



Apache Corporation

Eddy County, NM (NAD27 NME)

Crow Federal

#11H

OH/Job #1310714

Survey: Phoenix MWD Survey

Survey Report

25 June, 2013



30-015-
100515



PHOENIX
TECHNOLOGY SERVICES





Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #11H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3894.00usft (Capstar 114)
Site:	Crow Federal	MD Reference:	KB @ 3894.00usft (Capstar 114)
Well:	#11H	North Reference:	Grid
Wellbore:	OH/Job #1310714	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB v5000

Project	Eddy County, NM (NAD27 NME)
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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
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Site Position:		Northing:	671,130.90 usft	Latitude:	32° 50' 38.927956 N
From:	Map	Easting:	643,906.80 usft	Longitude:	103° 51' 53.166888 W
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.25 °

Well	#11H
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Well Position	+N/-S	0.00 usft	Northing:	671,195.90 usft	Latitude:	32° 50' 39.571153 N
	+E/-W	0.00 usft	Easting:	643,906.40 usft	Longitude:	103° 51' 53.168197 W
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	3,884.00 usft

Wellbore	OH/Job #1310714
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Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010_14	06/10/13	7.52	60.66	48,755

Design	Surveys (Capstar 114)
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Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.00
Vertical Section:	Depth From (TVD)	+N/-S	+E/-W	Direction	
	(usft)	(usft)	(usft)	(°)	
	0.00	0.00	0.00	89.57	

Survey Program	Date 06/25/13
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From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description
622.00	10,262.00	Phoenix MWD Survey (OH/Job #1310714)	MWD	MWD - Standard



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Wellbore:	OH/Job #1310714	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB v5000

MD (usft)	Inc (°)	Azi (azimuth) (°)	TVDSS (usft)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg. (°/100usft)	Northing (usft)	Easting (usft)
600.00	0.43	226.12	-3,294.01	599.99	-2.30	-1.78	-1.80	0.00	671,193.60	643,904.62
Gyro Tie-on										
622.00	0.60	221.50	-3,272.01	621.99	-2.44	-1.91	-1.93	0.79	671,193.46	643,904.49
First Phoenix MWD Survey										
695.00	0.60	206.10	-3,199.01	694.99	-3.07	-2.34	-2.36	0.22	671,192.83	643,904.06
781.00	0.60	150.20	-3,113.02	780.98	-3.87	-2.31	-2.34	0.65	671,192.03	643,904.09
866.00	1.50	102.10	-3,028.03	865.97	-4.49	-1.00	-1.03	1.40	671,191.41	643,905.40
952.00	2.20	98.50	-2,942.08	951.92	-4.97	1.73	1.70	0.82	671,190.93	643,908.13
1,038.00	2.70	94.90	-2,856.16	1,037.84	-5.38	5.38	5.34	0.61	671,190.52	643,911.78
1,123.00	3.60	87.40	-2,771.29	1,122.71	-5.43	10.04	10.00	1.16	671,190.47	643,916.44
1,209.00	4.00	90.20	-2,685.47	1,208.53	-5.32	15.74	15.70	0.51	671,190.58	643,922.14
1,294.00	4.40	91.30	-2,600.70	1,293.30	-5.41	21.97	21.92	0.48	671,190.49	643,928.37
1,380.00	4.70	93.60	-2,514.97	1,379.03	-5.70	28.78	28.74	0.41	671,190.20	643,935.18
1,466.00	5.00	94.60	-2,429.28	1,464.72	-6.22	36.03	35.98	0.36	671,189.68	643,942.43
1,550.00	3.70	98.60	-2,345.53	1,548.47	-6.92	42.36	42.31	1.59	671,188.98	643,948.76
1,636.00	2.20	106.60	-2,259.64	1,634.36	-7.81	46.69	46.63	1.80	671,188.09	643,953.09
1,721.00	1.00	144.60	-2,174.67	1,719.33	-8.88	48.68	48.61	1.81	671,187.02	643,955.08
1,807.00	1.10	142.90	-2,088.69	1,805.31	-10.15	49.61	49.53	0.12	671,185.75	643,956.01
1,893.00	1.50	82.90	-2,002.71	1,891.29	-10.67	51.23	51.15	1.56	671,185.23	643,957.63
1,978.00	1.50	73.80	-1,917.74	1,976.26	-10.22	53.40	53.32	0.28	671,185.68	643,959.80
2,064.00	1.50	71.30	-1,831.77	2,062.23	-9.55	55.55	55.47	0.08	671,186.35	643,961.95
2,149.00	1.10	35.00	-1,746.79	2,147.21	-8.52	57.07	57.00	1.05	671,187.38	643,963.47
2,235.00	1.30	16.20	-1,660.80	2,233.20	-6.91	57.81	57.76	0.51	671,188.99	643,964.21
2,321.00	1.40	17.00	-1,574.83	2,319.17	-4.97	58.39	58.35	0.12	671,190.93	643,964.79
2,405.00	1.40	11.00	-1,490.85	2,403.15	-2.98	58.89	58.87	0.17	671,192.92	643,965.29
2,491.00	1.50	11.80	-1,404.88	2,489.12	-0.84	59.32	59.31	0.12	671,195.06	643,965.72
2,577.00	1.50	6.00	-1,318.91	2,575.09	1.38	59.67	59.68	0.18	671,197.28	643,966.07



Survey Report



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Project: Eddy County, NM (NAD27 NME)	TVD Reference: KB @ 3894.00usft (Capstar 114)
Site: Crow Federal	MD Reference: KB @ 3894.00usft (Capstar 114)
Well: #11H	North Reference: Grid
Wellbore: OH/Job #1310714	Survey Calculation Method: Minimum Curvature
Design: Surveys (Capstar 114)	Database: GCR DB v5000

MD (usft)	Inc (°)	Azi (azimuth) (°)	TVDSS (usft)	TVD (usft)	N/S (usft)	EW (usft)	V. Sec (usft)	DLeg (°/100usft)	Northing (usft)	Easting (usft)
2,662.00	1.70	7.20	-1,233.94	2,660.06	3.73	59.94	59.97	0.24	671,199.63	643,966.34
2,748.00	0.50	355.90	-1,147.96	2,746.04	5.37	60.08	60.11	1.41	671,201.27	643,966.48
2,833.00	0.40	328.70	-1,062.96	2,831.04	6.00	59.89	59.94	0.27	671,201.90	643,966.29
2,919.00	0.70	330.70	-976.97	2,917.03	6.71	59.48	59.53	0.35	671,202.61	643,965.88
3,005.00	0.80	340.80	-890.98	3,003.02	7.74	59.03	59.08	0.19	671,203.64	643,965.43
3,090.00	0.90	333.60	-805.98	3,088.02	8.90	58.54	58.60	0.17	671,204.80	643,964.94
3,176.00	0.90	329.50	-720.00	3,174.00	10.08	57.89	57.97	0.07	671,205.98	643,964.29
3,261.00	1.00	323.40	-635.01	3,258.99	11.25	57.11	57.19	0.17	671,207.15	643,963.51
3,347.00	1.10	324.70	-549.02	3,344.98	12.53	56.19	56.28	0.12	671,208.43	643,962.59
3,432.00	1.10	330.40	-464.04	3,429.96	13.90	55.31	55.41	0.13	671,209.80	643,961.71
3,451.00	1.10	329.70	-445.04	3,448.96	14.22	55.13	55.24	0.07	671,210.12	643,961.53
3,516.00	1.10	327.40	-380.05	3,513.95	15.28	54.48	54.59	0.07	671,211.18	643,960.88
3,602.00	1.20	321.10	-294.07	3,599.93	16.68	53.47	53.59	0.19	671,212.58	643,959.87
3,688.00	1.10	321.50	-208.09	3,685.91	18.03	52.39	52.52	0.12	671,213.93	643,958.79
3,773.00	0.80	160.30	-123.09	3,770.91	18.11	52.08	52.22	2.21	671,214.01	643,958.48
3,859.00	1.70	147.20	-37.11	3,856.89	16.47	52.97	53.10	1.09	671,212.37	643,959.37
3,944.00	1.60	145.90	47.85	3,941.85	14.43	54.32	54.43	0.13	671,210.33	643,960.72
4,030.00	1.50	144.60	133.82	4,027.82	12.52	55.65	55.74	0.12	671,208.42	643,962.05
4,116.00	1.50	147.00	219.79	4,113.79	10.65	56.91	56.99	0.07	671,206.55	643,963.31
4,201.00	1.20	144.20	304.77	4,198.77	9.00	58.04	58.11	0.36	671,204.90	643,964.44
4,287.00	1.10	140.90	390.75	4,284.75	7.63	59.09	59.14	0.14	671,203.53	643,965.49
4,372.00	1.20	152.30	475.73	4,369.73	6.21	60.02	60.06	0.29	671,202.11	643,966.42
4,458.00	0.90	143.10	561.72	4,455.72	4.87	60.84	60.87	0.40	671,200.77	643,967.24
4,543.00	0.70	149.20	646.71	4,540.71	3.89	61.51	61.53	0.26	671,199.79	643,967.91
4,629.00	0.80	148.90	732.70	4,626.70	2.92	62.09	62.11	0.12	671,198.82	643,968.49
4,714.00	0.90	139.20	817.69	4,711.69	1.91	62.83	62.84	0.21	671,197.81	643,969.23
4,800.00	0.80	251.20	903.69	4,797.69	1.21	62.70	62.71	1.64	671,197.11	643,969.10



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Well:	#11H	North Reference:	Grid
Wellbore:	OH/Job #1310714	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB v5000

MD (usft)	Inc (°)	Azi (azimuth) (°)	TVDSS (usft)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)	Northing (usft)	Easting (usft)
4,885.00	0.70	252.20	988.68	4,882.68	0.86	61.65	61.65	0.12	671,196.76	643,968.05
4,971.00	0.70	266.70	1,074.67	4,968.67	0.67	60.62	60.62	0.21	671,196.57	643,967.02
5,057.00	0.60	291.70	1,160.67	5,054.67	0.80	59.68	59.68	0.35	671,196.70	643,966.08
5,142.00	0.80	306.40	1,245.66	5,139.66	1.32	58.79	58.79	0.31	671,197.22	643,965.19
5,227.00	1.10	347.00	1,330.65	5,224.65	2.47	58.13	58.14	0.84	671,198.37	643,964.53
5,295.00	1.10	335.50	1,398.64	5,292.64	3.70	57.71	57.73	0.32	671,199.60	643,964.11
5,327.00	1.00	351.50	1,430.63	5,324.63	4.25	57.54	57.57	0.96	671,200.15	643,963.94
5,370.00	3.80	65.10	1,473.60	5,367.60	5.22	58.78	58.81	8.48	671,201.12	643,965.18
5,413.00	9.10	72.60	1,516.31	5,410.31	6.84	63.32	63.37	12.45	671,202.74	643,969.72
5,454.00	14.20	71.00	1,556.45	5,450.45	9.45	71.17	71.24	12.46	671,205.35	643,977.57
5,497.00	19.80	68.90	1,597.56	5,491.56	13.79	82.96	83.06	13.10	671,209.69	643,989.36
5,540.00	24.30	70.50	1,637.40	5,531.40	19.37	98.10	98.25	10.56	671,215.27	644,004.50
5,583.00	29.00	74.80	1,675.83	5,569.83	25.06	116.52	116.70	11.81	671,220.96	644,022.92
5,625.00	34.50	80.00	1,711.54	5,605.54	29.80	138.07	138.29	14.62	671,225.70	644,044.47
5,668.00	39.40	85.30	1,745.90	5,639.90	33.03	163.69	163.93	13.58	671,228.93	644,070.09
5,711.00	43.90	91.20	1,778.03	5,672.03	33.84	192.22	192.47	13.87	671,229.74	644,098.62
5,754.00	48.40	94.80	1,807.82	5,701.82	32.18	223.17	223.40	12.08	671,228.08	644,129.57
5,797.00	53.00	95.70	1,835.05	5,729.05	29.13	256.29	256.51	10.82	671,225.03	644,162.69
5,840.00	58.00	95.50	1,859.40	5,753.40	25.68	291.55	291.74	11.63	671,221.58	644,197.95
5,882.00	64.80	94.70	1,879.49	5,773.49	22.41	328.26	328.42	16.28	671,218.31	644,234.66
5,925.00	71.30	93.80	1,895.55	5,789.55	19.46	368.01	368.15	15.24	671,215.36	644,274.41
5,968.00	75.30	92.50	1,907.91	5,801.91	17.20	409.13	409.24	9.74	671,213.10	644,315.53
6,011.00	78.60	89.90	1,917.62	5,811.62	16.33	451.00	451.11	9.67	671,212.23	644,357.40
6,054.00	82.70	88.90	1,924.60	5,818.60	16.78	493.41	493.53	9.81	671,212.68	644,399.81
6,096.00	87.80	88.30	1,928.08	5,822.08	17.80	535.24	535.36	12.23	671,213.70	644,441.64
6,139.00	89.90	88.40	1,928.94	5,822.94	19.04	578.21	578.34	4.89	671,214.94	644,484.61
6,182.00	88.80	89.50	1,929.43	5,823.43	19.83	621.20	621.33	3.62	671,215.73	644,527.60



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MD (usft)	Inc (°)	Azi (azimuth) (°)	TVDSS (usft)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)	Northing (usft)	Easting (usft)
6,267.00	88.70	89.60	1,931.29	5,825.29	20.49	706.18	706.31	0.17	671,216.39	644,612.58
6,353.00	88.70	89.00	1,933.24	5,827.24	21.54	792.15	792.29	0.70	671,217.44	644,698.55
6,438.00	88.80	88.30	1,935.09	5,829.09	23.55	877.11	877.26	0.83	671,219.45	644,783.51
6,524.00	89.90	90.90	1,936.07	5,830.07	24.15	963.09	963.24	3.28	671,220.05	644,869.49
6,609.00	90.00	90.80	1,936.14	5,830.14	22.89	1,048.08	1,048.22	0.17	671,218.79	644,954.48
6,695.00	90.10	90.40	1,936.07	5,830.07	21.99	1,134.08	1,134.21	0.48	671,217.89	645,040.48
6,780.00	90.10	90.10	1,935.92	5,829.92	21.61	1,219.08	1,219.20	0.35	671,217.51	645,125.48
6,866.00	90.00	89.50	1,935.84	5,829.84	21.91	1,305.07	1,305.20	0.71	671,217.81	645,211.47
6,952.00	90.20	89.40	1,935.69	5,829.69	22.74	1,391.07	1,391.20	0.26	671,218.64	645,297.47
7,037.00	89.70	90.90	1,935.77	5,829.77	22.52	1,476.07	1,476.19	1.86	671,218.42	645,382.47
7,123.00	89.80	90.80	1,936.14	5,830.14	21.24	1,562.06	1,562.17	0.16	671,217.14	645,468.46
7,208.00	89.60	90.70	1,936.59	5,830.59	20.13	1,647.05	1,647.15	0.26	671,216.03	645,553.45
7,294.00	89.30	90.90	1,937.41	5,831.41	18.93	1,733.04	1,733.13	0.42	671,214.83	645,639.44
7,380.00	88.90	90.90	1,938.76	5,832.76	17.58	1,819.01	1,819.10	0.47	671,213.48	645,725.41
7,465.00	88.60	90.90	1,940.62	5,834.62	16.24	1,903.98	1,904.05	0.35	671,212.14	645,810.38
7,551.00	88.40	90.90	1,942.87	5,836.87	14.89	1,989.94	1,990.00	0.23	671,210.79	645,896.34
7,636.00	88.20	91.00	1,945.39	5,839.39	13.48	2,074.89	2,074.94	0.26	671,209.38	645,981.29
7,722.00	88.80	88.70	1,947.64	5,841.64	13.71	2,160.86	2,160.90	2.76	671,209.61	646,067.26
7,807.00	88.60	88.50	1,949.57	5,843.57	15.79	2,245.81	2,245.87	0.33	671,211.69	646,152.21
7,893.00	88.40	87.70	1,951.82	5,845.82	18.64	2,331.73	2,331.81	0.96	671,214.54	646,238.13
7,979.00	90.20	88.20	1,952.87	5,846.87	21.71	2,417.67	2,417.76	2.17	671,217.61	646,324.07
8,064.00	90.10	88.10	1,952.65	5,846.65	24.46	2,502.62	2,502.74	0.17	671,220.36	646,409.02
8,150.00	90.00	89.70	1,952.57	5,846.57	26.11	2,588.61	2,588.73	1.86	671,222.01	646,495.01
8,235.00	89.70	89.20	1,952.80	5,846.80	26.92	2,673.60	2,673.73	0.69	671,222.82	646,580.00
8,321.00	89.70	89.30	1,953.25	5,847.25	28.05	2,759.59	2,759.72	0.12	671,223.95	646,665.99
8,406.00	88.80	90.20	1,954.36	5,848.36	28.42	2,844.58	2,844.72	1.50	671,224.32	646,750.98
8,492.00	88.80	89.70	1,956.16	5,850.16	28.49	2,930.56	2,930.69	0.58	671,224.39	646,836.96



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Wellbore:	OH/Job #1310714	Survey Calculation Method:	Minimum Curvature
Design:	Surveys (Capstar 114)	Database:	GCR DB v5000

Survey											
MD (usft)	Inc (°)	Azi (azimuth) (°)	TVDSS (usft)	TVD (usft)	N/S (usft)	E/W (usft)	V. Sec (usft)	DLeg (°/100usft)	Northing (usft)	Easting (usft)	
8,577.00	88.70	89.30	1,958.02	5,852.02	29.24	3,015.54	3,015.67	0.48	671,225.14	646,921.94	
8,663.00	88.70	89.40	1,959.97	5,853.97	30.21	3,101.51	3,101.65	0.12	671,226.11	647,007.91	
8,748.00	88.50	88.90	1,962.04	5,856.04	31.47	3,186.48	3,186.62	0.63	671,227.37	647,092.88	
8,834.00	88.40	89.30	1,964.37	5,858.37	32.82	3,272.43	3,272.59	0.48	671,228.72	647,178.83	
8,920.00	88.20	89.40	1,966.92	5,860.92	33.80	3,358.39	3,358.55	0.26	671,229.70	647,264.79	
9,005.00	89.20	89.70	1,968.85	5,862.85	34.46	3,443.37	3,443.53	1.23	671,230.36	647,349.77	
9,091.00	89.10	90.10	1,970.12	5,864.12	34.62	3,529.36	3,529.52	0.48	671,230.52	647,435.76	
9,176.00	89.10	90.20	1,971.46	5,865.46	34.39	3,614.34	3,614.50	0.12	671,230.29	647,520.74	
9,262.00	88.70	90.20	1,973.11	5,867.11	34.09	3,700.33	3,700.48	0.47	671,229.99	647,606.73	
9,347.00	88.50	90.20	1,975.19	5,869.19	33.80	3,785.30	3,785.45	0.24	671,229.70	647,691.70	
9,433.00	88.60	89.90	1,977.36	5,871.36	33.72	3,871.27	3,871.42	0.37	671,229.62	647,777.67	
9,518.00	88.40	89.90	1,979.59	5,873.59	33.87	3,956.25	3,956.39	0.24	671,229.77	647,862.65	
9,604.00	88.30	90.10	1,982.07	5,876.07	33.87	4,042.21	4,042.35	0.26	671,229.77	647,948.61	
9,690.00	90.20	90.20	1,983.19	5,877.19	33.64	4,128.20	4,128.33	2.21	671,229.54	648,034.60	
9,775.00	90.00	89.90	1,983.04	5,877.04	33.57	4,213.20	4,213.33	0.42	671,229.47	648,119.60	
9,861.00	89.90	89.80	1,983.12	5,877.12	33.79	4,299.20	4,299.33	0.16	671,229.69	648,205.60	
9,946.00	89.70	89.90	1,983.41	5,877.41	34.02	4,384.20	4,384.33	0.26	671,229.92	648,290.60	
10,032.00	89.50	90.10	1,984.01	5,878.01	34.02	4,470.19	4,470.32	0.33	671,229.92	648,376.59	
10,118.00	89.40	90.10	1,984.84	5,878.84	33.87	4,556.19	4,556.32	0.12	671,229.77	648,462.59	
10,208.00	89.30	90.10	1,985.86	5,879.86	33.71	4,646.18	4,646.31	0.11	671,229.61	648,552.58	
Final MWD Survey											
10,262.00	89.30	90.10	1,986.52	5,880.52	33.62	4,700.18	4,700.30	0.00	671,229.52	648,606.58	
Projection to TD											



Survey Report



Company: Apache Corporation
Project: Eddy County, NM (NAD27 NME)
Site: Crow Federal
Well: #11H
Wellbore: OH/Job #1310714
Design: Surveys (Capstar 114)

Local Co-ordinate Reference: Well #11H
TVD Reference: KB @ 3894.00usft (Capstar 114)
MD Reference: KB @ 3894.00usft (Capstar 114)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: GCR DB v5000

Survey Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
600.00	599.99	-2.30	-1.78	Gyro Tie-on
622.00	621.99	-2.44	-1.91	First Phoenix MWD Survey
10,208.00	5,879.86	33.71	4,646.18	Final MWD Survey
10,262.00	5,880.52	33.62	4,700.18	Projection to TD