



Apache Corporation

Eddy County, NM (NAD27 NME)
Cedar Lake Federal CA
411H

OH / Job #61262

30.015-43522

NM OIL CONSERVATION
ARTESIA DISTRICT

FEB 15 2018

RECEIVED

Survey: Phoenix MWD Surveys

Standard Survey Report

22 June, 2017





Phoenix Technology Services LP

Survey Report



Company: Apache Corporation
Project: Eddy County, NM (NAD27 NME)
Site: Cedar Lake Federal CA
Well: 411H
Wellbore: OH / Job #61262
Design: Surveys (Trinidad 436)

Local Co-ordinate Reference: Well 411H
TVD Reference: GL + KB @ 3974.50usft (Trinidad 436)
MD Reference: GL + KB @ 3974.50usft (Trinidad 436)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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	Cedar Lake Federal CA				
Site Position:		Northing:	670,624.80 usft	Latitude:	32° 50' 34.37962 N
From:	Map	Easting:	633,024.10 usft	Longitude:	103° 54' 0.75173 W
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.23 °

Well	411H				
Well Position	+N/-S	0.00 usft	Northing:	679,755.99 usft	Latitude: 32° 52' 4.32852 N
	+E/-W	0.00 usft	Easting:	642,651.80 usft	Longitude: 103° 52' 7.43244 W
Position Uncertainty	0.00 usft		Wellhead Elevation:	0.00 usft	Ground Level: 3,958.00 usft

Wellbore	OH / Job #61262				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	HDGM	6/15/2017	7.40	60.80	48,406

Design	Surveys (Trinidad 436)				
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	279.39	

Survey Program	Date 6/19/2017				
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
61.46	611.00	Phoenix Gyro Surveys (OH / Job #61262)	PHX_SPT_GTD	PHX Continuous north-seeking gyro	
776.00	9,181.00	Phoenix MWD Surveys (OH / Job #61262)	MWD+HDGM	OWSG Rev.2 MWD + HDGM	

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)	
611.00	0.32	111.66	610.99	-0.52	2.05	-2.11	0.00	0.00	0.00	
Tie In										
776.00	0.34	283.09	775.99	-0.58	2.00	-2.07	0.40	0.01	103.90	
First Phoenix MWD Survey										
900.00	0.50	290.42	899.99	-0.31	1.14	-1.17	0.14	0.13	5.91	
1,025.00	0.54	307.27	1,024.98	0.24	0.16	-0.12	0.13	0.03	13.48	
1,149.00	0.54	296.02	1,148.98	0.85	-0.83	0.96	0.09	0.00	-9.07	
1,274.00	0.49	287.77	1,273.97	1.27	-1.87	2.05	0.07	-0.04	-6.60	
1,398.00	0.30	289.80	1,397.97	1.54	-2.68	2.90	0.15	-0.15	1.64	

Company: Apache Corporation
Project: Eddy County, NM (NAD27 NME)
Site: Cedar Lake Federal CA
Well: 411H
Wellbore: OH / Job #61262
Design: Surveys (Trinidad 436)

Local Co-ordinate Reference: Well 411H
TVD Reference: GL + KB @ 3974.50usft (Trinidad 436)
MD Reference: GL + KB @ 3974.50usft (Trinidad 436)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
1,523.00	0.34	318.32	1,522.97	1.93	-3.24	3.51	0.13	0.03	22.82
1,647.00	0.22	9.01	1,646.96	2.44	-3.44	3.80	0.21	-0.10	40.88
1,771.00	0.30	38.44	1,770.96	2.93	-3.20	3.64	0.12	0.06	23.73
1,896.00	0.30	33.84	1,895.96	3.46	-2.82	3.34	0.02	0.00	-3.68
2,022.00	0.29	35.77	2,021.96	3.99	-2.45	3.07	0.01	-0.01	1.53
2,147.00	0.31	18.04	2,146.96	4.57	-2.16	2.88	0.08	0.02	-14.18
2,272.00	0.33	355.52	2,271.96	5.25	-2.08	2.91	0.10	0.02	-18.02
2,396.00	0.36	335.28	2,395.95	5.96	-2.27	3.21	0.10	0.02	-16.32
2,522.00	0.40	333.17	2,521.95	6.71	-2.64	3.70	0.03	0.03	-1.67
2,645.00	0.46	317.27	2,644.95	7.45	-3.17	4.34	0.11	0.05	-12.93
2,770.00	0.56	318.94	2,769.94	8.28	-3.91	5.21	0.08	0.08	1.34
2,895.00	0.59	324.18	2,894.94	9.27	-4.69	6.14	0.05	0.02	4.19
3,019.00	0.55	321.40	3,018.93	10.25	-5.43	7.03	0.04	-0.03	-2.24
3,143.00	0.58	326.55	3,142.92	11.24	-6.15	7.90	0.05	0.02	4.15
3,268.00	0.59	323.40	3,267.92	12.28	-6.88	8.79	0.03	0.01	-2.52
3,392.00	0.60	321.98	3,391.91	13.31	-7.66	9.73	0.01	0.01	-1.15
3,458.00	0.64	315.11	3,457.91	13.84	-8.13	10.28	0.13	0.06	-10.41
3,572.00	0.54	319.63	3,571.90	14.70	-8.93	11.21	0.10	-0.09	3.96
3,697.00	0.78	306.28	3,696.89	15.65	-10.00	12.42	0.23	0.19	-10.68
3,821.00	0.76	314.35	3,820.88	16.73	-11.27	13.85	0.09	-0.02	6.51
3,945.00	0.40	150.73	3,944.88	16.92	-11.64	14.25	0.93	-0.29	-131.95
4,070.00	0.25	158.29	4,069.88	16.29	-11.33	13.84	0.12	-0.12	6.05
4,195.00	0.24	163.97	4,194.88	15.78	-11.16	13.58	0.02	-0.01	4.54
4,319.00	0.15	156.26	4,318.88	15.39	-11.02	13.38	0.08	-0.07	-6.22
4,443.00	0.33	176.30	4,442.87	14.88	-10.93	13.21	0.16	0.15	16.16
4,568.00	0.13	204.33	4,567.87	14.39	-10.97	13.17	0.18	-0.16	22.42
4,704.00	2.15	303.00	4,703.84	15.64	-13.17	15.55	1.60	1.49	72.55
4,767.00	10.25	313.57	4,766.42	20.16	-18.23	21.27	12.93	12.86	16.78
4,829.00	19.39	315.21	4,826.30	31.29	-29.50	34.21	14.76	14.74	2.65
4,891.00	26.91	312.06	4,883.27	48.01	-47.19	54.40	12.29	12.13	-5.08
4,954.00	32.33	309.24	4,938.01	68.24	-70.85	81.03	8.88	8.60	-4.48
5,016.00	37.87	305.53	4,988.73	89.80	-99.20	112.52	9.57	8.94	-5.98
5,079.00	43.39	304.34	5,036.52	113.27	-132.83	149.53	8.85	8.76	-1.89
5,141.00	50.70	305.54	5,078.74	139.26	-169.98	190.43	11.87	11.79	1.94
5,203.00	57.78	306.04	5,114.95	168.67	-210.76	235.46	11.44	11.42	0.81
5,265.00	62.33	305.57	5,145.89	200.09	-254.32	283.57	7.37	7.34	-0.76
5,328.00	69.93	306.10	5,171.37	233.80	-300.99	335.11	12.09	12.06	0.84
5,390.00	76.72	305.93	5,189.15	268.70	-349.01	388.18	10.95	10.95	-0.27
5,452.00	82.84	305.73	5,200.14	304.40	-398.45	442.78	9.88	9.87	-0.32
5,483.00	85.15	305.89	5,203.38	322.44	-423.45	470.39	7.47	7.45	0.52
5,511.00	88.99	306.11	5,204.82	338.87	-446.07	495.39	13.74	13.71	0.79
5,573.00	91.77	305.37	5,204.40	375.08	-496.39	550.94	4.64	4.48	-1.19
5,635.00	92.63	303.76	5,202.02	410.23	-547.40	607.01	2.94	1.39	-2.60

Company: Apache Corporation
Project: Eddy County, NM (NAD27 NME)
Site: Cedar Lake Federal CA
Well: 411H
Wellbore: OH / Job #61262
Design: Surveys (Trinidad 436)

Local Co-ordinate Reference: Well 411H
TVD Reference: GL + KB @ 3974.50usft (Trinidad 436)
MD Reference: GL + KB @ 3974.50usft (Trinidad 436)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
5,698.00	93.19	302.37	5,198.83	444.55	-600.13	664.63	2.38	0.89	-2.21
5,759.00	92.69	300.84	5,195.70	476.48	-652.01	721.03	2.64	-0.82	-2.51
5,821.00	91.26	299.53	5,193.56	507.63	-705.57	778.95	3.13	-2.31	-2.11
5,884.00	90.50	298.42	5,192.59	538.15	-760.68	838.30	2.14	-1.21	-1.76
5,946.00	90.87	296.34	5,191.85	566.66	-815.73	897.26	3.41	0.60	-3.35
6,009.00	90.50	291.99	5,191.10	592.44	-873.19	958.16	6.93	-0.59	-6.90
6,071.00	90.67	288.93	5,190.46	614.11	-931.27	1,019.00	4.94	0.27	-4.94
6,134.00	90.53	284.39	5,189.80	632.16	-991.60	1,081.47	7.21	-0.22	-7.21
6,196.00	89.91	280.88	5,189.57	645.72	-1,052.09	1,143.36	5.75	-1.00	-5.66
6,258.00	90.31	277.48	5,189.45	655.61	-1,113.29	1,205.35	5.52	0.65	-5.48
6,321.00	91.29	273.33	5,188.57	661.54	-1,175.99	1,268.18	6.77	1.56	-6.59
6,383.00	91.46	270.99	5,187.08	663.88	-1,237.92	1,329.66	3.78	0.27	-3.77
6,445.00	89.89	269.68	5,186.35	664.24	-1,299.91	1,390.88	3.30	-2.53	-2.11
6,508.00	90.81	270.06	5,185.96	664.10	-1,362.91	1,453.01	1.58	1.46	0.60
6,570.00	91.79	270.77	5,184.56	664.55	-1,424.89	1,514.24	1.95	1.58	1.15
6,633.00	92.52	271.33	5,182.19	665.70	-1,487.84	1,576.53	1.46	1.16	0.89
6,695.00	90.59	270.85	5,180.51	666.88	-1,549.80	1,637.85	3.21	-3.11	-0.77
6,757.00	88.91	270.61	5,180.78	667.67	-1,611.79	1,699.14	2.74	-2.71	-0.39
6,820.00	89.97	270.23	5,181.39	668.13	-1,674.79	1,761.37	1.79	1.68	-0.60
6,882.00	90.81	270.16	5,180.97	668.34	-1,736.78	1,822.57	1.36	1.35	-0.11
6,944.00	91.43	270.10	5,179.76	668.48	-1,798.77	1,883.75	1.00	1.00	-0.10
7,006.00	92.72	270.26	5,177.51	668.68	-1,860.73	1,944.91	2.10	2.08	0.26
7,069.00	93.73	270.55	5,173.97	669.12	-1,923.63	2,007.03	1.67	1.60	0.46
7,131.00	92.83	269.97	5,170.42	669.40	-1,985.52	2,068.15	1.73	-1.45	-0.94
7,193.00	93.11	270.10	5,167.21	669.44	-2,047.44	2,129.24	0.50	0.45	0.21
7,256.00	92.18	270.37	5,164.30	669.70	-2,110.37	2,191.37	1.54	-1.48	0.43
7,318.00	92.99	270.80	5,161.51	670.33	-2,172.30	2,252.57	1.48	1.31	0.69
7,381.00	91.85	270.26	5,158.85	670.91	-2,235.24	2,314.77	2.00	-1.81	-0.86
7,443.00	90.64	270.37	5,157.50	671.26	-2,297.23	2,375.97	1.96	-1.95	0.18
7,505.00	91.15	269.70	5,156.53	671.29	-2,359.22	2,437.14	1.36	0.82	-1.08
7,568.00	90.25	270.76	5,155.76	671.55	-2,422.21	2,499.33	2.21	-1.43	1.68
7,630.00	90.95	270.58	5,155.11	672.27	-2,484.20	2,560.61	1.17	1.13	-0.29
7,692.00	91.90	270.01	5,153.57	672.59	-2,546.18	2,621.81	1.79	1.53	-0.92
7,755.00	89.75	268.88	5,152.66	671.98	-2,609.17	2,683.85	3.86	-3.41	-1.79
7,817.00	90.61	268.73	5,152.47	670.69	-2,671.16	2,744.80	1.41	1.39	-0.24
7,879.00	91.71	268.44	5,151.21	669.16	-2,733.12	2,805.68	1.83	1.77	-0.47
7,941.00	92.77	268.70	5,148.79	667.61	-2,795.05	2,866.53	1.76	1.71	0.42
8,003.00	90.64	268.29	5,146.94	665.98	-2,857.00	2,927.38	3.50	-3.44	-0.66
8,066.00	91.12	268.53	5,145.98	664.23	-2,919.97	2,989.22	0.85	0.76	0.38
8,129.00	90.11	268.12	5,145.30	662.39	-2,982.94	3,051.05	1.73	-1.60	-0.65
8,191.00	91.23	268.23	5,144.58	660.42	-3,044.90	3,111.86	1.82	1.81	0.18
8,253.00	92.57	268.47	5,142.52	658.63	-3,106.84	3,172.68	2.20	2.16	0.39
8,316.00	91.71	269.08	5,140.17	657.29	-3,169.78	3,234.55	1.67	-1.37	0.97
8,378.00	93.22	269.14	5,137.50	656.33	-3,231.72	3,295.50	2.44	2.44	0.10

Company: Apache Corporation
Project: Eddy County, NM (NAD27 NME)
Site: Cedar Lake Federal CA
Well: 411H
Wellbore: OH / Job #61262
Design: Surveys (Trinidad 436)

Local Co-ordinate Reference: Well 411H
TVD Reference: GL + KB @ 3974.50usft (Trinidad 436)
MD Reference: GL + KB @ 3974.50usft (Trinidad 436)
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: Compass 5000 GCR

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)
8,440.00	91.23	269.67	5,135.09	655.68	-3,293.66	3,356.51	3.32	-3.21	0.85
8,502.00	92.16	269.51	5,133.26	655.24	-3,355.63	3,417.58	1.52	1.50	-0.26
8,565.00	91.01	270.68	5,131.52	655.34	-3,418.61	3,479.72	2.60	-1.83	1.86
8,627.00	92.04	270.82	5,129.87	656.16	-3,480.58	3,541.00	1.68	1.66	0.23
8,688.00	90.79	271.22	5,128.36	657.24	-3,541.55	3,601.33	2.15	-2.05	0.66
8,751.00	92.07	271.49	5,126.79	658.73	-3,604.51	3,663.69	2.08	2.03	0.43
8,813.00	91.26	271.72	5,124.99	660.47	-3,666.46	3,725.09	1.36	-1.31	0.37
8,875.00	92.29	272.00	5,123.07	662.48	-3,728.40	3,786.52	1.72	1.66	0.45
8,937.00	91.77	272.27	5,120.87	664.79	-3,790.31	3,847.99	0.94	-0.84	0.44
8,999.00	93.22	272.25	5,118.17	667.23	-3,852.20	3,909.45	2.34	2.34	-0.03
9,062.00	91.88	272.09	5,115.37	669.61	-3,915.10	3,971.89	2.14	-2.13	-0.25
9,111.00	92.47	272.72	5,113.51	671.67	-3,964.02	4,020.49	1.76	1.20	1.29
Final Phoenix MWD Survey									
9,146.30	92.47	272.72	5,111.99	673.34	-3,999.24	4,055.52	0.00	0.00	0.00
LTP									
9,181.00	92.47	272.72	5,110.49	674.99	-4,033.87	4,089.95	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)	
611.00	610.99	-0.52	2.05	Tie In
776.00	775.99	-0.58	2.00	First Phoenix MWD Survey
9,111.00	5,113.51	671.67	-3,964.02	Final Phoenix MWD Survey
9,146.30	5,111.99	673.34	-3,999.24	LTP
9,181.00	5,110.49	674.99	-4,033.87	Projection to TD