
# Use of Riserless Mud Recovery (RMR™) to improve drilling efficiency in Block 9 shallow reservoirs

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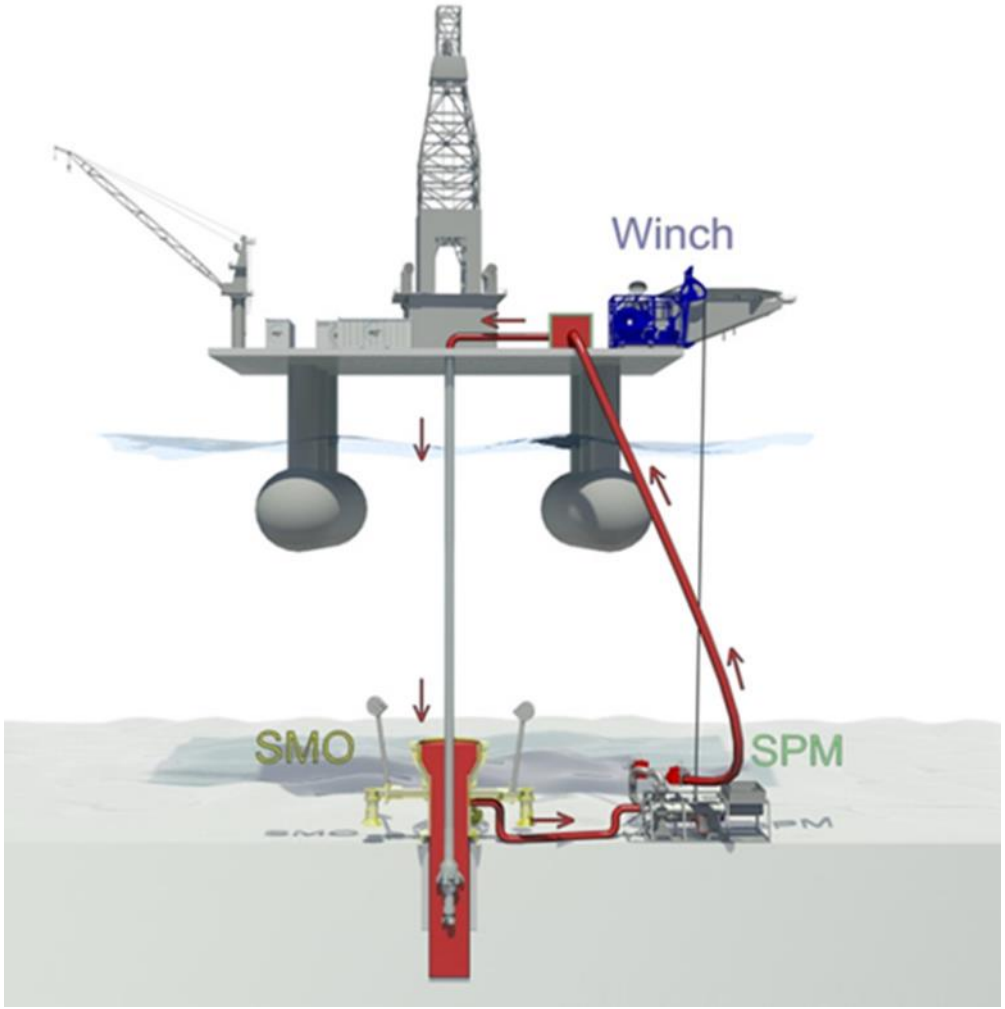
# RISERLESS MUD RECOVERY SYSTEM




RMR© is an innovative way to return mud and cuttings to the rig before the marine riser is run, without discharge to the seabed, there is no “Pump & Dump”

RMR© is a risk reduction system that allows you to drill a better, more stable top hole safely, quickly and with less environmental impact

# RISERLESS MUD RECOVERY SYSTEM

RMR Benefits – Drilling Top Holes with Weighted Mud

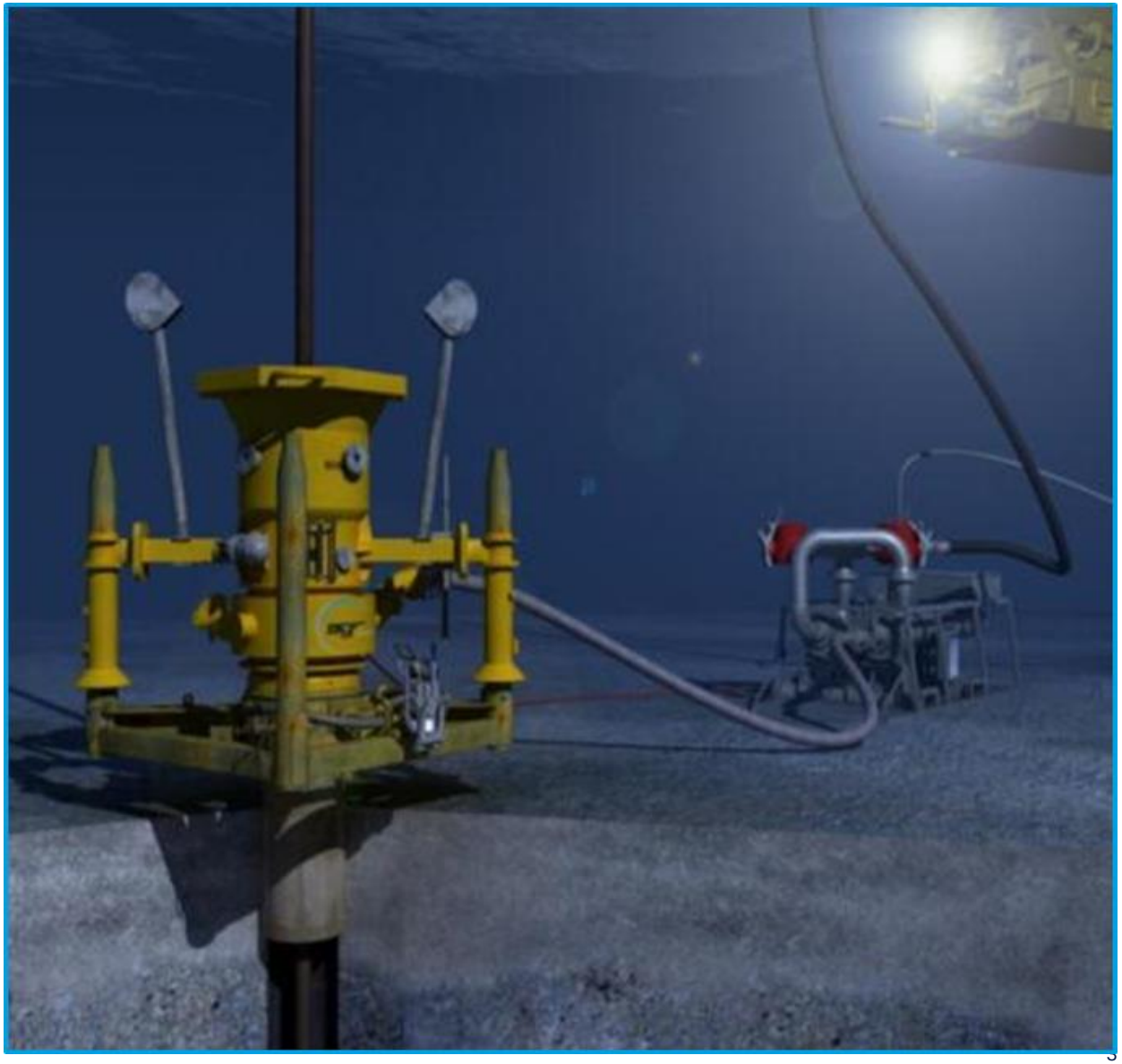
Mitigates Geo-hazard Occurrences
Shallow Water / Gas Flow
Early kick detection
Formation Instability
Alternative to pilot hole

Allows Well Design / Construction Optimization
Reduced number of casing strings
Drill deeper open hole sections
Set the 20” deeper to get a best possible shoe or
Skip the 20” and go for a 17½” and 13 3/8” casing directly
Improved well bore quality / structural integrity

Reduces environmental impact
Saves mud & reduces logistics costs

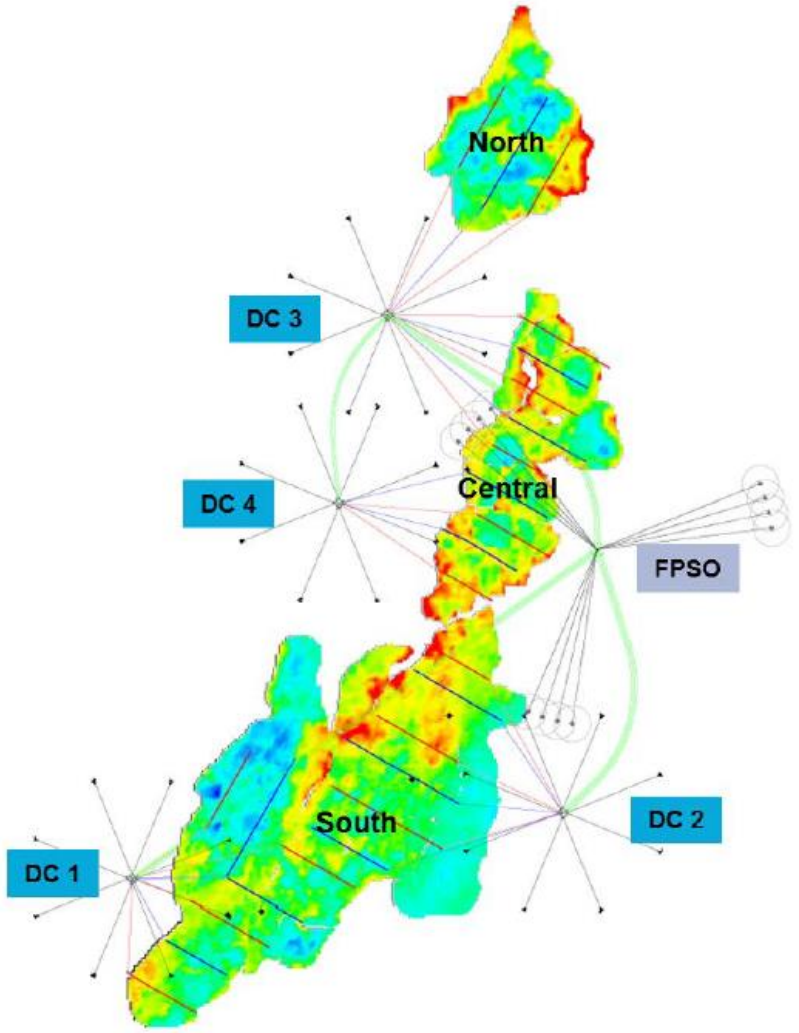
# RISERLESS MUD RECOVERY SYSTEM

- ‘Sub-sea’ technology
- ROV friendly
- Minimal rig time
- Off line deployment & retrieval
- Real time monitoring / communication
- Well head, template, self spudding options
- Proven! Over 300 wells to date



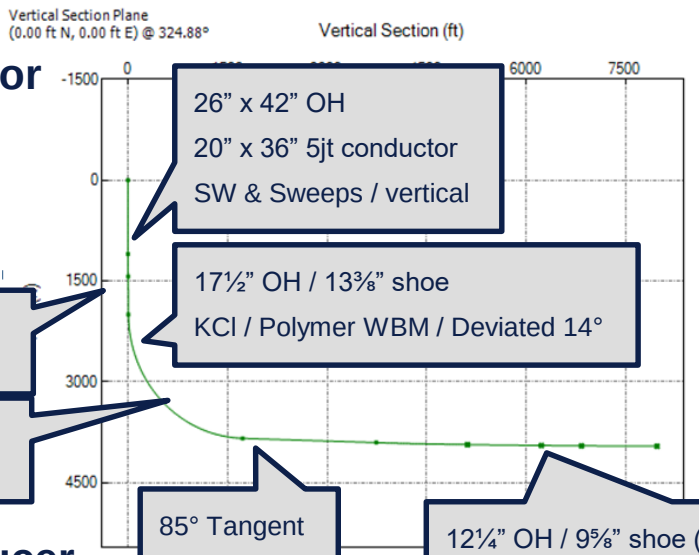
# Kraken overview

- 24-well development in Block 9/02b
  - local offsets include Harding, Gryphon, Mariner
- FDP - four drill centres (DCs), each with 4-slot production and injection templates, either template within rig skidding pattern
- 370-410ft water depth across field
- Top Heimdal III reservoir 3,850 – 3,950ft TVDSS
- Slim-hole well design (originally full-hole)



# Typical Kraken well plans (pre-drill stage)

## DC2 Injector
## Sou-I01



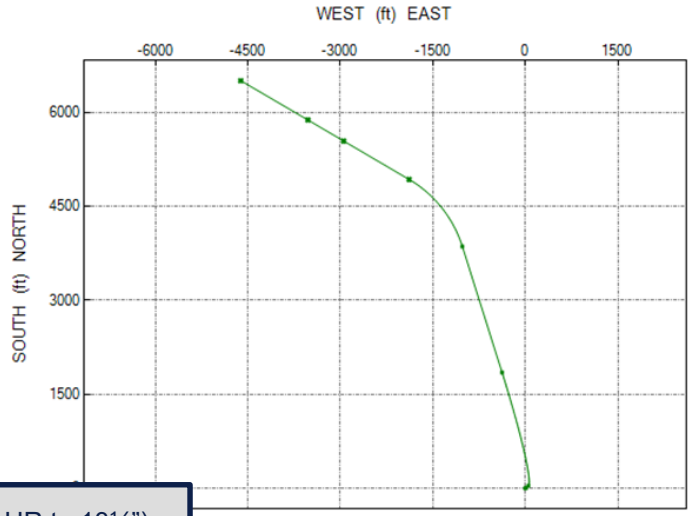

26” x 42” OH
20” x 36” 5jt conductor
SW & Sweeps / vertical

17½” OH / 13⅜” shoe
KCl / Polymer WBM / Deviated 14°

Original 20” shoe depth

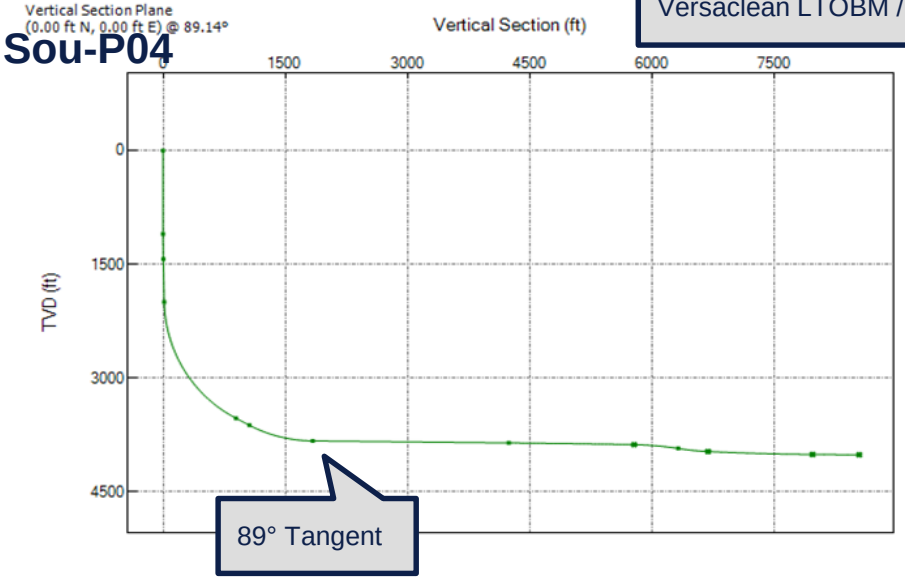
Original 13⅜” shoe depth

85° Tangent

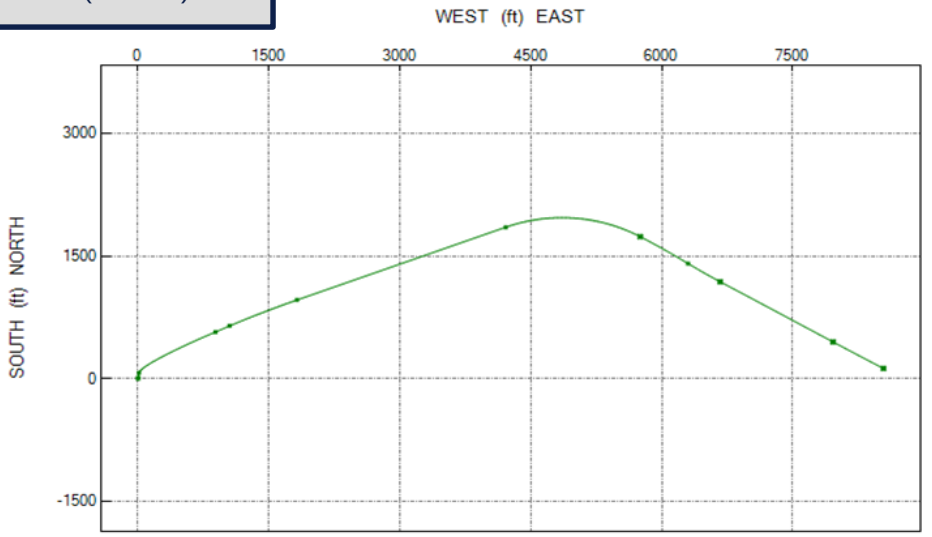



12¼” OH / 9⅝” shoe (Producers UR to 13½”)
Versaclean LTOBM / Horizontal (85°-90°)

## DC1 Producer
## Sou-P04




89° Tangent



# Achieving shallow build in weak, unconsolidated formations

- **Use of engineered mud system**
  - Conductor shoe set at ±700ft
  - Section TD ±2,400ft
  - Conventional riserless sections with seawater & sweeps
    - Kraken 9/02b- 6 appraisal – 14° achieved
    - Kraken 9/02b- 7 appraisal – 18° achieved
      - field test of small batch of engineered mud
    - Other Block 9 – 6.5° by 1,900ft
    - Other Block 9 – 5.5° by 2,000ft
  - Engineered mud systems
    - Gryphon and Harding achieve well in excess of 20° through
      - use of LP riser (platform)
      - Subsea wells with pre-packed wellhead and BOP in place
  - Conclusion that engineered mud system with means of transporting returns to surface is critical

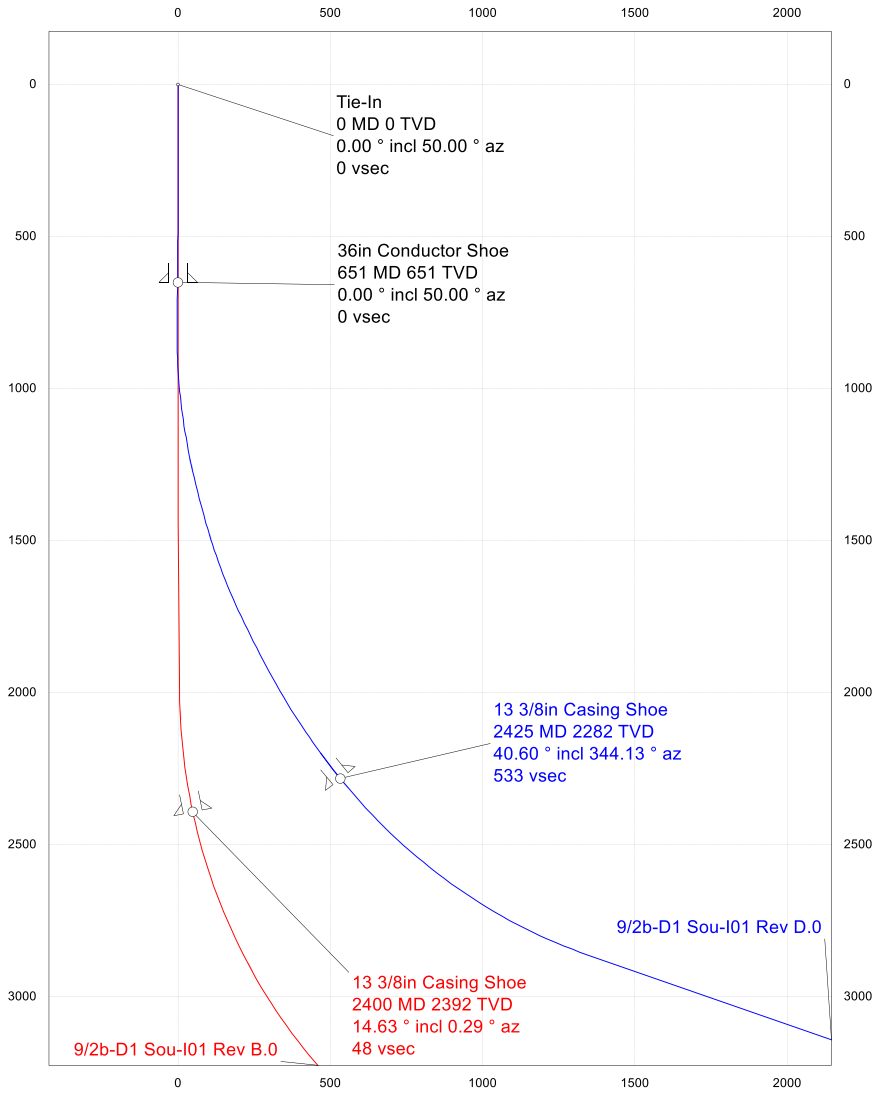
- **Use of Riserless Mud Recovery System (RMR™)**
  - Enables use of engineered mud system with returns to surface
  - Kraken template system – requirement to remove cuttings and cement on riserless systems from template anyway (CTS™ so RMR™ was a simple next step)
    - Use the same pump unit for both systems for simplicity
    - Return line to shaker required (hardline installed)
  - Attaches to the Concrete & Cuttings Disposal System (CCDS) on the template or directly on to the Subsea Module (SMO).

# Enhanced Drilling RMR™ system on Transocean Leader

# Summary of results

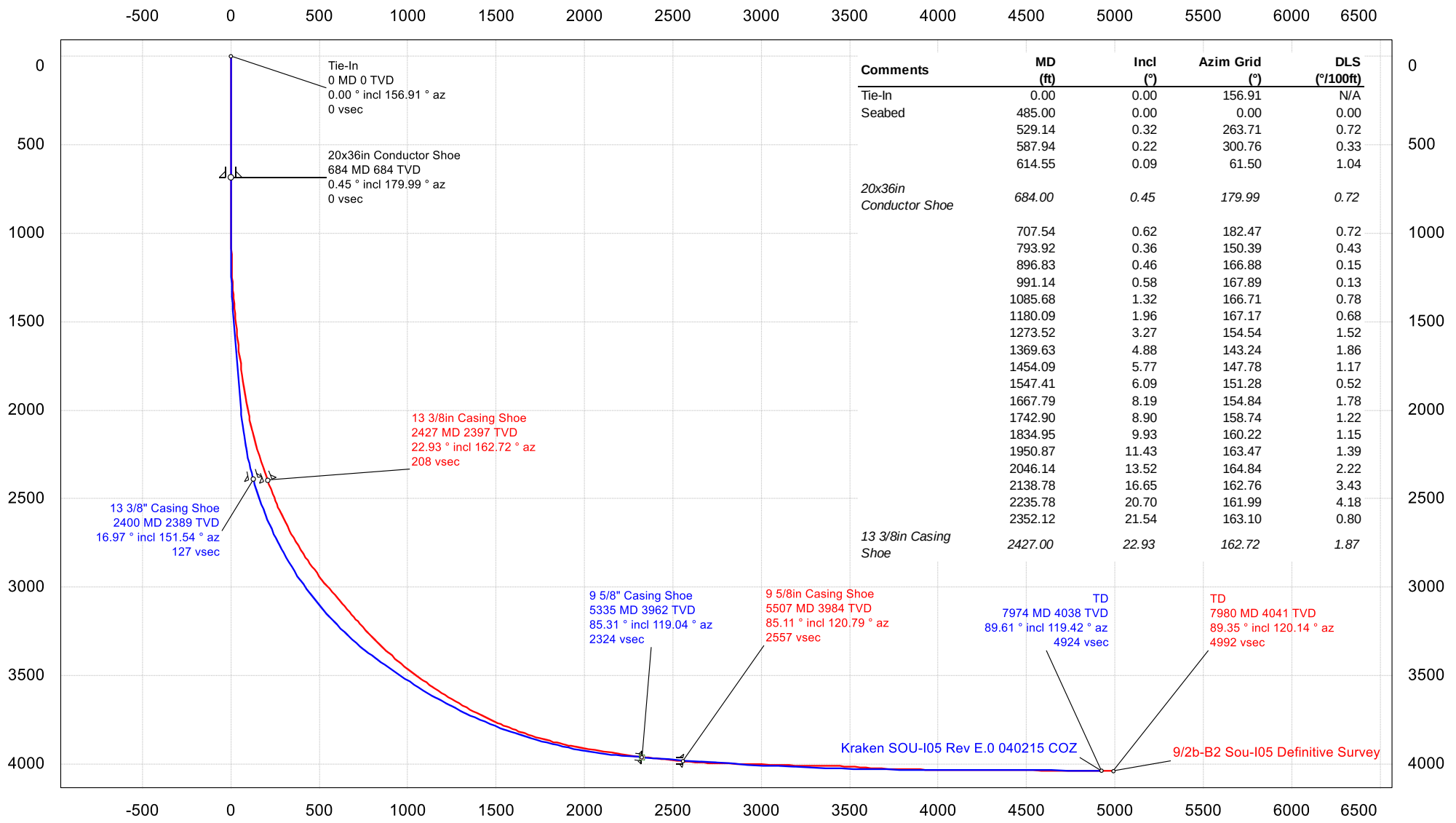
- **Surpassed expectations**
  - 24 off 26” x 42” sections with CTS (batched)
  - 24 off 17½” sections with RMR (batched)
  - DC1 - maximum of 25° achieved
    - Held back following initial doglegs >3°
  - DC2 – pushed boundary to a final survey of 41°
    - Casing run to bottom on Overdrive without issue
  - 50° considered to be a technical limit
  - No issues with equipment or personnel
  - Pushed boundaries of pump life
    - >300 circulating hours on one subsea pump module (SPM)
  - Optimised such that the SPM was left in one position & the use of two hoses meant all the slots on each template could be reached without moving the SPM.
  - Aker CCDS interface used for tophole drilling and both cementing operations
  - SMO used for 17½”

# DC2 - 9/02b-D1 – 17½” section 40.6° actual vs 14.6° plan




| | MD (ft) | Incl (°) | Azim Grid (°) | DLS (°/100ft) |
|---|---|---|---|---|
| | 0.00 | 0.00 | 330.00 | N/A |
| | 451.00 | 0.00 | 330.00 | 0.00 |
| | 491.42 | 0.40 | 210.74 | 0.99 |
| | 566.80 | 0.75 | 184.27 | 0.57 |
| | 705.22 | 1.49 | 213.63 | 0.66 |
| | 804.83 | 1.20 | 216.43 | 0.30 |
| | 900.41 | 2.49 | 348.36 | 3.57 |
| | 990.91 | 5.25 | 346.99 | 3.05 |
| | 1083.90 | 8.31 | 348.17 | 3.29 |
| | 1183.46 | 11.62 | 351.50 | 3.37 |
| | 1276.16 | 14.30 | 353.15 | 2.92 |
| | 1370.51 | 16.49 | 353.40 | 2.32 |
| | 1455.78 | 17.27 | 352.32 | 0.99 |
| | 1547.26 | 20.36 | 348.79 | 3.60 |
| | 1653.51 | 23.14 | 348.21 | 2.62 |
| | 1739.58 | 26.22 | 347.97 | 3.58 |
| | 1835.22 | 27.59 | 345.69 | 1.79 |
| | 1926.25 | 29.48 | 347.30 | 2.24 |
| | 2017.49 | 30.55 | 346.85 | 1.20 |
| | 2116.41 | 32.92 | 346.77 | 2.40 |
| | 2208.77 | 35.41 | 345.63 | 2.78 |
| | 2316.22 | 37.98 | 344.86 | 2.43 |
| Projection to TD | 2437.00 | 40.89 | 344.05 | 2.45 |

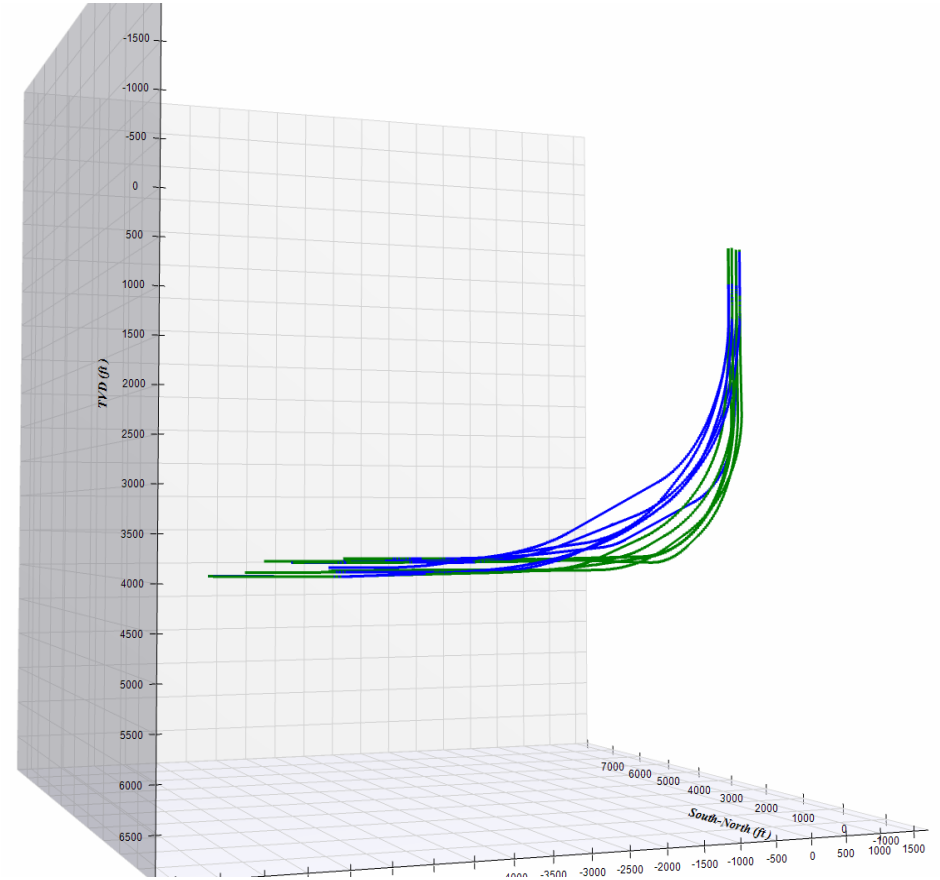
# DC1 - 9/02b-B2, first completion (injector)

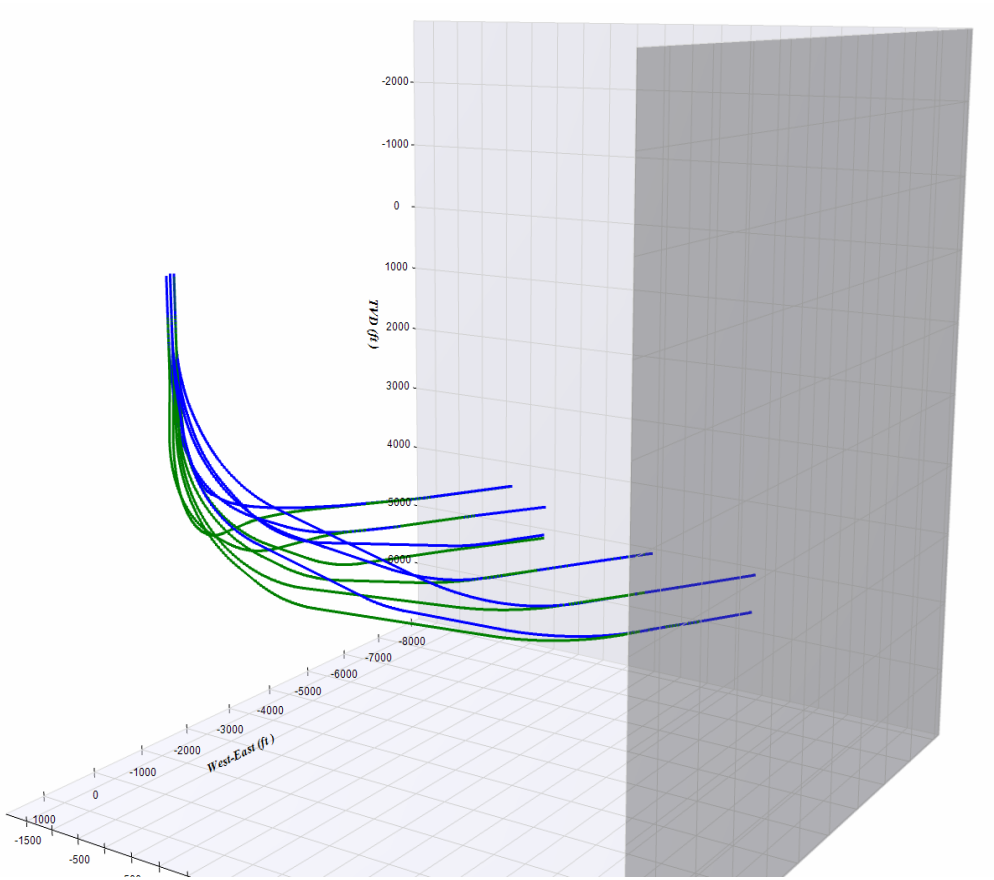



| Comments | MD (ft) | Incl (°) | Azim Grid (°) | DLS (°/100ft) |
|---|---|---|---|---|
| Tie-In | 0.00 | 0.00 | 156.91 | N/A |
| Seabed | 485.00 | 0.00 | 0.00 | 0.00 |
| | 529.14 | 0.32 | 263.71 | 0.72 |
| | 587.94 | 0.22 | 300.76 | 0.33 |
| | 614.55 | 0.09 | 61.50 | 1.04 |
| *20x36in Conductor Shoe* | *684.00* | *0.45* | *179.99* | *0.72* |
| | 707.54 | 0.62 | 182.47 | 0.72 |
| | 793.92 | 0.36 | 150.39 | 0.43 |
| | 896.83 | 0.46 | 166.88 | 0.15 |
| | 991.14 | 0.58 | 167.89 | 0.13 |
| | 1085.68 | 1.32 | 166.71 | 0.78 |
| | 1180.09 | 1.96 | 167.17 | 0.68 |
| | 1273.52 | 3.27 | 154.54 | 1.52 |
| | 1369.63 | 4.88 | 143.24 | 1.86 |
| | 1454.09 | 5.77 | 147.78 | 1.17 |
| | 1547.41 | 6.09 | 151.28 | 0.52 |
| | 1667.79 | 8.19 | 154.84 | 1.78 |
| | 1742.90 | 8.90 | 158.74 | 1.22 |
| | 1834.95 | 9.93 | 160.22 | 1.15 |
| | 1950.87 | 11.43 | 163.47 | 1.39 |
| | 2046.14 | 13.52 | 164.84 | 2.22 |
| | 2138.78 | 16.65 | 162.76 | 3.43 |
| | 2235.78 | 20.70 | 161.99 | 4.18 |
| | 2352.12 | 21.54 | 163.10 | 0.80 |
| *13 3/8in Casing Shoe* | *2427.00* | *22.93* | *162.72* | *1.87* |

# DC2 – pre-drill vs actual

- **Pre-drill plan**
- **Actual**



# DC2 - longest injector (12¼” to drill Q4 2016) 775ft reduction