

# **COG Operating LLC**

**Lea County, NM (NAD83 NME)**

**Shovel Head Federal Com**

**18H**

**HOBBS OCD**

**DEC 11 2018**

**RECEIVED**

**OH**

**Survey: Phoenix MWD Surveys**

## **Standard Survey Report**

**10 July, 2018**

## Survey Report

**Company:** COG Operating LLC  
**Project:** Lea County, NM (NAD83 NME)  
**Site:** Shovel Head Federal Com  
**Well:** 18H  
**Wellbore:** OH  
**Design:** Surveys (Double K 7)

**Local Co-ordinate Reference:** Well 18H  
**TVD Reference:** RKB @ 4107.00usft (Double K 7)  
**MD Reference:** RKB @ 4107.00usft (Double K 7)  
**North Reference:** Grid  
**Survey Calculation Method:** Minimum Curvature  
**Database:** USA Compass

**Project** Lea County, NM (NAD83 NME)

**Map System:** US State Plane 1983  
**Geo Datum:** North American Datum 1983  
**Map Zone:** New Mexico Eastern Zone

**System Datum:** Mean Sea Level

**Site** Shovel Head Federal Com

**Site Position:**  
**From:** Lat/Long  
**Position Uncertainty:** 0.00 usft  
**Northing:** 676,071.26 usft  
**Easting:** 711,040.45 usft  
**Slot Radius:** 13-3/16 "  
**Latitude:** 32° 51' 26.36028 N  
**Longitude:** 103° 46' 50.45808 W  
**Grid Convergence:** 0.30 °

**Well** 18H

**Well Position** +N/-S 0.00 usft **Northing:** 676,071.26 usft **Latitude:** 32° 51' 26.36028 N  
 +E/-W 0.00 usft **Easting:** 711,040.45 usft **Longitude:** 103° 46' 50.45808 W  
**Position Uncertainty** 0.00 usft **Wellhead Elevation:** usft **Ground Level:** 4,090.00 usft

**Wellbore** OH

| Magnetics | Model Name | Sample Date | Declination (°) | Dip Angle (°) | Field Strength (nT) |
|-----------|------------|-------------|-----------------|---------------|---------------------|
|           | MVHD       | 6/27/2018   | 7.02            | 60.80         | 48,329.79015089     |

**Design** Surveys (Double K 7)

**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         | 89.69         |

**Survey Program** Date 7/10/2018

| From (usft) | To (usft) | Survey (Wellbore)            | Tool Name  | Description                      |
|-------------|-----------|------------------------------|------------|----------------------------------|
| 100.00      | 4,780.00  | Scientific Gyro Surveys (OH) | NS-GYRO-MS | North sensing gyrocompassing m/s |
| 4,826.00    | 13,776.00 | Phoenix MWD Surveys (OH)     | MWD+HDGM   | OWSG Rev.2 MWD + HDGM            |

**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) |
|---------------------------------|-----------------|-------------|-----------------------|--------------|--------------|-------------------------|-------------------------|------------------------|-----------------------|
| 4,780.00                        | 5.12            | 265.20      | 4,764.37              | 23.44        | -253.26      | -253.13                 | 0.00                    | 0.00                   | 0.00                  |
| <b>Tie In</b>                   |                 |             |                       |              |              |                         |                         |                        |                       |
| 4,826.00                        | 4.75            | 266.68      | 4,810.20              | 23.16        | -257.21      | -257.08                 | 0.85                    | -0.80                  | 3.22                  |
| <b>First Phoenix MWD Survey</b> |                 |             |                       |              |              |                         |                         |                        |                       |
| 4,898.00                        | 3.07            | 265.16      | 4,882.03              | 22.82        | -262.10      | -261.98                 | 2.34                    | -2.33                  | -2.11                 |
| 4,961.00                        | 2.70            | 265.97      | 4,944.95              | 22.58        | -265.27      | -265.14                 | 0.59                    | -0.59                  | 1.29                  |
| 5,024.00                        | 1.58            | 286.25      | 5,007.91              | 22.71        | -267.58      | -267.45                 | 2.12                    | -1.78                  | 32.19                 |
| 5,087.00                        | 1.41            | 293.53      | 5,070.88              | 23.27        | -269.12      | -268.99                 | 0.40                    | -0.27                  | 11.56                 |
| 5,118.00                        | 1.20            | 350.00      | 5,101.88              | 23.74        | -269.53      | -269.40                 | 4.03                    | -0.68                  | 182.16                |

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**MD Reference:** RKB @ 4107.00usft (Double K 7)  
**North Reference:** Grid  
**Survey Calculation Method:** Minimum Curvature  
**Database:** USA Compass

## 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) |
|-----------------------|-----------------|-------------|-----------------------|--------------|--------------|-------------------------|-------------------------|------------------------|-----------------------|
| 5,150.00              | 2.17            | 59.46       | 5,133.87              | 24.38        | -269.07      | -268.93                 | 6.50                    | 3.03                   | 217.06                |
| 5,181.00              | 4.81            | 81.85       | 5,164.81              | 24.86        | -267.27      | -267.14                 | 9.43                    | 8.52                   | 72.23                 |
| 5,213.00              | 7.80            | 86.91       | 5,196.61              | 25.17        | -263.78      | -263.64                 | 9.49                    | 9.34                   | 15.81                 |
| 5,244.00              | 10.87           | 88.28       | 5,227.20              | 25.37        | -258.75      | -258.61                 | 9.93                    | 9.90                   | 4.42                  |
| 5,275.00              | 13.81           | 88.51       | 5,257.48              | 25.55        | -252.13      | -251.99                 | 9.49                    | 9.48                   | 0.74                  |
| 5,307.00              | 17.29           | 88.96       | 5,288.30              | 25.74        | -243.56      | -243.41                 | 10.88                   | 10.88                  | 1.41                  |
| 5,338.00              | 20.52           | 89.40       | 5,317.62              | 25.88        | -233.51      | -233.37                 | 10.43                   | 10.42                  | 1.42                  |
| 5,370.00              | 24.19           | 90.98       | 5,347.21              | 25.82        | -221.35      | -221.20                 | 11.62                   | 11.47                  | 4.94                  |
| 5,402.00              | 27.92           | 91.31       | 5,375.96              | 25.54        | -207.30      | -207.16                 | 11.67                   | 11.66                  | 1.03                  |
| 5,433.00              | 30.34           | 92.48       | 5,403.04              | 25.04        | -192.22      | -192.08                 | 8.02                    | 7.81                   | 3.77                  |
| 5,464.00              | 32.39           | 92.68       | 5,429.50              | 24.31        | -176.10      | -175.96                 | 6.62                    | 6.61                   | 0.65                  |
| 5,496.00              | 34.18           | 94.53       | 5,456.25              | 23.20        | -158.57      | -158.45                 | 6.43                    | 5.59                   | 5.78                  |
| 5,519.00              | 35.80           | 94.58       | 5,475.10              | 22.15        | -145.43      | -145.31                 | 7.04                    | 7.04                   | 0.22                  |
| 5,551.00              | 38.80           | 93.24       | 5,500.55              | 20.84        | -126.08      | -125.97                 | 9.71                    | 9.38                   | -4.19                 |
| 5,583.00              | 41.93           | 91.39       | 5,524.93              | 20.01        | -105.38      | -105.27                 | 10.47                   | 9.78                   | -5.78                 |
| 5,646.00              | 47.40           | 90.07       | 5,569.72              | 19.47        | -61.12       | -61.01                  | 8.81                    | 8.68                   | -2.10                 |
| 5,709.00              | 50.17           | 89.56       | 5,611.23              | 19.63        | -13.73       | -13.62                  | 4.44                    | 4.40                   | -0.81                 |
| 5,772.00              | 51.13           | 88.75       | 5,651.17              | 20.35        | 34.98        | 35.09                   | 1.82                    | 1.52                   | -1.29                 |
| 5,835.00              | 52.65           | 87.23       | 5,690.05              | 22.09        | 84.52        | 84.63                   | 3.07                    | 2.41                   | -2.41                 |
| 5,898.00              | 61.62           | 86.68       | 5,724.21              | 24.92        | 137.30       | 137.44                  | 14.26                   | 14.24                  | -0.87                 |
| 5,930.00              | 66.46           | 86.86       | 5,738.21              | 26.54        | 166.02       | 166.16                  | 15.13                   | 15.13                  | 0.56                  |
| 5,961.00              | 71.20           | 87.72       | 5,749.40              | 27.90        | 194.89       | 195.04                  | 15.51                   | 15.29                  | 2.77                  |
| 5,993.00              | 75.26           | 89.92       | 5,758.63              | 28.52        | 225.51       | 225.66                  | 14.29                   | 12.69                  | 6.88                  |
| 6,024.00              | 76.64           | 90.49       | 5,766.16              | 28.41        | 255.58       | 255.73                  | 4.80                    | 4.45                   | 1.84                  |
| 6,056.00              | 79.33           | 90.97       | 5,772.82              | 28.02        | 286.88       | 287.02                  | 8.53                    | 8.41                   | 1.50                  |
| 6,087.00              | 82.71           | 91.02       | 5,777.66              | 27.48        | 317.49       | 317.63                  | 10.90                   | 10.90                  | 0.16                  |
| 6,118.00              | 84.91           | 91.12       | 5,781.00              | 26.91        | 348.30       | 348.44                  | 7.10                    | 7.10                   | 0.32                  |
| 6,150.00              | 88.67           | 90.81       | 5,782.79              | 26.37        | 380.24       | 380.38                  | 11.79                   | 11.75                  | -0.97                 |
| 6,157.00              | 89.27           | 88.90       | 5,782.92              | 26.39        | 387.24       | 387.37                  | 28.60                   | 8.57                   | -27.29                |
| 6,221.00              | 91.51           | 90.03       | 5,782.48              | 26.99        | 451.23       | 451.37                  | 3.92                    | 3.50                   | 1.77                  |
| 6,284.00              | 93.30           | 89.94       | 5,779.84              | 27.00        | 514.17       | 514.31                  | 2.84                    | 2.84                   | -0.14                 |
| 6,347.00              | 91.11           | 89.50       | 5,777.42              | 27.31        | 577.12       | 577.26                  | 3.55                    | -3.48                  | -0.70                 |
| 6,411.00              | 91.98           | 88.97       | 5,775.69              | 28.16        | 641.09       | 641.23                  | 1.59                    | 1.36                   | -0.83                 |
| 6,474.00              | 93.29           | 89.43       | 5,772.79              | 29.04        | 704.01       | 704.16                  | 2.20                    | 2.08                   | 0.73                  |
| 6,536.00              | 90.91           | 89.26       | 5,770.52              | 29.75        | 765.96       | 766.11                  | 3.85                    | -3.84                  | -0.27                 |
| 6,599.00              | 88.44           | 88.93       | 5,770.88              | 30.75        | 828.95       | 829.10                  | 3.96                    | -3.92                  | -0.52                 |
| 6,662.00              | 90.08           | 88.95       | 5,771.69              | 31.91        | 891.93       | 892.09                  | 2.60                    | 2.60                   | 0.03                  |
| 6,725.00              | 88.05           | 89.85       | 5,772.72              | 32.57        | 954.92       | 955.08                  | 3.52                    | -3.22                  | 1.43                  |
| 6,789.00              | 89.73           | 90.42       | 5,773.96              | 32.42        | 1,018.90     | 1,019.06                | 2.77                    | 2.63                   | 0.89                  |
| 6,852.00              | 91.44           | 90.65       | 5,773.32              | 31.83        | 1,081.89     | 1,082.05                | 2.74                    | 2.71                   | 0.37                  |
| 6,915.00              | 89.62           | 90.10       | 5,772.73              | 31.42        | 1,144.89     | 1,145.04                | 3.02                    | -2.89                  | -0.87                 |
| 6,978.00              | 90.98           | 89.61       | 5,772.40              | 31.58        | 1,207.88     | 1,208.04                | 2.29                    | 2.16                   | -0.78                 |
| 7,041.00              | 90.76           | 92.29       | 5,771.45              | 30.54        | 1,270.86     | 1,271.01                | 4.27                    | -0.35                  | 4.25                  |

## Survey Report

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**Well:** 18H  
**Wellbore:** OH  
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**Local Co-ordinate Reference:** Well 18H  
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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) |
|-----------------------|-----------------|-------------|-----------------------|--------------|--------------|-------------------------|-------------------------|------------------------|-----------------------|
| 7,105.00              | 91.32           | 92.26       | 5,770.29              | 27.99        | 1,334.80     | 1,334.93                | 0.88                    | 0.88                   | -0.05                 |
| 7,167.00              | 92.28           | 91.99       | 5,768.34              | 25.70        | 1,396.73     | 1,396.85                | 1.61                    | 1.55                   | -0.44                 |
| 7,230.00              | 91.05           | 92.30       | 5,766.51              | 23.34        | 1,459.65     | 1,459.76                | 2.01                    | -1.95                  | 0.49                  |
| 7,293.00              | 89.47           | 92.09       | 5,766.22              | 20.93        | 1,522.61     | 1,522.70                | 2.53                    | -2.51                  | -0.33                 |
| 7,357.00              | 88.38           | 92.18       | 5,767.42              | 18.54        | 1,586.55     | 1,586.63                | 1.71                    | -1.70                  | 0.14                  |
| 7,420.00              | 87.50           | 90.70       | 5,769.69              | 16.96        | 1,649.49     | 1,649.55                | 2.73                    | -1.40                  | -2.35                 |
| 7,484.00              | 86.24           | 88.98       | 5,773.18              | 17.14        | 1,713.39     | 1,713.45                | 3.33                    | -1.97                  | -2.69                 |
| 7,546.00              | 86.62           | 87.23       | 5,777.04              | 19.19        | 1,775.23     | 1,775.31                | 2.88                    | 0.61                   | -2.82                 |
| 7,609.00              | 86.82           | 87.10       | 5,780.65              | 22.30        | 1,838.05     | 1,838.14                | 0.38                    | 0.32                   | -0.21                 |
| 7,672.00              | 86.84           | 87.08       | 5,784.13              | 25.49        | 1,900.87     | 1,900.98                | 0.04                    | 0.03                   | -0.03                 |
| 7,735.00              | 86.79           | 87.06       | 5,787.63              | 28.71        | 1,963.69     | 1,963.82                | 0.09                    | -0.08                  | -0.03                 |
| 7,798.00              | 88.08           | 86.99       | 5,790.45              | 31.97        | 2,026.54     | 2,026.69                | 2.05                    | 2.05                   | -0.11                 |
| 7,861.00              | 89.72           | 88.20       | 5,791.66              | 34.61        | 2,089.47     | 2,089.63                | 3.23                    | 2.60                   | 1.92                  |
| 7,924.00              | 91.55           | 89.21       | 5,790.96              | 36.04        | 2,152.45     | 2,152.61                | 3.32                    | 2.90                   | 1.60                  |
| 7,987.00              | 91.62           | 89.21       | 5,789.22              | 36.91        | 2,215.42     | 2,215.59                | 0.11                    | 0.11                   | 0.00                  |
| 8,050.00              | 91.73           | 89.22       | 5,787.38              | 37.77        | 2,278.39     | 2,278.56                | 0.18                    | 0.17                   | 0.02                  |
| 8,112.00              | 91.79           | 89.15       | 5,785.47              | 38.65        | 2,340.35     | 2,340.53                | 0.15                    | 0.10                   | -0.11                 |
| 8,176.00              | 91.88           | 89.40       | 5,783.43              | 39.46        | 2,404.31     | 2,404.49                | 0.41                    | 0.14                   | 0.39                  |
| 8,239.00              | 92.05           | 89.53       | 5,781.27              | 40.05        | 2,467.27     | 2,467.45                | 0.34                    | 0.27                   | 0.21                  |
| 8,302.00              | 89.90           | 89.45       | 5,780.19              | 40.61        | 2,530.26     | 2,530.44                | 3.42                    | -3.41                  | -0.13                 |
| 8,365.00              | 89.72           | 89.73       | 5,780.40              | 41.06        | 2,593.26     | 2,593.44                | 0.53                    | -0.29                  | 0.44                  |
| 8,427.00              | 89.55           | 89.89       | 5,780.80              | 41.26        | 2,655.25     | 2,655.44                | 0.38                    | -0.27                  | 0.26                  |
| 8,491.00              | 89.56           | 90.20       | 5,781.29              | 41.21        | 2,719.25     | 2,719.44                | 0.48                    | 0.02                   | 0.48                  |
| 8,554.00              | 89.60           | 90.40       | 5,781.76              | 40.88        | 2,782.25     | 2,782.43                | 0.32                    | 0.06                   | 0.32                  |
| 8,617.00              | 89.21           | 89.93       | 5,782.41              | 40.70        | 2,845.25     | 2,845.42                | 0.97                    | -0.62                  | -0.75                 |
| 8,680.00              | 88.96           | 89.79       | 5,783.42              | 40.86        | 2,908.24     | 2,908.42                | 0.45                    | -0.40                  | -0.22                 |
| 8,744.00              | 89.47           | 89.51       | 5,784.29              | 41.25        | 2,972.23     | 2,972.41                | 0.91                    | 0.80                   | -0.44                 |
| 8,807.00              | 90.76           | 89.90       | 5,784.17              | 41.57        | 3,035.23     | 3,035.41                | 2.14                    | 2.05                   | 0.62                  |
| 8,870.00              | 90.75           | 89.80       | 5,783.34              | 41.74        | 3,098.22     | 3,098.40                | 0.16                    | -0.02                  | -0.16                 |
| 8,933.00              | 90.72           | 89.70       | 5,782.53              | 42.01        | 3,161.22     | 3,161.40                | 0.17                    | -0.05                  | -0.16                 |
| 8,996.00              | 90.24           | 89.41       | 5,782.00              | 42.50        | 3,224.21     | 3,224.39                | 0.89                    | -0.76                  | -0.46                 |
| 9,059.00              | 90.10           | 89.28       | 5,781.81              | 43.22        | 3,287.21     | 3,287.39                | 0.30                    | -0.22                  | -0.21                 |
| 9,122.00              | 89.56           | 88.76       | 5,782.00              | 44.30        | 3,350.20     | 3,350.39                | 1.19                    | -0.86                  | -0.83                 |
| 9,185.00              | 89.02           | 88.58       | 5,782.78              | 45.76        | 3,413.18     | 3,413.37                | 0.90                    | -0.86                  | -0.29                 |
| 9,247.00              | 90.07           | 88.42       | 5,783.27              | 47.38        | 3,475.15     | 3,475.36                | 1.71                    | 1.69                   | -0.26                 |
| 9,311.00              | 90.19           | 87.83       | 5,783.13              | 49.48        | 3,539.12     | 3,539.33                | 0.94                    | 0.19                   | -0.92                 |
| 9,374.00              | 91.10           | 89.53       | 5,782.42              | 50.93        | 3,602.09     | 3,602.32                | 3.06                    | 1.44                   | 2.70                  |
| 9,437.00              | 91.28           | 89.92       | 5,781.11              | 51.23        | 3,665.08     | 3,665.30                | 0.68                    | 0.29                   | 0.62                  |
| 9,500.00              | 91.50           | 91.15       | 5,779.58              | 50.64        | 3,728.06     | 3,728.28                | 1.98                    | 0.35                   | 1.95                  |
| 9,563.00              | 91.67           | 91.19       | 5,777.84              | 49.36        | 3,791.02     | 3,791.23                | 0.28                    | 0.27                   | 0.06                  |
| 9,627.00              | 91.73           | 91.18       | 5,775.94              | 48.03        | 3,854.98     | 3,855.18                | 0.10                    | 0.09                   | -0.02                 |
| 9,689.00              | 92.12           | 91.29       | 5,773.86              | 46.70        | 3,916.93     | 3,917.12                | 0.65                    | 0.63                   | 0.18                  |
| 9,753.00              | 90.18           | 91.21       | 5,772.57              | 45.30        | 3,980.90     | 3,981.08                | 3.03                    | -3.03                  | -0.13                 |
| 9,816.00              | 90.19           | 91.33       | 5,772.37              | 43.91        | 4,043.88     | 4,044.06                | 0.19                    | 0.02                   | 0.19                  |

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|-----------------------|-----------------|-------------|-----------------------|--------------|--------------|-------------------------|-------------------------|------------------------|-----------------------|
| 9,879.00              | 90.19           | 91.09       | 5,772.16              | 42.58        | 4,106.87     | 4,107.04                | 0.38                    | 0.00                   | -0.38                 |
| 9,942.00              | 90.07           | 91.11       | 5,772.02              | 41.37        | 4,169.85     | 4,170.02                | 0.19                    | -0.19                  | 0.03                  |
| 10,005.00             | 90.10           | 91.15       | 5,771.93              | 40.13        | 4,232.84     | 4,233.00                | 0.08                    | 0.05                   | 0.06                  |
| 10,068.00             | 89.92           | 91.18       | 5,771.91              | 38.84        | 4,295.83     | 4,295.98                | 0.29                    | -0.29                  | 0.05                  |
| 10,131.00             | 89.62           | 91.09       | 5,772.17              | 37.60        | 4,358.82     | 4,358.96                | 0.50                    | -0.48                  | -0.14                 |
| 10,194.00             | 89.39           | 90.98       | 5,772.71              | 36.46        | 4,421.80     | 4,421.94                | 0.40                    | -0.37                  | -0.17                 |
| 10,257.00             | 89.30           | 90.48       | 5,773.43              | 35.66        | 4,484.79     | 4,484.92                | 0.81                    | -0.14                  | -0.79                 |
| 10,320.00             | 89.25           | 90.33       | 5,774.23              | 35.21        | 4,547.79     | 4,547.91                | 0.25                    | -0.08                  | -0.24                 |
| 10,383.00             | 89.36           | 91.03       | 5,774.99              | 34.46        | 4,610.78     | 4,610.90                | 1.12                    | 0.17                   | 1.11                  |
| 10,447.00             | 89.58           | 91.22       | 5,775.59              | 33.21        | 4,674.76     | 4,674.87                | 0.45                    | 0.34                   | 0.30                  |
| 10,509.00             | 89.01           | 90.52       | 5,776.35              | 32.27        | 4,736.75     | 4,736.86                | 1.46                    | -0.92                  | -1.13                 |
| 10,573.00             | 89.42           | 90.59       | 5,777.22              | 31.65        | 4,800.74     | 4,800.84                | 0.65                    | 0.64                   | 0.11                  |
| 10,635.00             | 89.62           | 90.37       | 5,777.74              | 31.13        | 4,862.74     | 4,862.83                | 0.48                    | 0.32                   | -0.35                 |
| 10,698.00             | 89.42           | 89.20       | 5,778.27              | 31.36        | 4,925.73     | 4,925.83                | 1.88                    | -0.32                  | -1.86                 |
| 10,761.00             | 89.81           | 89.34       | 5,778.70              | 32.16        | 4,988.73     | 4,988.83                | 0.66                    | 0.62                   | 0.22                  |
| 10,825.00             | 89.99           | 89.62       | 5,778.81              | 32.75        | 5,052.72     | 5,052.83                | 0.52                    | 0.28                   | 0.44                  |
| 10,888.00             | 89.90           | 89.50       | 5,778.87              | 33.23        | 5,115.72     | 5,115.83                | 0.24                    | -0.14                  | -0.19                 |
| 10,950.00             | 88.92           | 88.44       | 5,779.51              | 34.34        | 5,177.71     | 5,177.82                | 2.33                    | -1.58                  | -1.71                 |
| 11,011.00             | 88.88           | 88.49       | 5,780.68              | 35.98        | 5,238.67     | 5,238.79                | 0.10                    | -0.07                  | 0.08                  |
| 11,074.00             | 88.70           | 88.32       | 5,782.01              | 37.73        | 5,301.63     | 5,301.76                | 0.39                    | -0.29                  | -0.27                 |
| 11,137.00             | 88.67           | 87.92       | 5,783.45              | 39.80        | 5,364.58     | 5,364.72                | 0.64                    | -0.05                  | -0.63                 |
| 11,201.00             | 88.53           | 87.98       | 5,785.02              | 42.09        | 5,428.52     | 5,428.67                | 0.24                    | -0.22                  | 0.09                  |
| 11,264.00             | 88.96           | 88.28       | 5,786.40              | 44.14        | 5,491.48     | 5,491.63                | 0.83                    | 0.68                   | 0.48                  |
| 11,327.00             | 89.59           | 88.56       | 5,787.19              | 45.88        | 5,554.45     | 5,554.61                | 1.09                    | 1.00                   | 0.44                  |
| 11,390.00             | 89.24           | 88.20       | 5,787.84              | 47.66        | 5,617.42     | 5,617.59                | 0.80                    | -0.56                  | -0.57                 |
| 11,451.00             | 89.25           | 88.55       | 5,788.64              | 49.39        | 5,678.39     | 5,678.57                | 0.57                    | 0.02                   | 0.57                  |
| 11,514.00             | 89.58           | 89.51       | 5,789.28              | 50.45        | 5,741.37     | 5,741.56                | 1.61                    | 0.52                   | 1.52                  |
| 11,578.00             | 89.42           | 89.36       | 5,789.84              | 51.09        | 5,805.37     | 5,805.56                | 0.34                    | -0.25                  | -0.23                 |
| 11,641.00             | 89.88           | 90.65       | 5,790.23              | 51.08        | 5,868.37     | 5,868.56                | 2.17                    | 0.73                   | 2.05                  |
| 11,705.00             | 90.62           | 91.21       | 5,789.95              | 50.04        | 5,932.36     | 5,932.54                | 1.45                    | 1.16                   | 0.88                  |
| 11,768.00             | 91.78           | 91.14       | 5,788.63              | 48.75        | 5,995.33     | 5,995.50                | 1.84                    | 1.84                   | -0.11                 |
| 11,832.00             | 91.65           | 91.03       | 5,786.71              | 47.54        | 6,059.29     | 6,059.46                | 0.27                    | -0.20                  | -0.17                 |
| 11,895.00             | 91.52           | 90.98       | 5,784.97              | 46.43        | 6,122.25     | 6,122.42                | 0.22                    | -0.21                  | -0.08                 |
| 11,958.00             | 91.87           | 90.96       | 5,783.11              | 45.37        | 6,185.22     | 6,185.37                | 0.56                    | 0.56                   | -0.03                 |
| 12,020.00             | 91.99           | 90.92       | 5,781.02              | 44.35        | 6,247.17     | 6,247.32                | 0.20                    | 0.19                   | -0.06                 |
| 12,081.00             | 92.10           | 90.99       | 5,778.84              | 43.34        | 6,308.13     | 6,308.27                | 0.21                    | 0.18                   | 0.11                  |
| 12,143.00             | 91.21           | 91.49       | 5,777.05              | 41.99        | 6,370.09     | 6,370.22                | 1.65                    | -1.44                  | 0.81                  |
| 12,204.00             | 91.45           | 91.62       | 5,775.64              | 40.34        | 6,431.05     | 6,431.17                | 0.45                    | 0.39                   | 0.21                  |
| 12,266.00             | 91.88           | 92.19       | 5,773.83              | 38.28        | 6,492.99     | 6,493.10                | 1.15                    | 0.69                   | 0.92                  |
| 12,327.00             | 89.73           | 91.91       | 5,772.98              | 36.10        | 6,553.94     | 6,554.04                | 3.55                    | -3.52                  | -0.46                 |
| 12,389.00             | 89.45           | 91.64       | 5,773.42              | 34.18        | 6,615.91     | 6,615.99                | 0.63                    | -0.45                  | -0.44                 |
| 12,451.00             | 89.38           | 90.77       | 5,774.05              | 32.87        | 6,677.89     | 6,677.97                | 1.41                    | -0.11                  | -1.40                 |
| 12,512.00             | 88.72           | 90.15       | 5,775.07              | 32.38        | 6,738.88     | 6,738.95                | 1.48                    | -1.08                  | -1.02                 |

## Survey Report

**Company:** COG Operating LLC  
**Project:** Lea County, NM (NAD83 NME)  
**Site:** Shovel Head Federal Com  
**Well:** 18H  
**Wellbore:** OH  
**Design:** Surveys (Double K 7)

**Local Co-ordinate Reference:** Well 18H  
**TVD Reference:** RKB @ 4107.00usft (Double K 7)  
**MD Reference:** RKB @ 4107.00usft (Double K 7)  
**North Reference:** Grid  
**Survey Calculation Method:** Minimum Curvature  
**Database:** USA Compass

### 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) |
|------------------------------------------------|-----------------|-------------|-----------------------|--------------|--------------|-------------------------|-------------------------|------------------------|-----------------------|
| 12,574.00                                      | 87.61           | 87.54       | 5,777.05              | 33.63        | 6,800.83     | 6,800.91                | 4.57                    | -1.79                  | -4.21                 |
| 12,635.00                                      | 87.52           | 87.55       | 5,779.64              | 36.24        | 6,861.72     | 6,861.81                | 0.15                    | -0.15                  | 0.02                  |
| 12,697.00                                      | 87.96           | 87.49       | 5,782.09              | 38.92        | 6,923.61     | 6,923.72                | 0.72                    | 0.71                   | -0.10                 |
| 12,758.00                                      | 88.39           | 87.59       | 5,784.03              | 41.54        | 6,984.52     | 6,984.64                | 0.72                    | 0.70                   | 0.16                  |
| 12,819.00                                      | 90.05           | 87.61       | 5,784.86              | 44.09        | 7,045.46     | 7,045.60                | 2.72                    | 2.72                   | 0.03                  |
| 12,880.00                                      | 91.44           | 87.74       | 5,784.07              | 46.57        | 7,106.40     | 7,106.55                | 2.29                    | 2.28                   | 0.21                  |
| 12,941.00                                      | 92.45           | 87.86       | 5,782.00              | 48.91        | 7,167.32     | 7,167.48                | 1.67                    | 1.66                   | 0.20                  |
| 13,003.00                                      | 91.12           | 87.90       | 5,780.07              | 51.20        | 7,229.25     | 7,229.42                | 2.15                    | -2.15                  | 0.06                  |
| 13,064.00                                      | 91.87           | 87.44       | 5,778.47              | 53.68        | 7,290.18     | 7,290.36                | 1.44                    | 1.23                   | -0.75                 |
| 13,126.00                                      | 91.79           | 89.07       | 5,776.49              | 55.57        | 7,352.11     | 7,352.31                | 2.63                    | -0.13                  | 2.63                  |
| 13,187.00                                      | 92.53           | 89.31       | 5,774.20              | 56.43        | 7,413.06     | 7,413.26                | 1.28                    | 1.21                   | 0.39                  |
| 13,248.00                                      | 91.84           | 89.88       | 5,771.87              | 56.86        | 7,474.02     | 7,474.22                | 1.47                    | -1.13                  | 0.93                  |
| 13,310.00                                      | 90.53           | 90.57       | 5,770.59              | 56.62        | 7,536.00     | 7,536.20                | 2.39                    | -2.11                  | 1.11                  |
| 13,371.00                                      | 91.04           | 90.91       | 5,769.75              | 55.83        | 7,596.99     | 7,597.18                | 1.00                    | 0.84                   | 0.56                  |
| 13,433.00                                      | 89.93           | 90.50       | 5,769.23              | 55.07        | 7,658.98     | 7,659.17                | 1.91                    | -1.79                  | -0.66                 |
| 13,494.00                                      | 90.42           | 90.39       | 5,769.04              | 54.59        | 7,719.98     | 7,720.16                | 0.82                    | 0.80                   | -0.18                 |
| 13,551.96                                      | 90.17           | 89.78       | 5,768.74              | 54.51        | 7,777.94     | 7,778.12                | 1.13                    | -0.43                  | -1.05                 |
| <b>LTP: 13552' MD, 359 FSL &amp; 2738' FEL</b> |                 |             |                       |              |              |                         |                         |                        |                       |
| 13,557.00                                      | 90.15           | 89.73       | 5,768.73              | 54.53        | 7,782.98     | 7,783.16                | 1.13                    | -0.43                  | -1.05                 |
| 13,620.00                                      | 90.23           | 89.89       | 5,768.52              | 54.74        | 7,845.98     | 7,846.16                | 0.28                    | 0.13                   | 0.25                  |
| 13,684.00                                      | 89.82           | 90.45       | 5,768.49              | 54.55        | 7,909.98     | 7,910.16                | 1.08                    | -0.64                  | 0.88                  |
| 13,714.00                                      | 90.36           | 90.63       | 5,768.44              | 54.26        | 7,939.98     | 7,940.15                | 1.90                    | 1.80                   | 0.60                  |
| <b>Final Phoenix MWD Survey</b>                |                 |             |                       |              |              |                         |                         |                        |                       |
| 13,776.00                                      | 90.36           | 90.63       | 5,768.05              | 53.58        | 8,001.97     | 8,002.14                | 0.00                    | 0.00                   | 0.00                  |
| <b>Projection to TD</b>                        |                 |             |                       |              |              |                         |                         |                        |                       |

### Survey Annotations

| Measured Depth (usft) | Vertical Depth (usft) | Local Coordinates |              | Comment                             |
|-----------------------|-----------------------|-------------------|--------------|-------------------------------------|
|                       |                       | +N/-S (usft)      | +E/-W (usft) |                                     |
| 4,780.00              | 4,764.37              | 23.44             | -253.26      | Tie In                              |
| 4,826.00              | 4,810.20              | 23.16             | -257.21      | First Phoenix MWD Survey            |
| 13,551.96             | 5,768.74              | 54.51             | 7,777.94     | LTP: 13552' MD, 359 FSL & 2738' FEL |
| 13,714.00             | 5,768.44              | 54.26             | 7,939.98     | Final Phoenix MWD Survey            |
| 13,776.00             | 5,768.05              | 53.58             | 8,001.97     | Projection to TD                    |

COG

# SURVEY REPORT

SHOVEL HEAD FEDERAL COM 18H

DOUBLE K 7

6/28/2018



The Ultimate Partner In Wellbore Placement

**SURVEY REPORT****SHOVEL HEAD FEDERAL COM 18H****KEEPER GYRO SURVEY**

**CUSTOMER** COG  
**PROJECT** Shovel Head Federal Com 18H  
**FIELD** NA

**SDI JOB NO.** OP011236  
**SDI DISTRICT** Midland  
**SDI KIT/UNIT**

**SITE INFORMATION**

**Site Name** Shovel Head Federal Com 18H  
**Lat/Long** 32.857533° N , 103.7802767° W  
**Northing** 676,006.84 ft  
**Easting** 669,862.24 ft

**Section**  
**Township**  
**Range**

**MAP INFORMATION**

**North Reference** Grid North  
**Grid Correction** 0.30 deg  
**System** US State Plane 1927  
**Datum** North American Datum 1927 (Clarke 1866)  
**Map Zone** New Mexico East: 3001

**WELL INFORMATION**

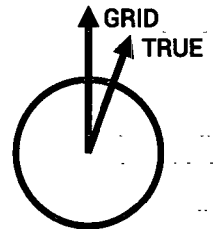
**Lat/Long** 32.857533° N , 103.78027° W  
**Northing**  
**Easting**  
**UWI** 30-025-44518

**DEPTH AND ELEVATION REFERENCE**

**Ground Level** 4090 ft above Mean Sea Level  
**Reference Datum** KB  
**Reference Height** 17 ft above G.L.  
**Reference Elevation** 4107 ft

**VERTICAL SECTION REFERENCE**

**+N/-S** 0 ft  
**+E/-W** 0 ft  
**Proposal Direction** 89.69°  
**Calculation Method** Minimum Curvature

**LOCAL GRAVITY REFERENCE INFORMATION**

**Local Gravity** 998.489 mG [computed]  
**True to Grid** add 0.3°

**WELL NOTES****OPERATORS**

J Mendoza

SDI Operator Name (Printed)

SIGNATURE

DATE



| MD     | INC  | AZIM   | TVD    | VS    | +N/-S | +E/-W | DLS     | CLOSURE<br>DIST | CLOSURE<br>DIR |
|--------|------|--------|--------|-------|-------|-------|---------|-----------------|----------------|
| ft     | deg  | deg    | ft     | ft    | ft    | ft    | °/100ft | ft              | deg            |
| 0.00   | 0.00 | 0.00   | 0.00   | 0.00  | 0.00  | 0.00  | Invalid | 0.00            | 0.00           |
| 100.00 | 0.26 | 254.69 | 100.00 | -0.22 | -0.06 | -0.22 | 0.26    | 0.23            | 254.69         |
| 125.00 | 0.21 | 210.49 | 125.00 | -0.30 | -0.12 | -0.30 | 0.74    | 0.32            | 249.01         |
| 150.00 | 0.31 | 180.04 | 150.00 | -0.33 | -0.22 | -0.32 | 0.68    | 0.39            | 235.44         |
| 175.00 | 0.19 | 262.28 | 175.00 | -0.37 | -0.30 | -0.37 | 1.37    | 0.47            | 230.81         |
| 200.00 | 0.20 | 170.59 | 200.00 | -0.40 | -0.35 | -0.40 | 1.10    | 0.53            | 229.06         |
| 225.00 | 0.16 | 249.42 | 225.00 | -0.43 | -0.40 | -0.42 | 0.91    | 0.58            | 226.60         |
| 250.00 | 0.11 | 214.61 | 250.00 | -0.47 | -0.43 | -0.47 | 0.36    | 0.64            | 227.35         |
| 275.00 | 0.10 | 218.24 | 275.00 | -0.50 | -0.47 | -0.50 | 0.03    | 0.68            | 226.63         |
| 300.00 | 0.05 | 256.60 | 300.00 | -0.52 | -0.49 | -0.52 | 0.28    | 0.71            | 226.77         |
| 325.00 | 0.09 | 286.03 | 325.00 | -0.55 | -0.48 | -0.55 | 0.23    | 0.73            | 228.54         |
| 350.00 | 0.16 | 262.96 | 350.00 | -0.60 | -0.48 | -0.60 | 0.32    | 0.77            | 231.25         |
| 375.00 | 0.11 | 291.39 | 375.00 | -0.66 | -0.48 | -0.66 | 0.31    | 0.81            | 234.01         |
| 400.00 | 0.11 | 269.43 | 400.00 | -0.71 | -0.47 | -0.70 | 0.17    | 0.85            | 236.33         |
| 425.00 | 0.14 | 277.14 | 425.00 | -0.76 | -0.47 | -0.76 | 0.16    | 0.89            | 238.48         |
| 450.00 | 0.16 | 281.58 | 450.00 | -0.83 | -0.45 | -0.82 | 0.08    | 0.94            | 241.14         |
| 475.00 | 0.14 | 283.48 | 475.00 | -0.89 | -0.44 | -0.89 | 0.08    | 0.99            | 243.66         |
| 500.00 | 0.08 | 309.91 | 500.00 | -0.93 | -0.42 | -0.93 | 0.33    | 1.02            | 245.61         |
| 525.00 | 0.17 | 281.06 | 525.00 | -0.98 | -0.40 | -0.98 | 0.46    | 1.06            | 247.59         |
| 550.00 | 0.11 | 319.57 | 550.00 | -1.04 | -0.38 | -1.03 | 0.45    | 1.10            | 249.86         |
| 575.00 | 0.20 | 240.74 | 575.00 | -1.09 | -0.38 | -1.09 | 0.82    | 1.15            | 250.63         |
| 600.00 | 0.28 | 223.00 | 600.00 | -1.17 | -0.45 | -1.17 | 0.45    | 1.25            | 248.98         |
| 625.00 | 0.38 | 260.05 | 625.00 | -1.29 | -0.51 | -1.29 | 0.91    | 1.39            | 248.51         |
| 650.00 | 0.34 | 209.44 | 650.00 | -1.41 | -0.59 | -1.41 | 1.24    | 1.52            | 247.36         |
| 675.00 | 0.35 | 242.57 | 675.00 | -1.51 | -0.69 | -1.51 | 0.79    | 1.66            | 245.55         |
| 700.00 | 0.35 | 230.15 | 700.00 | -1.64 | -0.77 | -1.64 | 0.30    | 1.81            | 244.79         |
| 725.00 | 0.23 | 216.53 | 725.00 | -1.73 | -0.86 | -1.72 | 0.54    | 1.93            | 243.51         |
| 750.00 | 0.29 | 236.44 | 750.00 | -1.81 | -0.94 | -1.81 | 0.43    | 2.04            | 242.64         |
| 775.00 | 0.25 | 210.90 | 775.00 | -1.89 | -1.02 | -1.89 | 0.50    | 2.14            | 241.69         |
| 800.00 | 0.29 | 215.13 | 799.99 | -1.96 | -1.12 | -1.95 | 0.19    | 2.25            | 240.25         |
| 825.00 | 0.21 | 202.99 | 824.99 | -2.01 | -1.21 | -2.01 | 0.39    | 2.35            | 238.90         |
| 850.00 | 0.29 | 205.08 | 849.99 | -2.06 | -1.31 | -2.05 | 0.31    | 2.44            | 237.44         |

| MD      | INC  | AZIM   | TVD     | VS    | +N/-S | +E/-W | DLS     | CLOSURE<br>DIST | CLOSURE<br>DIR |
|---------|------|--------|---------|-------|-------|-------|---------|-----------------|----------------|
| ft      | deg  | deg    | ft      | ft    | ft    | ft    | °/100ft | ft              | deg            |
| 875.00  | 0.25 | 216.54 | 874.99  | -2.12 | -1.41 | -2.11 | 0.26    | 2.54            | 236.24         |
| 900.00  | 0.29 | 224.65 | 899.99  | -2.20 | -1.50 | -2.19 | 0.23    | 2.65            | 235.57         |
| 925.00  | 0.29 | 210.74 | 924.99  | -2.27 | -1.60 | -2.27 | 0.28    | 2.77            | 234.78         |
| 950.00  | 0.26 | 221.82 | 949.99  | -2.35 | -1.70 | -2.34 | 0.23    | 2.89            | 234.02         |
| 975.00  | 0.32 | 212.34 | 974.99  | -2.42 | -1.80 | -2.41 | 0.29    | 3.01            | 233.30         |
| 1000.00 | 0.30 | 202.28 | 999.99  | -2.48 | -1.92 | -2.47 | 0.23    | 3.13            | 232.24         |
| 1025.00 | 0.32 | 218.50 | 1024.99 | -2.55 | -2.03 | -2.54 | 0.36    | 3.25            | 231.38         |
| 1050.00 | 0.35 | 218.36 | 1049.99 | -2.64 | -2.14 | -2.63 | 0.13    | 3.39            | 230.83         |
| 1075.00 | 0.26 | 205.51 | 1074.99 | -2.71 | -2.25 | -2.70 | 0.45    | 3.52            | 230.17         |
| 1100.00 | 0.26 | 231.94 | 1099.99 | -2.78 | -2.34 | -2.77 | 0.47    | 3.63            | 229.82         |
| 1125.00 | 0.24 | 213.36 | 1124.99 | -2.86 | -2.42 | -2.84 | 0.33    | 3.73            | 229.63         |
| 1150.00 | 0.40 | 212.09 | 1149.99 | -2.93 | -2.53 | -2.92 | 0.66    | 3.86            | 229.03         |
| 1175.00 | 0.27 | 218.70 | 1174.99 | -3.02 | -2.65 | -3.00 | 0.52    | 4.01            | 228.51         |
| 1200.00 | 0.33 | 212.63 | 1199.99 | -3.09 | -2.76 | -3.08 | 0.26    | 4.14            | 228.09         |
| 1225.00 | 0.36 | 218.63 | 1224.99 | -3.18 | -2.88 | -3.17 | 0.19    | 4.28            | 227.66         |
| 1250.00 | 0.44 | 204.59 | 1249.99 | -3.27 | -3.03 | -3.26 | 0.49    | 4.45            | 227.02         |
| 1275.00 | 0.30 | 228.25 | 1274.99 | -3.36 | -3.16 | -3.34 | 0.79    | 4.60            | 226.59         |
| 1300.00 | 0.33 | 234.06 | 1299.99 | -3.47 | -3.25 | -3.45 | 0.17    | 4.74            | 226.73         |
| 1325.00 | 0.34 | 223.30 | 1324.99 | -3.58 | -3.35 | -3.56 | 0.26    | 4.89            | 226.78         |
| 1350.00 | 0.38 | 208.20 | 1349.99 | -3.67 | -3.48 | -3.65 | 0.40    | 5.04            | 226.43         |
| 1375.00 | 0.45 | 202.78 | 1374.99 | -3.75 | -3.64 | -3.73 | 0.33    | 5.21            | 225.72         |
| 1400.00 | 0.38 | 188.03 | 1399.99 | -3.80 | -3.81 | -3.78 | 0.50    | 5.37            | 224.76         |
| 1425.00 | 0.40 | 201.57 | 1424.99 | -3.85 | -3.98 | -3.82 | 0.38    | 5.52            | 223.88         |
| 1450.00 | 0.45 | 205.95 | 1449.98 | -3.92 | -4.15 | -3.90 | 0.23    | 5.69            | 223.24         |
| 1475.00 | 0.37 | 198.31 | 1474.98 | -3.99 | -4.31 | -3.97 | 0.40    | 5.86            | 222.63         |
| 1500.00 | 0.46 | 198.75 | 1499.98 | -4.05 | -4.48 | -4.02 | 0.35    | 6.02            | 221.93         |
| 1525.00 | 0.46 | 200.74 | 1524.98 | -4.12 | -4.67 | -4.09 | 0.07    | 6.21            | 221.23         |
| 1550.00 | 0.41 | 207.80 | 1549.98 | -4.20 | -4.84 | -4.17 | 0.30    | 6.39            | 220.73         |
| 1575.00 | 0.43 | 200.95 | 1574.98 | -4.27 | -5.01 | -4.25 | 0.22    | 6.57            | 220.27         |
| 1600.00 | 0.49 | 211.11 | 1599.98 | -4.36 | -5.19 | -4.33 | 0.40    | 6.76            | 219.86         |
| 1625.00 | 0.59 | 204.12 | 1624.98 | -4.47 | -5.40 | -4.44 | 0.46    | 6.99            | 219.45         |
| 1650.00 | 0.35 | 196.77 | 1649.98 | -4.55 | -5.59 | -4.52 | 0.96    | 7.19            | 218.94         |

| MD      | INC  | AZIM   | TVD     | VS    | +N/-S  | +E/-W | DLS     | CLOSURE<br>DIST | CLOSURE<br>DIR |
|---------|------|--------|---------|-------|--------|-------|---------|-----------------|----------------|
| ft      | deg  | deg    | ft      | ft    | ft     | ft    | °/100ft | ft              | deg            |
| 1675.00 | 0.51 | 200.89 | 1674.98 | -4.61 | -5.77  | -4.58 | 0.64    | 7.36            | 218.44         |
| 1700.00 | 0.51 | 203.31 | 1699.98 | -4.70 | -5.97  | -4.66 | 0.09    | 7.58            | 217.97         |
| 1725.00 | 0.50 | 206.10 | 1724.98 | -4.79 | -6.17  | -4.75 | 0.12    | 7.79            | 217.60         |
| 1750.00 | 0.55 | 204.50 | 1749.97 | -4.89 | -6.38  | -4.85 | 0.22    | 8.02            | 217.25         |
| 1775.00 | 0.53 | 212.06 | 1774.97 | -5.00 | -6.59  | -4.96 | 0.29    | 8.25            | 216.99         |
| 1800.00 | 0.55 | 198.74 | 1799.97 | -5.10 | -6.80  | -5.06 | 0.51    | 8.48            | 216.67         |
| 1825.00 | 0.57 | 208.13 | 1824.97 | -5.20 | -7.02  | -5.16 | 0.37    | 8.71            | 216.31         |
| 1850.00 | 0.58 | 199.24 | 1849.97 | -5.30 | -7.25  | -5.26 | 0.36    | 8.96            | 215.96         |
| 1875.00 | 0.54 | 200.95 | 1874.97 | -5.39 | -7.48  | -5.35 | 0.17    | 9.20            | 215.54         |
| 1900.00 | 0.56 | 199.22 | 1899.97 | -5.47 | -7.71  | -5.43 | 0.09    | 9.43            | 215.15         |
| 1925.00 | 0.65 | 190.51 | 1924.97 | -5.54 | -7.96  | -5.49 | 0.52    | 9.68            | 214.60         |
| 1950.00 | 0.47 | 195.59 | 1949.96 | -5.59 | -8.20  | -5.55 | 0.74    | 9.90            | 214.07         |
| 1975.00 | 0.46 | 189.82 | 1974.96 | -5.64 | -8.40  | -5.59 | 0.19    | 10.09           | 213.65         |
| 2000.00 | 0.45 | 184.03 | 1999.96 | -5.66 | -8.60  | -5.62 | 0.19    | 10.27           | 213.15         |
| 2025.00 | 0.49 | 175.62 | 2024.96 | -5.66 | -8.81  | -5.62 | 0.33    | 10.44           | 212.53         |
| 2050.00 | 0.49 | 164.56 | 2049.96 | -5.63 | -9.01  | -5.58 | 0.38    | 10.60           | 211.75         |
| 2075.00 | 0.55 | 172.75 | 2074.96 | -5.59 | -9.24  | -5.54 | 0.38    | 10.77           | 210.94         |
| 2100.00 | 0.62 | 175.75 | 2099.96 | -5.56 | -9.49  | -5.51 | 0.32    | 10.97           | 210.15         |
| 2125.00 | 0.55 | 172.60 | 2124.96 | -5.54 | -9.74  | -5.49 | 0.32    | 11.18           | 209.38         |
| 2150.00 | 0.49 | 172.55 | 2149.96 | -5.51 | -9.97  | -5.46 | 0.24    | 11.36           | 208.70         |
| 2175.00 | 0.55 | 171.48 | 2174.96 | -5.48 | -10.19 | -5.42 | 0.26    | 11.54           | 208.02         |
| 2200.00 | 0.60 | 169.79 | 2199.95 | -5.44 | -10.44 | -5.38 | 0.21    | 11.75           | 207.28         |
| 2225.00 | 0.59 | 171.25 | 2224.95 | -5.40 | -10.70 | -5.34 | 0.07    | 11.96           | 206.53         |
| 2250.00 | 0.43 | 178.32 | 2249.95 | -5.38 | -10.92 | -5.32 | 0.68    | 12.15           | 205.97         |
| 2275.00 | 0.56 | 170.99 | 2274.95 | -5.36 | -11.13 | -5.30 | 0.57    | 12.33           | 205.44         |
| 2300.00 | 0.54 | 169.54 | 2299.95 | -5.32 | -11.37 | -5.26 | 0.11    | 12.53           | 204.80         |
| 2325.00 | 0.76 | 167.07 | 2324.95 | -5.26 | -11.65 | -5.20 | 0.89    | 12.76           | 204.04         |
| 2350.00 | 0.67 | 156.78 | 2349.95 | -5.17 | -11.94 | -5.10 | 0.63    | 12.99           | 203.13         |
| 2375.00 | 0.70 | 159.01 | 2374.94 | -5.06 | -12.22 | -4.99 | 0.16    | 13.20           | 202.21         |
| 2400.00 | 0.68 | 162.16 | 2399.94 | -4.96 | -12.50 | -4.89 | 0.17    | 13.43           | 201.36         |
| 2425.00 | 0.79 | 164.68 | 2424.94 | -4.87 | -12.81 | -4.80 | 0.46    | 13.68           | 200.54         |
| 2450.00 | 0.84 | 183.20 | 2449.94 | -4.84 | -13.16 | -4.76 | 1.07    | 14.00           | 199.90         |

| MD      | INC  | AZIM   | TVD     | VS     | +N/-S  | +E/-W  | DLS     | CLOSURE<br>DIST | CLOSURE<br>DIR |
|---------|------|--------|---------|--------|--------|--------|---------|-----------------|----------------|
| ft      | deg  | deg    | ft      | ft     | ft     | ft     | °/100ft | ft              | deg            |
| 2475.00 | 0.93 | 180.74 | 2474.94 | -4.85  | -13.55 | -4.78  | 0.39    | 14.36           | 199.42         |
| 2500.00 | 0.85 | 181.39 | 2499.93 | -4.86  | -13.94 | -4.78  | 0.31    | 14.73           | 198.95         |
| 2525.00 | 0.81 | 193.24 | 2524.93 | -4.91  | -14.29 | -4.83  | 0.71    | 15.09           | 198.67         |
| 2550.00 | 0.95 | 207.92 | 2549.93 | -5.05  | -14.65 | -4.97  | 1.06    | 15.47           | 198.73         |
| 2575.00 | 1.62 | 256.64 | 2574.92 | -5.49  | -14.92 | -5.41  | 4.90    | 15.87           | 199.93         |
| 2600.00 | 1.80 | 261.00 | 2599.91 | -6.22  | -15.06 | -6.14  | 0.88    | 16.26           | 202.18         |
| 2625.00 | 3.00 | 287.21 | 2624.89 | -7.23  | -14.93 | -7.15  | 6.40    | 16.55           | 205.61         |
| 2650.00 | 4.08 | 296.97 | 2649.84 | -8.65  | -14.33 | -8.57  | 4.93    | 16.70           | 210.89         |
| 2675.00 | 4.70 | 296.12 | 2674.77 | -10.36 | -13.48 | -10.28 | 2.48    | 16.95           | 217.35         |
| 2700.00 | 5.98 | 297.82 | 2699.66 | -12.42 | -12.42 | -12.36 | 5.18    | 17.52           | 224.86         |
| 2725.00 | 6.61 | 298.00 | 2724.51 | -14.84 | -11.13 | -14.78 | 2.50    | 18.50           | 233.00         |
| 2750.00 | 7.58 | 299.04 | 2749.32 | -17.54 | -9.66  | -17.49 | 3.91    | 19.98           | 241.09         |
| 2775.00 | 8.31 | 299.50 | 2774.08 | -20.54 | -7.97  | -20.50 | 2.94    | 22.00           | 248.76         |
| 2800.00 | 8.62 | 299.16 | 2798.80 | -23.74 | -6.17  | -23.71 | 1.27    | 24.50           | 255.42         |
| 2825.00 | 8.71 | 299.08 | 2823.52 | -27.02 | -4.33  | -27.00 | 0.35    | 27.34           | 260.88         |
| 2850.00 | 9.00 | 298.95 | 2848.22 | -30.38 | -2.47  | -30.36 | 1.18    | 30.46           | 265.35         |
| 2875.00 | 8.84 | 298.83 | 2872.92 | -33.76 | -0.59  | -33.76 | 0.66    | 33.76           | 268.99         |
| 2900.00 | 9.03 | 299.09 | 2897.61 | -37.15 | 1.28   | -37.15 | 0.77    | 37.18           | 271.98         |
| 2925.00 | 8.76 | 300.63 | 2922.31 | -40.49 | 3.21   | -40.51 | 1.41    | 40.63           | 274.53         |
| 2950.00 | 8.32 | 305.12 | 2947.04 | -43.60 | 5.22   | -43.63 | 3.21    | 43.94           | 276.82         |
| 2975.00 | 7.90 | 307.13 | 2971.79 | -46.43 | 7.30   | -46.47 | 2.01    | 47.04           | 278.92         |
| 3000.00 | 7.17 | 304.44 | 2996.57 | -49.08 | 9.22   | -49.13 | 3.25    | 49.99           | 280.62         |
| 3025.00 | 6.87 | 301.12 | 3021.38 | -51.64 | 10.87  | -51.70 | 2.01    | 52.83           | 281.88         |
| 3050.00 | 6.93 | 300.25 | 3046.20 | -54.22 | 12.41  | -54.28 | 0.48    | 55.68           | 282.87         |
| 3075.00 | 6.62 | 294.81 | 3071.03 | -56.82 | 13.77  | -56.89 | 2.85    | 58.54           | 283.61         |
| 3100.00 | 6.16 | 285.84 | 3095.87 | -59.41 | 14.74  | -59.49 | 4.39    | 61.29           | 283.92         |
| 3125.00 | 6.16 | 282.33 | 3120.73 | -62.01 | 15.39  | -62.09 | 1.51    | 63.97           | 283.92         |
| 3150.00 | 6.08 | 280.56 | 3145.59 | -64.62 | 15.92  | -64.71 | 0.82    | 66.64           | 283.82         |
| 3175.00 | 6.08 | 280.11 | 3170.45 | -67.22 | 16.40  | -67.31 | 0.19    | 69.28           | 283.69         |
| 3200.00 | 6.04 | 276.60 | 3195.31 | -69.83 | 16.78  | -69.92 | 1.49    | 71.91           | 283.50         |
| 3225.00 | 6.05 | 278.74 | 3220.17 | -72.43 | 17.13  | -72.53 | 0.90    | 74.52           | 283.29         |
| 3250.00 | 5.82 | 277.95 | 3245.03 | -74.99 | 17.51  | -75.09 | 0.99    | 77.10           | 283.13         |

| MD      | INC  | AZIM   | TVD     | VS      | +N/-S | +E/-W   | DLS     | CLOSURE<br>DIST | CLOSURE<br>DIR |
|---------|------|--------|---------|---------|-------|---------|---------|-----------------|----------------|
| ft      | deg  | deg    | ft      | ft      | ft    | ft      | °/100ft | ft              | deg            |
| 3275.00 | 5.75 | 277.19 | 3269.91 | -77.48  | 17.84 | -77.58  | 0.42    | 79.61           | 282.95         |
| 3300.00 | 5.69 | 276.99 | 3294.78 | -79.95  | 18.15 | -80.05  | 0.25    | 82.08           | 282.77         |
| 3325.00 | 5.82 | 276.65 | 3319.66 | -82.44  | 18.44 | -82.54  | 0.54    | 84.57           | 282.60         |
| 3350.00 | 5.75 | 275.01 | 3344.53 | -84.94  | 18.70 | -85.04  | 0.71    | 87.08           | 282.40         |
| 3375.00 | 6.03 | 272.12 | 3369.40 | -87.50  | 18.86 | -87.60  | 1.64    | 89.61           | 282.15         |
| 3400.00 | 6.28 | 269.68 | 3394.25 | -90.18  | 18.90 | -90.28  | 1.44    | 92.24           | 281.82         |
| 3425.00 | 6.40 | 266.23 | 3419.10 | -92.94  | 18.80 | -93.04  | 1.59    | 94.92           | 281.42         |
| 3450.00 | 6.61 | 266.84 | 3443.94 | -95.77  | 18.63 | -95.87  | 0.92    | 97.66           | 281.00         |
| 3475.00 | 6.74 | 266.64 | 3468.77 | -98.67  | 18.46 | -98.77  | 0.50    | 100.48          | 280.59         |
| 3500.00 | 6.57 | 265.67 | 3493.60 | -101.56 | 18.27 | -101.66 | 0.81    | 103.29          | 280.19         |
| 3525.00 | 6.67 | 265.57 | 3518.43 | -104.43 | 18.05 | -104.53 | 0.40    | 106.08          | 279.80         |
| 3550.00 | 6.56 | 265.54 | 3543.27 | -107.30 | 17.83 | -107.40 | 0.44    | 108.87          | 279.42         |
| 3575.00 | 6.44 | 264.43 | 3568.11 | -110.13 | 17.58 | -110.22 | 0.68    | 111.61          | 279.06         |
| 3600.00 | 6.35 | 265.49 | 3592.95 | -112.90 | 17.34 | -112.99 | 0.61    | 114.32          | 278.72         |
| 3625.00 | 6.32 | 265.39 | 3617.80 | -115.65 | 17.12 | -115.74 | 0.10    | 117.00          | 278.41         |
| 3650.00 | 6.26 | 265.45 | 3642.65 | -118.38 | 16.90 | -118.48 | 0.24    | 119.68          | 278.12         |
| 3675.00 | 6.31 | 266.76 | 3667.50 | -121.12 | 16.71 | -121.21 | 0.61    | 122.36          | 277.85         |
| 3700.00 | 6.38 | 265.54 | 3692.34 | -123.88 | 16.53 | -123.97 | 0.61    | 125.06          | 277.59         |
| 3725.00 | 6.45 | 266.69 | 3717.19 | -126.66 | 16.34 | -126.75 | 0.58    | 127.80          | 277.34         |
| 3750.00 | 6.48 | 266.79 | 3742.03 | -129.48 | 16.18 | -129.56 | 0.15    | 130.57          | 277.12         |
| 3775.00 | 6.69 | 267.53 | 3766.86 | -132.34 | 16.03 | -132.43 | 0.88    | 133.40          | 276.90         |
| 3800.00 | 6.77 | 265.81 | 3791.69 | -135.27 | 15.86 | -135.35 | 0.88    | 136.28          | 276.68         |
| 3825.00 | 6.99 | 268.41 | 3816.51 | -138.26 | 15.71 | -138.34 | 1.51    | 139.23          | 276.48         |
| 3850.00 | 7.06 | 267.23 | 3841.32 | -141.31 | 15.60 | -141.40 | 0.64    | 142.25          | 276.29         |
| 3875.00 | 7.22 | 267.80 | 3866.13 | -144.42 | 15.46 | -144.50 | 0.71    | 145.33          | 276.11         |
| 3900.00 | 7.35 | 268.48 | 3890.93 | -147.58 | 15.36 | -147.67 | 0.63    | 148.47          | 275.94         |
| 3925.00 | 7.52 | 268.11 | 3915.72 | -150.82 | 15.26 | -150.90 | 0.69    | 151.67          | 275.78         |
| 3950.00 | 7.57 | 268.03 | 3940.50 | -154.10 | 15.15 | -154.18 | 0.22    | 154.93          | 275.61         |
| 3975.00 | 7.83 | 268.49 | 3965.28 | -157.45 | 15.05 | -157.53 | 1.04    | 158.25          | 275.46         |
| 4000.00 | 7.96 | 267.94 | 3990.04 | -160.88 | 14.94 | -160.96 | 0.62    | 161.65          | 275.30         |
| 4025.00 | 8.18 | 267.66 | 4014.79 | -164.39 | 14.81 | -164.47 | 0.89    | 165.13          | 275.15         |
| 4050.00 | 8.34 | 269.04 | 4039.53 | -167.98 | 14.71 | -168.06 | 1.04    | 168.70          | 275.00         |

| MD      | INC  | AZIM   | TVD     | VS      | +N/-S | +E/-W   | DLS     | CLOSURE<br>DIST | CLOSURE<br>DIR |
|---------|------|--------|---------|---------|-------|---------|---------|-----------------|----------------|
| ft      | deg  | deg    | ft      | ft      | ft    | ft      | °/100ft | ft              | deg            |
| 4075.00 | 8.24 | 271.52 | 4064.27 | -171.58 | 14.72 | -171.66 | 1.49    | 172.29          | 274.90         |
| 4100.00 | 8.27 | 273.27 | 4089.01 | -175.17 | 14.87 | -175.25 | 1.01    | 175.88          | 274.85         |
| 4125.00 | 8.16 | 273.30 | 4113.76 | -178.73 | 15.08 | -178.82 | 0.41    | 179.45          | 274.82         |
| 4150.00 | 8.03 | 275.31 | 4138.51 | -182.24 | 15.34 | -182.33 | 1.25    | 182.97          | 274.81         |
| 4175.00 | 7.53 | 276.52 | 4163.28 | -185.61 | 15.69 | -185.69 | 2.13    | 186.36          | 274.83         |
| 4200.00 | 7.46 | 276.74 | 4188.06 | -188.84 | 16.07 | -188.93 | 0.29    | 189.61          | 274.86         |
| 4225.00 | 7.64 | 277.12 | 4212.85 | -192.10 | 16.46 | -192.19 | 0.73    | 192.90          | 274.90         |
| 4250.00 | 7.71 | 278.58 | 4237.62 | -195.40 | 16.92 | -195.50 | 0.84    | 196.23          | 274.95         |
| 4275.00 | 7.84 | 279.10 | 4262.39 | -198.74 | 17.44 | -198.84 | 0.58    | 199.60          | 275.01         |
| 4300.00 | 7.89 | 278.33 | 4287.16 | -202.12 | 17.96 | -202.22 | 0.47    | 203.02          | 275.07         |
| 4325.00 | 7.13 | 276.62 | 4311.94 | -205.36 | 18.38 | -205.46 | 3.17    | 206.28          | 275.11         |
| 4350.00 | 6.34 | 275.95 | 4336.77 | -208.27 | 18.71 | -208.37 | 3.19    | 209.21          | 275.13         |
| 4375.00 | 6.17 | 275.50 | 4361.62 | -210.97 | 18.98 | -211.08 | 0.68    | 211.93          | 275.14         |
| 4400.00 | 6.14 | 273.49 | 4386.48 | -213.65 | 19.19 | -213.75 | 0.87    | 214.61          | 275.13         |
| 4425.00 | 6.15 | 275.27 | 4411.33 | -216.31 | 19.39 | -216.42 | 0.76    | 217.29          | 275.12         |
| 4450.00 | 6.14 | 275.58 | 4436.19 | -218.97 | 19.65 | -219.08 | 0.14    | 219.96          | 275.12         |
| 4475.00 | 6.21 | 274.85 | 4461.05 | -221.65 | 19.89 | -221.76 | 0.42    | 222.65          | 275.13         |
| 4500.00 | 6.23 | 275.78 | 4485.90 | -224.34 | 20.14 | -224.45 | 0.41    | 225.36          | 275.13         |
| 4525.00 | 6.17 | 277.05 | 4510.75 | -227.02 | 20.44 | -227.14 | 0.60    | 228.05          | 275.14         |
| 4550.00 | 6.25 | 276.69 | 4535.61 | -229.71 | 20.77 | -229.82 | 0.38    | 230.76          | 275.16         |
| 4575.00 | 6.36 | 278.17 | 4560.46 | -232.43 | 21.12 | -232.54 | 0.77    | 233.50          | 275.19         |
| 4600.00 | 6.26 | 279.62 | 4585.30 | -235.14 | 21.55 | -235.26 | 0.75    | 236.24          | 275.23         |
| 4625.00 | 6.40 | 280.45 | 4610.15 | -237.85 | 22.03 | -237.97 | 0.66    | 238.99          | 275.29         |
| 4650.00 | 6.33 | 280.60 | 4635.00 | -240.57 | 22.53 | -240.70 | 0.29    | 241.75          | 275.35         |
| 4675.00 | 6.35 | 281.27 | 4659.84 | -243.28 | 23.06 | -243.41 | 0.31    | 244.50          | 275.41         |
| 4700.00 | 5.78 | 277.72 | 4684.70 | -245.88 | 23.49 | -246.01 | 2.74    | 247.13          | 275.46         |
| 4725.00 | 5.25 | 270.38 | 4709.59 | -248.27 | 23.67 | -248.40 | 3.52    | 249.53          | 275.44         |
| 4750.00 | 4.95 | 266.50 | 4734.49 | -250.49 | 23.61 | -250.62 | 1.84    | 251.73          | 275.38         |
| 4775.00 | 5.14 | 266.32 | 4759.39 | -252.68 | 23.48 | -252.82 | 0.79    | 253.90          | 275.30         |
| 4780.00 | 5.12 | 265.20 | 4764.37 | -253.13 | 23.44 | -253.26 | 2.07    | 254.34          | 275.29         |