



Hadaway Consulting & Eng. LLC

Chaves County, NM (NAD 83)

Muirfield 2H

Muirfield 2H

30.005-64298

Muirfield 2H Curve & Lateral

NM OIL CONSERVATION
ARTESIA DISTRICT

Survey: DrilTech MWD

JAN 04 2019

RECEIVED

Standard Survey Report

18 December, 2018



Survey Report

Company: Hadaway Consulting & Eng. LLC
Project: Chaves County, NM (NAD 83)
Site: Muirfield 2H
Well: Muirfield 2H
Wellbore: Muirfield 2H Curve & Lateral
Design: Muirfield 2H Curve & Lateral

Local Co-ordinate Reference: Well Muirfield 2H
TVD Reference: GL 3895.4' + 17' RKB @ 3912.40ft
MD Reference: GL 3895.4' + 17' RKB @ 3912.40ft
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: EDM 5000.14 Single User Db

Project	Chaves County, NM (NAD 83)		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	New Mexico Eastern Zone		

Site		Muirfield 2H				
Site Position:		Northing:	887,383.30 usft	Latitude:	33° 26' 20.184 N	
From:	Map	Easting:	636,707.80 usft	Longitude:	104° 1' 14.503 W	
Position Uncertainty:		0.00 ft	Slot Radius:	13.200 in	Grid Convergence:	0.17 °

Well	Muirfield 2H					
Well Position	+N/-S	0.00 ft	Northing:	887,383.30 usft	Latitude:	33° 26' 20.184 N
	+E/-W	0.00 ft	Easting:	636,707.80 usft	Longitude:	104° 1' 14.503 W
Position Uncertainty		0.00 ft	Wellhead Elevation:	ft	Ground Level:	3,895.40 ft

Wellbore	Muirfield 2H Curve & Lateral				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	10/12/2018	7.11	61.08	48,466.35557021

Design	Muirfield 2H Curve & Lateral				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	1,664.00
Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)	
	0.00	0.00	0.00	359.39	

Survey Program	Date 12/18/2018				
From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description	
137.00	1,664.00	Invictus MWD (Muirfield 2H Pilot Hole)	MWD	MWD - Standard	
1,697.00	7,550.00	DrilTech MWD (Muirfield 2H Curve & Late	MWD	MWD - Standard	

Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Bulld Rate (°/100ft)	Turn Rate (°/100ft)	
1,664.00	1.60	103.97	1,663.80	-6.20	10.31	-6.31	0.00	0.00	0.00	
1664'MD: Tie-Into Invictus SVY's										
1,697.00	1.85	82.44	1,696.79	-6.25	11.28	-6.37	2.09	0.76	-65.24	
1697'MD: Begin DrilTech Survey										
1,729.00	1.49	76.46	1,728.78	-6.08	12.20	-6.21	1.25	-1.13	-18.69	
1,742.00	1.58	62.93	1,741.77	-5.96	12.52	-6.09	2.87	0.69	-104.08	
1,758.00	1.58	44.38	1,757.77	-5.70	12.87	-5.84	3.18	0.00	-115.94	
1,763.00	1.76	40.51	1,762.76	-5.59	12.97	-5.73	4.25	3.60	-77.40	
1,791.00	2.99	15.20	1,790.74	-4.56	13.44	-4.70	5.67	4.39	-90.39	



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Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
1,822.00	4.31	8.70	1,821.68	-2.63	13.83	-2.78	4.46	4.26	-20.97
1,854.00	5.28	7.03	1,853.56	0.02	14.19	-0.13	3.06	3.03	-5.22
1,884.00	6.33	5.09	1,883.41	3.04	14.51	2.88	3.56	3.50	-6.47
1,915.00	6.51	5.09	1,914.22	6.49	14.82	6.33	0.58	0.58	0.00
1,946.00	7.12	5.01	1,945.00	10.15	15.14	9.99	1.97	1.97	-0.26
1,976.00	8.18	2.19	1,974.73	14.14	15.38	13.97	3.75	3.53	-9.40
2,007.00	9.58	358.68	2,005.36	18.92	15.41	18.76	4.84	4.52	-11.32
2,037.00	12.13	356.66	2,034.82	24.57	15.17	24.40	8.59	8.50	-6.73
2,069.00	13.89	355.69	2,066.00	31.75	14.68	31.59	5.54	5.50	-3.03
2,100.00	15.30	356.39	2,095.99	39.55	14.15	39.39	4.58	4.55	2.26
2,131.00	17.50	358.33	2,125.73	48.29	13.75	48.14	7.31	7.10	6.26
2,162.00	19.61	359.73	2,155.12	58.15	13.59	58.00	6.96	6.81	4.52
2,192.00	21.19	359.65	2,183.24	68.61	13.54	68.46	5.27	5.27	-0.27
2,223.00	22.77	359.21	2,211.98	80.21	13.42	80.06	5.12	5.10	-1.42
2,254.00	24.18	359.65	2,240.42	92.56	13.30	92.41	4.58	4.55	1.42
2,285.00	25.06	0.44	2,268.60	105.47	13.31	105.32	3.03	2.84	2.55
2,315.00	26.38	1.23	2,295.62	118.49	13.50	118.34	4.55	4.40	2.63
2,345.00	28.84	2.63	2,322.21	132.38	13.98	132.22	8.48	8.20	4.67
2,376.00	31.39	2.28	2,349.02	147.92	14.64	147.75	8.25	8.23	-1.13
2,406.00	33.33	1.23	2,374.36	163.97	15.13	163.80	6.73	6.47	-3.50
2,437.00	34.37	0.44	2,400.10	181.23	15.38	181.06	3.64	3.35	-2.55
2,468.00	36.49	0.44	2,425.36	199.20	15.52	199.03	6.84	6.84	0.00
2,499.00	37.81	359.21	2,450.07	217.92	15.46	217.74	4.89	4.26	-3.97
2,530.00	39.75	357.89	2,474.24	237.33	14.96	237.16	6.80	6.26	-4.26
2,562.00	41.33	357.98	2,498.55	258.11	14.21	257.95	4.94	4.94	0.28
2,569.09	41.69	357.98	2,503.86	262.81	14.05	262.65	5.10	5.10	0.00
2596'MD: 330' FSL Crossing									
2,593.00	42.91	357.98	2,521.55	278.89	13.48	278.73	5.10	5.10	0.00
2,625.00	43.88	358.68	2,544.80	300.87	12.84	300.71	3.38	3.03	2.19
2,654.00	44.58	358.85	2,565.58	321.09	12.40	320.94	2.45	2.41	0.59
2,683.00	46.60	359.56	2,585.87	341.80	12.12	341.66	7.18	6.97	2.45
2,713.00	48.80	359.21	2,606.06	363.99	11.88	363.84	7.38	7.33	-1.17
2,744.00	50.65	358.77	2,626.10	387.64	11.46	387.49	6.07	5.97	-1.42
2,775.00	52.23	358.77	2,645.42	411.87	10.94	411.73	5.10	5.10	0.00
2,806.00	54.24	358.24	2,663.98	436.70	10.29	436.56	6.63	6.48	-1.71
2,836.00	56.01	358.41	2,681.13	461.30	9.57	461.17	5.92	5.90	0.57
2,867.00	55.66	357.71	2,698.54	486.93	8.70	486.81	2.18	-1.13	-2.26
2,897.00	55.49	357.10	2,715.50	511.65	7.58	511.54	1.77	-0.57	-2.03
2,928.00	55.66	356.74	2,733.02	537.19	6.21	537.09	1.10	0.55	-1.16
2,959.00	55.22	355.60	2,750.61	562.66	4.50	562.58	3.34	-1.42	-3.68
2,990.00	55.05	355.00	2,768.33	588.01	2.42	587.95	1.68	-0.55	-1.94
3,011.00	55.93	354.90	2,780.23	605.24	0.90	605.20	4.21	4.19	-0.48
3,020.00	56.37	354.72	2,785.24	612.69	0.22	612.65	5.16	4.89	-2.00
3,051.00	57.95	354.55	2,802.05	638.62	-2.21	638.61	5.12	5.10	-0.55



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Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
3,140.00	64.28	356.13	2,845.02	716.25	-8.51	716.30	7.28	7.11	1.78
3,171.00	68.06	357.27	2,857.55	744.55	-10.14	744.62	12.65	12.19	3.68
3,202.00	71.93	359.82	2,868.15	773.66	-10.87	773.74	14.68	12.48	8.23
3,232.00	75.97	0.96	2,876.45	802.49	-10.67	802.56	13.95	13.47	3.80
3,263.00	79.84	1.68	2,882.94	832.79	-9.97	832.84	12.69	12.48	2.32
3,281.00	81.53	2.23	2,885.85	850.54	-9.36	850.59	9.86	9.39	3.07
3281'MD: 905' FSL - 1276' FEL - FTP (as Drilled) - Muirfield 2H FTP (as drilled)									
3,294.00	82.75	2.63	2,887.63	863.40	-8.82	863.45	9.86	9.39	3.05
3,324.00	86.17	2.19	2,890.53	893.23	-7.56	893.26	11.49	11.40	-1.47
3,355.00	89.25	2.55	2,891.77	924.18	-6.28	924.19	10.00	9.94	1.16
3,386.00	89.78	2.63	2,892.03	955.14	-4.88	955.14	1.73	1.71	0.26
3,417.00	89.60	3.78	2,892.20	986.10	-3.15	986.07	3.75	-0.58	3.71
3,508.00	90.92	2.81	2,891.78	1,076.94	2.08	1,076.86	1.80	1.45	-1.07
3,600.00	91.01	1.49	2,890.23	1,168.86	5.53	1,168.74	1.44	0.10	-1.43
3,692.00	91.01	359.82	2,888.61	1,260.84	6.59	1,260.70	1.81	0.00	-1.82
3,785.00	90.66	359.12	2,887.26	1,353.82	5.73	1,353.68	0.84	-0.38	-0.75
3,876.00	91.54	359.56	2,885.51	1,444.80	4.68	1,444.67	1.08	0.97	0.48
3,967.00	90.04	0.00	2,884.25	1,535.79	4.33	1,535.65	1.72	-1.65	0.48
4,059.00	91.01	358.77	2,883.41	1,627.77	3.34	1,627.65	1.70	1.05	-1.34
4,151.00	91.10	357.01	2,881.72	1,719.69	-0.05	1,719.60	1.92	0.10	-1.91
4,243.00	90.75	357.89	2,880.23	1,811.59	-4.14	1,811.53	1.03	-0.38	0.96
4,334.00	90.75	357.62	2,879.04	1,902.51	-7.70	1,902.49	0.30	0.00	-0.30
4,426.00	91.10	356.57	2,877.56	1,994.38	-12.36	1,994.40	1.20	0.38	-1.14
4,518.00	90.57	359.47	2,876.21	2,086.30	-15.54	2,086.35	3.20	-0.58	3.15
4,610.00	91.63	357.71	2,874.45	2,178.25	-17.81	2,178.32	2.23	1.15	-1.91
4,701.00	92.24	358.24	2,871.38	2,269.15	-21.02	2,269.24	0.89	0.67	0.58
4,793.00	89.25	357.80	2,870.18	2,361.07	-24.20	2,361.20	3.28	-3.25	-0.48
4,885.00	90.66	358.06	2,870.25	2,453.01	-27.52	2,453.16	1.56	1.53	0.28
4,977.00	90.13	357.18	2,869.62	2,544.93	-31.34	2,545.12	1.12	-0.58	-0.96
5,035.00	89.08	356.74	2,870.02	2,602.84	-34.42	2,603.06	1.96	-1.81	-0.76
5,129.00	91.89	358.85	2,869.22	2,696.76	-38.03	2,697.01	3.74	2.99	2.24
5,222.00	89.60	358.50	2,868.01	2,789.72	-40.18	2,789.99	2.49	-2.46	-0.38
5,317.00	90.48	358.68	2,867.95	2,884.69	-42.52	2,884.98	0.95	0.93	0.19
5,408.00	90.66	357.54	2,867.04	2,975.63	-45.52	2,975.95	1.27	0.20	-1.25
5,500.00	92.77	359.38	2,864.29	3,067.55	-47.99	3,067.88	3.04	2.29	2.00
5,592.00	93.65	359.91	2,859.14	3,159.40	-48.56	3,159.74	1.12	0.96	0.58
5,684.00	94.70	1.05	2,852.44	3,251.15	-47.80	3,251.47	1.68	1.14	1.24
5,776.00	93.21	1.75	2,846.09	3,342.90	-45.55	3,343.20	1.79	-1.62	0.76
5,869.00	92.86	1.84	2,841.17	3,435.72	-42.64	3,435.98	0.39	-0.38	0.10
5,960.00	91.98	3.86	2,837.33	3,526.52	-38.12	3,526.73	2.42	-0.97	2.22
6,052.00	91.45	3.07	2,834.57	3,618.31	-32.56	3,618.46	1.03	-0.58	-0.86
6,144.00	88.81	2.81	2,834.36	3,710.18	-27.85	3,710.27	2.88	-2.87	-0.28
6,237.00	90.75	3.78	2,834.72	3,803.02	-22.50	3,803.05	2.33	2.09	1.04



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Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Turn Rate (°/100ft)
6,327.00	89.08	3.07	2,834.85	3,892.86	-17.12	3,892.82	2.02	-1.86	-0.79
6,418.00	89.69	359.38	2,835.83	3,983.82	-15.18	3,983.75	4.11	0.67	-4.05
6,511.00	88.72	358.24	2,837.12	4,076.79	-17.11	4,076.74	1.61	-1.04	-1.23
6,603.00	90.31	357.45	2,837.90	4,168.71	-20.57	4,168.70	1.93	1.73	-0.86
6,695.00	91.19	359.38	2,836.70	4,260.67	-23.11	4,260.67	2.31	0.96	2.10
6,786.00	90.66	359.82	2,835.23	4,351.65	-23.75	4,351.66	0.76	-0.58	0.48
6,877.00	90.57	359.73	2,834.25	4,442.65	-24.11	4,442.65	0.14	-0.10	-0.10
6,970.00	90.22	358.77	2,833.61	4,535.63	-25.32	4,535.65	1.10	-0.38	-1.03
7,061.00	90.04	356.13	2,833.40	4,626.54	-29.37	4,626.59	2.91	-0.20	-2.90
7,153.00	91.45	356.57	2,832.21	4,718.34	-35.23	4,718.45	1.61	1.53	0.48
7,245.00	91.28	357.01	2,830.01	4,810.17	-40.38	4,810.33	0.51	-0.18	0.48
7,337.00	89.69	356.83	2,829.24	4,902.03	-45.32	4,902.23	1.74	-1.73	-0.20
7,429.00	89.69	359.12	2,829.73	4,993.96	-48.57	4,994.20	2.49	0.00	2.49
7,500.00	90.48	359.12	2,829.63	5,064.95	-49.66	5,065.20	1.11	1.11	0.00
7500'MD: Final MWD Survey									
7,550.00	90.48	359.12	2,829.21	5,114.95	-50.43	5,115.19	0.00	0.00	0.00
7550'MD: Projected to Total Depth - 7550'MD: 100' FNL - 1300' FEL - Bottom Hole(as drilled) - Muirfield 2H BHL (As Drilled)									

Design Targets

Target Name

- hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (usft)	Easting (usft)	Latitude	Longitude
Muirfield 2H BHL (As - survey hits target center - Point	0.00	0.00	2,829.21	5,114.95	-50.43	892,498.24	636,657.37	33° 27' 10.793 N	104° 1' 14.916 W
Muirfield 2H FTP (as - survey hits target center - Point	0.00	0.00	2,885.85	850.54	-9.36	888,233.84	636,698.44	33° 26' 28.600 N	104° 1' 14.583 W

Survey Annotations

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates		Comment
		+N/-S (ft)	+E/-W (ft)	
1,664.00	1,663.80	-6.20	10.31	1664'MD: Tie-into Invictus SVY's
1,697.00	1,696.79	-6.25	11.28	1697'MD: Begin DriTech Survey
2,569.09	2,503.86	262.81	14.05	2596'MD: 330' FSL Crossing
3,281.00	2,885.85	850.54	-9.36	3281'MD: 905' FSL - 1276' FEL - FTP (as Drilled)
7,500.00	2,829.63	5,064.95	-49.66	7500'MD: Final MWD Survey
7,550.00	2,829.21	5,114.95	-50.43	7550'MD: Projected to Total Depth
7,550.00	2,829.21	5,114.95	-50.43	7550'MD: 100' FNL - 1300' FEL - Bottom Hole(as drilled)

Checked By: _____ Approved By: _____ Date: _____

Hadaway Consulting & Eng. LLC

DrilTech, LLC

Chaves County, NM (NAD 83)
Hadaway Consulting & Eng. LLC
Muirfield 2H
Muirfield 2H Curve & Lateral
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SURFACE LOCATION

US State Plane 1983
New Mexico Eastern Zone
Elevation: GL 3895.4' + 17' RKB @ 3912.40R
Northing 887383.30 Easting 636707.80 33° 26' 20.184 N 104° 1' 14.503 W

WELLBORE TARGET DETAILS (MAP CO-ORDINATES)

Name	TVD	+N/-S	+E/-W	Northing	Easting
Muirfield 2H BHL (As Drilled)	2829.21	5114.95	-50.43	892498.24	636657.37
Muirfield 2H FTP (as drilled)	2885.85	850.54	-9.36	888233.84	636698.44

