



**NM OIL CONSERVATION**  
ARTESIA DISTRICT

JAN 19 2018

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## **COG OPERATING, LLC**

**Eddy /Lea County, NM (NAD27) NMEZ**

**Carmen 3 Federal COM 91H 91H**

**SL - 430'FNL 170'FEL SEC 3, T17S/R30E/Lot1**

**PP - 350'FNL 691'FEL SEC 3, T17S/R30E/Lot1**

**Lateral**

30-015-44271

**Planned BHL - 350'FNL, 10'FWL SEC 3 T17S/R30E /Lot4**

**Actual BHL - 344'FNL, 10'FWL SEC3/T17S/R30E/Lot4**



# Survey Report

**Company:** COG OPERATING, LLC  
**Project:** Eddy /Lea County, NM (NAD27) NMEZ  
**Site:** Carmen 3 Federal COM 91H  
**Well:** 91H  
**Wellbore:** Lateral  
**Design:** Lateral

**Local Co-ordinate Reference:** Well 91H - Slot Carmen 91H  
**TVD Reference:** 3756+18 @ 3774.00ft (Planningp2)  
**MD Reference:** 3756+18 @ 3774.00ft (Planningp2)  
**North Reference:** Grid  
**Survey Calculation Method:** Minimum Curvature  
**Database:** VON\_EDM

|                    |                                      |                      |                |
|--------------------|--------------------------------------|----------------------|----------------|
| <b>Project</b>     | Eddy /Lea County, NM (NAD27) NMEZ    |                      |                |
| <b>Map System:</b> | US State Plane 1927 (Exact solution) | <b>System Datum:</b> | Mean Sea Level |
| <b>Geo Datum:</b>  | NAD 1927 (NADCON CONUS)              |                      |                |
| <b>Map Zone:</b>   | New Mexico East 3001                 |                      |                |

|                              |                          |                     |               |                                    |
|------------------------------|--------------------------|---------------------|---------------|------------------------------------|
| <b>Site</b>                  | Carmen 3 Federal COM 91H |                     |               |                                    |
| <b>Site Position:</b>        |                          | <b>Northing:</b>    | 680,235.50 ft | <b>Latitude:</b> 32° 52' 10.065 N  |
| <b>From:</b>                 | Map                      | <b>Easting:</b>     | 617,326.10 ft | <b>Longitude:</b> 103° 57' 4.360 W |
| <b>Position Uncertainty:</b> | 0.00 ft                  | <b>Slot Radius:</b> | 13.20 in      | <b>Grid Convergence:</b> 0.21 °    |

|                             |                       |                            |                  |                                  |
|-----------------------------|-----------------------|----------------------------|------------------|----------------------------------|
| <b>Well</b>                 | 91H - Slot Carmen 91H |                            |                  |                                  |
| <b>Well Position</b>        | <b>+N/-S</b>          | 0.00 ft                    | <b>Northing:</b> | 680,235.50 ft                    |
|                             | <b>+E/-W</b>          | 0.00 ft                    | <b>Easting:</b>  | 617,326.10 ft                    |
| <b>Position Uncertainty</b> | 0.00 ft               | <b>Wellhead Elevation:</b> | ft               | <b>Ground Level:</b> 3,756.00 ft |

|                  |                   |                    |                        |                      |                            |
|------------------|-------------------|--------------------|------------------------|----------------------|----------------------------|
| <b>Wellbore</b>  | Lateral           |                    |                        |                      |                            |
| <b>Magnetics</b> | <b>Model Name</b> | <b>Sample Date</b> | <b>Declination (°)</b> | <b>Dip Angle (°)</b> | <b>Field Strength (nT)</b> |
|                  | IGRF2015          | 09/07/17           | 7.16                   | 60.59                | 48,254                     |

|                          |                              |                   |                   |                      |      |
|--------------------------|------------------------------|-------------------|-------------------|----------------------|------|
| <b>Design</b>            | Lateral                      |                   |                   |                      |      |
| <b>Audit Notes:</b>      |                              |                   |                   |                      |      |
| <b>Version:</b>          | 1.0                          | <b>Phase:</b>     | ACTUAL            | <b>Tie On Depth:</b> | 0.00 |
| <b>Vertical Section:</b> | <b>Depth From (TVD) (ft)</b> | <b>+N/-S (ft)</b> | <b>+E/-W (ft)</b> | <b>Direction (°)</b> |      |
|                          | 0.00                         | 0.00              | 0.00              | 269.82               |      |

|                       |                |                          |                  |                                   |  |
|-----------------------|----------------|--------------------------|------------------|-----------------------------------|--|
| <b>Survey Program</b> | <b>Date</b>    | 10/03/17                 |                  |                                   |  |
| <b>From (ft)</b>      | <b>To (ft)</b> | <b>Survey (Wellbore)</b> | <b>Tool Name</b> | <b>Description</b>                |  |
| 100.00                | 1,410.00       | Survey #1 (Lateral)      | GYD_DP_MS        | Gyrodata gyro-compassing and drop |  |
| 1,506.00              | 9,633.00       | Survey #2 (Lateral)      | MWD              | MWD v3: standard declination      |  |
| 9,707.00              | 9,707.00       | Survey #3 (Lateral)      | Projection       | Projection                        |  |

|                            |                        |                    |                            |                   |                   |                              |                              |                             |                            |
|----------------------------|------------------------|--------------------|----------------------------|-------------------|-------------------|------------------------------|------------------------------|-----------------------------|----------------------------|
| <b>Survey</b>              |                        |                    |                            |                   |                   |                              |                              |                             |                            |
| <b>Measured Depth (ft)</b> | <b>Inclination (°)</b> | <b>Azimuth (°)</b> | <b>Vertical Depth (ft)</b> | <b>+N/-S (ft)</b> | <b>+E/-W (ft)</b> | <b>Vertical Section (ft)</b> | <b>Dogleg Rate (°/100ft)</b> | <b>Build Rate (°/100ft)</b> | <b>Turn Rate (°/100ft)</b> |
| 0.00                       | 0.00                   | 0.00               | 0.00                       | 0.00              | 0.00              | 0.00                         | 0.00                         | 0.00                        | 0.00                       |
| <b>Carmen 91H SL</b>       |                        |                    |                            |                   |                   |                              |                              |                             |                            |
| 100.00                     | 0.35                   | 67.46              | 100.00                     | 0.12              | 0.28              | -0.28                        | 0.35                         | 0.35                        | 0.00                       |
| 200.00                     | 1.06                   | 71.00              | 199.99                     | 0.54              | 1.44              | -1.44                        | 0.71                         | 0.71                        | 3.54                       |
| 300.00                     | 0.86                   | 122.49             | 299.98                     | 0.43              | 2.95              | -2.95                        | 0.85                         | -0.20                       | 51.49                      |
| 400.00                     | 0.53                   | 176.62             | 399.97                     | -0.43             | 3.61              | -3.61                        | 0.70                         | -0.33                       | 54.13                      |
| 500.00                     | 0.79                   | 199.53             | 499.97                     | -1.54             | 3.40              | -3.40                        | 0.37                         | 0.26                        | 22.91                      |
| 600.00                     | 0.96                   | 187.43             | 599.96                     | -3.02             | 3.06              | -3.06                        | 0.25                         | 0.17                        | -12.10                     |
| 700.00                     | 1.02                   | 184.62             | 699.94                     | -4.74             | 2.88              | -2.87                        | 0.08                         | 0.06                        | -2.81                      |



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**North Reference:** Grid  
**Survey Calculation Method:** Minimum Curvature  
**Database:** VON\_EDM

### Survey

| Measured Depth (ft)      | Inclination (°) | Azimuth (°) | Vertical Depth (ft) | +N/-S (ft) | +E/-W (ft) | Vertical Section (ft) | Dogleg Rate (°/100ft) | Build Rate (°/100ft) | Turn Rate (°/100ft) |
|--------------------------|-----------------|-------------|---------------------|------------|------------|-----------------------|-----------------------|----------------------|---------------------|
| 800.00                   | 0.81            | 177.26      | 799.93              | -6.33      | 2.85       | -2.83                 | 0.24                  | -0.21                | -7.36               |
| 900.00                   | 0.70            | 172.82      | 899.92              | -7.65      | 2.96       | -2.93                 | 0.12                  | -0.11                | -4.44               |
| 1,000.00                 | 0.64            | 160.60      | 999.91              | -8.78      | 3.22       | -3.19                 | 0.15                  | -0.06                | -12.22              |
| 1,100.00                 | 0.35            | 140.28      | 1,099.91            | -9.54      | 3.60       | -3.57                 | 0.33                  | -0.29                | -20.32              |
| 1,200.00                 | 0.23            | 145.16      | 1,199.91            | -9.94      | 3.91       | -3.88                 | 0.12                  | -0.12                | 4.88                |
| 1,300.00                 | 0.27            | 148.12      | 1,299.91            | -10.31     | 4.15       | -4.12                 | 0.04                  | 0.04                 | 2.96                |
| 1,400.00                 | 0.50            | 150.18      | 1,399.91            | -10.88     | 4.49       | -4.46                 | 0.23                  | 0.23                 | 2.06                |
| 1,410.00                 | 0.55            | 153.32      | 1,409.91            | -10.96     | 4.53       | -4.50                 | 0.58                  | 0.50                 | 31.40               |
| 1,506.00                 | 0.16            | 102.07      | 1,505.90            | -11.40     | 4.87       | -4.84                 | 0.49                  | -0.41                | -53.39              |
| 1,537.00                 | 0.30            | 83.72       | 1,536.90            | -11.40     | 4.99       | -4.96                 | 0.50                  | 0.45                 | -59.19              |
| 1,631.00                 | 1.79            | 56.57       | 1,630.88            | -10.57     | 6.46       | -6.43                 | 1.63                  | 1.59                 | -28.88              |
| 1,726.00                 | 2.98            | 68.18       | 1,725.80            | -8.83      | 9.99       | -9.97                 | 1.35                  | 1.25                 | 12.22               |
| 1,821.00                 | 4.63            | 66.71       | 1,820.59            | -6.40      | 15.81      | -15.79                | 1.74                  | 1.74                 | -1.55               |
| 1,916.00                 | 4.72            | 66.48       | 1,915.27            | -3.32      | 22.92      | -22.90                | 0.10                  | 0.09                 | -0.24               |
| 2,010.00                 | 4.28            | 66.21       | 2,008.98            | -0.37      | 29.67      | -29.67                | 0.47                  | -0.47                | -0.29               |
| 2,105.00                 | 4.04            | 67.46       | 2,103.73            | 2.35       | 36.01      | -36.01                | 0.27                  | -0.25                | 1.32                |
| 2,200.00                 | 3.84            | 68.50       | 2,198.51            | 4.80       | 42.06      | -42.07                | 0.22                  | -0.21                | 1.09                |
| 2,295.00                 | 3.41            | 68.04       | 2,293.31            | 7.02       | 47.64      | -47.66                | 0.45                  | -0.45                | -0.48               |
| 2,393.00                 | 4.99            | 62.82       | 2,391.05            | 10.06      | 54.13      | -54.16                | 1.66                  | 1.61                 | -5.33               |
| 2,488.00                 | 4.57            | 60.87       | 2,485.72            | 13.79      | 61.11      | -61.16                | 0.47                  | -0.44                | -2.05               |
| 2,583.00                 | 3.77            | 57.05       | 2,580.47            | 17.33      | 67.04      | -67.09                | 0.89                  | -0.84                | -4.02               |
| 2,677.00                 | 4.99            | 42.35       | 2,674.19            | 22.03      | 72.39      | -72.46                | 1.75                  | 1.30                 | -15.64              |
| 2,772.00                 | 5.02            | 40.27       | 2,768.83            | 28.25      | 77.86      | -77.95                | 0.19                  | 0.03                 | -2.19               |
| 2,867.00                 | 5.12            | 38.81       | 2,863.46            | 34.73      | 83.20      | -83.31                | 0.17                  | 0.11                 | -1.54               |
| 2,962.00                 | 6.22            | 44.56       | 2,957.99            | 41.70      | 89.47      | -89.60                | 1.30                  | 1.16                 | 6.05                |
| 3,056.00                 | 6.44            | 45.34       | 3,051.42            | 49.03      | 96.79      | -96.94                | 0.25                  | 0.23                 | 0.83                |
| 3,150.00                 | 6.67            | 47.70       | 3,144.81            | 56.41      | 104.58     | -104.76               | 0.38                  | 0.24                 | 2.51                |
| 3,245.00                 | 6.63            | 47.67       | 3,239.17            | 63.82      | 112.71     | -112.91               | 0.04                  | -0.04                | -0.03               |
| 3,340.00                 | 6.96            | 61.49       | 3,333.51            | 70.26      | 121.83     | -122.05               | 1.75                  | 0.35                 | 14.55               |
| 3,434.00                 | 5.49            | 66.65       | 3,426.95            | 74.76      | 130.96     | -131.19               | 1.67                  | -1.56                | 5.49                |
| 3,529.00                 | 4.01            | 71.92       | 3,521.62            | 77.59      | 138.29     | -138.53               | 1.62                  | -1.56                | 5.55                |
| 3,624.00                 | 2.62            | 71.54       | 3,616.46            | 79.31      | 143.51     | -143.76               | 1.46                  | -1.46                | -0.40               |
| 3,719.00                 | 2.72            | 69.40       | 3,711.36            | 80.79      | 147.68     | -147.93               | 0.15                  | 0.11                 | -2.25               |
| 3,814.00                 | 2.97            | 73.10       | 3,806.24            | 82.30      | 152.14     | -152.40               | 0.33                  | 0.26                 | 3.89                |
| 3,909.00                 | 2.25            | 35.86       | 3,901.15            | 84.53      | 155.59     | -155.85               | 1.90                  | -0.76                | -39.20              |
| 3,916.39                 | 2.11            | 34.36       | 3,908.54            | 84.76      | 155.75     | -156.02               | 2.02                  | -1.87                | -20.29              |
| <b>Carmen 91H Tgt p3</b> |                 |             |                     |            |            |                       |                       |                      |                     |
| 3,924.66                 | 1.96            | 32.43       | 3,916.80            | 85.00      | 155.91     | -156.18               | 2.02                  | -1.84                | -23.29              |
| <b>Carmen 91H Tgt c</b>  |                 |             |                     |            |            |                       |                       |                      |                     |
| 4,004.00                 | 0.85            | 339.21      | 3,996.11            | 86.70      | 156.43     | -156.70               | 2.02                  | -1.40                | -67.08              |
| 4,035.00                 | 0.79            | 329.28      | 4,027.11            | 87.10      | 156.24     | -156.51               | 0.50                  | -0.19                | -32.03              |
| 4,066.00                 | 0.88            | 312.51      | 4,058.11            | 87.44      | 155.96     | -156.23               | 0.84                  | 0.29                 | -54.10              |
| 4,098.00                 | 2.09            | 284.66      | 4,090.10            | 87.75      | 155.21     | -155.49               | 4.30                  | 3.78                 | -87.03              |
| 4,129.00                 | 3.75            | 275.72      | 4,121.06            | 88.00      | 153.66     | -153.93               | 5.54                  | 5.35                 | -28.84              |



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|-------------------------|-----------------|-------------|---------------------|------------|------------|-----------------------|-----------------------|----------------------|---------------------|
| 4,161.00                | 6.00            | 273.02      | 4,152.94            | 88.19      | 150.94     | -151.22               | 7.07                  | 7.03                 | -8.44               |
| 4,192.00                | 9.00            | 273.13      | 4,183.67            | 88.41      | 146.90     | -147.18               | 9.68                  | 9.68                 | 0.35                |
| 4,224.00                | 12.17           | 275.72      | 4,215.12            | 88.88      | 141.05     | -141.33               | 10.01                 | 9.91                 | 8.09                |
| 4,255.00                | 15.57           | 276.92      | 4,245.21            | 89.71      | 133.66     | -133.94               | 11.01                 | 10.97                | 3.87                |
| 4,286.00                | 18.58           | 275.30      | 4,274.84            | 90.67      | 124.61     | -124.90               | 9.83                  | 9.71                 | -5.23               |
| 4,318.00                | 21.73           | 271.32      | 4,304.88            | 91.27      | 113.61     | -113.90               | 10.73                 | 9.84                 | -12.44              |
| 4,349.00                | 24.95           | 267.61      | 4,333.34            | 91.13      | 101.34     | -101.62               | 11.41                 | 10.39                | -11.97              |
| 4,381.00                | 28.34           | 266.69      | 4,361.94            | 90.41      | 87.01      | -87.29                | 10.67                 | 10.59                | -2.88               |
| 4,413.00                | 31.66           | 267.44      | 4,389.65            | 89.60      | 71.03      | -71.31                | 10.44                 | 10.38                | 2.34                |
| 4,444.00                | 35.08           | 269.04      | 4,415.53            | 89.09      | 53.99      | -54.27                | 11.39                 | 11.03                | 5.16                |
| 4,476.00                | 38.88           | 268.56      | 4,441.09            | 88.68      | 34.75      | -35.03                | 11.91                 | 11.88                | -1.44               |
| 4,508.00                | 43.21           | 267.50      | 4,465.22            | 87.96      | 13.76      | -14.03                | 13.71                 | 13.53                | -3.38               |
| 4,539.00                | 46.31           | 266.37      | 4,487.23            | 86.78      | -8.04      | 7.77                  | 10.32                 | 10.00                | -3.65               |
| 4,634.00                | 47.92           | 266.68      | 4,551.88            | 82.57      | -77.52     | 77.26                 | 1.71                  | 1.69                 | 0.33                |
| 4,719.71                | 49.32           | 266.29      | 4,608.54            | 78.62      | -141.71    | 141.46                | 1.67                  | 1.63                 | -0.45               |
| <b>Carmen 91H Tgt</b>   |                 |             |                     |            |            |                       |                       |                      |                     |
| 4,729.00                | 49.47           | 266.25      | 4,614.58            | 78.16      | -146.74    | 148.50                | 1.67                  | 1.63                 | -0.44               |
| 4,761.00                | 51.53           | 266.08      | 4,634.94            | 76.51      | -173.38    | 173.14                | 6.45                  | 6.44                 | -0.53               |
| 4,792.00                | 55.00           | 267.08      | 4,653.48            | 75.03      | -198.17    | 197.94                | 11.49                 | 11.19                | 3.23                |
| 4,824.00                | 58.17           | 268.75      | 4,671.10            | 74.07      | -224.86    | 224.63                | 10.82                 | 9.91                 | 5.22                |
| 4,856.00                | 60.53           | 269.42      | 4,687.41            | 73.63      | -252.39    | 252.15                | 7.59                  | 7.38                 | 2.09                |
| 4,887.00                | 62.71           | 269.52      | 4,702.14            | 73.38      | -279.66    | 279.42                | 7.04                  | 7.03                 | 0.32                |
| 4,919.00                | 65.18           | 269.11      | 4,716.20            | 73.04      | -308.40    | 308.17                | 7.80                  | 7.72                 | -1.28               |
| 4,951.00                | 67.59           | 270.05      | 4,729.02            | 72.82      | -337.72    | 337.49                | 8.00                  | 7.53                 | 2.94                |
| 4,982.00                | 70.03           | 270.92      | 4,740.22            | 73.07      | -366.62    | 366.39                | 8.29                  | 7.87                 | 2.81                |
| 5,014.00                | 73.09           | 272.46      | 4,750.34            | 73.97      | -396.96    | 396.72                | 10.60                 | 9.56                 | 4.81                |
| 5,045.00                | 76.63           | 273.70      | 4,758.44            | 75.58      | -426.83    | 426.59                | 12.05                 | 11.42                | 4.00                |
| 5,077.00                | 80.48           | 273.59      | 4,764.79            | 77.57      | -458.13    | 457.88                | 12.04                 | 12.03                | -0.34               |
| 5,109.00                | 83.26           | 273.32      | 4,769.31            | 79.48      | -489.74    | 489.49                | 8.73                  | 8.69                 | -0.84               |
| 5,130.49                | 84.91           | 272.76      | 4,771.53            | 80.61      | -511.09    | 510.84                | 8.11                  | 7.68                 | -2.62               |
| <b>Carmen 91H LP</b>    |                 |             |                     |            |            |                       |                       |                      |                     |
| 5,140.00                | 85.64           | 272.51      | 4,772.31            | 81.05      | -520.56    | 520.30                | 8.11                  | 7.68                 | -2.61               |
| 5,140.92                | 85.72           | 272.49      | 4,772.38            | 81.09      | -521.48    | 521.22                | 8.55                  | 8.22                 | -2.38               |
| <b>Carmen 91H LP p3</b> |                 |             |                     |            |            |                       |                       |                      |                     |
| 5,172.00                | 88.27           | 271.75      | 4,774.01            | 82.24      | -552.49    | 552.22                | 8.55                  | 8.22                 | -2.37               |
| 5,203.00                | 90.46           | 270.49      | 4,774.35            | 82.84      | -583.48    | 583.21                | 8.15                  | 7.06                 | -4.06               |
| 5,234.00                | 91.44           | 270.09      | 4,773.84            | 83.00      | -614.47    | 614.21                | 3.41                  | 3.16                 | -1.29               |
| 5,334.00                | 92.27           | 270.10      | 4,770.60            | 83.16      | -714.42    | 714.15                | 0.83                  | 0.83                 | 0.01                |
| 5,429.00                | 91.29           | 270.40      | 4,767.65            | 83.58      | -809.37    | 809.10                | 1.08                  | -1.03                | 0.32                |
| 5,523.00                | 91.05           | 270.14      | 4,765.73            | 84.02      | -903.35    | 903.08                | 0.38                  | -0.26                | -0.28               |
| 5,617.00                | 90.79           | 269.85      | 4,764.22            | 84.01      | -997.34    | 997.07                | 0.41                  | -0.28                | -0.31               |
| 5,712.00                | 90.84           | 270.57      | 4,762.87            | 84.36      | -1,092.32  | 1,092.05              | 0.76                  | 0.05                 | 0.76                |
| 5,807.00                | 91.61           | 270.68      | 4,760.84            | 85.40      | -1,187.30  | 1,187.02              | 0.82                  | 0.81                 | 0.12                |



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| Measured Depth (ft)    | Inclination (°) | Azimuth (°) | Vertical Depth (ft) | +N/-S (ft) | +E/-W (ft) | Vertical Section (ft) | Dogleg Rate (°/100ft) | Build Rate (°/100ft) | Turn Rate (°/100ft) |
|------------------------|-----------------|-------------|---------------------|------------|------------|-----------------------|-----------------------|----------------------|---------------------|
| 5,901.00               | 91.13           | 269.02      | 4,758.59            | 85.15      | -1,281.27  | 1,280.99              | 1.84                  | -0.51                | -1.77               |
| 5,996.00               | 90.72           | 269.46      | 4,757.06            | 83.89      | -1,376.24  | 1,375.97              | 0.63                  | -0.43                | 0.46                |
| 6,090.00               | 90.33           | 269.69      | 4,756.20            | 83.19      | -1,470.24  | 1,469.97              | 0.48                  | -0.41                | 0.24                |
| 6,185.00               | 89.31           | 269.39      | 4,756.50            | 82.43      | -1,565.23  | 1,564.97              | 1.12                  | -1.07                | -0.32               |
| 6,279.00               | 90.28           | 268.73      | 4,756.83            | 80.89      | -1,659.22  | 1,658.96              | 1.25                  | 1.03                 | -0.70               |
| 6,374.00               | 90.23           | 269.95      | 4,756.41            | 79.80      | -1,754.21  | 1,753.95              | 1.29                  | -0.05                | 1.28                |
| 6,470.00               | 91.76           | 270.80      | 4,754.74            | 80.42      | -1,850.19  | 1,849.93              | 1.82                  | 1.59                 | 0.89                |
| 6,565.00               | 92.10           | 269.73      | 4,751.54            | 80.86      | -1,945.13  | 1,944.87              | 1.18                  | 0.36                 | -1.13               |
| 6,660.00               | 92.04           | 270.12      | 4,748.11            | 80.74      | -2,040.07  | 2,039.81              | 0.42                  | -0.06                | 0.41                |
| 6,755.00               | 92.60           | 271.27      | 4,744.27            | 81.89      | -2,134.98  | 2,134.72              | 1.35                  | 0.59                 | 1.21                |
| 6,850.00               | 91.40           | 269.19      | 4,740.95            | 82.27      | -2,229.92  | 2,229.65              | 2.53                  | -1.26                | -2.19               |
| 6,945.00               | 91.54           | 269.09      | 4,738.51            | 80.84      | -2,324.88  | 2,324.61              | 0.18                  | 0.15                 | -0.11               |
| 7,040.00               | 91.15           | 269.36      | 4,736.28            | 79.56      | -2,419.84  | 2,419.58              | 0.50                  | -0.41                | 0.28                |
| 7,135.00               | 91.88           | 270.56      | 4,733.77            | 79.49      | -2,514.81  | 2,514.54              | 1.48                  | 0.77                 | 1.26                |
| 7,230.00               | 90.56           | 267.37      | 4,731.75            | 77.78      | -2,609.75  | 2,609.50              | 3.63                  | -1.39                | -3.36               |
| 7,325.00               | 90.43           | 267.58      | 4,730.93            | 73.59      | -2,704.66  | 2,704.41              | 0.26                  | -0.14                | 0.22                |
| 7,420.00               | 90.00           | 267.27      | 4,730.57            | 69.32      | -2,799.56  | 2,799.33              | 0.56                  | -0.45                | -0.33               |
| 7,515.00               | 89.80           | 267.69      | 4,730.74            | 65.15      | -2,894.47  | 2,894.25              | 0.49                  | -0.21                | 0.44                |
| 7,610.00               | 91.58           | 270.30      | 4,729.59            | 63.48      | -2,989.44  | 2,989.22              | 3.33                  | 1.87                 | 2.75                |
| 7,705.00               | 91.36           | 270.47      | 4,727.16            | 64.12      | -3,084.40  | 3,084.18              | 0.29                  | -0.23                | 0.18                |
| 7,800.00               | 91.48           | 270.30      | 4,724.80            | 64.76      | -3,179.37  | 3,179.15              | 0.22                  | 0.13                 | -0.18               |
| 7,894.00               | 90.66           | 271.02      | 4,723.05            | 65.84      | -3,273.35  | 3,273.12              | 1.16                  | -0.87                | 0.77                |
| 7,989.00               | 90.09           | 271.42      | 4,722.42            | 67.86      | -3,368.32  | 3,368.09              | 0.73                  | -0.60                | 0.42                |
| 8,084.00               | 90.32           | 268.79      | 4,722.08            | 68.04      | -3,463.31  | 3,463.08              | 2.78                  | 0.24                 | -2.77               |
| 8,178.00               | 89.76           | 268.75      | 4,722.02            | 66.02      | -3,557.29  | 3,557.07              | 0.60                  | -0.60                | -0.04               |
| 8,273.00               | 89.78           | 269.41      | 4,722.40            | 64.49      | -3,652.28  | 3,652.06              | 0.70                  | 0.02                 | 0.69                |
| 8,368.00               | 90.97           | 269.68      | 4,721.78            | 63.74      | -3,747.27  | 3,747.05              | 1.28                  | 1.25                 | 0.28                |
| 8,463.00               | 91.44           | 270.56      | 4,719.78            | 63.94      | -3,842.25  | 3,842.03              | 1.05                  | 0.49                 | 0.93                |
| 8,556.00               | 91.23           | 271.25      | 4,717.61            | 65.41      | -3,935.21  | 3,934.99              | 0.78                  | -0.23                | 0.74                |
| 8,651.00               | 92.35           | 271.77      | 4,714.65            | 67.91      | -4,030.13  | 4,029.90              | 1.30                  | 1.18                 | 0.55                |
| 8,746.00               | 89.51           | 270.58      | 4,713.10            | 69.86      | -4,125.09  | 4,124.85              | 3.24                  | -2.99                | -1.25               |
| 8,841.00               | 88.71           | 270.54      | 4,714.58            | 70.78      | -4,220.07  | 4,219.83              | 0.84                  | -0.84                | -0.04               |
| 8,936.00               | 89.83           | 270.09      | 4,715.79            | 71.31      | -4,315.06  | 4,314.81              | 1.27                  | 1.18                 | -0.47               |
| 9,031.00               | 90.91           | 269.56      | 4,715.18            | 71.02      | -4,410.05  | 4,409.81              | 1.27                  | 1.14                 | -0.56               |
| 9,126.00               | 90.80           | 269.63      | 4,713.76            | 70.34      | -4,505.04  | 4,504.80              | 0.14                  | -0.12                | 0.07                |
| 9,221.00               | 92.03           | 269.90      | 4,711.41            | 69.96      | -4,600.01  | 4,599.77              | 1.33                  | 1.29                 | 0.28                |
| 9,315.00               | 91.99           | 269.80      | 4,708.12            | 69.71      | -4,693.95  | 4,693.71              | 0.11                  | -0.04                | -0.11               |
| 9,410.00               | 92.19           | 270.90      | 4,704.65            | 70.29      | -4,788.88  | 4,788.64              | 1.18                  | 0.21                 | 1.16                |
| 9,423.13               | 92.22           | 270.74      | 4,704.15            | 70.48      | -4,802.00  | 4,801.75              | 1.23                  | 0.20                 | -1.22               |
| <b>Carmen 91H PBHL</b> |                 |             |                     |            |            |                       |                       |                      |                     |
| 9,506.00               | 92.38           | 269.73      | 4,700.82            | 70.82      | -4,884.80  | 4,884.56              | 1.23                  | 0.20                 | -1.22               |
| 9,570.00               | 91.39           | 269.36      | 4,698.72            | 70.31      | -4,948.77  | 4,948.52              | 1.65                  | -1.55                | -0.58               |
| 9,633.00               | 91.02           | 269.85      | 4,697.39            | 69.87      | -5,011.75  | 5,011.51              | 0.97                  | -0.59                | 0.78                |
| 9,707.00               | 91.02           | 269.85      | 4,696.08            | 69.68      | -5,085.74  | 5,085.50              | 0.00                  | 0.00                 | 0.00                |



## Survey Report

**Company:** COG OPERATING, LLC  
**Project:** Eddy /Lea County, NM (NAD27) NMEZ  
**Site:** Carmen 3 Federal COM 91H  
**Well:** 91H  
**Wellbore:** Lateral  
**Design:** Lateral

**Local Co-ordinate Reference:** Well 91H - Slot Carmen 91H  
**TVD Reference:** 3756+18 @ 3774.00ft (Planningp2)  
**MD Reference:** 3756+18 @ 3774.00ft (Planningp2)  
**North Reference:** Grid  
**Survey Calculation Method:** Minimum Curvature  
**Database:** VON\_EDM

### Survey

| Measured<br>Depth<br>(ft)                                     | Inclination<br>(°) | Azimuth<br>(°) | Vertical<br>Depth<br>(ft) | +N/-S<br>(ft) | +E/-W<br>(ft) | Vertical<br>Section<br>(ft) | Dogleg<br>Rate<br>(°/100ft) | Build<br>Rate<br>(°/100ft) | Turn<br>Rate<br>(°/100ft) |
|---------------------------------------------------------------|--------------------|----------------|---------------------------|---------------|---------------|-----------------------------|-----------------------------|----------------------------|---------------------------|
| Carmen 91H PBHL p3 - Carmen 91H BHL - Carmen 91H PBHL p3 proj |                    |                |                           |               |               |                             |                             |                            |                           |

### Design Targets

| Target Name<br>- hit/miss target<br>- Shape                       | Dip Angle<br>(°) | Dip Dir.<br>(°) | TVD<br>(ft) | +N/-S<br>(ft) | +E/-W<br>(ft) | Northing<br>(ft) | Easting<br>(ft) | Latitude         | Longitude        |
|-------------------------------------------------------------------|------------------|-----------------|-------------|---------------|---------------|------------------|-----------------|------------------|------------------|
| Carmen 91H SL<br>- actual wellpath hits target center<br>- Point  | 0.00             | 0.00            | 0.00        | 0.00          | 0.00          | 680,235.50       | 617,326.10      | 32° 52' 10.065 N | 103° 57' 4.360 W |
| Carmen 91H BHL<br>- actual wellpath hits target center<br>- Point | 0.00             | 0.00            | 4,696.08    | 69.68         | -5,085.74     | 680,305.18       | 612,240.36      | 32° 52' 10.933 N | 103° 58' 3.986 W |

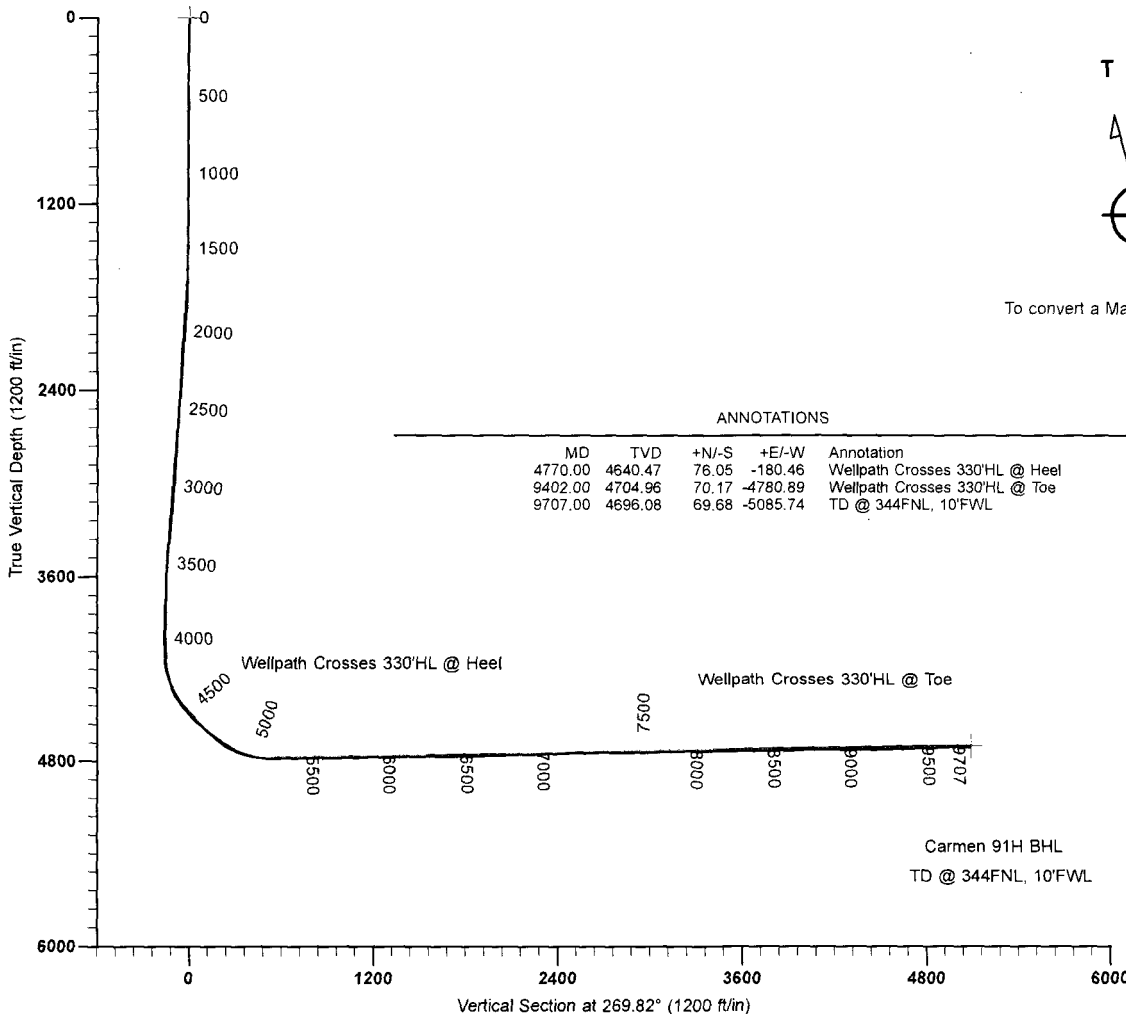
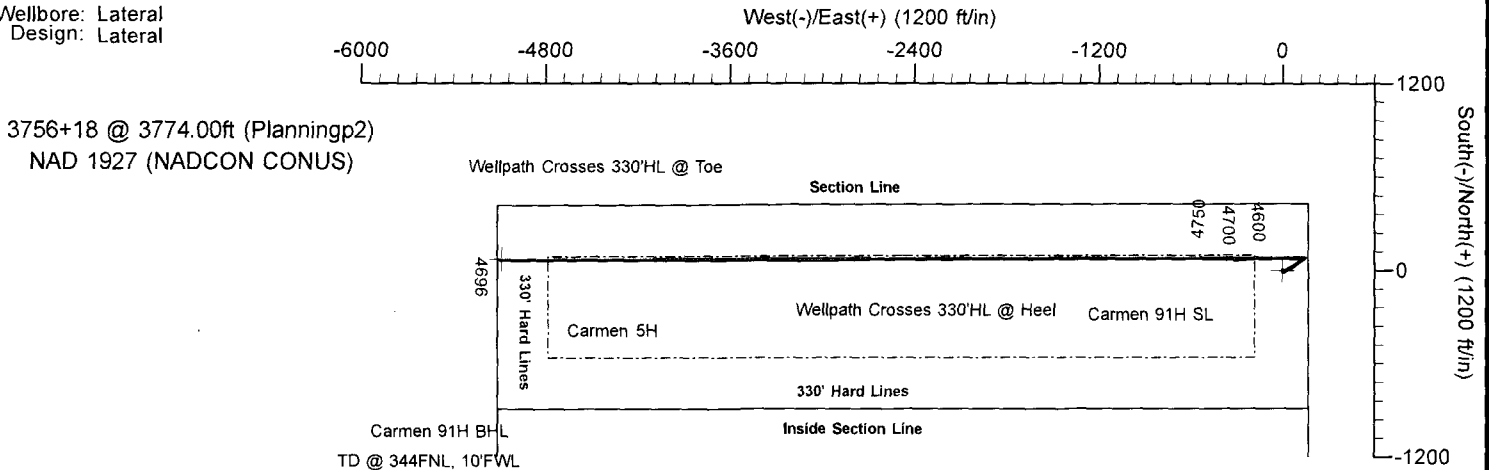
### Design Annotations

| Measured<br>Depth<br>(ft) | Vertical<br>Depth<br>(ft) | Local Coordinates |               | Comment                        |
|---------------------------|---------------------------|-------------------|---------------|--------------------------------|
|                           |                           | +N/-S<br>(ft)     | +E/-W<br>(ft) |                                |
| 4,770.00                  | 4,640.47                  | 76.05             | -180.46       | Wellpath Crosses 330'HL @ Heel |
| 9,402.00                  | 4,704.96                  | 70.17             | -4,780.89     | Wellpath Crosses 330'HL @ Toe  |
| 9,707.00                  | 4,696.08                  | 69.68             | -5,085.74     | TD @ 344FNL, 10'FWL            |

Checked By: \_\_\_\_\_ Approved By: \_\_\_\_\_ Date: \_\_\_\_\_

# COG OPERATING, LLC

Project: Eddy /Lea County, NM (NAD27) NMEZ  
 Site: Carmen 3 Federal COM 91H  
 Well: 91H  
 Wellbore: Lateral  
 Design: Lateral



Azimuths to Grid North  
 True North: -0.21°  
 Magnetic North: 6.95°

Magnetic Field  
 Strength: 48254.4snT  
 Dip Angle: 60.59°  
 Date: 09/07/2017  
 Model: IGRF2015

To convert a Magnetic Direction to a Grid Direction, Add 6.95°

## ANNOTATIONS

| MD      | TVD     | +N/-S | +E/-W    | Annotation                     |
|---------|---------|-------|----------|--------------------------------|
| 4770.00 | 4640.47 | 76.05 | -180.46  | Wellpath Crosses 330'HL @ Heel |
| 9402.00 | 4704.96 | 70.17 | -4780.89 | Wellpath Crosses 330'HL @ Toe  |
| 9707.00 | 4696.08 | 69.68 | -5085.74 | TD @ 344FNL, 10'FWL            |

## TARGET DETAILS

| Name           | TVD     | +N/-S | +E/-W    | Northing  | Easting   | Shape |
|----------------|---------|-------|----------|-----------|-----------|-------|
| Carmen 91H SL  | 0.00    | 0.00  | 0.00     | 680235.50 | 617326.10 | Point |
| Carmen 91H BHL | 4696.08 | 69.68 | -5085.74 | 680305.18 | 612240.36 | Point |

Design: Lateral (91H/Lateral)  
 Created By: Mekka Williams  
 eSomina Well Design  
 mekka@esominawell.com  
 10:22, October 03 2017

VON DIRECTIONAL  
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 936-756-2400

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