



2011 AADE Operators Symposium

Chesapeake Energy

Anadarko – Granite Wash Improvements

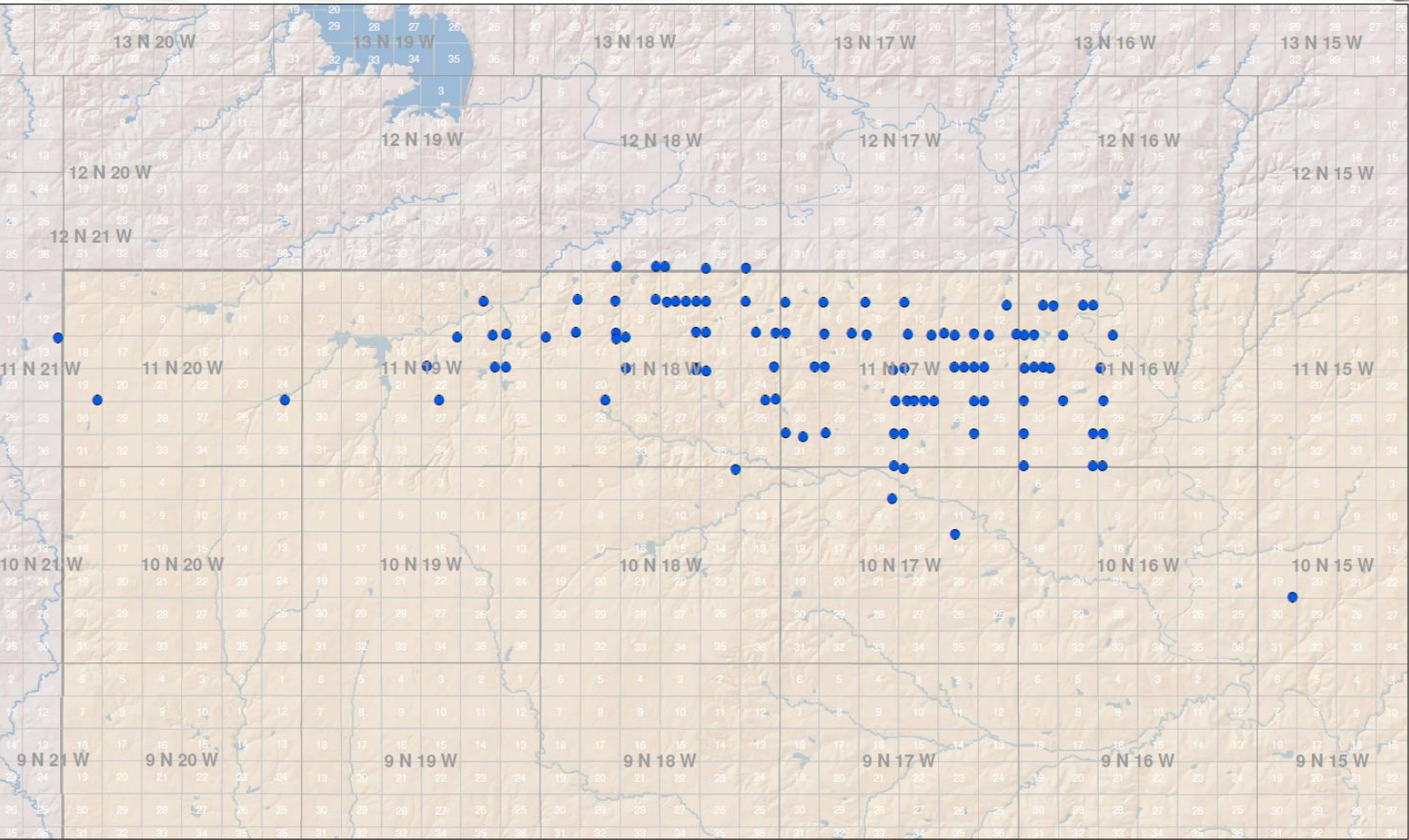
Craig Staley, Drilling Engineer – Anadarko Basin



Colony Wash – Overview



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Colony Wash – Overview



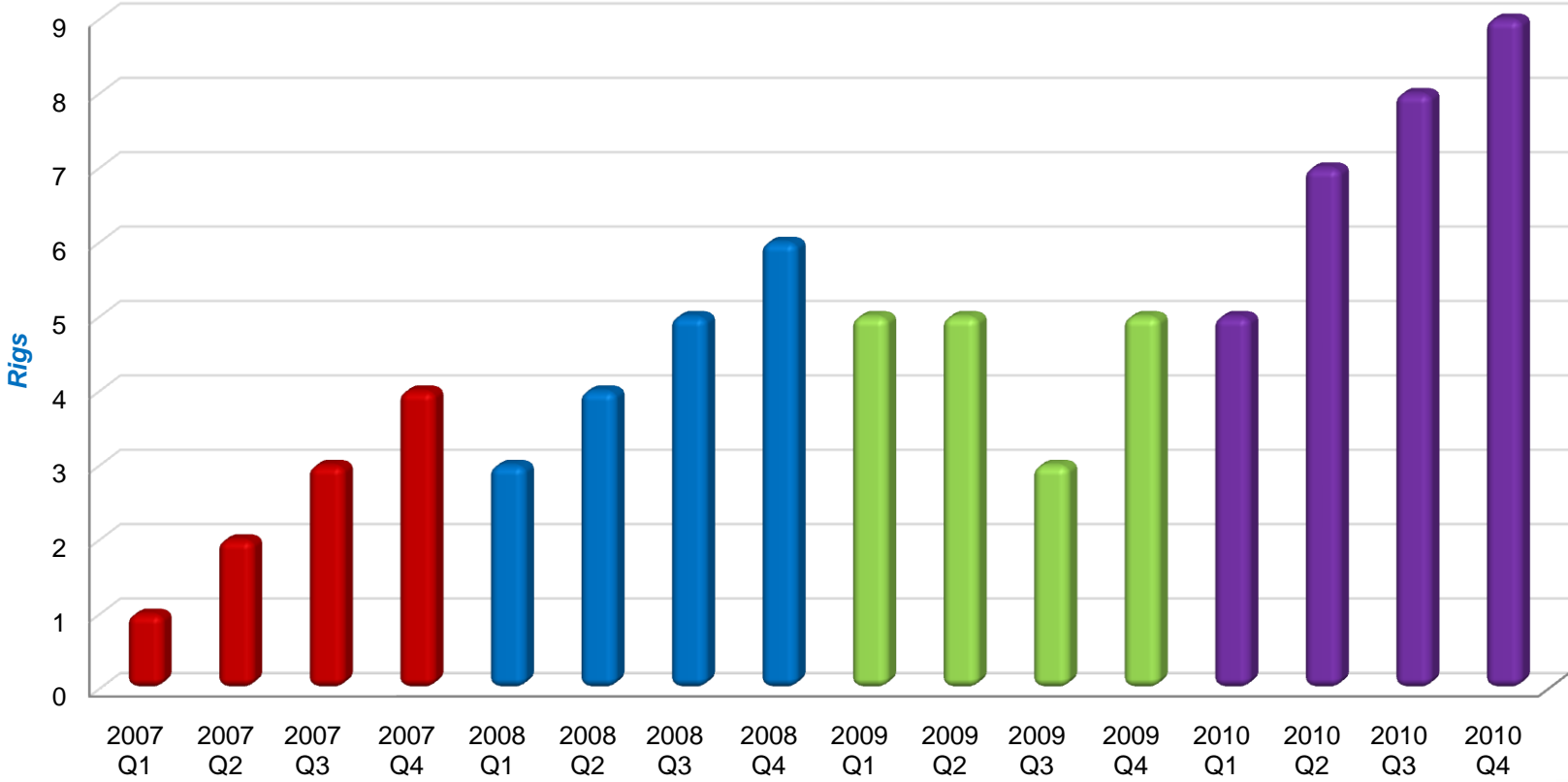
- Highlights

- 1st Spud November 2006
- 9 Rig Program
- 118 Wells
 - 43 in 2010
 - » 12,500' TVD 16,900' MD
 - » 48 Days - \$3.96MM

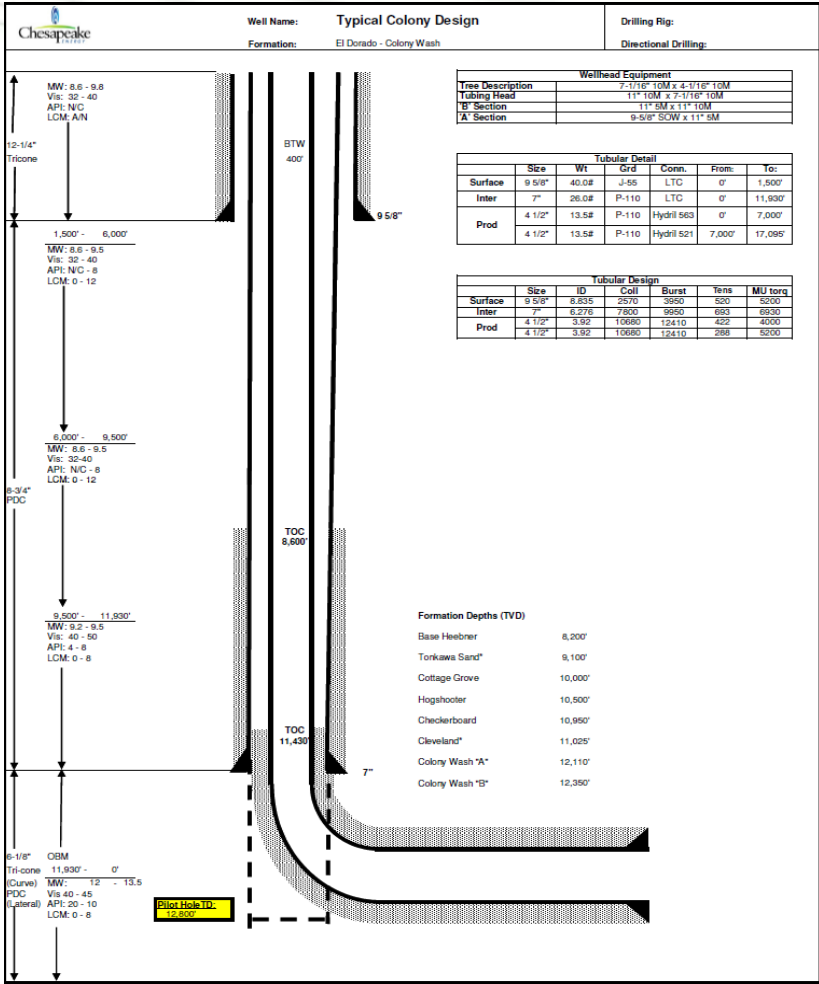
Colony Wash – Overview



Colony Wash Rig Count



Colony Wash – Well Design



● 4th Edition

- 9 5/8" Surface 1,500'
- 7" Inter. 12,000'
- 4 1/2" Prod. 16,900'





Colony Wash – Surface Hole

- Spud to Drill Out Float Equipment
- Surface Casing Waiver to OCC (BTW 300' – 500')
- 12 1/4" hole to 1,500'
- Drill with 117 IADC roller cone bit

	2010	Delta
Overall Time, avg hrs	52	6.5
Drilling Time, avg hrs	14.5	1.6
Technical Limit, hrs	29.5	-

- 2011 Improvements: Rig to Rig Consistency



Colony Wash – Intermediate Hole

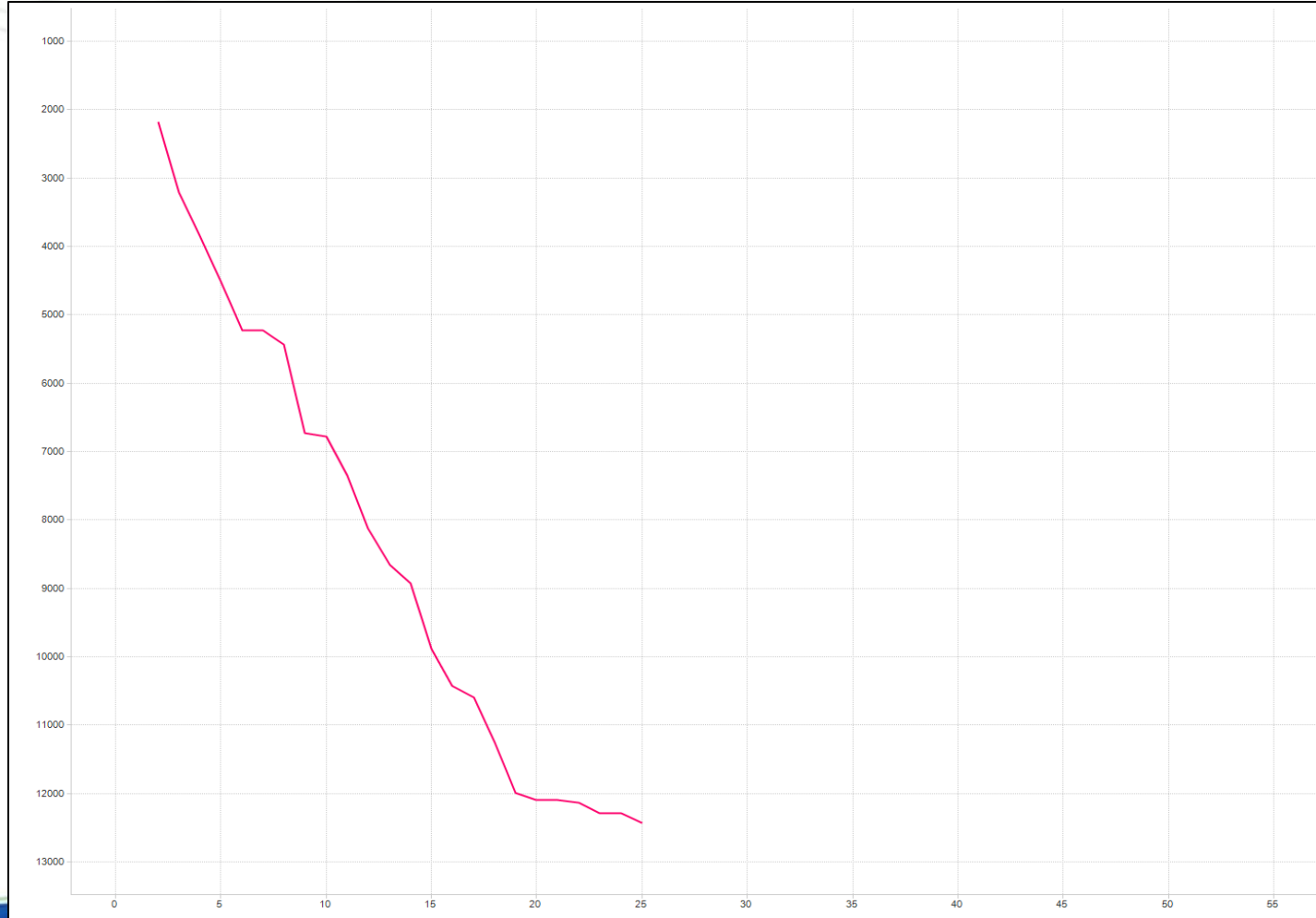
- Drill Out Surface to FIT
- Drill Out 8 3/4” to depth of 100’ above KOP (12,000’)

	Avg Ftg 2010	Avg Ftg Prior	Delta
Drill-Out	6173	6140	33
Follow Up	1927	2390	463
Bottom	1100	646	646

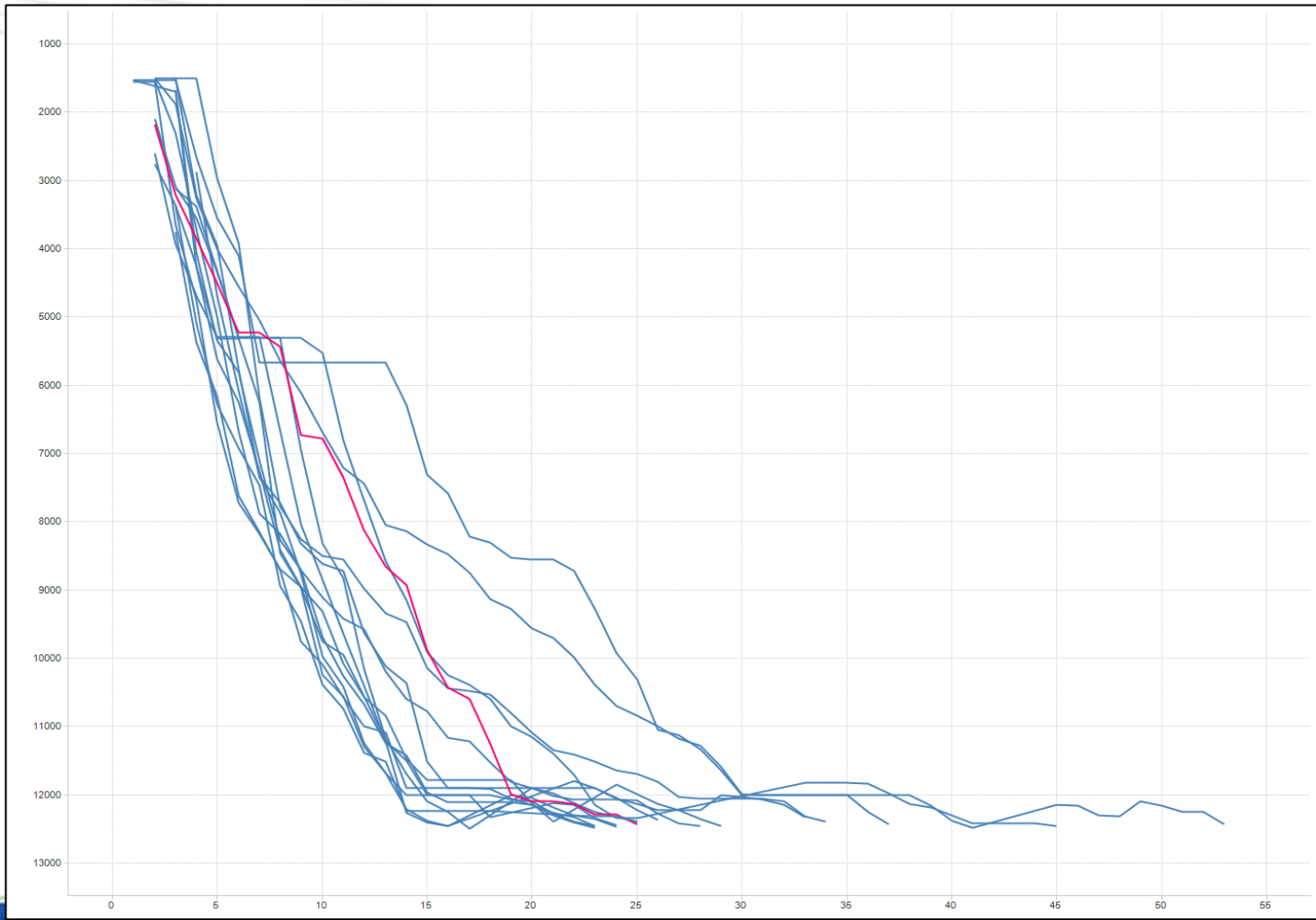
	Avg ROP 2010	Avg ROP Prior	Delta
Drill-Out	94.7	79.1	15.6
Follow Up	47.1	35.9	11.2
Bottom	38.0	11.4	26.6



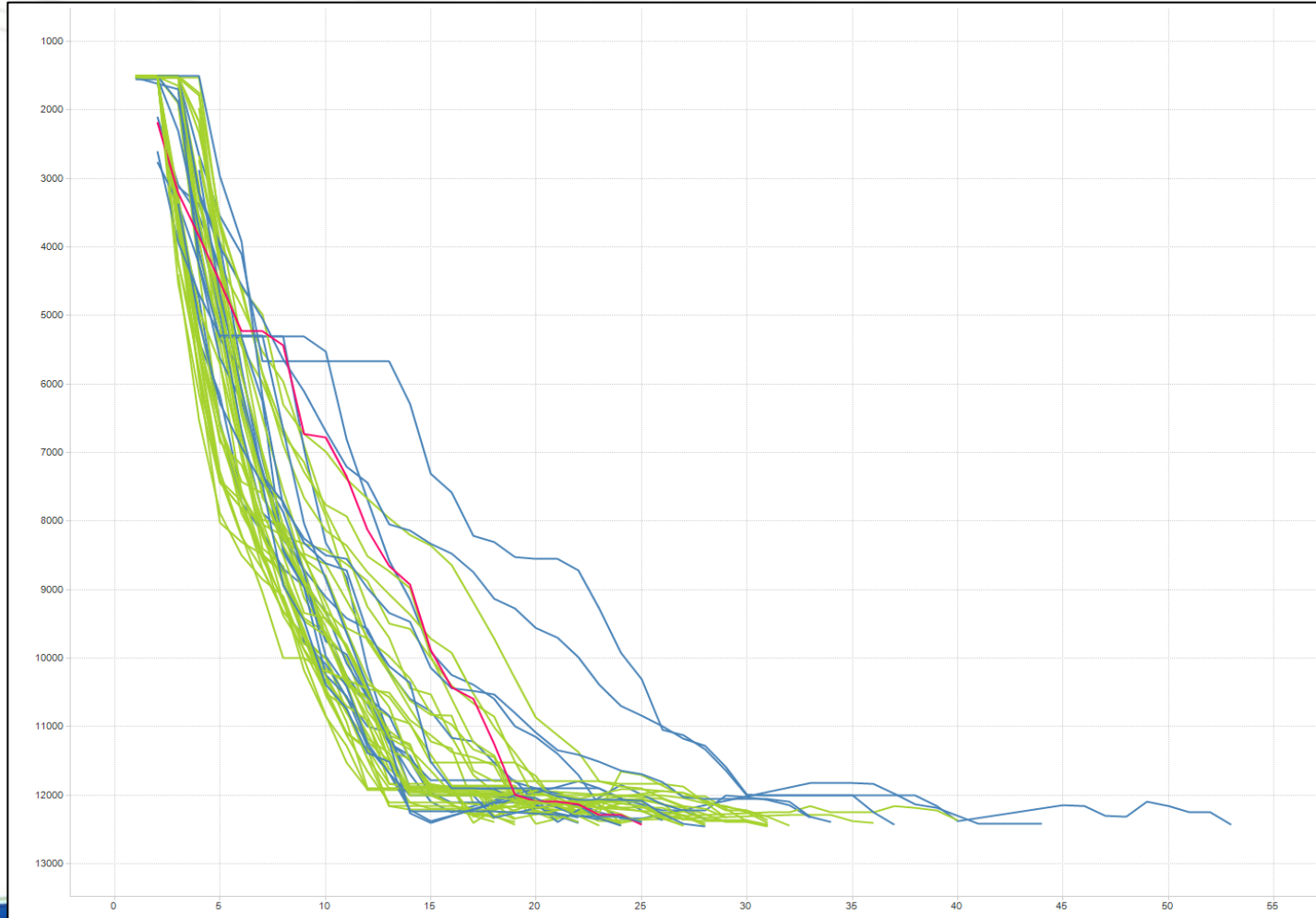
Colony Wash – Intermediate Hole (Cont.)



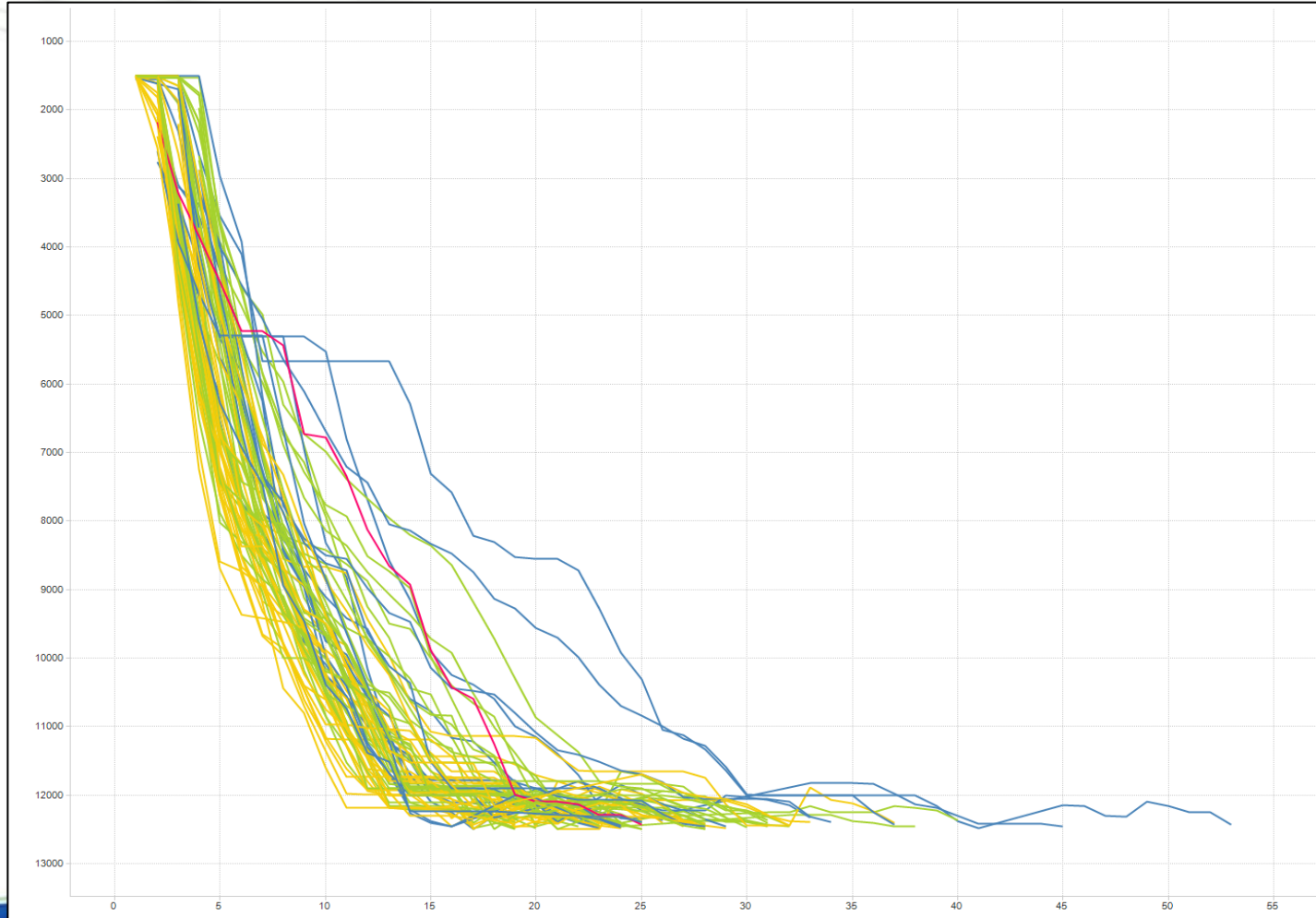
Colony Wash – Intermediate Hole (Cont.)



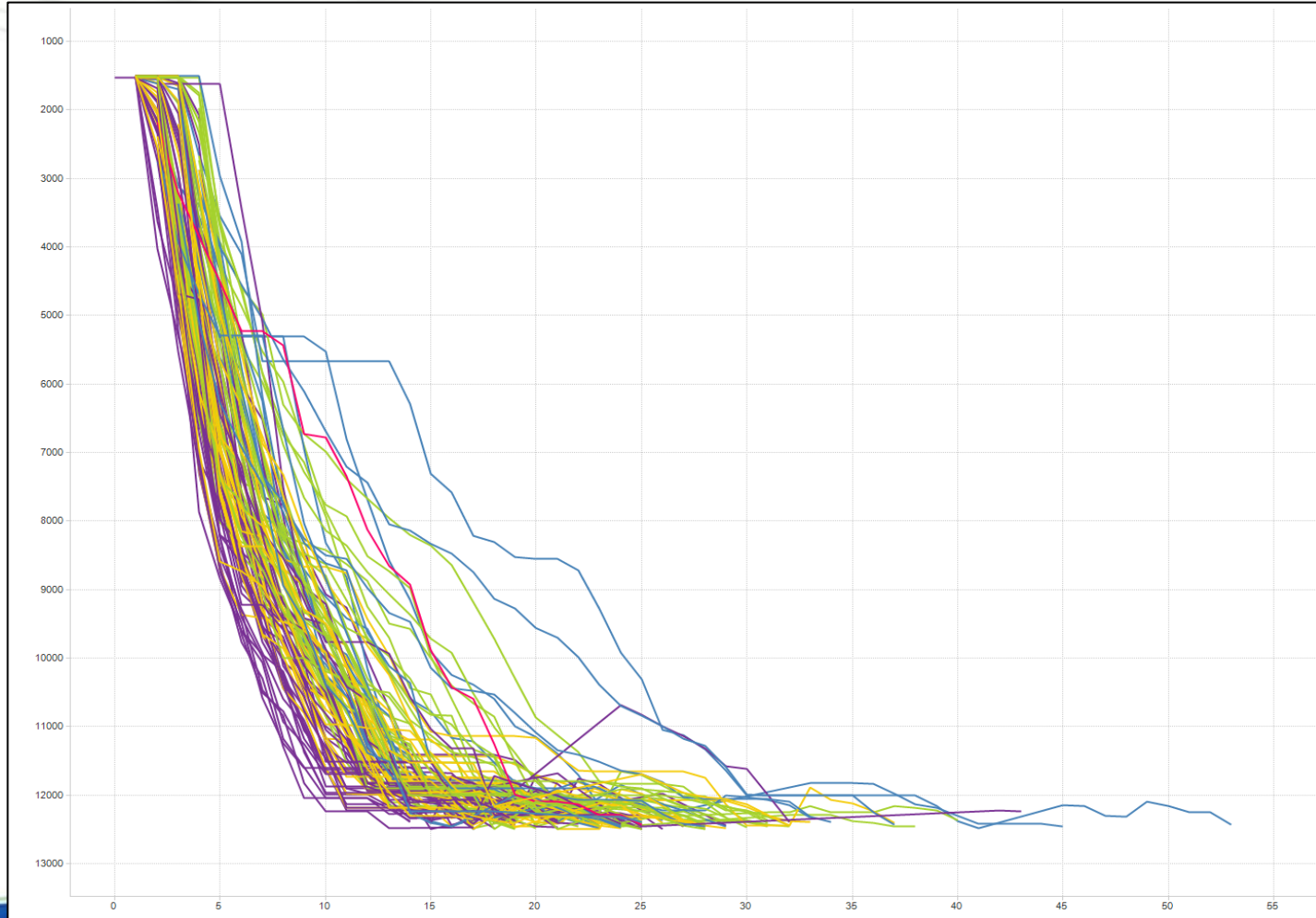
Colony Wash – Intermediate Hole (Cont.)



Colony Wash – Intermediate Hole (Cont.)



Colony Wash – Intermediate Hole (Cont.)



Colony Wash – Intermediate Hole (Cont.)



	2010	Delta
Overall Time, avg hrs	300	40
Drilling Time, avg hrs	172	47
Technical Limit, avg hrs	246.5	28

- 2011 Improvements: Continued bit development

Colony Wash – Pilot Hole



- FIT to PU Directional Tools
- 60% have Pilot holes
- Drill 6 1/8” Hole (12,000’ – 13,500’)
- PDC Drillable
 - 2.5% 1 bit 60% 2 bits 22.5% 3 bits 15% 4 bits or more
- MW 11.5 ppg – 12.5 ppg OBM
 - Have done WBM for cores (Geology)



Colony Wash – Pilot Hole (Cont.)

- 2010 Average footage in Pilot Hole = 1030' (174')
- Set open hole whipstock
 - STC Track Master Plus w/ Expandable Anchor
 - Mill 2' - 4' TOOH for tools

	2010	Delta
Overall Time, avg hrs	130	16
Drilling Time, avg hrs	60	8
Technical Limit, hrs	61.5	5

- Improvements in 2011: Hybrid Impreg/PDC bit



Colony Wash – Curve



- **PU Tools to Landing Point**
- **Drill 6 1/8” Hole**
- **History**
 - Build with insert, finish with PDC
 - 2 Bit Interval = 38%
 - 3 Bit Interval = 32%
 - 4 Bits+ Interval = 30%
- **Drilling Statistics**
 - 78% Slide Drilling
 - Sliding ROP = 7.8 fph
 - Rotating ROP = 10.4 fph
 - Section ROP = 8.8 fph
 - Average = 7.3 days

Colony Wash – Curve (Cont.)



● Turbine and Impreg Development

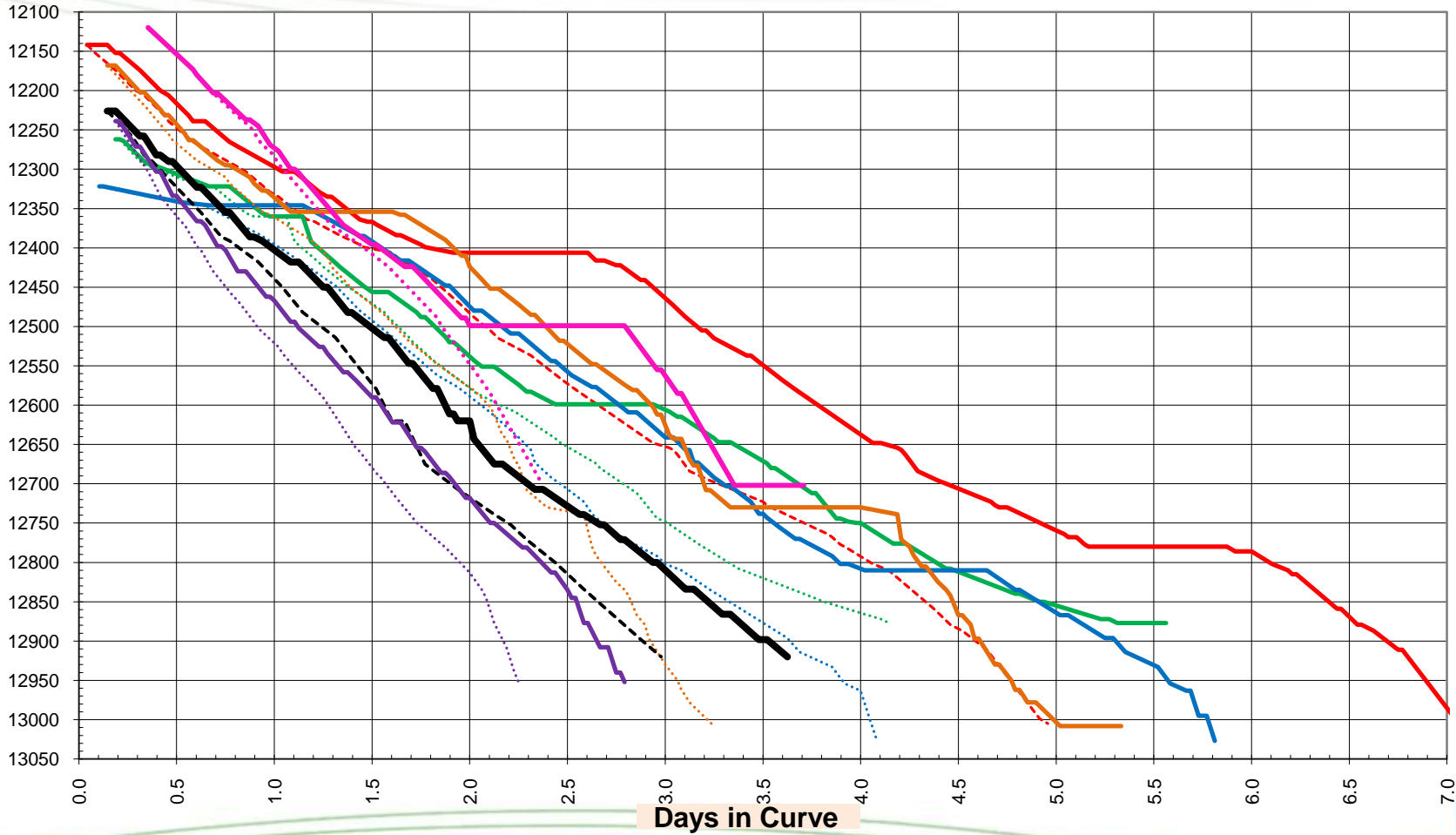
- Engineering wanted technology for horizontal drilling
 - Geometry
 - 2-23 Bits in the Lateral (Average = 8 bits)
- Build the curve
 - 1st Well
 - » Build rates of 12°/100'
 - » 1.5° Bend Turbine (7.66 rpg = +/- 1700 rpms)
 - » Mid-body Stab, String Stab, full length bit
 - » ROP = 16.7 fph (190% faster)
 - » 9.5 °/100' TOO H to PU conventional tools
 - 2nd Well
 - » Same 12°/100'
 - » 1.5 Bend on Turbine
 - » No stabs, 4" shorter bit
 - » ROP was 9.8 fph (50% better than motor)
 - » 10.5°/100' TOO H to PU conventional tools

Colony Wash – Curve (Cont.)



- 3rd Run
 - Set up for 12°/100'
 - Bend to 1.75°
 - Able to achieve 14°/100' (Had to back off to prevent landing high)
 - Landed curve and drilled 256' in lateral
 - Drilled 1158' in 78 hours for 14.8 fph average
 - Beat best offset by 2.2 days and others by 4+days (\$150k savings)
 - *Set new technical limit for hole section*
- 4th Run
 - Set up for 14°/100' (moved KOP up about 20' 13.4°/100')
 - Getting 13.5°/100' consistently
 - Beat best offset by 1.7 days and others by 3+ days
 - Tied previous technical limit hole section

Colony Wash – Curve (Cont.)





Colony Wash – Curve (Cont.)

- **Consistently build curve at 14°/100'**
 - Open hole and whipstock
 - High as 18°/100'

	2010	Delta
Overall Time, avg hrs	113	62
Drilling Time, avg hrs	79	29
Technical Limit, hrs	57	50

- **2011 Improvements: Consistent Rig to Rig performance with turbine**



Colony Wash – Lateral

- Landing Point to Casing Operations
- Drill 6 1/8” Hole
- Small Target – 10’ window
- Bit Selection
 - Offset Data, Geology Mapping
 - Number of Bits in Lateral ranges from 2 – 23 (AVG = 8)
 - » Heavy Set 6,7,8, and 9 blade PDC’s
 - » ‘627’ insert bits
- BHA
 - 1.5° Motor w/ kickpad 0.48 RPG, 5 Stage, 5/6 Lobe, BTB = 5.2’
 - 1.7° Turbine 7.44 RPG, 147 stage, BTB = 3’
 - 68% Time Rotating
 - » ROP = 16.7 fph (4.5)
 - 32% Time Sliding
 - » ROP = 8.7 fph (1.8)



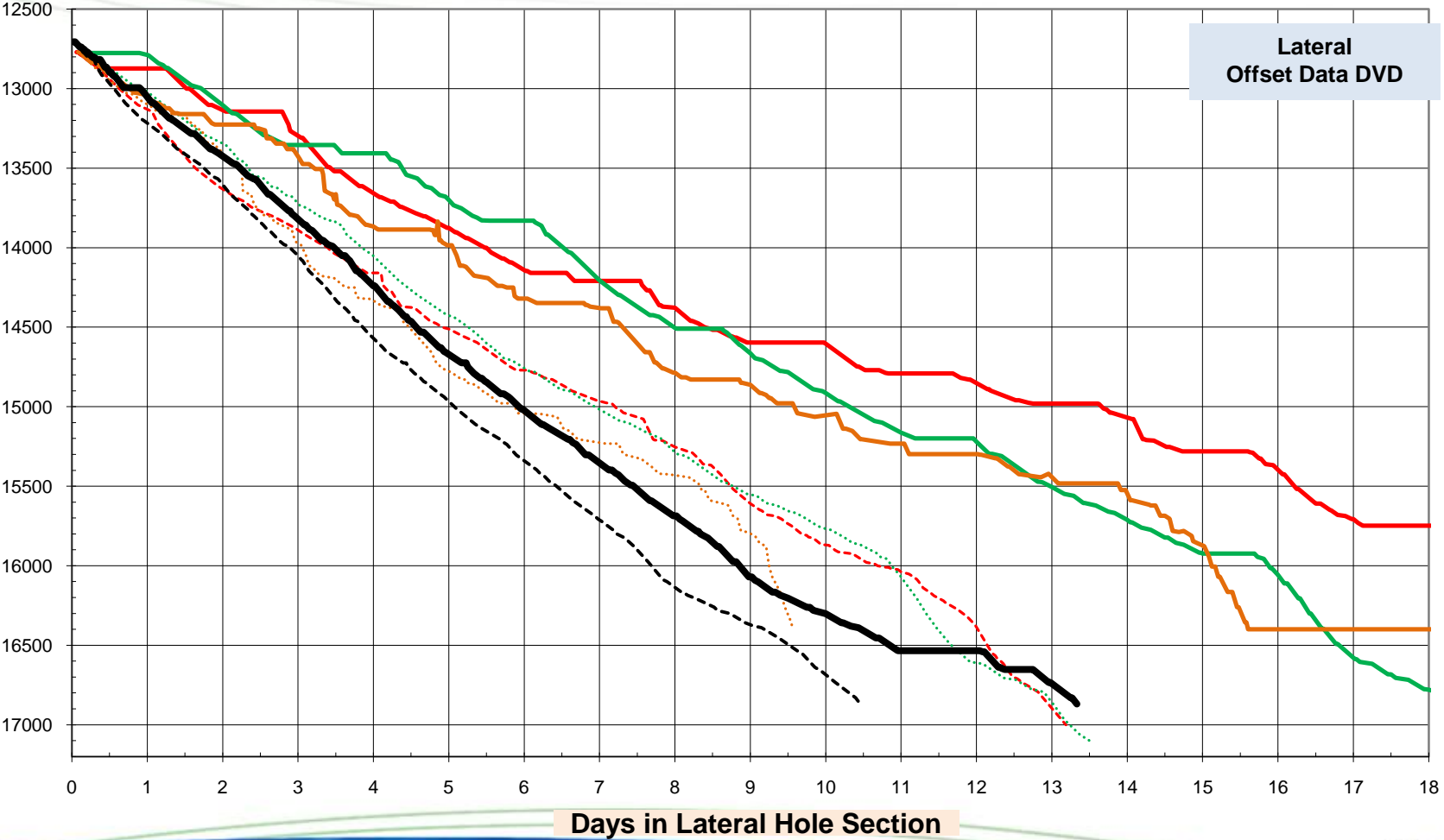
Colony Wash – Lateral (Cont.)



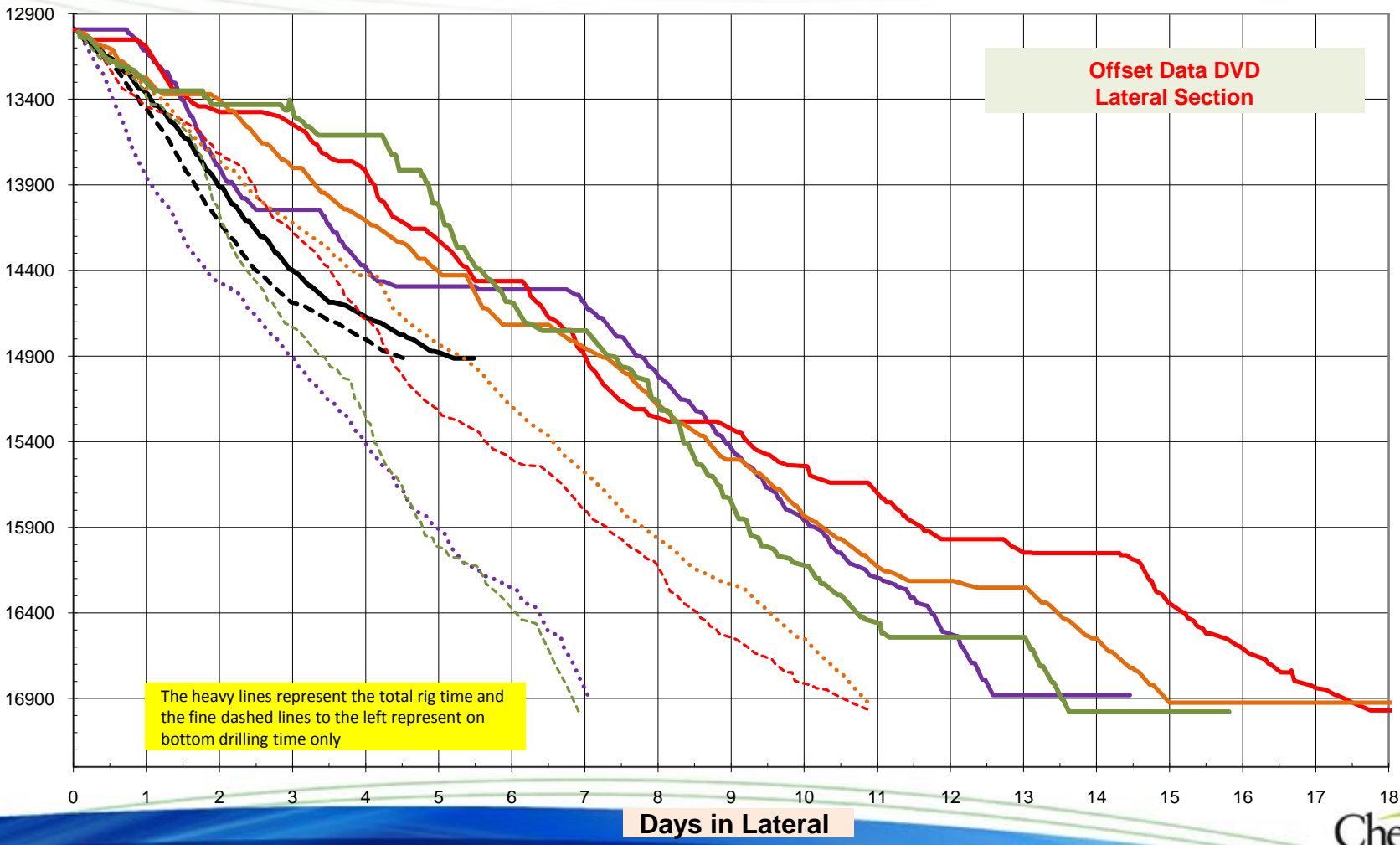
	2010	Delta
Overall Time, avg hrs	540	37
Drilling Time, avg hrs	342	28
Technical Limit, hrs	230	-

- 2011 Improvements: Continued use of turbines, bit development

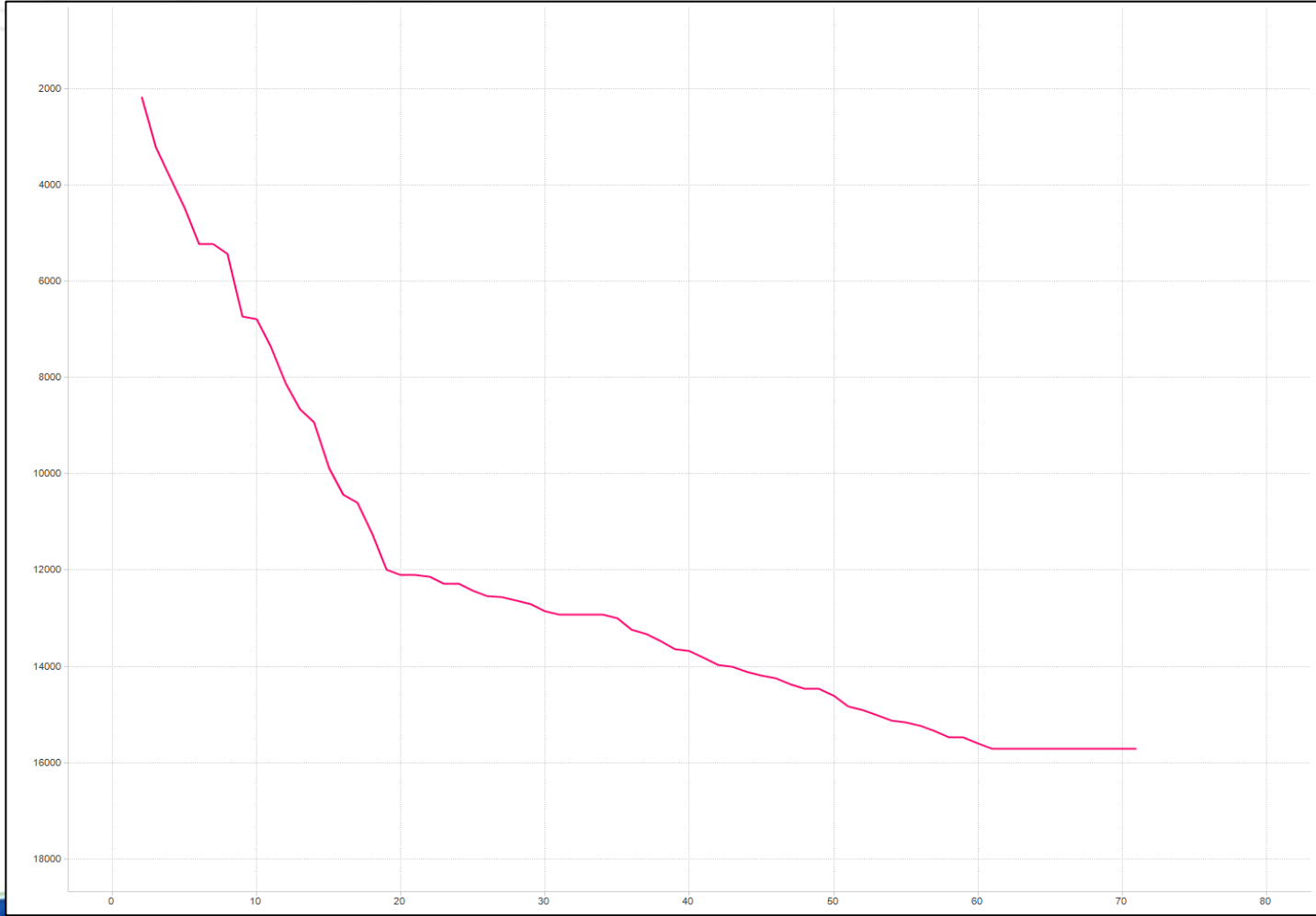
Colony Wash - Lateral (Cont.)



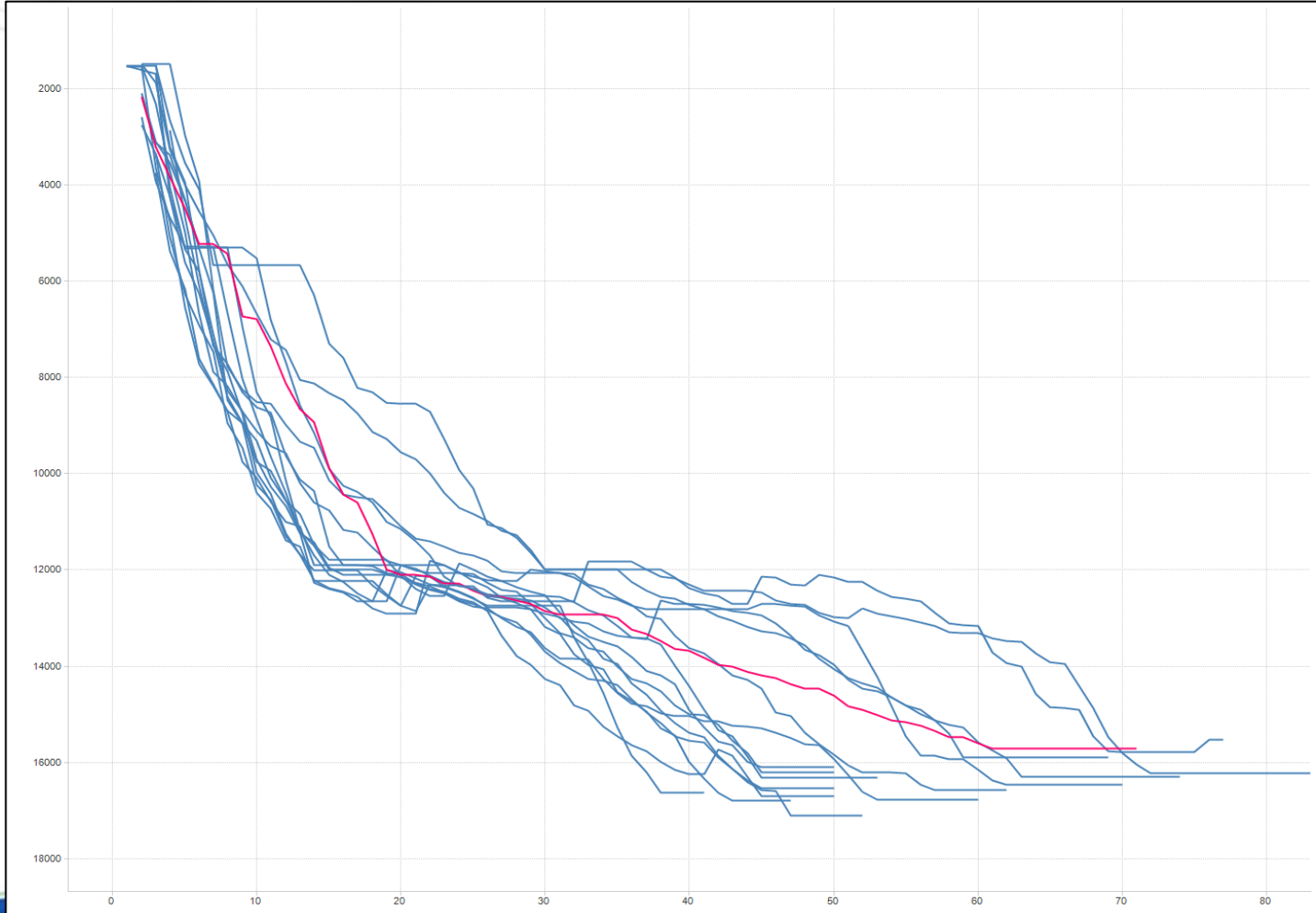
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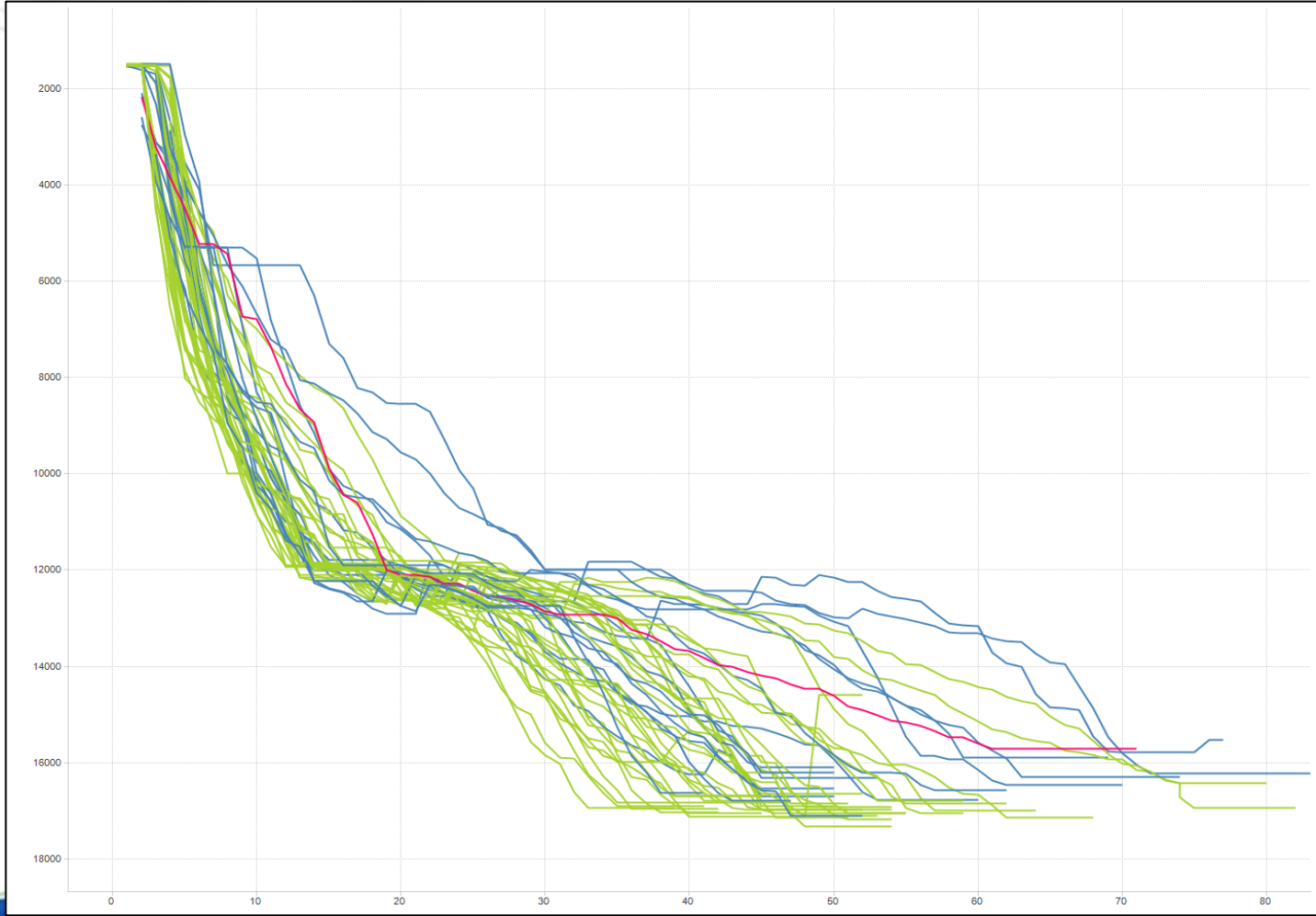
Colony Wash - Time Summary



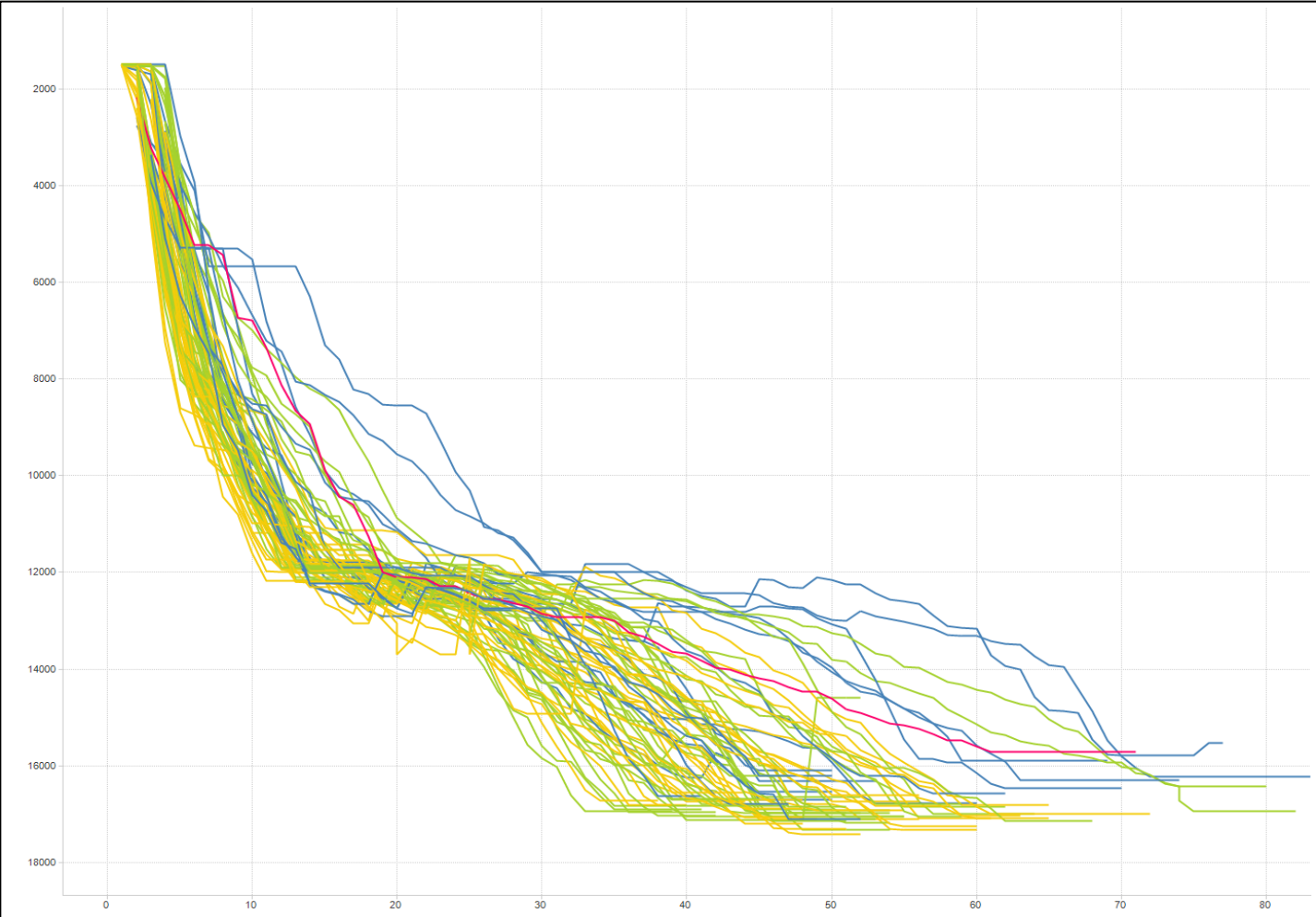
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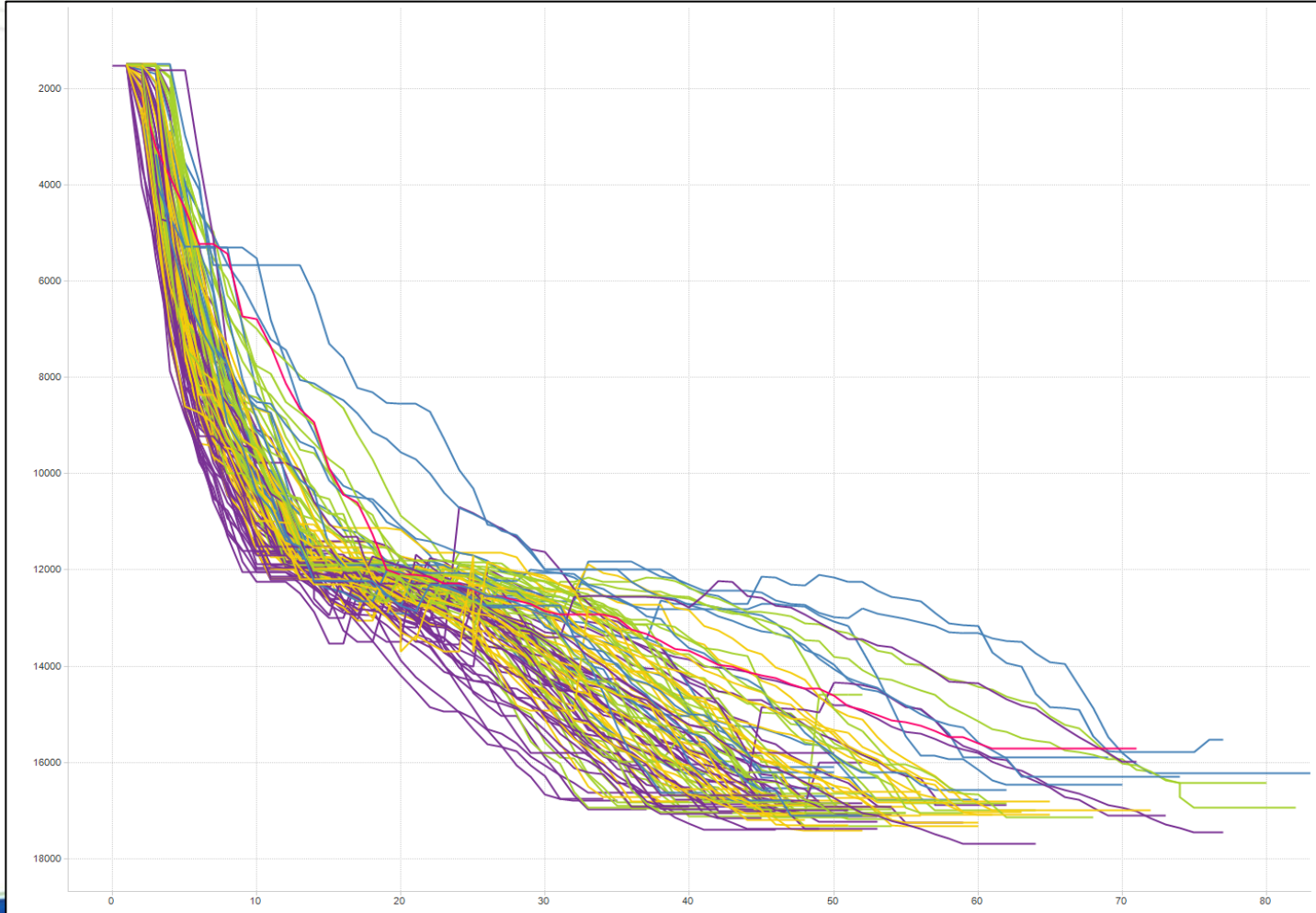
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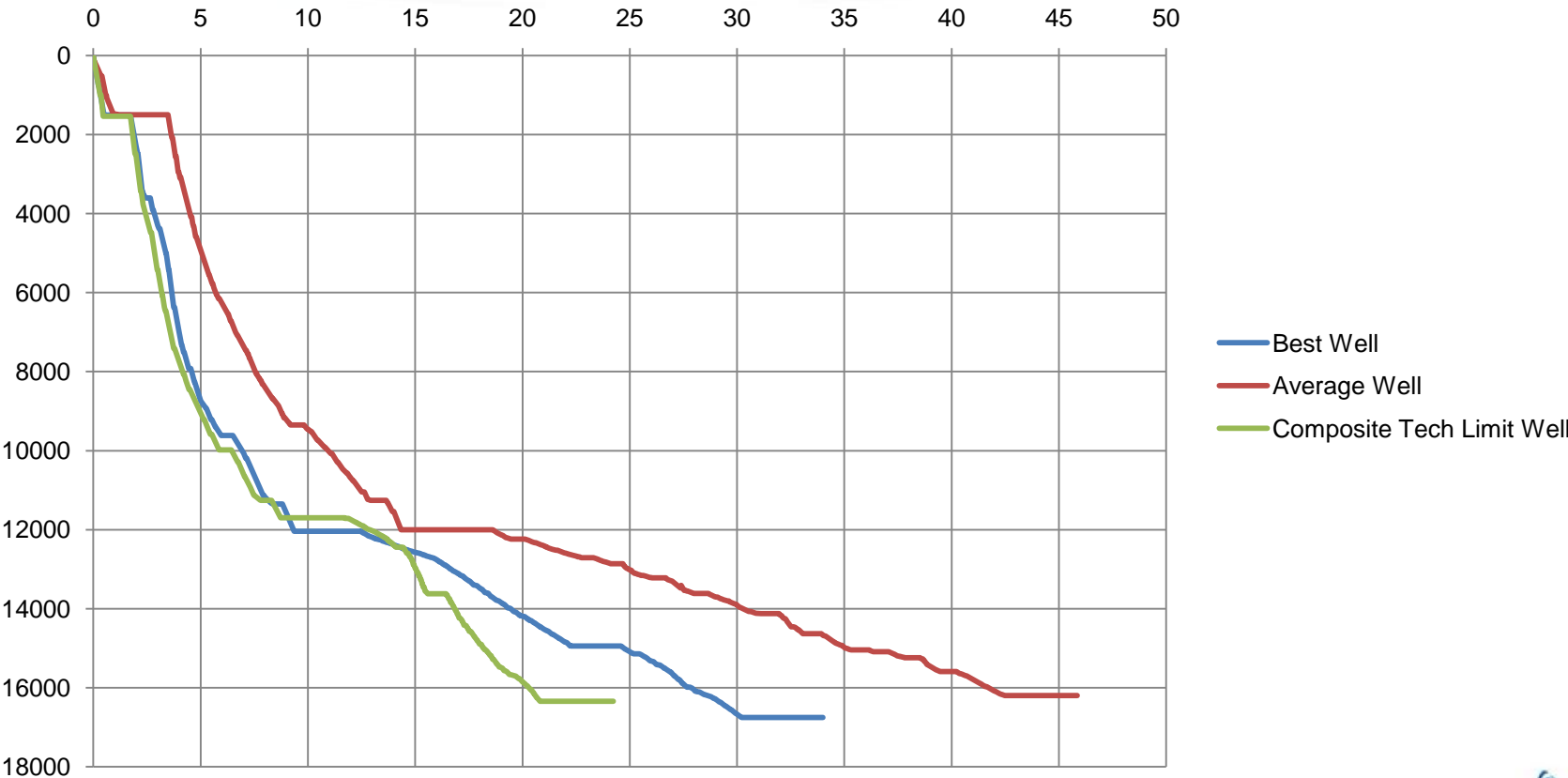
Colony Wash - Time Summary



Colony Wash - Summary



Colony Wash Performance



Colony Wash – Summary



- **Competition**
- **Quality Control**
- **Anadarko Team**



Questions

Anadarko – Granite Wash Improvements

Craig Staley, Drilling Engineer – Anadarko Basin