



Apache Corporation

Eddy County, NM (NAD27 NME)

Raven Federal

#21H API #30-015-40918

SL: 330' FSL + 180' FEL WL: P 07-178-31E

WB1/Job #1410583

NM OIL CONSERVATION
ARTESIA DISTRICT

APR 27 2015

Survey: Phoenix MWD Survey

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Standard Survey Report

08 September, 2014





Phoenix Technology Services

Survey Report



Company:	Apache Corporation	Local Co-ordinate Reference:	Well #21H
Project:	Eddy County, NM (NAD27 NME)	TVD Reference:	KB @ 3727.00usft (Capstar 114)
Site:	Raven Federal	MD Reference:	KB @ 3727.00usft (Capstar 114)
Well:	#21H	North Reference:	Grid
Wellbore:	WB1/Job #1410583	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	Raven Federal		
Site Position:		Northing:	673,239.70 usft
From:	Map	Easting:	633,303.50 usft
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "
		Latitude:	32° 51' 0.24298 N
		Longitude:	103° 53' 57.35087 W
		Grid Convergence:	0.24 °

Well	#21H		
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' 33.18951 N
		Longitude:	103° 54' 1.98123 W
		Ground Level:	3,716.00 usft

Wellbore	WB1/Job #1410583				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010_14	08/21/14	7.39	60.62	48,631

Design	Surveys (Capstar 114)				
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	269.94	

Survey Program	Date 09/08/14				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
100.00	410.00	Gyrodata Gyro Survey (WB1/Job #1410583)	NS-GYRO-MS	North sensing gyrocompassing m/s	
459.00	9,121.00	Phoenix MWD Survey (WB1/Job #1410583)	PHX+MWD+BGGM	PHX+MWD+BGGM v3:standard declination	

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)	
410.00	1.31	133.70	409.94	-4.53	4.62	-4.62	0.00	0.00	0.00	
Tie-on to Gyrodata Survey										
459.00	1.70	142.00	458.92	-5.49	5.47	-5.47	0.91	0.80	16.94	
First Phoenix MWD Survey										
588.00	0.90	80.60	587.89	-6.83	7.65	-7.64	1.16	-0.62	-47.60	
716.00	1.60	7.20	715.87	-4.89	8.87	-8.86	1.25	0.55	-57.34	
844.00	3.10	352.50	843.76	0.31	8.64	-8.64	1.25	1.17	-11.48	
976.00	3.50	350.60	975.54	7.83	7.52	-7.52	0.31	0.30	-1.44	
1,103.00	4.30	334.80	1,102.25	15.96	4.86	-4.87	1.05	0.63	-12.44	



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Wellbore:	WB1/Job #1410583	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)
1,234.00	2.30	309.20	1,233.03	22.06	0.73	-0.75	1.86	-1.53	-19.54
1,365.00	1.20	228.00	1,363.98	22.81	-2.33	2.31	1.85	-0.84	-61.98
1,494.00	1.60	228.20	1,492.94	20.70	-4.68	4.66	0.31	0.31	0.16
1,625.00	1.30	206.40	1,623.90	18.15	-6.70	6.68	0.48	-0.23	-16.64
1,753.00	1.80	187.40	1,751.86	14.86	-7.61	7.59	0.56	0.39	-14.84
1,882.00	1.90	195.20	1,880.79	10.79	-8.43	8.42	0.21	0.08	6.05
2,010.00	1.90	192.20	2,008.72	6.66	-9.43	9.42	0.08	0.00	-2.34
2,138.00	1.20	196.50	2,136.67	3.31	-10.26	10.26	0.55	-0.55	3.36
2,266.00	1.20	206.40	2,264.64	0.82	-11.24	11.24	0.16	0.00	7.73
2,395.00	1.40	224.30	2,393.61	-1.52	-12.94	12.94	0.35	0.16	13.88
2,522.00	0.80	227.40	2,520.59	-3.23	-14.67	14.68	0.47	-0.47	2.44
2,650.00	0.40	331.90	2,648.58	-3.44	-15.54	15.55	0.77	-0.31	81.64
2,779.00	0.70	310.80	2,777.57	-2.53	-16.35	16.35	0.28	0.23	-16.36
2,907.00	1.20	309.50	2,905.56	-1.16	-17.98	17.98	0.39	0.39	-1.02
3,038.00	1.10	300.20	3,036.53	0.34	-20.12	20.12	0.16	-0.08	-7.10
3,167.00	1.20	317.50	3,165.51	1.96	-22.11	22.10	0.28	0.08	13.41
3,295.00	1.20	318.60	3,293.48	3.95	-23.90	23.89	0.02	0.00	0.86
3,460.00	1.30	322.50	3,458.44	6.74	-26.18	26.17	0.08	0.06	2.36
3,584.00	1.30	334.20	3,582.41	9.12	-27.65	27.64	0.21	0.00	9.44
3,712.00	1.80	51.50	3,710.37	11.68	-26.71	26.69	1.54	0.39	60.39
3,841.00	2.50	55.90	3,839.28	14.51	-22.79	22.78	0.56	0.54	3.41
3,969.00	3.30	70.40	3,967.12	17.32	-17.01	16.99	0.84	0.63	11.33
4,097.00	4.00	72.60	4,094.86	19.89	-9.28	9.26	0.56	0.55	1.72
4,226.00	3.00	68.20	4,223.61	22.49	-1.85	1.83	0.80	-0.78	-3.41
4,311.00	1.90	58.60	4,308.53	24.05	1.42	-1.44	1.38	-1.29	-11.29
4,371.00	1.60	293.20	4,368.52	24.89	1.50	-1.52	5.19	-0.50	-209.00
4,414.00	7.00	281.50	4,411.39	25.65	-1.62	1.60	12.66	12.56	-27.21
4,456.00	13.50	281.60	4,452.69	27.15	-8.94	8.91	15.48	15.48	0.24
4,499.00	19.90	280.00	4,493.86	29.43	-21.08	21.05	14.92	14.88	-3.72
4,542.00	25.80	275.40	4,533.47	31.59	-37.62	37.58	14.33	13.72	-10.70
4,584.00	31.00	269.80	4,570.41	32.41	-57.55	57.52	13.90	12.38	-13.33
4,627.00	36.80	269.90	4,606.08	32.35	-81.52	81.49	13.49	13.49	0.23
4,670.00	42.30	273.30	4,639.23	33.16	-108.87	108.84	13.74	12.79	7.91
4,713.00	46.40	275.10	4,669.97	35.38	-138.84	138.80	9.97	9.53	4.19
4,756.00	50.50	274.10	4,698.49	37.95	-170.91	170.87	9.69	9.53	-2.33
4,798.00	55.40	272.30	4,723.79	39.80	-204.37	204.32	12.16	11.67	-4.29
4,841.00	59.60	271.20	4,746.89	40.90	-240.61	240.56	10.00	9.77	-2.56
4,884.00	62.80	272.00	4,767.60	41.96	-278.27	278.22	7.62	7.44	1.86
4,927.00	66.90	271.40	4,785.87	43.11	-317.17	317.12	9.62	9.53	-1.40
4,970.00	72.00	269.70	4,800.96	43.49	-357.41	357.37	12.42	11.86	-3.95
5,012.00	74.50	267.80	4,813.07	42.60	-397.62	397.57	7.36	5.95	-4.52
5,055.00	77.10	267.10	4,823.61	40.75	-439.26	439.21	6.25	6.05	-1.63
5,098.00	80.90	267.70	4,831.82	38.84	-481.41	481.37	8.94	8.84	1.40

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Wellbore:	WB1/Job #1410583	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)
5,141.00	86.60	269.30	4,836.50	37.72	-524.13	524.09	13.76	13.26	3.72
5,187.00	89.60	269.90	4,838.02	37.40	-570.09	570.05	6.65	6.52	1.30
5,315.00	90.30	269.50	4,838.13	36.73	-698.09	698.05	0.63	0.55	-0.31
5,446.00	90.30	268.80	4,837.45	34.79	-829.07	829.04	0.53	0.00	-0.53
5,574.00	90.20	268.40	4,836.89	31.66	-957.03	957.00	0.32	-0.08	-0.31
5,702.00	91.80	268.60	4,834.65	28.31	-1,084.97	1,084.94	1.26	1.25	0.16
5,831.00	92.40	268.70	4,829.93	25.27	-1,213.84	1,213.82	0.47	0.47	0.08
5,962.00	91.30	269.70	4,825.70	23.44	-1,344.76	1,344.73	1.13	-0.84	0.76
6,090.00	91.20	269.30	4,822.91	22.33	-1,472.72	1,472.70	0.32	-0.08	-0.31
6,218.00	91.60	269.00	4,819.78	20.43	-1,600.67	1,600.65	0.39	0.31	-0.23
6,347.00	91.60	268.90	4,816.18	18.07	-1,729.60	1,729.58	0.08	0.00	-0.08
6,474.00	91.70	269.20	4,812.52	15.96	-1,856.53	1,856.51	0.25	0.08	0.24
6,607.00	92.00	268.90	4,808.23	13.76	-1,989.44	1,989.42	0.32	0.23	-0.23
6,736.00	90.40	269.60	4,805.52	12.07	-2,118.40	2,118.38	1.35	-1.24	0.54
6,864.00	90.10	268.90	4,804.97	10.39	-2,246.38	2,246.37	0.59	-0.23	-0.55
6,993.00	89.50	270.00	4,805.42	9.16	-2,375.37	2,375.36	0.97	-0.47	0.85
7,124.00	91.00	270.50	4,804.84	9.73	-2,506.37	2,506.36	1.21	1.15	0.38
7,255.00	91.20	270.60	4,802.33	10.98	-2,637.34	2,637.32	0.17	0.15	0.08
7,383.00	91.30	270.40	4,799.54	12.10	-2,765.30	2,765.29	0.17	0.08	-0.16
7,512.00	91.40	270.00	4,796.50	12.55	-2,894.26	2,894.25	0.32	0.08	-0.31
7,640.00	91.50	269.30	4,793.26	11.77	-3,022.22	3,022.21	0.55	0.08	-0.55
7,768.00	91.60	268.90	4,789.80	9.76	-3,150.16	3,150.15	0.32	0.08	-0.31
7,896.00	91.60	268.60	4,786.22	6.97	-3,278.08	3,278.07	0.23	0.00	-0.23
8,025.00	91.60	267.90	4,782.62	3.03	-3,406.97	3,406.96	0.54	0.00	-0.54
8,153.00	90.40	268.60	4,780.39	-0.88	-3,534.88	3,534.88	1.09	-0.94	0.55
8,282.00	90.90	270.00	4,778.92	-2.45	-3,663.86	3,663.86	1.15	0.39	1.09
8,410.00	89.80	270.70	4,778.14	-1.67	-3,791.85	3,791.85	1.02	-0.86	0.55
8,539.00	89.70	269.80	4,778.70	-1.11	-3,920.85	3,920.85	0.70	-0.08	-0.70
8,666.00	89.70	269.30	4,779.37	-2.11	-4,047.84	4,047.84	0.39	0.00	-0.39
8,794.00	89.90	268.30	4,779.82	-4.79	-4,175.81	4,175.82	0.80	0.16	-0.78
8,925.00	91.40	269.20	4,778.33	-7.64	-4,306.77	4,306.77	1.34	1.15	0.69
9,053.00	91.00	267.80	4,775.65	-10.99	-4,434.69	4,434.70	1.14	-0.31	-1.09
Last Phoenix MWD Survey									
9,121.00	91.00	267.80	4,774.46	-13.60	-4,502.63	4,502.65	0.00	0.00	0.00
Projection to TD									

Survey Annotations				
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
410.00	409.94	-4.53	4.62	Tie-on to Gyrodata Survey
459.00	458.92	-5.49	5.47	First Phoenix MWD Survey
9,053.00	4,775.65	-10.99	-4,434.69	Last Phoenix MWD Survey
9,121.00	4,774.46	-13.60	-4,502.63	Projection to TD



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Checked By: _____	Approved By: _____	Date: _____
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