



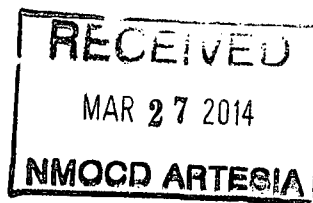
Apache Corporation

Eddy County, NM (NAD27 NME)

Crow Federal

#23H API# 30-015-41167

WB1/Job #1311257



Survey: Phoenix MWD Survey

Phoenix Final Survey Report

07 October, 2013





Phoenix Technology Services
Phoenix Final Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #23H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3881.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3881.00usft (Capstar 114)
Well:	#23H	North Reference:	Grid
Wellbore:	WB1/Job #1311257	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' 38.92796 N
		Longitude:	103° 51' 53.16689 W
		Grid Convergence:	0.25 °

Well	#23H		
Well Position	+N-S	0.00 usft	Northing:
	+E-W	0.00 usft	Easting:
Position Uncertainty	0.00 usft	Wellhead Elevation:	usft
		Latitude:	32° 51' 6.00472 N
		Longitude:	103° 52' 57.92907 W
		Ground Level:	3,870.00 usft

Wellbore	WB1/Job #1311257				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010_14	09/18/13	7.50	60.66	48,730

Design	Surveys (Capstar 114)			
Audit Notes:				
Version:	1.0	Phase:	ACTUAL	Tie On Depth:
Vertical Section:	Depth From (TVD) (usft)	+N-S (usft)	+E-W (usft)	Direction (°)
	0.00	0.00	0.00	89.59

Survey Program	Date	10/07/13		
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description
100.00	482.00	Gyro Surveys (WB1/Job #1311257)	CB-GYRO-MS	Camera based gyro multishot
569.00	10,357.00	Phoenix MWD Survey (WB1/Job #131125)	MWD	MWD - Standard

Survey							
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)
482.00	0.80	16.28	481.98	4.46	0.92	0.95	0.00
Tie-on to Gyro							
569.00	0.80	17.40	568.97	5.62	1.27	1.31	0.02
First Phoenix MWD Survey							
649.00	0.50	4.60	648.96	6.50	1.46	1.51	0.41
734.00	0.30	255.70	733.96	6.82	1.28	1.33	0.78
820.00	0.50	236.30	819.96	6.55	0.75	0.79	0.28
906.00	0.30	237.40	905.96	6.22	0.25	0.29	0.23
991.00	0.20	249.10	990.96	6.05	-0.08	-0.04	0.13
1,076.00	0.30	267.60	1,075.95	5.99	-0.44	-0.40	0.15
1,161.00	0.20	288.10	1,160.95	6.03	-0.80	-0.76	0.16



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Site:	Crow Federal	MD Reference:	KB @ 3881.00usft (Capstar 114)
Well:	#23H	North Reference:	Grid
Wellbore:	WB1/Job #1311257	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

Survey							
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)
1,247.00	0.10	123.50	1,246.95	6.03	-0.88	-0.84	0.35
1,332.00	0.00	83.90	1,331.95	5.99	-0.82	-0.78	0.12
1,418.00	0.30	38.50	1,417.95	6.17	-0.68	-0.64	0.35
1,502.00	0.50	67.90	1,501.95	6.48	-0.21	-0.16	0.33
1,587.00	0.60	85.50	1,586.95	6.65	0.58	0.63	0.23
1,673.00	0.70	94.60	1,672.94	6.64	1.55	1.60	0.17
1,759.00	0.70	106.20	1,758.94	6.46	2.58	2.63	0.16
1,844.00	0.60	105.40	1,843.93	6.19	3.51	3.55	0.12
1,929.00	0.60	92.00	1,928.93	6.06	4.38	4.43	0.16
2,015.00	0.60	91.50	2,014.92	6.03	5.28	5.33	0.01
2,101.00	0.40	84.70	2,100.92	6.05	6.03	6.08	0.24
2,186.00	0.40	95.50	2,185.92	6.05	6.62	6.67	0.09
2,271.00	0.30	110.10	2,270.91	5.94	7.13	7.17	0.16
2,357.00	0.30	98.40	2,356.91	5.83	7.56	7.60	0.07
2,444.00	0.30	89.30	2,443.91	5.80	8.02	8.06	0.05
2,529.00	0.20	107.40	2,528.91	5.76	8.38	8.42	0.15
2,614.00	0.20	52.30	2,613.91	5.80	8.64	8.68	0.22
2,700.00	0.30	47.50	2,699.91	6.05	8.92	8.97	0.12
2,789.00	0.30	48.90	2,788.91	6.36	9.27	9.32	0.01
2,877.00	0.00	250.40	2,876.91	6.51	9.44	9.49	0.34
2,963.00	0.40	225.00	2,962.91	6.30	9.23	9.28	0.47
3,048.00	0.40	235.10	3,047.90	5.92	8.78	8.82	0.08
3,134.00	0.40	215.50	3,133.90	5.50	8.36	8.40	0.16
3,219.00	0.50	232.40	3,218.90	5.03	7.89	7.93	0.19
3,305.00	0.40	225.80	3,304.90	4.60	7.38	7.41	0.13
3,391.00	0.40	214.70	3,390.90	4.14	6.99	7.02	0.09
3,449.00	0.50	232.30	3,448.89	3.82	6.68	6.70	0.29
3,559.00	0.60	228.60	3,558.89	3.15	5.87	5.89	0.10
3,647.00	0.70	244.60	3,646.88	2.61	5.03	5.05	0.23
3,733.00	0.50	257.70	3,732.88	2.30	4.19	4.21	0.28
3,818.00	0.50	248.50	3,817.87	2.09	3.49	3.50	0.09
3,904.00	0.70	249.20	3,903.87	1.77	2.65	2.66	0.23
3,989.00	0.60	248.90	3,988.86	1.42	1.75	1.76	0.12
4,075.00	0.80	256.10	4,074.86	1.11	0.74	0.75	0.25
4,160.00	0.70	261.40	4,159.85	0.89	-0.35	-0.34	0.14
4,246.00	0.70	263.60	4,245.84	0.76	-1.39	-1.38	0.03
4,332.00	0.80	274.70	4,331.84	0.75	-2.51	-2.50	0.20
4,417.00	0.80	275.90	4,416.83	0.86	-3.69	-3.68	0.02
4,503.00	0.70	274.20	4,502.82	0.96	-4.81	-4.80	0.12
4,588.00	0.80	270.80	4,587.81	1.00	-5.92	-5.92	0.13
4,674.00	0.70	67.50	4,673.81	1.21	-6.04	-6.03	1.71
4,759.00	0.70	58.90	4,758.81	1.68	-5.11	-5.10	0.12
4,844.00	1.00	48.20	4,843.80	2.44	-4.12	-4.10	0.40
4,933.00	1.00	30.90	4,932.78	3.63	-3.14	-3.11	0.34



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Site:	Crow Federal	MD Reference:	KB @ 3881.00usft (Capstar 114)
Well:	#23H	North Reference:	Grid
Wellbore:	WB1/Job #1311257	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

Survey							
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)
5,018.00	1.10	39.90	5,017.77	4.89	-2.23	-2.20	0.23
5,093.00	0.90	16.60	5,092.76	6.01	-1.60	-1.56	0.60
5,114.00	1.00	20.50	5,113.75	6.34	-1.49	-1.45	0.57
5,157.00	2.00	74.30	5,156.74	6.89	-0.64	-0.59	3.78
5,199.00	7.10	86.30	5,198.60	7.26	2.66	2.71	12.29
5,242.00	13.00	85.70	5,240.92	7.79	10.14	10.20	13.72
5,285.00	19.00	84.20	5,282.23	8.86	21.94	22.00	13.99
5,328.00	23.60	85.50	5,322.28	10.25	37.49	37.56	10.75
5,371.00	28.30	87.90	5,360.94	11.29	56.27	56.35	11.20
5,414.00	33.00	89.90	5,397.92	11.69	78.18	78.26	11.18
5,456.00	37.90	91.40	5,432.13	11.39	102.53	102.61	11.85
5,499.00	42.90	92.00	5,464.86	10.56	130.37	130.45	11.66
5,542.00	47.70	91.50	5,495.10	9.63	160.92	160.98	11.19
5,585.00	52.90	90.80	5,522.56	8.98	193.98	194.04	12.16
5,628.00	57.70	90.10	5,547.03	8.70	229.32	229.38	11.24
5,671.00	62.40	90.80	5,568.49	8.41	266.57	266.62	11.02
5,713.00	67.20	90.70	5,586.37	7.91	304.56	304.61	11.43
5,756.00	73.00	89.70	5,601.00	7.78	344.97	345.02	13.66
5,799.00	79.10	88.90	5,611.36	8.29	386.68	386.73	14.30
5,844.00	84.40	89.50	5,617.82	8.91	431.19	431.25	11.85
5,887.00	86.10	89.30	5,621.38	9.36	474.04	474.10	3.98
5,977.00	88.30	89.30	5,625.77	10.46	563.92	563.98	2.44
6,062.00	88.10	89.30	5,628.44	11.49	648.87	648.94	0.24
6,148.00	87.50	89.00	5,631.74	12.77	734.80	734.87	0.78
6,237.00	86.80	88.20	5,636.17	14.94	823.66	823.75	1.19
6,324.00	87.70	89.00	5,640.34	17.06	910.53	910.63	1.38
6,410.00	87.30	89.30	5,644.09	18.34	996.44	996.55	0.58
6,497.00	86.60	89.20	5,648.72	19.47	1,083.31	1,083.42	0.81
6,584.00	87.30	90.70	5,653.35	19.55	1,170.19	1,170.30	1.90
6,669.00	87.70	91.70	5,657.06	17.77	1,255.08	1,255.18	1.27
6,754.00	87.30	92.20	5,660.77	14.88	1,339.95	1,340.03	0.75
6,840.00	87.60	90.70	5,664.59	12.71	1,425.84	1,425.89	1.78
6,925.00	87.50	90.30	5,668.23	11.97	1,510.76	1,510.80	0.48
7,011.00	87.30	89.90	5,672.13	11.82	1,596.67	1,596.71	0.52
7,096.00	87.40	89.60	5,676.06	12.19	1,681.58	1,681.62	0.37
7,182.00	87.30	89.90	5,680.04	12.56	1,767.48	1,767.53	0.37
7,268.00	87.20	89.90	5,684.16	12.71	1,853.39	1,853.43	0.12
7,353.00	87.40	88.90	5,688.17	13.60	1,938.28	1,938.33	1.20
7,439.00	87.60	88.20	5,691.92	15.78	2,024.17	2,024.24	0.85
7,526.00	87.40	88.00	5,695.71	18.66	2,111.04	2,111.12	0.32
7,612.00	87.30	87.50	5,699.69	22.03	2,196.89	2,196.99	0.59
7,700.00	87.90	87.00	5,703.37	26.25	2,284.71	2,284.84	0.89
7,785.00	88.60	88.00	5,705.97	29.95	2,369.58	2,369.74	1.44
7,873.00	88.70	87.70	5,708.04	33.26	2,457.50	2,457.67	0.36



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Well:	#23H	North Reference:	Grid
Wellbore:	WB1/Job #1311257	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

Survey							
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)
7,958.00	88.50	89.60	5,710.12	35.26	2,542.45	2,542.63	2.25
8,044.00	88.60	89.60	5,712.30	35.86	2,628.42	2,628.60	0.12
8,130.00	88.90	89.50	5,714.17	36.53	2,714.39	2,714.58	0.37
8,215.00	88.90	89.70	5,715.80	37.13	2,799.37	2,799.57	0.24
8,301.00	88.70	90.00	5,717.60	37.35	2,885.36	2,885.55	0.42
8,386.00	88.90	90.10	5,719.38	37.28	2,970.34	2,970.53	0.26
8,472.00	89.10	89.90	5,720.89	37.28	3,056.32	3,056.51	0.33
8,557.00	89.10	89.90	5,722.22	37.43	3,141.31	3,141.50	0.00
8,642.00	88.90	89.80	5,723.70	37.65	3,226.30	3,226.49	0.26
8,728.00	88.90	89.50	5,725.36	38.17	3,312.28	3,312.47	0.35
8,813.00	88.60	89.40	5,727.21	38.99	3,397.26	3,397.45	0.37
8,899.00	88.30	89.30	5,729.54	39.96	3,483.22	3,483.42	0.37
8,985.00	88.80	91.10	5,731.71	39.66	3,569.19	3,569.38	2.17
9,070.00	88.50	90.90	5,733.71	38.18	3,654.15	3,654.33	0.42
9,158.00	88.10	90.50	5,736.33	37.11	3,742.11	3,742.28	0.64
9,244.00	87.80	90.40	5,739.40	36.43	3,828.05	3,828.21	0.37
9,329.00	87.50	90.30	5,742.89	35.91	3,912.98	3,913.13	0.37
9,415.00	87.30	90.40	5,746.79	35.39	3,998.89	3,999.04	0.26
9,501.00	87.40	89.90	5,750.76	35.16	4,084.79	4,084.94	0.59
9,586.00	87.60	90.40	5,754.47	34.94	4,169.71	4,169.85	0.63
9,672.00	87.60	90.00	5,758.07	34.64	4,255.63	4,255.77	0.46
9,757.00	89.10	90.70	5,760.52	34.12	4,340.60	4,340.73	1.95
9,843.00	89.30	91.10	5,761.72	32.77	4,426.58	4,426.70	0.52
9,929.00	89.30	90.60	5,762.77	31.49	4,512.56	4,512.67	0.58
10,014.00	88.90	90.90	5,764.11	30.38	4,597.54	4,597.64	0.59
10,100.00	88.90	91.00	5,765.76	28.96	4,683.51	4,683.60	0.12
10,185.00	89.10	91.00	5,767.24	27.47	4,768.49	4,768.56	0.24
10,271.00	89.10	90.90	5,768.59	26.05	4,854.47	4,854.53	0.12
10,303.00	89.20	91.40	5,769.07	25.41	4,886.46	4,886.51	1.59
Last Phoenix MWD Survey							
10,357.00	89.20	91.40	5,769.82	24.09	4,940.43	4,940.48	0.00
Projection to TD							

Survey Annotations				
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
482.00	481.98	4.46	0.92	Tie-on to Gyro
569.00	568.97	5.62	1.27	First Phoenix MWD Survey
10,303.00	5,769.07	25.41	4,886.46	Last Phoenix MWD Survey
10,357.00	5,769.82	24.09	4,940.43	Projection to TD

Checked By: _____ Approved By: _____ Date: _____

Phoenix Technology Services SURVEY DATA CERTIFICATION



PHOENIX
TECHNOLOGY SERVICES

PHOENIX JOB NUMBER

1311257

OPERATOR

Apache Corporation

WELL NAME

Crow Federal #23H

COUNTY & STATE

Eddy County, New Mexico

API WELL NUMBER

30-015-41167

PROPOSED DIRECTION

89.59

TIE-IN DATA						
MEASURED	VERTICAL			N-S	E-W	DATA
DEPTH	DEPTH	INCLIN	AZIMUTH	COORD	COORD	SOURCE
482 ft	481.98 ft	0.8	16.28	4.46 N	0.92 E	Gyrodatta Surveys

FIRST	FIRST		
SURVEY	SURVEY		
DATE	DEPTH	INCLIN	AZIMUTH
27-Sep-13	569 ft	0.8	17.4

SURVEY INSTRUMENT

TYPE

Phoenix MWD

LAST	LAST		
SURVEY	SURVEY		
DATE	DEPTH	INCLIN	AZIMUTH
7-Oct-13	10,303 ft	89.2	91.4

TO THE BEST OF MY KNOWLEDGE I
CERTIFY THIS SURVEY DATA TO BE
TRUE AND CORRECT.

PROJECTED	PROJECTED		
TD SURVEY	TD SURVEY		
DATE	DEPTH	INCLIN	AZIMUTH
7-Oct-13	10,357 ft	89.2	91.4

Brad Hill

PRINT YOUR NAME ABOVE

Brad Hill

SIGN YOUR NAME ABOVE

MAGNETIC DECLINATION OR TOTAL GRID

TOTAL CORRECTION USED	
	7.25
DECLINATION OR GRID	GRID

10/7/2013

TODAY'S DATE

MWD SUPERVISOR 1

Brad Hill

DIRECTIONAL DRILLER 1

Ken Smith

MWD SUPERVISOR 2

Austin Brown

DIRECTIONAL DRILLER 2

Joseph Paup

1805 Brittmore Road

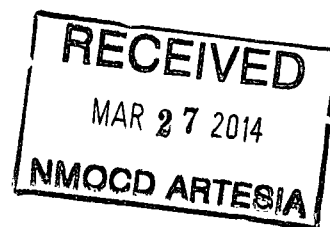
Houston, Texas 77043

(713)3370609 (Voice), (713)337-0599 (Fax)

Apache Corporation
303 Veterans Airpark Lane, #3000
Midland, TX 79705

Crow Federal #023H API #30-015-41167
Eddy County, New Mexico 1650' FNL + 10' FWL UL: E 9-17S-31E

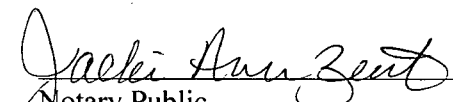
235	2.35	0.25	0.44	1.03	1.03
510	5.10	0.50	0.88	4.46	4.46





Archie Brown - General Manager

The attached instrument was acknowledged before me on the 18th day of October, 2013 by
Archie Brown - General Manager, CapStar Drilling, Inc.



Notary Public

