

## SPERRY-SUN DRILLING SERVICES

### CERTIFIED SURVEY WORK SHEET

<b>OPERATOR:</b>	Anadarko
<b>WELL:</b>	Pennington 2N-2HZ
<b>FIELD:</b>	Wattenberg
<b>RIG:</b>	Ensign 123
<b>LEGALS:</b>	Sec. 2-T2N-R67W
<b>COUNTY:</b>	Weld
<b>STATE:</b>	CO
<b>CAL. METHOD:</b>	True North
<b>MAG. DECL. APPLIED:</b>	8.6
<b>VERTICAL SEC. DIR. :</b>	0.750

<b>SSDS Job Number :</b>	900823959
<b>Start Date of Job :</b>	11/24/2013
<b>End Date of Job :</b>	12/2/2013
<b>Lead Directional Driller:</b>	Jordan Timbs
<b>Directional Driller</b>	
<b>Directional Trainee</b>	
<b>SSDS MWD Engineers :</b>	Patrick Megee
<b>MWD :</b>	
<b>MWD Trainee</b>	

	Main Hole =====>	1st Side Track =====>	2nd Side Track =====>	3rd Side Track =====>	4th Side Track =====>
Surface Casing	1026.00	Tie-on	Tie On	Tie On	Tie On
First Wireline Survey	113.00	Gyro	MWD		
Last Wireline Survey	953.00	Gyro			
KOP Depth/Sidetrack MD	6653.00	KOP	KOP-ST1	KOP-ST2	KOP-ST3
MWD Tie-on	953.00	Gyro			
First MWD Survey Depth	1116.00	MWD	MWD	MWD	MWD
Last MWD Survey Depth	11769.00	MWD	MWD	MWD	MWD
Bit Extrapolation @ TD	11814.00	T.D.	T.D.	T.D.	T.D.

The following Sperry Drilling Services personnel, certify the above survey information to be accurate to the best of our knowledge:

Print Name : Jordan Timbs	Print Name : Patrick Megee	Print Name :
Sign Name : <i>Jordan Timbs</i>	Sign Name : <i>for megee</i>	Sign Name :
Print Name :	Print Name :	Print Name :
Sign Name :	Sign Name :	Sign Name :

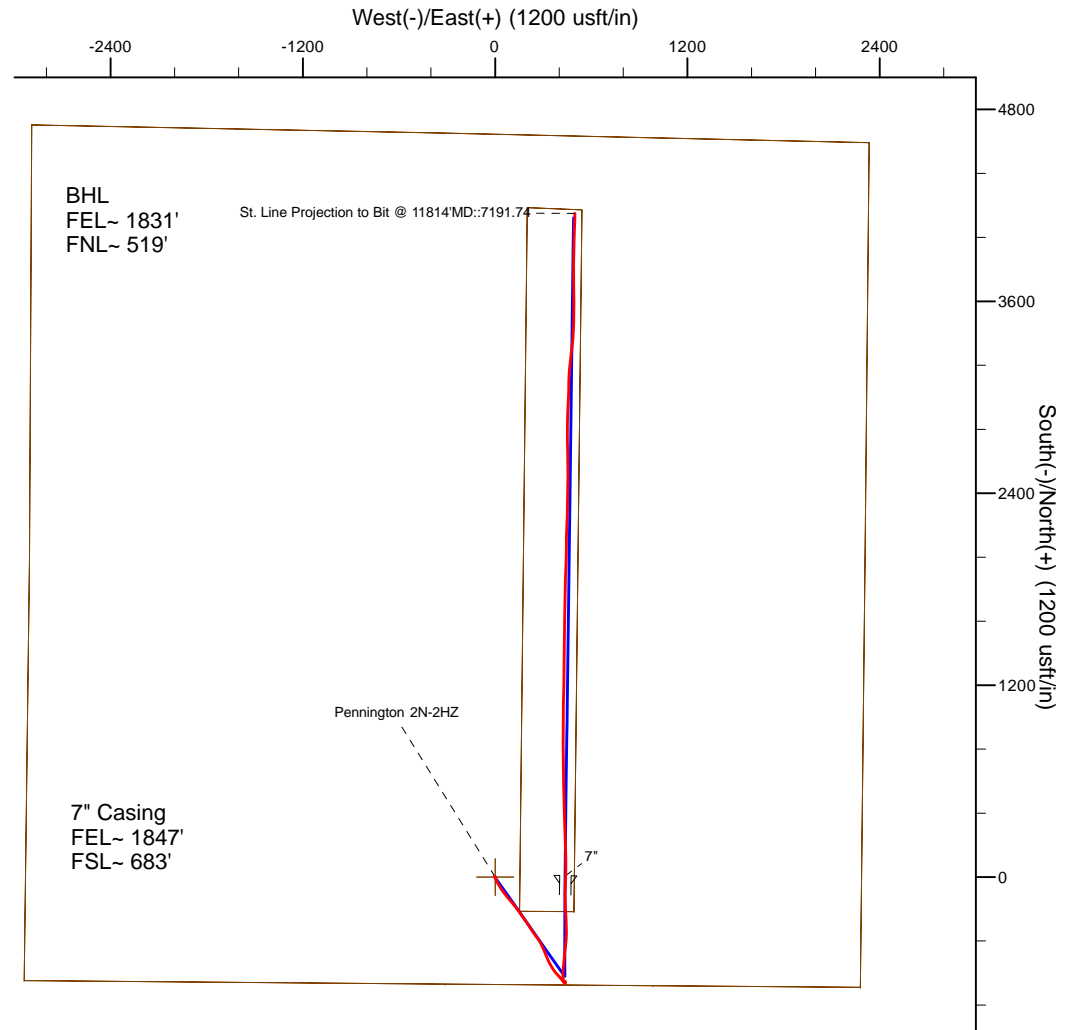
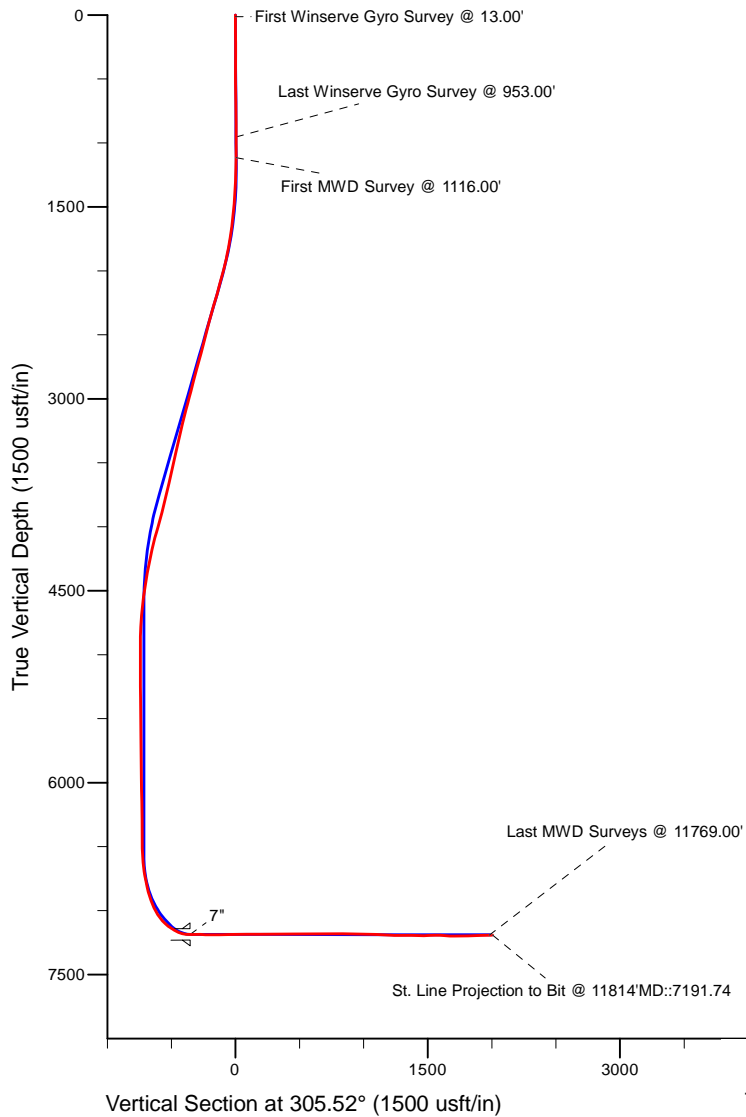
<b>Examples of Survey Types:</b>	TieOn	Tie On to Surface Casing (Assumed Vertical), Tie On to existing MWD Survey (prior drilled hole)
	MWD	Sperry-Sun Drilling Services (SSDS) Measurement While Drilling (MWD) Survey's
	ESS	Sperry-Sun Drilling Services (SSDS) Electronic Survey System (ESS) Survey's
	Gyro	Gyro Survey's ; Provided by third party vendor, or by Sperry-Sun Drilling Services (SSDS)
	SS	Single Shot (SS) Survey's ; Provided by Sperry-Sun Drilling Services (SSDS) or third party vendor.

Project: Weld County, CO (NAD 83)  
 Site: Sec. 2-T2N-R67W  
 Well: Pennington 2N-2HZ  
 Wellbore: Plan B  
 Design: Actual Field Surveys



LEGEND

- ▲ Pennington 2N-2HZ, Plan B, Rev B0 V0
- Actual Field Surveys



	Latitude	Longitude	Northing	Easting
7" Casing:	40.161641	-104.855034	1,302,384.61	3,180,259.84
BHL:	40.173009	-104.854824	1,306,525.85	3,180,288.23

WELL DETAILS: Pennington 2N-2HZ	
Ground Level:	4860.00
RKB = 13' @ 4873.00usft (Ensign 123)	
Design: Actual Field Surveys (Pennington 2N-2HZ/Plan B)	
Created By: Pari Amanlou	Date: 12/115/2013

# Anadarko Petroleum Corp.

Weld County, CO (NAD 83)

Sec. 2-T2N-R67W

Pennington 2N-2HZ

API: 05-123-37771:: Job# 900823959

Plan B

Design: Actual Field Surveys

## Sperry Drilling Services

### Standard Report

25 August, 2014

Surface UWI : API: 05-123-37771:: Job# 900823959

Well Coordinates: 1,302,373.29 N, 3,179,819.83 E (40° 09' 41.83" N, 104° 51' 23.79" W)

Ground Level: 4,860.00 usft

Local Coordinate Origin:

Centered on Well Pennington 2N-2HZ

Viewing Datum:

RKB = 13' @ 4873.00usft (Ensign 123)

TVDs to System:

N

North Reference:

True

Unit System:

API - US Survey Feet - Custom

Geodetic Scale Factor Applied

Version: 5000.1 Build: 70

**HALLIBURTON**

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.00	0.00	0.00	13.00	0.00	0.00	0.00	0.00
<b>First Winserve Gyro Survey @ 13.00'</b>							
113.00	0.32	1.58	113.00	0.28	0.01	0.28	0.32
213.00	0.37	353.34	213.00	0.88	-0.02	0.88	0.07
313.00	0.48	339.34	312.99	1.59	-0.21	1.59	0.15
413.00	0.58	322.70	412.99	2.39	-0.66	2.38	0.18
513.00	0.63	281.35	512.99	2.90	-1.51	2.88	0.43
613.00	0.58	258.30	612.98	2.90	-2.54	2.87	0.25
713.00	0.38	232.81	712.98	2.60	-3.30	2.56	0.29
813.00	0.17	197.91	812.98	2.26	-3.61	2.21	0.26
913.00	0.29	13.92	912.98	2.36	-3.60	2.32	0.46
953.00	0.35	342.20	952.97	2.58	-3.61	2.53	0.46
<b>Last Winserve Gyro Survey @ 953.00'</b>							
1,116.00	0.14	193.36	1,115.97	2.86	-3.81	2.81	0.29
<b>First MWD Survey @ 1116.00'</b>							
1,210.00	0.11	176.37	1,209.97	2.66	-3.83	2.61	0.05
1,303.00	2.98	147.69	1,302.93	0.52	-2.53	0.49	3.10
1,396.00	4.47	154.74	1,395.73	-4.80	0.31	-4.79	1.67
1,489.00	5.93	153.16	1,488.35	-12.36	4.02	-12.31	1.58
1,582.00	7.24	155.68	1,580.73	-21.99	8.61	-21.88	1.44
1,683.00	8.72	153.68	1,680.75	-34.65	14.62	-34.46	1.49
1,776.00	11.02	151.77	1,772.37	-48.80	21.95	-48.51	2.50
1,870.00	12.12	145.14	1,864.46	-64.82	31.84	-64.40	1.83
1,963.00	14.13	144.73	1,955.03	-82.10	43.98	-81.52	2.16
2,057.00	15.91	142.52	2,045.81	-101.69	58.45	-100.92	1.99
2,150.00	15.41	142.43	2,135.36	-121.60	73.74	-120.63	0.54
2,244.00	17.28	140.45	2,225.56	-142.27	90.24	-141.07	2.08
2,337.00	16.13	141.30	2,314.63	-163.00	107.12	-161.59	1.26
2,431.00	15.33	139.98	2,405.11	-182.71	123.27	-181.08	0.93
2,525.00	15.52	141.14	2,495.72	-202.02	139.15	-200.18	0.39
2,618.00	14.51	142.71	2,585.55	-220.97	154.02	-218.94	1.17
2,805.00	16.72	147.58	2,765.64	-262.33	182.64	-259.91	1.37
2,899.00	16.13	147.23	2,855.81	-284.72	196.95	-282.12	0.64
2,992.00	15.14	147.73	2,945.37	-305.85	210.43	-303.07	1.07
3,086.00	16.28	144.82	3,035.85	-327.00	224.58	-324.03	1.47
3,179.00	15.25	144.79	3,125.35	-347.65	239.14	-344.49	1.11
3,273.00	13.52	143.44	3,216.40	-366.58	252.81	-363.24	1.87
3,366.00	14.04	142.24	3,306.73	-384.23	266.20	-380.71	0.64
3,456.00	12.97	149.52	3,394.24	-401.56	278.01	-397.89	2.23
3,546.00	13.54	155.59	3,481.85	-419.86	287.48	-416.06	1.67
3,636.00	14.57	153.52	3,569.15	-439.59	296.89	-435.67	1.27
3,726.00	15.27	157.52	3,656.12	-460.68	306.46	-456.62	1.38
3,816.00	16.98	157.29	3,742.58	-483.75	316.07	-479.57	1.90
3,906.00	15.09	158.90	3,829.07	-506.81	325.36	-502.50	2.16
3,997.00	16.97	153.38	3,916.54	-529.73	335.58	-525.29	2.66
4,087.00	17.16	148.20	4,002.58	-552.76	348.46	-548.15	1.70
4,177.00	16.05	148.77	4,088.82	-574.68	361.91	-569.90	1.25
4,267.00	14.17	140.11	4,175.72	-593.78	375.43	-588.81	3.26
4,357.00	11.40	138.50	4,263.48	-608.89	388.39	-603.76	3.10

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
4,447.00	10.29	139.35	4,351.87	-621.66	399.52	-616.37	1.25
4,537.00	9.07	140.05	4,440.59	-633.19	409.31	-627.78	1.36
4,627.00	7.65	139.65	4,529.63	-643.20	417.74	-637.67	1.58
4,717.00	7.39	139.52	4,618.86	-652.17	425.38	-646.54	0.29
4,807.00	3.88	134.02	4,708.41	-658.69	431.33	-652.98	3.94
4,897.00	2.72	152.62	4,798.26	-662.70	434.50	-656.95	1.74
4,987.00	0.55	91.53	4,888.22	-664.61	435.92	-658.84	2.78
5,077.00	1.30	35.43	4,978.21	-663.79	436.94	-658.01	1.21
5,167.00	1.36	27.47	5,068.19	-662.01	438.02	-656.22	0.22
5,257.00	1.08	26.00	5,158.17	-660.30	438.89	-654.50	0.31
5,347.00	0.80	17.76	5,248.15	-658.94	439.45	-653.13	0.34
5,437.00	0.79	9.19	5,338.14	-657.72	439.74	-651.91	0.13
5,527.00	0.70	0.47	5,428.14	-656.56	439.85	-650.75	0.16
5,617.00	0.65	338.05	5,518.13	-655.54	439.66	-649.73	0.30
5,707.00	0.58	324.56	5,608.13	-654.69	439.20	-648.89	0.18
5,797.00	0.62	335.15	5,698.12	-653.88	438.74	-648.08	0.13
5,887.00	0.72	316.16	5,788.11	-653.03	438.14	-647.24	0.27
5,977.00	0.74	299.39	5,878.11	-652.34	437.24	-646.56	0.24
6,067.00	1.08	285.73	5,968.10	-651.82	435.92	-646.06	0.45
6,157.00	0.99	276.25	6,058.08	-651.51	434.33	-645.77	0.21
6,247.00	1.09	263.25	6,148.07	-651.53	432.71	-645.81	0.28
6,337.00	1.04	255.22	6,238.05	-651.83	431.07	-646.14	0.17
6,427.00	1.02	249.55	6,328.04	-652.32	429.53	-646.64	0.12
6,517.00	1.39	245.47	6,418.02	-653.06	427.78	-647.40	0.42
6,606.00	0.76	313.42	6,507.00	-653.10	426.37	-647.46	1.47
6,696.00	5.96	349.55	6,596.82	-648.09	425.09	-642.47	5.96
6,742.00	8.05	354.30	6,642.48	-642.53	424.34	-636.93	4.71
6,786.00	11.72	355.04	6,685.82	-635.01	423.64	-629.41	8.35
6,832.00	16.28	357.30	6,730.44	-623.91	422.94	-618.32	9.98
6,876.00	20.85	0.69	6,772.14	-609.92	422.74	-604.33	10.67
6,922.00	24.47	4.89	6,814.58	-592.23	423.65	-586.63	8.62
6,966.00	27.93	5.66	6,854.06	-572.89	425.44	-567.27	7.90
7,012.00	32.19	5.58	6,893.86	-549.97	427.70	-544.32	9.26
7,056.00	36.43	4.45	6,930.20	-525.26	429.85	-519.59	9.74
7,102.00	40.11	5.01	6,966.31	-496.88	432.21	-491.18	8.04
7,146.00	46.99	6.53	6,998.18	-466.74	435.28	-461.00	15.82
7,192.00	54.14	7.45	7,027.38	-431.50	439.61	-425.71	15.62
7,237.00	55.05	5.13	7,053.45	-395.04	443.63	-389.20	4.66
7,282.00	57.45	1.94	7,078.45	-357.71	445.92	-351.84	7.95
7,327.00	61.13	357.28	7,101.44	-319.04	445.63	-313.18	12.09
7,372.00	63.60	356.22	7,122.31	-279.25	443.36	-273.42	5.87
7,418.00	67.39	356.95	7,141.39	-237.47	440.87	-231.68	8.36
7,463.00	70.39	358.30	7,157.59	-195.53	439.14	-189.77	7.23
7,508.00	75.93	358.92	7,170.63	-152.49	438.10	-146.74	12.38
7,553.00	80.53	0.51	7,179.80	-108.45	437.88	-102.71	10.79
7,598.00	85.40	1.04	7,185.31	-63.81	438.49	-58.06	10.89
7,633.00	88.95	1.49	7,187.04	-28.87	439.26	-23.11	10.22
7,670.00	90.24	1.10	7,187.30	8.12	440.10	13.88	3.65
<b>7" Casing @ 7670.00' - 7"</b>							
7,694.00	91.08	0.85	7,187.02	32.12	440.51	37.88	3.65
7,784.00	89.11	359.38	7,186.87	122.11	440.69	127.87	2.73

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)
7,874.00	88.95	358.00	7,188.40	212.07	438.63	217.80	1.54
7,964.00	90.06	357.24	7,189.17	301.99	434.89	307.66	1.49
8,054.00	90.62	358.23	7,188.64	391.92	431.34	397.53	1.26
8,234.00	90.34	0.17	7,187.13	571.88	428.82	577.45	1.09
8,414.00	90.83	357.92	7,185.29	751.84	425.82	757.35	1.28
8,594.00	89.01	1.24	7,185.55	931.80	424.50	937.28	2.10
8,774.00	91.60	0.70	7,184.59	1,111.75	427.55	1,117.26	1.47
8,864.00	90.55	1.21	7,182.90	1,201.72	429.05	1,207.24	1.30
8,954.00	89.57	0.49	7,182.80	1,291.71	430.39	1,297.24	1.35
9,044.00	89.88	1.36	7,183.24	1,381.70	431.84	1,387.23	1.03
9,134.00	89.85	0.75	7,183.45	1,471.68	433.50	1,477.23	0.68
9,224.00	91.20	359.94	7,182.62	1,561.68	434.04	1,567.22	1.75
9,314.00	90.12	0.64	7,181.59	1,651.67	434.49	1,657.21	1.43
9,404.00	89.41	1.77	7,181.96	1,741.64	436.39	1,747.21	1.48
9,494.00	89.82	0.93	7,182.56	1,831.62	438.51	1,837.20	1.04
9,584.00	90.34	2.82	7,182.44	1,921.56	441.45	1,927.18	2.18
9,674.00	89.54	1.00	7,182.53	2,011.51	444.45	2,017.15	2.21
9,764.00	90.00	0.63	7,182.89	2,101.50	445.73	2,107.15	0.66
9,854.00	90.89	2.44	7,182.19	2,191.46	448.14	2,197.14	2.24
9,944.00	90.25	1.12	7,181.30	2,281.41	450.94	2,287.12	1.63
10,034.00	88.34	1.27	7,182.40	2,371.38	452.81	2,377.10	2.13
10,124.00	88.06	0.63	7,185.23	2,461.32	454.30	2,467.06	0.78
10,305.00	88.64	358.66	7,190.44	2,642.23	453.18	2,647.94	1.13
10,395.00	87.72	359.31	7,193.30	2,732.17	451.59	2,737.85	1.25
10,485.00	90.00	0.48	7,195.09	2,822.15	451.43	2,827.81	2.85
10,575.00	90.46	2.80	7,194.73	2,912.10	454.00	2,917.79	2.63
10,665.00	90.06	2.66	7,194.32	3,002.00	458.29	3,007.74	0.47
10,755.00	88.67	0.21	7,195.32	3,091.96	460.54	3,097.72	3.13
10,845.00	90.65	6.00	7,195.85	3,181.78	465.41	3,187.60	6.80
10,935.00	91.66	7.03	7,194.04	3,271.18	475.62	3,277.12	1.60
11,025.00	90.03	4.82	7,192.71	3,360.68	484.91	3,366.74	3.05
11,115.00	87.44	1.77	7,194.70	3,450.49	490.08	3,456.61	4.45
11,205.00	88.43	0.22	7,197.94	3,540.41	491.64	3,546.55	2.04
11,295.00	89.97	359.31	7,199.20	3,630.40	491.28	3,636.52	1.99
11,475.00	90.65	0.21	7,198.23	3,810.39	490.52	3,816.49	0.63
11,655.00	91.23	1.82	7,195.27	3,990.33	493.71	3,996.45	0.95
11,745.00	91.29	1.90	7,193.29	4,080.26	496.63	4,086.42	0.11
11,769.00	91.29	1.52	7,192.75	4,104.25	497.35	4,110.41	1.58
<b>Last MWD Surveys @ 11769.00'</b>							
11,814.00	91.29	1.52	7,191.74	4,149.22	498.54	4,155.39	0.00
<b>St. Line Projection to Bit @ 11814'MD::7191.74</b>							

**Design Report for Pennington 2N-2HZ - Actual Field Surveys****Design Annotations**

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
13.00	13.00	0.00	0.00	First Winserve Gyro Survey @ 13.00'
953.00	952.97	2.58	-3.61	Last Winserve Gyro Survey @ 953.00'
1,116.00	1,115.97	2.86	-3.81	First MWD Survey @ 1116.00'
7,670.00	7,187.30	8.12	440.10	7" Casing @ 7670.00'
11,769.00	7,192.75	4,104.25	497.35	Last MWD Surveys @ 11769.00'
11,814.00	7,191.74	4,149.22	498.54	St. Line Projection to Bit @ 11814'MD::7191.74

**Vertical Section Information**

Angle Type	Target	Azimuth (°)	Origin Type	Origin		Start TVD (usft)
				+N/_S (usft)	+E/-W (usft)	
User	No Target (Freehand)	0.75	Slot	0.00	0.00	0.00

**Survey tool program**

From (usft)	To (usft)	Survey/Plan	Survey Tool
13.00	953.00	Winserve Gyro Surveys	NS-GYRO-MS
953.00	7,633.00	MWD-Vertical & Build	MWD+SC
7,633.00	11,769.00	MWD- Lateral	MWD+SC

**Casing Details**

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
7,670.00	7,187.30	7"	7	8-3/4

**Design Report for Pennington 2N-2HZ - Actual Field Surveys****Wellbore 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
Pennington 2N-2HZ_L	0.00	0.00	0.00	0.01	0.00	1,302,373.30	3,179,819.83	40° 9' 41.828 N	104° 51' 23.789 W
- actual wellpath misses target center by 0.01usft at 0.00usft MD (0.00 TVD, 0.00 N, 0.00 E)									
- Polygon									
Point 1				0.00	4,185.53	201.55	1,306,560.00	3,179,991.00	
Point 2				0.00	4,173.06	541.48	1,306,550.00	3,180,331.00	
Point 3				0.00	-215.89	492.63	1,302,161.00	3,180,314.00	
Point 4				0.00	-212.92	152.93	1,302,161.50	3,179,974.30	
Pennington 2N-2HZ_S	0.00	0.00	0.00	0.01	0.00	1,302,373.30	3,179,819.83	40° 9' 41.828 N	104° 51' 23.789 W
- actual wellpath misses target center by 0.01usft at 0.00usft MD (0.00 TVD, 0.00 N, 0.00 E)									
- Point									
Pennington 2N-2HZ_S	0.00	0.00	0.00	0.01	0.00	1,302,373.30	3,179,819.83	40° 9' 41.828 N	104° 51' 23.789 W
- actual wellpath misses target center by 0.01usft at 0.00usft MD (0.00 TVD, 0.00 N, 0.00 E)									
- Polygon									
Point 1				0.00	4,702.98	-2,890.87	1,307,054.98	3,176,895.04	
Point 2				0.00	4,652.18	-323.47	1,307,022.81	3,179,462.63	
Point 3				0.00	4,592.08	2,334.65	1,306,982.00	3,182,121.01	
Point 4				0.00	1,964.15	2,307.84	1,304,354.06	3,182,113.26	
Point 5				0.00	-689.09	2,279.62	1,301,700.79	3,182,104.30	
Point 6				0.00	-679.24	984.39	1,301,701.25	3,180,809.08	
Point 7				0.00	-669.44	-311.23	1,301,701.65	3,179,513.48	
Point 8				0.00	-647.09	-2,938.20	1,301,704.93	3,176,886.53	
Point 9				0.00	1,981.84	-2,905.60	1,304,333.92	3,176,900.05	
Point 10				0.00	4,702.98	-2,890.87	1,307,054.98	3,176,895.04	
Pennington 2N-2HZ_B	0.00	0.00	7,189.00	4,123.04	490.16	1,306,499.60	3,180,280.05	40° 10' 22.572 N	104° 51' 17.474 W
- actual wellpath misses target center by 20.47usft at 11769.00usft MD (7192.75 TVD, 4104.25 N, 497.35 E)									
- Point									

**Directional Difficulty Index**

Average Dogleg over Survey:	2.02 °/100usft	Maximum Dogleg over Survey:	15.82 °/100usft at 7,146.00 usft
Net Tortousity applicable to Plans:	0.94 °/100usft	Directional Difficulty Index:	6.344

**Audit Info**

**North Reference Sheet for Sec. 2-T2N-R67W - Pennington 2N-2HZ - Plan B**

All data is in US Feet unless otherwise stated. Directions and Coordinates are relative to True North Reference.

Vertical Depths are relative to RKB = 13' @ 4873.00usft (Ensign 123). Northing and Easting are relative to Pennington 2N-2HZ

Coordinate System is US State Plane 1983, Colorado Northern Zone using datum North American Datum 1983, ellipsoid GRS 1980

Projection method is Lambert Conformal Conic (2 parallel)

Central Meridian is 105° 30' 0.000 W°, Longitude Origin:0° 0' 0.000 E°, Latitude Origin:40° 47' 0.000 N°

False Easting: 3,000,000.00usft, False Northing: 1,000,000.00usft, Scale Reduction: 0.99995805

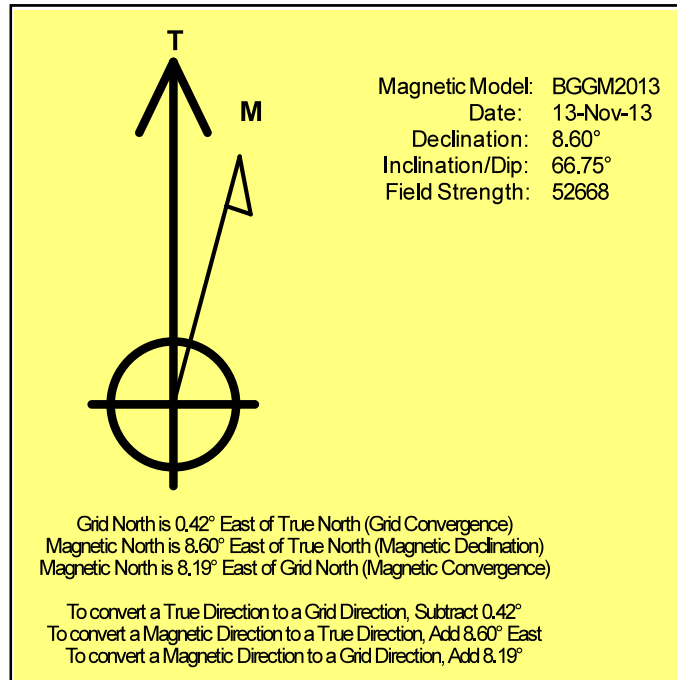
Grid Coordinates of Well: 1,302,373.29 usft N, 3,179,819.83 usft E

Geographical Coordinates of Well: 40° 09' 41.83" N, 104° 51' 23.79" W

Grid Convergence at Surface is: 0.42°

Based upon Minimum Curvature type calculations, at a Measured Depth of 11,814.00usft  
the Bottom Hole Displacement is 4,179.06usft in the Direction of 6.85° ( True).

Magnetic Convergence at surface is: -8.19° (13 November 2013, , BGGM2013)



# Anadarko Petroleum Corp.

Weld County, CO (NAD 83)

Sec. 2-T2N-R67W

Pennington 2N-2HZ

API: 05-123-37771:: Job# 900823959

Plan B

Design: Actual Field Surveys

## Sperry Drilling Services

### Geodetic Report

25 August, 2014

Well Coordinates: 1,302,373.29 N, 3,179,819.83 E (40° 09' 41.83" N, 104° 51' 23.79" W)

Ground Level: 4,860.00 usft

Local Coordinate Origin:

Centered on Well Pennington 2N-2HZ

Viewing Datum:

RKB = 13' @ 4873.00usft (Ensign 123)

TVDs to System:

N

North Reference:

True

Unit System:

Dec-Deg - API - US Survey Feet - Custom

Geodetic Scale Factor Applied

Version: 5000.1 Build: 70

**HALLIBURTON**

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	Local Coordinates		Geographic Coordinates		UTM Coordinates	
				+N/-S (usft)	+E/-W (usft)	Latitude (usft)	Longitude (usft)	Northing (usft)	Easting (usft)
0.00	0.00	0.00	0.00	0.00	0.00	40.161619	-104.856608	1,302,373.29	3,179,819.83
13.00	0.00	0.00	13.00	0.00	0.00	40.161619	-104.856608	1,302,373.29	3,179,819.83
113.00	0.32	1.58	113.00	0.28	0.01	40.161620	-104.856608	1,302,373.56	3,179,819.84
213.00	0.37	353.34	213.00	0.88	-0.02	40.161621	-104.856608	1,302,374.16	3,179,819.80
313.00	0.48	339.34	312.99	1.59	-0.21	40.161623	-104.856609	1,302,374.88	3,179,819.61
413.00	0.58	322.70	412.99	2.39	-0.66	40.161626	-104.856611	1,302,375.67	3,179,819.15
513.00	0.63	281.35	512.99	2.90	-1.51	40.161627	-104.856614	1,302,376.17	3,179,818.30
613.00	0.58	258.30	612.98	2.90	-2.54	40.161627	-104.856617	1,302,376.17	3,179,817.27
713.00	0.38	232.81	712.98	2.60	-3.30	40.161626	-104.856620	1,302,375.86	3,179,816.51
813.00	0.17	197.91	812.98	2.26	-3.61	40.161625	-104.856621	1,302,375.52	3,179,816.21
913.00	0.29	13.92	912.98	2.36	-3.60	40.161626	-104.856621	1,302,375.62	3,179,816.22
953.00	0.35	342.20	952.97	2.58	-3.61	40.161626	-104.856621	1,302,375.84	3,179,816.21
1,116.00	0.14	193.36	1,115.97	2.86	-3.81	40.161627	-104.856622	1,302,376.11	3,179,816.00
1,210.00	0.11	176.37	1,209.97	2.66	-3.83	40.161626	-104.856622	1,302,375.91	3,179,815.99
1,303.00	2.98	147.69	1,302.93	0.52	-2.53	40.161620	-104.856617	1,302,373.79	3,179,817.30
1,396.00	4.47	154.74	1,395.73	-4.80	0.31	40.161606	-104.856607	1,302,368.49	3,179,820.18
1,489.00	5.93	153.16	1,488.35	-12.36	4.02	40.161585	-104.856594	1,302,360.95	3,179,823.95
1,582.00	7.24	155.68	1,580.73	-21.99	8.61	40.161559	-104.856577	1,302,351.36	3,179,828.60
1,683.00	8.72	153.68	1,680.75	-34.65	14.62	40.161524	-104.856556	1,302,338.74	3,179,834.71
1,776.00	11.02	151.77	1,772.37	-48.80	21.95	40.161485	-104.856530	1,302,324.64	3,179,842.14
1,870.00	12.12	145.14	1,864.46	-64.82	31.84	40.161441	-104.856494	1,302,308.70	3,179,852.15
1,963.00	14.13	144.73	1,955.03	-82.10	43.98	40.161394	-104.856451	1,302,291.51	3,179,864.41
2,057.00	15.91	142.52	2,045.81	-101.69	58.45	40.161340	-104.856399	1,302,272.02	3,179,879.01
2,150.00	15.41	142.43	2,135.36	-121.60	73.74	40.161285	-104.856344	1,302,252.23	3,179,894.45
2,244.00	17.28	140.45	2,225.56	-142.27	90.24	40.161229	-104.856285	1,302,231.68	3,179,911.10
2,337.00	16.13	141.30	2,314.63	-163.00	107.12	40.161172	-104.856225	1,302,211.07	3,179,928.12
2,431.00	15.33	139.98	2,405.11	-182.71	123.27	40.161117	-104.856167	1,302,191.48	3,179,944.42
2,525.00	15.52	141.14	2,495.72	-202.02	139.15	40.161064	-104.856110	1,302,172.29	3,179,960.44
2,618.00	14.51	142.71	2,585.55	-220.97	154.02	40.161012	-104.856057	1,302,153.44	3,179,975.44
2,805.00	16.72	147.58	2,765.64	-262.33	182.64	40.160899	-104.855955	1,302,112.30	3,180,004.36
2,899.00	16.13	147.23	2,855.81	-284.72	196.95	40.160837	-104.855904	1,302,090.01	3,180,018.84
2,992.00	15.14	147.73	2,945.37	-305.85	210.43	40.160779	-104.855855	1,302,068.98	3,180,032.47
3,086.00	16.28	144.82	3,035.85	-327.00	224.58	40.160721	-104.855805	1,302,047.94	3,180,046.77
3,179.00	15.25	144.79	3,125.35	-347.65	239.14	40.160665	-104.855753	1,302,027.39	3,180,061.48
3,273.00	13.52	143.44	3,216.40	-366.58	252.81	40.160613	-104.855704	1,302,008.57	3,180,075.29
3,366.00	14.04	142.24	3,306.73	-384.23	266.20	40.160564	-104.855656	1,301,991.01	3,180,088.80
3,456.00	12.97	149.52	3,394.24	-401.56	278.01	40.160517	-104.855614	1,301,973.76	3,180,100.73
3,546.00	13.54	155.59	3,481.85	-419.86	287.48	40.160466	-104.855580	1,301,955.54	3,180,110.34
3,636.00	14.57	153.52	3,569.15	-439.59	296.89	40.160412	-104.855546	1,301,935.88	3,180,119.89
3,726.00	15.27	157.52	3,656.12	-460.68	306.46	40.160354	-104.855512	1,301,914.86	3,180,129.62
3,816.00	16.98	157.29	3,742.58	-483.75	316.07	40.160291	-104.855477	1,301,891.86	3,180,139.39
3,906.00	15.09	158.90	3,829.07	-506.81	325.36	40.160228	-104.855444	1,301,868.87	3,180,148.85

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	Local Coordinates		Geographic Coordinates		UTM Coordinates	
				+N/-S (usft)	+E/-W (usft)	Latitude (usft)	Longitude (usft)	Northing (usft)	Easting (usft)
3,997.00	16.97	153.38	3,916.54	-529.73	335.58	40.160165	-104.855408	1,301,846.02	3,180,159.23
4,087.00	17.16	148.20	4,002.58	-552.76	348.46	40.160102	-104.855362	1,301,823.09	3,180,172.28
4,177.00	16.05	148.77	4,088.82	-574.68	361.91	40.160042	-104.855313	1,301,801.27	3,180,185.89
4,267.00	14.17	140.11	4,175.72	-593.78	375.43	40.159989	-104.855265	1,301,782.27	3,180,199.54
4,357.00	11.40	138.50	4,263.48	-608.89	388.39	40.159948	-104.855219	1,301,767.25	3,180,212.61
4,447.00	10.29	139.35	4,351.87	-621.66	399.52	40.159913	-104.855179	1,301,754.57	3,180,223.83
4,537.00	9.07	140.05	4,440.59	-633.19	409.31	40.159881	-104.855144	1,301,743.11	3,180,233.71
4,627.00	7.65	139.65	4,529.63	-643.20	417.74	40.159853	-104.855114	1,301,733.16	3,180,242.22
4,717.00	7.39	139.52	4,618.86	-652.17	425.38	40.159829	-104.855086	1,301,724.25	3,180,249.92
4,807.00	3.88	134.02	4,708.41	-658.69	431.33	40.159811	-104.855065	1,301,717.77	3,180,255.91
4,897.00	2.72	152.62	4,798.26	-662.70	434.50	40.159800	-104.855054	1,301,713.78	3,180,259.11
4,987.00	0.55	91.53	4,888.22	-664.61	435.92	40.159795	-104.855049	1,301,711.89	3,180,260.54
5,077.00	1.30	35.43	4,978.21	-663.79	436.94	40.159797	-104.855045	1,301,712.71	3,180,261.56
5,167.00	1.36	27.47	5,068.19	-662.01	438.02	40.159802	-104.855041	1,301,714.50	3,180,262.63
5,257.00	1.08	26.00	5,158.17	-660.30	438.89	40.159806	-104.855038	1,301,716.22	3,180,263.48
5,347.00	0.80	17.76	5,248.15	-658.94	439.45	40.159810	-104.855036	1,301,717.58	3,180,264.04
5,437.00	0.79	9.19	5,338.14	-657.72	439.74	40.159814	-104.855035	1,301,718.80	3,180,264.32
5,527.00	0.70	0.47	5,428.14	-656.56	439.85	40.159817	-104.855035	1,301,719.96	3,180,264.41
5,617.00	0.65	338.05	5,518.13	-655.54	439.66	40.159820	-104.855035	1,301,720.98	3,180,264.22
5,707.00	0.58	324.56	5,608.13	-654.69	439.20	40.159822	-104.855037	1,301,721.82	3,180,263.76
5,797.00	0.62	335.15	5,698.12	-653.88	438.74	40.159824	-104.855039	1,301,722.63	3,180,263.28
5,887.00	0.72	316.16	5,788.11	-653.03	438.14	40.159826	-104.855041	1,301,723.48	3,180,262.68
5,977.00	0.74	299.39	5,878.11	-652.34	437.24	40.159828	-104.855044	1,301,724.16	3,180,261.78
6,067.00	1.08	285.73	5,968.10	-651.82	435.92	40.159830	-104.855049	1,301,724.67	3,180,260.45
6,157.00	0.99	276.25	6,058.08	-651.51	434.33	40.159831	-104.855054	1,301,724.97	3,180,258.86
6,247.00	1.09	263.25	6,148.07	-651.53	432.71	40.159831	-104.855060	1,301,724.94	3,180,257.24
6,337.00	1.04	255.22	6,238.05	-651.83	431.07	40.159830	-104.855066	1,301,724.62	3,180,255.60
6,427.00	1.02	249.55	6,328.04	-652.32	429.53	40.159828	-104.855072	1,301,724.12	3,180,254.06
6,517.00	1.39	245.47	6,418.02	-653.06	427.78	40.159826	-104.855078	1,301,723.38	3,180,252.32
6,606.00	0.76	313.42	6,507.00	-653.10	426.37	40.159826	-104.855083	1,301,723.33	3,180,250.91
6,696.00	5.96	349.55	6,596.82	-648.09	425.09	40.159840	-104.855087	1,301,728.32	3,180,249.60
6,742.00	8.05	354.30	6,642.48	-642.53	424.34	40.159855	-104.855090	1,301,733.87	3,180,248.80
6,786.00	11.72	355.04	6,685.82	-635.01	423.64	40.159876	-104.855093	1,301,741.39	3,180,248.06
6,832.00	16.28	357.30	6,730.44	-623.91	422.94	40.159906	-104.855095	1,301,752.48	3,180,247.27
6,876.00	20.85	0.69	6,772.14	-609.92	422.74	40.159945	-104.855096	1,301,766.48	3,180,246.97
6,922.00	24.47	4.89	6,814.58	-592.23	423.65	40.159993	-104.855093	1,301,784.17	3,180,247.75
6,966.00	27.93	5.66	6,854.06	-572.89	425.44	40.160046	-104.855086	1,301,803.52	3,180,249.40
7,012.00	32.19	5.58	6,893.86	-549.97	427.70	40.160109	-104.855078	1,301,826.46	3,180,251.49
7,056.00	36.43	4.45	6,930.20	-525.26	429.85	40.160177	-104.855070	1,301,851.18	3,180,253.47
7,102.00	40.11	5.01	6,966.31	-496.88	432.21	40.160255	-104.855062	1,301,879.58	3,180,255.62
7,146.00	46.99	6.53	6,998.18	-466.74	435.28	40.160338	-104.855051	1,301,909.74	3,180,258.47
7,192.00	54.14	7.45	7,027.38	-431.50	439.61	40.160435	-104.855035	1,301,945.01	3,180,262.55

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	Local Coordinates		Geographic Coordinates		UTM Coordinates	
				+N/-S (usft)	+E/-W (usft)	Latitude (usft)	Longitude (usft)	Northing (usft)	Easting (usft)
7,237.00	55.05	5.13	7,053.45	-395.04	443.63	40.160535	-104.855021	1,301,981.49	3,180,266.30
7,282.00	57.45	1.94	7,078.45	-357.71	445.92	40.160637	-104.855013	1,302,018.84	3,180,268.32
7,327.00	61.13	357.28	7,101.44	-319.04	445.63	40.160743	-104.855014	1,302,057.50	3,180,267.74
7,372.00	63.60	356.22	7,122.31	-279.25	443.36	40.160852	-104.855022	1,302,097.28	3,180,265.19
7,418.00	67.39	356.95	7,141.39	-237.47	440.87	40.160967	-104.855031	1,302,139.03	3,180,262.40
7,463.00	70.39	358.30	7,157.59	-195.53	439.14	40.161082	-104.855037	1,302,180.95	3,180,260.36
7,508.00	75.93	358.92	7,170.63	-152.49	438.10	40.161200	-104.855041	1,302,223.98	3,180,259.01
7,553.00	80.53	0.51	7,179.80	-108.45	437.88	40.161321	-104.855042	1,302,268.02	3,180,258.47
7,598.00	85.40	1.04	7,185.31	-63.81	438.49	40.161444	-104.855039	1,302,312.66	3,180,258.76
7,633.00	88.95	1.49	7,187.04	-28.87	439.26	40.161540	-104.855037	1,302,347.61	3,180,259.27
7,670.00	90.24	1.10	7,187.30	8.12	440.10	40.161641	-104.855034	1,302,384.60	3,180,259.84
7,694.00	91.08	0.85	7,187.02	32.12	440.51	40.161707	-104.855032	1,302,408.60	3,180,260.08
7,784.00	89.11	359.38	7,186.87	122.11	440.69	40.161954	-104.855032	1,302,498.59	3,180,259.60
7,874.00	88.95	358.00	7,188.40	212.07	438.63	40.162201	-104.855039	1,302,588.53	3,180,256.89
7,964.00	90.06	357.24	7,189.17	301.99	434.89	40.162448	-104.855052	1,302,678.41	3,180,252.51
8,054.00	90.62	358.23	7,188.64	391.92	431.34	40.162695	-104.855065	1,302,768.30	3,180,248.30
8,234.00	90.34	0.17	7,187.13	571.88	428.82	40.163189	-104.855074	1,302,948.24	3,180,244.48
8,414.00	90.83	357.92	7,185.29	751.84	425.82	40.163683	-104.855085	1,303,128.16	3,180,240.17
8,594.00	89.01	1.24	7,185.55	931.80	424.50	40.164177	-104.855089	1,303,308.10	3,180,237.55
8,774.00	91.60	0.70	7,184.59	1,111.75	427.55	40.164671	-104.855079	1,303,488.07	3,180,239.29
8,864.00	90.55	1.21	7,182.90	1,201.72	429.05	40.164918	-104.855073	1,303,578.04	3,180,240.14
8,954.00	89.57	0.49	7,182.80	1,291.71	430.39	40.165165	-104.855068	1,303,668.03	3,180,240.82
9,044.00	89.88	1.36	7,183.24	1,381.70	431.84	40.165412	-104.855063	1,303,758.02	3,180,241.62
9,134.00	89.85	0.75	7,183.45	1,471.68	433.50	40.165659	-104.855057	1,303,848.01	3,180,242.62
9,224.00	91.20	359.94	7,182.62	1,561.68	434.04	40.165906	-104.855055	1,303,938.00	3,180,242.51
9,314.00	90.12	0.64	7,181.59	1,651.67	434.49	40.166153	-104.855054	1,304,027.99	3,180,242.31
9,404.00	89.41	1.77	7,181.96	1,741.64	436.39	40.166400	-104.855047	1,304,117.98	3,180,243.55
9,494.00	89.82	0.93	7,182.56	1,831.62	438.51	40.166647	-104.855039	1,304,207.96	3,180,245.02
9,584.00	90.34	2.82	7,182.44	1,921.56	441.45	40.166894	-104.855029	1,304,297.92	3,180,247.31
9,674.00	89.54	1.00	7,182.53	2,011.51	444.45	40.167141	-104.855018	1,304,387.88	3,180,249.66
9,764.00	90.00	0.63	7,182.89	2,101.50	445.73	40.167388	-104.855013	1,304,477.87	3,180,250.29
9,854.00	90.89	2.44	7,182.19	2,191.46	448.14	40.167635	-104.855005	1,304,567.85	3,180,252.04
9,944.00	90.25	1.12	7,181.30	2,281.41	450.94	40.167882	-104.854995	1,304,657.81	3,180,254.19
10,034.00	88.34	1.27	7,182.40	2,371.38	452.81	40.168128	-104.854988	1,304,747.79	3,180,255.41
10,124.00	88.06	0.63	7,185.23	2,461.32	454.30	40.168375	-104.854983	1,304,837.73	3,180,256.25
10,305.00	88.64	358.66	7,190.44	2,642.23	453.18	40.168872	-104.854987	1,305,018.62	3,180,253.82
10,395.00	87.72	359.31	7,193.30	2,732.17	451.59	40.169119	-104.854992	1,305,108.55	3,180,251.57
10,485.00	90.00	0.48	7,195.09	2,822.15	451.43	40.169366	-104.854993	1,305,198.51	3,180,250.75
10,575.00	90.46	2.80	7,194.73	2,912.10	454.00	40.169613	-104.854984	1,305,288.48	3,180,252.67
10,665.00	90.06	2.66	7,194.32	3,002.00	458.29	40.169860	-104.854968	1,305,378.40	3,180,256.31
10,755.00	88.67	0.21	7,195.32	3,091.96	460.54	40.170106	-104.854960	1,305,468.37	3,180,257.91
10,845.00	90.65	6.00	7,195.85	3,181.78	465.41	40.170353	-104.854943	1,305,558.22	3,180,262.13

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	Local Coordinates		Geographic Coordinates		UTM Coordinates	
				+N/-S (usft)	+E/-W (usft)	Latitude (usft)	Longitude (usft)	Northing (usft)	Easting (usft)
10,935.00	91.66	7.03	7,194.04	3,271.18	475.62	40.170598	-104.854906	1,305,647.69	3,180,271.69
11,025.00	90.03	4.82	7,192.71	3,360.68	484.91	40.170844	-104.854873	1,305,737.25	3,180,280.33
11,115.00	87.44	1.77	7,194.70	3,450.49	490.08	40.171091	-104.854855	1,305,827.09	3,180,284.85
11,205.00	88.43	0.22	7,197.94	3,540.41	491.64	40.171338	-104.854849	1,305,917.02	3,180,285.76
11,295.00	89.97	359.31	7,199.20	3,630.40	491.28	40.171585	-104.854850	1,306,007.00	3,180,284.74
11,475.00	90.65	0.21	7,198.23	3,810.39	490.52	40.172079	-104.854853	1,306,186.98	3,180,282.68
11,655.00	91.23	1.82	7,195.27	3,990.33	493.71	40.172573	-104.854842	1,306,366.93	3,180,284.56
11,745.00	91.29	1.90	7,193.29	4,080.26	496.63	40.172819	-104.854831	1,306,456.87	3,180,286.83
11,769.00	91.29	1.52	7,192.75	4,104.25	497.35	40.172885	-104.854829	1,306,480.86	3,180,287.37
11,814.00	91.29	1.52	7,191.74	4,149.22	498.54	40.173009	-104.854824	1,306,525.84	3,180,288.23

**Design Annotations**

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates +N/-S (usft)	Local Coordinates +E/-W (usft)	Comment
13.00	13.00	0.00	0.00	First Winserve Gyro Survey @ 13.00'
953.00	952.97	2.58	-3.61	Last Winserve Gyro Survey @ 953.00'
1,116.00	1,115.97	2.86	-3.81	First MWD Survey @ 1116.00'
7,670.00	7,187.30	8.12	440.10	7" Casing @ 7670.00'
11,769.00	7,192.75	4,104.25	497.35	Last MWD Surveys @ 11769.00'
11,814.00	7,191.74	4,149.22	498.54	St. Line Projection to Bit @ 11814'MD::7191.74

**Vertical Section Information**

Angle Type	Target	Azimuth (°)	Origin Type	Origin +N/_S (usft)	Origin +E/-W (usft)	Start TVD (usft)
User	No Target (Freehand)	0.75	Slot	0.00	0.00	0.00

**Survey tool program**

From (usft)	To (usft)	Survey/Plan	Survey Tool
13.00	953.00	Winserve Gyro Surveys	NS-GYRO-MS
953.00	7,633.00	MWD-Vertical & Build	MWD+SC
7,633.00	11,769.00	MWD- Lateral	MWD+SC

**Design Report for Pennington 2N-2HZ - Actual Field Surveys**

**Casing Details**

Measured Depth (usft)	Vertical Depth (usft)	Name	Casing Diameter (")	Hole Diameter (")
7,670.00	7,187.30	7"	7	8-3/4

**Design Targets**

Shape	Target Name	TVD (usft)	Northing (usft)	Easting (usft)	+N/-S usft	+E/-W usft	Created	Updated
Polygon	Pennington 2N-2HZ_LD	0.00	1,302,373.30	3,179,819.83	0.01	0.00	11/13/2013	11/13/2013
Polygon	Pennington 2N-2HZ_SEC	0.00	1,302,373.30	3,179,819.83	0.01	0.00	11/13/2013	11/13/2013

**Directional Difficulty Index**

Average Dogleg over Survey:	2.02 °/100usft	Maximum Dogleg over Survey:	15.82 °/100usft at 7,146.00 usft
Net Tortosity applicable to Plans:	0.94 °/100usft	Directional Difficulty Index:	6.344

**Audit Info**

**North Reference Sheet for Sec. 2-T2N-R67W - Pennington 2N-2HZ - Plan B**

All data is in US Feet unless otherwise stated. Directions and Coordinates are relative to True North Reference.

Vertical Depths are relative to RKB = 13' @ 4873.00usft (Ensign 123). Northing and Easting are relative to Pennington 2N-2HZ

Coordinate System is US State Plane 1983, Colorado Northern Zone using datum North American Datum 1983, ellipsoid GRS 1980

Projection method is Lambert Conformal Conic (2 parallel)

Central Meridian is -105.500000°, Longitude Origin:0.000000°, Latitude Origin:40.783333°

False Easting: 3,000,000.00usft, False Northing: 1,000,000.00usft, Scale Reduction: 0.99995805

Grid Coordinates of Well: 1,302,373.29 usft N, 3,179,819.83 usft E

Geographical Coordinates of Well: 40° 09' 41.83" N, 104° 51' 23.79" W

Grid Convergence at Surface is: 0.42°

Based upon Minimum Curvature type calculations, at a Measured Depth of 11,814.00usft

the Bottom Hole Displacement is 4,179.06usft in the Direction of 6.85° ( True).

Magnetic Convergence at surface is: -8.19° (13 November 2013, , BGGM2013)

