# *Ensuring Wellbore Quality and Integrity in Real Time*

A real-time advisory system can improve geoscience, and multidisciplinary collaboration.

*Presenters:*
*Jeremiah Myers – DrillSage Development Leader*

*Authors:*
*William Hagan – DrillSage President*
*David Pritchard – DrillSage Advisor*
*Robert Foster – BlackBrush*
*Jeremiah Myers – DrillSage Development Leader*

DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

The BlackBrush Campaign with DrillSage Analytics

- Eighteen Total Wells

No major incidents

- Stuck pipe
- Primary barrier loss
- Well control

The near-term goal was to:

- Eliminate costly events by raising drill team awareness through stage-gated notifications: drill-floor to management.
- **Enhance multidisciplinary participation**: Drill Team and Geology

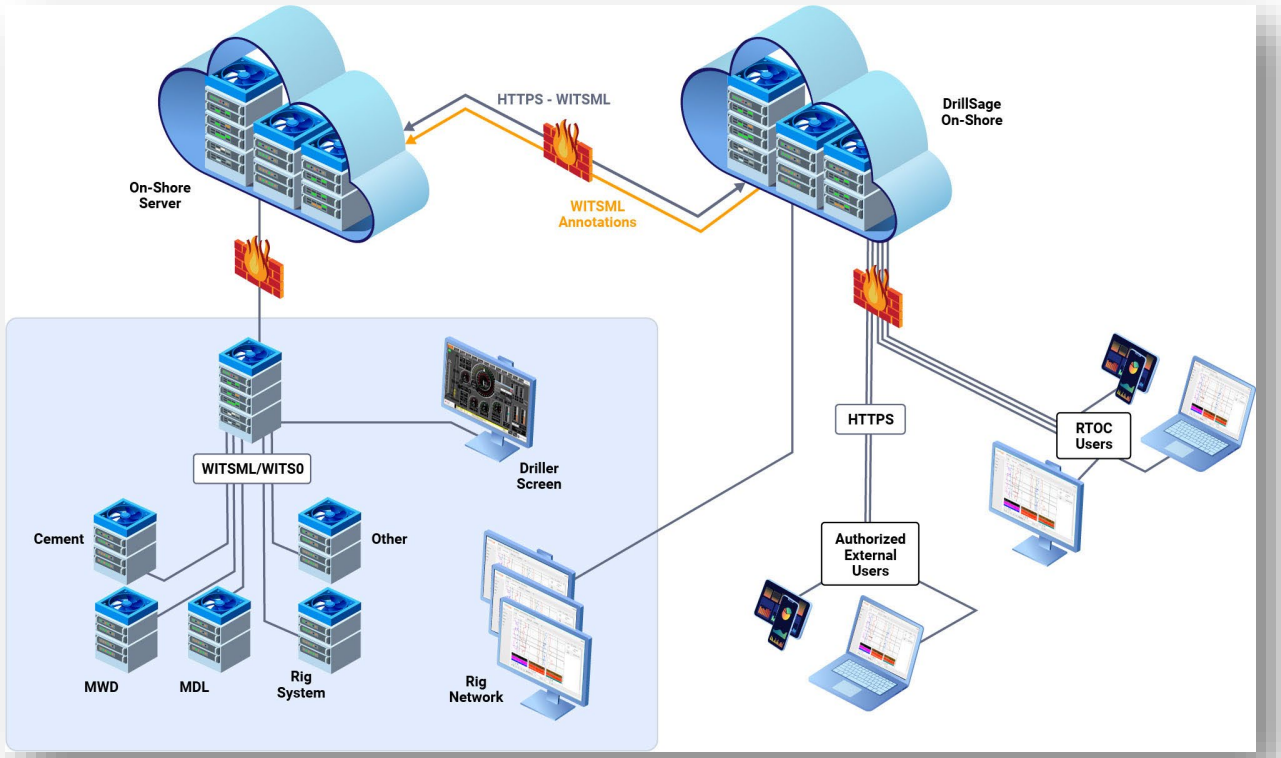
Starting in January of 2023, BlackBrush and DrillSage successfully completed an 18-well drilling campaign with no major operational issues. Although previous campaigns had seen issues with stuck pipe and lost BHA's, these issues were not encountered. This recent successful campaign reflects the effectiveness of the DrillSage real-time advisories and data-driven decision-making in preventing common drilling issues.

DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

# Real Time Advisory System (RTAS©)

RTAS© utilizes conventional EDR* data to identify evolving hazardous conditions, like:

- Stuck Pipe
- Inordinate fluid losses
- Kicks leading to well control




***EDR (Electronic Drilling Recorder)***

# Bringing The Multidisciplinary Team Together

- The notification system is fully customizable to cater to the specific needs of any operation.
  - For example, geologists can receive alerts relevant to Gas, Chromatograph, Mudlog, or even ECD vs. PP/FG when downhole tools are available.
- Create as many groups as needed for each type of watch or alarm to reflect the monitoring and communication plan of the operation.

- **Providing time for drill team and geoscience proactive actions**

  "Watch's" raise Situational Awareness via ***escalated notifications*** of evolving anomalies that impact wellbore stability": Typical, Customizable Example:

| Level 1<br>Rig Team, RTOC | Level 2<br>Geos, Direct Supervision | Level 3<br>Management |
|---|---|---|

- Alarm notifications when limits are exceeded:
  - Gas levels
  - Pit gain (volumetrics)
  - Flow rate
  - Torque
  - Equipment limitations, like motor differential
  - Hookload

- The customizable notification system not only enhances communication but also optimizes operations. As a result:
  - We facilitate the optimization of the Wellpath:
    - Minimizing production conditions/impairments such as slugging and impact on artificial lift and production equipment design and limits.
    - Minimizing time to casing running, cementing
    - Improve stimulation efficiency toe-heel.
    - Use of drilled gas data to improve fracturing efficiency.
  - Provide a system:
    - To reliably chart Key Performance Indicators (KPI's): Drilling Optimization improvements
      - That is a precursor to *successful* automation which will never be sustained absent a stable wellbore.
  - Identify real time solutions via drill team corrective actions leading to improved Artificial Intelligence.

# First and Foremost: Hazards Avoidance Saves Time and Money

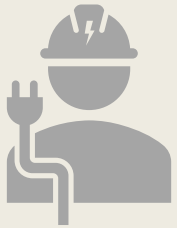
## Primary Root Causes of Hazardous Events - Examples

- Avoiding hazards is the best strategy in drilling operations. Understanding the root causes of hazard events is crucial for prevention and maintaining ‘a groove’ while drilling.
- The strength of DrillSage's system lies in its ability to identify early warning signs, rather than just symptoms of these problems.
- By providing early Watches before these conditions escalate into problems, DrillSage allows operational teams to act proactively, enhancing the efficiency and safety of drilling operations.

**Stuck Pipe Root Cause:**

***Hole Cleaning***

Cuttings loading
Caving
Differential Pore Pressure Anomalies
Mechanical: Dog Leg Severity
Porpoise Undulations

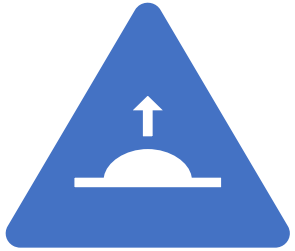


**Motor and BHA equipment failures:**

Exceeding motor design
Pressure differential limits
Vibrations

DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

# ‘Getting in a Groove’ Vs. Transient, FAST ROP *- Comparative Value -*



## What is a groove? Steady State

A steady state flow process requires conditions at all points in an apparatus or system remain constant as time changes. ***There must be no accumulation of mass or energy***

*In the case of drilling operations, accumulation of mass can be represented by “excess cuttings”.*

- Hole cleaning at optimal cleaning rates governed by cutting carrying indices is imperative.

## What is Transient or Non-Steady State?

Unsteady-State: in unsteady-state processes, mass and energy in the system are changing with time (not constant).

***A condition not conducive to processes like automation***

*Steady State processes are always more reliable and efficient.*
*DrillSage helps in maintaining your 'groove' by providing early warnings and facilitating proactive actions.*

DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

# The Rate of Penetration (ROP) Conundrum

Fast ROP often out-runs the ability to clean the hole and can create:

- Doglegs
- Undulations
- Destructive Motor/BHA forces
- Fast ROP can compromise the ability to make sound geological decisions

Optimum ROP seeks a rate that ensures hole cleaning and stability

Tracking a moving average ROP is the key to steady state: DrillSage Average ROP

**- So, What's the Value? -**

The Rate of Penetration (ROP) Conundrum refers to the challenge in balancing the speed of drilling (ROP) with maintaining wellbore stability and integrity. While a high ROP may lead to quicker drilling times, it can also outpace the ability to effectively clean the hole, leading to issues and non-productive time. On the other hand, a slower ROP may ensure better hole cleaning and stability, but it can also lead to longer drilling times and increased costs.
The conundrum, therefore, lies in finding the optimal ROP that ensures both efficient drilling and wellbore stability. This is where DrillSage's ability to track DS_ROP and advisories proves invaluable, helping maintain a steady state in drilling.

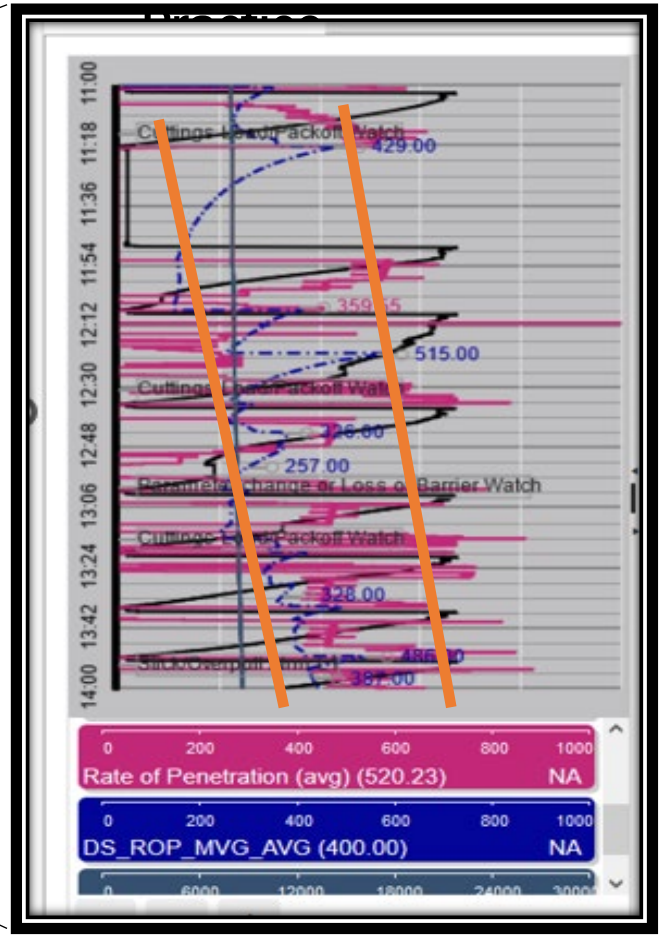
DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

# ROP Moving Average – Stand x Stand

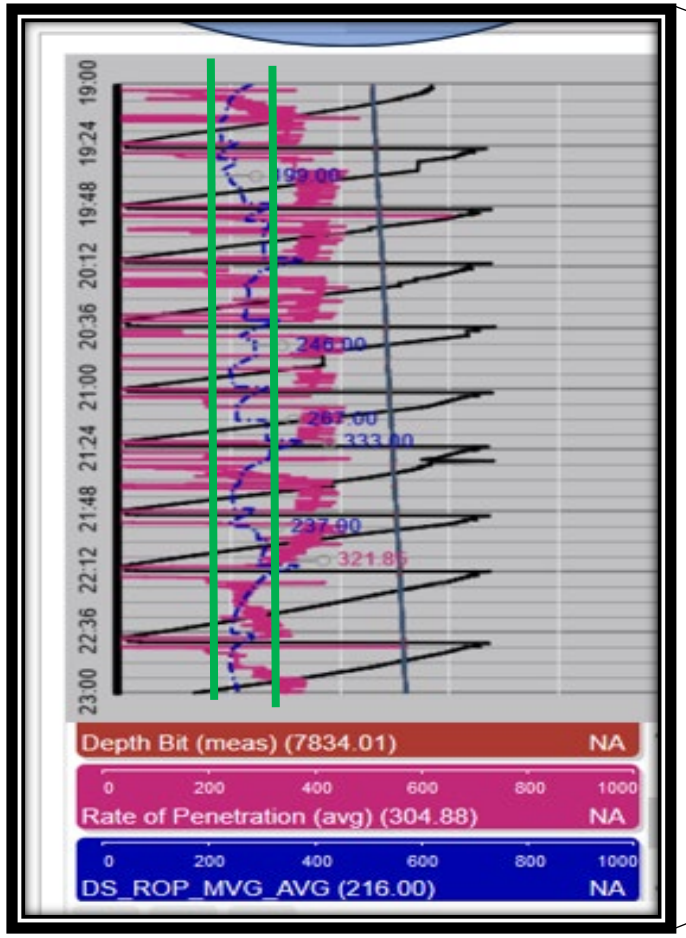
## Erratic Drilling Practice VS Transient Drilling

Note Excessive Bandwidth:

- Creates potential hazards due to "mass" or cuttings loading
- Exacerbates motor and downhole tool wear




- 6000' Lateral
- Drilling ROP avg: 180 FPH
- Total hours: 33.33




- 6000' Lateral
- Drilling ROP avg: 164 FPH
- Total hours: 36.59

Note Bandwidth Improvement:

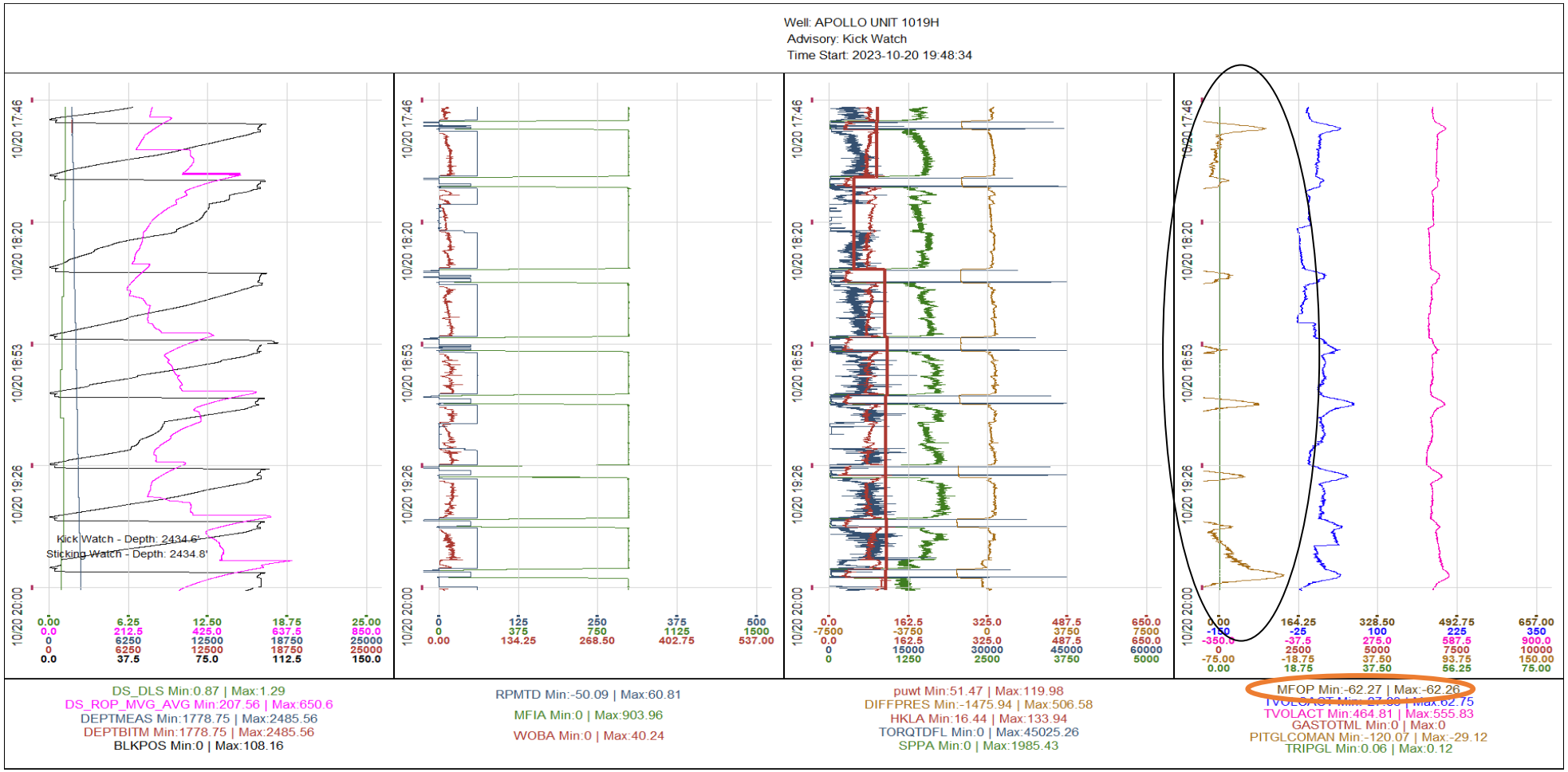
- *Reliable and efficient hole cleaning*
- Better average ROP even though ultra high rates are not forced

Is 3.2 total section hours gained worth the hazards?

DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

# Case History – Unintended Consequences

- Note: Mud Flow Out from vendor reading -62.27%.
- Mud Flow Out is an analyzed curve for some Watches.
- The bad data caused a firing of watches, which caused the team to notice the sensor issues from the EDR provider, bringing **awareness** to the problem.

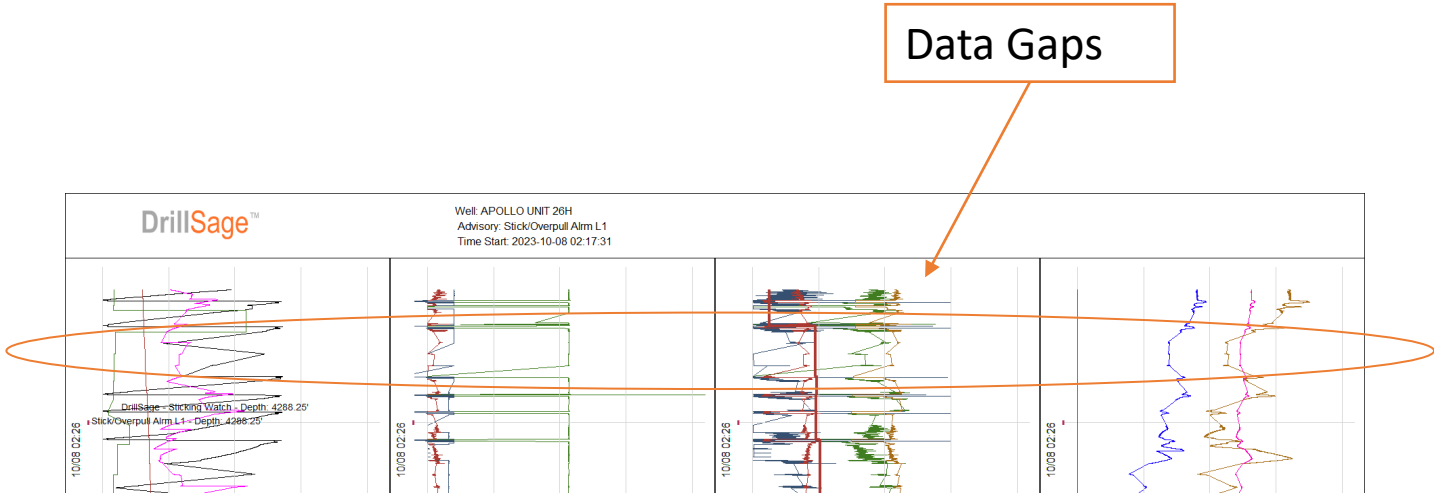


DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

# Case History – Unintended Consequences

## Data Quality Monitor

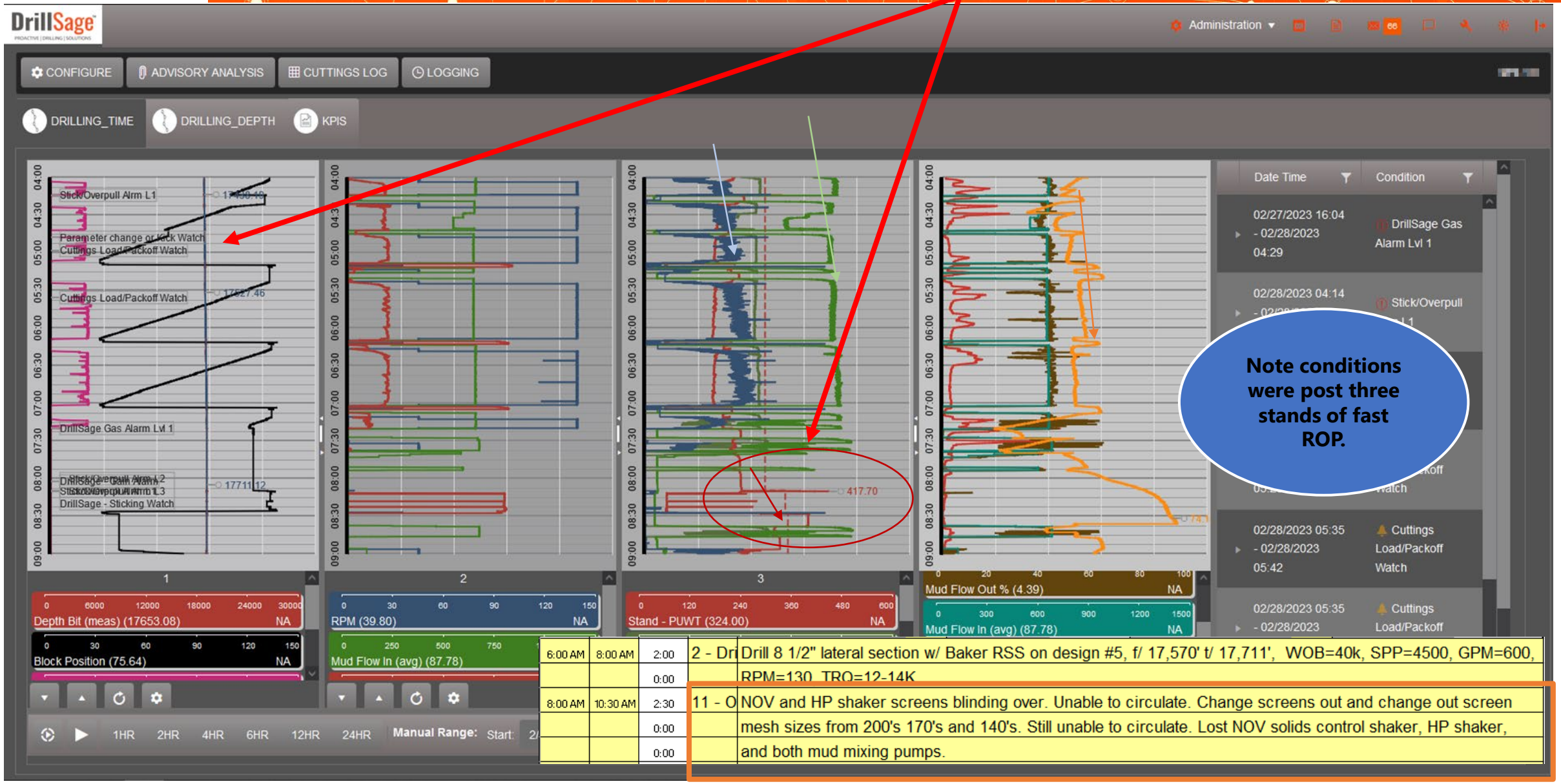
- Adding new watch and curve measurement for data quality.
  - Expectation: 1 data point per second.
  - Threshold: Dynamic
- Each curve used in watches will be measured, and the resulting quality measurement will be fed into related watches as a negation.
- If data quality is below expectations, any watches will be negated.
  - If this occurs, a notification will be fired to support.



# Advisory & Notification Example

DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

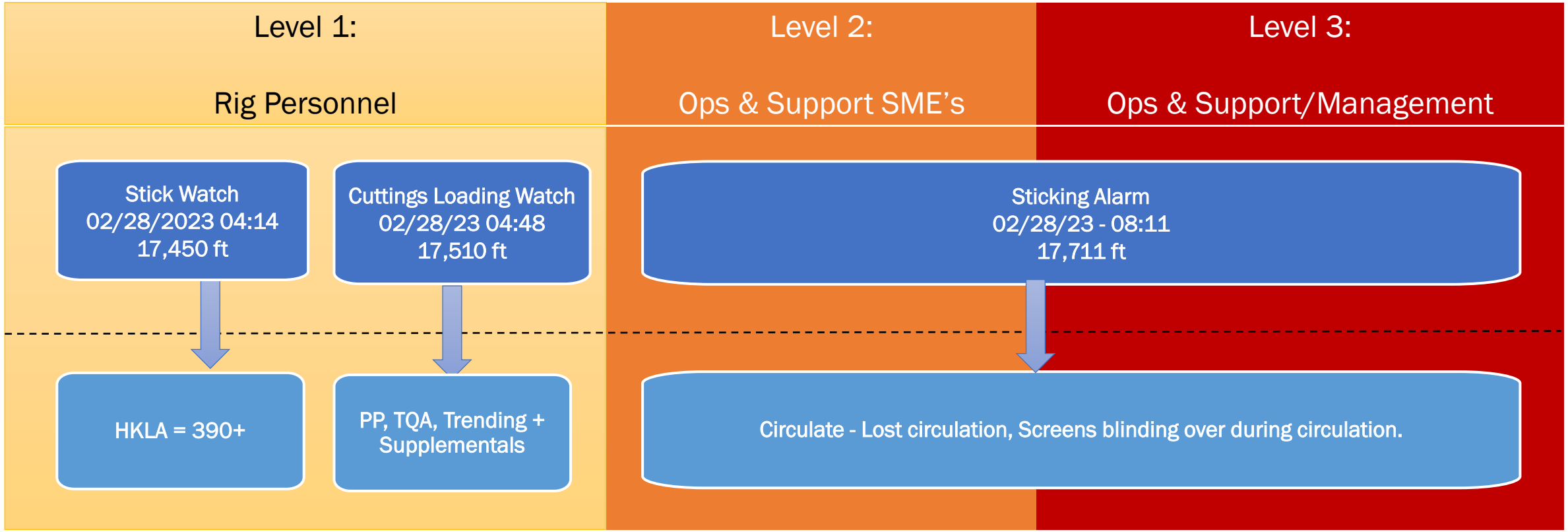
# Evolving Sticking Anomolies




**Note conditions were post three stands of fast ROP.**

DrillSage™
PROACTIVE | DRILLING | SOLUTIONS

# Example Sticking Event – Watch Summary




*Drillers are sometimes only looking at the last 30 minutes of time data and can forget what parameters & patterns looked like in previous stands.*
*What if the contextual awareness wasn't availabe for the personnel?*
*Would a new, inexperienced crew catch these warning signs?*

# Thank you!

- Structured and repeatable risk mitigation of human behavioral factors.
- DrillSage is a non-destructive integration. It is NOT a new parallel process.
- Enables and Improves the decision-making capability of the drilling team.

DrillSage™

PROACTIVE | DRILLING | SOLUTIONS