Company: COG OPERATING
Lease/Well: COPPERHEAD 31 FEDERAL COM No. /21H

Rig Name: LATSHAW 44
State/County: NEW MEXICO/EDDY
VS-Azi: 182.77 Degrees
Latitude: 32.02031, Longitude: -104.02052
Grid North = True North -0.17 degs (NAD 27)
Grid Correction Applied = -0.17 degs

Depth Reference : RKB=25 FEET

DRILLOG HA GYRO SURVEY CALCULATIONS
Filename: e-line gyro-de_01.ut
Minimum Curvature Method
Report Date/Time: 5/23/2017 / 13:33

VES Survey International
Midland, Texas
432-563-5444
Surveyor: Michael Cook

Copperhead 31 Federal Com No. 21H / API 30-015-44118

Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	****
100.00	0.28	291.36	100.00	0.09	-0.23	-0.08	0.24	291.36	0.28
200.00	0.31	315.71	200.00	0.37	-0.64	-0.34	0.74	299.89	0.13
300.00	0.13	349.84	300.00	0.67	-0.85	-0.63	1.08	308.46	0.21
400.00	0.18	50.52	400.00	0.89	-0.75	-0.85	1.16	320.07	0.17
500.00	0.13	51.29	500.00	1.06	-0.53	-1.04	1.19	333.35	0.05
600.00	0.25	68.35	600.00	1.21	-0.25	-1.20	1.24	348.55	0.13
700.00	0.34	40.75	700.00	1.52	0.15	-1.52	1.52	5.58	0.17
800.00	0.76	116.77	799.99	1.44	0.93	-1.49	1.72	32.85	0.75
900.00	1.04	94.36	899.98	1.08	2.43	-1.19	2.66	66.07	0.45
1000.00	1.09	25.35	999.97	1.87	3.74	-2.05	4.19	63.43	1.21
1100.00	1.03	333.80	1099.95	3.54	3.75	-3.72	5.16	46.64	0.93
1200.00	0.99	271.41	1199.94	4.38	2.50	-4.49	5.04	29.70	1.05
1300.00	0.95	233.60	1299.92	3.91	0.97	-3.95	4.02	13.94	0.63
1400.00	1.03	232.05	1399.91	2.86	-0.41	-2.84	2.89	351.94	0.09
1500.00	1.17	226.56	1499.89	1.61	-1.85	-1.52	2.45	311.00	0.17
1600.00	0.94	212.72	1599.87	0.22	-3.03	-0.07	3.04	274.15	0.34

V.E.S. Survey Date: 5/16/2017

Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
1700.00	0.83	214.69	1699.86	-1.07	-3.89	1.25	4.03	254.66	0.11
1800.00	0.38	228.07	1799.86	-1.89	-4.55	2.10	4.93	247.49	0.47
1900.00	0.59	170.21	1899.85	-2.62	-4.71	2.84	5.39	240.93	0.51
2000.00	0.82	102.44	1999.85	-3.28	-3.92	3.47	5.11	230.08	0.81
2100.00	2.65	67.71	2099.80	-2.56	-1.09	2.61	2.78	203.01	2.03
2200.00	3.28	69.62	2199.67	-0.69	3.73	0.51	3.79	100.47	0.64
2300.00	3.26	48.58	2299.51	2.19	8.54	-2.60	8.82	75.64	1.19
2400.00	2.78	44.67	2399.37	5.79	12.38	-6.38	13.67	64.92	0.52
2500.00	1.52	32.17	2499.30	8.64	14.79	-9.35	17.13	59.71	1.33
2600.00	1.36	298.89	2599.27	10.34	14.46	-11.02	17.78	54.44	2.09
2700.00	1.55	293.22	2699.24	11.44	12.19	-12.02	16.72	46.81	0.24
2800.00	1.71	290.25	2799.20	12.49	9.55	-12.93	15.72	37.40	0.18
2900.00	1.60	288.78	2899.16	13.45	6.83	-13.77	15.09	26.91	0.12
3000.00	1.54	290.74	2999.12	14.38	4.25	-14.57	14.99	16.48	0.08
3100.00	1.88	292.49	3099.08	15.48	1.48	-15.53	15.55	5.48	0.34
3200.00	2.72	298.82	3199.00	17.25	-2.11	-17.13	17.38	353.03	0.88
3300.00	2.53	295.35	3298.89	19.34	-6.18	-19.02	20.30	342.27	0.25
3400.00	2.50	293.53	3398.80	21.15	-10.18	-20.64	23.48	334.31	0.09
3500.00	2.43	295.61	3498.70	22.94	-14.09	-22.23	26.92	328.45	0.11
3600.00	2.50	296.43	3598.61	24.83	-17.95	-23.93	30.63	324.14	0.08
3700.00	2.51	289.48	3698.52	26.53	-21.96	-25.43	34.44	320.37	0.30
3800.00	2.83	291.02	3798.41	28.14	-26.34	-26.84	38.54	316.90	0.33
3900.00	2.74	289.81	3898.29	29.84	-30.89	-28.31	42.95	314.01	0.11
4000.00	3.63	289.50	3998.13	31.71	-36.12	-29.92	48.06	311.27	0.89
4100.00	3.59	292.68	4097.94	33.97	-42.00	-31.90	54.02	308.97	0.20
4200.00	3.21	289.22	4197.76	36.10	-47.53	-33.76	59.69	307.22	0.43
4300.00	3.22	286.72	4297.60	37.83	-52.87	-35.23	65.01	305.59	0.14
4400.00	2.80	282.57	4397.46	39.17	-57.94	-36.32	69.94	304.06	0.47
4500.00	3.21	279.73	4497.33	40.18	-63.08	-37.08	74.79	302.49	0.44
4600.00	3.54	276.19	4597.15	40.98	-68.92	-37.60	80.18	300.74	0.39
4700.00	2.99	273.93	4696.99	41.49	-74.60	-37.84	85.36	299.09	0.57
4800.00	3.54	283.00	4796.83	42.37	-80.20	-38.44	90.71	297.84	0.75
4900.00	3.59	285.54	4896.63	43.90	-86.23	-39.68	96.76	296.98	0.17
5000.00	3.45	284.39	4996.44	45.49	-92.16	-40.98	102.77	296.27	0.16
5100.00	3.40	282.26	5096.27	46.86	-97.97	-42.07	108.60	295.56	0.14
5200.00	3.35	280.58	5196.09	48.03	-103.74	-42.96	114.32	294.84	0.11
5300.00	3.24	279.54	5295.93	49.03	-109.40	-43.69	119.88	294.14	0.13
5400.00	3.36	274.68	5395.76	49.74	-115.10	-44.12	125.39	293.37	0.31
5500.00	3.18	275.55	5495.60	50.25	-120.78	-44.35	130.82	292.59	0.19

V.E.S. Survey Date: 5/16/2017

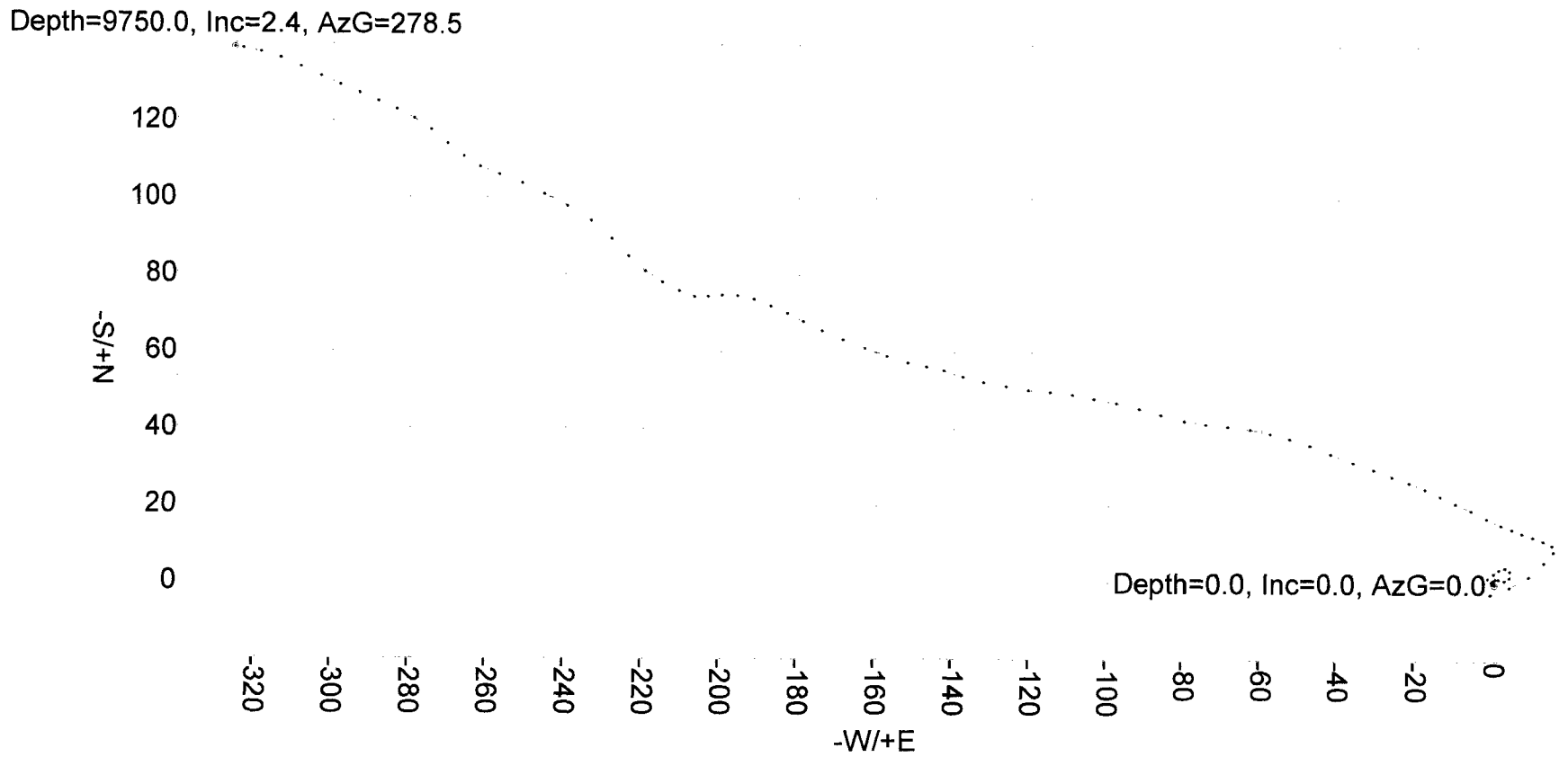
Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
5600.00	3.46	281.81	5595.43	51.14	-126.50	-44.96	136.44	292.01	0.46
5700.00	3.31	279.11	5695.26	52.21	-132.30	-45.76	142.23	291.54	0.22
5800.00	3.26	289.99	5795.09	53.64	-137.83	-46.92	147.90	291.27	0.62
5900.00	2.61	285.44	5894.96	55.22	-142.69	-48.26	153.00	291.16	0.69
6000.00	2.64	280.30	5994.86	56.23	-147.14	-49.06	157.52	290.92	0.24
6100.00	3.02	284.42	6094.74	57.30	-151.96	-49.89	162.40	290.66	0.44
6200.00	3.41	290.38	6194.58	58.99	-157.30	-51.32	168.00	290.56	0.51
6300.00	3.60	290.01	6294.39	61.10	-163.04	-53.15	174.11	290.55	0.19
6400.00	3.35	293.90	6394.21	63.36	-168.66	-55.14	180.17	290.59	0.34
6500.00	3.31	294.25	6494.04	65.73	-173.97	-57.25	185.97	290.70	0.05
6600.00	2.80	296.07	6593.90	67.99	-178.79	-59.27	191.29	290.82	0.52
6700.00	2.65	297.77	6693.78	70.14	-183.03	-61.21	196.01	290.97	0.17
6800.00	2.68	290.85	6793.68	72.05	-187.26	-62.92	200.65	291.04	0.32
6900.00	2.59	289.61	6893.57	73.64	-191.58	-64.30	205.25	291.03	0.11
7000.00	2.42	275.30	6993.47	74.60	-195.81	-65.05	209.54	290.85	0.65
7100.00	2.18	269.04	7093.39	74.76	-199.81	-65.02	213.34	290.51	0.35
7200.00	1.98	262.06	7193.33	74.49	-203.42	-64.57	216.63	290.11	0.32
7300.00	2.07	276.88	7293.27	74.47	-206.92	-64.38	219.91	289.79	0.53
7400.00	2.85	298.32	7393.18	75.86	-210.91	-65.58	224.13	289.78	1.19
7500.00	2.73	297.38	7493.06	78.14	-215.21	-67.65	228.95	289.95	0.13
7600.00	3.27	309.20	7592.92	81.03	-219.53	-70.33	234.01	290.26	0.82
7700.00	3.26	313.78	7692.76	84.80	-223.79	-73.89	239.32	290.75	0.26
7800.00	3.97	318.59	7792.56	89.37	-228.14	-78.24	245.02	291.39	0.77
7900.00	4.22	305.68	7892.31	94.11	-233.42	-82.72	251.68	291.96	0.95
8000.00	3.97	298.46	7992.05	97.91	-239.45	-86.22	258.70	292.24	0.57
8100.00	3.67	296.08	8091.83	100.97	-245.37	-88.99	265.34	292.37	0.34
8200.00	3.74	296.35	8191.62	103.82	-251.17	-91.56	271.78	292.46	0.07
8300.00	3.47	284.45	8291.42	106.03	-257.02	-93.48	278.03	292.42	0.79
8400.00	2.77	301.21	8391.28	108.03	-262.02	-95.25	283.42	292.41	1.14
8500.00	2.98	305.00	8491.15	110.78	-266.22	-97.79	288.35	292.59	0.28
8600.00	3.12	312.41	8591.01	114.11	-270.36	-100.91	293.46	292.88	0.42
8700.00	3.23	306.73	8690.86	117.63	-274.63	-104.22	298.76	293.19	0.33
8800.00	2.95	299.71	8790.71	120.59	-279.13	-106.96	304.06	293.37	0.47
8900.00	2.91	296.16	8890.58	122.99	-283.65	-109.14	309.16	293.44	0.19
9000.00	2.98	292.71	8990.45	125.12	-288.33	-111.04	314.30	293.46	0.19
9100.00	3.11	292.01	9090.31	127.14	-293.24	-112.82	319.61	293.44	0.13
9200.00	3.10	296.26	9190.16	129.35	-298.18	-114.79	325.03	293.45	0.23
9300.00	3.11	293.19	9290.01	131.61	-303.09	-116.81	330.43	293.47	0.17
9400.00	3.42	294.86	9389.85	133.93	-308.29	-118.88	336.13	293.48	0.33

V.E.S. Survey Date: 5/16/2017

Measured Depth FT	Incl Angle Deg	Drift Direction Deg	TVD FT	+N/-S FT	+E/-W FT	Vertical Section FT	Closure Distance FT	Closure Direction Deg	Dogleg Severity Deg/100
9500.00	3.34	291.97	9489.68	136.28	-313.70	-120.96	342.03	293.48	0.19
9600.00	2.70	280.87	9589.54	137.81	-318.72	-122.25	347.23	293.38	0.86
9700.00	2.52	280.11	9689.43	138.64	-323.19	-122.86	351.68	293.22	0.18
9750.00	2.38	278.48	9739.39	138.99	-325.30	-123.11	353.75	293.14	0.32

V.E.S. Survey Date: 5/16/2017

VES Survey International
Midland, Texas
432-563-5444
Surveyor: Michael Cook
Copperhead 31 Federal Com No. 21H / API 30-015-44118



V.E.S. Survey Date: 5/16/2017

VES SURVEY

I Michael Cook certify that I am employed by VES Survey International. That I did on the day(s) of 05/17/17 through 05/17/17 conduct or supervise the taking of a Rate Gyro survey from a depth of 0.00 feet to a depth of 9,750.00 feet; that the data is true, correct, complete and within the limitations of the tool as set forth by Vaughn Energy Services, that I am authorized and qualified to make this report; that this survey was conducted at the request of COG Operating for the Copperhead 31 Federal Com Well # 21H API # 30-015-44118 in Eddy County / Parish New Mexico ; and that I have reviewed this report and find that it conforms to the principles and procedures as set forth by VES Survey International.

Michael Cook
Service Technician
VES Survey International