

**AP - 087**

**STAGE 1  
WORKPLAN**

**7/08/2008**

AP087



# Highlander Environmental Corp.

Midland, Texas

**Stage 1 Abatement Plan  
OXY, USA, Inc.  
E.C. Hill Abandoned Tank Battery (ATB) at Well #24  
Section 34, T23S, R37E  
Lea County, New Mexico  
NMOCD AP087**

July 8, 2008

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## 1.0 EXECUTIVE SUMMARY

As part of a due diligence assessment for Pogo Producing Company (Pogo), this site, formerly operated by Latigo Petroleum, Inc., was inspected by Highlander Environmental Corp. of Midland, Texas. Due to visual historic spills, Highlander supervised the installation of auger holes and soil borings at the site. The site location is shown on Figures 1 and 2.

Two impacted areas were investigated east of the abandoned facility. Eight auger holes and one borehole were installed in an area measuring 75' x 25'. One auger hole was placed in the second impacted area measuring 12' x 12'. Chloride impact was not observed in any of the auger hole samples analyzed. Elevated Total Petroleum Hydrocarbon (TPH) concentrations were found from the surface to 62' in the borehole. The auger hole and borehole locations are shown on Figure 3. The analytical results are shown in Table 1 and Table 2.

Based on the results, borehole (BH-1) was converted to a temporary 2-inch monitor well. Groundwater was encountered at approximately 82 feet below the top of casing (TOC). On September 22 and 29, 2006 and October 4, 2006, Highlander purged and sampled the well per New Mexico Oil Conservation Division (NMOCD) guidelines for analyses of chlorides, TPH and BTEX. Chloride concentrations did not exceed New Mexico Water Quality Control Commission (NMWQCC) standards, while hydrocarbon constituents (BTEX) were detected at levels below the NMWQCC action levels and total TPH was 73.3 mg/L. The well was scheduled to be sampled on May 16, 2007, however, at that time 2.68' of Phase-Separated Hydrocarbons (PSH) was encountered in the well. The analytical results are shown in Table 3.

A total of four (4) monitor wells have been installed at this facility. The well locations have not been surveyed at this time.

On June 25, 2007, the Director of the (NMOCD), Environmental Bureau was notified in writing of groundwater impact at the above-referenced site in accordance with NM Rule 116. In order to further delineate the site, additional monitor wells were installed. During this time

Plains Exploration & Production Company (PXP) purchased Pogo. In March 2008, OXY assumed operating responsibility for this site from PXP.

## 2.0 BACKGROUND & PREVIOUS WORK

Highlander Environmental Corp. (Highlander) performed a limited subsurface investigation at the Latigo E.C. Hill B ATB at well #24, Section 34, Township 23 South, Range 37 East, Lea County, New Mexico. The site location is shown on Figures 1 and 2.

Two impacted areas were investigated east of the abandoned facility. A total of eight (8) auger holes were installed in an area measuring 75' x 25'. One auger hole was placed in the second impacted area measuring 12' x 12'. Chloride impact was not observed in any of the auger hole samples analyzed. TPH concentrations were defined below the RRAL in six of the nine auger holes. One borehole was installed near auger hole AH-2. BH-1 exhibited TPH concentrations above the RRAL to a depth of 60'-62' below ground surface (bgs). The sample from 70'-72' was below the RRAL. The auger and borehole locations are shown on Figure 3. The analytical results are shown in Table 1 and Table 2.

Based on the results, borehole (BH-1) was converted to a temporary 2-inch monitor well. Groundwater was encountered at approximately 82 feet below top of casing (TOC). On September 22 and 29, 2006 and October 4, 2006, Highlander purged and sampled the well per New Mexico Oil Conservation Division (NMOCD) guidelines for analyses of chlorides, TPH and BTEX. Chloride concentrations did not exceed New Mexico Water Quality Control Commission (NMWQCC) standards, while hydrocarbon constituents (BTEX) were detected at levels below the NMWQCC action levels and total TPH was 73.3 mg/L. The well was scheduled to be sampled on May 16, 2007, however, at that time 2.68' of Phase-Separated Hydrocarbons (PSH) was encountered in the well. The monitor well was completed as a permanent monitor well. On June 25, 2007, the Director of the (NMOCD), Environmental Bureau was notified in writing of groundwater impact at the above-referenced site in accordance with NM Rule 116. The analytical results are shown in Table 3.

In September 2007, an additional three (3) monitor wells were installed at this facility. The well locations have not yet been surveyed.

## 3.0 GEOLOGY & HYDROGEOLOGY

### 3.1 Regional and Local Geology

According to the *Geologic Atlas of Texas, Hobbs Sheet* (1976), the site is comprised of windblown sand. The sands are dark brown to grayish brown and occur in sheets locally in the form of cover sand, dunes and dune ridges. The sands are derived from lacustrine, fluvial, and eolian deposits. Dune and dune ridges comprised of light brown to reddish sand overly the windblown sands in



the western part of the area. These sands are mostly derived from the Gatuna Formation and average in thickness from 5 to 10 feet.

### 3.2 Regional and Local Hydrogeology

Groundwater in the study area, southern Lea County, is obtained almost entirely from the Ogallala formation with some wells in the Quaternary alluvium. Sediments of Quaternary age can be observed in southern Lea County in the form of alluvial deposits, probably of both Pleistocene and Recent age, and dune sands of Recent age. The Quaternary alluvium has been deposited in topographically low areas where the older Ogallala formation had been stripped away.

The primary aquifer, the Ogallala formation, consists of inter-fingering bodies of fine to coarse sand, gravel, silt, and clay-material. In places, the upper part of the formation contains several hard, erosionally resistant beds of caliche. The thickness of the Ogallala formation is primarily controlled by the morphology of the eroded pre-Ogallala surface. To the east of the study area, in the San Simon Ridge area, the Ogallala has been stripped. To the west of the study area, in the Rattlesnake Ridge area, the base of the Ogallala is above the elevation of the water table.

Water in the Ogallala formation is unconfined and is contained in the pore spaces of unconsolidated or partly consolidated sediments. The saturated thickness of the Ogallala in the study area varies between 60 and 80 feet below ground surface (bgs). The altitude of the water table in the area is approximately 3,225 feet above mean sea level (MSL) and the average depth to groundwater in the area is about 80 to 120 feet below ground surface. Groundwater flow in the general area of the Teague Paddock Field is south-southeast.

The quality of groundwater in the area is generally fresh with a total dissolved solids being typically less than 1,000 ppm. Water from the Quaternary alluvium generally is high in silica (65 to 82 ppm), moderately high in calcium plus magnesium, low in sodium plus potassium, moderately low in sulfate and chloride. Uncontaminated water from the Ogallala formation is high in silica (49 to 73 ppm), contains moderate concentrations of calcium and magnesium. The water is generally hard.

The hydrogeologic data presented in this section was derived from Ground Water Report 6, "Geology and Ground Water Conditions in Southern Lea County, New Mexico," published by New Mexico Institute of Mining & Technology (1961). Water was encountered in the monitor wells at approximately 82' (TOC).

### 3.3 Water Well Inventory

Highlander performed an internet search of the New Mexico Office of the State Engineer (OSE) and the United States Geologic Survey (USGS) databases for water wells within a ½ mile radius of the subject site.



According to the New Mexico State Engineer Office W.A.T.E.R.S. database, Average Depth to Water Report, water wells are located in Section 9, 16 and 32, Township 23 South, Range 37 East, with an average depth to water of 100', 115' and 106', respectively. Based on monitor wells installed at the Site the depth to groundwater at the Site is approximately 82.0' below surface. The water well inventory data sheet is included in Appendix A.

#### 4.0 SUBSURFACE SOILS

The soils in the vicinity of this site are deep sandy soils of the Kermit and Dune land association. The Kermit soils are hummocky and undulating and are adjacent to or surround Dune land areas. The surface is fine to coarse sand. Dunes can be 8'-12' high. These sandy soils range from pale brown to yellowish and reddish brown sands.

#### 5.0 GROUNDWATER QUALITY

##### 5.1 Installation of Additional Monitor Wells

Additional monitor wells may be required at this facility to further delineate the source or sources and extent of groundwater impact. If deemed necessary, one additional monitor well, as required in the April 25, 2008 NMOCD letter, will be installed with the screened interval placed entirely below the water table. If the sampling data indicate the necessity for additional monitor wells, they will be installed accordingly to complete delineation. Copies of the boring and completion logs are included in Appendix B.

##### 5.2 Monitoring Program

The original monitoring well, MW-1, has been sampled or inspected four times since September 22, 2006. The monitor wells at this site have not been surveyed. Once surveyed, all four monitor wells will be inspected prior to sampling. Quarterly sampling of all wells will commence in the third quarter of 2008 and continue until further notice.

##### 5.3 Hydrocarbons in Groundwater

Traces of benzene, ethylbenzene and xylene observed in MW-1, were at concentrations below the NMWQCC standards. MW-1 currently contains PSH.

##### 5.4 Other Constituents of Concern

No elevated chloride concentrations were observed in either soil sampling or groundwater samples at this site.



## 6.0 CONCLUSIONS

The original monitoring well, MW-1, has been sampled or inspected four times since September 22, 2006. The monitor wells at this site have not been surveyed. Once surveyed, all four monitor wells will be inspected prior to sampling. Quarterly sampling of all wells will commence in the third quarter of 2008 and continue until further notice. The site will be evaluated for the necessity of additional monitor wells. No elevated chloride concentrations were observed in either soil sampling or groundwater samples at this site.

As an interim abatement plan, OXY proposes to install a 4-inch diameter recovery well in the immediate vicinity of MW-1, in order to initiate recovery of phase separated hydrocarbons (PSH). The extraction system will utilize a Xitech product pump, and recovered PSH will be placed into above ground storage tanks for appropriate disposition.

## 7.0 SOIL CORRECTIVE ACTION PLAN (CAP)

The majority of TPH impact is limited to the C12 - C-35 range. The southern end of the 25' x 75' impacted area (AH-2, AH-4 and AH-5) has TPH concentrations above the RRAL ranging in depth from 6.5' to 62' bgs. Due to the extreme depth and relative lack of BTEX constituents, OXY proposes to excavate this area to a depth of 4.0' and placement of an impermeable infiltration barrier. The remainder of the 25' x 75' impacted area will be evaluated either for excavation down to depths of 4.5' to 8.5' to remove TPH impacted soils above the RRAL or inclusion in the infiltration barrier footprint.

## 8.0 QUALITY ASSURANCE/ QUALITY CONTROL

All monitor wells were constructed to EPA and industry standards. All downhole equipment (i.e., drill rods, drill bits, etc.) were thoroughly decontaminated between each use with a steam cleaner.

The wells were inspected for the presence of phase-separated hydrocarbons (PSH) and found not to contain any. The wells were properly purged and sampled with clean, dedicated, polyethylene bailers and disposable line. The groundwater samples were submitted to a laboratory for analysis of Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) by method EPA 8021B and chlorides.

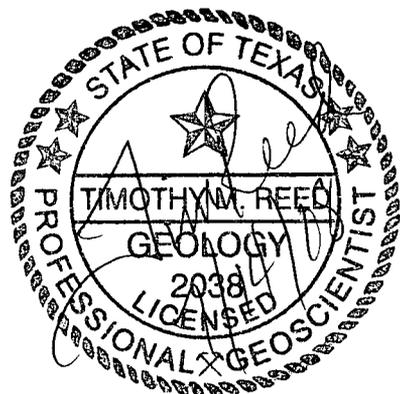
## 9.0 PROPOSED SCHEDULE OF ACTIVITIES

The monitor wells will be surveyed and gauged. Quarterly sampling of the four (4) existing monitor wells will be commenced and all results will be submitted in an annual summary report within the first quarter of 2009.

As an interim abatement plan, OXY proposes to install a 4-inch diameter recovery well in the immediate vicinity of MW-1, in order to initiate recovery of phase separated hydrocarbons



(PSH). The extraction system will utilize a Xitech product pump, and recovered PSH will be placed into above ground storage tanks for appropriate disposition.



Respectfully submitted,  
Highlander-Tetra Tech

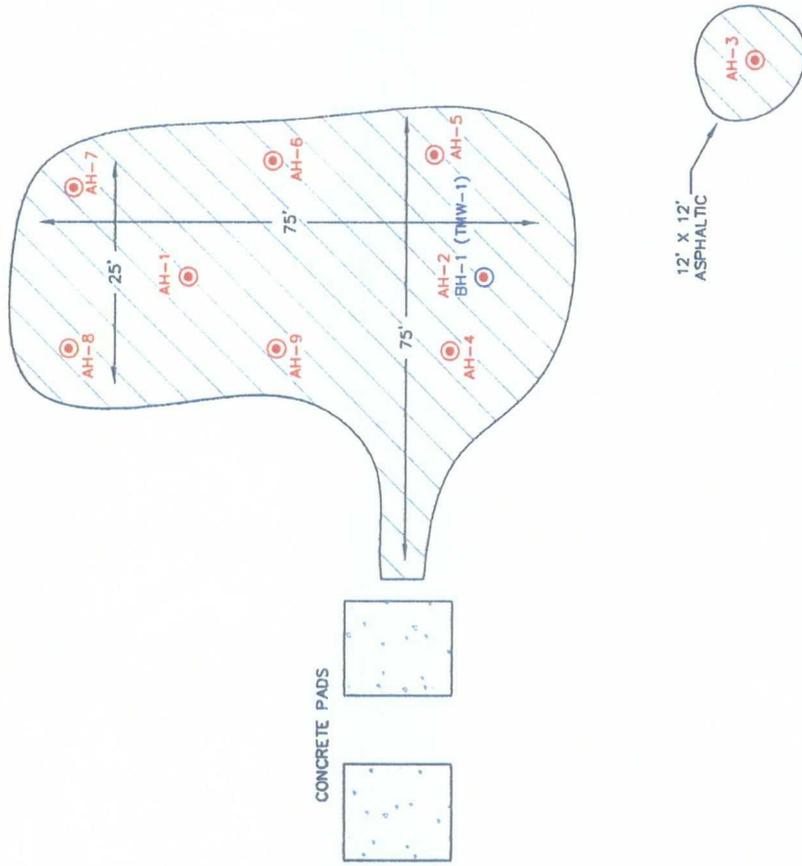
A handwritten signature in cursive script that reads "Tim Reed".

Timothy M. Reed, P.G.  
Senior Project Manager

cc: Daniel Sanchez-NMOCD

enclosures: figures, water well information, boring and completion logs, tables





- BORE HOLES
- ▨ SPILL AREAS
- SAMPLE LOCATIONS

FIGURE NO. 3

LEA COUNTY, NEW MEXICO

OXY USA, INC.

E.C. HILL "B" ATB AT WELL #24

HIGHLANDER ENVIRONMENTAL CORP.  
MIDLAND, TEXAS

DATE: 11/30/06

DRAWN BY: JJ

FILE: C:\WOOD\3817\ E.C. HILL B ATB

NOT TO SCALE

TABLES

Table 1  
 Pogo Producing Company  
 E.C. HILL B ATB AT #24 WELL  
 Lea County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)		Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35					
AH-1	8/10/2006	0-1	<20.0	763	<0.200	<0.200	<0.200	<0.200	<50.0
	8/10/2006	1-1.5	<20.0	912	-	-	-	-	<50.0
	8/10/2006	2-2.5	<20.0	1780	-	-	-	-	<50.0
	8/10/2006	4-4.5	<20.0	9300	<0.200	<0.200	<0.200	<0.200	<50.0
	8/10/2006	6-6.5	39.5	648	-	-	-	-	<50.0
	8/10/2006	8-8.5	43.7	522	-	-	-	-	<50.0
AH-2	8/10/2006	10-10.5	<20.0	85.6	<0.200	<0.200	<0.200	0.331	<50.0
	8/10/2006	0-1	<20.0	627	<0.200	<0.200	<0.200	<0.200	<50.0
	8/10/2006	1-1.5	<20.0	700	-	-	-	-	<50.0
	8/10/2006	2-2.5	<20.0	2800	-	-	-	-	<50.0
	8/10/2006	4-4.5	<20.0	5670	<0.200	<0.200	<0.200	<0.200	<50.0
	8/10/2006	6-6.5	56.7	726	-	-	-	-	<50.0
AH-3	8/10/2006	8-8.5	406	4820	-	-	-	-	<50.0
	8/10/2006	10-10.5	408	3290	<0.200	<0.200	2.88	5.64	<50.0
	8/10/2006	0-1	27.6	636	<0.200	<0.200	<0.200	<0.200	<50.0
	8/10/2006	1-1.5	<20.0	197	-	-	-	-	<50.0
	8/10/2006	2-2.5	<1.00	74.4	<0.0100	<0.0100	<0.0100	<0.0100	<50.0
	8/10/2006	4-4.5	5.73	287	-	-	-	-	-
AH-4	10/25/2007	0-1	5.26	2740	-	-	-	-	-
	10/25/2007	2-2.5	14.90	3750	-	-	-	-	-
	10/25/2007	4-4.5	260	4260	-	-	-	-	-
	10/25/2007	6-6.5	88.20	135	-	-	-	-	-
10/25/2007	8-8.5	223.20							

Table 1  
 Pogo Producing Company  
 E.C. HILL B ATB AT #24 WELL  
 Lea County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)			Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35	Total					
	10/25/2007	10-10.5	787	761	1548	-	-	-	-	-
AH-5	10/25/2007	0-1	7.78	<50.0	7.78	-	-	-	-	-
	10/25/2007	2-2.5	1.86	<50.0	1.86	-	-	-	-	-
	10/25/2007	4-4.5	<1.00	900	900	-	-	-	-	-
	10/25/2007	6-6.5	230	4060	4290	-	-	-	-	-
	10/25/2007	8-8.5	227	2790	3017	-	-	-	-	-
	10/25/2007	10-10.5	258	1470	1728	-	-	-	-	-
AH-6	10/25/2007	0-1	4.45	116	120.45	-	-	-	-	-
	10/25/2007	2-2.5	<1.00	359	359	-	-	-	-	-
	10/25/2007	4-4.5	13.30	16500	16513.30	-	-	-	-	-
	10/25/2007	6-6.5	49.90	1710	1759.90	-	-	-	-	-
	10/25/2007	8-8.5	68.90	926	994.90	-	-	-	-	-
	10/25/2007	10-10.5	73.20	482	555.20	-	-	-	-	-
AH-7	10/25/2007	0-1	4.02	1420	1424.02	-	-	-	-	-
	10/25/2007	2-2.5	1.24	409	410.24	-	-	-	-	-
	10/25/2007	4-4.5	4.54	6110	6114.54	-	-	-	-	-
	10/25/2007	6-6.5	44.70	150	194.70	-	-	-	-	-
	10/25/2007	8-8.5	32.40	70.70	103.10	-	-	-	-	-
	10/25/2007	10-10.5	132	304	436	-	-	-	-	-
AH-8	10/25/2007	0-1	4.93	<50.0	4.9	-	-	-	-	-
	10/25/2007	2-2.5	1.96	318	319.96	-	-	-	-	-
	10/25/2007	4-4.5	12	6200	6212	-	-	-	-	-

Table 1  
 Pogo Producing Company  
 E.C. HILL B ATB AT #24 WELL  
 Lea County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)			Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35	Total					
	10/25/2007	6-6.5	143	430	573	-	-	-	-	-
	10/25/2007	8-8.5	258	1280	1538	-	-	-	-	-
	10/25/2007	10-10.5	10.10	<50.0	10.1	-	-	-	-	-
AH-9	10/25/2007	0-1	3.49	439	442.49	-	-	-	-	-
	10/25/2007	2-2.5	1.20	439	440.20	-	-	-	-	-
	10/25/2007	4-4.5	3.14	4170	4173.14	-	-	-	-	-
	10/25/2007	6-6.5	290	1240	1530	-	-	-	-	-
	10/25/2007	8-8.5	745	5980	6725	-	-	-	-	-
	10/25/2007	10-10.5	134	316	450	-	-	-	-	-

(-) not analyzed

Table 2  
 Pogo Producing Company  
 E.C. HILL B ATB AT WELL #24  
 Lea County, New Mexico

Sample ID	Date Sampled	Sample Depth (ft)	TPH (mg/kg)			Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylene (mg/kg)	Chloride (mg/kg)
			C6-C12	C12-C35	Total					
BH-1	9/13/2006	10-12'	414	5300	5714	<0.200	<0.200	3.18	6.62	-
	9/13/2006	15-17'	563	8000	8563	<0.200	<0.200	4.88	9.80	-
	9/13/2006	20-22'	679	10500	11179	<0.200	<0.200	5.94	13.4	-
	9/13/2006	30-32'	569	4760	5329	<0.200	<0.200	3.85	9.18	-
	9/13/2006	40-42'	506	3900	4406	<0.200	<0.200	4.35	9.83	-
	9/13/2006	50-52'	504	7590	8094	<0.200	0.284	4.48	2.83	-
	9/13/2006	60-62'	253	7670	7923	<0.200	0.390	3.53	3.81	-
	9/13/2006	70-72'	<20.0	<50.0	<50.0	<0.200	<0.200	<0.200	0.585	-

( - ) not analyzed

Table 3  
 Pogo Producing Company  
 E.C. Hill B ATB AT WELL #24  
 Lea County, New Mexico

Sample ID	Date Sampled	Sample Number	TPH (mg/kg)			Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylene (mg/L)	Chloride (mg/L)
			C6-C12	C12-C35	Total					
TMW-1	9/22/2006	104311	-	-	-	<0.00100	<0.00100	0.0310	0.0669	138
TMW-1	9/29/2006	104831	-	-	-	0.00120	<0.00100	0.0143	0.0386	111
TMW-1	10/4/2006	105191	12.0	61.7	73.7	<0.00100	<0.00100	0.0175	0.0970	119
* TMW-1	5/16/2007	124888	* PSH in well (2.68')							

(-) not analyzed

APPENDIX A

**Water Well Data**  
**Average Depth to Groundwater (ft)**  
**E.C. Hill B ATB at Well #24, Lea County, New Mexico**

**22 South 36 East**

6	5	4	3	2	1
195	212				137
7	8	9	10	11	12
18	17	16	15	14	13
		170			
19	20	21	22	23	24
			22		
30	29	28	27	26	25
			160		118
31	32	33	34	35 181	36
				187	

**22 South 37 East**

6	5	85	4	3	2	1
7	8	9	90	10	11	12
18	17	16	15	14	13	
190			125	65		
19	20	21	22	23	24	
		65			60	
30	29	28	27	26	25	
			53	65		
31	32	33	34	35	36	

**22 South 38 East**

6	5	4
7	8	9
18	17	16
19	20	21
30	29	28
31	32	33

**23 South 36 East**

6	5	4	3	2	1
		160			
7	8	9	10	11	12
18	17	16	15	14	13
		220	149		
19	20	21	22	23	24
			400	143	
30	29	28	27	26	25
31	32	33	34	35	36 127
189					

**23 South 37 East**

6	102	5	4	3	70	2	64	1
7	8	9	100	10	11	12		
				66	68			
18	17	16	115	15	14	13		
			100					
19	20	21	22	23	24			
		108						
30	29	28	27	26	25			
			117	88				
31	32	106	33	34	35	36		
		97	87					

**23 South 38 East**

6	5	4
7	8	9
18	17	16
19	20	21
30	29	28
31	32	33

**24 South 36 East**

6	5	4	3	2	1	
		165				
7	8	9	10	11	12	
18	17	16	15	14	13	
			312			
19	20	21	22	23	24	
				160		
30	29	28	27	26	25	
31	32	33	54	34	35	36
		53				

**24 South 37 East**

6	5	4	3	2	1		
	111						
7	8	9	10	11	64	12	18
119	90		120				
18	17	16	15	14	13		
124		67					
19	20	21	22	23	94	24	
		69				100	
30	29	28	27	41	26	25	89
			70			90	
31	32	33	34	35	36		
			55				

**24 South 38 East**

6	5	4	
7	8	9	
18	17	16	
19	20	21	
56			
30	68	29	28
30			
31	32	33	
97			

- 88 New Mexico State Engineers Well Reports
- 105 USGS Well Reports
- 90 Geology and Groundwater Conditions in Southern Lea, County, NM (Report 6)
- Geology and Groundwater Resources of Eddy County, NM (Report 3)
- 34 NMOCD - Groundwater Data

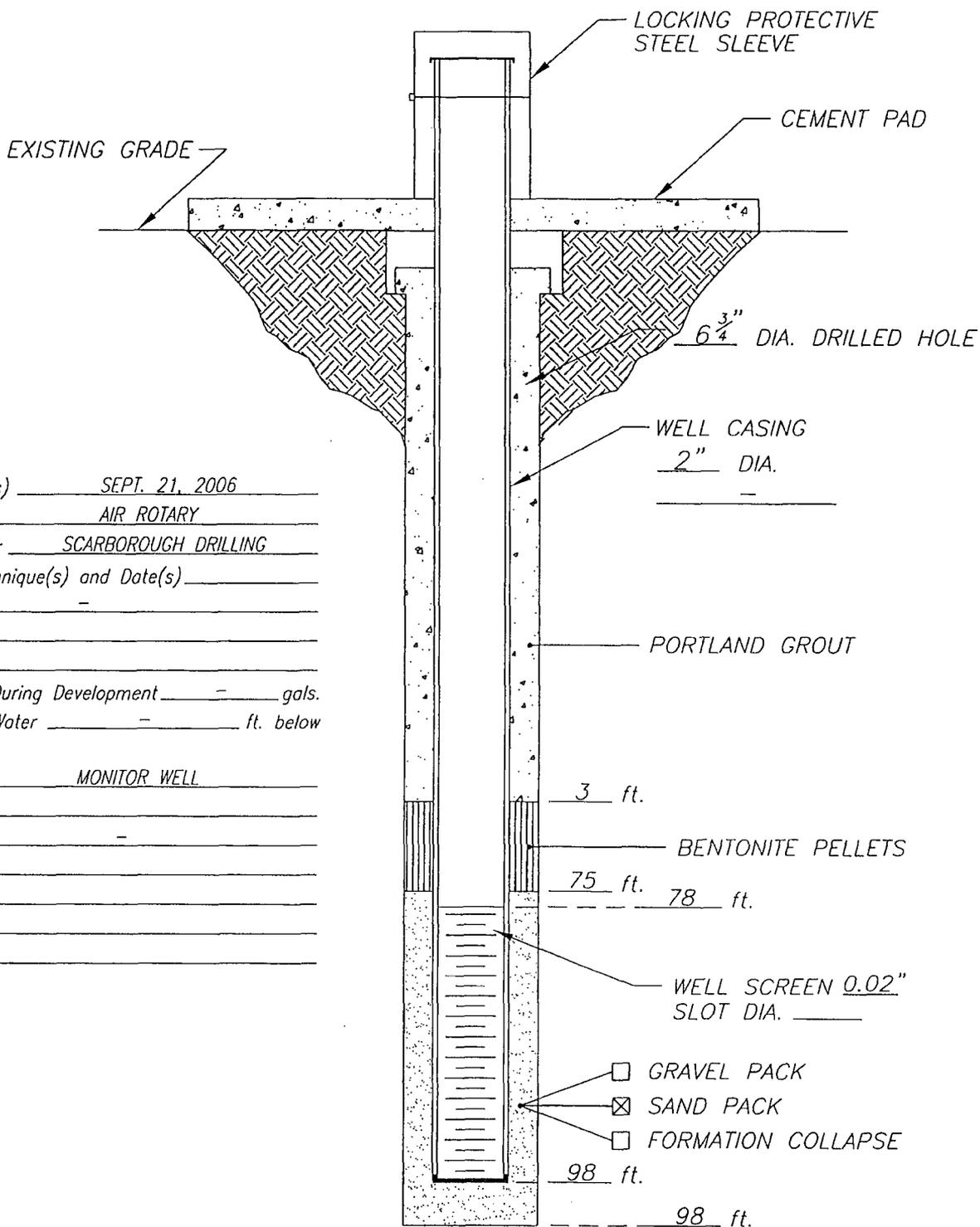
## SAMPLE LOG

Boring/Well: MW-1  
 Project Number: 2617  
 Client: Pogo Production Inc.  
 Site Location: E.C. Hill "B" ATB at Well #24  
 Location: Lea County, New Mexico  
 Total Depth: 98  
 Date Installed: 09/21/06

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Dark brown silty fine grain sand
5-10	--	Dark brown to dark gray silty fine grain sand
10-15	--	Dark brown to dark gray silty fine grain sand
15-20	--	Dark and light gray silty fine grain sand
20-30	--	Tan fine to very fine grain silty sand
30-35	--	Tan/gray very fine silty sand with sandstone at 38 feet
40-50	--	Buff/tan sandstone
50-55	--	Tan sandstone with very fine silty sand
55-60	--	Tan/brown very fine silty sand
60-70	--	Tan very fine silty sand
70-75	--	Tan very fine silty sand
75-80	--	Tan very fine silty sand
80-90	--	Tan very fine silty sand
90-98	--	Tan very fine silty sand

Total Depth is 98 feet      Groundwater encountered at 82 feet below ground surface.

# WELL CONSTRUCTION LOG



Installation Date(s) SEPT. 21, 2006  
 Drilling Method AIR ROTARY  
 Drilling Contractor SCARBOROUGH DRILLING  
 Development Technique(s) and Date(s) \_\_\_\_\_  
 \_\_\_\_\_

Water Removed During Development \_\_\_\_\_ gals.  
 Static Depth to Water \_\_\_\_\_ ft. below  
 Ground Level  
 Well Purpose MONITOR WELL

Remarks \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

- GRAVEL PACK
- SAND PACK
- FORMATION COLLAPSE

DATE: SEPT. 21, 2006  <div style="text-align: center; font-size: 1.2em; font-weight: bold;">             Highlander              Environmental           </div>	CLIENT: POGO PRODUCING INC PROJECT: E.C. HILL "B" ATB AT WELL #24 LOCATION: LEA CO, NM	WELL NO.  <div style="text-align: center; font-size: 1.2em; font-weight: bold;">             MW-1           </div>
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## SAMPLE LOG

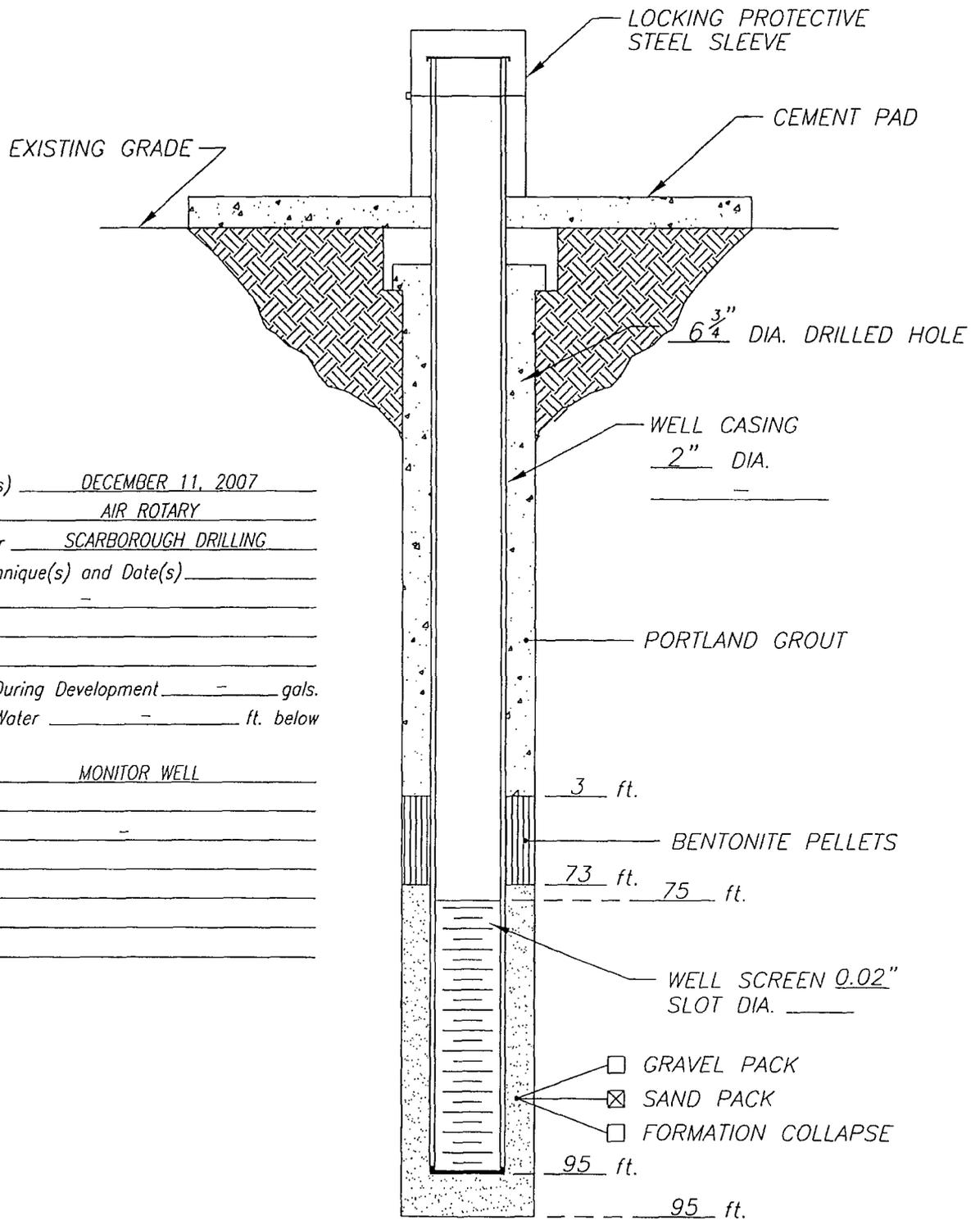
Boring/Well: MW-2  
 Project Number: 2617  
 Client: Pogo Production Inc.  
 Site Location: E.C. Hill "B" ATB at Well #24  
 Location: Lea County, New Mexico  
 Total Depth: 95  
 Date Installed: 12/11/04

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Brown medium grain sand (sugar sand)
5-10	--	Brown medium grain sand (sugar sand)
10-15	--	Brown medium grain sand (sugar sand)
15-20	--	Brown/buff medium grain calcareous sand (70% S)
20-25	--	Yellow/buff calcareous sand (50/50)
25-30	--	Yellow/buff calcareous sand (50/50)
30-35	--	Tan calcareous sand with some sandstone intermixed (70% S)
35-40	--	Tan calcareous sand
40-45	--	Tan calcareous sand with some sandstone intermixed
45-50	--	Tan calcareous sand with some sandstone intermixed
50-55	--	Tan calcareous sand with some sandstone intermixed
55-60	--	Tan calcareous sand with some sandstone intermixed
60-65	--	Tan fine grain sand
65-70	--	Tan fine grain sand
70-75	--	Tan fine to medium grain sand
75-80	--	Tan fine to medium grain sand (beach sand)
80-85	--	Tan fine to medium grains sand (beach sand)
85-90	--	Tan fine to medium grain sand (beach sand)
90-95	--	Tan fine to medium grain sand (beach sand)

Total Depth is 95 feet

Groundwater encountered at 85 feet below ground surface.

# WELL CONSTRUCTION LOG



Installation Date(s) DECEMBER 11, 2007  
 Drilling Method AIR ROTARY  
 Drilling Contractor SCARBOROUGH DRILLING  
 Development Technique(s) and Date(s) \_\_\_\_\_  
 \_\_\_\_\_

Water Removed During Development \_\_\_\_\_ gals.  
 Static Depth to Water \_\_\_\_\_ ft. below  
 Ground Level  
 Well Purpose MONITOR WELL

Remarks \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

- GRAVEL PACK
- SAND PACK
- FORMATION COLLAPSE

DATE: 12/11/07  <div style="font-size: 1.2em; font-weight: bold; text-align: center;">             Highlander              Environmental           </div>	CLIENT: <i>POGO PRODUCING INC</i> PROJECT: <i>E.C. HILL "B" ATB AT WELL #24</i> LOCATION: <i>LEA CO, NM</i>	WELL NO.  <div style="font-size: 1.2em; font-weight: bold;">             MW-2           </div>
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## SAMPLE LOG

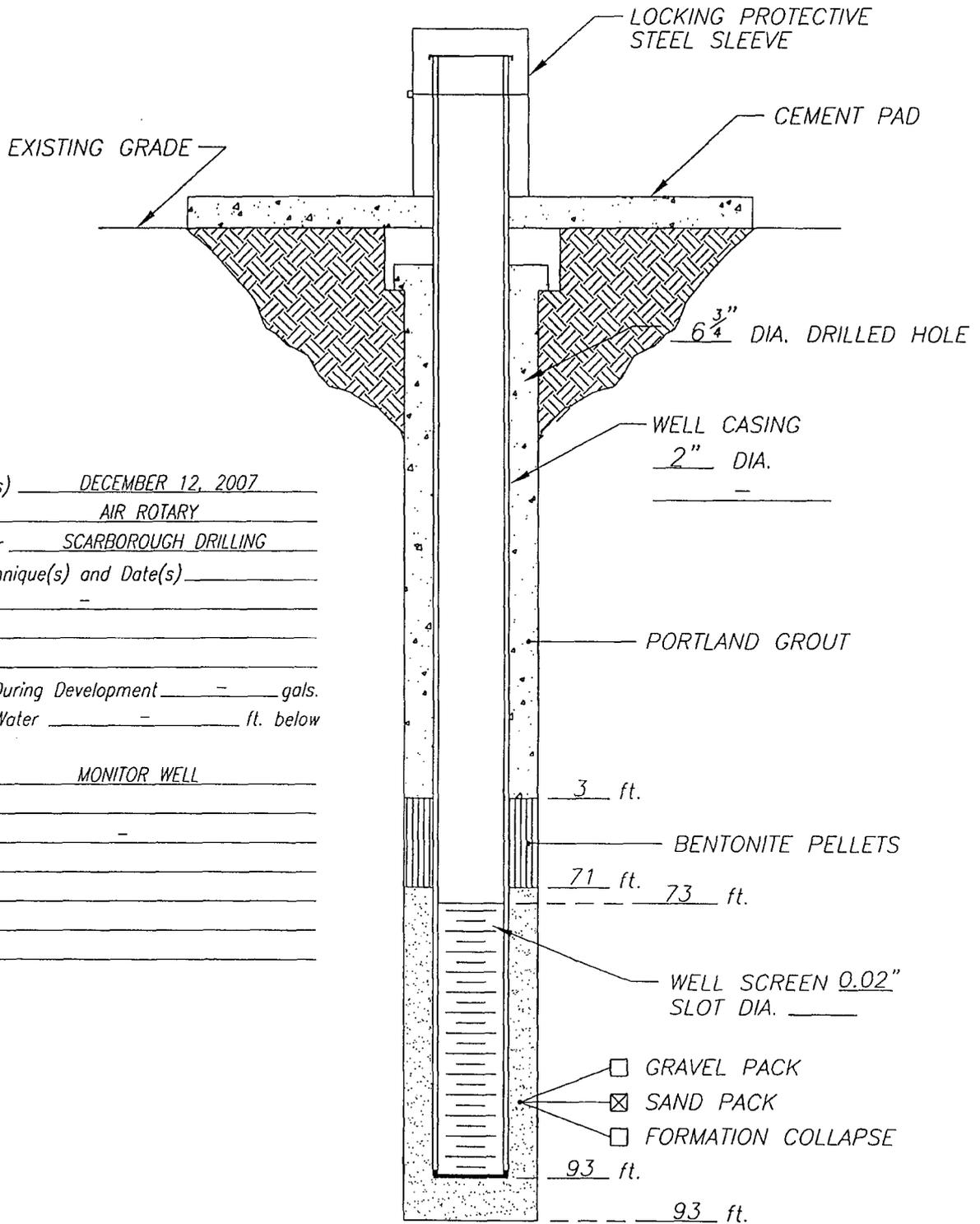
Boring/Well: MW-3  
 Project Number: 2617  
 Client: Pogo Production Inc.  
 Site Location: E.C. Hill "B" ATB at Well #24  
 Location: Lea County, New Mexico  
 Total Depth: 93  
 Date Installed: 12/12/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Tan fine to medium grain well sorted sand
5-10	--	Brown medium grain well sorted sand
10-15	--	Tan fine grain sand
15-20	--	Tan fine grain sand
20-25	--	Tan fine grain sand
25-30	--	Tan fine grain sand
30-35	--	Tan fine grain sand with some limestone (90% sand)
35-40	--	Tan fine grain sand with some limestone (90% sand)
40-45	--	Tan fine grain sand with sandstone intermixed
45-50	--	Tan fine grain sand
50-55	--	Tan fine grain sand with sandstone intermixed
55-60	--	Tan fine grain sand with sandstone intermixed
60-65	--	Tan fine grain sand
65-70	--	Tan fine grain sand
70-75	--	Tan fine grain sand
75-80	--	Tan medium grain sand
80-85	--	Tan medium grain sand
85-90	--	Tan medium grain sand
90-95	--	Tan medium grain sand

Total Depth is 94 feet

Groundwater encountered at 85 feet below ground surface.

# WELL CONSTRUCTION LOG



Installation Date(s) DECEMBER 12, 2007  
 Drilling Method AIR ROTARY  
 Drilling Contractor SCARBOROUGH DRILLING  
 Development Technique(s) and Date(s) \_\_\_\_\_

Water Removed During Development - gals.  
 Static Depth to Water - ft. below  
 Ground Level  
 Well Purpose MONITOR WELL

Remarks \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

DATE: 12/12/07

**Highlander  
Environmental**

CLIENT: *POGO PRODUCING INC*  
 PROJECT: *E.C. HILL "B" ATB AT WELL #24*  
 LOCATION: *LEA CO, NM*

WELL NO.

MW-3

## SAMPLE LOG

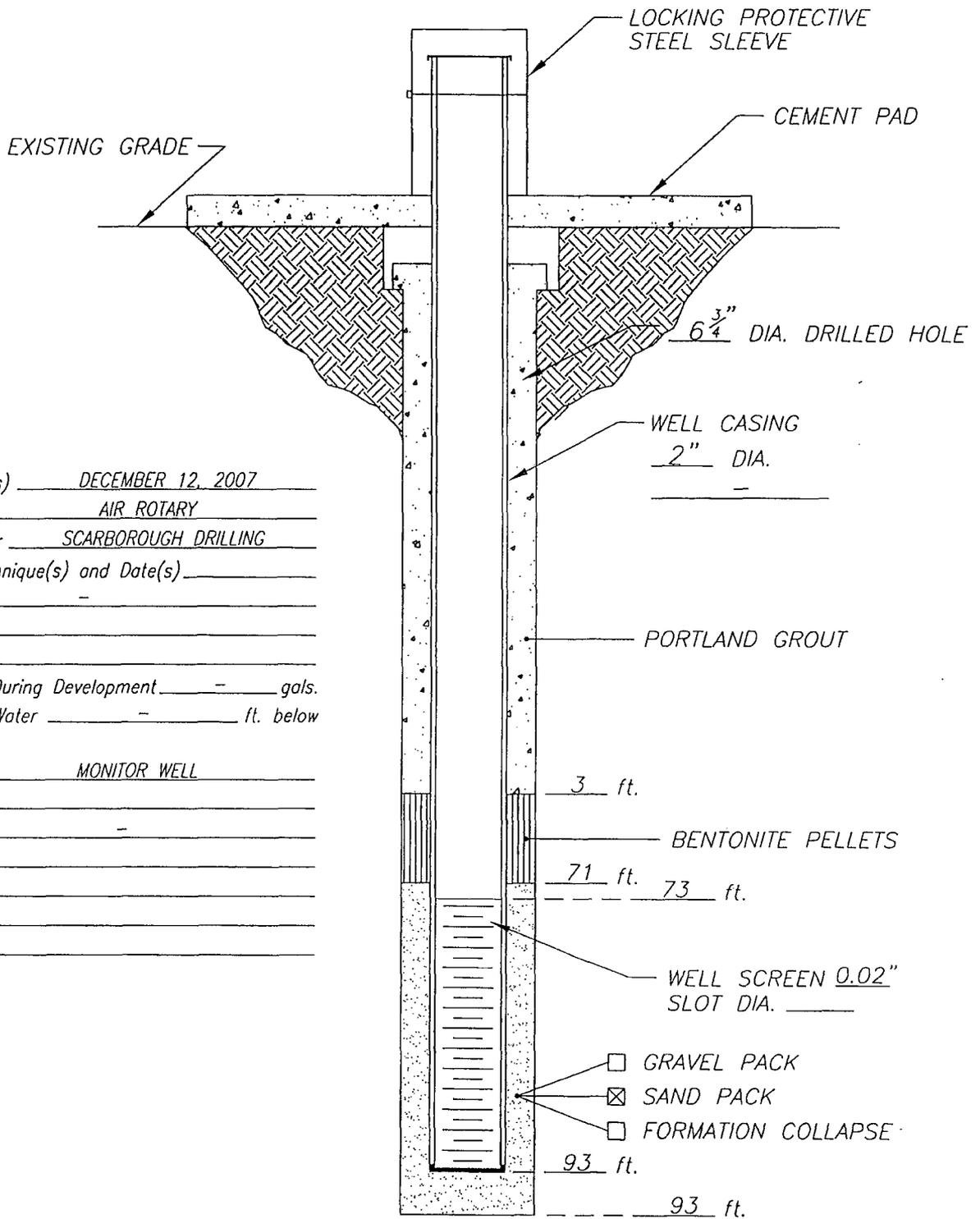
Boring/Well: MW-4  
 Project Number: 2617  
 Client: Pogo Production Inc.  
 Site Location: E.C. Hill "B" ATB at Well #24  
 Location: Lea County, New Mexico  
 Total Depth: 93  
 Date Installed: 12/12/07

DEPTH (Ft)	OVM	SAMPLE DESCRIPTION
0-5	--	Brown fine to medium grain sand
5-10	--	Brown fine to medium grain sand
10-15	--	Brown fine to medium grain sand with some clay intermixed
15-20	--	Buff to tan calcareous sand (50/50)
20-25	--	Tan fine grain well sorted sand
25-30	--	Tan fine grain well sorted sand
30-35	--	Tan to buff calcareous sand (70% sand)
35-40	--	Tan/yellow fine grain sand with sandstone intermixed
40-45	--	Tan/buff calcareous sand (80% sand)
45-50	--	Tan fine grain sand with small amounts of sandstone
50-55	--	Tan fine grain sand with small amounts of sandstone
55-60	--	Tan fine grain well sorted sand
60-65	--	Tan fine grain well sorted sand with small amounts of sandstone
65-70	--	Tan fine grain well sorted sand
70-75	--	Tan fine grain well sorted sand
75-80	--	Tan fine grain well sorted sand
80-85	--	Tan fine grain well sorted sand
85-90	--	Tan fine grain well sorted sand
90-95	--	Tan fine grain well sorted sand

Total Depth is 93 feet

Groundwater encountered at 85 feet below ground surface.

# WELL CONSTRUCTION LOG



Installation Date(s) DECEMBER 12, 2007  
 Drilling Method AIR ROTARY  
 Drilling Contractor SCARBOROUGH DRILLING  
 Development Technique(s) and Date(s) \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Water Removed During Development \_\_\_\_\_ gals.  
 Static Depth to Water \_\_\_\_\_ ft. below  
 Ground Level  
 Well Purpose MONITOR WELL

Remarks \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

DATE: 12/12/07  
**Highlander  
Environmental**

CLIENT: POGO PRODUCING INC  
 PROJECT: E.C. HILL "B" ATB AT WELL #24  
 LOCATION: LEA CO, NM

WELL NO.  
MW-4

FIGURES

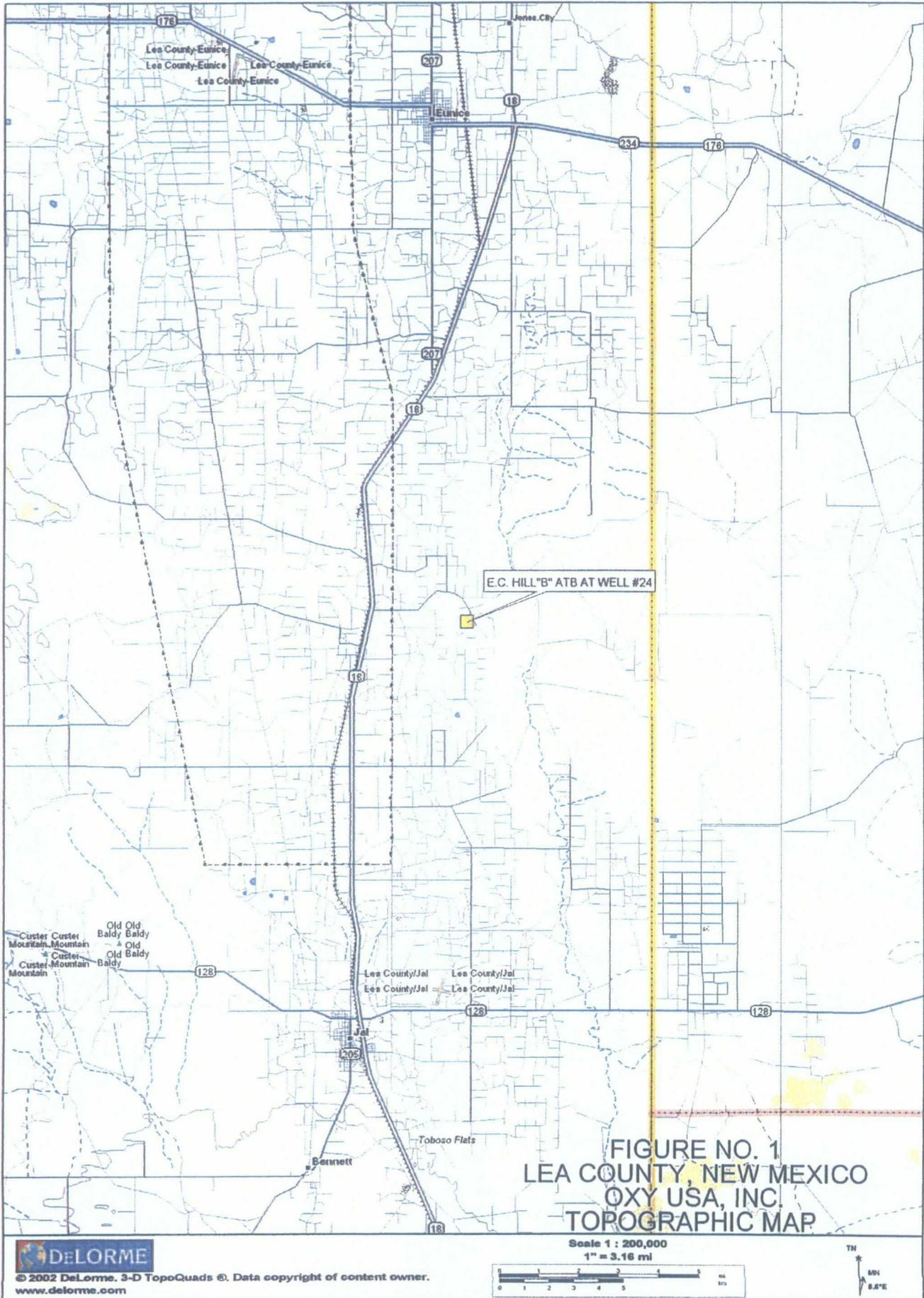


FIGURE NO. 1  
 LEA COUNTY, NEW MEXICO  
 OXY USA, INC.  
 TOPOGRAPHIC MAP



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[www.delorme.com](http://www.delorme.com)

Scale 1 : 200,000  
 1" = 3.16 mi



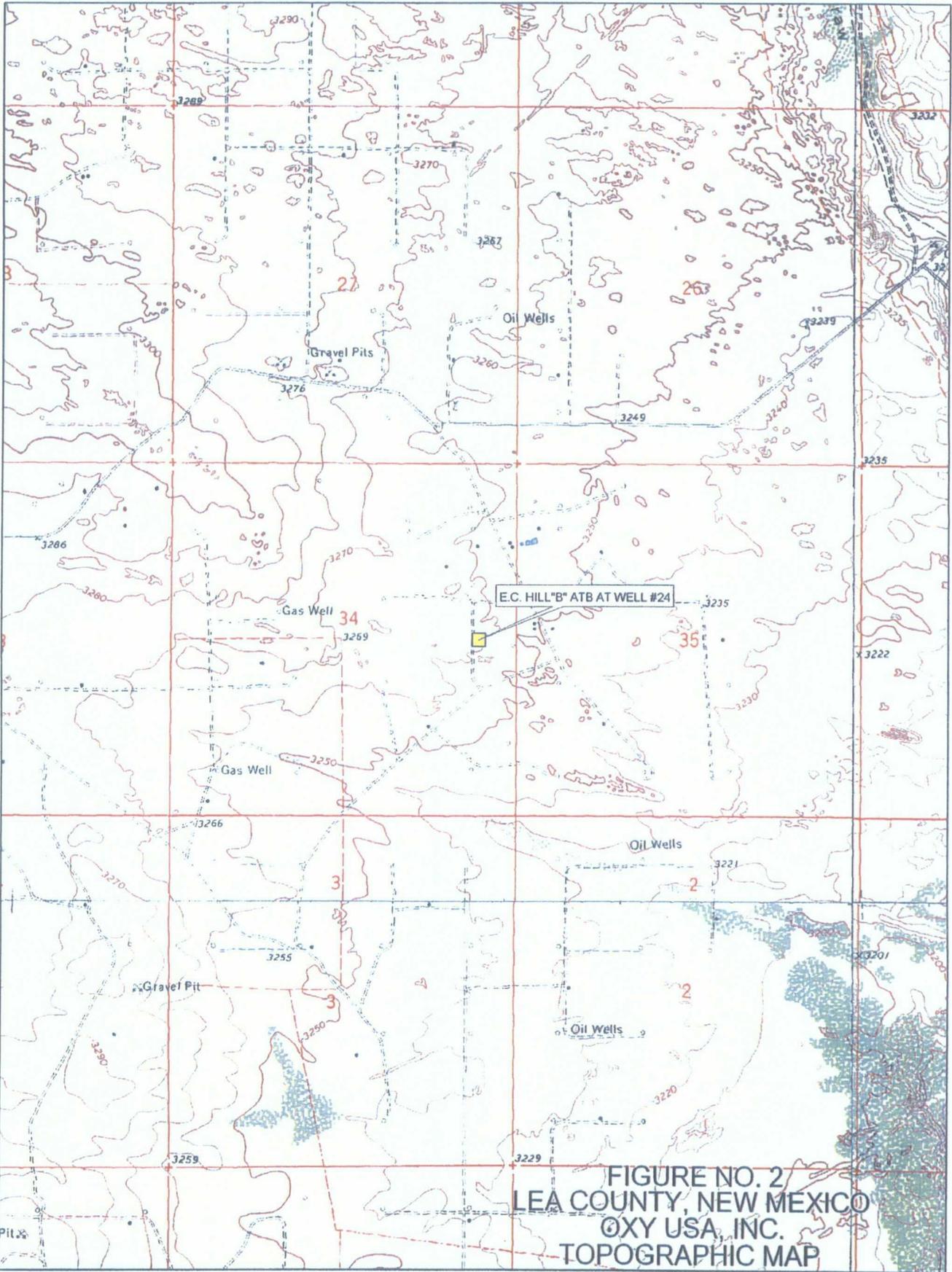


FIGURE NO. 2  
 LEA COUNTY, NEW MEXICO  
 OXY USA, INC.  
 TOPOGRAPHIC MAP



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