Hard Till	35.6	204.4	1165.8	1166	34	0	610	102
525.50	5.00		31	Hard Till	35.6	204.4	1201.4	1201	34	0	630	107
520.50	5.00		31	Hard Till	35.6	204.4	1237.0	1237	34	0	650	112
515.50	5.00		31	Hard Till	35.6	204.4	1272.6	1273	34	0	669	117
510.50	5.00		31	Hard Till	35.6	204.4	1308.3	1308	34	0	689	122
505.50	5.00		31	Hard Till	35.6	204.4	1343.9	1344	34	0	708	127
500.50	5.00		31	Hard Till	35.6	204.4	1379.5	1380	34	0	728	132
495.50	5.00		31	Hard Till	35.6	204.4	1415.2	1415	34	0	748	137
490.50	5.00		31	Hard Till		204.4						

Attachment 3 Pier 2

Pile Design Table for PIER 2 utilizing Boring #B-2

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls			Steel HP 10 X 57			Steel HP 14 X 73		
365	170	30	309	154	137	360	176	77
397	187	32	Steel HP 12 X 53			367	180	82
410	195	35	353	176	122	375	184	87
541	267	37	360	179	127	383	189	92
Metal Shell 16"Φ w/.375" walls			366	183	132	391	193	97
365	170	30	373	187	137	399	197	102
397	187	32	Steel HP 12 X 63			407	202	107
410	195	35	350	174	117	415	206	112
541	267	37	357	177	122	423	210	117
608	303	40	363	181	127	431	215	122
686	347	42	370	185	132	439	219	127
Metal Shell 14"Φ w/.25" walls			377	188	137	447	224	132
335	157	35	Steel HP 12 X 74			454	228	137
Metal Shell 14"Φ w/.312" walls			355	176	117	Steel HP 14 X 89		
335	157	35	362	180	122	361	176	75
437	214	37	369	184	127	364	178	77
492	244	40	375	187	132	372	182	82
Steel HP 8 X 36			382	191	137	380	187	87
241	120	137	Steel HP 12 X 84			388	191	92
Steel HP 10 X 42			353	175	112	396	196	97
302	151	137	360	179	117	404	200	102
			367	183	122	412	204	107
			374	186	127	420	209	112
			381	190	132	428	213	117
			388	194	137	436	218	122
						444	222	127
						452	226	132
						460	231	137
						Steel HP 14 X 102		
						362	177	73
						366	179	75
						369	180	77
						377	185	82
						385	189	87
						393	194	92
						401	198	97
						409	203	102
						417	207	107
						425	212	112
						434	216	117
						442	220	122
						450	225	127
						458	229	132
						466	234	137
						Steel HP 14 X 117		
						361	176	69
						364	177	71
						367	179	73
						370	181	75
						374	183	77
						382	187	82
						390	192	87
						398	196	92
						406	201	97
						414	205	102
						423	210	107
						431	214	112
						439	219	117
						447	223	122
						455	228	127
						463	232	132
						472	237	137
						Precast 14"x 14"		
						199	75	27
						Timber Pile		
						134	43	27

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

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

Modified 10/18/2011

SUBSTRUCTURE===== **SOUTH ABUTMENT**

REFERENCE BORING ===== **1**
 LRFD or ASD or SEISMIC ===== **LRFD**
 PILE CUTOFF ELEV. ===== **631.45** ft
 GROUND SURFACE ELEV. AGAINST PILE DURING DR ===== **629.45** 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
704 KIPS	699 KIPS	384 KIPS	48 FT.

TOTAL FACTORED SUBSTRUCTURE LOAD ===== **1822** kips
 TOTAL LENGTH OF SUBSTRUCTURE (along skew)==== **43.80** ft
 NUMBER OF ROWS OF PILES PER SUBSTRUCTURE = **1**
 Approx. Factored Loading Applied per pile at 8 ft. Cts ===== 332.79 KIPS
 Approx. Factored Loading Applied per pile at 3 ft. Cts ===== 124.79 KIPS

PILE TYPE AND SIZE ===== **Metal Shell 16"Φ w/.375" walls**
 Pile Perimeter===== 4.189 FT.
 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			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)					
627.99	1.46		8	Medium Sand	4.5		12.3	12	0	0	7	3
625.49	2.50		3	Medium Sand	2.9	7.8	20.2	20	0	0	11	6
622.99	2.50		3	Medium Sand	2.9	12.8	36.5	37	0	0	20	8
621.49	1.50		5	Medium Sand	2.9	26.2	95.9	96	0	0	53	10
618.99	2.50		12	Sandy Gravel	14.8	82.7	133.5	133	0	0	73	12
615.99	3.00		12	Sandy Gravel	17.8	105.5	111.7	112	0	0	61	15
613.49	2.50	4.30	22		32.9	65.9	140.0	140	0	0	77	18
610.99	2.50	4.00	15		31.1	61.3	171.0	171	0	0	94	20
608.49	2.50	4.00	19		31.1	61.3	202.1	202	0	0	111	23
605.99	2.50	4.00	22		31.1	61.3	233.2	233	0	0	128	25
603.49	2.50	4.00	19		31.1	61.3	275.0	275	0	0	151	28
600.99	2.50	4.70	22		34.1	72.0	309.1	309	0	0	170	30
598.49	2.50	4.70	22		34.1	72.0	340.1	340	0	0	187	33
595.99	2.50	4.50	21		34.1	68.9	371.1	371	0	0	204	35
593.49	2.50	4.30	20		32.9	65.9	410.1	410	0	0	226	38
590.99	2.50	4.70	22		34.1	72.0	441.1	441	0	0	243	40
588.49	2.50	4.50	20		34.1	68.9	489.0	489	0	0	269	43
585.99	2.50	5.40	23		34.1	82.7	523.0	523	0	0	288	45
583.49	2.50	5.40	22		34.1	82.7	698.6	699	0	0	384	48
580.99	2.50		34	Hard Till	19.8	224.1	738.1	738	0	0	406	50
578.49	2.50		37	Hard Till	21.9	243.9	779.8	780	0	0	429	53
575.99	2.50		40	Hard Till	24.3	263.7	810.8	811	0	0	446	55
573.49	2.50		41	Hard Till	25.2	270.3	835.9	836	0	0	460	58
570.99	2.50		41	Hard Till	25.2	270.3	880.8	881	0	0	484	60
568.99	2.00		44	Hard Till	22.2	290.1	903.1	903	0	0	497	62
563.99	5.00		44	Hard Till	55.6	290.1	958.6	959	0	0	527	67
558.99	5.00		44	Hard Till	55.6	290.1	1014.2	1014	0	0	558	72
553.99	5.00		44	Hard Till	55.6	290.1	1069.8	1070	0	0	588	77
548.99	5.00		44	Hard Till	55.6	290.1	1125.4	1125	0	0	619	82
543.99	5.00		44	Hard Till	55.6	290.1	1181.0	1181	0	0	650	87
538.99	5.00		44	Hard Till	55.6	290.1	1236.5	1237	0	0	680	92
533.99	5.00		44	Hard Till	55.6	290.1	1292.1	1292	0	0	711	97
528.99	5.00		44	Hard Till	55.6	290.1	1347.7	1348	0	0	741	102
523.99	5.00		44	Hard Till	55.6	290.1	1403.3	1403	0	0	772	107
518.99	5.00		44	Hard Till	55.6	290.1	1458.8	1459	0	0	802	112
513.99	5.00		44	Hard Till	55.6	290.1	1514.4	1514	0	0	833	117
508.99	5.00		44	Hard Till	55.6	290.1	1570.0	1570	0	0	864	122
503.99	5.00		44	Hard Till		290.1			0	0		

Attachment 3 South Abutment

Pile Design Table for SOUTH ABUTMENT utilizing Boring #1

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 16"Φ w/.312" walls				Steel HP 10 X 57				Steel HP 14 X 73			
202	111	23		219	121	40		192	106	28	
233	128	25		246	135	43		228	126	30	
275	151	28		263	145	45		259	142	33	
309	170	30		272	150	48		279	154	35	
340	187	33		279	154	50		311	171	38	
371	204	35		287	158	53		331	182	40	
410	226	38		292	161	55		373	205	43	
441	243	40		296	163	58		397	219	45	
489	269	43		304	167	60		405	223	48	
523	288	45		307	169	62		417	229	50	
Metal Shell 16"Φ w/.375" walls				316	174	67		430	236	53	
202	111	23		325	179	72		438	241	55	
233	128	25		334	184	77		443	244	58	
275	151	28		343	189	82		457	251	60	
309	170	30		352	193	87		462	254	62	
340	187	33		360	198	92		474	261	67	
371	204	35		369	203	97		486	267	72	
410	226	38		378	208	102		499	274	77	
441	243	40		387	213	107		511	281	82	
489	269	43		396	218	112		523	288	87	
523	288	45		405	223	117		536	295	92	
699	384	48		413	227	122		548	301	97	
Metal Shell 14"Φ w/.25" walls				Steel HP 12 X 53				Steel HP 14 X 89			
197	109	25		225	124	35		560	308	102	
233	128	28		250	138	38		573	315	107	
263	144	30		268	147	40		Steel HP 14 X 89			
290	160	33		301	166	43		196	108	28	
317	175	35		322	177	45		232	128	30	
351	193	38		330	182	48		262	144	33	
378	208	40		340	187	50		283	156	35	
Metal Shell 14"Φ w/.312" walls				349	192	53		315	173	38	
197	109	25		356	196	55		336	185	40	
233	128	28		360	198	58		378	208	43	
263	144	30		371	204	60		403	221	45	
290	160	33		375	206	62		410	226	48	
317	175	35		385	212	67		423	232	50	
351	193	38		396	218	72		435	239	53	
378	208	40		406	223	77		444	244	55	
419	230	43		416	229	82		449	247	58	
449	247	45		Steel HP 12 X 63				463	254	60	
Steel HP 8 X 36				209	115	33		468	257	62	
225	124	55		227	125	35		480	264	67	
228	126	58		253	139	38		493	271	72	
234	129	60		271	149	40		505	278	77	
237	130	62		304	167	43		518	285	82	
244	134	67		325	179	45		530	292	87	
251	138	72		334	184	48		543	298	92	
258	142	77		343	189	50		555	305	97	
265	146	82		353	194	53		567	312	102	
272	150	87		359	198	55		580	319	107	
279	154	92		364	200	58		592	326	112	
Steel HP 10 X 42				374	206	60		605	333	117	
214	118	40		379	208	62		617	340	122	
240	132	43		389	214	67		Steel HP 14 X 102			
257	141	45		400	220	72		198	109	28	
266	146	48		410	226	77		235	129	30	
273	150	50		421	231	82		266	146	33	
280	154	53		431	237	87		287	158	35	
285	157	55		442	243	92		319	176	38	
289	159	58		452	249	97		340	187	40	
297	163	60		463	254	102		383	211	43	
300	165	62		473	260	107		408	224	45	
309	170	67		484	266	112		416	229	48	
318	175	72		494	272	117		428	235	50	
326	180	77		Steel HP 12 X 74				441	243	53	
				213	117	33		449	247	55	
				231	127	35		455	250	58	
				257	141	38		469	258	60	
				275	151	40		474	261	62	
				309	170	43		486	268	67	
				330	182	45		499	274	72	
				339	186	48		512	281	77	
				348	191	50		524	288	82	
				358	197	53		537	295	87	
				365	201	55		549	302	92	
				369	203	58		562	309	97	
				380	209	60		575	316	102	
				384	211	62		587	323	107	
				395	217	67		600	330	112	
				406	223	72		612	337	117	
				416	229	77		625	344	122	
				427	235	82		Steel HP 14 X 117			
				437	241	87		202	111	28	
				448	246	92		239	131	30	
				459	252	97		270	148	33	
				469	258	102		291	160	35	
				480	264	107		323	178	38	
				491	270	112		345	190	40	
				501	276	117		388	214	43	
				512	282	122		414	227	45	
				Steel HP 12 X 84				421	231	48	
				216	119	33		434	238	50	
				234	129	35		447	246	53	
				261	143	38		455	250	55	
				279	154	40		461	254	58	
				314	173	43		475	261	60	
				335	184	45		480	264	62	
				344	189	48		493	271	67	
				353	194	50		506	278	72	
				363	200	53		518	285	77	
				370	204	55		531	292	82	
				375	206	58		544	299	87	
				386	212	60		556	306	92	
				390	215	62		569	313	97	
				401	220	67		582	320	102	
				412	226	72		595	327	107	
				422	232	77		607	334	112	
				433	238	82		620	341	117	
				444	244	87		633	348	122	
				455	250	92		Precast 14"x 14"			
				465	256	97		217	119	23	
				476	262	102		251	138	25	
				487	268	107		Timber Pile			
				498	274	112		121	67	20	
				509	280	117					
				519	286	122					



Original Report Date: <u>5-16-2014</u>	Proposed SN: <u>006-0187</u>	Route: <u>FAP 316 (IL 26)</u>
Revised Date: <u>4-23-2015</u>	Existing SN: <u>006-0136</u>	Section: <u>(116 BR) BR</u>
Geotechnical Engineer: <u>Michael Short; IDOT District 3</u>		County: <u>Bureau</u>
Structural Engineer: <u>Mark Wylie; Farnsworth Group, Inc.</u>		Contract: <u>66A19</u>

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): *The proposed structure is a three span bridge with a reinforced concrete deck. Integral abutments are preferred. The preliminary TS&L is attached. The proposed structure will be a total of 255 feet long and will have a 10 degree skew to improve the alignment with the channel.*

Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot): *Soil borings from 2009 and 1972 are attached and are adequate for design of the structure, provided pile tip elevations are above elevation 570 and drilled shaft tip elevations are two shaft diameters above elevation 570. The existing structure is founded on timber piles, with precast piling added to widen the structure in 1980. Pile records from the original construction in 1927 are attached.*

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary: *The profile of the roadway will be raised by nearly 3 feet. This is not expected to cause any significant settlement. A recent field visit to the site did not indicate any settlement problems with the existing structure. No further testing or analysis for settlement is warranted.*

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary. *The proposed side slopes will be 1:3 and approximately 10 feet high. A slope stability analysis was performed for STA 1581+50 and the minimum FOS is 1.8. The north end slope was determined to have a FOS of 1.5.*

Indicate at each substructure, the 100-year and 500-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations. *The Hydraulic Report Revisions Memo (12-3-2014) indicates the 100, 200, and 500 year total scour depths are 6.74 feet, 6.78 feet, and 10.57 feet, respectively. A scour reduction of 25% is recommended. The proposed streambed elevation is 617 feet. The recommended TSL scour elevations are shown in the attachment section labeled "Scour".*

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable. *The seismic soil site class is C for each of the three pier foundation diameters evaluated, 1 ft, 3 ft, and 4 ft. The seismic performance zone is 1. The 0.2 second design spectral acceleration is 0.116. The 1.0 second design spectral acceleration is 0.067. Liquefaction is not a concern at this location.*

Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary skin friction and end bearing values shall be indicated when drilled shafts are proposed. *Please see the section labeled "Foundations" in the attachment.*

Calculate the estimated water surface elevation and determine the need for cofferdam(s) and seal coat: *The EWSE is 621.3. A Type II cofferdam is required at each pier unless drilled shafts with permanent casing or web walls are used. A seal coat is not necessary.*

Assess the need for sheeting/soil retention versus using a temporary construction slope and provide recommendation for the most feasible option. *Temporary sheet piling is feasible at the south abutment. However, a temporary soil retention system should be specified at the north abutment due to conflicts with the existing footing.*

SCOUR

Recommended TSL Scour Elevation Table

	North Abutment	Pier 1	Pier 2	South Abutment
Q100	630.4	611.9	611.9	629.5
Q200	630.4	611.9	611.9	629.5
Design	630.4	611.9	611.9	629.5
Check	630.4	611.9	611.9	629.5

FOUNDATIONS

Pile design tables are attached. In these tables, the shaded areas are not permitted for use with integral abutments according to ABD 12.3. However, these shapes are permitted for semi-integral abutments. The use of semi-integral abutments with metal shell pile should be considered as the length of the piles will be much shorter than using an HP shape.

The following cutoff elevations were used: 632.19 at the north abutment, 632.52 at pier 1, 632.28 at pier 2, and 631.69 at the south abutment.

At the piers, all of the standard IDOT pile sizes are available for use. The HP shapes will need to be driven significantly deeper than elevation 570, which is the depth of the subsurface information that is available. If one of these pile shapes is chosen, additional subsurface information will be required.

Drilled shafts are feasible for the piers. Drilled shaft design tables are attached for 2.5 ft, 3 ft, and 4 ft diameter shafts. Additional shaft diameters are feasible, and design tables will be provided via a Geotechnical Design Memorandum if needed. Subsurface information is not available below elevation 570, therefore conservative estimates of soil properties below this elevation were used. If it is necessary for the tip of the drilled shafts to be less than two shaft diameters above elevation 570, additional soil borings will be required. AASHTO Section 10.8.3.5.1b does not allow the top 5 feet of any shaft to contribute to the development of resistance through skin friction.

For the lateral load analysis of the drilled shafts, the following soil properties are recommended. These properties are based on B-2 (1972) and should be used at both pier 1 and pier 2. These values were determined by averaging the measured soil properties within each range of elevations indicated below.

Elevation	Soil Type	Effective Unit Weight	Angle of Internal Friction	Cohesion	Static Soil Modulus	Axial Strain at which 50% of Soil Strength is Mobilized	SPT N
feet		lb / cu ft	degrees	kip / sq ft	kip lb / cu in	Percent	
609.0 - 592.5	Stiff Clay	73.8	0	4.2	1435	0.44	32
592.5 - 575.0	Stiff Clay	77.5	0	7.0	2738	0.31	56
575.0 - 569.0	Stiff Clay	72.6	0	3.5	1260	0.47	28

Horizontal cantilever wingwalls are feasible.

Benchmarks: #1, Disk on Northwest Headwall of Structure No. 006-0136, Elevation = 636.75 (NAVD 88), Sta. 1579+30.66/17.43' RT.
 #2, Railroad Spike in power pole approximately 750' North of \bar{C} of Big Bureau Creek, Elevation = 630.65 (NAVD 88), Sta. 1573+06.22/50.19' RT.

Existing Structure: Structure No. 006-0079 was originally built in 1927 as SBI Route 89, Section 115B. In 1981, the superstructure was replaced, the North abutment was replaced and relocated, and the remaining substructure was widened to build Structure No. 006-0136 as FA Route 38, Section 115BR. In 1993, the existing bituminous wearing surface was removed and replaced with a 5" reinforced concrete wearing surface as FA Route 316, Section 115BR-M. The superstructure consists of a four-span, precast prestressed concrete deck beam bridge with a 5" reinforced concrete wearing surface. The substructure consists of an open pile bent abutment at the North end supported by precast concrete piles, a closed abutment wall at the south end supported by untreated timber piles, and solid wall pile bent piers supported by untreated timber piles and precast concrete piles. The back-to-back of abutment dimension measures 228'-1" and the out-to-out dimension measures 33'-0". The span lengths are 67'-8", 53'-0", 53'-0", and 54'-5". The structure is not skewed. One lane of traffic will be maintained utilizing stage construction.

No Salvage.

APPROVED

MAR 04 2015

AS A BASIS FOR
 PREPARATION OF DETAILED PLANS

WATERWAY INFORMATION

Drainage Area = 175.5 Sq. Mi.		Existing Low Grade Elev. 629.83 @ Sta. 1597+25		Proposed Low Grade Elev. 629.83 @ Sta. 1597+25	
Flood	Yr.	Q	Opening Sq. Ft.	Nat. Head - Ft.	Headwater El.
		C.F.S.	Exist. Prop.	Exist. Prop.	Exist. Prop.
Ex. Overtopping	9	7,490	1,455	2,541	629.7
Pr. Overtopping	9	7,530	1,468	2,557	629.8
	10	7,920	1,504	2,600	630.0
Hydraulic Design	50	12,500	1,910	3,075	632.0
Base/Scour Design	100	14,500	2,042	3,233	632.7
Scour Check	200	16,579	2,121	3,351	633.2
Max. Calc.	500	19,300	3,522	3,493	633.8

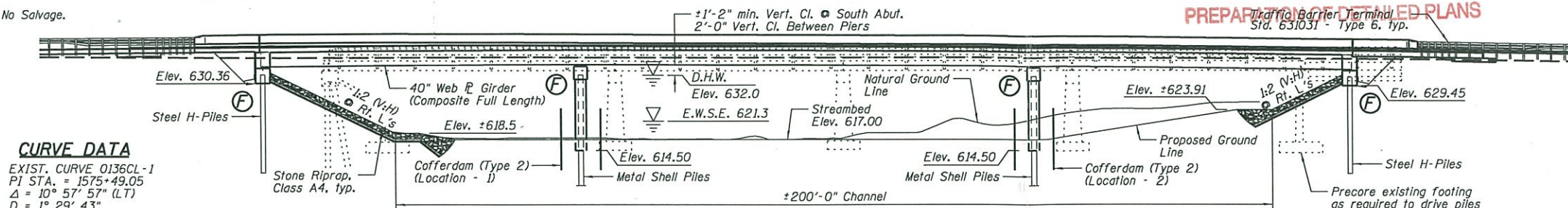
10-Yr. Velocity = 5.3 ft./sec. (Exist.)
 10-Yr. Velocity = 3.0 ft./sec. (Prop.)

DESIGN SCOUR ELEVATION TABLE

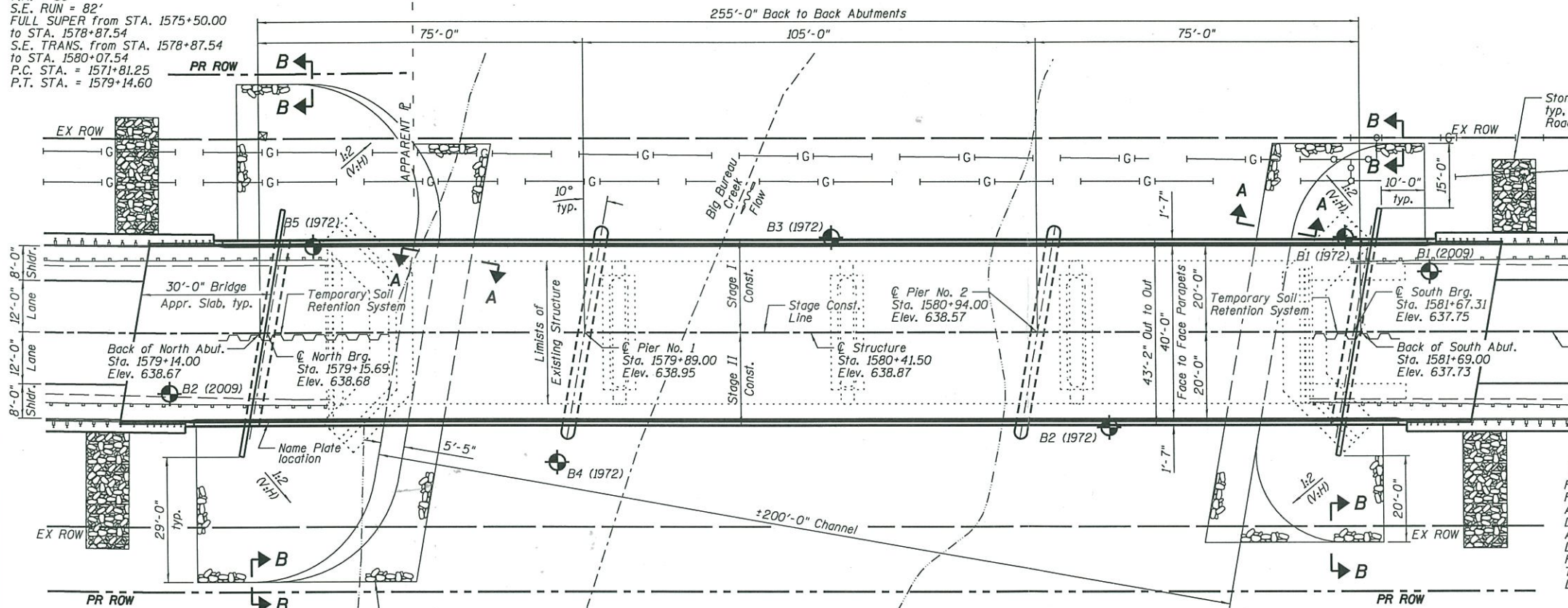
Event/Limit State	Design Scour Elevations (ft.)				Item #13
	N. Abut.	Pier 1	Pier 2	S. Abut.	
0100	630.4	611.9	611.9	629.5	8
0200	630.4	611.9	611.9	629.5	
Design	630.4	611.9	611.9	629.5	
Check	630.4	611.9	611.9	629.5	

CURVE DATA

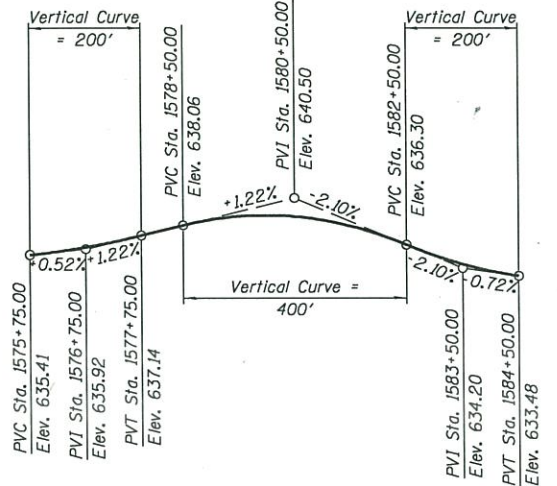
EXIST. CURVE 0136CL-1
 P.I. STA. = 1575+49.05
 $\Delta = 10^\circ 57' 57''$ (LT)
 $D = 1^\circ 29' 43''$
 $R = 3,831.70'$
 $T = 367.80'$
 $L = 733.35'$
 $E = 17.61'$
 $e = 3.20\%$
 $T.R. = 38'$
 $S.E. RUN = 82'$
 FULL SUPER FROM STA. 1575+50.00 TO STA. 1578+87.54
 S.E. TRANS. FROM STA. 1578+87.54 TO STA. 1580+07.54
 P.C. STA. = 1571+81.25
 P.T. STA. = 1579+14.60



ELEVATION



PLAN



PROFILE GRADE
 (Along \bar{C} Roadway)

HIGHWAY CLASSIFICATION

F.A.P. Route 316 (IL 26)
 Functional Class: Other Principal Arterial
 A.D.T.: 5600 (2013), 7800 (2033)
 D.H.V.: 680
 A.D.T.T.: 1008 (2013)
 Design Speed: 55 M.P.H.
 Posted Speed: 55 M.P.H.
 Two Way Traffic
 Directional Distribution: 50/50

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 7th Edition

DESIGN STRESSES

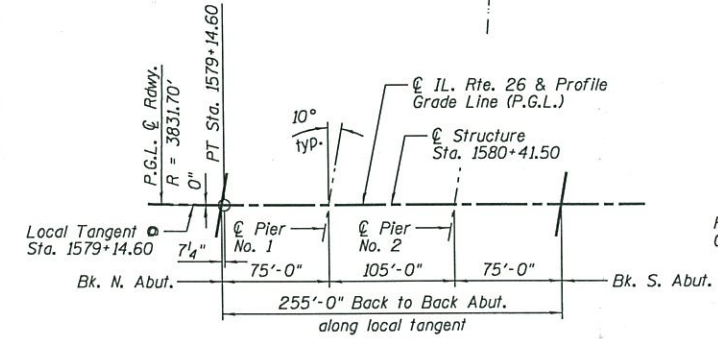
FIELD UNITS:
 $f'_c = 3,500$ psi
 $f_y = 60,000$ psi (Reinforcement)
 $f_y = 50,000$ psi (AASHTO M270 Grade 50W)

LOADING HL-93

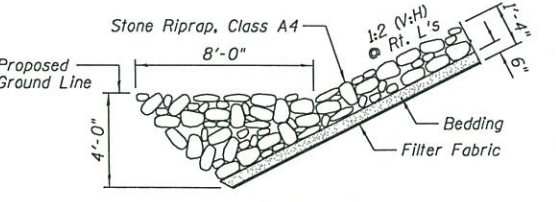
Allow 50#/sq. ft. for future wearing surface.

SEISMIC DATA

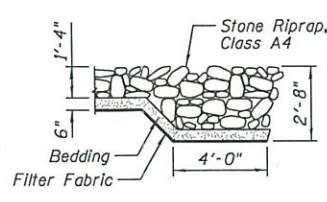
Seismic Performance Zone (SPZ) = 1
 Design Spectral Acceleration at 1.0 sec. (SD1) = 0.067
 Design Spectral Acceleration at 0.2 sec. (SDS) = 0.116
 Soil Site Class = C



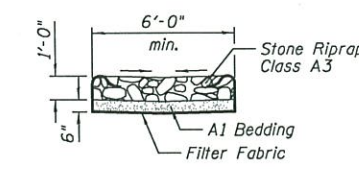
OFFSET DETAIL



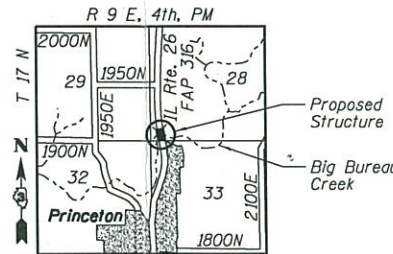
SECTION A-A



SECTION B-B



SECTION THRU ROADWAY EMBANKMENT



LOCATION SKETCH

**IL. ROUTE 26 OVER
 BIG BUREAU CREEK
 F.A.P. 316 - SECTION (116 BR)BR
 BUREAU COUNTY
 STATION 1580+41.50
 STRUCTURE NO. 006-0187**

Farnsworth GROUP, INC.
 2706 McGraw Drive
 Bloomington, Illinois 61704
 309/963-8455, 309/963-1571 fax

DESIGNED - TCR	REVISOR
CHECKED - JCZ	REVISOR
DRAWN - TCR	REVISOR
CHECKED - JML	REVISOR
DATE - 02/23/15	

STATE OF ILLINOIS
 DEPARTMENT OF TRANSPORTATION

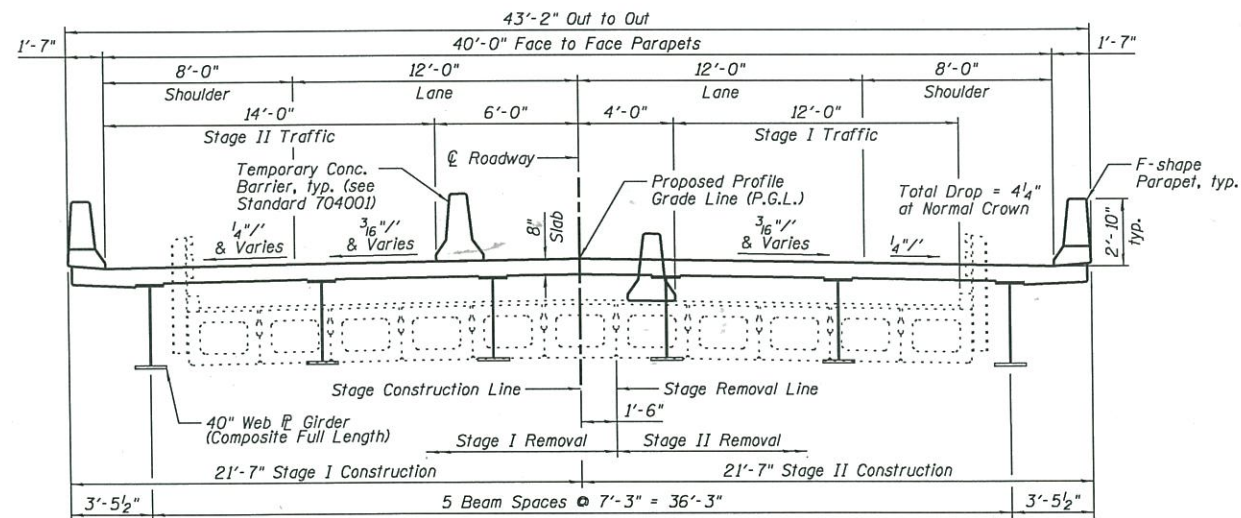
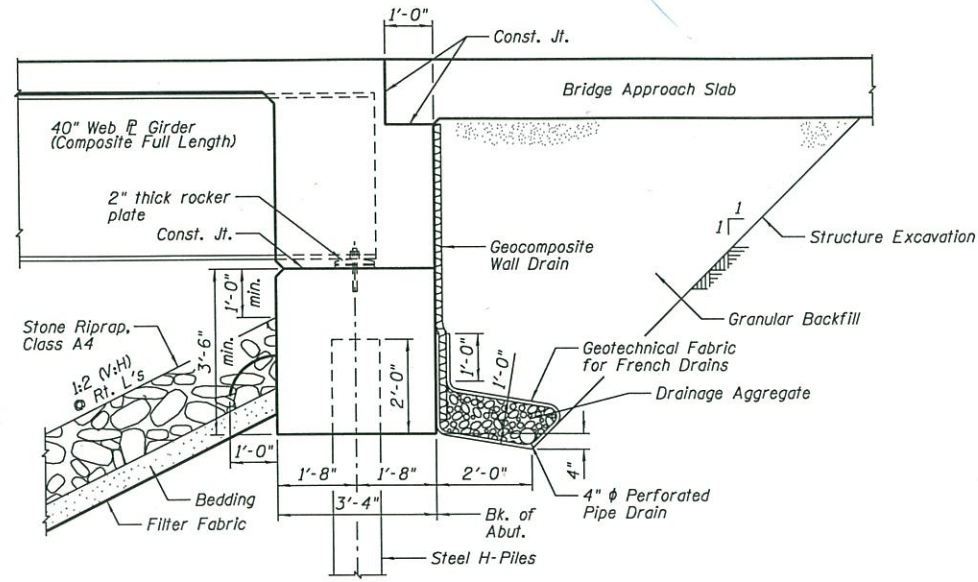
GENERAL PLAN
 STRUCTURE NO. 006-0187

SHEET NO. OF SHEETS

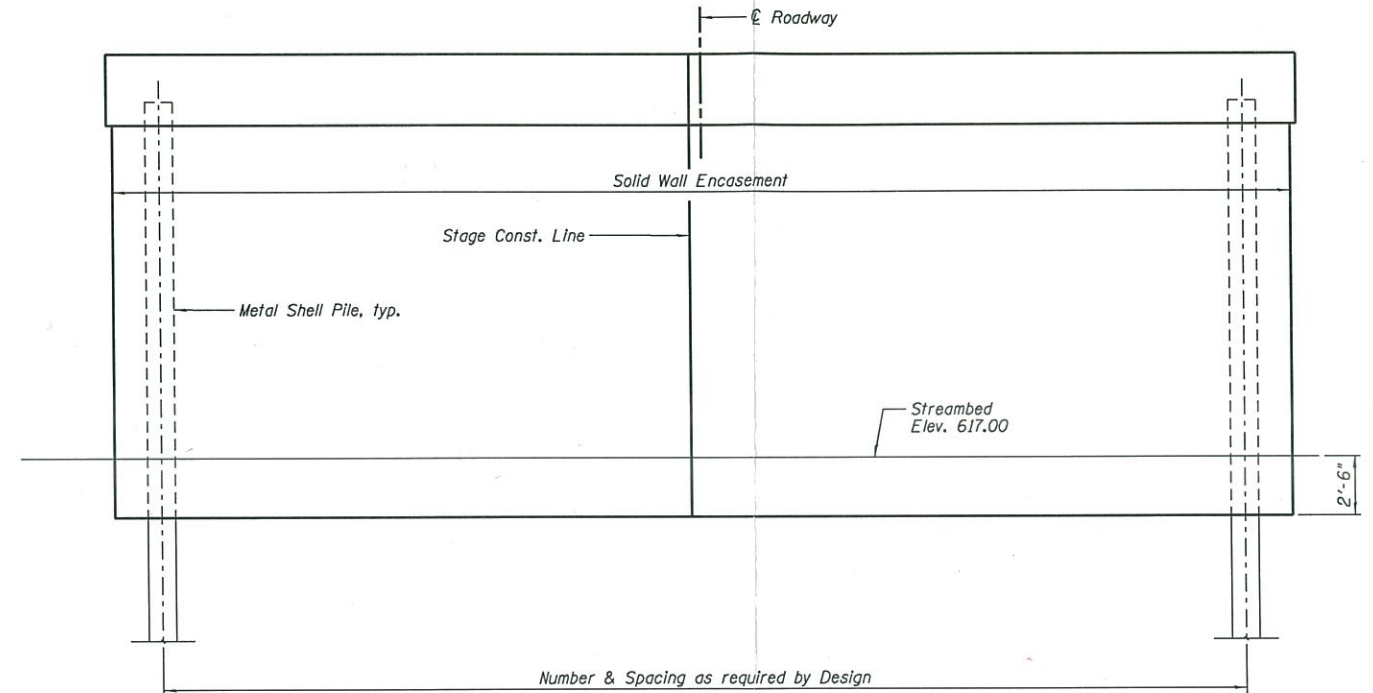
F.A.P. RTE. 316	SECTION (116 BR)BR	COUNTY BUREAU	TOTAL SHEETS 2	SHEET NO. 1
CONTRACT NO. 66A19				
ILLINOIS FED. AID PROJECT				

APPROVED

MAR 04 2015
 AS A BASIS FOR
 PREPARATION OF DETAILED PLANS



Notes: Cross Section transitions from full superelevation at Station 1578+87.54 to normal crown at Station 1580+07.54.
 The condition of the existing PPC deck beams intended to carry Stage I Traffic shall be verified in the design phase.



PIER SKETCH
 (Looking South)

DESIGNED - TCR	REVISED
CHECKED - JCZ	REVISED
DRAWN - TCR	REVISED
DATE - 02/23/15	CHECKED - JML
	REVISED

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
316	(116 BR)BR	BUREAU	2	2
CONTRACT NO. 66A19				
ILLINOIS FED. AID PROJECT				



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY L. Myers

SECTION (116 BR)BR LOCATION SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
Latitude 41.422535, Longitude -89.469217

COUNTY Bureau DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME Automatic

STRUCT. NO. Station	D E P T H H	B L O W S	U C S Qu	M O I S T T	Surface Water Elev.	D E P T H	B L O W S	U C S Qu	M O I S T T
006-0136 (Exist.) 1580+50					618.91 ft				
					616.85 ft				
BORING NO. 01 (S. Abut.) Station 1581+85 Offset 14.0 ft Lt. Ground Surface Elev. 635.49 ft					Groundwater Elev.:				
					First Encounter 617.5 ft ▼				
					Upon Completion 614.5 ft ▼				
					After _____ Hrs.				
Augered Bituminous Shoulder					Hard Reddish Brown Silty Clay Loam Till (continued)		7		
							9	4.3	13
							13	S	
632.99									
Medium Black/Brown Sandy Loam Fill with Gravel & Sand Fill		5					4		
		3		10			6	4.0	13
		6					9	S	
		-5					-25		
		2					6		
		4		11			9	4.0	13
		4					10	S	
627.99									
Loose Brown Loamy Sand with Gravel pieces		3					8		
		1		16			10	4.0	13
		2					12	S	
		-10					-30		
		2					5		
		1		9			8	4.0	12
		2					11	S	
		2					6		
		2		15			9	4.7	13
621.49		3					13	S	
Medium Fine to Coarse Gravel in Sand/Silt Matrix (Potential Cobble/Boulders) (Free water @ 18')									
		-15					-35		
		10					5		
		13		3			9	4.7	13
		12					13	S	
		9					6		
		7		7			9	4.5	13
		5					12	S	
615.99									
		-20					-40		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY L. Myers

SECTION (116 BR)BR LOCATION SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
Latitude 41.422535, Longitude -89.469217

COUNTY Bureau DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME Automatic

STRUCT. NO. 006-0136 (Exist.)
Station 1580+50

BORING NO. 01 (S. Abut.)
Station 1581+85
Offset 14.0 ft Lt.
Ground Surface Elev. 635.49 ft

DEPTH H S	B L O W S	U C S Qu	M O I S T	Surface Water Elev.	618.91	ft	D E P T H	B L O W S	U C S Qu	M O I S T	
				Stream Bed Elev.	616.85	ft					
ft	(/6")	(tsf)	(%)	Groundwater Elev.:				ft	(/6")	(tsf)	(%)
				First Encounter	617.5	ft	▼				
				Upon Completion	614.5	ft	▼				
				After	Hrs.						
Hard Reddish Brown Silty Clay Loam Till (continued)	5			Hard Reddish Brown Silty Clay Loam Till (continued)	12						
	8	4.3	13		16	7.4	11				
	12	S			25	S					
	6										
	9	4.7	12								
	13	S									
	-45				-65						
	6				13						
	8	4.5	13		18	7.6	9				
	12	S			26	S					
					568.99						
				End of Boring							
	6										
	9	5.4	12								
	14	S									
	-50				-70						
	8										
	9	5.4	12								
	13	S									
	8										
	14	6.8	11								
	20	S									
	-55				-75						
	9										
	16	7.0	12								
	21	S									
	12										
	16	7.4	12								
	24	S									
	-60				-80						

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY J. Matsko

SECTION (116 BR)BR LOCATION SW 1/4 of SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
Latitude , Longitude

COUNTY Bureau DRILLING METHOD _____ HAMMER TYPE _____

STRUCT. NO. <u>006-0079 (Exist.)</u>	D E P T H H	B L O W S	U C S Qu	M O I S T	Surface Water Elev. <u>619.00</u> ft	D E P T H H	B L O W S	U C S Qu	M O I S T
Station <u>1536+94.55</u>					Stream Bed Elev. _____ ft				
BORING NO. <u>B-1 (S. Abut.)</u>	ft (ft)	(/6")	(tsf)	(%)	Groundwater Elev.:	ft (ft)	(/6")	(tsf)	(%)
Station <u>1538+10</u>					First Encounter _____ ft				
Offset <u>22.0 ft Lt.</u>					Upon Completion <u>618.0</u> ft				
Ground Surface Elev. <u>627.00</u> ft					After _____ Hrs. _____ ft				

Soil Description	Depth (ft)	Blows (/6")	UCS (tsf)	Moist (%)	Soil Description	Depth (ft)	Blows (/6")	UCS (tsf)	Moist (%)
Medium Brown Sand & Gravel (Dirty with 3" pebbles)	11			8	Very Stiff Gray Silty Clay Till	606.50	68	3.2 S	16
Medium Brown Sand (Very Fine Texture - Dirty)	12			10	Hard Tan Sandy Clay Till	604.00	26	4.7 B	13
Stiff Brown Sandy Loam	7	1.6 B		14	Same as above		27	4.9 B	12
Medium Brown Sand & Gravel (Clean & Wet)	14	0.9 B		15	Same as above		34	5.4 B	11
Very Stiff Tan Sandy Clay Till	6	2.7 B		13	Same as above		31	5.0 B	11
Same as above	16	3.1 B		13	Same as above		32	4.9 B	10
Same as above	20	3.7 B		12	Same as above		39	7.0 B	10
Hard Tan Sandy Clay Till	23	4.3 B		12	Same as above		54	8.5 B	10
End of Boring	-20					587.50	-40		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY Matsko & H. Williams

SECTION (116 BR)BR LOCATION SW 1/4 of SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
 Latitude , Longitude

COUNTY Bureau DRILLING METHOD _____ HAMMER TYPE _____

STRUCT. NO. 006-0079 (Exist.)
006-0136 (Prop.)
 Station 1536+94.55

BORING NO. B-2
 Station 1537+55
 Offset 22.0 ft Rt.
 Ground Surface Elev. 628.00 ft

DEPTH H S	B L O W S	U C S Qu	M O I S T	Surface Water Elev. _____ ft	Stream Bed Elev. _____ ft	GROUNDWATER ELEV.: First Encounter _____ ft	Upon Completion _____ ft	After _____ Hrs. _____ ft	DEPTH H S	B L O W S	U C S Qu	M O I S T
(ft)	(/6")	(tsf)	(%)				Wash		(ft)	(/6")	(tsf)	(%)
	3	0.5 P	13							28	4.2 B	12
Soft Brown Sandy Loam					Same as above							
	3	0.5 P	9							29	4.3 B	13
Same as above					Hard Tan Sandy Clay Till (Some Small Silt Layers Throughout)							
				623.00						-25		
	38		10							32	4.5 B	13
Medium Gray Sand & Gravel (Dirty with 3" Gravel)					Same as above							
	13									34	4.6 B	13
Medium Brown Sand & Gravel (Clean & Wet)					Hard Tan Sandy Clay Till							
				618.00						-30		
	18	3.5 B	14							34	3.9 B	13
Very Stiff Tan Sandy Clay Till					Very Stiff Tan Sandy Clay Till							
	22	3.8 B	11							33	3.4 B	13
Same as above					Same as above							
				-15						-35		
	25	4.0 B	12							50	5.0 B	11
Hard Tan Sandy Clay Till					Hard Tan Sandy Clay Till							
	27	4.3 S	12							55	5.2 B	11
Same as above					Same as above							
				-20						-40		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
 The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY Matsko & H. Williams

SECTION (116 BR)BR LOCATION SW 1/4 of SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
 Latitude , Longitude

COUNTY Bureau DRILLING METHOD _____ HAMMER TYPE _____

STRUCT. NO. 006-0079 (Exist.)
006-0136 (Prop.)
 Station 1536+94.55

BORING NO. B-2
 Station 1537+55
 Offset 22.0 ft Rt.
 Ground Surface Elev. 628.00 ft

D E P T H	B L O W S	U C S Qu	M O I S T
(ft)	(/6")	(tsf)	(%)

Surface Water Elev. 620.00 ft
 Stream Bed Elev. _____ ft
 Groundwater Elev.:
 First Encounter _____ ft
 Upon Completion Wash ft
 After _____ Hrs. _____ ft

Same as above	61	6.1 B	11	
Same as above	67	6.3 B	11	
	-45			
Hard Tan Sandy Clay Till	76	6.8 B	12	
	100/4"			
Hard Tan Sandy Clay Till (With Large Pebbles)				
	-50			
Same as above	45	6.2 B	11	
	39	5.1 B		
Hard Tan Sandy Clay Till				
	-55			
Same as above	31	4.2 B	9	
	26	3.8 B	8	
Very Stiff Tan Sandy Clay Till (Wet)				569.00
End of Boring	-60			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
 The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY Matsko & H. Williams

SECTION (116 BR)BR LOCATION SW 1/4 of SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
 Latitude , Longitude

COUNTY Bureau DRILLING METHOD _____ HAMMER TYPE _____

STRUCT. NO. 006-0079 (Exist.)
006-0136 (Prop.)
 Station 1536+94.55

BORING NO. B-3
 Station 1536+91
 Offset 22.0 ft Lt.
 Ground Surface Elev. 626.50 ft

DEPTH H S	B L O W S	U C S Qu	M O I S T T	Surface Water Elev. _____ ft	D E P T H H	B L O W S	U C S Qu	M O I S T T	
(ft)	(/6")	(tsf)	(%)	Stream Bed Elev. _____ ft	(ft)	(/6")	(tsf)	(%)	
3			5	622.50	20	3.6	13		
Very Loose Brown Sand (Clean & Moist)				Same as above					
624.00									
4	1.0	B	10		27	3.9	13		
Medium Brown Sandy Loam (Dirty with Gravel)				Very Stiff Tan Sandy Clay Till					
-5					-25				
3	0.8	P	14		28	4.3	12		
Same as above (Gray in color)				Hard Tan Sandy Clay Till					
619.00									
5	1.2	P	13		28	4.4	12		
Stiff Tan Sandy Clay Till				Same as above					
-10					-30				
16	2.5	B	14		34	4.7	12		
Very Stiff Tan Sandy Clay Till				Same as above					
18	2.7	B	12		37	4.9	11		
Same as above				Same as above					
-15					-35				
19	2.8	B	13		36	5.0	12		
Same as above				Same as above					
19	3.2	B	13		35	4.9	12		
Same as above				Same as above					
					587.50				
				End of Boring					
-20					-40				

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
 The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY J. Matsko

SECTION (116 BR)BR LOCATION SW 1/4 of SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
Latitude , Longitude

COUNTY Bureau DRILLING METHOD _____ HAMMER TYPE _____

STRUCT. NO. 006-0079 (Exist.)
006-0136 (Prop.)
Station 1536+94.55

BORING NO. B-4
Station 1536+27
Offset 30.0 ft Rt.
Ground Surface Elev. 620.00 ft

DEPTH (ft)	BLOWS (/6")	UCS (tsf)	MOIST (%)	Surface Water Elev. _____ ft	Stream Bed Elev. _____ ft	GROUNDWATER Elev.:	DEPTH (ft)	BLOWS (/6")	UCS (tsf)	MOIST (%)
						First Encounter _____ ft				
						Upon Completion <u>619.5</u> ft				
						After _____ Hrs. _____ ft				
617.00	25		16					30	4.5 B	12
	15	3.1 B	13					31	4.7 B	12
-5								-25		
	24	3.8 B	12					31	4.7 B	12
	17	2.9 B	13					32	4.8 B	12
-10								-30		
	26	3.8 B	12					37	5.0 B	11
	29	4.0 B	12					38	5.1 B	12
-15								-35		
	27	3.9 B	12					584.50		
	22	3.6 B	12							
-20								-40		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)



SOIL BORING LOG

ROUTE FAP 316 (IL 26) DESCRIPTION IL 26 over Bureau Creek, North of Princeton LOGGED BY J. Matsko

SECTION (116 BR)BR LOCATION SW 1/4 of SW 1/4, SEC. 28, TWP. 17N, RNG. 9E, 4th PM,
 Latitude , Longitude

COUNTY Bureau DRILLING METHOD _____ HAMMER TYPE _____

STRUCT. NO. 006-0079 (Exist.)
006-0136 (Prop.)
 Station 1536+94.55

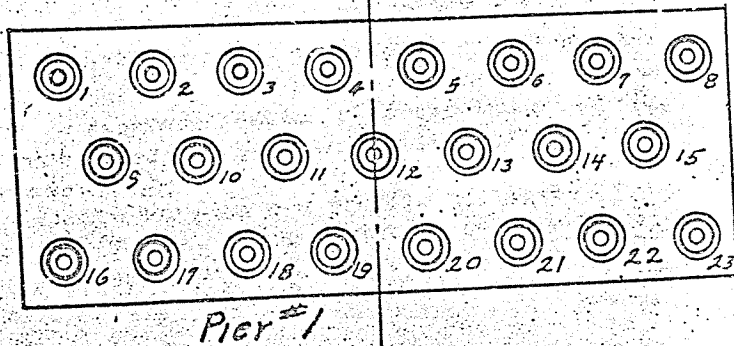
BORING NO. B-5 (N. Abut.)
 Station 1535+71
 Offset 20.0 ft Lt.
 Ground Surface Elev. 635.00 ft

D E P T H H	B L O W S	U C S Qu	M O I S T T	Surface Water Elev. _____ ft	D E P T H H	B L O W S	U C S Qu	M O I S T T
(ft)	(/6")	(tsf)	(%)	Stream Bed Elev. _____ ft	(ft)	(/6")	(tsf)	(%)

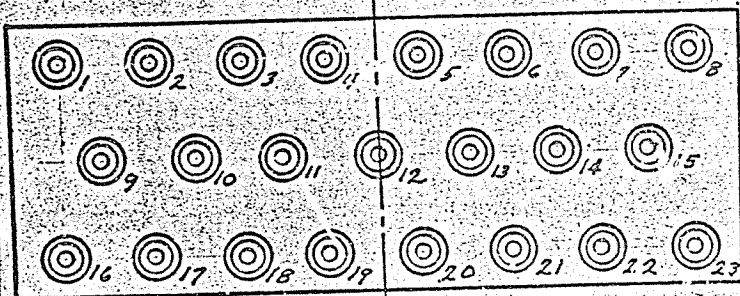
Medium Brown Sandy Loam (Moist with Trace of Gravel)	5	0.5 P	10		23	2.8 B	13	
Very Stiff Tan Sandy Clay Till								
Same as above	7	0.7 P	12		29	3.0 B	13	
Same as above								
	-5				-25			
Stiff Brown Sandy Loam	15	1.1 P	13		30	3.2 B	13	
Same as above								
Same as above	6	1.0 P	17		29	3.1 B	13	
Same as above								
	-10				-30			
624.50								
Medium Light Brown Sand (Clean & Uniform)	10		5		30	3.4 B	12	
Same as above								
Loose Brown Sand & Gravel (Wet)	7				31	3.5 B	12	
Same as above								
	-15				-35			
Medium Brown Sand & Gravel (Wet & Dirty)	23				42	5.1 B	10	
Same as above								
	17				46	5.3 B	14	
Same as above								
615.50								
	-20				-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
 The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

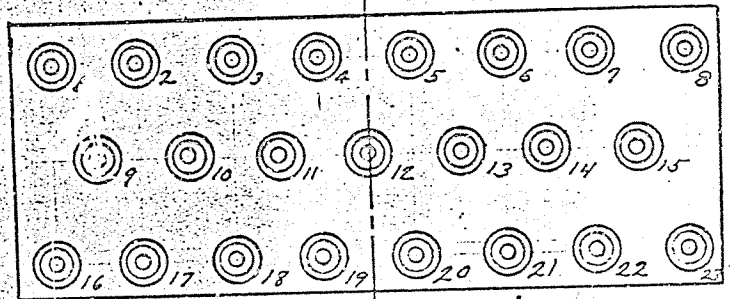
Rte 89 Sec 115 B S.N. 006 0136
 Sta 1580+50
 OLD STRUCTURE — S.N. 006 0079



Pier #1



Pier #2



Pier #3

Total 15 ton piling used 1041'

PIER NO. 1 PIER NO. 2 PIER NO. 3

Pile No	Length	Pile No	Length	Pile No	Length
1	15'-3"	1	15'-0"	1	15'-0"
2	15'-0"	2	15'-0"	2	15'-0"
3	15'-0"	3	15'-0"	3	15'-0"
4	15'-6"	4	15'-0"	4	15'-0"
5	15'-0"	5	15'-0"	5	15'-0"
6	15'-6"	6	15'-0"	6	15'-0"
7	15'-3"	7	15'-0"	7	15'-0"
8	15'-3"	8	15'-0"	8	15'-0"
9	15'-6"	9	15'-0"	9	15'-0"
10	15'-0"	10	15'-0"	10	15'-0"
11	15'-3"	11	15'-0"	11	15'-0"
12	15'-6"	12	15'-0"	12	15'-0"
13	15'-3"	13	15'-0"	13	15'-0"
14	15'-6"	14	15'-0"	14	15'-0"
15	15'-3"	15	15'-0"	15	15'-0"
16	15'-0"	16	15'-0"	16	15'-0"
17	15'-6"	17	15'-0"	17	15'-0"
18	15'-3"	18	15'-0"	18	15'-0"
19	15'-3"	19	15'-0"	19	15'-0"
20	15'-3"	20	15'-0"	20	15'-0"
21	15'-3"	21	15'-0"	21	15'-0"
22	15'-3"	22	15'-0"	22	15'-0"
23	15'-3"	23	15'-0"	23	15'-0"

Pier 2

$$\frac{345}{23} = 15.0$$

Pier 3

$$\frac{345}{23} = 15.0$$

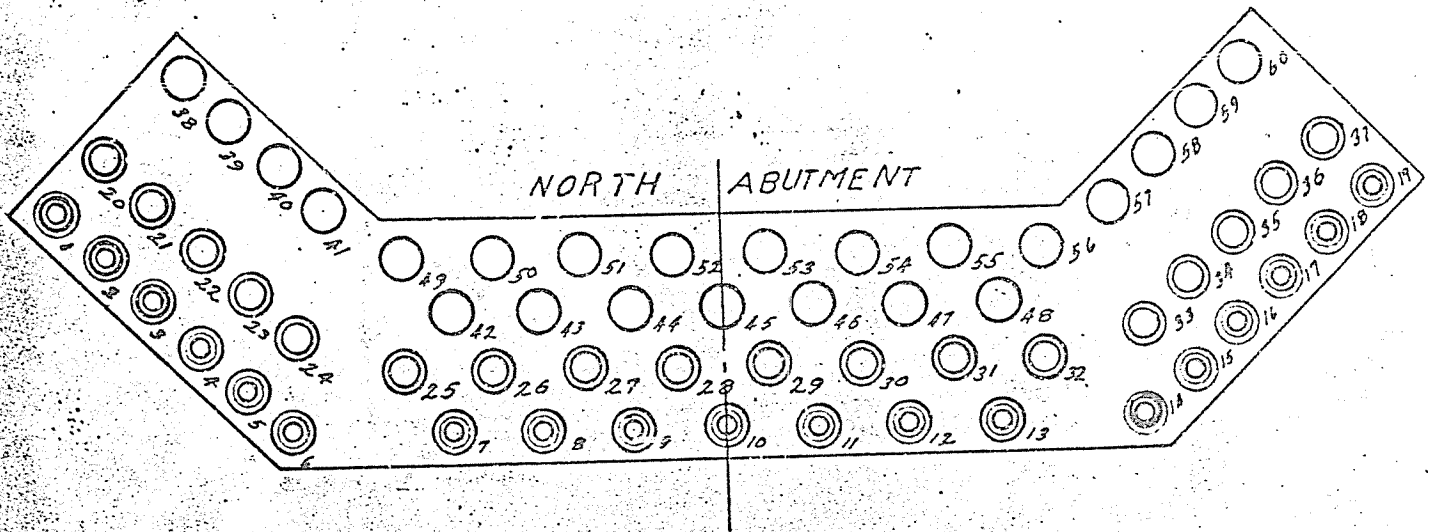
115 0

FA 38

SUB 89

BRACOM

Rte. 89 Sec. 115 B Sta. 1580+50



South Abutment same as North Abutment

NORTH ABUTMENT			SOUTH ABUTMENT		
10 TON	12 TON	15 TON	10 TON	12 TON	15 TON
No. Length	No. Length	No. Length	No. Length	No. Length	No. Length
38 12'-0"	20 17'-0"	1 15'-3"	38 12'-0"	20 15'-0"	1 15'-0"
39 12'-0"	21 15'-0"	2 15'-3"	39 12'-0"	21 15'-0"	2 15'-0"
40 12'-0"	22 15'-0"	3 15'-3"	40 12'-0"	22 15'-0"	3 15'-0"
41 12'-0"	23 15'-0"	4 15'-3"	41 12'-0"	23 15'-0"	4 15'-0"
42 12'-0"	24 15'-0"	5 15'-3"	42 12'-0"	24 15'-0"	5 15'-0"
43 12'-0"	25 15'-0"	6 15'-3"	43 12'-0"	25 15'-0"	6 15'-0"
44 12'-0"	26 15'-0"	7 15'-3"	44 12'-0"	26 15'-0"	7 15'-0"
45 12'-0"	27 15'-0"	8 15'-3"	45 12'-0"	27 15'-0"	8 15'-0"
46 12'-0"	28 15'-0"	9 17'-0"	46 12'-0"	28 15'-0"	9 15'-0"
47 12'-0"	29 17'-0"	10 15'-0"	47 12'-0"	29 15'-0"	10 15'-0"
48 12'-0"	30 15'-3"	11 15'-0"	48 12'-0"	30 15'-0"	11 15'-0"
49 12'-0"	31 15'-3"	12 15'-3"	49 12'-0"	31 15'-0"	12 15'-0"
50 15'-0"	32 15'-3"	13 15'-3"	50 12'-0"	32 15'-0"	13 15'-0"
51 15'-0"	33 15'-3"	14 15'-3"	51 12'-0"	33 15'-0"	14 15'-0"
52 15'-0"	34 15'-3"	15 15'-3"	52 12'-0"	34 15'-0"	15 15'-0"
53 15'-0"	35 15'-3"	16 15'-3"	53 12'-0"	35 15'-0"	16 15'-0"
54 15'-0"	36 15'-3"	17 15'-3"	54 12'-0"	36 15'-0"	17 15'-0"
55 15'-0"	37 15'-3"	18 15'-3"	55 12'-0"	37 15'-0"	18 15'-0"
56 15'-0"		19 15'-3"	56 12'-0"		19 15'-0"
57 15'-0"			57 12'-0"		
58 15'-0"			58 12'-0"		
59 15'-0"			59 12'-0"		
60 15'-0"			60 12'-0"		
Total 309.0	Total 276.0	Total 219.0	Total 276.0	Total 270.0	Total 285.0

309 276 219 276 270

285

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS AND BUILDINGS
Division of Highways

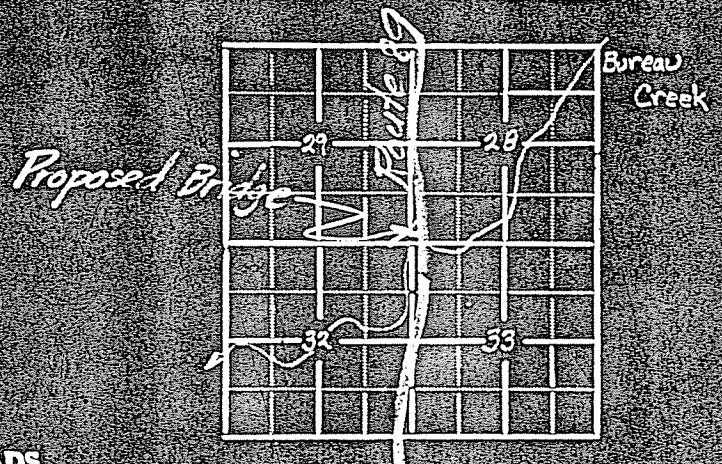
OCTOBER, 1924.

BRIDGE INSPECTION REPORT

Copy

Route 29 Section 115 B Project _____
Bridge known as Bureau Creek Bridge Sta. 1580+50
over Bureau Creek
in between Sec 28 Dover Township, Bureau County,
and _____ Township, _____ County,
on _____ class road.
Inspected by R.M. Ferguson Date May 10, 1927
accompanied by _____

Give section numbers and show exact location of bridge with respect to section lines.



ROADS.

2 1/2 miles from bridge site to Princeton Station on C.B. & Q. Railroad.
_____ miles from bridge site to _____ Station on _____ Railroad.
Character of road from bridge site to Princeton: Good gravel road from Princeton to S. End of relocation. No road from there to bridge
hilly, rolling, level, clay, black loam, sand, gravel, macadam.

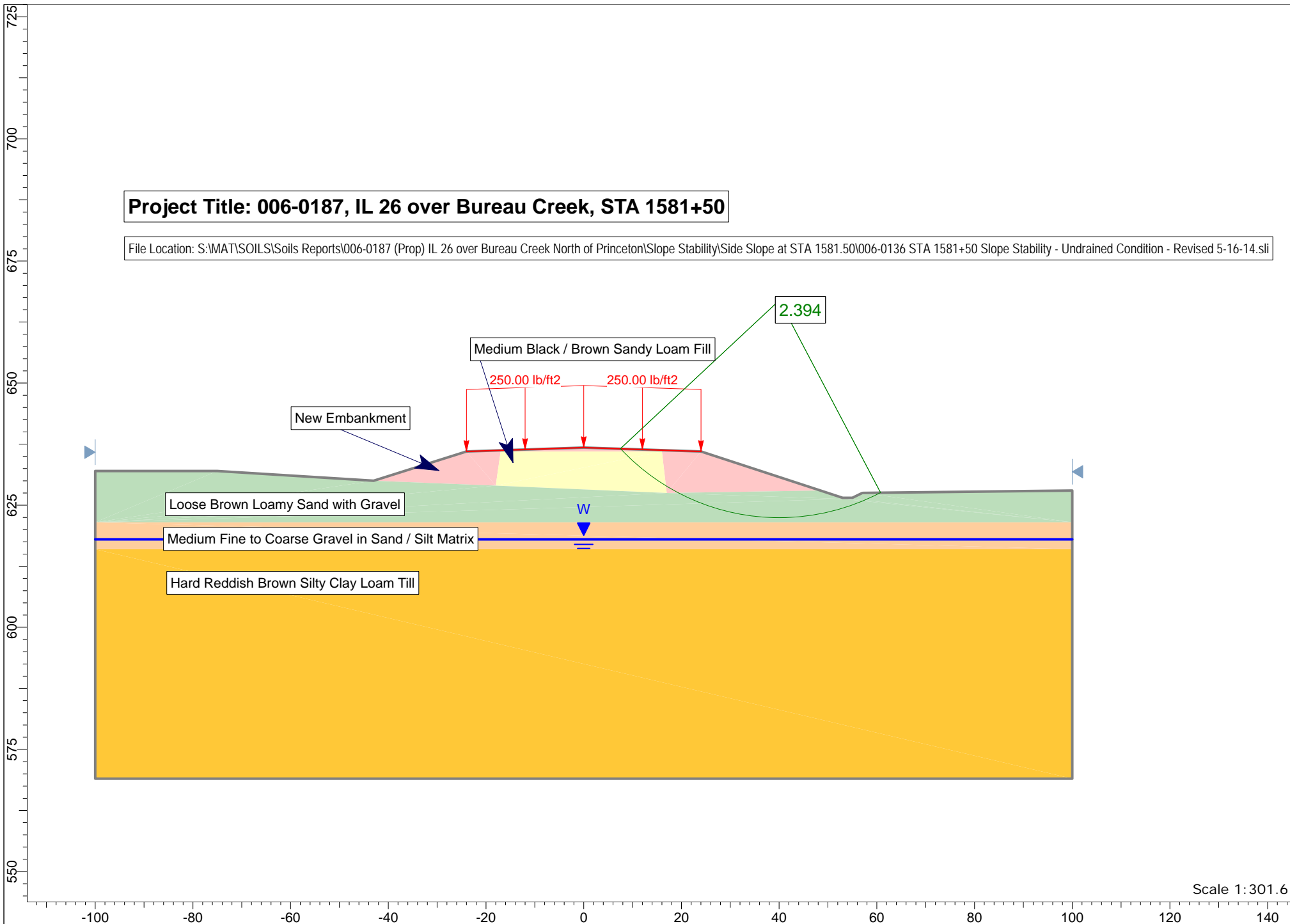
Average load _____ lbs.

MATERIALS AND LABOR.

Crushed stone available at _____
Cost per cubic yard _____ per ton _____
Length of haul to bridge site _____ miles.
Screened Gravel (stone) available at Princeton
Cost per cubic yard \$ 2.40 per ton \$ 1.60
Length of haul to bridge site 2 1/2 miles.
Sand available at Princeton
Cost per cubic yard \$ 2.10 per ton 1.20
Length of haul to bridge site 2 1/2 miles.
Pit Run Gravel available at _____
Cost per cubic yard _____ per ton _____

Project Title: 006-0187, IL 26 over Bureau Creek, STA 1581+50

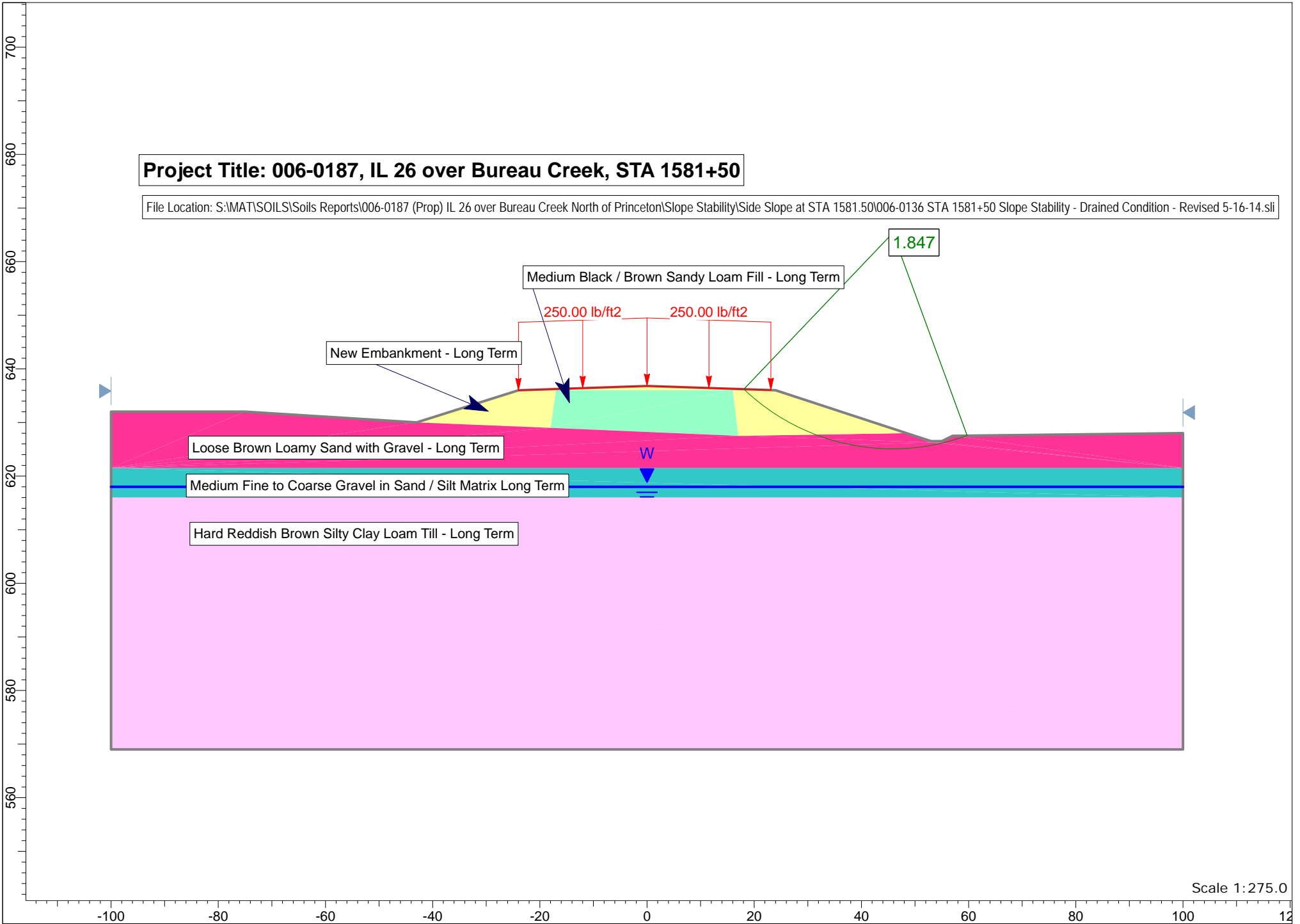
File Location: S:\MAT\SOILS\Soils Reports\006-0187 (Prop) IL 26 over Bureau Creek North of Princeton\Slope Stability\Side Slope at STA 1581.50\006-0136 STA 1581+50 Slope Stability - Undrained Condition - Revised 5-16-14.sli



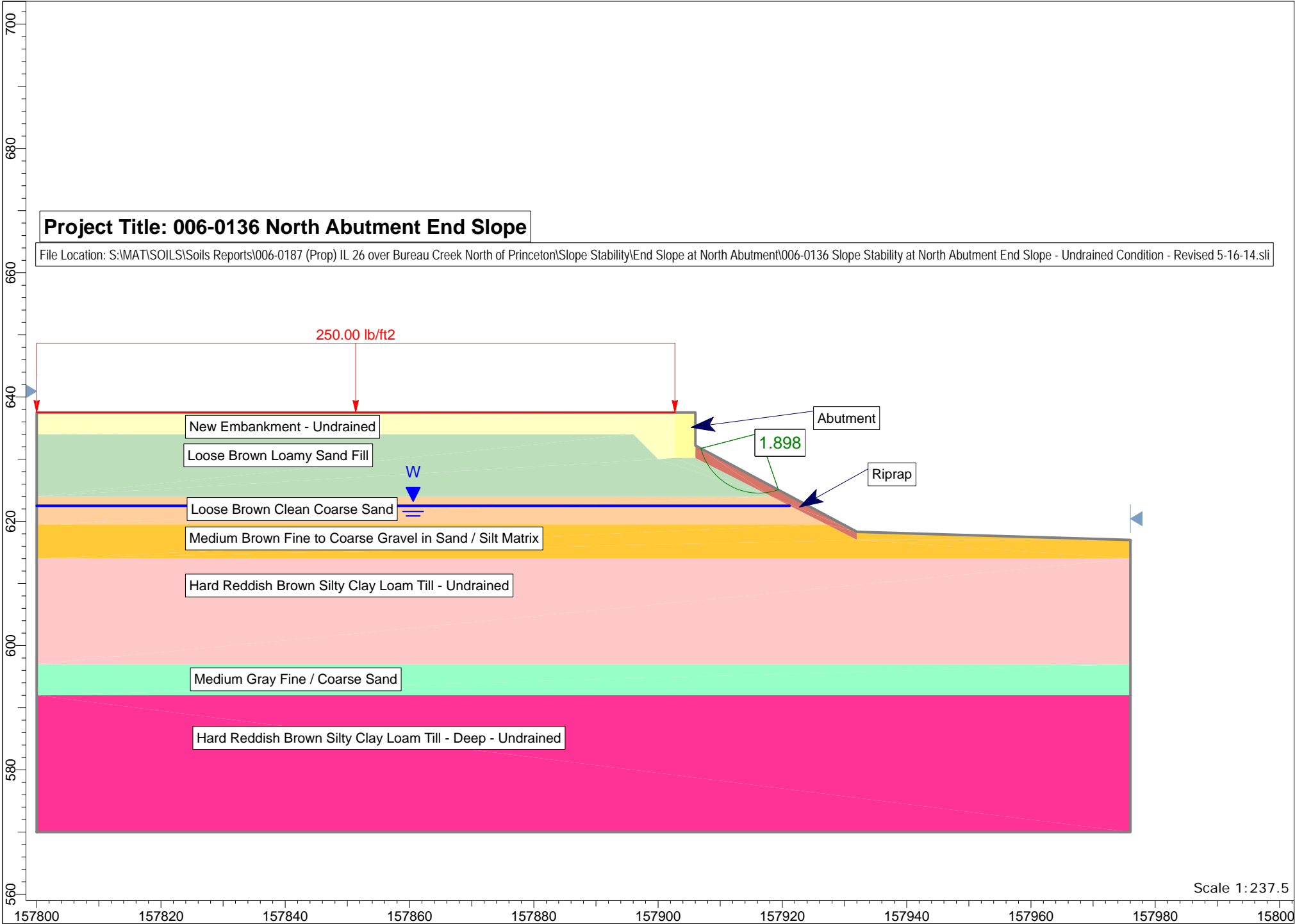
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Project Title: 006-0187, IL 26 over Bureau Creek, STA 1581+50

File Location: S:\MAT\SOILS\Soils Reports\006-0187 (Prop) IL 26 over Bureau Creek North of Princeton\Slope Stability\Side Slope at STA 1581.50\006-0136 STA 1581+50 Slope Stability - Drained Condition - Revised 5-16-14.sli

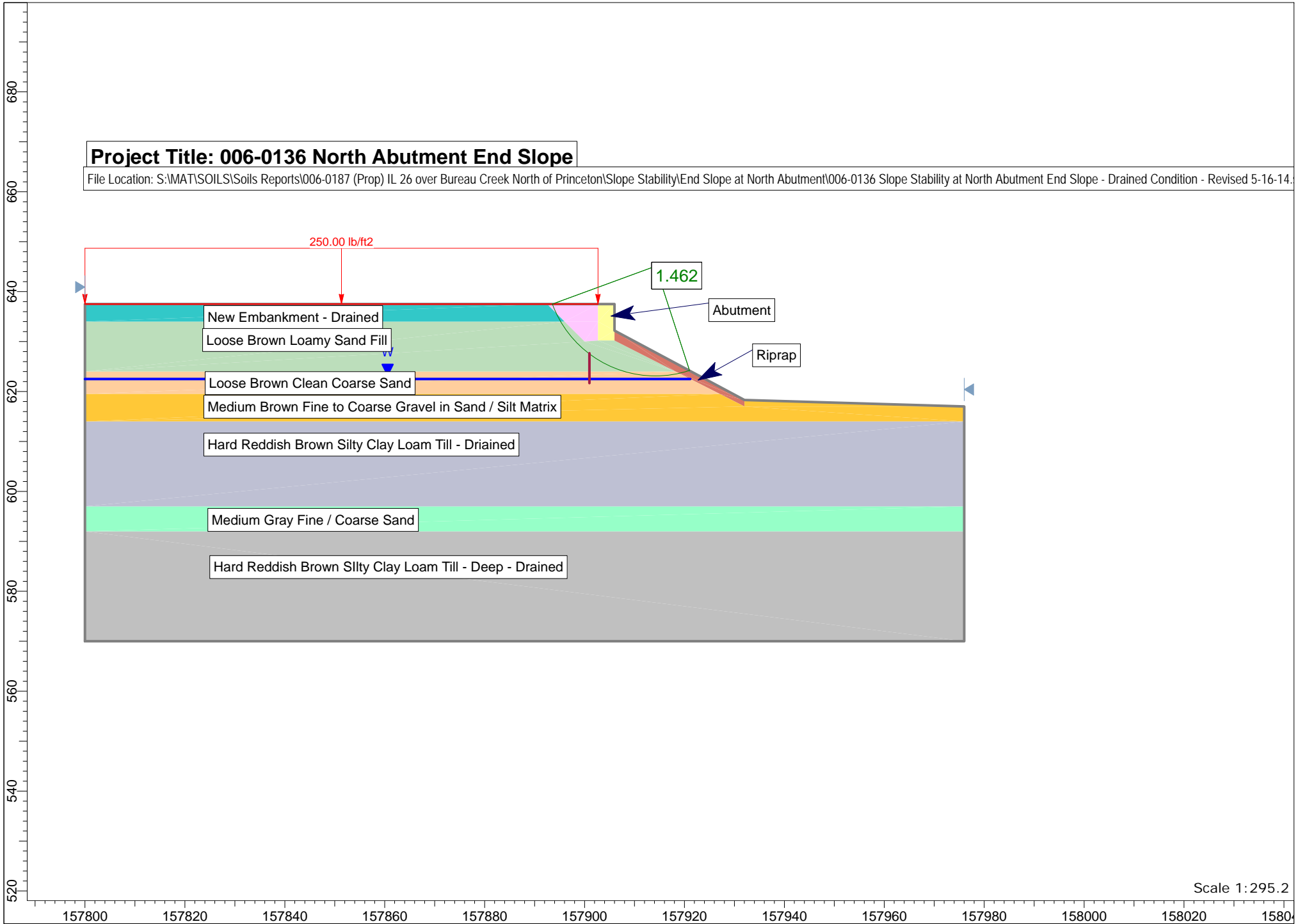


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Project Title: 006-0136 North Abutment End Slope

File Location: S:\MAT\SOILS\Soils Reports\006-0187 (Prop) IL 26 over Bureau Creek North of Princeton\Slope Stability\End Slope at North Abutment\006-0136 Slope Stability at North Abutment End Slope - Drained Condition - Revised 5-16-14.



SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE===== **006-0187: IL 26 OVER BUREAU CREEK, NORTH OF PRINCETON - PILE FOUNDATION AT PIERS**

Substructure 1 NORTH ABUTMENT

Base of Substruct. Elev. (or ground surf for bents)	630.36	ft.
Pile or Shaft Dia.	12	inches
Boring Number	2	
Top of Boring Elev.	636.45	ft.

Approximate Fixity Elev. 624.36 ft.

Individual Site Class Definition:

N (bar): 25 (Blows/ft.) Soil Site Class D <----Controls
 N_{ch} (bar): 11 (Blows/ft.) Soil Site Class E
 s_u (bar): 4.91 (ksf) Soil Site Class C

Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	634.0	2.50	1		B
	631.5	2.50	7		
	629.0	2.50	6		
	626.5	2.50	8		
0.4	624.0	2.50	4		B
2.9	621.5	2.50	6		
4.9	619.5	2.00	6		B
7.4	617.0	2.50	15		
10.4	614.0	3.00	15		B
12.9	611.5	2.50	16	4.10	
15.4	609.0	2.50	19	4.30	
17.9	606.5	2.50	19	4.30	
20.4	604.0	2.50	20	4.30	
22.9	601.5	2.50	25	5.00	
25.4	599.0	2.50	28	5.20	
27.4	597.0	2.00	27	5.20	B
29.9	594.5	2.50	26		
32.4	592.0	2.50	29		B
34.9	589.5	2.50	29	5.40	
37.4	587.0	2.50	29	5.40	
39.9	584.5	2.50	37	6.60	
42.4	582.0	2.50	37	6.60	
44.9	579.5	2.50	33	6.60	
47.4	577.0	2.50	33	6.60	
49.9	574.5	2.50	40	8.70	
52.4	572.0	2.50	40	8.70	
54.4	570.0	2.00	37	8.20	
59.4	565.0	5.00	37	7.80	
64.4	560.0	5.00	37	7.80	
69.4	555.0	5.00	37	7.80	
74.4	550.0	5.00	37	7.80	
79.4	545.0	5.00	37	7.80	
84.4	540.0	5.00	37	7.80	
89.4	535.0	5.00	37	7.80	
94.4	530.0	5.00	37	7.80	
99.4	525.0	5.00	37	7.80	
104.4	520.0	5.00	37	7.80	

Substructure 2 PIER 1

Base of Substruct. Elev. (or ground surf for bents)	614.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-4	
Top of Boring Elev.	620	ft.

Approximate Fixity Elev. 608.5 ft.

Individual Site Class Definition:

N (bar): 34 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA
 s_u (bar): 4.77 (ksf) Soil Site Class C <----Controls

Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	617.0	3.00	25		B
	614.5	2.50	15	3.10	
	612.0	2.50	24	3.80	
	609.5	2.50	17	2.90	
1.5	607.0	2.50	26	3.80	
4.0	604.5	2.50	29	4.00	
6.5	602.0	2.50	27	3.90	
9.0	599.5	2.50	22	3.60	
11.5	597.0	2.50	30	4.50	
14.0	594.5	2.50	31	4.70	
16.5	592.0	2.50	31	4.70	
19.0	589.5	2.50	32	4.80	
21.5	587.0	2.50	37	5.00	
24.0	584.5	2.50	38	5.10	
29.0	579.5	5.00	36	5.00	
34.0	574.5	5.00	36	5.00	
39.0	569.5	5.00	36	5.00	
44.0	564.5	5.00	36	5.00	
49.0	559.5	5.00	36	5.00	
54.0	554.5	5.00	36	5.00	
59.0	549.5	5.00	36	5.00	
64.0	544.5	5.00	36	5.00	
69.0	539.5	5.00	36	5.00	
74.0	534.5	5.00	36	5.00	
79.0	529.5	5.00	36	5.00	
84.0	524.5	5.00	36	5.00	
89.0	519.5	5.00	36	5.00	
94.0	514.5	5.00	36	5.00	
99.0	509.5	5.00	36	5.00	
104.0	504.5	5.00	36	5.00	

Substructure 3 PIER 2

Base of Substruct. Elev. (or ground surf for bents)	614.5	ft.
Pile or Shaft Dia.	12	inches
Boring Number	B-3	
Top of Boring Elev.	626.5	ft.

Approximate Fixity Elev. 608.5 ft.

Individual Site Class Definition:

N (bar): 34 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA
 s_u (bar): 4.79 (ksf) Soil Site Class C <----Controls

Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	624.0	2.50	3		B
	621.5	2.50	4	1.00	
	619.0	2.50	3	0.80	B
	616.5	2.50	5	1.20	B
	614.0	2.50	16	2.50	
	611.5	2.50	18	2.70	
	609.0	2.50	19	2.80	
2.0	606.5	2.50	19	3.20	
4.5	604.0	2.50	20	3.60	B
7.0	601.5	2.50	27	3.90	B
9.5	599.0	2.50	28	4.30	
12.0	596.5	2.50	28	4.40	
14.5	594.0	2.50	34	4.70	
17.0	591.5	2.50	37	4.90	
19.5	589.0	2.50	36	5.00	
22.0	586.5	2.50	35	4.90	
27.0	581.5	5.00	36	5.00	
32.0	576.5	5.00	36	5.00	
37.0	571.5	5.00	36	5.00	
42.0	566.5	5.00	36	5.00	
47.0	561.5	5.00	36	5.00	
52.0	556.5	5.00	36	5.00	
57.0	551.5	5.00	36	5.00	
62.0	546.5	5.00	36	5.00	
67.0	541.5	5.00	36	5.00	
72.0	536.5	5.00	36	5.00	
77.0	531.5	5.00	36	5.00	
82.0	526.5	5.00	36	5.00	
87.0	521.5	5.00	36	5.00	
92.0	516.5	5.00	36	5.00	
97.0	511.5	5.00	36	5.00	
102.0	506.5	5.00	36	5.00	

Substructure 4 SOUTH ABUTMENT

Base of Substruct. Elev. (or ground surf for bents)	629.45	ft.
Pile or Shaft Dia.	12	inches
Boring Number	1	
Top of Boring Elev.	635.49	ft.

Approximate Fixity Elev. 623.45 ft.

Individual Site Class Definition:

N (bar): 27 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): NA (Blows/ft.) NA
 s_u (bar): 4.76 (ksf) Soil Site Class C <----Controls

Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	633.0	2.50	1		B
	630.5	2.50	9		
	628.0	2.50	8		B
	626.0	2.00	3		
	624.0	2.00	3		
2.0	621.5	2.50	5		B
4.5	619.0	2.50	12		
7.5	616.0	3.00	12		B
10.0	613.5	2.50	22	4.30	
12.5	611.0	2.50	15	4.00	
15.0	608.5	2.50	19	4.00	
17.5	606.0	2.50	22	4.00	
20.0	603.5	2.50	19	4.00	
22.5	601.0	2.50	22	4.70	
25.0	598.5	2.50	22	4.70	
27.5	596.0	2.50	21	4.50	
30.0	593.5	2.50	20	4.30	
32.5	591.0	2.50	22	4.70	
35.0	588.5	2.50	20	4.50	
37.5	586.0	2.50	23	5.40	
40.0	583.5	2.50	22	5.40	
42.5	581.0	2.50	34	6.80	
45.0	578.5	2.50	37	7.00	
47.5	576.0	2.50	40	7.40	
49.5	574.0	2.00	41	7.40	
51.0	572.5	1.50	41	7.40	
53.0	570.5	2.00	44	7.60	
54.5	569.0	1.50	44	7.60	
59.5	564.0	5.00	42	7.50	
64.5	559.0	5.00	42	7.50	
69.5	554.0	5.00	42	7.50	
74.5	549.0	5.00	42	7.50	
79.5	544.0	5.00	42	7.50	
84.5	539.0	5.00	42	7.50	
89.5	534.0	5.00	42	7.50	
94.5	529.0	5.00	42	7.50	
99.5	524.0	5.00	42	7.50	
104.5	519.0	5.00	42	7.50	

Global Site Class Definition: Substructures 1 through 4

N (bar): 30 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA, H < 0.1*H (Total)
 s_u (bar): 4.8 (ksf) Soil Site Class C <----Controls

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE===== **006-0187: IL 26 OVER BUREAU CREEK, NORTH OF PRINCETON - 3 FT DRILLED SHAFT FOUNDATION AT PIERS**

Substructure 1 NORTH ABUTMENT

Base of Substruct. Elev. (or ground surf for bents)	630.36	ft.
Pile or Shaft Dia.	12	inches
Boring Number	2	
Top of Boring Elev.	636.45	ft.
Approximate Fixity Elev.	624.36	ft.

Individual Site Class Definition:

N (bar): 25 (Blows/ft.) Soil Site Class D <----Controls
 N_{ch} (bar): 11 (Blows/ft.) Soil Site Class E
 s_u (bar): 4.91 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	634.0	2.50	1		B
	631.5	2.50	7		
	629.0	2.50	6		
	626.5	2.50	8		
0.4	624.0	2.50	4		B
2.9	621.5	2.50	6		
4.9	619.5	2.00	6		B
7.4	617.0	2.50	15		
10.4	614.0	3.00	15		B
12.9	611.5	2.50	16	4.10	
15.4	609.0	2.50	19	4.30	
17.9	606.5	2.50	19	4.30	
20.4	604.0	2.50	20	4.30	
22.9	601.5	2.50	25	5.00	
25.4	599.0	2.50	28	5.20	
27.4	597.0	2.00	27	5.20	B
29.9	594.5	2.50	26		
32.4	592.0	2.50	29		B
34.9	589.5	2.50	29	5.40	
37.4	587.0	2.50	29	5.40	
39.9	584.5	2.50	37	6.60	
42.4	582.0	2.50	37	6.60	
44.9	579.5	2.50	33	6.60	
47.4	577.0	2.50	33	6.60	
49.9	574.5	2.50	40	8.70	
52.4	572.0	2.50	40	8.70	
54.4	570.0	2.00	37	8.20	
59.4	565.0	5.00	37	7.80	
64.4	560.0	5.00	37	7.80	
69.4	555.0	5.00	37	7.80	
74.4	550.0	5.00	37	7.80	
79.4	545.0	5.00	37	7.80	
84.4	540.0	5.00	37	7.80	
89.4	535.0	5.00	37	7.80	
94.4	530.0	5.00	37	7.80	
99.4	525.0	5.00	37	7.80	
104.4	520.0	5.00	37	7.80	

Substructure 2 PIER 1

Base of Substruct. Elev. (or ground surf for bents)	614.5	ft.
Pile or Shaft Dia.	36	inches
Boring Number	B-4	
Top of Boring Elev.	620	ft.
Approximate Fixity Elev.	596.5	ft.

Individual Site Class Definition:

N (bar): 35 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA
 s_u (bar): 4.96 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	617.0	3.00	25		B
	614.5	2.50	15	3.10	
	612.0	2.50	24	3.80	
	609.5	2.50	17	2.90	
	607.0	2.50	26	3.80	
	604.5	2.50	29	4.00	
	602.0	2.50	27	3.90	
	599.5	2.50	22	3.60	
	597.0	2.50	30	4.50	
2.0	594.5	2.50	31	4.70	
4.5	592.0	2.50	31	4.70	
7.0	589.5	2.50	32	4.80	
9.5	587.0	2.50	37	5.00	
12.0	584.5	2.50	38	5.10	
17.0	579.5	5.00	36	5.00	
22.0	574.5	5.00	36	5.00	
27.0	569.5	5.00	36	5.00	
32.0	564.5	5.00	36	5.00	
37.0	559.5	5.00	36	5.00	
42.0	554.5	5.00	36	5.00	
47.0	549.5	5.00	36	5.00	
52.0	544.5	5.00	36	5.00	
57.0	539.5	5.00	36	5.00	
62.0	534.5	5.00	36	5.00	
67.0	529.5	5.00	36	5.00	
72.0	524.5	5.00	36	5.00	
77.0	519.5	5.00	36	5.00	
82.0	514.5	5.00	36	5.00	
87.0	509.5	5.00	36	5.00	
92.0	504.5	5.00	36	5.00	

Substructure 3 PIER 2

Base of Substruct. Elev. (or ground surf for bents)	614.5	ft.
Pile or Shaft Dia.	36	inches
Boring Number	B-3	
Top of Boring Elev.	628.5	ft.
Approximate Fixity Elev.	596.5	ft.

Individual Site Class Definition:

N (bar): 36 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA
 s_u (bar): 4.98 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	624.0	2.50	3		B
	621.5	2.50	4	1.00	
	619.0	2.50	3	0.80	B
	616.5	2.50	5	1.20	B
	614.0	2.50	16	2.50	
	611.5	2.50	18	2.70	
	609.0	2.50	19	2.80	
	606.5	2.50	19	3.20	
	604.0	2.50	20	3.60	B
	601.5	2.50	27	3.90	B
	599.0	2.50	28	4.30	
	596.5	2.50	28	4.40	
2.5	594.0	2.50	34	4.70	
5.0	591.5	2.50	37	4.90	
7.5	589.0	2.50	36	5.00	
10.0	586.5	2.50	35	4.90	
15.0	581.5	5.00	36	5.00	
20.0	576.5	5.00	36	5.00	
25.0	571.5	5.00	36	5.00	
30.0	566.5	5.00	36	5.00	
35.0	561.5	5.00	36	5.00	
40.0	556.5	5.00	36	5.00	
45.0	551.5	5.00	36	5.00	
50.0	546.5	5.00	36	5.00	
55.0	541.5	5.00	36	5.00	
60.0	536.5	5.00	36	5.00	
65.0	531.5	5.00	36	5.00	
70.0	526.5	5.00	36	5.00	
75.0	521.5	5.00	36	5.00	
80.0	516.5	5.00	36	5.00	
85.0	511.5	5.00	36	5.00	
90.0	506.5	5.00	36	5.00	

Substructure 4 SOUTH ABUTMENT

Base of Substruct. Elev. (or ground surf for bents)	629.45	ft.
Pile or Shaft Dia.	12	inches
Boring Number	1	
Top of Boring Elev.	635.49	ft.
Approximate Fixity Elev.	623.45	ft.

Individual Site Class Definition:

N (bar): 27 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): NA (Blows/ft.) NA
 s_u (bar): 4.76 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	633.0	2.50	1		B
	630.5	2.50	9		
	628.0	2.50	8		B
	626.0	2.00	3		
	624.0	2.00	3		
2.0	621.5	2.50	5		B
4.5	619.0	2.50	12		
7.5	616.0	3.00	12		B
10.0	613.5	2.50	22	4.30	
12.5	611.0	2.50	15	4.00	
15.0	608.5	2.50	19	4.00	
17.5	606.0	2.50	22	4.00	
20.0	603.5	2.50	19	4.00	
22.5	601.0	2.50	22	4.70	
25.0	598.5	2.50	22	4.70	
27.5	596.0	2.50	21	4.50	
30.0	593.5	2.50	20	4.30	
32.5	591.0	2.50	22	4.70	
35.0	588.5	2.50	20	4.50	
37.5	586.0	2.50	23	5.40	
40.0	583.5	2.50	22	5.40	
42.5	581.0	2.50	34	6.80	
45.0	578.5	2.50	37	7.00	
47.5	576.0	2.50	40	7.40	
49.5	574.0	2.00	41	7.40	
51.0	572.5	1.50	41	7.40	
53.0	570.5	2.00	44	7.60	
54.5	569.0	1.50	44	7.60	
59.5	564.0	5.00	42	7.50	
64.5	559.0	5.00	42	7.50	
69.5	554.0	5.00	42	7.50	
74.5	549.0	5.00	42	7.50	
79.5	544.0	5.00	42	7.50	
84.5	539.0	5.00	42	7.50	
89.5	534.0	5.00	42	7.50	
94.5	529.0	5.00	42	7.50	
99.5	524.0	5.00	42	7.50	
104.5	519.0	5.00	42	7.50	

Global Site Class Definition: Substructures 1 through 4

N (bar): 31 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA, H < 0.1*H (Total)
 s_u (bar): 4.9 (ksf) Soil Site Class C <----Controls

SEISMIC SITE CLASS DETERMINATION

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

Modified on 12/10/10

PROJECT TITLE===== **006-0187: IL 26 OVER BUREAU CREEK, NORTH OF PRINCETON - 4 FT DRILLED SHAFT FOUNDATION AT PIERS**

Substructure 1 NORTH ABUTMENT	
Base of Substruct. Elev. (or ground surf for bents)	630.36 ft.
Pile or Shaft Dia.	12 inches
Boring Number	2
Top of Boring Elev.	636.45 ft.

Approximate Fixity Elev. 624.36 ft.

Individual Site Class Definition:

N (bar): 25 (Blows/ft.) Soil Site Class D <----Controls
 N_{ch} (bar): 11 (Blows/ft.) Soil Site Class E
 s_u (bar): 4.91 (ksf) Soil Site Class C

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	634.0	2.50	1		B
	631.5	2.50	7		
	629.0	2.50	6		
	626.5	2.50	8		
0.4	624.0	2.50	4		B
2.9	621.5	2.50	6		
4.9	619.5	2.00	6		B
7.4	617.0	2.50	15		
10.4	614.0	3.00	15		B
12.9	611.5	2.50	16	4.10	
15.4	609.0	2.50	19	4.30	
17.9	606.5	2.50	19	4.30	
20.4	604.0	2.50	20	4.30	
22.9	601.5	2.50	25	5.00	
25.4	599.0	2.50	28	5.20	
27.4	597.0	2.00	27	5.20	B
29.9	594.5	2.50	26		
32.4	592.0	2.50	29		B
34.9	589.5	2.50	29	5.40	
37.4	587.0	2.50	29	5.40	
39.9	584.5	2.50	37	6.60	
42.4	582.0	2.50	37	6.60	
44.9	579.5	2.50	33	6.60	
47.4	577.0	2.50	33	6.60	
49.9	574.5	2.50	40	8.70	
52.4	572.0	2.50	40	8.70	
54.4	570.0	2.00	37	8.20	
59.4	565.0	5.00	37	7.80	
64.4	560.0	5.00	37	7.80	
69.4	555.0	5.00	37	7.80	
74.4	550.0	5.00	37	7.80	
79.4	545.0	5.00	37	7.80	
84.4	540.0	5.00	37	7.80	
89.4	535.0	5.00	37	7.80	
94.4	530.0	5.00	37	7.80	
99.4	525.0	5.00	37	7.80	
104.4	520.0	5.00	37	7.80	

Substructure 2 PIER 1	
Base of Substruct. Elev. (or ground surf for bents)	614.5 ft.
Pile or Shaft Dia.	48 inches
Boring Number	B-4
Top of Boring Elev.	620 ft.

Approximate Fixity Elev. 590.5 ft.

Individual Site Class Definition:

N (bar): 36 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA
 s_u (bar): 4.99 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	617.0	3.00	25		B
	614.5	2.50	15	3.10	
	612.0	2.50	24	3.80	
	609.5	2.50	17	2.90	
	607.0	2.50	26	3.80	
	604.5	2.50	29	4.00	
	602.0	2.50	27	3.90	
	599.5	2.50	22	3.60	
	597.0	2.50	30	4.50	
	594.5	2.50	31	4.70	
	592.0	2.50	31	4.70	
1.0	589.5	2.50	32	4.80	
3.5	587.0	2.50	37	5.00	
6.0	584.5	2.50	38	5.10	
11.0	579.5	5.00	36	5.00	
16.0	574.5	5.00	36	5.00	
21.0	569.5	5.00	36	5.00	
26.0	564.5	5.00	36	5.00	
31.0	559.5	5.00	36	5.00	
36.0	554.5	5.00	36	5.00	
41.0	549.5	5.00	36	5.00	
46.0	544.5	5.00	36	5.00	
51.0	539.5	5.00	36	5.00	
56.0	534.5	5.00	36	5.00	
61.0	529.5	5.00	36	5.00	
66.0	524.5	5.00	36	5.00	
71.0	519.5	5.00	36	5.00	
76.0	514.5	5.00	36	5.00	
81.0	509.5	5.00	36	5.00	
86.0	504.5	5.00	36	5.00	

Substructure 3 PIER 2	
Base of Substruct. Elev. (or ground surf for bents)	614.5 ft.
Pile or Shaft Dia.	48 inches
Boring Number	B-3
Top of Boring Elev.	626.5 ft.

Approximate Fixity Elev. 590.5 ft.

Individual Site Class Definition:

N (bar): 36 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA
 s_u (bar): 4.99 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	624.0	2.50	3		B
	621.5	2.50	4	1.00	
	619.0	2.50	3	0.80	B
	616.5	2.50	5	1.20	B
	614.0	2.50	16	2.50	
	611.5	2.50	18	2.70	
	609.0	2.50	19	2.80	
	606.5	2.50	19	3.20	
	604.0	2.50	20	3.60	B
	601.5	2.50	27	3.90	B
	599.0	2.50	28	4.30	
	596.5	2.50	28	4.40	
	594.0	2.50	34	4.70	
	591.5	2.50	37	4.90	
1.5	589.0	2.50	36	5.00	
4.0	586.5	2.50	35	4.90	
9.0	581.5	5.00	36	5.00	
14.0	576.5	5.00	36	5.00	
19.0	571.5	5.00	36	5.00	
24.0	566.5	5.00	36	5.00	
29.0	561.5	5.00	36	5.00	
34.0	556.5	5.00	36	5.00	
39.0	551.5	5.00	36	5.00	
44.0	546.5	5.00	36	5.00	
49.0	541.5	5.00	36	5.00	
54.0	536.5	5.00	36	5.00	
59.0	531.5	5.00	36	5.00	
64.0	526.5	5.00	36	5.00	
69.0	521.5	5.00	36	5.00	
74.0	516.5	5.00	36	5.00	
79.0	511.5	5.00	36	5.00	
84.0	506.5	5.00	36	5.00	

Substructure 4 SOUTH ABUTMENT	
Base of Substruct. Elev. (or ground surf for bents)	629.45 ft.
Pile or Shaft Dia.	12 inches
Boring Number	1
Top of Boring Elev.	635.49 ft.

Approximate Fixity Elev. 623.45 ft.

Individual Site Class Definition:

N (bar): 27 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): NA (Blows/ft.) NA
 s_u (bar): 4.76 (ksf) Soil Site Class C <----Controls

Seismic Soil Column Depth (ft)	Bot. Of Sample Elevation (ft)	Sample Thick. (ft.)	Layer Description		
			N (tsf)	Qu (tsf)	Boundary
	633.0	2.50	1		B
	630.5	2.50	9		
	628.0	2.50	8		B
	626.0	2.00	3		
	624.0	2.00	3		
2.0	621.5	2.50	5		B
4.5	619.0	2.50	12		
7.5	616.0	3.00	12		B
10.0	613.5	2.50	22	4.30	
12.5	611.0	2.50	15	4.00	
15.0	608.5	2.50	19	4.00	
17.5	606.0	2.50	22	4.00	
20.0	603.5	2.50	19	4.00	
22.5	601.0	2.50	22	4.70	
25.0	598.5	2.50	22	4.70	
27.5	596.0	2.50	21	4.50	
30.0	593.5	2.50	20	4.30	
32.5	591.0	2.50	22	4.70	
35.0	588.5	2.50	20	4.50	
37.5	586.0	2.50	23	5.40	
40.0	583.5	2.50	22	5.40	
42.5	581.0	2.50	34	6.80	
45.0	578.5	2.50	37	7.00	
47.5	576.0	2.50	40	7.40	
49.5	574.0	2.00	41	7.40	
51.0	572.5	1.50	41	7.40	
53.0	570.5	2.00	44	7.60	
54.5	569.0	1.50	44	7.60	
59.5	564.0	5.00	42	7.50	
64.5	559.0	5.00	42	7.50	
69.5	554.0	5.00	42	7.50	
74.5	549.0	5.00	42	7.50	
79.5	544.0	5.00	42	7.50	
84.5	539.0	5.00	42	7.50	
89.5	534.0	5.00	42	7.50	
94.5	529.0	5.00	42	7.50	
99.5	524.0	5.00	42	7.50	
104.5	519.0	5.00	42	7.50	

Global Site Class Definition: Substructures 1 through 4

N (bar): 31 (Blows/ft.) Soil Site Class D
 N_{ch} (bar): (Blows/ft.) NA, H < 0.1*H (Total)
 s_u (bar): 4.91 (ksf) Soil Site Class C <----Controls

INTEGRAL ABUTMENT FEASIBILITY ANALYSIS

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

Modified 1/7/2014

STRUCTURE NUMBER=====006-0187
 STRUCTURE TYPE =====MULTI-SPAN
 STRUCTURE SKEW =====10 DEGREES
 TOTAL STRUCTURE LENGTH=====255.00 FT
 LONGEST END SPAN LENGTH =====75.00 FT

ABUTMENT #1 DATA

ABUTMENT NAME =====North Abutment
 ABUTMENT REFERENCE BORING=====2
 BOTTOM OF ABUTMENT ELEVATION=====630.36 FT
 ESTIMATED NUMBER OF PILES AT ABUT.=====6

ABUTMENT #2 DATA

ABUTMENT NAME =====South Abutment
 ABUTMENT REFERENCE BORING=====1
 BOTTOM OF ABUTMENT ELEVATION=====629.45 FT
 ESTIMATED NUMBER OF PILES AT ABUT.=====6

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #1				
BOT. OF LAYER ELEV. (FT)	LAYER THICKNESS (FT)	UNCONFINED COMPRESSIVE STRENGTH (TSF)	N S.P.T. VALUE (BLOWS/12 IN.)	Qu EQUIV. FOR N VALUE (TSF)
628.93	1.43		7	2.2
626.43	2.50		8	2.3
623.93	2.50		4	1.7
621.43	2.50		6	2.0
620.36	1.07		6	2.0

10.00 FT = TOTAL DEPTH ENTERED

SOIL DATA FOR 10 FT BENEATH BOTTOM OF ABUTMENT #2				
BOT. OF LAYER ELEV. (FT)	LAYER THICKNESS (FT)	UNCONFINED COMPRESSIVE STRENGTH (TSF)	N S.P.T. VALUE (BLOWS/12 IN.)	Qu EQUIV. FOR N VALUE (TSF)
627.99	1.46		8	2.3
625.49	2.50		3	1.5
622.99	2.50		3	1.5
621.49	1.50		5	1.9
619.45	2.04		5	1.9

10.00 FT = TOTAL DEPTH ENTERED

WEIGHTED AVERAGE Qu FOR ABUTMENT #1=====2.04 TSF

WEIGHTED AVERAGE Qu FOR ABUTMENT #2=====1.77 TSF

PILE STIFFNESS MODIFIER FOR ABUTMENT #1
 = 1/(1.45-[0.3*2.04])=====1.19

PILE STIFFNESS MODIFIER FOR ABUTMENT #2
 = 1/(1.45-[0.3*1.77])=====1.09

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #1 = [1.19*6*0+1.09*6*255]/[1.19*6+1.09*6]=====121.60 FT

DISTANCE TO CENTROID OF STIFFNESS FROM ABUTMENT #2 = [1.09*6*0+1.19*6*255]/[1.09*6+1.19*6]=====133.40 FT

EFFECTIVE EXPANSION LENGTH (EEL) CALCULATION

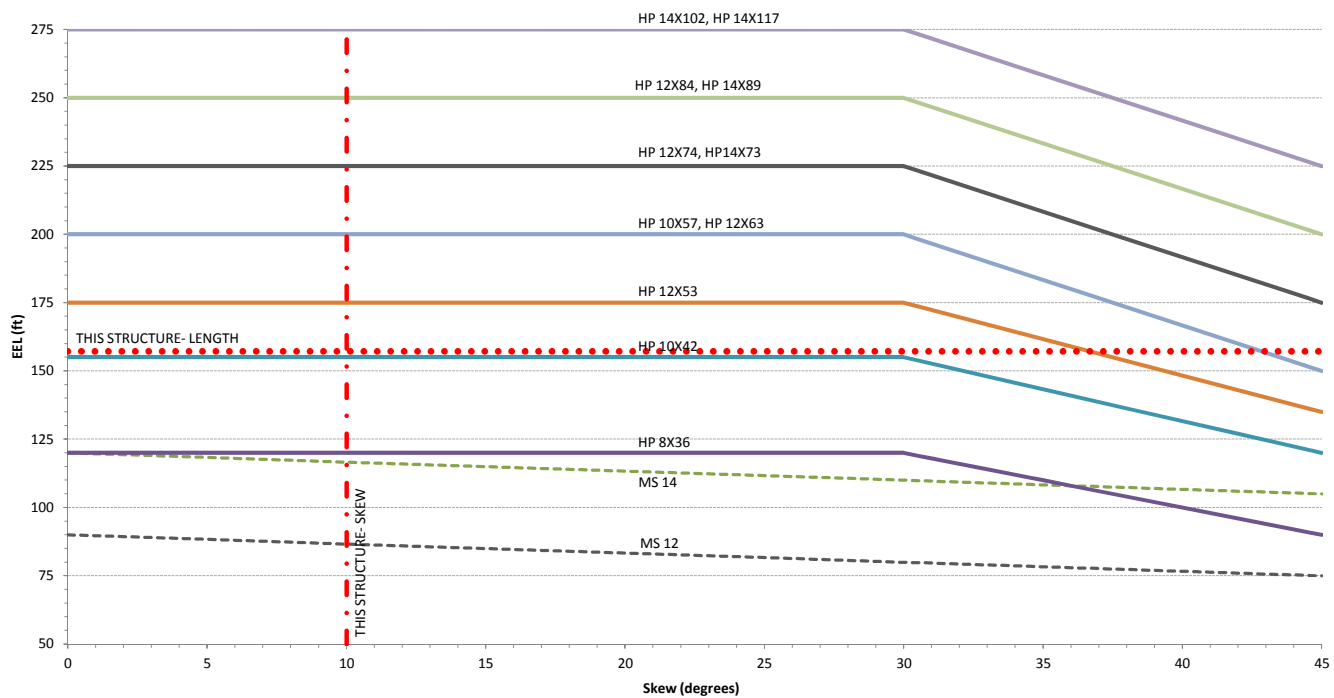
CONTROLLING ABUTMENT=====ABUT. #2 South Abutment
 CONTROLLING EXPANSION LENGTH (DISTANCE TO CENTROID OF STIFFNESS FROM CONTROLLING ABUTMENT) =====133.40 FT
 WEIGHTED AVE. Qu FOR CONTROLLING ABUTMENT =====1.77/1.5 TSF
 Qu CORRECTION FACTOR =====1.77/1.5
 EFFECTIVE EXPANSION LENGTH (EEL) =====EEL = 133.4*1.18 =====157.15 FT

FEASIBLE PILE TYPES PER CHART IN ABD MEMO 12.3 BASED ON SKEW AND EEL OR MODIFIED EEL:

PILE SIZES AT OR ABOVE THE LENGTH LINE AT THE INTERSECTION WITH THE SKEW LINE ARE ALLOWED FOR USE WITH THIS INTEGRAL ABUTMENT STRUCTURE

AVAILABLE PILE SIZES:

HP 12X53, HP 10X57, HP 12X63, HP 12X74, HP 14X73, HP 12X84, HP 14X89, HP 14X102, HP 14X117



Pile Design Table for NORTH ABUTMENT utilizing Boring #2

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FL)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FL)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (FL)
Metal Shell 12" Φ w/.179" walls			Steel HP 10 X 67			Steel HP 14 X 73		
218	120	31	224	123	53	208	114	31
244	134	33	236	130	55	244	134	33
Metal Shell 12" Φ w/.25" walls			240	132	60	266	146	35
218	120	31	243	133	62	281	155	38
244	134	33	250	137	67	291	160	40
Metal Shell 14" Φ w/.25" walls			257	141	72	317	175	43
194	107	26	263	145	77	332	183	50
231	127	28	270	149	82	337	185	53
263	145	31	277	153	87	359	197	55
293	161	33	284	156	92	362	199	60
Metal Shell 14" Φ w/.312" walls			291	160	97	366	201	62
194	107	26	298	164	102	376	207	67
231	127	28	305	168	107	385	212	72
263	145	31	312	172	112	396	217	77
293	161	33	319	176	117	406	223	82
367	202	40	326	179	122	415	228	87
397	218	43	Steel HP 12 X 63			424	233	92
Steel HP 8 X 36			225	124	38	434	239	97
226	124	97	234	129	40	444	244	102
231	127	102	254	140	43	453	249	107
237	130	107	268	148	45	463	255	112
242	133	112	269	148	50	473	260	117
248	136	117	273	150	53	483	265	122
254	139	122	289	159	55	Steel HP 14 X 89		
Steel HP 10 X 42			293	161	60	212	116	31
219	120	53	296	163	62	248	137	33
230	127	55	304	167	67	270	148	35
234	129	60	313	172	72	286	157	38
237	130	62	321	176	77	296	163	40
244	134	67	329	181	82	322	177	43
251	138	72	337	186	87	337	185	50
257	142	77	346	190	92	341	188	53
264	145	82	354	195	97	364	200	55
271	149	87	362	199	102	367	202	60
278	153	92	370	204	107	371	204	62
285	157	97	378	208	112	381	209	67
292	160	102	387	213	117	390	215	72
299	164	107	395	217	122	400	220	77
305	168	112	Steel HP 12 X 63			410	226	82
312	172	117	227	125	38	420	231	87
319	175	122	236	130	40	430	236	92
			257	141	43	440	242	97
			271	149	45	450	247	102
			272	150	50	459	253	107
			276	152	53	469	258	112
			292	161	55	479	263	117
			296	163	60	489	269	122
			299	165	62	Steel HP 14 X 102		
			308	169	67	214	118	31
			316	174	72	251	138	33
			324	178	77	274	151	35
			332	183	82	289	159	38
			341	187	87	299	165	40
			349	192	92	327	180	43
			357	197	97	341	188	50
			366	201	102	346	190	53
			374	206	107	369	203	55
			382	210	112	372	204	60
			391	215	117	376	207	62
			399	219	122	386	212	67
			Steel HP 12 X 74			396	218	72
			219	120	35	406	223	77
			231	127	38	415	229	82
			240	132	40	425	234	87
			261	144	43	435	239	92
			276	152	45	446	245	97
			276	152	50	455	250	102
			280	154	53	465	256	107
			297	163	55	475	261	112
			301	165	60	485	267	117
			304	167	62	495	272	122
			312	172	67	Steel HP 14 X 117		
			321	176	72	218	120	31
			329	181	77	255	140	33
			338	186	82	277	153	35
			346	190	87	293	161	38
			354	195	92	304	167	40
			363	199	97	331	182	43
			371	204	102	346	190	50
			379	209	107	350	193	53
			388	213	112	374	206	55
			396	218	117	377	207	60
			405	223	122	381	209	62
			Steel HP 12 X 84			391	215	67
			222	122	35	401	220	72
			235	129	38	411	226	77
			244	134	40	421	231	82
			265	146	43	431	237	87
			280	154	45	441	243	92
			280	154	50	451	248	97
			284	156	53	461	254	102
			302	166	55	471	259	107
			305	168	60	481	265	112
			309	170	62	491	270	117
			317	174	67	501	276	122
			326	179	72	Precast 14"x 14"		
			334	184	77	211	116	23
			343	188	82	247	136	26
			351	193	87	Timber Pile		
			360	198	92	136	75	26
			368	202	97			
			377	207	102			
			385	212	107			
			394	216	112			
			402	221	117			
			411	226	122			

SHADED PILE SIZES ARE NOT PERMITTED FOR INTEGRAL ABUTMENTS (ABD 12.3).

Pile Design Table for SOUTH ABUTMENT utilizing Boring #1

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Ø w/.179" walls			Steel HP 10 X 57			Steel HP 14 X 73		
218	120	30	219	121	40	192	106	28
242	133	33	246	135	43	228	126	30
Metal Shell 12"Ø w/.25" walls			263	145	45	259	142	33
218	120	30	272	150	48	279	154	35
242	133	33	279	154	50	311	171	38
266	146	35	287	158	53	331	182	40
294	162	38	292	161	55	373	205	43
318	175	40	296	163	58	397	219	45
351	193	43	304	167	60	405	223	48
Metal Shell 14"Ø w/.25" walls			307	169	62	417	229	50
197	109	25	316	174	67	430	236	53
233	128	28	325	179	72	438	241	55
263	144	30	334	184	77	443	244	58
290	160	33	343	189	82	457	251	60
317	175	35	352	193	87	462	254	62
351	193	38	360	198	92	474	261	67
378	208	40	369	203	97	486	267	72
Metal Shell 14"Ø w/.312" walls			378	208	102	499	274	77
197	109	25	387	213	107	511	281	82
233	128	28	396	218	112	523	288	87
263	144	30	405	223	117	536	295	92
290	160	33	413	227	122	548	301	97
317	175	35	Steel HP 12 X 53			560	308	102
351	193	38	225	124	35	573	315	107
378	208	40	250	138	38	Steel HP 14 X 89		
419	230	43	268	147	40	196	108	28
449	247	45	301	166	43	232	128	30
Steel HP 8 X 36			322	177	45	262	144	33
225	124	55	330	182	48	283	156	35
228	126	58	340	187	50	315	173	38
234	129	60	349	192	53	336	185	40
237	130	62	356	196	55	378	208	43
244	134	67	360	198	58	403	221	45
251	138	72	371	204	60	410	226	48
258	142	77	375	206	62	423	232	50
265	146	82	385	212	67	435	239	53
272	150	87	396	218	72	444	244	55
279	154	92	406	223	77	449	247	58
Steel HP 10 X 42			416	229	82	463	254	60
214	118	40	Steel HP 12 X 63			468	257	62
240	132	43	209	115	33	480	264	67
257	141	45	227	125	35	493	271	72
266	146	48	253	139	38	505	278	77
273	150	50	271	149	40	518	285	82
280	154	53	304	167	43	530	292	87
285	157	55	325	179	45	543	298	92
289	159	58	334	184	48	555	305	97
297	163	60	343	189	50	567	312	102
300	165	62	353	194	53	580	319	107
309	170	67	359	198	55	592	326	112
318	175	72	364	200	58	605	333	117
326	180	77	374	206	60	617	340	122
			379	208	62	Steel HP 14 X 102		
			389	214	67	198	109	28
			400	220	72	235	129	30
			410	226	77	265	146	33
			421	231	82	287	158	35
			431	237	87	319	176	38
			442	243	92	340	187	40
			452	249	97	383	211	43
			463	254	102	408	224	45
			473	260	107	416	229	48
			484	266	112	428	235	50
			494	272	117	441	243	53
			Steel HP 12 X 74			448	247	55
			213	117	33	455	250	58
			231	127	35	469	258	60
			257	141	38	474	261	62
			275	151	40	486	268	67
			309	170	43	499	274	72
			330	182	45	512	281	77
			339	186	48	524	288	82
			348	191	50	537	295	87
			358	197	53	549	302	92
			365	201	55	562	309	97
			369	203	58	575	316	102
			380	209	60	587	323	107
			384	211	62	600	330	112
			395	217	67	612	337	117
			406	223	72	625	344	122
			416	229	77	Steel HP 14 X 117		
			427	235	82	202	111	28
			437	241	87	239	131	30
			448	246	92	270	148	33
			459	252	97	291	160	35
			469	258	102	323	178	38
			480	264	107	345	190	40
			491	270	112	388	214	43
			501	276	117	414	227	45
			512	282	122	421	231	48
			Steel HP 12 X 84			434	238	50
			216	119	33	447	246	53
			234	129	35	455	250	55
			261	143	38	461	251	58
			279	154	40	475	261	60
			314	173	43	480	264	62
			335	184	45	493	271	67
			344	189	48	506	278	72
			353	194	50	518	285	77
			363	200	53	531	292	82
			370	204	55	544	299	87
			375	206	58	556	306	92
			386	212	60	569	313	97
			390	215	62	582	320	102
			401	220	67	595	327	107
			412	226	72	607	334	112
			422	232	77	620	341	117
			433	238	82	633	348	122
			444	244	87	Precast 14"x 14"		
			455	250	92	217	119	23
			465	256	97	251	138	25
			476	262	102	Timber Pile		
			487	268	107	141	77	25
			498	274	112			
			509	280	117			
			519	286	122			

SHADED PILE SIZES ARE NOT PERMITTED FOR INTEGRAL ABUTMENTS (ADD 12.3).

Pile Design Table for Pier 1 utilizing Boring #B-4

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			Steel HP 10 X 57			Steel HP 14 X 73		
170	71	33	290	144	137	356	175	97
Metal Shell 12"Φ w/.25" walls			Steel HP 12 X 53			366		
334	161	43	352	176	137	375	185	102
Metal Shell 14"Φ w/.25" walls			Steel HP 12 X 63			385		
355	169	38	348	173	132	394	195	112
375	180	40	356	177	137	404	200	122
Metal Shell 14"Φ w/.312" walls			Steel HP 12 X 74			413		
355	169	38	353	176	132	422	211	132
375	180	40	361	180	137	432	216	137
417	203	43	Steel HP 12 X 84			Steel HP 14 X 89		
441	216	45	350	174	127	352	172	92
451	222	48	358	178	132	361	177	97
458	226	49	366	183	137	371	182	102
465	230	50				380	187	107
473	234	51				390	193	112
480	238	52				399	198	117
488	242	53				409	203	122
495	246	54				418	208	127
502	250	55				428	214	132
510	254	56				437	219	137
Steel HP 8 X 36						Steel HP 14 X 102		
225	111	137				356	174	92
Steel HP 10 X 42						366	179	97
284	141	137				376	185	102
						385	190	107
						395	195	112
						405	201	117
						414	206	122
						424	211	127
						433	216	132
						443	222	137
						Steel HP 14 X 117		
						361	177	92
						371	182	97
						381	187	102
						390	193	107
						400	198	112
						410	203	117
						419	209	122
						429	214	127
						439	219	132
						449	225	137
						Precast 14"x 14"		
						262	111	33
						Timber Pile		
						144	57	33

Pile Design Table for PIER 2 utilizing Boring #B-2

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			Steel HP 10 X 57			Steel HP 14 X 73		
234	106	30	309	154	137	360	176	77
Metal Shell 12"Φ w/.25" walls			Steel HP 12 X 53			367	180	82
344	166	37	353	176	122	375	184	87
Metal Shell 14"Φ w/.25" walls						383	189	92
335	157	35	360	179	127	391	193	97
Metal Shell 14"Φ w/.312" walls						399	197	102
335	157	35	373	187	137	407	202	107
437	214	37	Steel HP 12 X 63			415	206	112
492	244	40	350	174	117	423	210	117
Steel HP 8 X 36			357	177	122	431	215	122
241	120	137	363	181	127	439	219	127
Steel HP 10 X 42			370	185	132	447	224	132
302	151	137	377	188	137	454	228	137
			Steel HP 12 X 74			Steel HP 14 X 89		
			355	176	117	361	176	75
			362	180	122	364	178	77
			369	184	127	372	182	82
			375	187	132	380	187	87
			382	191	137	388	191	92
			Steel HP 12 X 84			396	196	97
			353	175	112	404	200	102
			360	179	117	412	204	107
			367	183	122	420	209	112
			374	186	127	428	213	117
			381	190	132	436	218	122
			388	194	137	444	222	127
						452	226	132
						460	231	137
						Steel HP 14 X 102		
						362	177	73
						366	179	75
						369	180	77
						377	185	82
						385	189	87
						393	194	92
						401	198	97
						409	203	102
						417	207	107
						425	212	112
						434	216	117
						442	220	122
						450	225	127
						458	229	132
						466	234	137
						Steel HP 14 X 117		
						361	176	69
						364	177	71
						367	179	73
						370	181	75
						374	183	77
						382	187	82
						390	192	87
						398	196	92
						406	201	97
						414	205	102
						423	210	107
						431	214	112
						439	219	117
						447	223	122
						455	228	127
						463	232	132
						472	237	137
						Precast 14"x 14"		
						199	75	27
						Timber Pile		
						103	34	27

**006-0187 IL 26 OVER BUREAU CREEK
PIER 1 BORING B4 (1972) & 02 (2019)**

PRELIMINARY VALUES

APPROXIMATE SCOUR ELEVATION = 609 FEET
 COHESIVE SKIN FRICTION RESISTANCE FACTOR = 0.45
 COHESIVE TIP RESISTANCE RESISTANCE FACTOR = 0.40
 GRANULAR SKIN FRICTION RESISTANCE FACTOR = 0.55
 GRANULAR TIP RESISTANCE RESISTANCE FACTOR = 0.50

DEPTH BELOW SCOUR ELEVATION		UNFACTORED COHESIVE UNIT SKIN FRICTION		UNFACTORED GRANULAR UNIT SKIN FRICTION		DIAMETER = 2.50 FEET CIRCUMFERENCE = 7.85 FEET TIP AREA = 4.91 SQ FEET			DIAMETER = 3.00 FEET CIRCUMFERENCE = 9.42 FEET TIP AREA = 7.07 SQ FEET			DIAMETER = 4.00 FEET CIRCUMFERENCE = 12.57 FEET TIP AREA = 12.57 SQ FEET		
FEET	FEET	q _c KSF	q _c KSF	DIAMETER = 2.5 FEET CUMULATIVE SKIN RESISTANCE FACTORED KIP	DIAMETER = 2.5 FEET TIP RESISTANCE FACTORED KIP	DIAMETER = 2.5 FEET TOTAL RESISTANCE FACTORED KIP	DIAMETER = 3 FEET CUMULATIVE SKIN RESISTANCE FACTORED KIP	DIAMETER = 3 FEET TIP RESISTANCE FACTORED KIP	DIAMETER = 3 FEET TOTAL RESISTANCE FACTORED KIP	DIAMETER = 4 FEET CUMULATIVE SKIN RESISTANCE FACTORED KIP	DIAMETER = 4 FEET TIP RESISTANCE FACTORED KIP	DIAMETER = 4 FEET TOTAL RESISTANCE FACTORED KIP		
1	608	1.98	0	6.99	49.2	56.2	8.39	70.0	78.4	11.19	122.4	133.6		
2	607	1.98	0	13.99	52.4	66.4	16.79	73.7	90.5	22.38	127.2	149.6		
3	606	2.05	0	21.22	55.0	76.2	25.46	76.7	102.1	33.95	130.6	164.6		
4	605	2.05	0	28.45	59.9	88.3	34.13	82.7	116.9	45.51	139.3	184.8		
5	604	2.01	0	35.56	65.1	100.7	42.67	89.3	132.0	56.89	148.9	205.8		
6	603	2.01	0	42.67	70.6	113.3	51.21	96.2	147.4	68.27	158.8	227.1		
7	602	1.91	0	49.42	74.8	124.2	59.30	105.3	164.6	79.07	172.4	251.4		
8	601	1.91	0	56.16	78.0	134.2	67.40	112.4	179.8	89.86	186.5	276.3		
9	600	1.91	0	62.91	81.3	144.2	75.49	119.5	195.5	100.65	201.2	301.8		
10	599	2.19	0	70.67	81.9	152.5	84.80	117.9	202.7	113.06	209.6	322.7		
11	598	2.19	0	78.42	82.5	160.9	94.11	118.8	212.9	125.48	211.1	336.6		
12	597	2.19	0	86.18	83.4	169.5	103.42	120.0	223.4	137.89	213.4	351.3		
13	596	2.25	0	94.12	83.6	177.8	112.95	120.4	233.4	150.60	214.1	364.7		
14	595	2.25	0	102.07	84.5	186.6	122.48	121.7	244.2	163.31	216.4	379.7		
15	594	2.25	0	110.02	85.4	195.4	132.02	123.0	255.0	176.02	218.7	394.7		
16	593	2.25	0	117.96	86.3	204.3	141.55	124.3	265.8	188.74	220.9	409.7		
17	592	2.25	0	125.91	87.5	213.4	151.09	126.0	277.0	201.45	223.9	425.4		
18	591	2.27	0	133.94	88.4	222.3	160.73	127.2	288.0	214.30	226.2	440.5		
19	590	2.27	0	141.97	89.2	231.2	170.37	128.5	298.9	227.16	228.5	455.6		
20	589	2.32	0	150.18	90.0	240.1	180.11	130.3	310.3	240.28	232.5	480.8		
21	588	2.32	0	158.38	98.7	257.0	190.05	142.1	332.1	253.41	252.6	506.0		
22	587	2.32	0	166.58	103.4	270.0	199.90	148.9	348.8	266.53	264.6	531.2		
23	586	2.34	0	174.86	107.8	282.7	209.83	155.2	365.1	279.78	276.0	555.7		
24	585	2.34	0	183.14	112.2	295.4	219.77	161.6	381.4	293.03	287.3	580.3		
25	584	2.34	0	191.42	116.6	308.1	229.71	167.9	397.7	306.28	298.6	604.9		
26	583	2.37	0	201.92	116.6	318.6	241.21	167.9	410.3	323.07	298.6	621.7		
27	582	2.97	0	212.42	122.8	335.2	254.90	176.9	431.8	339.87	314.4	654.3		
28	581	2.97	0	222.91	129.0	351.9	267.50	185.8	453.3	356.66	330.2	686.9		
29	580	2.97	0	233.41	135.2	368.6	280.09	194.7	474.8	373.46	346.1	719.5		
30	579	2.97	0	243.91	141.4	385.3	292.69	203.6	496.3	390.25	361.9	752.2		
31	578	2.97	0	254.41	146.1	400.5	305.29	210.4	515.6	407.05	374.0	785.0		
32	577	2.97	0	264.90	150.8	415.7	317.88	217.1	535.0	423.84	386.0	809.9		
33	576	3.92	0	278.74	149.3	428.1	334.49	215.0	549.5	445.98	382.3	828.3		
34	575	3.92	0	292.58	147.9	440.4	351.09	212.9	564.0	468.12	378.5	846.6		
35	574	3.92	0	306.41	128.1	434.5	367.69	184.5	552.2	490.26	328.0	818.2		
36	573	3.92	0	320.25	108.4	428.6	384.30	156.1	540.4	512.40	277.5	789.9		
37	572	3.69	0	333.29	90.1	423.4	399.95	129.8	529.7	533.27	230.7	764.0		
38	571	3.69	0	346.33	71.9	418.2	415.60	103.5	519.1	554.13	184.0	738.1		
39	570	3.69	0	359.37	53.6	413.0	431.25	77.2	508.4	575.00	137.2	712.2		
40	569	3.69	0	372.42	35.3	407.8	446.90	50.9	497.8	595.86	90.5	686.3		
41	568	1.10	0	376.30	35.3	411.6	451.56	50.9	502.5	602.08	90.5	692.6		
42	567	1.10	0	380.19	35.3	415.5	456.23	50.9	507.1	608.31	90.5	698.8		
43	566	1.10	0	384.08	35.3	419.4	460.89	50.9	511.8	614.54	90.5	705.0		
44	565	1.10	0	387.97	35.3	423.3	465.56	50.9	516.5	620.75	90.5	711.2		
45	564	1.10	0	391.85	35.3	427.2	470.22	50.9	521.1	626.97	90.5	717.4		
46	563	1.10	0	395.74	35.3	431.1	474.89	50.9	525.8	633.19	90.5	723.7		
47	562	1.10	0	399.63	35.3	435.0	479.56	50.9	530.4	639.41	90.5	729.9		
48	561	1.10	0	403.52	35.3	438.9	484.22	50.9	535.1	645.63	90.5	736.1		
49	560	1.10	0	407.40	35.3	442.7	488.89	50.9	539.8	651.85	90.5	742.3		
50	559	1.10	0	411.29	35.3	446.6	493.55	50.9	544.4	658.07	90.5	748.5		
51	558	1.10	0	415.18	35.3	450.5	498.22	50.9	549.1	664.29	90.5	754.8		
52	557	1.10	0	419.07	35.3	454.4	502.88	50.9	553.8	670.51	90.5	761.0		
53	556	1.10	0	422.96	35.3	458.3	507.55	50.9	558.4	676.73	90.5	767.2		
54	555	1.10	0	426.84	35.3	462.2	512.21	50.9	563.1	682.95	90.5	773.4		
55	554	1.10	0	430.73	35.3	466.1	516.88	50.9	567.8	689.17	90.5	779.6		
56	553	1.10	0	434.62	35.3	470.0	521.54	50.9	572.4	695.39	90.5	785.9		
57	552	1.10	0	438.51	35.3	473.8	526.21	50.9	577.1	701.61	90.5	792.1		
58	551	1.10	0	442.39	35.3	477.7	530.87	50.9	581.8	707.83	90.5	798.3		
59	550	1.10	0	446.28	35.3	481.6	535.54	50.9	586.5	714.05	90.5	804.5		
60	549	1.10	0	450.17	35.3	485.5	540.20	50.9	591.1	720.27	90.5	810.7		
61	548	1.10	0	454.06	35.3	489.4	544.87	50.9	595.8	726.49	90.5	817.0		
62	547	1.10	0	457.95	35.3	493.3	549.53	50.9	600.4	732.71	90.5	823.2		
63	546	1.10	0	461.83	35.3	497.2	554.20	50.9	605.1	738.93	90.5	829.4		
64	545	1.10	0	465.72	35.3	501.1	558.86	50.9	609.8	745.15	90.5	835.6		
65	544	1.10	0	469.61	35.3	505.0	563.53	50.9	614.4	751.37	90.5	841.9		
66	543	1.10	0	473.50	35.3	508.8	568.20	50.9	619.1	757.59	90.5	848.1		
67	542	1.10	0	477.38	35.3	512.7	572.86	50.9	623.8	763.81	90.5	854.3		
68	541	1.10	0	481.27	32.4	513.7	577.53	46.7	624.2	770.03	82.9	853.0		
69	540	1.10	0	485.16	31.8	517.0	582.19	45.8	628.0	776.25	81.4	857.7		
70	539	1.10	0	489.05	30.0	520.0	586.86	44.5	631.4	782.48	79.2	861.6		
71	538	1.10	0	492.93	29.5	522.4	591.52	42.4	633.9	788.70	75.4	864.1		
72	537	1.10	0	496.82	26.5	523.3	596.19	38.2	634.4	794.92	67.9	862.8		
73	536	1.10	0	500.71	17.7	518.4	600.85	25.4	626.3	801.14	45.2	846.4		
0	0	0.55	0	500.71			600.85			801.14				

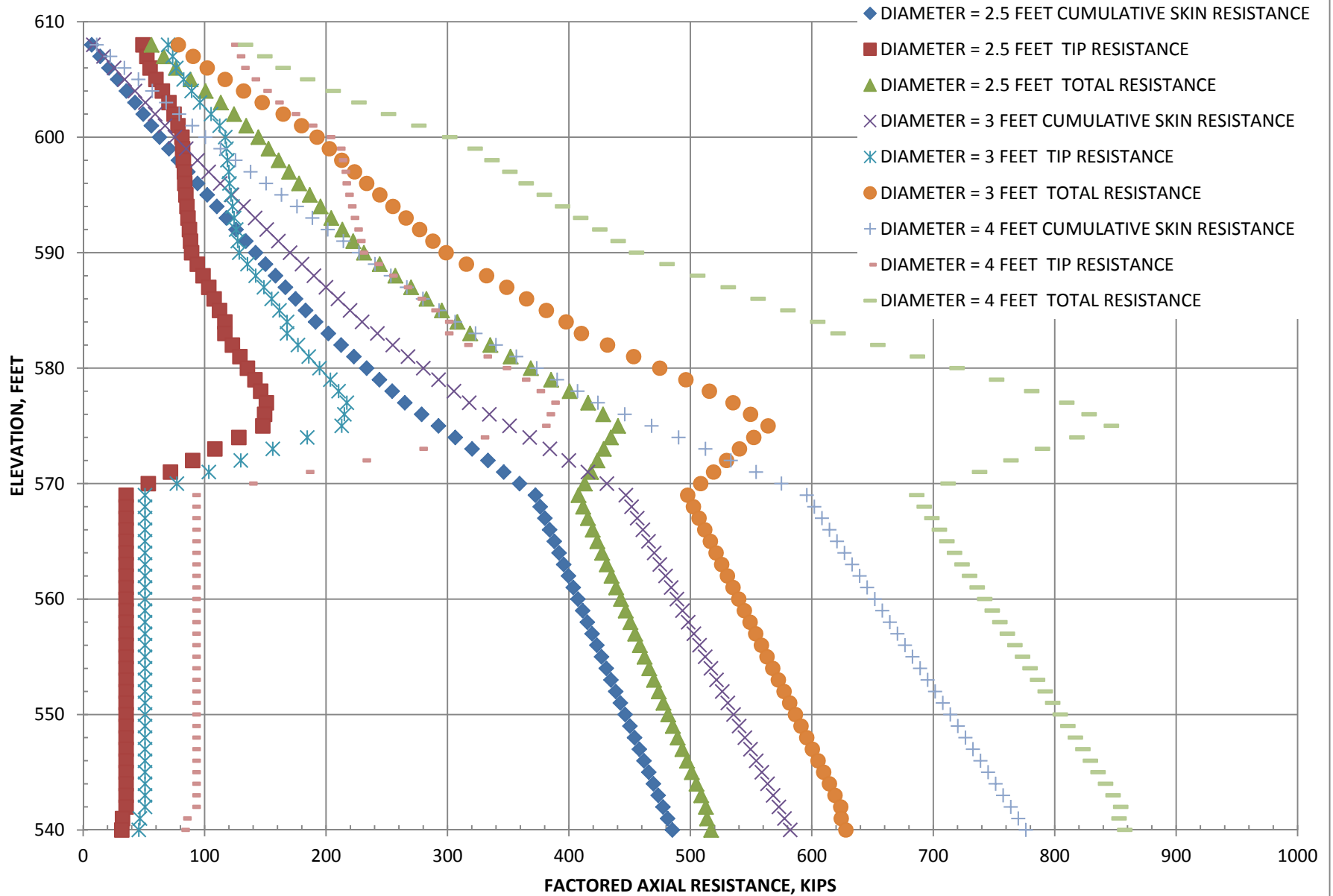
UNFACTORED COHESIVE UNIT SKIN FRICTION = q_c = α S_v (AASHTO 10.8.3.5.1b-1)
 UNFACTORED GRANULAR UNIT SKIN FRICTION = q_c = β σ_v (AASHTO 10.8.3.5.2b-1)

UNFACTORED COHESIVE TIP RESISTANCE = Q_c = N_s <= 80.0 ksf (AASHTO 10.8.3.5.1c-1)
 UNFACTORED GRANULAR TIP RESISTANCE = Q_c = 1.2 N₆₀ if N₆₀ <= 50 (AASHTO 10.8.3.5.2c-1)

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PIER 1 - BORING B4 (1972) & 02 (2019)



006-0187 IL 26 OVER BUREAU CREEK
PIER 2 BORING B2 (1972)

PRELIMINARY VALUES

APPROXIMATE SCOUR ELEVATION = 609 FEET
 COHESIVE SKIN FRICTION RESISTANCE FACTOR = 0.45
 COHESIVE TIP RESISTANCE RESISTANCE FACTOR = 0.40
 GRANULAR SKIN FRICTION RESISTANCE FACTOR = 0.55
 GRANULAR TIP RESISTANCE RESISTANCE FACTOR = 0.50

DEPTH BELOW SCOUR ELEVATION	ELEVATION	UNFACTORED COHESIVE UNIT SKIN FRICTION		DIAMETER = 2.5 FEET CUMULATIVE SKIN RESISTANCE			DIAMETER = 3 FEET CUMULATIVE SKIN RESISTANCE			DIAMETER = 4 FEET CUMULATIVE SKIN RESISTANCE		
		q _s	KSF	DIAMETER = 2.5 FEET FACTORED KIP	DIAMETER = 2.5 FEET TIP RESISTANCE FACTORED KIP	DIAMETER = 2.5 FEET TOTAL RESISTANCE FACTORED KIP	DIAMETER = 3 FEET FACTORED KIP	DIAMETER = 3 FEET TIP RESISTANCE FACTORED KIP	DIAMETER = 3 FEET TOTAL RESISTANCE FACTORED KIP	DIAMETER = 4 FEET FACTORED KIP	DIAMETER = 4 FEET TIP RESISTANCE FACTORED KIP	DIAMETER = 4 FEET TOTAL RESISTANCE FACTORED KIP
1	608	2.11	0	7.45	54.7	62.2	8.94	77.8	86.8	11.92	136.2	148.1
2	607	2.11	0	14.90	59.7	74.6	17.88	84.0	101.8	23.84	144.9	168.7
3	606	2.11	0	22.35	64.8	87.1	26.82	90.3	117.1	35.76	153.8	189.5
4	605	2.14	0	29.91	69.7	99.6	35.89	96.3	132.2	47.85	162.3	210.1
5	604	2.14	0	37.46	72.8	114.8	44.95	99.9	144.9	59.94	166.5	226.4
6	603	2.14	0	45.02	74.8	130.9	54.02	105.3	157.3	72.03	170.6	242.6
7	602	2.19	0	52.77	75.1	147.9	63.33	105.7	169.1	84.44	173.0	257.5
8	601	2.22	0	60.63	71.6	164.5	72.75	103.1	175.8	97.00	171.0	268.0
9	600	2.22	0	68.48	68.0	181.5	82.18	98.0	180.1	109.57	168.4	277.9
10	599	2.22	0	76.33	64.5	198.0	91.60	92.9	184.5	122.13	165.1	287.3
11	598	2.01	0	83.45	67.7	215.2	100.13	97.5	197.7	133.51	173.4	306.9
12	597	2.01	0	90.56	71.0	232.5	108.67	102.2	210.9	144.89	181.7	326.6
13	596	2.01	0	97.67	74.8	249.8	117.21	107.7	224.9	156.27	191.5	347.8
14	595	1.83	0	104.16	80.1	267.0	125.74	112.4	239.3	167.65	205.1	371.7
15	594	1.83	0	110.64	85.4	284.2	132.77	123.0	255.8	177.02	218.7	395.7
16	593	1.83	0	117.12	93.4	301.5	140.55	134.4	275.0	187.40	239.0	426.4
17	592	2.32	0	125.33	96.6	318.8	150.39	139.1	289.5	200.52	247.3	447.8
18	591	2.32	0	133.53	100.4	336.0	160.24	144.6	304.9	213.65	257.1	470.8
19	590	2.36	0	141.89	103.7	353.3	170.26	149.3	319.6	227.02	265.4	492.4
20	589	2.36	0	150.24	107.0	370.6	180.29	154.0	334.2	240.39	273.7	514.1
21	588	2.36	0	158.60	109.9	387.9	190.32	158.2	348.5	253.76	281.2	535.0
22	587	2.75	0	168.30	110.2	405.2	201.96	158.6	360.6	269.28	282.0	551.3
23	586	2.75	0	178.00	110.4	422.5	213.60	159.0	372.6	284.81	282.7	567.5
24	585	2.84	0	188.02	110.2	439.8	225.63	158.6	384.2	300.84	282.0	582.8
25	584	2.84	0	198.04	109.9	457.1	237.65	158.2	395.8	316.87	281.2	598.1
26	583	2.84	0	208.06	109.6	474.4	249.67	157.8	407.4	332.90	280.5	613.4
27	582	2.79	0	217.92	107.6	491.7	261.52	157.0	418.9	348.68	280.5	629.7
28	581	2.79	0	227.78	106.3	509.0	273.34	153.1	426.4	364.45	272.2	636.6
29	580	2.79	0	237.64	103.1	526.3	285.17	148.4	433.6	380.23	263.9	644.1
30	579	2.79	0	247.51	97.2	543.6	297.01	140.0	437.0	396.01	248.8	644.8
31	578	2.79	0	257.37	91.3	560.9	308.84	131.5	440.3	411.79	233.7	645.5
32	577	2.79	0	267.23	85.4	578.2	320.67	123.0	443.7	427.56	218.7	646.2
33	576	2.79	0	277.09	78.3	595.5	332.50	112.8	445.3	443.34	200.6	643.9
34	575	2.34	0	285.37	74.5	612.8	344.34	107.3	449.7	456.59	190.8	647.3
35	574	2.34	0	293.65	65.4	630.1	356.17	94.2	446.5	469.84	167.4	637.2
36	573	2.11	0	301.10	58.9	647.4	368.00	84.8	446.1	481.76	150.8	632.6
37	572	2.11	0	308.55	52.4	664.7	379.83	75.5	445.8	493.68	134.2	627.9
38	571	2.11	0	316.00	45.9	682.0	391.66	66.2	445.4	505.60	117.6	623.2
39	570	1.98	0	322.99	40.6	699.3	403.49	58.5	446.1	517.52	104.0	620.8
40	569	1.98	0	329.99	35.3	716.6	415.32	50.9	446.0	529.44	90.5	618.5
41	568	1.10	0	333.88	35.3	733.9	427.15	50.9	451.5	541.36	90.5	624.7
42	567	1.10	0	337.76	35.3	751.2	438.98	50.9	456.2	553.28	90.5	630.9
43	566	1.10	0	341.65	35.3	768.5	450.81	50.9	460.9	565.20	90.5	637.1
44	565	1.10	0	345.54	35.3	785.8	462.64	50.9	465.5	577.12	90.5	643.3
45	564	1.10	0	349.43	35.3	803.1	474.47	50.9	470.2	589.04	90.5	649.5
46	563	1.10	0	353.31	35.3	820.4	486.30	50.9	474.9	600.96	90.5	655.8
47	562	1.10	0	357.20	35.3	837.7	498.13	50.9	479.5	612.88	90.5	662.0
48	561	1.10	0	361.09	35.3	855.0	509.96	50.9	484.2	624.80	90.5	668.2
49	560	1.10	0	364.98	35.3	872.3	521.79	50.9	488.9	636.72	90.5	674.4
50	559	1.10	0	368.86	35.3	889.6	533.62	50.9	493.5	648.64	90.5	680.7
51	558	1.10	0	372.75	35.3	906.9	545.45	50.9	498.2	660.56	90.5	686.9
52	557	1.10	0	376.64	35.3	924.2	557.28	50.9	502.9	672.48	90.5	693.1
53	556	1.10	0	380.53	35.3	941.5	569.11	50.9	507.5	684.40	90.5	699.3
54	555	1.10	0	384.42	35.3	958.8	580.94	50.9	512.2	696.32	90.5	705.5
55	554	1.10	0	388.30	35.3	976.1	592.77	50.9	516.9	708.24	90.5	711.8
56	553	1.10	0	392.19	35.3	993.4	604.60	50.9	521.5	720.16	90.5	718.0
57	552	1.10	0	396.08	35.3	1010.7	616.43	50.9	526.2	732.08	90.5	724.2
58	551	1.10	0	399.97	35.3	1028.0	628.26	50.9	530.9	744.00	90.5	730.4
59	550	1.10	0	403.85	35.3	1045.3	640.09	50.9	535.5	755.92	90.5	736.6
60	549	1.10	0	407.74	35.3	1062.6	651.92	50.9	540.2	767.84	90.5	742.9
61	548	1.10	0	411.63	35.3	1079.9	663.75	50.9	544.8	779.76	90.5	749.1
62	547	1.10	0	415.52	35.3	1097.2	675.58	50.9	549.5	791.68	90.5	755.3
63	546	1.10	0	419.41	35.3	1114.5	687.41	50.9	554.1	803.60	90.5	761.5
64	545	1.10	0	423.29	35.3	1131.8	699.24	50.9	558.8	815.52	90.5	767.7
65	544	1.10	0	427.18	35.3	1149.1	711.07	50.9	563.5	827.44	90.5	774.0
66	543	1.10	0	431.07	35.3	1166.4	722.90	50.9	568.2	839.36	90.5	780.2
67	542	1.10	0	434.96	35.3	1183.7	734.73	50.9	572.8	851.28	90.5	786.4
68	541	1.10	0	438.84	32.4	1201.0	746.56	46.7	573.3	863.20	82.9	785.1
69	540	1.10	0	442.73	31.8	1218.3	758.39	45.8	577.1	875.12	81.4	789.8
70	539	1.10	0	446.62	30.9	1235.6	770.22	44.5	580.5	887.04	79.2	793.9
71	538	1.10	0	450.51	29.5	1252.9	782.05	42.4	583.0	898.96	75.4	796.2
72	537	1.10	0	454.39	26.5	1270.2	793.88	38.2	583.4	910.88	67.9	794.9
73	536	1.10	0	458.28	17.7	1287.5	805.71	25.4	575.4	922.80	45.2	778.5
0	0	0.55	0	458.28			805.71			922.80		

UNFACTORED COHESIVE UNIT SKIN FRICTION = q_s = α S_u (AASHTO 10.8.3.5.1b-1)

UNFACTORED GRANULAR UNIT SKIN FRICTION = q_s = βσ_v' (AASHTO 10.8.3.5.2b-1)

UNFACTORED COHESIVE TIP RESISTANCE = Q_u = N_c s_c <= 80.0 ksf (AASHTO 10.8.3.5.1c-1)

UNFACTORED GRANULAR TIP RESISTANCE = Q_u = 1.2N_q if m_{qc} <= 50 (AASHTO 10.8.3.5.2c-1)

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PIER 2 - BORING B2 (1972)

- ◆ DIAMETER = 2.5 FEET CUMULATIVE SKIN RESISTANCE
- DIAMETER = 2.5 FEET TIP RESISTANCE
- ▲ DIAMETER = 2.5 FEET TOTAL RESISTANCE
- × DIAMETER = 3 FEET CUMULATIVE SKIN RESISTANCE
- ✕ DIAMETER = 3 FEET TIP RESISTANCE
- DIAMETER = 3 FEET TOTAL RESISTANCE
- + DIAMETER = 4 FEET CUMULATIVE SKIN RESISTANCE
- DIAMETER = 4 FEET TIP RESISTANCE
- DIAMETER = 4 FEET TOTAL RESISTANCE

