May 9, 2012 Project #: 123-84274

Ameren Services
One Ameren Plaza
1901 Chouteau Avenue
St. Louis, Missouri 63103

RE: REPORT ON PIEZOMETER INSTALLATION, WATER LEVEL MONITORING, AND GROUNDWATER SAMPLING
LABADIE, MISSOURI

Golder Associates Inc. (Golder) is pleased to submit this letter report summarizing drilling and piezometer installation south of the Ameren Missouri (Ameren) Labadie Power Plant facility in Franklin County, Missouri. This letter summarizes piezometer installation, groundwater sampling methods, water level monitoring methods, and laboratory analyses of the groundwater samples collected during April 2012. A tabulated summary of the periodic water level data collected to date is provided in Table 1. Laboratory analytical results are summarized in Table 2. The site layout and piezometer locations are shown on Figure 1 with the groundwater potentiometric surface map. Borehole logs are provided as Attachment A. Piezometer construction forms are provided as Attachment B. Attachment C contains copies of the MDNR Well Registration Forms and receipt confirmation from the MDNR Wellhead Protection Program.

1.0 PROJECT SCOPE OF WORK

Our scope of work included the following:

- Drill and install three new groundwater piezometers
- Develop and sample the three new groundwater piezometers
- Survey the ground surface and casing elevations of the new piezometers
- Install electronic instruments in the new piezometers for periodic water level measurements
- Tabulate sampling results and prepare a summary report

2.0 DRILLING, PIEZOMETER INSTALLATION, AND DEVELOPMENT

Three new groundwater piezometers were installed based on the January 24, 2012 map of proposed locations provided by Ameren in the Preliminary Work Plan. Roberts Environmental Drilling, Inc. performed the drilling and piezometer installation under the direct supervision of Golder. The new piezometers were installed with open or screened intervals in bedrock at similar depths to nearby residential water wells in general accordance with Missouri Department of Natural Resources (MDNR) Well Construction Rules (10 CSR 23-4.060 Construction Standards for Monitoring Wells). New piezometers were installed using air rotary drilling methods. Geologic borehole logs and piezometer construction logs were prepared for each new piezometer installation and are included as Attachments A and B. Two of the new piezometers (TGP-A and TGP-B) were constructed of two-inch diameter, schedule 80 polyvinyl chloride (PVC) riser pipe with 0.01-inch machine slotted PVC screen. The screened portion was constructed with a sand pack consisting of environmental silica sand. A bentonite seal was placed in the annulus above the sand pack and extended up to two feet below ground surface to

Golder Associates Inc.
820 S. Main Street, Suite 100
St. Charles, MO 63301 USA
Tel: (636) 724-9191 Fax: (636) 724-9323 www.golder.com

form a well seal. A small concrete surface pad and protective steel cover extends down to the top of the bentonite seal. The riser extends to approximately three feet above ground surface to facilitate groundwater sampling. The third piezometer (TGP-C) was constructed as a six-inch open-hole completion in bedrock with six-inch steel surface casing extending to 95 feet below ground surface. The surface casing was grouted into bedrock using a cement bentonite grout to form a seal above the open-hole interval. A small concrete surface pad and flush-mount protective steel cover extend down to the top of the grouted casing seal.

Zahner & Associates, Inc. provided professional land survey of the three new piezometers. Surveyed piezometer coordinates and elevations are located on monitoring well construction logs in Attachment B.

New piezometers were developed using surging and purging techniques. A stainless steel bailer was lowered into each piezometer and used to surge and remove drilling sediment from the bottom of each installation. A submersible electric pump with polyethylene tubing was lowered into each piezometer and at least three well-bore volumes of groundwater were removed. Development was deemed complete when at least three consecutive readings of field parameters (pH, turbidity, conductivity, and temperature) were within 10% of previous measurements.

3.0 WATER LEVEL MONITORING

Following development, Golder installed electronic instruments in each piezometer for the purpose of periodic (daily) water level measurements. An In-Situ Inc. Level Troll 500 device with vented cable was installed in each piezometer for this purpose. The devices electronically measure water column pressures (piezometric head) and record the data in on-board dataloggers at the selected intervals. The water level data was then retrieved from the surface using a readout device and downloaded to a computer for tabulation. Golder manually measured water levels in each piezometer when the instrument data was retrieved. A tabulated summary of daily water level data collected to date is provided in Table 1. Table 1 will be regularly updated during the monitoring period. Figure 1 provides a groundwater potentiometric surface map showing the gradient and direction of groundwater flow using the surveyed piezometer coordinates and elevations and the most recent water level data. Figure 1 shows that the groundwater flow direction observed in these three piezometers is from the southeast to the northwest, towards the Missouri River.

4.0 GROUNDWATER SAMPLING AND ANALYTICAL RESULTS

After the piezometers equilibrated for a minimum one month period following development, groundwater samples were collected from each piezometer. Samples were collected after three well-bore volumes had again been purged from each piezometer using a submersible electric pump with dedicated polyethylene tubing. Field parameters including pH, conductivity, temperature, and turbidity were measured and recorded during purging and sampling.

After three well-bore volumes were removed and three consecutive sets of field parameter measurements were stabilized within 10% of previous measurements for conductivity and temperature and within 0.1 for pH, groundwater samples were collected and submitted to Test America - Chicago for total metals analysis using USEPA Method 6010B, anions analysis using USEPA Method 9056, and mercury analysis using USEPA Method 7470A. The samples were analyzed for boron, an indicator constituent for leachate from coal combustion products, and inorganic constituents that have regulatory standards for protection of drinking water supplies specified in Table A of 10 CSR 20-7.031.

Groundwater sampled for analysis was collected into laboratory-supplied containers directly from the pump tubing discharge. One duplicate groundwater sample was collected from one of the piezometers for quality assurance/quality control (QA/QC) purposes. One equipment rinsate blank was collected from the submersible sampling pump using laboratory grade de-ionized water and analyzed at the laboratory. After collection in the field, groundwater samples were labeled with the sample identification number,

requested analysis, collection date, and sampler's initials, and placed on ice in a cooler for shipment under chain-of-custody protocol via overnight transport to the Test America – Chicago Laboratory.

Analytical results for groundwater are summarized below and tabulated in Table 2. Boron concentrations were below detection limits in all three samples, suggesting that groundwater at the three monitoring points is not affected by leachate from coal combustion products. Other metal constituents and anions were detected; however, concentrations of the other constituents were lower than both the Missouri and federal drinking water standards. It is not uncommon to detect low levels of inorganic constituents in uncontaminated groundwater samples because these elements are often naturally present in the soils and rocks that are in contact with the groundwater.

Several analytical results are qualified with a B, J, or ^ data flags. The B flag indicates that the constituent was detected in a laboratory blank, and therefore the analytical result may be biased high. Since all results were low and below drinking water standards, any such bias was minimal and does not significantly affect interpretation of the results. The J flag indicates that the constituent was detected at a very low level, in a range where the precision of the laboratory instruments is low, and therefore the reported concentration is qualified as estimated. Again, this does not adversely affect the interpretation because all results were lower than the drinking water standards. The ^ flag indicates that the laboratory interference check was slightly above acceptance limits; however, all of the results for the affected constituents were non-detect, so there was no relevant bias affecting results.

5.0 CLOSING

Golder appreciates the opportunity to serve as your consultant on this project. If you have any questions concerning this letter report or need additional information, please contact the undersigned at 636-724-9191.

Sincerely,

GOLDER ASSOCIATES INC.

Michael Dreyer, E.I.T.
Staff Engineer

Mark N. Haddock, R.G., P.E.
Senior Engineer
Associate

Mark R. Sandfort, P.E.
Senior Consultant
Principal

Attachments:
Table 1 – Record of Water Level Readings
Table 2 – Summary of Groundwater Analytical Results
Figure 1 – Groundwater Potentiometric Surface Map
Attachment A – Borehole Logs
Attachment B – Well Construction Logs
Attachment C – MDNR Well Registration Forms and Receipt Confirmation

MWD/MNH

TABLES

TABLE 1: RECORD OF WATER LEVEL READINGS

Ameren, Labadie MO Hydrogeology Study

Labadie, MO

	TGP-A		TGP-B		TGP-C	
Ground Surface Elevation (ft MSL)* NAVD 88	479.78		491.27		612.23	
Top of Casing Elevation (ft MSL)* NAVD 88	482.32		494.62		611.5	
Date	**Water Level (ft BTOC)**	**Water Elevation (ft MSL)**	**Water Level (ft BTOC)**	**Water Elevation (ft MSL)**	**Water Level (ft BTOC)**	**Water Elevation (ft MSL)**
3/17/2012	21.60	460.72	28.24	466.38	114.23	497.27
3/18/2012	21.31	461.01	28.00	466.62	114.10	497.40
3/19/2012	20.91	461.41	27.64	466.98	114.04	497.46
3/20/2012	20.77	461.55	27.35	467.27	113.89	497.61
3/21/2012	20.78	461.55	27.31	467.31	113.63	497.87
3/22/2012	20.77	461.55	27.29	467.33	113.63	497.87
3/23/2012	20.51	461.81	27.23	467.39	113.63	497.87
3/24/2012	20.08	462.24	27.04	467.58	113.34	498.16
3/25/2012	19.62	462.70	26.95	467.67	113.50	498.00
3/26/2012	19.14	463.18	26.83	467.79	113.66	497.84
3/27/2012	18.62	463.71	26.63	467.99	113.63	497.87
3/28/2012	18.33	463.99	26.42	468.20	113.41	498.09
3/29/2012	18.35	463.97	26.34	468.28	113.47	498.04
3/30/2012	18.29	464.03	26.19	468.44	113.18	498.32
3/31/2012	18.41	463.91	26.20	468.42	113.18	498.32
4/1/2012	18.31	464.01	26.14	468.48	113.33	498.17
4/2/2012	18.06	464.26	26.01	468.61	113.41	498.09
4/3/2012	18.13	464.19	26.07	468.56	113.67	497.83
4/4/2012	18.17	464.15	26.28	468.34	113.55	497.95
4/5/2012	18.10	464.22	26.02	468.60	113.48	498.03
4/6/2012	18.29	464.03	26.13	468.49	113.35	498.15
4/7/2012	18.40	463.92	26.14	468.48	113.42	498.08
4/8/2012	18.53	463.79	26.20	468.42	113.40	498.10
4/9/2012	18.58	463.74	26.12	468.50	113.45	498.05
4/10/2012	18.58	463.74	26.13	468.49	113.57	497.93
4/11/2012	18.71	463.62	26.27	468.35	113.56	497.94
4/12/2012	18.80	463.52	26.38	468.25	113.87	497.63

Notes:

* - Survey performed by Zahner & Associates, 3-5-12 and 3-6-12

BTOC - Below the Top of Casing (water level depth)

MSL - Elevation in feet above Mean Sea Level

Prepared By: MWD Date: 4/19/2012

Checked By: ALD Date: 4/20/2012

Reviewed By: MNH Date: 5/8/2012

Table 2
Summary of Groundwater Analytical Results
Ameren, Labadie MO

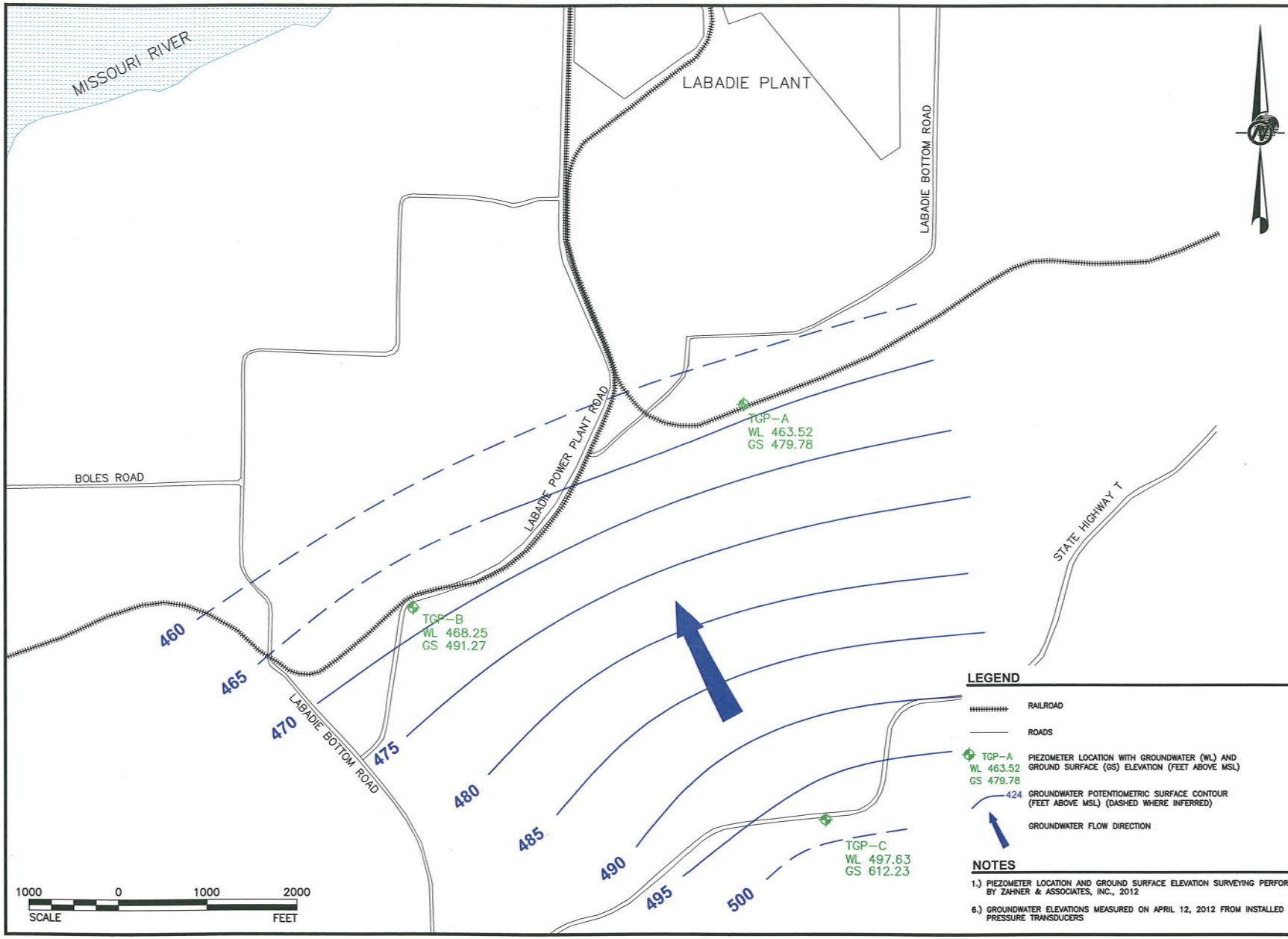
		Missouri Drinking Water Supply (DWS) Standard[1]	US EPA Federal Maximum Contaminant Level (MCL)[2]	TGP-A	MDL	TGP-B	MDL	TGP-C	MDL	DUP-1	MDL	RB-1	MDL
Sample Date				4/12/12		4/13/12		4/12/12		4/12/12		4/13/12	
Sample Time				17:05		11:35		15:00		0:00		12:00	
Total Metals (SW846 Method 6010B)													
Analyte	**CAS No.**	mg/L	mg/L	mg/L		mg/L		mg/L		mg/L		mg/L	
Antimony	7440-36-0	0.006	0.006	< 0.0026	0.0026	**0.0026 J**	0.0026	< 0.0026	0.0026	< 0.0026	0.0026	< 0.0026	0.0026
Arsenic	7440-38-2	0.05	0.01	< 0.0024	0.0024	< 0.0024	0.0024	< 0.0024	0.0024	< 0.0024	0.0024	< 0.0024	0.0024
Barium	7440-39-3	2.0	2.0	**0.21 B**	0.00044	**0.10 B**	0.00044	**0.15 B**	0.00044	**0.22 B**	0.00044	**0.0028 JB**	0.00044
Beryllium	7440-41-7	0.004	0.004	< 0.00044	0.00044	< 0.00044	0.00044	< 0.00044	0.00044	< 0.00044	0.00044	< 0.00044	0.00044
Boron	7440-42-8	No DWS[3]	No MCL[4]	< 0.024	0.024	< 0.024	0.024	< 0.024	0.024	< 0.024	0.024	< 0.024	0.024
Cadmium	7440-43-9	0.005	0.005	< 0.00054 ^	0.00054	< 0.00054 ^	0.00054	< 0.00054 ^	0.00054	< 0.00054 ^	0.00054	< 0.00054 ^	0.00054
Chromium	7440-47-3	0.1	0.1	**0.0029 J**	0.00096	**0.0025 J**	0.00096	**0.0013 J**	0.00096	**0.0034 J**	0.00096	**0.0011 J**	0.00096
Copper	7440-50-8	1.3	1.3	< 0.0011	0.0011	< 0.0011	0.0011	< 0.0011	0.0011	< 0.0011	0.0011	**0.0017 J**	0.0011
Lead	7439-92-1	0.015	0.015	**0.0031 JB**	0.0016	**0.0036 JB**	0.0016	**0.0044 JB**	0.0016	**0.0037 JB**	0.0016	**0.0020 JB**	0.0016
Nickel	7440-02-0	0.1	No MCL[4]	**0.0020 J**	0.0019	< 0.0019	0.0019	< 0.0019	0.0019	**0.0021 J**	0.0019	< 0.0019	0.0019
Selenium	7782-49-2	0.05	0.05	< 0.0027	0.0027	< 0.0027	0.0027	< 0.0027	0.0027	< 0.0027	0.0027	< 0.0027	0.0027
Silver	7440-22-4	0.05	[0.10]	< 0.0011	0.0011	< 0.0011	0.0011	< 0.0011	0.0011	< 0.0011	0.0011	< 0.0011	0.0011
Thallium	7440-28-0	0.002	0.002	< 0.0013	0.0013	< 0.0013	0.0013	< 0.0013	0.0013	< 0.0013	0.0013	< 0.0013	0.0013
Zinc	7440-66-6	5.0	[5.0]	< 0.0047	0.0047	< 0.0047	0.0047	**0.0064 J**	0.0047	< 0.0047	0.0047	**0.052**	0.0047
Anions, Ion Chromotography (SW846 Method 9056)													
Analyte	**CAS No.**	mg/L	mg/L	mg/L		mg/L		mg/L		mg/L		mg/L	
Chloride	16887-00-6	250	[250]	**5.8 B**	0.083	**29 B**	0.83	**43 B**	0.83	**5.7 B**	0.083	**0.64 B**	0.083
Fluoride	16984-48-8	4	4	**0.20**	0.029	**0.25**	0.029	**0.16 J**	0.029	**0.18 J**	0.029	< 0.029	0.029
Nitrate as N	14797-55-8	10	10	**1.3**	0.023	**7.9**	0.23	**5.0**	0.23	**1.3**	0.023	**0.28**	0.023
Sulfate	14808-79-8	250	[250]	**13**	0.90	**25**	0.90	**34**	0.90	**14**	0.90	**0.17 J**	0.090
Mercury (SW846 Method 7470A)													
Analyte	**CAS No.**	µg/L	µg/L	µg/L		µg/L		µg/L		µg/L		µg/L	
Mercury	7439-97-6	2.0	2.0	< 0.070	0.070	< 0.070	0.070	< 0.070	0.070	< 0.070	0.070	< 0.070	0.070

Notes:

1) Missouri Drinking Water Supply (DWS) Standard per 10 CSR 20-7.031 Table A
2) Federal Maximum Contaminant Level (MCL)
   - [ ] indicates that there is no MCL for the constituent, and the non-enforceable secondary MCL is displayed
3) A DWS for Boron does not exist
4) MCL or secondary MCL values for Boron and Nickel do not exist
5) The following qualifiers are used;
   - **B**, the compound was found in the blank and the sample
   - **J**, the result is less than the reporting limit (RL) but greater than or equal to the method detection limit (MDL) and the concentration is an appoximate value
   - ^, ICV, CCV, ICB, CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Insturment related QC exceeds the control limits.
6) **BOLD** values indicate a detection
7) SW846 - "Test Method for Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates
8.) mg/l = milligrams per liter
9.) µg/l = micrograms per liter

Prepared By: MWD 4/19/2012
Checked By: ALD 4/20/2012, MWD 5/8/2012
Reviewed By: MNH 5/8/2012

FIGURES



Golder Associates
St. Louis, Missouri

PROJECT
GROUNDWATER PIEZOMETER INSTALLATION
AMEREN LABADIE PIEZOMETERS
Labadie, MO

TITLE
GROUNDWATER POTENTIOMETRIC SURFACE MAP (APRIL 2012)

PROJECT No.	123-84274	
FILE No.	12384274-F01	
REV. 0	SCALE AS SHOWN	
DESIGN	MWD	04/09/12
CADD	MWD	04/20/12
CHECK	ALD	04/20/12
REVIEW	MWH	05/08/12

FIGURE
1

APPENDIX A

BOREHOLE LOGS

RECORD OF BOREHOLE TGP-A

SHEET 1 of 3

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-A

DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/27/2012
DRILL RIG: CME 75

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 988,186.35 E: 724,460.71

ELEVATION: 482.32
INCLINATION: -90

DEPTH (feet)	BORING METHOD	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
0	6 1/4" HSA	(0.0 - 0.5) Soft, brownish black (5YR 2/1), CLAYEY SILT, some organics, tree roots, moist (ML) TOPSOIL	CL-ML		481.8 / 0.5							Soil and rock type and descriptions determined from cuttings. Strength and weathering inferred from drilling. Sampling and discontinuity measurements not conducted.
		(0.5 - 10.0) Soft, dark yellowish brown (10YR 4/2), SILT, some clay, some fine to medium sand, trace fine gravel (ML), moist	ML									
10		(10.0 - 25.0) Soft, olive gray (5Y 4/1), CLAYEY SILT, little fine to medium sand (CL-ML), moist	CL-ML		472.3 / 10.0							
20												▽ Water Level 21.55 ft bgs 3/2/12 prior to development
25		(25.0 - 32.5) Firm, light brownish gray (5YR 6/1), SILTY CLAY, trace fine sand (CL), very moist	CL		457.3 / 25.0							
30		(32.5 - 36.0) Compact, moderate brown (5YR 4/4), fine to medium grained, SILTY SAND, trace fine gravel, trace organics (SM), very moist	SM		449.8 / 32.5							(32.5) Drilling penetration resistance increases
35	6" Air Rotary	(36.0 - 53.0) Slightly to moderately weathered, yellowish gray (5Y 8/1), very fine to fine crystaline, medium strong (R3), DOLOMITE, little chert (likely SMITHVILLE POWELL FORMATION)			446.3 / 36.0							(36.0) HSA refusal on top of bedrock switch to air rotary drilling
40		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: J. Crank/C. Hebel

LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-A

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-A
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/27/2012
DRILL RIG: CME 75
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 988,186.35 E: 724,460.71
ELEVATION: 482.32
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
40	6" Air Rotary	(36.0 - 53.0) Slightly to moderately weathered, yellowish gray (5Y 8/1), very fine to fine crystaline, medium strong (R3), DOLOMITE, little chert (likely SMITHVILLE POWELL FORMATION) *(Continued)*										(41.0) Stop rock drilling after roughly 5 feet. Attempt to push casing deeper to cut off flowing sands.
					437.3							
45		(45.0) Color changes to yellowish gray (5Y 8/1) and pale olive (10Y 6/2)			45.0							
50												
					429.3							
		(53.0 - 57.0) Slightly weathered, light gray (N7), very fine crystalline, medium strong (R3), DOLOMITE and yellowish gray (5Y 8/1) and grayish orange (10YR 7/4), fine to medium grained, SANDSTONE, little chert.			53.0							Unable to seal off flowing sands on top fo bedrock. Offset ~5' north, set 6" steel casing and resume.
55												
					425.3							
		(57.0 - 62.0) Slightly weathered, yellowish gray (5Y 8/1) and pale olive (10Y 6/2), very fine to fine crystalline, medium strong (R3), DOLOMITE, little chert			57.0							
60												
					421.3							
		(61.0) Very light gray (N8), solutioned limestone			61.0							
					420.3							
		(62.0 - 67.0) Mud filled void			62.0							(62.0) Stop drilling. Pump grout into mud filled void to seal mud and rock debris from falling into borehole
65												
					415.3							
		(67.0 - 105.0) Slightly to moderately weathered, yellowish gray (5Y 8/1) and pale olive (10Y 6/2), very fine to fine crystalline, medium strong (R3), DOLOMITE, some chert, little solutioned limestone			67.0							
70												
75												
					406.3							
		(76.0) Slightly weathered, little chert, trace solutioned limestone			76.0							
80												

Log continued on next page

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: J. Crank/C. Hebel
LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-A

SHEET 3 of 3

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-A

DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/27/2012
DRILL RIG: CME 75

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 988,186.35 E: 724,460.71

ELEVATION: 482.32
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
80	6" Air Rotary	(67.0 - 105.0) Slightly to moderately weathered, yellowish gray (5Y 8/1) and pale olive (10Y 6/2), very fine to fine crystalline, medium strong (R3), DOLOMITE, some chert, little solutioned limestone *(Continued)*										
85												
90												
95												
100												
105		END OF BORING AT 105 FT BGS			377.3 / 105.0							Terminate boring at 105 ft BGS, 3/1/2012 @ 1100. Install piezometer TPG-A. See monitoring well construction log TGP-A for details.
110												
115												
120												

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: J. Crank/C. Hebel

LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

GOLDER STL RECORD OF BOREHOLE MWD 12384274_AMEREN LABADIE WELLS.GPJ GLDR_CO.GDT 4/20/12

RECORD OF BOREHOLE TGP-B

SHEET 1 of 4

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-B

DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/20/2012
DRILL RIG: Ingersol Rand T3W

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 985,894.58 E: 720,699.99

ELEVATION: 494.62
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
0	6" Air Rotary	(0.0-1.0) Dense, yellowish gray (5Y 8/1), medium to coarse GRAVEL, some fine to coarse sand (GW), dry (OVERBURDEN)	GW		493.6 / 1.0							(1.0) Top of bedrock at 1.0 ft BGS
		(1.0 - 10.0) Moderately to slightly weathered, yellowish gray (5Y 8/1), very fine to fine crystalline, medium strong (R3), DOLOMITE, little chert										Soil and rock type and descriptions determined from cuttings. Strength and weathering inferred from drilling. Sampling and discontinuity measurements not conducted.
10		(10.0 - 20.0) Slightly weathered to fresh, yellowish gray (5Y 8/1) to moderate yellowish brown (10YR 5/4), very fine to fine crystalline, medium strong (R3), DOLOMITE, some chert, little sandstone			484.6 / 10.0							
20		(20.0 - 76.0) Fresh, yellowish gray (5Y 8/1) and pale olive (10Y 6/2), very fine to fine crystalline, medium strong (R3), DOLOMITE, little chert			474.6 / 20.0							(19.0) Driller notes ~1 foot water pocket (20.0) Cuttings pulverized to sandlike consistency
40		Log continued on next page			454.6							▽ Water Level 28.04 ft bgs 2/24/12 at 08:00

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel

LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

GOLDER STL RECORD OF BOREHOLE MWD 12384274_AMEREN LABADIE WELLS.GPJ GLDR_CO.GDT 4/20/12

RECORD OF BOREHOLE TGP-B

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-B
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/20/2012
DRILL RIG: Ingersol Rand T3W
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 985,894.58 E: 720,699.99
ELEVATION: 494.62
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in, 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
40	6" Air Rotary	(20.0 - 76.0) Fresh, yellowish gray (5Y 8/1) and pale olive (10Y 6/2), very fine to fine crystalline, medium strong (R3), DOLOMITE, little chert *(Continued)* (40.0) Dolomite becomes strong (R4)			40.0							(40.0) Water encountered
45												
50												
55												
60												
65												
70												
75												
		(76.0 - 95.0) Fresh, light gray (N7), very fine to fine crystalline, strong (R4), DOLOMITE, little chert			418.6 76.0							
80		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel
LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-B

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-B
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/20/2012
DRILL RIG: Ingersol Rand T3W
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 985,894.58 E: 720,699.99
ELEVATION: 494.62
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
80	6" Air Rotary	(76.0 - 95.0) Fresh, light gray (N7), very fine to fine crystalline, strong (R4), DOLOMITE, little chert *(Continued)*										
85												
90												
95					399.6 95.0							
		(95.0 - 115.0) Fresh, light brownish gray (5YR 6/1) and brownish gray (5YR 4/1), very fine to fine crystalline, strong (R4), DOLOMITE, little chert										
100												
105												
110		(110.0) Also some light bluish gray (5B 7/1)			384.6 110.0							
115					379.6 115.0							
		(115.0 - 130.0) Fresh, light gray (N7), very fine to fine crystalline, strong (R4), DOLOMITE, little chert										
120		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel
LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-B

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-B
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/20/2012
DRILL RIG: Ingersol Rand T3W
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 985,894.58 E: 720,699.99
ELEVATION: 494.62
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in / 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
120	6" Air Rotary	(115.0 - 130.0) Fresh, light gray (N7), very fine to fine crystalline, strong (R4), DOLOMITE, little chert *(Continued)*										
125												
130		END OF BORING AT 130 FT BGS			364.6 / 130.0							Terminate boring at 130 ft BGS, 2/20/2012 @ 1200. Installed Well TGP-B. Install piezometer TGP-A. See monitoring well construction log TGP-A for details.
135												
140												
145												
150												
155												
160												

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel

LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-C

SHEET 1 of 7

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-C

DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/21/2012
DRILL RIG: Ingersol Rand T3W

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 983,559.90 E: 725,352.32

ELEVATION: 611.50
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
0	10" Tri-Cone Air Rotary	(0.0 - 14.0) Firm, moderate brown (5YR 3/4), CLAYEY SILT, little fine sand (CL-ML), slightly moist	CL-ML		597.5							Soil and rock type and descriptions determined from cuttings. Strength and weathering inferred from drilling. Sampling and discontinuity measurements not conducted.
15		(14.0 - 17.0) Moderately to highly weathered, moderate brown (5YR 4/4), fine to medium grained, weak (R2), SANDSTONE			14.0 594.5							
20		(17.0 - 23.0) Moderately weathered, pale yellowish orange (10YR 8/6), fine grained, weak (R2), SANDSTONE (20.0) color changes to very pale orange (10YR 8/2)			17.0 591.5 20.0 588.5							
25		(23.0 - 30.0) Highly weathered, pale yellowish brown (10YR 6/2), very fine to fine crystalline, weak (R2), DOLOMITE, some chert, little clay			23.0							
30		(30.0 - 36.0) Moderately to slightly weathered, yellowish gray (5Y 8/1) and light greenish gray (5GY 8/1), very fine to fine crystalline, medium strong (R3), DOLOMITE, little chert			581.5 30.0							
35		(36.0 - 42.0) Highly weathered, grayish orange (10YR 7/4) and light greenish gray (5GY 8/1), fine to medium grained, weak (R2), DOLOMITE, and sand, some silt, trace clay			575.5 36.0							
40		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel

LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-C

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-C
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/21/2012
DRILL RIG: Ingersol Rand T3W
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 983,559.90 E: 725,352.32
ELEVATION: 611.50
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
40	10" Tri-Cone Air Rotary	(42.0 - 95.0) Moderately weathered, light olive gray (5Y 6/1) and greenish gray (5G 6/1), very fine to fine crystalline, medium strong (R3), DOLOMITE, little chert, little silt			569.5 / 42.0							
60												(60.0 - 65.0) Several voids observed
65												(65.0) Encounter water
70												(65.0 - 70.0) Driller notes suspected sand/sandstone pocket
80		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel
LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-C

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-C
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/21/2012
DRILL RIG: Ingersol Rand T3W
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 983,559.90 E: 725,352.32
ELEVATION: 611.50
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
80	10" Tri-Cone Air Rotary	(42.0 - 95.0) Moderately weathered, light olive gray (5Y 6/1) and greenish gray (5G 6/1), very fine to fine crystalline, medium strong (R3), DOLOMITE, little chert, little silt *(Continued)*										
85												
90												
95					516.5 / 95.0							(95.0) Set 6" steel casing at 95 ft BGS. Conitnue drilling open hole with 6" air rotary hammer.
100	6" Air Rotary Hammer	(95.0 - 105.0) Slightly weathered to fresh, pale yellowish brown (10YR 6/2) and moderate yellowish brown (10YR 5/4), fine crystalline, medium strong (R3), DOLOMITE, trace chert, trace quartz sandstone										
105		(105.0 - 125.0) Slightly to moderately weathered, light olive gray (5Y 6/1), fine crystalline, weak to medium strong (R2 to R3), DOLOMITIC LIMESTONE, some shale			506.5 / 105.0							
110												
115												▽ Water Level 115.4 ft bgs 2/24/12 at 10:45
120		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel
LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-C

SHEET 4 of 7

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-C

DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/21/2012
DRILL RIG: Ingersol Rand T3W

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 983,559.90 E: 725,352.32

ELEVATION: 611.50
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
120	6" Air Rotary Hammer	(105.0 - 125.0) Slightly to moderately weathered, light olive gray (5Y 6/1), fine crystalline, weak to medium strong (R2 to R3), DOLOMITIC LIMESTONE, some shale *(Continued)*			486.5							
125		(125.0 - 138.0) Slightly weathered to fresh, pale yellowish brown (10YR 6/2), and moderate yellowish brown (10YR 5/4), fine crystalline, medium strong (R3), DOLOMITE, little sandstone, trace chert			125.0							
130		(132.0) little chert			479.5 132.0							
135					473.5							
140		(138.0 to 240.0) Slightly weathered, pale yellowish brown (10YR 6/2) and medium light gray (N6), very fine crystalline, medium strong (R3), DOLOMITE, trace quartz sandstone, trace chert			138.0							
145												
150		(150.0 - 190.0) occasional shale layers			461.5 150.0							
155												
160		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel

LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

GOLDER STL RECORD OF BOREHOLE MWD 12384274_AMEREN LABADIE WELLS.GPJ GLDR_CO.GDT 4/20/12

RECORD OF BOREHOLE TGP-C

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-C
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/21/2012
DRILL RIG: Ingersol Rand T3W
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 983,559.90 E: 725,352.32
ELEVATION: 611.50
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in / 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
160	6" Air Rotary Hammer	(138.0 to 240.0) Slightly weathered, pale yellowish brown (10YR 6/2) and medium light gray (N6), very fine crystalline, medium strong (R3), DOLOMITE, trace quartz sandstone, trace chert *(Continued)*										
165												
170												
175												
180												
185												
190												
195												
200		Log continued on next page										

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel
LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-C

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-C
DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/21/2012
DRILL RIG: Ingersol Rand T3W
DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 983,559.90 E: 725,352.32
ELEVATION: 611.50
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in / 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
200	6" Air Rotary Hammer	(138.0 to 240.0) Slightly weathered, pale yellowish brown (10YR 6/2) and medium light gray (N6), very fine crystalline, medium strong (R3), DOLOMITE, trace quartz sandstone, trace chert *(Continued)*										
205												
210												
215												
220												
225												
230												
235												
240		Log continued on next page			371.5							

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel
LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

RECORD OF BOREHOLE TGP-C

SHEET 7 of 7

PROJECT: Ameren Labadie Wells
PROJECT NUMBER: 123-84274
LOCATION: TGP-C

DRILLING METHOD: Air Rotary 6"
DRILLING DATE: 2/21/2012
DRILL RIG: Ingersol Rand T3W

DATUM: NAVD88
AZIMUTH: N/A
COORDINATES: N: 983,559.90 E: 725,352.32

ELEVATION: 611.50
INCLINATION: -90

DEPTH (feet)	BORING METHOD	SOIL/ROCK PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in / 140 lb hammer 30 inch drop	N	REC / ATT	PENETRATION RESISTANCE BLOWS / ft ■ (10 20 30 40)	REMARKS
240		END OF BORING AT 240 FT BGS			240.0							Terminate boring at 240 ft BGS, 2/23/12. Piezometer TGP-C installed in borehole as open hole completion. See monitoring well construction log TGP-A for details.
245												
250												
255												
260												
265												
270												
275												
280												

SCALE: 1 in = 5 ft
DRILLING CONTRACTOR: Roberts Environmental Drilling, Inc.
DRILLER: C. Hebel

LOGGED: MWD
CHECKED: PJJ
REVIEWED: MNH

Golder Associates

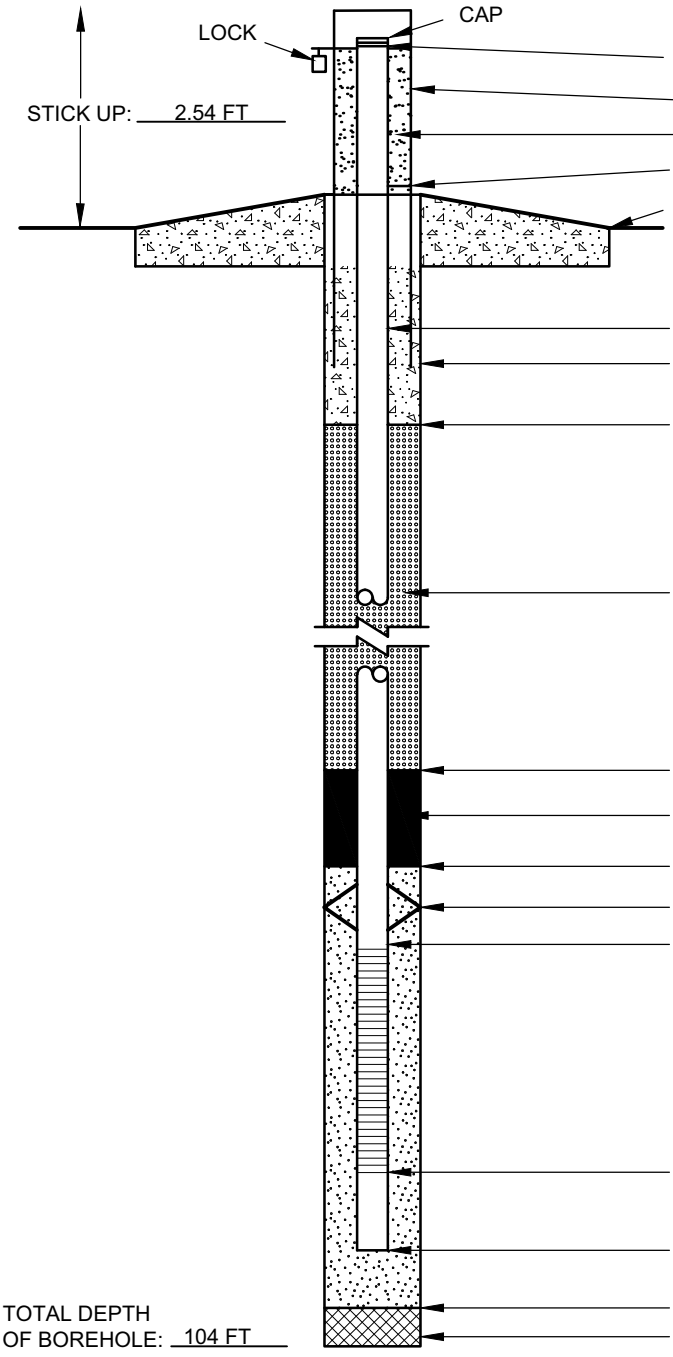
GOLDER STL RECORD OF BOREHOLE MWD 12384274_AMEREN LABADIE WELLS.GPJ GLDR_CO.GDT 4/20/12

APPENDIX B

WELL CONSTRUCTION LOGS

ABOVE GROUND MONITORING WELL CONSTRUCTION LOG TGP-A

PROJECT NAME: AMEREN LABADIE WELLS	PROJECT NUMBER: 123-84274	
SITE NAME: AMEREN, LABADIE MO	LOCATION: TGP-A	
CLIENT: AMEREN MO	SURFACE ELEVATION: 479.78 FT	
GEOLOGIST: M. DREYER	NORTHING: 988186.35	EASTING: 724460.71
DRILLER: C. HEBEL	STATIC WATER LEVEL: 21.55 FT BTOC	COMPLETION DATE: 3-1-2012
DRILLING COMPANY: ROBERTS ENVIRONMENTAL	DRILLING METHODS: 6 $\frac{1}{4}$" HSA/ 6" AIR ROTARY	



TOP OF CASING ELEVATION: 482.32 FT

PROTECTIVE CASING (yes / no): YES, AND 3 STEEL BOLLARDS

PEA GRAVEL OR (SAND)

WEEP HOLE

GROUND SURFACE ELEVATION: 479.78 FT

DIAMETER OF RISER PIPE (in.): 2 IN.

DIAMETER OF BOREHOLE (in.): 6 IN

CONCRETE SEAL DEPTH (ft. bgs): 2.0 FT

TYPE AND AMOUNT OF ANNULAR SEAL: HIGH SOLIDS CEMENT BENTONITE GROUT

TOP OF BENTONITE SEAL DEPTH (ft. bgs): 67.0 FT

TYPE AND AMOUNT OF BENTONITE SEAL: COATED $\frac{1}{2}$" CHIPS

TOP OF SAND PACK DEPTH (ft. bgs): 70.4 FT BGS

CENTRALIZER (yes / no) - TYPE: NO

TOP OF SCREEN DEPTH (ft. bgs): 74 FT

TYPE OF SCREEN: 2" X 10' SCHEDULE 80 PVC

SCREEN SLOT SIZE (in.): 0.010 IN.

SIZE OF SAND PACK: WG1 UNIMIN FILTERSIL QUARTZ

AMOUNT OF SAND: 7x 50 LB BAGS

BOTTOM OF SCREEN DEPTH (ft. bgs): 103.6 FT

BOTTOM OF WELL DEPTH (ft. bgs): 103.85 FT

BOTTOM OF FILTER PACK (ft. bgs): 103.85 FT

TYPE AND AMOUNT OF BACKFILL: 0.15 FT BROKEN ROCK DEBRIS

ADDITIONAL NOTES: CENTRALIZER WAS NOT INSTALLED DUE TO CAVING FORMATION AND INABILITY TO GET RISER WITH CENTERALIZER TO DEPTH.

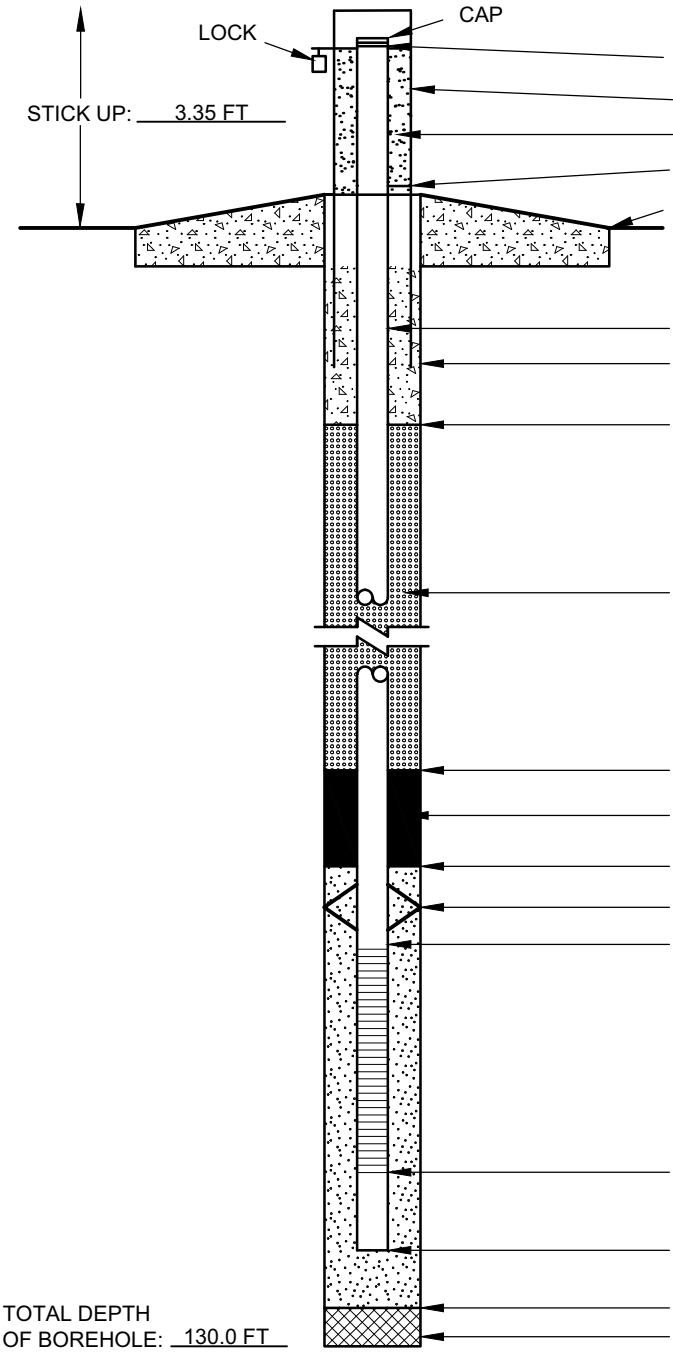
CHECKED BY: P. JOPLIN

DATE CHECKED: 3-16-2012

PREPARED BY: M. DREYER

ABOVE GROUND MONITORING WELL CONSTRUCTION LOG TGP-B

PROJECT NAME: AMEREN LABADIE WELLS	PROJECT NUMBER: 123-84274	
SITE NAME: AMEREN, LABADIE MO	LOCATION: TGP-B	
CLIENT: AMEREN MO	SURFACE ELEVATION: 491.27 FT	
GEOLOGIST: M. DREYER	NORTHING: 985894.54	EASTING: 720699.99
DRILLER: C. HEBEL	STATIC WATER LEVEL: 28.00 FT BTOC	COMPLETION DATE: 2-20-2012
DRILLING COMPANY: ROBERTS ENVIRONMENTAL	DRILLING METHODS: 6" AIR ROTARY	



TOP OF CASING ELEVATION: 494.62 FT

PROTECTIVE CASING (yes / no): STEEL W/ 3 BOLLARDS

PEA GRAVEL OR (SAND)

WEEP HOLE

GROUND SURFACE ELEVATION: 491.27 FT

DIAMETER OF RISER PIPE (in.): 2 IN.

DIAMETER OF BOREHOLE (in.): 6 IN

CONCRETE SEAL DEPTH (ft. bgs): 2.0 FT

TYPE AND AMOUNT OF ANNULAR SEAL: N/A

TOP OF BENTONITE SEAL DEPTH (ft. bgs): 1.0 FT

TYPE AND AMOUNT OF BENTONITE SEAL: 4 BAGS, COATED $\frac{1}{2}$" CHIPS

TOP OF SAND PACK DEPTH (ft. bgs): 17.0 FT BGS

CENTRALIZER (yes / no) - TYPE: SS (TOP/MIDDLE/BOTTOM OF SCREEN)

TOP OF SCREEN DEPTH (ft. bgs): 20.0 FT BGS

TYPE OF SCREEN: 2" X 10' SCHEDULE 80 PVC

SCREEN SLOT SIZE (in.): 0.010 IN.

SIZE OF SAND PACK: WG1 UNIMIN FILTERSIL QUARTZ

AMOUNT OF SAND: 30x 50 LB BAGS

BOTTOM OF SCREEN DEPTH (ft. bgs): 129.7 FT

BOTTOM OF WELL DEPTH (ft. bgs): 130.0 FT

BOTTOM OF FILTER PACK (ft. bgs): 130.0 FT

TYPE AND AMOUNT OF BACKFILL: N/A

ADDITIONAL NOTES:

CHECKED BY: P. JOPLIN

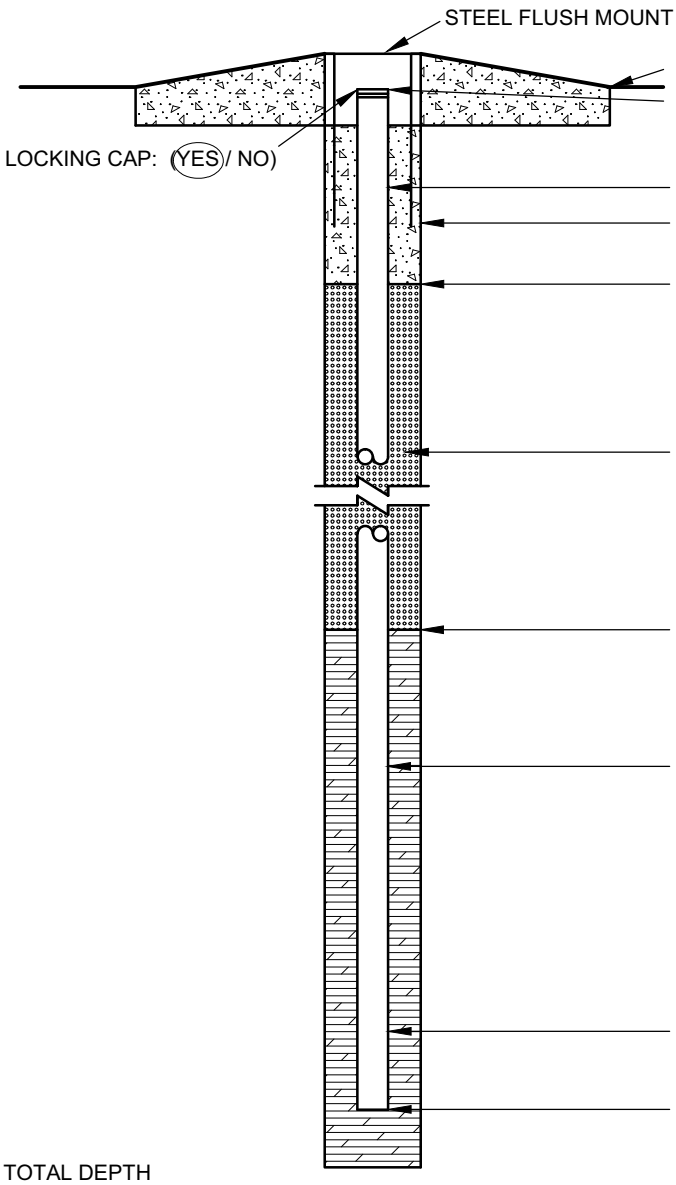
DATE CHECKED: 3-16-2012

PREPARED BY: M. DREYER

FLUSH-MOUNT MONITORING WELL CONSTRUCTION LOG

TGP-C

PROJECT NAME: AMEREN LABADIE PIEZOMETERS	PROJECT NUMBER: 123-84274	
SITE NAME: AMEREN, LABADIE MO	LOCATION: TGP-C	
CLIENT: AMEREN MO	SURFACE ELEVATION: 612.23 FT	
GEOLOGIST: M. DREYER	NORTHING: 983559.9	EASTING: 725352.32
DRILLER: C. HEBEL	STATIC WATER LEVEL: 115.4 FT BGS	COMPLETION DATE: C. HEBEL
DRILLING COMPANY: ROBERTS ENVIRONMENTAL	DRILLING METHODS: ROBERTS ENVIRONMENTAL	



GROUND SURFACE ELEVATION: 612.23 FT

TOP OF CASING ELEVATION: 611.50 FT

DIAMETER OF RISER PIPE (in.): 6 IN.

DIAMETER OF BOREHOLE (in.): 10 IN. (0' - 95' BGS) 6 IN. (95' - 240' BGS)

CONCRETE SEAL DEPTH (ft. bgs): 2.0 FT

TYPE AND AMOUNT OF ANNULAR SEAL: CEMENT BENTONITE GROUT

GROUT THICKNESS: 94 FT

TOP OF SCREEN DEPTH (ft. bgs): 95 FT BGS

TYPE OF SCREEN: 6" OPEN BOREHOLE FROM 95 TO 240 FT BGS

CASING - TYPE: 6" OPEN BOREHOLE

BOTTOM OF SCREEN DEPTH (ft. bgs): 240 FT

BOTTOM OF WELL DEPTH (ft. bgs): 240 FT

TOTAL DEPTH OF BOREHOLE: 240 FT

ADDITIONAL NOTES: INSTALLED AS 6" OPEN BOREHOLE FROM 95' TO 240' BGS.

CHECKED BY: P. JOPLIN

DATE CHECKED: 3-16-2012

Golder Associates

PREPARED BY: M. DREYER

APPENDIX C

MDNR WELL REGISTRATION FORMS AND RECEIPT CONFIRMATION

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED
REFERENCE NO. 449718	
C.R. NO.	CHECK NO.
STATE WELL NUMBER	REVENUE NO.
ENTERED Ph1 Ph2 Ph3	APPROVED BY / ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME	CONTACT NAME	VARIANCE GRANTED BY DNR
Ameren Missouri	314-342-1000	

OWNER ADDRESS	CITY	STATE	ZIP CODE	NUMBER
One Ameren Plaza, 1901 Chouteau Ave.	St. Louis	MO	63166	

SITE NAME	WELL NUMBER	COUNTY
Labadie Energy Center	TGP-A	St. Louis

SITE ADDRESS	CITY	STATIC WATER LEVEL
226 Labadie Power Plant Road	Labadie	21.55 ft

SURFACE COMPLETION

TYPE: ☒ ABOVE GROUND ☐ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 5 FT. DIAMETER 4x4 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 12 IN. LENGTH 2.5 FT.

SURFACE COMPLETION GROUT: ☒ CONCRETE ☐ OTHER

LOCATION OF WELL (D/M/S FORMAT ONLY)

LAT. 38 ° 32 ' 49.5 "

LONG. 90 ° 50 ' 5.0 "

SMALLEST NE ¼ SW ¼ LARGEST NE ¼

SECTION 19 TOWNSHIP 44 NORTH

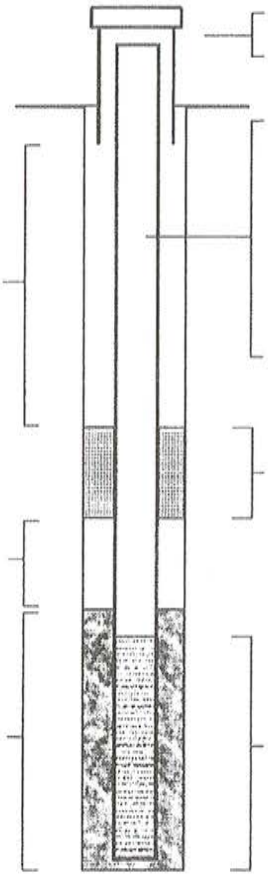
RANGE 2 ☒ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)

☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL

☐ GAS MIGRATION WELL ☐ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☒ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH



☒ LOCKING CAP
☒ WEEP HOLE

ELEVATION 479.78 FT.

ANNULAR SEAL

LENGTH 64.5 FT.

☒ SLURRY ☐ CHIPS ☐ PELLETS ☐ GRANULAR ☒ CEMENT/SLURRY

IF CEMENT/BENTONITE MIX:

BAGS OF CEMENT USED 12

% OF BENTONITE USED 5

WATER USED/BAG 7 GAL.

SECONDARY FILTER PACK

LENGTH NA FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 70 FT.

LENGTH OF PRIMARY FILTER PACK 34 FT.

SURFACE COMPLETION

☒ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER

RISER PIPE DIAMETER 2 IN.

RISER PIPE LENGTH 76.5 FT.

DIAMETER OF DRILL HOLE 6 IN.

WEIGHT OR SDR# 80

MATERIAL

☒ STEEL ☒ THERMOPLASTIC (PVC) ☐ OTHER

STEEL = 0 - 40ft.

BENTONITE SEAL

LENGTH 3 FT.

☒ CHIPS ☐ PELLETS ☐ GRANULAR ☐ SLURRY

☐ SATURATED ZONE ☐ HYDRATED

SCREEN

SCREEN DIAMETER 2 IN.

SCREEN LENGTH 30 FT.

DIAMETER OF DRILL HOLE 6 IN.

DEPTH TO TOP 74 FT.

SCREEN MATERIAL

☐ STEEL ☒ THERMOPLASTIC (PVC) ☐ OTHER

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
(REDI	JOB#	121014-AR/D)
0'	25'	Silt/Clayey Silt
25'	32'	Silty Clay
32'	36'	Silty Sand
36'	53'	Dolomite
53'	62'	Dolomite and Sandstone
62'	67'	Mud Filled VOID
67'	105'	Dolomite
*	SEE	ATTACHED
TOTAL DEPTH:		104 FT.

* FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
	004753-M	03/01/2012

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
Tracy Roberts	1440 MPMH		

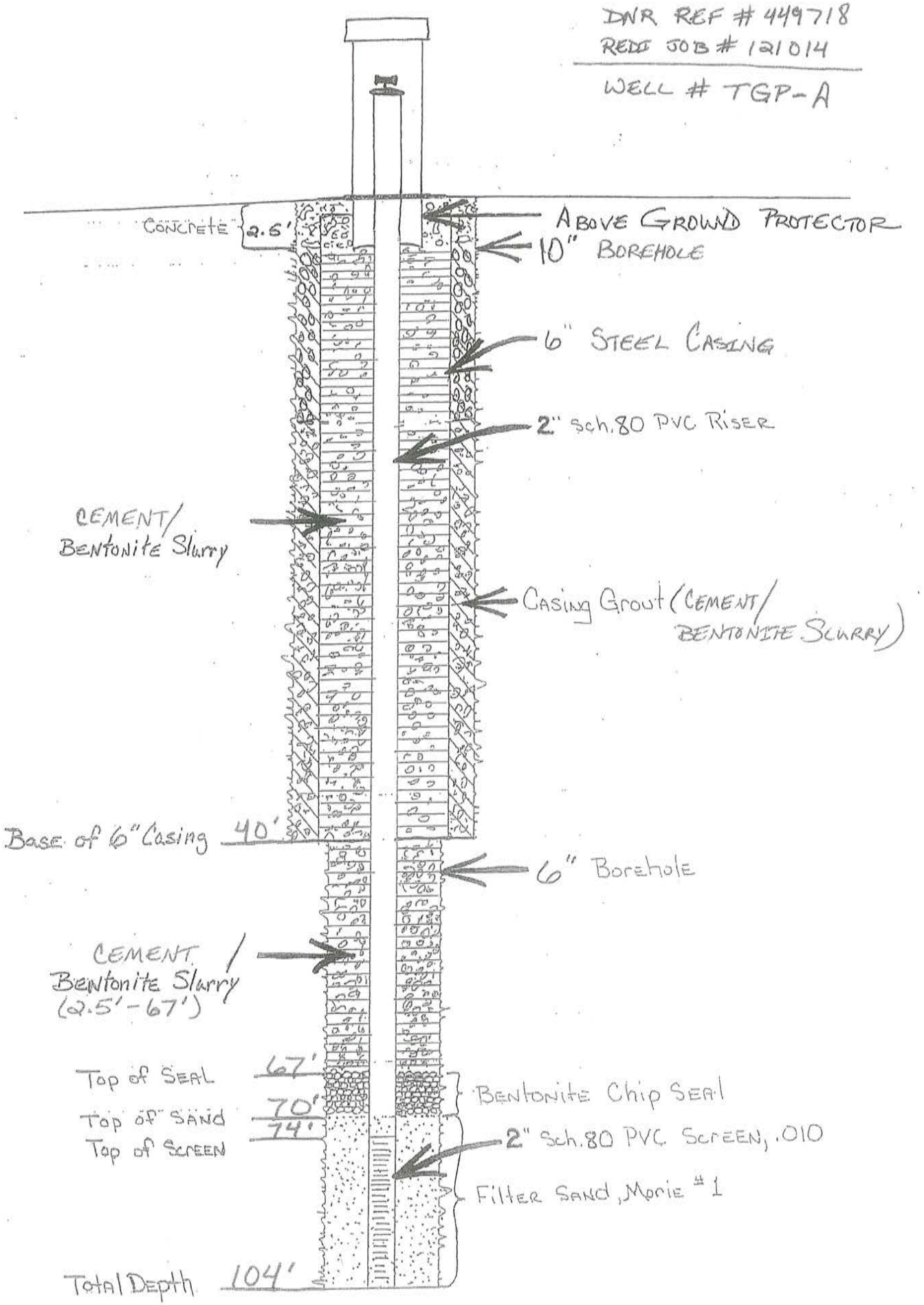
MO 780-1415 (07-11)

DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER

RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

DNR REF # 449718
REDI JOB # 121014

WELL # TGP-A



MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO. 449719		
C.R. NO.	CHECK NO.	
STATE WELL NUMBER	REVENUE NO.	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME	CONTACT NAME			VARIANCE GRANTED BY DNR
Ameren Missouri	314-342-1000			
OWNER ADDRESS	**CITY**	**STATE**	**ZIP CODE**	**NUMBER**
One Ameren Plaza, 1901 Chouteau Ave.	St. Louis	MO	63166	
SITE NAME		**WELL NUMBER**		**COUNTY**
Labadie Energy Center		TGP-B		St. Louis
SITE ADDRESS	**CITY**			**STATIC WATER LEVEL**
226 Labadie Power Plant Road	Labadie			28 ft

SURFACE COMPLETION

TYPE	LENGTH AND DIAMETER OF SURFACE COMPLETION	DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED	SURFACE COMPLETION GROUT
☒ ABOVE GROUND	LENGTH 5 FT.	DIAMETER 12 IN.	☒ CONCRETE
☐ FLUSH MOUNT	DIAMETER 4x4 IN.	LENGTH 2.5 FT.	☐ OTHER

☒ LOCKING CAP
☒ WEEP HOLE

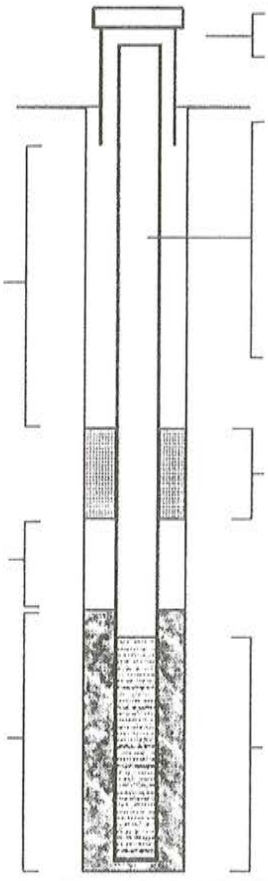
ELEVATION 491.27 FT.

ANNULAR SEAL
LENGTH NA FT.
☐ SLURRY ☐ CHIPS
☐ PELLETS ☐ GRANULAR
☐ CEMENT/SLURRY
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED ____
% OF BENTONITE USED ____
WATER USED/BAG ____ GAL.

SECONDARY FILTER PACK
LENGTH NA FT.

DEPTH TO TOP OF PRIMARY FILTER PACK 17 FT.

LENGTH OF PRIMARY FILTER PACK 113 FT.



SURFACE COMPLETION
☒ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER
RISER PIPE DIAMETER 2 IN.
RISER PIPE LENGTH 22.5 FT.
DIAMETER OF DRILL HOLE 6 IN.
WEIGHT OR SDR# 80

MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ____

BENTONITE SEAL
LENGTH 14.5 FT.
☒ CHIPS ☐ PELLETS ☐ GRANULAR ☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SCREEN
SCREEN DIAMETER 2 IN.
SCREEN LENGTH 110 FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP 20 FT.

SCREEN MATERIAL
☐ STEEL ☒ THERMOPLASTIC (PVC)
☐ OTHER ____

LOCATION OF WELL (D/M/S FORMAT ONLY)
LAT. 38 ° 32 ' 26.3 "
LONG. 90 ° 50 ' 51.6 "

SMALLEST NW ¼ SW ¼ LARGEST SW ¼
SECTION 19 TOWNSHIP 44 NORTH
RANGE 2 ☒ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☐ OBSERVATION
☐ EXTRACTION WELL ☐ OPEN HOLE
☒ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
(REDI	JOB#	121014-AR/D)
0'	20'	Moderately Weathered to Fresh Dolomite
20'	130'	Fresh Dolomite
TOTAL DEPTH:		130 FT.

FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
	004753-M	03/01/2012

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
	4440 WPSRA		

MO 780-1415 (07-11)

DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

MISSOURI DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY PROGRAM

MONITORING WELL CERTIFICATION RECORD

OFFICE USE ONLY	DATE RECEIVED	
REFERENCE NO. 449780		
C.R. NO.	CHECK NO.	
STATE WELL NUMBER	REVENUE NO.	
ENTERED Ph1 Ph2 Ph3	APPROVED BY	ROUTE

INFORMATION SUPPLIED BY PRIMARY CONTRACTOR OR DRILLING CONTRACTOR

NOTE: THIS FORM IS NOT TO BE USED FOR NESTED WELLS

OWNER NAME	CONTACT NAME			VARIANCE GRANTED BY DNR
Ameren Missouri	314-342-1000			
OWNER ADDRESS	**CITY**	**STATE**	**ZIP CODE**	**NUMBER**
One Ameren Plaza, 1901 Chouteau Ave.	St. Louis	MO	63166	5214
SITE NAME		**WELL NUMBER**		**COUNTY**
Labadie Energy Center Project - PRIVATE RESIDENCE		TGP-C		St. Louis
SITE ADDRESS	**CITY**			**STATIC WATER LEVEL**
2272 Highway T	Labadie			115.4 ft

SURFACE COMPLETION

TYPE: ☐ ABOVE GROUND ☒ FLUSH MOUNT

LENGTH AND DIAMETER OF SURFACE COMPLETION: LENGTH 1 FT. DIAMETER 8 IN.

DIAMETER AND DEPTH OF THE HOLE SURFACE COMPLETION WAS PLACED: DIAMETER 14 IN. LENGTH 1 FT.

SURFACE COMPLETION GROUT: ☑ CONCRETE ☐ OTHER

☒ LOCKING CAP

☐ WEEP HOLE

ELEVATION 612.93 FT.

ANNULAR SEAL

LENGTH 94 FT.

☐ SLURRY ☐ CHIPS ☐ PELLETS ☐ GRANULAR ☒ CEMENT/SLURRY

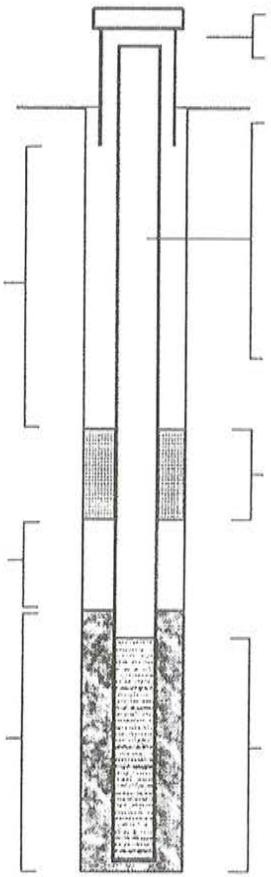
IF CEMENT/BENTONITE MIX:
BAGS OF CEMENT USED 16
% OF BENTONITE USED 5
WATER USED/BAG 7 GAL.

SECONDARY FILTER PACK

LENGTH NA FT.

DEPTH TO TOP OF PRIMARY FILTER PACK NA FT.

LENGTH OF PRIMARY FILTER PACK NA FT.



SURFACE COMPLETION

☑ STEEL ☐ ALUMINUM ☐ PLASTIC

RISER

RISER PIPE DIAMETER 6 IN.
RISER PIPE LENGTH 95 FT.
DIAMETER OF DRILL HOLE 10 IN.
WEIGHT OR SDR#

MATERIAL: ☑ STEEL ☐ THERMOPLASTIC (PVC) ☐ OTHER

BENTONITE SEAL

LENGTH NA
☐ CHIPS ☐ PELLETS ☐ GRANULAR ☐ SLURRY
☐ SATURATED ZONE ☐ HYDRATED

SCREEN

SCREEN DIAMETER NA IN.
SCREEN LENGTH NA FT.
DIAMETER OF DRILL HOLE 6 IN.
DEPTH TO TOP NA FT.

SCREEN MATERIAL: ☐ STEEL ☐ THERMOPLASTIC (PVC) ☑ OTHER OPEN HOLE

LOCATION OF WELL (D/M/S FORMAT ONLY)

LAT. 38 ° 32 ' 3.8 "
LONG. 90 ° 50 ' 53.8 "

SMALLEST SE ¼ NE ¼ LARGEST NE ¼
SECTION 30 TOWNSHIP 44 NORTH
RANGE 2 ☑ EAST ☐ WEST

MONITORING FOR: (CHECK ALL THAT APPLY)
☐ RADIONUCLIDES ☐ PETROLEUM PRODUCTS ONLY
☐ EXPLOSIVES ☐ METALS ☐ VOC
☐ SVOCS ☐ PESTICIDES/HERBICIDES

PROPOSED USE OF WELL
☐ GAS MIGRATION WELL ☐ OBSERVATION
☐ EXTRACTION WELL ☑ OPEN HOLE
☐ PIEZOMETERS ☐ INJECTION WELL
☐ DIRECT PUSH

DEPTH TO	DEPTH FROM	FORMATION DESCRIPTION
(REDI	JOB#	121014-AR/D)
0'	14'	Clayey Silt
14'	23'	Sandstone
23'	105'	Dolomite
105'	125'	Dolom. Limestone
125'	240'	Dolomite
@ 150'	190'	Occassional Shale
		Layers
*	SEE	ATTACHED
0	95'	10" Borehole
95'	240'	6" OPEN Borehole
TOTAL DEPTH:		240 FT.

* FOR CASED WELLS, SUBMIT ADDITIONAL AS BUILT DIAGRAMS SHOWING WELL CONSTRUCTION DETAILS INCLUDING TYPE & SIZE OF ALL CASING, HOLE DIAMETER & GROUT USED.

SIGNATURE (PRIMARY CONTACTOR)	PERMIT NUMBER	DATE WELL DRILLING WAS COMPELTED
	004753-M	03/01/2012

I HEREBY CERTIFY THAT THE MONITORING WELL HEREIN DESCRIBED WAS CONSTRUCTED IN ACCORDANCE WITH MISSOURI DEPARTMENT OF NATURAL RESOURCES REQUIREMENTS FOR THE CONSTRUCTION OF MONITORING WELLS. ☐ PUMP INSTALLED

SIGNATURE (WELL DRILLER)	PERMIT NUMBER	SIGNATURE (OF APPRENTICE)	APPRENTICE PERMIT NUMBER
	440WPRM		

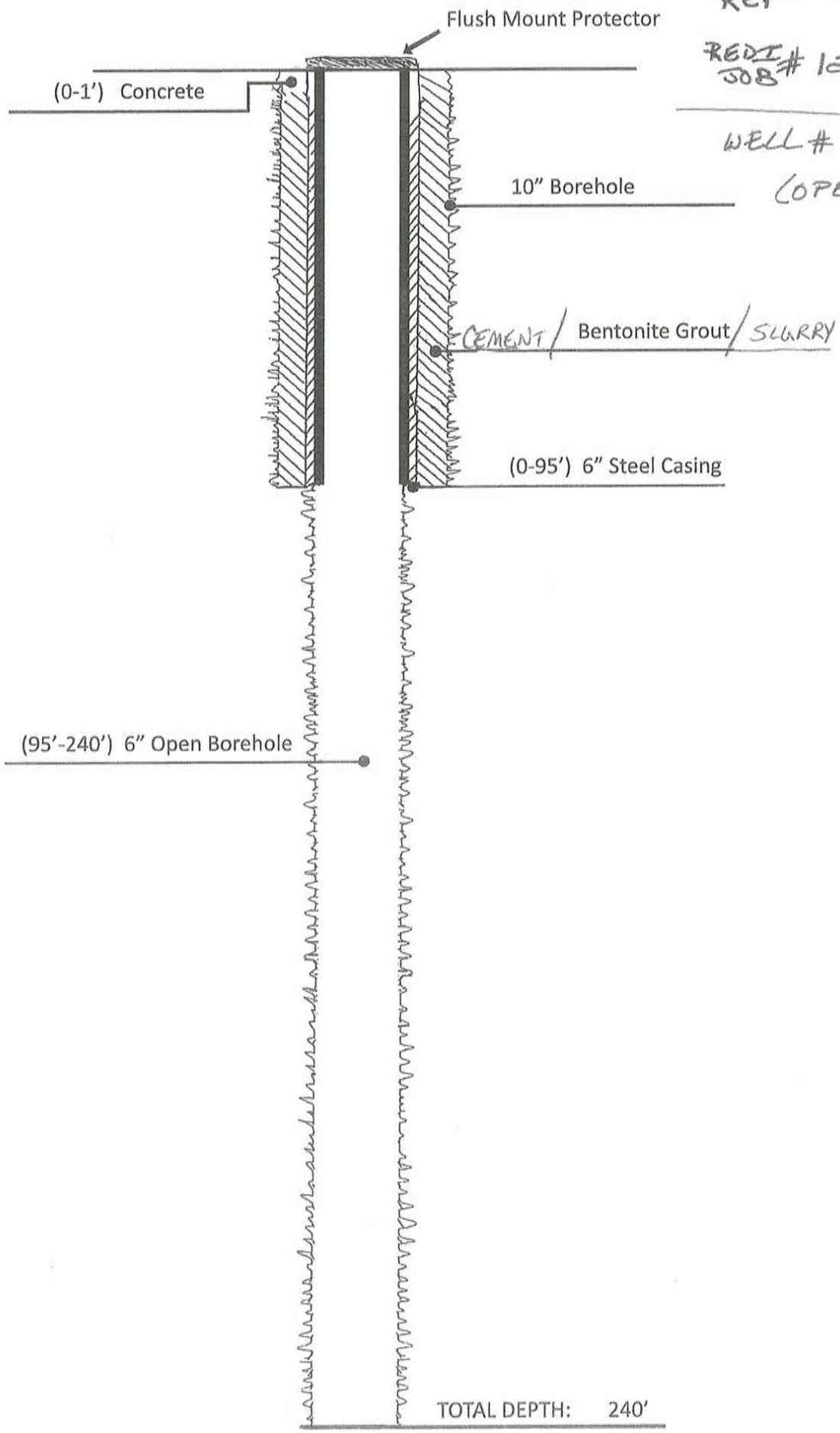
MO 780-1415 (07-11)

DISTRIBUTION: WHITE/DIVISION CANARY/CONTACTOR PINK/OWNER
RETURN WHITE COPY WITH APPROPRIATE FEE TO: MISSOURI DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGY AND LAND SURVEY, WELLHEAD PROTECTION SECTION, PO BOX 250, ROLLA, MO 65402 573-368-2165

DNR REF # 449720

REDI JOB # 121014-AR/D

WELL # TGP-C (OPEN HOLE)



STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

P.O. Box 250 111 Fairgrounds Rd. Rolla, MO 65402-0250
(573) 368-2165
FAX(573) 368-2317

VARIANCE: Approved **VARIANCE NUMBER:** 5214

WELL OWNER INFORMATION									
NAME:	AMEREN UE								
ADDRESS LINE 1:	ONE AMEREN PLAZA						**FAX:**		
ADDRESS LINE 2:	1901 CHOTEAU AVE								
CITY:	ST. LOUIS	**STATE:** MO	**ZIP:** 63103				**TELEPHONE:**		
WELL LOCATION									
COUNTY:	FRANKLIN		**LAT.**	38	32	3.8	**LONG.**	90 50	53.8
1/4	**1/4**	**1/4**	NW	**SEC.** 30			**TWN.** 44 N		**RNG.** 2E
CONTRACTOR INFORMATION									
COMPANY NAME:	ROBERTS ENVIRONMENTAL DRLG INC						**PERMIT NUMBER:**		004440
CONTRACTOR NAME:	TRAVIS ROBERTS								
ADDRESS:	1107 S MULBERRY ST						**FAX:** 618-476-3619		
CITY:	MILLSTADT	**STATE:** IL	**ZIP:** 62260				**TELEPHONE:** 618-476-7334		

VARIANCE INFORMATION

VARIANCE EXPLANATION

APPROVAL GRANTED TO COMPLETE AN OPEN-HOLE MONITORING WELL AT THIS LOCATION. REQUIRED: THE WELL MUST MEET MINIMUM CASING REQUIREMENTS FOR DOMESTIC WELLS IN AREA 1: SET NO LESS THAN 80 FEET OF CASING, NO LESS THAN 30 FEET INTO COMPETENT BEDROCK.

RULE NUMBER MODIFIED: 10 CSR 23-4.060

REASON FOR VARIANCE

VERBAL APPROVAL GIVEN 2/10/2012 BY MATTHEW PARKER. WELL WAS CONSTRUCTED TO A TOTAL DEPTH OF 200 FEET AND CONTAINS 95 FEET OF CASING.

DATE:	04/18/2012	**BY:**	MOLLY STARKEY MS
COPY SENT TO OWNER (DATE):		**BY:**	
COPY SENT TO CONTRACTOR (DATE):		**BY:**	
Cc:	**Cc:**		

WIMS
Bi-Monthly Well and Pump Report

Report Date: 05/01/2012 **From - 03/01/2012 to - 04/30/2012**

The table below lists the well and/or pump reports that the Wellhead Protection Section received from your company during the time period identified above. Compare these reports with your record of reports submitted. If you have turned in reports during this time period that are not on the list, please call us at (573) 368-2165.

GOLDER ASSOCIATES INC
820 SOUTH MAIN STREET
ST CHARLES, MO 63303

Ref Num	Rec Type	Date Rcvd	Owner	City	Contractor	Permit #	Cert #
00449718	Monitoring Well	04/26/2012	AMEREN MISSOURI	ST. LOUIS	GOLDER ASSOCIAT	004753	*
00449719	Monitoring Well	04/26/2012	AMEREN MISSOURI	ST. LOUIS	GOLDER ASSOCIAT	004753	*
00449720	Monitoring Well	04/26/2012	AMEREN MISSOURI	ST. LOUIS	GOLDER ASSOCIAT	004753	*