



GAIA CABLE

PROTECTION SYSTEM

Prevent cable sticking and keyseating.





GAIA CABLE P R O T E C T I O N S Y S T E M

Maximising wireline performance: lower risk, less time & better data.

Gaia's Cable Protection System (**GCPS**) has four elements:

- **Wire-pro** tension modelling and sticking-risk package
- **Benchmarking** wells with a global sticking database
- **Wireline standoff** and roller portfolio
- **Experienced conveyance specialist** at the well site, to lead job execution

GCPS enables safe and efficient wireline operations in tortuous, soft or depleted boreholes where the risk of cable sticking is mitigated through engineering evaluation.

GCPS offers compelling operational and financial benefits by avoiding the costs and NPT of stuck cable (fishing operations, pipe-conveyed logging, additional wireline runs and missing data & sample objectives).

GCPS enables the systematic evaluation of wireline conveyance risks and determines optimal well paths for lowest risk acquisition.

GCPS increases the effective cable rating in tortuous wells by reducing cased hole cable drag. Tension transmission and overpull capacity are improved, reducing sticking risks. Costly conveyance system upgrades may not be required.

GCPS improves the efficiency of formation tester surveys by utilizing cable dynamics and wellbore diagnostics data for "smart targeting" of thin or heterogeneous beds through statistical analysis of wireline creep.

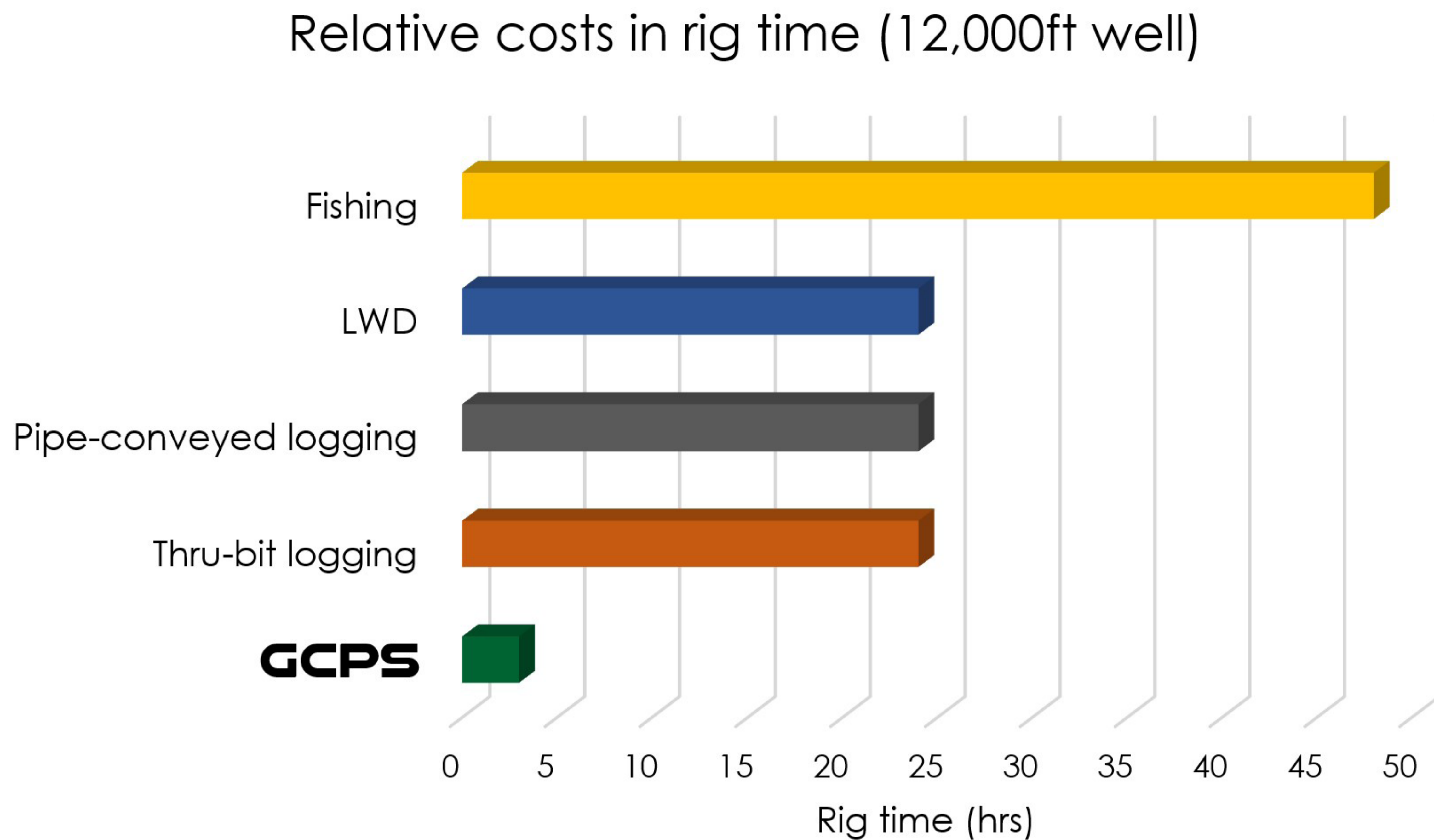
Through **GCPS**, our clients have achieved to date:

96% success in eliminating initial signs of cable sticking.

98% success in avoiding fishing due to stuck cable.



GCPS is a driver for cost-effective wireline acquisition. Relative costs on a typical well are displayed below:



The return on investment (ROI) of GCPS can range from 10:1 to 50:1 depending on well depth and risk profile, illustrated below:

STUCK CABLE

- Cancelled surveys
- Missing data, pressures or samples
- 1-2 days wiper trip
- 1-2 days to re-run sampling strings
- 2-3 days for pipe conveyed logging
- Jars may stop firing (cable stuck at higher tensions)
- Can't release cable head: Strip over fishing
- Can't pull free: strip-over fishing
- HSE & DROPS hazards during strip over fishing
- 2-3 days of rig time for strip over fishing
- Tools stuck by the time BHA reaches cable head
- Cable parts during strip-over fishing
- Days or weeks of open hole cable fishing
- Lost in hole charges for tools

WLSOs & FREE CABLE

- No cancelled surveys
- No missing pressures and samples
- No wiper trips
- No pipe conveyed logging
- No issue firing jars
- No issues with cable release
- No delay in tripping-in to fish the tools (if needed)
- LIH charges less likely

“Is everything being done, in terms of modelling & analysis, technologies & procedures to reduce wireline conveyance risk to the lowest possible level?”



WIRE-PRO

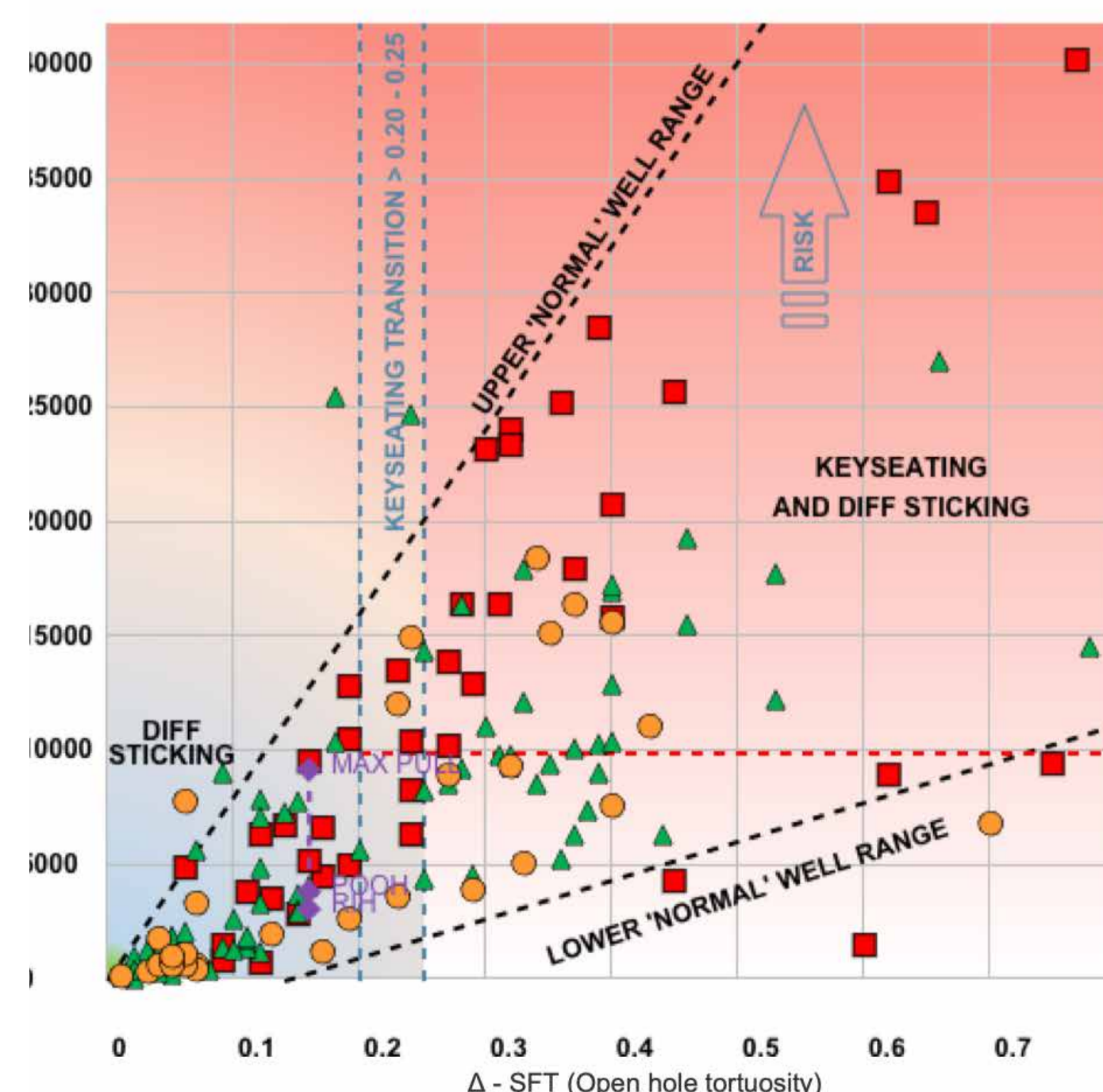
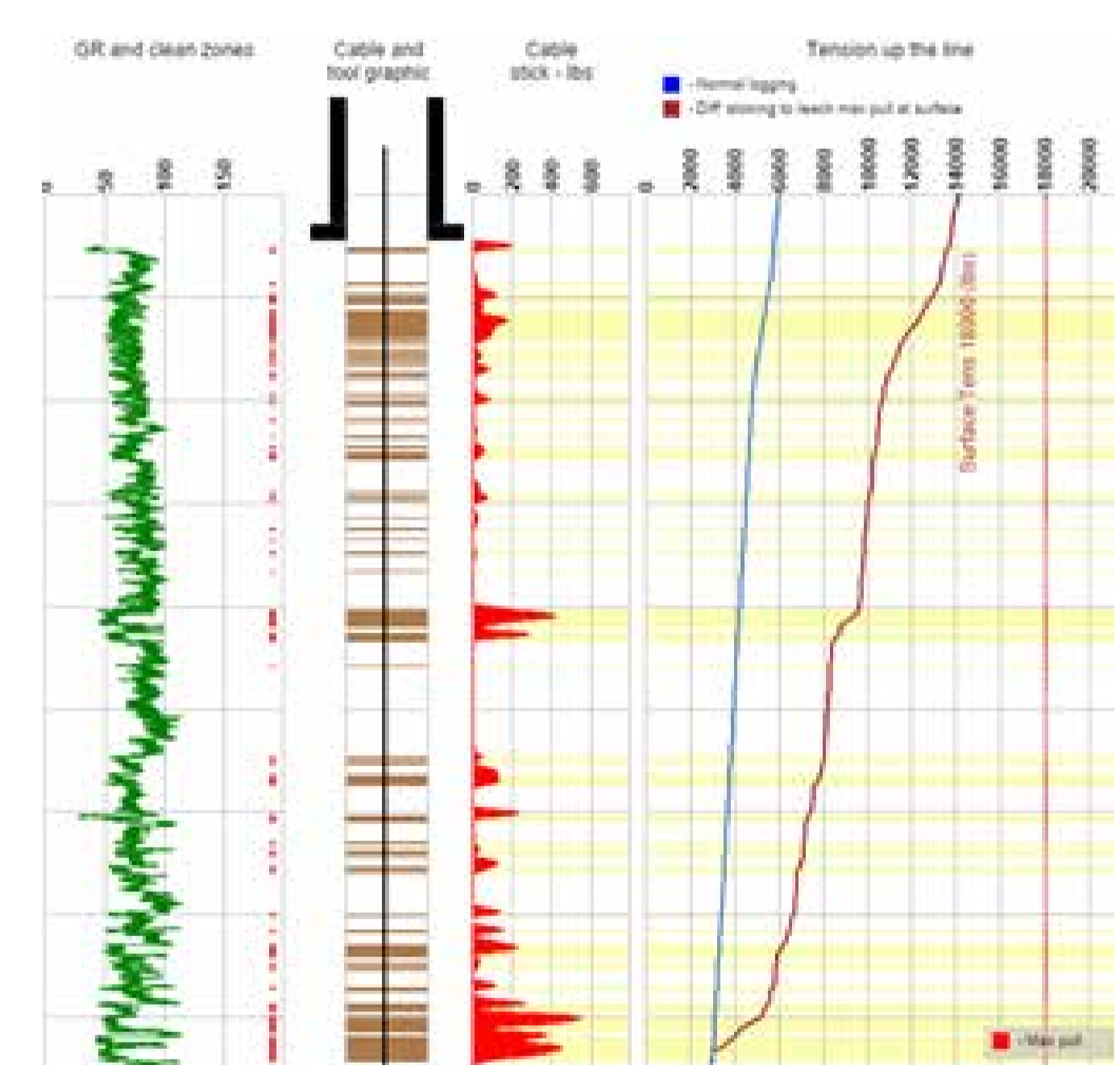
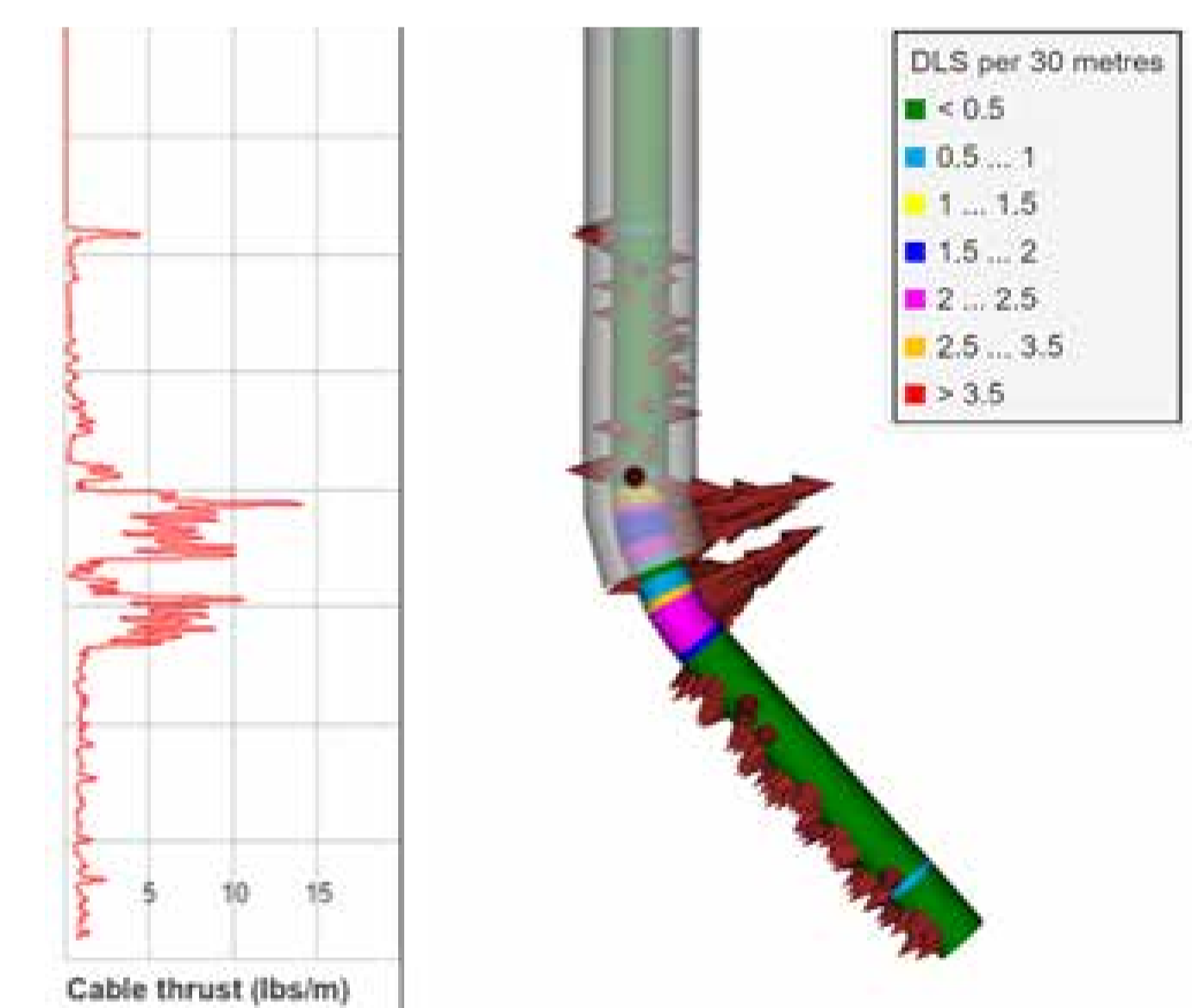
MODELLING AND BENCHMARKING

Wire-pro is Gaia's proprietary tension modelling package.

- Superior to other models on the market.
- Focused on open hole cable sticking and cable forces.
- Integration of petrophysical data and pore pressures.
- Deployment planning for Wireline Standoffs (WLSOs).
- Benchmarking of cable sticking risk via Gaia's global well database.

Wire-pro Modelling and Benchmarking

- A model is created using Wire-pro to calculate the cable thrust at different points in the well.
- Well parameters, petrophysical data and pore pressures are incorporated to assess the risk of differential sticking.
- The Benchmark plot compares the operational risk with our local and global sticking databases, allowing the need for **Wireline Standoffs (WLSOs)** to be evaluated.



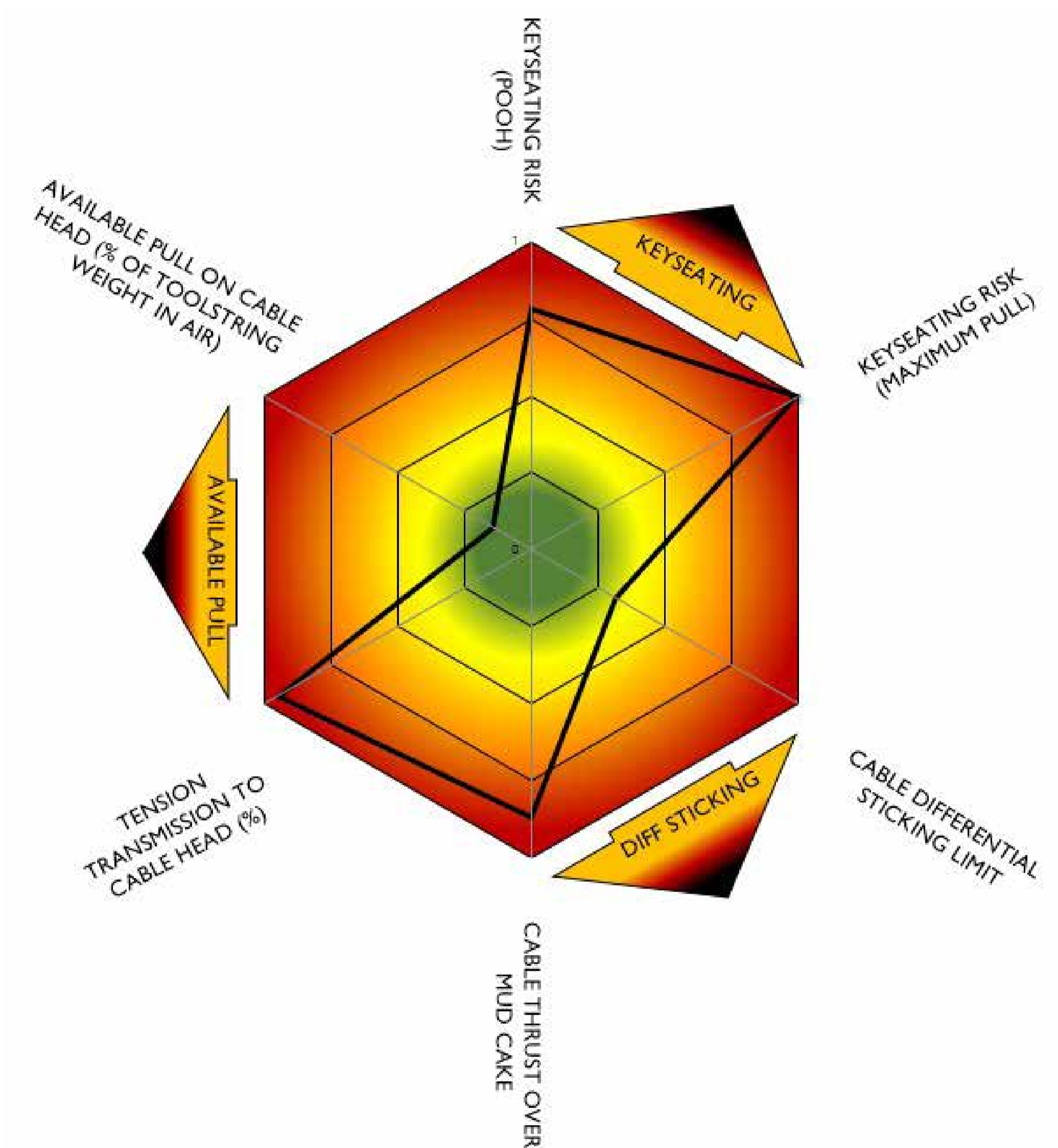
WIRE-PRO

MODELLING AND BENCHMARKING

Spider Plot

The Spider Plot summarizes the overall conveyance risk:

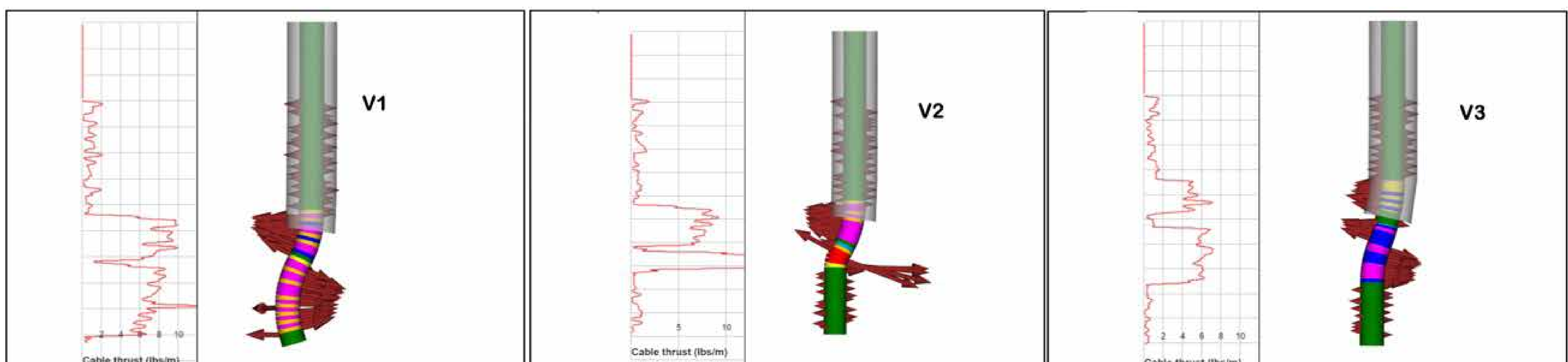
- Keyseating risk
- Differential sticking limit
- Cable thrust over mud cake
- Available pull at the cablehead
- Tension transmission to the cablehead



Well design for wireline

To de-risk wireline operations at the well design stage, Gaia works closely with drilling and subsurface teams. Alternate well paths may be evaluated and benchmarked to determine the lowest risk option.

In the example below, the v3 well path has ~50% less open hole tortuosity than v1 and presents a significantly lower risk for cable keyseating and differential sticking. Many cable fishing jobs can be avoided at the well design stage.

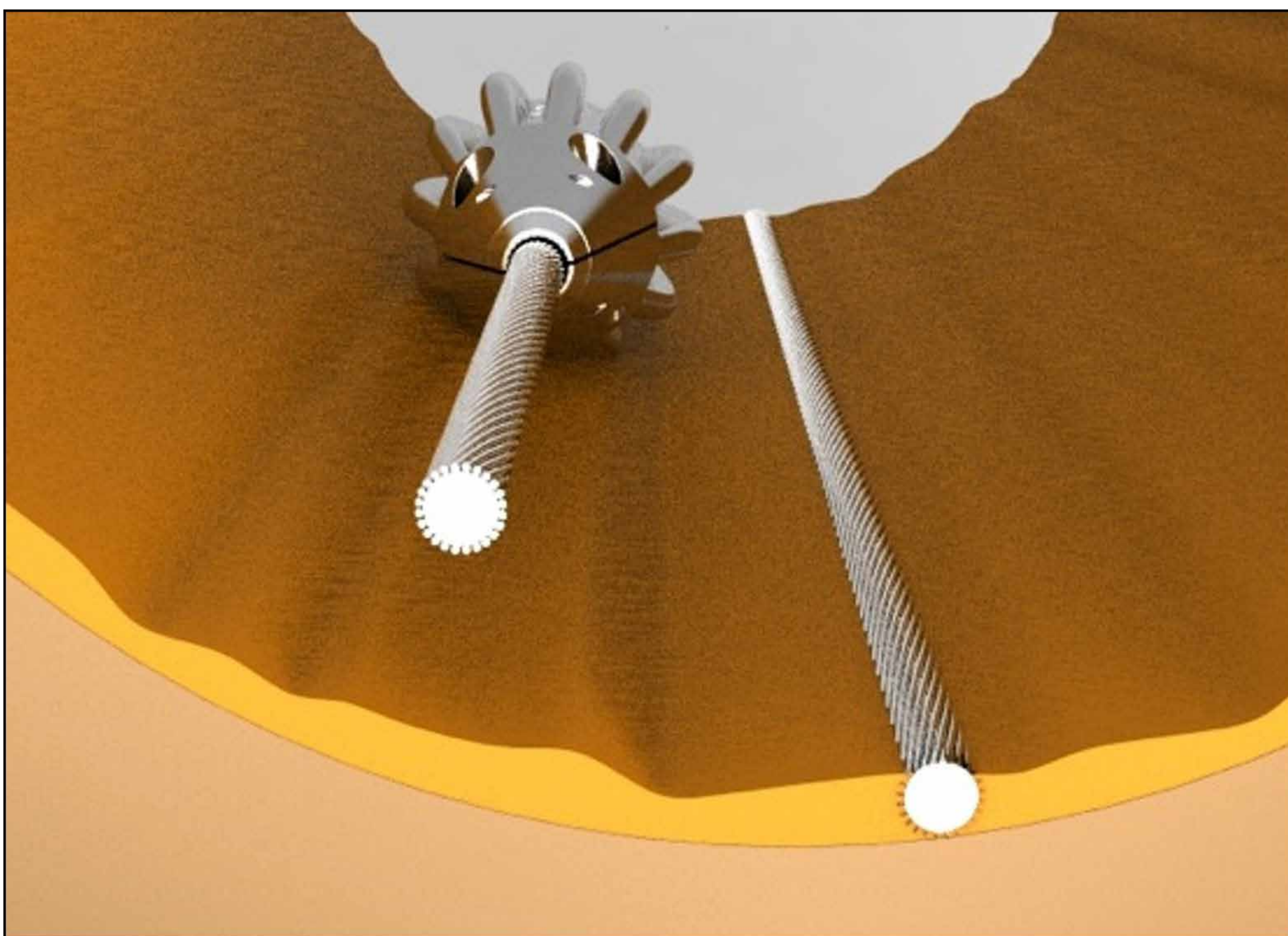




WIRELINER STANDOFFS

INTRODUCTION

Wireline Standoffs (WLSOs) are precision mechanical clamps that attach to the logging cable, to suspend the cable above mud cake, or above a cable slot, so it cannot get stuck. WLSOs typically reduce cable contact with the borehole wall by **99%**.



Historically, WLSOs have been recommended on ~25% of modelled wells.

If WLSOs are mobilised to the wellsite, our **G²⁴** service gives you the best of both worlds:

Two consultants, and full 24-hour cover for both **Wireline QA/QC**, and **GCPS**.

SPE papers available on OnePetro; links at www.gcps.tech:

174068: Using Wireline Standoffs (WLSOs) to mitigate cable sticking

193232: Wireline cable protection: Enabling fluid sampling in high-risk wellbores

207644: A Drilling Engineer's guide to optimizing well design for wireline operations

Wireline Keyseating (PetroWiki article): https://petrowiki.spe.org/Wireline_keyseating

WIRELINER STANDOFFS

ARRAYS AND COMBINATIONS

Wireline Standoffs are deployed in arrays to cover the risk zones in the well. The average number deployed is 35, and the average space-out is 55ft (16m).

Different types of wireline standoffs are available.

- **WLSO**: Wireline Open Hole Standoff. To prevent cable sticking.
- **WXSO**: Wireline X-ray Standoff. Incorporates a memory gauge for pressure, temperature and accelerometer readings.
- **WCRO**: Wireline Cased Hole Roller Standoff. To reduce drag and aid deployment, especially at high deviations.
- **WTSO**: Wireline Temperature Standoff. For recording maximum borehole temperature.

Wireline Standoff deployment plans are generated with Wire-pro.





WLSO

WIRELINER OPEN HOLE STANDOFF

- Prevents keyseating and differential sticking.
- Suspends the cable above mud cake or a cable slot.
- Reduces cable contact with the borehole wall.
- Deployed in arrays to cover risk zones in the well.
- Precision inserts ensure a tight fit on the cable.

WLSO

FACTS AND FIGURES

400+

Hole sections modelled to date

9,400+

Wireline standoffs run in hole

250+

Descents with WLSOs

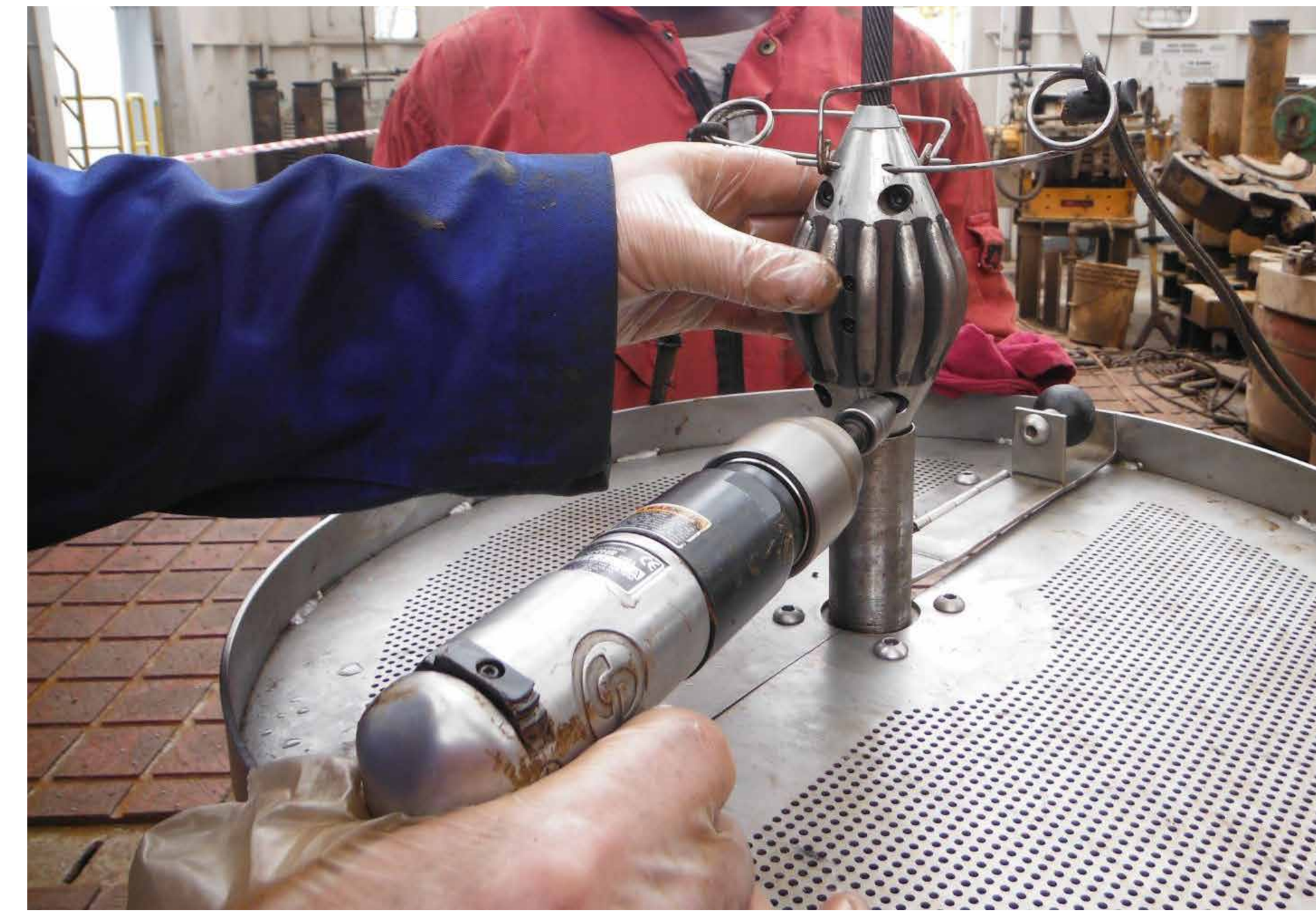
(98.8% with successful wireline acquisition)

34,880

Maximum depth reached (ft)

- WLSOs are typically deployed on around a quarter of modelled wells.
- A WLSO takes only one minute to install, with the Express Kit.
- WLSOs remain firmly attached on the wire, with no recorded slippage and none lost in hole.
- WLSOs fit all wireline cables. Precision cable inserts fit every logging cable in the industry.
- Different sizes are available to suit drill pipe internal diameter.
- WLSOs allow strip-over fishing. Procedures are well established.

* Statistics updated as of 05-Jan-2022.





WX50

DIGITAL CABLE STANDOFF

- Continuous pressure and temperature log.
- Mud integrity log.
- Independent wireline jar firing and re-cocking record.
- Cable torque log for stranding risk analysis.
- Loss and influx zone identification.
- Wellbore transient analysis during clean-up and sampling.
- Cable creep analysis for formation testing depth control.
- Cased hole contact log for predicting wireline wear zones.



WXSO

DIGITAL CABLE STANDOFF

WXSO is the result of Gaia's ongoing R&D into wellbore and cable dynamics (drag, creep and torque) and future conveyance technologies. It can be considered a "black-box" for a logging run.

The WXSO provides downhole recordings of borehole data and cable dynamics including pressure, temperature, deviation, rotation, cable movement, road noise and CCL.

WXSO Products

✓ WXSO Report

A comprehensive report on all the WXSO data acquired on the logging operation. Includes time and depth logs, station logs, temperature, mud weight, cable rotation and creep analysis, plus analysis of any sticking points encountered on the job.

✓ Temperature Analysis

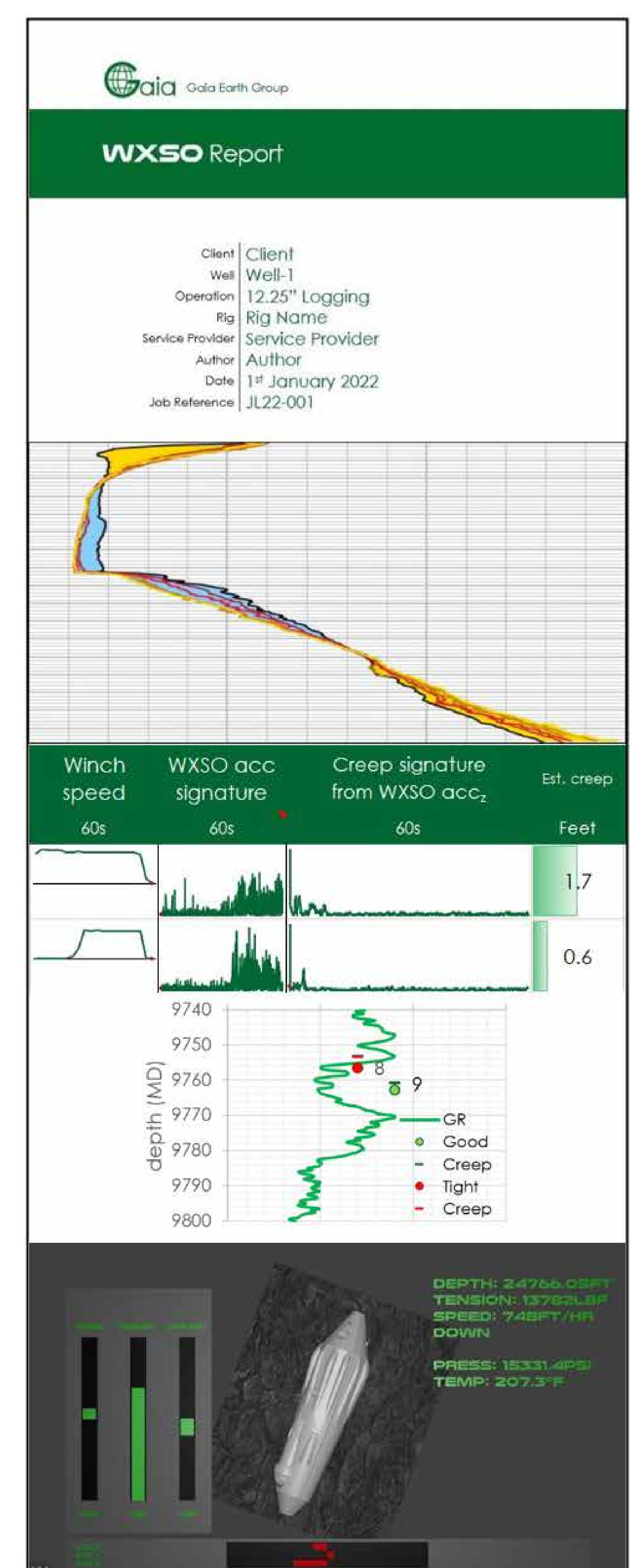
Analysis of temperatures from the WXSO's continuous-reading external temperature sensor. This includes an extrapolated borehole temperature if multiple logs are run.

✓ Cable Creep Analysis

Analysis of cable creep for station logs using the WXSO accelerometer. Creep distance is calculated for each station, and the planned and actual depths are plotted against the GR log. Actual depths can also be used to improve pressure gradients.

✓ Event Visualisation

Events can be played back as an animation to show cable spin, jar firing, cable creep, stuck tool situations and more.





Combat Wireline Casing Wear

WC50

WIRELINE CASED HOLE STANDOFF

- Reduce logging tensions
- Increase pull on cable head
- Improve tension transmission
- Increase effective cable rating



Minimize Cable Drag

WCRO

WIRELINER CASED HOLE ROLLER



- Aid wireline descent $>70^\circ$
- Extend tractor reach
- Reduce logging tensions
- Improve tension transmission
- Increase pull on cable head
- Increase effective cable rating



WT50

WIRELINE TEMPERATURE STANDOFF

- Measure maximum borehole temperature
- Open hole or cased hole
- 1 11/16" O.D. (suitable for pipe recovery operations)
- Rated to 204°C (400°F)



WIRELINER STANDOFFS

SUMMARY AND SPECIFICATIONS



	WLS0	WXS0	WCS0	WCRO	WTS0
Cable keyseating mitigation	✓	✓			
Cable differential sticking mitigation	✓	✓			
Assist re-cocking of wireline jars	✓	✓			
Cable sticking sensor		✓			
Temperature and mud weight analysis		✓			
Cable creep analysis for station logs		✓			
Image sticking events (tools and cable)		✓			
Rotation and torque analysis		✓			
Casing collar locator (CCL) log		✓			
Casing wear identification		✓			
Maximum borehole temperature reading		✓			✓
Casing wear mitigation			✓	✓	
Increase effective cable rating			✓	✓	
Additional overpull on logging tools			✓	✓	
High angle wireline deployments			✓	✓	
Extend tractor reach			✓	✓	
Log glass reinforced epoxy (GRE) liner			✓	✓	
Specifications					
Outer diameter (inches)	2.15-2.95	2.95	2.95	2.89	1.69
Temperature rating (°C °F)	200 392	150 302	177 350	177 350	204 400
Pressure rating (psi)	20,000	20,000	20,000	20,000	20,000

GCPS clients include:



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