

30-015-41429



Scientific Drilling

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Legend Natural Gas

Eddy County, New Mexico

State GQ

State GQ 4H

Original Wellpath

Design: Original Wellpath

Standard Survey Report

19 July, 2013



Scientific Drilling

www.scientificdrilling.com

Company:	Legend Natural Gas	Local Co-ordinate Reference:	Well State GQ 4H
Project:	Eddy County, New Mexico	TVD Reference:	KB @ 3083.6usft (Patterson 444)
Site:	State GQ	MD Reference:	KB @ 3083.6usft (Patterson 444)
Well:	State GQ 4H	North Reference:	Grid
Wellbore:	Original Wellpath	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellpath	Database:	CompassC

Project:	Eddy County, New Mexico		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	New Mexico Eastern Zone		

Site						State.GO											
Site Position:			Northing:			418,855.50 usft			Latitude:			32° 9' 4.822 N					
From:			Map			Easting:			606,046.40 usft			Longitude:			104° 7' 27.275 W		
Position Uncertainty:			0.0 usft			Slot Radius:			13-3/16 "			Grid Convergence:			0.11 °		

Well:	State GQ 4H					
Well Position	+N/-S	0.0 usft	Northing:	418,855.50 usft	Latitude:	32° 9' 4.822 N
	+E/-W	0.0 usft	Easting:	606,046.40 usft	Longitude:	104° 7' 27.275 W
Position Uncertainty		0.0 usft	Wellhead Elevation:	usft	Ground Level:	3,054.0 usft

Wellbore					
Original Wellpath					
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	7/8/2013	7.58	59.97	48,308

Design		Original Wellpath			
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	184.74	

Survey Program		Date 7/19/2013		
From (usft)	To (usft)	Survey (Wellbore)	Tool Name	Description
200.0	7,115.0	SDI Gyro (Original Wellpath)	SRG-GYRO-MS	surface readout gyro multishot
7,139.0	12,590.0	SDI MWD (Original Wellpath)	MWD	MWD - Standard

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)
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00
200.0	0.56	346.52	200.0	1.0	-0.2	-0.9	0.28	0.28	0.00
400.0	0.74	276.90	400.0	2.1	-1.7	-1.9	0.38	0.09	-34.81
600.0	0.68	250.69	600.0	1.8	-4.1	-1.5	0.16	-0.03	-13.11
800.0	0.61	253.74	800.0	1.1	-6.3	-0.6	0.04	-0.04	1.53
1,000.0	1.65	292.46	999.9	1.9	-10.0	-1.1	0.62	0.52	19.36
1,200.0	2.20	351.57	1,199.8	6.8	-13.2	-5.7	0.98	0.28	29.56
1,400.0	2.45	19.62	1,399.7	14.7	-12.3	-13.6	0.58	0.13	14.03
1,600.0	4.12	27.44	1,599.3	25.1	-7.6	-24.3	0.86	0.84	3.91
1,800.0	4.25	55.69	1,798.8	35.6	1.9	-35.6	1.02	0.07	14.13

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Wellbore:	Original Wellpath	Survey Calculation Method:	Minimum Curvature
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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)
2,000.0	4.60	78.30	1,998.2	41.4	15.8	-42.6	0.88	0.18	11.31
2,200.0	5.78	104.30	2,197.4	40.6	33.5	-43.2	1.30	0.59	13.00
2,400.0	4.19	103.56	2,396.7	36.4	50.3	-40.4	0.80	-0.80	-0.37
2,600.0	2.30	106.28	2,596.3	33.5	61.3	-38.5	0.95	-0.95	1.36
2,800.0	1.80	114.36	2,796.2	31.1	68.0	-36.6	0.29	-0.25	4.04
3,000.0	1.32	120.72	2,996.1	28.6	72.8	-34.5	0.25	-0.24	3.18
3,200.0	1.20	124.36	3,196.1	26.3	76.5	-32.5	0.07	-0.06	1.82
3,400.0	0.81	127.96	3,396.1	24.2	79.4	-30.7	0.20	-0.20	1.80
3,600.0	0.55	142.34	3,596.1	22.6	81.1	-29.2	0.15	-0.13	7.19
3,800.0	0.47	142.67	3,796.0	21.2	82.2	-27.9	0.04	-0.04	0.17
4,000.0	0.51	132.43	3,996.0	19.9	83.3	-26.7	0.05	0.02	-5.12
4,200.0	0.31	144.15	4,196.0	18.9	84.3	-25.8	0.11	-0.10	5.86
4,400.0	0.46	142.22	4,396.0	17.8	85.1	-24.8	0.08	0.08	-0.97
4,600.0	0.56	180.89	4,596.0	16.2	85.6	-23.2	0.18	0.05	19.34
4,800.0	0.39	196.49	4,796.0	14.6	85.4	-21.6	0.11	-0.09	7.80
5,000.0	0.41	209.93	4,996.0	13.3	84.8	-20.3	0.05	0.01	6.72
5,200.0	0.56	162.43	5,196.0	11.7	84.8	-18.7	0.21	0.08	-23.75
5,400.0	0.61	149.43	5,396.0	9.9	85.6	-16.9	0.07	0.03	-6.50
5,600.0	0.64	177.73	5,596.0	7.9	86.2	-15.0	0.15	0.02	14.15
5,800.0	0.97	175.80	5,796.0	5.1	86.3	-12.2	0.17	0.17	-0.97
5,981.1	0.85	192.41	5,977.0	2.2	86.2	-9.3	0.16	-0.07	9.17
Bone Springs Top									
6,000.0	0.84	194.39	5,995.9	1.9	86.1	-9.1	0.16	-0.04	10.45
6,134.1	1.55	216.97	6,130.0	-0.5	84.8	-6.6	0.62	0.53	16.84
BS Avalon Upper									
6,200.0	1.93	221.68	6,195.9	-2.0	83.5	-4.9	0.62	0.58	7.15
6,265.2	1.86	227.61	6,261.0	-3.5	82.0	-3.3	0.32	-0.11	9.09
BN Sprng Sh Top									
6,400.0	1.78	241.00	6,395.8	-6.0	78.5	-0.5	0.32	-0.06	9.93
6,416.2	1.68	240.45	6,412.0	-6.3	78.1	-0.2	0.64	-0.63	-3.41
BN Sprng B Ls Top									
6,562.3	0.77	228.84	6,558.0	-8.0	75.5	1.7	0.64	-0.62	-7.95
BN Sprng B Ls BS									
6,600.0	0.55	219.72	6,595.7	-8.3	75.2	2.0	0.64	-0.58	-24.17
6,710.3	0.36	212.50	6,706.0	-9.0	74.7	2.7	0.18	-0.18	-6.55
BN Sprng Ca LS									
6,800.0	0.21	196.95	6,795.7	-9.3	74.5	3.2	0.18	-0.16	-17.33
6,954.3	0.79	347.10	6,950.0	-8.6	74.2	2.4	0.63	0.38	97.32
BN Sprng 1st Cedar									
7,000.0	1.08	348.74	6,995.7	-7.8	74.0	1.7	0.63	0.63	3.60
7,115.0	1.07	356.27	7,110.7	-5.7	73.7	-0.4	0.12	-0.01	6.55
7,139.0	0.84	306.97	7,134.7	-5.4	73.6	-0.7	3.43	-0.96	-205.42
7,170.0	2.80	260.92	7,165.7	-5.4	72.7	-0.7	7.41	6.32	-148.55
7,202.0	5.72	249.26	7,197.6	-6.1	70.4	0.2	9.47	9.13	-36.44

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Survey									
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7,234.0	10.11	250.14	7,229.3	-7.6	66.3	2.1	13.72	13.72	2.75
7,263.3	13.42	253.19	7,258.0	-9.4	60.6	4.4	11.47	11.28	10.38
BN Sprgn 1st Cedar Bs									
7,266.0	13.72	253.39	7,260.6	-9.6	60.0	4.6	11.47	11.33	7.68
7,298.0	16.32	255.54	7,291.5	-11.8	52.0	7.5	8.31	8.13	6.72
7,329.0	18.52	254.37	7,321.1	-14.2	43.0	10.6	7.19	7.10	-3.77
7,360.0	20.48	251.38	7,350.3	-17.3	33.1	14.5	7.09	6.32	-9.65
7,392.0	22.51	249.70	7,380.1	-21.2	22.1	19.3	6.63	6.34	-5.25
7,423.0	24.45	247.85	7,408.5	-25.7	10.6	24.7	6.69	6.26	-5.97
7,455.0	27.70	248.73	7,437.2	-30.9	-2.5	31.0	10.23	10.16	2.75
7,486.0	30.16	249.96	7,464.4	-36.2	-16.5	37.4	8.16	7.94	3.97
7,518.0	31.83	250.93	7,491.8	-41.7	-32.0	44.2	5.45	5.22	3.03
7,549.0	33.68	252.07	7,517.9	-47.0	-47.9	50.8	6.29	5.97	3.68
7,581.0	36.40	251.63	7,544.0	-52.7	-65.4	57.9	8.54	8.50	-1.38
7,612.0	40.10	251.81	7,568.4	-58.7	-83.6	65.5	11.94	11.94	0.58
7,644.0	43.70	251.98	7,592.2	-65.4	-103.9	73.7	11.26	11.25	0.53
7,676.0	46.37	251.44	7,614.8	-72.5	-125.4	82.6	8.43	8.34	-1.69
7,708.0	46.70	247.20	7,636.8	-80.7	-147.1	92.6	9.67	1.03	-13.25
7,739.0	46.22	241.80	7,658.2	-90.3	-167.4	103.9	12.72	-1.55	-17.42
7,741.6	46.19	241.35	7,660.0	-91.2	-169.1	104.9	12.50	-1.23	-17.23
CC BR 8000 SH									
7,771.0	45.95	236.26	7,680.4	-102.2	-187.2	117.3	12.50	-0.81	-17.32
7,802.0	45.99	231.15	7,702.0	-115.4	-205.1	131.9	11.85	0.13	-16.48
7,829.4	47.71	228.51	7,720.7	-128.3	-220.4	146.1	9.44	6.29	-9.64
330 Entry 7829.4									
7,834.0	48.01	228.08	7,723.8	-130.6	-222.9	148.5	9.44	6.42	-9.33
7,866.0	50.65	226.67	7,744.6	-147.0	-240.8	166.4	8.90	8.25	-4.41
7,897.0	52.98	225.72	7,763.8	-163.9	-258.4	184.7	7.89	7.52	-3.06
7,928.0	54.87	224.38	7,782.1	-181.6	-276.1	203.8	7.03	6.10	-4.32
7,958.0	56.72	222.44	7,798.9	-199.6	-293.1	223.1	8.16	6.17	-6.47
7,989.0	58.06	219.31	7,815.6	-219.3	-310.2	244.2	9.54	4.32	-10.10
8,021.0	60.11	217.61	7,832.1	-240.8	-327.3	267.1	7.86	6.41	-5.31
8,052.0	61.45	215.19	7,847.2	-262.6	-343.3	290.1	8.07	4.32	-7.81
4H PP									
8,084.0	62.73	213.20	7,862.2	-286.0	-359.2	314.7	6.80	4.00	-6.22
8,115.0	63.52	211.70	7,876.2	-309.3	-374.1	339.2	5.01	2.55	-4.84
8,147.0	64.43	209.37	7,890.2	-334.1	-388.7	365.1	7.13	2.84	-7.28
8,178.0	66.33	205.92	7,903.2	-359.1	-401.7	391.0	11.83	6.13	-11.13
8,210.0	67.80	201.97	7,915.6	-386.0	-413.7	418.9	12.26	4.59	-12.34
8,241.0	69.91	198.90	7,926.8	-413.1	-423.8	446.7	11.47	6.81	-9.90
8,273.0	72.19	195.29	7,937.2	-442.0	-432.7	476.3	12.83	7.13	-11.28
8,304.0	75.49	192.84	7,945.8	-470.9	-439.9	505.6	13.07	10.65	-7.90
8,336.0	78.90	190.42	7,952.9	-501.4	-446.2	536.6	12.96	10.66	-7.56
8,368.0	81.78	188.00	7,958.3	-532.6	-451.2	568.0	11.69	9.00	-7.56

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Design:	Original Wellpath	Database:	CompassC

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)
8,380.6	82.67	186.78	7,960.0	-545.0	-452.8	580.5	11.91	7.08	-9.67
Bone Springs 2nd Target									
8,399.0	83.98	185.01	7,962.1	-563.1	-454.7	598.8	11.91	7.11	-9.63
8,430.0	86.44	181.67	7,964.7	-594.0	-456.5	629.7	13.35	7.94	-10.77
8,476.0	90.22	177.89	7,966.1	-639.9	-456.3	675.5	11.62	8.22	-8.22
8,525.0	91.01	177.79	7,965.5	-688.9	-454.5	724.1	1.63	1.61	-0.20
8,621.0	91.63	177.89	7,963.3	-784.8	-450.9	819.4	0.65	0.65	0.10
8,717.0	90.30	177.68	7,961.7	-880.7	-447.2	914.7	1.40	-1.39	-0.22
8,812.0	90.81	177.59	7,960.8	-975.6	-443.2	1,008.9	0.55	0.54	-0.09
8,908.0	91.65	177.65	7,958.7	-1,071.5	-439.3	1,104.2	0.88	0.88	0.06
9,003.0	90.67	178.24	7,956.8	-1,166.4	-435.8	1,198.5	1.20	-1.03	0.62
9,097.0	91.36	178.24	7,955.1	-1,260.4	-433.0	1,291.8	0.73	0.73	0.00
9,192.0	89.25	179.12	7,954.6	-1,355.3	-430.8	1,386.3	2.41	-2.22	0.93
9,287.0	89.43	179.47	7,955.7	-1,450.3	-429.6	1,480.9	0.41	0.19	0.37
9,381.0	89.96	179.47	7,956.2	-1,544.3	-428.7	1,574.5	0.56	0.56	0.00
9,476.0	90.64	180.08	7,955.7	-1,639.3	-428.4	1,669.1	0.96	0.72	0.64
9,571.0	91.19	180.26	7,954.2	-1,734.3	-428.6	1,763.8	0.61	0.58	0.19
9,666.0	90.13	180.00	7,953.1	-1,829.3	-428.9	1,858.5	1.15	-1.12	-0.27
9,760.0	90.48	180.53	7,952.6	-1,923.3	-429.3	1,952.2	0.68	0.37	0.56
9,855.0	90.40	180.61	7,951.9	-2,018.3	-430.2	2,046.9	0.12	-0.08	0.08
9,950.0	90.17	180.52	7,951.4	-2,113.3	-431.2	2,141.7	0.26	-0.24	-0.09
10,045.0	90.40	180.88	7,950.9	-2,208.3	-432.3	2,236.4	0.45	0.24	0.38
10,140.0	91.25	181.21	7,949.6	-2,303.2	-434.1	2,331.2	0.96	0.89	0.35
10,234.0	90.10	181.29	7,948.5	-2,397.2	-436.1	2,425.1	1.23	-1.22	0.09
10,329.0	89.43	180.09	7,948.9	-2,492.2	-437.3	2,519.8	1.45	-0.71	-1.26
10,424.0	88.79	178.87	7,950.3	-2,587.2	-436.4	2,614.4	1.45	-0.67	-1.28
10,518.0	89.52	179.12	7,951.7	-2,681.2	-434.8	2,707.9	0.82	0.78	0.27
10,613.0	88.96	179.46	7,953.0	-2,776.1	-433.6	2,802.5	0.69	-0.59	0.36
10,708.0	89.08	179.65	7,954.6	-2,871.1	-432.8	2,897.1	0.24	0.13	0.20
10,803.0	89.40	180.08	7,955.9	-2,966.1	-432.6	2,991.7	0.56	0.34	0.45
10,896.0	89.73	180.23	7,956.6	-3,059.1	-432.9	3,084.4	0.39	0.35	0.16
10,990.0	89.63	179.43	7,957.1	-3,153.1	-432.6	3,178.1	0.86	-0.11	-0.85
11,085.0	90.00	179.08	7,957.4	-3,248.1	-431.4	3,272.6	0.54	0.39	-0.37
11,180.0	89.80	179.19	7,957.6	-3,343.1	-429.9	3,367.2	0.24	-0.21	0.12
11,275.0	90.07	179.19	7,957.7	-3,438.1	-428.6	3,461.7	0.28	0.28	0.00
11,369.0	89.16	177.48	7,958.3	-3,532.0	-425.8	3,555.1	2.06	-0.97	-1.82
11,464.0	88.46	177.18	7,960.3	-3,626.9	-421.4	3,649.3	0.80	-0.74	-0.32
11,559.0	87.75	177.17	7,963.4	-3,721.7	-416.7	3,743.5	0.75	-0.75	-0.01
11,654.0	87.45	176.83	7,967.4	-3,816.5	-411.8	3,837.5	0.48	-0.32	-0.36
11,749.0	87.49	176.91	7,971.6	-3,911.3	-406.6	3,931.5	0.09	0.04	0.08
11,843.0	88.35	176.75	7,975.0	-4,005.1	-401.4	4,024.6	0.93	0.91	-0.17
11,938.0	88.63	176.45	7,977.5	-4,099.9	-395.8	4,118.6	0.43	0.29	-0.32
12,033.0	88.69	176.73	7,979.7	-4,194.7	-390.1	4,212.6	0.30	0.06	0.29
12,127.0	89.46	176.27	7,981.3	-4,288.5	-384.4	4,305.6	0.95	0.82	-0.49

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Wellbore:	Original Wellpath	Survey Calculation Method:	Minimum Curvature
Design:	Original Wellpath	Database:	CompassC

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)
12,222.0	89.36	177.09	7,982.2	-4,383.3	-378.9	4,399.7	0.87	-0.11	0.86
12,317.0	88.15	176.81	7,984.3	-4,478.2	-373.8	4,493.8	1.31	-1.27	-0.29
12,412.0	88.52	176.94	7,987.1	-4,573.0	-368.6	4,587.8	0.41	0.39	0.14
12,473.0	88.52	176.94	7,988.6	-4,633.9	-365.4	4,648.2	0.00	0.00	0.00
12,507.0	87.34	177.48	7,989.9	-4,667.8	-363.7	4,681.9	3.82	-3.47	1.59
12,529.0	87.11	177.56	7,990.9	-4,689.8	-362.8	4,703.7	1.11	-1.05	0.36
SDI MWD									
12,584.6	86.53	177.76	7,994.0	-4,745.3	-360.5	4,758.8	1.11	-1.05	0.36
4H PBHL									
12,590.0	86.47	177.78	7,994.3	-4,750.6	-360.3	4,764.2	1.11	-1.05	0.36
Bit Projection									

Measured Depth (usft)	Vertical Depth (usft)	Name	Lithology	Dip (°)	Dip Direction (°)
5,981.1	5,977.0	Bone Springs Top			
6,134.1	6,130.0	BS Avalon Upper		0.00	
6,265.2	6,261.0	BN Sprng Sh Top			
6,416.2	6,412.0	BN Sprng B Ls Top		0.00	
6,562.3	6,558.0	BN Sprng B Ls BS		0.00	
6,710.3	6,706.0	BN Sprng Ca LS			
6,954.3	6,950.0	BN Sprng 1st Cedar		0.00	
7,263.3	7,258.0	BN Sprng 1st Cedar Bs			
7,741.6	7,660.0	CC BR 8000 SH			
8,380.6	7,960.0	Bone Springs 2nd Target			

Measured Depth (usft)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Comment
7,829.4	7,720.7	-128.3	-220.4	330' Entry 7829.4
12,529.0	7,990.9	-4,689.8	-362.8	SDI MWD
12,590.0	7,994.3	-4,750.6	-360.3	Bit Projection

Checked By: _____ Approved By: _____ Date: _____