

NM OIL CONSERVATION
ARTESIA DISTRICT

AUG 30 2017

RECEIVED

COG OPERATING, LLC

Eddy County, NM (NAD27) NMEZ

Burch Keely Unit 940H

BKU 940H SLOT 195'FEL, 1650'FNL - Slot 940H

Lateral ACTUAL BHL 220'FEL, 1670'FNL

30-015-44080

Design: Lateral PLANNED BHL 220'FEL, 1670'FNL

Standard Survey Report

16 May, 2017



Survey Report



Company: COG OPERATING, LLC
Project: Eddy County, NM (NAD27) NMEZ
Site: Burch Keely Unit 940H
Well: BKU 940H
Wellbore: Lateral
Design: Lateral

Local Co-ordinate Reference: Well BKU 940H - Slot 940H
TVD Reference: 3640+18 @ 3658.0usft (SilverOak3)
MD Reference: 3640+18 @ 3658.0usft (SilverOak3)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: VONEDM

Project	Eddy County, NM (NAD27) NMEZ		
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	Burch Keely Unit 940H, centered on 940H		
Site Position:		Northing:	668,403.17 usft
From:	Map	Easting:	596,303.81 usft
Position Uncertainty:	0.0 usft	Slot Radius:	13-3/16 "
		Latitude:	32° 50' 13.680 N
		Longitude:	104° 1' 11.241 W
		Grid Convergence:	0.17 °

Well	BKU 940H - Slot 940H		
Well Position	+N/-S	0.0 usft	Northing: 668,403.17 usft
	+E/-W	0.0 usft	Easting: 596,303.81 usft
Position Uncertainty	0.0 usft	Wellhead Elevation:	0.0 usft
		Latitude:	32° 50' 13.680 N
		Longitude:	104° 1' 11.241 W
		Ground Level:	3,640.0 usft

Wellbore	Lateral		
Magnetics	Model Name	Sample Date	Declination
			(°)
	IGRF2015	04/27/17	7.22
			Dip Angle
			(°)
			60.55
			Field Strength
			(nT)
			48,266

Design	Lateral		
Audit Notes:			
Version:	1.0	Phase:	ACTUAL
		Tie On Depth:	0.0
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W
	(usft)	(usft)	(usft)
	0.0	0.0	0.0
			Direction
			(°)
			89.76

Survey Program	Date 05/15/17		
From	To	Survey (Wellbore)	Tool Name
(usft)	(usft)		
100.0	1,116.0	Survey #1 (Lateral)	GYD_DP_MS
1,158.0	9,901.0	Survey #2 (Lateral)	MWD
9,970.0	9,970.0	Survey #3 (Lateral)	Projection
			Description
			Gyrodata gyro-compassing and drop
			MWD v3:standard declination
			Projection

Survey									
Measured	Inclination	Azimuth	Vertical	+N/-S	+E/-W	Vertical	Dogleg	Build	Turn
Depth	(°)	(°)	Depth	(usft)	(usft)	Section	Rate	Rate	Rate
(usft)			(usft)			(usft)	(°/100usft)	(°/100usft)	(°/100usft)
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
100.0	0.39	164.92	100.0	-0.3	0.1	0.1	0.39	0.39	0.00
200.0	0.32	168.27	200.0	-0.9	0.2	0.2	0.07	-0.07	3.35
300.0	0.36	166.68	300.0	-1.5	0.4	0.4	0.04	0.04	-1.59
400.0	0.37	174.42	400.0	-2.1	0.5	0.5	0.05	0.01	7.74
500.0	0.08	177.05	500.0	-2.5	0.5	0.5	0.29	-0.29	2.63
600.0	0.07	115.31	600.0	-2.6	0.6	0.5	0.08	-0.01	-61.74
700.0	0.44	56.02	700.0	-2.4	0.9	0.9	0.41	0.37	-59.29
800.0	0.64	61.99	800.0	-2.0	1.7	1.7	0.21	0.20	5.97

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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)
900.0	0.80	53.87	900.0	-1.3	2.8	2.8	0.19	0.16	-8.12
1,000.0	0.88	52.94	1,000.0	-0.4	4.0	4.0	0.08	0.08	-0.93
1,100.0	0.75	49.94	1,100.0	0.5	5.1	5.1	0.14	-0.13	-3.00
1,116.0	0.70	53.46	1,116.0	0.6	5.3	5.3	0.42	-0.31	22.00
1,158.0	0.76	47.62	1,158.0	0.9	5.7	5.7	0.23	0.14	-13.90
1,221.0	0.76	72.59	1,220.9	1.3	6.4	6.4	0.52	0.00	39.63
1,315.0	1.28	342.46	1,314.9	2.5	6.6	6.7	1.59	0.55	-95.88
1,410.0	2.65	320.93	1,409.9	5.3	4.9	5.0	1.61	1.44	-22.66
1,505.0	2.59	292.59	1,504.8	7.8	1.6	1.6	1.35	-0.06	-29.83
1,599.0	4.32	262.16	1,598.6	8.1	-3.9	-3.9	2.62	1.84	-32.37
1,694.0	4.68	259.51	1,693.3	6.9	-11.2	-11.2	0.44	0.38	-2.79
1,788.0	4.53	259.00	1,787.0	5.5	-18.7	-18.6	0.17	-0.16	-0.54
1,883.0	4.37	257.91	1,881.7	4.0	-25.9	-25.9	0.19	-0.17	-1.15
1,978.0	4.18	258.69	1,976.5	2.6	-32.8	-32.8	0.21	-0.20	0.82
2,072.0	4.18	257.19	2,070.2	1.2	-39.5	-39.5	0.12	0.00	-1.60
2,167.0	3.95	258.05	2,165.0	-0.3	-46.1	-46.1	0.25	-0.24	0.91
2,262.0	3.88	259.33	2,259.8	-1.5	-52.5	-52.5	0.12	-0.07	1.35
2,356.0	3.67	257.82	2,353.6	-2.8	-58.5	-58.5	0.25	-0.22	-1.61
2,450.0	3.82	258.35	2,447.4	-4.0	-64.5	-64.5	0.16	0.16	0.56
2,545.0	3.86	256.35	2,542.1	-5.4	-70.7	-70.8	0.15	0.04	-2.11
2,640.0	3.97	259.69	2,636.9	-6.8	-77.1	-77.1	0.27	0.12	3.52
2,735.0	3.91	256.82	2,731.7	-8.1	-83.5	-83.5	0.22	-0.06	-3.02
2,829.0	3.83	258.46	2,825.5	-9.5	-89.7	-89.7	0.15	-0.09	1.74
2,924.0	4.14	261.49	2,920.3	-10.6	-96.2	-96.2	0.39	0.33	3.19
3,020.0	4.10	262.83	3,016.0	-11.5	-103.0	-103.0	0.11	-0.04	1.40
3,114.0	3.30	252.10	3,109.8	-12.8	-108.9	-109.0	1.12	-0.85	-11.41
3,209.0	3.30	253.34	3,204.7	-14.4	-114.1	-114.2	0.08	0.00	1.31
3,303.0	3.10	256.24	3,298.5	-15.8	-119.2	-119.2	0.27	-0.21	3.09
3,398.0	3.17	259.28	3,393.4	-16.9	-124.3	-124.3	0.19	0.07	3.20
3,493.0	3.35	261.56	3,488.2	-17.8	-129.6	-129.7	0.23	0.19	2.40
3,587.0	3.08	256.52	3,582.1	-18.8	-134.8	-134.8	0.42	-0.29	-5.36
3,682.0	3.04	252.55	3,676.9	-20.1	-139.6	-139.7	0.23	-0.04	-4.18
3,776.0	3.12	254.04	3,770.8	-21.6	-144.5	-144.6	0.12	0.09	1.59
3,870.0	3.28	259.03	3,864.6	-22.8	-149.6	-149.7	0.34	0.17	5.31
3,965.0	2.30	246.52	3,959.5	-24.1	-154.0	-154.1	1.21	-1.03	-13.17
4,059.0	0.51	251.81	4,053.5	-25.0	-156.1	-156.2	1.91	-1.90	5.63
4,154.0	0.38	185.29	4,148.5	-25.4	-156.6	-156.7	0.53	-0.14	-70.02
4,217.0	0.61	200.79	4,211.5	-25.9	-156.7	-156.8	0.42	0.37	24.60
4,248.0	0.35	182.94	4,242.5	-26.2	-156.8	-156.9	0.96	-0.84	-57.58
4,280.0	1.10	98.26	4,274.5	-26.3	-156.5	-156.6	3.51	2.34	-264.63
4,311.0	2.96	86.56	4,305.5	-26.3	-155.4	-155.5	6.12	6.00	-37.74
4,343.0	5.29	85.40	4,337.4	-26.1	-153.1	-153.2	7.29	7.28	-3.63
4,374.0	8.43	86.77	4,368.2	-25.9	-149.4	-149.5	10.14	10.13	4.42

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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)
4,406.0	11.95	89.67	4,399.6	-25.8	-143.7	-143.8	11.11	11.00	9.06
4,438.0	15.64	89.82	4,430.7	-25.7	-136.1	-136.2	11.53	11.53	0.47
4,469.0	19.35	88.53	4,460.3	-25.6	-126.8	-126.9	12.03	11.97	-4.16
4,501.0	23.37	87.22	4,490.1	-25.1	-115.1	-115.2	12.65	12.56	-4.09
4,533.0	26.81	87.04	4,519.1	-24.4	-101.6	-101.7	10.75	10.75	-0.56
4,564.0	29.57	87.16	4,546.4	-23.7	-87.0	-87.1	8.91	8.90	0.39
4,596.0	31.71	88.93	4,573.9	-23.2	-70.7	-70.8	7.26	6.69	5.53
4,627.0	33.99	91.03	4,599.9	-23.2	-53.8	-53.9	8.22	7.35	6.77
4,659.0	36.85	92.22	4,626.0	-23.7	-35.3	-35.4	9.19	8.94	3.72
4,690.0	40.53	91.90	4,650.2	-24.4	-15.9	-16.1	11.89	11.87	-1.03
4,722.0	44.30	91.39	4,673.8	-25.0	5.6	5.5	11.83	11.78	-1.59
4,753.0	46.50	91.25	4,695.6	-25.5	27.7	27.6	7.10	7.10	-0.45
4,785.0	47.49	90.11	4,717.4	-25.8	51.1	51.0	4.04	3.09	-3.56
4,816.0	48.09	89.58	4,738.3	-25.7	74.0	73.9	2.31	1.94	-1.71
4,848.0	48.76	89.71	4,759.5	-25.6	98.0	97.9	2.12	2.09	0.41
4,879.0	49.31	89.46	4,779.8	-25.4	121.4	121.3	1.88	1.77	-0.81
4,911.0	50.10	89.41	4,800.5	-25.2	145.8	145.7	2.47	2.47	-0.16
4,942.0	52.81	89.58	4,819.8	-25.0	170.0	169.9	8.75	8.74	0.55
4,973.0	56.56	90.04	4,837.7	-24.9	195.3	195.2	12.15	12.09	1.47
Wellpath Crosses Section Line @ Heel									
4,974.0	56.68	90.05	4,838.3	-24.9	196.2	196.1	12.15	12.10	1.40
5,006.0	60.35	90.14	4,855.0	-24.9	223.5	223.3	11.47	11.47	0.28
5,037.0	62.60	90.11	4,869.8	-25.0	250.7	250.6	7.26	7.26	-0.10
5,069.0	64.63	90.90	4,884.0	-25.2	279.3	279.2	6.72	6.34	2.47
5,101.0	66.77	90.99	4,897.2	-25.7	308.5	308.4	6.69	6.69	0.28
5,133.0	68.50	91.09	4,909.4	-26.3	338.1	338.0	5.41	5.41	0.31
5,164.0	70.35	91.15	4,920.3	-26.8	367.1	367.0	5.97	5.97	0.19
5,196.0	73.65	91.85	4,930.1	-27.6	397.5	397.4	10.52	10.31	2.19
5,227.0	77.38	91.36	4,937.9	-28.5	427.5	427.4	12.13	12.03	-1.58
5,259.0	80.33	90.85	4,944.1	-29.1	458.9	458.8	9.35	9.22	-1.59
5,291.0	83.73	89.87	4,948.5	-29.3	490.6	490.5	11.05	10.63	-3.06
5,322.0	87.36	88.89	4,950.9	-28.9	521.5	521.4	12.13	11.71	-3.16
5,324.0	87.53	88.87	4,951.0	-28.9	523.5	523.4	8.52	8.47	-0.94
Wellpath Crosses 330°HL @ Heel									
5,354.0	90.07	88.59	4,951.6	-28.2	553.5	553.4	8.52	8.47	-0.94
5,386.0	90.92	88.34	4,951.4	-27.4	585.5	585.3	2.77	2.66	-0.78
5,422.0	91.76	90.47	4,950.5	-27.0	621.5	621.3	6.36	2.33	5.92
5,516.0	91.84	89.53	4,947.6	-27.0	715.4	715.3	1.00	0.09	-1.00
5,611.0	92.11	89.96	4,944.3	-26.6	810.3	810.2	0.53	0.28	0.45
5,705.0	90.76	89.27	4,941.9	-25.9	904.3	904.2	1.61	-1.44	-0.73
5,800.0	90.68	89.65	4,940.8	-25.0	999.3	999.2	0.41	-0.08	0.40
5,895.0	89.57	88.58	4,940.5	-23.6	1,094.3	1,094.2	1.62	-1.17	-1.13
5,990.0	89.58	88.87	4,941.3	-21.5	1,189.3	1,189.2	0.31	0.01	0.31
6,085.0	89.37	88.83	4,942.1	-19.6	1,284.2	1,284.1	0.23	-0.22	-0.04

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6,179.0	89.52	88.92	4,943.0	-17.7	1,378.2	1,378.1	0.19	0.16	0.10
6,273.0	91.29	90.02	4,942.4	-16.8	1,472.2	1,472.1	2.22	1.88	1.17
6,368.0	91.48	90.54	4,940.1	-17.3	1,567.2	1,567.1	0.58	0.20	0.55
6,462.0	91.54	91.04	4,937.6	-18.6	1,661.1	1,661.0	0.54	0.06	0.53
6,557.0	91.50	89.75	4,935.1	-19.3	1,756.1	1,756.0	1.36	-0.04	-1.36
6,652.0	91.43	90.02	4,932.6	-19.1	1,851.1	1,851.0	0.29	-0.07	0.28
6,747.0	91.64	90.67	4,930.1	-19.6	1,946.0	1,945.9	0.72	0.22	0.68
6,842.0	91.86	89.15	4,927.2	-19.5	2,041.0	2,040.9	1.62	0.23	-1.60
6,936.0	91.67	89.15	4,924.3	-18.1	2,134.9	2,134.8	0.20	-0.20	0.00
7,031.0	91.66	88.98	4,921.5	-16.5	2,229.9	2,229.8	0.18	-0.01	-0.18
7,126.0	91.67	89.77	4,918.8	-15.5	2,324.8	2,324.7	0.83	0.01	0.83
7,221.0	90.53	89.12	4,917.0	-14.6	2,419.8	2,419.7	1.38	-1.20	-0.68
7,316.0	90.53	89.21	4,916.1	-13.2	2,514.8	2,514.7	0.09	0.00	0.09
7,410.0	90.28	89.88	4,915.4	-12.5	2,608.8	2,608.7	0.76	-0.27	0.71
7,505.0	89.68	89.37	4,915.5	-11.8	2,703.8	2,703.7	0.83	-0.63	-0.54
7,599.0	90.00	88.37	4,915.7	-10.0	2,797.8	2,797.7	1.12	0.34	-1.06
7,694.0	88.72	87.09	4,916.8	-6.2	2,892.7	2,892.6	1.91	-1.35	-1.35
7,788.0	91.05	88.60	4,917.0	-2.7	2,986.6	2,986.6	2.95	2.48	1.61
7,883.0	92.69	89.56	4,913.9	-1.2	3,081.5	3,081.5	2.00	1.73	1.01
7,978.0	92.10	90.25	4,909.9	-1.0	3,176.4	3,176.4	0.96	-0.62	0.73
8,073.0	91.54	90.65	4,906.9	-1.7	3,271.4	3,271.4	0.72	-0.59	0.42
8,167.0	91.60	89.03	4,904.3	-1.5	3,365.4	3,365.3	1.72	0.06	-1.72
8,262.0	91.80	89.27	4,901.5	-0.1	3,460.3	3,460.3	0.33	0.21	0.25
8,356.0	91.82	89.86	4,898.5	0.6	3,554.3	3,554.2	0.63	0.02	0.63
8,451.0	91.80	89.70	4,895.5	1.0	3,649.2	3,649.2	0.17	-0.02	-0.17
8,546.0	92.15	90.69	4,892.2	0.7	3,744.1	3,744.1	1.10	0.37	1.04
8,640.0	90.52	90.20	4,890.0	-0.1	3,838.1	3,838.1	1.81	-1.73	-0.52
8,734.0	91.31	91.49	4,888.5	-1.4	3,932.1	3,932.1	1.61	0.84	1.37
8,829.0	90.64	89.96	4,886.9	-2.6	4,027.1	4,027.0	1.76	-0.71	-1.61
8,923.0	90.72	90.35	4,885.8	-2.9	4,121.1	4,121.0	0.42	0.09	0.41
9,018.0	90.88	90.56	4,884.5	-3.6	4,216.0	4,216.0	0.28	0.17	0.22
9,113.0	90.62	89.48	4,883.2	-3.7	4,311.0	4,311.0	1.17	-0.27	-1.14
9,208.0	90.91	89.99	4,882.0	-3.2	4,406.0	4,406.0	0.62	0.31	0.54
9,302.0	90.99	90.36	4,880.4	-3.5	4,500.0	4,500.0	0.40	0.09	0.39
9,397.0	91.27	90.75	4,878.5	-4.4	4,595.0	4,594.9	0.51	0.29	0.41
9,491.0	90.78	88.48	4,876.9	-3.8	4,689.0	4,688.9	2.47	-0.52	-2.41
9,586.0	91.25	88.88	4,875.2	-1.6	4,783.9	4,783.9	0.65	0.49	0.42
9,680.0	91.21	89.45	4,873.2	-0.3	4,877.9	4,877.9	0.61	-0.04	0.61
9,775.0	91.19	89.83	4,871.2	0.3	4,972.9	4,972.8	0.40	-0.02	0.40
9,860.0	91.13	90.03	4,869.5	0.4	5,057.9	5,057.8	0.25	-0.07	0.23
Wellpath Crosses 330'HL @ Toe									
9,869.0	91.12	90.05	4,869.3	0.4	5,066.9	5,066.8	0.25	-0.07	0.23
9,901.0	91.24	90.27	4,868.6	0.3	5,098.8	5,098.8	0.78	0.38	0.69

Survey Report



Company: COG OPERATING, LLC
Project: Eddy County, NM (NAD27) NMEZ
Site: Burch Keely Unit 940H
Well: BKU 940H
Wellbore: Lateral
Design: Lateral

Local Co-ordinate Reference: Well BKU 940H - Slot 940H
TVD Reference: 3640+18 @ 3658.0usft (SilverOak3)
MD Reference: 3640+18 @ 3658.0usft (SilverOak3)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: VONEDM

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)
9,970.0	91.24	90.27	4,867.1	0.0	5,167.8	5,167.8	0.00	0.00	0.00
TD @ 220°FEL, 1670°FNL									

Design Targets

Target Name - hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Northing (usft)	Easting (usft)	Latitude	Longitude
BK 940 SL - actual wellpath hits target center - Point	0.00	0.00	0.0	0.0	0.0	668,403.17	596,303.81	32° 50' 13.680 N	104° 1' 11.241 W
BK 940 BHL - actual wellpath hits target center - Point	0.00	0.00	4,867.1	0.0	5,167.8	668,403.17	601,471.61	32° 50' 13.524 N	104° 0' 10.671 W

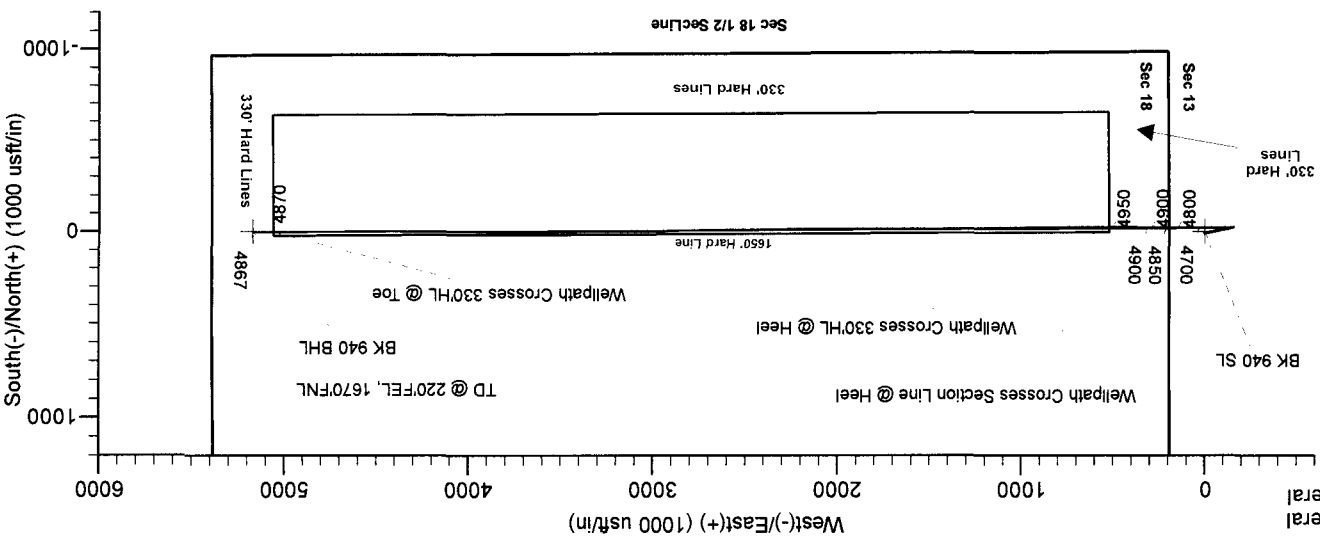
Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
4,973.0	4,837.7	-24.9	195.3	Wellpath Crosses Section Line @ Heel
5,324.0	4,951.0	-28.9	523.5	Wellpath Crosses 330'HL @ Heel
9,860.0	4,869.5	0.4	5,057.9	Wellpath Crosses 330'HL @ Toe
9,970.0	4,867.1	0.0	5,167.8	TD @ 220°FEL, 1670°FNL

Checked By: _____ Approved By: _____ Date: _____

COG OPERATING, LLC

Project: Eddy County, NM (NAD27) NMEZ
 Site: Burch Keely Unit 940H
 Well: BKU 940H
 Wellbore: Lateral
 Design: Lateral



3640+18 @ 3658.0ustf (SilverOak3)
 NAD 1927 (NADCON CONUS)

Azimuths to Grid North
 True North: -0.17°
 Magnetic North: 7.05°

Magnetic Field
 Strength: 48266.5sNT
 Dip Angle: 60.55°
 Date: 04/27/2017
 Model: IGRF2015



Slot Name	+N/-S	+E/-W	North	East
947H	-47.9	2712.1	599015.88	596822.41
932H	-212.3	518.6	596822.41	596822.41
940H	0.0	0.0	596303.81	596303.81
944H	-2593.0	51.5	596303.81	596303.81
946H	-4126.5	-5417.0	590886.82	590886.82

ANNOTATIONS

TVD	4837.7	MD	4973.0	-24.9	195.3	Wellpath Crosses Section Line @ Heel
	4869.5		5324.0	-28.9	523.5	Wellpath Crosses 330'HL @ Heel
	4867.1		9860.0	0.4	5057.9	Wellpath Crosses 330'HL @ Toe
			9970.0	0.0	5167.8	TD @ 220'FNL, 1670'FNL

Wellpath Crosses Section Line @ Heel

Wellpath Crosses 330'HL @ Toe

TD @ 220'FNL, 1670'FNL

BK 940 BHL

TARGET DETAILS

Name	BK 940 SL	TVD	4867.1	+N/-S	0.0	+E/-W	5167.8	Nothing	668403.16	Nothing	596303.81	East	Point	Shape
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Design: Lateral (BKU 940H, lateral)
 Created By: Mekka Williams
 esomina Well Design
 mekka@esomina.com
 14.34, May 15 2017

VON DIRECTIONAL
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 936-756-2400

