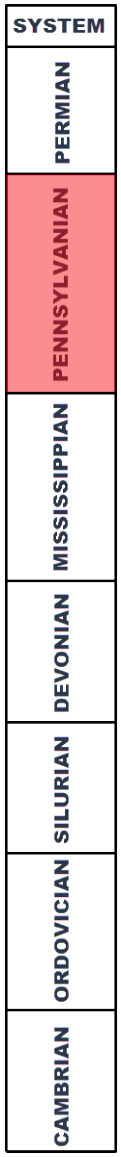
UNIT CORPORATION

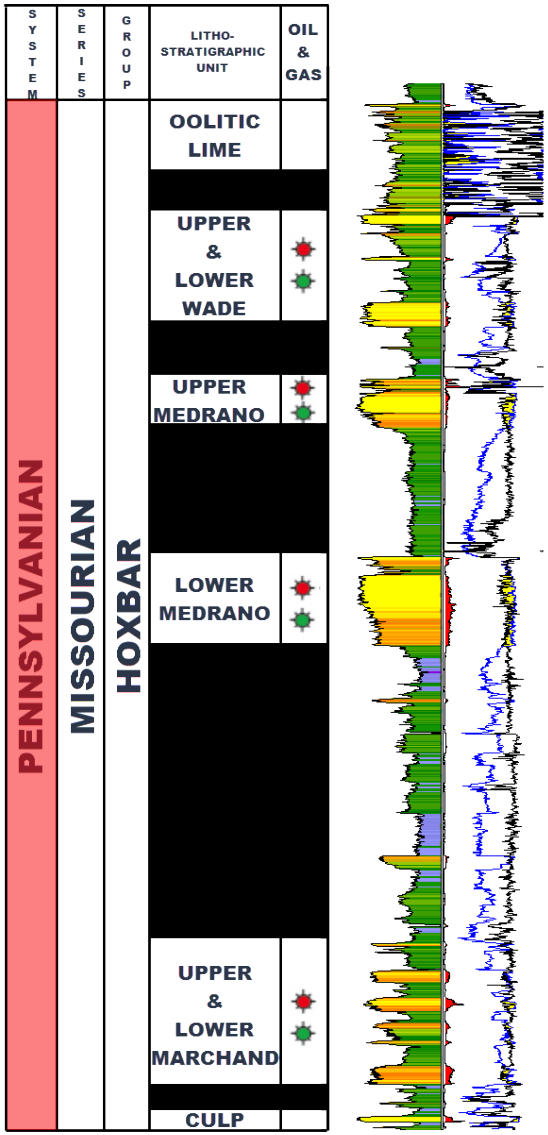
DRILLING REVIEW OF SOUTHERN OKLAHOMA HOXBAR OIL TREND

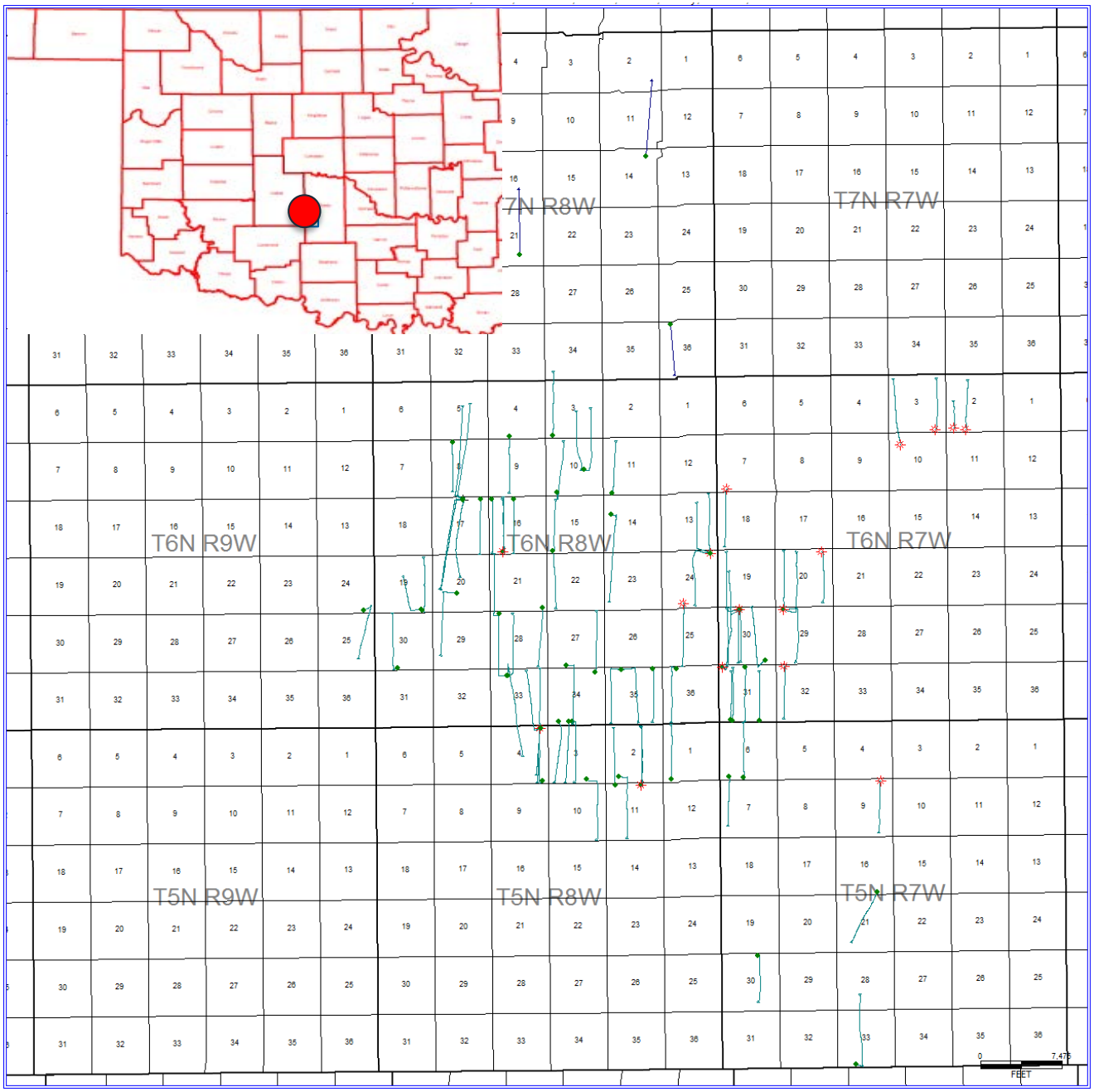
Asad Khan

SOHOT GEOLOGIC TARGETS (HOXBAR)

UNIT CORPORATION



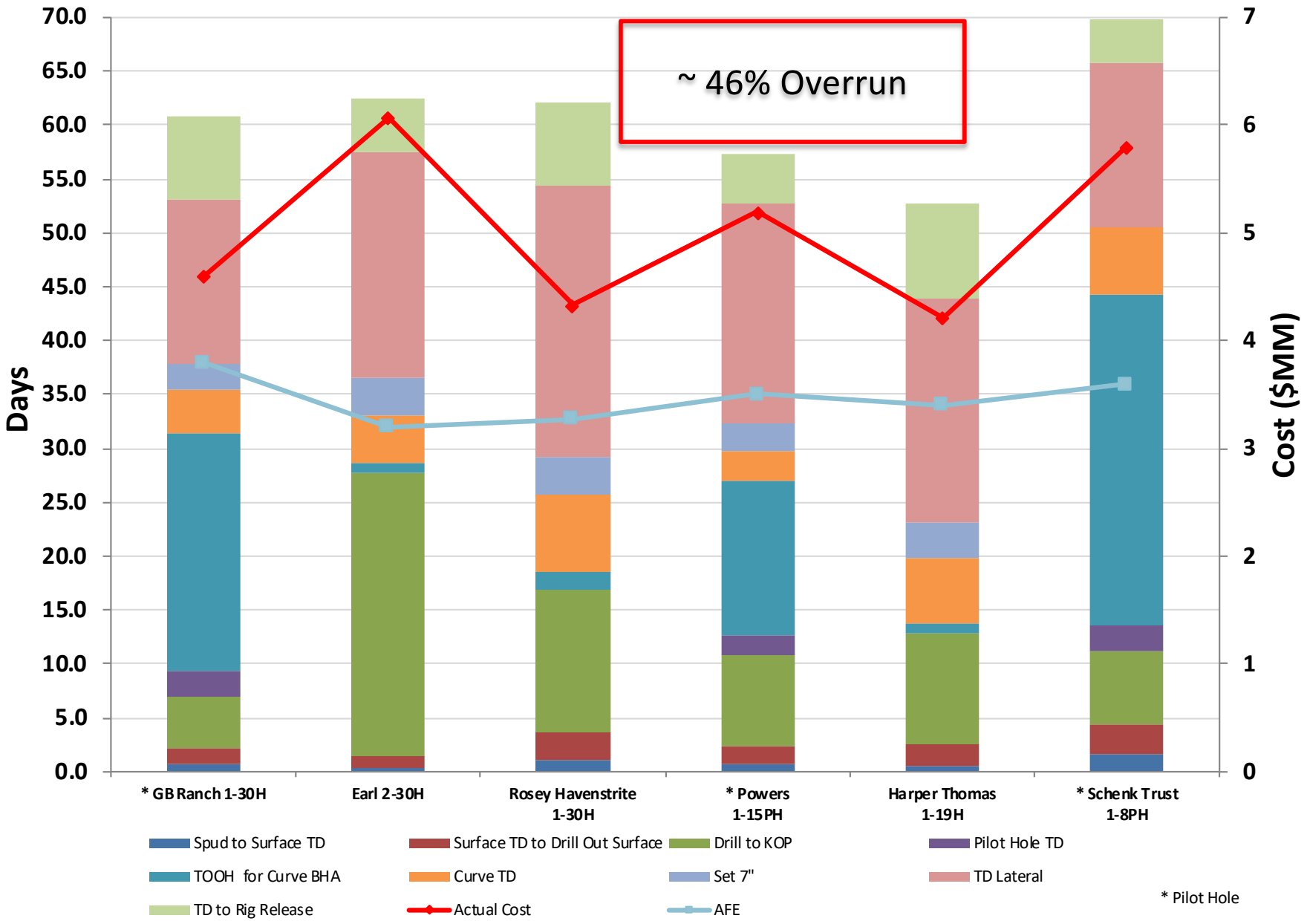




PERFORMANCE ANALYSIS: 2013-15

- Drilling program started in late 2013.
- By Sept 2015, we had drilled 24 wells (6 Marchand, 18 Medrano). 7 at or below AFE. 16 over AFE.
- No Marchand wells had been drilled at or close to the planned AFE.
- Average Marchand drilling cost was at $5.0MM/well (46% over AFE).
- Majority of the wells were troubled. Routine wells were the exceptions.
- No Medrano wells have been drilled since 2016. Therefore, focus of this presentation will be on the Marchand.

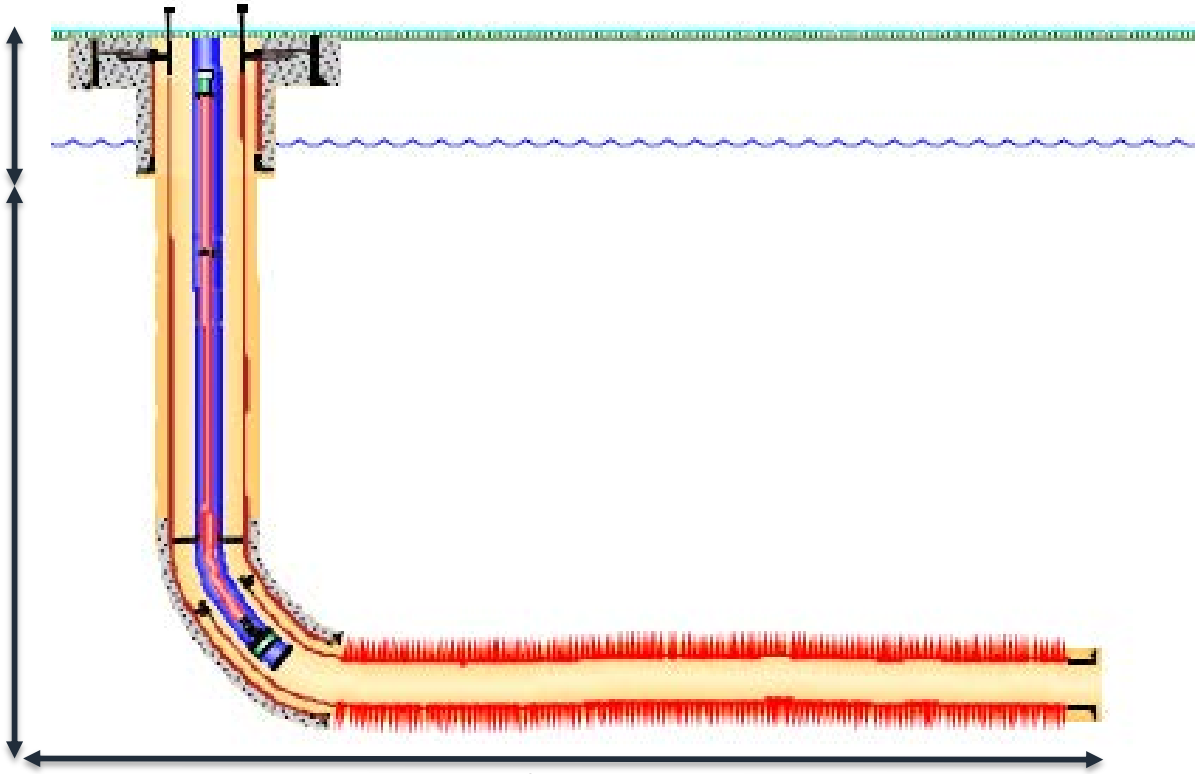
MARCHAND PERFORMANCE: 2013-15



WELLBORE DESIGN

12 ¼” Hole Size
9 5/8” 36#/ft
Surface

8 ¾” Hole Size
7” 29#/ft
Intermediate
& Curve



6 1/8”Hole Size
4 ½” 13.5# Liner

Interval	Fluid Type	Weight	FV	PV	YP	API/HTHP
Surface	Spud Mud	8.6-9.6	32-40	<10	5-10	NC
INT	Dispersed	9.5	60-65	25-30	20-25	<6
Curve	OBM	8.7-9.0	65-70	20-25	15-20	<5
Lateral	OBM	8.7-9.0	65-70	20-25	15-20	<5

DRILLING ISSUES

- Intermediate Section
  - Tight hole
  - Rubble Zone
  - Stuck Pipe
  - Tools Lost in Hole
  - Open hole displacement to OBM. In some cases, resulting in wellbore instability.
- Curve and Lateral
  - Inconsistent BUR's through the curve
  - Casing through the curve
  - Shale instability in the lateral during the trips
  - Challenging geology
  - Motor wear & directional failures in the lateral
  - Directional control in the lateral

CHALLENGES AND QUESTIONS

UNIT CORPORATION

- Questions
  - Is casing needed through the curve?
  - If not, what mud weight do we need?
  - Are we using the right type of mud in the intermediate section?
  - Can we reduce directional failures in the lateral?
  - What needs to be changed to avoid excessive sliding in the lateral?

CASING NEEDED THROUGH CURVE?

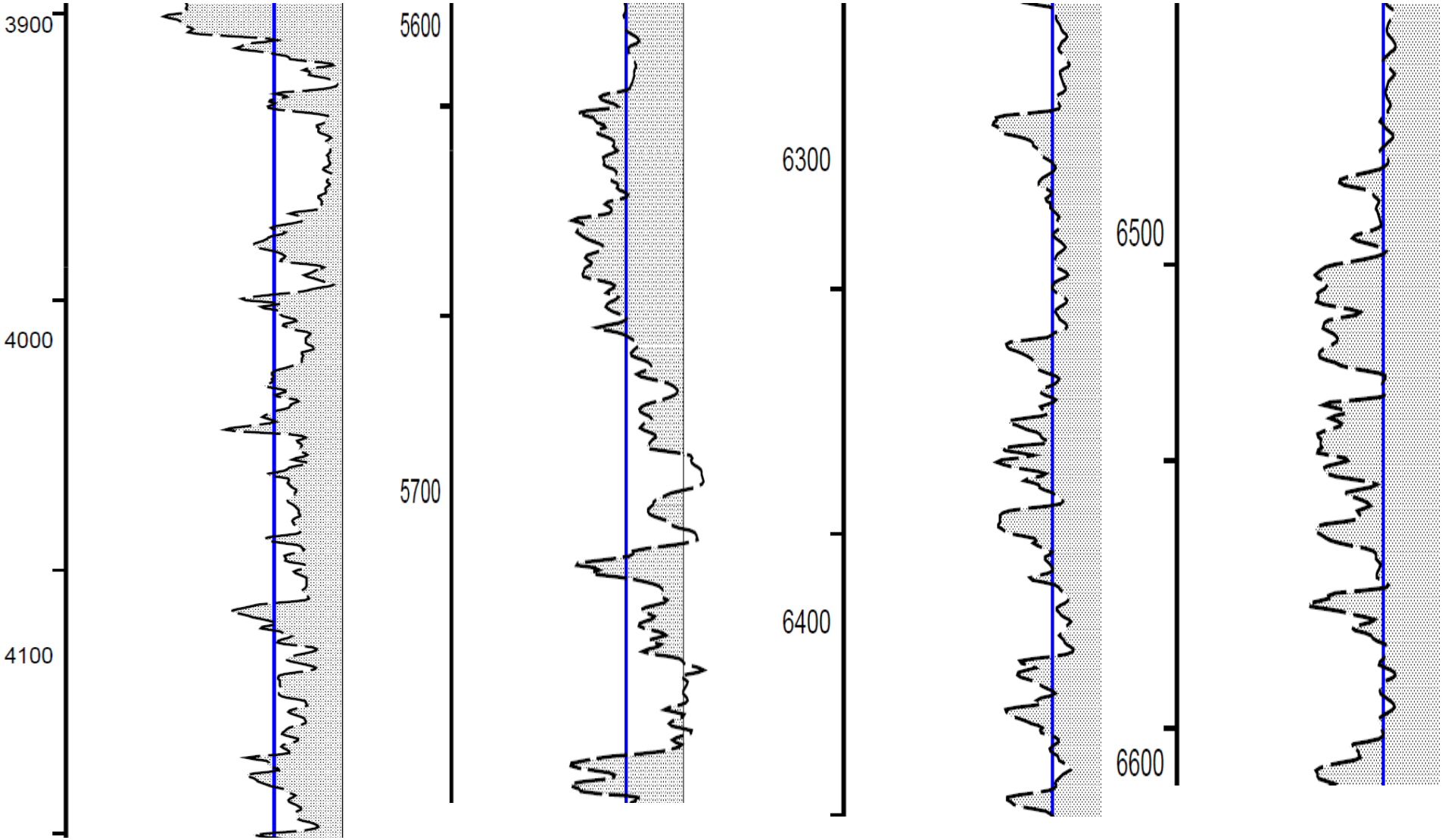
Noted trouble occurred only while tripping

- Increased MW from 9.0 ppg to 10.3 ppg.
- Set intermediate casing above the KOP.
- Eliminated open hole displacement of OBM.

INTERMEDIATE SECTION MUD

- Analyzed pilot hole logs.
- Shifted focus from hole cleaning only to hole cleaning and wall cake.

INTERMEDIATE PILOT LOG

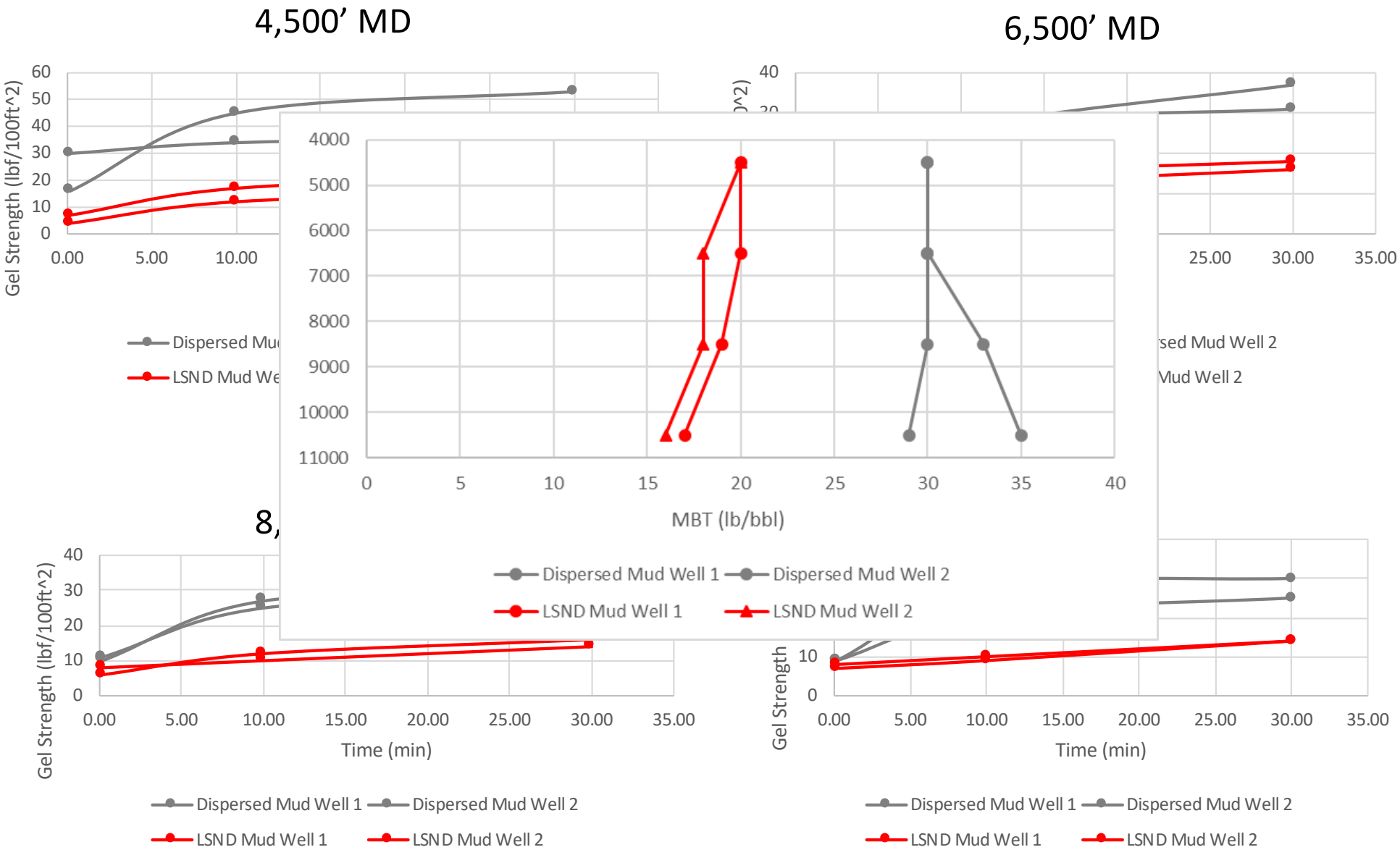


* Caliper log showing bit (blue) and hole size

INTERMEDIATE SECTION MUD

- Analyzed pilot hole logs.
- Shifted focus from hole cleaning only to hole cleaning and wall cake.
- Moved from dispersed to LSND.
- Increased water usage from 0-5 GPMs to 20-25 GPMs.
- Focused on reducing gel strengths and MBT Cap.

INTERMEDIATE MUD

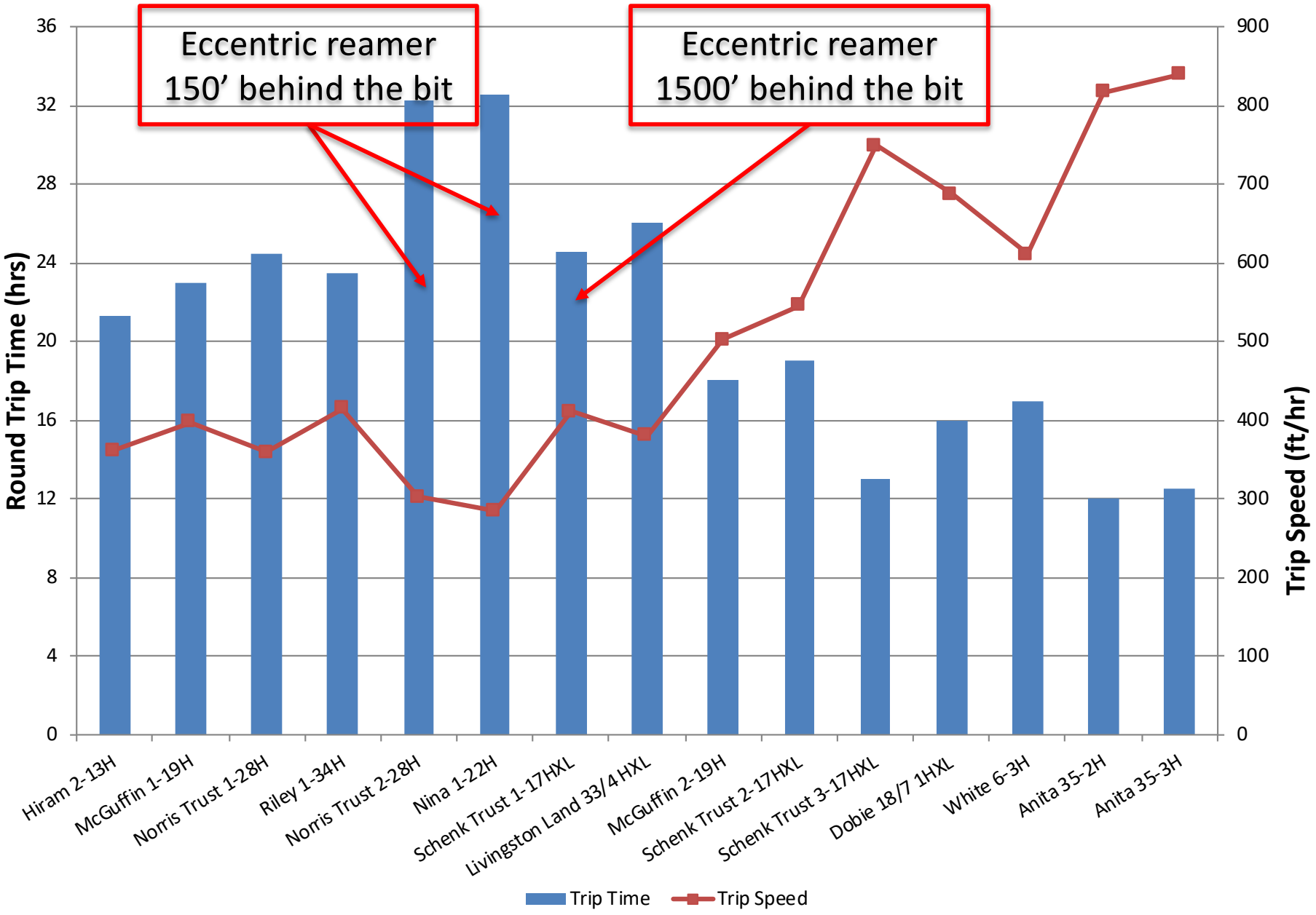


INTERMEDIATE SECTION MUD

- Analyzed pilot hole logs.
- Shifted focus from hole cleaning only to hole cleaning and wall cake.
- Moved from dispersed to LSND.
- Increased water usage from 0-5 GPMs to 20-25 GPMs.
- Focused on reducing gel strengths and MBT Cap.

Tight hole issues persisted.

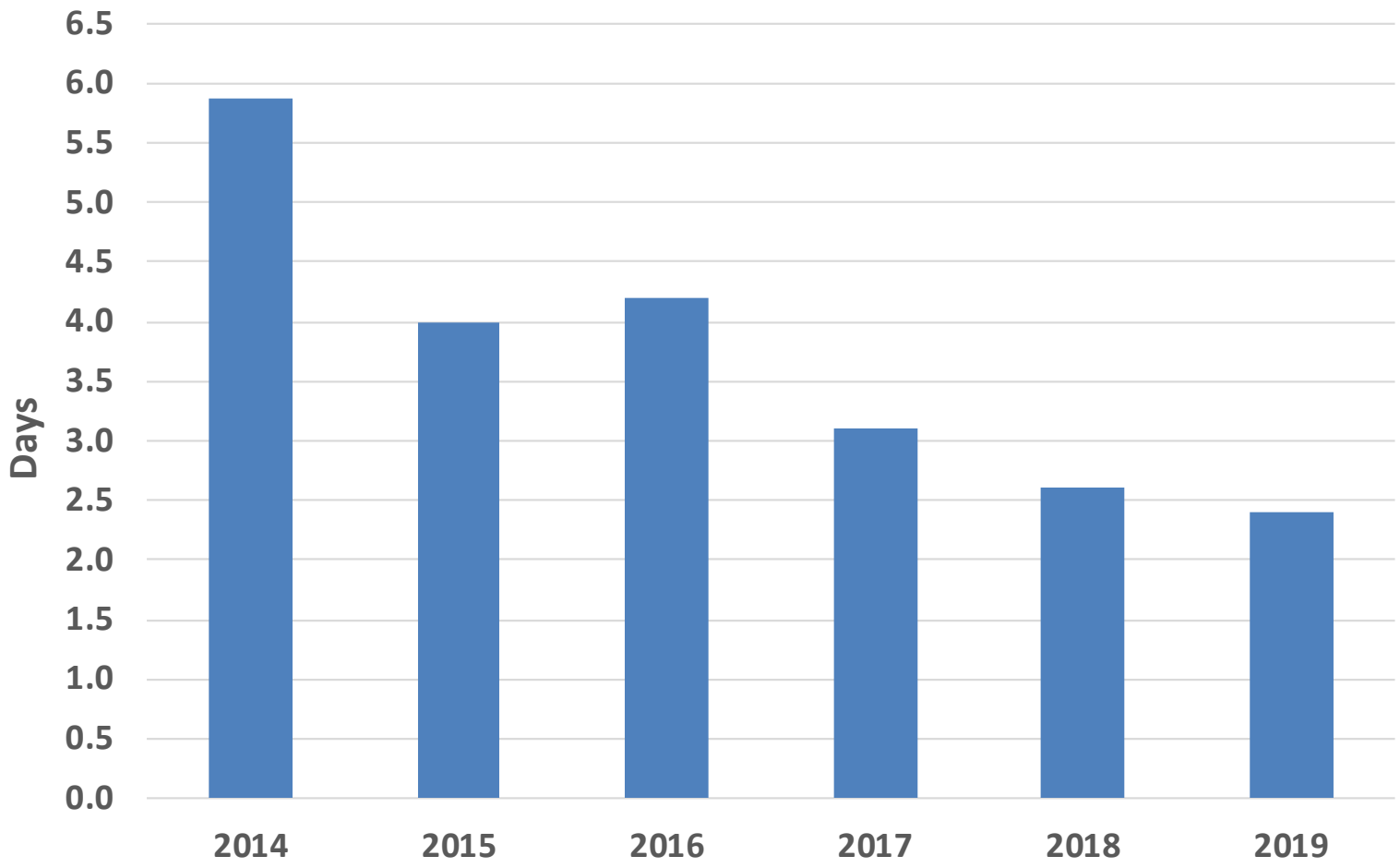
INTERMEDIATE ECCENTRIC REAMER



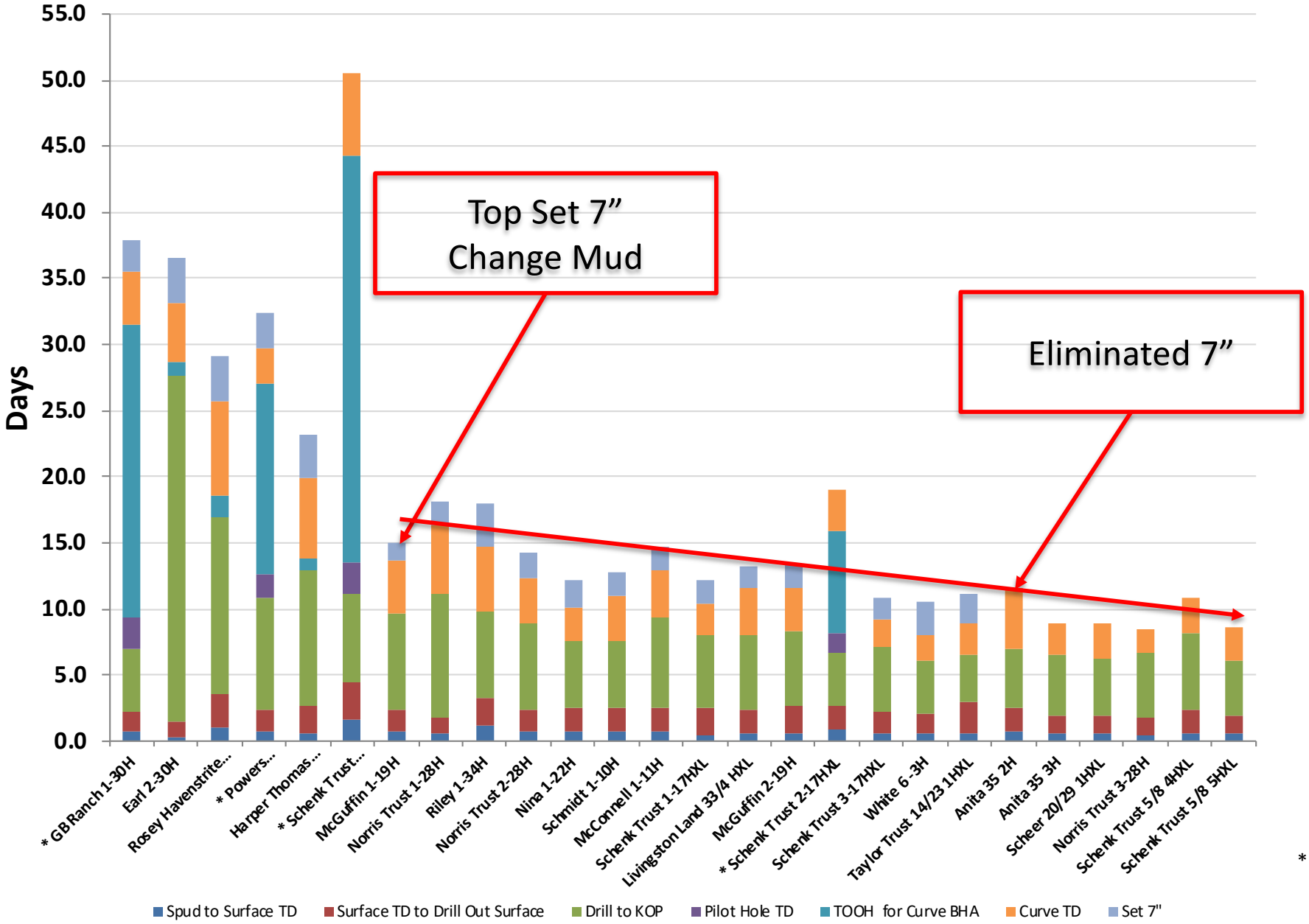
CURVE PERFORMANCE

- Inconsistent BUR's through the Hogshooter with PDC .
- Replaced PDC bits with Kymera 322 (.27 RPG motor).
- Replaced Kymera 322 with 414 (.5 RPG motor).

MARCHAND CURVE PERFORMANCE



INTERMEDIATE AND CURVE

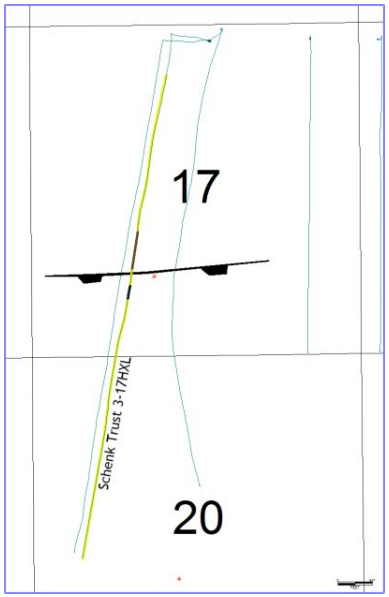


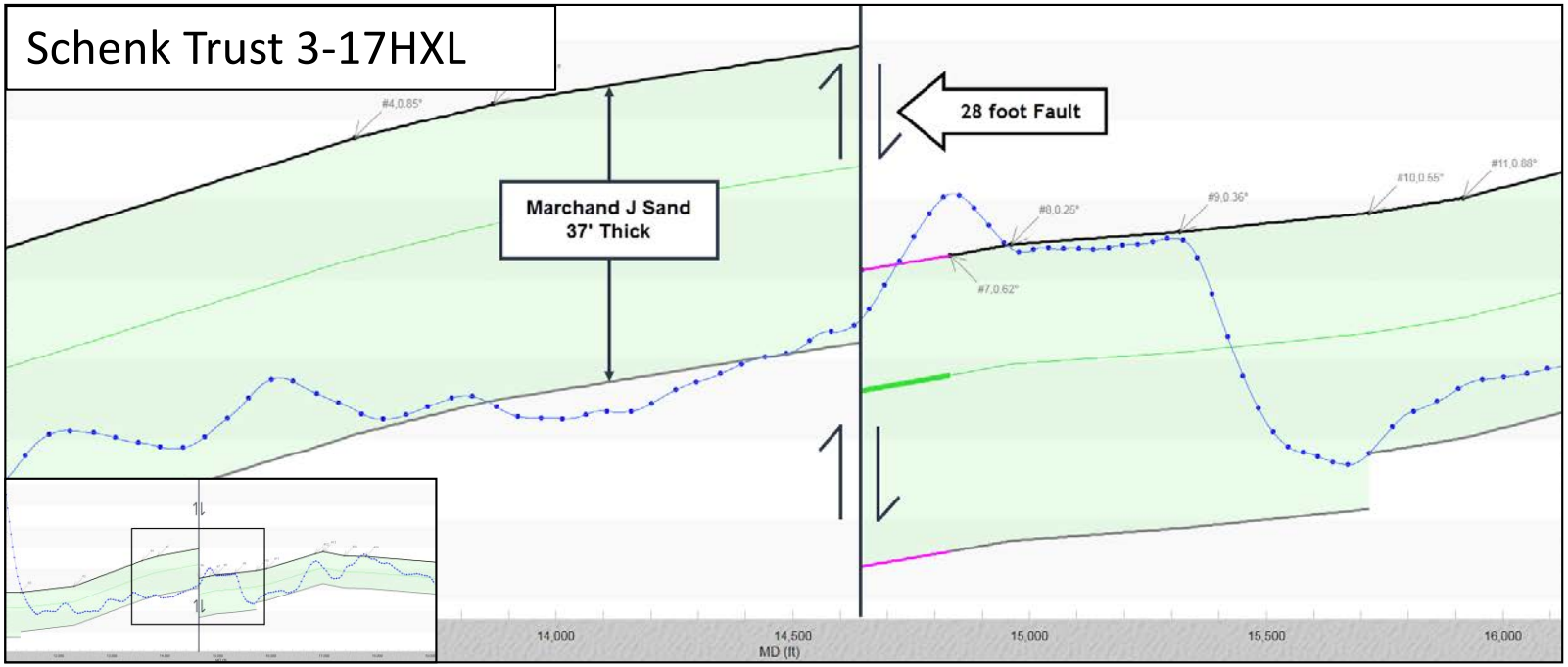
* Pilot Hole

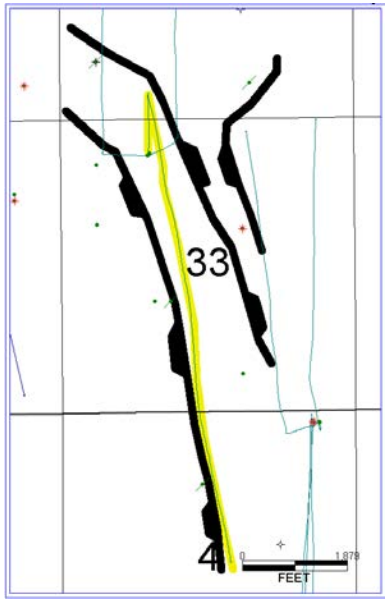
LATERAL SECTION

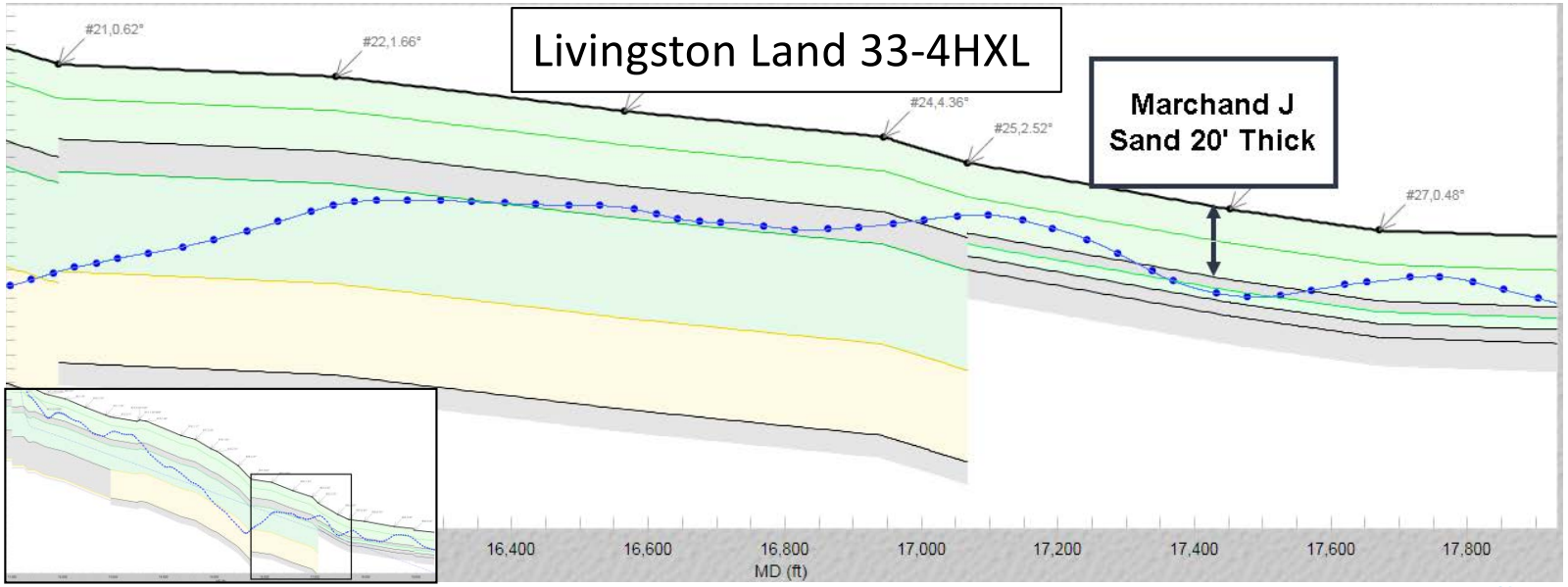
- Havier MW resolved shale instability issues.
- Worked with geologists and directional drillers to reduce sliding and keep wellbore in the pay zone.
- Captured formation tendencies and how it affected motor yield and bit life in the lateral.
- Adjusted stabilizer placement to counteract build or drop tendencies.
- Reduced Motor/MWD failures.

SOHOT GEOLOGIC CHALLENGES

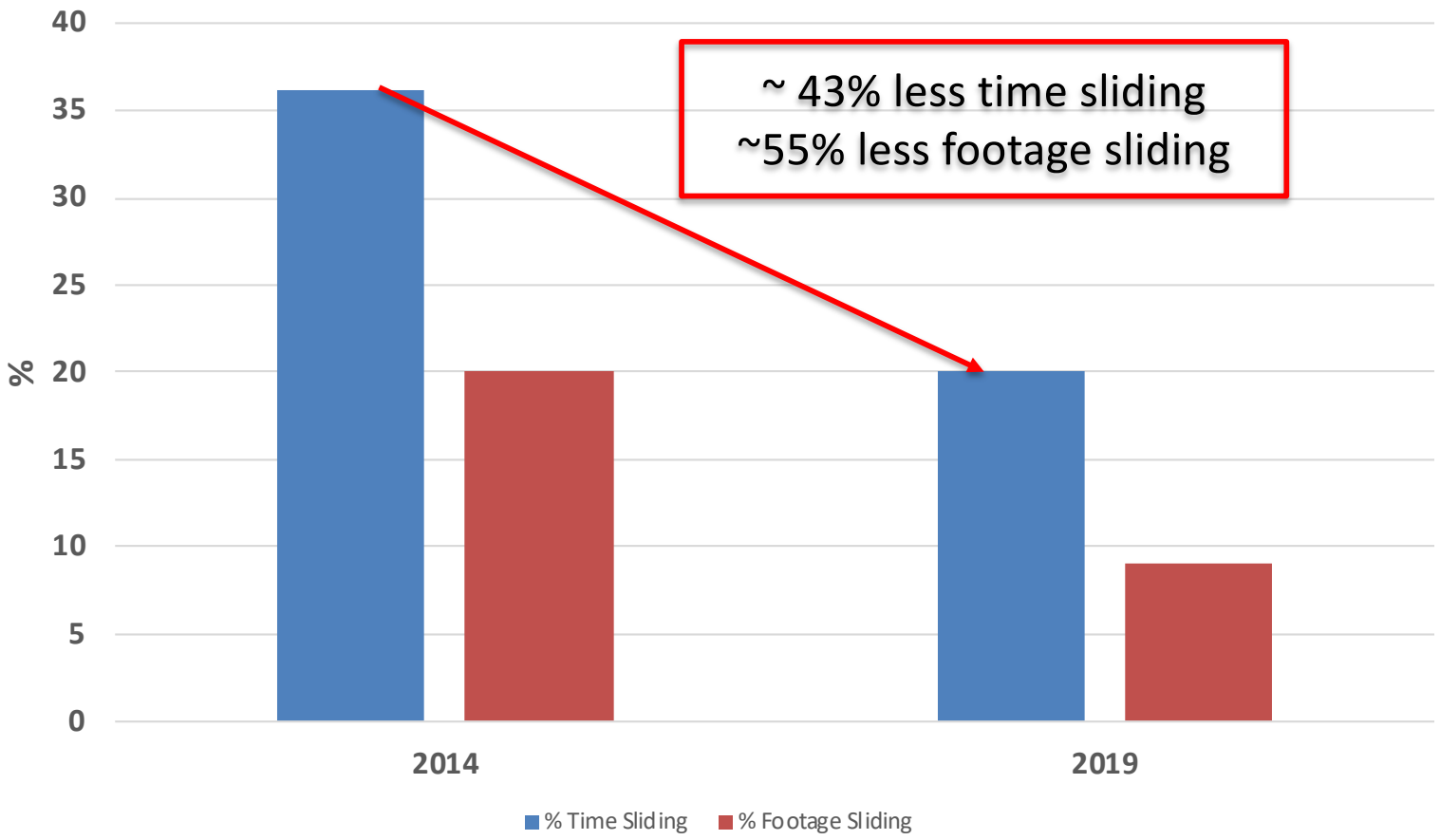








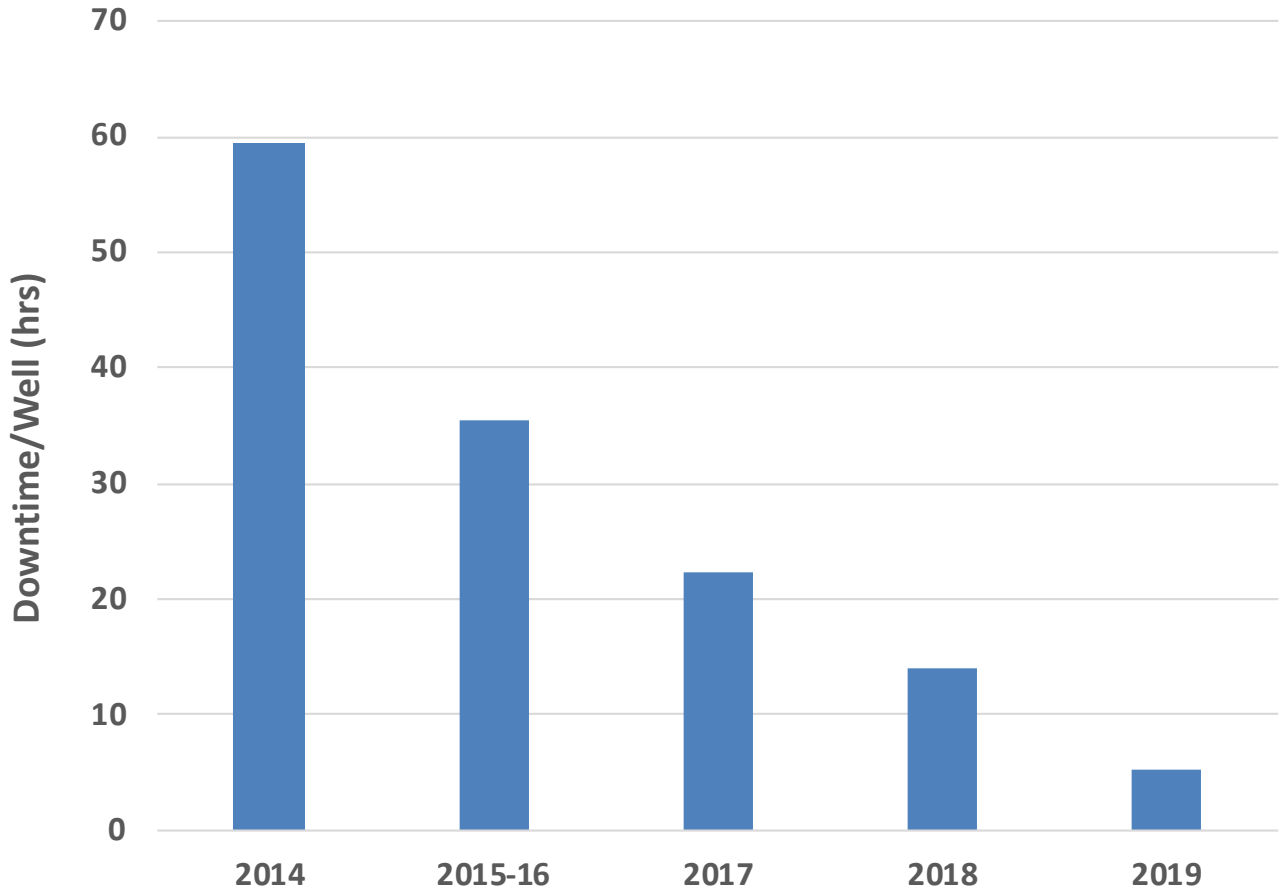
LATERAL SLIDE TIME AND FOOTAGE



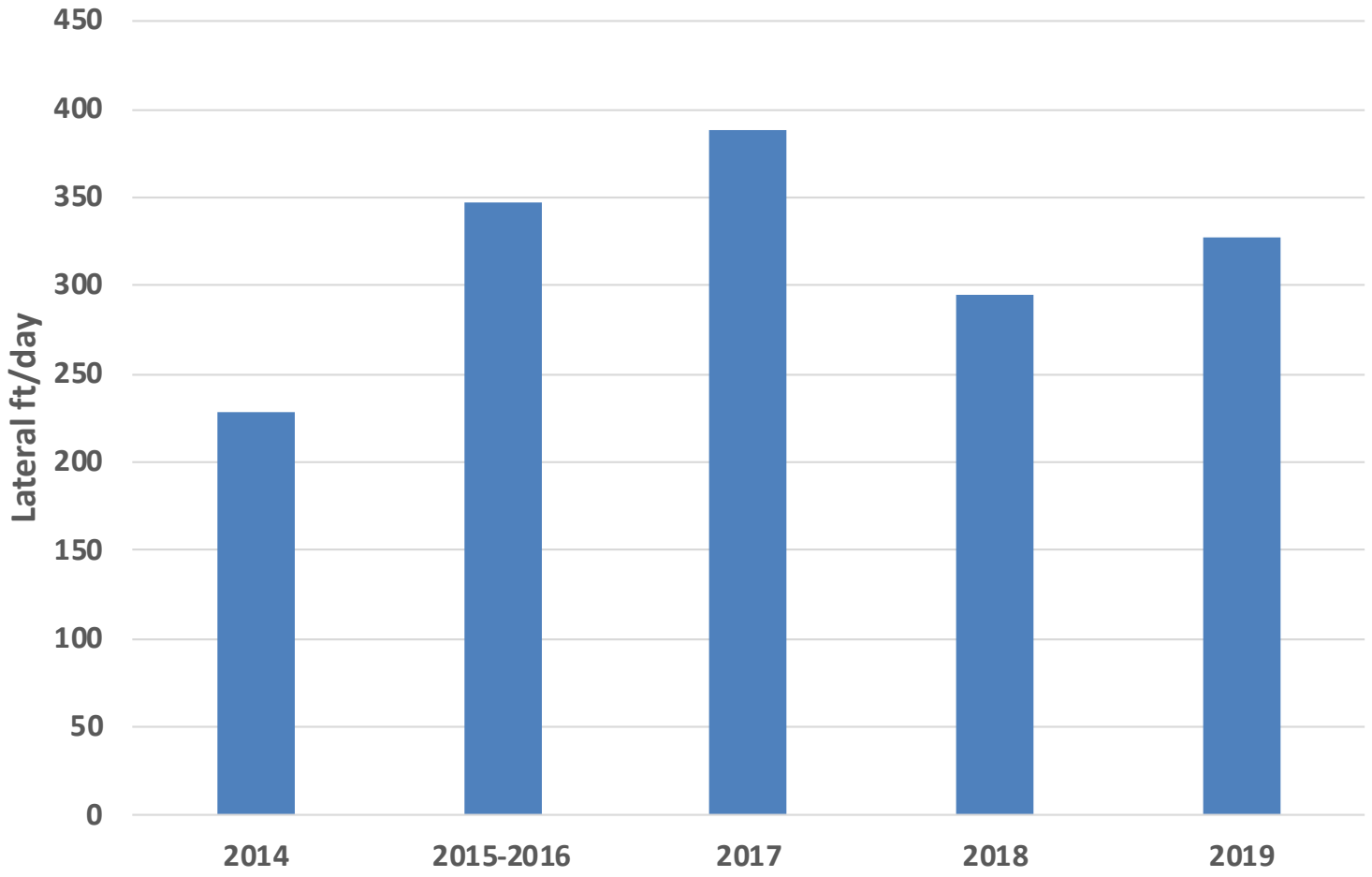
- Average On Bottom ROP Increased by 44%
- Average On Bottom Time decreased by 4.5 days/well

* Comparing single section laterals only

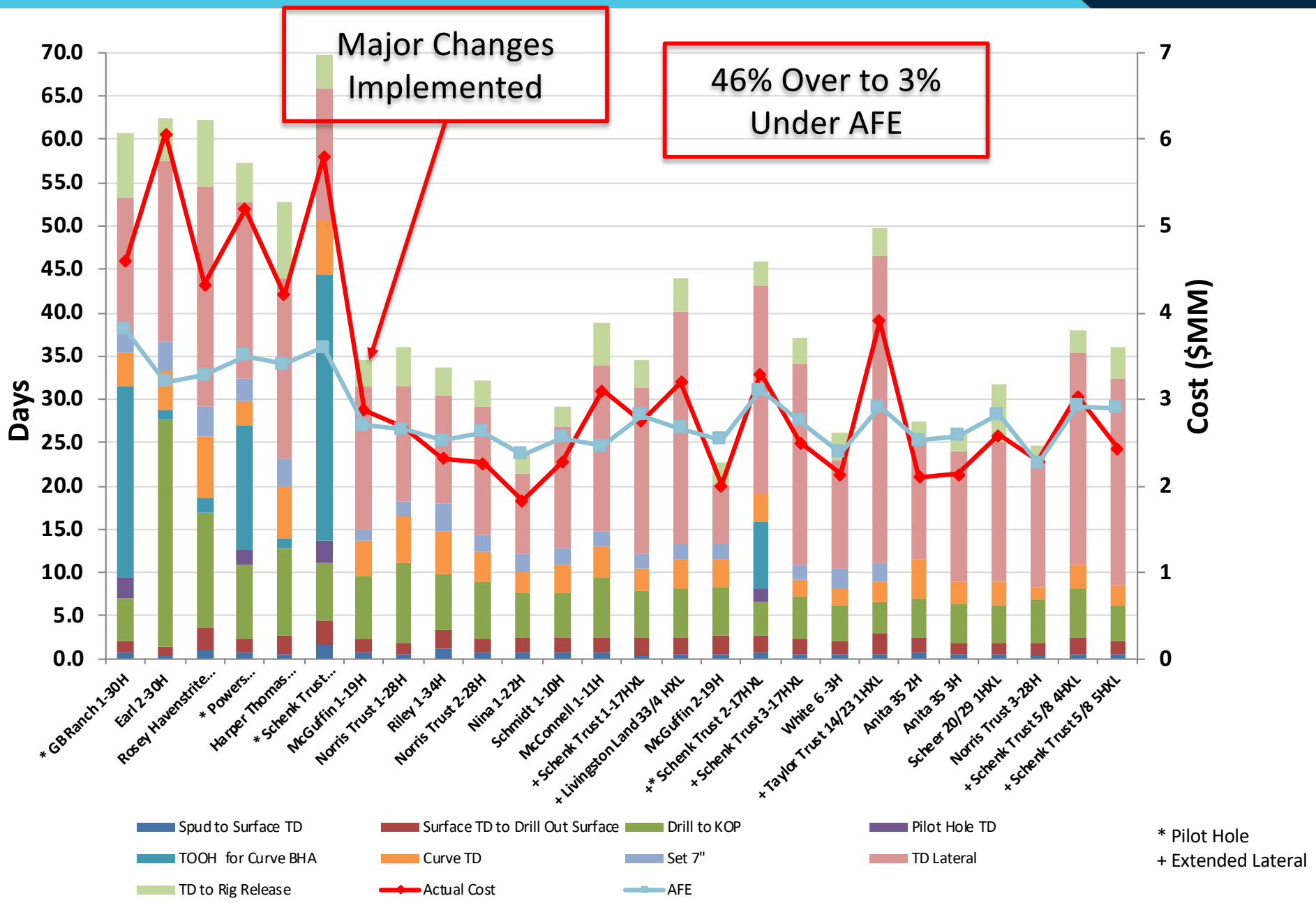
DIRECTIONAL DOWNTIME TREND (LATERAL)



MARCHAND LATERAL PERFORMANCE

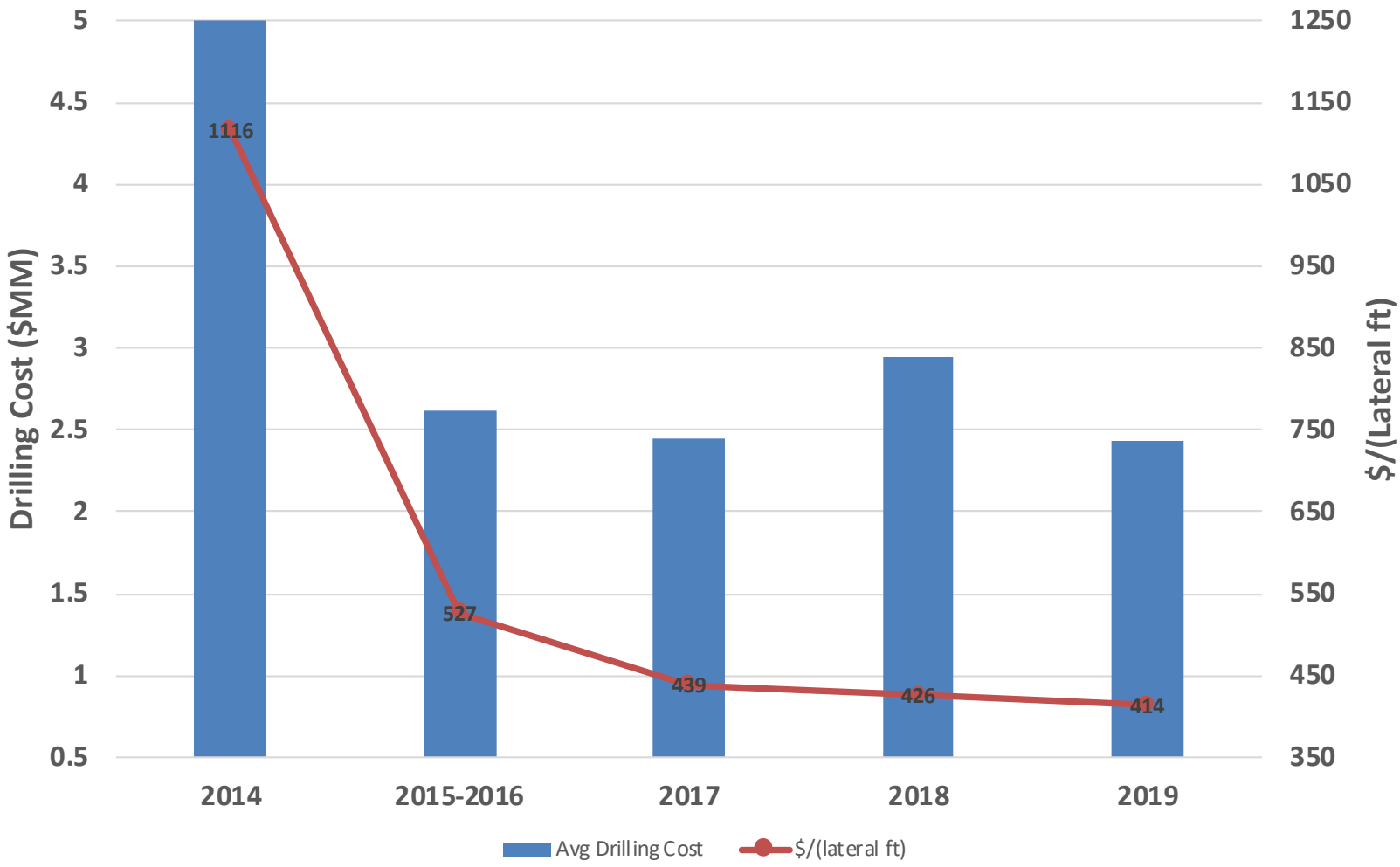


PERFORMANCE COMPARISON



* Pilot Hole
\+ Extended Lateral

CORE AREA MARCHAND DRILLING COST



RESULTS

- Avoided stuck pipe and lost in hole tools in the intermediate section.
- Consistent intermediate performance, averaging 5 days vs 17 days.
- Consistent curve performance, averaging 2.5 days vs. 5 days.
- Lowered sliding and directional failures in the lateral, averaging 13.5 days vs. 19.8 days.
- Consistent TD to RR performance, averaging 3.3 days vs. 6.3 days.
- Reduced spud to RR days from 61 days to 30 days.
- Lowered drilling cost from $5.0MM in 2014 to $2.1MM in 2019.