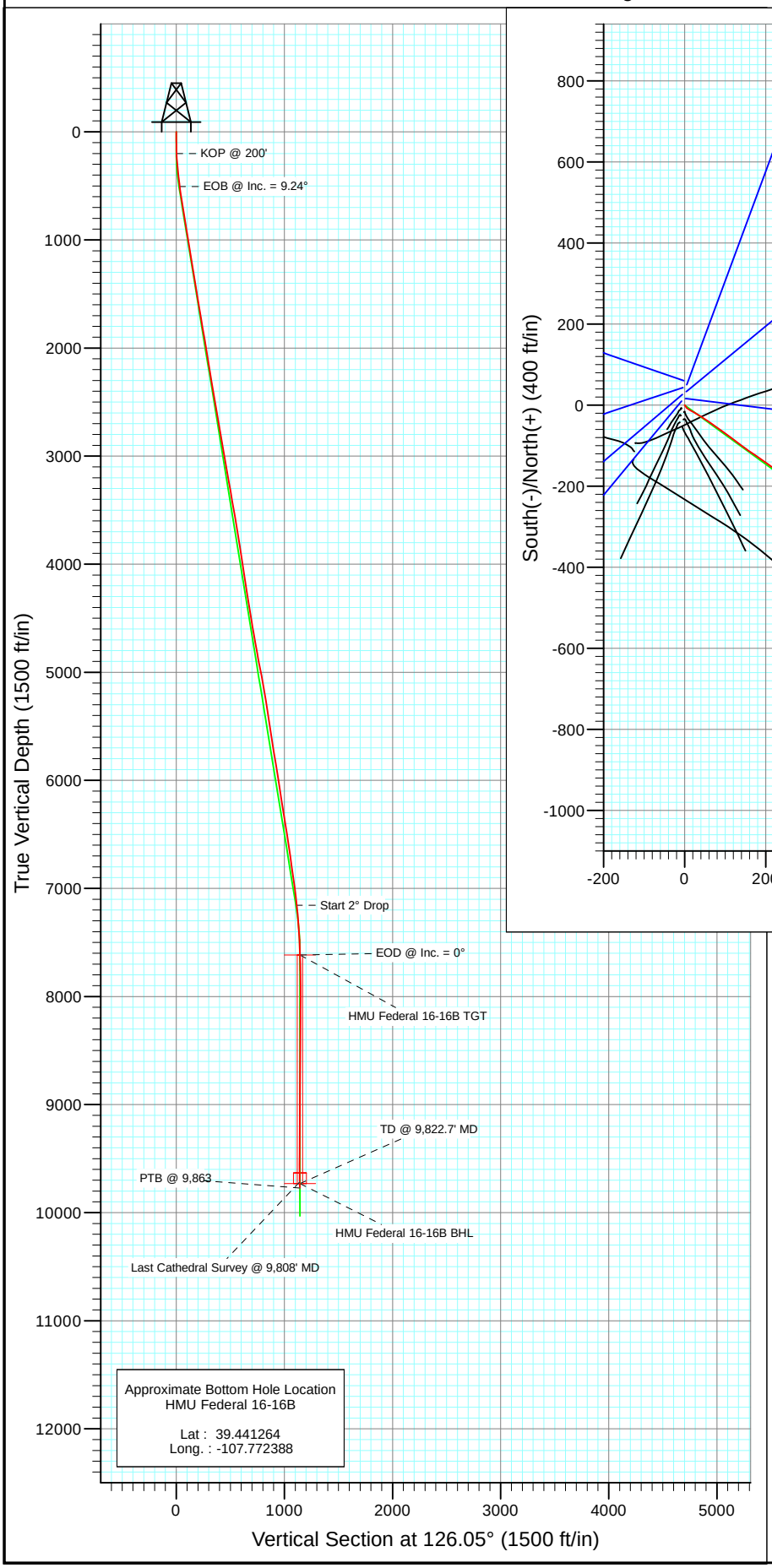
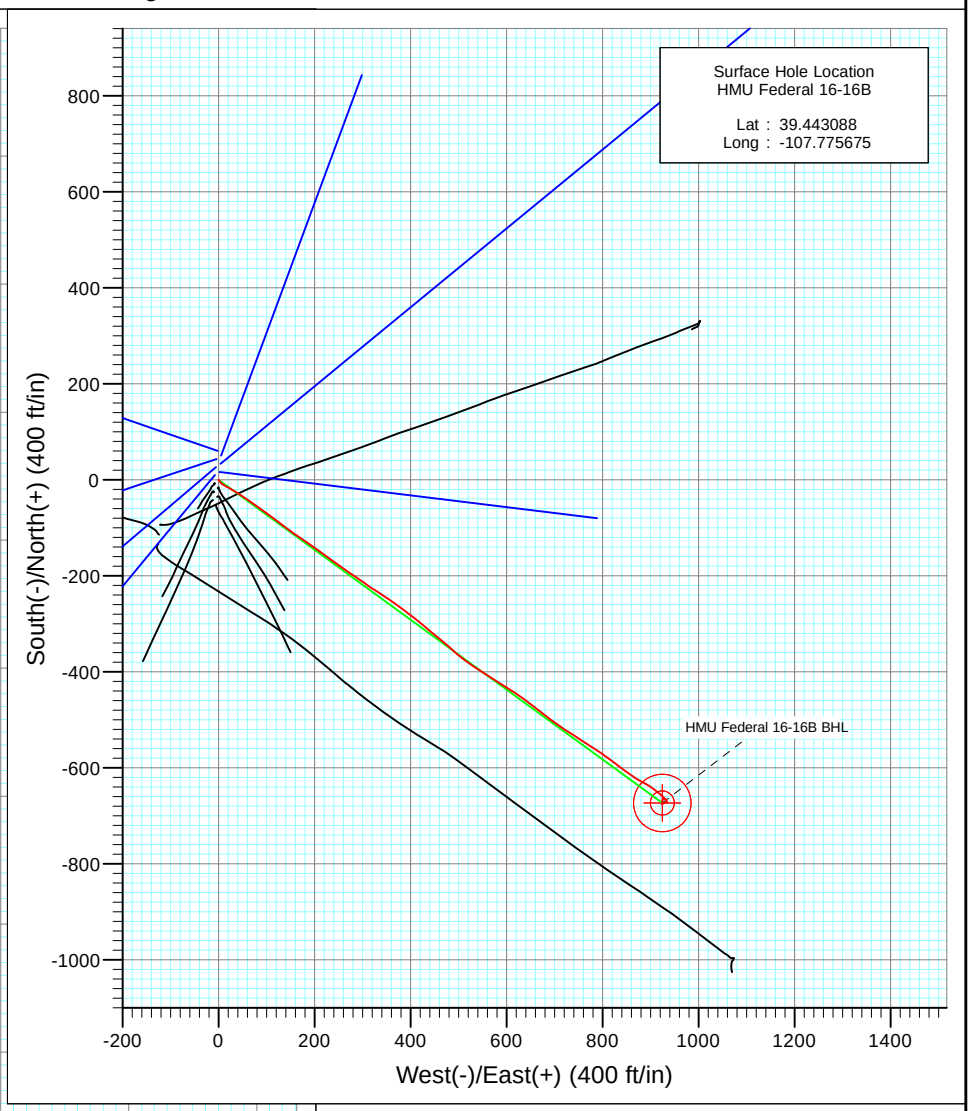
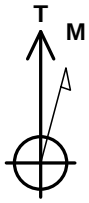
encana natural gas

Project: Mamm Creek
Site: J16W Pad
Well: HMU Federal 16-16B
Wellbore: DD
Design: Final

CATHEDRAL







Azimuths to True North
Magnetic North: 10.15°

Magnetic Field
Strength: 52162.5snT
Dip Angle: 65.72°
Date: 3/9/2012
Model: IGRF2010

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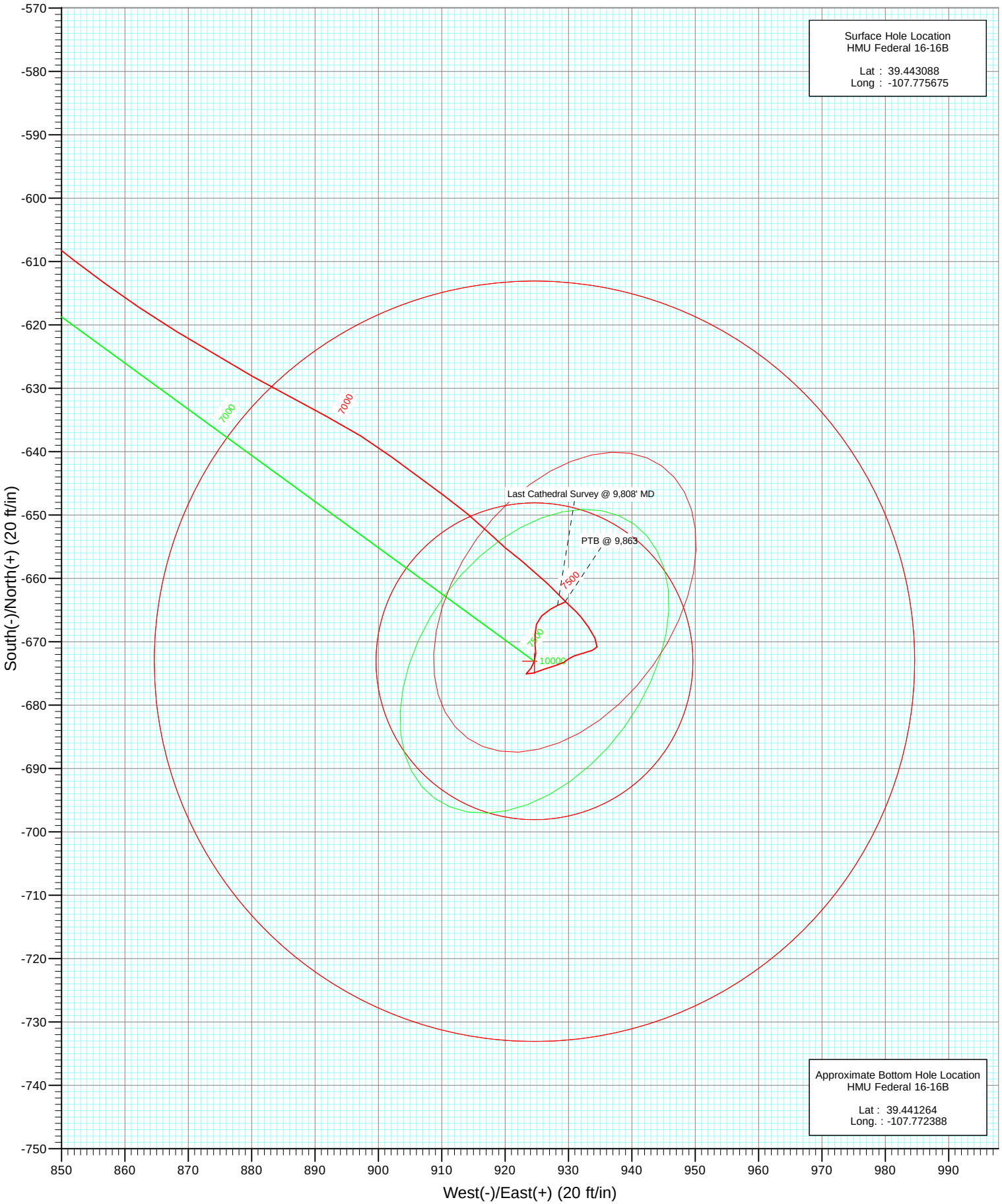

Cathedral Energy Services

Survey Report

Company:	EnCana Oil & Gas (USA) Inc	**Local Co-ordinate Reference:**	Well HMU Federal 16-16B
Project:	Mamm Creek	**TVD Reference:**	WELL @ 7667.0ft (Nabors M11)
Site:	J16W Pad	**MD Reference:**	WELL @ 7667.0ft (Nabors M11)
Well:	HMU Federal 16-16B	**North Reference:**	True
Wellbore:	DD	**Survey Calculation Method:**	Minimum Curvature
Design:	DD	**Database:**	USA EDM 5000 Multi Users DB

Project Mamm Creek

Map System:	US State Plane 1983	**System Datum:**	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	Colorado Central Zone		

Site J16W Pad

Site Position:		**Northing:**	1,594,381.52 ft	**Latitude:**	39.443239
From:	Lat/Long	**Easting:**	2,357,395.39 ft	**Longitude:**	-107.775670
Position Uncertainty:	0.0 ft	**Slot Radius:**	13.200 in	**Grid Convergence:**	-1.44 °

Well HMU Federal 16-16B

Well Position	**+N/-S**	0.0 ft	**Northing:**	1,594,326.56 ft	**Latitude:**	39.443088
	+E/-W	0.0 ft	**Easting:**	2,357,392.60 ft	**Longitude:**	-107.775675
Position Uncertainty		0.0 ft	**Wellhead Elevation:**	ft	**Ground Level:**	7,645.0 ft

Wellbore DD

Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	3/9/2012	10.15	65.72	52,162

Design DD

Audit Notes:

Version:	1.0	**Phase:**	ACTUAL	**Tie On Depth:**	0.0

Vertical Section:	Depth From (TVD) (ft)	+N/-S (ft)	+E/-W (ft)	Direction (°)
	0.0	0.0	0.0	126.05

Survey Program **Date** 3/23/2012

From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description
81.0	9,863.0	Survey #1 (DD)	MWD	Geolink MWD

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	
81.0	0.40	117.10	81.0	-0.1	0.3	0.3	0.49	0.49	
112.0	0.80	130.30	112.0	-0.3	0.5	0.6	1.36	1.29	
143.0	0.80	155.40	143.0	-0.7	0.8	1.0	1.12	0.00	
173.0	1.50	138.80	173.0	-1.1	1.1	1.6	2.56	2.33	
204.0	2.50	148.40	204.0	-2.0	1.7	2.6	3.39	3.23	
235.0	4.00	142.10	234.9	-3.5	2.8	4.3	4.97	4.84	
265.0	4.30	141.40	264.8	-5.2	4.1	6.3	1.01	1.00	
295.0	4.50	137.70	294.8	-6.9	5.6	8.6	1.16	0.67	
325.0	5.10	121.70	324.6	-8.5	7.5	11.1	4.87	2.00	
357.0	5.60	127.10	356.5	-10.2	10.0	14.0	2.22	1.56	
388.0	5.90	117.70	387.4	-11.8	12.6	17.1	3.18	0.97	
419.0	6.30	117.20	418.2	-13.3	15.5	20.4	1.30	1.29	

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Survey Report

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Project:	Mamm Creek	**TVD Reference:**	WELL @ 7667.0ft (Nabors M11)
Site:	J16W Pad	**MD Reference:**	WELL @ 7667.0ft (Nabors M11)
Well:	HMU Federal 16-16B	**North Reference:**	True
Wellbore:	DD	**Survey Calculation Method:**	Minimum Curvature
Design:	DD	**Database:**	USA EDM 5000 Multi Users DB

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments
450.0	7.30	117.80	449.0	-15.0	18.8	24.0	3.23	3.23	
480.0	7.30	118.50	478.7	-16.8	22.1	27.8	0.30	0.00	
572.0	8.30	121.70	569.9	-23.1	32.9	40.2	1.18	1.09	
664.0	9.20	124.10	660.8	-30.7	44.7	54.2	1.06	0.98	
755.0	9.00	124.40	750.6	-38.8	56.6	68.6	0.23	-0.22	
848.0	9.80	122.90	842.4	-47.2	69.2	83.7	0.90	0.86	
939.0	9.10	126.10	932.2	-55.7	81.5	98.7	0.96	-0.77	
1,031.0	9.20	126.90	1,023.0	-64.4	93.3	113.3	0.18	0.11	
1,123.0	9.60	125.80	1,113.8	-73.3	105.4	128.3	0.48	0.43	
1,214.0	8.50	127.30	1,203.6	-81.8	116.9	142.6	1.24	-1.21	
1,306.0	9.30	127.20	1,294.5	-90.4	128.2	156.9	0.87	0.87	
1,398.0	9.30	126.60	1,385.3	-99.3	140.1	171.7	0.11	0.00	
1,490.0	9.60	126.10	1,476.1	-108.3	152.3	186.8	0.34	0.33	
1,525.0	9.80	125.70	1,510.6	-111.7	157.0	192.7	0.60	0.57	
1,646.0	9.80	123.90	1,629.8	-123.5	174.0	213.3	0.25	0.00	
1,741.0	9.60	123.60	1,723.4	-132.4	187.3	229.3	0.22	-0.21	
1,836.0	9.30	125.20	1,817.1	-141.2	200.1	244.9	0.42	-0.32	
1,932.0	9.10	127.10	1,911.9	-150.3	212.5	260.3	0.38	-0.21	
2,027.0	9.10	126.50	2,005.7	-159.3	224.6	275.3	0.10	0.00	
2,122.0	9.70	125.10	2,099.4	-168.3	237.1	290.8	0.68	0.63	
2,217.0	9.50	125.30	2,193.1	-177.5	250.1	306.6	0.21	-0.21	
2,313.0	9.40	125.20	2,287.8	-186.6	263.0	322.4	0.11	-0.10	
2,408.0	9.10	124.20	2,381.6	-195.2	275.5	337.7	0.36	-0.32	
2,503.0	9.90	124.20	2,475.3	-204.1	288.5	353.3	0.84	0.84	
2,598.0	10.10	125.30	2,568.8	-213.5	302.0	369.8	0.29	0.21	
2,693.0	9.80	124.90	2,662.4	-222.9	315.5	386.2	0.32	-0.32	
2,789.0	9.30	121.60	2,757.1	-231.6	328.8	402.1	0.77	-0.52	
2,883.0	10.10	124.60	2,849.7	-240.3	342.0	418.0	1.01	0.85	
2,979.0	10.00	124.90	2,944.2	-249.9	355.8	434.7	0.12	-0.10	
3,074.0	10.20	122.70	3,037.8	-259.1	369.6	451.3	0.46	0.21	
3,169.0	10.40	129.80	3,131.2	-269.2	383.3	468.3	1.35	0.21	
3,265.0	9.60	127.00	3,225.8	-279.5	396.4	484.9	0.97	-0.83	
3,360.0	9.20	126.30	3,319.5	-288.8	408.8	500.5	0.44	-0.42	
3,455.0	10.20	130.00	3,413.2	-298.7	421.4	516.4	1.24	1.05	
3,550.0	10.10	130.60	3,506.7	-309.5	434.1	533.1	0.15	-0.11	
3,646.0	9.80	129.40	3,601.2	-320.2	446.8	549.7	0.38	-0.31	
3,741.0	9.50	128.60	3,694.9	-330.2	459.2	565.6	0.35	-0.32	
3,835.0	9.00	129.90	3,787.7	-339.8	470.9	580.7	0.58	-0.53	
3,930.0	8.70	131.50	3,881.5	-349.3	482.0	595.2	0.41	-0.32	
4,026.0	8.60	131.90	3,976.4	-358.9	492.8	609.6	0.12	-0.10	
4,121.0	8.40	131.30	4,070.4	-368.2	503.3	623.6	0.23	-0.21	
4,217.0	9.30	124.40	4,165.2	-377.2	515.0	638.3	1.45	0.94	
4,312.0	8.40	123.70	4,259.1	-385.4	527.1	652.9	0.95	-0.95	
4,407.0	9.90	124.50	4,352.9	-393.9	539.6	668.0	1.58	1.58	
4,502.0	9.40	122.80	4,446.6	-402.7	552.8	683.9	0.61	-0.53	
4,597.0	8.80	122.30	4,540.4	-410.8	565.5	698.9	0.64	-0.63	
4,693.0	10.30	122.40	4,635.0	-419.3	578.9	714.8	1.56	1.56	
4,789.0	10.40	121.80	4,729.5	-428.5	593.5	732.0	0.15	0.10	
4,884.0	9.40	121.20	4,823.1	-437.0	607.5	748.3	1.06	-1.05	
4,979.0	11.00	125.80	4,916.6	-446.3	621.5	765.1	1.89	1.68	
5,075.0	10.70	126.10	5,010.8	-456.9	636.1	783.2	0.32	-0.31	
5,170.0	11.10	125.50	5,104.1	-467.5	650.7	801.1	0.44	0.42	
5,265.0	9.60	128.60	5,197.6	-477.7	664.3	818.2	1.68	-1.58	

Cathedral Energy Services

Survey Report

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Project:	Mamm Creek	**TVD Reference:**	WELL @ 7667.0ft (Nabors M11)
Site:	J16W Pad	**MD Reference:**	WELL @ 7667.0ft (Nabors M11)
Well:	HMU Federal 16-16B	**North Reference:**	True
Wellbore:	DD	**Survey Calculation Method:**	Minimum Curvature
Design:	DD	**Database:**	USA EDM 5000 Multi Users DB

Survey

Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments
5,361.0	9.00	128.40	5,292.3	-487.4	676.4	833.7	0.63	-0.62	
5,457.0	8.20	129.70	5,387.2	-496.4	687.6	848.0	0.86	-0.83	
5,552.0	8.30	125.60	5,481.2	-504.7	698.4	861.7	0.63	0.11	
5,646.0	8.30	122.50	5,574.3	-512.3	709.6	875.2	0.48	0.00	
5,742.0	10.00	123.20	5,669.0	-520.6	722.4	890.5	1.77	1.77	
5,837.0	9.80	122.90	5,762.6	-529.5	736.1	906.8	0.22	-0.21	
5,933.0	9.20	123.90	5,857.3	-538.2	749.3	922.6	0.65	-0.62	
6,028.0	9.00	122.80	5,951.1	-546.5	761.9	937.6	0.28	-0.21	
6,124.0	7.80	122.60	6,046.1	-554.1	773.7	951.6	1.25	-1.25	
6,220.0	8.80	123.10	6,141.1	-561.6	785.3	965.4	1.04	1.04	
6,276.0	9.30	124.10	6,196.4	-566.5	792.7	974.2	0.94	0.89	
6,315.0	9.20	126.00	6,234.9	-570.1	797.8	980.5	0.82	-0.26	
6,411.0	9.40	124.10	6,329.6	-579.0	810.5	996.0	0.38	0.21	
6,506.0	9.40	125.80	6,423.3	-587.9	823.2	1,011.5	0.29	0.00	
6,601.0	8.80	127.50	6,517.1	-596.8	835.3	1,026.6	0.69	-0.63	
6,697.0	8.40	128.40	6,612.1	-605.6	846.6	1,040.9	0.44	-0.42	
6,792.0	7.40	126.00	6,706.2	-613.6	857.0	1,053.9	1.11	-1.05	
6,888.0	8.70	122.00	6,801.2	-621.0	868.1	1,067.4	1.47	1.35	
6,983.0	8.20	119.00	6,895.2	-628.1	880.2	1,081.3	0.70	-0.53	
7,079.0	7.70	117.80	6,990.3	-634.4	891.8	1,094.4	0.55	-0.52	
7,174.0	6.90	126.40	7,084.5	-640.8	902.1	1,106.4	1.42	-0.84	
7,269.0	5.70	126.40	7,178.9	-647.0	910.5	1,116.9	1.26	-1.26	
7,365.0	4.80	133.60	7,274.5	-652.6	917.2	1,125.6	1.16	-0.94	
7,460.0	3.70	126.80	7,369.2	-657.2	922.5	1,132.6	1.27	-1.16	
7,555.0	3.10	136.70	7,464.1	-660.9	926.8	1,138.2	0.88	-0.63	
7,649.0	2.30	132.20	7,558.0	-664.0	929.9	1,142.6	0.88	-0.85	
7,707.1	1.69	136.33	7,616.0	-665.4	931.3	1,144.6	1.08	-1.05	**HMU Federal 16-16B TGT**
7,745.0	1.30	141.10	7,653.9	-666.1	932.0	1,145.5	1.08	-1.03	
7,839.0	1.00	146.10	7,747.9	-667.6	933.1	1,147.3	0.34	-0.32	
7,934.0	1.50	150.90	7,842.9	-669.4	934.2	1,149.2	0.54	0.53	
8,030.0	0.50	225.00	7,938.9	-670.8	934.5	1,150.3	1.51	-1.04	
8,125.0	0.60	239.00	8,033.9	-671.4	933.8	1,150.1	0.18	0.11	
8,220.0	1.10	260.30	8,128.9	-671.8	932.5	1,149.2	0.61	0.53	
8,316.0	0.80	244.50	8,224.8	-672.2	931.0	1,148.3	0.41	-0.31	
8,409.0	0.40	236.30	8,317.8	-672.7	930.1	1,147.8	0.44	-0.43	
8,504.0	0.80	234.40	8,412.8	-673.2	929.3	1,147.5	0.42	0.42	
8,599.0	1.00	260.70	8,507.8	-673.8	927.9	1,146.7	0.48	0.21	
8,695.0	1.00	243.80	8,603.8	-674.3	926.3	1,145.8	0.31	0.00	
8,790.0	1.40	255.20	8,698.8	-674.9	924.5	1,144.6	0.49	0.42	
8,886.0	0.20	355.90	8,794.8	-675.1	923.3	1,143.8	1.51	-1.25	
8,981.0	0.40	59.00	8,889.8	-674.7	923.6	1,143.8	0.38	0.21	
9,077.0	0.50	28.90	8,985.8	-674.2	924.1	1,143.9	0.26	0.10	
9,172.0	0.90	22.40	9,080.8	-673.1	924.6	1,143.7	0.43	0.42	
9,268.0	0.70	358.00	9,176.8	-671.8	924.9	1,143.1	0.41	-0.21	
9,363.0	1.00	353.00	9,271.7	-670.4	924.7	1,142.2	0.33	0.32	
9,458.0	1.00	8.70	9,366.7	-668.8	924.8	1,141.3	0.29	0.00	
9,554.0	0.90	7.30	9,462.7	-667.2	925.0	1,140.5	0.11	-0.10	
9,649.0	1.10	51.40	9,557.7	-665.9	925.8	1,140.4	0.81	0.21	
9,744.0	1.00	55.10	9,652.7	-664.9	927.2	1,140.9	0.13	-0.11	
9,808.0	1.30	65.90	9,716.7	-664.3	928.3	1,141.4	0.58	0.47	**Last Cathedral Survey @ 9,808' MD - HMU Fede**
9,863.0	1.30	65.90	9,771.7	-663.8	929.4	1,142.1	0.00	0.00	**PTB @ 9,863**

Cathedral Energy Services

Survey Report

Company:	EnCana Oil & Gas (USA) Inc	**Local Co-ordinate Reference:**	Well HMU Federal 16-16B
Project:	Mamm Creek	**TVD Reference:**	WELL @ 7667.0ft (Nabors M11)
Site:	J16W Pad	**MD Reference:**	WELL @ 7667.0ft (Nabors M11)
Well:	HMU Federal 16-16B	**North Reference:**	True
Wellbore:	DD	**Survey Calculation Method:**	Minimum Curvature
Design:	DD	**Database:**	USA EDM 5000 Multi Users DB

Targets

Target Name - hit/miss target - Shape	Dip Angle (°)	Dip Dir. (°)	TVD (ft)	+N/-S (ft)	+E/-W (ft)	Northing (ft)	Easting (ft)	Latitude	Longitude
HMU Federal 16-16B TC	0.00	0.00	7,616.0	-673.1	924.6	1,593,630.54	2,358,300.09	39.441240	-107.772401
- actual wellpath misses target center by 10.2ft at 7707.1ft MD (7616.0 TVD, -665.4 N, 931.3 E)									
- Circle (radius 25.0)									
HMU Federal 16-16B BH	0.00	0.00	9,732.0	-673.1	924.6	1,593,630.54	2,358,300.09	39.441240	-107.772401
- actual wellpath misses target center by 18.1ft at 9808.0ft MD (9716.7 TVD, -664.3 N, 928.3 E)									
- Circle (radius 60.0)									

Design Annotations

Measured Depth (ft)	Vertical Depth (ft)	Local Coordinates +N/-S (ft)	Local Coordinates +E/-W (ft)	Comment
9,808.0	9,716.7	-664.3	928.3	Last Cathedral Survey @ 9,808' MD
9,863.0	9,771.7	-663.8	929.4	PTB @ 9,863

Checked By: _____ Approved By: _____ Date: _____