

30-025-43655



COG Operating, LLC

Lea County, NM

Sec 17, T26S, R33E

Vast State #20H

Curve & Lateral

Plan: Design #2

QES Well Planning Report

24 February, 2017





Well Planning Report



Database:	EDM5002	Local Co-ordinate Reference:	Well Vast State #20H
Company:	COG Operating, LLC	TVD Reference:	KB @ 3283.0usft (Noram #21)
Project:	Lea County, NM	MD Reference:	KB @ 3283.0usft (Noram #21)
Site:	Sec 17, T26S, R33E	North Reference:	Grid
Well:	Vast State #20H	Survey Calculation Method:	Minimum Curvature
Wellbore:	Curve & Lateral		
Design:	Design #2		

Project	Lea 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	Sec 17, T26S, R33E				
Site Position:		Northing:	378,083.90 usft	Latitude:	32° 2' 14.178 N
From:	Map	Easting:	731,217.50 usft	Longitude:	103° 35' 13.794 W
Position Uncertainty:	0.0 usft	Slot Radius:	13-3/16 "	Grid Convergence:	0.40 °

Well	Vast State #20H					
Well Position	+N/-S	0.0 usft	Northing:	378,083.90 usft	Latitude:	32° 2' 14.178 N
	+E/-W	0.0 usft	Easting:	731,217.50 usft	Longitude:	103° 35' 13.794 W
Position Uncertainty		0.0 usft	Wellhead Elevation:	0.0 usft	Ground Level:	3,254.0 usft

Wellbore	Curve & Lateral				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2015	2/23/2017	6.98	59.89	47,859

Design	Design #2			
Audit Notes:				
Version:	Phase:	PLAN	Tie On Depth:	11,993.0
Vertical Section:	Depth From (TVD) (usft)	+N/-S (usft)	+E/-W (usft)	Direction (°)
	0.0	0.0	0.0	2.64

Plan Sections										
Measured Depth (usft)	Inclination (°)	Azimuth (°)	Vertical Depth (usft)	+N/-S (usft)	+E/-W (usft)	Dogleg Rate (°/100usft)	Build Rate (°/100usft)	Turn Rate (°/100usft)	TFO (°)	Target
11,993.0	0.00	0.00	11,975.8	-164.9	244.5	0.00	0.00	0.00	0.00	
12,013.0	1.00	359.66	11,995.8	-164.7	244.5	5.00	5.00	0.00	359.66	
12,761.5	90.82	359.66	12,464.9	319.5	241.6	12.00	12.00	0.00	0.00	
17,114.0	90.82	359.66	12,403.0	4,671.5	215.5	0.00	0.00	0.00	0.00	PBHL Vast State #20H



Well Planning Report



Database:	EDM5002	Local Co-ordinate Reference:	Well Vast State #20H
Company:	COG Operating, LLC	TVD Reference:	KB @ 3283.0usft (Noram #21)
Project:	Lea County, NM	MD Reference:	KB @ 3283.0usft (Noram #21)
Site:	Sec 17, T26S, R33E	North Reference:	Grid
Well:	Vast State #20H	Survey Calculation Method:	Minimum Curvature
Wellbore:	Curve & Lateral		
Design:	Design #2		

Planned 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)	
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.00	
100.0	0.00	0.00	100.0	0.0	0.0	0.0	0.00	0.00	0.00	
200.0	0.00	0.00	200.0	0.0	0.0	0.0	0.00	0.00	0.00	
300.0	0.00	0.00	300.0	0.0	0.0	0.0	0.00	0.00	0.00	
400.0	0.00	0.00	400.0	0.0	0.0	0.0	0.00	0.00	0.00	
500.0	0.00	0.00	500.0	0.0	0.0	0.0	0.00	0.00	0.00	
600.0	0.00	0.00	600.0	0.0	0.0	0.0	0.00	0.00	0.00	
700.0	0.00	0.00	700.0	0.0	0.0	0.0	0.00	0.00	0.00	
800.0	0.00	0.00	800.0	0.0	0.0	0.0	0.00	0.00	0.00	
Rustler										
803.0	0.00	0.00	803.0	0.0	0.0	0.0	0.00	0.00	0.00	
900.0	0.00	0.00	900.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,000.0	0.00	0.00	1,000.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,100.0	0.00	0.00	1,100.0	0.0	0.0	0.0	0.00	0.00	0.00	
TOS										
1,163.0	0.00	0.00	1,163.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,200.0	0.00	0.00	1,200.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,300.0	0.00	0.00	1,300.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,400.0	0.00	0.00	1,400.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,500.0	0.00	0.00	1,500.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,600.0	0.00	0.00	1,600.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,700.0	0.00	0.00	1,700.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,800.0	0.00	0.00	1,800.0	0.0	0.0	0.0	0.00	0.00	0.00	
1,900.0	0.00	0.00	1,900.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,000.0	0.00	0.00	2,000.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,100.0	0.00	0.00	2,100.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,200.0	0.00	0.00	2,200.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,300.0	0.00	0.00	2,300.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,400.0	0.00	0.00	2,400.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,500.0	0.00	0.00	2,500.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,600.0	0.00	0.00	2,600.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,700.0	0.00	0.00	2,700.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,800.0	0.00	0.00	2,800.0	0.0	0.0	0.0	0.00	0.00	0.00	
2,900.0	0.00	0.00	2,900.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,000.0	0.00	0.00	3,000.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,100.0	0.00	0.00	3,100.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,200.0	0.00	0.00	3,200.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,300.0	0.00	0.00	3,300.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,400.0	0.00	0.00	3,400.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,500.0	0.00	0.00	3,500.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,600.0	0.00	0.00	3,600.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,700.0	0.00	0.00	3,700.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,800.0	0.00	0.00	3,800.0	0.0	0.0	0.0	0.00	0.00	0.00	
3,900.0	0.00	0.00	3,900.0	0.0	0.0	0.0	0.00	0.00	0.00	
4,000.0	0.00	0.00	4,000.0	0.0	0.0	0.0	0.00	0.00	0.00	
4,100.0	0.00	0.00	4,100.0	0.0	0.0	0.0	0.00	0.00	0.00	
4,200.0	0.00	0.00	4,200.0	0.0	0.0	0.0	0.00	0.00	0.00	
4,300.0	0.00	0.00	4,300.0	0.0	0.0	0.0	0.00	0.00	0.00	
4,400.0	0.00	0.00	4,400.0	0.0	0.0	0.0	0.00	0.00	0.00	
4,500.0	0.00	0.00	4,500.0	0.0	0.0	0.0	0.00	0.00	0.00	
4,600.0	0.00	0.00	4,600.0	0.0	0.0	0.0	0.00	0.00	0.00	
BOS (Fletcher)										
4,618.0	0.00	0.00	4,618.0	0.0	0.0	0.0	0.00	0.00	0.00	



Well Planning Report



Database: EDM5002
Company: COG Operating, LLC
Project: Lea County, NM
Site: Sec 17, T26S, R33E
Well: Vast State #20H
Wellbore: Curve & Lateral
Design: Design #2

Local Co-ordinate Reference:
TVD Reference:
MD Reference:
North Reference:
Survey Calculation Method:

Well Vast State #20H
KB @ 3283.0usft (Noram #21)
KB @ 3283.0usft (Noram #21)
Grid
Minimum Curvature

Planned 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)
4,700.0	0.00	0.00	4,700.0	0.0	0.0	0.0	0.00	0.00	0.00
4,800.0	0.00	0.00	4,800.0	0.0	0.0	0.0	0.00	0.00	0.00
LMAR (Top Delaware)									
4,858.0	0.00	0.00	4,858.0	0.0	0.0	0.0	0.00	0.00	0.00
BLCN									
4,888.0	0.00	0.00	4,888.0	0.0	0.0	0.0	0.00	0.00	0.00
4,900.0	0.00	0.00	4,900.0	0.0	0.0	0.0	0.00	0.00	0.00
5,000.0	0.00	0.00	5,000.0	0.0	0.0	0.0	0.00	0.00	0.00
5,100.0	0.00	0.00	5,100.0	0.0	0.0	0.0	0.00	0.00	0.00
5,200.0	0.00	0.00	5,200.0	0.0	0.0	0.0	0.00	0.00	0.00
5,300.0	0.00	0.00	5,300.0	0.0	0.0	0.0	0.00	0.00	0.00
5,400.0	0.00	0.00	5,400.0	0.0	0.0	0.0	0.00	0.00	0.00
5,500.0	0.00	0.00	5,500.0	0.0	0.0	0.0	0.00	0.00	0.00
5,600.0	0.00	0.00	5,600.0	0.0	0.0	0.0	0.00	0.00	0.00
5,700.0	0.00	0.00	5,700.0	0.0	0.0	0.0	0.00	0.00	0.00
5,800.0	0.00	0.00	5,800.0	0.0	0.0	0.0	0.00	0.00	0.00
5,900.0	0.00	0.00	5,900.0	0.0	0.0	0.0	0.00	0.00	0.00
CYCN									
5,923.0	0.00	0.00	5,923.0	0.0	0.0	0.0	0.00	0.00	0.00
6,000.0	0.00	0.00	6,000.0	0.0	0.0	0.0	0.00	0.00	0.00
6,100.0	0.00	0.00	6,100.0	0.0	0.0	0.0	0.00	0.00	0.00
6,200.0	0.00	0.00	6,200.0	0.0	0.0	0.0	0.00	0.00	0.00
6,300.0	0.00	0.00	6,300.0	0.0	0.0	0.0	0.00	0.00	0.00
6,400.0	0.00	0.00	6,400.0	0.0	0.0	0.0	0.00	0.00	0.00
6,500.0	0.00	0.00	6,500.0	0.0	0.0	0.0	0.00	0.00	0.00
6,600.0	0.00	0.00	6,600.0	0.0	0.0	0.0	0.00	0.00	0.00
6,700.0	0.00	0.00	6,700.0	0.0	0.0	0.0	0.00	0.00	0.00
6,800.0	0.00	0.00	6,800.0	0.0	0.0	0.0	0.00	0.00	0.00
6,900.0	0.00	0.00	6,900.0	0.0	0.0	0.0	0.00	0.00	0.00
7,000.0	0.00	0.00	7,000.0	0.0	0.0	0.0	0.00	0.00	0.00
7,100.0	0.00	0.00	7,100.0	0.0	0.0	0.0	0.00	0.00	0.00
7,200.0	0.00	0.00	7,200.0	0.0	0.0	0.0	0.00	0.00	0.00
7,300.0	0.00	0.00	7,300.0	0.0	0.0	0.0	0.00	0.00	0.00
7,400.0	0.00	0.00	7,400.0	0.0	0.0	0.0	0.00	0.00	0.00
7,500.0	0.00	0.00	7,500.0	0.0	0.0	0.0	0.00	0.00	0.00
BYCN									
7,543.0	0.00	0.00	7,543.0	0.0	0.0	0.0	0.00	0.00	0.00
7,600.0	0.00	0.00	7,600.0	0.0	0.0	0.0	0.00	0.00	0.00
7,700.0	0.00	0.00	7,700.0	0.0	0.0	0.0	0.00	0.00	0.00
7,800.0	0.00	0.00	7,800.0	0.0	0.0	0.0	0.00	0.00	0.00
7,900.0	0.00	0.00	7,900.0	0.0	0.0	0.0	0.00	0.00	0.00
8,000.0	0.00	0.00	8,000.0	0.0	0.0	0.0	0.00	0.00	0.00
8,100.0	0.00	0.00	8,100.0	0.0	0.0	0.0	0.00	0.00	0.00
8,200.0	0.00	0.00	8,200.0	0.0	0.0	0.0	0.00	0.00	0.00
8,300.0	0.00	0.00	8,300.0	0.0	0.0	0.0	0.00	0.00	0.00
8,400.0	0.00	0.00	8,400.0	0.0	0.0	0.0	0.00	0.00	0.00
8,500.0	0.00	0.00	8,500.0	0.0	0.0	0.0	0.00	0.00	0.00
8,600.0	0.00	0.00	8,600.0	0.0	0.0	0.0	0.00	0.00	0.00
8,700.0	0.00	0.00	8,700.0	0.0	0.0	0.0	0.00	0.00	0.00
8,800.0	0.00	0.00	8,800.0	0.0	0.0	0.0	0.00	0.00	0.00
8,900.0	0.00	0.00	8,900.0	0.0	0.0	0.0	0.00	0.00	0.00
9,000.0	0.00	0.00	9,000.0	0.0	0.0	0.0	0.00	0.00	0.00
Bone Sprg (BSGL)									
9,043.0	0.00	0.00	9,043.0	0.0	0.0	0.0	0.00	0.00	0.00

Database:	EDM5002	Local Co-ordinate Reference:	Well Vast State #20H
Company:	COG Operating, LLC	TVD Reference:	KB @ 3283.0usft (Noram #21)
Project:	Lea County, NM	MD Reference:	KB @ 3283.0usft (Noram #21)
Site:	Sec 17, T26S, R33E	North Reference:	Grid
Well:	Vast State #20H	Survey Calculation Method:	Minimum Curvature
Wellbore:	Curve & Lateral		
Design:	Design #2		

Planned 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)
9,100.0	0.00	0.00	9,100.0	0.0	0.0	0.0	0.00	0.00	0.00
9,200.0	2.00	124.00	9,200.0	-1.0	1.4	-0.9	2.00	2.00	0.00
U Avalon Sh									
9,233.1	2.66	124.00	9,233.0	-1.7	2.6	-1.6	2.00	2.00	0.00
9,300.0	4.00	124.00	9,299.8	-3.9	5.8	-3.6	2.00	2.00	0.00
9,400.0	6.00	124.00	9,399.5	-8.8	13.0	-8.2	2.00	2.00	0.00
9,449.9	7.00	124.00	9,449.0	-11.9	17.7	-11.1	2.00	2.00	0.00
L Avalon Sh									
9,474.2	7.00	124.00	9,473.2	-13.6	20.2	-12.6	0.00	0.00	0.00
9,500.0	7.00	124.00	9,498.8	-15.3	22.8	-14.3	0.00	0.00	0.00
9,600.0	7.00	124.00	9,598.0	-22.2	32.9	-20.6	0.00	0.00	0.00
9,700.0	7.00	124.00	9,697.3	-29.0	43.0	-27.0	0.00	0.00	0.00
9,800.0	7.00	124.00	9,796.5	-35.8	53.1	-33.3	0.00	0.00	0.00
9,900.0	7.00	124.00	9,895.8	-42.6	63.2	-39.6	0.00	0.00	0.00
10,000.0	7.00	124.00	9,995.0	-49.4	73.3	-46.0	0.00	0.00	0.00
FBSG_sand									
10,018.8	7.00	124.00	10,013.7	-50.7	75.2	-47.2	0.00	0.00	0.00
10,100.0	7.00	124.00	10,094.3	-56.2	83.4	-52.3	0.00	0.00	0.00
10,200.0	7.00	124.00	10,193.5	-63.0	93.5	-58.7	0.00	0.00	0.00
10,300.0	7.00	124.00	10,292.8	-69.8	103.6	-65.0	0.00	0.00	0.00
10,400.0	7.00	124.00	10,392.1	-76.7	113.7	-71.3	0.00	0.00	0.00
10,500.0	7.00	124.00	10,491.3	-83.5	123.8	-77.7	0.00	0.00	0.00
SBSG_sand									
10,553.2	7.00	124.00	10,544.2	-87.1	129.1	-81.1	0.00	0.00	0.00
10,600.0	7.00	124.00	10,590.6	-90.3	133.9	-84.0	0.00	0.00	0.00
10,700.0	7.00	124.00	10,689.8	-97.1	144.0	-90.4	0.00	0.00	0.00
10,800.0	7.00	124.00	10,789.1	-103.9	154.1	-96.7	0.00	0.00	0.00
10,900.0	7.00	124.00	10,888.3	-110.7	164.2	-103.0	0.00	0.00	0.00
11,000.0	7.00	124.00	10,987.6	-117.5	174.3	-109.4	0.00	0.00	0.00
11,100.0	7.00	124.00	11,086.8	-124.3	184.4	-115.7	0.00	0.00	0.00
11,200.0	7.00	124.00	11,186.1	-131.2	194.5	-122.1	0.00	0.00	0.00
11,300.0	7.00	124.00	11,285.3	-138.0	204.6	-128.4	0.00	0.00	0.00
11,400.0	7.00	124.00	11,384.6	-144.8	214.7	-134.7	0.00	0.00	0.00
11,500.0	7.00	124.00	11,483.9	-151.6	224.8	-141.1	0.00	0.00	0.00
11,520.0	7.00	124.00	11,503.8	-153.0	226.8	-142.4	0.00	0.00	0.00
11,600.0	5.40	124.00	11,583.2	-157.8	234.0	-146.8	2.00	-2.00	0.00
11,700.0	3.40	124.00	11,682.9	-162.1	240.3	-150.8	2.00	-2.00	0.00
TBSG_sand									
11,702.2	3.35	124.00	11,685.2	-162.2	240.4	-150.9	2.00	-2.00	0.00
11,800.0	1.40	124.00	11,782.8	-164.4	243.8	-153.0	2.00	-2.00	0.00
11,870.0	0.00	0.00	11,852.8	-164.9	244.5	-153.5	2.00	-2.00	0.00
11,900.0	0.00	0.00	11,882.8	-164.9	244.5	-153.5	0.00	0.00	0.00
Kick off of cmt plug @ 11993.0' MD									
11,993.0	0.00	0.00	11,975.8	-164.9	244.5	-153.5	0.00	0.00	0.00
12,000.0	0.35	359.66	11,982.8	-164.9	244.5	-153.4	5.00	5.00	0.00
KOP: Build 12°/100' @ 12013.0' MD									
12,013.0	1.00	359.66	11,995.8	-164.7	244.5	-153.3	5.00	5.00	0.00
12,025.0	2.44	359.66	12,007.8	-164.4	244.5	-152.9	12.00	12.00	-0.02
12,050.0	5.44	359.66	12,032.8	-162.6	244.5	-151.2	12.00	12.00	0.00
12,075.0	8.44	359.66	12,057.6	-159.6	244.5	-148.2	12.00	12.00	0.00
12,100.0	11.44	359.66	12,082.2	-155.3	244.4	-143.9	12.00	12.00	0.00
WFMP									
12,113.1	13.01	359.66	12,095.0	-152.5	244.4	-141.1	12.00	12.00	0.00



Well Planning Report



Database:	EDM5002	Local Co-ordinate Reference:	Well Vast State #20H
Company:	COG Operating, LLC	TVD Reference:	KB @ 3283.0usft (Noram #21)
Project:	Lea County, NM	MD Reference:	KB @ 3283.0usft (Noram #21)
Site:	Sec 17, T26S, R33E	North Reference:	Grid
Well:	Vast State #20H	Survey Calculation Method:	Minimum Curvature
Wellbore:	Curve & Lateral		
Design:	Design #2		

Planned 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)
12,125.0	14.44	359.66	12,106.6	-149.7	244.4	-138.3	12.00	12.00	0.00
12,150.0	17.44	359.66	12,130.6	-142.9	244.4	-131.4	12.00	12.00	0.00
12,175.0	20.44	359.66	12,154.2	-134.7	244.3	-123.3	12.00	12.00	0.00
12,200.0	23.44	359.66	12,177.4	-125.4	244.3	-114.0	12.00	12.00	0.00
12,225.0	26.44	359.66	12,200.1	-114.9	244.2	-103.5	12.00	12.00	0.00
12,250.0	29.44	359.66	12,222.2	-103.1	244.1	-91.8	12.00	12.00	0.00
12,275.0	32.44	359.66	12,243.6	-90.3	244.1	-79.0	12.00	12.00	0.00
12,300.0	35.44	359.66	12,264.4	-76.3	244.0	-65.0	12.00	12.00	0.00
12,325.0	38.44	359.66	12,284.3	-61.3	243.9	-50.0	12.00	12.00	0.00
12,350.0	41.44	359.66	12,303.5	-45.3	243.8	-34.0	12.00	12.00	0.00
12,375.0	44.44	359.66	12,321.8	-28.2	243.7	-17.0	12.00	12.00	0.00
12,400.0	47.44	359.66	12,339.2	-10.3	243.6	1.0	12.00	12.00	0.00
12,425.0	50.44	359.66	12,355.6	8.6	243.5	19.8	12.00	12.00	0.00
12,450.0	53.44	359.66	12,371.0	28.3	243.3	39.4	12.00	12.00	0.00
12,475.0	56.44	359.66	12,385.4	48.7	243.2	59.9	12.00	12.00	0.00
12,500.0	59.44	359.66	12,398.6	69.9	243.1	81.0	12.00	12.00	0.00
12,525.0	62.44	359.66	12,410.8	91.7	243.0	102.8	12.00	12.00	0.00
12,550.0	65.44	359.66	12,421.8	114.2	242.8	125.3	12.00	12.00	0.00
12,575.0	68.44	359.66	12,431.6	137.2	242.7	148.2	12.00	12.00	0.00
12,600.0	71.44	359.66	12,440.1	160.7	242.5	171.7	12.00	12.00	0.00
12,625.0	74.44	359.66	12,447.5	184.6	242.4	195.6	12.00	12.00	0.00
12,650.0	77.44	359.66	12,453.5	208.8	242.3	219.8	12.00	12.00	0.00
12,675.0	80.44	359.66	12,458.3	233.4	242.1	244.3	12.00	12.00	0.00
12,700.0	83.44	359.66	12,461.8	258.1	242.0	269.0	12.00	12.00	0.00
12,725.0	86.44	359.66	12,464.0	283.0	241.8	293.9	12.00	12.00	0.00
12,750.0	89.44	359.66	12,464.9	308.0	241.7	318.8	12.00	12.00	0.00
EOC: 12761.5' MD, 90.82° Inc, 359.66° Azm									
12,761.5	90.82	359.66	12,464.9	319.5	241.6	330.2	12.00	12.00	0.00
12,800.0	90.82	359.66	12,464.4	358.0	241.4	368.7	0.00	0.00	0.00
12,900.0	90.82	359.66	12,462.9	458.0	240.8	468.6	0.00	0.00	0.00
13,000.0	90.82	359.66	12,461.5	558.0	240.2	568.4	0.00	0.00	0.00
13,100.0	90.82	359.66	12,460.1	658.0	239.6	668.3	0.00	0.00	0.00
13,200.0	90.82	359.66	12,458.7	757.9	239.0	768.1	0.00	0.00	0.00
13,300.0	90.82	359.66	12,457.3	857.9	238.4	868.0	0.00	0.00	0.00
13,400.0	90.82	359.66	12,455.8	957.9	237.8	967.9	0.00	0.00	0.00
13,500.0	90.82	359.66	12,454.4	1,057.9	237.2	1,067.7	0.00	0.00	0.00
13,600.0	90.82	359.66	12,453.0	1,157.9	236.6	1,167.6	0.00	0.00	0.00
13,700.0	90.82	359.66	12,451.6	1,257.9	236.0	1,267.4	0.00	0.00	0.00
13,800.0	90.82	359.66	12,450.1	1,357.9	235.4	1,367.3	0.00	0.00	0.00
13,900.0	90.82	359.66	12,448.7	1,457.9	234.8	1,467.1	0.00	0.00	0.00
14,000.0	90.82	359.66	12,447.3	1,557.8	234.2	1,567.0	0.00	0.00	0.00
14,100.0	90.82	359.66	12,445.9	1,657.8	233.6	1,666.8	0.00	0.00	0.00
14,200.0	90.82	359.66	12,444.5	1,757.8	233.0	1,766.7	0.00	0.00	0.00
14,300.0	90.82	359.66	12,443.0	1,857.8	232.4	1,866.5	0.00	0.00	0.00
14,400.0	90.82	359.66	12,441.6	1,957.8	231.8	1,966.4	0.00	0.00	0.00
14,500.0	90.82	359.66	12,440.2	2,057.8	231.2	2,066.3	0.00	0.00	0.00
14,600.0	90.82	359.66	12,438.8	2,157.8	230.6	2,166.1	0.00	0.00	0.00
14,700.0	90.82	359.66	12,437.3	2,257.8	230.0	2,266.0	0.00	0.00	0.00
14,800.0	90.82	359.66	12,435.9	2,357.7	229.4	2,365.8	0.00	0.00	0.00
14,900.0	90.82	359.66	12,434.5	2,457.7	228.8	2,465.7	0.00	0.00	0.00
15,000.0	90.82	359.66	12,433.1	2,557.7	228.2	2,565.5	0.00	0.00	0.00
15,100.0	90.82	359.66	12,431.7	2,657.7	227.6	2,665.4	0.00	0.00	0.00
15,200.0	90.82	359.66	12,430.2	2,757.7	227.0	2,765.2	0.00	0.00	0.00



Well Planning Report



Database:	EDM5002	Local Co-ordinate Reference:	Well Vast State #20H
Company:	COG Operating, LLC	TVD Reference:	KB @ 3283.0usft (Noram #21)
Project:	Lea County, NM	MD Reference:	KB @ 3283.0usft (Noram #21)
Site:	Sec 17, T26S, R33E	North Reference:	Grid
Well:	Vast State #20H	Survey Calculation Method:	Minimum Curvature
Wellbore:	Curve & Lateral		
Design:	Design #2		

Planned 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)
15,300.0	90.82	359.66	12,428.8	2,857.7	226.4	2,865.1	0.00	0.00	0.00
15,400.0	90.82	359.66	12,427.4	2,957.7	225.8	2,964.9	0.00	0.00	0.00
15,500.0	90.82	359.66	12,426.0	3,057.7	225.2	3,064.8	0.00	0.00	0.00
15,600.0	90.82	359.66	12,424.5	3,157.7	224.6	3,164.6	0.00	0.00	0.00
15,700.0	90.82	359.66	12,423.1	3,257.6	224.0	3,264.5	0.00	0.00	0.00
15,800.0	90.82	359.66	12,421.7	3,357.6	223.4	3,364.4	0.00	0.00	0.00
15,900.0	90.82	359.66	12,420.3	3,457.6	222.8	3,464.2	0.00	0.00	0.00
16,000.0	90.82	359.66	12,418.8	3,557.6	222.2	3,564.1	0.00	0.00	0.00
16,100.0	90.82	359.66	12,417.4	3,657.6	221.6	3,663.9	0.00	0.00	0.00
16,200.0	90.82	359.66	12,416.0	3,757.6	221.0	3,763.8	0.00	0.00	0.00
16,300.0	90.82	359.66	12,414.6	3,857.6	220.4	3,863.6	0.00	0.00	0.00
16,400.0	90.82	359.66	12,413.2	3,957.6	219.8	3,963.5	0.00	0.00	0.00
16,500.0	90.82	359.66	12,411.7	4,057.5	219.2	4,063.3	0.00	0.00	0.00
16,600.0	90.82	359.66	12,410.3	4,157.5	218.6	4,163.2	0.00	0.00	0.00
16,700.0	90.82	359.66	12,408.9	4,257.5	218.0	4,263.0	0.00	0.00	0.00
16,800.0	90.82	359.66	12,407.5	4,357.5	217.4	4,362.9	0.00	0.00	0.00
16,900.0	90.82	359.66	12,406.0	4,457.5	216.8	4,462.8	0.00	0.00	0.00
17,000.0	90.82	359.66	12,404.6	4,557.5	216.2	4,562.6	0.00	0.00	0.00
17,100.0	90.82	359.66	12,403.2	4,657.5	215.6	4,662.5	0.00	0.00	0.00
TD @ 17114.0' MD/12403.0' TVD									
17,114.0	90.82	359.66	12,403.0	4,671.5	215.5	4,676.5	0.00	0.00	0.00

Design 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									
PBHL Vast State #20H	0.00	0.00	12,403.0	4,671.5	215.5	382,755.40	731,433.00	32° 3' 0.392 N	103° 35' 10.915 W
- plan hits target center									
- Point									

Database:	EDM5002	Local Co-ordinate Reference:	Well Vast State #20H
Company:	COG Operating, LLC	TVD Reference:	KB @ 3283.0usft (Noram #21)
Project:	Lea County, NM	MD Reference:	KB @ 3283.0usft (Noram #21)
Site:	Sec 17, T26S, R33E	North Reference:	Grid
Well:	Vast State #20H	Survey Calculation Method:	Minimum Curvature
Wellbore:	Curve & Lateral		
Design:	Design #2		

Formations						
Measured Depth (usft)	Vertical Depth (usft)	Name	Lithology	Dip (°)	Dip Direction (°)	
803.0	803.0	Rustler		-0.82	2.64	
1,163.0	1,163.0	TOS		-0.82	2.64	
4,618.0	4,618.0	BOS (Fletcher)		-0.82	2.64	
4,858.0	4,858.0	LMAR (Top Delaware)		-0.82	2.64	
4,888.0	4,888.0	BLCN		-0.82	2.64	
5,923.0	5,923.0	CYCN		-0.82	2.64	
7,543.0	7,543.0	BYCN		-0.82	2.64	
9,043.0	9,043.0	Bone Sprg (BSGL)		-0.82	2.64	
9,233.1	9,233.0	U Avalon Sh		-0.82	2.64	
9,474.2	9,473.2	L Avalon Sh		-0.82	2.64	
10,018.8	10,013.7	FBSG_sand		-0.82	2.64	
10,553.2	10,544.2	SBSG_sand		-0.82	2.64	
11,702.2	11,685.2	TBSG_sand		-0.82	2.64	
12,113.1	12,095.0	WFMP		-0.82	2.64	

Plan Annotations					
Measured Depth (usft)	Vertical Depth (usft)	Local Coordinates			
		+N/-S (usft)	+E/-W (usft)	Comment	
11,993.0	11,975.8	-164.9	244.5	Kick off of cmt plug @ 11993.0' MD	
12,013.0	11,995.8	-164.7	244.5	KOP: Build 12"/100' @ 12013.0' MD	
12,761.5	12,464.9	319.5	241.6	EOC: 12761.5' MD, 90.82° Inc, 359.66° Azm	
17,114.0	12,403.0	4,671.5	215.5	TD @ 17114.0' MD/12403.0' TVD	



Company Name: COG Operating, LLC
Vest State #20H
Lea County, NM
Rlg: Noram #21
Created By: Shelly Cale Peterkin
Date: 2/24/2017

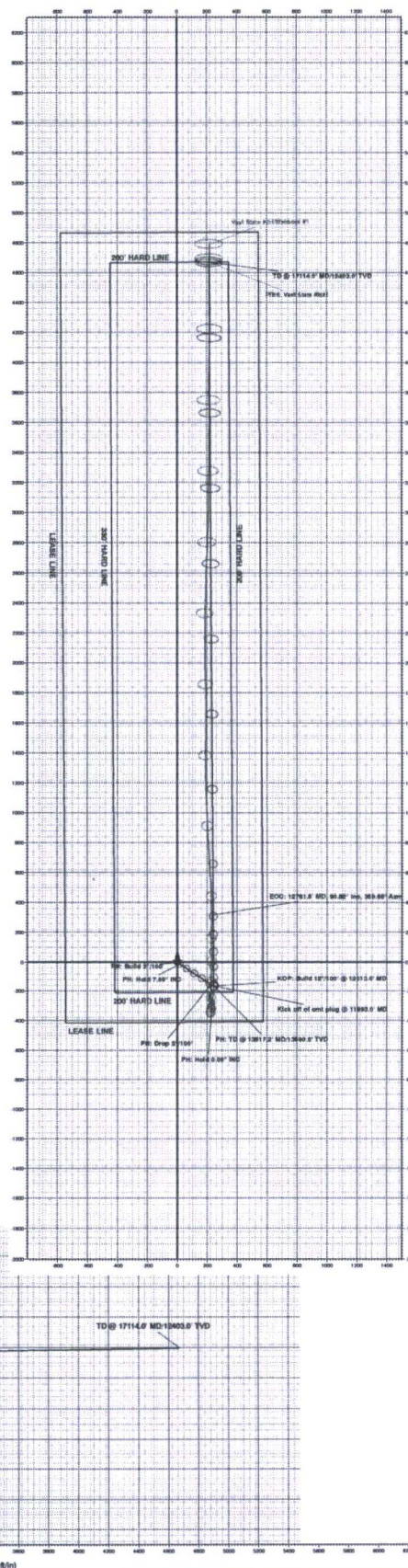
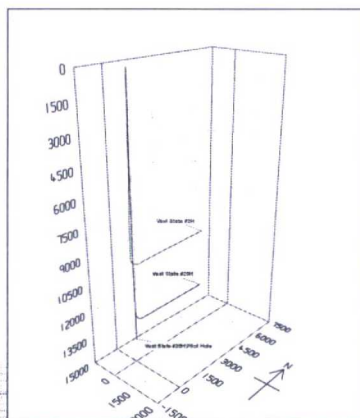
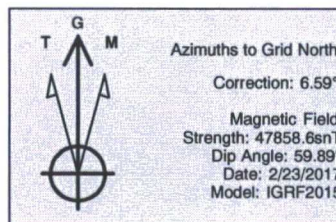
WELL DETAILS: Vest State #20H						
+N-S	+E-W	Northing	Ground Level: Easting	3254.0 Latitude	Longitude	Slot
0.0	0.0	378083.90	731217.50	32° 2' 14.178 N	103° 35' 13.704 W	

DESIGN TARGET DETAILS						
Name	TYD	+N-S	+E-W	Northing	Latitude	Longitude
PdM, Vest Study #001	12403.9	4871.9	219.9	302799.49	32° 3' 0.360 N	107° 38' 10.919 W

ANNOTATIONS: Plot Rule									
MD	Ina	Ad	TYD	+R-6	+R-W	VBest	Departure	Annotation	
9106	0.00	0.00	9106.0	0.0	0.0			Start 9'106'	
9449	7.00	134.00	9449.0	-11.9	17.7	-11.1	91.3	Hold 7.94' INC	
11920	7.00	134.00	11920.8	-123.0	226.8	-142.4	273.6	Hold 9'106'	
11970	0.00	0.00	11970.9	-164.9	244.5	-153.5	294.5	Hold 0.50' INC	
13817	0.00	0.00	13817.9	-164.9	244.5	-153.5	294.5	TD @ 13817.9 MD13800.9 TYD	

ANNOTATIONS: Curve & Lateral									
WD	Inc	Azi	TYD	+N-S	+E-W	Vbsect	Departure	Annotation	
11963.0	0.00	0.00	11945.8			-153.5		Exit of slab @ 11963.0/ MD	
12013.0	90.00	359.66	11995.8	-164.7	244.5	-153.3		2nd KOP: Build 12"/100' @ 12013.0/ MD	
12761.5	90.82	359.66	12464.9	319.8	241.8	330.2	494.4	EOC: 12761.5/ MD, 90.82° Inc, 330.66° Azm	
17714.0	90.82	359.66	12403.0	4671.5	215.5	4676.5	4836.5	TD @ 17714.0/ MD 12403.0/ TYD	

PROJECT DETAILS: Lee County, NM	
Geodetic System:	US State Plane 1927 (Exact solution)
Datum:	NAD 1927 (NADCON CONUS)
Ellipsoid:	Clarke 1866
Zone:	New Mexico East 3001
System Datum:	Mean Sea Level



Vertical Section at 2.64° (200 $\mu\text{m}/\text{in}$)