



Titan Directional Drilling, LLC

Survey Report

Company:	Carrizo Oil & Gas, Inc.	Local Co-ordinate Reference:	Well 13-20-9-58 - Slot 13
Project:	Niobrara CON'83	TVD Reference:	WELL @ 4889.00usft (Original Well Elev)
Site:	Bringelson 20-9-58 Pad	MD Reference:	WELL @ 4889.00usft (Original Well Elev)
Well:	13-20-9-58	North Reference:	Grid
Wellbore:	13-20-9-58 OH	Survey Calculation Method:	Minimum Curvature
Design:	13-20-9-58 OH	Database:	EDM 5000.1 Single User Db

Project	Niobrara CON'83, Weld County, CO		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	Colorado Northern Zone		Using geodetic scale factor

Site	Bringelson 20-9-58 Pad, Centered on 17-20-9-58		
Site Position:		Northing:	1,515,768.94 usft
From:	Map	Easting:	3,444,594.58 usft
Position Uncertainty:	0.00 usft	Slot Radius:	13.20 in
		Latitude:	40° 44' 17.28 N
		Longitude:	103° 53' 44.09 W
		Grid Convergence:	1.04 °

Well	13-20-9-58 - Slot 13		
Well Position	+N/-S	0.00 usft	Northing:
	+E/-W	0.00 usft	Easting:
Position Uncertainty	0.00 usft		Wellhead Elevation:
			Latitude:
			Longitude:
			Ground Level:

Wellbore	13-20-9-58 OH		
Magnetics	Model Name	Sample Date	Declination
			(°)
	IGRF2015	02/16/15	8.01
			Dip Angle
			(°)
			67.32
			Field Strength
			(nT)
			52,923

Design	13-20-9-58 OH		
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
			(°)
			91.79

Survey Program	Date	03/03/15		
From	To	Survey (Wellbore)	Tool Name	Description
(usft)	(usft)			
141.00	10,561.00	Survey #1 (13-20-9-58 OH)	MWD	MWD - Standard
10,627.00	10,627.00	Survey #2 (13-20-9-58 OH)	ZERO-ERROR	Zero Error

Survey										
Measured	Inclination	Azimuth	Vertical	+N/-S	+E/-W	Vertical	Dogleg	Build	Turn	
Depth	(°)	(°)	Depth	(usft)	(usft)	Section	Rate	Rate	Rate	
(usft)			(usft)			(usft)	(°/100usft)	(°/100usft)	(°/100usft)	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
141.00	0.40	273.90	141.00	0.03	-0.49	-0.49	0.28	0.28	0.00	
233.00	0.50	290.20	233.00	0.19	-1.19	-1.19	0.18	0.11	17.72	
325.00	1.70	289.20	324.98	0.78	-2.85	-2.88	1.30	1.30	-1.09	
415.00	2.10	294.90	414.93	1.91	-5.61	-5.67	0.49	0.44	6.33	
505.00	3.10	291.00	504.83	3.48	-9.38	-9.48	1.13	1.11	-4.33	
596.00	4.40	291.10	595.64	5.62	-14.93	-15.10	1.43	1.43	0.11	
687.00	5.70	297.50	686.28	8.96	-22.20	-22.47	1.55	1.43	7.03	
778.00	6.20	299.00	776.79	13.43	-30.50	-30.91	0.58	0.55	1.65	
870.00	6.40	299.90	868.24	18.40	-39.29	-39.85	0.24	0.22	0.98	

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Wellbore:	13-20-9-58 OH	Survey Calculation Method:	Minimum Curvature
Design:	13-20-9-58 OH	Database:	EDM 5000.1 Single User 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)
962.00	6.50	297.80	959.65	23.38	-48.35	-49.05	0.28	0.11	-2.28
1,053.00	6.80	298.20	1,050.04	28.33	-57.65	-58.51	0.33	0.33	0.44
1,145.00	5.80	291.10	1,141.49	32.58	-66.79	-67.77	1.38	-1.09	-7.72
1,237.00	5.80	293.20	1,233.02	36.08	-75.40	-76.49	0.23	0.00	2.28
1,328.00	6.10	292.70	1,323.53	39.76	-84.08	-85.28	0.33	0.33	-0.55
1,392.00	6.20	293.60	1,387.16	42.45	-90.39	-91.67	0.22	0.16	1.41
1,427.00	6.20	293.11	1,421.95	43.95	-93.86	-95.18	0.15	0.00	-1.40
9 5/8"									
1,492.00	6.20	292.20	1,486.57	46.66	-100.34	-101.74	0.15	0.00	-1.40
1,578.00	5.80	293.90	1,572.10	50.17	-108.61	-110.12	0.51	-0.47	1.98
1,663.00	5.70	291.60	1,656.67	53.47	-116.46	-118.07	0.30	-0.12	-2.71
1,748.00	5.50	293.90	1,741.27	56.67	-124.11	-125.82	0.35	-0.24	2.71
1,833.00	5.10	287.50	1,825.91	59.46	-131.44	-133.23	0.84	-0.47	-7.53
1,918.00	6.30	294.50	1,910.48	62.53	-139.28	-141.17	1.63	1.41	8.24
2,003.00	6.20	292.20	1,994.98	66.20	-147.78	-149.77	0.32	-0.12	-2.71
2,088.00	5.80	293.00	2,079.51	69.61	-155.98	-158.08	0.48	-0.47	0.94
2,173.00	5.90	292.90	2,164.07	72.99	-163.96	-166.16	0.12	0.12	-0.12
2,259.00	6.00	294.20	2,249.61	76.55	-172.13	-174.44	0.20	0.12	1.51
2,344.00	5.30	295.30	2,334.19	80.05	-179.73	-182.14	0.83	-0.82	1.29
2,428.00	5.10	295.00	2,417.85	83.28	-186.62	-189.13	0.24	-0.24	-0.36
2,512.00	6.90	295.70	2,501.38	87.05	-194.55	-197.18	2.14	2.14	0.83
2,596.00	7.30	294.70	2,584.74	91.47	-203.95	-206.70	0.50	0.48	-1.19
2,680.00	7.60	297.00	2,668.03	96.22	-213.75	-216.65	0.50	0.36	2.74
2,765.00	7.60	296.40	2,752.28	101.27	-223.79	-226.84	0.09	0.00	-0.71
2,850.00	7.50	298.90	2,836.55	106.45	-233.68	-236.89	0.40	-0.12	2.94
2,935.00	7.10	299.10	2,920.86	111.69	-243.13	-246.50	0.47	-0.47	0.24
3,019.00	6.70	295.20	3,004.25	116.30	-252.10	-255.61	0.73	-0.48	-4.64
3,102.00	6.30	291.00	3,086.72	119.99	-260.73	-264.35	0.75	-0.48	-5.06
3,186.00	6.10	286.90	3,170.23	122.94	-269.30	-273.01	0.58	-0.24	-4.88
3,271.00	6.10	280.80	3,254.75	125.10	-278.06	-281.83	0.76	0.00	-7.18
3,356.00	6.50	281.50	3,339.23	126.90	-287.21	-291.03	0.48	0.47	0.82
3,441.00	7.10	283.20	3,423.63	129.06	-297.04	-300.93	0.74	0.71	2.00
3,525.00	8.00	285.20	3,506.91	131.78	-307.73	-311.70	1.12	1.07	2.38
3,610.00	7.60	296.90	3,591.12	135.88	-318.46	-322.54	1.92	-0.47	13.76
3,693.00	7.60	299.00	3,673.40	141.02	-328.15	-332.40	0.33	0.00	2.53
3,778.00	7.70	300.00	3,757.64	146.59	-338.00	-342.41	0.20	0.12	1.18
3,863.00	7.70	299.70	3,841.87	152.26	-347.88	-352.46	0.05	0.00	-0.35
3,948.00	7.00	297.10	3,926.17	157.44	-357.43	-362.18	0.91	-0.82	-3.06
4,033.00	6.70	294.70	4,010.57	161.87	-366.55	-371.43	0.49	-0.35	-2.82
4,118.00	5.90	290.10	4,095.05	165.45	-375.16	-380.14	1.11	-0.94	-5.41
4,203.00	5.30	285.90	4,179.65	168.02	-383.04	-388.10	0.85	-0.71	-4.94
4,288.00	5.00	280.60	4,264.31	169.78	-390.45	-395.56	0.66	-0.35	-6.24
4,372.00	4.70	277.60	4,348.00	170.91	-397.46	-402.61	0.47	-0.36	-3.57

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4,458.00	4.20	278.30	4,433.75	171.83	-404.07	-409.24	0.58	-0.58	0.81
4,543.00	4.00	265.70	4,518.53	172.06	-410.11	-415.28	1.08	-0.24	-14.82
4,628.00	4.10	255.40	4,603.32	171.07	-416.00	-421.14	0.86	0.12	-12.12
4,712.00	5.40	269.90	4,687.03	170.30	-422.86	-427.98	2.10	1.55	17.26
4,797.00	7.10	292.20	4,771.53	172.28	-431.73	-436.90	3.45	2.00	26.24
4,882.00	7.10	294.20	4,855.88	176.42	-441.38	-446.68	0.29	0.00	2.35
4,967.00	6.40	290.30	4,940.29	180.22	-450.62	-456.03	0.98	-0.82	-4.59
5,052.00	5.90	288.40	5,024.80	183.24	-459.21	-464.71	0.64	-0.59	-2.24
5,136.00	4.20	300.00	5,108.48	186.14	-465.97	-471.55	2.35	-2.02	13.81
5,221.00	3.50	299.30	5,193.29	188.97	-470.92	-476.60	0.83	-0.82	-0.82
5,263.00	3.20	295.10	5,235.21	190.09	-473.10	-478.81	0.92	-0.71	-10.00
5,305.00	3.30	301.20	5,277.15	191.22	-475.20	-480.94	0.86	0.24	14.52
5,347.00	4.00	32.10	5,319.09	193.08	-475.46	-481.26	12.44	1.67	216.43
5,390.00	7.50	43.70	5,361.87	196.38	-472.72	-478.62	8.54	8.14	26.98
5,432.00	11.60	42.70	5,403.28	201.47	-467.96	-474.02	9.77	9.76	-2.38
5,474.00	13.60	54.10	5,444.27	207.47	-461.09	-467.35	7.58	4.76	27.14
5,517.00	16.70	70.40	5,485.79	212.51	-451.17	-457.59	12.19	7.21	37.91
5,560.00	19.20	83.40	5,526.71	215.40	-438.32	-444.84	10.95	5.81	30.23
5,602.00	22.10	82.90	5,566.01	217.17	-423.62	-430.19	6.92	6.90	-1.19
5,645.00	26.20	82.60	5,605.23	219.39	-406.17	-412.82	9.54	9.53	-0.70
5,687.00	30.50	83.30	5,642.19	221.83	-386.38	-393.12	10.27	10.24	1.67
5,730.00	34.20	88.90	5,678.52	223.34	-363.45	-370.25	11.06	8.60	13.02
5,772.00	39.00	93.50	5,712.23	222.76	-338.43	-345.23	13.16	11.43	10.95
5,815.00	44.60	93.80	5,744.27	220.93	-309.84	-316.59	13.03	13.02	0.70
5,857.00	50.60	92.80	5,772.58	219.16	-278.89	-285.60	14.39	14.29	-2.38
5,900.00	56.30	92.80	5,798.18	217.47	-244.41	-251.08	13.26	13.26	0.00
5,942.00	59.50	91.90	5,820.50	216.02	-208.86	-215.51	7.83	7.62	-2.14
5,985.00	63.20	89.90	5,841.11	215.44	-171.14	-177.79	9.52	8.60	-4.65
6,023.00	68.10	89.40	5,856.77	215.65	-136.53	-143.20	12.95	12.89	-1.32
6,065.00	73.03	88.83	5,870.75	216.27	-96.94	-103.65	11.80	11.73	-1.36
7"									
6,098.00	76.90	88.40	5,879.30	217.04	-65.09	-71.84	11.80	11.74	-1.30
6,144.00	82.70	89.60	5,887.45	217.82	-19.84	-26.64	12.87	12.61	2.61
6,189.00	87.10	90.70	5,891.45	217.70	24.97	18.16	10.08	9.78	2.44
6,281.00	91.00	90.30	5,892.97	216.90	116.93	110.10	4.26	4.24	-0.43
6,372.00	87.90	91.40	5,893.85	215.55	207.91	201.07	3.61	-3.41	1.21
6,464.00	87.60	90.80	5,897.46	213.79	299.82	292.99	0.73	-0.33	-0.65
6,556.00	88.30	91.40	5,900.75	212.02	391.74	384.93	1.00	0.76	0.65
6,648.00	92.00	94.70	5,900.51	207.13	483.58	476.88	5.39	4.02	3.59
6,739.00	89.20	92.20	5,899.55	201.65	574.40	567.82	4.12	-3.08	-2.75
6,829.00	88.80	92.10	5,901.13	198.28	664.32	657.80	0.46	-0.44	-0.11
6,920.00	90.20	91.20	5,901.92	195.66	755.27	748.79	1.83	1.54	-0.99
7,005.00	90.30	90.50	5,901.55	194.40	840.26	833.78	0.83	0.12	-0.82
7,090.00	90.40	92.40	5,901.03	192.25	925.23	918.77	2.24	0.12	2.24

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7,173.00	90.10	91.50	5,900.67	189.42	1,008.18	1,001.77	1.14	-0.36	-1.08
7,258.00	90.60	91.00	5,900.15	187.57	1,093.16	1,086.77	0.83	0.59	-0.59
7,343.00	90.00	91.70	5,899.70	185.57	1,178.13	1,171.76	1.08	-0.71	0.82
7,428.00	89.60	93.60	5,900.00	181.64	1,263.04	1,256.75	2.28	-0.47	2.24
7,513.00	88.90	92.20	5,901.11	177.34	1,347.92	1,341.72	1.84	-0.82	-1.65
7,598.00	90.80	93.10	5,901.33	173.41	1,432.82	1,426.71	2.47	2.24	1.06
7,682.00	91.40	92.60	5,899.72	169.23	1,516.70	1,510.68	0.93	0.71	-0.60
7,767.00	90.00	92.20	5,898.68	165.67	1,601.62	1,595.66	1.71	-1.65	-0.47
7,851.00	91.00	91.70	5,897.95	162.81	1,685.57	1,679.66	1.33	1.19	-0.60
7,935.00	89.20	90.50	5,897.80	161.20	1,769.55	1,763.65	2.58	-2.14	-1.43
8,020.00	90.20	89.80	5,898.25	160.98	1,854.54	1,848.61	1.44	1.18	-0.82
8,105.00	92.20	91.00	5,896.47	160.39	1,939.52	1,933.56	2.74	2.35	1.41
8,189.00	91.70	91.90	5,893.61	158.26	2,023.44	2,017.51	1.23	-0.60	1.07
8,274.00	90.30	91.70	5,892.13	155.59	2,108.38	2,102.49	1.66	-1.65	-0.24
8,359.00	87.60	91.90	5,893.68	152.92	2,193.32	2,187.47	3.19	-3.18	0.24
8,443.00	87.20	91.70	5,897.50	150.29	2,277.19	2,271.39	0.53	-0.48	-0.24
8,528.00	86.40	90.50	5,902.24	148.66	2,362.04	2,356.24	1.69	-0.94	-1.41
8,612.00	88.50	91.00	5,905.98	147.56	2,445.95	2,440.14	2.57	2.50	0.60
8,697.00	89.20	94.30	5,907.68	143.63	2,530.82	2,525.10	3.97	0.82	3.88
8,782.00	92.30	92.80	5,906.57	138.37	2,615.64	2,610.04	4.05	3.65	-1.76
8,867.00	92.10	91.40	5,903.31	135.26	2,700.52	2,694.98	1.66	-0.24	-1.65
8,952.00	91.70	91.20	5,900.49	133.33	2,785.45	2,779.93	0.53	-0.47	-0.24
9,037.00	91.70	91.40	5,897.97	131.40	2,870.39	2,864.89	0.24	0.00	0.24
9,121.00	92.00	91.40	5,895.26	129.35	2,954.32	2,948.84	0.36	0.36	0.00
9,206.00	91.80	91.00	5,892.44	127.57	3,039.26	3,033.79	0.53	-0.24	-0.47
9,291.00	92.50	89.90	5,889.25	126.90	3,124.19	3,118.70	1.53	0.82	-1.29
9,376.00	92.90	90.80	5,885.25	126.38	3,209.10	3,203.58	1.16	0.47	1.06
9,461.00	90.70	92.20	5,882.58	124.16	3,294.02	3,288.53	3.07	-2.59	1.65
9,545.00	91.00	91.90	5,881.33	121.16	3,377.95	3,372.52	0.51	0.36	-0.36
9,630.00	89.30	90.50	5,881.11	119.38	3,462.93	3,457.51	2.59	-2.00	-1.65
9,715.00	88.10	92.80	5,883.04	116.93	3,547.87	3,542.48	3.05	-1.41	2.71
9,800.00	90.60	94.90	5,884.00	111.22	3,632.66	3,627.41	3.84	2.94	2.47
9,884.00	90.70	101.00	5,883.05	99.61	3,715.80	3,710.88	7.26	0.12	7.26
9,969.00	91.60	101.40	5,881.34	83.10	3,799.17	3,794.72	1.16	1.06	0.47
10,054.00	89.90	91.90	5,880.22	73.28	3,883.49	3,879.31	11.35	-2.00	-11.18
10,139.00	89.80	90.30	5,880.45	71.64	3,968.47	3,964.30	1.89	-0.12	-1.88
10,224.00	90.90	90.30	5,879.93	71.20	4,053.47	4,049.26	1.29	1.29	0.00
10,309.00	91.50	88.70	5,878.15	71.94	4,138.44	4,134.18	2.01	0.71	-1.88
10,394.00	92.10	88.40	5,875.48	74.09	4,223.37	4,219.00	0.79	0.71	-0.35
10,478.00	91.50	88.00	5,872.84	76.73	4,307.29	4,302.79	0.86	-0.71	-0.48
10,561.00	91.30	87.30	5,870.81	80.13	4,390.19	4,385.55	0.88	-0.24	-0.84
10,627.00	91.30	87.30	5,869.31	83.24	4,456.10	4,451.33	0.00	0.00	0.00

Titan Directional Drilling, LLC

Survey Report

Company:	Carrizo Oil & Gas, Inc.	Local Co-ordinate Reference:	Well 13-20-9-58 - Slot 13
Project:	Niobrara CON'83	TVD Reference:	WELL @ 4889.00usft (Original Well Elev)
Site:	Bringelson 20-9-58 Pad	MD Reference:	WELL @ 4889.00usft (Original Well Elev)
Well:	13-20-9-58	North Reference:	Grid
Wellbore:	13-20-9-58 OH	Survey Calculation Method:	Minimum Curvature
Design:	13-20-9-58 OH	Database:	EDM 5000.1 Single User Db

Design Targets									
Target Name - hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Northing (usft)	Easting (usft)	Latitude	Longitude
13-20-9-58 SL - actual wellpath hits target center - Point	0.00	0.00	0.00	0.00	0.00	1,515,767.89	3,444,534.59	40° 44' 17.28 N	103° 53' 44.87 W
13-20-9-58 BHL - actual wellpath hits target center - Point	0.00	0.00	5,869.31	83.24	4,456.10	1,515,851.13	3,448,990.66	40° 44' 17.30 N	103° 52' 46.97 W

Casing Points					
Measured Depth (usft)	Vertical Depth (usft)	Name		Casing Diameter (in)	Hole Diameter (in)
1,427.00	1,421.95	9 5/8"		9.62	12.25
6,065.00	5,870.75	7"		7.00	8.75

Design Annotations					
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment	
		+N/-S (usft)	+E/-W (usft)		
5,932.00	5,815.36	216.32	-217.44	300' entry	