



October 19, 2016

Manzano, LLC.

PO Box 2107

Roswell, NM 88202-2107

CATHEDRAL ENERGY SERVICES

The Trinity Building
Suite 300, 1801 Broadway Street
Denver, Colorado, United States
80202

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CathedralEnergyServices.com

Drilling + Completions

**OCD – HOBBS
10/20/2016
RECEIVED**

Re: Certified Final Directional Survey

Dear Sir/ Madam,

Please find enclosed Cathedral Energy Services Certificate Final Survey for Manzano, LLC.

Rig: Norton #4

Well: Dog Bar 11 State #1H

API # 30-025-42873

County: Lea County, NM

The data and calculations included in this survey have been reviewed and conform to the operational standards as outlined by the State of New Mexico EMNRD. Should you have any questions please do not hesitate to contact Cathedral Energy Services.

Sincerely,

Cathedral Energy Services

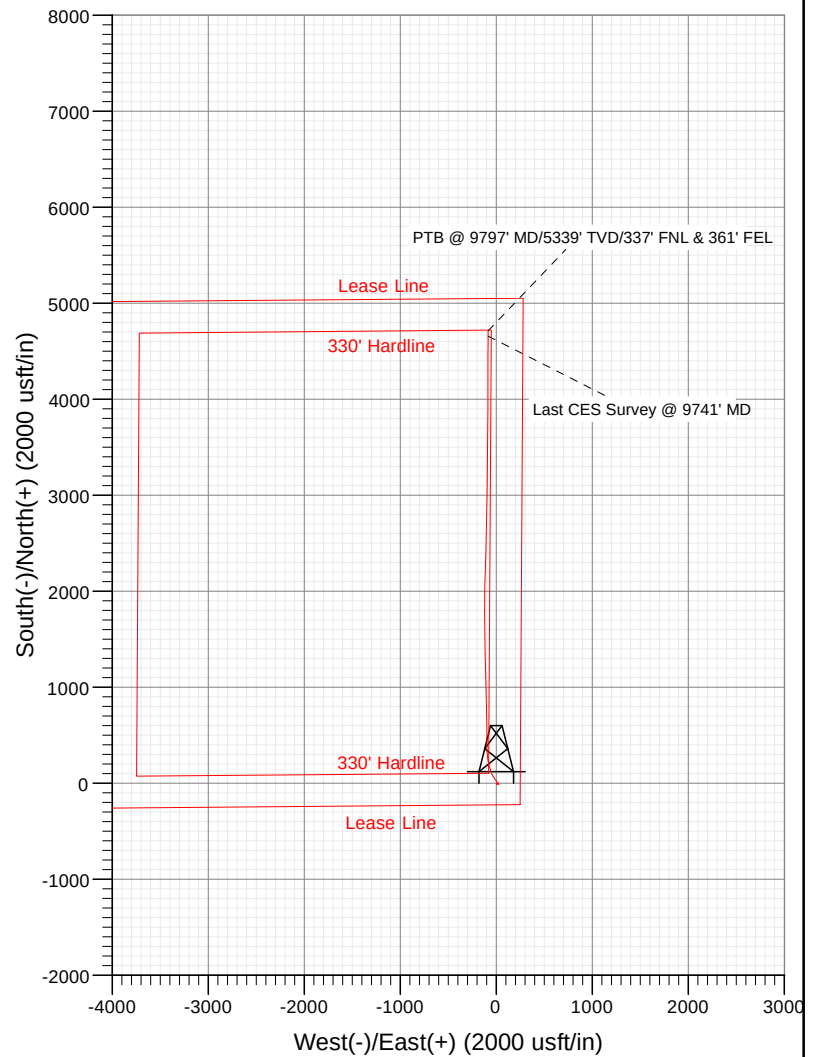
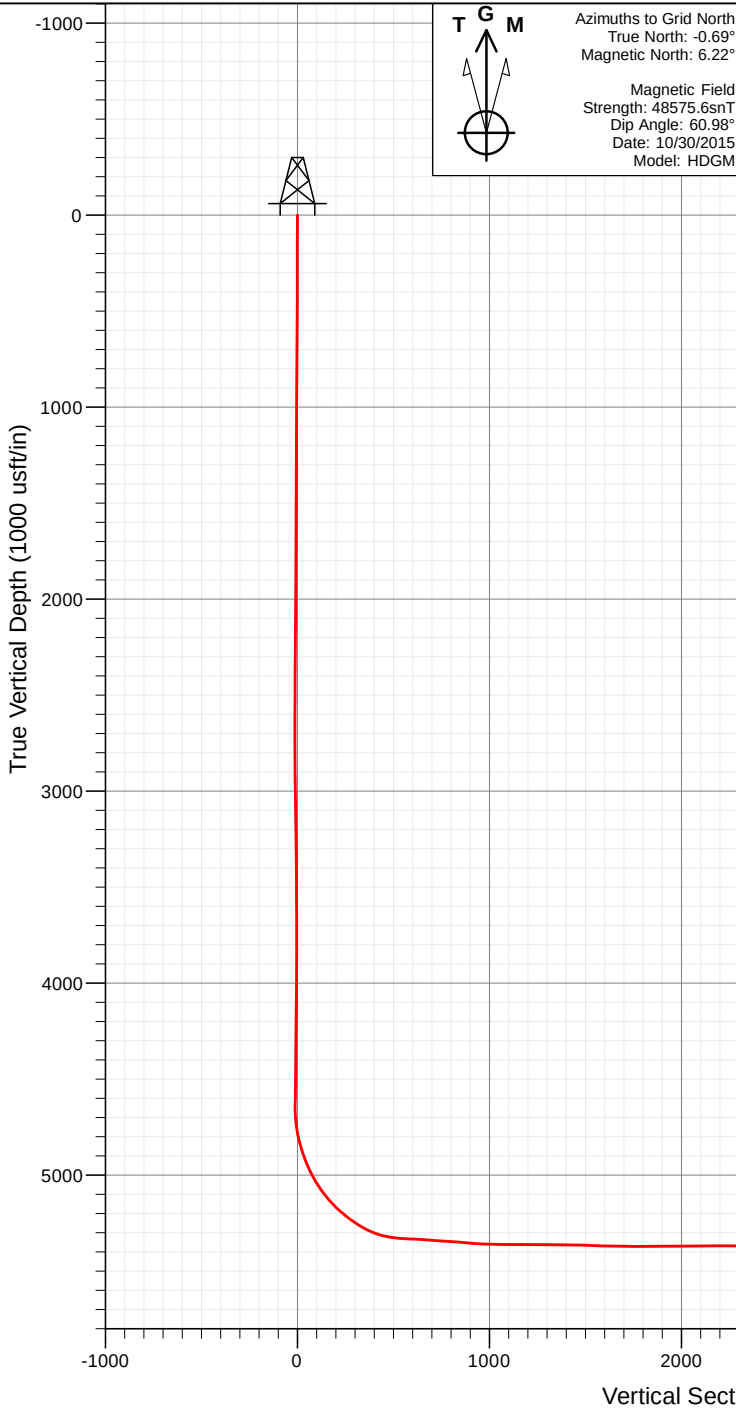
Randy Burns

Well Planner Print Name

Well Planner Signature

MANZANO LLC

Project: Lea Co., NM
 Site: Sec 11-T14S-R38E
 Well: Dog Bar 11 State #1H
 Wellbore: HZ
 Design: Final



Final
 Dog Bar 11 State #1H
 14" KB @ 3778' Oust (Norton #4)
 Ground Level @ 3765.0
 North American Datum 1983
 Well Dog Bar 11 State #1H, Grid North

Type	Target	Azimuth	Origin	Type	N/S	E/W	From
User	No Target (Freehand)	359.39	Slot		0.0	0.0	0.0

Last CES Survey @ 9741' MD

PTB @ 9797' MD/5339' TVD/337' FNL & 361' FEL



WELL DETAILS: Dog Bar 11 State #1H

+N/-S	+E/-W	Northing	Ground Level:	3765.0	Latitude	Longitude
0.0	0.0	770748.10	Easting	930273.10	33.112295	-103.063123



Cathedral Energy Services

Survey Report

Company:	Manzano LLC	Local Co-ordinate Reference:	Well Dog Bar 11 State #1H
Project:	Lea Co., NM	TVD Reference:	14' KB @ 3779.0usft (Norton #4)
Site:	Sec 11-T14S-R38E	MD Reference:	14' KB @ 3779.0usft (Norton #4)
Well:	Dog Bar 11 State #1H	North Reference:	Grid
Wellbore:	HZ	Survey Calculation Method:	Minimum Curvature
Design:	Final	Database:	USA EDM 5000 Multi Users DB

Project	Lea Co., NM		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	New Mexico Eastern Zone		

Site		Sec 11-T14S-R38E			
Site Position:		Northing:	770,708.00 usft	Latitude:	33.112247
From:	Map	Easting:	928,396.60 usft	Longitude:	-103.069252
Position Uncertainty:	0.0 usft	Slot Radius:	13-3/16"	Grid Convergence:	0.69 °

Well	Dog Bar 11 State #1H					
Well Position	+N/-S	0.0 usft	Northing:	770,748.10 usft	Latitude:	33.112295
	+E/-W	0.0 usft	Easting:	930,273.10 usft	Longitude:	-103.063123
Position Uncertainty		0.0 usft	Wellhead Elevation:	0.0 usft	Ground Level:	3,765.0 usft

Wellbore	HZ				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	HDGM	10/30/2015	6.92	60.98	48,576

Design	Final				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.0
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)	
	0.0	0.0	0.0	359.39	

Survey Program	Date	11/9/2015			
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description	
195.3	2,215.3	Gyro (HZ)	NS-GYRO-SS	NS Gyro single shots	
2,333.0	9,797.0	MWD (HZ)	MWD+HDGM	OWSG MWD + HDGM	

Survey										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usf)	Build Rate (°/100u)	Formations / Comments	
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00		
195.3	0.10	178.70	195.3	-0.2	0.0	-0.2	0.05	0.05		
244.9	0.20	106.90	244.9	-0.2	0.1	-0.2	0.39	0.20		
371.5	0.10	130.80	371.5	-0.4	0.4	-0.4	0.09	-0.08		
464.5	0.40	141.10	464.5	-0.7	0.6	-0.7	0.32	0.32		
552.4	0.50	111.10	552.4	-1.1	1.2	-1.1	0.29	0.11		
640.3	0.50	140.00	640.3	-1.5	1.8	-1.5	0.28	0.00		
735.9	0.60	143.50	735.8	-2.2	2.4	-2.2	0.11	0.10		
829.1	0.40	118.10	829.1	-2.8	2.9	-2.8	0.32	-0.21		
922.0	0.20	119.50	922.0	-3.0	3.4	-3.0	0.22	-0.22		
1,016.2	0.20	207.60	1,016.2	-3.2	3.4	-3.3	0.30	0.00		
1,110.9	0.40	149.10	1,110.9	-3.6	3.5	-3.7	0.36	0.21		

Cathedral Energy Services

Survey Report

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Site:	Sec 11-T14S-R38E	MD Reference:	14' KB @ 3779.0usft (Norton #4)
Well:	Dog Bar 11 State #1H	North Reference:	Grid
Wellbore:	HZ	Survey Calculation Method:	Minimum Curvature
Design:	Final	Database:	USA EDM 5000 Multi Users DB

Survey									
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usf)	Build Rate (°/100u)	Formations / Comments
1,202.8	0.30	173.10	1,202.8	-4.2	3.7	-4.2	0.19	-0.11	
1,297.5	0.40	160.40	1,297.4	-4.7	3.9	-4.8	0.13	0.11	
1,391.2	0.50	182.90	1,391.1	-5.4	4.0	-5.5	0.21	0.11	
1,484.8	0.40	186.50	1,484.8	-6.2	3.9	-6.2	0.11	-0.11	
1,577.6	0.30	207.60	1,577.6	-6.7	3.7	-6.7	0.17	-0.11	
1,671.1	0.40	175.20	1,671.1	-7.2	3.7	-7.3	0.23	0.11	
1,766.1	0.30	144.90	1,766.1	-7.8	3.8	-7.8	0.22	-0.11	
1,822.3	0.30	133.60	1,822.2	-8.0	4.0	-8.0	0.11	0.00	
1,954.7	0.20	118.80	1,954.7	-8.4	4.5	-8.4	0.09	-0.08	
2,016.4	0.10	109.00	2,016.4	-8.4	4.6	-8.5	0.17	-0.16	
2,140.5	0.20	144.90	2,140.5	-8.6	4.9	-8.7	0.11	0.08	
2,215.3	0.80	148.40	2,215.3	-9.2	5.2	-9.2	0.80	0.80	
2,333.0	0.50	166.20	2,333.0	-10.4	5.8	-10.4	0.30	-0.25	
2,428.0	0.60	153.50	2,427.9	-11.2	6.1	-11.3	0.17	0.11	
2,522.0	0.20	190.50	2,521.9	-11.8	6.3	-11.9	0.49	-0.43	
2,617.0	0.20	140.30	2,616.9	-12.1	6.3	-12.2	0.18	0.00	
2,712.0	0.20	88.00	2,711.9	-12.2	6.6	-12.3	0.19	0.00	
2,808.0	0.40	67.40	2,807.9	-12.1	7.1	-12.2	0.23	0.21	
2,901.0	0.60	6.40	2,900.9	-11.5	7.4	-11.6	0.58	0.22	
2,996.0	0.80	16.20	2,995.9	-10.4	7.7	-10.5	0.24	0.21	
3,091.0	0.80	3.80	3,090.9	-9.1	7.9	-9.2	0.18	0.00	
3,186.0	0.90	7.30	3,185.9	-7.7	8.0	-7.8	0.12	0.11	
3,280.0	0.80	1.90	3,279.9	-6.3	8.2	-6.4	0.14	-0.11	
3,374.0	0.60	23.50	3,373.9	-5.2	8.4	-5.3	0.35	-0.21	
3,469.0	0.30	71.60	3,468.9	-4.6	8.8	-4.7	0.48	-0.32	
3,562.0	0.80	68.80	3,561.9	-4.3	9.7	-4.4	0.54	0.54	
3,657.0	1.10	72.30	3,656.9	-3.8	11.1	-3.9	0.32	0.32	
3,847.0	0.80	76.70	3,846.9	-3.0	14.2	-3.1	0.16	-0.16	
4,034.0	1.30	129.20	4,033.8	-4.0	17.1	-4.2	0.55	0.27	
4,224.0	1.20	123.50	4,223.8	-6.5	20.4	-6.7	0.08	-0.05	
4,414.0	1.50	117.40	4,413.7	-8.7	24.3	-9.0	0.17	0.16	
4,600.0	1.10	113.40	4,599.7	-10.5	28.1	-10.8	0.22	-0.22	
4,632.0	1.20	114.30	4,631.7	-10.8	28.7	-11.1	0.32	0.31	
4,662.0	0.60	65.40	4,661.7	-10.8	29.1	-11.2	3.08	-2.00	
4,693.0	3.90	324.30	4,692.6	-9.9	28.6	-10.2	13.09	10.65	
4,724.0	7.80	319.80	4,723.5	-7.5	26.7	-7.7	12.66	12.58	
4,756.0	10.90	320.10	4,755.0	-3.5	23.3	-3.7	9.69	9.69	
4,787.0	13.70	321.60	4,785.3	1.6	19.2	1.4	9.09	9.03	
4,818.0	16.70	321.40	4,815.2	8.0	14.1	7.9	9.68	9.68	
4,849.0	19.40	323.10	4,844.7	15.6	8.2	15.5	8.87	8.71	
4,880.0	21.80	323.20	4,873.7	24.3	1.7	24.3	7.74	7.74	
4,912.0	23.80	324.80	4,903.2	34.4	-5.6	34.4	6.54	6.25	
4,944.0	26.10	324.80	4,932.2	45.4	-13.4	45.5	7.19	7.19	
4,975.0	28.20	326.30	4,959.8	57.1	-21.4	57.3	7.12	6.77	
5,006.0	29.80	328.40	4,986.9	69.7	-29.5	70.0	6.12	5.16	
5,037.0	31.40	331.50	5,013.6	83.4	-37.4	83.8	7.25	5.16	
5,069.0	33.60	335.30	5,040.6	98.8	-45.1	99.2	9.38	6.87	
5,100.0	36.10	339.30	5,066.1	115.1	-51.9	115.6	10.92	8.06	
5,131.0	38.20	342.10	5,090.8	132.8	-58.0	133.4	8.70	6.77	
5,162.0	40.70	343.90	5,114.7	151.6	-63.8	152.3	8.87	8.06	
5,194.0	43.20	345.70	5,138.5	172.2	-69.4	173.0	8.67	7.81	
5,225.0	45.80	346.50	5,160.6	193.3	-74.6	194.1	8.58	8.39	
5,256.0	48.60	347.70	5,181.7	215.5	-79.7	216.3	9.47	9.03	

Cathedral Energy Services

Survey Report

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Project:	Lea Co., NM	TVD Reference:	14' KB @ 3779.0usft (Norton #4)
Site:	Sec 11-T14S-R38E	MD Reference:	14' KB @ 3779.0usft (Norton #4)
Well:	Dog Bar 11 State #1H	North Reference:	Grid
Wellbore:	HZ	Survey Calculation Method:	Minimum Curvature
Design:	Final	Database:	USA EDM 5000 Multi Users DB

Survey									
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usf)	Build Rate (°/100u)	Formations / Comments
5,287.0	50.50	350.50	5,201.8	238.7	-84.1	239.5	9.21	6.13	
5,319.0	52.70	351.60	5,221.7	263.4	-88.0	264.4	7.38	6.87	
5,350.0	54.60	354.80	5,240.0	288.2	-91.0	289.2	10.33	6.13	
5,381.0	57.60	357.20	5,257.3	313.9	-92.8	314.9	11.62	9.68	
5,413.0	60.70	359.20	5,273.7	341.3	-93.6	342.3	11.07	9.69	
5,445.0	64.10	358.90	5,288.6	369.7	-94.1	370.7	10.66	10.62	
5,476.0	68.60	359.60	5,301.0	398.1	-94.5	399.1	14.66	14.52	
5,507.0	73.40	0.20	5,311.1	427.4	-94.5	428.4	15.59	15.48	
5,539.0	77.70	0.10	5,319.1	458.4	-94.4	459.3	13.44	13.44	
5,571.0	81.80	359.30	5,324.8	489.8	-94.6	490.8	13.05	12.81	
5,602.0	85.10	358.90	5,328.3	520.6	-95.1	521.6	10.72	10.65	
5,633.0	87.90	359.40	5,330.2	551.6	-95.5	552.6	9.17	9.03	
5,725.0	85.80	358.60	5,335.2	643.4	-97.1	644.4	2.44	-2.28	
5,820.0	86.00	358.50	5,342.0	738.1	-99.5	739.2	0.24	0.21	
5,914.0	85.80	358.40	5,348.7	831.9	-102.1	832.9	0.24	-0.21	
6,009.0	85.40	358.00	5,356.0	926.5	-105.0	927.6	0.59	-0.42	
6,104.0	89.10	358.80	5,360.6	1,021.4	-107.7	1,022.5	3.98	3.89	
6,198.0	90.20	359.20	5,361.2	1,115.3	-109.3	1,116.5	1.25	1.17	
6,293.0	89.70	358.70	5,361.3	1,210.3	-111.1	1,211.4	0.74	-0.53	
6,388.0	89.10	358.90	5,362.2	1,305.3	-113.1	1,306.4	0.67	-0.63	
6,482.0	88.80	358.80	5,364.0	1,399.3	-114.9	1,400.4	0.34	-0.32	
6,576.0	89.00	358.70	5,365.8	1,493.2	-117.0	1,494.4	0.24	0.21	
6,671.0	88.60	359.30	5,367.8	1,588.2	-118.7	1,589.4	0.76	-0.42	
6,765.0	88.40	359.40	5,370.2	1,682.2	-119.7	1,683.3	0.24	-0.21	
6,858.0	89.40	0.00	5,372.0	1,775.1	-120.2	1,776.3	1.25	1.08	
6,952.0	90.90	0.30	5,371.8	1,869.1	-120.0	1,870.3	1.63	1.60	
7,040.0	90.50	359.80	5,370.7	1,957.1	-119.9	1,958.3	0.73	-0.45	
7,127.0	91.00	2.10	5,369.5	2,044.1	-118.4	2,045.2	2.71	0.57	
7,219.0	90.40	1.90	5,368.4	2,136.0	-115.2	2,137.1	0.69	-0.65	
7,309.0	89.10	1.50	5,368.8	2,226.0	-112.6	2,227.1	1.51	-1.44	
7,396.0	89.80	1.80	5,369.7	2,312.9	-110.1	2,314.0	0.88	0.80	
7,489.0	91.50	1.30	5,368.6	2,405.9	-107.5	2,406.9	1.91	1.83	
7,583.0	91.00	1.30	5,366.5	2,499.9	-105.4	2,500.8	0.53	-0.53	
7,677.0	90.90	1.70	5,365.0	2,593.8	-103.0	2,594.8	0.44	-0.11	
7,772.0	90.10	1.30	5,364.2	2,688.8	-100.5	2,689.7	0.94	-0.84	
7,866.0	89.60	1.00	5,364.4	2,782.8	-98.6	2,783.7	0.62	-0.53	
7,961.0	91.30	1.40	5,363.7	2,877.7	-96.6	2,878.6	1.84	1.79	
8,055.0	90.40	0.90	5,362.3	2,971.7	-94.7	2,972.5	1.10	-0.96	
8,149.0	90.10	1.00	5,361.9	3,065.7	-93.1	3,066.5	0.34	-0.32	
8,244.0	90.20	0.40	5,361.6	3,160.7	-92.0	3,161.5	0.64	0.11	
8,339.0	90.00	0.30	5,361.4	3,255.7	-91.4	3,256.5	0.24	-0.21	
8,434.0	89.10	359.50	5,362.2	3,350.7	-91.6	3,351.5	1.27	-0.95	
8,527.0	91.50	0.70	5,361.7	3,443.7	-91.4	3,444.4	2.89	2.58	
8,620.0	91.30	0.80	5,359.4	3,536.6	-90.2	3,537.4	0.24	-0.22	
8,715.0	90.80	0.90	5,357.7	3,631.6	-88.8	3,632.3	0.54	-0.53	
8,809.0	91.00	0.60	5,356.2	3,725.6	-87.5	3,726.3	0.38	0.21	
8,904.0	91.10	0.70	5,354.5	3,820.6	-86.5	3,821.3	0.15	0.11	
8,999.0	91.10	0.40	5,352.6	3,915.5	-85.6	3,916.2	0.32	0.00	
9,093.0	91.00	0.30	5,350.9	4,009.5	-85.0	4,010.2	0.15	-0.11	
9,188.0	90.90	359.90	5,349.3	4,104.5	-84.8	4,105.2	0.43	-0.11	
9,282.0	91.70	0.30	5,347.2	4,198.5	-84.7	4,199.1	0.95	0.85	
9,375.0	90.40	359.90	5,345.5	4,291.5	-84.5	4,292.1	1.46	-1.40	
9,469.0	91.00	359.90	5,344.4	4,385.5	-84.7	4,386.1	0.64	0.64	

Cathedral Energy Services

Survey Report

Company:	Manzano LLC	Local Co-ordinate Reference:	Well Dog Bar 11 State #1H
Project:	Lea Co., NM	TVD Reference:	14' KB @ 3779.0usft (Norton #4)
Site:	Sec 11-T14S-R38E	MD Reference:	14' KB @ 3779.0usft (Norton #4)
Well:	Dog Bar 11 State #1H	North Reference:	Grid
Wellbore:	HZ	Survey Calculation Method:	Minimum Curvature
Design:	Final	Database:	USA EDM 5000 Multi Users DB

Survey									
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usf)	Build Rate (°/100u)	Formations / Comments
9,564.0	90.00	0.30	5,343.5	4,480.4	-84.5	4,481.1	1.13	-1.05	
9,660.0	91.10	0.60	5,342.6	4,576.4	-83.7	4,577.1	1.19	1.15	
9,741.0	91.30	0.40	5,340.9	4,657.4	-83.0	4,658.0	0.35	0.25	Last CES Survey @ 9741' MD
9,797.0	91.30	0.40	5,339.6	4,713.4	-82.6	4,714.0	0.00	0.00	PTB @ 9797' MD/5339' TVD/337' FNL & 361' FEL

Targets									
Target Name	Dip Angle (°)	Dip Dir. (°)	TVD (usft)	+N/-S (usft)	+E/-W (usft)	Northing (usft)	Easting (usft)	Latitude	Longitude
- hit/miss target									
- Shape									
BHL DBS 11 1H P4	0.00	0.00	5,354.0	4,720.9	-70.6	775,469.00	930,202.50	33.125270	-103.063167
- actual wellpath misses target center by 20.2usft at 9797.0usft MD (5339.6 TVD, 4713.4 N, -82.6 E)									
- Point									

Design Annotations					
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment	
		+N/-S (usft)	+E/-W (usft)		
9,741.0	5,340.9	4,657.4	-83.0	Last CES Survey @ 9741' MD	
9,797.0	5,339.6	4,713.4	-82.6	PTB @ 9797' MD/5339' TVD/337' FNL & 361' FEL	

Checked By: _____ Approved By: _____ Date: _____