



Apache Corporation

Eddy County, NM (NAD27 NME)

Crow Federal

#15H API#30-015-40579

OH/Job #1310461



Survey: Phoenix MWD Surveys

Phoenix Final Survey Report

16 July, 2013





Phoenix Technology Services
Phoenix Final Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #15H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3895.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3895.00usft (Capstar 114)
Well:	#15H	North Reference:	Grid
Wellbore:	OH/Job #1310461	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	#15H		
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' 39.966968 N
		Longitude:	103° 51' 53.169634 W
		Ground Level:	3,885.00 usft

Wellbore	OH/Job #1310461		
Magnetics	Model Name	Sample Date	Declination
			(°)
	IGRF2010_14	04/18/13	7.54
			Dip Angle
			(°)
			60.66
			Field Strength
			(nT)
			48,770

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
			Direction
			(°)
			269.63

Survey Program	Date: 07/16/13		
From	To	Survey (Wellbore)	Tool Name
(usft)	(usft)		
100.00	500.00	Gyro (OH/Job #1310461)	ISCWSA-GYRO-3
604.00	11,084.00	Phoenix MWD Surveys (OH/Job #1310461)	MWD
			Description
			VES Gyro
			MWD - Standard

Survey							
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)
500.00	0.64	176.61	499.98	-2.98	1.77	-1.75	0.00
Tie-on to Gyro							
604.00	0.70	211.50	603.98	-4.10	1.47	-1.44	0.39
First Phoenix MWD Survey							
693.00	0.60	206.20	692.97	-4.98	0.98	-0.95	0.13
778.00	0.70	218.10	777.97	-5.79	0.46	-0.43	0.20
864.00	0.70	236.00	863.96	-6.49	-0.30	0.34	0.25
950.00	0.70	232.60	949.95	-7.11	-1.15	1.20	0.05
1,035.00	1.20	224.60	1,034.94	-8.06	-2.19	2.24	0.61
1,121.00	0.80	152.10	1,120.93	-9.23	-2.54	2.60	1.43
1,206.00	1.80	70.70	1,205.91	-9.31	-1.00	1.06	2.18



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Site:	Crow Federal	MD Reference:	KB @ 3895.00usft (Capstar 114)
Well:	#15H	North Reference:	Grid
Wellbore:	OH/Job #1310461	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)
1,292.00	2.00	69.60	1,291.87	-8.34	1.68	-1.63	0.24
1,377.00	1.60	67.80	1,376.82	-7.38	4.17	-4.12	0.48
1,463.00	1.90	67.60	1,462.78	-6.38	6.60	-6.56	0.35
1,549.00	1.20	81.70	1,548.75	-5.71	8.81	-8.77	0.92
1,634.00	1.30	92.50	1,633.73	-5.62	10.65	-10.62	0.30
1,720.00	1.60	91.70	1,719.70	-5.70	12.83	-12.79	0.35
1,805.00	0.40	136.30	1,804.69	-5.95	14.22	-14.18	1.58
1,891.00	0.00	89.80	1,890.69	-6.16	14.43	-14.39	0.47
1,976.00	0.10	6.10	1,975.69	-6.09	14.43	-14.39	0.12
2,062.00	0.30	8.50	2,061.69	-5.79	14.48	-14.44	0.23
2,148.00	0.40	351.00	2,147.69	-5.27	14.46	-14.43	0.17
2,233.00	0.60	357.50	2,232.68	-4.54	14.40	-14.37	0.24
2,319.00	0.70	4.30	2,318.68	-3.56	14.42	-14.39	0.15
2,405.00	0.90	350.90	2,404.67	-2.37	14.35	-14.33	0.32
2,490.00	1.00	359.60	2,489.66	-0.97	14.24	-14.23	0.21
2,576.00	1.30	346.80	2,575.64	0.73	14.01	-14.01	0.46
2,662.00	1.00	338.30	2,661.62	2.38	13.51	-13.52	0.40
2,746.00	1.10	340.10	2,745.61	3.82	12.96	-12.99	0.13
2,832.00	1.20	338.40	2,831.59	5.43	12.35	-12.39	0.12
2,918.00	0.90	318.90	2,917.58	6.78	11.58	-11.62	0.54
3,003.00	0.60	237.70	3,002.57	7.04	10.76	-10.81	1.18
3,089.00	0.60	220.20	3,088.57	6.46	10.09	-10.13	0.21
3,175.00	0.70	231.10	3,174.56	5.78	9.39	-9.43	0.18
3,260.00	0.80	236.90	3,259.56	5.13	8.49	-8.52	0.15
3,346.00	0.60	244.20	3,345.55	4.61	7.58	-7.61	0.25
3,448.00	0.70	243.60	3,447.54	4.10	6.54	-6.57	0.10
3,518.00	1.00	256.10	3,517.53	3.76	5.57	-5.59	0.50
3,603.00	0.90	259.20	3,602.52	3.46	4.19	-4.21	0.13
3,689.00	1.00	256.40	3,688.51	3.16	2.80	-2.82	0.13
3,774.00	0.90	258.00	3,773.50	2.84	1.42	-1.44	0.12
3,860.00	0.90	246.20	3,859.49	2.43	0.14	-0.16	0.22
3,945.00	0.80	245.50	3,944.48	1.91	-1.01	0.99	0.12
4,031.00	0.80	240.10	4,030.47	1.37	-2.07	2.06	0.09
4,117.00	0.90	239.10	4,116.46	0.72	-3.17	3.17	0.12
4,202.00	1.10	240.70	4,201.45	-0.02	-4.46	4.46	0.24
4,288.00	1.30	241.30	4,287.43	-0.89	-6.03	6.04	0.23
4,373.00	2.00	186.70	4,372.40	-2.83	-7.05	7.07	1.92
4,459.00	0.40	76.50	4,458.38	-4.25	-6.94	6.96	2.52
4,544.00	1.90	34.60	4,543.36	-3.02	-5.85	5.87	1.91
4,630.00	1.70	41.30	4,629.32	-0.89	-4.20	4.20	0.34
4,715.00	1.50	42.30	4,714.29	0.88	-2.61	2.61	0.24
4,801.00	1.60	38.60	4,800.26	2.65	-1.11	1.09	0.16
4,887.00	1.70	45.00	4,886.22	4.49	0.54	-0.57	0.24
4,972.00	1.60	45.80	4,971.18	6.21	2.29	-2.33	0.12



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Well:	#15H	North Reference:	Grid
Wellbore:	OH/Job #1310461	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)
5,058.00	0.50	2.50	5,057.17	7.42	3.16	-3.21	1.49
5,143.00	0.30	11.20	5,142.17	8.01	3.22	-3.27	0.25
5,229.00	1.80	171.00	5,228.16	6.90	3.48	-3.52	2.42
5,315.00	1.90	171.60	5,314.11	4.15	3.90	-3.92	0.12
5,400.00	1.90	170.90	5,399.06	1.37	4.33	-4.33	0.03
5,486.00	2.30	216.20	5,485.01	-1.43	3.53	-3.52	1.93
5,573.00	1.70	213.60	5,571.96	-3.92	1.79	-1.76	0.70
5,617.00	2.00	224.40	5,615.94	-5.01	0.89	-0.86	1.04
5,660.00	6.20	258.80	5,658.82	-6.00	-1.92	1.95	10.90
5,703.00	12.20	267.80	5,701.25	-6.62	-8.74	8.78	14.31
5,746.00	18.30	274.60	5,742.72	-6.26	-20.02	20.06	14.76
5,788.00	23.60	276.20	5,781.93	-4.82	-34.96	34.99	12.69
5,831.00	29.00	274.80	5,820.46	-3.01	-53.92	53.94	12.64
5,874.00	34.20	272.20	5,857.08	-1.68	-76.40	76.41	12.50
5,917.00	38.80	270.00	5,891.64	-1.21	-101.96	101.97	11.12
5,960.00	42.40	269.10	5,924.28	-1.44	-129.94	129.95	8.48
6,002.00	46.30	269.10	5,954.31	-1.90	-159.29	159.30	9.29
6,045.00	50.50	269.10	5,982.85	-2.41	-191.43	191.45	9.77
6,088.00	55.30	269.20	6,008.78	-2.91	-225.72	225.73	11.16
6,131.00	59.50	270.20	6,031.94	-3.10	-261.93	261.95	9.96
6,173.00	63.90	270.80	6,051.85	-2.77	-298.90	298.91	10.55
6,216.00	68.90	271.50	6,069.06	-1.97	-338.29	338.29	11.72
6,259.00	73.80	271.20	6,082.81	-1.02	-379.00	379.00	11.41
6,302.00	79.40	270.50	6,092.77	-0.40	-420.81	420.81	13.12
6,340.00	84.60	269.80	6,098.05	-0.30	-458.43	458.42	13.81
6,404.00	91.50	269.80	6,100.23	-0.53	-522.35	522.34	10.78
6,489.00	91.20	269.40	6,098.23	-1.12	-607.33	607.32	0.59
6,575.00	91.00	269.10	6,096.58	-2.24	-693.30	693.30	0.42
6,661.00	90.50	269.50	6,095.45	-3.30	-779.29	779.29	0.74
6,746.00	90.00	270.20	6,095.08	-3.52	-864.29	864.29	1.01
6,832.00	93.00	269.30	6,092.83	-3.89	-950.25	950.25	3.64
6,917.00	92.70	269.50	6,088.60	-4.78	-1,035.14	1,035.15	0.42
7,003.00	92.70	269.40	6,084.55	-5.61	-1,121.04	1,121.05	0.12
7,089.00	92.20	269.40	6,080.88	-6.51	-1,206.95	1,206.97	0.58
7,174.00	91.70	269.20	6,077.98	-7.54	-1,291.90	1,291.92	0.63
7,260.00	91.50	269.00	6,075.58	-8.89	-1,377.85	1,377.88	0.33
7,346.00	91.30	268.70	6,073.48	-10.62	-1,463.81	1,463.85	0.42
7,431.00	91.30	268.70	6,071.55	-12.55	-1,548.77	1,548.81	0.00
7,516.00	91.00	268.00	6,069.85	-14.99	-1,633.71	1,633.78	0.90
7,602.00	92.60	268.30	6,067.14	-17.77	-1,719.62	1,719.70	1.89
7,688.00	92.40	268.40	6,063.39	-20.24	-1,805.51	1,805.60	0.26
7,773.00	92.20	270.50	6,059.98	-21.06	-1,890.43	1,890.52	2.48
7,859.00	92.30	270.60	6,056.61	-20.23	-1,976.36	1,976.45	0.16
7,944.00	92.20	270.50	6,053.27	-19.42	-2,061.29	2,061.37	0.17



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Site:	Crow Federal	MD Reference:	KB @ 3895.00usft (Capstar 114)
Well:	#15H	North Reference:	Grid
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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)
8,030.00	92.00	270.10	6,050.12	-18.97	-2,147.23	2,147.31	0.52
8,116.00	91.60	269.60	6,047.42	-19.19	-2,233.19	2,233.26	0.74
8,201.00	91.40	269.40	6,045.19	-19.93	-2,318.15	2,318.23	0.33
8,287.00	92.00	270.80	6,042.64	-19.78	-2,404.11	2,404.19	1.77
8,372.00	91.80	270.30	6,039.82	-18.97	-2,489.06	2,489.13	0.63
8,458.00	91.60	270.20	6,037.27	-18.59	-2,575.02	2,575.09	0.26
8,543.00	91.60	270.10	6,034.90	-18.37	-2,659.99	2,660.05	0.12
8,629.00	91.30	269.40	6,032.72	-18.75	-2,745.96	2,746.02	0.89
8,715.00	91.10	269.20	6,030.92	-19.80	-2,831.94	2,832.00	0.33
8,800.00	90.90	268.70	6,029.44	-21.35	-2,916.91	2,916.99	0.63
8,886.00	90.70	268.70	6,028.24	-23.31	-3,002.88	3,002.97	0.23
8,971.00	90.30	270.80	6,027.49	-23.68	-3,087.87	3,087.96	2.51
9,056.00	90.20	270.40	6,027.12	-22.79	-3,172.86	3,172.94	0.49
9,141.00	91.30	270.00	6,026.01	-22.49	-3,257.85	3,257.93	1.38
9,227.00	90.90	269.50	6,024.36	-22.86	-3,343.84	3,343.91	0.74
9,312.00	90.30	268.70	6,023.47	-24.20	-3,428.82	3,428.90	1.18
9,398.00	89.90	269.10	6,023.32	-25.85	-3,514.80	3,514.90	0.66
9,484.00	89.60	269.50	6,023.69	-26.90	-3,600.80	3,600.89	0.58
9,569.00	88.80	269.50	6,024.88	-27.64	-3,685.78	3,685.89	0.94
9,655.00	88.80	269.90	6,026.68	-28.09	-3,771.76	3,771.87	0.47
9,740.00	90.40	271.30	6,027.28	-27.20	-3,856.75	3,856.85	2.50
9,826.00	91.30	271.60	6,026.00	-25.03	-3,942.71	3,942.79	1.10
9,911.00	90.90	271.10	6,024.37	-23.03	-4,027.67	4,027.74	0.75
9,997.00	90.70	270.80	6,023.17	-21.60	-4,113.65	4,113.71	0.42
10,084.00	89.70	270.70	6,022.86	-20.46	-4,200.65	4,200.69	1.16
10,169.00	90.50	270.90	6,022.71	-19.27	-4,285.64	4,285.67	0.97
10,255.00	90.00	270.90	6,022.34	-17.92	-4,371.62	4,371.65	0.58
10,343.00	92.10	270.80	6,020.73	-16.62	-4,459.59	4,459.61	2.39
10,429.00	92.20	270.90	6,017.50	-15.34	-4,545.52	4,545.53	0.16
10,520.00	91.80	269.40	6,014.32	-15.11	-4,636.47	4,636.47	1.70
10,607.00	91.50	269.40	6,011.82	-16.02	-4,723.43	4,723.43	0.34
10,697.00	91.10	269.30	6,009.78	-17.04	-4,813.40	4,813.41	0.46
10,787.00	90.90	269.40	6,008.21	-18.06	-4,903.38	4,903.39	0.25
10,879.00	90.50	269.20	6,007.08	-19.18	-4,995.36	4,995.38	0.49
10,970.00	90.10	269.10	6,006.61	-20.53	-5,086.35	5,086.38	0.45
11,029.00	90.00	269.20	6,006.56	-21.41	-5,145.34	5,145.38	0.24
Last Phoenix MWD Survey							
11,084.00	90.00	269.20	6,006.56	-22.17	-5,200.34	5,200.37	0.00
Projection to TD							



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Well:	#15H	North Reference:	Grid
Wellbore:	OH/Job #1310461	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB

Survey Annotations				
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
500.00	499.98	-2.98	1.77	Tie-on to Gyro
604.00	603.98	-4.10	1.47	First Phoenix MWD Survey
11,029.00	6,006.56	-21.41	-5,145.34	Last Phoenix MWD Survey
11,084.00	6,006.56	-22.17	-5,200.34	Projection to TD

Checked By: _____	Approved By: _____	Date: _____
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Phoenix Technology Services SURVEY DATA CERTIFICATION



PHOENIX
TECHNOLOGY SERVICES

PHOENIX JOB NUMBER

1310461

OPERATOR

Apache Corporation

WELL NAME

Crow Federal 15H

COUNTY & STATE

Eddy, NM

API WELL NUMBER

30-015-40579

PROPOSED DIRECTION

269.63

TIE-IN DATA						
MEASURED	VERTICAL			N-S	E-W	DATA
DEPTH	DEPTH	INCLIN	AZIMUTH	COORD	COORD	SOURCE
ft	.00 ft	.0 ft	.0 ft	.00 ft	.00 ft	Surface

FIRST SURVEY DATE	FIRST SURVEY DEPTH	INCLIN	AZIMUTH
30-Jun-13	604 ft	0.7	211.5

SURVEY INSTRUMENT TYPE
Phoenix MWD

LAST SURVEY DATE	LAST SURVEY DEPTH	INCLIN	AZIMUTH
15-Jul-13	11,029 ft	90	269.2

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

PROJECTED TD SURVEY DATE	PROJECTED TD SURVEY DEPTH	INCLIN	AZIMUTH
15-Jul-13	11,084 ft	90	269.2

Matthew Dice

PRINT YOUR NAME ABOVE

Matthew Dice

SIGN YOUR NAME ABOVE

MAGNETIC DECLINATION OR TOTAL GRID

TOTAL CORRECTION USED	DECLINATION
0.25	

7/15/2013

TODAY'S DATE

MWD SUPERVISOR 1

Brad Hill

DIRECTIONAL DRILLER 1

Matt Boyt

MWD SUPERVISOR 2

Matt Dice

DIRECTIONAL DRILLER 2

Danny Rieger

1805 Brittmore Road

Houston, Texas 77043

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