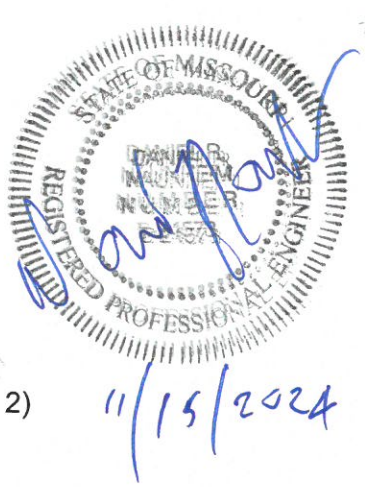

11/15/2024

MEMORANDUM

TO:	All Plan Holders
FROM:	Jefferson County
PROJECT:	Project Redbird – North Improvements (Phase 2)
DATE:	November 15, 2024
SUBJECT:	Addendum No. 1
PROJECT NUMBER:	SNS-0025

This addendum forms a part of the Contract Documents for the Jefferson County Project Redbird – North Improvements (Phase 2). Contractors are required to acknowledge the receipt of addenda by signing and including all addenda with each bid form. FAILURE TO ACKNOWLEDGE RECEIPT OF ADDENDUM MAY SUBJECT BIDDER TO DISQUALIFICATION.

Notice to Bidders:

1. **Move Bid Opening to November 26th**

   - Project Specifications have been amended to change the bid opening to as follows ""Sealed bids for Project Redbird (North) Phase 2, SNS – 0025, will be received at the office of the Department of the County Clerk, Jefferson County Administration Center, 729 Maple Street, Hillsboro, Missouri until 2:00 o'clock P.M. DST on November 26th, 2024, and at that time will be publicly opened and read."

     "Reference pages not included"

2. **Revised Sheet 3, Quantities, Sheet 3 of 17.**

   Updated SH-Flat Sheet quantity:
   - Updated Summary of Quantities for SH-Flat Sheet quantity to 221 S.F.

3. **Revised Sheet 149 (Pavement Marking & Signing Sheet 12 of 22).**

   Updated signs 22(b) and 23(b) to yield signs at railroad crossing.
   - Revised the signing callouts to say:

     "(b) R1-2, 36"x36""

4. **Revised Sheet 150 (Pavement Marking & Signing Sheet 13 of 22).**

   Updated signs 26(b) and 27(b) to yield signs at railroad crossing.
   - Revised the signing callouts to say:

     "(b) R1-2, 36"x36""

5. **Revised Sheet 159 (D-30 Sheet) (Pavement Marking & Signing Sheet 22 of 22).**

Revised JSP DDD – Uninterruptible Power Supply (City Intersections):

- Added R1-2 Yield 36" x 36" to sign assemblies and sign summary
- Removed stop signs R1-1 Stop 30" x 30" from signs 22, 23, 26, 27
- Added Yield signs R1-2 Yield 36" x 36" to signs 22, 23, 26, 27

6. **Revised Sheet 169 (St. Pius Drive Railroad Crossing)**

Revised callouts with sign 2 assembly

- Removed "By Others" from signing callouts

7. **Revised Sheet 170 (Airport Railroad Crossing)**

Revised callouts with yield and crossbuck sign assembly

- Removed "By Others" from signing callouts

8. **Revised Sheet 171 (Calvary Church Road Railroad Crossing)**

Revised callouts with yield and crossbuck sign assembly

- Removed "By Others" from signing callouts

9. **Revised Job Special Provisions (Railroad Coordination)**

Removed and replaced paragraph 2.1

- Removed paragraph 2.1 in its entirety and replaced with the following:

  2.1 In order to enter in and upon the Railroad's real property, right of way, tracks and other facilities (Railroad's Property) to perform the contractor's work relating to this project the contractor is required to follow the Railroad Requirements set forth in the agreement between the Union Pacific Railroad Company (Railroad) and Jefferson County, Missouri (County), the Contractor's Right of Entry (CROE) and the requirements of this specification.

Revised paragraph 5.2.c

- Removed "of $2,200" and replaced with "(amount depends on the type of work to be completed)"

Removed and replaced paragraph 6.3

- Removed paragraph 6.3 in its entirety and replaced with the following:

  6.3 The contractor's work shall not impede on the Railroad's operations.

Revised paragraph 8.2 Excavation.

- Revised "at least 12 feet from centerline" to read "at least 15 feet from centerline"
- Added the following sentence to the end of the paragraph:

  Refer to the Railroad's shoring guidelines.

Revised paragraph 13.1.3

- Removed John Moralez contact information and replaced with the following:

  Jared Treaster – Manager of Track Maintenance
  573-218-4382
  jtreast@up.com

10. **Issuing of The Geotechnical Report for the South Access Road**

- South Access Road Geotechnical report is attached and added in the project specifications. Please pay special attention to the benching and/or the geogrid backfill.

Name and Title of Signer (Print or type)
Contractor / Bidder Signature _____ (Signature of person authorized to sign)
Date Signed:

End of Addendum No. 1

PROJECT REDBIRD NORTH IMPROVEMENTS (PHASE 2) - SNS-0025

BASE BID FORM

PAY ITEM	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
		ROADWAY ITEMS				
1	2013000	CLEARING AND GRUBBING	ACRE	6		
2	2022010	REMOVAL OF IMPROVEMENTS	L.S.	1		
3	2031000	CLASS A EXCAVATION	C.Y.	18,363		
4	2035500	EMBANKMENT IN PLACE	C.Y.	58,081		
5	2036000	COMPACTING EMBANKMENT	C.Y.	11,056		
10	3040183	TYPE 1 AGGREGATE FOR BASE (8 IN. THICK)	S.Y.	7,120		
11	3040193	TYPE 1 AGGREGATE FOR BASE (9 IN. THICK)	S.Y.	657		
12	3040504	TYPE 5 AGGREGATE FOR BASE (4 IN. THICK)	S.Y.	4,996		
13	3040506	TYPE 5 AGGREGATE FOR BASE (6 IN. THICK)	S.Y.	20,040		
16	4011209	BITUMINOUS PAVEMENT MIXTURE PG64-22, (BP-1)	TON	1,206.6		
17	4013000	BITUMINOUS PAVEMENT MIXTURE PG64-22 (BASE)	TON	2,650.3		
18	4071007	TACK COAT - NON OR LOW TRACKING TACK	GAL	710		
19	5021308	CONCRETE PAVEMENT (8 IN. NON-REINFORCED, 15 FT. JOINTS)	S.Y.	1,043.4		
20	5021310	CONCRETE PAVEMENT (10 IN. NON-REINFORCED 15 FT. JOINTS)	S.Y.	17,640.2		
21	5024006	CONCRETE BASE (6 IN. NON-REINF)	S.Y.	1,691.1		
33	6071012A	CHAIN-LINK FENCE (60 IN.)	L.F.	1,154		
34	6079902 {A}	MISC. {BOLLARD}	EACH	4		
35	6079903 {A}	MISC. {SPECIAL CHAIN-LINK FENCE (60")}	L.F.	188		
36	6083006	6 IN. CONCRETE MEDIAN STRIP	S.Y.	26		
37	6085008	PAVED APPROACH, 8 IN.	S.Y.	1,728		
38	6086004	CONCRETE SIDEWALK, 4 IN.	S.Y.	16		
39	6091010	CONCRETE CURB (6 IN. HEIGHT AND UNDER) TYPE S	L.F.	366		
40	6092011	INTEGRAL CURB (6 IN. HEIGHT AND UNDER) TYPE A	L.F.	256		
48	6116010A	SLOPE PROTECTION	S.Y.	267		
53	6151000	OFFICE FOR ENGINEER	MONTHS	21		
64	6181000	MOBILIZATION	L.S.	1		
65	6181015	RAILROAD PLAN SUBMITTAL	L.S.	1		
66	6181020	ADDITIONAL MOBILIZATION FOR SEEDING	EACH	4		
67	6189902 {A}	MISC. {RAILROAD FLAGGER}	DAYS	30		
86	6274000	CONTRACTOR FURNISHED SURVEYING AND STAKING	L.S.	1		
					SUB-TOTAL ROADWAY ITEMS :	

		GUARDRAIL ITEMS				
31	6061061	MGS GUARDRAIL, 8 FT. POSTS, 6 FT. - 3 IN. SPACING	L.F.	859		
32	6063014	TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	8		
					SUB-TOTAL GUARDRAIL ITEMS :	

		UTILITY ITEMS				
22	6039902 {A}	MISC. {CUT AND CAP EXISTING WATERMAIN}	EACH	3		
23	6039902 {B}	MISC. {FIRE HYDRANT WITH AUXILIARY VALVE, VALVE BOX AND TEE}	EACH	2		
24	6039902 {C}	MISC. {TRANSFER EXISTING SERVICE CONNECTION}	EACH	1		

PROJECT REDBIRD NORTH IMPROVEMENTS (PHASE 2) - SNS-0025

BASE BID FORM

PAY ITEM	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
25	6039902 {D}	MISC. {ADJUST TO GRADE WATER VALVE}	EACH	7		
26	6039902 {E}	MISC. {ADJUST TO GRADE WATER METER}	EACH	2		
27	6039903 {A}	MISC. {6 IN. DIAMETER WATERMAIN}	L.F.	895		
28	6039932 {A}	MISC. {ADJUST TO GRADE GAS VALVE}	EACH	3		
29	6042010	ADJUSTING MANHOLE	EACH	1		
30	6049902 {A}	MISC. {POT HOLING FOR UTILITY FACILITIES}	EACH	30		
					SUB-TOTAL UTILITY ITEMS :	
		DRAINAGE ITEMS				
6	2063000	CLASS 3 EXCAVATION	C.Y.	901		
7	2063300	CLASS 4 EXCAVATION	C.Y.	710		
8	2069901 {A}	MISC. {DEWATERING}	L.S.	2		
9	2069901 {B}	MISC. {BYPASS PUMPING}	L.S.	2		
14	3049905 {A}	MISC. {TYPE 5 AGGREGATE FOR BASE (18 IN. THICK)}	S.Y.	200		
15	3049905 {B}	MISC. {TYPE 5 AGGREGATE FOR BASE (24 IN. THICK)}	S.Y.	497		
49	6141021	GRATE AND BEARING PLATE (3 FT. X 2 FT.)	EACH	5		
50	6141024	GRATE AND BEARING PLATE (5 FT. X 3 FT.)	EACH	1		
51	6143014	MANHOLE FRAME AND COVER, TYPE 4	EACH	9		
52	6149902 {A}	MISC. {CONVERT INLET TO MANHOLE}	EACH	1		
87	7034001	CLASS B-1 CONCRETE	C.Y.	519		
88	7061020	REINFORCING STEEL (CULVERTS-BRIDGE)	LBS	74,280		
89	7250321A	21 IN. PIPE GROUP B	L.F.	54		
90	7250330A	30 IN. PIPE GROUP B	L.F.	62		
91	7261012	12 IN. PIPE GROUP A	L.F.	61		
92	7261015	15 IN. PIPE GROUP A	L.F.	299		
93	7261018	18 IN. PIPE GROUP A	L.F.	72		
94	7261024	24 IN. PIPE GROUP A	L.F.	115		
95	7261030	30 IN. PIPE GROUP A	L.F.	47		
97	7261042	42 IN. PIPE GROUP A	L.F.	583		
98	7269923 {A}	MISC. {10 IN. PIPE, SANITARY SEWER}	L.F.	65		
99	7269924 {A}	MISC. {CONCRETE ENCASEMENT}	C.Y.	3		
100	7269924 {B}	MISC. {CONCRETE CRADLE}	C.Y.	1		
101	7310048	PRECAST CONCRETE MANHOLE - 48 IN.	L.F.	53		
102	7311032	PRECAST CONCRETE DROP INLET 3 FT X 2 FT	L.F.	22		
103	7311053	PRECAST CONCRETE DROP INLET 5 FT X 3 FT	L.F.	4		
104	7319913 {A}	MISC. {PRECAST CONCRETE MANHOLE 42 IN.}	FT	17		
105	7320021A	21 IN. OR ALLOWED SUBSTITUTE GROUP B FLARED END SECTION	EACH	2		
106	7320030A	30 IN. OR ALLOWED SUBSTITUTE GROUP B FLARED END SECTION	EACH	2		
107	7320615A	15 IN. OR ALLOWED SUBSTITUTE GROUP A FLARED END SECTION	EACH	6		
108	7320624A	24 IN. OR ALLOWED SUBSTITUTE GROUP A FLARED END SECTION	EACH	2		
109	7320630A	30 IN. OR ALLOWED SUBSTITUTE GROUP A FLARED END SECTION	EACH	1		
111	7320642A	42 IN. OR ALLOWED SUBSTITUTE GROUP A FLARED END SECTION	EACH	3		
					SUB-TOTAL DRAINAGE ITEMS :	
		EROSION CONTROL / GROUND COVERING ITEMS				
41	6096020	FURNISHING TYPE 2 ROCK DITCH LINER	C.Y.	60		
42	6096042	PLACING TYPE 2 ROCK DITCH LINER	C.Y.	60		

PROJECT REDBIRD NORTH IMPROVEMENTS (PHASE 2) - SNS-0025

BASE BID FORM

PAY ITEM	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
43	6097000	ROCK LINING	C.Y.	38		
44	6113010	FURNISHING TYPE 1 ROCK BLANKET	C.Y.	983		
45	6113020	FURNISHING TYPE 2 ROCK BLANKET	C.Y.	222		
46	6113030	PLACING TYPE 1 ROCK BLANKET	C.Y.	983		
47	6113040	PLACING TYPE 2 ROCK BLANKET	C.Y.	222		
85	6240103A	PERMANENT EROSION CONTROL GEOTEXTILE	S.Y.	2,591		
112	8031000A	TURF TYPE TALL FESCUE SODDING	S.Y.	9,766		
113	8041000	TOPSOIL	C.Y.	6,531		
114	8059919 {A}	MISC. {SEEDING}	ACRE	6.1		
115	8061005	ROCK DITCH CHECK	L.F.	604		
116	8061007A	CURB INLET CHECK	EACH	14		
117	8061016	SEDIMENT REMOVAL	C.Y.	150		
118	8061017	TEMPORARY SEEDING	ACRE	2.0		
119	8061019	SILT FENCE	L.F.	13,048		
120	8064134	TYPE 1D EROSION CONTROL BLANKET	S.Y.	29,421		
				SUB-TOTAL EROSION CONTROL :		

		TRAFFIC CONTROL ITEMS				
54	6161005	CONSTRUCTION SIGNS	S.F.	1,197		
55	6161008	ADVANCED WARNING RAIL SYSTEM	EACH	6		
56	6161025	CHANNELIZER (TRIM LINE)	EACH	226		
57	6161030	TYPE III MOVEABLE BARRICADE	EACH	55		
58	6161033	DIRECTIONAL INDICATOR BARRICADE	EACH	30		
59	6161040	FLASHING ARROW PANEL	EACH	4		
60	6161099	CHANGEABLE MESSAGE SIGN WITH COMMUNICATION INTERFACE, CONTRACTOR FURNISHED, CONTRACTOR RETAINED	EACH	10		
61	6173600D	"TEMPORARY TRAFFIC BARRIER, CONTRACTOR FURNISHED / RETAINED"	L.F.	388		
62	6174000A	TEMPORARY TRAFFIC BARRIER HEIGHT TRANSITION	EACH	2		
63	6175010A	RELOCATING TEMPORARY TRAFFIC BARRIER	L.F.	662		
68	6191000	PAVEMENT EDGE TREATMENT	L.F.	1,665		
				SUB-TOTAL TRAFFIC CONTROL :		

		STRIPING ITEMS				
69	6200015	PREFORMED THERMOPLASTIC PAVEMENT MARKING, 24 IN. WHITE	L.F.	680		
70	6200018	PREFORMED THERMOPLASTIC PAVEMENT MARKING, 24 IN. YELLOW	L.F.	167		
71	6200021	PREFORMED THERMOPLASTIC PAVEMENT MARKING, LEFT/RIGHT ARROW	EACH	12		
72	6200027	PREFORMED THERMOPLASTIC PAVEMENT MARKING, COMBINATION STR/LT/RT	EACH	3		
73	6200033	PREFORMED THERMOPLASTIC PAVEMENT MARKING, R/R CROSSING MARKER	EACH	5		
74	6200042	PREFORMED THERMOPLASTIC PAVEMENT MARKING, 12 IN WHITE, YIELD LINE TRIANGLES	EACH	22		
75	6205301B	TEMPORARY REMOVABLE MARKING TAPE 4 IN., WHITE	L.F.	8,528		
76	6205303B	TEMPORARY REMOVABLE MARKING TAPE 4 IN., YELLOW	L.F.	19,325		
77	6205901A	4 IN. YELLOW HIGH BUILD WATERBORNE PAVEMENT MARKING PAINT, TYPE L BEADS	L.F.	3,240		
78	6205902A	6 IN. WHITE HIGH BUILD WATERBORNE PAVEMENT MARKING PAINT, TYPE L BEADS	L.F.	3,198		
79	6206000C	4 IN. WHITE STANDARD WATERBORNE PAVEMENT MARKING PAINT, TYPE P BEADS	L.F.	11,710		
80	6206001C	4 IN. YELLOW STANDARD WATERBORNE PAVEMENT MARKING PAINT, TYPE P BEADS	L.F.	10,059		
81	6207001	PAVEMENT MARKING REMOVAL	L.F.	4,175		
82	6207002	PAVEMENT MARKING REMOVAL (SYMBOLS)	EACH	9		
83	6208076	4 IN. TEMPORARY PAVEMENT MARKING PAINT	L.F.	5,271		

PROJECT REDBIRD NORTH IMPROVEMENTS (PHASE 2) - SNS-0025

BASE BID FORM

PAY ITEM	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
84	6209902 {A}	MISC. {18 IN. WHITE ISLAND TUBULAR MARKER}	EACH	12		
					SUB-TOTAL SRIPING ITEMS:	
		TRAFFIC SIGNAL ITEMS				
121	9020213	SIGNAL HEAD, TYPE 3S	EACH	3		
122	9020513	SIGNAL HEAD, TYPE 3B	EACH	9		
123	9020514	SIGNAL HEAD, TYPE 4B	EACH	1		
124	9020515	SIGNAL HEAD, TYPE 5B	EACH	2		
125	9020833	SH-FLAT SHEET - SIGNAL SIGN	S.F.	106		
126	9020834	SIGNAL SIGN, MOUNTING HARDWARE	EACH	18		
127	9023230	POST, TYPE C, 30 FT. ARM	EACH	1		
128	9023235	POST, TYPE C, 35 FT. ARM	EACH	1		
129	9023240	POST, TYPE C, 40 FT. ARM	EACH	1		
130	9023255	POST, TYPE C, 55 FT. ARM	EACH	1		
131	9023355	POST, TYPE B, LONGEST ARM 55 FT.	EACH	1		
132	9024283	CONTROLLER ASSEMBLY HOUSING, NEMA TS2 CONTROLLER	EACH	1		
133	9025200	CONDUIT, 2 IN., TRENCH WITH TRACER WIRE	L.F.	140		
134	9025300	CONDUIT, 3 IN., TRENCH WITH TRACER WIRE	L.F.	279		
135	9027300	CONDUIT, 3 IN., PUSHED WITH TRACER WIRE	L.F.	362		
136	9028208	CABLE, 8 AWG 1 CONDUCTOR, POWER	L.F.	330		
137	9028311	CABLE, 16 AWG 7 CONDUCTOR	L.F.	3,520		
138	9028354	FIBER OPTIC CABLE, 24 - FIBER, 18 SINGLE MODE, 6 MULTIMODE	L.F.	130		
139	9028810	PULL BOX, PREFORMED CLASS 1	EACH	1		
140	9028811	PULL BOX, PREFORMED CLASS 2	EACH	2		
141	9028812	PULL BOX, PREFORMED CLASS 3	EACH	2		
142	9028816	PULL BOX, PREFORMED CLASS 5	EACH	1		
143	9029100	BASE, CONCRETE	C.Y.	18.2		
144	9029400	TEMPORARY TRAFFIC SIGNALS	L.S.	2		
145	9029901 {A}	MISC. {TRAFFIC SIGNAL MAINTENANCE & PROGRAMMING}	L.S.	1		
146	9029902 {A}	MISC. {NETWORK CONNECTED SIGNAL MONITOR}	EACH	1		
147	9029902 {B}	MISC. {PAD MOUNTED 120V/240V SIGNAL POWER SUPPLY AND LIGHTING CONTROLLER WITH UNINTERRUPTIBLE POWER SUPPLY}	EACH	1		
148	9029902 {C}	MISC. {ADJUST PULL BOX TO GRADE}	EACH	3		
149	9029903 {A}	MISC. {CCTV CAMERA CABLE}	L.F.	280		
163	9109901 {A}	MISC. {ITS ASSET MANAGEMENT TOOL}	L.S.	1		
164	9109901 {B}	MISC. {CONNECT EXISTING CCTV CAMERA}	L.S.	1		
165	9109902 {A}	MISC. {INSTALL MoDOT FURNISHED TRAFFIC SIGNAL CONTROLLER}	EACH	1		
166	9109902 {B}	MISC. {CONTRACTOR FURNISHED AND INSTALLED IP-ADDRESSABLE POWER STRIP}	EACH	1		
167	9109902 {C}	MISC. {INSTALL OR RELOCATE EXISTING COMMUNICATION EQUIPMENT}	EACH	1		
168	9109902 {D}	MISC. {SL DISTRICT TRAFFIC SIGNAL DETECTION SYSTEM}	EACH	1		
169	9109902 {E}	MISC. {INSTALL CONDUIT INTO EXISTING BOX}	EACH	2		
170	9109902 {F}	MISC. {WALL-MOUNT FIBER INTERCONNECT CENTER}	EACH	1		
171	9109902 {G}	MISC. {RACK-MOUNT FIBER INTERCONNECT CENTER}	EACH	1		
172	9109902 {H}	MISC. {SM FIBER OPTIC PIGTAIL}	EACH	8		
173	9109902 {I}	MISC. {SM FIBER OPTIC JUMPER}	EACH	8		
174	9109902 {J}	MISC. {FUSION SPLICE}	EACH	10		
175	9109903 {A}	MISC. {RELOCATE FIBER OPTIC CABLE, 24 STRAND}	L.F.	30		
					SUB-TOTAL TRAFFIC SIGNAL ITEMS :	

PROJECT REDBIRD NORTH IMPROVEMENTS (PHASE 2) - SNS-0025

BASE BID FORM

PAY ITEM	ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
		SIGNING ITEMS				
150	9031010	CONCRETE FOOTINGS, EMBEDDED	C.Y.	1		
151	9031220	PIPE POSTS	LBS	290		
152	9031270A	2 IN. PSST POST - 12 GA.	L.F.	171		
153	9031271A	DRIVEN POST ANCHOR FOR 2 IN. PSST - 12 GA.	EACH	14		
154	9031272A	2.25 IN. PSST POST INSERT (6 FOOT) - 12 GA.	EACH	26		
155	9031274	CONCRETE POST ANCHOR FOR 2 IN. PSST - 7 GA.	EACH	1		
156	9031280	2.5 IN. PSST POST - 12 GA.	L.F.	459		
157	9031281A	DRIVEN POST ANCHOR FOR 2.5 IN. PSST - 7 GA.	EACH	33		
158	9031241	BREAKAWAY ASSEMBLY (PERFORATED SQUARE STEEL TUBE)	EACH	26		
159	9035004A	SH-FLAT SHEET	S.F.	221		
160	9035069A	SHF-FLAT SHEET FLUORESCENT	S.F.	84		
161	9039902 {A}	MISC. {REMOVE AND RELOCATE EXISTING GROUND MOUNT SIGN ASSEMBLY}	EACH	7		
162	9039902 {C}	MISC. {PRIVATE SIGN REMOVAL AND RELOCATION}	EACH	4		
				SUB-TOTAL SIGNING ITEMS :		

QTY UPDATED

BASE BID TOTAL :	

SUMMARY OF QUANTITIES

LINE NO.	ITEM NO.	DESCRIPTION	UNIT	PART A QUANTITY BASE	PART A QUANTITY ALT. A	PART B QUANTITY ALT. B	TOTAL QUANTITY
118	8061017	TEMPORARY SEEDING	ACRE	2.0	----	----	**2.0**
119	8061019	SILT FENCE	L.F.	13,048	2,554	1,212	**16,814**
120	8064134	TYPE 1D EROSION CONTROL BLANKET	S.Y.	29,421	6,251	8,469	**44,141**
121	9020213	SIGNAL HEAD, TYPE 3S	EACH	3	----	----	**3**
122	9020513	SIGNAL HEAD, TYPE 3B	EACH	9	----	----	**9**
123	9020514	SIGNAL HEAD, TYPE 4B	EACH	1	----	----	**1**
124	9020515	SIGNAL HEAD, TYPE 5B	EACH	2	----	----	**2**
125	9020833	SH-FLAT SHEET - SIGNAL SIGN	S.F.	106	----	----	**106**
126	9020834	SIGNAL SIGN, MOUNTING HARDWARE	EACH	18	----	----	**18**
127	9023230	POST, TYPE C, 30 FT. ARM	EACH	1	----	----	**1**
128	9023235	POST, TYPE C, 35 FT. ARM	EACH	1	----	----	**1**
129	9023240	POST, TYPE C, 40 FT. ARM	EACH	1	----	----	**1**
130	9023255	POST, TYPE C, 55 FT. ARM	EACH	1	----	----	**1**
131	9023355	POST, TYPE B, LONGEST ARM 55 FT.	EACH	1	----	----	**1**
132	9024283	CONTROLLER ASSEMBLY HOUSING, NEMA TS2 CONTROLLER	EACH	1	----	----	**1**
133	9025200	CONDUIT, 2 IN., TRENCH WITH TRACER WIRE	L.F.	140	----	----	**140**
134	9025300	CONDUIT, 3 IN., TRENCH WITH TRACER WIRE	L.F.	279	----	----	**279**
135	9027300	CONDUIT, 3 IN., PUSHED WITH TRACER WIRE	L.F.	362	----	----	**362**
136	9028208	CABLE, 8 AWG 1 CONDUCTOR, POWER	L.F.	330	----	----	**330**
137	9028311	CABLE, 16 AWG 7 CONDUCTOR	L.F.	3,520	----	----	**3,520**
138	9028354	FIBER OPTIC CABLE, 24 - FIBER, 18 SINGLE MODE, 6 MULTIMODE	L.F.	130	----	----	**130**
139	9028810	PULL BOX, PREFORMED CLASS 1	EACH	1	----	----	**1**
140	9028811	PULL BOX, PREFORMED CLASS 2	EACH	2	----	----	**2**
141	9028812	PULL BOX, PREFORMED CLASS 3	EACH	2	----	----	**2**
142	9028816	PULL BOX, PREFORMED CLASS 5	EACH	1	----	----	**1**
143	9029100	BASE, CONCRETE	C.Y.	18.2	----	----	**18.2**
144	9029400	TEMPORARY TRAFFIC SIGNALS	L.S.	2	----	----	**2**
145	9029901 {A}	MISC. {TRAFFIC SIGNAL MAINTENANCE & PROGRAMMING}	L.S.	1	----	----	**1**
146	9029902 {A}	MISC. {NETWORK CONNECTED SIGNAL MONITOR}	EACH	1	----	----	**1**
147	9029902 {B}	MISC. {PAD MOUNTED 120V/240V SIGNAL POWER SUPPLY AND LIGHTING CONTROLLER WITH UNINTERRUPTIBLE POWER SUPPLY}	EACH	1	----	----	**1**
148	9029902 {C}	MISC. {ADJUST PULL BOX TO GRADE}	EACH	3	----	----	**3**
149	9029903 {A}	MISC. {CCTV CAMERA CABLE}	L.F.	280	----	----	**280**
150	9031010	CONCRETE FOOTINGS, EMBEDDED	C.Y.	1.4	----	----	**1.4**
151	9031220	PIPE POSTS	LBS	290	----	----	**290**
152	9031270A	2 IN. PSST POST - 12 GA.	L.F.	171	12	----	**183**
153	9031271A	DRIVEN POST ANCHOR FOR 2 IN. PSST - 12 GA.	EACH	14	1	----	**15**
154	9031272A	2.25 IN. PSST POST INSERT (6 FOOT) - 12 GA.	EACH	26	----	----	**26**
155	9031274	CONCRETE POST ANCHOR FOR 2 IN. PSST - 7 GA.	EACH	1	----	----	**1**
156	9031280	2.5 IN. PSST POST - 12 GA.	L.F.	459	----	----	**459**
157	9031281A	DRIVEN POST ANCHOR FOR 2.5 IN. PSST - 7 GA.	EACH	33	----	----	**33**
158	9031241	BREAKAWAY ASSEMBLY (PERFORATED SQUARE STEEL TUBE)	EACH	26	----	----	**26**
159	9035004A	SH-FLAT SHEET	S.F.	221	----	----	**221**
160	9035069A	SHF-FLAT SHEET FLUORESCENT	S.F.	84	6	----	**90**
161	9039902 {A}	MISC. {REMOVE AND RELOCATE EXISTING GROUND MOUNT SIGN ASSEMBLY}	EACH	7	----	----	**7**
162	9039902 {C}	MISC. {PRIVATE SIGN REMOVAL AND RELOCATION}	EACH	4	----	----	**4**
163	9109901 {A}	MISC. {ITS ASSET MANAGEMENT TOOL}	L.S.	1	----	----	**1**
164	9109901 {B}	MISC. {CONNECT EXISTING CCTV CAMERA}	L.S.	1	----	----	**1**
165	9109902 {A}	MISC. {INSTALL MoDOT FURNISHED TRAFFIC SIGNAL CONTROLLER}	EACH	1	----	----	**1**
166	9109902 {B}	MISC. {CONTRACTOR FURNISHED AND INSTALLED IP-ADDRESSABLE POWER STRIP}	EACH	1	----	----	**1**
167	9109902 {C}	MISC. {INSTALL OR RELOCATE EXISTING COMMUNICATION EQUIPMENT}	EACH	1	----	----	**1**
168	9109902 {D}	MISC. {SL DISTRICT TRAFFIC SIGNAL DETECTION SYSTEM}	EACH	1	----	----	**1**
169	9109902 {E}	MISC. {INSTALL CONDUIT INTO EXISTING BOX}	EACH	2	----	----	**2**
170	9109902 {F}	MISC. {WALL-MOUNT FIBER INTERCONNECT CENTER}	EACH	1	----	----	**1**
171	9109902 {G}	MISC. {RACK-MOUNT FIBER INTERCONNECT CENTER}	EACH	1	----	----	**1**
172	9109902 {H}	MISC. {SM FIBER OPTIC PIGTAIL}	EACH	8	----	----	**8**
173	9109902 {I}	MISC. {SM FIBER OPTIC JUMPER}	EACH	8	----	----	**8**
174	9109902 {J}	MISC. {FUSION SPLICE}	EACH	10	----	----	**10**
175	9109903 {A}	MISC. {RELOCATE FIBER OPTIC CABLE, 24 STRAND}	L.F.	30	----	----	**30**

1 QTY UPDATED

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STATE OF MISSOURI
TODD EHLEN
NUMBER PE-2006019649
PROFESSIONAL ENGINEER
10/29/2024

DATE PREPARED
10/16/2024

STATE MO | SHEET NO. 3

COUNTY
JEFFERSON

JOB NO.
SNS-0025

DATE	DESCRIPTION
10/29/24	ADDENDUM 1: SIGNING REVISION AT RAILROADS

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

JEFFERSON COUNTY, MISSOURI
DEPARTMENT OF PUBLIC WORKS
MAPLE STREET ANNEX
725 MAPLE STREET
HILLSBORO, MO 63050
(636) 797-5340
WWW.JEFFCO.ORG

CMT

CRAWFORD, MURPHY, & TILLY, INC.
ONE MEMORIAL DRIVE, SUITE 500
ST. LOUIS, MO 63102 (314) 435-8500
ENGINEERING CORPORATION - 000631

QUANTITIES
SHEET 3 OF 17

PROJECT REDBIRD
NORTH IMPROVEMENTS
(PHASE 2)

DISCLAIMER

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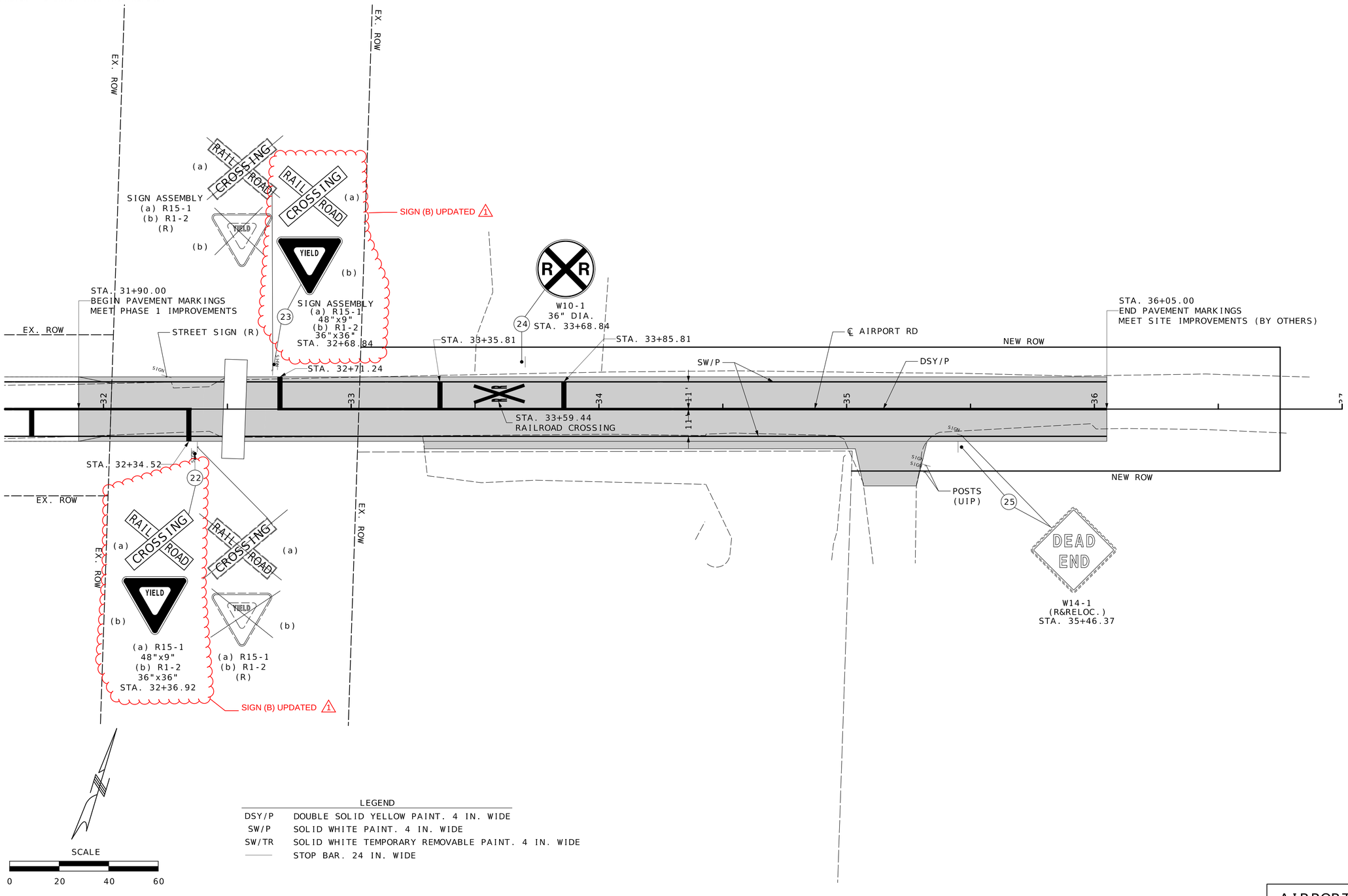

LEGEND

DSY/P	DOUBLE SOLID YELLOW PAINT. 4 IN. WIDE
SW/P	SOLID WHITE PAINT. 4 IN. WIDE
SW/TR	SOLID WHITE TEMPORARY REMOVABLE PAINT. 4 IN. WIDE
———	STOP BAR. 24 IN. WIDE

SCALE

0 20 40 60

AIRPORT ROAD

STATE OF MISSOURI
TODD EHLEN NUMBER PE-2006019649
PROFESSIONAL ENGINEER
10/29/2024

DATE PREPARED
10/29/2024

STATE MO | SHEET NO. 149

COUNTY
JEFFERSON

JOB NO.
SNS-0025

DATE	DESCRIPTION
10/29/24	ADDENDUM 1: SIGNING REVISION AT RAILROADS

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

JEFFERSON COUNTY, MISSOURI
DEPARTMENT OF PUBLIC WORKS
MAPLE STREET ANNEX
725 MAPLE STREET
HILLSBORO, MO 63050
(636) 797-5340
WWW.JEFFCO.ORG

CMT
CRAWFORD, MURPHY, & TILLY, INC.
ONE MEMORIAL DRIVE, SUITE 300
ST. LOUIS, MO 63102-2430 (314) 436-3500
ENGINEERING CORPORATION - 000631

PAVEMENT MARKING & SIGNING
SHEET 12 OF 22

PROJECT REDBIRD
NORTH IMPROVEMENTS
(PHASE 2)

DISCLAIMER
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STATE OF MISSOURI
TODD EHLEN NUMBER PE-2006019649
PROFESSIONAL ENGINEER
10/29/2024

DATE PREPARED
10/29/2024

STATE MO | SHEET NO. 150

COUNTY
JEFFERSON

JOB NO.
SNS-0025

DESCRIPTION | DATE
ADDENDUM 1: SIGNING REVISION AT RAILROADS | 10/29/24

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

JEFFERSON COUNTY, MISSOURI
DEPARTMENT OF PUBLIC WORKS
MAPLE STREET ANNEX
725 MAPLE STREET
HILLSBORO, MO 63050
(636) 797-5340
WWW.JEFFCO.ORG

CMT
CRAWFORD, MURPHY & TILLY, INC.
ONE MEMORIAL DRIVE, SUITE 500
ST. LOUIS, MO 63102-2430 (314) 436-5500
ENGINEERING CORPORATION - 000631

EX. ROW
EX. ROW
EX. ROW
EX. ROW
EX. ROW
EX. ROW

BEGIN PAVEMENT MARKING
STA. 1007+20.00 CALVARY CHURCH ROAD

STA. 1007+31.73
RAILROAD CROSSING

℄ CALVARY ROAD

STA. 1008+14.53
STOP BAR

STA. 1007+56.44

STA. 1008+60.35
STOP BAR

STA. 1009+44.05
RAILROAD CROSSING

STA. 1009+69.10

STA. 1009+19.10

DSY/P

SW/P

1007 1008 1009 1010 1011

15' 15' 11' 11'

MATCHLINE STA. 1011+40.00

SIGN ASSEMBLY
(a) R15-1
48"x9"
(b) R1-2
36"x36"
STA. 1008+60.21

SIGN (B) UPDATED 1

(a) RAIL CROSSING ROAD
(b) YIELD

W10-1
36" DIA.
STA. 1009+57.78

(a) R15-1
(b) R1-2
(R)

SIGN ASSEMBLY
(a) R15-1
48"x9"
(b) R1-2
36"x36"
STA. 1008+14.67

1 SIGN (B) UPDATED

(a) R15-1
(b) R1-2
(R)

LEGEND

DSY/P	DOUBLE SOLID YELLOW PAINT. 4 IN. WIDE
SW/P	SOLID WHITE PAINT. 4 IN. WIDE
SW/TR	SOLID WHITE TEMPORARY REMOVABLE PAINT. 4 IN. WIDE
———	STOP BAR. 24 IN. WIDE

SCALE
0 20 40 60

CALVARY CHURCH ROAD

PAVEMENT MARKING & SIGNING
SHEET 13 OF 22

PROJECT REDBIRD
SOUTH IMPROVEMENTS
(PHASE 2)

M:\JeffersonCO\23005922-00_ProjectRedbird\592200\PavementMarking\Sheets\04_Pvmtmrk_Signing_592200_SAR Plan.dgn 1:20:37 PM 10/29/2024

D-30 SHEET

STANDARD SIGN ASSEMBLIES

SIGN NUMBER	STATION	LOCATION	ROADWAY	TYPE: W12-1	R1-1	R1-3P	D3-1*	D3-1*	W14-2	R2-1	R2-1	W1-2R	W10-1	R15-1	W1-2L	W1-3R	W4-4P	D3-1*	D3-1*	D3-1*	W10-4	R1-2	D3-1*	D3-1*	R1-2	M1-1	M6-3	M1-4	M1-4	M6-1L	R5-1	R5-1A
				SIGN DESCRIPTION, SIZES & NUMBER OF EACH *																													
				DOUBLE ARROW 30" x 30"	STOP 30" x 30"	ALL-WAY (PLAQUE) 18" x 6"	ST. PIUS SPUR* 42" x 12"	ST. PIUS DR* 36" x 12"	NO OUTLET 30" x 30"	SPEED LIMIT 20 24" x 30"	SPEED LIMIT 30 24" x 30"	CURVE (RIGHT) 30" x 30"	HIGHWAY-RAIL GRADE CROSSING ADVANCE WARNING 36" DIA.	GRADE CROSSING (CROSSBUCK) 48" x 9"	CURVE (LEFT) 30" x 30"	REVERSE CURVE (RIGHT) 30" x 30"	CROSS TRAFFIC DOES NOT STOP 24" x 12"	VFW DR* 36" x 12"	N. ACCESS RD* 36" x 12"	COUNTY RD* 36" x 12"	T INTERSECTION RAILROAD CROSSING ADVANCED WARNING 36" x 36"	YIELD 36" x 36"	CALVARY RD* 36" x 12"	S. ACCESS RD* 36"x12"	YIELD 48" x 48"	I-55 24" x 24"	STRAIGHT ARROW 21" x 15"	US 61 24" x 24"	US 67 24" x 24"	LEFT ARROW 21" x 15"	DO NOT ENTER 48" x 48"	WRONG WAY 42" x 30"
1	5+90.00	RT	ST. PIUS SPUR	1																												
2	5+95.00	RT	ST. PIUS SPUR		1	1	1	1																								
3	8+55.00	LT	ST. PIUS DR						1																								
6	10+60.00	LT	ST. PIUS DR				1	1																								
7	10+80.00	RT	ST. PIUS DR							1																						
8	11+50.00	RT	ST. PIUS DR									1																				
9	14+21.80	RT	ST. PIUS DR										1																			
10	15+23.57	RT	ST. PIUS DR		1									1																		
11	15+59.93	LT	ST. PIUS DR		1									1																		
12	16+59.60	LT	VFW DR										1																			
13	20+00.00	LT	VFW DR												1																	
14	22+00.00	RT	VFW DR							1																						
15	22+00.00	LT	VFW DR							1																						
16	24+00.00	RT	VFW DR													1																
17	31+50.00	LT	VFW DR													1																
18	125+15.00	RT	NORTH ACCESS RD		1												1	1	1													
19	33+24.00	LT	VFW DR							1																						
20	10+31.40	LT	COUNTY RD		1													1		1												
21	11+14.40	LT	COUNTY RD																		1											
22	32+36.92	RT	AIRPORT RD											1								1										
23	32+68.84	LT	AIRPORT RD											1								1										
24	33+68.84	LT	AIRPORT RD										1																			
26	1008+14.67	RT	CALVARY CHURCH RD											1								1										
27	1008+60.21	LT	CALVARY CHURCH RD											1								1										
28	1009+57.78	LT	CALVARY CHURCH RD										1																			
29	1015+65.00	LT	CALVARY CHURCH RD								1																					
30	10+41.29	LT	SOUTH ACCESS RD		1																		1	1								
31	11+02.00	RT	SOUTH ACCESS RD								1																					
35	16+66.79	RT	US 61																						1					1	1	
36	1085+05.57	RT	US 67																							1	2	1	1	1			
																										*D3-1 S. ACCESS RD - 30							
																										R1-2 YIELD - 22, 23, 26, 27							
			TOTAL :	1	6	1	2	2	1	4	2	1	4	6	1	2	1	2	1	1	1	4	1	1	1	1	2	1	1	1	1	1

SIGNS REMOVED 1

SIGNS REMOVED 1

SIGN TYPE ADDED 1

SIGNS REMOVED 1

SIGN TYPE ADDED 1

QTY UPDATED 1

SIGN SUMMARY

STANDARD SIGN OR SPECIAL SIGN NUMBER		SIGN DETAIL SHEET NO.	NO. EACH	SIZE, TYPE & SQUARE FEET: SIZE (SF)	FLAT SHEET SH ITEM NO. 9035004A (SF)	FLAT SHEET FLUORE-SCENT SHF * ITEM NO. 9035069A (SF)	STRUCTURAL ST ITEM NO. 9035011A (SF)
W2-1 DOUBLE ARROW - 1	30" x 30"		1	6.3		6.3	
R1-2 YIELD - 35	48" x 48"		1	16.0	16.0		
R1-1 STOP - 2,10,11,18,20,30	30" x 30"		6	6.3	37.5		
R1-3P ALL WAY (PLAQUE) - 2	18" x 6"		1	0.8	0.8		
*D3-1 ST. PIUS SPUR - 2, 6	42" x 12"		2	0.8	1.5		
*D3-1 ST. PIUS DR - 2, 6	36" x 12"		2	0.8	1.5		
W14-2 NO OUTLET - 3	30" x 30"		1	6.3		6.3	
R2-1 SPEED LIMIT 20 - 7,14,15,19	24" x 30"		4	5.0	20.0		
R2-1 SPEED LIMIT 30 - 29, 31	24" x 30"		2	5.0	10.0		
W1-2R CURVE (RIGHT) - 8	30" x 30"		1	6.3		6.3	
W4-4P CROSS TRAFFIC DOES NOT STOP - 18	24" x 12"		1	5.0	5.0		
*D3-1 VFW DR - 18, 20	36" x 12"		2	5.0	10.0		
*D3-1 N. ACCESS RD - 18	36" x 12"		1	5.0	5.0		
*D3-1 COUNTY RD - 20	36" x 12"		1	5.0	5.0		
W10-1 HIGHWAY-RAIL GRADE CROSSING ADVANCED WARNING - 9,12,24, 28	36" DIA.		4	9.4		37.7	
R15-1 GRADE CROSSING (CROSSBUCK) - 10,11,22,23,26,27	48" x 9"		6	3.0	18.0		
W1-2L CURB (LEFT) - 13	30" x 30"		1	6.3		6.3	
W1-3R REVERSE CURVE (RIGHT) - 16,17	30" x 30"		2	6.3		12.5	
*D3-1 CALVARY RD - 30	36" x 12"		1	3.0	3.0		
W10-4 T INTERSECTION RAILROAD CROSSING ADVANCED WARNING - 21	36" x 36"		1	9.0		9.0	
M1-4 US 67 - 36	24" x 24"		1	4.0	4.0		
M1-1 INTERSTATE 55 - 36	24" x 24"		1	4.0	4.0		
M6-3 STRAIGHT ARROW - 36	21" x 15"		2	2.2	4.4		
M1-4 US 61 - 36	24" x 24"		1	4.0	4.0		
M6-1L LEFT ARROW - 36	21" x 15"		1	2.2	2.2		
R5-1 DO NOT ENTER - 35	48" x 48"		1	16.0	16.0		
R5-1a WRONG WAY - 35	42" x 30"		1	8.8	8.8		
*D3-1 S. ACCESS RD - 30	36" x 12"		1	8.8	8.8		
R1-2 YIELD - 22, 23, 26, 27	36" x 36"		4	9.0	36.0		
			TOTAL:		221	84	0

NOTE: 1. BRACKETS AND HARDWARE NEEDED TO MOUNT SIGNS ON MAST ARM WILL NOT BE PAID FOR SEPARATELY AND ARE INCLUDED IN THE SIGN PAY ITEM.
2. CONTRACTOR TO DESIGN
3. SEE SIGNAL SHEETS FOR OVERHEAD SIGNING.

REMOVE AND RELOCATE EXISTING GROUND MOUNT SIGN QUANTITY

SIGNING SHEET	SIGN NO.	STATION	ROADWAY	LOCATION	MISC. {REMOVE & RELOCATE EXISTING GROUND MOUNT SIGN ASSEMBLY} (EA)	MISC. {PRIVATE SIGN REMOVAL AND RELOCATION} (EA)	FOOTINGS: CONC EMBD (CY)	REMARKS
2	4	9+65.00	ST. PIUS DR.	RT	1			STOP SIGN ASSEMBLY
2	5	10+19.00	ST. PIUS DR.	RT	1			STOP SIGN ASSEMBLY
2	6	10+60.00	ST. PIUS DR.	LT	1			STOP SIGN ASSEMBLY
2	39	10+67.40	ST PIUS. DR.	RT		1	0.15	VFW SIGN
4	40	19+74.05	VFW DR.	RT		1	0.15	VFW SIGN
7	41	125+24.81	N. ACCESS RD.	RT		1	0.15	SAND PLANT SIGN
8	42	11+55.63	COUNTY RD.	LT		1	0.15	VFW SIGN
12	25	35+46.37	AIRPORT RD.	RT	1			DEAD END SIGN
	34	13+90.41	US 61	44.5' RT	1			GUIDE SIGN ASSEMBLY
	37	1088+06.21	US 67	55.0' LT	1			BYPASS ROUTE ASSEMBLY
	38	1088+11.82	US 67	54.5' LT	1			GUIDE SIGN ASSEMBLY
				SUB-TOTAL	7	4	0.60	SEE D29 FOR CONC TOTAL
* NO DIRECT PAYMENT				TOTALS	7	4	---	

D-30 SHEET - ALTERNATE A

SIGN NUMBER	STATION	LOCATION	ROADWAY	TYPE: W3-1	STOP AHEAD 30" x 30"	STANDARD SIGN OR SPECIAL SIGN NUMBER		SIGN DETAIL SHEET NO.	NO. EACH	SIZE, TYPE & SQUARE FEET: SIZE (SF)	FLAT SHEET SH ITEM NO. 9035004A (SF)	FLAT SHEET FLUORE-SCENT SHF * ITEM NO. 9035069A (SF)	STRUCTURAL ST ITEM NO. 9035011A (SF)
32	14+53.00	LT	SOUTH ACCESS RD	1		W3-1 STOP AHEAD	30" x 30"		1	6.3		6.3	
			TOTAL :	1	0					TOTAL :	0	6	0

NOTE: 1. BRACKETS AND HARDWARE NEEDED TO MOUNT SIGNS ON MAST ARM WILL NOT BE PAID FOR SEPARATELY AND ARE INCLUDED IN THE SIGN PAY ITEM.
2. CONTRACTOR TO DESIGN
3. SEE SIGNAL SHEETS FOR OVERHEAD SIGNING.

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STATE OF MISSOURI
TODD EHLEN
NUMBER PE-2006019649
PROFESSIONAL ENGINEER
10/29/2024

DATE PREPARED
10/16/2024

STATE MO | SHEET NO. 159

COUNTY
JEFFERSON

JOB NO.
SNS-0025

DATE	DESCRIPTION
10/29/24	ADDENDUM 1: SIGNING REVISION AT RAILROADS

JEFFERSON COUNTY, MISSOURI
DEPARTMENT OF PUBLIC WORKS
MAPLE STREET ANNEX
725 MAPLE STREET
HILLSBORO, MO 63050
(636) 797-5340
WWW.JEFFCO.ORG

CMT
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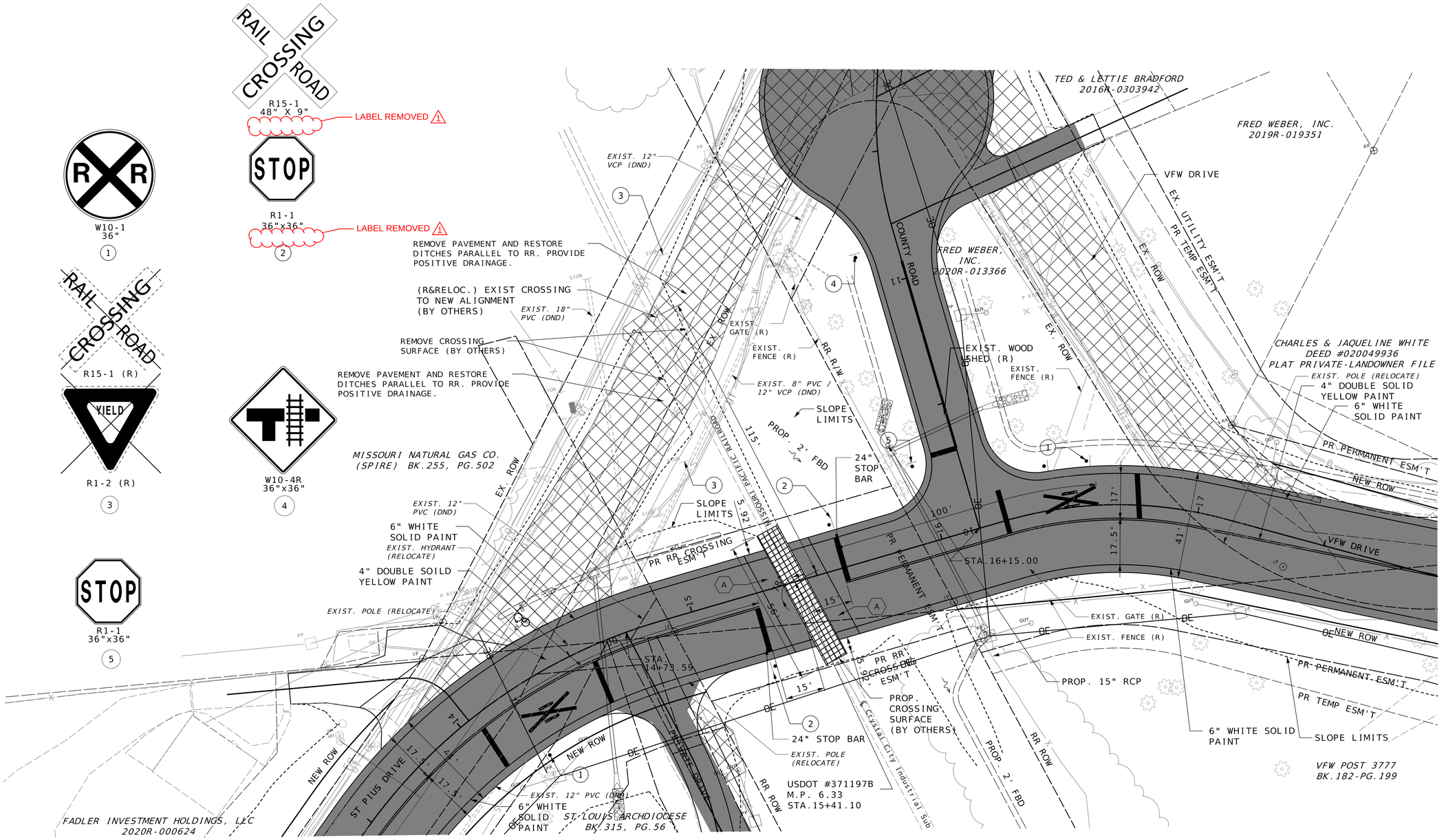
CRAWFORD, MURPHY & TILLY, INC.
ONE MEMORIAL DRIVE, SUITE 1500
ST. LOUIS, MISSOURI 63102-2450
ENGINEERING CORPORATION - 000631

PAVEMENT MARKING/ SIGNING SHEETS

SHEET 22 OF 22

PROJECT REDBIRD NORTH IMPROVEMENTS (PHASE 2)



FOR REFERENCE ONLY

STATE OF MISSOURI
TODD EHLEN NUMBER PE-2006019649
PROFESSIONAL ENGINEER
10/29/2024

DATE PREPARED	
10/16/2024	
STATE	SHEET NO.
MO	169
COUNTY	
JEFFERSON	
JOB NO.	
SNS-0025	

DATE	DESCRIPTION
10/29/24	ADDENDUM 1: SIGNING REVISION AT RAILROADS

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

JEFFERSON COUNTY, MISSOURI
DEPARTMENT OF PUBLIC WORKS
MAPLE STREET ANNEX
725 MAPLE STREET
HILLSBORO, MO 63050
(636) 797-5340
WWW.JEFFCO.ORG

CMT
CRAWFORD, MURPHY & TILLY, INC.
ONE MEMORIAL DRIVE, SUITE 500
ST. LOUIS, MISSOURI 63102-2500
ENGINEERING CORPORATION - 000631

ST PIUS DRIVE
RAILROAD CROSSING
USDOT #371197B

PROJECT REDBIRD
NORTH IMPROVEMENTS
(PHASE 2)

N/F
MELVIN & DOROTHY MEYER
DOC. #040027483

N/F
FESTUS SPECIAL
ROAD DISTRICT
BK.393, PG.519

N/F
MISSOURI PACIFIC
RAILROAD (100')

RR ROW

EXIST. 18"X24" RCP (DND)

6" WHITE SOLID PAINT

4" DOUBLE SOLID YELLOW PAINT

T.C.E.

SLOPE LIMITS

EX. ROW

USDOT #371198H
M.P. 6.944
STA. 32+52.93

EXIST. 18" CMP
R&REPLACE
W/ 18" RCP

MISSOURI PACIFIC RAILROAD

6.83'

24" SOLID STOP BAR

STA. 31+11.23

℄ AIRPORT ROAD

NEW ROW

RAIL CROSSING ROAD

R15-1
48"
REMOVE AND REPLACE

LABEL REMOVED 1

YIELD

R1-2
36"
REMOVE AND REPLACE

LABEL REMOVED 1

W10-1
36"

25
M.P.H.

W13-1P
18"

AIRPORT SUBDIVISION
2022P-000188
LOT 1

JAMES HARDIE BUILDING
PRODUCTS, INC.
2023R-008874

EXIST. 18"X24" RCP (DND)

EX. ROW

SLOPE LIMITS

6" WHITE SOLID PAINT

N/F
STATE OF MISSOURI
(MoDOT)
BK.504, PG.995

℄ Crystal City Industrial Sub

(R&REPLACE) EX. CROSSING SURFACE (BY OTHERS)

CROWN PLASTICS, INC.
2015R-004330

FESTUS MEMORIAL AIRPORT

SCALE
0 20 40 60

LEGEND

- NEW PAVEMENT
- SLOPE LIMITS
- EXIST. PROPERTY LINE
- GUARDRAIL
- EXIST. R/W
- TEMPORARY CONSTRUCTION EASEMENT
- PAVEMENT REMOVAL/DRIVEWAY

FOR REFERENCE ONLY

STATE OF MISSOURI
TODD EHLEN NUMBER
PE-2006019649
PROFESSIONAL ENGINEER
10/29/2024

DATE PREPARED
10/16/2024

STATE MO | SHEET NO. 170

COUNTY
JEFFERSON

JOB NO.
SNS-0025

DATE	DESCRIPTION
10/29/24	ADDENDUM 1: SIGNING REVISION AT RAILROADS

IF A SEAL IS PRESENT ON THIS SHEET IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

JEFFERSON COUNTY, MISSOURI
DEPARTMENT OF PUBLIC WORKS
MAPLE STREET ANNEX
725 MAPLE STREET
HILLSBORO, MO 63050
(636) 797-5340
WWW.JEFFCO.ORG

CMT
CRAWFORD, MURPHY & TILLY, INC.
ONE MEMORIAL DRIVE, SUITE 500
ST. LOUIS, MISSOURI 63102-2500
ENGINEERING CORPORATION - 000631

AIRPORT ROAD
RAILROAD
CROSSING
USDOT #371198H

PROJECT REDBIRD
NORTH IMPROVEMENTS
(PHASE 2)

(17)
GIP/ABT,LLC
2022R-010240
NO AQUISITION

(9)
MISSOURI PACIFIC
RAILROAD (100')
NO AQUISITION

(17)
GIP/ABT,LLC
2022R-010240
NO AQUISITION

EXIST. R/W

RR R/W

MISSOURI PACIFIC RAILROAD

EXIST. 42" RCP & HEADWALL (UIP)

CONSTRUCTION LIMITS

6 WHITE SOLID PAINT

4" DOUBLE SOLID YELLOW PAINT

PR. MGS GUARDRIL

C.E.T.

(R&REPLACE) EX. CROSSING SURFACE (BY OTHERS)

1006

1007

1008

1009

1010

26'

11'

11'

4'

15'

100'

24" STOP BAR

EXIST. 30" CMP (UIP)

EXIST. CONC DITCH (UIP)

℄ CALVARY CHURCH ROAD

FUTURE PROP. R/W

CP#1

STA. 1008+37.37
USDOT #371199P
M.P. 7.550

DRAINAGE INLET (UIP)

℄ CRYSTAL CITY INDUSTRIAL SUB.

EXIST. DITCH (UIP)

EXIST. 8" CMP (DND)

EXIST. 18" CMP & INLET (DND)

RAIL CROSSING ROAD

R15-1
48" X 9"

YIELD

R1-2
36" X 36" X 36"

W10-1
36"

LABEL REMOVED (1)

LEGEND

- NEW PAVEMENT
- GUARDRAIL
- CONSTRUCTION LIMITS
- EXIST. PROPERTY LINE
- EXIST. R/W

SCALE
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CRAWFORD, MURPHY & TILLY, INC.
ONE MEMORIAL DRIVE, SUITE 500
ST. LOUIS, MISSOURI 63102-2500
ENGINEERING CORPORATION - 000631

CALVARY CHURCH ROAD
RAILROAD CROSSING
USDOT #371199P

PROJECT REDBIRD
SOUTH IMPROVEMENTS
(PHASE 2)

Job Special Provisions shall prevail over General Special Provisions whenever in conflict therewith.

JOB SPECIAL PROVISIONS
TABLE OF CONTENTS

A. RAILROAD COORDINATION

1.0 Description. Work within the Union Pacific Railroad Right-of-Way is proposed for this phase of construction and to include roadway improvements up to both sides of crossing.

2.0 Union Pacific Railroad Requirements.

2.1 In order to enter in and upon the Railroad's real property, right of way, tracks and other facilities (Railroad's Property) to perform the contractor's work relating to this project the contractor is required to follow the Railroad Requirements set forth in the agreement between the Union Pacific Railroad Company (Railroad) and Jefferson County, Missouri (County), the Contractor's Right of Entry (CROE) and the requirements of this specification.

2.1.1 The project will be administered by Jefferson County, Missouri ("County"). All reference to the "Owner" or "Commission" or "State" made in the above Standard Specifications shall be interpreted as Jefferson County Public Works Department, Hillsboro, Missouri.

2.2 To report an emergency on the Railroad, call: (888) 877-7267.

2.3 The project is at the following locations:

2.3.1 St. Pius Drive / VFW Drive: Abolish St. Pius Drive / VFW Drive at UPRR DOT # 371197B, Mile Post 6.310, Crystal City Ind. Lead in Crystal City, MO. Construct St. Pius Drive / VFW Drive at UPRR DOT # TBD, Approximate Mile Post 6.3, Crystal City Ind. Lead in Crystal City, MO Current FRA data shows approximately 2 trains per week, freight/industry/switching train.

2.3.2 Airport Road: Alter Airport Road at UPRR DOT # 371198H, Mile Post 6.944, Crystal City Ind. Lead in Crystal City, MO. Current FRA data shows approximately 2 trains per week, freight/industry/switching train.

2.3.3 Calvary Church Road: Alter Calvary Church Road at UPRR DOT # 371199P, Mile Post 7.550, Crystal City Ind. Load in Crystal City, MO. Current FRA data shows approximately 2 trains per week, freight/industry/switching train.

2.4 Definitions of terms set forth in the current edition of the Missouri Standard Specifications for Highway Construction shall be applicable to those terms as used in these Railroad Requirements.

3.0 Authority of Railroad Representative and Engineer.

3.1 The authorized representative of the Railroad, herein called "Railroad Representative", shall have final authority in all matters affecting the safe maintenance and operation of railroad traffic including the adequacy of the foundations and structures supporting the railroad tracks.

3.1.1 The Railroad designates the following individual as the Railroad Representative for this project. Except as otherwise provided in these Railroad Requirements, the contractor shall address all notices concerning this project to the Railroad Representative, as follows:

Chris Duran
Public Projects Manager

Telephone: Direct – NA Mobile – (479) 440-0390
E-mail: cduran@benesch.com

3.1.2 The Railroad, or the individual identified above, may designate a different individual to act as the Railroad Representative for this project, and may change the address information stated above, by giving written notice of the changes to the contractor and to the Engineer, as provided in these Railroad Requirements.

3.2 The authorized representative of the Commission (Engineer) shall have authority over all other matters as prescribed herein and in the project specifications.

4.0 Contractor's Indemnity Obligations to the Railroad.

4.1 The contractor agrees to indemnify, defend and hold harmless the Railroad from and against any injury or death of persons whomsoever, or from any loss or damage to the Railroad's Property, caused by acts or omissions of the contractor in performing work on this project, whether on, over, under or in the vicinity of the Railroad's Property. In the event the contractor shall fail to restore the Railroad's Property immediately to a condition acceptable to the Railroad when any such loss or damage to the Railroad's Property is called to the contractor's attention by the Railroad, then the Railroad may perform such corrective work at the cost of the contractor. The Railroad shall have the right to bring an action directly against the contractor to recover any loss or damage sustained by the Railroad by reason of the contractor's breach of agreements contained in these Railroad Requirements. In addition to such remedies of the Railroad, the Commission will withhold from final payment due to the contractor the amount reasonably necessary to reimburse the Railroad for such loss or damage or for performing such work. The term "loss or damage" as used herein shall include, but not be limited to, the erosion and silting of, water damage to, and the accidental or intentional placing or dropping of objects on the Railroad's Property.

5.0 Notice of Starting Work.

5.1 The contractor shall not commence any work on the Railroad's right of way until contractor has complied with the following conditions (no particular order):

5.1.1 At least thirty (30) days in advance of the date the contractor proposes to begin work on the Railroad's Property, the contractor has given written notice of the contractor's proposed start date and time to the Railroad Representative, and Railroad's Manager of Track Maintenance (see paragraph 13.2.3 below), with a copy to the Engineer.

5.1.2 The Commission has obtained written approval from the Railroad's Representative for the contractor's insurance coverage as required by Section 18 of these Railroad Requirements, and authorization for the contractor to begin work on the Railroad's Property.

5.1.3 The contractor has determined whether fiber optic cable systems are buried on the Railroad's Property. If fiber optic cable systems are buried on the Railroad's Property, then the contractor has contacted the Railroad at the 24-hour number, 800-336-9193, has contacted the telecommunications company involved, has arranged for a cable locator, and has made arrangements for relocation or other protection of the fiber optic cable system on the Railroad's Property.

5.1.4 Union Pacific Property Access Training must be completed by each person on UPRR right of way. A valid copy of certification must be with the individual anytime they are on the job site. For guidance on completing the training, visit the website provided:
https://www.up.com/aboutup/community/safety/erailsafe/up-pat/index.htm

5.2 Right of Entry. At least thirty (30) days in advance of the date the contractor proposes to begin work on the Railroad's Property, the contractor shall enter into a Contractor's Right of Entry Agreement (CROE) with Railroad prior to working on Railroad property. Below is the 4-step process that must be followed for the contractors right of entry:

a) Fill out a CROE using the following Scope of Work at each location:
   i. Roadway improvements up to the Union Pacific at DOT 371197B.
   ii. Roadway improvements up to the Union Pacific at DOT 371198H.
   iii. Roadway improvements up to the Union Pacific at DOT 371199P.
b) Sign each CROE.
c) Submit the Administrative fee (amount depends on the type of work to be completed), referencing your folder/project number on the payment submission for each CROE
d) Email each signed CROE to kelbey.heider@upcontractor.up.com.
e) Once the CROE Agreement and payment have been received, please allow a minimum of 30 days to process CROE and the railroad will return fully executed agreement.

5.2.1 If applicable to the project, the contractor must submit a plan for demolition, falsework, lifting plans over the Railroad property, shoring plans and any other applicable plans the Railroad may require as well as means and methods to the Railroad for review and approval. All plans submitted to the Railroad must be signed and sealed by Professional Engineer licensed in the State of Missouri. These plans can be submitted along with the Right of Entry application; however, the Right of Entry will not be approved until all required plans are approved by the Railroad.

6.0 Interference with Railroad's Operations.

6.1 The Railroad's right of way is located within the limits of this project. The contractor shall take care to ensure that it will not drop any debris or material on the Railroad's Property.

6.2 The contractor shall arrange and conduct all the contractor's work so that it causes no interference with the Railroad's operations, including train, signal, telephone, telegraphic services, damage to the Railroad's Property, poles, wires and other facilities of tenants on the Railroad's Property. Whenever the contractor's work may directly affect the operations or safety of trains, the contractor shall submit a written description of the method of doing such work to the Railroad Representative for approval, but such approval shall not relieve the contractor from liability resulting from the contractor's work. Any work to be performed by the contractor that requires flagging service shall be deferred by the contractor until the flagging services are available at the job site.

6.3 The contractor's work shall not impede on the Railroad's operations.

6.4 If conditions arising from, or in connection with the work require immediate and unusual provisions to protect the Railroad's operations and property, the contractor shall make such provisions. If in the judgment of the Railroad Representative, or the Engineer if the Railroad Representative is absent, such provision is insufficient, then the Railroad Representative or

Engineer may require or provide such provisions as he/she deems necessary. In any event, the contractor shall make such provisions at the contractor's expense, and without cost to the Railroad or the Commission.

7.0 Track Clearances.

7.1 During construction, the contractor shall maintain not less than the minimum track clearances as shown on the project plans. However, before undertaking any work within the Railroad's Property and before placing any obstruction over any track, the contractor shall:

7.1.1 Notify the Railroad Representative and the Railroad's Manager of Track Maintenance at least ten (10) days in advance of the proposed work.

7.1.2 Receive assurance from the Railroad's Manager of Track Maintenance that arrangements have been made for flagging service as may be necessary.

7.1.3 Receive permission from the Railroad Representative to proceed with the work, as provided in section 5.0.

7.1.4 Confirm that the Engineer has received copies of the contractor's notice to the Railroad, and of the Railroads' response.

7.1.5 Note that no temporary Work Zone traffic control must not circumvent the passive warning devices at this location.

7.1.6 Temporary traffic control must comply with MUTCD standards. Any time work is within 25' of the track, the potential to foul the track exists or a pilot car is used traversing the crossing will require a Railroad flag person to be present. Traffic control must be returned to normal operations through the crossing area before releasing the Railroad's flag person.

8.0 Construction Procedures.

8.1 General. The contractor's work on the Railroad's property shall be performed in accordance with these Railroad Requirements and shall be subject to the Railroad's inspection and review. The contractor shall submit plans that shall be signed, sealed, and stamped in accordance with the laws relating to Architects and Professional Engineers, Chapter 327, RSMo, for the demolition of any structure over Railroad right of way, and for temporary shoring and falsework that may affect the Railroad's facilities or traffic.

8.2 Excavation. The contractor shall maintain the subgrade of an operated track with the beam edge at least 15 feet from centerline of track and not more than 26 inches below top of rail, unless the existing section fails to meet this specification, in which case the contractor shall maintain the existing section. Refer to the Railroad's shoring guidelines.

9.0 Maintenance of Railroad Facilities. Within the project limits, the contractor shall maintain Railroad's Property, including all ditches and drainage structures, free of silt or other obstructions that may result from contractor's operations. The contractor shall promptly repair eroded areas within the Railroad's Property and repair any other damage to the Railroad's Property or the Railroad's tenants. The contractor shall perform all such maintenance and repair of damages due to the contractor's operations at the contractor's expense.

10.0 Storage of Materials and Equipment.

10.1 The contractor shall obtain permission from the Railroad Representative before storing any materials or equipment anywhere on Railroad's Property. The Railroad will not ordinarily permit storage within twenty-five feet (25') from the centerline of any track, or within three hundred feet (300') from any grade crossing. The Railroad will not be liable for damage to such material and equipment from any cause, and the Railroad Representative may move such material and equipment or require the contractor to move it, at the contractor's expense.

10.2 The contractor shall not leave unattended any grading or construction machinery parked upon Railroad's Property, unless it is effectively immobilized so that unauthorized persons cannot move such machinery.

11.0 Cleanup. Upon completion of the work, the contractor shall remove from within the limits of the Railroad's Property all machinery, equipment, surplus materials, falsework, rubbish or temporary buildings of the contractor's and shall leave Railroad's Property in a neat condition satisfactory to the Railroad Representative.

12.0 Damages. The Railroad shall not assume liability for any damages to the contractor, contractor's work, employees, servants, equipment and materials caused by the Railroad's traffic. However, the preceding sentence shall not exempt the Railroad from liability for any loss, damage or injury proximately caused by the Railroad's intentional misconduct or sole or gross negligence. The contractor shall directly reimburse the Railroad for any cost the Railroad reasonably incurs for repairing damages to the Railroad's Property or to property of the Railroad's tenants, caused by or resulting from the operations of the contractor relating to this project.

13.0 Flagging Services.

13.1 When Flagging is Required. The Railroad has sole authority to determine the need for flagging to protect the Railroad's operations. Whenever the Railroad requires flagging services with reference to any of the contractor's work on this project, the contractor shall not perform any such work until all required flaggers are present at the job site.

13.1.1 In general, the Railroad may require flagging services whenever the contractor's personnel or equipment are, or are likely to be, working on the Railroad's Property, or across, over, adjacent to, or under a track, or when such work has disturbed or is likely to disturb a railroad structure or the railroad roadbed or surface and alignment of any track to such extent that the movement of trains must be controlled by flagging, to prevent unreasonable risks of accidental hazard to the Railroad's operations or personnel.

13.1.2 Normally, the Railroad will assign one flagger to a project; but in some cases, more than one may be necessary, such as yard limits where the Railroad may assign up to three flaggers. However, if the contractor works within distances that violate instructions given by the Railroad Representative or performs work upon or adjacent to Railroad's Property that has not been scheduled with the Railroad Representative, the Railroad may require flagging services full time until the project is completed.

13.1.3 If flagging is determined to be required by the Manager of Track Maintenance (MTM), and the MTM advises that third party flagging is to be used, then third-party flagging must be used. If

flagging is determined to be required by the MTM and the MTM advises that an agreement employee flagging is to be used, then an agreement flagger will be put up for bid (and scheduled accordingly).

Jared Treaster – Manager of Track Maintenance
573-218-4382
jtreast@up.com

UPRR New Flagging Process Link
https://www.up.com/cs/groups/public/@uprr/@realestate/documents/up_pdf_nativedocs/pdf_flagging_cust_instr.pdf

UPRR Third Party Flagging Policy Link
https://www.up.com/real_estate/third-party-flagging/index.htm

13.2 Scheduling and Notification of Flagging Services.

13.2.1 The contractor shall arrange with the Railroad all flagging services required by the Railroad to accomplish the contractor's work on this project.

13.2.2 Before the contractor begins work on the Railroad's Property, the contractor shall furnish to the Railroad Representative and the Engineer a schedule for all work required to complete the contractor's portion of the project within the Railroad's Property and shall arrange for a job site meeting between the contractor, the Engineer, and the Railroad Representative. Until the contractor has provided its work schedule and met on-site with the Railroad Representative and the Engineer, the Railroad may withhold all flagging services from the contractor's proposed job site.

13.2.3 Before the contractor first begins any work upon or adjacent to the Railroad's Property, the contractor shall give not less than thirty (30) days advance notice to the Railroad, and to the Engineer, of its intent to begin such work. The contractor shall address all notices relating to flagging as instructed in the fully executed CROE agreement.

13.2.4 The Railroad usually assigns one flagger to work at the job site on a continuous basis until the contractor no longer needs flagging services. The contractor shall not call for flagging services on a spot basis. The Railroad's assigned flagger shall notify the Engineer when flagging services have begun and ended. The flagger shall give these notices immediately upon arrival at the job site on the first day, and before departing from the job site on the last day of each separate period when the Railroad provides flagging services, or as soon as possible thereafter. The Engineer shall document these notifications in the project records.

13.2.5 After the contractor has begun work that requires flagging services, the contractor shall give not less than ten (10) day's advance written notice to the Railroad before discontinuing flagging services and terminating the obligation to pay for flagging services. The contractor shall simultaneously provide a copy of this notice to the Engineer. If the contractor's work on or adjacent to the Railroad's Property is suspended at any time, or for any reason, then before the contractor resumes any work on or adjacent to the Railroad's Property, the contractor shall give advance, written notice to the Railroad and to the Engineer of its intent to resume such work. This notice shall provide sufficient details of the contractor's proposed work to enable the Railroad Representative to determine whether flagging services will be required before the contractor

resumes its work on or adjacent to the Railroad's Property. The contractor shall give this required notice at least three (3) working days before it intends to resume such work; however. The Railroad may take up to thirty (30) days after the contractor has given this notice before resuming flagging services at the job site. The requirements of this paragraph 13.2.5 shall not apply if the suspension and resumption of the contractor's work were previously scheduled with the Railroad pursuant to paragraph 13.2.2 of these Railroad Requirements, or the suspension was caused by an emergency as provided in paragraph 13.2.6 of these Railroad Requirements.

13.2.6 If, after the Railroad has assigned a flagger to the project site in accordance with section 13.0, any emergency requires the flagger's presence elsewhere, then the contractor shall suspend work on the Railroad's Property until the flagger is again available. Any additional costs to the contractor resulting from such delay shall be borne by the contractor and not by the Railroad.

13.3 Payment for Flagging Services.

13.3.1 The County will pay the Railroad directly for the cost of flagging services associated with this project by deducting the amount from the County's payments to the contractor. If a third-party flagger is used, the contractor has the option to pay the flagger directly but must notify the Engineer of such payments for flagging. Payment by Contractor for flagging services shall be made per pay item 618-99.01 {A}, MISC. {RAILROAD FLAGGER}, per lump sum. An estimated 30 days of flagging services has been estimated.

13.3.2 The estimated cost of flagging services is approximately $1,500.00 per day, based on an 8-hour workday and a 40-hour work week. The Railroad shall charge not more than its actual cost of providing these flagging services, which includes the base pay for the flagger or flaggers who actually performed the required flagging services, the Railroad's reasonable overhead costs, and the reasonable costs actually incurred for the flagger's travel expenses, meals and lodging if required. The Railroad may charge a maximum of one hour of travel time each way per day per flagger, for travel to and from the job site. A flagger's work in excess of 8 hours per day or 40 hours per week, but not more than 12 hours per day, will result in overtime pay at 1.5 times that employee's regular hourly rate. A flagger's work in excess of 12 hours per day will result in overtime pay at 2.0 times that employee's regular hourly rate. If a flagger performs required flagging services on a holiday, then the overtime pay rate shall be 2.5 times that employee's regular hourly rate. The Commission or contractor also shall reimburse the Railroad for its actual expenses reasonably incurred in preparing and handling invoices to the Commission or contractor for the cost of these flagging services. The Railroad's charges to the Commission or contractor shall comply with applicable provisions of the current Federal-Aid Policy Guide (FAPG) issued by the FHWA.

13.3.3 The Railroad shall submit progress invoices to the Engineer during the time the Railroad requires flagging services. The Railroad shall submit its final invoice for flagging services to the Engineer within one hundred eighty (180) days after the contractor has notified the Railroad and the Commission that all its work over the Railroad's Property is complete, in accordance with section 19.0 below. If the Commission does not receive the Railroad's final flagging invoice within this time period, then the Railroad shall obtain payment directly from the contractor.

13.3.4 If a dispute arises between the Railroad, the Commission and the contractor concerning the amount charged for flagging service, then the Commission may deduct the full amount of the Railroad's invoice from the contractor's payment until the dispute is resolved.

13.4 Flagging Complaints. The contractor and the Railroad shall attempt to resolve any complaints concerning flagging services in a timely manner. If the contractor disputes the need for a flagger, the contractor shall notify the Railroad Representative and the Engineer. The contractor shall confirm any verbal complaints in writing within five (5) working days, by sending a copy to the Railroad Representative and to the Engineer.

14.0 Temporary Construction Grade Crossing.

14.1 When the contractor has no reasonable alternate method of transporting construction materials and personnel across the Railroad's track, the contractor shall make all necessary arrangements with the Railroad for the installation, maintenance, and removal of one temporary grade crossing for a construction haul road. The contractor shall bear all costs incidental to such crossings, including flagging, whether services are performed by contractor's own forces or by the Railroad's personnel. The contractor shall execute the Railroad's standard Road Crossing Agreement covering terms and conditions for the temporary crossing.

14.2 Neither the contractor nor the Railroad shall construct any crossing for use by the contractor for transporting materials or equipment across the tracks of the Railroad until the Railroad Representative specifically authorizes the installation, maintenance, necessary watching and flagging thereof and removal, which shall be done at the contractor's expense.

15.0 Work for the Benefit of the Contractors. The project plans show all temporary or permanent changes in wire lines or other facilities that are necessary to complete the project, or these changes will be covered by appropriate plan revisions approved by the Commission and the Railroad. If the contractor desires any further changes, the contractor shall make separate arrangements with the Railroad for those changes, at the contractor's expense.

16.0 Cooperation and Delays. The contractor shall arrange a schedule with the Railroad for accomplishing staged construction involving work by the Railroad or tenants of the Railroad. In arranging a schedule, the contractor shall request information from the Railroad, and the Railroad shall promptly provide information concerning the minimum lead time required for assembling crews and materials. The contractor shall schedule adequate time for those activities. The contractor shall not make any claim against the Railroad for hindrance or delay on account of railway traffic for:

16.1 Any work the Railroad performs.

16.2 Other delay incident to or necessary for the safe maintenance of railway traffic.

16.3 Any delays due to compliance with these Railroad Requirements.

17.0 Trainman's Walkways. The contractor shall maintain along the outer side of each exterior track of multiple operated tracks, and on each side of single operated track, an unobstructed continuous space suitable for trainman's use in walking along trains, extending to a line not less than 12 feet from the centerline of the track. Before the close of each workday, the contractor shall remove all temporary impediments to walkways and track drainage encroachments or obstructions that were allowed during work hours when flagging services were available. Whenever the contractor excavates or maintains any excavation near the walkway, the contractor shall install a handrail with 12 feet minimum clearance from the centerline of the track.

18.0 Insurance.

18.1 General Insurance Provisions. The contractor shall, at its sole cost and expense, procure and continuously maintain in force during this project, the insurance coverage required under this section 18 until the contractor has completed all project work on the Railroad's Property, has removed all equipment and materials from the Railroad's Property, and has cleaned and restored the Railroad's Property to the satisfaction of the Engineer and the Railroad Representative. The amount of work to be performed upon, over or under the Railroad's Property is estimated to be one percent (1%) of the contractor's total bid for the project.

18.2 Commercial General Liability Insurance. The contractor shall maintain commercial general liability ("CGL") insurance with a limit of not less than $5,000,000 for each occurrence and an aggregate limit of not less than $10,000,000. CGL insurance must be written on ISO occurrence form CG 00 01 12 04 (or a substitute form providing equivalent coverage). The policy must contain the following endorsement, which must be stated on the certificate of insurance: **"**Contractual Liability Railroad's" ISO form CG 24 17 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Railroad Company Property" as the Designated Job Site.

18.3 Business Automobile Coverage Insurance. The contractor shall maintain business auto coverage written on ISO form CA 00 01 (or a substitute form providing equivalent liability coverage) with a combined single limit of not less than $5,000,000 for each accident. The policy must contain the following endorsements, which must be stated on the certificate of insurance: "Coverage For Certain Operations In Connection With Railroad's" ISO form CA 20 70 10 01 (or a substitute form providing equivalent coverage) showing "Union Pacific Property" as the Designated Job Site; and Motor Carrier Act Endorsement - Hazardous Materials Clean Up (MCS-90) if required by law.

18.4 Alternate Liability Insurance Limits. Instead of the minimum limits of insurance coverage described above in subsections 18.2 and 18.3, Railroad will accept CGL insurance limits of at least $2,000,000 for each occurrence or claim and an aggregate limit of at least $2,000,000, and will accept Business Automobile Insurance containing a combined single limit of at least $2,000,000 per occurrence or claim, if the contractor will secure Railroad Protective Liability Insurance coverage with a combined single limit of $5,000,000 per occurrence and an aggregate limit of $10,000,000. The contractor's election to maintain these alternate liability insurance limits shall not affect the applicability of any other terms and conditions set forth in these Railroad Requirements.

18.5 Workers' Compensation and Employers' Liability Insurance. The contractor shall maintain workers' compensation insurance coverage, with not less than the minimum statutory liability required under the workers' compensation laws of the State of Missouri. The contractor shall maintain Employers' Liability (Part B) insurance coverage with limits of at least $500,000 for each accident, a $500,000 disease policy limit, and $500,000 for each employee. If the contractor is self-insured, then the contractor shall provide evidence of state approval and excess workers' compensation coverage, which must include coverage for liability arising out of the U. S. Longshoremen's and Harbor Workers' Act, the Jones Act, and the Outer Continental Shelf Land Act, if applicable. The policy must contain the following endorsement, which must be stated on the certificate of insurance: "Alternate Employer Endorsement" ISO form WC 00 03 01 A (or a

substitute form providing equivalent coverage) showing the Railroad in the schedule as the alternate employer (or a substitute form providing equivalent coverage).

18.6 Railroad Protective Liability Insurance. The contractor must maintain Railroad Protective Liability insurance written on ISO occurrence form CG 00 35 12 04 (or a substitute form providing equivalent coverage) on behalf of the Railroad as named insured, with a limit of not less than $5,000,000 per occurrence and an aggregate limit of $10,000,000. Before commencing any work on the Railroad's Property, the contractor shall submit the original insurance policy to the Railroad, or may submit a binder stating that the required Railroad Protective Liability policy is in place until the contractor delivers the original policy to the Railroad. The contractor shall cause the Railroad Protective Liability Insurance policy to include a description of the named insured, the work, and the job site, as follows:

18.6.1 Named Insured: Union Pacific Railroad Company.

18.6.2 Description and Designation:

18.6.2.1 Roadway improvement up to the Union Pacific at DOT # 371197B
Jefferson County Route St. Pius Drive / VFW Drive
Job No. SNS-0025
USDOT # 371197B, Mile Post 6.310, Crystal City Ind. Lead in Crystal City, MO

18.6.2.2 Roadway improvement up to the Union Pacific at DOT # 371198H
Jefferson County Route Airport Road
Job No. SNS-0025
USDOT # 371198H, Mile Post 6.944, Crystal City Ind. Lead in Crystal City, MO

18.6.2.3 Roadway improvement up to the Union Pacific at DOT # 371199P
Jefferson County Route Calvary Church Road
Job No. SNS-0025
USDOT # 371199P, Mile Post 7.550, Crystal City Ind. Load in Crystal City, MO

18.7 Umbrella or Excess Insurance. If the contractor utilizes umbrella or excess insurance policies, these policies must "follow form" and afford no less coverage than the primary policy.

18.8 Pollution Liability Insurance. The contractor shall maintain pollution liability insurance coverage, which must be written on ISO form Pollution Liability Coverage Form Designated Sites CG 00 39 12 04 (or a substitute form providing equivalent liability coverage), with limits of at least $5,000,000 per occurrence and an aggregate limit of $10,000,000. If the scope of work as defined in this Project includes the disposal of any hazardous or non-hazardous materials from the job site, the contractor must furnish to the Railroad evidence of pollution legal liability insurance maintained by the disposal site operator for losses arising from the insured facility accepting the materials, with coverage in minimum amounts of $1,000,000 per loss, and an annual aggregate of $2,000,000.

18.9 Other Insurance Requirements.

18.9.1 Each policy required above (except workers' compensation and employers' liability) must include the Railroad as "Additional Insured" using ISO Additional Insured Endorsements CG 20 26, and CA 20 48 (or substitute forms providing equivalent coverage). The coverage provided to

the Railroad as an additional insured shall, to the extent provided under ISO Additional Insured Endorsement CG 20 26 and CA 20 48, provide coverage for the Railroad's negligence whether sole or partial, active or passive.

18.9.2 Where allowable by law, the punitive damage exclusion shall be deleted, and the deletion shall be indicated on the certificate of insurance.

18.9.3 The contractor waives all rights of recovery, and its insurers also waive all rights of subrogation of damages against the Railroad and its agents, officers, directors and employees, except that these waivers shall not apply to punitive damages, nor to any loss, damage or injury proximately caused by the Railroad's intentional misconduct or sole or gross negligence. The certificate of insurance shall acknowledge these waivers.

18.9.4 Prior to commencing any work on the Railroad's Property, the contractor shall furnish the Railroad with one or more certificates of insurance, executed by a duly authorized representative of each insurer, showing compliance with the insurance requirements set forth in this Section 18.0.

18.9.5 The contractor shall only obtain insurance policies written by a reputable insurance company acceptable to the Railroad, or which currently has a Best's Insurance Guide Rating of A– and Class VII or better, and which is authorized to do business in the State of Missouri.

18.9.6 The fact that insurance is obtained by the contractor or by the Railroad on behalf of the contractor will not be deemed to release or diminish the liability of the contractor, including, without limitation, liability under the indemnity provisions contained in Section 4.0 of these Railroad Requirements. Damages recoverable by the Railroad from the contractor or any third party will not be limited by the amount of the required insurance coverage, except to the extent of any payments the Railroad has received pursuant to that insurance coverage obtained and paid for by the contractor.

18.10 Evidence of Insurance. The contractor shall provide evidence of insurance as required above to the addresses shown below, for review by the Commission and transmittal to the Railroad.

Railroad
Mr. Jonathan Holland
Senior Analyst, Real Estate
Union Pacific Railroad Company
1400 Douglas St., MS 1690
Omaha, NE 68179-1690

County
Mr. Lane Harness
Civil Project Manager II
Jefferson County Public Works Department
725 Maple Street, P.O. Box 100
Hillsboro, MO 63050

18.11 Except as otherwise specifically provided in these Railroad Requirements, the Railroad will not accept binders as evidence of insurance, and the contractor shall provide the Railroad with the original insurance policy.

18.12 Insurance Required of Subcontractors. If any part of the work is sublet, the contractor shall maintain and provide evidence of similar insurance, in the same amounts as required of the prime contractor, to cover the subcontractor's operations. The Railroad will accept endorsements to the prime contractor's policies specifically naming subcontractors and describing the subcontractor's operations, for this purpose.

18.13 Cancellation of Insurance. The contractor and its insurers shall not cancel any of the required insurance coverage, except by permission of the Commission and the Railroad, or after thirty (30) days' written notice to the Commission and the Railroad at the addresses shown in subsection 18.10.

19.0 Completion of Work on Railroad's Property. The contractor shall notify Engineer and Railroad's Representative when the contractor has completed its work on Railroad's Property.

20.0 Failure to Comply. If the contractor violates or fails to comply with any of the requirements of these Railroad Requirements, then the Railroad Engineer may require that the contractor vacate the Railroad's property, and the Engineer may withhold all monies due to the contractor until the contractor has remedied the situation to the satisfaction of the Railroad Engineer and the Engineer.

21.0 Payment for Cost of Compliance. No separate payment will be made for any other cost incurred on account of compliance with this special provision. All such costs shall be included in the contract unit price for other items included in the contract. Railroad will not be responsible for paying the contractor for any work performed under this special provision.

21.1 If applicable to the project, the contractor must submit a plan for demolition, falsework, lifting plans over the Railroad property, shoring plans and any other applicable plans the Railroad may require as well as means and methods to the Railroad for review and approval. All plans submitted to the Railroad must be signed and sealed by Professional Engineer licensed in the State of Missouri. These plans can be submitted along with the Right of Entry application; however, the Right of Entry will not be approved until all required plan submittals are approved by the Railroad. The Railroad may also require an onsite inspector to assure the work is carried out in accordance with the Railroad approved plans.

21.1.1 Payment for plan submittal, Railroad plan review and Railroad inspection fees.

The contractor shall be responsible for all costs associated with the generation and submittal of Railroad plans required for the right of entry agreement. The County will be responsible for and directly pay the Railroad for all Railroad review fees associated with these plan submittals and any onsite inspection and management fees charged by the Railroad. Item number 618-10.15, RAILROAD PLAN SUBMITTAL, per lump sum is provided for all costs associated with the generation and submittal of plans required for all Railroad right of entry agreement(s).

The contractor shall be responsible for all costs associated with payment of a third-party flagger, if it is determined to be used by the Railroad. Item number 618-99.01, MISC. {RAILROAD FLAGGER}, per lump sum is provided for all costs associated with the use of a third-party flagger.

SUBMITTED TO:
Crawford, Murphy & Tilly. Inc.
One Memorial Drive, Ste 500
St. Louis, MO 63102

BY:
Shannon & Wilson, Inc.
2043 Westport Center Drive
St. Louis, Missouri 63146

(314) 699-9660
www.shannonwilson.com

GEOTECHNICAL ENGINEERING REPORT

PROJECT REDBIRD – OFFSITE IMPROVEMENT PROJECTS

CRYSTAL CITY, MISSOURI

November 11, 2024

Shannon & Wilson No: 112117-001

SHANNON & WILSON

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Submitted To: Crawford, Murphy & Tilly. Inc.
One Memorial Drive, Ste 500
St. Louis, MO 63102
Attn: Mr. Todd Ehlen, P.E.

Subject: GEOTECHNICAL ENGINEERING REPORT, PROJECT REDBIRD – OFFSITE IMPROVEMENT PROJECTS, CRYSTAL CITY, MISSOURI

Shannon & Wilson prepared this report and participated in this project as a subconsultant to Crawford, Murphy & Tilly. Our scope of services was specified in the Subcontract Agreement with Crawford, Murphy & Tilly, Inc. dated October 3, 2023. This report presents the findings of our geotechnical analysis and engineering recommendations for embankments, structures, and pavements at the South Access Road and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.
Professional Engineering Corporation
Missouri Certificate of Authority #000413

11/11/2024

Patrick M. Kinsella, P.E.
Associate

PMK:TJA/tad

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1 INTRODUCTION

This geotechnical report summarizes the results of our subsurface explorations for new embankments, structures, and pavements at the South Access Road (SAR) in Crystal City, Missouri. The purpose of the study was to provide geotechnical design and construction recommendations.

The scope of services included an exploration of the subsurface conditions along the roadway, field and laboratory testing of recovered soil samples, engineering analysis of the subsurface conditions as they relate to the proposed construction, and design recommendations for geotechnical related portions of the project. The services we have provided for the South Access Road are generally as outlined in our proposal dated September 11, 2023, which was incorporated into the Subcontract Agreement with Crawford, Murphy & Tilly, Inc. dated October 3, 2023.

2 PROJECT AND SITE DESCRIPTION

Jefferson County is planning roadway improvements to provide better access to the James Hardie development proposed at the former Festus Memorial Airport. A location map showing the general location of the project is attached as Figure 1. Plan view of the planned roadway improvements for South Access Road are shown on Figures 2.1 to 2.2.

This report includes explorations and design recommendations that extend a couple hundred feet north of the construction limits shown on Figure 2.1. The northern couple hundred feet includes a planned dual 12-foot wide by 10-foot-tall box culvert and is anticipated to be constructed separate from the roadway limits shown on Figure 2.1. The maximum fill depth along the south access road is about 22 feet. The slopes that are generally toward the east are inclined at two horizontal to one vertical (2H:1V). To the west, the roadway embankment generally either ties into the existing topography/slope or else is sloped downward at about 3H:1V.

3 SUBSURFACE EXPLORATIONS

The site exploration consisted of a visual reconnaissance of the site and surrounding area and performing test borings at the approximate locations shown on Figures 2.1 through 2.2. Five borings were completed along the SAR between October 18 and October 19, 2023, to planned depths ranging from 8 to 39.9 feet below the ground surface. SAR-2A was drilled

about 5-foot offset from Boring SAR-2 to confirm that the auger refusal elevation at Boring SAR-2 was on bedrock. Auger refusal was reached at each boring. SAR-4 was drilled to auger refusal and then advanced an additional 16.9 feet using rock coring methods. All borings were advanced with a CME 750 all-terrain mounted, rotary drill.

A geologist from Shannon & Wilson was present throughout the exploration to observe the drilling, assist in obtaining samples, and prepare field logs of the borings. Upon completion of the drilling, the borings were backfilled with soil cuttings.

3.1 Sampling

Drilling and sampling were accomplished in accordance with standard drilling practice and ASTM procedures where applicable. Standard Penetration Tests (SPTs) were generally obtained at about 2.5-foot intervals in the upper 15 feet with 5-foot intervals below this depth. Standard Penetration Tests (SPTs) were performed on each split barrel sample in general accordance with ASTM D 1586. Relatively undisturbed Shelby tube samples were obtained at selected depths and locations chosen by our geologist. Cohesive samples were tested to determine relative consistency with a calibrated penetrometer as indicated on the boring logs. Recovered samples were classified in the field using the visual manual procedure, as detailed on the Log Key sheets provided in Appendix A and transported to our laboratory for further inspection and testing.

3.2 Rock Coring

Each coring run was measured to determine recovery (the percentage ratio between the length of the core recovered and the length of the core attempted in a given run) and Rock Quality Designation (RQD). RQD is the percentage ratio between the sum of the lengths of all pieces of core greater than 4 inches and the length of the core drilled in a given run. A summary of RQD versus rock quality, which is generally accepted in the profession, is provided in Exhibit 3-1. Rock Core Photographs are presented in Appendix B.

Exhibit 3-1: RQD Versus Rock Quality

RQD (Percent	Rock Quality
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very Poor

3.3 Boring Logs

Individual logs detailing the data obtained at the borings are presented in Appendix A. These details include the sample intervals and types selected, material descriptions, groundwater observations, and other data. Stratification boundaries and characteristics of the soil materials are shown on the boring logs. The location of stratification boundaries between different material types is approximate because changes in these boundaries may occur gradually or between sampled intervals. The characteristics discussed in this report are based on observations made during the subsurface exploration, the results of sample examination, laboratory test results, and interpretations of the local geology.

4 LABORATORY TESTING

Soil samples were tested to determine their natural moisture content. Grain Size Analysis and Atterberg limit tests were conducted to determine the liquid and plastic limits of selected samples to aid in classification and in the evaluation of engineering properties. Selected relatively undisturbed samples were tested to determine in situ density, one-dimensional consolidation parameters, and shear strength in consolidated-undrained triaxial and unconsolidated-undrained triaxial strength tests. Laboratory testing was performed using current ASTM procedures. Laboratory test results are provided graphically on the boring logs in Appendix A, and select lab test reports are provided in Appendix C.

5 SUBSURFACE CONDITIONS

Soils encountered in the borings generally consisted of about one foot of topsoil overlying cohesive soil and dolomite bedrock. The cohesive soil ranged from soft to stiff, and typically consisted of lean clay with varying amounts of sand and gravel, with the exception being at SAR-1 where the cohesive soil was fat clay. Liquid limits and plastic limits of the fat clay were measured as 86 and 29, respectively, and the natural moisture content was

measured to be 29 percent. Liquid limits and plastic limits of the lean clay varied from 24 to 31 percent and 14 to 19 percent, respectively, and natural moisture contents ranged from 13 to 32 percent.

5.1 Groundwater

Groundwater was observed at a depth of 14 feet at SAR-4 during drilling. Groundwater was not encountered at the other borings. The presence or absence of groundwater should not be construed to represent an exact or permanent condition. There is uncertainty with the interpretation of groundwater level readings in bore holes that are left open for a short period of time. Groundwater levels should be expected to fluctuate with variations in precipitation, site grading, and drainage.

6 ENGINEERING RECOMMENDATIONS

6.1 Shallow Foundations

Concrete wingwalls may be constructed at either end of some culverts along the alignment of the project. Shallow foundations can be used to support these drainage structures. Bearing capacity analysis was performed at the locations of the wingwalls using classical bearing capacity theory. With a factor of safety of 3, we recommend the walls be designed for a maximum net allowable bearing pressure is 2,000 pounds per square foot (psf).

Strip footings should be a minimum of 18 inches in the least horizontal dimension, and a minimum of 30-inches below the lowest adjacent exterior grade for frost protection. The lateral load capacity of a footing may be designed for an allowable coefficient of friction of 0.35 for base shear resistance. This value reflects a factor of safety of 1.5.

At the time of this report, we do not have detailed information about the location and elevation of the proposed box culvert. As needed, we recommend over-excavating soft or loose soils and backfilling the over-excavation with MoDOT Type-1 aggregate. The over-excavation is anticipated being approximately 18-inches deep.

Foundation excavations should be made to the required line and grade as rapidly as possible and kept open for a minimum time to mitigate disturbance to the foundation soil. Concrete should be placed as quickly as possible. Disturbance of bearing surfaces from construction traffic is possible. If foundation subgrade disturbance is observed during construction, construction traffic including foot traffic over the foundation area should be halted. Hand cleaning and setting of reinforcing steel may need to be accomplished from the sides of the excavation.

The base of foundation excavations should be clean, dry, and free of soft and loose soil at the time of concrete placement. If groundwater or surface runoff is present in the excavation, the water should be promptly removed to prevent softening of the bearing surface. If bearing soil is softened by standing water, the soft soil should be removed and replaced with structural fill or additional concrete.

6.2 Settlement

Settlement analysis was conducted for the box culvert and the fill that will be required around the culvert. The analysis was conducted using a subsurface model based on the results of the subsurface exploration and the laboratory tests. Immediate settlements were computed based on elastic theory and consolidation settlements were computed based on classical consolidation theory. The culvert was modeled as a dual 12-foot wide by 10-foot tall box culvert for the drainage crossing on the South Access Road.

The box culvert and fill settlement were modeled using the computer software Settle3. This software allows settlements to be calculated at any point within the model due to applied loads. We calculated settlement of the box culvert and fill at four points: 1) below the midpoint of the box culvert; 2) below the outside edges of the box culverts in the middle of the embankment; 3) below the ends of the culvert at the edges of the embankment fill; and 4) below the embankment outside the influence of the culvert. Our estimated immediate and consolidation settlements, based on the results of our calculations, are presented below in Exhibit 6-1.

Exhibit 6-1: Calculated Settlement

Location	Total Settlement – SAR (in.)[1]
1 – Midpoint of Culvert	5.3
2 – Outside Edge of Culvert in Center of Embankment	8.2
3 – End of Culvert at Edge of Embankment	1 to 2
4 – Embankment	9.2

1. Predicted settlement assumes that existing any soft/loose stream bottom sediments that may exist within the influence of the box culvert have been removed and that the conditions below the new embankment are consistent with those encountered in Boring SAR-4.

Approximately 85 percent of the predicted settlement is expected to require approximately 3 months or less to complete. Existing utilities within the footprint of the new embankment fill may be impacted by the settlements imposed upon the underlying subgrade. Each facility owner should be contacted to discuss if additional consideration is needed to protect their facilities.

6.3 Lateral Earth Pressures

Concrete wingwalls may be constructed at either end of some culverts associated with the project. Recommendations for shallow foundations for wingwalls are presented in the Section 6.1 above. The effects of any hydrostatic pressures, sloping ground behind the walls, or footing loads behind the walls, have not been included in the equivalent fluid pressures presented in Exhibit 6-2 below. The influence zone should be considered to extend from the back of the wall to a line defined as beginning at the heel of the wall and extending up and away from the wall at a slope of 1 horizontal (H) to 1 vertical (V). For surcharge loads within the influence zone, the design lateral pressure should be increased by a value equal to half the surcharge load.

Exhibit 6-2: Lateral Earth Equivalent Fluid Pressures

Material	At-Rest (psf)	Active (psf)	Passive (psf)
Cohesive	66	47	283
Cohesionless	60	40	360

These values assume cohesive soils with a unit weight of 115 pounds per cubic foot (pcf) and an effective friction angle of 25 degrees, and cohesionless soils with a unit weight of 120 pcf and an effective friction angle of 30 degrees. These design values assume that soft clay, organic silt, and fat clay will not be used as backfill. Backfill should consist of lean clay or granular material placed and compacted in accordance with the grading recommendations in this report.

These design values further assume that a perimeter drain, such as that described below, or properly designed weep holes are installed so that hydrostatic pressures will not develop behind the walls. Both should provide drainage to at least the lowest adjacent exterior grade. The perimeter drain system could consist of 4- or 6-inch diameter PVC pipe, or equivalent, with ¼- or 3/8-inch perforations. The pipe should be laid with the perforations down and surrounded with ¾- or 1-inch clean crushed rock or gravel that extends a minimum of 2 feet horizontally from the wall and to within 2 feet of the adjacent ground surface. The drain should be capped with 2 feet of lean clay soil sloped to drain away from the structure. The crushed rock or gravel should be surrounded with Mirafi 140N filter cloth at all locations where it comes in contact with soil. Water collected by the drain should be discharged to a sump pit or by gravity to the adjacent ground surface.

6.4 Stability Model and Results

6.4.1 Definition of Factor of Safety

The factors of safety presented in this report are referenced to unity (1.0), which is considered to represent a slope on the verge of failure. Factors of safety below unity indicate an unsafe condition where movement is occurring. Alternately the higher a factor of safety above unity the safer the slope. A slope with a factor of safety of unity is assumed to be slowly creeping, and potentially on the verge of catastrophic failure as associated with sudden, significant movement.

6.4.2 Methods of Analysis

The computer program SLOPE/W was used for all the stability studies performed for this project. The program is capable of performing limit equilibrium analysis using several different methods. For this project the Morgenstern-Price method was used. The critical sliding surfaces were determined by the defined entry/exit method.

6.4.3 Model Inputs

We analyzed the stability of the proposed slopes for drained conditions (long-term) using effective stress-based drained strength parameters. Undrained strengths were evaluated for the end of construction (short-term) condition where pore water pressure changes induced by placement of fill have not had a chance to dissipate. We estimated the parameters using the field exploration and laboratory data.

Groundwater was assumed at the analysis locations based generally on where it was encountered at Boring SAR-4. Strength parameters used are shown on the output for each condition. The non-linear strength functions are shown in Exhibit 6-3 below. The other soil parameters used in the analysis are included on the Figures.

Exhibit 6-3: Non-linear Strength Functions

Fat Clay		Lean Clay	
Normal Stress (psf)	Shear Stress (psf)	Normal Stress (psf)	Shear Stress (psf)
0	250	0	0
251	250	251	167
1,044	497	1,044	610
2,089	843	2,089	1,079
8,354	2,788	8,354	3,700

psf = pounds per square foot

6.4.4 Results

The modeled soil conditions and stability results are shown in Figures 3 through 10. The strength of the new fill was first assumed using a friction angle of 26 degrees and no cohesion. The angle of internal friction was increased incrementally until the resulting factor of safety for all cases was found to be at least 1.5. The calculated factors of safety and required minimum strength of the new fill are summarized in Exhibit 6-4 below. A job special provision must be included to require the proposed fill materials be tested to verify that the materials have the required minimum drained strength. Alternately as shown in Figures 11 and 12, adequate factors of safety can also be achieved by providing reinforcement of the slope with embankment fill having a minimum friction angle of 26 degrees. The reinforcement should be placed every two feet and extend either 16 feet into the slope or should extend through the entire width of the new fill when embankment is being added onto the slope of the existing ground surface such as at Station 25+25. The reinforcement should be Tensar UX1100 or equivalent.

Exhibit 6-4: Stability Model Results

Model	Factor of Safety	Minimum Friction Angle of Fill	Figure
SAR Station 14+25 (Drained)	1.5	36	3
SAR Station 14+25 (Undrained)	13.3		4
SAR Station 14+50 (Drained)	1.5	36	5
SAR Station 14+50 (Undrained)	4.4		6
SAR Station 25+25 (Drained)	1.5	36	7
SAR Station 25+25 (Undrained)	1.5		8
SAR Station 30+00 (Drained)	1.5	36	9
SAR Station (Undrained)	1.5		10
SAR Station 25+25 (Drained) With Geogrid	1.5	26	11
SAR Station 30+00 (Drained) With Geogrid	1.6	26	12

6.5 Pavements

Performance of a pavement system depends on the pavement material and thicknesses, subgrade strength, traffic loads and repetitions, design life, and subgrade drainage characteristics. Our pavement analysis and results are based on the design procedures presented in the 1993 AASHTO Guide for the Design of Pavement Structures.

The pavements along the South Access Road will largely be constructed upon new engineered fill, or on subgrade that has been scarified, recompacted, and proofrolled. We have assumed that the subgrade will have a subgrade modulus of 100 pci or greater in evaluating the proposed pavement sections. Traffic loading was not available for the

sections analyzed. Therefore, the estimated traffic, 18-kip equivalent single axial loads (ESALs), assumed for each roadway are based on nearby data and the assumption described in the following paragraphs.

A concrete pavement section is being used for the South Access Road that consists of 10 inches of non-reinforced concrete over 6 inches of aggregate base.

The design life traffic estimates for Calvary Church Road and Castle Acres were considered to be combined to determine the traffic on the South Access Road. For a design life of 20 years, the combined ESALs for South Access Road were estimated at 4,034,488. Based on our analysis and assumed subgrade conditions, the planned concrete pavement section is adequate for a 20-year design life if traffic (ESALs) is equal to or less than 4,034,488. Pavements are anticipated having a shorter life if traffic is greater than that assumed.

6.5.1 Drainage

Drainage is the most important factor affecting pavement performance besides the design of the pavement section. Adequate slope must be provided to the pavement and subgrades to quickly drain away surface water and runoff that infiltrates into the pavement. Subgrades should be shaped and drained similar to the pavement surface so that there are no spots where water would pond and saturate the soil.

7 CONSTRUCTION CONSIDERATIONS

The applicability of the design parameters in Section 6 is contingent on good construction practice. Poor construction techniques may alter conditions from those upon which our recommendations are based, and therefore result in poor performance. Site preparation and any embankment fill placement should be performed in accordance with Division 200 of the Missouri Standard Specifications for Highway Construction and as discussed below. The following sections provide additional construction considerations for this project.

7.1 Site Preparation

In preparing the site for construction, debris and deleterious materials should be completely removed from the construction area and any other areas which are to be paved, cut, or receive fill. The remaining vegetative material in the soil subgrade should be less than 0.5%. In addition, limbs or root pieces greater than ½-inch diameter should be removed from the soil subgrade as well as any clusters of smaller vegetative matter and disposed of offsite. Proof rolling of exposed subgrade should also be monitored to identify areas that require treatment or replacement prior to further construction activities.

7.2 Earthwork

7.2.1 Proof Roll and Subgrade Preparation

The subgrade exposed directly below new base rock for pavement sections should be systematically proof rolled with a fully loaded, tandem axle dump truck. The proof rolling operation should be monitored full time by an experienced geotechnical engineer or technician. Any areas that rut or pump excessively should be removed and replaced with structural fill compacted to approved site standards. Any areas to receive embankment fill should be proof rolled prior to placing fill. Any areas that rut or pump excessively should be removed and replaced with structural fill compacted in accordance with the recommendations of this letter.

7.2.2 Structural Fill Material

Any material brought from off-site borrow areas should be approved by a geotechnical engineer before delivery at the site. Materials should be tested for drained shear strength by reconstituting a sample to 95% of standard Proctor and testing the soil using ASTM D 4767, Consolidated Undrained Triaxial Shear Strength with pore water pressure measurements. The results must meet the minimum strength requirements discussed in Exhibit 6-4 above. Alternately, select granular fill such MoDOT Type 5 is expected to meet the minimum strength requirement for all the locations.

Acceptable materials include, in general, crushed rock, well-graded sand and gravel, and lean clay exhibiting a liquid limit of less than 45 percent and a plasticity index of less than 20 percent. Satisfactory soil materials for structural fill are defined as those complying with ASTM D-2487 soil classification groups GW, GP, GM, SM, SW, SP, CL, and ML. Unsatisfactory soils include those complying with ASTM D-2487 soil classification groups MH, CH, OL, OH, and Peat.

7.2.3 Placement and Compaction of Fills

All structural fill placement and testing should meet the requirements of Missouri Department of Standard Specifications. The upper 18 inches of the earth subgrade extending the full width between roadbed slopes should be compacted to at least 95 percent of maximum density as determined by the standard Proctor test, AASHTO T-99 (ASTM D698). When embankments and backfills are composed of more than 18 inches of fill, the materials within 18 inches of the top of fill subgrade elevation should be compacted to a minimum of 95 percent of the dry density as determined by the standard Proctor test with material below the 18 inches of the top of fill subgrade elevation compacted to a minimum of 90 percent of the dry density as determined by the standard Proctor test. Aggregate base

should be compacted to at least 95 percent of maximum density as determined by the standard Proctor test.

7.2.4 Keyed Slopes for Filling

Any fill that is placed on existing slopes steeper than 1V to 5H should be keyed into the existing slope by continuously benching in not less than 12-inch rises. Benching shall be of sufficient width to permit placing and compacting operations. The horizontal cut shall begin at the intersection of the ground line and the vertical side of the previous bench. The surfaces of the slopes should be protected from erosion by seeding, sodding, or other acceptable means.

8 REFERENCES

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FIGURES

Figures

FIGURES

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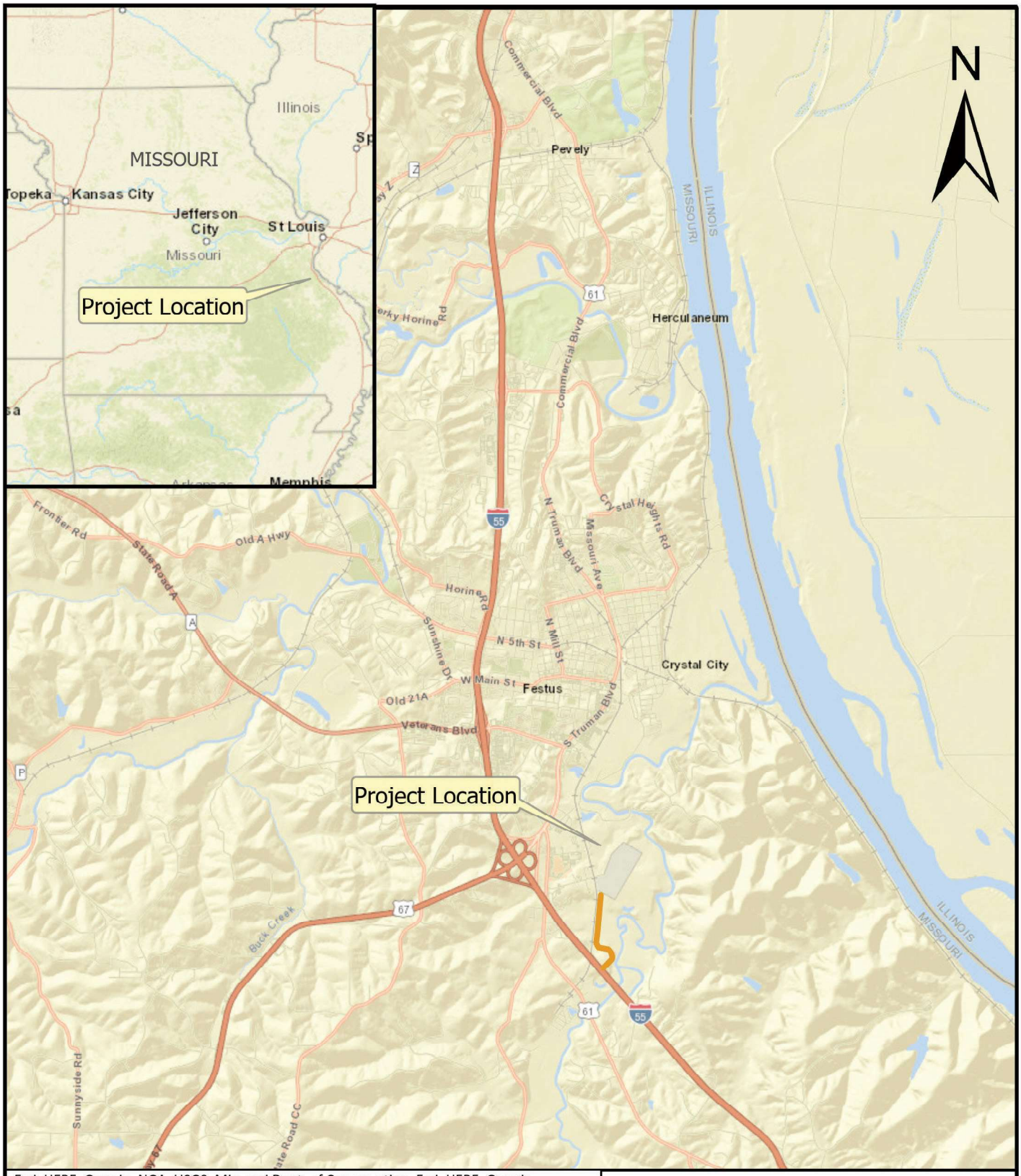

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Miles

South Access Road

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

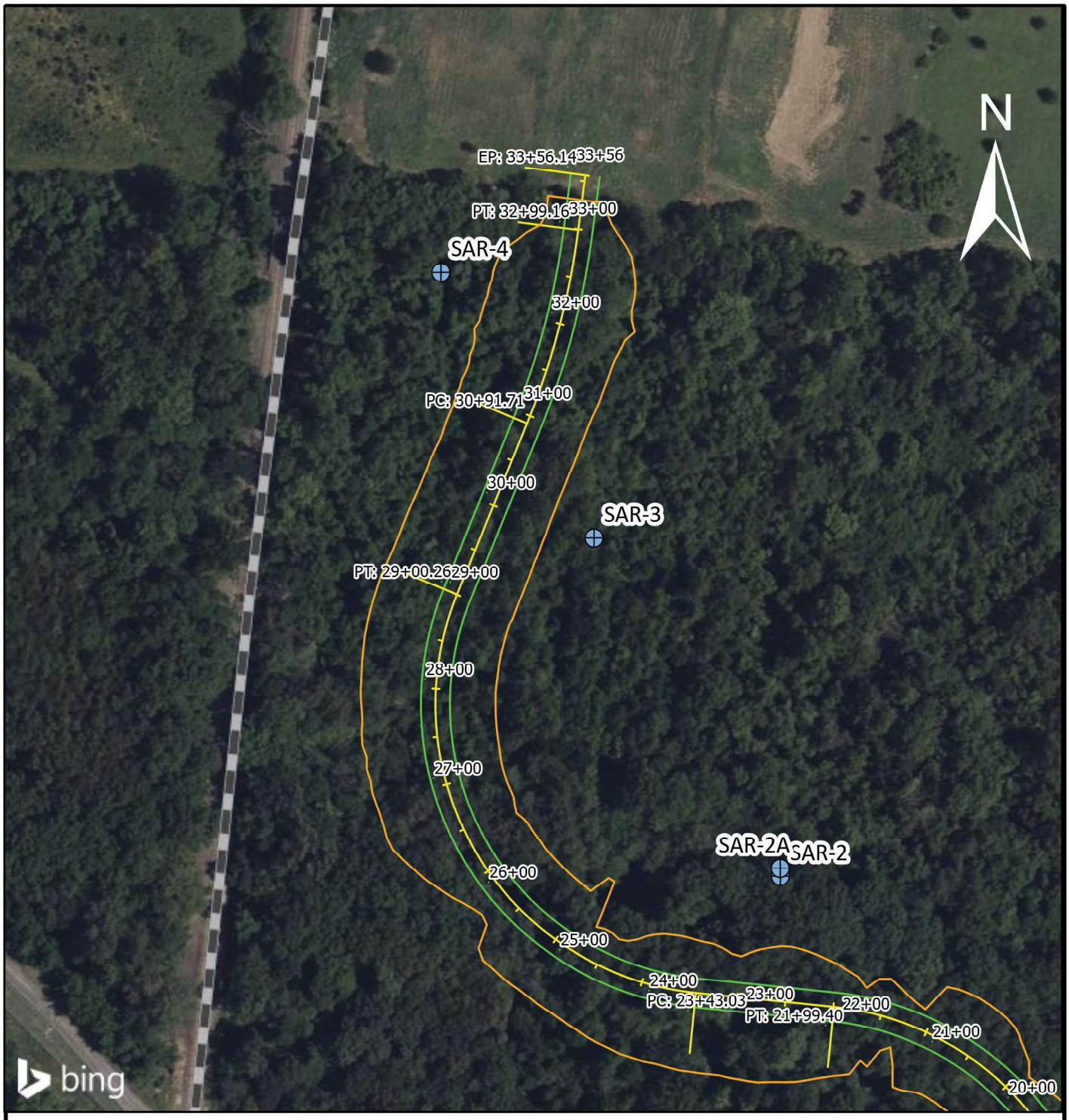
PROJECT LOCATION

October 2024

112117-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Figure 1



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Feet

Legend

- Completed Borings
- Limits of Construction
- Roadway - Proposed Centerline
- Roadway - Proposed Station Center Lines
- Proposed Road

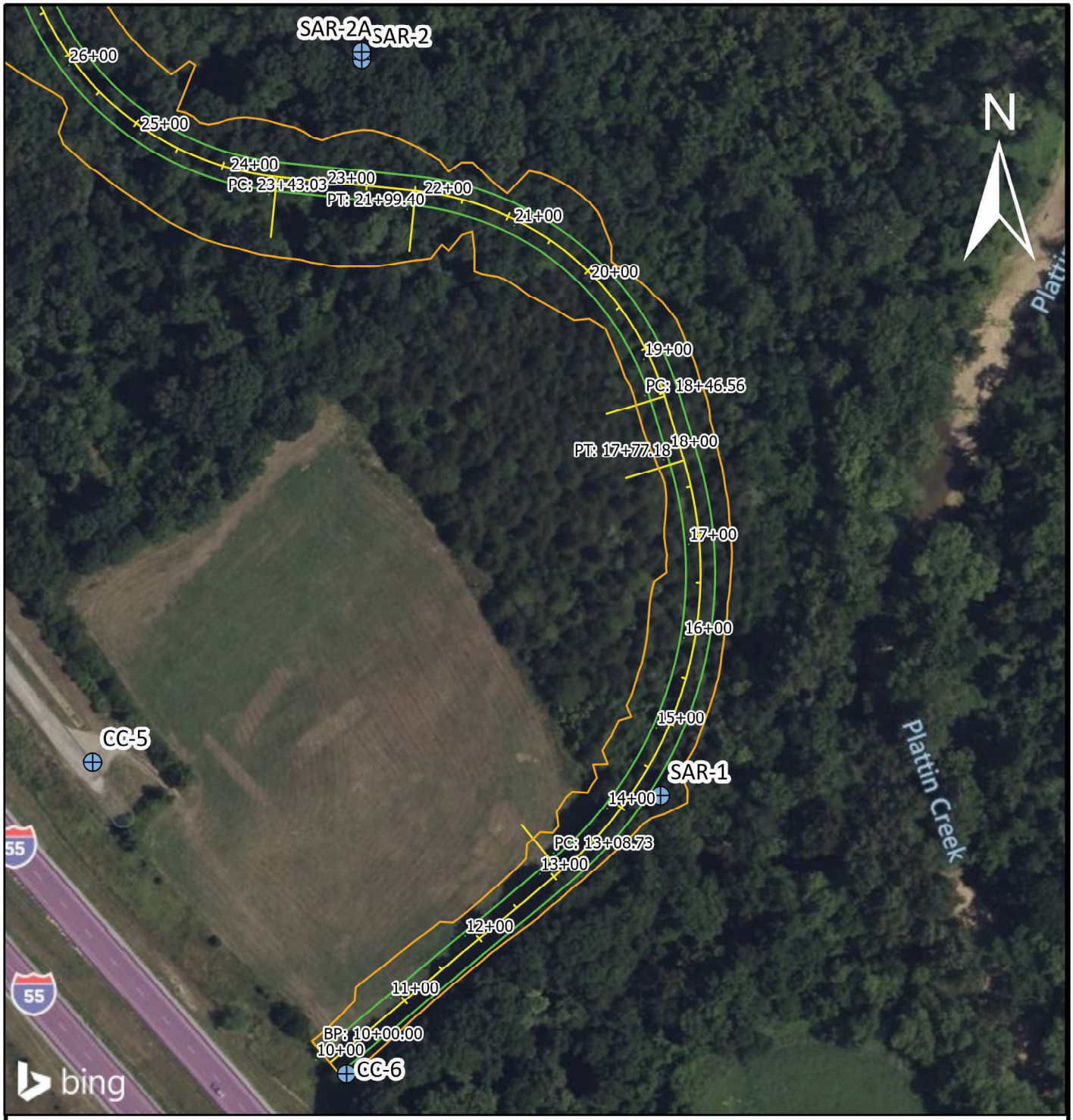
Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR BORING LOCATIONS AND CONSTRUCTION LIMITS (NORTH)

October 2024 112117-001

SHANNON & WILSON, INC. GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Figure 2.1



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Feet

Legend

- Completed Borings
- Limits of Construction
- Roadway - Proposed Centerline
- Roadway - Proposed Station Center Lines
- Proposed Road

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR BORING LOCATIONS AND CONSTRUCTION LIMITS (SOUTH)

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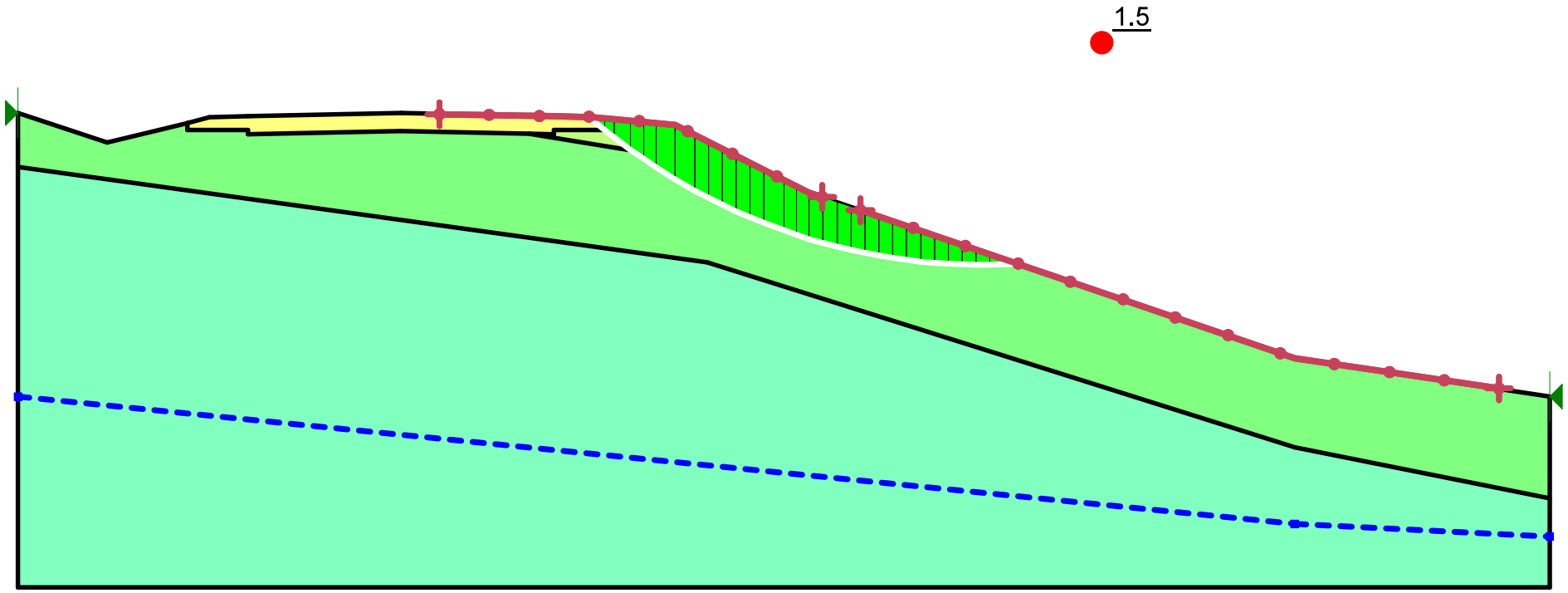
Figure 2.2

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Bedrock	Mohr-Coulomb	135	5,000	40
	Fat Clay	Shear/Normal Fn.	115		
	Fill	Mohr-Coulomb	120	0	36
	Gravel	Mohr-Coulomb	125	0	34



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 14+25 (Drained)

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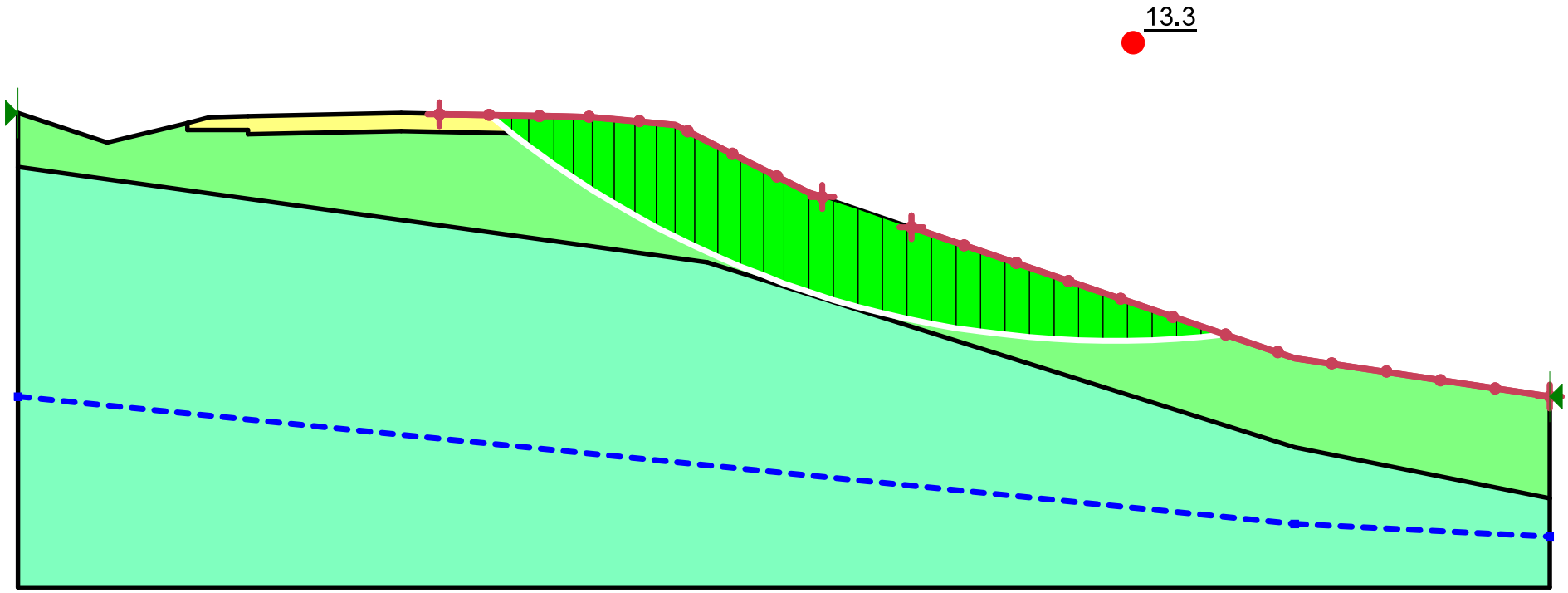
FIG. 3

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\SAR Slope Stability\Station 14+25.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Bedrock	Mohr-Coulomb	135		5,000	40
	Fat Clay	Undrained (Phi=0)	115	2,500		
	Fill	Mohr-Coulomb	120		0	36
	Gravel	Mohr-Coulomb	125		0	34



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 14+25 (Undrained)

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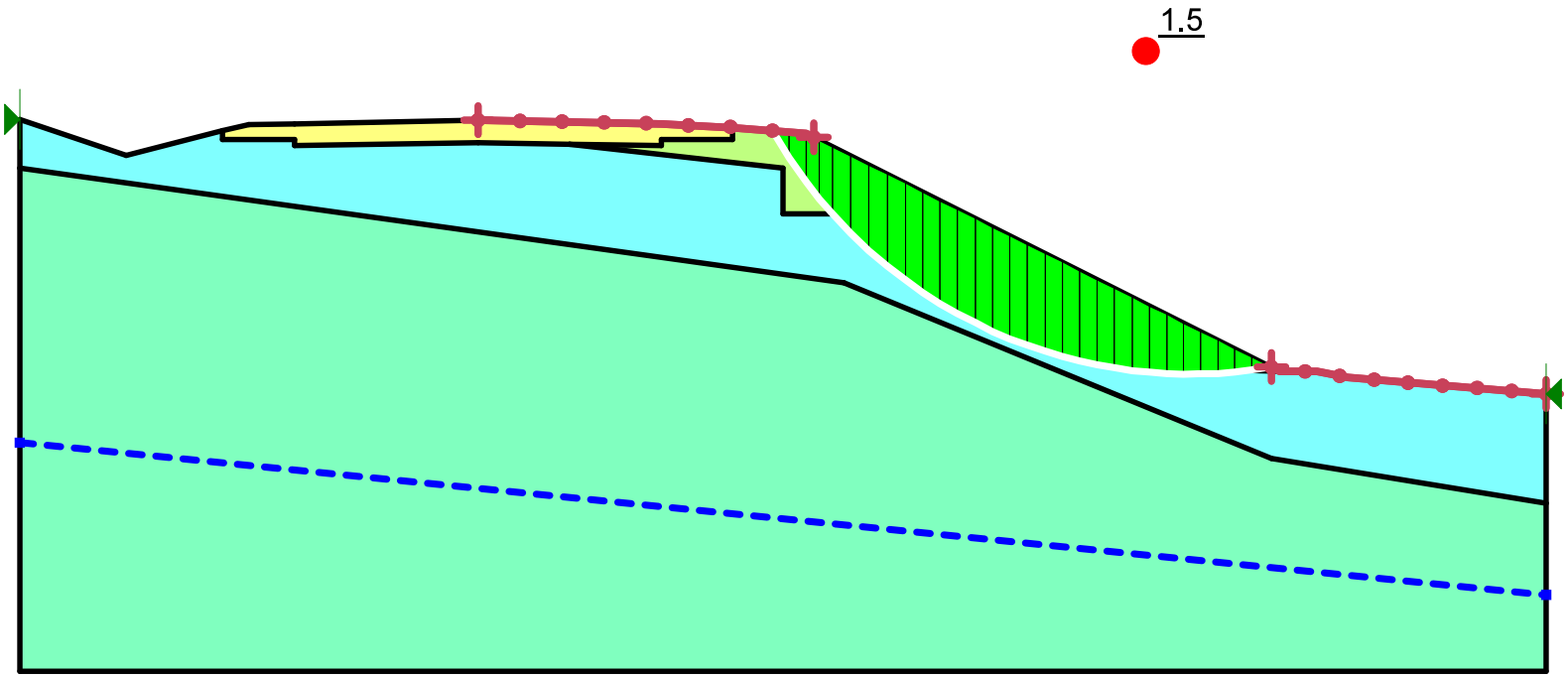
FIG. 4

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\SAR Slope Stability\Station 14+25 - Undrained.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Bedrock	Mohr-Coulomb	135	5,000	40
	Fat Clay Cohesion	Shear/Normal Fn.	115		
	Fill	Mohr-Coulomb	120	0	36
	Gravel	Mohr-Coulomb	125	0	34



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 14+50 (Drained)

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FIG. 5

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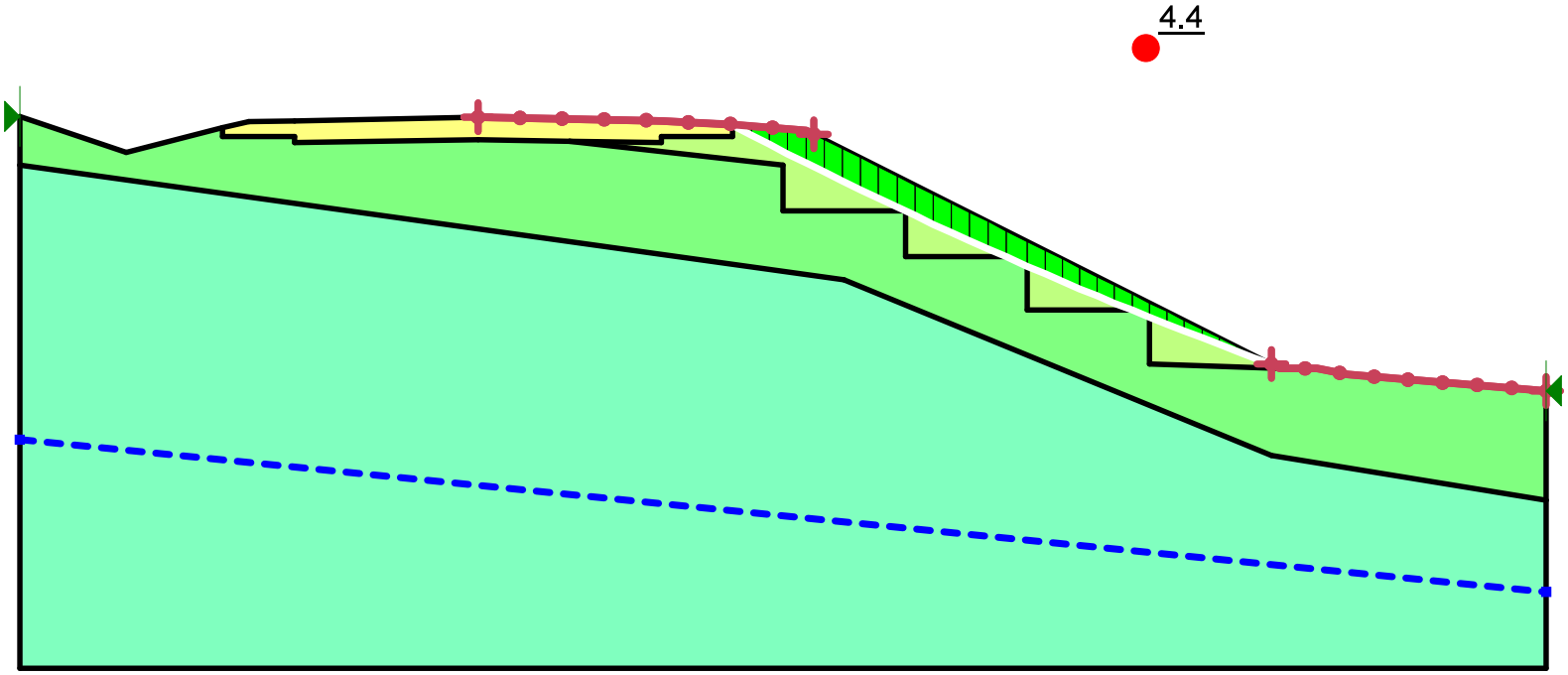
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Bedrock	Mohr-Coulomb	135		5,000	40
	Fat Clay	Undrained (Phi=0)	115	2,500		
	Fill	Mohr-Coulomb	120		0	36
	Gravel	Mohr-Coulomb	125		0	34



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 14+50 (Undrained)

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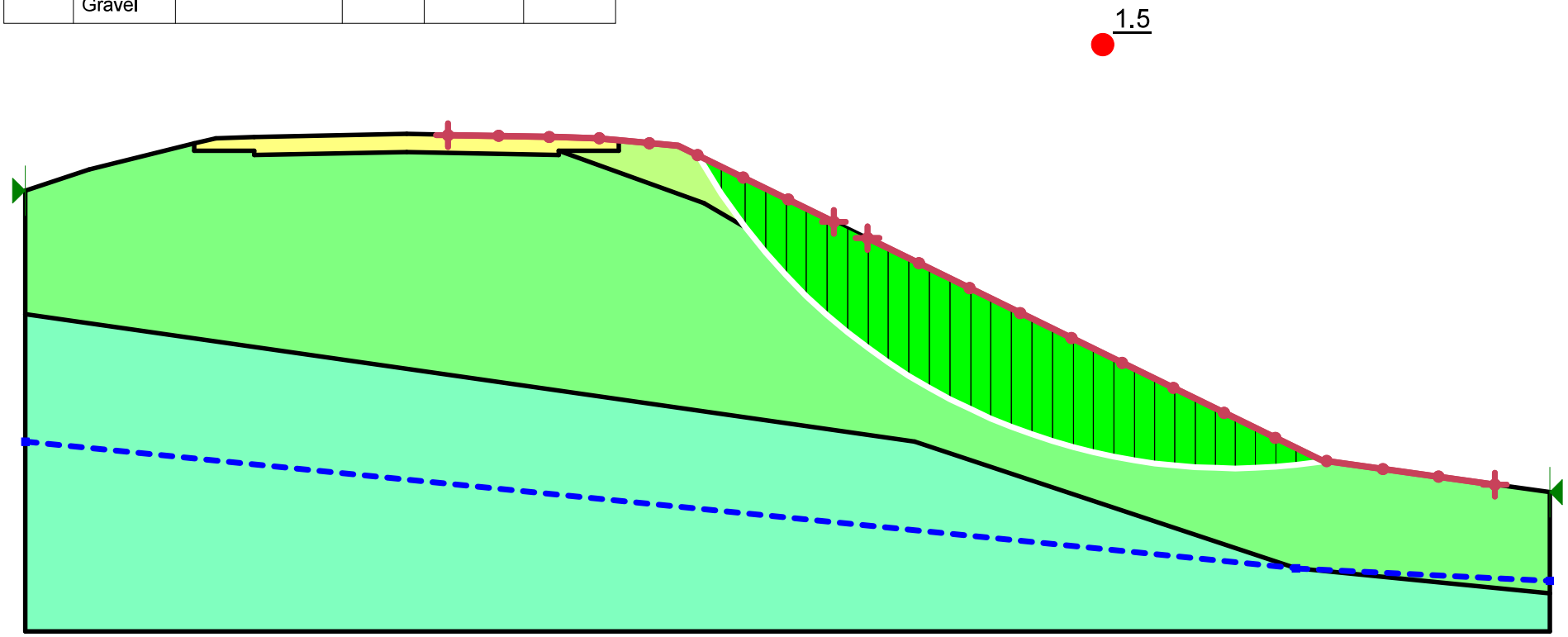
FIG. 6

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\SAR Slope Stability\Station 14+50 - Undrained.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Fill	Mohr-Coulomb	120	0	36
	Gravel	Mohr-Coulomb	125	0	34
	Lean Clay	Shear/Normal Fn.	115		
	Very Dense Gravel	Mohr-Coulomb	135	0	40



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 25+25 (Drained)

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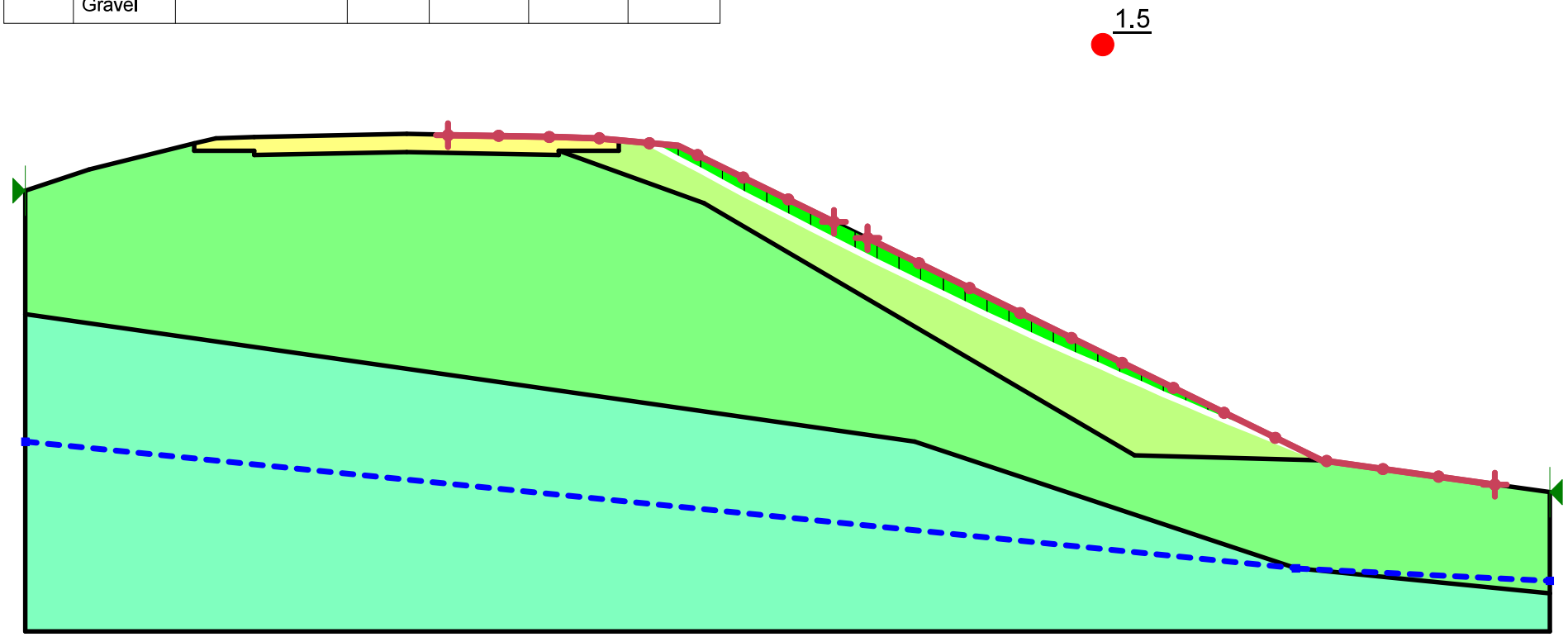
FIG. 7

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\South Access Road Slope Stability\Station 25+25.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Fill	Mohr-Coulomb	120		0	36
	Gravel	Mohr-Coulomb	125		0	34
	Lean Clay	Undrained (Phi=0)	115	1,000		
	Very Dense Gravel	Mohr-Coulomb	135		0	40



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 25+25 (Undrained)

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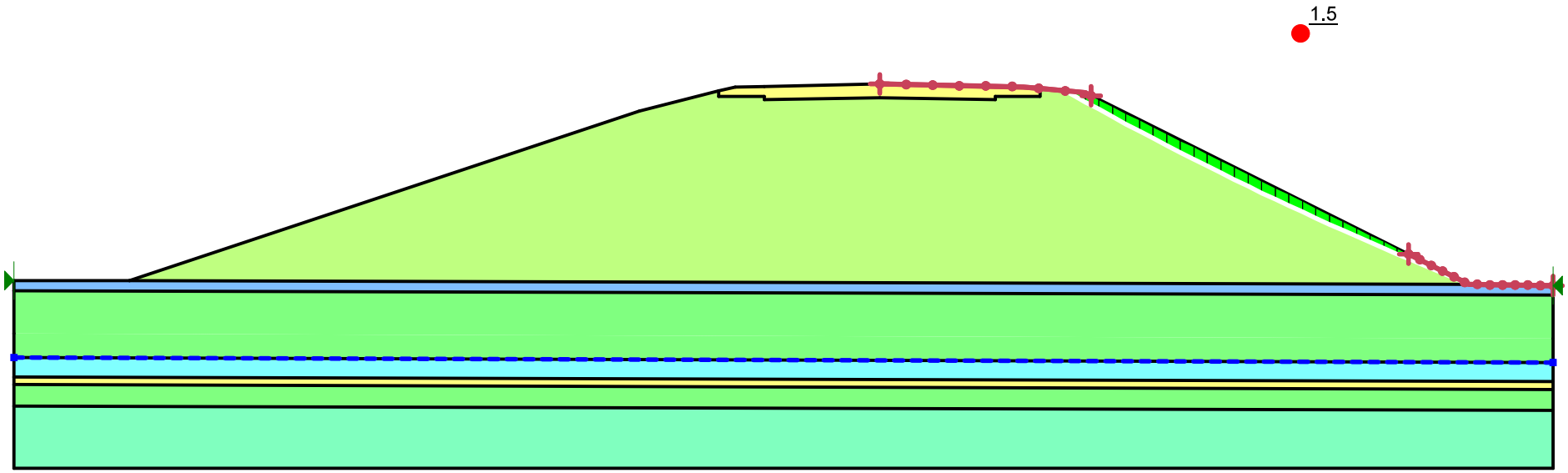
FIG. 8

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\South Access Road Slope Stability\Station 25+25 - Undrained.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	Mohr-Coulomb	120	0	27
	Fill	Mohr-Coulomb	120	0	36
	Gravel	Mohr-Coulomb	125	0	34
	Lean Clay	Shear/Normal Fn.	115		
	Organic Soil with Sand	Mohr-Coulomb	110	0	27
	Very Dense Gravel	Mohr-Coulomb	135	0	40



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 30+00 (Drained)

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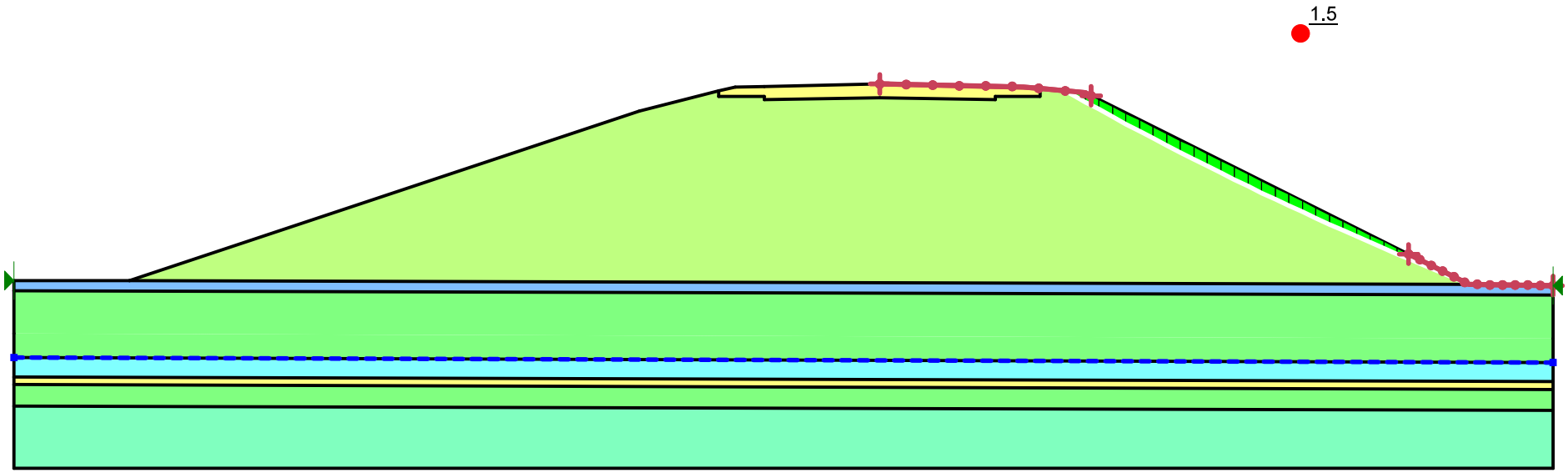
FIG. 9

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\South Access Road Slope Stability\Station 30+00.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	Mohr-Coulomb	120		0	27
	Fill	Mohr-Coulomb	120		0	36
	Gravel	Mohr-Coulomb	125		0	34
	Lean Clay	Undrained (Phi=0)	115	700		
	Organic Soil with Sand	Mohr-Coulomb	110	500		
	Very Dense Gravel	Mohr-Coulomb	135		0	40



NOTES

1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 30+00 (Undrained)

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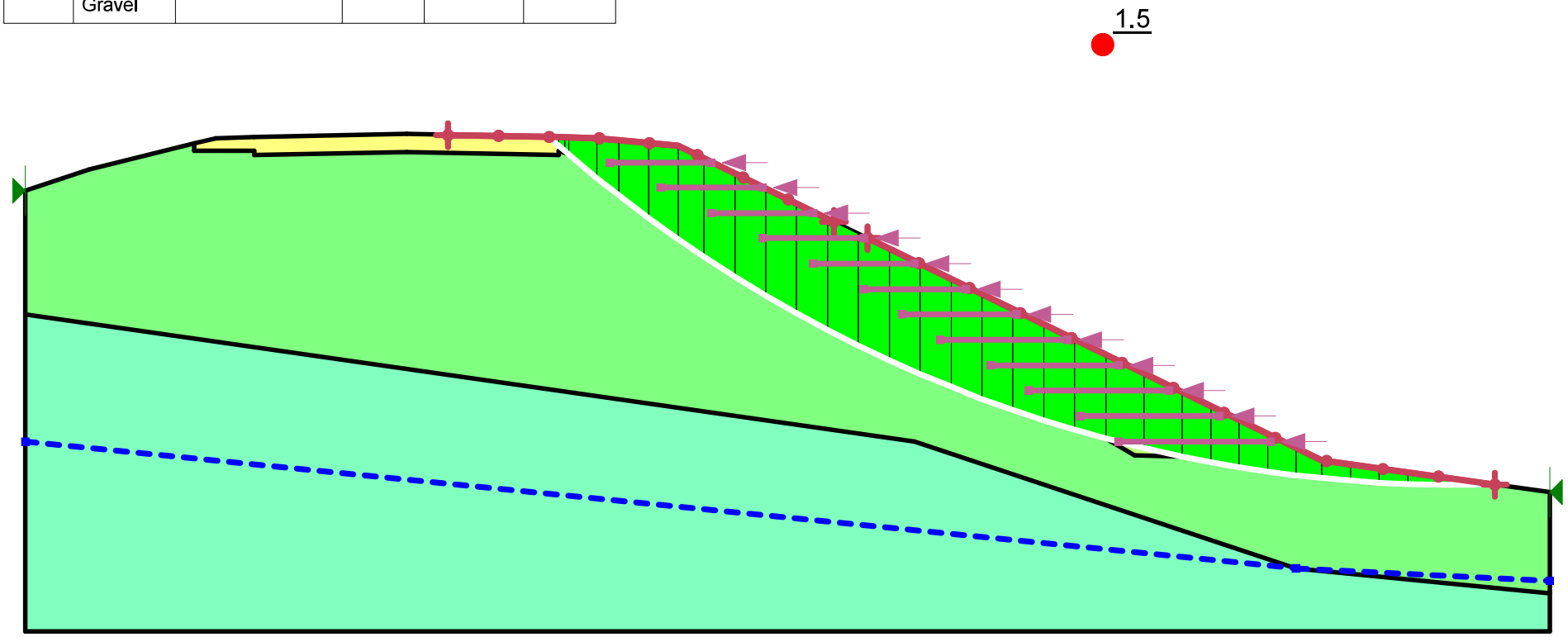
FIG. 10

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\South Access Road Slope Stability\Station 30+00 - Undrained.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Fill	Mohr-Coulomb	120	0	26
	Gravel	Mohr-Coulomb	125	0	34
	Lean Clay	Shear/Normal Fn.	115		
	Very Dense Gravel	Mohr-Coulomb	135	0	40



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 25+25 (Drained)
With Geogrid

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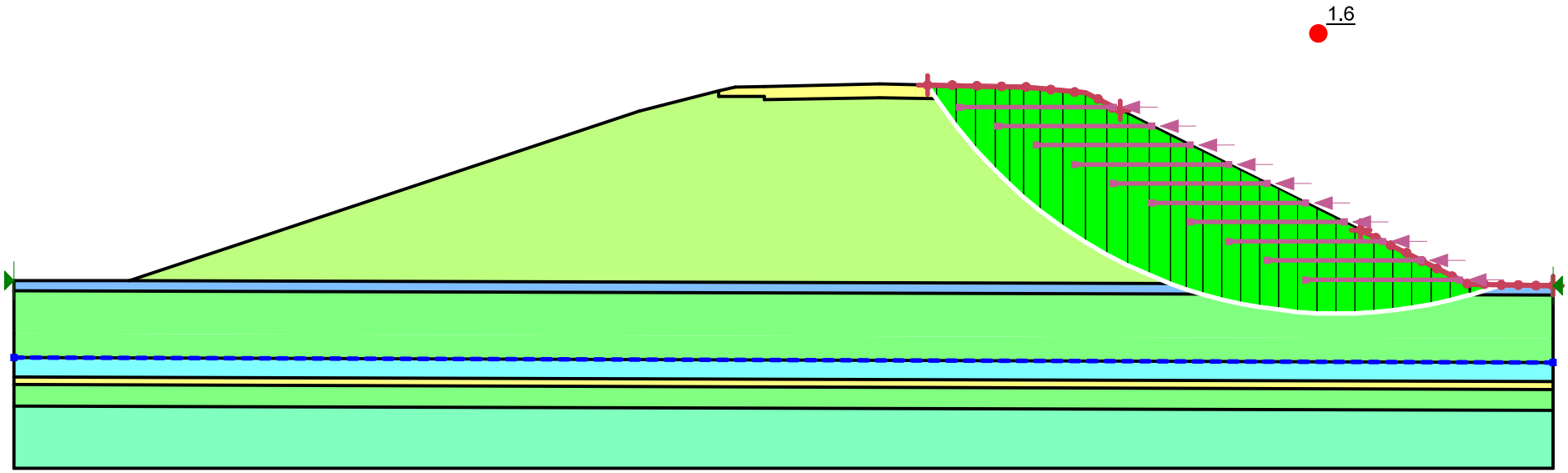
FIG. 11

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\SAR Slope Stability\Station 25+25.gsz

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Clayey Sand	Mohr-Coulomb	120	0	27
	Fill	Mohr-Coulomb	120	0	26
	Gravel	Mohr-Coulomb	125	0	36
	Lean Clay	Shear/Normal Fn.	115		
	Organic Soil with Sand	Mohr-Coulomb	110	0	27
	Very Dense Gravel	Mohr-Coulomb	135	0	40



NOTES
1. Critical failure surface estimated using the entry and exit search criteria and the Morgenstern-Price (1965) analysis method.
2. See report text for additional information about analyses and assumptions.

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR Station 30+00 (Drained) With Geogrid

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FIG. 12

P:\STL\112000s\112117 Project Redbird - Offsite Improvement Project\001 Geotechnical\Analysis\Station 30+00 3_1 - 15 ft Tensar.gsz

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APPENDIX A: BORING LOGS

Appendix A

Boring Logs

CONTENTS

APPENDIX A: BORING LOGS

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SOIL CLASSIFICATION

Shannon & Wilson uses a soil identification system modified from the Unified Soil Classification System (USCS) as described on this Key. Soil descriptions are based on visual-manual procedures (ASTM D2488) and available laboratory index test results (ASTM D2487).

Exhibit A: Unified Soil Classification System (USCS)[1]

Major Divisions			Symbol	Graphic	Typical Identifications (USCS Group Names)[2,4]
COARSE-GRAINED SOILS (> 50% of soil is retained on the No. 200 sieve[3])	GRAVELS (> 50% of coarse fraction retained on the No. 4 sieve[3])	Gravel (< 5% fines[3])	GW		Well-graded Gravel; Well-Graded Gravel with Sand
			GP		Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel (> 12% fines[3])	GM		Silty Gravel; Silty Gravel with Sand
			GC		Clayey Gravel; Clayey Gravel with Sand
	SANDS (≥ 50% of coarse fraction passes the No. 4 sieve[3])	Sand (< 5% fines[3])	SW		Well-graded Sand; Well-graded Sand with Gravel
			SP		Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand (> 12% fines[3])	SM		Silty Sand; Silty Sand with Gravel
			SC		Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS (≥ 50% of soil passes the No. 200 sieve[3])	SILTS AND CLAYS (liquid limit < 50)	Inorganic	ML		Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL		Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly, Lean Clay
		Organic	OL		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly, Organic Silt or Clay
	SILTS AND CLAYS (liquid limit ≥ 50)	Inorganic	MH		Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly, Elastic Silt
			CH		Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly, Fat Clay
		Organic	OH		Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly, Organic Silt or Clay
HIGHLY ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor		PT		Peat or other Highly Organic Soils (see ASTM D4427)

NOTE: *For gravels and sands with 5 to 12% fines[3], the following are added to the Group Name:* with Silt and/or Clay or Silty Clay. *Dual Symbols are used:* GW-GM, GP-GM, SW-SM, SP-SM GW-GC, GP-GC, SW-SC, SP-SC

EXHIBIT A NOTES:
1. Adapted, with permission, from USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488.
2. Borderline symbols (symbols separated by a slash) indicate that the soil characteristics are close to the defining boundary between two groups (e.g., CL/ML = Lean Clay to Silt; SP-SM/SM = Sand with Silt to Silty Sand).
3. No. 4 size = 4.75 millimeters (mm) = 0.187 inch; No. 200 sieve size = 0.075 mm = 0.003 inch. Particles smaller 0.075 mm are termed "fines".
4. Poorly graded indicates a narrow range or missing grain sizes. Well-graded indicates a full-range and even distribution of grain sizes.
5. If cobbles and/or boulders are observed, "with cobbles" or "with boulders" or "with cobbles and boulders" is added to the Group Name.

Exhibit B-1: Standard Penetration Test (SPT)

Term	Description
Hammer	140-pound weight with a 30-inch free fall. Hammer types vary (e.g., automatic, rope and cathead). If available, the hammer type and energy ratio (E-ratio) is noted on the boring log.
Sampler	Barrel I.D. / O.D. = 1.5 inches / 2 inches (liner not used) Barrel Length = 30 inches; Shoe I.D. = 1.375 inches
N-Value (N)[1]	Sum of the count of hammer blows to penetrate the second and third 6-inch increments in blows per foot (bpf). **Refusal**: 50 blows for 6 inches or less or 10 blows for 0 inch.

Exhibit B-2: Relative Consistency of Cohesive Soils

Term	N[2] (bpf)	PP[3] (tsf)	TV[3] (tsf)
Very Soft	0 - 2	0 - 0.25	0 - 0.12
Soft	2 - 4	0.25 - 0.5	0.12 - 0.25
Medium Stiff	4 - 8	0.5 - 1	0.25 - 0.5
Stiff	8 - 15	1 - 2	0.5 - 1
Very Stiff	15 - 30	2 - 4	1 - 2
Hard	> 30	> 4	> 2

Exhibit B-3: Relative Density of Cohesionless Soils

Term	N[2] (bpf)
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

EXHIBIT B NOTES:
1. N-values shown on boring logs are as recorded in the field and have not been corrected for hammer energy, overburden, or other factors. Where the hammer E-ratio is available, the N-value normalized to a ratio of 60% (N_{60}) is listed.
2. Based on ASTM Standard D1586. Relative densities/consistencies noted on the boring logs are based on uncorrected N-values.
3. PP = pocket penetrometer; TV = torvane, tsf = tons per square foot. Correlations based on experience and multiple published references.

Exhibit C: Soil Structure[1]

Term	Description
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Fissured	Breaks along definite planes or fractures with little resistance.
Homogeneous	Same color and appearance throughout.
Interbedded	Alternating layers at least 1/4 inch thick of varying material or color. *Singular: bed*
Laminated	Alternating layers less than 1/4 inch thick of varying material or color. *Singular: lamination*
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.

EXHIBIT C NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit D: Soil Plasticity[1]

Term	Description
Nonplastic	Cannot roll a 1/8-inch thread at any water content.
Low Plasticity	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.
Medium Plasticity	A thread is easy to roll and not much time in rolling is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.
High Plasticity	It takes considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.

EXHIBIT D NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit E: Soil Moisture Content[1]

Term	Description
Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, from below water table.

EXHIBIT E NOTE:
1. Adapted, with permission, from ASTM D2488 (Figure 2).

Exhibit F: Soil Cementation[1]

Term	Description
Weak	Crumbles or breaks with handling or slight finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

EXHIBIT F NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit G: Percentages

Term	Percent[1]
Trace	<5
Few	5 to 10
Little	15 to 25
Some	30 to 45
Mostly	>50

EXHIBIT G NOTE:
1. Percent estimated by weight for sand and gravel, and by volume for cobbles, organics, and other non-soil material (e.g., rubble, debris).

SOIL CLASSIFICATION *(continued)*

See Page 1 for Soil Classification Exhibits A through G

Exhibit H: Particle Angularity and Shape[1]

Term	Description
Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width to thickness ratio > 3.
Elongated	Width to thickness ratio < 3.

EXHIBIT H NOTE:
1. Adapted, with permission, from ASTM D2488.

Exhibit I: Additional Descriptive Terms

Term	Description
Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling action.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

SOIL CLASSIFICATION REFERENCES:
ASTM International, [current edition], Annual book of standards, v. 04.08, soil and rock (I): D420 - D5876, available: www.astm.org.
U.S. Army Corps of Engineers, 1953, The unified soil classification system: Vicksburg, Miss., Waterways Experiment Station, Technical Memorandum 3-357, 2 v., March.

SYMBOLOGY AND GRAPHICS

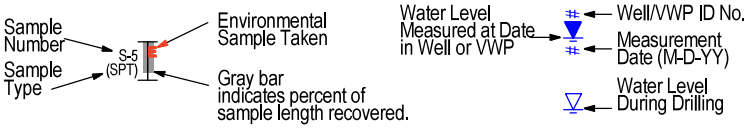
Exhibit J: Sample and Run Graphics

Graphic	Description	Graphic	Description	Graphic	Description
	SPT split spoon (2.5-inch OD)		Split spoon (SS) (diameters vary)		Core run (typically rock)
	Grab (GB) from cuttings or excavation		Modified California (MC) sampler		Sheath (SH) (used for geoprobes)
	Tube (TB) (e.g., Shelby, piston)		Sonic core (SC) run (typically soil)		

Exhibit K: Hole Backfill and Instrument Graphics

Graphic	Description	Graphic	Description	Graphic	Description
	Bentonite-cement grout		Surface cement seal		Blank pipe or instrument casing
	Bentonite grout		Sand filter pack		Perforated or slotted pipe
	Bentonite chips		Slough *(hole caved)*		VWP and electric lead

Exhibit L: Other Log Symbols



ROCK CLASSIFICATION

Shannon & Wilson uses a rock classification system modified from the system recommended by the International Society for Rock Mechanics (ISRM). Copyright limitations prevent us from reproducing summary tables from the ISRM system on this Key. General descriptions are provided in Exhibit M.

Exhibit M: General Rock Descriptive Terms - ISRM

Term	General Description
Strength	Ranges from extremely weak (q_u = 36 to 135 psi) to extremely strong (q_u > 36,250 psi), and is based on the ability to break the rock with a hammer or scrape the rock with a knife.
Weathering	Ranges from fresh (no visible signs of weathering) to completely weathered, based on observed degree of discoloration, decomposition, and/or disintegration. When the rock material has completely converted to soil, it is termed a residual soil.
Fabric	Describes the rock structure based on observed layering, tendency to break, and distribution of minerals (e.g., massive, bedded, foliated).
Roughness	For discontinuities: Includes rough, smooth, and slickensided, and includes other descriptive terms (e.g., stepped, undular, irregular, planar).
Spacing	For discontinuities: Ranges from extremely close (< 1 inch) to extremely wide (> 20 feet).
Persistence	For discontinuities: Ranges from very low to very high.
Other	Description of discontinuities (joints, fractures, bedding planes, etc.), observations of potential displacement, gouge, shear, etc.

REFERENCE: Brown, E. T., ed., 1981, Rock characterization, testing & monitoring: International Society of Rock Mechanics (ISRM) suggested methods: Oxford, Pergamon Press, 211 p.

Exhibit N: Rock Name Graphics

Graphic	Description	Graphic	Description
	Limestone		Shale
	Dolomite		Siltstone
	Sandstone		Chert

Exhibit O: Recovery and RQD Equations[1]

Term	Equation
Core Recovery (REC) in %	$100\% \times \frac{\text{Length of Core Recovered}}{\text{Length of Core Run}}$
Rock Quality Designation (RQD) in %	$100\% \times \frac{\text{Length of Core in Pieces} > 4 \text{ in}}{\text{Length of Core Run}}$

REFERENCE: Loehr, J. E.; Lutenegger, A.; Rosenblad, B.; and Boeckmann, A., 2016, Geotechnical site characterization: U.S. Federal Highway Administration Report FHWA NHI-16-072, Geotechnical Engineering Circular no. 5, 1 v.

ACRONYMS AND ABBREVIATIONS

ATD	at time of drilling	N	field (uncorrected) SPT N-value	REF	refusal
bpf	blows per foot	N_{60}	SPT N-value corrected for 60% ETR	RQD	rock quality designation (ASTM D6032)
Elev.	elevation	NA, n/a	not applicable or not available	SC	sonic core
ENV	environmental sample	NE	northeast	SE	southeast
ETR	energy transfer ratio (hammer)	NP	nonplastic	SPT	Standard Penetration Test (ASTM D1586)
FC	fines content (< 0.075 mm)	NR	no recovery	SW	southwest
FeO	iron oxide	NW	northwest	TP	test pit
ft or '	foot or feet	OC	organic content	tsf	tons per square foot
gal	gallons	OD	outside diameter	TV	tor vane reading
GP	geoprobe	OW	observation well	UCS, q_u	unconfined shear strength
GWT	groundwater table	pcf	pounds per cubic foot	USCS	Unified Soil Classification System
HCL	hydrochloric acid	PI	plasticity index	UU	Unconsolidated undrained triaxial shear strength
HSA	hollow-stem auger	PID	photoionization detector	VST	vane shear test
ID	inside diameter or identification	PL	plastic limit	VWP	vibrating wire piezometer
in or "	inch	PMT	pressuremeter test	WC	natural water content
incl	inclinometer	PP	pocket penetrometer shear strength	WOH	weight of hammer
ksf	kips per square foot	ppm	parts per million	WOR	weight of rods
lbs	pounds	psi	pounds per square inch		
LL	liquid limit	PT	nonstandard penetration test N-value		
mm	millimeter	REC	recovery		

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BORING LOG

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR-1
Page 1 of 1

EXPLORATION INFORMATION

Total Depth:	*8.0 feet*
Top Elevation:	*~423 feet*
Vertical Datum:	*n/a*
Latitude:	*~ 38.1846 degrees*
Longitude:	*~ -90.3853 degrees*
Horizontal Datum:	*WGS [GCS1984]*
Hole Start Date:	*October 18, 2023*
Hole Finish Date:	*October 18, 2023*

DRILLING INFORMATION

Drilling Method:	*Hollow Stem Auger*
Drilling Company:	*REDI*
Drill Rig Equipment:	*CME-75*
Hole Size:	*8 inch*
Rod Type/Dia.:	*AW 1.75 inch*
Hammer Wt. / Drop:	*140 lbs/30 inches*
Hammer ETR:	*n/a*

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

Abbreviations

N	Standard Penetration Test (SPT) blows per 6-inch increment
PT	Penetration test (not SPT) blows per 6-inch increment
bpf	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
PI	Plasticity index (Atterberg Limits)

Symbols

Sample Number / Sample Type → S-5 (SPT) ← Gray bar indicates percent of sample length recovered.

Water Level During Drilling →

Approx. Elev. (feet)	Depth (feet)	Material Description and Other Observations	Graphic	Depth (feet)	Samples	Field Data	Lab Data	Multiple Items Plotted *(see bottom legend on Page 1)* 0 50 100	Depth (feet)
420		Loose, light brown, ***ORGANIC SOIL*** (OL/OH); Topsoil.		1.0					
		Very dense, red-brown to light gray, ***POORLY GRADED GRAVEL WITH CLAY AND SAND*** (GP-GC); dry; (Fill).		1.4	SS-1 (SPT)	N = 41,47,43 PP = 2.25 tsf	WC=13%		
	5	Very stiff, brown, ***FAT CLAY*** (CH); dry.			SS-2 (SPT)	N = 6,8,11 PP = 1.75 tsf	WC=29% LL/PI=86/57		5
		LIMESTONE: light gray, highly weathered		5.5	SS-3 (SPT)	N = 50/5"			
415	8	-*Auger refusal at 8.0 feet.*		8.0					

No Observed Groundwater

BOTTOM OF HOLE AT 8 FEET

NOTES:
- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- Group symbol is based on visual-manual identification and selected lab testing.
- Report text contains limitations and information needed to contextually understand this log.

▲ Uncorrected N-value, bpf
▼ Uncorrected, Penetration N-value, bpf
● = WC%
Plastic Limit ——●—— Liquid Limit

FINAL

Logged by:	RRB
Review by:	MAR
Version:	1

Job#: 112117-001 | Template Ver:1 | File: 112117-001 BORING LOGS.GPJ | Rpt: BORING LOG - WITH SU | Library: SW GINT LIBRARY.GLB | Date: 10/1/24

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BORING LOG

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR-2
Page 1 of 1

EXPLORATION INFORMATION

Total Depth:	*10.5 feet*
Top Elevation:	*~407 feet*
Vertical Datum:	*n/a*
Latitude:	*~ 38.1867 degrees*
Longitude:	*~ -90.3864 degrees*
Horizontal Datum:	*WGS [GCS1984]*
Hole Start Date:	*October 18, 2023*
Hole Finish Date:	*October 18, 2023*

DRILLING INFORMATION

Drilling Method:	*Hollow Stem Auger*
Drilling Company:	*REDI*
Drill Rig Equipment:	*CME-75*
Hole Size:	*8 inch*
Rod Type/Dia.:	*AW 1.75 inch*
Hammer Wt. / Drop:	*140 lbs/30 inches*
Hammer ETR:	*n/a*

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

Abbreviations

N	Standard Penetration Test (SPT) blows per 6-inch increment
PT	Penetration test (not SPT) blows per 6-inch increment
bpf	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
PI	Plasticity index (Atterberg Limits)

Symbols

Sample Number / Sample Type → S-5 (SPT) ← Gray bar indicates percent of sample length recovered.

Water Level During Drilling →

Approx. Elev. (feet)	Depth (feet)	Material Description and Other Observations	Graphic	Depth (feet)	Samples	Field Data	Lab Data	Multiple Items Plotted *(see bottom legend on Page 1)* 0 50 100	Depth (feet)
405		Loose, brown, ***ORGANIC SILT WITH SAND*** (OL/OH); Topsoil.		1.0	SS-1 (SPT)	N = 6,6,4 PP = 0.875 tsf	WC=20%		
		Stiff, dark brown, ***LEAN CLAY*** (CL); moist.			SS-2 (SPT)	N = 3,4,6 PP = 0.75 tsf	WC=19%		
400	5	Stiff to medium stiff, red-brown, ***SANDY LEAN CLAY*** (CL); moist to wet.		5.5	SS-3 (SPT)	N = 2,2,3 PP = 0.25 tsf	WC=20% FC=67% LL/PI=30/15		5
		LIMESTONE: light gray, highly weathered		9.0	SS-4 (SPT)	N = 1,2,50/5" PP = 0.125 tsf	WC=29%		
	10 10.5	*-Auger refusal at 10.5 feet.*		10.5			WC=21%		10

No Observed Groundwater

BOTTOM OF HOLE AT 10.5 FEET

NOTES:
- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- Group symbol is based on visual-manual identification and selected lab testing.
- Report text contains limitations and information needed to contextually understand this log.

▲ Uncorrected N-value, bpf
▼ Uncorrected, Penetration N-value, bpf
● = WC% ◇ = FC%
Plastic Limit — Liquid Limit

FINAL

Logged by:	RRB
Review by:	MAR
Version:	1

Job#: 112117-001 | Template Ver:1 | File: 112117-001 BORING LOGS.GPJ | Rpt: BORING LOG - WITH SU | Library: SW GINT LIBRARY.GLB | Date: 10/1/24

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BORING LOG

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR-2A

EXPLORATION INFORMATION

Total Depth:	*10.5 feet*
Top Elevation:	*~407 feet*
Vertical Datum:	*n/a*
Latitude:	*~ 38.1867 degrees*
Longitude:	*~ -90.3864 degrees*
Horizontal Datum:	*WGS [GCS1984]*
Hole Start Date:	*October 18, 2023*
Hole Finish Date:	*October 18, 2023*

DRILLING INFORMATION

Drilling Method:	*Hollow Stem Auger*
Drilling Company:	*REDI*
Drill Rig Equipment:	*CME-75*
Hole Size:	*8 inch*
Rod Type/Dia.:	*AW 1.75 inch*
Hammer Wt. / Drop:	*140 lbs/30 inches*
Hammer ETR:	*n/a*

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

Abbreviations

N	Standard Penetration Test (SPT) blows per 6-inch increment
PT	Penetration test (not SPT) blows per 6-inch increment
bpf	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
PI	Plasticity index (Atterberg Limits)

Symbols

Sample Number / Sample Type → S-5 (SPT) ← Gray bar indicates percent of sample length recovered.

Water Level During Drilling →

Approx. Elev. (feet)	Depth (feet)	Material Description and Other Observations	Graphic	Depth (feet)	Samples	Field Data	Lab Data	Multiple Items Plotted *(see bottom legend on Page 1)* 0 50 100	Depth (feet)
405		Loose, brown, ***ORGANIC SOIL*** (OL/OH); Topsoil.		1.0					
		Stiff, dark brown, ***LEAN CLAY*** (CL); moist.			SS-1 (SPT)	N = 5,6,7 PP = 1.625 tsf	WC=19%		
		Stiff to medium stiff, dark brown and gray, ***LEAN CLAY WITH SAND*** (CL); dry.		3.0	SS-2 (SPT)	N = 5,6,10 PP = 2 tsf	WC=16%		
	5				ST-3 (TB)	PP = 0.5 tsf	WC=14% PP=0.875 tsf WC=20%		5
400		-8.4 Feet - Dry Density = 107.6 pcf			ST-4 (TB)	PP = 0.5 tsf	WC=23% PP=0.5 tsf WC=16% PP=0.625 tsf		
	10	-Auger refusal at 10.5 feet.		10.5			WC=20% WC=22% PP=0.25 tsf		10
	10.5	BOTTOM OF HOLE AT 10.5 FEET							

No Observed Groundwater

NOTES:
- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- Group symbol is based on visual-manual identification and selected lab testing.
- Report text contains limitations and information needed to contextually understand this log.

▲ Uncorrected N-value, bpf
▼ Uncorrected, Penetration N-value, bpf
● = WC%

FINAL

Logged by:	RRB
Review by:	MAR
Version:	1

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BORING LOG

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR-3
Page 1 of 1

EXPLORATION INFORMATION

Total Depth:	*15.0 feet*
Top Elevation:	*~399 feet*
Vertical Datum:	*n/a*
Latitude:	*~ 38.1876 degrees*
Longitude:	*~ -90.3871 degrees*
Horizontal Datum:	*WGS [GCS1984]*
Hole Start Date:	*October 18, 2023*
Hole Finish Date:	*October 18, 2023*

DRILLING INFORMATION

Drilling Method:	*Hollow Stem Auger*
Drilling Company:	*REDI*
Drill Rig Equipment:	*CME-75*
Hole Size:	*8 inch*
Rod Type/Dia.:	*AW 1.75 inch*
Hammer Wt. / Drop:	*140 lbs/30 inches*
Hammer ETR:	*n/a*

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

Abbreviations

N	Standard Penetration Test (SPT) blows per 6-inch increment
PT	Penetration test (not SPT) blows per 6-inch increment
bpf	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
PI	Plasticity index (Atterberg Limits)

Symbols

Sample Number / Sample Type → S-5 (SPT) ← Gray bar indicates percent of sample length recovered.

Water Level During Drilling →

Approx. Elev. (feet)	Depth (feet)	Material Description and Other Observations	Graphic	Depth (feet)	Samples	Field Data	Lab Data	Multiple Items Plotted *(see bottom legend on Page 1)* 0 50 100	Depth (feet)
		Loose, brown, ***ORGANIC SOIL WITH SAND*** (OL/OH);		1.0	SS-1 (SPT)	N = 13,11,7 PP = 0.875 tsf	WC=14%		
		Stiff, red to brown, ***LEAN CLAY*** (CL); dry; trace organics.		3.0	SS-2 (SPT)	N = 7,6,6 PP = 0.375 tsf	WC=15%		
395	5	Stiff, red to brown, ***LEAN CLAY WITH SAND*** (CL); moist.		5.5	ST-3 (TB)	PP = 0.25 tsf	WC=17% PP=0.375 tsf		5
		Medium stiff to soft, ***SANDY LEAN CLAY*** (CL); moist.		8.0			WC=19% LL/PI=24/10		
390		Loose, light gray, ***CLAYEY SAND*** (SC); wet.			SS-4 (SPT)	N = 1,1,1 PP = 0 tsf	WC=19% PP=0.125 tsf		
	10	Brown to gray, ***CLAYEY GRAVEL*** (GC); wet.		10.0			WC=21%		10
		Soft, gray, ***LEAN CLAY WITH SAND*** (CL); wet. *-11.3 Feet - Dry Density = 93.0 pcf*		10.8	ST-5 (TB)		FC=34% WC=20%		
385		Dense, light brown, ***POORLY GRADED GRAVEL WITH SILT AND SAND*** (GP-GM); wet.		13.0			WC=30% WC=31% PP=0.125 tsf		
	15	*-Auger refusal at 15.0 feet.*		15.0	SS-6 (SPT)	N = 3,50/5" PP = 0.625 tsf	WC=18%	>>	15
		BOTTOM OF HOLE AT 15 FEET							

No Observed Groundwater

NOTES:
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- Report text contains limitations and information needed to contextually understand this log.

▲ Uncorrected N-value, bpf
▼ Uncorrected, Penetration N-value, bpf
● = WC% ◇ = FC%
Plastic Limit ——●—— Liquid Limit

FINAL

Logged by:	RRB
Review by:	MAR
Version:	1

Job#: 112117-001 | Template Ver:1 | File: 112117-001 BORING LOGS.GPJ | Rpt: BORING LOG - WITH SU | Library: SW GINT LIBRARY.GLB | Date: 10/1/24

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR-4

EXPLORATION INFORMATION

Total Depth:	*39.9 feet*
Top Elevation:	*~401 feet*
Vertical Datum:	*n/a*
Latitude:	*~ 38.1884 degrees*
Longitude:	*~ -90.3876 degrees*
Horizontal Datum:	*WGS [GCS1984]*
Hole Start Date:	*October 18, 2023*
Hole Finish Date:	*October 19, 2023*

DRILLING INFORMATION

Drilling Method:	*varies - see log*
Drilling Company:	*REDI*
Drill Rig Equipment:	*CME-75*
Hole Size:	*varies - see log*
Rod Type/Dia.:	*varies - see log*
Hammer Wt. / Drop:	*140 lbs/30 inches*
Hammer ETR:	*n/a*

BASIC LEGEND

(See separate LOG KEY for additional symbols, acronyms, and definitions)

Abbreviations

N	Standard Penetration Test (SPT) blows per 6-inch increment
PT	Penetration test (not SPT) blows per 6-inch increment
bpf	Blows per foot for penetration test
WC	Natural water content (%)
FC	Fines content (% grains smaller than 0.075 mm)
PI	Plasticity index (Atterberg Limits)

Symbols

Sample Number / Sample Type → S-5 (SPT) ← Gray bar indicates percent of sample length recovered.

Water Level During Drilling →

Approx. Elev. (feet)	Depth (feet)	Material Description and Other Observations	Graphic	Depth (feet)	Samples	Field Data	Lab Data	Multiple Items Plotted *(see bottom legend on Page 1)* 0 50 100	Depth (feet)
400		Loose, brown, ***ORGANIC SILT*** (OL/OH); Topsoil.		1.0	SS-1 (SPT)	N = 8,8,9 PP = 1 tsf	WC=13%		
		Stiff, brown, ***LEAN CLAY*** (CL); dry.		3.0	SS-2 (SPT)	N = 4,4,5 PP = 0.625 tsf	WC=23%		
		Stiff to soft, brown to gray, ***LEAN CLAY WITH SAND*** (CL); moist to wet.			ST-3 (TB)	PP = 0.125 tsf	WC=22% PP=0.5 tsf WC=27% WC=27% PP=0.125 tsf		
395	5	*-6.0 Feet - Dry Density = 97.7 pcf*							5
					SS-4 (SPT)	N = 1,1,1 PP = 0.125 tsf	WC=31%		
390	10	*-10.9 Feet - Dry Density = 93.9 pcf*		11.4	ST-5 (TB)	PP = 0 tsf	WC=29% PP=0.125 tsf WC=29% WC=32% PP=0.125 tsf		10
		Soft to medium stiff, brown to gray, ***SANDY LEAN CLAY*** (CL); moist.							
		-Groundwater was encountered at 14.0 feet during drilling.			10-18-23 ▽				
385	15			16.5	SS-6 (SPT)	N = 1,1,2 PP = 0.125 tsf	WC=32% FC=64% LL/PI=31/12		15
		Very stiff, brown and gray, ***LEAN CLAY WITH GRAVEL*** (CL); moist; with sand.							
					SS-7 (SPT)	N = 6,11,13 PP = 0.75 tsf	WC=19%		
380	20	*-Auger refusal at 23.0 feet.*		23.0	Method: Hollow Stem Auger Hole Size: 8" Rod Type: AW				20
		DOLOMITE: weak, light gray-brown yellow, bedded; slightly vesicular; slightly weathered; smooth, fine grained; iron staining.			Method: Rock Core Hole Size: 7 7/8" Rod Type: NQ Run 1	REC = 95% RQD = 57%			
375	25								25
370	30			31.0					30
		Core loss 31.0 to 31.5 feet.		31.5					
		DOLOMITE: weak, gray yellow, bedded; moderately vesicular; slightly weathered; smooth, fine grained.			Run 2	REC = 100% RQD = 88%			
365	35	*-clay seam 34.6 to 34.7 feet.*							35

NOTES:
- Refer to LOG KEY for explanation of symbols, codes, abbreviations, and definitions.
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- Group symbol is based on visual-manual identification and selected lab testing.
- Report text contains limitations and information needed to contextually understand this log.

▲ Uncorrected N-value, bpf
▼ Uncorrected, Penetration N-value, bpf
● = WC% ◇ = FC%
Plastic Limit — Liquid Limit
RQD (%) Recovery (%)

FINAL

Logged by:	RRB
Review by:	MAR
Version:	1

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR-4
Page 2 of 2

Approx. Elev. (feet) / Depth (feet)	Material Description and Other Observations	Graphic	Depth (feet)	Samples	Field Data	Lab Data	Multiple Items Plotted (see bottom legend on Page 1) 0 50 100	Depth (feet)
	See Page 1 for Hole Information and Notes							
	DOLOMITE: weak, gray yellow, bedded; moderately vesicular; slightly weathered; smooth, fine grained. *(starts on previous page)* *-clay seam 36.6 to 36.7 feet.* *-clay seam 36.8 to 36.9 feet.*			Run 2				
39.9	BOTTOM OF HOLE AT 39.9 FEET		39.9					

APPENDIX B: ROCK CORE PHOTOGRAPHS

Appendix B

Rock Core Photograph

APPENDIX B: ROCK CORE PHOTOGRAPHS

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Redbird Off-Site Improvement
Crystal City, MO

ROCK CORE PHOTO
BORING SAR-4
BOX 1&2 OF 2

November 2024 112117-001

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FIG. B-1

FIG. B-1

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APPENDIX C: LAB TEST RESULTS

Appendix C

Lab Test Results

CONTENTS

APPENDIX C: LAB TEST RESULTS

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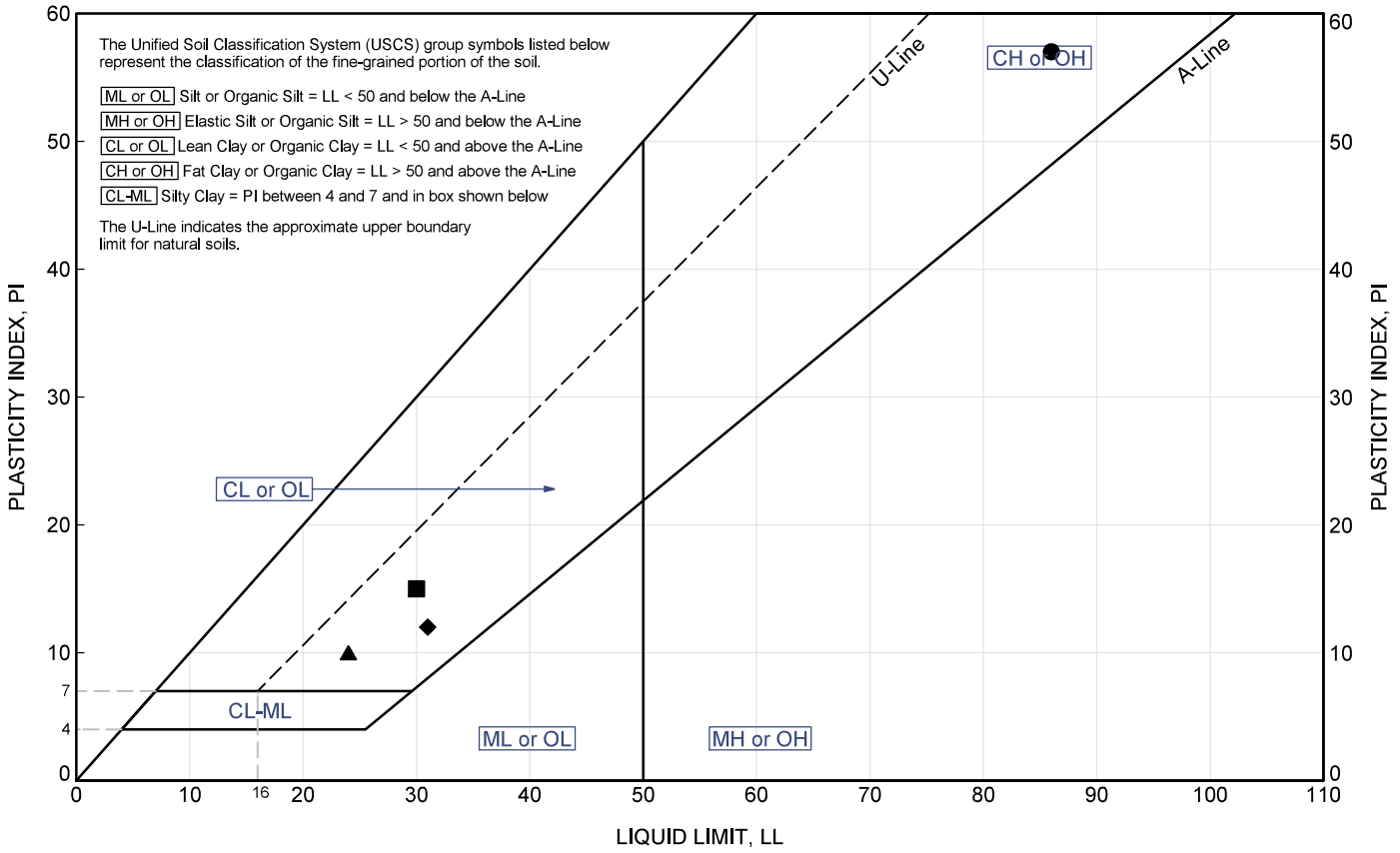
Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

SAR-1, SAR-2, SAR-3, SAR-4



EXPLORATION AND SAMPLE NUMBER	DEPTH (feet)	UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GROUP NAME	USCS SYMBOL	LL	PL	PI	FINES (%)	NAT MC %	TEST BY/RVW	TEST STD	TEST NOTE
● SAR-1, SS-2	4.3	FAT CLAY	CH	86	29	57		28.7	RRB CMB	D4318	
■ SAR-2, SS-3	6.8	SANDY LEAN CLAY	CL	30	15	15	67	20.3	RRB CMB	D4318	
▲ SAR-3, ST-3	7.0	LEAN CLAY with SAND	CL	24	14	10		19.0	JRZ CMB	D4318	
◆ SAR-4, SS-6	14.3	SANDY LEAN CLAY	CL	31	19	12	64	32.3	RRB CMB	D4318	

* Where indicated by *, the USCS Group Name was based on visual-manual examination procedures (ASTM D2488) and the Atterberg Limits test results.
ABBREVIATIONS: LL = liquid limit; NAT MC = natural moisture content; n/a = test attempted; NP = nonplastic; PI = plasticity index; PL = plastic limit; STD = standard; RVW = reviewed by; USCS = Unified Soil Classification System symbol

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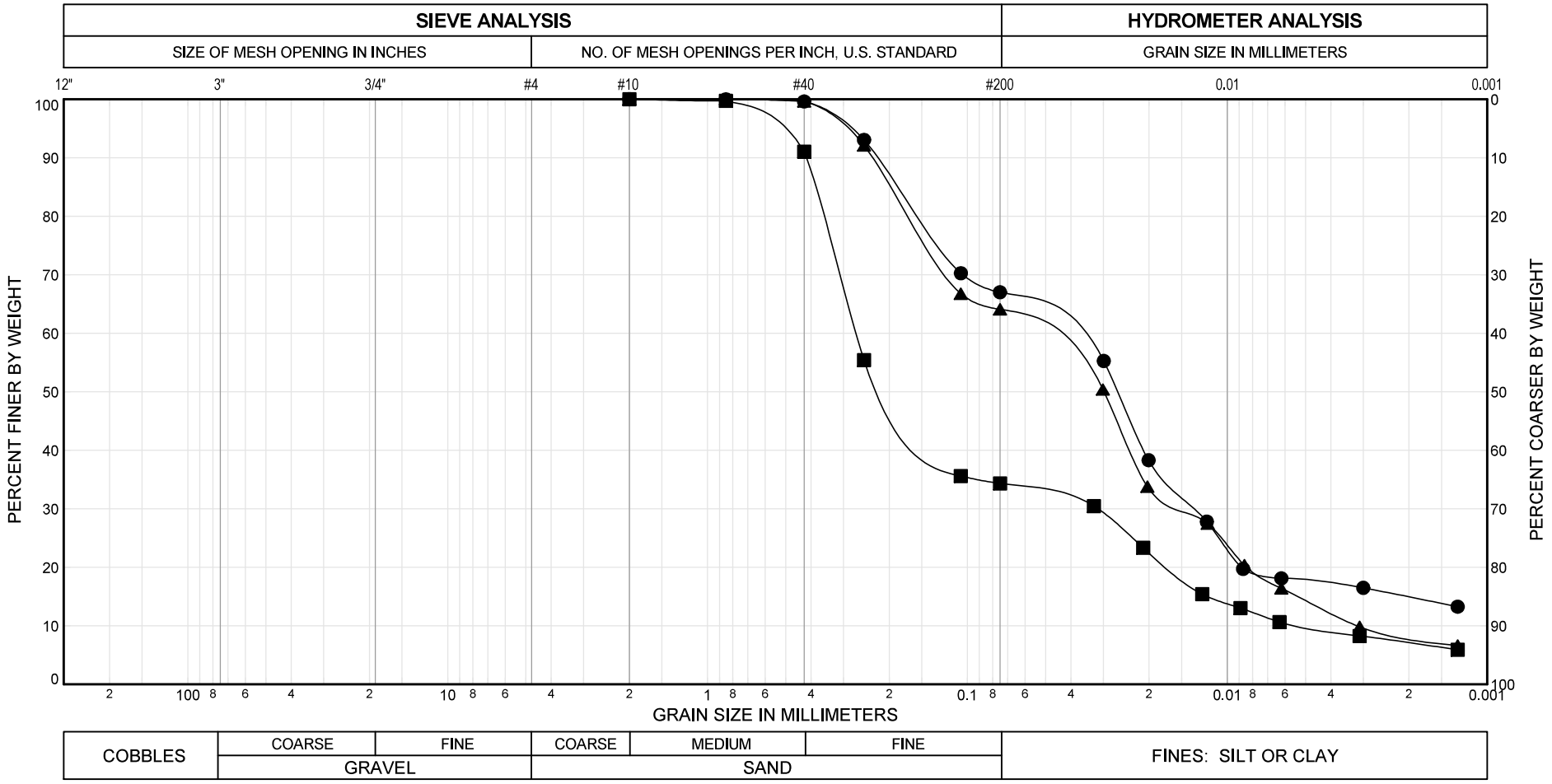
GRAIN SIZE DISTRIBUTION TEST RESULTS

Project Redbird - Offsite Improvement Projects
Crystal City, Missouri

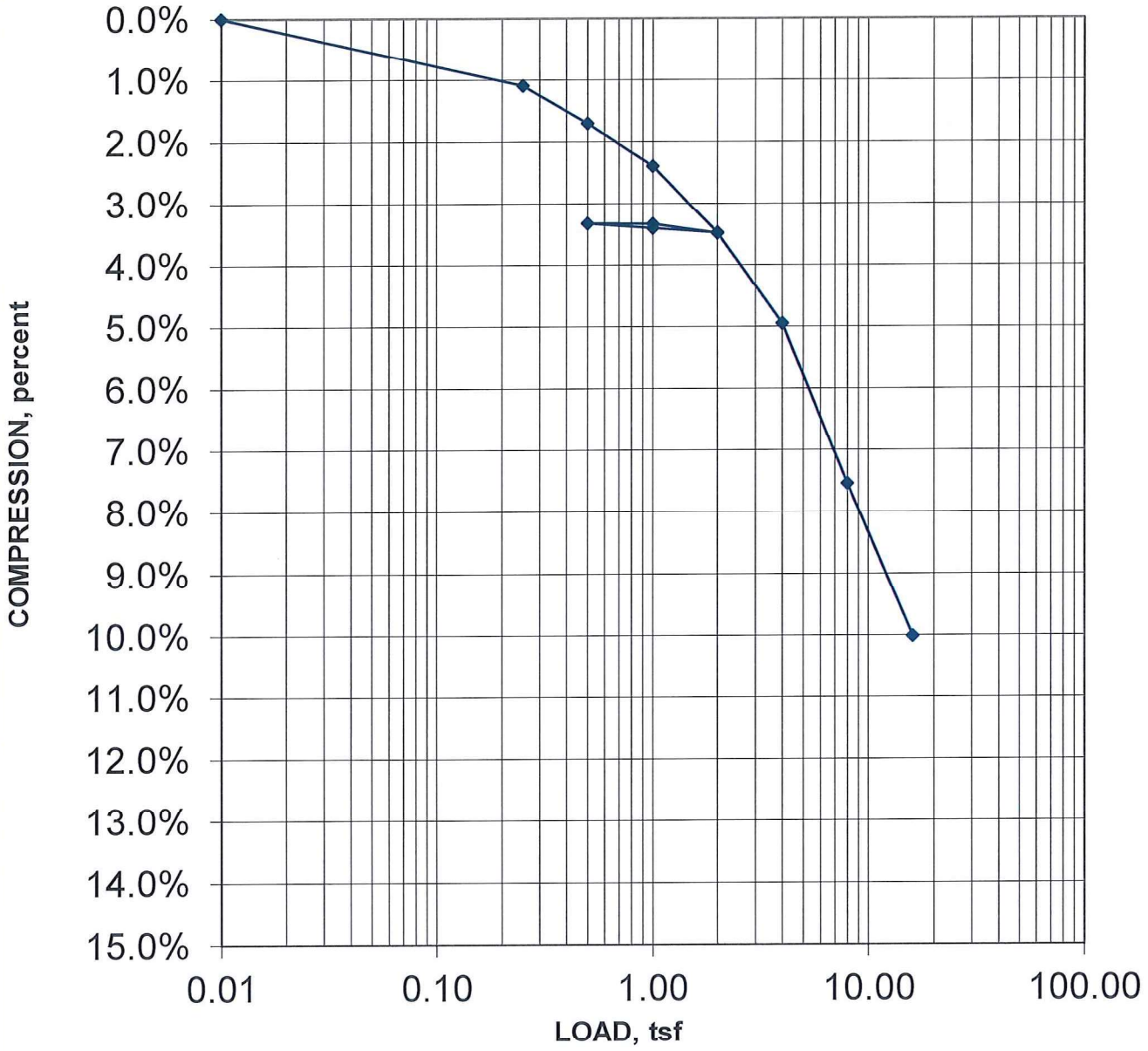
SAR-2, SAR-3, SAR-4



EXPLORATION AND SAMPLE NUMBER	DEPTH (feet)	UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) GROUP NAME	USCS SYMBOL	GRAVEL %	SAND %	FINES %	CF %	NAT WC %	TEST BY/RVW	TEST STD	TEST NOTE
● SAR-2, SS-3	6.8	SANDY LEAN CLAY	CL	0	33	67	15	20.3	JRZ CMB	D422 D422	
■ SAR-3, SS-4	9.3	CLAYEY SAND *	SC	0	66	34	7	20.8	JRZ CMB	D422 D422	
▲ SAR-4, SS-6	14.3	SANDY LEAN CLAY	CL	0	36	64	8	32.3	JRZ CMB	D422 D422	

* Where indicated by *, the USCS Group Name was based on visual-manual examination procedures (ASTM D2488) and the grain size distribution test results.
ABBREVIATIONS: NAT WC = natural moisture content; RVW = reviewed by; STD = Standard; USCS = Unified Soil Classification System code; ~ = approximately (used when measured but not greater than 0.5%)

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	1.8E+00	2.0	NA
0.5	5.1E-01	4.0	1.1E+00
1.0	2.4E+00	8.0	8.4E-01
2.0	1.4E+00	16.0	9.7E-01
1.0	NA		
0.5	NA		
1.0	NA		

Project Redbird
Crystal City, Missouri

SETTLEMENT PLOTS

SAR-2A

ST-3

October 2023 112117-001

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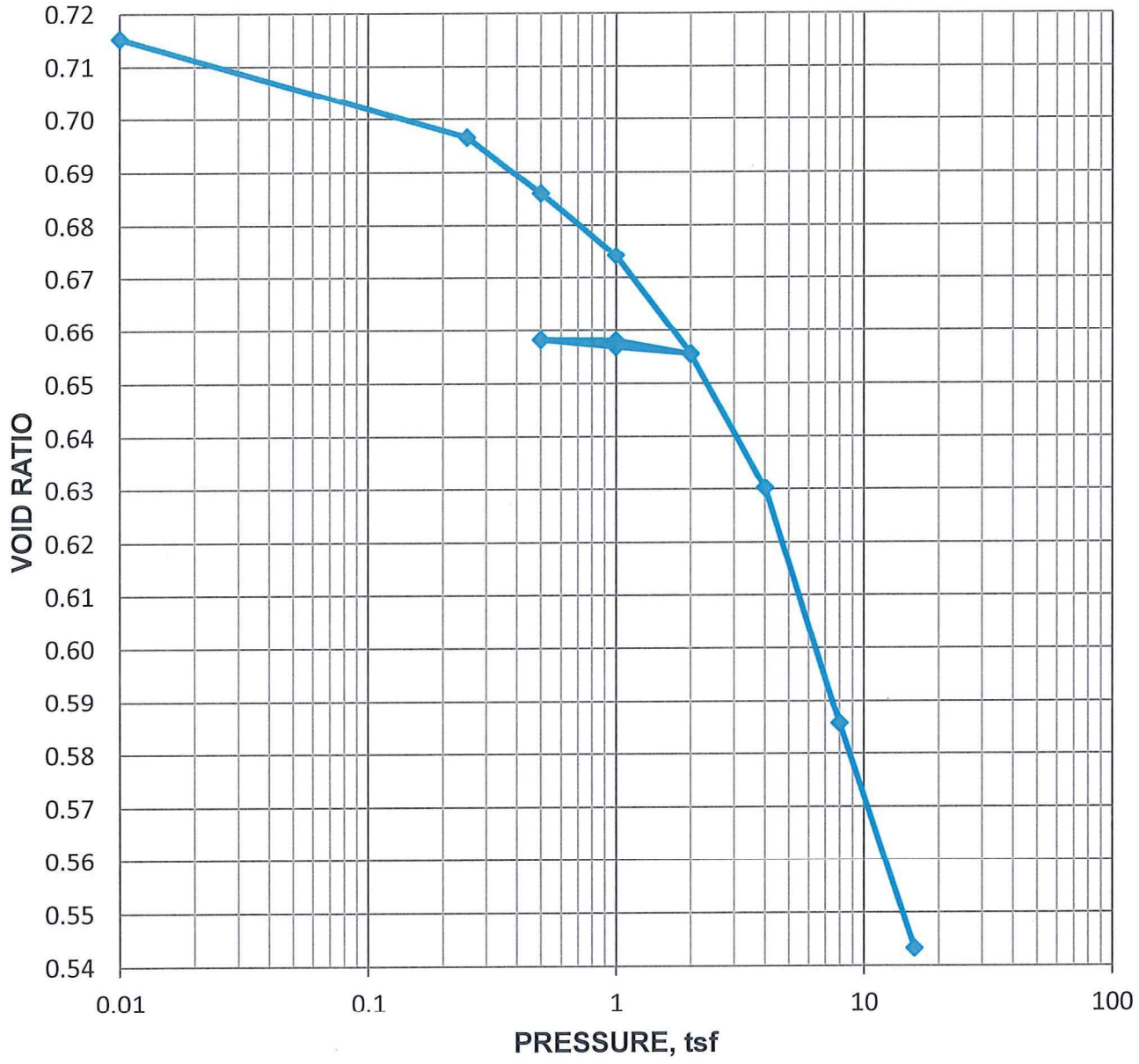
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	1.8E+00	2.0	NA
0.5	5.1E-01	4.0	1.1E+00
1.0	2.4E+00	8.0	8.4E-01
2.0	1.4E+00	16.0	9.7E-01
1.0	NA		
0.5	NA		
1.0	NA		

Project Redbird
Crystal City, Missouri

VOID RATIO PLOT

SAR-2A

ST-3

October 2023 112117-001

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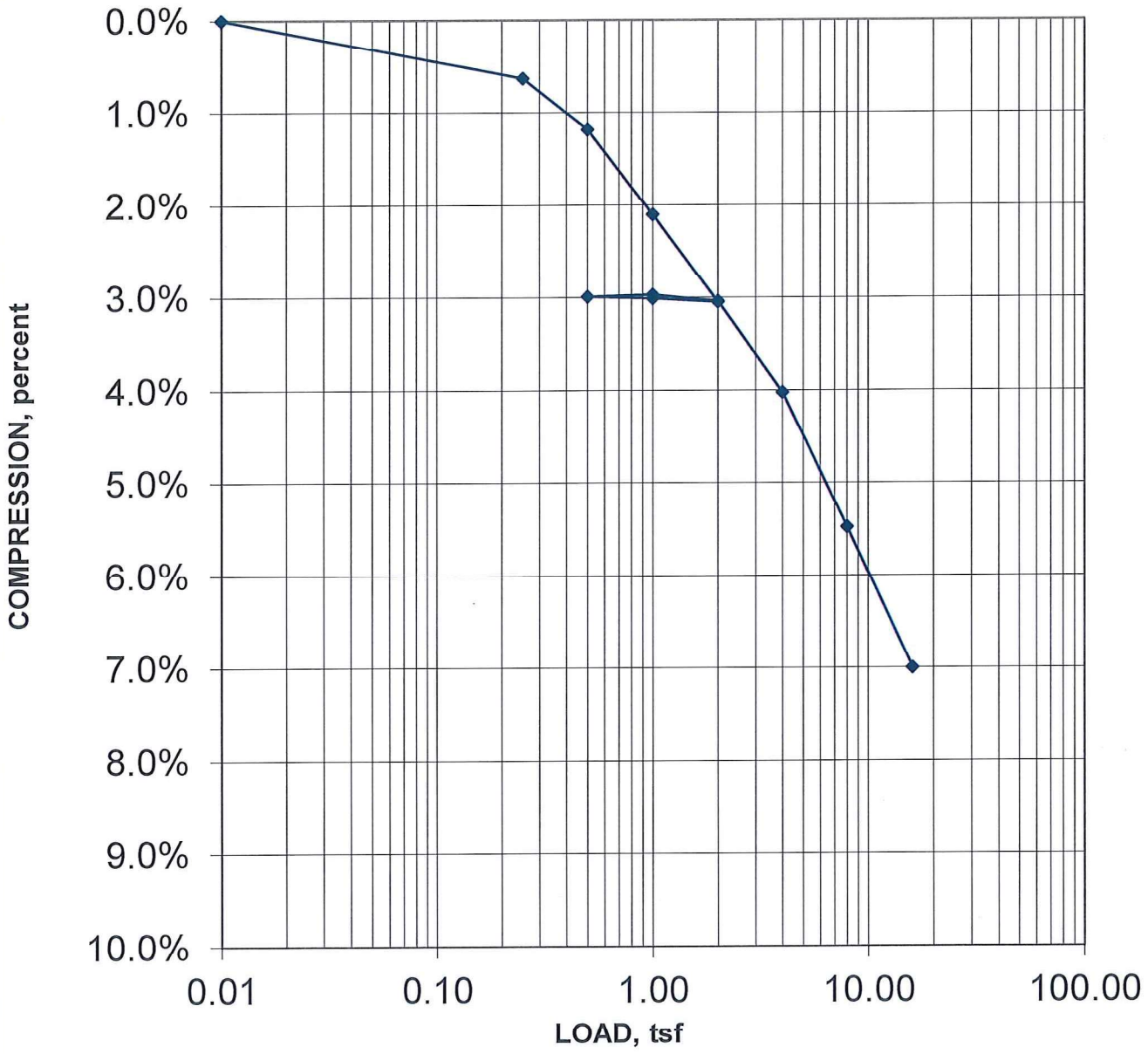
FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	7.6E-01	2.0	NA
0.5	2.3E-01	4.0	9.8E-01
1.0	4.2E-01	8.0	8.1E-01
2.0	4.1E-01	16.0	8.6E-01
1.0	NA		
0.5	NA		
1.0	NA		

Project Redbird
Crystal City, Missouri

SETTLEMENT PLOTS

SAR-3

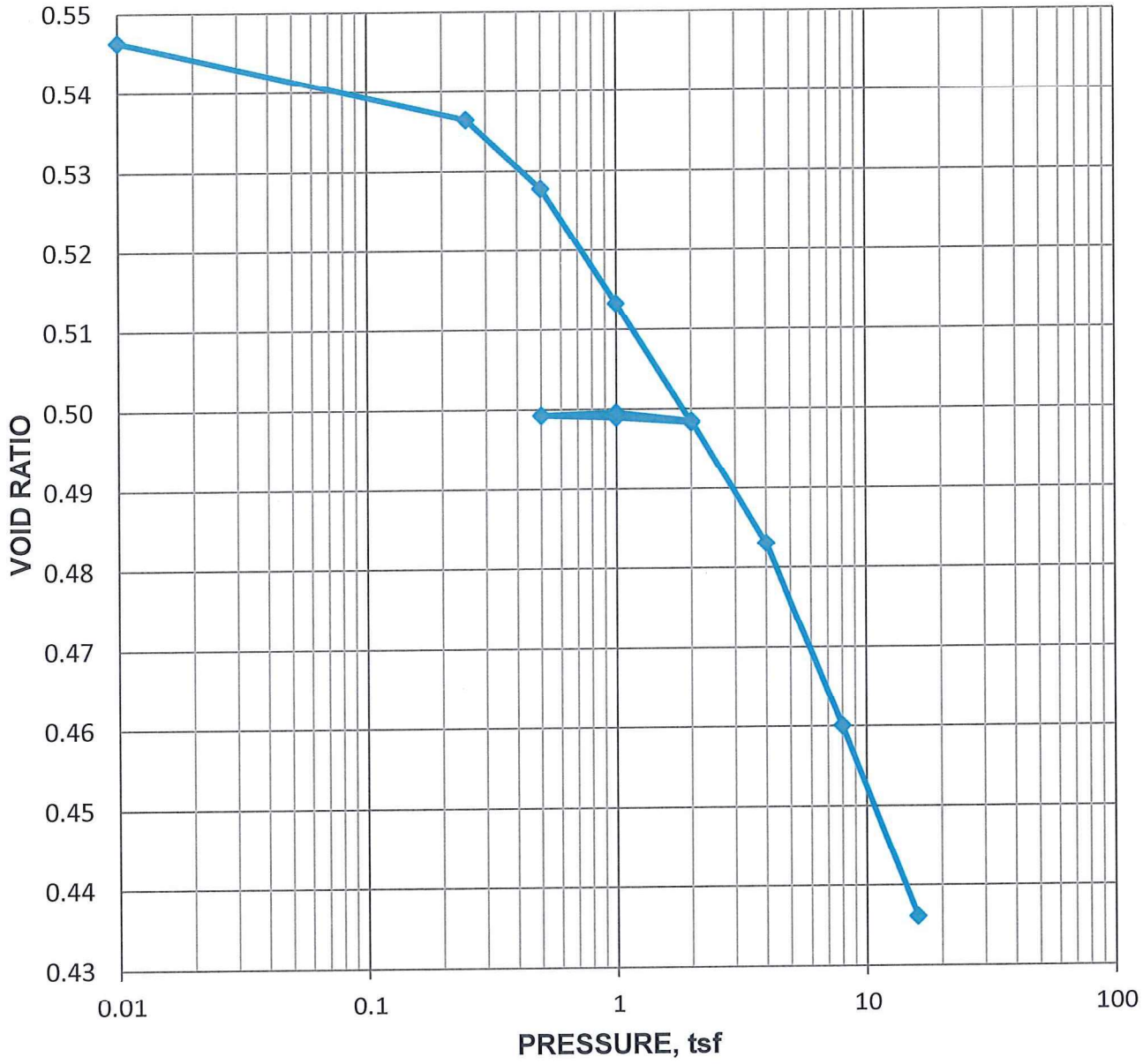
ST-3

October 2023 112117-001

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG.

CONSOLIDATION TEST



Load, tsf	Coefficient of Consolidation, mm^2/second	Load, tsf	Coefficient of Consolidation, mm^2/second
0.25	7.6E-01	2.0	NA
0.5	2.3E-01	4.0	9.8E-01
1.0	4.2E-01	8.0	8.1E-01
2.0	4.1E-01	16.0	8.6E-01
1.0	NA		
0.5	NA		
1.0	NA		

Project Redbird
Crystal City, Missouri

VOID RATIO PLOT

SAR-3

ST-3

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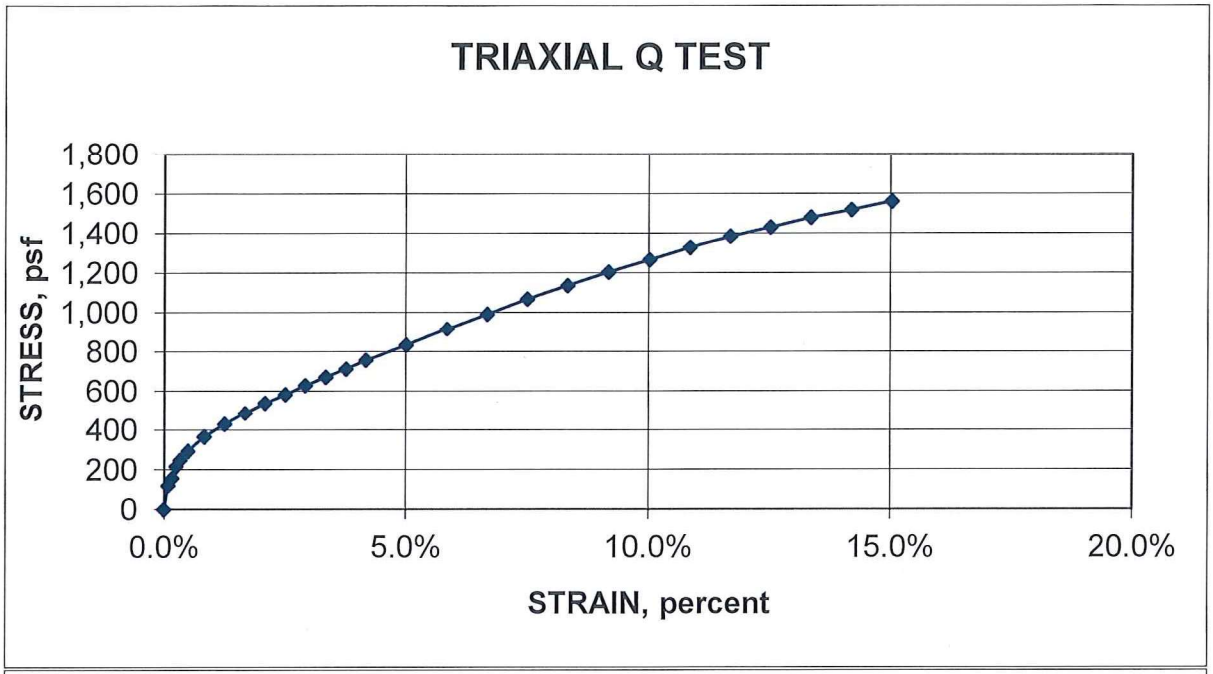
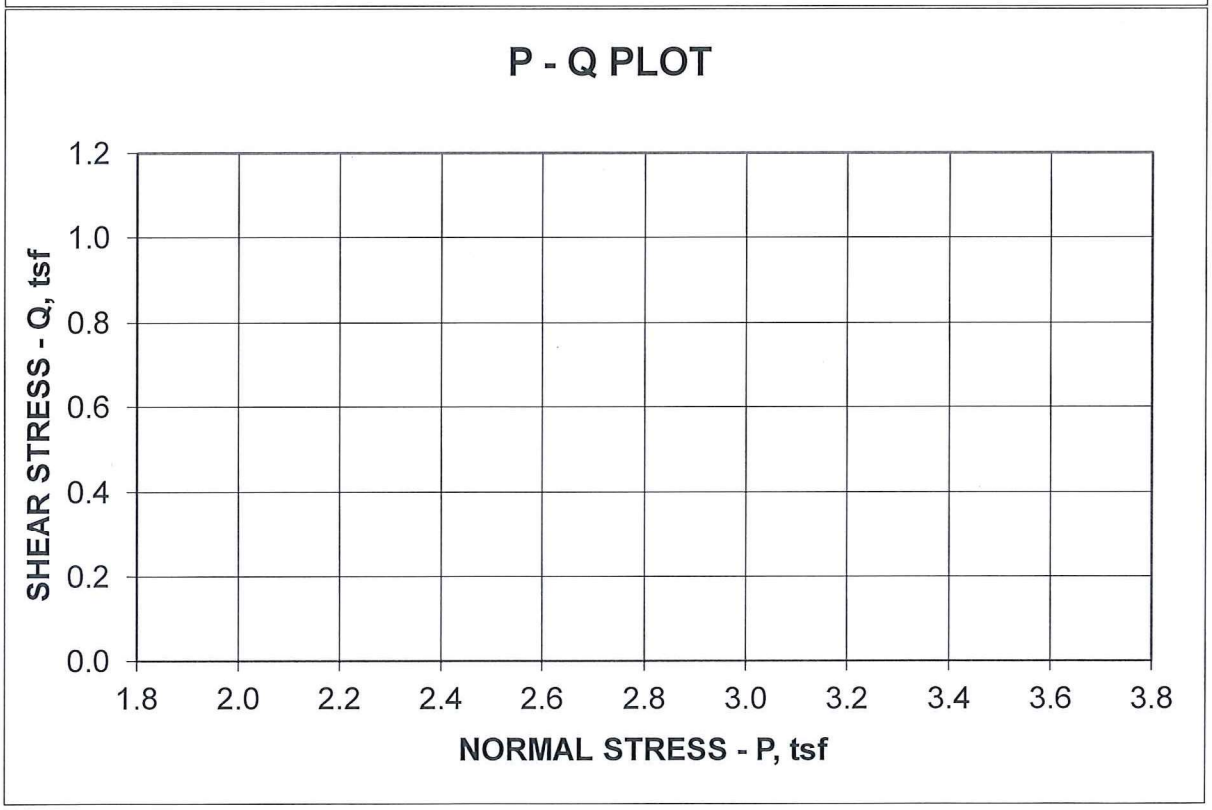
FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
PLOT OF TEST DATA





Photograph of Failure

Project Redbird
Crystal City, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

BORING - SAR-2A : SAMPLE - ST-4

November 2023 112117-001

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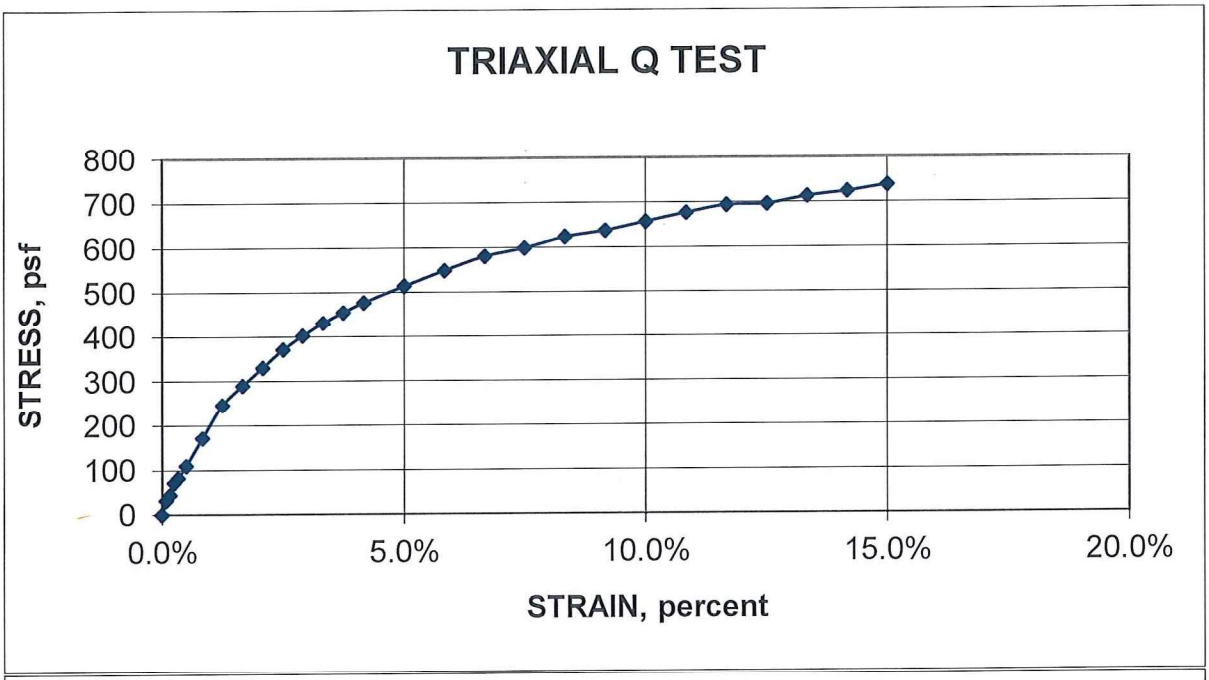
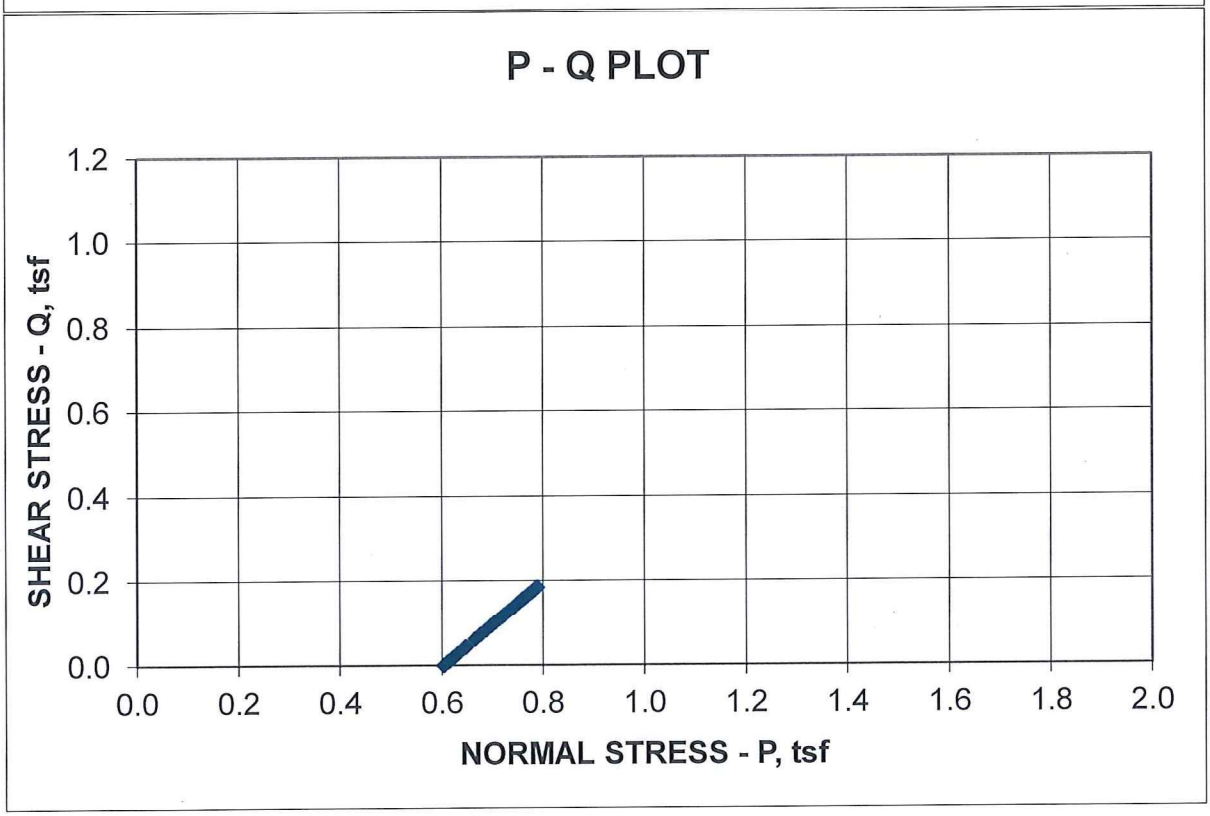
FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

PLOT OF TEST DATA





Photograph of Failure

Project Redbird
Crystal City, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

BORING - SAR-3 : SAMPLE - ST-5

November 2023 112117-001

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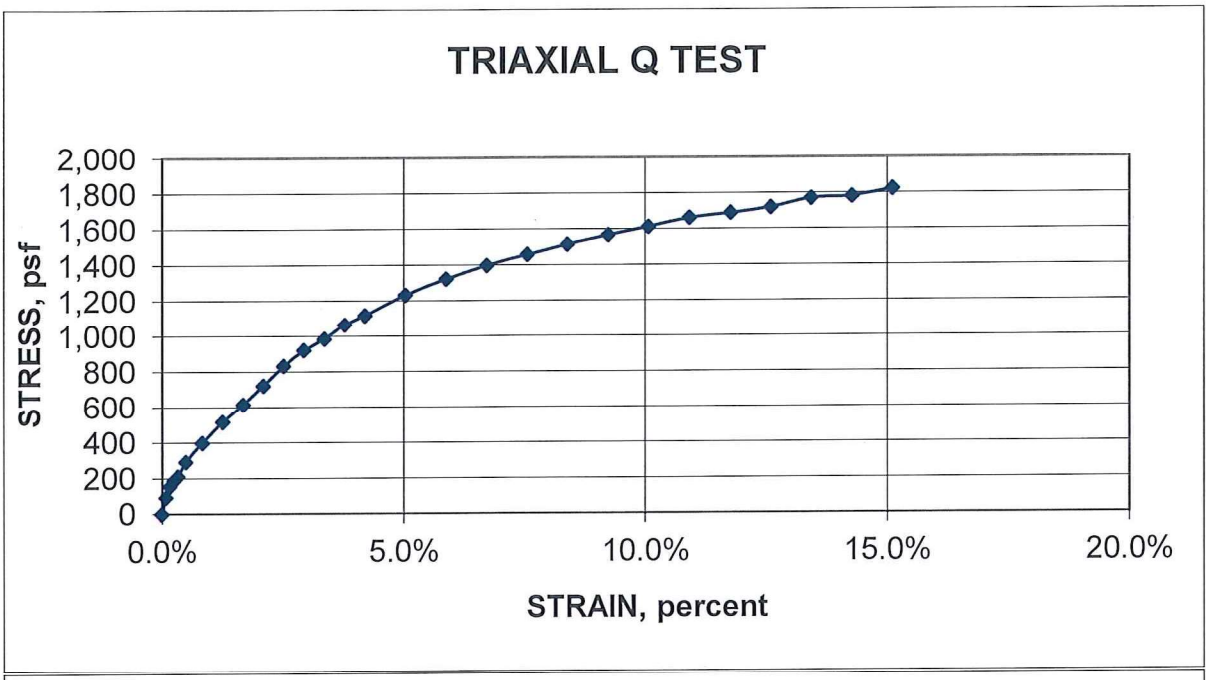
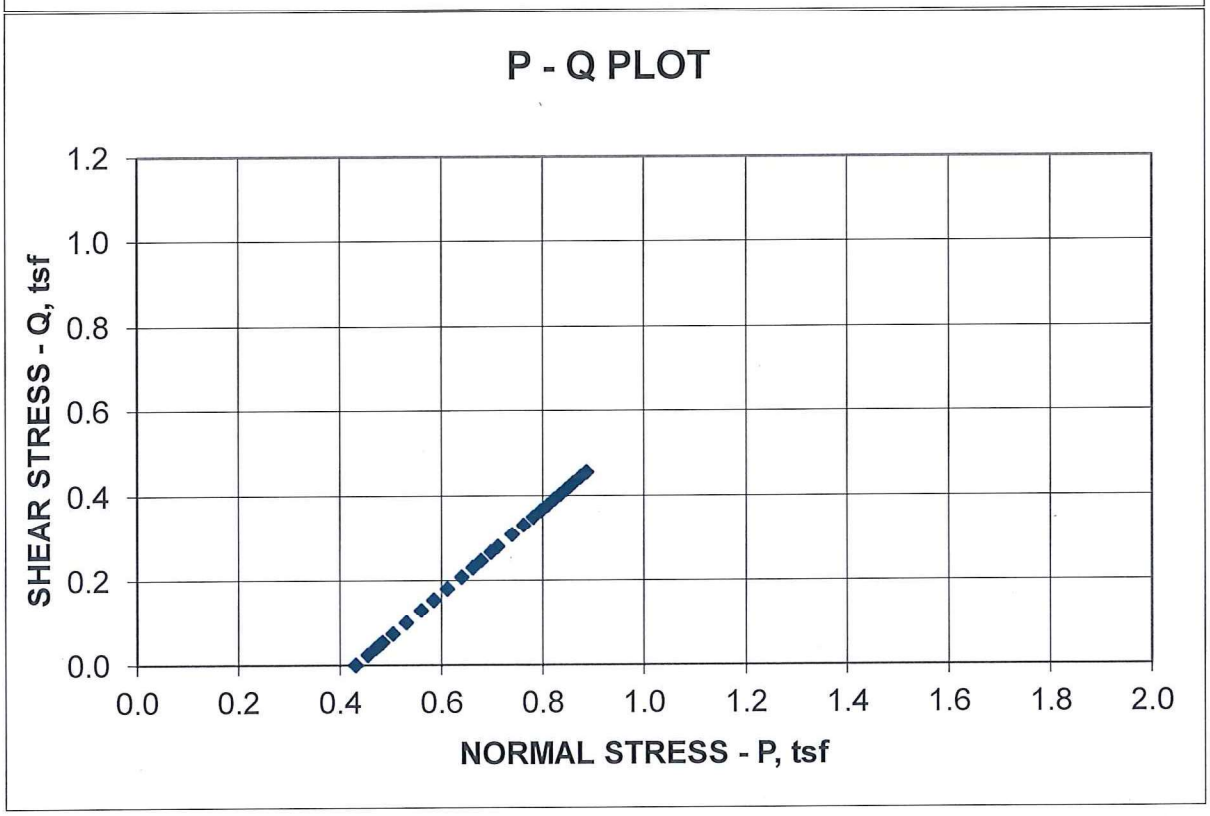
FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

PLOT OF TEST DATA





Photograph of Failure

Project Redbird
Crystal City, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

BORING - SAR-4 : SAMPLE - ST-3

November 2023 112117-001

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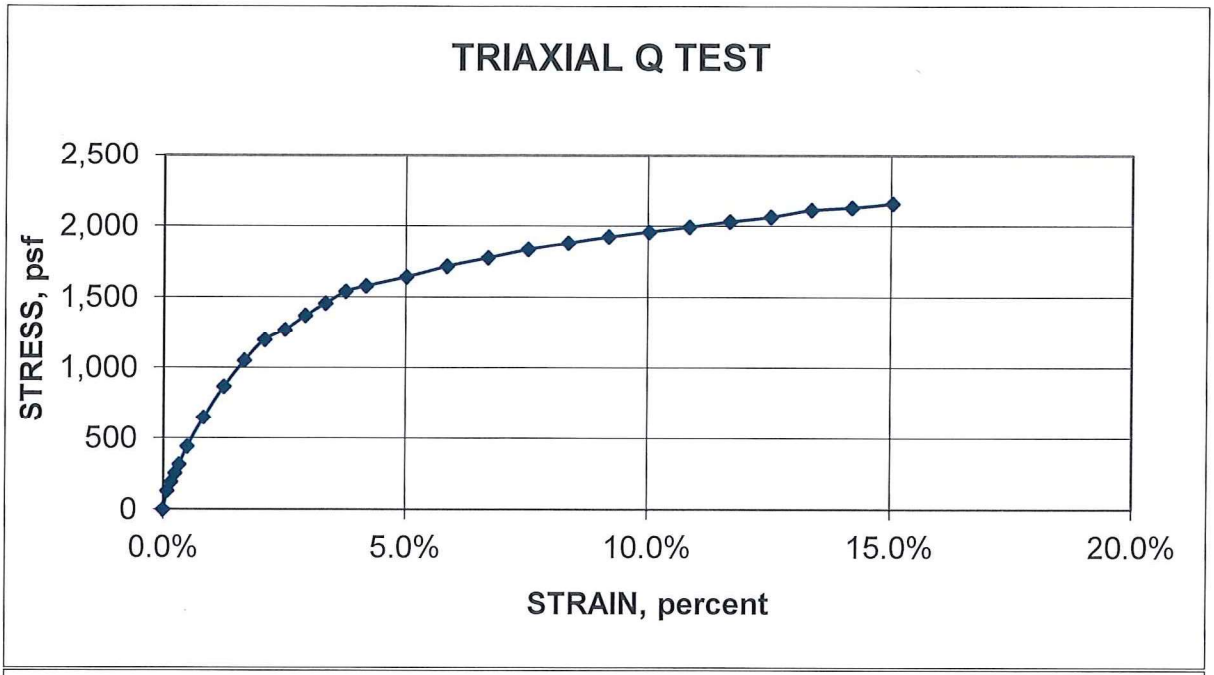
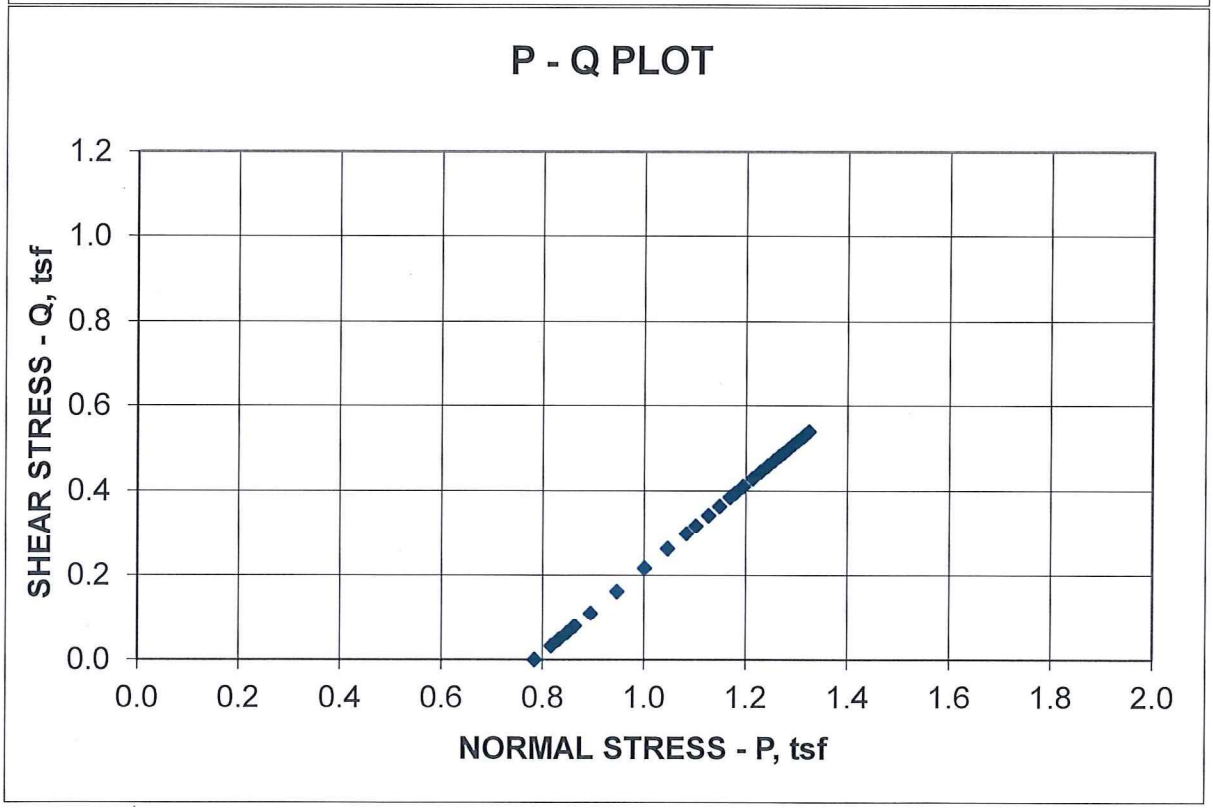
FIG.

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION
PLOT OF TEST DATA





Photograph of Failure

Project Redbird
Crystal City, Missouri

UNCONSOLIDATED, UNDRAINED STRENGTH IN TRIAXIAL COMPRESSION

BORING - SAR-4 : SAMPLE - ST-5

November 2023 112117-001

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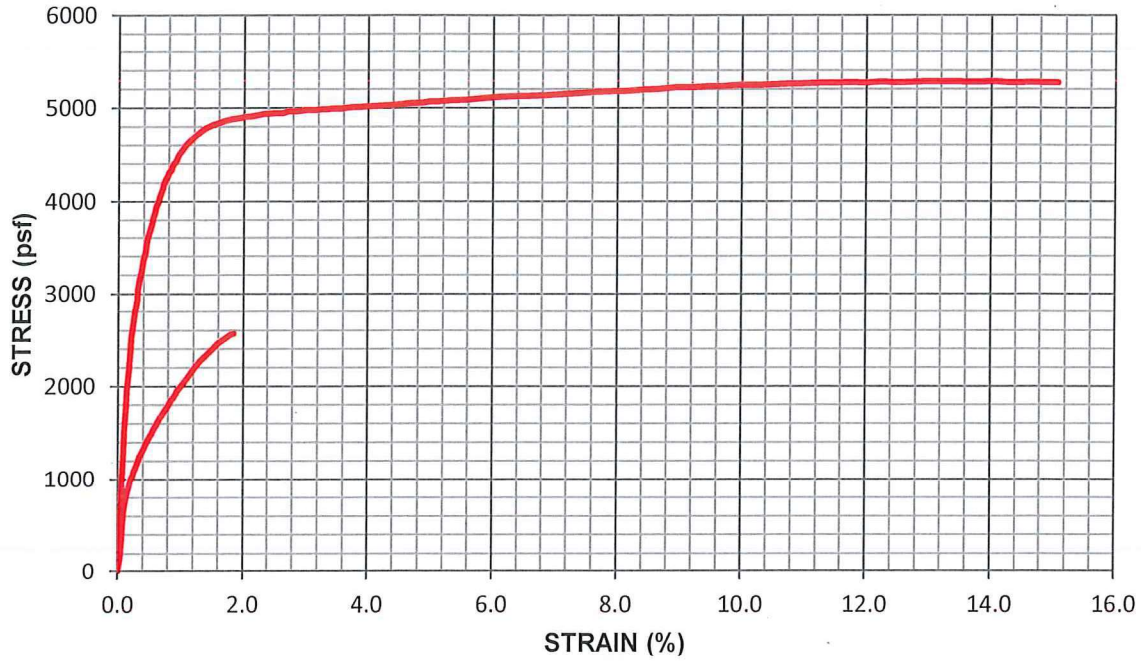
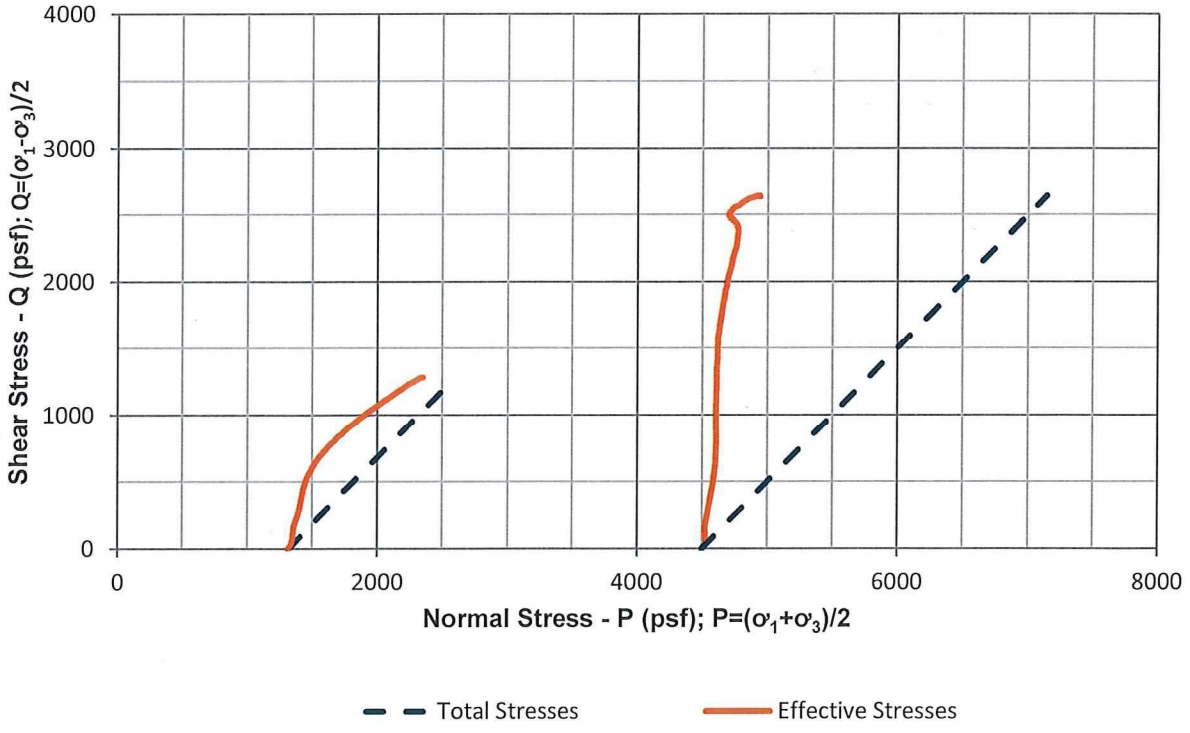
FIG.

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT

STRESS - STRAIN



P-Q PLOT



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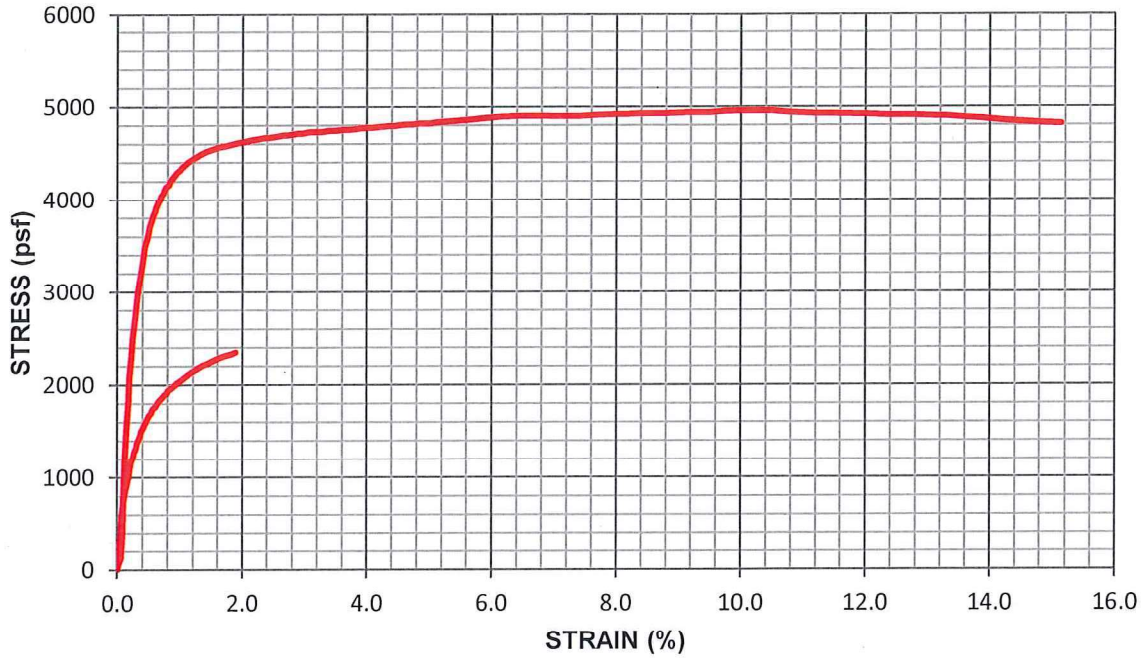
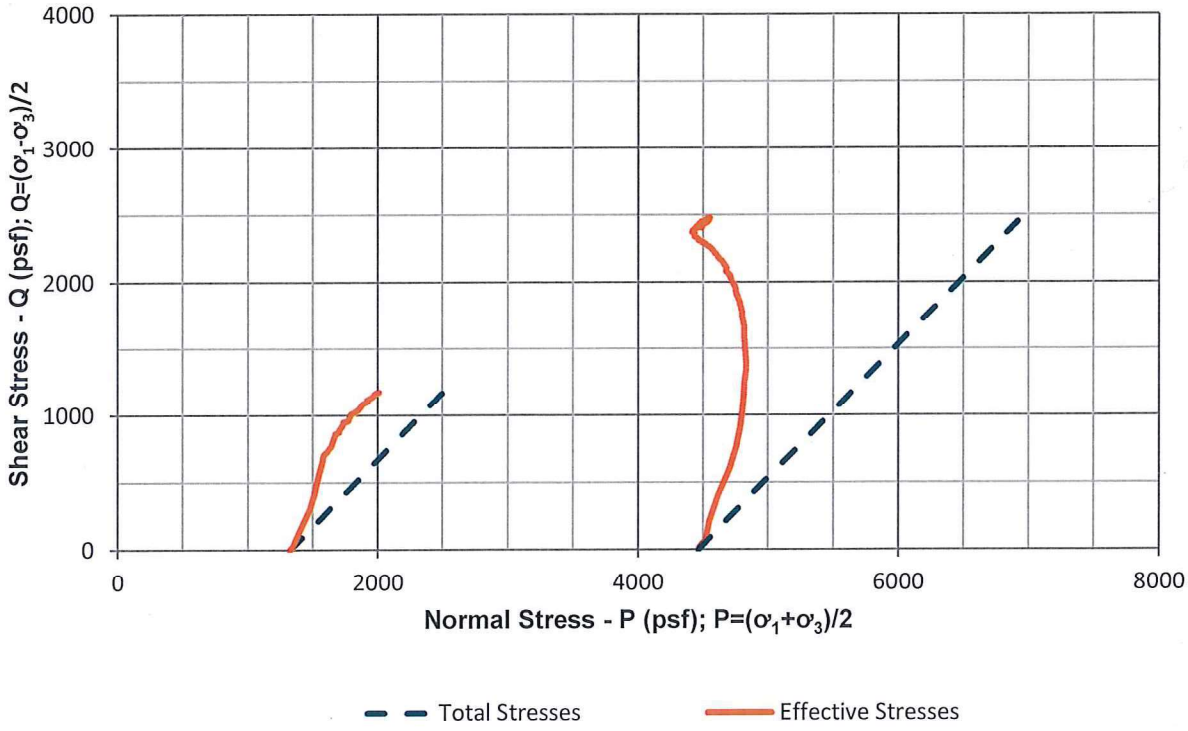
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST WITH PORE PRESSURE MEASUREMENT

STRESS - STRAIN



P-Q PLOT



SHANNON & WILSON, INC. 2043 WESTPORT CENTER DR. SAINT LOUIS, MISSOURI 63146 112117-001	CONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION Project Redbird Crystal City, Missouri SAR-3 / ST-3 / 7

IMPORTANT INFORMATION

Important Information

About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied

IMPORTANT INFORMATION

judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

IMPORTANT INFORMATION

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland.

IMPORTANT INFORMATION

IMPORTANT INFO HEADING

Important Info Body