



Goodrich's East Texas Gas Lift Results

ETGPA - March 11, 2008

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Discussion Topics



- Is gas lift a viable alternative in the Cotton Valley?
- How do I select a gas lift candidate?
- How do I quantify success/failure of gas lift?
- Show me some results!



Numerous Methods of Artificial Lift Available



- Compression
- Plunger
- Capillary String
- Velocity String
- Jet Pump
- ESP
- Pumping Unit
- Gas Lift



GL Below a Packer

WELL 4 GOODRICH PETROLEUM RUSK CO., TX

GL @ 335'
KB @ 353'
COMPLETION DATE: 3/2006

PRODUCTION STRING

188 JTS 2-3/8" 4.7# N-80 8RD EUE TBG
2 3/8", L-80 MANDREL VW1" VALVE SET @ 6119'
28 JTS 2 3/8", N-80 TBG
2 3/8", L-80 MANDREL VW1" VALVE SET @ 7039'
18 JTS 2 3/8", N-80 TBG
2 3/8", L-80 MANDREL VW1" VALVE SET @ 7831'
15 JTS 2 3/8", N-80 TBG
2 3/8", L-80 MANDREL VW1" VALVE SET @ 8122'
16 JTS 2 3/8", N-80 TBG
2 3/8", L-80 MANDREL VW1" VALVE SET @ 8645'
15 JTS 2 3/8", N-80 TBG
2 3/8", L-80 MANDREL VW1" VALVE SET @ 9133'
4 JTS 2 3/8", N-80 TBG
BAKER HORNET VW CROSS FLOW ASSY @ 9268'
8 JTS 2 3/8", N-80 TBG
2 3/8", L-80 IM MANDREL VW1" VALVE @ 9537'
12 JTS 2 3/8", N-80 TBG
2 3/8", L-80 MANDREL VW1" VALVE @ 9918'
10 JTS 2 3/8", N-80 TBG
2 3/8", L-80 IM MANDREL W/SCREENED
ORFICE @ 10242'
1 JT 2 3/8", N-80 TBG
2 3/8" BULL PLUG, EDT @ 10276'

GAS LIFT VALVE DEPTHS (MD)

6119' - CONVENTIONAL SET @ 940 PSI
7039' - CONVENTIONAL SET @ 920 PSI
7831' - CONVENTIONAL SET @ 900 PSI
8122' - CONVENTIONAL SET @ 880 PSI
8645' - CONVENTIONAL SET @ 860 PSI
9133' - CONVENTIONAL SET @ 840 PSI
9537' - CONVENTIONAL IM SET @ 825 PSI
9918' - CONVENTIONAL IM SET @ 810 PSI
10242' - SCREENED ORFICE

SURFACE CASING
9-5/8" 36# & 40# J-5
CMT W/ 355 SY

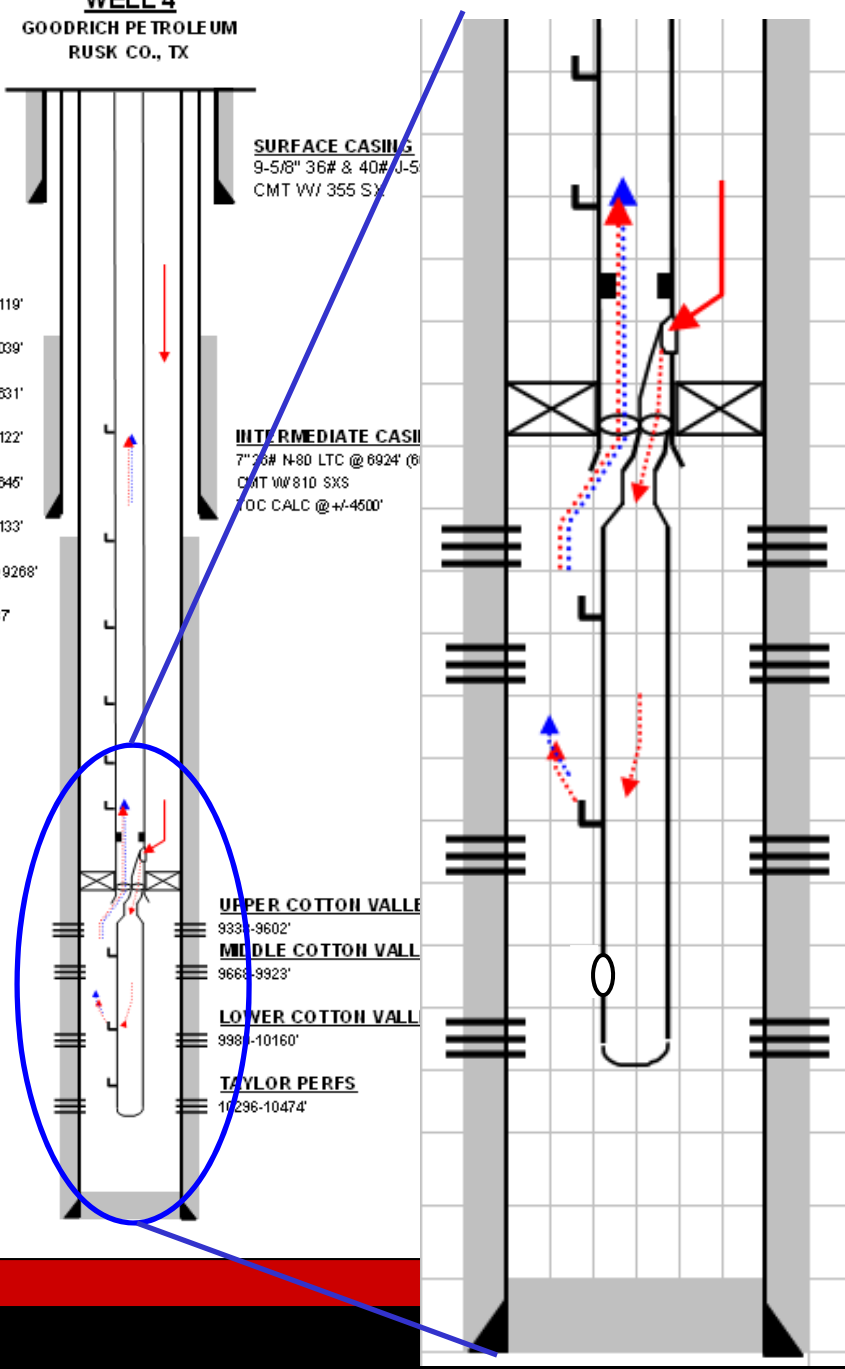
INTERMEDIATE CASI
7" 26# N-80 LTC @ 6924' @
CMT W/ 810 SXS
DOC CALC @ +74500'

UPPER COTTON VALL
933'-9602'

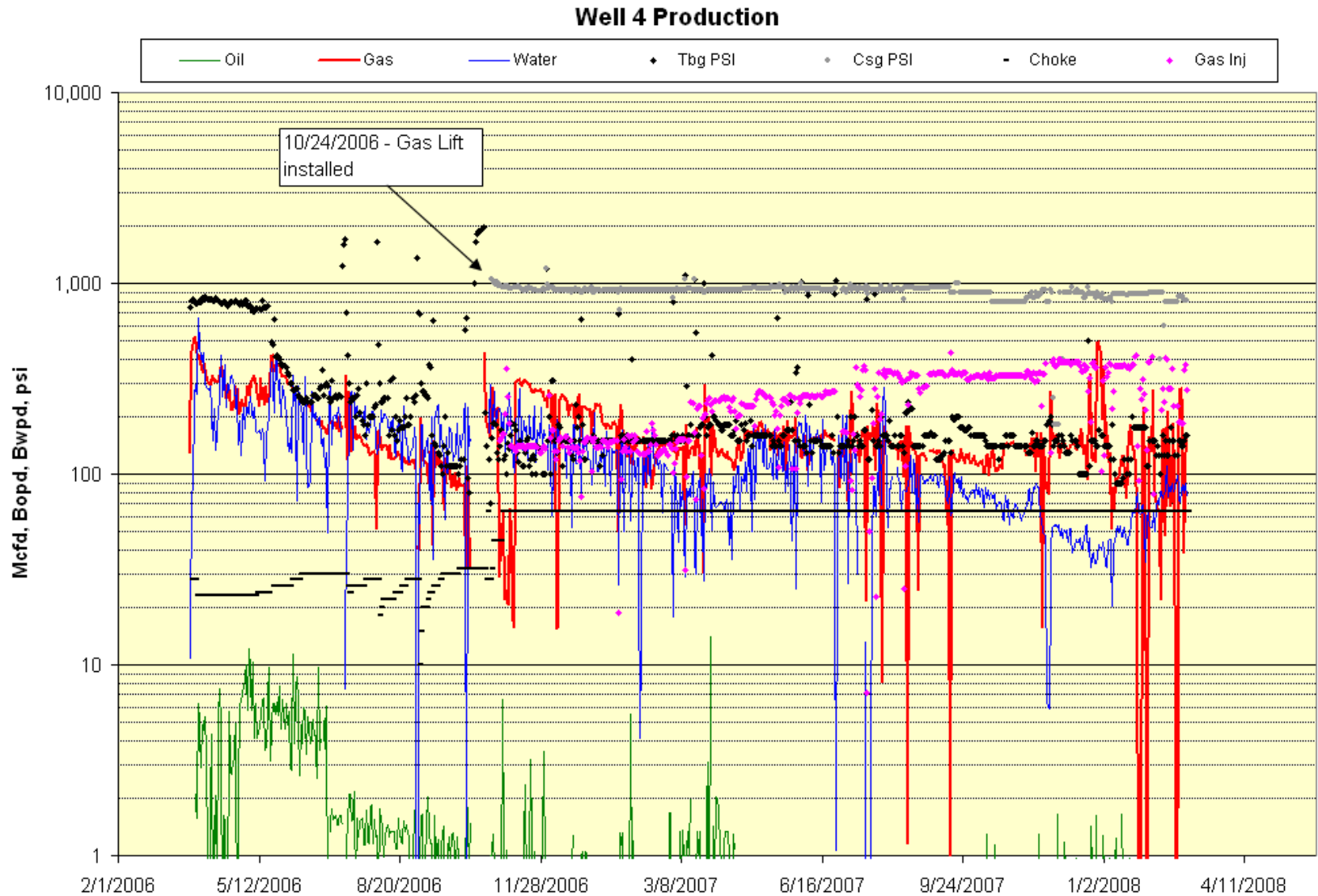
MIDDLE COTTON VALL
9668'-9923'

LOWER COTTON VALL
998'-10160'

TAYLOR PERFS
10296'-10474'



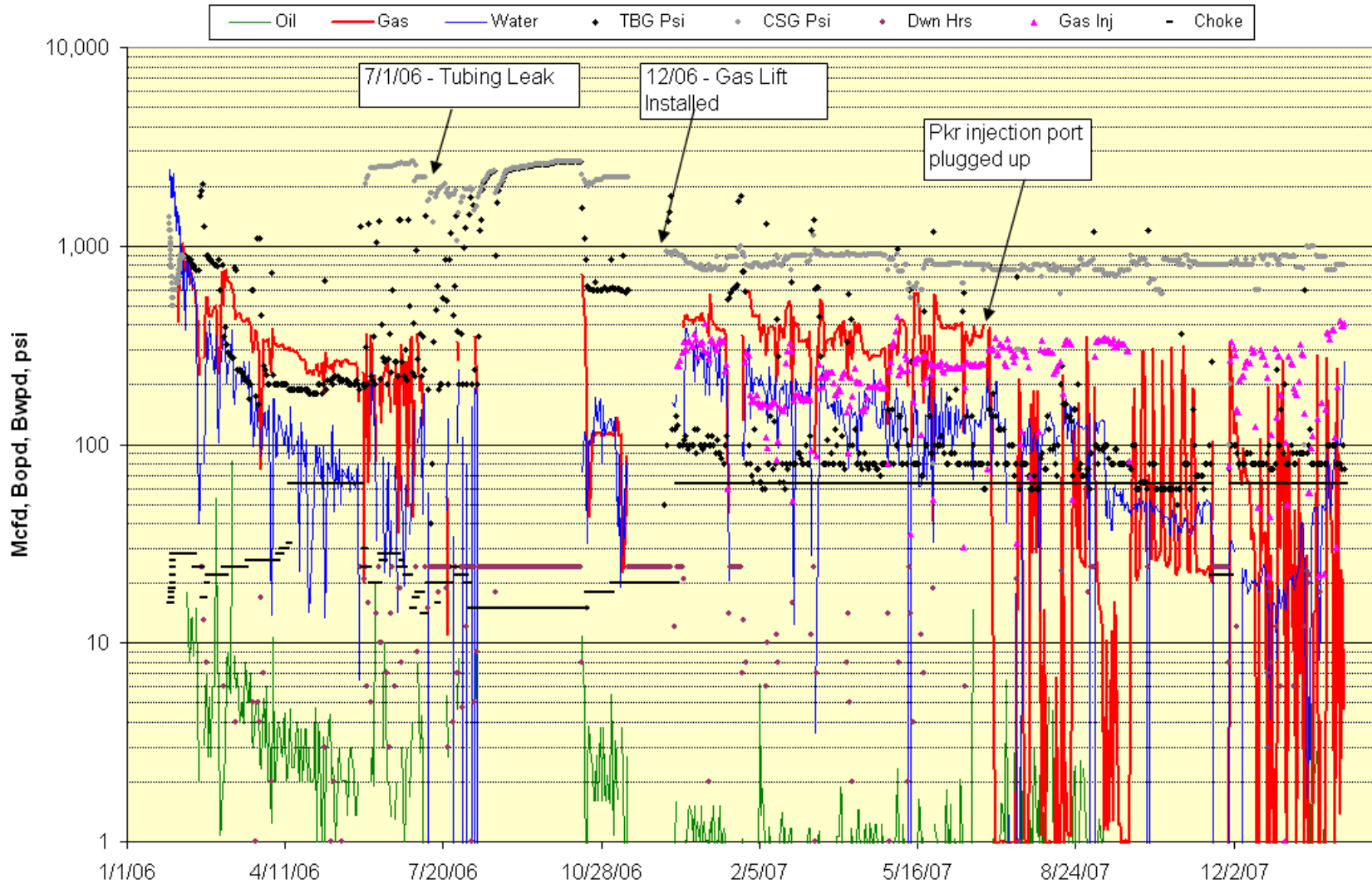
Incremental Production & Shallower Decline



Problems Can Develop.....



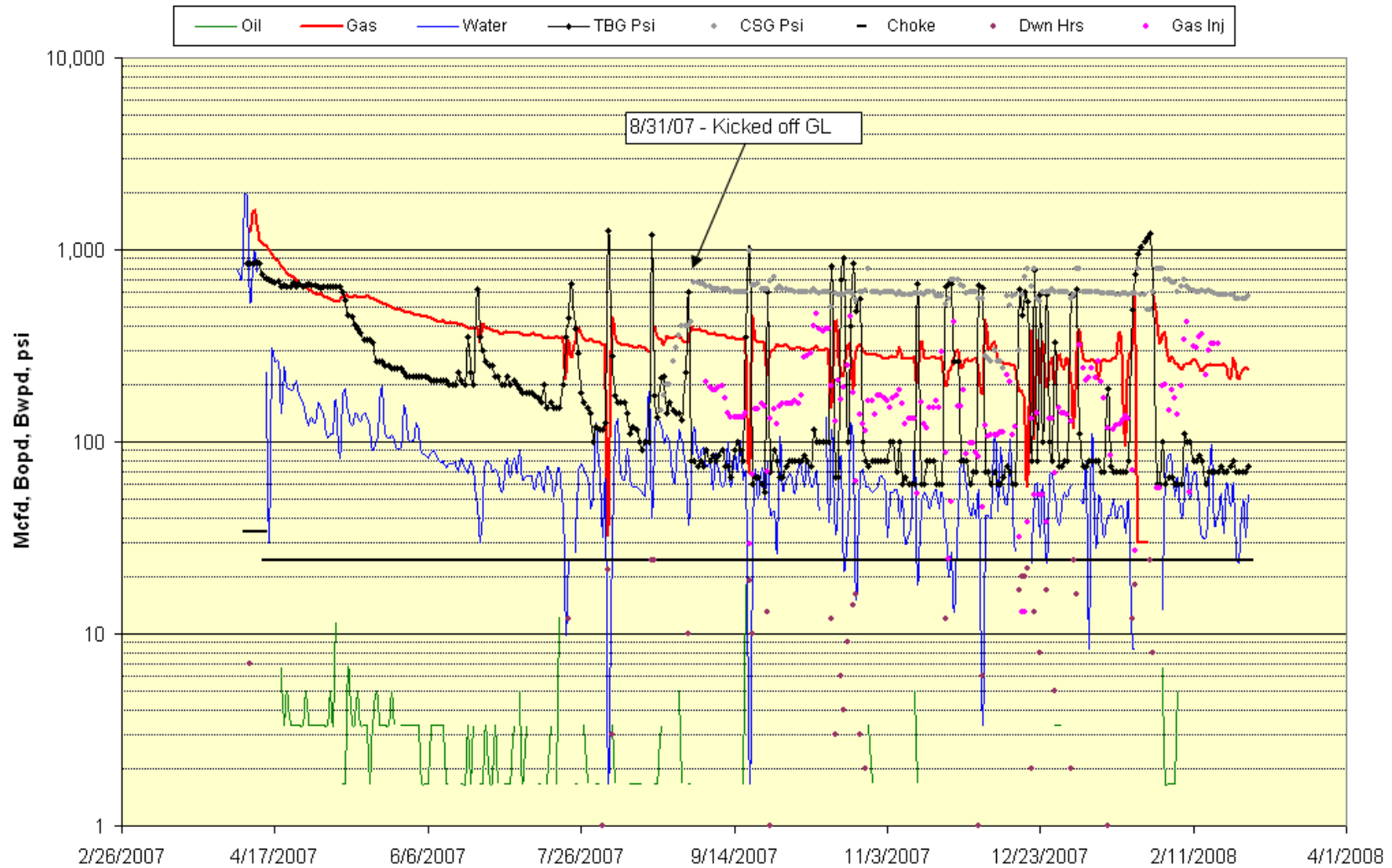
Well 6 Production



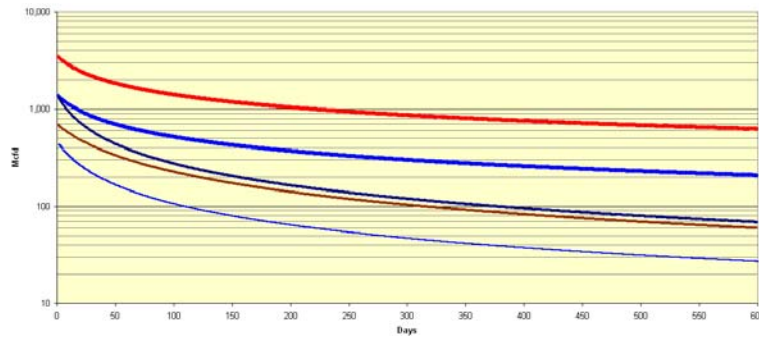
Did Gas Lift Help this Well??



Well 8 Production



Typecurve Analysis

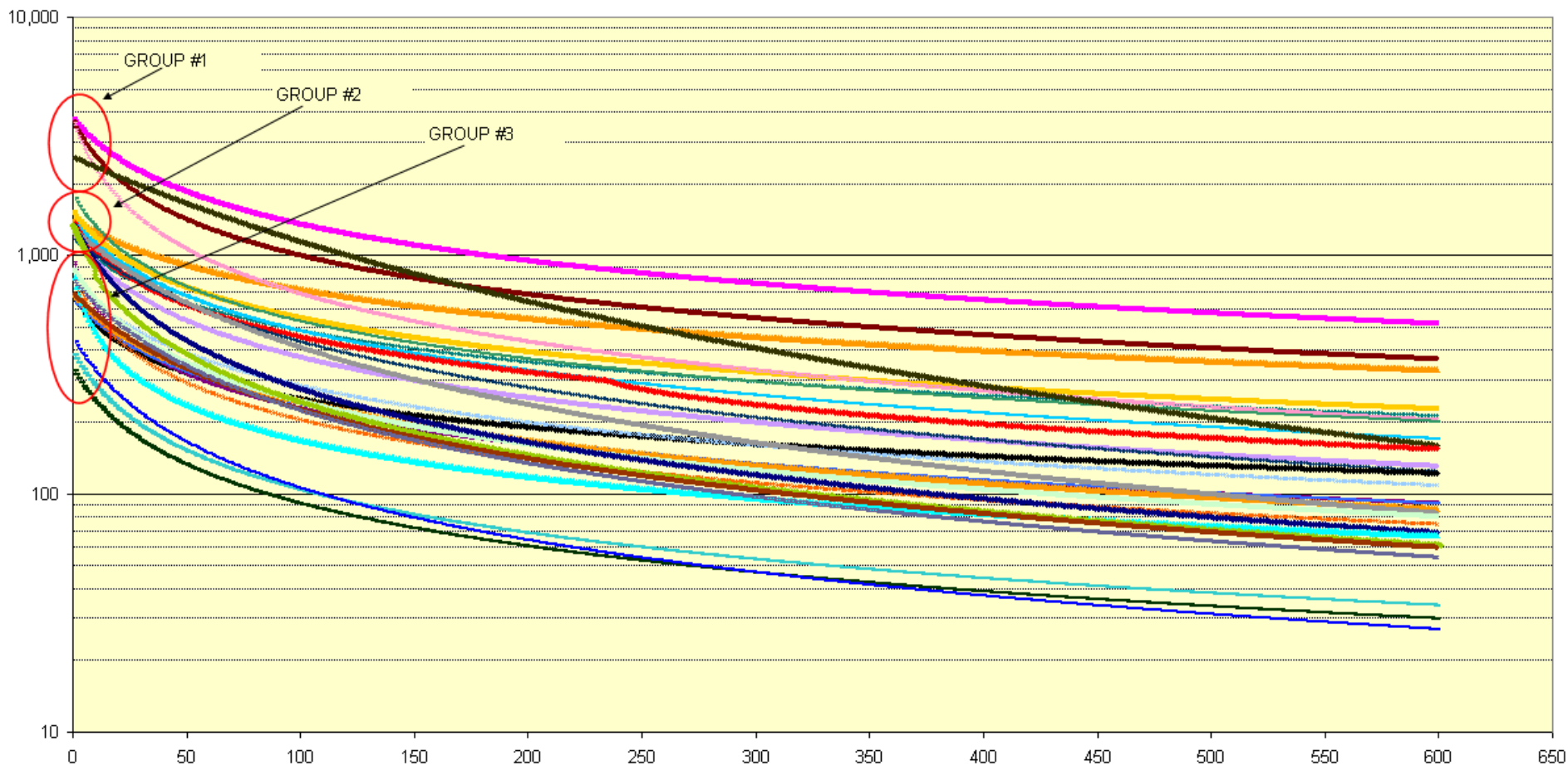


- Cotton Valley wells follow a very predictable decline curve – it is established early!
- Use TC analysis to identify gas lift candidates
 - Studied several reservoir and production characteristics.....porosity, perm, water sat, IP rate, liquid yield etc.
 - Decline curve analysis is the most reliable
- Also use to quantify gas lift results

Studied 40+ Decline Curves to develop area-specific Typecurves



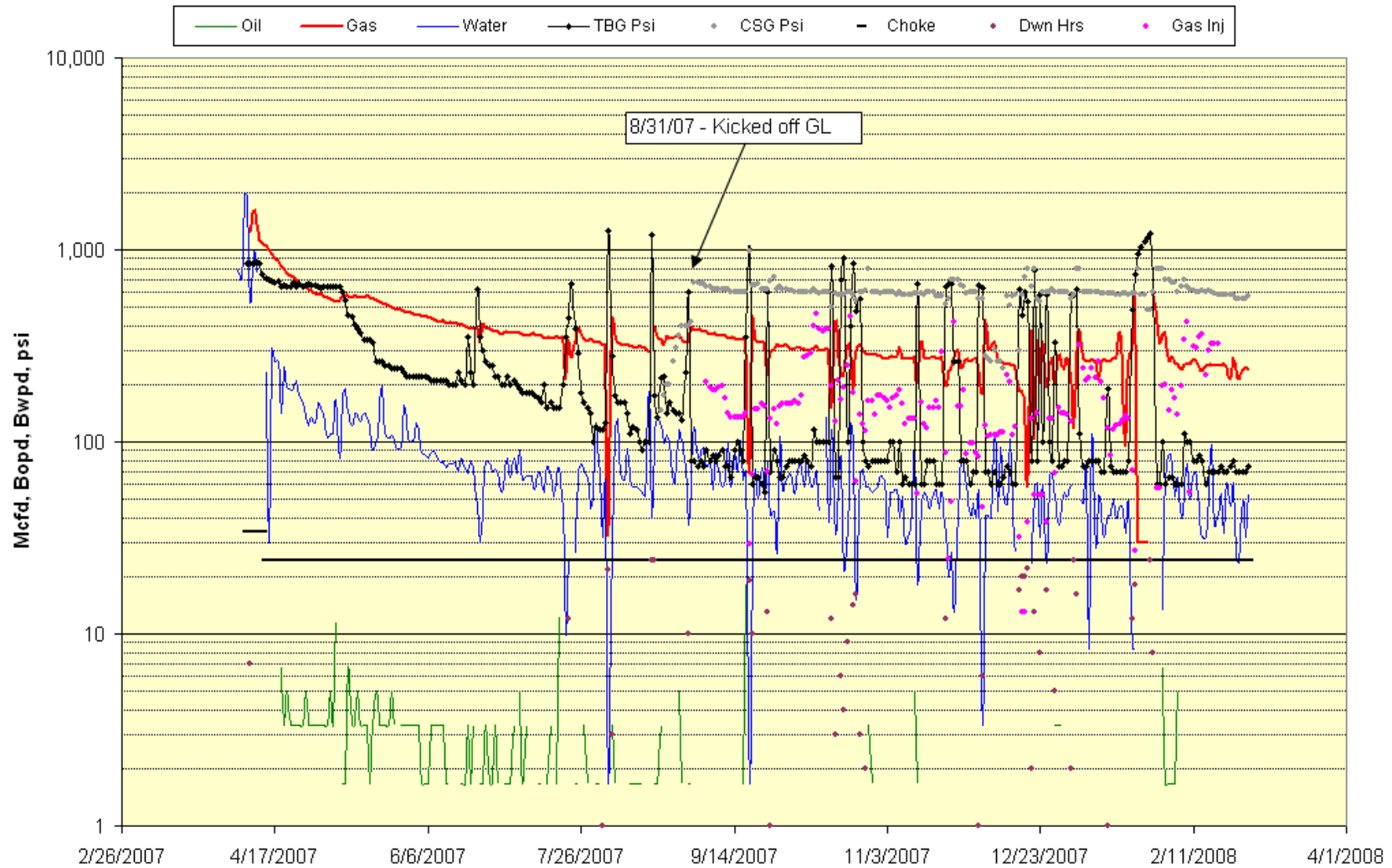
Cotton Valley Decline Curves



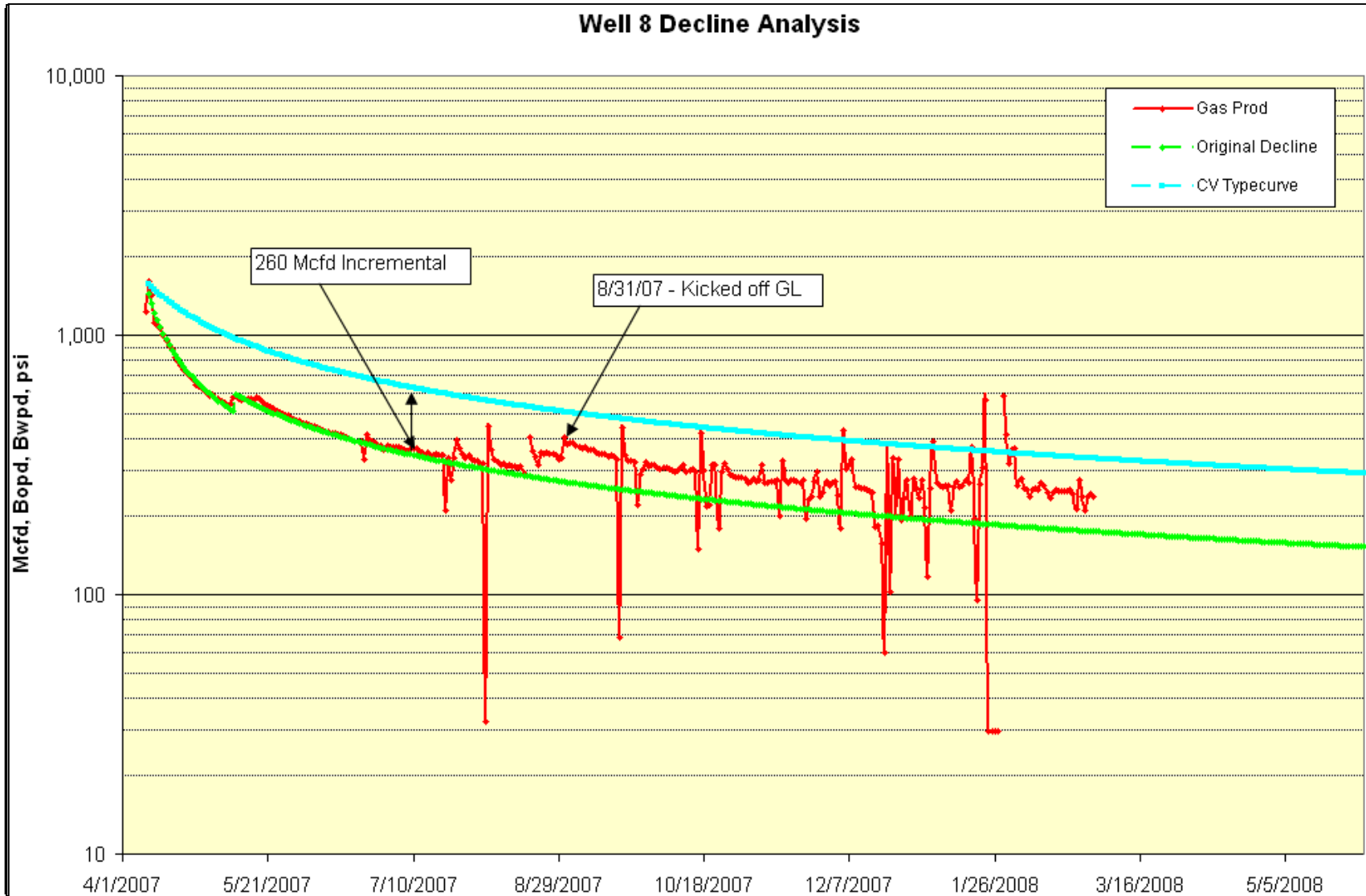
Did Gas Lift Help this Well??



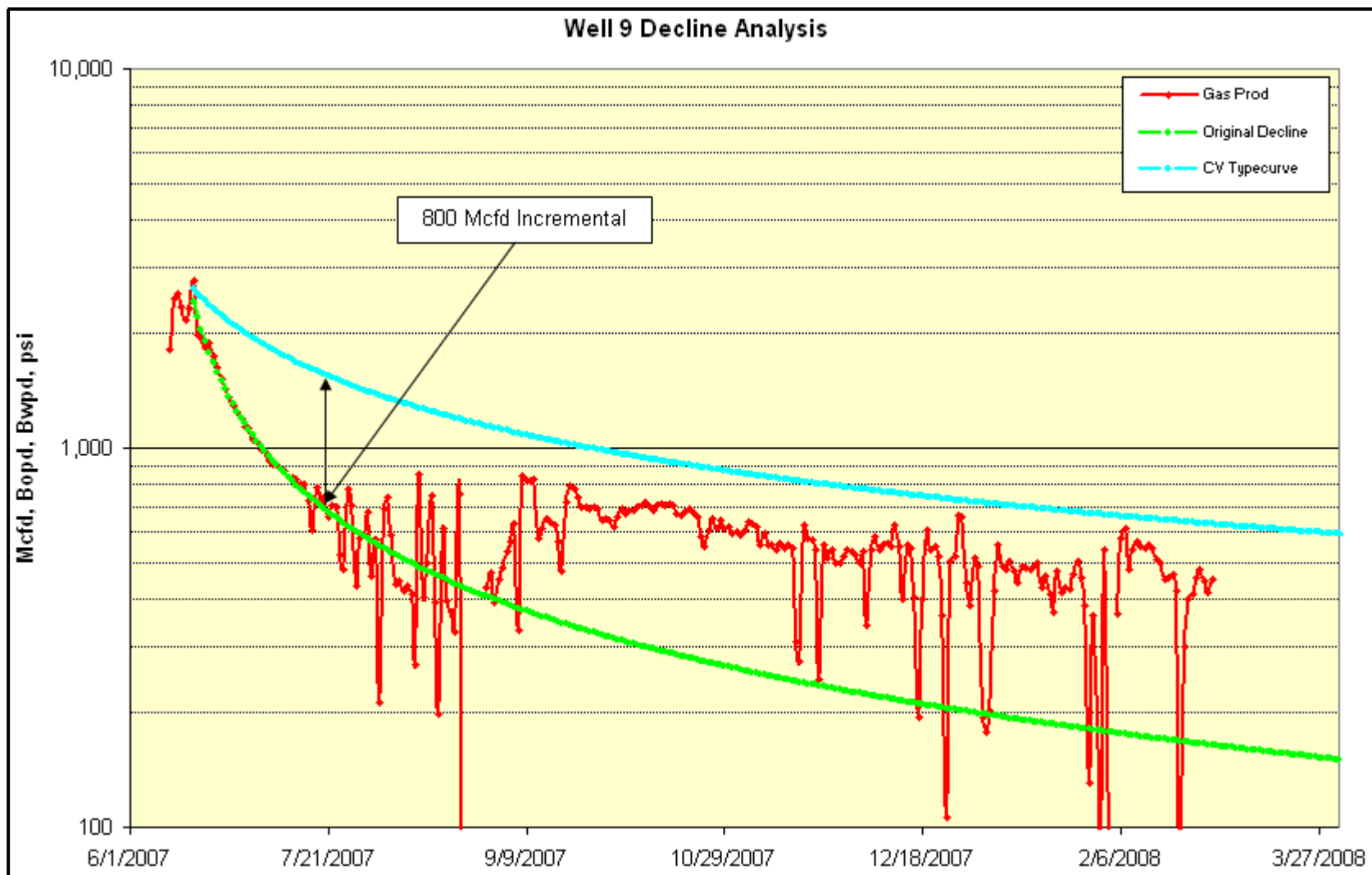
Well 8 Production



Typecurve Analysis helps Quantify Results



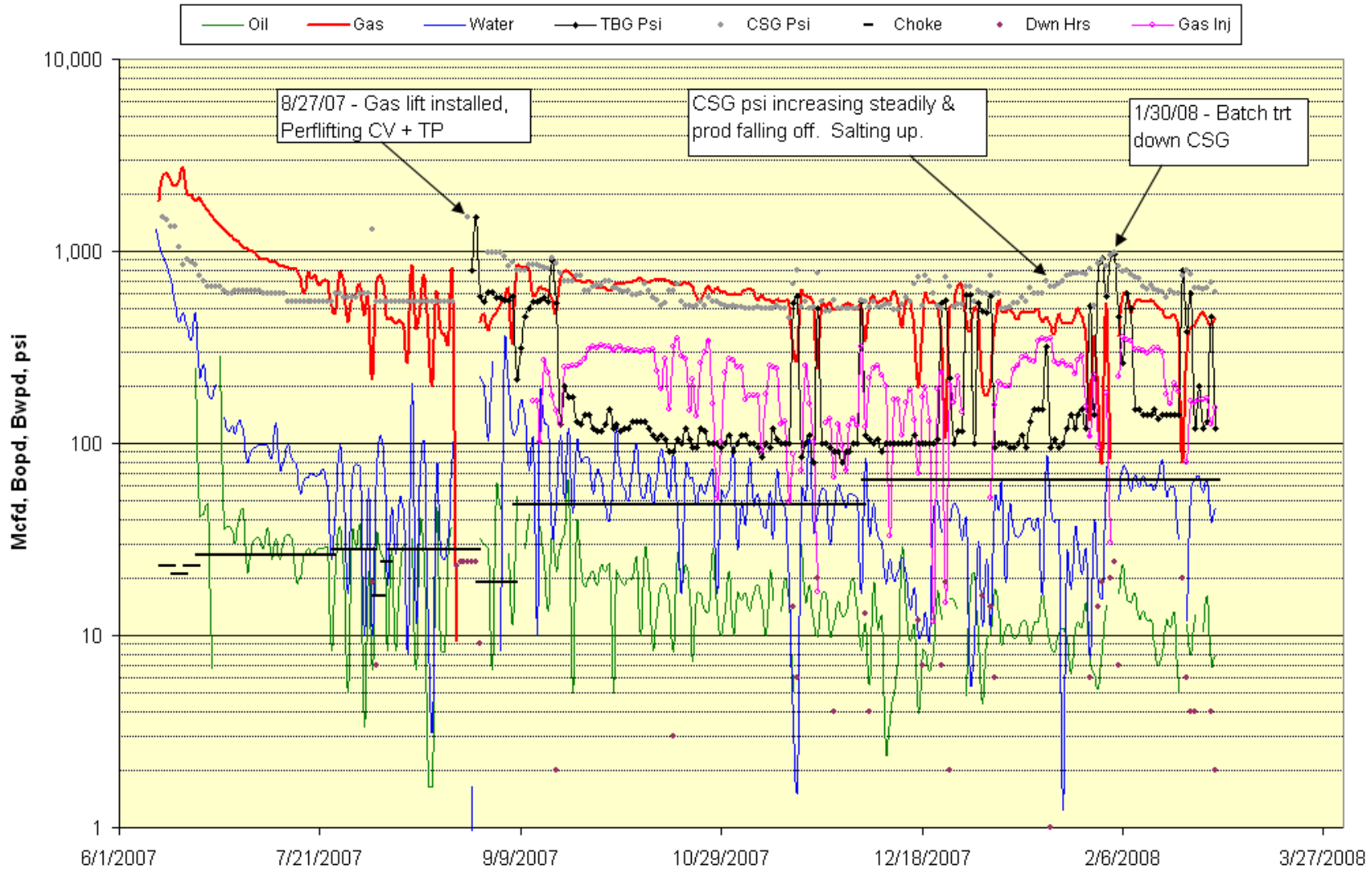
Flowing up Casing & Falling off the Typecurve



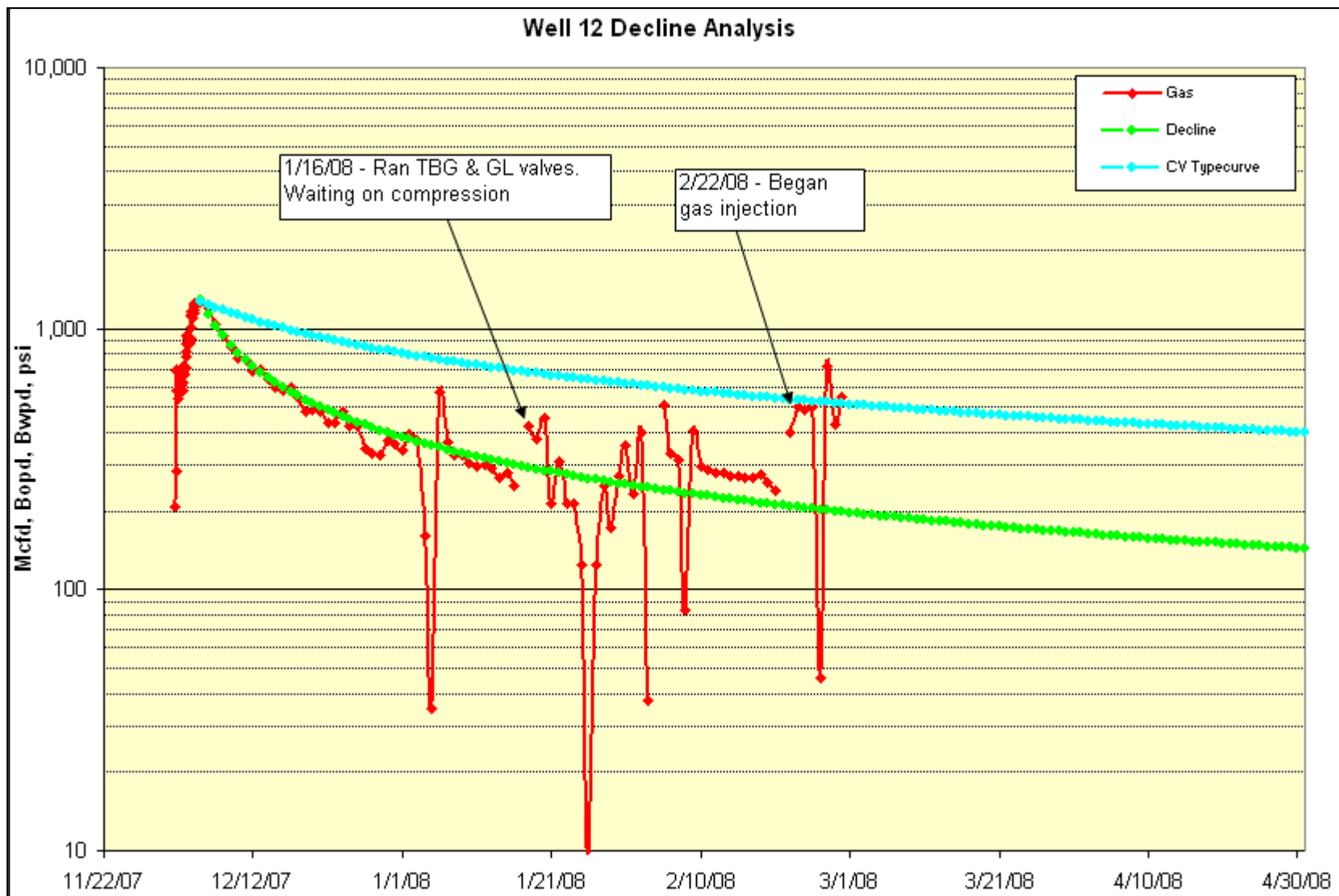
Incremental Production = \$\$\$\$



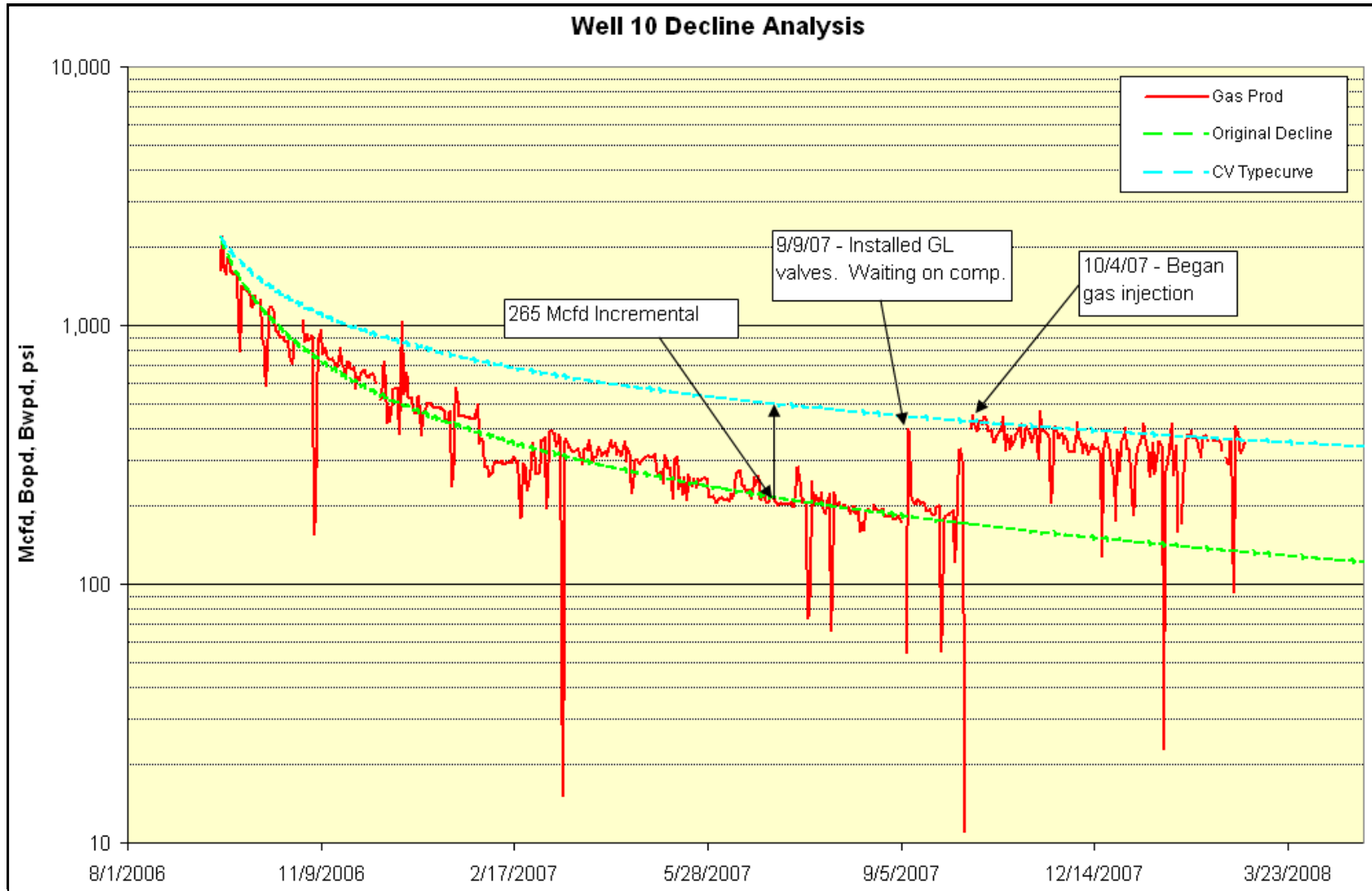
Well 9 Production



Typecurve Nails the Incremental Potential



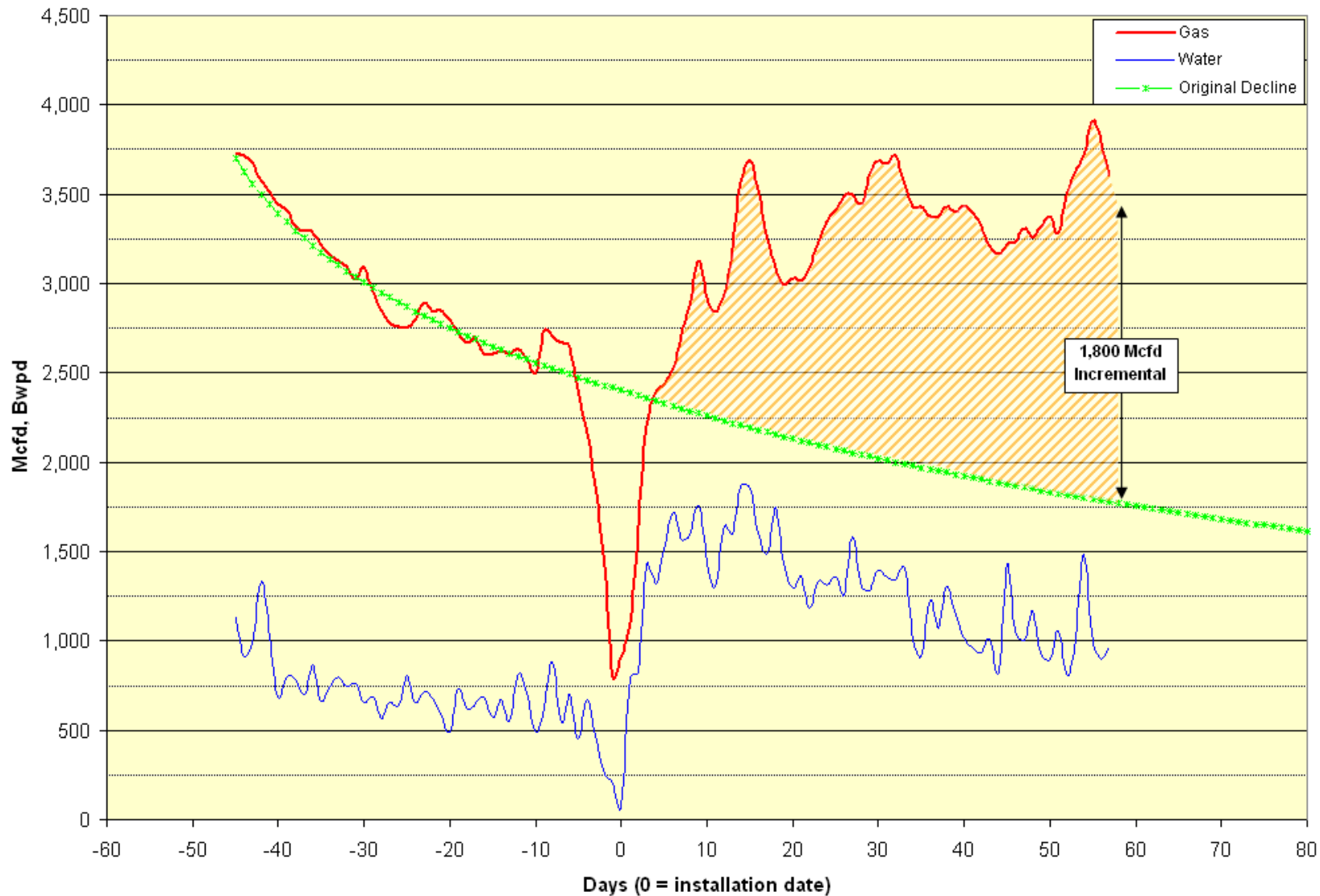
Typecurve Nails the Incremental Potential





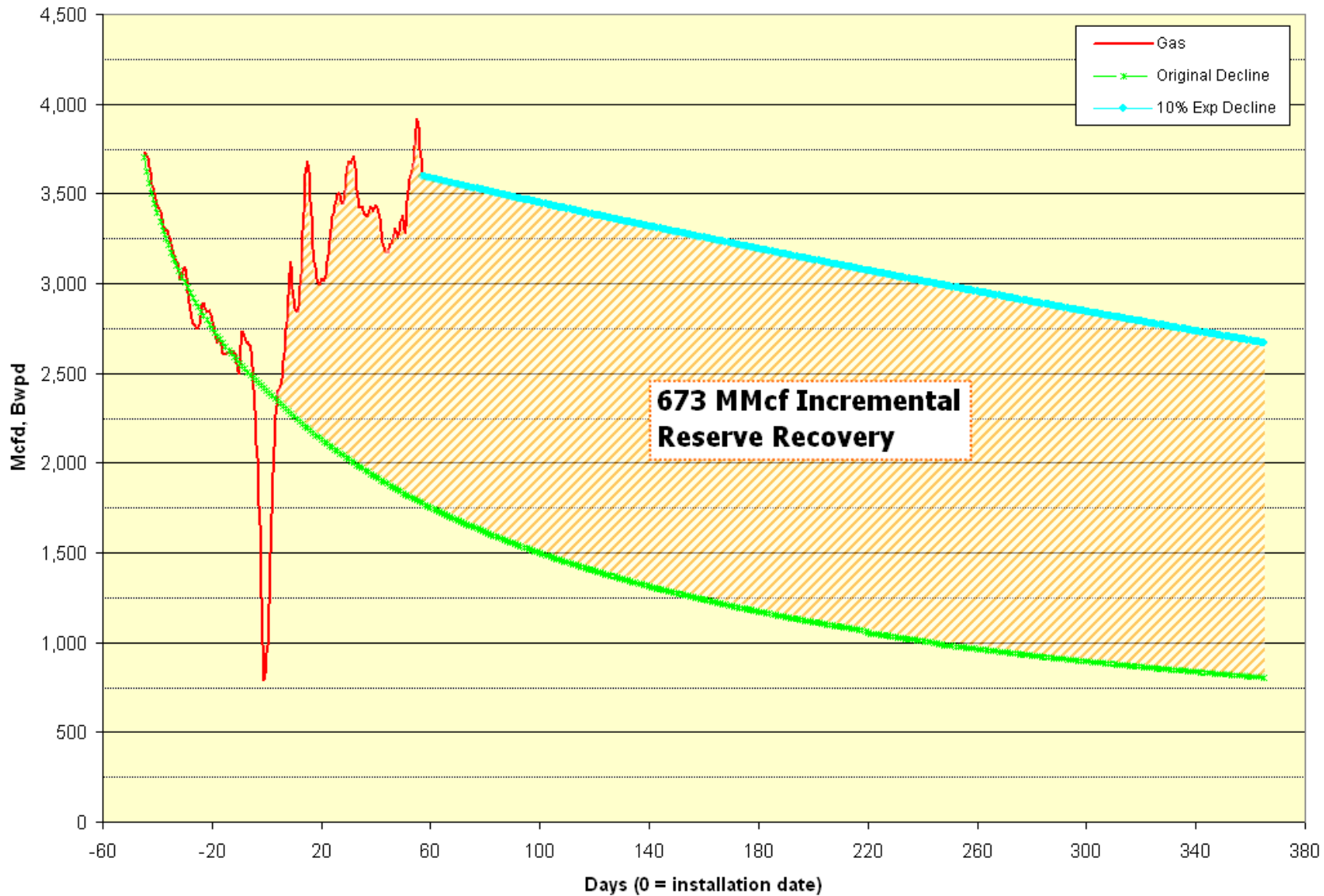
Normalized Gas Lift Results

(12 installations, Normalized 50 days prior to install)



1 Year Incremental Production due to Gas Lift

(12 installations, Normalized 50 days prior to install)



Economic Evaluation – 12 Well Package

\$7/mcf, 75% NRI, 95% WI



- \$1,400,000 capital investment
- 1,800 mcf/d incremental prod = \$287,000/mo
- Net out expenses
 - \$15,000 compression (2,500 mcf/d x \$0.07/mcf /stage x 3 stages)
 - \$23,000 fuel usage (2,500 mcf/d x 4.5% x \$7/mcf)
 - \$30,000 inc. water handling (750 bbl/d x \$1.30/bbl)
- Payout in +/- 6 months

Cotton Valley Gas Lift Summary



- Liquid loading is our #1 problem
- Typecurve analysis can be employed to help select GL candidates and quantify results
- Relatively inexpensive
- Provides highest incremental production
- A full-cycle solution
 - Can be installed with initial tubing and is one of the only AL methods that can produce to depletion
- Goodrich is now running GL whenever feasible on all new completions