



COG Operating LLC

Lea County, NM (NAD27 NME)

Little Bear Federal Com

5H

OH / 63526

Survey: Phoenix MWD Surveys

Standard Survey Report

23 October, 2018





Survey Report



Company:	COG Operating LLC	Local Co-ordinate Reference:	Well 5H
Project:	Lea County, NM (NAD27 NME)	TVD Reference:	RKB @ 3831.50usft (Ensign 155)
Site:	Little Bear Federal Com	MD Reference:	RKB @ 3831.50usft (Ensign 155)
Well:	5H	North Reference:	Grid
Wellbore:	OH / 63526	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Ensign 155)	Database:	USA Compass

Project	Lea County, NM (NAD27 NME)		
Map System:	US State Plane 1927 (Exact solution)	System Datum:	Mean Sea Level
Geo Datum:	NAD 1927 (NADCON CONUS)		
Map Zone:	New Mexico East 3001		

Site	Little Bear Federal Com				
Site Position:		Northing:	555,243.20 usft	Latitude:	32° 31' 26.81346 N
From:	Map	Easting:	737,377.40 usft	Longitude:	103° 33' 47.46075 W
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.41 °

Well	5H					
Well Position	+N/-S	0.00 usft	Northing:	554,915.40 usft	Latitude:	32° 31' 23.71516 N
	+E/-W	0.00 usft	Easting:	735,337.10 usft	Longitude:	103° 34' 11.31681 W
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	3,807.50 usft

Wellbore	OH / 63526				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	MVHD	9/11/2018	6.71	60.43	48,196.89785853

Design	Surveys (Ensign 155)				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)	
	0.00	0.00	0.00	353.66	

Survey Program	Date	10/23/2018			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	10,761.00	Scientific Gyros (OH / 63526)	Scientific Keeper	Scientific Drilling Intl. Standard Wireline Keeper	
10,797.00	18,797.00	Phoenix MWD Surveys (OH / 63526)	MWD+HDGM	OWSG Rev.2 MWD + HDGM	

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
10,761.00	1.64	206.10	10,734.63	-240.02	-517.08	-181.45	0.00	0.00	0.00	
Tie In										
10,797.00	0.56	120.42	10,770.62	-240.57	-517.15	-181.99	4.70	-3.00	-238.00	
First Phoenix MWD Survey										
10,815.00	0.68	94.23	10,788.62	-240.62	-516.97	-182.06	1.69	0.67	-145.50	
10,905.00	1.73	11.27	10,878.61	-239.33	-516.17	-180.87	1.98	1.17	-92.18	
10,952.00	8.22	344.16	10,925.41	-235.40	-516.95	-176.87	14.31	13.81	-57.68	
10,999.00	14.35	343.80	10,971.48	-226.56	-519.50	-167.81	13.04	13.04	-0.77	
11,046.00	20.77	341.28	11,016.26	-213.06	-523.80	-153.92	13.75	13.66	-5.36	



Survey Report



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Site:	Little Bear Federal Com	MD Reference:	RKB @ 3831.50usft (Ensign 155)
Well:	5H	North Reference:	Grid
Wellbore:	OH / 63526	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Ensign 155)	Database:	USA Compass

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
11,093.00	25.09	338.30	11,059.54	-195.90	-530.16	-136.16	9.51	9.19	-6.34	
11,140.00	28.36	339.04	11,101.52	-176.22	-537.84	-115.75	6.99	6.96	1.57	
11,187.00	33.38	340.51	11,141.84	-153.59	-546.16	-92.34	10.80	10.68	3.13	
11,234.00	39.66	340.91	11,179.60	-127.20	-555.39	-65.09	13.37	13.36	0.85	
11,281.00	44.45	341.92	11,214.49	-97.36	-565.40	-34.33	10.29	10.19	2.15	
11,328.00	47.75	345.04	11,247.07	-64.90	-575.01	-1.01	8.49	7.02	6.64	
11,337.00	48.76	345.48	11,253.07	-58.41	-576.71	5.63	11.76	11.18	4.91	
FTP: 11337.00' MD										
11,375.00	53.02	347.21	11,277.03	-29.76	-583.66	34.87	11.76	11.22	4.55	
11,422.00	58.44	349.37	11,303.49	8.26	-591.51	73.53	12.14	11.53	4.60	
11,469.00	63.21	348.33	11,326.40	48.51	-599.46	114.41	10.33	10.15	-2.21	
11,516.00	66.70	349.68	11,346.29	90.30	-607.57	156.84	7.87	7.43	2.87	
11,564.00	71.49	348.97	11,363.41	134.35	-615.88	201.54	10.07	9.98	-1.48	
11,611.00	75.55	347.84	11,376.75	178.49	-624.94	246.41	8.94	8.64	-2.40	
11,657.00	79.55	346.94	11,386.66	222.31	-634.74	291.05	8.90	8.70	-1.96	
11,704.00	84.14	346.09	11,393.33	267.54	-645.59	337.20	9.93	9.77	-1.81	
11,752.00	90.64	345.21	11,395.51	313.97	-657.47	384.65	13.66	13.54	-1.83	
11,846.00	91.20	344.36	11,394.00	404.66	-682.14	477.51	1.08	0.60	-0.90	
11,872.00	91.31	344.50	11,393.43	429.70	-689.11	503.17	0.68	0.42	0.54	
11,967.00	92.89	344.60	11,389.95	521.20	-714.40	596.91	1.67	1.66	0.11	
12,060.00	95.05	346.48	11,383.51	611.03	-737.57	688.74	3.08	2.32	2.02	
12,107.00	96.37	346.40	11,378.84	656.49	-748.54	735.14	2.81	2.81	-0.17	
12,154.00	95.55	348.97	11,373.95	702.16	-758.50	781.63	5.71	-1.74	5.47	
12,186.00	94.06	350.81	11,371.27	733.55	-764.10	813.44	7.38	-4.66	5.75	
12,217.00	92.97	352.42	11,369.37	764.16	-768.61	844.36	6.26	-3.52	5.19	
12,248.00	92.35	353.46	11,367.93	794.89	-772.42	875.33	3.90	-2.00	3.35	
12,295.00	90.48	354.95	11,366.77	841.63	-777.16	922.31	5.09	-3.98	3.17	
12,342.00	88.12	357.46	11,367.35	888.52	-780.27	969.25	7.33	-5.02	5.34	
12,389.00	87.17	359.70	11,369.28	935.46	-781.44	1,016.03	5.17	-2.02	4.77	
12,436.00	87.82	0.49	11,371.33	982.42	-781.36	1,062.69	2.18	1.38	1.68	
12,483.00	90.28	2.25	11,372.11	1,029.39	-780.23	1,109.26	6.44	5.23	3.74	
12,530.00	91.06	2.60	11,371.56	1,076.35	-778.25	1,155.70	1.82	1.66	0.74	
12,577.00	91.51	2.62	11,370.51	1,123.29	-776.11	1,202.12	0.96	0.96	0.04	
12,624.00	89.66	2.14	11,370.03	1,170.24	-774.15	1,248.57	4.07	-3.94	-1.02	
12,718.00	91.20	2.28	11,369.32	1,264.16	-770.53	1,341.52	1.65	1.64	0.15	
12,812.00	91.06	1.99	11,367.47	1,358.08	-767.03	1,434.48	0.34	-0.15	-0.31	
12,906.00	90.20	0.53	11,366.44	1,452.05	-764.96	1,527.64	1.80	-0.91	-1.55	
13,000.00	91.29	0.08	11,365.21	1,546.04	-764.46	1,621.00	1.25	1.16	-0.48	
13,094.00	90.42	359.93	11,363.81	1,640.03	-764.45	1,714.41	0.94	-0.93	-0.16	
13,188.00	91.43	0.21	11,362.29	1,734.01	-764.34	1,807.81	1.11	1.07	0.30	
13,282.00	91.23	359.84	11,360.11	1,827.99	-764.30	1,901.21	0.45	-0.21	-0.39	
13,375.00	90.00	358.96	11,359.11	1,920.97	-765.27	1,993.73	1.63	-1.32	-0.95	
13,469.00	91.06	358.99	11,358.24	2,014.95	-766.95	2,087.32	1.13	1.13	0.03	
13,563.00	92.83	359.46	11,355.05	2,108.89	-768.22	2,180.82	1.95	1.88	0.50	



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Design:	Surveys (Ensign 155)	Database:	USA Compass

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
13,657.00	92.21	359.24	11,350.92	2,202.79	-769.29	2,274.27	0.70	-0.66	-0.23	
13,751.00	91.06	358.92	11,348.24	2,296.74	-770.80	2,367.81	1.27	-1.22	-0.34	
13,844.00	90.03	358.01	11,347.36	2,389.70	-773.29	2,460.48	1.48	-1.11	-0.98	
13,939.00	91.07	358.13	11,346.44	2,484.64	-776.49	2,555.19	1.10	1.09	0.13	
14,033.00	92.99	358.10	11,343.11	2,578.52	-779.58	2,648.84	2.04	2.04	-0.03	
14,128.00	95.10	358.19	11,336.41	2,673.23	-782.65	2,743.31	2.22	2.22	0.09	
14,222.00	94.91	358.95	11,328.21	2,766.84	-784.98	2,836.61	0.83	-0.20	0.81	
14,316.00	92.66	359.79	11,322.01	2,860.63	-786.01	2,929.93	2.55	-2.39	0.89	
14,410.00	92.91	0.05	11,317.44	2,954.52	-786.14	3,023.26	0.38	0.27	0.28	
14,504.00	94.26	1.07	11,311.56	3,048.32	-785.23	3,116.39	1.80	1.44	1.09	
14,598.00	93.84	1.89	11,304.92	3,142.06	-782.81	3,209.28	0.98	-0.45	0.87	
14,692.00	93.45	1.24	11,298.95	3,235.83	-780.24	3,302.20	0.81	-0.41	-0.69	
14,786.00	92.77	1.09	11,293.85	3,329.67	-778.34	3,395.26	0.74	-0.72	-0.16	
14,880.00	93.62	1.01	11,288.61	3,423.51	-776.62	3,488.33	0.91	0.90	-0.09	
14,974.00	93.28	0.07	11,282.95	3,517.33	-775.73	3,581.48	1.06	-0.36	-1.00	
15,068.00	94.43	359.64	11,276.63	3,611.12	-775.97	3,674.72	1.31	1.22	-0.46	
15,162.00	94.57	358.85	11,269.26	3,704.82	-777.20	3,767.99	0.85	0.15	-0.84	
15,256.00	93.17	358.32	11,262.91	3,798.57	-779.52	3,861.42	1.59	-1.49	-0.56	
15,350.00	90.92	359.13	11,259.56	3,892.48	-781.61	3,954.99	2.54	-2.39	0.86	
15,444.00	91.09	359.69	11,257.91	3,986.47	-782.58	4,048.50	0.62	0.18	0.60	
15,538.00	90.25	0.40	11,256.81	4,080.46	-782.50	4,141.91	1.17	-0.89	0.76	
15,632.00	90.48	0.95	11,256.21	4,174.45	-781.40	4,235.21	0.63	0.24	0.59	
15,726.00	91.85	1.14	11,254.30	4,268.41	-779.68	4,328.40	1.47	1.46	0.20	
15,820.00	91.82	0.16	11,251.29	4,362.36	-778.62	4,421.66	1.04	-0.03	-1.04	
15,914.00	90.59	359.36	11,249.31	4,456.33	-779.01	4,515.10	1.56	-1.31	-0.85	
16,008.00	90.64	359.26	11,248.30	4,550.32	-780.14	4,608.64	0.12	0.05	-0.11	
16,101.00	92.02	359.51	11,246.15	4,643.29	-781.14	4,701.15	1.51	1.48	0.27	
16,195.00	92.19	359.72	11,242.69	4,737.22	-781.77	4,794.58	0.29	0.18	0.22	
16,289.00	90.67	359.99	11,240.35	4,831.19	-782.01	4,888.00	1.64	-1.62	0.29	
16,383.00	89.83	359.86	11,239.94	4,925.19	-782.13	4,981.43	0.90	-0.89	-0.14	
16,477.00	90.34	0.11	11,239.80	5,019.19	-782.16	5,074.86	0.60	0.54	0.27	
16,570.00	91.79	0.06	11,238.07	5,112.17	-782.02	5,167.26	1.56	1.56	-0.05	
16,664.00	92.21	359.91	11,235.14	5,196.12	-782.04	5,250.70	0.53	0.50	-0.18	
16,747.00	91.60	359.05	11,232.05	5,289.06	-782.88	5,343.16	1.13	-0.66	-0.92	
16,841.00	90.14	358.42	11,230.62	5,383.02	-784.96	5,436.78	1.69	-1.55	-0.67	
16,935.00	89.97	358.22	11,230.53	5,476.98	-787.71	5,530.47	0.28	-0.18	-0.21	
17,029.00	90.62	357.95	11,230.04	5,570.93	-790.86	5,624.19	0.75	0.69	-0.29	
17,123.00	91.23	357.85	11,228.53	5,664.85	-794.30	5,717.92	0.66	0.65	-0.11	
17,230.00	92.10	357.55	11,225.42	5,771.72	-798.59	5,824.61	0.86	0.81	-0.28	
17,324.00	91.06	357.93	11,222.83	5,865.61	-802.30	5,918.33	1.18	-1.11	0.40	
17,418.00	89.80	358.18	11,222.12	5,959.55	-805.49	6,012.05	1.37	-1.34	0.27	
17,512.00	90.03	358.53	11,222.26	6,053.51	-808.19	6,105.74	0.45	0.24	0.37	
17,606.00	90.22	358.82	11,222.06	6,147.49	-810.36	6,199.38	0.37	0.20	0.31	



Survey Report



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Project:	Lea County, NM (NAD27 NME)	TVD Reference:	RKB @ 3831.50usft (Ensign 155)
Site:	Little Bear Federal Com	MD Reference:	RKB @ 3831.50usft (Ensign 155)
Well:	5H	North Reference:	Grid
Wellbore:	OH / 63526	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Ensign 155)	Database:	USA Compass

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	
17,699.00	90.50	358.99	11,221.47	6,240.47	-812.14	6,291.98	0.35	0.30	0.18	
17,793.00	90.59	359.05	11,220.58	6,334.45	-813.74	6,385.57	0.12	0.10	0.06	
17,887.00	90.76	359.41	11,219.47	6,428.43	-815.01	6,479.12	0.42	0.18	0.38	
17,982.00	90.92	359.87	11,218.08	6,523.42	-815.60	6,573.59	0.51	0.17	0.48	
18,076.00	90.81	359.89	11,216.66	6,617.41	-815.80	6,667.03	0.12	-0.12	0.02	
18,170.00	90.98	0.51	11,215.19	6,711.40	-815.47	6,760.40	0.68	0.18	0.66	
18,264.00	90.95	0.29	11,213.61	6,805.38	-814.82	6,853.74	0.24	-0.03	-0.23	
18,358.00	90.98	0.62	11,212.02	6,899.37	-814.07	6,947.07	0.35	0.03	0.35	
18,452.00	90.95	0.91	11,210.44	6,993.34	-812.82	7,040.33	0.31	-0.03	0.31	
18,546.00	90.92	1.00	11,208.91	7,087.32	-811.25	7,133.56	0.10	-0.03	0.10	
18,641.00	90.90	1.21	11,207.40	7,182.29	-809.42	7,227.75	0.22	-0.02	0.22	
18,667.36	90.92	1.36	11,206.98	7,208.64	-808.83	7,253.87	0.57	0.09	0.57	
LTP: 18667.40' MD										
18,731.00	90.98	1.72	11,205.92	7,272.25	-807.12	7,316.90	0.57	0.09	0.57	
Final Phoenix MWD Survey										
18,797.00	90.98	1.72	11,204.79	7,338.21	-805.14	7,382.24	0.00	0.00	0.00	
Projection to TD										

Design Targets										
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Northing (usft)	Easting (usft)	Latitude	Longitude	
BHL v4 - Little Bear Fed	0.00	0.00	11,211.00	7,338.50	-815.80	562,253.90	734,521.30	32° 32' 36.38747 N	103° 34' 20.23218 W	
- hit/miss target										
- Shape										
- survey misses target center by 12.34usft at 18796.87usft MD (11204.79 TVD, 7338.07 N, -805.14 E)										
- Point										
LTP v4 - Little Bear Fed	0.00	0.00	11,212.77	7,208.64	-814.65	562,124.04	734,522.45	32° 32' 35.10240 N	103° 34' 20.22960 W	
- survey misses target center by 8.21usft at 18667.14usft MD (11206.98 TVD, 7208.41 N, -808.83 E)										
- Point										
FTP v3 - Little Bear Fed	0.00	0.00	11,407.00	-59.73	-760.57	554,855.68	734,576.53	32° 31' 23.17800 N	103° 34' 20.20440 W	
- survey misses target center by 208.36usft at 11442.80usft MD (11314.05 TVD, 25.86 N, -594.89 E)										
- Point										

Survey Annotations					
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment	
		+N/-S (usft)	+E/-W (usft)		
10,761.00	10,734.63	-240.02	-517.08	Tie In	
10,797.00	10,770.62	-240.57	-517.15	First Phoenix MWD Survey	
11,337.00	11,253.07	-58.41	-576.71	FTP: 11337.00' MD	
18,667.36	11,206.98	7,208.64	-808.83	LTP: 18667.40' MD	
18,731.00	11,205.92	7,272.25	-807.12	Final Phoenix MWD Survey	
18,797.00	11,204.79	7,338.21	-805.14	Projection to TD	

Sante Fe Main Office
Phone: (505) 476-3441

General Information
Phone: (505) 629-6116

Online Phone Directory
<https://www.emnrd.nm.gov/ocd/contact-us>

State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 552833

CONDITIONS

Operator: COG OPERATING LLC 600 W Illinois Ave Midland, TX 79701	OGRID: 229137
	Action Number: 552833
	Action Type: [C-103] Sub. Drilling (C-103N)

CONDITIONS

Created By	Condition	Condition Date
plmartinez	None	2/11/2026