



COG Operating LLC

Eddy County, NM (NAD27 NME)

Copperhead Fee A

4H

30-015-41210

OH / Job #60952

NM OIL CONSERVATION
ARTESIA DISTRICT

AUG 08 2017

Design: Surveys (Ensign 155)

RECEIVED

Standard Survey Report

28 April, 2017

**Please provide signature
page for directional survey**





Phoenix Technology Services LP

Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

Project	Eddy 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	Copperhead Fee A			
Site Position:		Northing:	364,196.80 usft	Latitude: 32° 0' 3.29951 N
From:	Map	Easting:	595,491.00 usft	Longitude: 104° 1' 31.04455 W
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence: 0.16 °

Well	4H			
Well Position	+N/-S	0.00 usft	Northing: 364,196.80 usft	Latitude: 32° 0' 3.29951 N
	+E/-W	0.00 usft	Easting: 595,491.00 usft	Longitude: 104° 1' 31.04455 W
Position Uncertainty	0.00 usft	Wellhead Elevation:	0.00 usft	Ground Level: 2,913.40 usft

Wellbore	OH / Job #60952				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	HDGM	3/31/2017	7.10	59.73	48,025

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	357.08

Survey Program	Date 4/28/2017			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description
100.00	9,758.20	Scientific Gyro Surveys (OH / Job #60952)	NS-GYRO-MS	North sensing gyrocompassing m/s
9,922.00	16,962.00	Phoenix MWD Surveys (OH / Job #60952)	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)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100.00	0.59	104.16	100.00	-0.13	0.50	-0.15	0.59	0.59	0.00
125.00	0.62	117.45	125.00	-0.22	0.74	-0.26	0.57	0.12	53.16
150.00	0.64	131.77	150.00	-0.38	0.97	-0.42	0.63	0.08	57.28
175.00	0.64	143.68	174.99	-0.58	1.16	-0.64	0.53	0.00	47.64
200.00	0.68	143.71	199.99	-0.81	1.33	-0.88	0.16	0.16	0.12
225.00	0.69	141.60	224.99	-1.05	1.51	-1.13	0.11	0.04	-8.44
250.00	0.71	142.65	249.99	-1.29	1.69	-1.38	0.10	0.08	4.20
275.00	0.81	147.44	274.99	-1.56	1.88	-1.66	0.47	0.40	19.16
300.00	0.81	149.11	299.98	-1.86	2.07	-1.97	0.09	0.00	6.68



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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)
325.00	0.78	146.88	324.98	-2.16	2.25	-2.27	0.17	-0.12	-8.92
350.00	0.81	142.75	349.98	-2.44	2.45	-2.56	0.26	0.12	-16.52
375.00	0.81	143.62	374.98	-2.72	2.66	-2.86	0.05	0.00	3.48
400.00	0.82	146.00	399.97	-3.01	2.87	-3.16	0.14	0.04	9.52
425.00	0.81	141.89	424.97	-3.30	3.08	-3.45	0.24	-0.04	-16.44
450.00	0.77	136.05	449.97	-3.56	3.30	-3.73	0.36	-0.16	-23.36
475.00	0.70	135.88	474.97	-3.79	3.53	-3.97	0.28	-0.28	-0.68
500.00	0.61	140.58	499.97	-4.01	3.72	-4.19	0.42	-0.36	18.80
525.00	0.56	141.15	524.96	-4.20	3.88	-4.40	0.20	-0.20	2.28
550.00	0.52	142.67	549.96	-4.39	4.02	-4.59	0.17	-0.16	6.08
575.00	0.46	140.27	574.96	-4.56	4.16	-4.76	0.25	-0.24	-9.60
600.00	0.37	146.36	599.96	-4.70	4.27	-4.91	0.40	-0.36	24.36
625.00	0.27	163.84	624.96	-4.82	4.33	-5.04	0.55	-0.40	69.92
650.00	0.11	161.47	649.96	-4.90	4.35	-5.12	0.64	-0.64	-9.48
675.00	0.15	345.37	674.96	-4.89	4.35	-5.11	1.04	0.16	-704.40
700.00	0.30	319.48	699.96	-4.81	4.30	-5.03	0.71	0.60	-103.56
725.00	0.39	306.98	724.96	-4.71	4.19	-4.92	0.47	0.36	-50.00
750.00	0.45	315.63	749.96	-4.59	4.05	-4.79	0.35	0.24	34.60
775.00	0.51	317.51	774.96	-4.44	3.91	-4.63	0.25	0.24	7.52
800.00	0.51	315.58	799.96	-4.28	3.76	-4.46	0.07	0.00	-7.72
825.00	0.49	310.21	824.96	-4.13	3.60	-4.31	0.20	-0.08	-21.48
850.00	0.48	305.48	849.96	-4.00	3.43	-4.17	0.17	-0.04	-18.92
875.00	0.48	306.07	874.95	-3.88	3.26	-4.04	0.02	0.00	2.36
900.00	0.52	293.92	899.95	-3.77	3.07	-3.92	0.45	0.16	-48.60
925.00	0.57	277.75	924.95	-3.71	2.84	-3.85	0.64	0.20	-64.68
950.00	0.60	276.57	949.95	-3.67	2.59	-3.80	0.13	0.12	-4.72
975.00	0.70	282.19	974.95	-3.63	2.31	-3.74	0.47	0.40	22.48
1,000.00	0.81	281.77	999.95	-3.56	1.99	-3.66	0.44	0.44	-1.68
1,025.00	0.86	284.89	1,024.95	-3.47	1.64	-3.55	0.27	0.20	12.48
1,050.00	0.92	293.66	1,049.94	-3.35	1.27	-3.41	0.59	0.24	35.08
1,075.00	1.01	298.37	1,074.94	-3.16	0.89	-3.20	0.48	0.36	18.84
1,100.00	1.09	296.45	1,099.93	-2.95	0.49	-2.97	0.35	0.32	-7.68
1,125.00	1.19	293.19	1,124.93	-2.74	0.03	-2.74	0.48	0.40	-13.04
1,150.00	1.25	290.73	1,149.92	-2.54	-0.46	-2.52	0.32	0.24	-9.84
1,175.00	1.24	287.39	1,174.92	-2.37	-0.97	-2.31	0.29	-0.04	-13.36
1,200.00	1.20	284.66	1,199.91	-2.22	-1.48	-2.14	0.28	-0.16	-10.92
1,225.00	1.17	287.55	1,224.91	-2.08	-1.98	-1.97	0.27	-0.12	11.56
1,250.00	1.13	292.39	1,249.90	-1.90	-2.45	-1.78	0.42	-0.16	19.36
1,275.00	1.11	291.84	1,274.90	-1.72	-2.90	-1.57	0.09	-0.08	-2.20
1,300.00	1.17	288.41	1,299.89	-1.55	-3.37	-1.38	0.36	0.24	-13.72
1,325.00	1.28	279.50	1,324.89	-1.42	-3.89	-1.22	0.88	0.44	-35.64
1,350.00	1.26	268.08	1,349.88	-1.39	-4.44	-1.16	1.01	-0.08	-45.68
1,375.00	1.22	258.51	1,374.87	-1.45	-4.97	-1.19	0.84	-0.16	-38.28



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Survey

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1,400.00	1.26	247.24	1,399.87	-1.61	-5.49	-1.33	0.99	0.16	-45.08
1,425.00	1.26	233.60	1,424.86	-1.88	-5.96	-1.57	1.20	0.00	-54.56
1,450.00	1.27	220.11	1,449.86	-2.25	-6.36	-1.92	1.19	0.04	-53.96
1,475.00	1.24	211.30	1,474.85	-2.70	-6.68	-2.35	0.78	-0.12	-35.24
1,500.00	1.13	206.02	1,499.85	-3.15	-6.93	-2.79	0.62	-0.44	-21.12
1,525.00	1.10	201.44	1,524.84	-3.59	-7.13	-3.22	0.38	-0.12	-18.32
1,550.00	1.06	202.00	1,549.84	-4.03	-7.30	-3.65	0.17	-0.16	2.24
1,575.00	1.01	201.02	1,574.83	-4.45	-7.47	-4.06	0.21	-0.20	-3.92
1,600.00	1.07	208.77	1,599.83	-4.86	-7.66	-4.46	0.61	0.24	31.00
1,625.00	1.10	212.20	1,624.82	-5.27	-7.90	-4.86	0.29	0.12	13.72
1,650.00	1.15	208.99	1,649.82	-5.69	-8.15	-5.27	0.32	0.20	-12.84
1,675.00	1.19	205.89	1,674.81	-6.14	-8.38	-5.71	0.30	0.16	-12.40
1,700.00	1.12	203.20	1,699.81	-6.60	-8.59	-6.16	0.35	-0.28	-10.76
1,725.00	1.05	198.95	1,724.80	-7.04	-8.76	-6.59	0.43	-0.28	-17.00
1,750.00	0.95	193.96	1,749.80	-7.46	-8.89	-7.00	0.53	-0.40	-19.96
1,775.00	0.86	193.30	1,774.80	-7.84	-8.98	-7.38	0.36	-0.36	-2.64
1,800.00	0.81	196.28	1,799.79	-8.20	-9.07	-7.72	0.26	-0.20	11.92
1,825.00	0.80	198.45	1,824.79	-8.53	-9.18	-8.05	0.13	-0.04	8.68
1,850.00	0.87	209.83	1,849.79	-8.86	-9.33	-8.38	0.72	0.28	45.52
1,875.00	1.10	219.58	1,874.79	-9.21	-9.58	-8.71	1.14	0.92	39.00
1,900.00	1.30	226.29	1,899.78	-9.59	-9.93	-9.07	0.98	0.80	26.84
1,925.00	1.54	231.84	1,924.77	-10.00	-10.40	-9.45	1.11	0.96	22.20
1,950.00	1.70	233.62	1,949.76	-10.42	-10.96	-9.85	0.67	0.64	7.12
1,975.00	1.72	234.10	1,974.75	-10.86	-11.57	-10.26	0.10	0.08	1.92
2,000.00	1.76	235.30	1,999.74	-11.30	-12.19	-10.67	0.22	0.16	4.80
2,025.00	1.62	234.50	2,024.73	-11.73	-12.79	-11.06	0.57	-0.56	-3.20
2,050.00	1.05	230.35	2,049.72	-12.08	-13.25	-11.39	2.31	-2.28	-16.60
2,075.00	0.43	189.49	2,074.72	-12.32	-13.45	-11.61	3.11	-2.48	-163.44
2,100.00	0.76	109.07	2,099.72	-12.46	-13.30	-11.77	3.23	1.32	-321.68
2,125.00	1.55	95.92	2,124.71	-12.55	-12.81	-11.88	3.31	3.16	-52.60
2,150.00	2.44	91.83	2,149.70	-12.60	-11.94	-11.98	3.60	3.56	-16.36
2,175.00	3.09	90.87	2,174.67	-12.63	-10.74	-12.07	2.61	2.60	-3.84
2,200.00	3.65	92.83	2,199.63	-12.68	-9.27	-12.19	2.29	2.24	7.84
2,225.00	4.22	94.33	2,224.57	-12.79	-7.56	-12.39	2.32	2.28	6.00
2,250.00	4.39	92.98	2,249.50	-12.91	-5.68	-12.60	0.79	0.68	-5.40
2,275.00	4.40	92.49	2,274.42	-13.00	-3.77	-12.79	0.16	0.04	-1.96
2,300.00	4.24	94.38	2,299.35	-13.11	-1.89	-13.00	0.86	-0.64	7.56
2,325.00	3.92	98.74	2,324.29	-13.31	-0.13	-13.29	1.78	-1.28	17.44
2,350.00	3.47	104.26	2,349.24	-13.63	1.45	-13.69	2.29	-1.80	22.08
2,375.00	2.97	107.78	2,374.20	-14.01	2.80	-14.14	2.15	-2.00	14.08
2,400.00	2.57	112.20	2,399.17	-14.42	3.94	-14.60	1.81	-1.60	17.68
2,425.00	2.25	118.11	2,424.15	-14.87	4.89	-15.10	1.62	-1.28	23.64
2,450.00	2.03	123.02	2,449.13	-15.34	5.69	-15.61	1.14	-0.88	19.64



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2,475.00	1.92	130.43	2,474.11	-15.85	6.38	-16.16	1.11	-0.44	29.64
2,500.00	1.81	140.12	2,499.10	-16.43	6.96	-16.76	1.33	-0.44	38.76
2,525.00	1.64	150.45	2,524.09	-17.04	7.39	-17.39	1.41	-0.68	41.32
2,550.00	1.55	160.26	2,549.08	-17.67	7.68	-18.04	1.15	-0.36	39.24
2,575.00	1.51	168.24	2,574.07	-18.31	7.86	-18.69	0.87	-0.16	31.92
2,600.00	1.48	170.87	2,599.06	-18.95	7.98	-19.33	0.30	-0.12	10.52
2,625.00	1.44	175.01	2,624.05	-19.58	8.05	-19.97	0.45	-0.16	16.56
2,650.00	1.39	186.03	2,649.05	-20.20	8.05	-20.58	1.10	-0.20	44.08
2,675.00	1.33	190.45	2,674.04	-20.78	7.97	-21.16	0.48	-0.24	17.68
2,700.00	1.41	187.71	2,699.03	-21.37	7.87	-21.75	0.41	0.32	-10.96
2,725.00	1.46	186.08	2,724.02	-22.00	7.80	-22.36	0.26	0.20	-6.52
2,750.00	1.51	184.09	2,749.02	-22.64	7.74	-23.01	0.29	0.20	-7.96
2,775.00	1.48	181.96	2,774.01	-23.29	7.70	-23.66	0.25	-0.12	-8.52
2,800.00	1.41	183.68	2,799.00	-23.92	7.67	-24.28	0.33	-0.28	6.88
2,825.00	1.37	186.20	2,823.99	-24.53	7.62	-24.88	0.29	-0.16	10.08
2,850.00	1.38	187.93	2,848.98	-25.12	7.55	-25.47	0.17	0.04	6.92
2,875.00	1.46	184.56	2,873.98	-25.74	7.48	-26.09	0.46	0.32	-13.48
2,900.00	1.50	181.18	2,898.97	-26.38	7.45	-26.73	0.38	0.16	-13.52
2,925.00	1.41	181.67	2,923.96	-27.02	7.43	-27.36	0.36	-0.36	1.96
2,950.00	1.34	185.51	2,948.95	-27.61	7.40	-27.96	0.46	-0.28	15.36
2,975.00	1.42	189.98	2,973.95	-28.21	7.31	-28.55	0.54	0.32	17.88
3,000.00	1.47	187.97	2,998.94	-28.83	7.22	-29.16	0.28	0.20	-8.04
3,025.00	1.46	183.98	3,023.93	-29.47	7.15	-29.79	0.41	-0.04	-15.96
3,050.00	1.41	183.70	3,048.92	-30.09	7.11	-30.42	0.20	-0.20	-1.12
3,075.00	1.39	188.39	3,073.91	-30.70	7.04	-31.02	0.47	-0.08	18.76
3,100.00	1.43	190.03	3,098.91	-31.31	6.95	-31.62	0.23	0.16	6.56
3,125.00	1.44	184.86	3,123.90	-31.93	6.86	-32.24	0.52	0.04	-20.68
3,150.00	1.44	181.76	3,148.89	-32.55	6.83	-32.86	0.31	0.00	-12.40
3,175.00	1.29	181.78	3,173.88	-33.15	6.81	-33.45	0.60	-0.60	0.08
3,200.00	1.15	184.80	3,198.88	-33.68	6.78	-33.98	0.62	-0.56	12.08
3,225.00	1.29	186.19	3,223.87	-34.21	6.73	-34.51	0.57	0.56	5.56
3,250.00	1.39	183.52	3,248.87	-34.79	6.68	-35.09	0.47	0.40	-10.68
3,275.00	1.34	179.95	3,273.86	-35.39	6.66	-35.68	0.39	-0.20	-14.28
3,300.00	1.25	176.53	3,298.85	-35.95	6.68	-36.25	0.47	-0.36	-13.68
3,325.00	1.15	179.94	3,323.85	-36.48	6.69	-36.77	0.49	-0.40	13.64
3,350.00	1.21	184.17	3,348.84	-36.99	6.68	-37.28	0.42	0.24	16.92
3,375.00	1.35	185.03	3,373.84	-37.55	6.63	-37.84	0.57	0.56	3.44
3,400.00	1.35	181.22	3,398.83	-38.13	6.60	-38.42	0.36	0.00	-15.24
3,425.00	1.27	177.83	3,423.82	-38.71	6.60	-38.99	0.45	-0.32	-13.56
3,450.00	1.19	178.74	3,448.82	-39.24	6.62	-39.53	0.33	-0.32	3.64
3,475.00	1.23	183.62	3,473.81	-39.77	6.61	-40.05	0.44	0.16	19.52
3,500.00	1.35	182.86	3,498.80	-40.33	6.58	-40.61	0.48	0.48	-3.04
3,525.00	1.34	178.09	3,523.80	-40.92	6.57	-41.20	0.45	-0.04	-19.08
3,550.00	1.26	176.87	3,548.79	-41.48	6.60	-41.77	0.34	-0.32	-4.88



Phoenix Technology Services LP
Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
3,575.00	1.21	182.36	3,573.79	-42.02	6.60	-42.30	0.51	-0.20	21.96
3,600.00	1.27	184.80	3,598.78	-42.56	6.57	-42.84	0.32	0.24	9.76
3,625.00	1.34	181.88	3,623.77	-43.13	6.53	-43.41	0.39	0.28	-11.68
3,650.00	1.21	180.55	3,648.77	-43.69	6.52	-43.96	0.53	-0.52	-5.32
3,675.00	1.14	182.17	3,673.76	-44.20	6.51	-44.47	0.31	-0.28	6.48
3,700.00	1.17	181.02	3,698.76	-44.70	6.50	-44.98	0.15	0.12	-4.60
3,725.00	1.21	178.95	3,723.75	-45.22	6.50	-45.49	0.23	0.16	-8.28
3,750.00	1.20	177.79	3,748.75	-45.75	6.51	-46.02	0.11	-0.04	-4.64
3,775.00	1.16	181.00	3,773.74	-46.26	6.52	-46.53	0.31	-0.16	12.84
3,800.00	1.24	186.18	3,798.73	-46.78	6.48	-47.05	0.54	0.32	20.72
3,825.00	1.31	183.06	3,823.73	-47.34	6.44	-47.60	0.39	0.28	-12.48
3,850.00	1.30	179.90	3,848.72	-47.91	6.42	-48.17	0.29	-0.04	-12.64
3,875.00	1.22	182.58	3,873.72	-48.46	6.41	-48.72	0.40	-0.32	10.72
3,900.00	1.22	184.70	3,898.71	-48.99	6.38	-49.25	0.18	0.00	8.48
3,925.00	1.28	180.69	3,923.70	-49.53	6.35	-49.79	0.42	0.24	-16.04
3,950.00	1.23	178.04	3,948.70	-50.08	6.36	-50.34	0.31	-0.20	-10.60
3,975.00	1.15	182.98	3,973.69	-50.60	6.36	-50.86	0.52	-0.32	19.76
4,000.00	1.17	188.08	3,998.69	-51.10	6.31	-51.36	0.42	0.08	20.40
4,025.00	1.03	196.21	4,023.68	-51.57	6.21	-51.82	0.84	-0.56	32.52
4,050.00	0.82	215.90	4,048.68	-51.93	6.04	-52.17	1.51	-0.84	78.76
4,075.00	0.80	227.55	4,073.68	-52.19	5.81	-52.42	0.66	-0.08	46.60
4,100.00	0.83	236.57	4,098.68	-52.41	5.53	-52.62	0.53	0.12	36.08
4,125.00	0.91	238.78	4,123.67	-52.61	5.21	-52.81	0.35	0.32	8.84
4,150.00	0.94	233.77	4,148.67	-52.84	4.87	-53.02	0.34	0.12	-20.04
4,175.00	0.87	229.43	4,173.67	-53.08	4.56	-53.25	0.39	-0.28	-17.36
4,200.00	0.88	228.92	4,198.66	-53.33	4.27	-53.48	0.05	0.04	-2.04
4,225.00	0.85	229.15	4,223.66	-53.58	3.99	-53.71	0.12	-0.12	0.92
4,250.00	0.78	231.94	4,248.66	-53.81	3.71	-53.92	0.32	-0.28	11.16
4,275.00	0.83	236.35	4,273.66	-54.01	3.43	-54.12	0.32	0.20	17.64
4,300.00	1.27	236.89	4,298.65	-54.26	3.05	-54.35	1.76	1.76	2.16
4,325.00	1.85	233.73	4,323.64	-54.65	2.49	-54.71	2.34	2.32	-12.64
4,350.00	2.10	231.47	4,348.63	-55.18	1.80	-55.20	1.05	1.00	-9.04
4,375.00	2.23	233.36	4,373.61	-55.75	1.06	-55.73	0.59	0.52	7.56
4,400.00	2.42	235.27	4,398.59	-56.34	0.23	-56.28	0.82	0.76	7.64
4,425.00	2.47	233.22	4,423.57	-56.97	-0.63	-56.86	0.40	0.20	-8.20
4,450.00	2.41	231.87	4,448.54	-57.61	-1.48	-57.46	0.33	-0.24	-5.40
4,475.00	2.33	233.61	4,473.52	-58.24	-2.30	-58.05	0.43	-0.32	6.96
4,500.00	2.36	236.11	4,498.50	-58.83	-3.14	-58.59	0.43	0.12	10.00
4,525.00	2.51	235.75	4,523.48	-59.42	-4.02	-59.14	0.60	0.60	-1.44
4,550.00	2.47	233.01	4,548.45	-60.06	-4.90	-59.73	0.50	-0.16	-10.96
4,575.00	2.35	232.59	4,573.43	-60.69	-5.74	-60.32	0.49	-0.48	-1.68
4,600.00	2.42	235.26	4,598.41	-61.30	-6.58	-60.89	0.53	0.28	10.68
4,625.00	2.53	235.91	4,623.39	-61.91	-7.47	-61.45	0.45	0.44	2.60



Phoenix Technology Services LP

Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
4,650.00	2.54	234.22	4,648.36	-62.55	-8.38	-62.04	0.30	0.04	-6.76
4,675.00	2.48	237.46	4,673.34	-63.16	-9.28	-62.61	0.62	-0.24	12.96
4,700.00	2.54	247.37	4,698.31	-63.66	-10.25	-63.06	1.75	0.24	39.64
4,725.00	2.74	250.04	4,723.29	-64.08	-11.32	-63.42	0.94	0.80	10.68
4,750.00	2.64	249.09	4,748.26	-64.49	-12.42	-63.77	0.44	-0.40	-3.80
4,775.00	2.58	251.04	4,773.23	-64.88	-13.49	-64.11	0.43	-0.24	7.80
4,800.00	2.71	252.13	4,798.21	-65.24	-14.59	-64.42	0.56	0.52	4.36
4,825.00	2.75	250.68	4,823.18	-65.62	-15.71	-64.74	0.32	0.16	-5.80
4,850.00	2.56	249.23	4,848.15	-66.02	-16.80	-65.08	0.81	-0.76	-5.80
4,875.00	2.56	252.39	4,873.13	-66.39	-17.86	-65.39	0.56	0.00	12.64
4,900.00	2.77	253.00	4,898.10	-66.73	-18.97	-65.68	0.85	0.84	2.44
4,925.00	2.73	251.74	4,923.07	-67.10	-20.11	-65.98	0.29	-0.16	-5.04
4,950.00	2.65	250.43	4,948.04	-67.48	-21.22	-66.31	0.40	-0.32	-5.24
4,975.00	2.64	251.44	4,973.02	-67.85	-22.31	-66.63	0.19	-0.04	4.04
5,000.00	2.71	252.18	4,997.99	-68.22	-23.42	-66.93	0.31	0.28	2.96
5,025.00	2.63	250.47	5,022.96	-68.59	-24.52	-67.25	0.45	-0.32	-6.84
5,050.00	2.57	252.85	5,047.94	-68.95	-25.60	-67.55	0.49	-0.24	9.52
5,075.00	2.68	251.58	5,072.91	-69.30	-26.69	-67.84	0.50	0.44	-5.08
5,100.00	2.63	249.12	5,097.88	-69.69	-27.78	-68.18	0.50	-0.20	-9.84
5,125.00	2.46	250.71	5,122.86	-70.07	-28.82	-68.51	0.74	-0.68	6.36
5,150.00	2.47	250.50	5,147.84	-70.42	-29.83	-68.81	0.05	0.04	-0.84
5,175.00	2.59	250.44	5,172.81	-70.79	-30.87	-69.13	0.48	0.48	-0.24
5,200.00	2.55	249.68	5,197.79	-71.18	-31.93	-69.45	0.21	-0.16	-3.04
5,225.00	2.38	246.78	5,222.76	-71.57	-32.93	-69.80	0.84	-0.68	-11.60
5,250.00	2.25	245.83	5,247.74	-71.98	-33.85	-70.16	0.54	-0.52	-3.80
5,275.00	2.24	246.65	5,272.72	-72.37	-34.75	-70.51	0.13	-0.04	3.28
5,300.00	2.30	247.38	5,297.71	-72.76	-35.66	-70.85	0.27	0.24	2.92
5,325.00	2.32	246.09	5,322.68	-73.16	-36.58	-71.20	0.22	0.08	-5.16
5,350.00	2.27	245.18	5,347.66	-73.57	-37.50	-71.56	0.25	-0.20	-3.64
5,375.00	2.17	246.39	5,372.65	-73.97	-38.38	-71.91	0.44	-0.40	4.84
5,400.00	2.17	242.86	5,397.63	-74.37	-39.23	-72.28	0.53	0.00	-14.12
5,425.00	2.19	239.20	5,422.61	-74.83	-40.07	-72.69	0.56	0.08	-14.64
5,450.00	2.12	243.46	5,447.59	-75.29	-40.89	-73.10	0.70	-0.28	17.04
5,475.00	2.16	246.62	5,472.58	-75.68	-41.74	-73.45	0.50	0.16	12.64
5,500.00	2.19	246.52	5,497.56	-76.06	-42.61	-73.78	0.12	0.12	-0.40
5,525.00	2.44	242.56	5,522.54	-76.49	-43.52	-74.17	1.19	1.00	-15.84
5,550.00	2.76	240.94	5,547.51	-77.03	-44.52	-74.66	1.31	1.28	-6.48
5,575.00	3.09	242.15	5,572.48	-77.64	-45.64	-75.21	1.34	1.32	4.84
5,600.00	3.29	242.08	5,597.44	-78.29	-46.87	-75.79	0.80	0.80	-0.28
5,625.00	3.34	239.71	5,622.40	-78.99	-48.13	-76.43	0.58	0.20	-9.48
5,650.00	3.35	238.36	5,647.36	-79.74	-49.38	-77.12	0.32	0.04	-5.40
5,675.00	3.29	239.04	5,672.31	-80.49	-50.62	-77.81	0.29	-0.24	2.72
5,700.00	3.25	240.59	5,697.27	-81.21	-51.85	-78.46	0.39	-0.16	6.20



Phoenix Technology Services LP

Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
5,725.00	3.40	241.17	5,722.23	-81.92	-53.12	-79.10	0.61	0.60	2.32
5,750.00	3.39	239.65	5,747.19	-82.65	-54.40	-79.76	0.36	-0.04	-6.08
5,775.00	3.23	238.38	5,772.14	-83.39	-55.64	-80.44	0.70	-0.64	-5.08
5,800.00	3.23	239.40	5,797.11	-84.12	-56.85	-81.11	0.23	0.00	4.08
5,825.00	3.29	240.45	5,822.06	-84.83	-58.08	-81.76	0.34	0.24	4.20
5,850.00	3.34	239.44	5,847.02	-85.55	-59.33	-82.42	0.31	0.20	-4.04
5,875.00	3.19	237.26	5,871.98	-86.30	-60.54	-83.10	0.78	-0.60	-8.72
5,900.00	3.02	235.76	5,896.95	-87.05	-61.67	-83.79	0.75	-0.68	-6.00
5,925.00	3.02	237.35	5,921.91	-87.77	-62.77	-84.46	0.34	0.00	6.36
5,950.00	3.12	237.03	5,946.87	-88.50	-63.90	-85.12	0.41	0.40	-1.28
5,975.00	3.10	234.73	5,971.84	-89.26	-65.02	-85.83	0.51	-0.08	-9.20
6,000.00	2.98	235.60	5,996.80	-90.02	-66.11	-86.53	0.51	-0.48	3.48
6,025.00	3.03	236.68	6,021.77	-90.75	-67.19	-87.20	0.30	0.20	4.32
6,050.00	3.12	235.00	6,046.73	-91.50	-68.30	-87.90	0.51	0.36	-6.72
6,075.00	3.21	233.66	6,071.69	-92.30	-69.42	-88.64	0.47	0.36	-5.36
6,100.00	3.25	232.55	6,096.65	-93.15	-70.55	-89.43	0.30	0.16	-4.44
6,125.00	3.45	232.51	6,121.61	-94.04	-71.71	-90.26	0.80	0.80	-0.16
6,150.00	3.56	232.90	6,146.57	-94.96	-72.93	-91.12	0.45	0.44	1.56
6,175.00	3.70	232.41	6,171.52	-95.93	-74.18	-92.02	0.57	0.56	-1.96
6,200.00	3.78	230.81	6,196.46	-96.94	-75.46	-92.96	0.53	0.32	-6.40
6,225.00	3.67	230.41	6,221.41	-97.97	-76.72	-93.93	0.45	-0.44	-1.60
6,250.00	3.66	232.32	6,246.36	-98.97	-77.97	-94.86	0.49	-0.04	7.64
6,275.00	3.87	232.76	6,271.30	-99.96	-79.27	-95.79	0.85	0.84	1.76
6,300.00	4.03	231.45	6,296.24	-101.02	-80.63	-96.78	0.73	0.64	-5.24
6,325.00	4.02	230.61	6,321.18	-102.13	-81.99	-97.81	0.24	-0.04	-3.36
6,350.00	4.04	232.36	6,346.12	-103.22	-83.37	-98.83	0.50	0.08	7.00
6,375.00	4.12	234.00	6,371.06	-104.29	-84.79	-99.82	0.57	0.32	6.56
6,400.00	4.23	233.16	6,395.99	-105.37	-86.26	-100.83	0.50	0.44	-3.36
6,425.00	4.24	231.04	6,420.92	-106.50	-87.71	-101.89	0.63	0.04	-8.48
6,450.00	4.11	229.50	6,445.86	-107.66	-89.11	-102.98	0.69	-0.52	-6.16
6,475.00	3.99	228.61	6,470.79	-108.82	-90.45	-104.06	0.54	-0.48	-3.56
6,500.00	4.05	227.52	6,495.73	-109.99	-91.75	-105.17	0.39	0.24	-4.36
6,525.00	3.99	224.69	6,520.67	-111.21	-93.01	-106.32	0.83	-0.24	-11.32
6,550.00	3.93	224.10	6,545.61	-112.44	-94.22	-107.49	0.29	-0.24	-2.36
6,575.00	3.91	225.32	6,570.55	-113.65	-95.42	-108.64	0.34	-0.08	4.88
6,600.00	3.95	226.88	6,595.49	-114.84	-96.66	-109.76	0.46	0.16	6.24
6,625.00	4.01	225.83	6,620.43	-116.04	-97.91	-110.89	0.38	0.24	-4.20
6,650.00	3.95	225.52	6,645.37	-117.25	-99.15	-112.04	0.25	-0.24	-1.24
6,675.00	3.90	229.50	6,670.32	-118.41	-100.41	-113.13	1.11	-0.20	15.92
6,700.00	3.90	233.08	6,695.26	-119.47	-101.74	-114.13	0.97	0.00	14.32
6,725.00	3.85	233.74	6,720.20	-120.48	-103.10	-115.06	0.27	-0.20	2.64
6,750.00	3.71	231.47	6,745.15	-121.48	-104.41	-115.99	0.82	-0.56	-9.08
6,775.00	3.39	229.78	6,770.10	-122.46	-105.60	-116.91	1.35	-1.28	-6.76
6,800.00	3.19	230.34	6,795.06	-123.38	-106.70	-117.78	0.81	-0.80	2.24



Phoenix Technology Services LP
Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
6,825.00	3.12	232.27	6,820.02	-124.24	-107.78	-118.58	0.51	-0.28	7.72
6,850.00	3.21	234.82	6,844.98	-125.06	-108.89	-119.34	0.67	0.36	10.20
6,875.00	3.25	235.17	6,869.94	-125.87	-110.04	-120.09	0.18	0.16	1.40
6,900.00	3.10	235.41	6,894.90	-126.66	-111.18	-120.82	0.60	-0.60	0.96
6,925.00	3.12	237.02	6,919.87	-127.41	-112.31	-121.52	0.36	0.08	6.44
6,950.00	3.38	236.42	6,944.83	-128.19	-113.49	-122.23	1.05	1.04	-2.40
6,975.00	3.73	232.75	6,969.78	-129.09	-114.75	-123.07	1.67	1.40	-14.68
7,000.00	4.01	232.65	6,994.72	-130.11	-116.09	-124.02	1.12	1.12	-0.40
7,025.00	4.15	234.63	7,019.66	-131.17	-117.53	-125.00	0.79	0.56	7.92
7,050.00	4.36	233.09	7,044.59	-132.26	-119.02	-126.02	0.96	0.84	-6.16
7,075.00	4.32	233.23	7,069.52	-133.39	-120.54	-127.07	0.17	-0.16	0.56
7,100.00	4.37	234.29	7,094.44	-134.51	-122.07	-128.11	0.38	0.20	4.24
7,125.00	4.35	233.89	7,119.37	-135.63	-123.61	-129.15	0.15	-0.08	-1.60
7,150.00	4.02	233.45	7,144.31	-136.71	-125.08	-130.15	1.33	-1.32	-1.76
7,175.00	3.72	233.91	7,169.25	-137.71	-126.43	-131.08	1.21	-1.20	1.84
7,200.00	3.70	233.96	7,194.20	-138.66	-127.74	-131.96	0.08	-0.08	0.20
7,225.00	3.70	232.60	7,219.14	-139.63	-129.04	-132.86	0.35	0.00	-5.44
7,250.00	3.68	233.12	7,244.09	-140.60	-130.32	-133.77	0.16	-0.08	2.08
7,275.00	3.81	234.30	7,269.04	-141.56	-131.63	-134.66	0.60	0.52	4.72
7,300.00	4.06	234.08	7,293.98	-142.57	-133.03	-135.60	1.00	1.00	-0.88
7,325.00	4.42	234.22	7,318.91	-143.65	-134.52	-136.60	1.44	1.44	0.56
7,350.00	4.75	236.04	7,343.83	-144.79	-136.16	-137.66	1.44	1.32	7.28
7,375.00	5.21	237.94	7,368.74	-145.97	-137.98	-138.74	1.95	1.84	7.60
7,400.00	5.68	238.35	7,393.62	-147.22	-140.00	-139.89	1.89	1.88	1.64
7,425.00	5.90	238.44	7,418.50	-148.54	-142.15	-141.10	0.88	0.88	0.36
7,450.00	5.92	238.61	7,443.36	-149.89	-144.34	-142.33	0.11	0.08	0.68
7,475.00	5.87	238.05	7,468.23	-151.24	-146.53	-143.57	0.30	-0.20	-2.24
7,500.00	5.69	238.34	7,493.10	-152.56	-148.67	-144.78	0.73	-0.72	1.16
7,525.00	5.49	240.86	7,517.99	-153.80	-150.77	-145.91	1.27	-0.80	10.08
7,550.00	5.41	242.13	7,542.87	-154.93	-152.85	-146.93	0.58	-0.32	5.08
7,575.00	5.27	241.24	7,567.76	-156.03	-154.90	-147.93	0.65	-0.56	-3.56
7,600.00	4.96	241.98	7,592.66	-157.09	-156.86	-148.89	1.27	-1.24	2.96
7,625.00	4.79	244.34	7,617.57	-158.05	-158.76	-149.75	1.05	-0.68	9.44
7,650.00	4.70	246.33	7,642.49	-158.92	-160.64	-150.51	0.75	-0.36	7.96
7,675.00	4.37	246.50	7,667.41	-159.71	-162.45	-151.21	1.32	-1.32	0.68
7,700.00	4.00	246.39	7,692.34	-160.44	-164.12	-151.86	1.48	-1.48	-0.44
7,725.00	4.00	248.62	7,717.28	-161.10	-165.73	-152.44	0.62	0.00	8.92
7,750.00	3.96	248.47	7,742.22	-161.74	-167.35	-152.99	0.17	-0.16	-0.60
7,775.00	3.79	244.28	7,767.16	-162.41	-168.89	-153.59	1.32	-0.68	-16.76
7,800.00	3.55	243.38	7,792.11	-163.12	-170.33	-154.22	0.99	-0.96	-3.60
7,825.00	3.40	243.61	7,817.07	-163.79	-171.69	-154.82	0.60	-0.60	0.92
7,850.00	3.43	241.75	7,842.02	-164.48	-173.01	-155.44	0.46	0.12	-7.44
7,875.00	3.34	239.70	7,866.98	-165.20	-174.30	-156.09	0.60	-0.36	-8.20



Phoenix Technology Services LP

Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
7,900.00	3.16	238.94	7,891.94	-165.92	-175.52	-156.75	0.74	-0.72	-3.04
7,925.00	2.92	239.51	7,916.90	-166.60	-176.65	-157.37	0.97	-0.96	2.28
7,950.00	2.86	239.83	7,941.87	-167.24	-177.74	-157.95	0.25	-0.24	1.28
7,975.00	2.81	236.95	7,966.84	-167.89	-178.80	-158.55	0.60	-0.20	-11.52
8,000.00	2.68	233.83	7,991.81	-168.56	-179.78	-159.17	0.79	-0.52	-12.48
8,025.00	2.60	230.31	8,016.79	-169.27	-180.69	-159.83	0.72	-0.32	-14.08
8,050.00	2.70	226.55	8,041.76	-170.04	-181.55	-160.56	0.80	0.40	-15.04
8,075.00	2.83	222.33	8,066.73	-170.90	-182.40	-161.37	0.97	0.52	-16.88
8,100.00	2.82	220.95	8,091.70	-171.82	-183.21	-162.25	0.27	-0.04	-5.52
8,125.00	2.81	221.73	8,116.67	-172.74	-184.03	-163.13	0.16	-0.04	3.12
8,150.00	2.91	221.40	8,141.64	-173.68	-184.85	-164.02	0.41	0.40	-1.32
8,175.00	2.97	226.59	8,166.61	-174.60	-185.74	-164.89	1.09	0.24	20.76
8,200.00	3.17	232.87	8,191.57	-175.46	-186.76	-165.70	1.56	0.80	25.12
8,225.00	3.30	233.34	8,216.53	-176.31	-187.89	-166.49	0.53	0.52	1.88
8,250.00	3.31	233.49	8,241.49	-177.17	-189.05	-167.29	0.05	0.04	0.60
8,275.00	3.32	233.10	8,266.45	-178.03	-190.21	-168.09	0.10	0.04	-1.56
8,300.00	3.21	234.25	8,291.41	-178.87	-191.36	-168.88	0.51	-0.44	4.60
8,325.00	3.10	235.50	8,316.37	-179.66	-192.48	-169.61	0.52	-0.44	5.00
8,350.00	2.91	234.36	8,341.33	-180.42	-193.55	-170.31	0.80	-0.76	-4.56
8,375.00	2.69	233.92	8,366.30	-181.13	-194.54	-170.97	0.88	-0.88	-1.76
8,400.00	2.51	230.30	8,391.28	-181.83	-195.44	-171.62	0.97	-0.72	-14.48
8,425.00	2.32	225.65	8,416.26	-182.53	-196.22	-172.28	1.09	-0.76	-18.60
8,450.00	2.19	228.09	8,441.24	-183.20	-196.94	-172.92	0.65	-0.52	9.76
8,475.00	2.14	230.39	8,466.22	-183.82	-197.66	-173.50	0.40	-0.20	9.20
8,500.00	2.07	228.40	8,491.20	-184.42	-198.35	-174.06	0.40	-0.28	-7.96
8,525.00	2.09	229.07	8,516.19	-185.02	-199.03	-174.62	0.13	0.08	2.68
8,550.00	2.19	229.90	8,541.17	-185.62	-199.74	-175.19	0.42	0.40	3.32
8,575.00	2.43	239.73	8,566.15	-186.20	-200.57	-175.72	1.85	0.96	39.32
8,600.00	2.72	240.92	8,591.12	-186.75	-201.54	-176.23	1.18	1.16	4.76
8,625.00	2.79	240.50	8,616.09	-187.34	-202.59	-176.76	0.29	0.28	-1.68
8,650.00	2.69	241.37	8,641.07	-187.92	-203.64	-177.29	0.43	-0.40	3.48
8,675.00	2.67	240.82	8,666.04	-188.49	-204.66	-177.80	0.13	-0.08	-2.20
8,700.00	2.63	241.58	8,691.01	-189.04	-205.67	-178.31	0.21	-0.16	3.04
8,725.00	2.47	240.67	8,715.99	-189.58	-206.65	-178.79	0.66	-0.64	-3.64
8,750.00	2.43	239.97	8,740.96	-190.11	-207.57	-179.27	0.20	-0.16	-2.80
8,775.00	2.33	238.85	8,765.94	-190.64	-208.47	-179.76	0.44	-0.40	-4.48
8,800.00	2.28	238.81	8,790.92	-191.16	-209.33	-180.23	0.20	-0.20	-0.16
8,825.00	2.17	239.93	8,815.90	-191.65	-210.16	-180.68	0.47	-0.44	4.48
8,850.00	2.17	240.16	8,840.89	-192.13	-210.98	-181.11	0.03	0.00	0.92
8,875.00	2.16	240.33	8,865.87	-192.59	-211.80	-181.54	0.05	-0.04	0.68
8,900.00	2.15	238.64	8,890.85	-193.07	-212.61	-181.97	0.26	-0.04	-6.76
8,925.00	2.09	238.48	8,915.83	-193.55	-213.40	-182.42	0.24	-0.24	-0.64
8,950.00	1.99	235.98	8,940.82	-194.03	-214.15	-182.86	0.54	-0.40	-10.00



Phoenix Technology Services LP
Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
8,975.00	1.98	237.91	8,965.80	-194.51	-214.88	-183.29	0.27	-0.04	7.72
9,000.00	2.02	237.78	8,990.79	-194.97	-215.62	-183.72	0.16	0.16	-0.52
9,025.00	2.07	238.33	9,015.77	-195.44	-216.37	-184.15	0.21	0.20	2.20
9,050.00	2.02	237.30	9,040.75	-195.92	-217.13	-184.59	0.25	-0.20	-4.12
9,075.00	1.99	232.76	9,065.74	-196.42	-217.84	-185.05	0.65	-0.12	-18.16
9,100.00	2.06	232.58	9,090.72	-196.96	-218.55	-185.55	0.28	0.28	-0.72
9,125.00	2.01	232.75	9,115.71	-197.49	-219.25	-186.05	0.20	-0.20	0.68
9,150.00	2.00	229.05	9,140.69	-198.04	-219.93	-186.57	0.52	-0.04	-14.80
9,175.00	2.09	232.25	9,165.68	-198.61	-220.62	-187.10	0.58	0.36	12.80
9,200.00	2.07	231.34	9,190.66	-199.17	-221.33	-187.62	0.15	-0.08	-3.64
9,225.00	1.98	227.78	9,215.64	-199.74	-222.01	-188.16	0.62	-0.36	-14.24
9,250.00	2.02	228.56	9,240.63	-200.33	-222.66	-188.71	0.19	0.16	3.12
9,275.00	2.06	230.12	9,265.61	-200.90	-223.33	-189.25	0.27	0.16	6.24
9,300.00	2.10	232.49	9,290.60	-201.47	-224.04	-189.78	0.38	0.16	9.48
9,325.00	2.24	237.43	9,315.58	-202.01	-224.81	-190.28	0.93	0.56	19.76
9,350.00	2.32	243.80	9,340.56	-202.50	-225.68	-190.72	1.06	0.32	25.48
9,375.00	2.43	245.44	9,365.54	-202.94	-226.62	-191.12	0.52	0.44	6.56
9,400.00	2.53	245.46	9,390.51	-203.39	-227.60	-191.52	0.40	0.40	0.08
9,425.00	2.58	245.57	9,415.49	-203.86	-228.61	-191.93	0.20	0.20	0.44
9,450.00	2.53	245.19	9,440.47	-204.32	-229.63	-192.34	0.21	-0.20	-1.52
9,475.00	2.55	242.69	9,465.44	-204.81	-230.62	-192.78	0.45	0.08	-10.00
9,500.00	2.47	242.77	9,490.42	-205.31	-231.60	-193.23	0.32	-0.32	0.32
9,525.00	2.44	240.89	9,515.39	-205.81	-232.54	-193.68	0.34	-0.12	-7.52
9,550.00	2.45	237.41	9,540.37	-206.36	-233.45	-194.18	0.60	0.04	-13.92
9,575.00	2.32	236.56	9,565.35	-206.93	-234.33	-194.70	0.54	-0.52	-3.40
9,600.00	2.40	233.93	9,590.33	-207.51	-235.17	-195.25	0.54	0.32	-10.52
9,625.00	2.67	232.71	9,615.30	-208.17	-236.06	-195.86	1.10	1.08	-4.88
9,650.00	2.78	233.18	9,640.28	-208.89	-237.01	-196.53	0.45	0.44	1.88
9,675.00	2.92	232.90	9,665.24	-209.64	-238.00	-197.22	0.56	0.56	-1.12
9,700.00	2.84	233.18	9,690.21	-210.39	-239.00	-197.93	0.32	-0.32	1.12
9,725.00	2.55	233.16	9,715.19	-211.10	-239.95	-198.58	1.16	-1.16	-0.08
9,750.00	2.49	233.02	9,740.16	-211.76	-240.82	-199.20	0.24	-0.24	-0.56
9,758.20	2.49	232.70	9,748.35	-211.97	-241.11	-199.40	0.17	0.00	-3.90
Tie In									
9,922.00	1.45	228.09	9,912.05	-215.51	-245.48	-202.71	0.64	-0.63	-2.81
First Phoenix MWD Survey									
10,016.00	1.12	295.93	10,006.04	-215.91	-247.19	-203.02	1.55	-0.35	72.17
10,110.00	1.54	317.23	10,100.01	-214.58	-248.88	-201.60	0.68	0.45	22.66
10,156.00	5.94	347.68	10,145.90	-211.80	-249.80	-198.78	10.17	9.57	66.20
10,204.00	10.66	357.72	10,193.39	-204.93	-250.51	-191.88	10.25	9.83	20.92
10,251.00	14.69	354.09	10,239.24	-194.65	-251.30	-181.58	8.74	8.57	-7.72
10,299.00	17.50	343.91	10,285.36	-181.66	-253.93	-168.47	8.28	5.85	-21.21
10,346.00	21.57	337.94	10,329.65	-166.86	-259.13	-153.42	9.63	8.66	-12.70
10,394.00	25.00	334.43	10,373.73	-149.52	-266.83	-135.72	7.71	7.15	-7.31



Phoenix Technology Services LP
Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
10,426.00	26.81	336.86	10,402.52	-136.79	-272.58	-122.70	6.56	5.66	7.59
10,458.00	28.45	338.07	10,430.87	-123.08	-278.26	-108.72	5.42	5.13	3.78
10,490.00	31.57	337.34	10,458.58	-108.27	-284.34	-93.63	9.82	9.75	-2.28
10,521.00	35.14	338.63	10,484.47	-92.47	-290.72	-77.52	11.74	11.52	4.16
10,553.00	39.09	341.00	10,509.98	-74.35	-297.36	-59.08	13.13	12.34	7.41
10,585.00	44.28	347.23	10,533.88	-53.89	-303.12	-38.36	20.74	16.22	19.47
10,616.00	51.22	350.72	10,554.71	-31.38	-307.47	-15.66	23.88	22.39	11.26
10,629.00	53.68	351.47	10,562.64	-21.20	-309.06	-5.41	19.46	18.91	5.75
FTP									
10,648.00	57.28	352.48	10,573.40	-5.70	-311.25	10.18	19.46	18.95	5.33
10,679.00	62.18	353.16	10,589.02	20.85	-314.59	36.87	15.92	15.81	2.19
10,711.00	66.52	353.18	10,602.87	49.49	-318.02	65.65	13.56	13.56	0.06
10,742.00	71.66	353.54	10,613.93	78.24	-321.36	94.53	16.62	16.58	1.16
10,774.00	76.67	353.22	10,622.66	108.81	-324.91	125.25	15.69	15.66	-1.00
10,809.00	80.89	353.02	10,629.47	142.89	-329.02	159.49	12.07	12.06	-0.57
10,840.00	83.49	353.36	10,633.68	173.38	-332.67	190.13	8.46	8.39	1.10
10,871.00	86.61	352.96	10,636.36	204.04	-336.34	220.93	10.15	10.06	-1.29
10,902.00	88.09	352.71	10,637.79	234.77	-340.21	251.82	4.84	4.77	-0.81
10,997.00	93.95	354.07	10,636.10	329.08	-351.14	346.56	6.33	6.17	1.43
11,091.00	96.14	355.11	10,627.83	422.29	-359.96	440.10	2.58	2.33	1.11
11,187.00	93.36	356.63	10,619.88	517.70	-366.85	535.74	3.30	-2.90	1.58
11,281.00	90.87	357.08	10,616.42	611.49	-372.00	629.67	2.69	-2.65	0.48
11,376.00	91.01	357.46	10,614.86	706.36	-376.53	724.65	0.43	0.15	0.40
11,471.00	86.61	358.42	10,616.83	801.26	-379.94	819.60	4.74	-4.63	1.01
11,565.00	88.01	359.81	10,621.24	895.14	-381.39	913.43	2.10	1.49	1.48
11,660.00	91.15	0.37	10,621.94	990.12	-381.24	1,008.28	3.36	3.31	0.59
11,754.00	89.97	0.59	10,621.02	1,084.11	-380.45	1,102.11	1.28	-1.26	0.23
11,849.00	89.47	0.79	10,621.48	1,179.11	-379.31	1,196.92	0.57	-0.53	0.21
11,944.00	89.13	0.63	10,622.64	1,274.09	-378.13	1,291.72	0.40	-0.36	-0.17
12,039.00	84.03	0.11	10,628.31	1,368.89	-377.52	1,386.36	5.40	-5.37	-0.55
12,134.00	83.23	359.73	10,638.85	1,463.30	-377.65	1,480.66	0.93	-0.84	-0.40
12,229.00	89.61	2.00	10,644.78	1,558.05	-376.21	1,575.21	7.13	6.72	2.39
12,322.00	91.51	2.25	10,643.87	1,650.98	-372.77	1,667.84	2.06	2.04	0.27
12,416.00	91.18	2.90	10,641.66	1,744.86	-368.54	1,761.38	0.78	-0.35	0.69
12,510.00	90.17	1.02	10,640.56	1,838.79	-365.33	1,855.03	2.27	-1.07	-2.00
12,604.00	87.98	1.49	10,642.07	1,932.75	-363.27	1,948.76	2.38	-2.33	0.50
12,699.00	90.17	0.14	10,643.61	2,027.72	-361.92	2,043.54	2.71	2.31	-1.42
12,793.00	88.63	357.93	10,644.59	2,121.69	-363.50	2,137.47	2.87	-1.64	-2.35
12,887.00	92.10	358.07	10,643.99	2,215.62	-366.78	2,231.44	3.69	3.69	0.15
12,981.00	89.94	356.56	10,642.32	2,309.49	-371.19	2,325.42	2.80	-2.30	-1.61
13,076.00	91.06	357.66	10,641.49	2,404.36	-375.98	2,420.41	1.65	1.18	1.16
13,170.00	88.68	359.47	10,641.70	2,498.32	-378.33	2,514.37	3.18	-2.53	1.93
13,264.00	88.49	1.33	10,644.03	2,592.29	-377.67	2,608.18	1.99	-0.20	1.98



Phoenix Technology Services LP
Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
13,359.00	92.44	3.81	10,643.25	2,687.16	-373.42	2,702.71	4.91	4.16	2.61
13,453.00	93.05	1.67	10,638.75	2,780.94	-368.93	2,796.14	2.36	0.65	-2.28
13,548.00	94.68	1.98	10,632.35	2,875.67	-365.91	2,890.60	1.75	1.72	0.33
13,643.00	90.50	0.68	10,628.06	2,970.53	-363.71	2,985.21	4.61	-4.40	-1.37
13,736.00	88.63	358.47	10,628.76	3,063.51	-364.40	3,078.11	3.11	-2.01	-2.38
13,830.00	90.36	357.87	10,629.59	3,157.46	-367.40	3,172.09	1.95	1.84	-0.64
13,924.00	89.55	357.45	10,629.67	3,251.38	-371.24	3,266.08	0.97	-0.86	-0.45
14,019.00	91.12	359.01	10,629.11	3,346.33	-374.17	3,361.06	2.33	1.65	1.64
14,113.00	87.79	358.54	10,630.00	3,440.29	-376.18	3,455.00	3.58	-3.54	-0.50
14,207.00	91.65	1.54	10,630.46	3,534.26	-376.12	3,548.84	5.20	4.11	3.19
14,302.00	89.24	0.54	10,629.73	3,629.23	-374.39	3,643.60	2.75	-2.54	-1.05
14,397.00	88.74	2.35	10,631.40	3,724.18	-372.00	3,738.31	1.98	-0.53	1.91
14,491.00	89.78	3.48	10,632.61	3,818.05	-367.22	3,831.81	1.63	1.11	1.20
14,586.00	89.19	0.74	10,633.47	3,912.97	-363.72	3,926.43	2.95	-0.62	-2.88
14,680.00	89.16	1.72	10,634.82	4,006.94	-361.70	4,020.17	1.04	-0.03	1.04
14,774.00	88.60	4.52	10,636.66	4,100.77	-356.59	4,113.62	3.04	-0.60	2.98
14,869.00	88.49	3.20	10,639.07	4,195.52	-350.19	4,207.92	1.39	-0.12	-1.39
14,964.00	88.49	2.59	10,641.58	4,290.37	-345.40	4,302.40	0.64	0.00	-0.64
15,060.00	87.98	2.52	10,644.53	4,386.23	-341.12	4,397.92	0.54	-0.53	-0.07
15,154.00	90.89	2.84	10,645.46	4,480.11	-336.73	4,491.45	3.11	3.10	0.34
15,249.00	88.38	0.33	10,646.06	4,575.06	-334.10	4,586.14	3.74	-2.64	-2.64
15,343.00	90.87	0.40	10,646.68	4,669.05	-333.50	4,679.98	2.65	2.65	0.07
15,438.00	91.73	359.34	10,644.52	4,764.02	-333.71	4,774.84	1.44	0.91	-1.12
15,532.00	90.34	359.14	10,642.83	4,857.99	-334.96	4,868.75	1.49	-1.48	-0.21
15,627.00	89.72	359.87	10,642.78	4,952.99	-335.78	4,963.67	1.01	-0.65	0.77
15,721.00	87.45	0.05	10,645.10	5,046.95	-335.85	5,057.51	2.42	-2.41	0.19
15,816.00	90.08	0.82	10,647.14	5,141.92	-335.13	5,152.32	2.88	2.77	0.81
15,909.00	90.03	0.39	10,647.06	5,234.91	-334.14	5,245.14	0.47	-0.05	-0.46
16,004.00	83.80	359.53	10,652.17	5,329.73	-334.21	5,339.84	6.62	-6.56	-0.91
16,098.00	84.57	359.05	10,661.69	5,423.24	-335.37	5,433.28	0.96	0.82	-0.51
16,192.00	92.49	0.16	10,664.10	5,517.13	-336.01	5,527.08	8.51	8.43	1.18
16,286.00	89.92	359.75	10,662.12	5,611.10	-336.09	5,620.94	2.77	-2.73	-0.44
16,380.00	90.53	0.31	10,661.75	5,705.10	-336.04	5,714.81	0.88	0.65	0.60
16,475.00	90.64	359.98	10,660.78	5,800.09	-335.80	5,809.67	0.37	0.12	-0.35
16,570.00	90.34	359.64	10,659.97	5,895.09	-336.11	5,904.56	0.48	-0.32	-0.36
16,663.00	92.52	0.53	10,657.65	5,988.05	-335.97	5,997.39	2.53	2.34	0.96
16,758.00	92.49	0.51	10,653.50	6,082.96	-335.11	6,092.13	0.04	-0.03	-0.02
16,852.00	91.71	0.31	10,650.05	6,176.89	-334.44	6,185.91	0.86	-0.83	-0.21
Final Phoenix MWD Survey									
16,962.00	91.71	0.31	10,646.77	6,286.84	-333.85	6,295.68	0.00	0.00	0.00
Projection to TD									



Phoenix Technology Services LP

Survey Report



Company: COG Operating LLC
Project: Eddy County, NM (NAD27 NME)
Site: Copperhead Fee A
Well: 4H
Wellbore: OH / Job #60952
Design: Surveys (Ensign 155)

Local Co-ordinate Reference: Well 4H
TVD Reference: GL + KB @ 2937.40usft (Ensign 155)
MD Reference: GL + KB @ 2937.40usft (Ensign 155)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
9,758.20	9,748.35	-211.97	-241.11	Tie In
9,922.00	9,912.05	-215.51	-245.48	First Phoenix MWD Survey
10,629.00	10,562.64	-21.20	-309.06	FTP
16,852.00	10,650.05	6,176.89	-334.44	Final Phoenix MWD Survey
16,962.00	10,646.77	6,286.84	-333.85	Projection to TD