



COG Operating LLC

Eddy County, NM (NAD-27 2015)

Halberd 27 State Com #1H

API #: 30-015-42967

SHL: 1003' FSL, 65' FWL, Sec 26, T17S, R28E, Unit M

PP: 937' FSL, 330' FEL, Sec 27, T17S, R28E, Unit P

BHL: 914' FSL, 365' FWL, Sec 27, T17S, R28E, Unit M

Design: BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M

Standard Survey Report

19 October, 2016





TDS
Survey Report



Company:	COG Operating LLC	Local Co-ordinate Reference:	Well SHL: 1003' FSL, 65' FWL, Sec 26, T17S, R28E, Unit M
Project:	Eddy County, NM (NAD-27 2015)	TVD Reference:	KB @ 3698.00usft (Silver Oak 3)
Site:	Halberd 27 State Com #1H	MD Reference:	KB @ 3698.00usft (Silver Oak 3)
Well:	SHL: 1003' FSL, 65' FWL, Sec 26, T17S, R28E, Unit M	North Reference:	Grid
Wellbore:	BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M	Survey Calculation Method:	Minimum Curvature
Design:	BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M	Database:	EDM 5000.1 Single User Db

Project	Eddy County, NM (NAD-27 2015)		
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	Halberd 27 State Com #1H		
Site Position:		Northing:	655,242.30 usft
From:	Map	Easting:	554,871.00 usft
Position Uncertainty:	0.00 usft	Slot Radius:	13.20 in
		Latitude:	32° 48' 4.403 N
		Longitude:	104° 9' 17.125 W
		Grid Convergence:	0.10 °

Well	SHL: 1003' FSL, 65' FWL, Sec 26, T17S, R28E, Unit M		
Well Position	+N/-S	0.00 usft	Northing: 655,242.30 usft
	+E/-W	0.00 usft	Easting: 554,871.00 usft
Position Uncertainty	0.00 usft	Wellhead Elevation:	0.00 usft
		Latitude:	32° 48' 4.403 N
		Longitude:	104° 9' 17.125 W
		Ground Level:	3,680.00 usft

Wellbore	BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	9/25/2016	7.35	60.51	48,291

Design	BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M			
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	268.23

Survey Program	Date	10/19/2016			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	890.30	Scientific Gyro #1 (BHL: 913' FSL, 350' FW	Scientific Gyro	Scientific Drilling Intl	
964.00	8,798.00	TDS MWD #2 (BHL: 913' FSL, 350' FWL, S	MWD	MWD - Standard	

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)	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
100.00	0.22	168.76	100.00	-0.19	0.04	-0.03	0.22	0.22	0.00	
125.00	0.17	175.48	125.00	-0.27	0.05	-0.04	0.22	-0.20	26.88	
150.00	0.16	176.00	150.00	-0.34	0.06	-0.04	0.04	-0.04	2.08	
175.00	0.14	175.38	175.00	-0.41	0.06	-0.05	0.08	-0.08	-2.48	
200.00	0.15	224.74	200.00	-0.46	0.04	-0.03	0.49	0.04	197.44	



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Wellbore:	BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M	Survey Calculation Method:	Minimum Curvature
Design:	BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M	Database:	EDM 5000.1 Single User Db

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)
225.00	0.12	217.07	225.00	-0.51	0.00	0.02	0.14	-0.12	-30.68
250.00	0.14	239.41	250.00	-0.54	-0.04	0.06	0.22	0.08	89.36
275.00	0.15	298.35	275.00	-0.54	-0.10	0.11	0.57	0.04	235.76
300.00	0.10	27.59	300.00	-0.51	-0.12	0.13	0.72	-0.20	356.96
325.00	0.14	15.62	325.00	-0.46	-0.10	0.11	0.19	0.16	-47.88
350.00	0.13	10.56	350.00	-0.40	-0.08	0.10	0.06	-0.04	-20.24
375.00	0.18	33.68	375.00	-0.34	-0.06	0.07	0.32	0.20	92.48
400.00	0.28	20.74	400.00	-0.25	-0.01	0.02	0.45	0.40	-51.76
425.00	0.19	29.37	425.00	-0.16	0.03	-0.02	0.39	-0.36	34.52
450.00	0.21	38.52	450.00	-0.09	0.08	-0.07	0.15	0.08	36.60
475.00	0.26	27.73	475.00	0.00	0.13	-0.13	0.27	0.20	-43.16
500.00	0.19	25.90	500.00	0.09	0.18	-0.18	0.28	-0.28	-7.32
525.00	0.28	21.39	525.00	0.18	0.22	-0.22	0.37	0.36	-18.04
550.00	0.20	34.06	550.00	0.27	0.26	-0.27	0.38	-0.32	50.68
575.00	0.25	33.57	575.00	0.36	0.32	-0.33	0.20	0.20	-1.96
600.00	0.28	26.49	600.00	0.46	0.38	-0.39	0.18	0.12	-28.32
625.00	0.25	17.51	625.00	0.56	0.42	-0.44	0.20	-0.12	-35.92
650.00	0.23	13.95	650.00	0.66	0.45	-0.47	0.10	-0.08	-14.24
675.00	0.26	359.30	675.00	0.77	0.46	-0.48	0.28	0.12	-58.60
700.00	0.20	345.75	700.00	0.87	0.45	-0.47	0.32	-0.24	-54.20
725.00	0.25	355.05	725.00	0.96	0.43	-0.46	0.25	0.20	37.20
750.00	0.21	19.20	750.00	1.06	0.44	-0.48	0.42	-0.16	96.60
775.00	0.18	11.87	775.00	1.14	0.47	-0.50	0.16	-0.12	-29.32
800.00	0.12	89.18	800.00	1.18	0.50	-0.54	0.77	-0.24	309.24
825.00	0.12	2.59	825.00	1.21	0.53	-0.57	0.66	0.00	-346.36
850.00	0.35	342.09	850.00	1.31	0.51	-0.55	0.97	0.92	-82.00
875.00	0.16	347.90	875.00	1.41	0.47	-0.52	0.77	-0.76	23.24
890.30	0.13	344.43	890.29	1.45	0.47	-0.51	0.20	-0.20	-22.68
Tie-In to Scientific Gyro									
964.00	0.30	264.20	963.99	1.51	0.25	-0.30	0.42	0.23	-108.86
First TDS MWD Survey									
1,027.00	0.70	163.30	1,026.99	1.13	0.20	-0.23	1.29	0.63	-160.16
1,121.00	2.60	118.40	1,120.95	-0.44	2.24	-2.22	2.30	2.02	-47.77
1,215.00	4.70	114.20	1,214.76	-3.03	7.63	-7.53	2.25	2.23	-4.47
1,310.00	6.30	103.20	1,309.32	-5.82	16.25	-16.07	2.01	1.68	-11.58
1,404.00	8.10	102.40	1,402.57	-8.42	27.74	-27.47	1.92	1.91	-0.85
1,498.00	7.80	103.10	1,495.67	-11.28	40.42	-40.06	0.34	-0.32	0.74
1,593.00	8.40	101.90	1,589.72	-14.18	53.49	-53.03	0.66	0.63	-1.26
1,687.00	9.40	100.70	1,682.59	-17.02	67.75	-67.20	1.08	1.06	-1.28
1,782.00	9.50	103.10	1,776.30	-20.23	83.01	-82.35	0.43	0.11	2.53
1,876.00	9.10	104.50	1,869.06	-23.85	97.76	-96.98	0.49	-0.43	1.49



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Survey									
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1,971.00	10.20	99.70	1,962.72	-27.15	113.33	-112.44	1.43	1.16	-5.05
2,066.00	10.50	98.60	2,056.17	-29.86	130.18	-129.20	0.38	0.32	-1.16
2,160.00	9.90	100.70	2,148.69	-32.64	146.59	-145.51	0.75	-0.64	2.23
2,254.00	9.90	102.70	2,241.29	-35.92	162.41	-161.23	0.37	0.00	2.13
2,348.00	10.30	103.20	2,333.83	-39.62	178.48	-177.17	0.44	0.43	0.53
2,443.00	9.70	102.40	2,427.39	-43.27	194.56	-193.13	0.65	-0.63	-0.84
2,537.00	9.80	101.60	2,520.03	-46.58	210.13	-208.59	0.18	0.11	-0.85
2,632.00	9.90	103.10	2,613.63	-50.06	226.01	-224.35	0.29	0.11	1.58
2,726.00	8.80	105.00	2,706.38	-53.75	240.82	-239.05	1.22	-1.17	2.02
2,821.00	7.30	106.00	2,800.44	-57.30	253.65	-251.75	1.59	-1.58	1.05
2,915.00	6.20	103.10	2,893.79	-60.09	264.33	-262.35	1.22	-1.17	-3.09
3,010.00	4.50	107.40	2,988.37	-62.37	272.88	-270.83	1.84	-1.79	4.53
3,104.00	2.40	119.70	3,082.20	-64.45	278.11	-275.99	2.36	-2.23	13.09
3,167.00	1.10	118.90	3,145.17	-65.40	279.79	-277.63	2.06	-2.06	-1.27
3,199.00	0.20	67.60	3,177.17	-65.52	280.11	-277.95	3.09	-2.81	-160.31
3,230.00	1.10	290.30	3,208.16	-65.40	279.88	-277.73	4.05	2.90	-442.90
3,262.00	3.50	286.50	3,240.14	-65.02	278.65	-276.51	7.51	7.50	-11.88
3,293.00	6.60	284.80	3,271.01	-64.29	276.02	-273.91	10.01	10.00	-5.48
3,325.00	10.10	284.50	3,302.67	-63.12	271.53	-269.45	10.94	10.94	-0.94
3,356.00	13.60	282.80	3,333.00	-61.63	265.34	-263.31	11.35	11.29	-5.48
3,388.00	17.50	279.80	3,363.82	-59.98	256.93	-254.95	12.44	12.19	-9.38
3,419.00	21.60	277.70	3,393.03	-58.42	246.68	-244.75	13.42	13.23	-6.77
3,450.00	25.60	274.80	3,421.43	-57.09	234.34	-232.47	13.43	12.90	-9.35
3,482.00	29.20	269.50	3,449.84	-56.58	219.64	-217.79	13.58	11.25	-16.56
3,514.00	32.90	265.70	3,477.26	-57.30	203.16	-201.29	13.08	11.56	-11.88
3,545.00	35.80	264.20	3,502.85	-58.85	185.74	-183.83	9.74	9.35	-4.84
3,576.00	38.80	264.50	3,527.51	-60.70	167.05	-165.09	9.70	9.68	0.97
3,608.00	41.90	266.10	3,551.89	-62.39	146.40	-144.41	10.21	9.69	5.00
3,639.00	44.40	267.80	3,574.51	-63.51	125.23	-123.21	8.89	8.06	5.48
3,671.00	45.80	268.50	3,597.09	-64.24	102.58	-100.55	4.64	4.38	2.19
3,702.00	46.30	268.50	3,618.61	-64.82	80.27	-78.23	1.61	1.61	0.00
3,734.00	46.50	268.40	3,640.68	-65.45	57.10	-55.06	0.66	0.63	-0.31
3,765.00	46.60	268.20	3,662.00	-66.12	34.61	-32.55	0.57	0.32	-0.65
3,797.00	46.80	268.00	3,683.94	-66.89	11.33	-9.26	0.77	0.63	-0.63
3,828.00	46.90	267.90	3,705.14	-67.70	-11.27	13.35	0.40	0.32	-0.32
3,859.00	48.00	267.80	3,726.11	-68.55	-34.09	36.19	3.56	3.55	-0.32
3,891.00	50.80	267.10	3,746.93	-69.64	-58.36	60.48	8.91	8.75	-2.19
3,922.00	53.80	268.00	3,765.88	-70.68	-82.86	85.01	9.95	9.68	2.90
3,954.00	57.70	268.80	3,783.89	-71.42	-109.30	111.45	12.36	12.19	2.50
3,985.00	61.60	269.40	3,799.55	-71.83	-136.04	138.19	12.69	12.58	1.94
4,017.00	66.00	270.00	3,813.68	-71.98	-164.74	166.89	13.85	13.75	1.88



TDS
Survey Report



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4,048.00	68.20	270.60	3,825.74	-71.83	-193.30	195.43	7.32	7.10	1.94
4,080.00	69.60	270.50	3,837.26	-71.54	-223.15	225.25	4.38	4.38	-0.31
4,111.00	71.60	270.20	3,847.55	-71.37	-252.39	254.47	6.52	6.45	-0.97
4,142.00	74.40	269.70	3,856.62	-71.39	-282.03	284.10	9.16	9.03	-1.61
4,174.00	77.50	269.30	3,864.38	-71.66	-313.07	315.13	9.76	9.69	-1.25
4,205.00	79.30	269.10	3,870.62	-72.09	-343.43	345.49	5.84	5.81	-0.65
4,237.00	80.80	268.80	3,876.15	-72.67	-374.94	377.01	4.78	4.69	-0.94
4,257.96	81.88	268.60	3,879.30	-73.14	-395.66	397.73	5.25	5.16	-0.97
As-Drilled PP									
4,268.00	82.40	268.50	3,880.68	-73.39	-405.60	407.68	5.25	5.16	-0.97
4,300.00	86.00	267.90	3,883.91	-74.39	-437.42	439.51	11.40	11.25	-1.88
4,332.00	89.30	267.70	3,885.22	-75.62	-469.36	471.47	10.33	10.31	-0.63
4,363.00	90.00	267.40	3,885.41	-76.94	-500.33	502.47	2.46	2.26	-0.97
4,395.00	90.50	267.10	3,885.27	-78.48	-532.30	534.47	1.82	1.56	-0.94
4,431.00	90.90	266.60	3,884.83	-80.45	-568.24	570.45	1.78	1.11	-1.39
4,525.00	90.30	269.10	3,883.85	-83.98	-662.16	664.44	2.73	-0.64	2.66
4,620.00	90.20	269.20	3,883.43	-85.39	-757.15	759.42	0.15	-0.11	0.11
4,714.00	89.80	269.30	3,883.43	-86.62	-851.14	853.41	0.44	-0.43	0.11
4,809.00	91.00	269.80	3,882.77	-87.37	-946.13	948.38	1.37	1.26	0.53
4,904.00	91.00	269.20	3,881.11	-88.20	-1,041.11	1,043.34	0.63	0.00	-0.63
4,998.00	90.50	269.60	3,879.88	-89.18	-1,135.10	1,137.31	0.68	-0.53	0.43
5,093.00	90.30	269.70	3,879.22	-89.76	-1,230.10	1,232.28	0.24	-0.21	0.11
5,187.00	91.70	269.20	3,877.58	-90.66	-1,324.07	1,326.24	1.58	1.49	-0.53
5,281.00	91.80	269.20	3,874.71	-91.97	-1,418.02	1,420.19	0.11	0.11	0.00
5,376.00	91.90	269.90	3,871.64	-92.72	-1,512.97	1,515.11	0.74	0.11	0.74
5,470.00	92.50	270.50	3,868.03	-92.39	-1,606.90	1,608.99	0.90	0.64	0.64
5,565.00	91.30	268.50	3,864.88	-93.22	-1,701.84	1,703.90	2.45	-1.26	-2.11
5,659.00	91.70	268.80	3,862.42	-95.43	-1,795.78	1,797.87	0.53	0.43	0.32
5,753.00	91.70	269.10	3,859.63	-97.16	-1,889.72	1,891.82	0.32	0.00	0.32
5,848.00	91.40	269.20	3,857.06	-98.57	-1,984.67	1,986.77	0.33	-0.32	0.11
5,942.00	91.10	268.80	3,855.01	-100.21	-2,078.64	2,080.74	0.53	-0.32	-0.43
6,037.00	91.30	269.30	3,853.02	-101.78	-2,173.60	2,175.71	0.57	0.21	0.53
6,131.00	90.70	269.10	3,851.38	-103.09	-2,267.58	2,269.68	0.67	-0.64	-0.21
6,226.00	90.50	268.80	3,850.39	-104.83	-2,362.56	2,364.67	0.38	-0.21	-0.32
6,320.00	90.30	268.70	3,849.73	-106.88	-2,456.53	2,458.66	0.24	-0.21	-0.11
6,415.00	90.00	268.80	3,849.48	-108.96	-2,551.51	2,553.66	0.33	-0.32	0.11
6,509.00	89.90	268.90	3,849.56	-110.84	-2,645.49	2,647.65	0.15	-0.11	0.11
6,604.00	90.00	268.90	3,849.65	-112.67	-2,740.47	2,742.65	0.11	0.11	0.00
6,698.00	89.90	269.30	3,849.73	-114.14	-2,834.46	2,836.63	0.44	-0.11	0.43
6,792.00	91.00	269.30	3,848.99	-115.29	-2,928.45	2,930.61	1.17	1.17	0.00
6,886.00	91.10	269.30	3,847.27	-116.44	-3,022.43	3,024.58	0.11	0.11	0.00



TDS
Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD-27 2015)
Site: Halberd 27 State Com #1H
Well: SHL: 1003' FSL, 65' FWL, Sec 26, T17S, R28E, Unit M
Wellbore: BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M
Design: BHL: 913' FSL, 350' FWL, Sec 27, T17S, R28E, Unit M
Local Co-ordinate Reference: Well SHL: 1003' FSL, 65' FWL, Sec 26, T17S, R28E, Unit M
TVD Reference: KB @ 3698.00usft (Silver Oak 3)
MD Reference: KB @ 3698.00usft (Silver Oak 3)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: EDM 5000.1 Single User Db

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)
6,980.00	91.00	269.80	3,845.54	-117.18	-3,116.41	3,118.54	0.54	-0.11	0.53
7,075.00	90.50	269.70	3,844.30	-117.59	-3,211.40	3,213.50	0.54	-0.53	-0.11
7,169.00	91.70	269.00	3,842.50	-118.66	-3,305.37	3,307.46	1.48	1.28	-0.74
7,263.00	91.70	268.90	3,839.71	-120.38	-3,399.32	3,401.41	0.11	0.00	-0.11
7,357.00	91.30	269.20	3,837.25	-121.94	-3,493.27	3,495.37	0.53	-0.43	0.32
7,452.00	91.00	268.70	3,835.34	-123.68	-3,588.24	3,590.34	0.61	-0.32	-0.53
7,546.00	90.70	268.80	3,833.95	-125.73	-3,682.20	3,684.33	0.34	-0.32	0.11
7,640.00	90.20	268.70	3,833.21	-127.78	-3,776.18	3,778.32	0.54	-0.53	-0.11
7,735.00	91.60	267.90	3,831.72	-130.60	-3,871.12	3,873.31	1.70	1.47	-0.84
7,830.00	92.30	268.60	3,828.48	-133.50	-3,966.02	3,968.25	1.04	0.74	0.74
7,924.00	91.70	268.20	3,825.20	-136.12	-4,059.93	4,062.19	0.77	-0.64	-0.43
8,018.00	91.60	268.40	3,822.50	-138.91	-4,153.85	4,156.15	0.24	-0.11	0.21
8,113.00	91.30	268.40	3,820.09	-141.56	-4,248.78	4,251.12	0.32	-0.32	0.00
8,207.00	90.80	268.10	3,818.37	-144.43	-4,342.72	4,345.11	0.62	-0.53	-0.32
8,301.00	90.30	268.50	3,817.47	-147.22	-4,436.67	4,439.10	0.68	-0.53	0.43
8,395.00	91.30	269.30	3,816.15	-149.02	-4,530.64	4,533.08	1.36	1.06	0.85
8,490.00	91.30	269.30	3,814.00	-150.18	-4,625.61	4,628.04	0.00	0.00	0.00
8,584.00	91.10	269.40	3,812.03	-151.25	-4,719.58	4,722.00	0.24	-0.21	0.11
8,678.00	90.80	269.90	3,810.47	-151.82	-4,813.57	4,815.96	0.62	-0.32	0.53
8,710.00	90.60	269.80	3,810.08	-151.91	-4,845.57	4,847.95	0.70	-0.63	-0.31
Last TDS MWD Survey									
8,798.00	90.60	269.80	3,809.16	-152.21	-4,933.56	4,935.91	0.00	0.00	0.00
Projection to Bit/TD									

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	+N-S (usft)	+E-W (usft)	Comment
890.30	890.29	1.45	0.47	Tie-In to Scientific Gyro
964.00	963.99	1.51	0.25	First TDS MWD Survey
4,257.96	3,879.30	-73.14	-395.66	As-Drilled PP
8,710.00	3,810.08	-151.91	-4,845.57	Last TDS MWD Survey
8,798.00	3,809.16	-152.21	-4,933.56	Projection to Bit/TD



DEBORAH L. MASON
My Commission Expires
February 20, 2019

Checked By: Deborah L. Mason Approved By: [Signature] Date: 11/2/2016



11/2/16

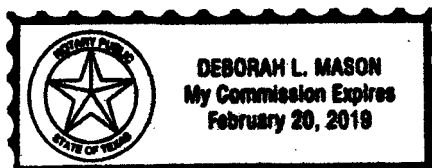
State of New Mexico
County of Eddy

I, Donald D. Mason, certify that: I am employed by Terra Directional Services LLC; that I did on the day(s) of 10/10/2016 through 10/15/2016 conduct or supervise the taking of a MWD survey from a depth of 964 feet to a depth of 8798 feet; that the data is true, correct, complete and within the limitations of the tool as set forth by Terra Directional Services LLC; that I am authorized and qualified to make this report; that this survey was conducted at the request of COG Operating LLC for the Halberd 27 State Com #1H Well API 30-015-42967 in Eddy County, New Mexico; and that I have reviewed this report and find that it conforms to the principles and procedures as set forth by Terra Directional Services LLC.

Donald D. Mason
President

State of Texas
County of Burnet

Before me, a notary public, on this day personally appeared Donald D mason, known to me to be the person whose name is subscribed to the foregoing document and, being by me first duly sworn, declared that the statements therein contained are true and correct.


Notary Public's Signature