

DIRECTIONAL SURVEY CALCULATION

MINIMUM CURVATURE METHOD

| Well Name | | Target Direction | Slot | N / S | E / W | Hole Size | Calculation by | | Date | |
|------------------|------------|------------------|---------------|---------------------|------------------|------------------|-----------------|-----------------|----------------------|-------------------|
| Sonderegger 2331 | | 1.19 | Coordinate | | | | | | 12/20/12 | |
| Job Number | | Type of Survey | Tie-in Point | | | | Directional Co. | | | |
| 0 | | | | | | | | | | |
| Measured Depth | Hole Angle | Hole Direction | Course Length | True Vertical Depth | Vertical Section | Total Coordinate | | Dogleg Severity | Build Up °/100 ft | Walk/ °/100 ft |
| | | | | | | N + / S - | E + / W - | | | |
| 0 | 0 | 0 | 0 | 0.00 | 0.00 | | | | | |
| 0 | 0 | 0 | | 0.00 | 0.00 | 0.00 | 0.00 | | | |
| 1821 | 1 | 356 | 1821 | 1,820.98 | 7.91 | 7.92 | -0.60 | 0.03 | 0.03 | 19.53 |
| 2044 | 1 | 21 | 223 | 2,043.97 | 9.98 | 9.98 | -0.25 | 0.12 | 0.04 | -150.04 |
| 2520 | 1 | 37 | 476 | 2,519.95 | 14.01 | 13.97 | 1.90 | 0.04 | -0.02 | 3.32 |
| 2994 | 0 | 23 | 474 | 2,993.93 | 16.83 | 16.76 | 3.63 | 0.05 | -0.04 | -2.85 |
| 3470 | 1 | 34 | 476 | 3,469.92 | 20.08 | 19.97 | 5.52 | 0.07 | 0.06 | 2.25 |
| 3903 | 1 | 6 | 433 | 3,902.90 | 23.87 | 23.73 | 6.98 | 0.07 | -0.02 | -6.54 |
| 3915 | 1 | 16 | 12 | 3,914.90 | 23.97 | 23.83 | 7.00 | 0.74 | 0.00 | 85.00 |
| 3946 | 1 | 360 | 31 | 3,945.90 | 24.32 | 24.17 | 7.04 | 1.13 | 0.97 | 1,109.03 |
| 3978 | 3 | 356 | 32 | 3,977.88 | 25.26 | 25.12 | 6.99 | 5.63 | 5.63 | -10.63 |
| 4009 | 5 | 355 | 31 | 4,008.81 | 27.25 | 27.12 | 6.84 | 7.10 | 7.10 | -4.84 |
| 4042 | 7 | 353 | 33 | 4,041.63 | 30.67 | 30.54 | 6.45 | 7.31 | 7.27 | -6.97 |
| 4073 | 9 | 355 | 31 | 4,072.31 | 35.08 | 34.97 | 5.99 | 6.90 | 6.77 | 9.03 |
| 4105 | 11 | 358 | 32 | 4,103.79 | 40.81 | 40.71 | 5.68 | 6.73 | 6.56 | 8.44 |
| 4136 | 14 | 359 | 31 | 4,134.04 | 47.54 | 47.44 | 5.52 | 7.45 | 7.42 | 3.23 |
| 4168 | 16 | 360 | 32 | 4,164.98 | 55.71 | 55.61 | 5.46 | 6.91 | 6.88 | 2.81 |
| 4199 | 18 | 360 | 31 | 4,194.64 | 64.72 | 64.62 | 5.46 | 6.45 | 6.45 | 0.00 |
| 4231 | 20 | 360 | 32 | 4,224.90 | 75.11 | 75.01 | 5.42 | 6.58 | 6.56 | -1.56 |
| 4263 | 22 | 359 | 32 | 4,254.77 | 86.60 | 86.51 | 5.23 | 6.62 | 6.56 | -2.50 |
| 4295 | 24 | 359 | 32 | 4,284.23 | 99.06 | 98.98 | 5.02 | 5.36 | 5.31 | 1.88 |
| 4327 | 25 | 360 | 32 | 4,313.43 | 112.15 | 112.07 | 4.91 | 2.28 | 2.19 | 1.56 |
| 4358 | 26 | 0 | 31 | 4,341.50 | 125.30 | 125.22 | 4.94 | 3.96 | 3.87 | ##### |
| 4390 | 28 | 1 | 32 | 4,370.12 | 139.62 | 139.55 | 5.08 | 5.64 | 5.63 | 0.94 |
| 4421 | 29 | 1 | 31 | 4,397.47 | 154.20 | 154.13 | 5.24 | 3.55 | 3.55 | -0.32 |
| 4453 | 31 | 359 | 32 | 4,425.28 | 170.02 | 169.95 | 5.15 | 7.13 | 6.56 | 1,119.38 |
| 4484 | 33 | 358 | 31 | 4,451.61 | 186.36 | 186.30 | 4.62 | 7.74 | 7.42 | -4.19 |
| 4516 | 35 | 358 | 32 | 4,478.16 | 204.19 | 204.16 | 3.85 | 5.94 | 5.94 | 0.31 |
| 4548 | 37 | 357 | 32 | 4,504.11 | 222.87 | 222.85 | 3.00 | 5.67 | 5.63 | -1.25 |
| 4580 | 39 | 357 | 32 | 4,529.34 | 242.50 | 242.51 | 2.08 | 7.82 | 7.81 | 0.62 |
| 4612 | 42 | 358 | 32 | 4,553.56 | 263.37 | 263.40 | 1.26 | 10.10 | 10.00 | 2.19 |
| 4643 | 46 | 358 | 31 | 4,575.84 | 284.89 | 284.94 | 0.60 | 10.67 | 10.65 | 0.97 |
| 4675 | 48 | 359 | 32 | 4,597.68 | 308.25 | 308.32 | -0.01 | 7.83 | 7.81 | 0.63 |
| 4707 | 50 | 359 | 32 | 4,618.74 | 332.32 | 332.41 | -0.49 | 4.23 | 4.06 | 1.56 |
| 4739 | 50 | 359 | 32 | 4,639.52 | 356.64 | 356.74 | -0.89 | 0.24 | 0.00 | -0.31 |
| 4771 | 49 | 358 | 32 | 4,660.35 | 380.91 | 381.02 | -1.46 | 1.77 | -0.63 | -2.19 |
| 4803 | 49 | 358 | 32 | 4,681.38 | 404.99 | 405.13 | -2.24 | 2.60 | -2.50 | -0.94 |
| 4835 | 49 | 358 | 32 | 4,702.59 | 428.93 | 429.08 | -3.00 | 0.94 | 0.00 | 1.25 |
| 4867 | 49 | 358 | 32 | 4,723.77 | 452.88 | 453.06 | -3.67 | 0.31 | 0.31 | 0.00 |
| 4899 | 49 | 358 | 32 | 4,744.91 | 476.88 | 477.07 | -4.34 | 0.31 | 0.31 | 0.00 |
| 4931 | 50 | 359 | 32 | 4,765.74 | 501.15 | 501.36 | -4.93 | 4.48 | 4.38 | 1.25 |
| 4960 | 53 | 360 | 29 | 4,783.77 | 523.84 | 524.06 | -5.26 | 10.18 | 10.00 | 2.41 |
| 4994 | 56 | 359 | 34 | 4,803.48 | 551.52 | 551.76 | -5.55 | 9.13 | 9.12 | -0.59 |
| 5026 | 59 | 359 | 32 | 4,820.58 | 578.55 | 578.80 | -5.96 | 10.03 | 10.00 | -0.94 |
| 5058 | 63 | 359 | 32 | 4,836.00 | 606.57 | 606.83 | -6.42 | 11.88 | 11.88 | 0.31 |
| 5090 | 67 | 360 | 32 | 4,849.54 | 635.54 | 635.81 | -6.70 | 11.73 | 11.56 | 2.19 |
| 5121 | 68 | 360 | 31 | 4,861.38 | 664.18 | 664.46 | -6.77 | 4.85 | 4.84 | 0.32 |
| 5153 | 71 | 1 | 32 | 4,872.51 | 694.18 | 694.46 | -6.67 | 8.62 | 8.44 | ##### |
| 5185 | 74 | 1 | 32 | 4,882.10 | 724.70 | 724.98 | -6.24 | 9.85 | 9.69 | 1.88 |
| 5217 | 78 | 2 | 32 | 4,889.79 | 755.75 | 756.03 | -5.53 | 12.56 | 12.50 | 1.25 |
| 5249 | 81 | 2 | 32 | 4,895.54 | 787.23 | 787.49 | -4.54 | 9.86 | 9.69 | 1.88 |
| 5281 | 84 | 3 | 32 | 4,899.55 | 818.97 | 819.21 | -3.27 | 10.08 | 10.00 | 1.25 |
| 5355 | 90 | 2 | 74 | 4,903.48 | 892.82 | 893.02 | -0.30 | 6.91 | 6.89 | -0.54 |
| 5386 | 90 | 2 | 31 | 4,903.75 | 923.82 | 924.00 | 0.72 | 1.29 | 0.00 | -1.29 |
| 5449 | 89 | 2 | 63 | 4,904.47 | 986.81 | 986.97 | 2.70 | 0.57 | -0.48 | 0.32 |
| 5511 | 90 | 2 | 62 | 4,905.17 | 1,048.80 | 1,048.94 | 4.54 | 0.81 | 0.48 | -0.65 |
| 5574 | 90 | 1 | 63 | 4,905.45 | 1,111.80 | 1,111.92 | 6.08 | 0.85 | 0.79 | -0.32 |
| 5636 | 91 | 1 | 62 | 4,905.18 | 1,173.80 | 1,173.90 | 7.49 | 0.81 | 0.81 | 0.00 |

DIRECTIONAL SURVEY CALCULATION

MINIMUM CURVATURE METHOD

| Well Name | | Target Direction | Slot | N / S | E / W | Hole Size | Calculation by | Date | | | |
|------------------|------------|------------------|---------------|---------------------|------------------|------------------|-----------------|--------------------|-------------------|----------------|--|
| Sonderegger 2331 | | 1.19 | Coordinate | | | | | 12/20/12 | | | |
| Job Number | | Type of Survey | Tie-in Point | | | | Directional Co. | | | | |
| 0 | | | | | | | | | | | |
| Measured Depth | Hole Angle | Hole Direction | Course Length | True Vertical Depth | Vertical Section | Total Coordinate | | Dogleg Severity | Build Up %/100 ft | Walk/ %/100 ft | |
| | | | | | | N + / S - | E + / W - | | | | |
| 0 | 0 | 0 | 0 | 0.00 | 0.00 | | | << TIE-IN POINT >> | | | |
| 5698 | 91 | 1 | 62 | 4,904.63 | 1,235.80 | 1,235.88 | 8.79 | 0.32 | 0.00 | -0.32 | |
| 5760 | 90 | 1 | 62 | 4,904.26 | 1,297.80 | 1,297.87 | 9.92 | 0.51 | -0.48 | -0.16 | |
| 5854 | 90 | 1 | 94 | 4,903.93 | 1,391.80 | 1,391.86 | 11.48 | 0.11 | 0.00 | -0.11 | |
| 5916 | 90 | 1 | 62 | 4,903.82 | 1,453.80 | 1,453.85 | 12.67 | 0.72 | -0.32 | 0.65 | |
| 5977 | 90 | 1 | 61 | 4,903.98 | 1,514.80 | 1,514.83 | 14.11 | 0.52 | -0.49 | 0.16 | |
| 6008 | 90 | 1 | 31 | 4,904.17 | 1,545.80 | 1,545.82 | 14.84 | 0.46 | -0.32 | -0.32 | |
| 6070 | 90 | 2 | 62 | 4,904.28 | 1,607.79 | 1,607.79 | 16.73 | 1.74 | 0.97 | 1.45 | |
| 6132 | 92 | 2 | 62 | 4,903.19 | 1,669.77 | 1,669.73 | 19.22 | 2.60 | 2.58 | 0.32 | |
| 6162 | 92 | 2 | 30 | 4,902.15 | 1,699.74 | 1,699.68 | 20.47 | 1.33 | 1.33 | 0.00 | |
| 6224 | 93 | 2 | 62 | 4,899.50 | 1,761.68 | 1,761.58 | 22.85 | 1.03 | 0.81 | -0.65 | |
| 6287 | 93 | 2 | 63 | 4,896.36 | 1,824.59 | 1,824.47 | 25.05 | 0.48 | 0.48 | 0.00 | |
| 6348 | 92 | 2 | 61 | 4,893.49 | 1,885.52 | 1,885.37 | 27.02 | 1.10 | -0.98 | -0.49 | |
| 6410 | 93 | 2 | 62 | 4,890.84 | 1,947.46 | 1,947.28 | 28.80 | 0.23 | 0.16 | -0.16 | |
| 6472 | 92 | 1 | 62 | 4,888.30 | 2,009.41 | 2,009.21 | 30.42 | 0.58 | -0.48 | -0.32 | |
| 6534 | 92 | 1 | 62 | 4,886.30 | 2,071.38 | 2,071.17 | 31.50 | 1.71 | -1.13 | -1.29 | |
| 6597 | 91 | 1 | 63 | 4,884.92 | 2,134.36 | 2,134.15 | 32.33 | 0.93 | -0.79 | 0.48 | |
| 6689 | 91 | 0 | 92 | 4,883.08 | 2,226.33 | 2,226.12 | 33.21 | 0.83 | 0.33 | -0.76 | |
| 6782 | 90 | 1 | 93 | 4,881.70 | 2,319.31 | 2,319.11 | 33.78 | 1.02 | -0.97 | 0.32 | |
| 6878 | 91 | 360 | 96 | 4,880.61 | 2,415.28 | 2,415.10 | 33.78 | 1.16 | 0.52 | 373.96 | |
| 6942 | 90 | 360 | 64 | 4,880.16 | 2,479.25 | 2,479.10 | 33.22 | 1.56 | -1.56 | 0.00 | |
| 6974 | 90 | 360 | 32 | 4,880.22 | 2,511.24 | 2,511.10 | 32.94 | 0.00 | 0.00 | 0.00 | |
| 7038 | 90 | 0 | 64 | 4,880.50 | 2,575.22 | 2,575.10 | 32.77 | 1.19 | -0.47 | -561.41 | |
| 7101 | 90 | 1 | 63 | 4,880.94 | 2,638.21 | 2,638.09 | 33.32 | 0.95 | 0.00 | 0.95 | |
| 7165 | 90 | 1 | 64 | 4,881.27 | 2,702.21 | 2,702.08 | 34.55 | 0.99 | 0.31 | 0.94 | |
| 7229 | 90 | 2 | 64 | 4,881.44 | 2,766.21 | 2,766.05 | 36.56 | 1.26 | 0.16 | 1.25 | |
| 7292 | 90 | 3 | 63 | 4,881.38 | 2,829.20 | 2,828.99 | 39.14 | 0.67 | 0.48 | 0.48 | |
| 7356 | 90 | 3 | 64 | 4,881.16 | 2,893.17 | 2,892.92 | 42.10 | 0.47 | 0.00 | 0.47 | |
| 7420 | 89 | 2 | 64 | 4,881.44 | 2,957.16 | 2,956.86 | 44.84 | 1.78 | -1.41 | -1.09 | |
| 7484 | 90 | 3 | 64 | 4,882.11 | 3,021.14 | 3,020.80 | 47.52 | 0.99 | 0.31 | 0.94 | |
| 7548 | 90 | 3 | 64 | 4,882.44 | 3,085.11 | 3,084.72 | 50.70 | 0.78 | 0.63 | 0.47 | |
| 7612 | 90 | 3 | 64 | 4,882.50 | 3,149.09 | 3,148.65 | 53.83 | 0.64 | 0.16 | -0.63 | |
| 7675 | 90 | 1 | 63 | 4,882.72 | 3,212.08 | 3,211.61 | 55.81 | 2.62 | -0.63 | -2.54 | |
| 7739 | 90 | 1 | 64 | 4,883.17 | 3,276.08 | 3,275.60 | 57.03 | 0.31 | 0.00 | 0.31 | |
| 7802 | 90 | 0 | 63 | 4,883.61 | 3,339.07 | 3,338.59 | 57.86 | 1.43 | 0.00 | -1.43 | |
| 7866 | 89 | 1 | 64 | 4,884.39 | 3,403.07 | 3,402.58 | 58.64 | 1.56 | -0.94 | 1.25 | |
| 7929 | 89 | 0 | 63 | 4,885.49 | 3,466.05 | 3,465.57 | 59.47 | 1.11 | 0.00 | -1.11 | |
| 7993 | 89 | 1 | 64 | 4,886.55 | 3,530.04 | 3,529.55 | 60.47 | 1.57 | 0.16 | 1.56 | |
| 8057 | 90 | 1 | 64 | 4,887.16 | 3,594.04 | 3,593.53 | 61.87 | 1.19 | 1.09 | -0.47 | |
| 8121 | 91 | 0 | 64 | 4,886.77 | 3,658.04 | 3,657.52 | 62.70 | 2.04 | 1.72 | -1.09 | |
| 8184 | 91 | 1 | 63 | 4,885.56 | 3,721.02 | 3,720.50 | 63.58 | 1.42 | 0.63 | 1.27 | |
| 8216 | 92 | 1 | 32 | 4,884.78 | 3,753.01 | 3,752.49 | 64.31 | 0.88 | 0.63 | 0.63 | |
| 8280 | 91 | 2 | 64 | 4,883.16 | 3,816.99 | 3,816.44 | 66.04 | 0.49 | -0.16 | 0.47 | |
| 8344 | 90 | 2 | 64 | 4,882.32 | 3,880.98 | 3,880.41 | 67.94 | 2.03 | -2.03 | 0.00 | |
| 8408 | 90 | 1 | 64 | 4,882.49 | 3,944.98 | 3,944.38 | 69.67 | 0.91 | -0.78 | -0.47 | |
| 8471 | 90 | 2 | 63 | 4,882.99 | 4,007.98 | 4,007.36 | 71.43 | 0.65 | -0.16 | 0.63 | |
| 8535 | 89 | 1 | 64 | 4,883.71 | 4,071.97 | 4,071.33 | 73.10 | 1.05 | -0.47 | -0.94 | |
| 8599 | 89 | 1 | 64 | 4,884.77 | 4,135.96 | 4,135.31 | 74.28 | 0.66 | -0.47 | -0.47 | |
| 8663 | 90 | 2 | 64 | 4,885.67 | 4,199.95 | 4,199.29 | 75.67 | 1.44 | 0.94 | 1.09 | |
| 8726 | 90 | 1 | 63 | 4,885.94 | 4,262.95 | 4,262.27 | 76.99 | 1.50 | 0.79 | -1.27 | |
| 8790 | 90 | 1 | 64 | 4,886.00 | 4,326.95 | 4,326.26 | 78.05 | 0.49 | -0.16 | 0.47 | |
| 8853 | 90 | 2 | 63 | 4,886.22 | 4,389.95 | 4,389.24 | 79.70 | 1.31 | -0.32 | 1.27 | |
| 8917 | 90 | 1 | 64 | 4,886.50 | 4,453.95 | 4,453.22 | 81.10 | 2.04 | 0.16 | -2.03 | |
| 8981 | 89 | 360 | 64 | 4,887.11 | 4,517.94 | 4,517.22 | 81.38 | 1.55 | -1.09 | 561.41 | |
| 9045 | 91 | 1 | 64 | 4,887.11 | 4,581.93 | 4,581.21 | 81.88 | 3.30 | 2.81 | -560.78 | |
| 9077 | 92 | 1 | 32 | 4,886.39 | 4,613.92 | 4,613.20 | 82.35 | 2.67 | 2.50 | -0.94 | |
| 9173 | 93 | 360 | 96 | 4,882.62 | 4,709.83 | 4,709.13 | 82.77 | 1.48 | 1.15 | 374.06 | |
| 9230 | 93 | 360 | 57 | 4,879.83 | 4,766.74 | 4,766.06 | 82.57 | 0.00 | 0.00 | 0.00 | |