

APPENDIX A
Test Borings and Field Exploration Program

A.1 Field Exploration Program

Our field exploration program consisted of drilling thirty-seven (37), 6-inch-diameter geotechnical test borings to obtain data necessary to evaluate subsurface conditions for the proposed project. The approximate boring locations, designated SB-1 through SB-34 and SB-38 through SB-40, are presented on Figures 3 through 8. It is noted that Borings SB-35 through SB-37, originally planned along the Cassady Lateral, have been eliminated from our scope of work since improvements to this lateral are no longer proposed. The elevations presented on the boring logs are relative to NAVD 88 and based on a topographic survey performed by R.E.Y. Engineers under contract with Provost & Pritchard.

Our investigation also included the construction of six (6), 13-foot-deep piezometers, designated BEL2, BEL5, SCH2, TRA2, TRA4, and TRA6, shown on Figures 3 through 8. Three of the piezometers (BEL2, BEL5, and SCH2) were constructed adjacent to borings and were not sampled and logged separately. The remaining piezometers are not near borings and were therefore drilled, sampled and logged separately as additional borings. Upon drilling of the boring, the piezometer components were placed. The components consisted of 2-inch diameter Monoflex (Campbell Mfg.) Schedule 40 flush thread slotted (0.02" wide – 1/8" spacing) PVC pipe for the lower 10 feet; solid Monoflex casing for the upper 3 feet; 3/8"-minus aggregate in the annulus around the slotted portion; hydrated bentonite chips around the solid portion; a surface-mounted monument cover set in concrete; and a threaded cap on the bottom of the pipe and a locking cap on the top.

Prior to the start of drilling, SAGE obtained a drilling permit from the Butte County Public Health - Environmental Health Division (BCPH) and notified Underground Services Alert (USA) at least 48 hours prior to the start of work. Furthermore, borings near county roads, railroads, and apparent utilities were cleared by Cruz Brothers, a private utility locator subcontracted to SAGE.

The borings and piezometers were completed between July 19, 2011 and August 10, 2011. The borings and piezometers were drilled by RSI Drilling using a truck-mounted CME-75 drill rig equipped with six-inch-diameter hollow-stem augers. The exceptions are two piezometers, TRA6 and BEL5, which were drilled using a track-mounted Geoprobe 6620DT drill rig. The borings were drilled to depths ranging from 26.5 to 51.5 feet below the existing ground surface. During drilling, an engineer logged the materials encountered and obtained representative samples for visual classification and laboratory testing. The materials encountered were classified in general accordance with the Unified Soil Classification System (USCS) as summarized on Figure A-1. Logs for borings B-1 through B-34 and B-38 through B-40 are presented as Figures A-2 through A-41.

Representative soil samples for this investigation were recovered using the following sampler types:

- Modified California (MCA) split-barrel sampler with a 3.0-inch-outside diameter fitted with 2.43-inch-inside-diameter, six-inch-long brass liners;
- California (CA) split-barrel sampler with a 2.5-inch-outside diameter fitted with 1.93-inch-inside-diameter, six-inch-long brass liners;
- Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch-outside diameter, without liners; and
- Thin-walled Shelby tube (30-inch length) sampler with a 3.0-inch-nominal diameter.

The split-barrel samplers were driven with a 140-pound, automatic trip hammer falling 30 inches; the Shelby tubes were pushed hydraulically. The blow counts required to drive the split-barrel samplers over a standard 18-inch-drive were recorded in six-inch increments in the field. Where refusal was encountered (defined as greater than 50 blows over any six-inch increment) drive lengths less than 12 inches were also recorded. The final 12-inches of the drive (less in the case of refusal) were added to develop the reported blow count. The blow counts for the CA and MCA samplers were corrected for the effects of sampler size and converted to SPT N values using conversion factors of 0.85 and 0.65, respectively. Because an automatic trip hammer was used, the corrected CA and MCA blow counts, as well as the raw SPT blow counts, were also corrected for the effects of hammer energy using an additional conversion factor of 1.3 (assuming about 80% efficiency). The final, corrected values for each drive are presented on the boring logs and represent N_{60} values.

Upon completion of the borings, the holes were backfilled with cement grout in accordance with BCPH requirements and were inspected by a Butte County inspector. The soil cuttings were spread out on the ground adjacent to the boring locations.

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > No. 200 sieve size)	Gravels (More than half of coarse fraction > No. 4 sieve size)	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction > No. 4 sieve size)	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils (more than half of soil < No. 200 sieve size)	Silts and Clays LL = < 50	ML	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	MH	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		PT	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel coarse fine	3" to No.4	76.2 to 4.76
	3" to 3/4"	76.2 to 19.1
	3/4" to No. 4	19.1 to 4.76
Sand coarse medium fine	No. 4 to No. 200	4.76 to 0.074
	No. 4 to No. 10	4.76 to 2.00
	No. 10 to No. 40	2.00 to 0.420
	No. 40 to No. 200	0.420 to 0.074
Silt and Clay	Below No. 200	Below 0.074

TYPES OF STRENGTH TESTS

PP	Pocket Penetrometer
TV	Field Torvane
LVS	Laboratory Vane Shear
UC	Unconfined Compression
TXUU	Triaxial, unconsolidated, undrained
DS	Direct Shear

▽ Unstabilized (initial) groundwater level

▼ Stabilized groundwater level

SAMPLER TYPE

C	 Core barrel	CC	 CME Continuous Sample Tube System sampler advanced with hollow stem auger	SPT	 Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter
O	 Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube	BULK	 Disturbed grab sample		 Sampling attempted without recovery
PT	 Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube	CA	 California split-barrel sampler with 2.5-inch outside diameter and 1.93-inch inside diameter	NOTE: Shaded portion of sampler symbol represents portion of sample recovered Examples:	
ST	 Shelby tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure	MCA	 Modified California split-barrel sampler with 3.0-inch outside diameter and 2.5-inch inside diameter		

MCA  SPT  CC  } Portion recovered

Gray Lodge Wildlife Area Water Supply Project
Biggs-West Gridley Water District

Butte County

California



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SOIL CLASSIFICATION CHART

Project No. 10-066.00

Date 12/22/11

Figure A-1

PROJECT: Gray Lodge Wildlife Area Water Supply Project Butte County, CA

LOG OF BORING SB-1

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/19/2011 **DATE FINISHED:** 7/19/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 101.0 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 6.5 **GW DATE:** 7/19/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, CA

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	100.0					CLAY (CL) brown, very stiff, moist								
2	99.0													
3	98.0				CL									
4	97.0													
5	96.0													
6	95.0	CA	X	25		CLAY WITH SAND (CH) brown, very stiff, wet, highly plastic Direct Shear: $\phi = 18.2^\circ$, $c = 240$ psf	20.0	109					49	33
7	94.0				CH									
8	93.0													
9	92.0					SILT WITH SAND (ML) gray brown, hard, wet, fine grained sand								
10	91.0					Pinhole Dispersion: ND2, clear								
11	90.0	MCA		31	ML		40.1 30.7	82 92	77.5	TXUU		0.95	33	NP
12	89.0													
13	88.0													
14	87.0					SILTY SAND (SM) brown to olive brown, very dense, wet, less than 5% gravel								
15	86.0													
16	85.0	CA	X	74/11"	SM		41.0		42.1					
17	84.0													
18	83.0													
19	82.0					SAND (SP) olive brown, dense, wet, medium grained sand approximately less than 5% fines								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	80.0	MCA		47/5"	SP	SAND (SP) (Con't)	25.5	94						
22	79.0				ML	SILT (ML) brown to olive, hard, wet								
23	78.0													
24	77.0					SAND (SP) olive brown, dense, wet, fine to medium grained sand local lenses with higher fines contents								
25	76.0													
26	75.0	CA		44										
27	74.0				SP									
28	73.0													
29	72.0													
30	71.0													
31	70.0	MCA		80	ML	SILT (ML) brown, hard, wet, local black lenses and hard clasts approximately less than 5% sand								
32	69.0													
33	68.0													
34	67.0													
35	66.0													
36	65.0													
37	64.0													
38	63.0													
39	62.0													
40	61.0													
41	60.0													
42	59.0													
43	58.0													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

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Figure:
A-2

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-2

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/19/2011 **DATE FINISHED:** 7/19/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 100.7 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 14.0 **GW DATE:** 7/19/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, CA, Shelby

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA									
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY			
													LL	PI		
1	99.7					SILT (ML) brown to red brown, very stiff to hard, dry to moist, less than 5% sand, trace organics										
2	98.7															
3	97.7				ML											
4	96.7															
5	95.7															
6	94.7	CA		46		CLAY (CH) dark brown, hard, moist, highly plastic										
7	93.7				CH											
8	92.7					CLAY WITH SAND (CL) dark brown, hard, moist, medium plasticity										
9	91.7				CL											
10	90.7															
11	89.7	MCA		42		CLAY WITH SAND (CL) brown, hard, moist to wet, fine grained sand	25.8	97					41	21		
12	88.7															
13	87.7															
14	86.7															
15	85.7					as above, olive with red and white mottling										
16	84.7	CA		69			38.6									
17	83.7															
18	82.7				CL											
19	81.7															

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	79.7	ST		500 psi		CLAY WITH SAND (CL) (Con't)	32.1	94						
22	78.7													
23	77.7	ST		500 psi										
24	76.7					SANDY SILT (ML) olive, hard, wet, red mottling, with clay								
25	75.7													
26	74.7	MCA		74/10"	ML				53.6					
27	73.7													
28	72.7					CLAY (CL) olive to red brown, hard, wet								
29	71.7													
30	70.7				CL									
31	69.7	CA		78		thin lens of olive gray, medium grained, very dense sand								
32	68.7													
33	67.7													
34	66.7													
35	65.7													
36	64.7													
37	63.7													
38	62.7													
39	61.7													
40	60.7													
41	59.7													
42	58.7													
43	57.7													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

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Figure:
A-3

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-3

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/19/2011 **DATE FINISHED:** 7/19/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 99.1 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 8.0 **GW DATE:** 7/19/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, CA

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	98.1					CLAY (CL) olive to light brown, very stiff, dry to moist, white mottling with some organics and charcoal in upper 6 inches								
2	97.1	CA		19			16.7							
3	96.1													
4	95.1													
5	94.1					CLAY (CL) light brown to olive gray, soft, moist to wet, with red mottling, organics and approximately 10% gravels in top 6"	51.1	74					43	29
6	93.1	MCA		4		Pinhole Dispersion: ND3, barely visible Swell/Compression: 0.4% swell Swell Pressure = 2,200 psf	29.7	90						
7	92.1													
8	91.1					CLAYEY SAND (SC) brown to light brown, medium dense, wet, trace gravels								
9	90.1													
10	89.1	CA		25			19.7		38.0					
11	88.1													
12	87.1													
13	86.1					SANDY SILT (ML) olive brown, very stiff, wet, red and white mottling, white coarse sand to fine gravel in bottom 6", trace clay								
14	85.1													
15	84.1	CA		28			42.0		75.9					
16	83.1													
17	82.1													
18	81.1													
19	80.1					SILTY SAND (SM) brown, medium dense, wet, fine to medium grained sand								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-3

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	78.1	MCA		28		SILTY SAND (SM) (Con't)	24.4	100	16.4					
22	77.1				SM									
23	76.1													
24	75.1													
25	74.1													
26	73.1	CA	84/11"		CL-ML	SANDY SILTY CLAY (CL-ML) olive, hard, wet								
27	72.1													
28	71.1													
29	70.1													
30	69.1													
31	68.1													
32	67.1													
33	66.1													
34	65.1													
35	64.1													
36	63.1													
37	62.1													
38	61.1													
39	60.1													
40	59.1													
41	58.1													
42	57.1													
43	56.1													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

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LOG OF BORING SB-4

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/19/2011 **DATE FINISHED:** 7/19/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 103.5 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 8.5 **GW DATE:** 7/20/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, CA, Shelby

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	102.5					SANDY CLAY (CL) brown, stiff, moist, Cobbles up to 8" in diameter, organics								
2	101.5				CL									
3	100.5													
4	99.5													
5	98.5					CLAY (CH) brown, stiff, moist to wet								
6	97.5	CA	X	10		increased sand, approximately 10% Swell/Compression: 0.1% swell Swell Pressure = 830 psf	20.7	106		UC	3.4	1.7		
7	96.5	ST		300 psi			22.9	101						
8	95.5				CH									
9	94.5													
10	93.5					as above, hard								
11	92.5	MCA	O	81/11"										
12	91.5													
13	90.5													
14	89.5					SAND WITH SILT (SP-SM) brown, medium dense, wet, approximately 10% fines								
15	88.5				SP-SM									
16	87.5					Direct Shear: $\phi = 37.0^\circ$, $c = 700$ psf								
17	86.5	MCA		21			18.6	109	18.2					
18	85.5				SM									
19	84.5					SANDY SILT (ML) olive, very stiff, wet, with red mottling, with clay								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	82.5	CA		25		SANDY SILT (ML) (Con't)	33.5		62.0					
22	81.5													
23	80.5													
24	79.5													
25	78.5				ML	as above, hard								
26	77.5	MCA		68/11"			33.8	89				45	17	
27	76.5													
28	75.5													
29	74.5													
30	73.5													
31	72.5	CA		44										
32	71.5													
33	70.5													
34	69.5													
35	68.5													
36	67.5													
37	66.5													
38	65.5													
39	64.5													
40	63.5													
41	62.5													
42	61.5													
43	60.5													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

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Figure:
A-5

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-5

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/21/2011 **DATE FINISHED:** 7/21/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 95.5 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 9.5 **GW DATE:** 7/21/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, CA

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	94.5	CA		8	CL	SANDY CLAY (CL) brown, stiff, dry to moist	13.9		62.3				46	29
2	93.5													
3	92.5													
4	91.5	MCA		20	CL	SANDY CLAY (CL) brown, very stiff, moist	19.8	107		TXUU		3.4		
5	90.5													
6	89.5													
7	88.5	CA		22	SC	CLAYEY SAND (SC) olive, medium dense, wet, brown mottling with fine grained sand	36.3		41.5					
8	87.5													
9	86.5													
10	85.5	MCA		20	ML	SANDY SILT (ML) olive, stiff to very stiff, wet, brown mottling, fine grained sand	27.6	95		TXUU		1.7	33	7
11	84.5													
12	83.5													
13	82.5													
14	81.5													
15	80.5													
16	79.5													
17	78.5													
18	77.5													
19	76.5					CLAY WITH SAND (CL) olive, stiff, wet, local white mottling at 21', fine grained sand								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-6

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-5

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	74.5	CA		12		CLAY WITH SAND (CL) (Con't)	35.5							
22	73.5													
23	72.5													
24	71.5													
25	70.5					as above, red mottling, hard								
26	69.5	MCA		34										
27	68.5													
28	67.5													
29	66.5													
30	65.5													
31	64.5													
32	63.5													
33	62.5													
34	61.5													
35	60.5													
36	59.5													
37	58.5													
38	57.5													
39	56.5													
40	55.5													
41	54.5													
42	53.5													
43	52.5													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-6

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA**LOG OF BORING SB-6**

Sheet 1 of 2

BORING LOCATION: See Figure 3**DRILLING SUBCONTRACTOR:** RSI Drilling**DATE STARTED:** 7/20/2011 **DATE FINISHED:** 7/20/2011**DRILL RIG:** CME 75**LOGGED BY:** R. Abernathy**DRILLING METHOD:****ELEVATION (FT):** 94.4**DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 9.0**GW DATE:** 7/20/2011**HAMMER TYPE:** Automatic**CASING NOTES:** N/A**HAMMER WT (LBS):** 140**HAMMER DROP (IN):** 30**BACKFILL MATERIAL:** Neat Cement Grout**SAMPLERS:** MCA, CA

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	93.4					SANDY CLAY WITH GRAVEL (CL) brown, stiff, dry, gravel up to 1.5" in diameter, cobbles in upper 2', trace organics								
2	92.4					Gradation: 23.9% sand, 22.1% gravel, 54.0% <#200								
3	91.4	CA		9	CL		5.8		54.0					
4	90.4													
5	89.4													
6	88.4	MCA		5	CH	CLAY (CH) gray, medium stiff to stiff, moist, highly plastic	28.0	87		TXUU		1.3	55	39
7	87.4													
8	86.4					CLAYEY SAND (SC) olive, medium dense, wet, brown mottling								
9	85.4													
10	84.4	CA		17	SC		47.4		31.9					
11	83.4													
12	82.4													
13	81.4					SILTY SAND (SM) brown, very dense, wet								
14	80.4													
15	79.4													
16	78.4	MCA		46	ML	SANDY SILT WITH CLAY (ML) brown, hard, wet Permeability: 2.12x10-6 cm/sec	28.5	96	63.5					
17	77.4													
18	76.4					SANDY CLAY (CL) brown, soft, wet, locally white								
19	75.4													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00**Figure:**
A-7

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	73.4	CA		2	CL	SANDY CLAY (CL) (Con't)	59.1		62.5					
22	72.4													
23	71.4					SANDY CLAY WITH GRAVEL (CL) olive, hard, wet, with red mottling								
24	70.4													
25	69.4			45	CL									
26	68.4	MCA												
27	67.4													
28	66.4					SANDY CLAY (CL) olive, hard, wet, brown mottling, higher silt content								
29	65.4													
30	64.4			36	CL									
31	63.4	CA												
32	62.4													
33	61.4													
34	60.4													
35	59.4													
36	58.4													
37	57.4													
38	56.4													
39	55.4													
40	54.4													
41	53.4													
42	52.4													
43	51.4													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDILIS & ASSOCIATES GEOSTRUCTURAL ENGINEERING



INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-7

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-7

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/21/2011 **DATE FINISHED:** 7/21/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 96.4 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 12.0 **GW DATE:** 7/21/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, CA, Shelby

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	95.4	CA		9	CL	CLAY WITH SAND (CL) dark brown, stiff, dry to moist, organics and clam shells from 0 to 1.5'	13.9							
2	94.4													
3	93.4													
4	92.4	MCA		14	CL	CLAY (CL) brown to gray, stiff, dry to moist, trace organics and shells at 5' Gradation: 12.9% sand, 34.9% silt, 52.2% clay Permeability: 9.62x10-9 cm/sec	21.5	108	87.1					
5	91.4													
6	90.4													
7	89.4	CA		11	CL	SANDY CLAY (CL) brown, stiff, moist to wet	61.7						34	14
8	88.4													
9	87.4													
10	86.4	MCA		41	CL	CLAY WITH SAND (CL) brown to olive, hard, wet Permeability: 1.03x10-7 cm/sec	25.5	99						
11	85.4													
12	84.4													
13	83.4	CA				CLAY (CL) olive, hard, wet, brown mottling, approximately 5% medium grained sand								
14	82.4													
15	81.4													
16	80.4	MCA												
17	79.4													
18	78.4													
19	77.4	CA												

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-8

LOG OF BORING: 10-066.00 BORING LOGS V3.GPJ SAGE.GDT 11/8/11

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	75.4	ST			CL	CLAY (CL) (Con't)								
22	74.4	CA		32										
23	73.4													
24	72.4					CLAY WITH SAND (CL) olive, hard, wet, iron staining								
25	71.4				CL									
26	70.4	MCA		36										
27	69.4													
28	68.4					SANDY CLAY (CL) olive, hard, wet, red mottling								
29	67.4				CL									
30	66.4	CA		59										
31	65.4													
32	64.4													
33	63.4													
34	62.4													
35	61.4													
36	60.4													
37	59.4													
38	58.4													
39	57.4													
40	56.4													
41	55.4													
42	54.4													
43	53.4													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-8

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/20/2011 **DATE FINISHED:** 7/20/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 94.8 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 9.0 **GW DATE:** 7/20/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, CA

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	93.8	CA		20	CL	SANDY CLAY (CL) brown, very stiff, dry to moist, fine grained sand								
2	92.8					SANDY CLAY WITH GRAVEL (CL) brown, very stiff, moist, 1" diameter gravel, fine grained sand								
3	91.8					SANDY CLAY (CL) dark brown to red brown, stiff, moist, fine grained sand								
4	90.8	MCA		12	CL	SANDY CLAY (CL) dark brown to red brown, stiff, moist, fine grained sand	27.4	93						
5	89.8					Direct Shear: $\phi=29.4^\circ$, $c=800$ psf								
6	88.8													
7	87.8	CA		41	CL	as above, stiff								
8	86.8					as above, brown, with white mottling, hard, wet								
9	85.8													
10	84.8	MCA		56	CL	CLAY (CL) brown, hard, wet	20.7	68						
11	83.8													
12	82.8													
13	81.8	CA			CL									
14	80.8													
15	79.8													
16	78.8	MCA			CL									
17	77.8													
18	76.8													
19	75.8	CA			CL									

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-9

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	73.8	CA	X	10		CLAY (CL) (Con't)								
22	72.8													
23	71.8													
24	70.8					SILTY SAND (SM) brown, loose, wet, fine grained sand								
25	69.8													
26	68.8	MCA		7	SM				34.8					
27	67.8													
28	66.8													
29	65.8					CLAY (CL) olive, hard, wet, trace fine sand								
30	64.8													
31	63.8	CA	X	81/11"	CL									
32	62.8													
33	61.8													
34	60.8					SAND WITH SILT (SP-SM) olive brown, medium dense, wet, fine to medium grained sand								
35	59.8													
36	58.8	CA	X	26	SP-SM				7.7					
37	57.8													
38	56.8													
39	55.8					SANDY CLAY (CL) olive to brown, hard, wet, red mottling								
40	54.8													
41	53.8	CA	X	89/10"	CL									
42	52.8													
43	51.8													

Boring terminated at a depth of 41.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-9

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/21/2011 **DATE FINISHED:** 7/21/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 93.7 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 20.5 **GW DATE:** 7/21/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT, Bulk

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	92.7	SPT		9	CH	CLAY WITH SAND (CH) dark brown, stiff, dry to moist, with brown mottling, up to 3/4" gravel in upper 3", trace organics								
2	91.7													
3	90.7	BULK				R Value: <5								
4	89.7					SANDY CLAY (CL) olive to brown, stiff, moist								
5	88.7													
6	87.7	MCA		10			24.5		64.5				35	20
7	86.7													
8	85.7				CL									
9	84.7													
10	83.7					as above, hard moist								
11	82.7	SPT		65										
12	81.7													
13	80.7					CLAY (CL) olive, very stiff to hard, moist								
14	79.7													
15	78.7													
16	77.7	MCA		37			22.3	104		TXUU		2.1		
17	76.7													
18	75.7				CL									
19	74.7													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
21	72.7	SPT		14		stiff, wet, black mottling CLAY (CL) (Con't)								
22	71.7													
23	70.7													
24	69.7					SAND (SP) gray brown, medium dense to dense, wet								
25	68.7													
26	67.7	MCA		31										
27	66.7				SP									
28	65.7													
29	64.7													
30	63.7													
31	62.7	SPT		98/11"		SANDY CLAY (CL) brown, hard, wet, fine grained sand								
32	61.7				CL									
33	60.7													
34	59.7													
35	58.7				SP-SC	SAND WITH CLAY (SP-SC) gray brown, medium dense, wet, fine to medium grained Gradation: 90.3% sand, 9.7% <#200								
36	57.7	SPT		18										
37	56.7				CL	CLAY (CL) brown, very stiff, wet								
38	55.7													
39	54.7													
40	53.7				CL	CLAY WITH SAND (CL) olive, hard, wet, red mottling, 3" SAND (SP) lens at 40'								
41	52.7	MCA		60/11"										
42	51.7													
43	50.7													

Boring terminated at a depth of 41.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-10

Sheet 1 of 2

BORING LOCATION: See Figure 3

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/22/2011 **DATE FINISHED:** 7/22/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 94.8 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 11.0 **GW DATE:** 7/22/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	93.8	SPT	○	26		CLAY (CL) brown to dark brown, very stiff, dry to moist, cobbles present 0 to 2'								
2	92.8				CL									
3	91.8													
4	90.8													
5	89.8					CLAY (CL) dark brown, very soft to soft, moist, gravel and organics at 5'								
6	88.8	MCA		3	CL	Swell/Compression: 0% swell	34.0 31.8	85 88		TXUU		0.4	30	16
7	87.8													
8	86.8													
9	85.8					SANDY CLAY (CL) brown, stiff, moist, higher silt content, low plasticity, fine grained sand								
10	84.8													
11	83.8	SPT	■	13										
12	82.8													
13	81.8				CL									
14	80.8													
15	79.8					as above, hard, wet								
16	78.8	MCA		68			22.6	90						
17	77.8													
18	76.8													
19	75.8					SILTY SAND (SM) brown, medium dense, wet, fine grained sand								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-10

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	73.8	SPT		16	SM	SILTY SAND (SM) (Con't)	29.1	99	39.2					
22	72.8													
23	71.8													
24	70.8													
25	69.8													
26	68.8	MCA		7	CL	SANDY CLAY (CL) olive, medium stiff, wet, fine grained sand								
27	67.8													
28	66.8													
29	65.8													
30	64.8													
31	63.8													
32	62.8													
33	61.8													
34	60.8													
35	59.8													
36	58.8													
37	57.8													
38	56.8													
39	55.8													
40	54.8													
41	53.8													
42	52.8													
43	51.8													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-11

Sheet 1 of 2

BORING LOCATION: See Figure 4

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/22/2011 **DATE FINISHED:** 7/22/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 93.2 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 14.0 **GW DATE:** 7/22/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	92.2	SPT		14		CLAY (CL) olive to dark brown, stiff, dry to moist, organics and clam shells 0 to 6"								
2	91.2				CL									
3	90.2													
4	89.2													
5	88.2					CLAY (CL) dark brown, stiff to very stiff, dry to moist, red mottling, approximately 15% medium grained sand Pinhole Dispersion: ND3, clear	19.2	97						
6	87.2	MCA		7	CL		15.3	100		TXUU		2.4	35	23
7	86.2													
8	85.2					CLAY (CL) brown, very stiff, moist, medium plastic								
9	84.2													
10	83.2													
11	82.2	SPT		27	CL		21.0						36	19
12	81.2													
13	80.2					CLAY WITH SAND (CL) olive, stiff, moist to wet, brown mottling, fine grained sand								
14	79.2													
15	78.2													
16	77.2	MCA		13	CL	Consolidation: Refer to Appendix B	36.6	84						
17	76.2													
18	75.2					SANDY CLAY (CL) brown, stiff, wet, fine grained sand								
19	74.2													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	72.2	SPT		8	CL	SANDY CLAY (CL) (Con't)			68.8					
22	71.2													
23	70.2													
24	69.2					CLAY WITH SAND (CL) brown, very stiff, wet, fine grained sand								
25	68.2													
26	67.2	MCA		19	CL									
27	66.2													
28	65.2													
29	64.2													
30	63.2													
31	62.2	SPT		12	CL	CLAY (CL) brown, stiff, wet to moist, local black mottling								
32	61.2													
33	60.2													
34	59.2													
35	58.2													
36	57.2													
37	56.2													
38	55.2													
39	54.2													
40	53.2													
41	52.2													
42	51.2													
43	50.2													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-12

Sheet 1 of 2

BORING LOCATION: See Figure 4

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/22/2011 **DATE FINISHED:** 7/22/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 93.2 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 9.5 **GW DATE:** 7/22/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	92.2	SPT		13	CL	SANDY CLAY (CL) brown, stiff, dry to moist, trace organics 0 to 6", fine grained sand	12.7							
2	91.2													
3	90.2													
4	89.2				CH	CLAY (CH) light brown to gray, stiff, dry to moist, highly plastic								
5	88.2													
6	87.2	MCA		13	CH		23.8	99					53	39
7	86.2													
8	85.2													
9	84.2					SANDY CLAY (CL) brown, hard, moist to wet, white and black mottling, fine grained sand								
10	83.2													
11	82.2	SPT		31	CL									
12	81.2													
13	80.2													
14	79.2													
15	78.2					as above, olive with brown mottling								
16	77.2	MCA		26			30.8	88						
17	76.2													
18	75.2					SANDY CLAY (CL) olive brown, very stiff, wet								
19	74.2													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	72.2	SPT		30		SANDY CLAY (CL) (Con't)	29.4							
22	71.2													
23	70.2				CL									
24	69.2													
25	68.2			19		as above, brown, moist	28.8	95	51.7					
26	67.2	MCA												
27	66.2													
28	65.2													
29	64.2					CLAY WITH SAND (CL) olive gray, very stiff, moist, brown mottling, white vains, medium grained sand content varies								
30	63.2			20	CL									
31	62.2	SPT												
32	61.2													
33	60.2													
34	59.2													
35	58.2													
36	57.2													
37	56.2													
38	55.2													
39	54.2													
40	53.2													
41	52.2													
42	51.2													
43	50.2													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-13

Sheet 1 of 2

BORING LOCATION: See Figure 4

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/25/2011 **DATE FINISHED:** 7/25/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 92.2 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 6.5 **GW DATE:** 7/25/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	91.2	SPT		14	CL	SANDY CLAY (CL) light brown to olive brown, stiff, dry to moist, approximately 5% gravels	19.0							
2	90.2				CL									
3	89.2				CL									
4	88.2				CH	CLAY (CH) olive brown, medium stiff, moist								
5	87.2				CH									
6	86.2	MCA		7	CH	Swell/Compression: 0.01% compression	24.1	100					52	39
7	85.2				CH									
8	84.2				SM	SILTY SAND (SM) olive brown, medium dense, wet								
9	83.2				SM									
10	82.2				SM	Gradation: 55.6% sand, 0.9% gravel, 43.5% <#200								
11	81.2	SPT		17	SC	CLAYEY SAND (SC) gray, medium dense, wet, coarse to medium grained sand, approximately 15% clay			43.5					
12	80.2				SC									
13	79.2				GM	SILTY GRAVEL (GM) brown, medium dense, wet								
14	78.2				GM									
15	77.2				ML	SANDY SILT (ML) brown, very stiff, wet, fine grained sand	25.9	87						
16	76.2	MCA		25	ML									
17	75.2				ML									
18	74.2				ML	SANDY SILT WITH CLAY (ML) brown, very stiff, wet								
19	73.2				ML									

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	71.2	SPT		17	ML	SANDY SILT WITH CLAY (ML) (Con't)			60.4					
22	70.2													
23	69.2													
24	68.2													
25	67.2			31	CL	SANDY CLAY WITH SILT (CL) brown, hard, moist								
26	66.2	MCA												
27	65.2													
28	64.2													
29	63.2													
30	62.2													
31	61.2													
32	60.2													
33	59.2													
34	58.2													
35	57.2													
36	56.2													
37	55.2													
38	54.2													
39	53.2													
40	52.2													
41	51.2													
42	50.2													
43	49.2													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDLITS & ASSOCIATES' GEOSTRUCTURAL ENGINEERING

SAGE

INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-14

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-14

Sheet 1 of 2

BORING LOCATION: See Figure 4

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/25/2011 **DATE FINISHED:** 7/25/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 89.6 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 5.0 **GW DATE:** 7/25/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

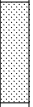
HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	88.6	SPT		10	SM	SILTY SAND WITH GRAVEL (SM) light brown, medium dense, dry								
2	87.6				SP	SAND (SP) olive, medium dense, dry to moist, medium to fine grained								
3	86.6													
4	85.6													
5	84.6					as above, brown, loose, moist to wet								
6	83.6	MCA		7			16.3	105						
7	82.6				CL	CLAY WITH SAND (CL) olive, medium stiff, wet, fine grained sand								
8	81.6													
9	80.6													
10	79.6					SANDY CLAY (CL) olive gray to olive brown, stiff, wet, red staining, fine grained sand			68.9					
11	78.6	SPT		14										
12	77.6													
13	76.6													
14	75.6													
15	74.6					as above, brown with white mottling, hard								
16	73.6	MCA		82/11"	CL		23.4	96						
17	72.6													
18	71.6													
19	70.6													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	68.6	SPT		9		SANDY CLAY (CL) (Con't) stiff, wet								
22	67.6													
23	66.6													
24	65.6													
25	64.6													
26	63.6	MCA		11	CL	Consolidation: See Appendix B	35.7	85						
27	62.6													
28	61.6													
29	60.6													
30	59.6													
31	58.6	SPT		34	CL	CLAY WITH SAND (CL) brown, very stiff, wet, fine grained sand								
32	57.6													
33	56.6													
34	55.6													
35	54.6													
36	53.6													
37	52.6													
38	51.6													
39	50.6													
40	49.6													
41	48.6													
42	47.6													
43	46.6													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA**LOG OF BORING SB-15**

Sheet 1 of 2

BORING LOCATION: See Figure 4**DRILLING SUBCONTRACTOR:** RSI Drilling**DATE STARTED:** 7/25/2011 **DATE FINISHED:** 7/25/2011**DRILL RIG:** CME 75**LOGGED BY:** R. Abernathy**DRILLING METHOD:****ELEVATION (FT):** 89.7 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 8.0 **GW DATE:** 7/25/2011**HAMMER TYPE:** Automatic**CASING NOTES:** N/A**HAMMER WT (LBS):** 140 **HAMMER DROP (IN):** 30**BACKFILL MATERIAL:** Neat Cement Grout**SAMPLERS:** MCA, SPT, SHELBY

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	88.7	SPT		9	SM	SILTY SAND (SM) light brown to brown, loose, dry to moist, approximately 15% silt increasing with depth, up to 1/2" gravels in upper 3"	9.3		29.3					
2	87.7													
3	86.7													
4	85.7				SP	SAND (SP) brown, very loose, moist, fine grained								
5	84.7													
6	83.7	MCA		2	CL SC	SANDY CLAY (CL) gray, very soft, moist, fine grained sand CLAYEY SAND (SC) brown, very loose, moist, medium grained								
7	82.7	ST		500 psi	CL	CLAY (CL) brown to olive gray, very soft, moist to wet Consolidation: See Appendix B	30.4	91						
8	81.7													
9	80.7					SANDY CLAY (CL) olive to olive brown, hard, wet, fine grained sand								
10	79.7													
11	78.7	MCA		55	CL		27.3	97						
12	77.7													
13	76.7					SANDY CLAY (CL) brown to olive brown, very stiff, wet								
14	75.7													
15	74.7													
16	73.7	SPT		20					66.8			34	11	
17	72.7													
18	71.7													
19	70.7													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-15

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	68.7	MCA		13		SANDY CLAY (CL) (Con't) stiff	38.0	84						
22	67.7													
23	66.7													
24	65.7													
25	64.7			10										
26	63.7	SPT												
27	62.7													
28	61.7													
29	60.7													
30	59.7													
31	58.7													
32	57.7													
33	56.7													
34	55.7													
35	54.7													
36	53.7													
37	52.7													
38	51.7													
39	50.7													
40	49.7													
41	48.7													
42	47.7													
43	46.7													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-16

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-16

Sheet 1 of 2

BORING LOCATION: See Figures 5 & 7

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/26/2011 **DATE FINISHED:** 7/26/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 84.7 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 5.0 **GW DATE:** 7/25/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	83.7	SPT		8		CLAY WITH SAND (CL) light brown to brown, medium stiff, dry to moist, fine grained sand								
2	82.7				CL									
3	81.7													
4	80.7				CL	CLAY WITH SAND (CL) dark brown, stiff to very stiff, moist to wet								
5	79.7													
6	78.7	MCA		44	ML	SILT (ML) brown to olive brown, hard, wet	18.2	103						
7	77.7					SANDY CLAY (CL) brown to olive brown, hard, wet								
8	76.7													
9	75.7													
10	74.7				CL	as above, very stiff								
11	73.7	SPT		22					75.0					
12	72.7													
13	71.7													
14	70.7					SAND (SP) olive brown, very dense, wet, fine grained sand								
15	69.7				SP									
16	68.7	MCA		84/11"			19.5	106						
17	67.7				CL	SANDY CLAY (CL) brown, hard, wet								
18	66.7													
19	65.7				SC	CLAYEY SAND (SC) olive, medium dense, wet, fine grained sand								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-17

LOG OF BORING - 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA								
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY		
													LL	PI	
21	63.7	SPT		13		SILT WITH SAND (ML) brown, stiff, wet, fine grained sand	36.2		73.7					29	4
22	62.7				ML										
23	61.7					CLAY (CL) brown, hard, wet									
24	60.7														
25	59.7				CL										
26	58.7	MCA		58											
27	57.7														
28	56.7														
29	55.7														
30	54.7														
31	53.7														
32	52.7														
33	51.7														
34	50.7														
35	49.7														
36	48.7														
37	47.7														
38	46.7														
39	45.7														
40	44.7														
41	43.7														
42	42.7														
43	41.7														

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDLITS & ASSOCIATES' GEOSTRUCTURAL ENGINEERING

SAGE

INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-17

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project Butte County, CA

LOG OF BORING SB-17

Sheet 1 of 2

BORING LOCATION: See Figures 5 & 7

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/26/2011 **DATE FINISHED:** 7/26/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 82.8

DATUM: NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 7.0

GW DATE: 7/26/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	81.8	SPT		7	CL	CLAY (CL) brown to dark brown, medium stiff, dry to moist	19.6							
2	80.8					CLAY (CL) olive to olive gray, hard, moist								
3	79.8													
4	78.8													
5	77.8				CL	Pinhole Dispersion: ND3, barely visible	29.7	93						
6	76.8	MCA		47		Permeability: 8.80×10^{-7} cm/sec	22.3	102						
7	75.8													
8	74.8					CLAY WITH SAND (CL) brown, stiff, wet, fine grained sand								
9	73.8													
10	72.8				CL									
11	71.8	SPT		12			28.0							
12	70.8													
13	69.8					SANDY CLAY (CL) brown, hard, wet, fine grained sand								
14	68.8													
15	67.8				CL									
16	66.8	MCA		35		Permeability: 8.95×10^{-7} cm/sec	26.6	97						
17	65.8													
18	64.8					CLAY (CL) brown to olive brown, very stiff, wet								
19	63.8													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-18

LOG OF BORING - 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	61.8	SPT		17	CL	CLAY (CL) (Con't)								
22	60.8													
23	59.8													
24	58.8					CLAY WITH SAND (CL) brown to olive brown, very stiff, wet, fine grained sand								
25	57.8				CL									
26	56.8	MCA		21										
27	55.8													
28	54.8													
29	53.8													
30	52.8													
31	51.8													
32	50.8													
33	49.8													
34	48.8													
35	47.8													
36	46.8													
37	45.8													
38	44.8													
39	43.8													
40	42.8													
41	41.8													
42	40.8													
43	39.8													
Boring terminated at a depth of 26.5 feet below ground surface. MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.							SANDERS & ASSOCIATES' GEOSTRUCTURAL ENGINEERING SAGE INTEGRATING EARTH & STRUCTURE Project No: 10-066.00 Figure: A-18							

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-18

Sheet 1 of 2

BORING LOCATION: See Figure 5

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/26/2011 **DATE FINISHED:** 7/26/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 80.0

DATUM: NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 5.5

GW DATE: 7/26/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: SPT, Bulk

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	79.0	SPT	▲	13	CL	CLAY (CL) dark brown, stiff, moist								
2	78.0				CL	CLAY (CL) olive gray, stiff, dry, approx. 10% medium to coarse grained sand								
3	77.0													
4	76.0													
5	75.0					CLAYEY SAND (SC) brown, very loose, moist to wet								
6	74.0	MCA	○	1	SC									
7	73.0													
8	72.0													
9	71.0													
10	70.0					SAND (SP) blue gray, dense, wet, fine to medium grained Gradation: 92.0% sand, 4.2% gravel, 3.8% <#200								
11	69.0	SPT	▲	46					3.8					
12	68.0													
13	67.0													
14	66.0													
15	65.0					flowing, clean sand, can't sample								
16	64.0				SP									
17	63.0													
18	62.0													
19	61.0													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-19

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-18

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	59.0					SAND (SP) (Con't)								
22	58.0													
23	57.0													
24	56.0													
25	55.0													
26	54.0	SPT		35										
27	53.0													
28	52.0													
29	51.0													
30	50.0													
31	49.0													
32	48.0													
33	47.0													
34	46.0													
35	45.0													
36	44.0													
37	43.0													
38	42.0													
39	41.0													
40	40.0													
41	39.0													
42	38.0													
43	37.0													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-19

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-19

Sheet 1 of 2

BORING LOCATION: See Figure 5

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/26/2011 **DATE FINISHED:** 7/26/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 80.8 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 6.0 **GW DATE:** 7/26/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	79.8	SPT		10	CL	CLAY WITH SAND (CL) light brown to brown, stiff, dry to moist, approximately 25% sand, glass in upper 3"								
2	78.8					CLAY WITH SAND (CL) dark brown, stiff, moist								
3	77.8													
4	76.8													
5	75.8				CL	as above, brown to dark brown, moist to wet								
6	74.8	MCA		15			16.1	115		TXUU		2.2		
7	73.8													
8	72.8													
9	71.8					SAND (SP-SC) blue gray, medium dense, wet, fine to medium grained, CLAYEY SAND (SC) lenses approximately 1" thick								
10	70.8					Gradation: 89.8% sand, 4.0% gravel, 6.2% <#200								
11	69.8	SPT		20	SP-SC				6.2					
12	68.8													
13	67.8													
14	66.8													
15	65.8													
16	64.8	MCA		18	CL	CLAY (CL) brown, very stiff, wet	26.2							
17	63.8													
18	62.8													
19	61.8					SILT WITH SAND (ML) brown, very stiff, wet								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-20

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-19

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	59.8	SPT		29	ML	SILT WITH SAND (ML) (Con't)	35.3							
22	58.8													
23	57.8													
24	56.8					SAND (SP) brown to dark brown, medium dense, wet, fines decrease with depth, density increases with depth								
25	55.8				SP									
26	54.8	MCA		24					0.4					
27	53.8													
28	52.8													
29	51.8													
30	50.8													
31	49.8													
32	48.8													
33	47.8													
34	46.8													
35	45.8													
36	44.8													
37	43.8													
38	42.8													
39	41.8													
40	40.8													
41	39.8													
42	38.8													
43	37.8													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDULIS & ASSOCIATES' GEOSTRUCTURAL ENGINEERING

SAGE

INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-20

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-20

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-20

Sheet 1 of 2

BORING LOCATION: See Figure 5

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/27/2011 **DATE FINISHED:** 7/27/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 78.7 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 6.0 **GW DATE:** 7/27/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT, Bulk

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	77.7	SPT		12	CL	CLAY (CL) olive brown to dark brown, stiff, dry to moist, 1/2" gravels in upper 3"	17.1							
2	76.7													
3	75.7	BULK				R Value: 17								
4	74.7					CLAY WITH SAND (CL) olive gray, very stiff, moist to wet, red staining								
5	73.7													
6	72.7	MCA		30	CL	Direct Shear: $\phi = 36.7^\circ$, $c = 420$ psf	34.7	86						
7	71.7													
8	70.7					CLAYEY SAND (SC) olive, medium dense, wet, fine grained sand								
9	69.7													
10	68.7								12.7					
11	67.7	SPT		14	CL	CLAY (CL) brown, stiff, wet	24.9							
12	66.7													
13	65.7					SAND WITH SILT (SW-SM) olive, medium dense, wet, fine to medium grained								
14	64.7				SW-SM									
15	63.7					Gradation: 93.3% sand, 0.2% gravel, 6.5% <#200			6.5					
16	62.7	MCA		25	CL	SANDY CLAY (CL) brown, very stiff, wet, fine grained sand	22.1	104		TXUU		2.8		
17	61.7													
18	60.7					SANDY SILT (ML) brown, very stiff, wet, 3" SAND (SP) lens at 20', local red staining at 21'								
19	59.7													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDERS & ASSOCIATES GEOSTRUCTURAL ENGINEERING
SAGE
INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-21

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	57.7	SPT		17	ML	SANDY SILT (ML) (Con't)								
22	56.7													
23	55.7													
24	54.7					SAND WITH SILT (SP-SM) olive gray, medium dense, wet, fine to medium grained								
25	53.7													
26	52.7	MCA		15					7.4					
27	51.7													
28	50.7				SP-SM	as above, olive to brown, loose								
29	49.7													
30	48.7													
31	47.7	SPT		7					11.6					
32	46.7													
33	45.7													
34	44.7					GRAVEL (GP) gray, very dense, wet, fine grained								
35	43.7	MCA		42/2"										
36	42.7													
37	41.7				GP									
38	40.7													
39	39.7													
40	38.7					as above, medium dense								
41	37.7	SPT		27										
42	36.7													
43	35.7													

Boring terminated at a depth of 41.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-21

Sheet 1 of 2

BORING LOCATION: See Figure 5

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/27/2011 **DATE FINISHED:** 7/27/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 78.2 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 4.5 **GW DATE:** 7/27/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	77.2	SPT	▲	10	CL	CLAY WITH SAND (CL) olive to olive gray, stiff, dry to moist, fine grained sands, fine gravels in upper 3"								
2	76.2													
3	75.2					SANDY CLAY (CL) brown to dark brown, very soft, moist to wet								
4	74.2				CL									
5	73.2					Consolidation: See Appendix B								
6	72.2	MCA	○	4			22.7	104	27.0					
7	71.2				SC	CLAYEY SAND (SC) brown, medium dense, wet, fine grained sands								
8	70.2													
9	69.2				SP	SAND (SP) brown, medium dense, wet, fine grained								
10	68.2													
11	67.2	SPT	▲	21			24.1							
12	66.2				CL	CLAY (CL) olive gray, very stiff, wet								
13	65.2													
14	64.2													
15	63.2													
16	62.2	MCA	○	9		SANDY SILT (ML) brown, stiff to very stiff, wet, with clay								
17	61.2													
18	60.2													
19	59.2				ML									

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	57.2	SPT		20		SANDY SILT (ML) (Con't)	31.2							
22	56.2													
23	55.2													
24	54.2				SP	SAND (SP) brown, very dense, wet								
25	53.2													
26	52.2	MCA		63		SAND WITH GRAVEL (SP) olive gray, very dense, wet, gravels up to 1" in diameter								
27	51.2				SP									
28	50.2													
29	49.2													
30	48.2													
31	47.2	BULK												
32	46.2													
33	45.2				SP-SM									
34	44.2													
35	43.2					Gradation: 94% sand, 6.0% <#200			6.0					
36	42.2	SPT		74		as above, coarse grained, gravels up to 1" in diameter								
37	41.2													
38	40.2													
39	39.2													
40	38.2													
41	37.2	SPT		55	GW	GRAVEL WITH SAND (GW) olive to blue gray, very dense, wet, CLAY (CL) lens at 41'								
42	36.2													
43	35.2													

Boring terminated at a depth of 41.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA**LOG OF BORING SB-22**

Sheet 1 of 2

BORING LOCATION: See Figure 5**DRILLING SUBCONTRACTOR:** RSI Drilling**DATE STARTED:** 7/28/2011 **DATE FINISHED:** 7/28/2011**DRILL RIG:** CME 75**LOGGED BY:** R. Abernathy**DRILLING METHOD:****ELEVATION (FT):** 76.8**DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 6.0**GW DATE:** 7/28/2011**HAMMER TYPE:** Automatic**CASING NOTES:** N/A**HAMMER WT (LBS):** 140**HAMMER DROP (IN):** 30**BACKFILL MATERIAL:** Neat Cement Grout**SAMPLERS:** MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	75.8	SPT		12	CH	CLAY (CH) olive gray, stiff, dry to moist, highly plastic								
2	74.8													
3	73.8													
4	72.8													
5	71.8													
6	70.8	MCA		36	ML	SANDY SILT WITH CLAY (ML) olive to olive gray, hard, moist to wet	30.1	89						
7	69.8													
8	68.8													
9	67.8													
10	66.8													
11	65.8	SPT		35	CL	SANDY CLAY (CL) brown, hard, wet, white mottling			59.2					
12	64.8													
13	63.8													
14	62.8													
15	61.8													
16	60.8	MCA		48	CL	SANDY CLAY (CL) brown to olive gray, hard, wet	21.7	106						
17	59.8													
18	58.8													
19	57.8													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	55.8	SPT		57	CL	CLAY (CL) (Con't)								
22	54.8													
23	53.8													
24	52.8				SP	SAND WITH GRAVEL (SP) olive brown, dense, wet, gravels up to 1/2" in diameter								
25	51.8	MCA		31										
26	50.8													
27	49.8													
28	48.8													
29	47.8													
30	46.8													
31	45.8													
32	44.8													
33	43.8													
34	42.8													
35	41.8													
36	40.8													
37	39.8													
38	38.8													
39	37.8													
40	36.8													
41	35.8													
42	34.8													
43	33.8													
Boring terminated at a depth of 25.5 feet below ground surface. MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.							SANDERS & ASSOCIATES' GEOSTRUCTURAL ENGINEERING SAGE INTEGRATING EARTH & STRUCTURE Project No: 10-066.00 Figure: A-23							

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-23

Sheet 1 of 2

BORING LOCATION: See Figure 6

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/1/2011 **DATE FINISHED:** 8/1/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 73.7 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 6.0 **GW DATE:** 8/1/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	72.7	SPT		7	CH	CLAY (CH) dark olive gray to light brown, medium stiff, dry to moist, fine gravels and rootlets in upper 6", highly plastic							65	44
2	71.7													
3	70.7					CLAY WITH SAND (CL) dark olive gray, stiff, moist to wet								
4	69.7													
5	68.7					Permeability: 1.4x10-8 cm/sec								
6	67.7	MCA		14		Direct Shear: $\phi = 19.6^\circ$, $c = 1160$ psf	37.5 29.8	84 87	76.5					
7	66.7				CL									
8	65.7													
9	64.7													
10	63.7					as above, olive brown								
11	62.7	SPT		13										
12	61.7				ML	SILT (ML) brown, stiff, wet								
13	60.7					CLAY (CL) brown, very stiff, wet								
14	59.7													
15	58.7													
16	57.7	MCA		21			30.4	94						
17	56.7													
18	55.7				CL									
19	54.7													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-24

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-23

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	52.7	SPT		22		CLAY (CL) (Con't)								
22	51.7													
23	50.7													
24	49.7					CLAY WITH SAND (CL) brown, very stiff, wet, fine grained sand								
25	48.7				CL									
26	47.7	MCA		26			29.5	90						
27	46.7													
28	45.7													
29	44.7													
30	43.7													
31	42.7													
32	41.7													
33	40.7													
34	39.7													
35	38.7													
36	37.7													
37	36.7													
38	35.7													
39	34.7													
40	33.7													
41	32.7													
42	31.7													
43	30.7													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-24

Sheet 1 of 2

BORING LOCATION: See Figure 6

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/29/2011 **DATE FINISHED:** 7/29/2011

DRILL RIG: CME 75

LOGGED BY: C. Smith

DRILLING METHOD:

ELEVATION (FT): 74.7

DATUM: NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 5.0

GW DATE: 7/29/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	73.7	SPT		5	CL	SANDY CLAY (CL) brown, medium stiff, dry to moist								
2	72.7													
3	71.7					CLAY (CH) dark brown, medium stiff to stiff, moist to wet, highly plastic								
4	70.7													
5	69.7					Pinhole Dispersion: ND3, barely visible	34.4	89						
6	68.7	MCA		12	CH		32.1	84		TXUU		1.5		
7	67.7													
8	66.7													
9	65.7													
10	64.7													
11	63.7	SPT		9		SANDY CLAY (CL) olive, stiff, wet, medium plasticity, iron oxide mottling, few calcium carbonate stringers							45	22
12	62.7													
13	61.7													
14	60.7													
15	59.7					color becoming more tan-yellow with depth								
16	58.7	MCA		17			27.6	92						
17	57.7													
18	56.7				CL									
19	55.7													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-24

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	53.7	SPT		13		SANDY CLAY (CL) (Con't) as above, tan	27.7		70.1					
22	52.7													
23	51.7													
24	50.7													
25	49.7													
26	48.7	MCA		22										
27	47.7													
28	46.7													
29	45.7													
30	44.7													
31	43.7													
32	42.7													
33	41.7													
34	40.7													
35	39.7													
36	38.7													
37	37.7													
38	36.7													
39	35.7													
40	34.7													
41	33.7													
42	32.7													
43	31.7													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA**LOG OF BORING SB-25**

Sheet 1 of 2

BORING LOCATION: See Figure 6**DRILLING SUBCONTRACTOR:** RSI Drilling**DATE STARTED:** 7/29/2011**DATE FINISHED:** 7/29/2011**DRILL RIG:** CME 75**LOGGED BY:** C. Smith**DRILLING METHOD:****ELEVATION (FT):** 75.3**DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 3.8**GW DATE:** 7/29/2011**HAMMER TYPE:** Automatic**CASING NOTES:** N/A**HAMMER WT (LBS):** 140**HAMMER DROP (IN):** 30**BACKFILL MATERIAL:** Neat Cement Grout**SAMPLERS:** MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	74.3	SPT		8	CH	CLAY (CH) dark brown, stiff, dry to moist, gravels in upper 6"								
2	73.3													
3	72.3					CLAY (CL) olive gray, stiff to very stiff, wet, medium plasticity, calcium carbonate nodules and stringers								
4	71.3													
5	70.3													
6	69.3	MCA		16	CL		30.1	82						
7	68.3													
8	67.3													
9	66.3													
10	65.3					SILT (ML) olive gray, very stiff, moist, mottled with some iron oxide staining as above, mottled with some iron oxide staining								
11	64.3	SPT		23	ML								41	14
12	63.3													
13	62.3													
14	61.3					CLAY (CL) olive gray, very stiff, moist to wet, with local lenses of SAND (SP), olive gray, medium dense, very fine grained Permeability: 2.77x10-6 cm/sec								
15	60.3													
16	59.3	MCA		25			24.0	102						
17	58.3													
18	57.3													
19	56.3													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-25

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	54.3	SPT		27	CL	CLAY (CL) (Con't)								
22	53.3													
23	52.3													
24	51.3													
25	50.3													
26	49.3	MCA		20										
27	48.3													
28	47.3													
29	46.3													
30	45.3													
31	44.3													
32	43.3													
33	42.3													
34	41.3													
35	40.3													
36	39.3													
37	38.3													
38	37.3													
39	36.3													
40	35.3													
41	34.3													
42	33.3													
43	32.3													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project Butte County, CA

LOG OF BORING SB-26

Sheet 1 of 2

BORING LOCATION: See Figure 6

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/1/2011 **DATE FINISHED:** 8/1/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 74.5 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 5.0 **GW DATE:** 8/1/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	73.5	SPT		8	CH	CLAY (CH) olive brown, medium stiff, dry								
2	72.5				CH									
3	71.5				CH	CLAY (CH) brown, stiff, moist								
4	70.5				CL	SANDY CLAY (CL) olive to brown, stiff, moist to wet, fine grained sand								
5	69.5				CL									
6	68.5	MCA		14	CL		24.6	100		TXUU		0.9		
7	67.5													
8	66.5					CLAY (CL) yellow brown to brown, stiff, wet								
9	65.5													
10	64.5				CL									
11	63.5	SPT		12	CL								38	18
12	62.5													
13	61.5					SILTY SAND (SM) brown, medium dense, wet, fine grained sand								
14	60.5													
15	59.5				SM				21.4					
16	58.5	MCA		28	SM		28.6	93	28.0					
17	57.5													
18	56.5					SANDY SILT (ML) brown to olive gray, very stiff, wet, fine grained sand								
19	55.5				ML									

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-27

LOG OF BORING: 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-26

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	53.5	SPT		26		SANDY SILT (ML) (Con't)								
22	52.5					SANDY CLAY (CL) brown/olive gray to light brown, very stiff, wet, fine grained sand								
23	51.5													
24	50.5				CL									
25	49.5													
26	48.5	MCA		20			29.3	93						
27	47.5													
28	46.5													
29	45.5													
30	44.5													
31	43.5													
32	42.5													
33	41.5													
34	40.5													
35	39.5													
36	38.5													
37	37.5													
38	36.5													
39	35.5													
40	34.5													
41	33.5													
42	32.5													
43	31.5													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-27

Sheet 1 of 2

BORING LOCATION: See Figure 6

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/1/2011 **DATE FINISHED:** 8/1/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 73.3 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 7.0 **GW DATE:** 8/1/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	72.3	SPT	▲	7	CH	CLAY (CH) dark brown, medium stiff, dry to moist, organics in upper 3"								
2	71.3				CH									
3	70.3				CH	CLAY (CH) dark brown, stiff, moist								
4	69.3				CH									
5	68.3													
6	67.3	MCA	■	9	CL	CLAY (CL) gray brown, stiff, moist to wet Direct Shear: $\phi = 22.4^\circ$, $c = 1190$ psf	25.9	96					40	15
7	66.3													
8	65.3													
9	64.3				CL									
10	63.3					as above, light brown with white mottling, very stiff								
11	62.3	SPT	▲	21										
12	61.3													
13	60.3					SANDY SILT (ML) brown, hard, wet, , with clay								
14	59.3													
15	58.3													
16	57.3	MCA	■	39	ML	Consolidation: See Appendix B	30.0 31.5	97 91	54.0					
17	56.3													
18	55.3					SAND WITH SILT (SP-SM) olive, medium dense, wet, fine grained sand								
19	54.3				SP									

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-27

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	52.3	SPT		21	SM	SAND WITH SILT (SP-SM) (Con't) Gradation: 94% sand, 6.0% <#200			6.0					
22	51.3					CLAY (CL) brown, very stiff, wet								
23	50.3													
24	49.3													
25	48.3				CL	as above, red veining, medium stiff								
26	47.3	MCA		8										
27	46.3													
28	45.3													
29	44.3													
30	43.3													
31	42.3													
32	41.3													
33	40.3													
34	39.3													
35	38.3													
36	37.3													
37	36.3													
38	35.3													
39	34.3													
40	33.3													
41	32.3													
42	31.3													
43	30.3													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-28

Sheet 1 of 2

BORING LOCATION: See Figure 6

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/1/2011 **DATE FINISHED:** 8/1/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 71.4 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 8.0 **GW DATE:** 8/1/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	70.4	SPT		13	CH	CLAY (CH) dark brown, stiff, dry, oranics, shells, and trace gravels up to 1" in diameter in upper 3"	13.3							
2	69.4				CH	CLAY (CH) dark brown, stiff, moist								
3	68.4					CLAY WITH SAND (CL) light gray to olive gray, hard, moist, red staining								
4	67.4													
5	66.4													
6	65.4	MCA		59	CL		32.9	91						
7	64.4													
8	63.4					CLAY WITH SAND (CL) olive to light brown, very stiff, wet								
9	62.4													
10	61.4													
11	60.4	SPT		17					82.4					
12	59.4													
13	58.4													
14	57.4													
15	56.4					as above, light brown, hard								
16	55.4	MCA		35	CL		28.8	97						
17	54.4													
18	53.4													
19	52.4													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-29

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	50.4	SPT		34	 CL	CLAY WITH SAND (CL) (Con't) brown, with white mottling								
22	49.4													
23	48.4					CLAY WITH SAND (CL) brown, stiff, wet, fine grained sand								
24	47.4													
25	46.4			15					82.9					
26	45.4	MCA												
27	44.4													
28	43.4					as above, olive to brown								
29	42.4													
30	41.4			10					83.0					
31	40.4	SPT												
32	39.4													
33	38.4													
34	37.4													
35	36.4													
36	35.4													
37	34.4													
38	33.4													
39	32.4													
40	31.4													
41	30.4													
42	29.4													
43	28.4													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-29

Sheet 1 of 2

BORING LOCATION: See Figure 6

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/2/2011 **DATE FINISHED:** 8/2/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 72.2 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 5.5 **GW DATE:** 8/2/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	71.2	SPT		14	CL	SANDY CLAY (CL) brown to olive gray, stiff, dry to moist, trace organics, fine grained sand								
2	70.2					SANDY CLAY (CL) olive to olive gray, very stiff, moist to wet								
3	69.2													
4	68.2													
5	67.2					olive to olive gray, very stiff								
6	66.2	MCA		27	CL		26.5	95		TXUU		1.9		
7	65.2													
8	64.2													
9	63.2													
10	62.2					SANDY SILT (ML) olive to olive gray, stiff, wet, with white mottling								
11	61.2	SPT		14	ML				56.4				37	11
12	60.2													
13	59.2					CLAY (CL) olive to brown, hard, wet								
14	58.2													
15	57.2													
16	56.2	MCA		40			16.2	115		TXUU		3.9		
17	55.2													
18	54.2													
19	53.2													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00

Figure:
A-30

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	51.2	SPT		48	 CL	CLAY (CL) (Con't) brown, wet	33.3	87						
22	50.2													
23	49.2													
24	48.2													
25	47.2			17		as above, olive to brown, very stiff								
26	46.2	MCA												
27	45.2													
28	44.2													
29	43.2													
30	42.2			20										
31	41.2	SPT												
32	40.2													
33	39.2													
34	38.2													
35	37.2													
36	36.2													
37	35.2													
38	34.2													
39	33.2													
40	32.2													
41	31.2													
42	30.2													
43	29.2													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDERS & ASSOCIATES GEOSTRUCTURAL ENGINEERING



INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-30

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-30

Sheet 1 of 2

BORING LOCATION: See Figure 7

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 7/25/2011 **DATE FINISHED:** 7/25/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 87.8 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 8.0 **GW DATE:** 7/25/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT, Bulk, ST

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	86.8	SPT	▲	5	CL	SANDY CLAY (CL) light brown to gray, medium stiff, dry, trace clam shells Gradation: 38.8% sand, 0.8% gravel, 60.4% <#200			60.4				32	15
2	85.8													
3	84.8													
4	83.8					CLAY (CH) dark gray to black, very soft, moist to wet, highly plastic								
5	82.8													
6	81.8	MCA	○	2	CH									
7	80.8													
8	79.8	BULK	⊗											
9	78.8													
10	77.8					SILT (MH) gray, soft, wet, as above, gray								
11	76.8	SPT	▲	3	MH									
12	75.8					Consolidation: See Appendix B								
13	74.8	ST		250 psi			31.7	87					62	20
14	73.8													
15	72.8					CLAY (CL) yellow brown to blue, stiff, wet								
16	71.8	SPT	▲	8			29.4							
17	70.8													
18	69.8													
19	68.8													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDERS & ASSOCIATES' GEOSTRUCTURAL ENGINEERING
SAGE
INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-31

LOG OF BORING - 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-30

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	66.8	SPT		25	CL	CLAY (CL) (Con't) brown to olive gray, very stiff, trace organics (rootlets)								
22	65.8													
23	64.8													
24	63.8													
25	62.8					as above, hard								
26	61.8	MCA		52			25.6	93						
27	60.8													
28	59.8													
29	58.8					CLAY WITH SAND (CL) brown, hard, wet, fine grained sand								
30	57.8				CL									
31	56.8	SPT		47										
32	55.8													
33	54.8													
34	53.8													
35	52.8													
36	51.8													
37	50.8													
38	49.8													
39	48.8													
40	47.8													
41	46.8													
42	45.8													
43	44.8													

Boring terminated at a depth of 31.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA**LOG OF BORING SB-31**

Sheet 1 of 2

BORING LOCATION: See Figure 7**DRILLING SUBCONTRACTOR:** RSI Drilling**DATE STARTED:** 8/3/2011**DATE FINISHED:** 8/3/2011**DRILL RIG:** CME 75**LOGGED BY:** R. Abernathy**DRILLING METHOD:****ELEVATION (FT):** 87.4**DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 7.5**GW DATE:** 8/3/2011**HAMMER TYPE:** Automatic**CASING NOTES:** N/A**HAMMER WT (LBS):** 140**HAMMER DROP (IN):** 30**BACKFILL MATERIAL:** Neat Cement Grout**SAMPLERS:** MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	86.4	SPT		16		SANDY CLAY (CL) brown to dark brown, very stiff, dry to moist, fine grained sand, 1" lens of coarse sand and some gravel at 6"								
2	85.4				CL									
3	84.4													
4	83.4					CLAY WITH GRAVEL (CL) brown, very stiff, dry to moist, approximately 15% fine gravel								
5	82.4													
6	81.4	MCA		26	CL		30.6	90						
7	80.4													
8	79.4					SAND (SP) gray, medium dense, wet, fine grained sand								
9	78.4													
10	77.4				SP									
11	76.4	SPT		16										
12	75.4				ML	SILT (ML) brown, very stiff, wet								
13	74.4													
14	73.4					SANDY CLAY (CL) gray, hard, wet, fine grained sand								
15	72.4				CL	Gradation: 39.4% sand, 60.6% <#200 Permeability: 1.30x10 ⁻⁷ cm/sec	18.6	111	60.6				25	9
16	71.4	MCA		54		CLAY (CL) brown, hard, wet								
17	70.4				CL									
18	69.4					SANDY CLAY (CL) brown, hard, wet, increased silt content at 21', fine grained sand								
19	68.4													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00**Figure:**
A-32

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-31

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA						
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY
21	66.4	SPT		56	CL	SANDY CLAY (CL) (Con't)							
22	65.4												
23	64.4												
24	63.4												
25	62.4				CL	CLAY (CL) olive gray to brown, hard, wet, white mottling							
26	61.4	MCA		32									
27	60.4												
28	59.4												
29	58.4												
30	57.4												
31	56.4												
32	55.4												
33	54.4												
34	53.4												
35	52.4												
36	51.4												
37	50.4												
38	49.4												
39	48.4												
40	47.4												
41	46.4												
42	45.4												
43	44.4												

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-32

Sheet 1 of 2

BORING LOCATION: See Figure 7

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/3/2011 **DATE FINISHED:** 8/3/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 88.5 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 8.0 **GW DATE:** 8/3/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	87.5	SPT		5		CLAY (CL) brown to dark brown, medium stiff, dry to moist	24.2							
2	86.5				CL									
3	85.5													
4	84.5													
5	83.5					CLAY (CH) dark brown, medium stiff to stiff, moist								
6	82.5	MCA		7	CH	Swell/Compression: 0.1% compression	23.4 25.9	102 97		TXUU		1.3	53	36
7	81.5													
8	80.5					SANDY SILT (ML) olive, very stiff to hard, wet, fine grained sand								
9	79.5													
10	78.5													
11	77.5	SPT		31	ML		29.5						NV	NP
12	76.5													
13	75.5					as above, brown gray, medium stiff to very stiff								
14	74.5													
15	73.5													
16	72.5	MCA		27		CLAY WITH SAND (CL) olive, very stiff, wet	34.2	88	82.4					
17	71.5													
18	70.5													
19	69.5													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-32

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	67.5	SPT		30	CL	CLAY WITH SAND (CL) (Con't) brown mottling								
22	66.5													
23	65.5													
24	64.5													
25	63.5					as above, olive gray with brown mottling								
26	62.5	MCA		19										
27	61.5													
28	60.5													
29	59.5													
30	58.5													
31	57.5													
32	56.5													
33	55.5													
34	54.5													
35	53.5													
36	52.5													
37	51.5													
38	50.5													
39	49.5													
40	48.5													
41	47.5													
42	46.5													
43	45.5													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.



Project No:
10-066.00

Figure:
A-33

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-33

Sheet 1 of 3

BORING LOCATION: See Figure 7

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/3/2011 **DATE FINISHED:** 8/3/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:
6-inch hollow stem auger

ELEVATION (FT): 88.4 **DATUM:** NAVD88

GW DEPTH (FT): 6.5 **GW DATE:** 8/3/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	87.4	SPT		13		CLAY WITH SAND (CL) brown, stiff to medium stiff, dry to moist, gravels up to 3/4" in diameter							35	17
2	86.4				CL									
3	85.4													
4	84.4													
5	83.4					CLAY (CL) brown, soft, dry to moist, gravel up to 1" in diameter Swell/Compression: 0.5% Compression	36.7	84		TXUU		0.3		
6	82.4	MCA		3			31.9	88						
7	81.4				CL									
8	80.4													
9	79.4					CLAY (CL) olive, hard, wet								
10	78.4													
11	77.4	SPT		55	CL									
12	76.4													
13	75.4					SAND (SP) gray, dense, wet, fine to medium grained								
14	74.4													
15	73.4													
16	72.4	SPT		38	SP									
17	71.4													
18	70.4													
19	69.4													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
21	67.4	MCA		22		SAND (SP) (Con't)								
22	66.4					CLAY (CL) brown, very stiff, wet	28.5	91						
23	65.4													
24	64.4													
25	63.4													
26	62.4	SPT		17										
27	61.4													
28	60.4													
29	59.4					SILTY SAND (SM) olive, dense, wet, fine grained sand, with some clay								
30	58.4													
31	57.4	MCA		44			20.1	110	41.7					
32	56.4													
33	55.4													
34	54.4					SANDY CLAY (CL) olive, hard, wet, brown mottling, fine grained sand								
35	53.4													
36	52.4	SPT		38										
37	51.4													
38	50.4					as above, olive gray, stiff								
39	49.4													
40	48.4													
41	47.4	MCA		54		CLAY WITH SAND (CL) olive brown, hard, wet, red staining, fine grained sand								
42	46.4													
43	45.4					SAND (SP)								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
44	44.4				SP	SAND (SP) (Con't) gray, medium dense, wet, medium grained								
45	43.4													
46	42.4	SPT		38	CL	CLAY (CL) olive gray, hard, wet, red staining								
47	41.4													
48	40.4													
49	39.4				SC	CLAYEY SAND (SC) brown, medium dense, wet, fine grained sand								
50	38.4													
51	37.4	MCA		14	CL	SANDY CLAY (CL) olive, stiff, wet, fine grained sand			59.6				25	10
52	36.4													
53	35.4													
54	34.4													
55	33.4													
56	32.4													
57	31.4													
58	30.4													
59	29.4													
60	28.4													
61	27.4													
62	26.4													
63	25.4													
64	24.4													
65	23.4													
66	22.4													
Boring terminated at a depth of 51.5 feet below ground surface. MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.							SANDERS & ASSOCIATES' GEOSTRUCTURAL ENGINEERING SAGE INTEGRATING EARTH & STRUCTURE Project No: 10-066.00 Figure: A-34							

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-34

Sheet 1 of 3

BORING LOCATION: See Figure 7

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/2/2011 **DATE FINISHED:** 8/2/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 87.6 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 13.0 **GW DATE:** 8/2/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT, Bulk

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	86.6	SPT	▲	10	CL	CLAY WITH SAND (CL) brown, stiff, dry to moist, gravels up to 1" in diameter	10.6							
2	85.6													
3	84.6	BULK				R Value: 19								
4	83.6					CLAY (CL) dark brown, stiff, moist								
5	82.6													
6	81.6	MCA	■	10	CL		18.9	110		TXUU		2		
7	80.6													
8	79.6					SILT WITH SAND (ML) brown, hard, moist								
9	78.6													
10	77.6													
11	76.6	SPT	▲	34	ML								NV	NP
12	75.6													
13	74.6													
14	73.6					SANDY SILT (ML) brown, very stiff, wet								
15	72.6													
16	71.6	MCA	■	63	SP-SM	SAND WITH SILT (SP-SM) olive, very dense, wet, fine to medium grained Gradation: 91.7% sand, 8.3% <#200	20.0	111	8.3					
17	70.6													
18	69.6					CLAY WITH SAND (CL) brown, hard, wet, fine grained sand								
19	68.6													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDERS & ASSOCIATES GEOSTRUCTURAL ENGINEERING
SAGE
INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-35

LOG OF BORING - 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	66.6	SPT		33	CL	CLAY WITH SAND (CL) (Con't)								
22	65.6													
23	64.6					CLAY (CL) brown, very stiff, wet								
24	63.6													
25	62.6													
26	61.6	MCA		26	CL									
27	60.6													
28	59.6					SANDY CLAY (CL) brown, very stiff, wet, fine grained sand								
29	58.6													
30	57.6													
31	56.6	SPT		18	CL									
32	55.6													
33	54.6					SILTY SAND (SM) olive, medium dense, wet, fine grained sand								
34	53.6													
35	52.6													
36	51.6	MCA		16	SM				22.7					
37	50.6													
38	49.6					CLAY (CL) olive, very stiff, wet								
39	48.6													
40	47.6													
41	46.6	SPT		25										
42	45.6													
43	44.6													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
44	43.6	MCA		48		CLAY (CL) (Con't)								
45	42.6					as above, gray, hard								
46	41.6													
47	40.6													
48	39.6	SPT		25		as above, olive to brown, very stiff								
49	38.6													
50	37.6													
51	36.6													
52	35.6													
53	34.6													
54	33.6													
55	32.6													
56	31.6													
57	30.6													
58	29.6													
59	28.6													
60	27.6													
61	26.6													
62	25.6													
63	24.6													
64	23.6													
65	22.6													
66	21.6													

Boring terminated at a depth of 51.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDLITS & ASSOCIATES' GEOTECHNICAL ENGINEERING

SAGE

INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-35

LOG OF BORING 10-066.00 BORING LOGS V.3.GPJ SAGE.GDT 11/8/11

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA**LOG OF BORING SB-38**

Sheet 1 of 2

BORING LOCATION: See Figure 8**DRILLING SUBCONTRACTOR:** RSI Drilling**DATE STARTED:** 8/5/2011**DATE FINISHED:** 8/5/2011**DRILL RIG:** CME 75**LOGGED BY:** R. Abernathy**DRILLING METHOD:**

6-inch hollow stem auger

ELEVATION (FT): 81.3**DATUM:** NAVD88**GW DEPTH (FT):** 5.0**GW DATE:** 8/5/2011**HAMMER TYPE:** Automatic**CASING NOTES:** N/A**HAMMER WT (LBS):** 140**HAMMER DROP (IN):** 30**BACKFILL MATERIAL:** Neat Cement Grout**SAMPLERS:** MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	80.3	SPT		3	CH	CLAY (CH) dark brown, soft, dry to moist, high plasticity								
2	79.3				CH	CLAY (CH) dark brown, stiff, moist								
3	78.3													
4	77.3				CL	CLAY WITH SAND (CL) dark brown, very stiff, moist to wet, fine grained sand								
5	76.3													
6	75.3	MCA		26	ML	SILT (ML) olive, very stiff, wet, brown mottling, some clay Permeability: 4.56x10 ⁻⁵ cm/sec	36.4 37.6	81 83	91.6				32	3
7	74.3													
8	73.3													
9	72.3				CL	CLAY (CL) olive gray, very stiff, wet								
10	71.3													
11	70.3	SPT		27	ML	SILT WITH CLAY (ML) olive gray, very stiff, wet, brown mottling	36.8		91.1				36	12
12	69.3													
13	68.3													
14	67.3													
15	66.3													
16	65.3	MCA		14	CL	CLAY (CL) light gray, hard, wet	36.3	82		TXUU		4.6		
17	64.3													
18	63.3													
19	62.3													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-38

Sheet 2 of 2

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	60.3	SPT		20		CLAY (CL) (Con't) olive, very stiff								
22	59.3													
23	58.3													
24	57.3													
25	56.3					as above, brown, hard								
26	55.3	MCA		31										
27	54.3													
28	53.3													
29	52.3													
30	51.3													
31	50.3													
32	49.3													
33	48.3													
34	47.3													
35	46.3													
36	45.3													
37	44.3													
38	43.3													
39	42.3													
40	41.3													
41	40.3													
42	39.3													
43	38.3													

Boring terminated at a depth of 26.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING SB-39

Sheet 1 of 2

BORING LOCATION: See Figure 8

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/4/2011 **DATE FINISHED:** 8/4/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 81.2 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 7.0 **GW DATE:** 8/4/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140 **HAMMER DROP (IN):** 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	80.2	SPT		10		SANDY CLAY (CL) dark brown gray, stiff, dry to moist, some fine gravels 0 to 3"								
2	79.2				CL									
3	78.2													
4	77.2													
5	76.2					SANDY CLAY (CL) olive, soft, moist to wet, fine grained sand								
6	75.2	MCA		3	CL	Swell/Compression: 0% swell	34.0	85					26	11
7	74.2													
8	73.2													
9	72.2				SC	CLAYEY SAND (SC) gray, medium dense, wet								
10	71.2													
11	70.2	SPT		31					23.6					
12	69.2					SAND WITH GRAVEL (SP) Gradation: 70.2% sand, 27.0% gravel, 2.8% <#200 gray, dense, wet, medium grained sand								
13	68.2													
14	67.2													
15	66.2				SP									
16	65.2	MCA		34		Gradation: 63.5% sand, 36.3% gravel, 0.2% <#200	6.8	121						
17	64.2													
18	63.2													
19	62.2				SP	SILTY SAND (SP-SM) olive, medium dense, wet, varying fines								

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	60.2	SPT		16	SM	SILTY SAND (SP-SM) (Con't)								
22	59.2				CL	CLAY (CL) olive, very stiff, wet								
23	58.2													
24	57.2					SANDY CLAY (CL) brown, stiff, wet								
25	56.2													
26	55.2	MCA		10	CL									
27	54.2													
28	53.2					SAND WITH CLAY (SP-SC) olive, loose, wet, fine grained								
29	52.2				SP-SC									
30	51.2													
31	50.2	SPT		12	CL-ML	SANDY SILTY CLAY (CL-ML) olive, stiff, wet, fine grained sand			55.8				24	6
32	49.2				CL-ML									
33	48.2					SAND (SP) gray, medium dense, wet, fine to medium grained								
34	47.2				SP									
35	46.2													
36	45.2	MCA		28	CL	SANDY CLAY (CL) brown, very stiff, wet, fine grained sand								
37	44.2													
38	43.2				CL									
39	42.2					SANDY SILT WITH CLAY (ML) olive to olive gray, hard, wet, fine grained sand								
40	41.2				ML									
41	40.2	SPT		31										
42	39.2													
43	38.2													

Boring terminated at a depth of 41.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

SANDLITS & ASSOCIATES GEOSTRUCTURAL ENGINEERING

SAGE

INTEGRATING EARTH & STRUCTURE

Project No:
10-066.00

Figure:
A-37

Boring terminated at a depth of 41.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA**LOG OF BORING SB-40**

Sheet 1 of 2

BORING LOCATION: See Figure 8**DRILLING SUBCONTRACTOR:** RSI Drilling**DATE STARTED:** 8/4/2011 **DATE FINISHED:** 8/4/2011**DRILL RIG:** CME 75**LOGGED BY:** R. Abernathy**DRILLING METHOD:****ELEVATION (FT):** 80.2 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 12.0 **GW DATE:** 8/4/2011**HAMMER TYPE:** Automatic**CASING NOTES:** N/A**HAMMER WT (LBS):** 140 **HAMMER DROP (IN):** 30**BACKFILL MATERIAL:** Neat Cement Grout**SAMPLERS:** MCA, SPT, Bulk

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
1	79.2	SPT		10	CH	CLAY (CH) dark brown, stiff, dry to moist, highly plastic, some gravels and organics in upper 6"								
2	78.2	BULK				R Value: <5								
3	77.2					CLAY (CL) olive to olive gray, very stiff, moist, increased silt content with depth								
4	76.2													
5	75.2	MCA		21	CL		30.8	91		TXUU		1.2		
6	74.2													
7	73.2													
8	72.2					SILTY SAND (SM) olive, medium dense, moist								
9	71.2													
10	70.2	SPT		17	SM									
11	69.2													
12	68.2					CLAY (CL) olive, stiff, moist to wet, brown mottling								
13	67.2													
14	66.2					SANDY CLAY (CL) olive gray, very stiff, wet, fine grained sand								
15	65.2	MCA		23	CL		31.4	93	66.3					
16	64.2													
17	63.2													
18	62.2					CLAY (CL) olive gray, stiff, wet								
19	61.2													

MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

Project No:
10-066.00**Figure:**
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DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
													LL	PI
21	59.2	SPT		13	CL	CLAY (CL) (Con't)								
22	58.2													
23	57.2													
24	56.2					SILT (ML) brown, very stiff, wet								
25	55.2													
26	54.2	MCA		23	ML		30.2	94						
27	53.2													
28	52.2													
29	51.2					SILTY SAND (SM) olive, loose, wet, fine grained sand								
30	50.2								25.2					
31	49.2	SPT		12	SP	SAND (SP) gray, medium dense, wet, fine grained								
32	48.2													
33	47.2													
34	46.2													
35	45.2													
36	44.2	MCA		43	CL	SANDY CLAY (CL) brown, hard, wet, fine grained sand								
37	43.2													
38	42.2													
39	41.2					SILTY SAND (SM) gray to brown, dense, wet, fine grained sand								
40	40.2													
41	39.2	SPT		31	SM									
42	38.2													
43	37.2													

Boring terminated at a depth of 41.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING TRA2

Sheet 1 of 1

BORING LOCATION: See Figure 7

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/3/2011

DATE FINISHED: 8/3/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

6-inch hollow stem auger

ELEVATION (FT): 88.4

DATUM: NAVD88

GW DEPTH (FT): 9.0

GW DATE: 8/3/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA										
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY				
													LL	PI			
1	87.4				CL	CLAY (CL) dark brown, very soft, dry to moist											
2	86.4																
3	85.4																
4	84.4	SPT		2	CL	CLAY (CL) dark brown, soft, moist	18.7								30	15	
5	83.4																
6	82.4					SILT (ML) brown, stiff, moist to wet											
7	81.4				ML	Gradation: 4.8% sand, 90.4% silt, 4.8% clay Permeability: 3.61x10-6 cm/sec			95.2								
8	80.4	MCA		12			34.1	87									
9	79.4																
10	78.4					very stiff, wet, transitions from sandy to clayey between 10' and 11.5'											
11	77.4	SPT		22													
12	76.4																
13	75.4																
14	74.4																
15	73.4																
16	72.4																
17	71.4																
18	70.4																
19	69.4																

Boring terminated at a depth of 13.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING TRA4

Sheet 1 of 1

BORING LOCATION: See Figure 8

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/10/2011 **DATE FINISHED:** 8/10/2011

DRILL RIG: CME 75

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 90.3 **DATUM:** NAVD88

6-inch hollow stem auger

GW DEPTH (FT): 11.5 **GW DATE:** 8/10/2011

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	89.3					CLAY (CL) light brown, medium stiff, dry to moist								
2	88.3				CL									
3	87.3													
4	86.3	SPT		5										
5	85.3				CL	CLAY (CL) brown, medium stiff, moist								
6	84.3													
7	83.3					SANDY SILT (ML) brown, stiff, moist Gradation: 20.9% sand, 51.6% silt, 27.5% clay Permeability: 7.27x10-9 cm/sec			79.1					
8	82.3	MCA		10			16.5	116						
9	81.3													
10	80.3				ML									
11	79.3	SPT		18		as above, olive gray, wet								
12	78.3													
13	77.3													
14	76.3													
15	75.3													
16	74.3													
17	73.3													
18	72.3													
19	71.3													

Boring terminated at a depth of 13.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.

PROJECT: Gray Lodge Wildlife Area Water Supply Project
Butte County, CA

LOG OF BORING TRA6

Sheet 1 of 1

BORING LOCATION: See Figure 8

DRILLING SUBCONTRACTOR: RSI Drilling

DATE STARTED: 8/5/2011

DATE FINISHED: 8/5/2011

DRILL RIG: Geoprobe 6620DT

LOGGED BY: R. Abernathy

DRILLING METHOD:

ELEVATION (FT): 81.7

DATUM: NAVD88

6-inch hollow stem auger

GW DEPTH (FT): N/A

GW DATE: N/A

HAMMER TYPE: Automatic

CASING NOTES: N/A

HAMMER WT (LBS): 140

HAMMER DROP (IN): 30

BACKFILL MATERIAL: Neat Cement Grout

SAMPLERS: MCA, SPT

DEPTH (FT)	ELEV. (FT)	SAMPLE TYPE	SAMPLE	SPT N60 VALUE	LITHOLOGY	DESCRIPTION	LABORATORY TEST DATA							
							MOISTURE CONTENT (%)	DRY DENSITY (pcf)	FINES (%)	TYPE of TEST	UNCONFINED STRENGTH (tsf)	SHEAR STRENGTH (ksf)	PLASTICITY	
1	80.7				CL	CLAY (CL) dark brown, stiff, dry to moist							LL	PI
2	79.7													
3	78.7					CLAY (CL) dark brown, stiff, moist								
4	77.7	SPT		8	CL		23.1		75.5					
5	76.7													
6	75.7													
7	74.7					SANDY SILT (ML) olive, very stiff, moist, with brown mottling								
8	73.7	MCA		18		Gradation: 0.1% gravel, 24.4% sand, 54.9% silt, 20.6% clay Permeability: 1.16x10 ⁻⁵ cm/sec	32.8	89						
9	72.7													
10	71.7				ML									
11	70.7	SPT		20		as above, olive gray								
12	69.7													
13	68.7													
14	67.7													
15	66.7													
16	65.7													
17	64.7													
18	63.7													
19	62.7													

Boring terminated at a depth of 13.5 feet below ground surface.
MCA, CA, and SPT blow counts converted to SPT N60 values using conversion factors of 0.85, 1.1, and 1.3, respectively.