



Apache Corporation

Eddy County, NM (NAD27 NME)

Crow Federal

#13H API #30-015-40577

Wellbore #1 / Job #1310316

Survey: Phoenix MWD Survey

Standard Survey Report

11 April, 2013



PHOENIX
TECHNOLOGY SERVICES



Phoenix Technology Services

Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #13H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3894.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3894.00usft (Capstar 114)
Well:	#13H	North Reference:	Grid
Wellbore:	Wellbore #1 / Job #1310316	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

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	Crow Federal		
Site Position:		Northing:	671,130.90 usft
From:	Map	Easting:	643,906.80 usft
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "
		Latitude:	32° 50' 38.927956 N
		Longitude:	103° 51' 53.166888 W
		Grid Convergence:	0.25 °

Well	#13H		
Well Position	+N/-S	0.00 usft	Northing:
	+E/-W	0.00 usft	Easting:
Position Uncertainty	0.00 usft	Wellhead Elevation:	usft
		Latitude:	32° 50' 38.680575 N
		Longitude:	103° 51' 53.167016 W
		Ground Level:	3,884.00 usft

Wellbore	Wellbore #1 / Job #1310316		
Magnetics	Model Name	Sample Date	Declination
			(°)
	IGRF2010_14	04/10/13	7.54
			Dip Angle
			(°)
			Field Strength
			(nT)
			48,772

Design	Surveys (Capstar 114)		
Audit Notes:			
Version:	1.0	Phase:	ACTUAL
		Tie On Depth:	0.00
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W
	(usft)	(usft)	(usft)
	0.00	0.00	0.00
			271.31

Survey Program	Date	04/10/13		
From	To	Survey (Wellbore)	Tool Name	Description
(usft)	(usft)			
613.00	9,160.00	Phoenix MWD Survey (Wellbore #1 / Job #	MWD	MWD - Standard

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)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
613.00	0.40	173.00	613.00	-2.12	0.26	-0.31	0.07	0.07	0.00
Phoenix First MWD Survey									
656.00	0.60	218.80	655.99	-2.45	0.14	-0.19	1.00	0.47	106.51
703.00	1.60	250.10	702.98	-2.86	-0.63	0.57	2.41	2.13	66.60
827.00	5.50	259.90	826.72	-4.50	-8.11	8.01	3.17	3.15	7.90
912.00	5.10	259.40	911.36	-5.90	-15.84	15.70	0.47	-0.47	-0.59
998.00	3.70	276.20	997.11	-6.31	-22.35	22.20	2.20	-1.63	19.53
1,126.00	4.60	270.30	1,124.77	-5.84	-31.59	31.45	0.78	0.70	-4.61
1,212.00	5.80	263.00	1,210.42	-6.35	-39.36	39.20	1.59	1.40	-8.49
1,297.00	5.50	266.50	1,295.00	-7.12	-47.68	47.51	0.54	-0.35	4.12



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Site:	Crow Federal	MD Reference:	KB @ 3894.00usft (Capstar 114)
Well:	#13H	North Reference:	Grid
Wellbore:	Wellbore #1 / Job #1310316	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR 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)
1,383.00	3.90	264.40	1,380.71	-7.66	-54.71	54.52	1.87	-1.86	-2.44
1,469.00	2.40	262.70	1,466.58	-8.17	-59.41	59.20	1.75	-1.74	-1.98
1,554.00	1.60	272.20	1,551.53	-8.35	-62.36	62.15	1.02	-0.94	11.18
1,640.00	0.10	282.60	1,637.52	-8.29	-63.63	63.42	1.75	-1.74	12.09
1,725.00	0.40	65.80	1,722.52	-8.15	-63.43	63.23	0.57	0.35	168.47
1,811.00	1.00	71.10	1,808.51	-7.78	-62.45	62.25	0.70	0.70	6.16
1,896.00	1.50	88.80	1,893.49	-7.52	-60.63	60.45	0.74	0.59	20.82
1,982.00	1.20	63.70	1,979.47	-7.10	-58.70	58.52	0.76	-0.35	-29.19
2,068.00	0.60	84.80	2,065.45	-6.66	-57.45	57.28	0.79	-0.70	24.53
2,153.00	0.50	98.90	2,150.45	-6.68	-56.64	56.47	0.20	-0.12	16.59
2,239.00	0.20	118.60	2,236.45	-6.81	-56.13	55.96	0.37	-0.35	22.91
2,324.00	0.30	27.30	2,321.45	-6.68	-55.90	55.73	0.43	0.12	-107.41
2,410.00	0.20	341.40	2,407.45	-6.34	-55.85	55.69	0.25	-0.12	-53.37
2,496.00	0.50	331.70	2,493.45	-5.86	-56.07	55.92	0.35	0.35	-11.28
2,581.00	0.90	352.10	2,578.44	-4.88	-56.34	56.21	0.55	0.47	24.00
2,667.00	1.50	328.00	2,664.42	-3.25	-57.03	56.94	0.90	0.70	-28.02
2,752.00	1.10	318.20	2,749.40	-1.70	-58.16	58.11	0.54	-0.47	-11.53
2,838.00	0.70	325.70	2,835.39	-0.65	-59.01	58.98	0.48	-0.47	8.72
2,924.00	0.70	318.20	2,921.38	0.17	-59.65	59.64	0.11	0.00	-8.72
3,009.00	1.50	300.00	3,006.37	1.12	-60.96	60.97	1.02	0.94	-21.41
3,094.00	1.40	292.50	3,091.34	2.07	-62.89	62.92	0.25	-0.12	-8.82
3,180.00	1.40	290.50	3,177.31	2.84	-64.84	64.89	0.06	0.00	-2.33
3,265.00	0.80	249.20	3,262.30	2.99	-66.37	66.42	1.13	-0.71	-48.59
3,350.00	0.50	177.20	3,347.29	2.41	-66.91	66.94	0.94	-0.35	-84.71
3,436.00	0.70	168.60	3,433.29	1.52	-66.78	66.80	0.25	0.23	-10.00
3,558.00	0.30	123.00	3,555.28	0.62	-66.37	66.36	0.44	-0.33	-37.38
3,644.00	1.60	93.60	3,641.27	0.42	-64.98	64.97	1.57	1.51	-34.19
3,730.00	1.50	95.20	3,727.24	0.24	-62.66	62.65	0.13	-0.12	1.86
3,815.00	1.30	99.90	3,812.21	-0.02	-60.60	60.59	0.27	-0.24	5.53
3,900.00	1.50	97.80	3,897.19	-0.34	-58.55	58.53	0.24	0.24	-2.47
3,986.00	1.30	92.50	3,983.16	-0.54	-56.46	56.43	0.28	-0.23	-6.16
4,072.00	1.50	85.50	4,069.14	-0.49	-54.37	54.34	0.31	0.23	-8.14
4,157.00	1.20	87.80	4,154.11	-0.37	-52.37	52.34	0.36	-0.35	2.71
4,243.00	1.10	89.30	4,240.10	-0.32	-50.64	50.62	0.12	-0.12	1.74
4,329.00	0.80	96.00	4,326.08	-0.38	-49.22	49.20	0.37	-0.35	7.79
4,414.00	1.00	87.30	4,411.07	-0.40	-47.89	47.87	0.28	0.24	-10.24
4,500.00	0.70	65.60	4,497.06	-0.15	-46.66	46.64	0.51	-0.35	-25.23
4,586.00	0.10	26.20	4,583.06	0.13	-46.15	46.14	0.73	-0.70	-45.81
4,671.00	0.00	86.80	4,668.06	0.20	-46.12	46.11	0.12	-0.12	0.00
4,694.00	0.00	17.50	4,691.06	0.20	-46.12	46.11	0.00	0.00	0.00
4,787.00	0.30	219.50	4,784.06	0.01	-46.27	46.26	0.32	0.32	0.00
4,819.00	0.60	305.40	4,816.06	0.04	-46.46	46.45	2.04	0.94	268.44
4,851.00	6.70	267.80	4,847.98	0.07	-48.46	48.45	19.49	19.06	-117.50



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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)
4,883.00	13.70	268.70	4,879.46	-0.09	-54.12	54.11	21.88	21.88	2.81
4,915.00	20.00	270.60	4,910.07	-0.12	-63.39	63.38	19.76	19.69	5.94
4,946.00	25.10	270.20	4,938.69	-0.04	-75.28	75.26	16.46	16.45	-1.29
4,979.00	29.60	268.80	4,967.99	-0.18	-90.43	90.41	13.77	13.64	-4.24
5,011.00	32.10	268.70	4,995.46	-0.54	-106.84	106.80	7.81	7.81	-0.31
5,043.00	36.90	267.30	5,021.83	-1.19	-124.95	124.89	15.20	15.00	-4.38
5,075.00	39.30	267.50	5,047.01	-2.08	-144.67	144.58	7.51	7.50	0.63
5,107.00	44.00	268.20	5,070.91	-2.87	-165.91	165.81	14.76	14.69	2.19
5,139.00	49.50	269.00	5,092.83	-3.44	-189.21	189.08	17.28	17.19	2.50
5,171.00	55.60	269.90	5,112.28	-3.67	-214.60	214.46	19.19	19.06	2.81
5,203.00	59.50	270.00	5,129.45	-3.70	-241.60	241.45	12.19	12.19	0.31
5,235.00	61.00	270.40	5,145.32	-3.60	-269.38	269.22	4.81	4.69	1.25
5,267.00	65.50	270.70	5,159.72	-3.32	-297.94	297.79	14.09	14.06	0.94
5,299.00	68.00	272.70	5,172.36	-2.45	-327.33	327.19	9.70	7.81	6.25
5,331.00	72.50	271.90	5,183.17	-1.24	-357.41	357.29	14.26	14.06	-2.50
5,363.00	77.80	269.90	5,191.36	-0.76	-388.33	388.21	17.63	16.56	-6.25
5,395.00	83.20	268.60	5,196.64	-1.18	-419.87	419.74	17.34	16.88	-4.06
5,449.00	90.60	267.10	5,199.56	-3.20	-473.72	473.52	13.98	13.70	-2.78
5,545.00	91.30	268.70	5,197.97	-6.72	-569.64	569.33	1.82	0.73	1.67
5,641.00	92.70	270.00	5,194.62	-7.81	-665.57	665.22	1.99	1.46	1.35
5,737.00	90.80	267.00	5,191.69	-10.32	-761.47	761.04	3.70	-1.98	-3.13
5,833.00	93.00	268.30	5,188.51	-14.25	-857.33	856.78	2.66	2.29	1.35
5,929.00	93.40	270.50	5,183.15	-15.26	-953.17	952.58	2.33	0.42	2.29
6,025.00	92.40	270.10	5,178.29	-14.76	-1,049.05	1,048.44	1.12	-1.04	-0.42
6,121.00	95.20	271.70	5,171.93	-13.25	-1,144.81	1,144.21	3.36	2.92	1.67
6,217.00	93.90	271.00	5,164.31	-11.00	-1,240.48	1,239.90	1.54	-1.35	-0.73
6,313.00	93.10	270.80	5,158.45	-9.49	-1,336.29	1,335.72	0.86	-0.83	-0.21
6,408.00	92.50	270.40	5,153.81	-8.50	-1,431.17	1,430.60	0.76	-0.63	-0.42
6,504.00	92.00	271.00	5,150.04	-7.33	-1,527.09	1,526.52	0.81	-0.52	0.63
6,600.00	92.40	271.40	5,146.36	-5.32	-1,622.99	1,622.45	0.59	0.42	0.42
6,696.00	91.90	268.80	5,142.75	-5.15	-1,718.92	1,718.35	2.76	-0.52	-2.71
6,792.00	91.40	269.70	5,139.99	-6.41	-1,814.87	1,814.25	1.07	-0.52	0.94
6,888.00	91.50	269.10	5,137.56	-7.41	-1,910.83	1,910.17	0.63	0.10	-0.63
6,984.00	93.20	268.30	5,133.62	-9.59	-2,006.72	2,005.98	1.96	1.77	-0.83
7,080.00	92.80	267.80	5,128.60	-12.85	-2,102.53	2,101.69	0.67	-0.42	-0.52
7,176.00	93.10	267.30	5,123.66	-16.95	-2,198.32	2,197.36	0.61	0.31	-0.52
7,272.00	92.00	266.40	5,119.39	-22.22	-2,294.08	2,292.97	1.48	-1.15	-0.94
7,368.00	92.30	268.40	5,115.79	-26.57	-2,389.90	2,388.68	2.11	0.31	2.08
7,464.00	93.60	269.10	5,110.85	-28.66	-2,485.75	2,484.45	1.54	1.35	0.73
7,559.00	93.10	271.50	5,105.29	-28.17	-2,580.58	2,579.27	2.58	-0.53	2.53
7,655.00	90.30	271.50	5,102.45	-25.66	-2,676.50	2,675.22	2.92	-2.92	0.00
7,751.00	90.70	272.50	5,101.61	-22.30	-2,772.43	2,771.20	1.12	0.42	1.04
7,847.00	90.00	270.70	5,101.02	-19.62	-2,868.39	2,867.20	2.01	-0.73	-1.88



Phoenix Technology Services

Survey Report



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Site:	Crow Federal	MD Reference:	KB @ 3894.00usft (Capstar 114)
Well:	#13H	North Reference:	Grid
Wellbore:	Wellbore #1 / Job #1310316	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

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)
7,943.00	88.10	268.80	5,102.61	-20.04	-2,964.37	2,963.14	2.80	-1.98	-1.98
8,039.00	90.00	268.60	5,104.21	-22.22	-3,060.32	3,059.02	1.99	1.98	-0.21
8,135.00	90.80	268.80	5,103.53	-24.40	-3,156.30	3,154.92	0.86	0.83	0.21
8,231.00	92.10	268.90	5,101.11	-26.32	-3,252.24	3,250.80	1.36	1.35	0.10
8,327.00	92.20	269.60	5,097.50	-27.58	-3,348.17	3,346.67	0.74	0.10	0.73
8,424.00	92.00	270.20	5,093.95	-27.75	-3,445.10	3,443.57	0.65	-0.21	0.62
8,520.00	91.60	270.40	5,090.93	-27.25	-3,541.05	3,539.51	0.47	-0.42	0.21
8,616.00	90.70	270.80	5,089.01	-26.24	-3,637.03	3,635.48	1.03	-0.94	0.42
8,712.00	90.50	270.90	5,088.00	-24.82	-3,733.01	3,731.47	0.23	-0.21	0.10
8,809.00	90.40	270.00	5,087.24	-24.06	-3,830.00	3,828.46	0.93	-0.10	-0.93
8,905.00	90.40	270.20	5,086.57	-23.89	-3,926.00	3,924.44	0.21	0.00	0.21
9,001.00	91.30	269.40	5,085.15	-24.22	-4,021.99	4,020.39	1.25	0.94	-0.83
9,097.00	90.90	268.80	5,083.30	-25.73	-4,117.96	4,116.30	0.75	-0.42	-0.63
9,194.00	90.30	268.70	5,082.29	-27.85	-4,214.93	4,213.20	0.63	-0.62	-0.10
9,290.00	91.60	268.10	5,080.70	-30.53	-4,310.88	4,309.06	1.49	1.35	-0.63
9,386.00	91.00	267.70	5,078.52	-34.04	-4,406.79	4,404.86	0.75	-0.63	-0.42
9,483.00	90.20	268.90	5,077.50	-36.92	-4,503.74	4,501.72	1.49	-0.82	1.24
9,579.00	90.20	268.30	5,077.17	-39.27	-4,599.71	4,597.61	0.62	0.00	-0.63
9,675.00	89.10	268.50	5,077.75	-41.95	-4,695.67	4,693.49	1.16	-1.15	0.21
9,772.00	89.30	269.20	5,079.11	-43.89	-4,792.64	4,790.39	0.75	0.21	0.72
9,868.00	89.20	269.30	5,080.36	-45.15	-4,888.62	4,886.32	0.15	-0.10	0.10
9,964.00	88.60	268.70	5,082.21	-46.83	-4,984.59	4,982.22	0.88	-0.63	-0.63
Current MWD Survey									
10,061.00	88.00	268.40	5,085.08	-49.28	-5,081.51	5,079.07	0.69	-0.62	-0.31
Projection to Bit									

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates	
		+N/-S (usft)	+E/-W (usft)
613.00	613.00	-2.12	0.26
9,964.00	5,082.21	-46.83	-4,984.59
10,061.00	5,085.08	-49.28	-5,081.51
			Comment:
			Phoenix First MWD Survey
			Current MWD Survey
			Projection to Bit

Checked By:	Approved By:	Date:
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