



Marathon Oil

Marathon Oil

Eddy County, NM

Cass 16 State

No. 4H

30-015- 44370

OH

Design: Gyros/MWD 173' - 11761' PTB 11830'

Standard Survey Report

28 August, 2017

*Rec'd
1-8-2018*



PRODIRECTIONAL

Company: Marathon Oil
Project: Eddy County, NM
Site: Cass 16 State
Well: No. 4H
Wellbore: OH
Design: Gyros/MWD 173' - 11761' PTB 11830'

Local Co-ordinate Reference: Well No. 4H
TVD Reference: Well @ 3185.00usft (GL: 3160' + KB: 25' (H&P498))
MD Reference: Well @ 3185.00usft (GL: 3160' + KB: 25' (H&P498))
North Reference: Grid
Survey Calculation Method: Minimum Curvature
Database: WellPlanner1

Project	Eddy County, NM		
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		Cass 16 State			
Site Position:		Northing:	475,277.35 usft	Latitude:	32.3065858
From:	Map	Easting:	540,500.53 usft	Longitude:	-104.2022462
Position Uncertainty:	0.00 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.07 °

Well	No. 4H					
Well Position	+N/-S	0.00 usft	Northing:	475,247.35 usft	Latitude:	32.3065033
	+E/-W	0.00 usft	Easting:	540,500.53 usft	Longitude:	-104.2022463
Position Uncertainty		0.00 usft	Wellhead Elevation:	usft	Ground Level:	3,160.00 usft

Wellbore	OH				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	HDGM	8/5/2017	7.42	60.10	48,087.30

Design	Gyros/MWD 173' - 11761' PTB 11830'				
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	88.16	

Survey Program		Date	8/28/2017	
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description
173.00	430.00	Gyros (OH)	GYRO-NS-CT	OWSG XYZ Accel with XY Static and Continuous Gyro
482.00	11,830.00	MWD (OH)	MWD - OWSG	MWD - OWSG

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)
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
173.00	0.70	87.00	173.00	0.06	1.06	1.06	0.40	0.40	0.00
203.00	1.10	22.00	202.99	0.33	1.35	1.36	3.41	1.33	-216.67
296.00	2.90	357.00	295.93	3.51	1.56	1.67	2.11	1.94	-26.88
326.00	2.40	359.00	325.90	4.90	1.51	1.66	1.69	-1.67	6.67
357.00	2.40	357.00	356.87	6.19	1.46	1.66	0.27	0.00	-6.45
387.00	2.40	357.00	386.85	7.45	1.40	1.63	0.00	0.00	0.00
417.00	2.70	356.00	416.82	8.78	1.31	1.59	1.01	1.00	-3.33

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Survey

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430.00	2.30	351.00	429.81	9.34	1.25	1.55	3.50	-3.08	-38.46
482.00	2.80	349.90	481.75	11.62	0.87	1.24	0.97	0.96	-2.12
513.00	2.80	350.80	512.72	13.12	0.61	1.03	0.14	0.00	2.90
606.00	1.80	345.50	605.64	16.77	-0.12	0.42	1.10	-1.08	-5.70
697.00	1.30	343.80	696.61	19.15	-0.76	-0.15	0.55	-0.55	-1.87
789.00	0.30	268.40	788.60	20.14	-1.30	-0.65	1.37	-1.09	-81.96
882.00	1.50	207.90	881.59	19.06	-2.11	-1.49	1.48	1.29	-65.05
973.00	2.00	213.90	972.54	16.69	-3.55	-3.01	0.58	0.55	6.59
1,065.00	1.60	206.80	1,064.50	14.21	-5.03	-4.57	0.50	-0.43	-7.72
1,160.00	1.50	199.50	1,159.46	11.85	-6.04	-5.65	0.23	-0.11	-7.68
1,254.00	2.00	158.40	1,253.42	9.17	-5.85	-5.55	1.40	0.53	-43.72
1,349.00	2.50	159.10	1,348.35	5.69	-4.50	-4.31	0.53	0.53	0.74
1,444.00	1.50	206.90	1,443.30	2.65	-4.32	-4.23	1.96	-1.05	50.32
1,538.00	1.10	232.00	1,537.27	1.00	-5.59	-5.55	0.73	-0.43	26.70
1,633.00	1.10	251.00	1,632.26	0.14	-7.17	-7.16	0.38	0.00	20.00
1,727.00	1.90	251.30	1,726.22	-0.66	-9.50	-9.51	0.85	0.85	0.32
1,822.00	3.00	255.00	1,821.13	-1.80	-13.39	-13.44	1.17	1.16	3.89
1,917.00	3.20	259.70	1,916.00	-2.92	-18.40	-18.48	0.34	0.21	4.95
1,971.00	3.10	261.30	1,969.91	-3.41	-21.33	-21.43	0.25	-0.19	2.96
2,003.00	2.80	259.40	2,001.87	-3.69	-22.95	-23.06	0.99	-0.94	-5.94
2,098.00	4.80	252.70	2,096.66	-5.30	-29.03	-29.18	2.15	2.11	-7.05
2,192.00	4.80	252.30	2,190.33	-7.66	-36.53	-36.76	0.04	0.00	-0.43
2,287.00	4.90	253.40	2,284.99	-10.03	-44.20	-44.50	0.14	0.11	1.16
2,382.00	3.80	252.60	2,379.71	-12.13	-51.10	-51.46	1.16	-1.16	-0.84
2,476.00	3.60	251.00	2,473.52	-14.02	-56.86	-57.28	0.24	-0.21	-1.70
2,571.00	3.50	249.80	2,568.34	-15.99	-62.40	-62.88	0.13	-0.11	-1.26
2,666.00	5.50	243.60	2,663.04	-19.02	-69.20	-69.77	2.16	2.11	-6.53
2,760.00	5.20	242.30	2,756.63	-23.00	-77.01	-77.70	0.34	-0.32	-1.38
2,855.00	4.80	242.40	2,851.27	-26.85	-84.34	-85.16	0.42	-0.42	0.11
2,950.00	4.80	244.00	2,945.93	-30.43	-91.43	-92.36	0.14	0.00	1.68
3,044.00	6.20	255.90	3,039.50	-33.39	-99.89	-100.91	1.91	1.49	12.66
3,138.00	6.00	256.00	3,132.97	-35.82	-109.58	-110.68	0.21	-0.21	0.11
3,233.00	5.80	255.00	3,227.47	-38.26	-119.04	-120.20	0.24	-0.21	-1.05
3,328.00	5.70	255.70	3,321.99	-40.67	-128.25	-129.49	0.13	-0.11	0.74
3,422.00	5.60	255.60	3,415.53	-42.96	-137.21	-138.52	0.11	-0.11	-0.11
3,517.00	5.60	255.80	3,510.08	-45.25	-146.19	-147.57	0.02	0.00	0.21
3,612.00	5.40	255.00	3,604.64	-47.54	-155.01	-156.45	0.23	-0.21	-0.84
3,707.00	5.70	251.50	3,699.20	-50.20	-163.80	-165.32	0.48	0.32	-3.68
3,801.00	5.60	251.80	3,792.74	-53.11	-172.58	-174.20	0.11	-0.11	0.32
3,896.00	5.50	249.00	3,887.29	-56.19	-181.24	-182.95	0.30	-0.11	-2.95
3,991.00	5.40	248.20	3,981.86	-59.48	-189.64	-191.45	0.13	-0.11	-0.84
4,085.00	5.00	248.10	4,075.48	-62.65	-197.54	-199.45	0.43	-0.43	-0.11

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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)
4,179.00	4.80	246.90	4,169.13	-65.72	-204.96	-206.97	0.24	-0.21	-1.28
4,273.00	4.70	247.00	4,262.81	-68.77	-212.12	-214.22	0.11	-0.11	0.11
4,368.00	4.60	248.10	4,357.50	-71.71	-219.24	-221.43	0.14	-0.11	1.16
4,462.00	3.20	253.30	4,451.28	-73.87	-225.25	-227.51	1.53	-1.49	5.53
4,557.00	2.10	226.20	4,546.18	-75.84	-229.05	-231.37	1.72	-1.16	-28.53
4,652.00	1.90	225.80	4,641.12	-78.14	-231.43	-233.82	0.21	-0.21	-0.42
4,746.00	1.10	145.60	4,735.10	-79.97	-232.04	-234.49	2.16	-0.85	-85.32
4,841.00	2.20	94.30	4,830.06	-80.86	-229.71	-232.19	1.83	1.16	-54.00
4,936.00	3.00	75.80	4,924.96	-80.39	-225.48	-227.94	1.21	0.84	-19.47
5,031.00	3.00	73.50	5,019.83	-79.07	-220.69	-223.11	0.13	0.00	-2.42
5,126.00	2.50	74.80	5,114.72	-77.82	-216.30	-218.69	0.53	-0.53	1.37
5,220.00	2.30	80.70	5,208.64	-76.98	-212.46	-214.82	0.34	-0.21	6.28
5,315.00	2.10	87.50	5,303.57	-76.60	-208.84	-211.19	0.35	-0.21	7.16
5,409.00	1.40	13.00	5,397.54	-75.40	-206.86	-209.18	2.33	-0.74	-79.26
5,504.00	1.60	3.20	5,492.50	-72.95	-206.53	-208.76	0.34	0.21	-10.32
5,598.00	1.40	27.30	5,586.47	-70.62	-205.93	-208.09	0.70	-0.21	25.64
5,693.00	1.40	24.00	5,681.44	-68.53	-204.92	-207.02	0.08	0.00	-3.47
5,787.00	0.30	327.80	5,775.43	-67.27	-204.59	-206.64	1.34	-1.17	-59.79
5,882.00	1.00	341.30	5,870.43	-66.27	-204.99	-207.01	0.75	0.74	14.21
5,976.00	1.50	308.60	5,964.41	-64.73	-206.21	-208.18	0.91	0.53	-34.79
6,071.00	3.50	259.20	6,059.32	-64.50	-210.03	-211.99	2.91	2.11	-52.00
6,165.00	3.20	260.00	6,153.16	-65.49	-215.43	-217.43	0.32	-0.32	0.85
6,260.00	1.90	236.80	6,248.06	-66.81	-219.36	-221.40	1.72	-1.37	-24.42
6,354.00	1.80	209.60	6,342.02	-68.95	-221.40	-223.50	0.93	-0.11	-28.94
6,449.00	1.70	200.00	6,436.97	-71.57	-222.62	-224.80	0.33	-0.11	-10.11
6,557.00	2.10	149.00	6,544.92	-74.77	-222.14	-224.43	1.55	0.37	-47.22
6,604.00	5.90	103.80	6,591.81	-76.09	-219.35	-221.68	9.92	8.09	-96.17
6,651.00	9.80	84.80	6,638.36	-76.30	-213.02	-215.36	9.86	8.30	-40.43
6,698.00	14.80	81.10	6,684.27	-75.01	-203.10	-205.40	10.76	10.64	-7.87
6,746.00	18.30	84.00	6,730.28	-73.27	-189.54	-191.80	7.49	7.29	6.04
6,793.00	23.00	85.30	6,774.25	-71.75	-173.04	-175.26	10.05	10.00	2.77
6,840.00	28.10	84.80	6,816.63	-69.99	-152.86	-155.03	10.86	10.85	-1.06
6,887.00	32.70	84.80	6,857.16	-67.84	-129.18	-131.29	9.79	9.79	0.00
6,935.00	37.10	85.10	6,896.52	-65.42	-101.83	-103.88	9.17	9.17	0.63
6,982.00	41.50	85.30	6,932.88	-62.94	-72.17	-74.15	9.37	9.36	0.43
7,029.00	44.80	86.20	6,967.17	-60.56	-40.12	-42.04	7.14	7.02	1.91
7,076.00	47.90	87.00	6,999.60	-58.55	-6.18	-8.05	6.71	6.60	1.70
7,124.00	51.00	88.30	7,030.81	-57.07	30.26	28.41	6.78	6.46	2.71
7,171.00	54.90	89.20	7,059.12	-56.26	67.75	65.91	8.44	8.30	1.91
7,219.00	60.20	90.10	7,084.87	-56.02	108.24	106.39	11.15	11.04	1.88
7,266.00	65.80	90.60	7,106.20	-56.28	150.10	148.22	11.95	11.91	1.06
7,313.00	70.00	90.20	7,123.87	-56.58	193.64	191.72	8.97	8.94	-0.85

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7,361.00	73.70	89.60	7,138.82	-56.50	239.24	237.31	7.80	7.71	-1.25
7,408.00	77.80	88.70	7,150.39	-55.82	284.78	282.84	8.92	8.72	-1.91
7,456.00	79.80	88.20	7,159.71	-54.54	331.85	329.93	4.29	4.17	-1.04
7,502.00	81.10	87.70	7,167.35	-52.92	377.18	375.29	3.02	2.83	-1.09
7,550.00	84.30	87.10	7,173.44	-50.76	424.74	422.89	6.78	6.67	-1.25
7,597.00	87.60	87.60	7,176.76	-48.59	471.56	469.76	7.10	7.02	1.06
7,670.00	89.50	87.20	7,178.61	-45.28	544.46	542.73	2.66	2.60	-0.55
7,691.00	90.00	87.10	7,178.70	-44.24	565.43	563.72	2.43	2.38	-0.48
7,786.00	91.60	85.80	7,177.38	-38.36	660.24	658.66	2.17	1.68	-1.37
7,867.00	93.00	85.30	7,174.12	-32.08	740.93	739.51	1.84	1.73	-0.62
7,961.00	90.90	85.80	7,170.93	-24.79	834.58	833.36	2.30	-2.23	0.53
8,056.00	88.60	87.00	7,171.34	-18.83	929.39	928.30	2.73	-2.42	1.26
8,150.00	86.60	89.30	7,175.28	-15.79	1,023.24	1,022.21	3.24	-2.13	2.45
8,244.00	87.30	89.70	7,180.28	-14.97	1,117.11	1,116.05	0.86	0.74	0.43
8,339.00	88.50	89.80	7,183.76	-14.56	1,212.04	1,210.95	1.27	1.26	0.11
8,433.00	86.30	90.50	7,188.02	-14.80	1,305.94	1,304.79	2.46	-2.34	0.74
8,528.00	87.10	91.10	7,193.49	-16.13	1,400.77	1,399.53	1.05	0.84	0.63
8,622.00	88.10	91.60	7,197.43	-18.34	1,494.66	1,493.30	1.19	1.06	0.53
8,717.00	86.40	89.80	7,201.99	-19.50	1,589.53	1,588.09	2.60	-1.79	-1.89
8,811.00	86.20	90.90	7,208.05	-20.08	1,683.33	1,681.82	1.19	-0.21	1.17
8,906.00	87.10	90.30	7,213.60	-21.07	1,778.17	1,776.57	1.14	0.95	-0.63
9,000.00	88.10	91.10	7,217.54	-22.22	1,872.07	1,870.40	1.36	1.06	0.85
9,095.00	87.30	90.40	7,221.35	-23.46	1,966.99	1,965.22	1.12	-0.84	-0.74
9,189.00	86.90	88.70	7,226.11	-22.72	2,060.86	2,059.07	1.86	-0.43	-1.81
9,284.00	87.70	88.20	7,230.58	-20.15	2,155.72	2,153.96	0.99	0.84	-0.53
9,378.00	88.40	86.60	7,233.78	-15.89	2,249.57	2,247.90	1.86	0.74	-1.70
9,473.00	89.50	87.30	7,235.52	-10.84	2,344.41	2,342.86	1.37	1.16	0.74
9,568.00	90.50	87.90	7,235.52	-6.86	2,439.33	2,437.85	1.23	1.05	0.63
9,662.00	91.60	87.30	7,233.80	-2.93	2,533.23	2,531.83	1.33	1.17	-0.64
9,757.00	90.30	88.40	7,232.23	0.64	2,628.14	2,626.81	1.79	-1.37	1.16
9,851.00	91.50	89.10	7,230.75	2.69	2,722.11	2,720.79	1.48	1.28	0.74
9,946.00	90.50	88.40	7,229.09	4.76	2,817.07	2,815.77	1.28	-1.05	-0.74
10,040.00	89.90	87.40	7,228.76	8.20	2,911.00	2,909.77	1.24	-0.64	-1.06
10,135.00	90.90	88.10	7,228.10	11.93	3,005.93	3,004.76	1.28	1.05	0.74
10,230.00	90.60	86.80	7,226.86	16.16	3,100.82	3,099.74	1.40	-0.32	-1.37
10,324.00	89.70	85.80	7,226.61	22.23	3,194.62	3,193.69	1.43	-0.96	-1.06
10,419.00	90.80	85.80	7,226.20	29.18	3,289.37	3,288.61	1.16	1.16	0.00
10,513.00	88.70	87.80	7,226.61	34.43	3,383.21	3,382.57	3.09	-2.23	2.13
10,608.00	88.40	88.10	7,229.01	37.83	3,478.12	3,477.54	0.45	-0.32	0.32
10,702.00	86.60	88.20	7,233.11	40.86	3,571.98	3,571.45	1.92	-1.91	0.11
10,797.00	87.50	88.60	7,238.00	43.51	3,666.81	3,666.32	1.04	0.95	0.42
10,891.00	88.30	89.30	7,241.44	45.23	3,760.73	3,760.24	1.13	0.85	0.74

Company: Marathon Oil
Project: Eddy County, NM

Site: Cass 16 State

Well: No. 4H

Wellbore: OH

Design: Gyros/MWD 173' - 11761' PTB 11830'

Local Co-ordinate Reference:

TVD Reference:

MD Reference:

North Reference:

Survey Calculation Method:

Database:

Well No. 4H

Well @ 3185.00usft (GL: 3160' + KB: 25'
(H&P498))

Well @ 3185.00usft (GL: 3160' + KB: 25'
(H&P498))

Grid

Minimum Curvature

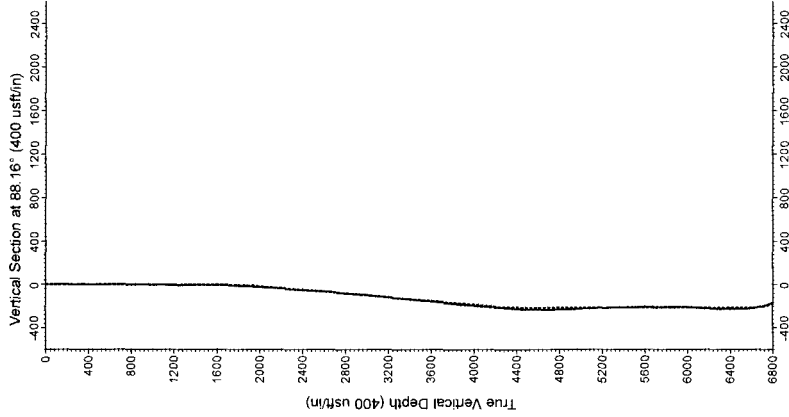
WellPlanner1

Survey

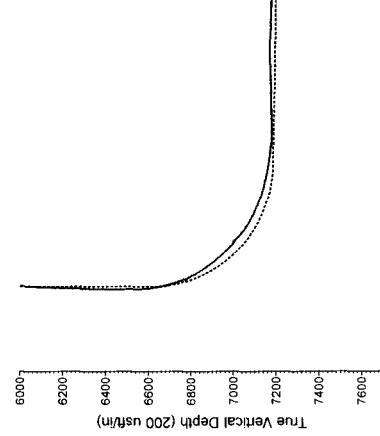
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Vertical Section (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)
10,986.00	89.40	89.40	7,243.35	46.31	3,855.70	3,855.20	1.16	1.16	0.11
11,080.00	90.20	89.50	7,243.68	47.21	3,949.70	3,949.18	0.86	0.85	0.11
11,175.00	90.00	88.90	7,243.51	48.54	4,044.69	4,044.16	0.67	-0.21	-0.63
11,269.00	88.90	88.50	7,244.42	50.67	4,138.66	4,138.15	1.25	-1.17	-0.43
11,363.00	88.60	87.50	7,246.47	53.95	4,232.58	4,232.13	1.11	-0.32	-1.06
11,458.00	89.40	88.20	7,248.12	57.51	4,327.49	4,327.11	1.12	0.84	0.74
11,552.00	90.50	87.90	7,248.21	60.71	4,421.44	4,421.11	1.21	1.17	-0.32
11,647.00	91.40	88.00	7,246.63	64.11	4,516.36	4,516.09	0.95	0.95	0.11
11,742.00	89.40	88.90	7,245.97	66.68	4,611.32	4,611.08	2.31	-2.11	0.95
11,761.00	89.00	88.70	7,246.23	67.07	4,630.32	4,630.08	2.35	-2.11	-1.05
Last Survey: 11761' MD, 7246' TVD									
11,830.00	89.00	88.70	7,247.44	68.64	4,699.29	4,699.07	0.00	0.00	0.00
PTB: 11830' MD, 7247' TVD									

Design Annotations

Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates		Comment
		+N/-S (usft)	+E/-W (usft)	
11,761.00	7,246.23	67.07	4,630.32	Last Survey: 11761' MD, 7246' TVD
11,830.00	7,247.44	68.64	4,699.29	PTB: 11830' MD, 7247' TVD



Target Line: 7180' TVD @ 0° VS, 89° INC



36" x 48"

US State Plane 1927 (Exact solution)
 NAD 1983 (NAD83 CONUS)
 New Mexico East 3001
 Mean Sea Level

RKS Elevation: Well @ 3165.00usft (GL: 3160' + KB: 25' (H&P498))

+N/S	+E/W	North	East	Latitude	Longitude	Slot
0.00	0.00	475247.25	540500.53	32.3065033	-104.2022463	

SECTION DETAILS

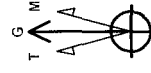
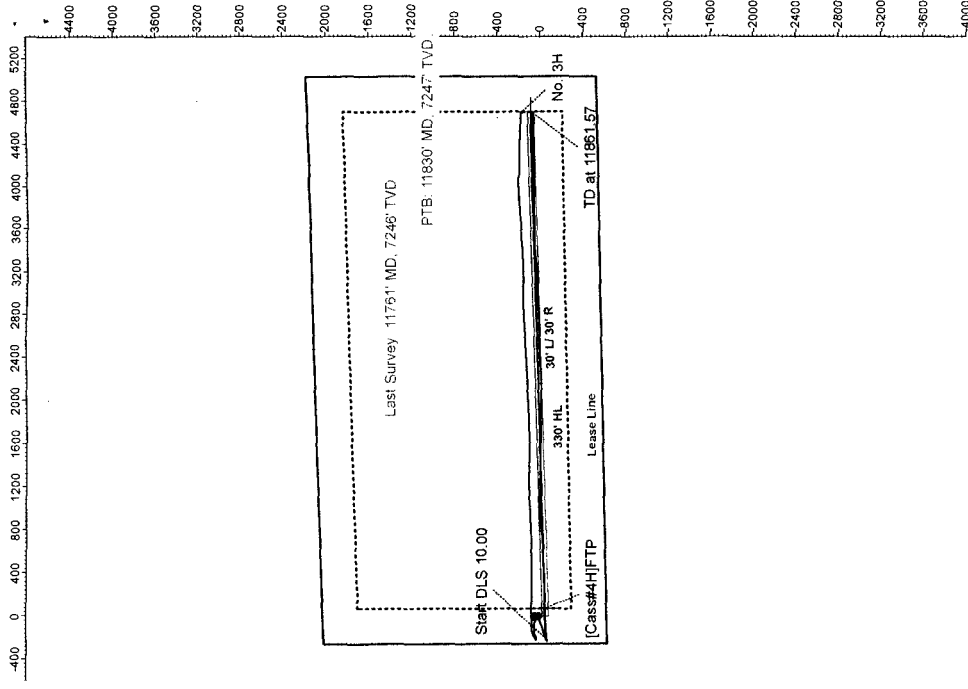
Sec	MD	Inc	Azi	TVD	+N/S	+E/W	Dleg	VSet
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	1500.00	0.00	0.00	1500.00	0.00	0.00	0.00	0.00
3	2166.67	5.00	251.08	2166.82	-9.43	-27.50	0.75	-27.78
4	4130.13	5.00	251.08	4121.81	-84.93	-188.38	0.00	-191.36
5	4630.13	0.00	0.00	4621.18	-72.00	-210.00	1.00	-212.20
6	5211.85	0.00	0.00	5211.85	-72.00	-210.00	0.00	-212.20
7	5921.85	88.16	88.16	5921.85	-53.96	-458.72	0.00	-458.72
8	11661.57	88.00	88.16	7322.03	85.36	4699.39	0.00	4699.39

WELLBORE TARGET DETAILS (MAP CO-ORDINATES)

Name	TVD	+N/S	+E/W	North	East
[Cass#4]JFTP	0.00	-63.53	73.86	475183.82	540574.39
[Cass#4]JLTP/BHL	7262.03	85.38	4699.39	475332.73	545199.92



West(-)/East(+) (400 usft/in)



Azimuths to Grid North
 True North: 0.07°
 Magnetic North: 7.35°
 Magnetic Field
 Strength: 46057.3nT
 Dip Angle: 60.10°
 Declination: 7.35° East
 Model: IGSN

Azimuth Corrections

Total Magnetic Corr. (M to G): 7.35°
 Declination (M to T): 7.42° East

Last Survey 11761' MD, 7246' TVD
 PTB: 11830' MD, 7247' TVD

TD at 11861.57

Vertical Section at 88.16° (200 usft/in)