



COG Operating LLC

Eddy County, NM (NAN27 NME)

Harvard Federal #18

Harvard Federal #18

OH

Design: Actual

Standard Survey Report

11 November, 2010



Scientific Drilling
Directional Drilling Operations



Scientific Drilling Survey Report



Company:	COG Operating LLC	Local Co-ordinate Reference:	Site Harvard Federal #18
Project:	Eddy County, NM (NAN27 NME)	TVD Reference:	KB Elev (12') @ 3777.00usft (Silver Oak #5)
Site:	Harvard Federal #18	MD Reference:	KB Elev (12') @ 3777.00usft (Silver Oak #5)
Well:	Harvard Federal #18	North Reference:	Grid
Wellbore:	OH	Survey Calculation Method:	Minimum Curvature
Design:	Actual	Database:	EDM-Julio

Project:	Eddy County, NM (NAN27 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	Harvard Federal #18				
Site Position:		Northing:	675,014.20 usft	Latitude:	32° 51' 18.171 N
From:	Map	Easting:	623,893.70 usft	Longitude:	103° 55' 47.575 W
Position Uncertainty:	0.00 usft	Slot Radius:	0 "	Grid Convergence:	0.22 °

Well	Harvard Federal #18					
Well Position	+N/-S	0.00 usft	Northing:	675,014.20 usft	Latitude:	32° 51' 18.171 N
	+E/-W	0.00 usft	Easting:	623,893.70 usft	Longitude:	103° 55' 47.575 W
Position Uncertainty	0.00 usft	Wellhead Elevation:	usft	Ground Level:	3,765.00 usft	

Wellbore	OH				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	2010/11/03	7.88	60.72	49,016

Design:	Actual				
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	195.48	

Survey Program		Date	2010/11/11		
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	1,300.00	Gyro Survey (OH)	Keeper	Standard Wireline Keeper ver 1.0.2	
1,396.00	6,318.00	MWD Survey (OH)	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	0.27	265.50	100.00	-0.02	-0.23	0.08	0.27	0.27	0.00
200.00	0.36	198.27	200.00	-0.34	-0.57	0.47	0.36	0.09	-67.23
300.00	0.47	194.41	300.00	-1.03	-0.77	1.20	0.11	0.11	-3.86
400.00	0.58	189.79	399.99	-1.93	-0.96	2.11	0.12	0.11	-4.62
500.00	0.65	211.55	499.99	-2.91	-1.34	3.16	0.24	0.07	21.76
600.00	0.47	226.92	599.98	-3.67	-1.94	4.06	0.23	-0.18	15.37
700.00	0.45	224.58	699.98	-4.23	-2.51	4.75	0.03	-0.02	-2.34
800.00	0.33	226.31	799.98	-4.71	-3.00	5.34	0.12	-0.12	1.73
900.00	0.19	189.50	899.97	-5.07	-3.23	5.75	0.21	-0.14	-36.81



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Site: Harvard Federal #18
Well: Harvard Federal #18
Wellbore: OH
Design: Actual

Local Co-ordinate Reference: Site Harvard Federal #18
TVD Reference: KB Elev (12') @ 3777.00usft (Silver Oak #5)
MD Reference: KB Elev (12') @ 3777.00usft (Silver Oak #5)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: EDM-Julio

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)
1,000.00	0.29	104.05	999.97	-5.30	-3.01	5.91	0.33	0.10	-85.45
1,100.00	0.45	95.64	1,099.97	-5.40	-2.38	5.84	0.17	0.16	-8.41
1,200.00	0.98	115.07	1,199.96	-5.80	-1.21	5.91	0.58	0.53	19.43
1,300.00	0.67	98.81	1,299.95	-6.25	0.14	5.99	0.39	-0.31	-16.26
Gyro Tie-in									
1,396.00	0.77	122.52	1,395.95	-6.68	1.24	6.11	0.32	0.10	24.70
1,460.00	1.94	185.77	1,459.93	-7.99	1.49	7.30	2.71	1.83	98.83
1,524.00	2.78	205.63	1,523.88	-10.47	0.71	9.90	1.81	1.31	31.03
1,587.00	4.16	207.31	1,586.76	-13.88	-1.00	13.64	2.20	2.19	2.67
1,651.00	5.19	200.51	1,650.55	-18.65	-3.08	18.80	1.82	1.61	-10.63
1,715.00	6.50	199.25	1,714.21	-24.78	-5.28	25.29	2.06	2.05	-1.97
1,778.00	7.77	200.05	1,776.72	-32.15	-7.92	33.10	2.02	2.02	1.27
1,842.00	8.80	197.60	1,840.05	-40.88	-10.88	42.30	1.70	1.61	-3.83
1,906.00	9.71	193.33	1,903.22	-50.80	-13.61	52.59	1.78	1.42	-6.67
2,001.00	9.48	193.50	1,996.89	-66.20	-17.28	68.41	0.24	-0.24	0.18
2,097.00	8.97	193.28	2,091.65	-81.17	-20.85	83.79	0.53	-0.53	-0.23
2,192.00	8.62	192.07	2,185.53	-95.34	-24.04	98.30	0.42	-0.37	-1.27
2,256.00	9.26	193.79	2,248.76	-105.04	-26.27	108.24	1.08	1.00	2.69
2,320.00	10.19	195.35	2,311.83	-115.50	-28.99	119.04	1.51	1.45	2.44
2,416.00	10.16	195.53	2,406.33	-131.84	-33.51	136.00	0.05	-0.03	0.19
2,512.00	9.49	195.41	2,500.92	-147.63	-37.88	152.38	0.70	-0.70	-0.13
2,575.00	10.16	194.95	2,562.99	-158.01	-40.69	163.13	1.07	1.06	-0.73
2,671.00	9.96	197.70	2,657.52	-174.10	-45.40	179.90	0.54	-0.21	2.86
2,767.00	9.35	195.63	2,752.16	-189.51	-50.02	195.99	0.73	-0.64	-2.16
2,830.00	10.26	197.44	2,814.24	-199.80	-53.09	206.72	1.52	1.44	2.87
2,926.00	10.28	197.87	2,908.70	-216.11	-58.28	223.82	0.08	0.02	0.45
3,022.00	10.07	197.97	3,003.19	-232.24	-63.49	240.76	0.22	-0.22	0.10
3,117.00	9.78	197.97	3,096.77	-247.82	-68.55	257.12	0.31	-0.31	0.00
3,213.00	9.55	198.01	3,191.40	-263.15	-73.52	273.22	0.24	-0.24	0.04
3,277.00	10.45	197.74	3,254.43	-273.72	-76.93	284.33	1.41	1.41	-0.42
3,340.00	12.02	197.71	3,316.22	-285.42	-80.67	296.59	2.49	2.49	-0.05
3,436.00	12.17	196.96	3,410.09	-304.62	-86.66	316.70	0.23	0.16	-0.78
3,531.00	11.51	198.00	3,503.07	-323.21	-92.51	336.18	0.73	-0.69	1.09
3,627.00	11.08	196.38	3,597.21	-341.17	-98.07	354.97	0.56	-0.45	-1.69
3,722.00	11.12	195.45	3,690.43	-358.76	-103.09	373.26	0.19	0.04	-0.98
3,818.00	10.56	195.26	3,784.72	-376.17	-107.87	391.31	0.58	-0.58	-0.20
3,914.00	10.49	192.97	3,879.10	-393.17	-112.15	408.84	0.44	-0.07	-2.39
4,009.00	10.10	193.35	3,972.57	-409.70	-116.01	425.80	0.42	-0.41	0.40
4,105.00	10.08	192.51	4,067.09	-426.09	-119.77	442.60	0.15	-0.02	-0.88
4,169.00	9.19	193.66	4,130.19	-436.53	-122.19	453.31	1.42	-1.39	1.80
4,233.00	8.53	193.14	4,193.42	-446.12	-124.48	463.16	1.04	-1.03	-0.81
4,296.00	7.49	196.39	4,255.81	-454.61	-126.70	471.93	1.80	-1.65	5.16
4,360.00	6.26	196.62	4,319.35	-461.95	-128.88	479.59	1.92	-1.92	0.36



Scientific Drilling
Survey Report



Company: COG Operating LLC

Project: Eddy County, NM (NAN27 NME)

Site: Harvard Federal #18

Well: Harvard Federal #18

Wellbore: OH

Design: Actual

Local Co-ordinate Reference:

Site Harvard Federal #18

TVD Reference:

KB Elev (12') @ 3777.00usft (Silver Oak #5)

MD Reference:

KB Elev (12') @ 3777.00usft (Silver Oak #5)

North Reference:

Grid

Survey Calculation Method:

Minimum Curvature

Database:

EDM-Julio

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)
4,424.00	6.09	197.19	4,382.97	-468.54	-130.88	486.47	0.28	-0.27	0.89
4,488.00	4.93	200.83	4,446.68	-474.35	-132.86	492.60	1.89	-1.81	5.69
4,551.00	3.91	210.24	4,509.49	-478.74	-134.90	497.38	1.98	-1.62	14.94
4,647.00	3.74	210.22	4,605.28	-484.27	-138.13	503.57	0.18	-0.18	-0.02
4,743.00	3.71	208.85	4,701.07	-489.70	-141.20	509.62	0.10	-0.03	-1.43
4,838.00	3.81	212.25	4,795.87	-495.06	-144.37	515.63	0.26	0.11	3.58
4,902.00	3.69	207.78	4,859.73	-498.68	-146.46	519.68	0.49	-0.19	-6.98
4,998.00	3.59	205.17	4,955.54	-504.13	-149.18	525.66	0.20	-0.10	-2.72
5,061.00	3.38	197.26	5,018.42	-507.69	-150.57	529.46	0.83	-0.33	-12.56
5,157.00	3.46	196.04	5,114.25	-513.18	-152.21	535.19	0.11	0.08	-1.27
5,253.00	3.24	196.02	5,210.09	-518.57	-153.76	540.80	0.23	-0.23	-0.02
5,348.00	3.08	195.51	5,304.94	-523.61	-155.19	546.03	0.17	-0.17	-0.54
5,444.00	3.14	194.52	5,400.80	-528.64	-156.53	551.24	0.08	0.06	-1.03
5,540.00	3.18	189.76	5,496.66	-533.81	-157.64	556.52	0.28	0.04	-4.96
5,635.00	3.13	190.57	5,591.51	-538.95	-158.57	561.72	0.07	-0.05	0.85
5,731.00	3.00	192.24	5,687.37	-543.99	-159.58	566.84	0.16	-0.14	1.74
5,821.00	3.02	188.33	5,777.25	-548.63	-160.42	571.55	0.23	0.02	-4.34
5,916.00	2.85	189.58	5,872.13	-553.44	-161.18	576.38	0.19	-0.18	1.32
6,012.00	2.80	187.63	5,968.01	-558.12	-161.89	581.08	0.11	-0.05	-2.03
6,149.00	2.48	188.70	6,104.86	-564.36	-162.78	587.34	0.24	-0.23	0.78
6,268.00	2.49	190.23	6,223.75	-569.45	-163.63	592.47	0.06	0.01	1.29
Last MWD Survey									
6,318.00	2.49	190.23	6,273.70	-571.59	-164.01	594.63	0.00	0.00	0.00
Projection to Bit									

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates	+N/-S (usft)	+E/-W (usft)	Comment
1,300.00	1,299.95	-6.25	0.14		Gyro Tie-in
6,268.00	6,223.75	-569.45	-163.63		Last MWD Survey
6,318.00	6,273.70	-571.59	-164.01		Projection to Bit

Checked By:

Approved By:

Date: