2022 GAS LIFT WORKSHOP

Gas Assisted Liquid Lift using Oscillating Pressure (GALLOP)

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ALRDC Gas Lift Workshop
June 20-23, 2022

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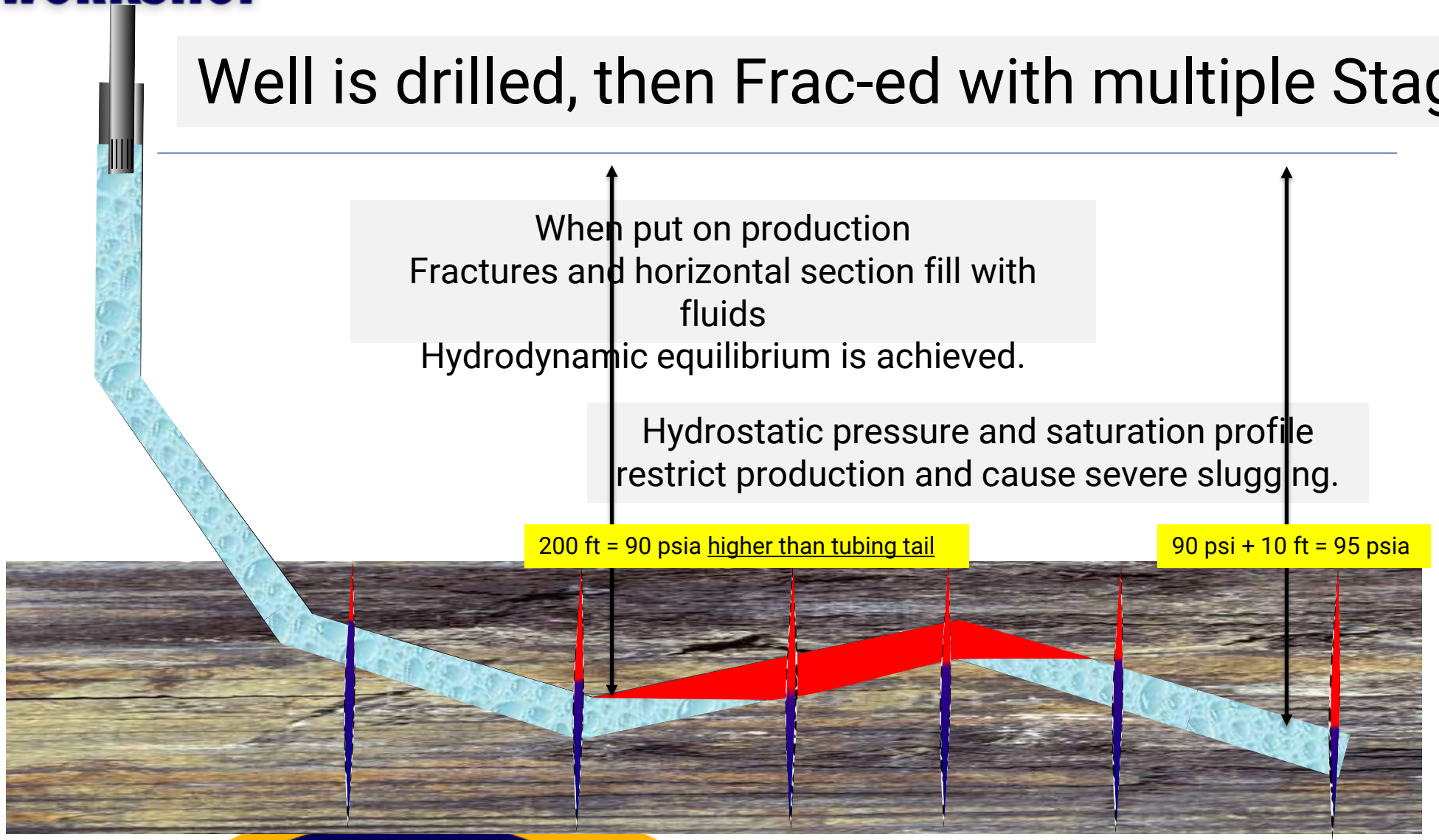
Gas Assisted Liquid Lift Oscillating Pressure

- What happens to a Horizontal Well as it matures.
- Are there examples? / What is the inventory?
- What are the typical options for lifting horizontals?
- What is GALLOP?
- Lab & Field Tests
- Summary & Conclusions

Well is drilled, then Frac-ed with multiple Stages

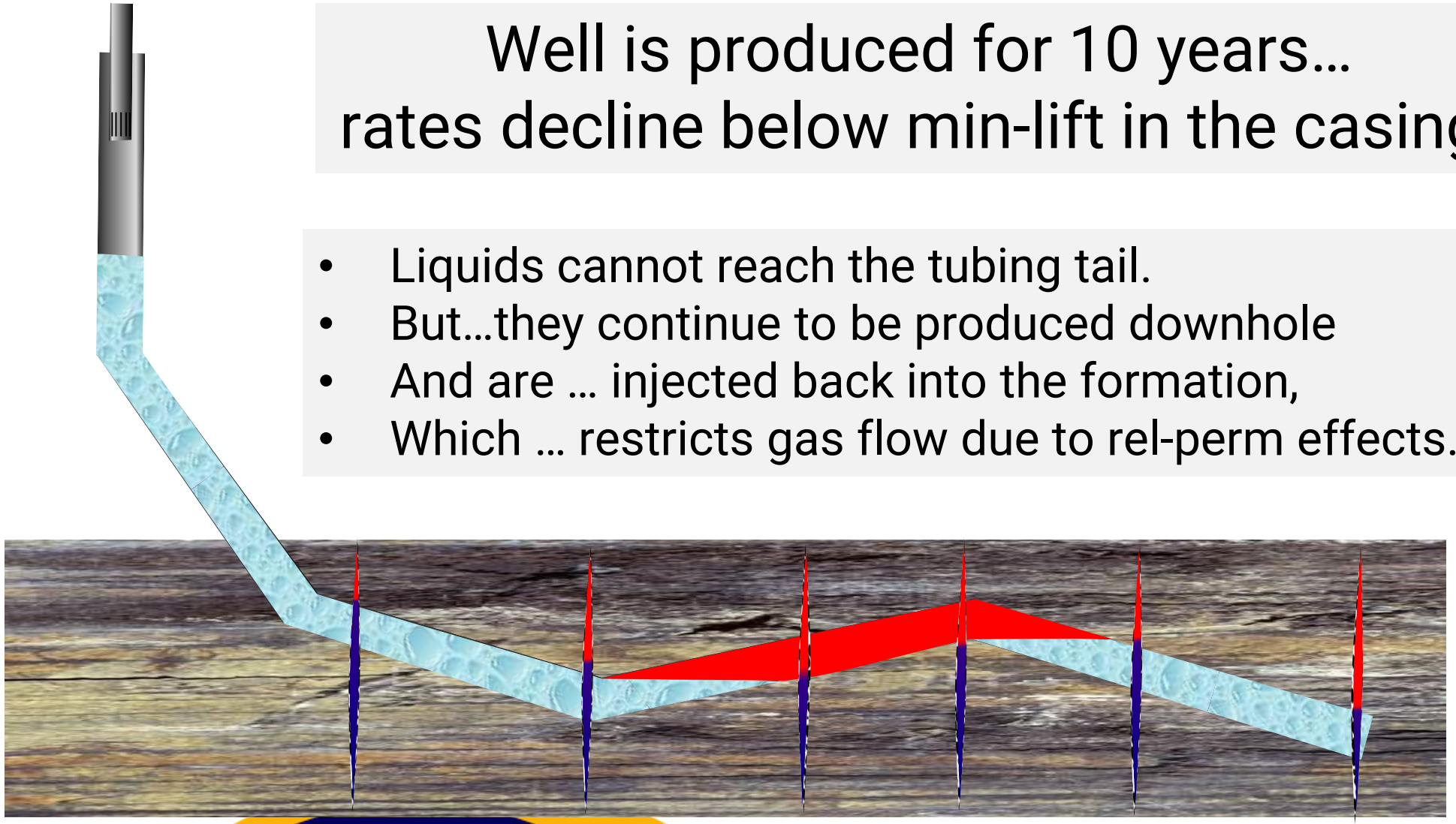
When put on production
Fractures and horizontal section fill with fluids
Hydrodynamic equilibrium is achieved.

Hydrostatic pressure and saturation profile restrict production and cause severe slugging.

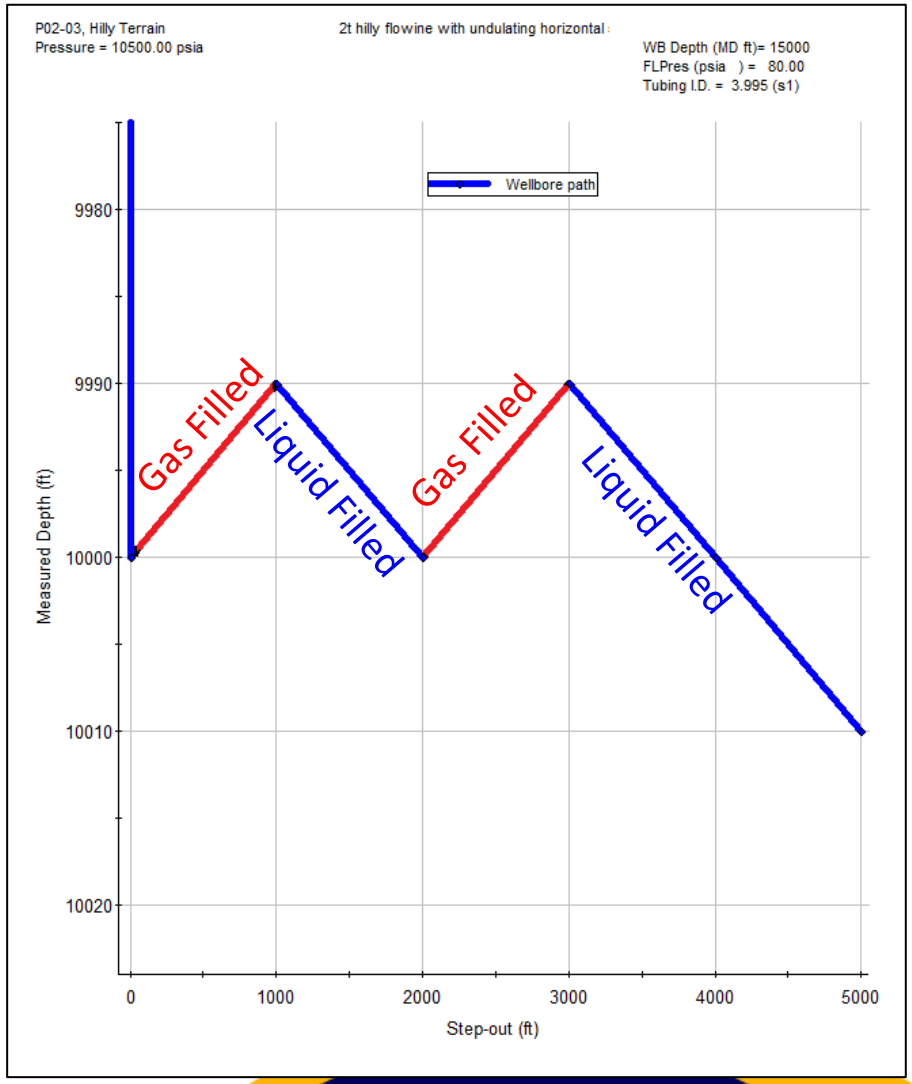


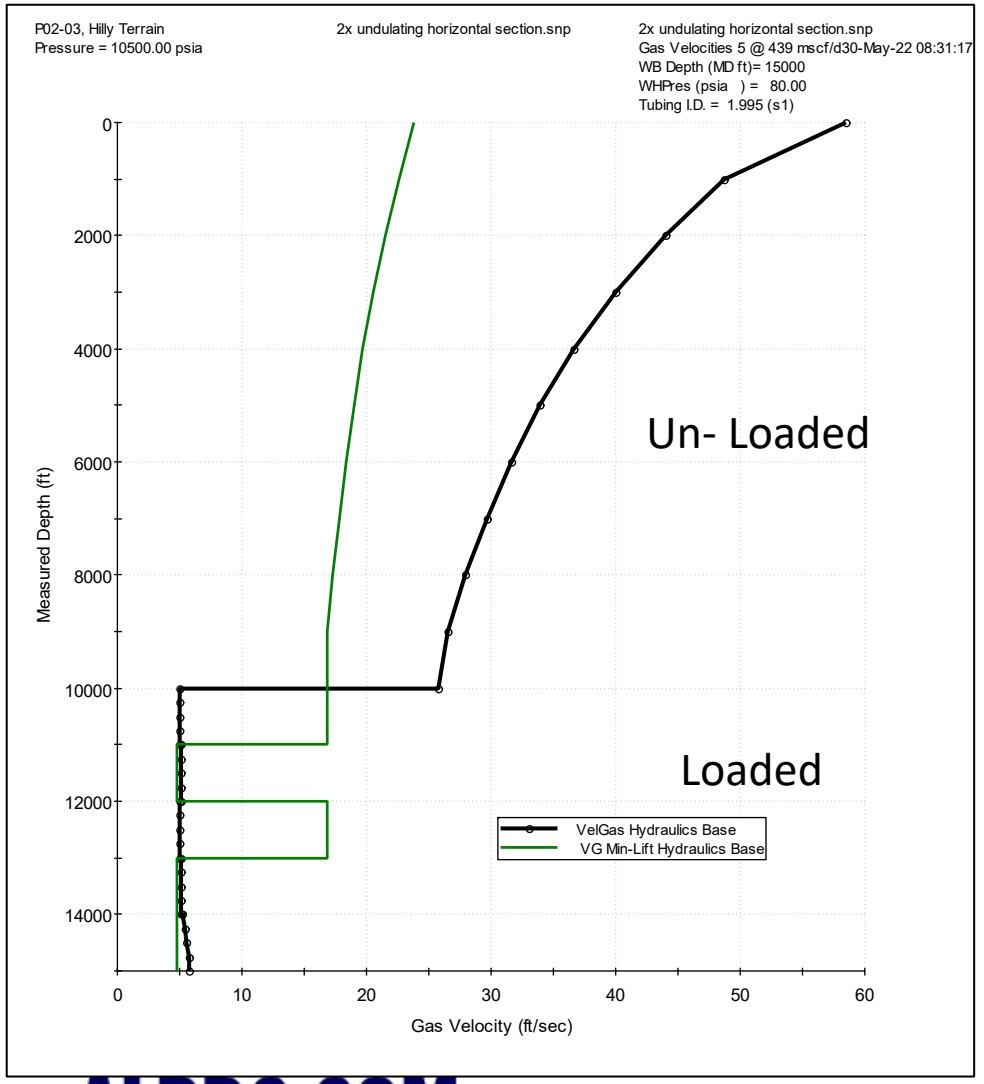
Well is produced for 10 years… rates decline below min-lift in the casing.

- Liquids cannot reach the tubing tail.
- But…they continue to be produced downhole
- And are … injected back into the formation,
- Which … restricts gas flow due to rel-perm effects.

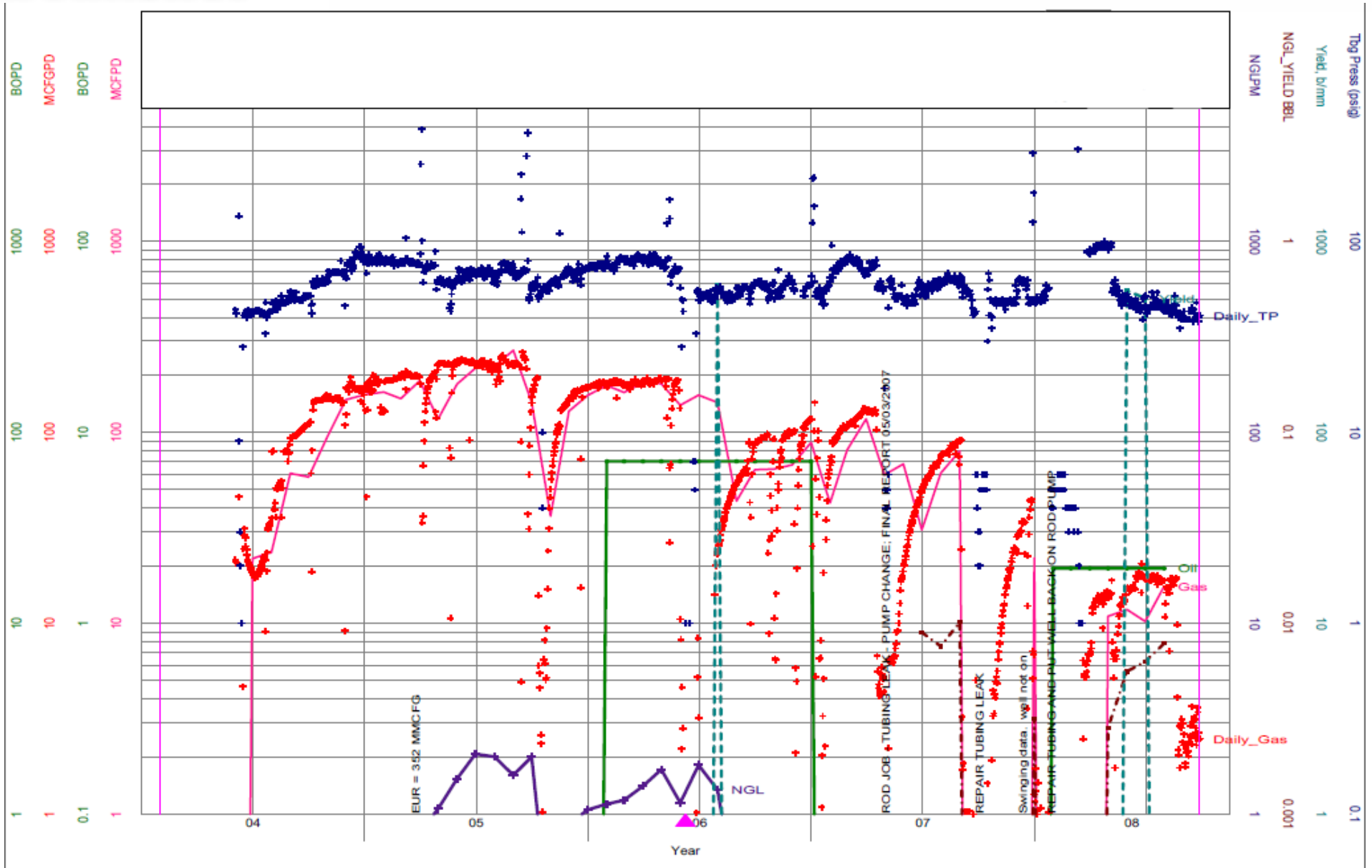


Dynamic Wellbore modelling

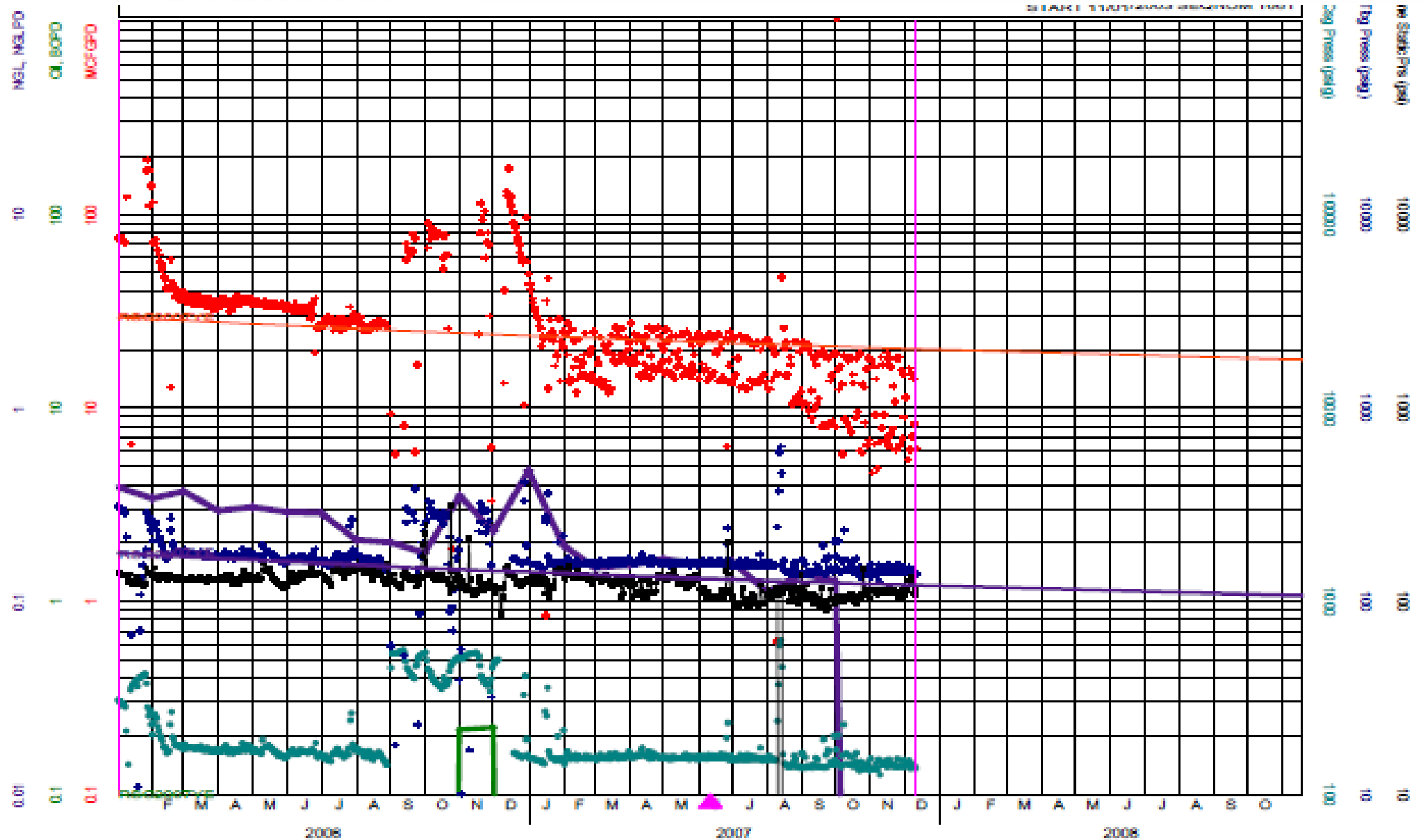




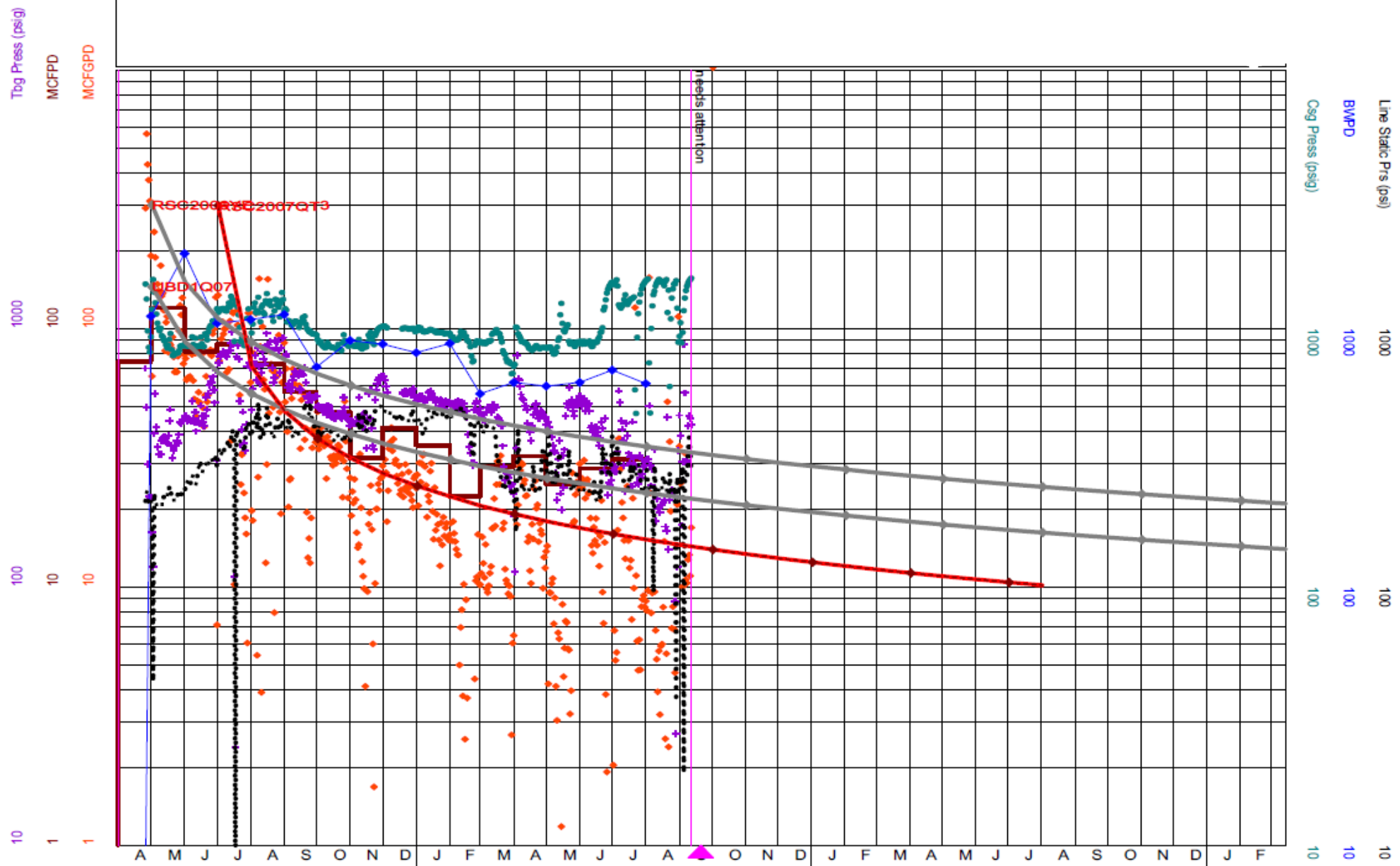
Liquids pushed back into fractures hurt production.



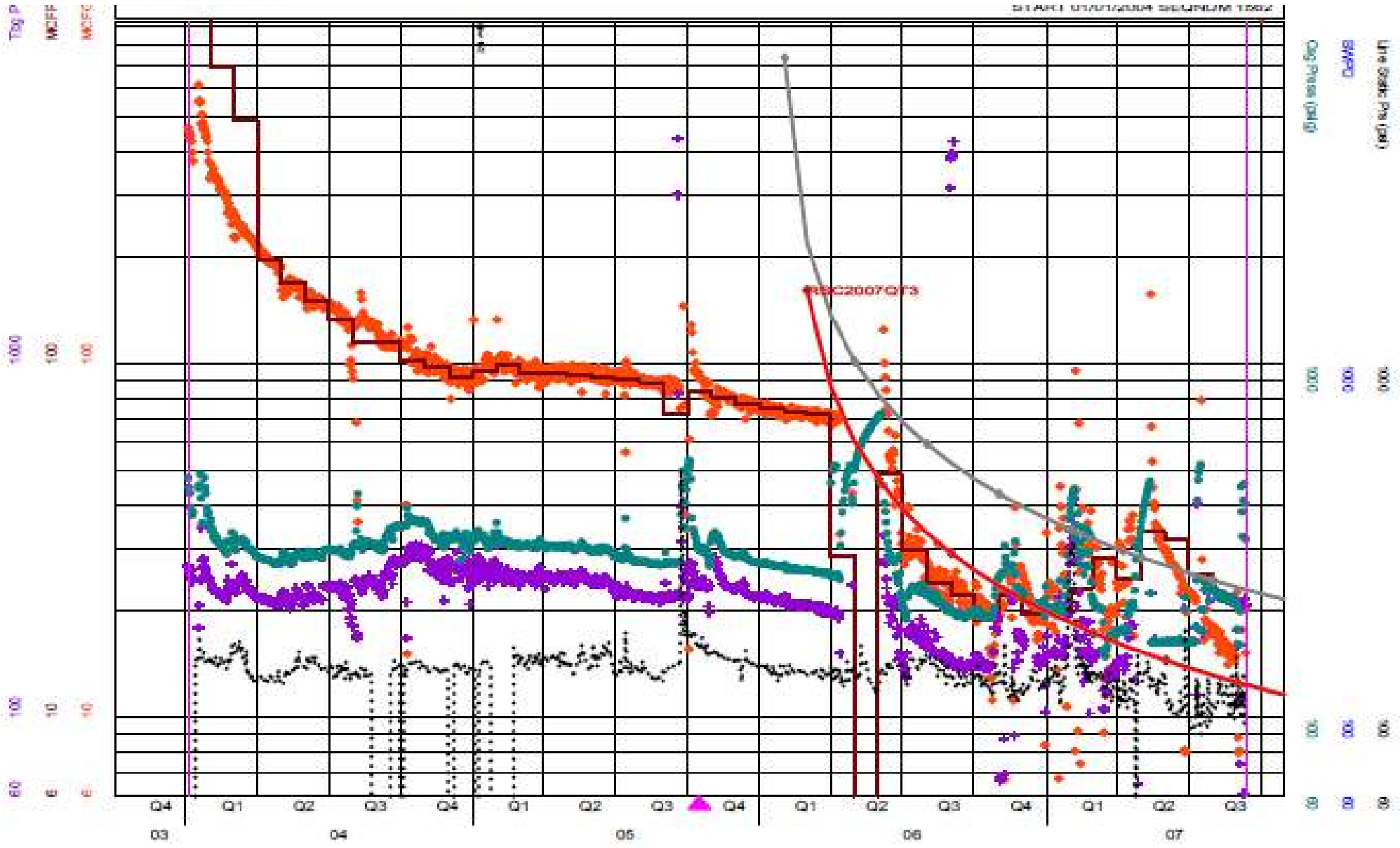
Wells typically show signs of stress before loading up.



Wells will show signs of stress before loading up.



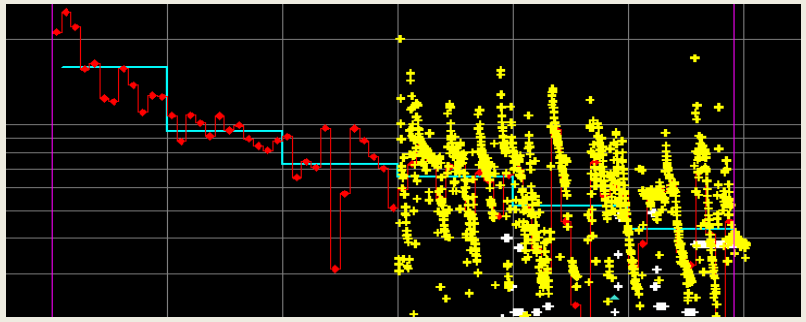
Some wells do not recover after a water loading event.



How can you spot a loading problem?

1. Well is approaching min-lift rates anywhere in the wellbore
   (horizontal section has the largest ID and highest pressure)

2. High frequency data shows surging or cycling gas rates.



Annual Data Monthly Data Daily Data

3. Decreasing (or zero) surface liquid yield.
   (liquids are being left downhole)

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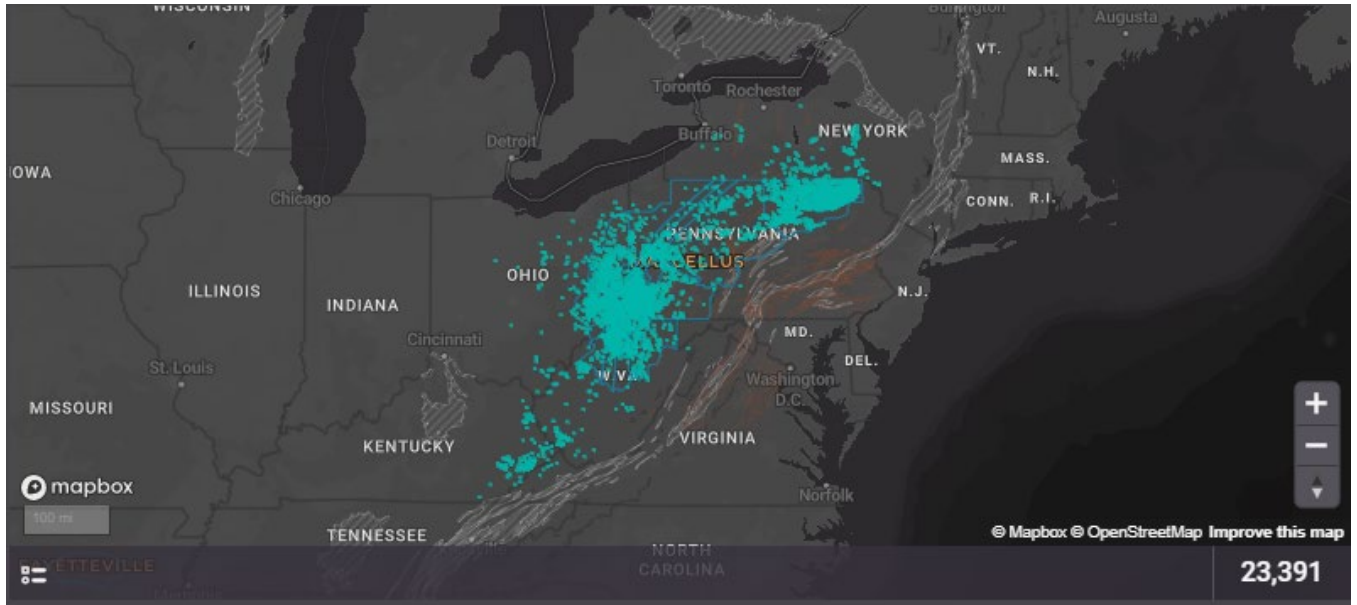
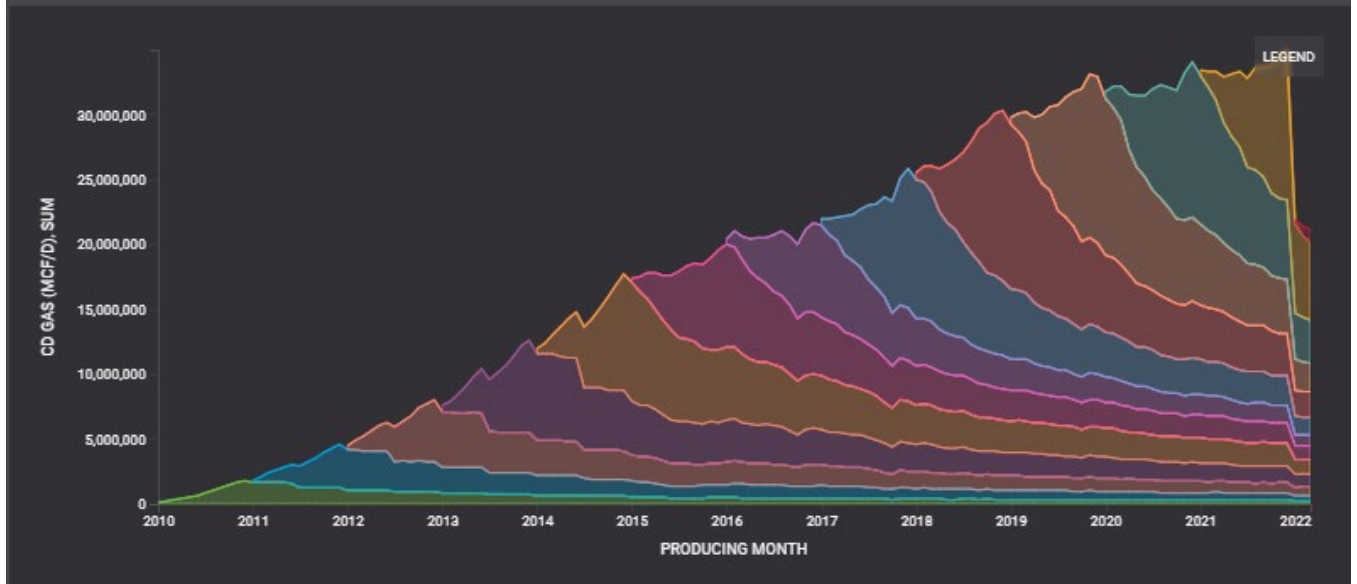
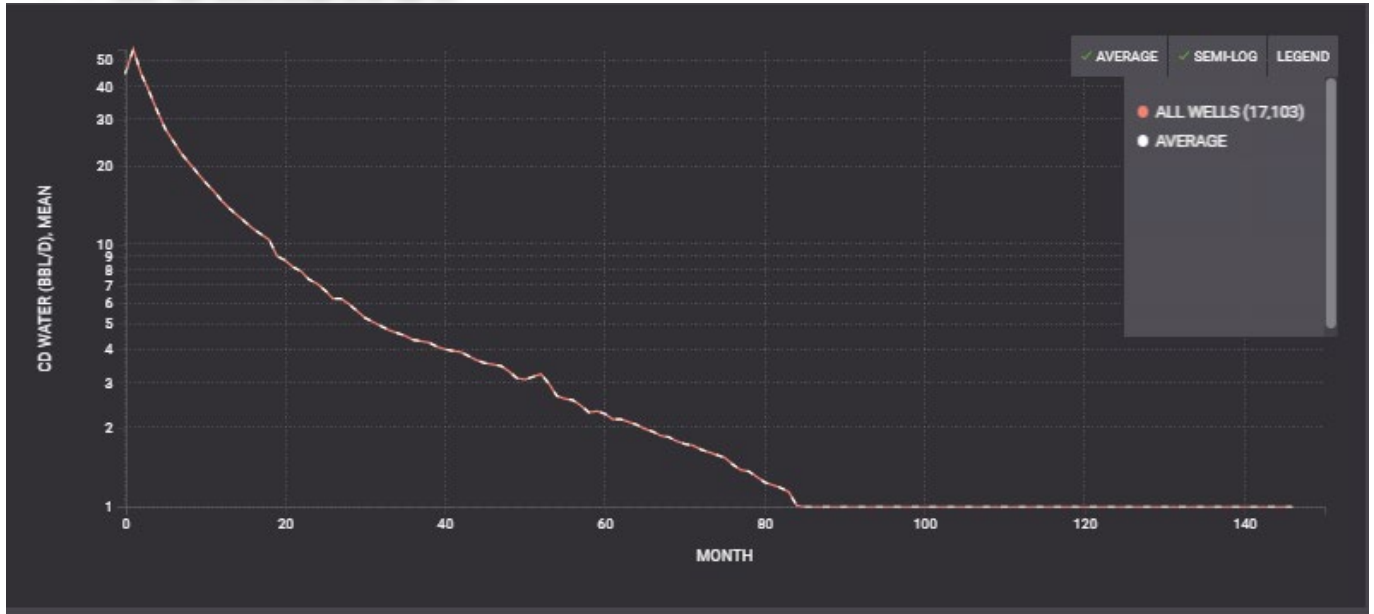
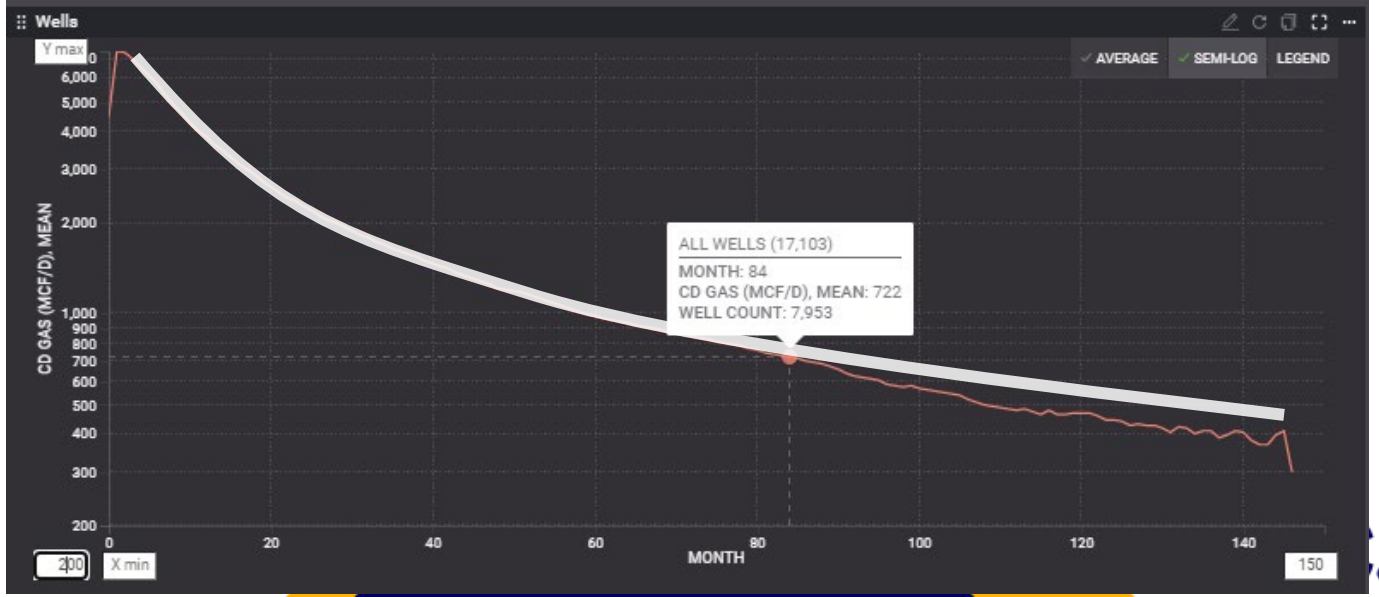
Are any of these wells loading?





Average Water and Gas rates,10+ year old wells…





~100 mscfpd incremental

X $5 / mscf =
$500 / day

X 17,000 wells =
$8,500,000 / day

(Ignoring incremental liquid production)

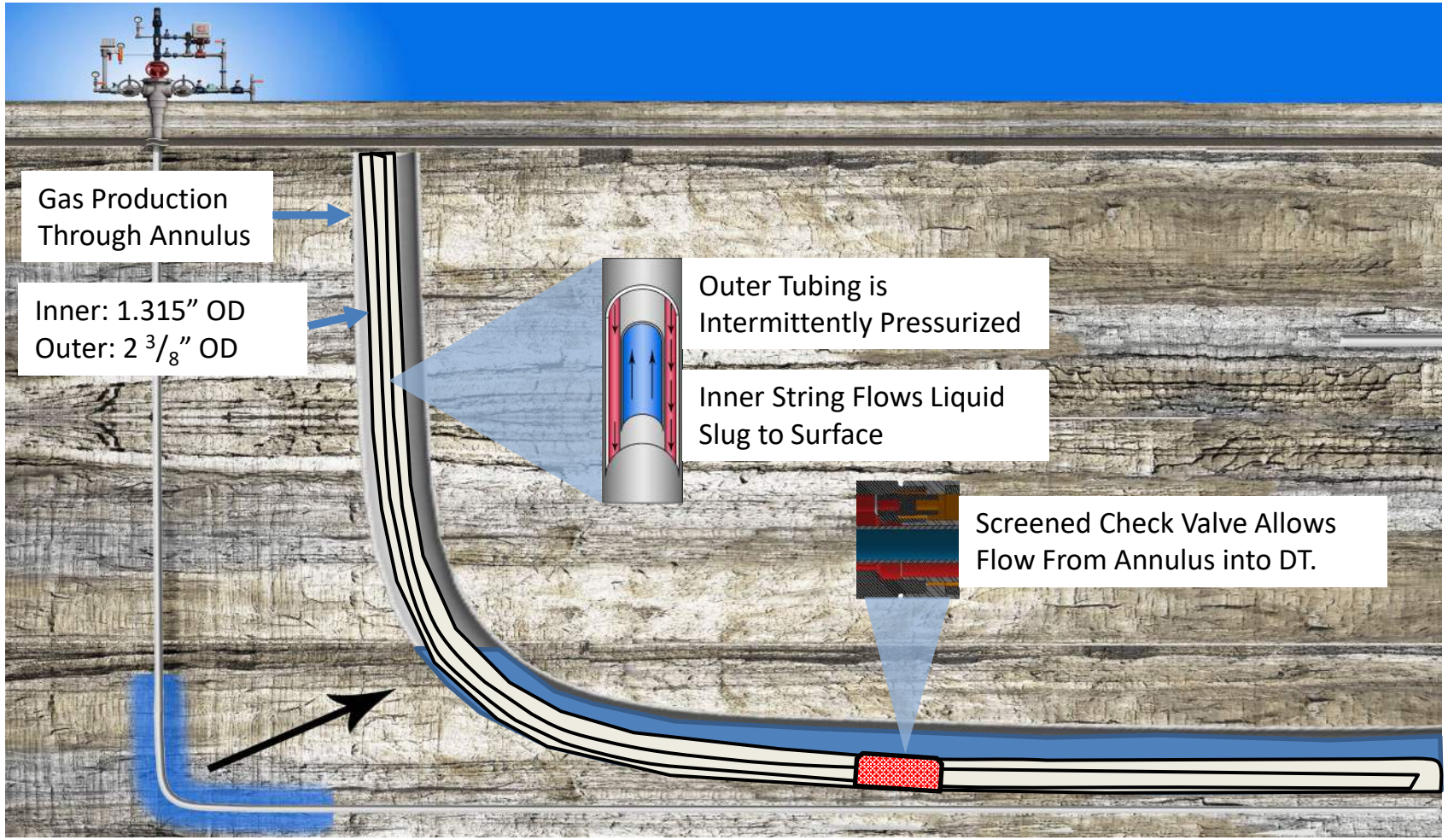
Comparing Lift Methods.

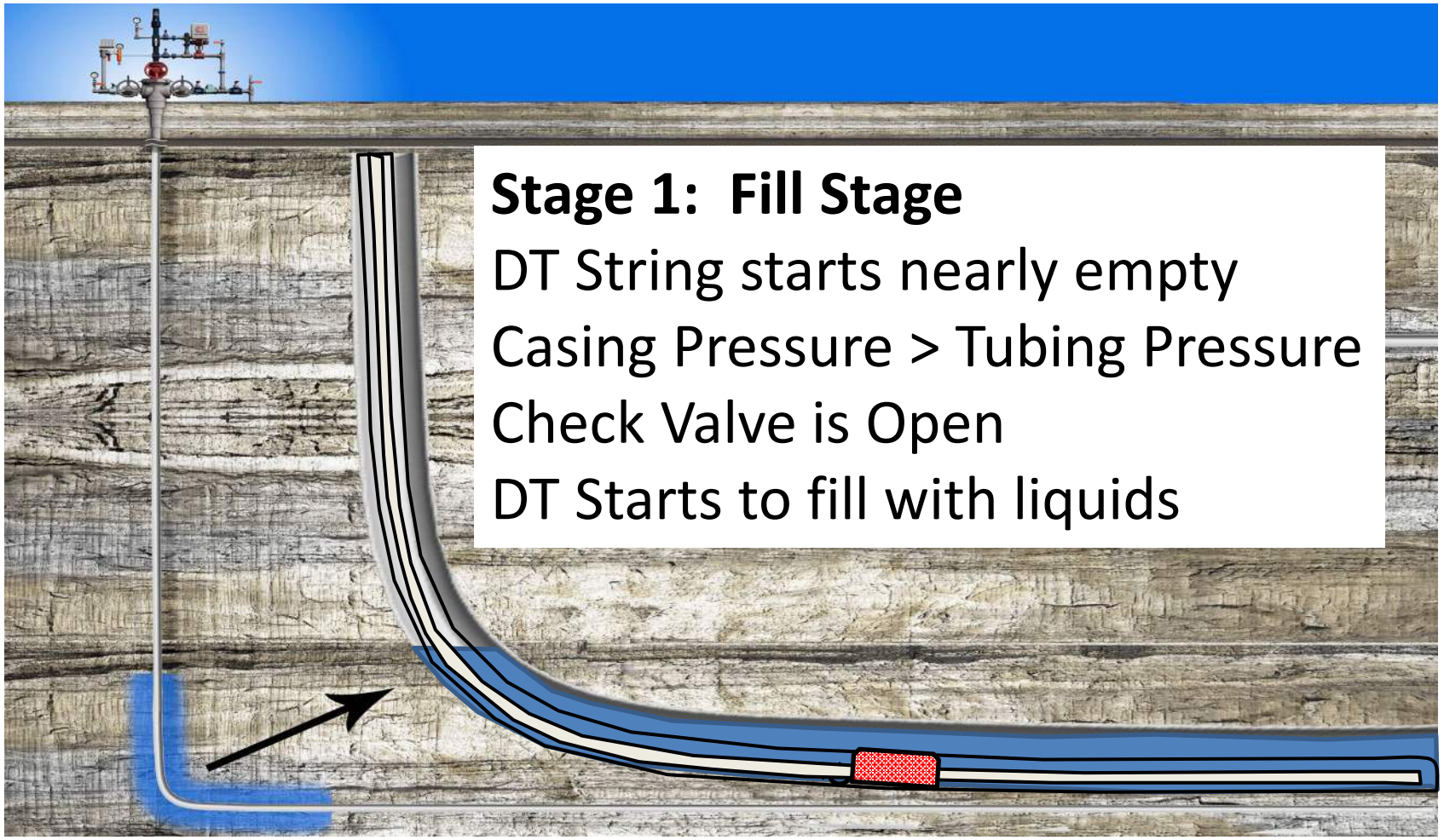
	Natural Flow	Gas-Lift	Sucker Rod Pump	Plunger	PerfLift DeepLift	GALLOP
Typical minimum pressure @ heel (psi above WHP)	500 psi	400 psi	300 psi	300-500 psi	450 psi	30 psia
Flow condition at perforations	Slugging	Slugging / loading	Slugging/ loaded	Cyclic/ Loaded	High velocity gas	Low pressure high velocity
Liquid backflow into reservoir	Maybe	Yes	Yes	Yes	No	No
Well maturity when applicable	<2 years	2+ years	6+ years	7+ years	8+ years	9+ years

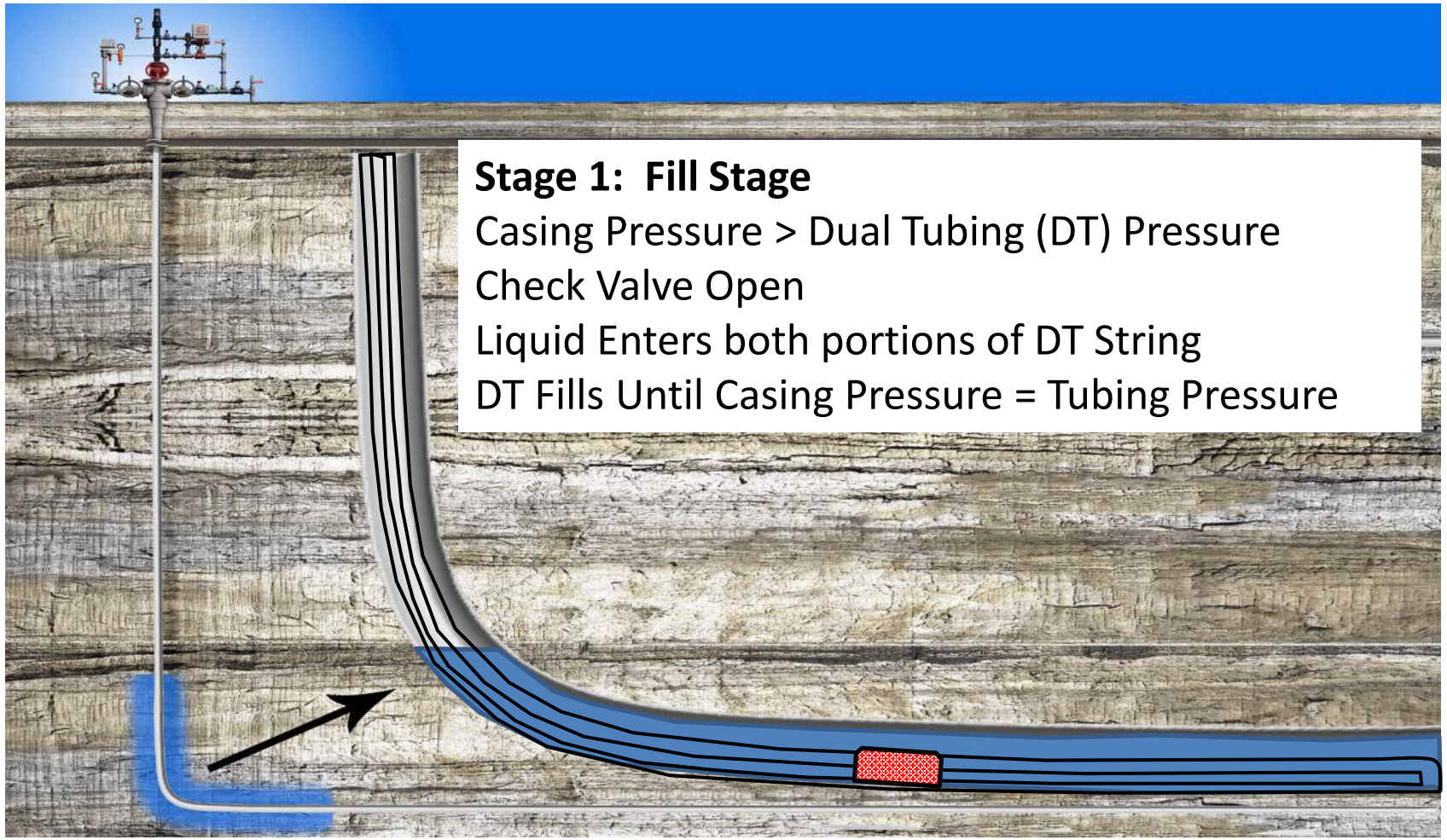
What is GALLOP?

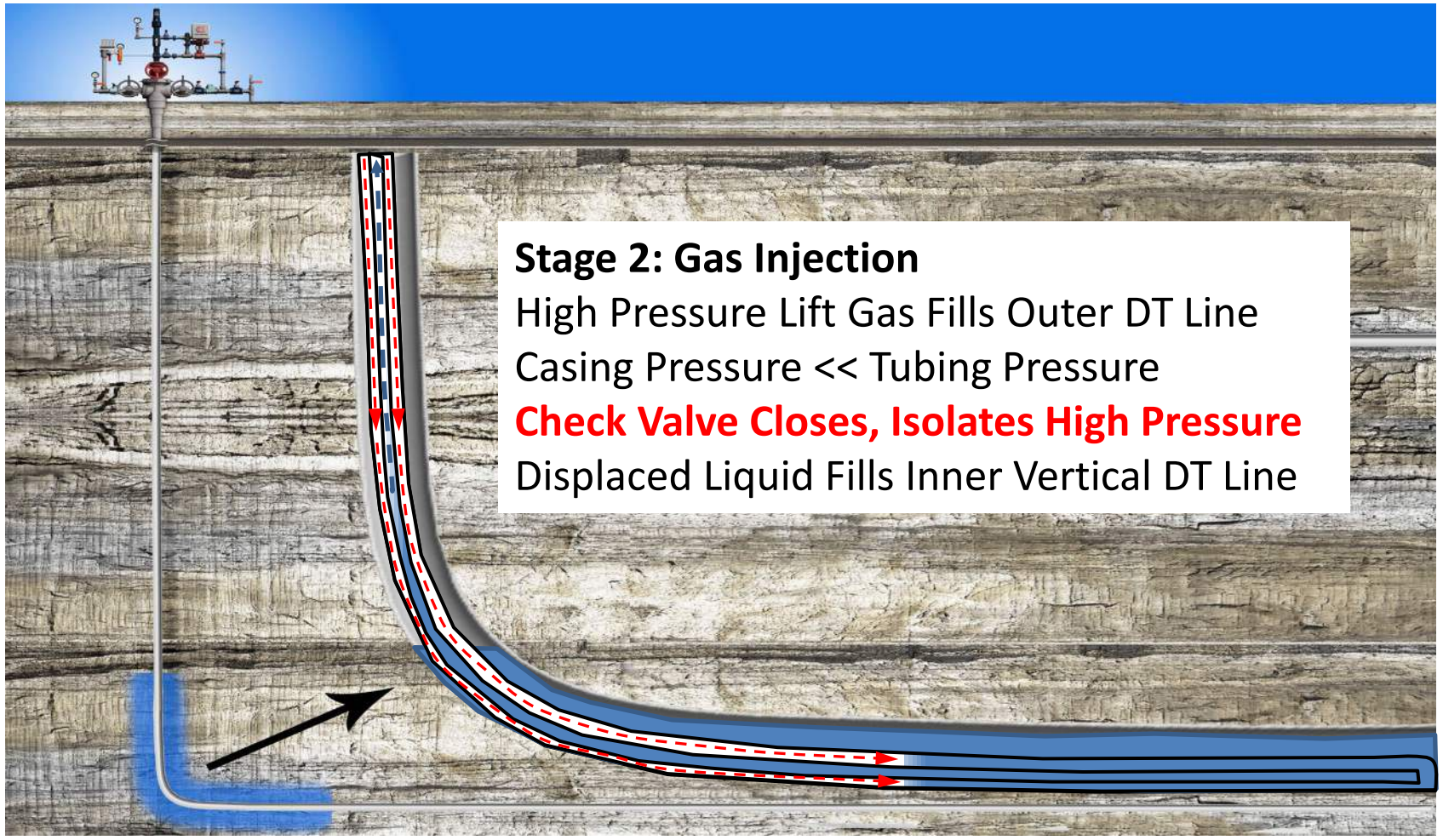
A dual tubing (DT) system that can lift liquids from any point in the horizontal without putting extra pressure on the perfs/fractures.

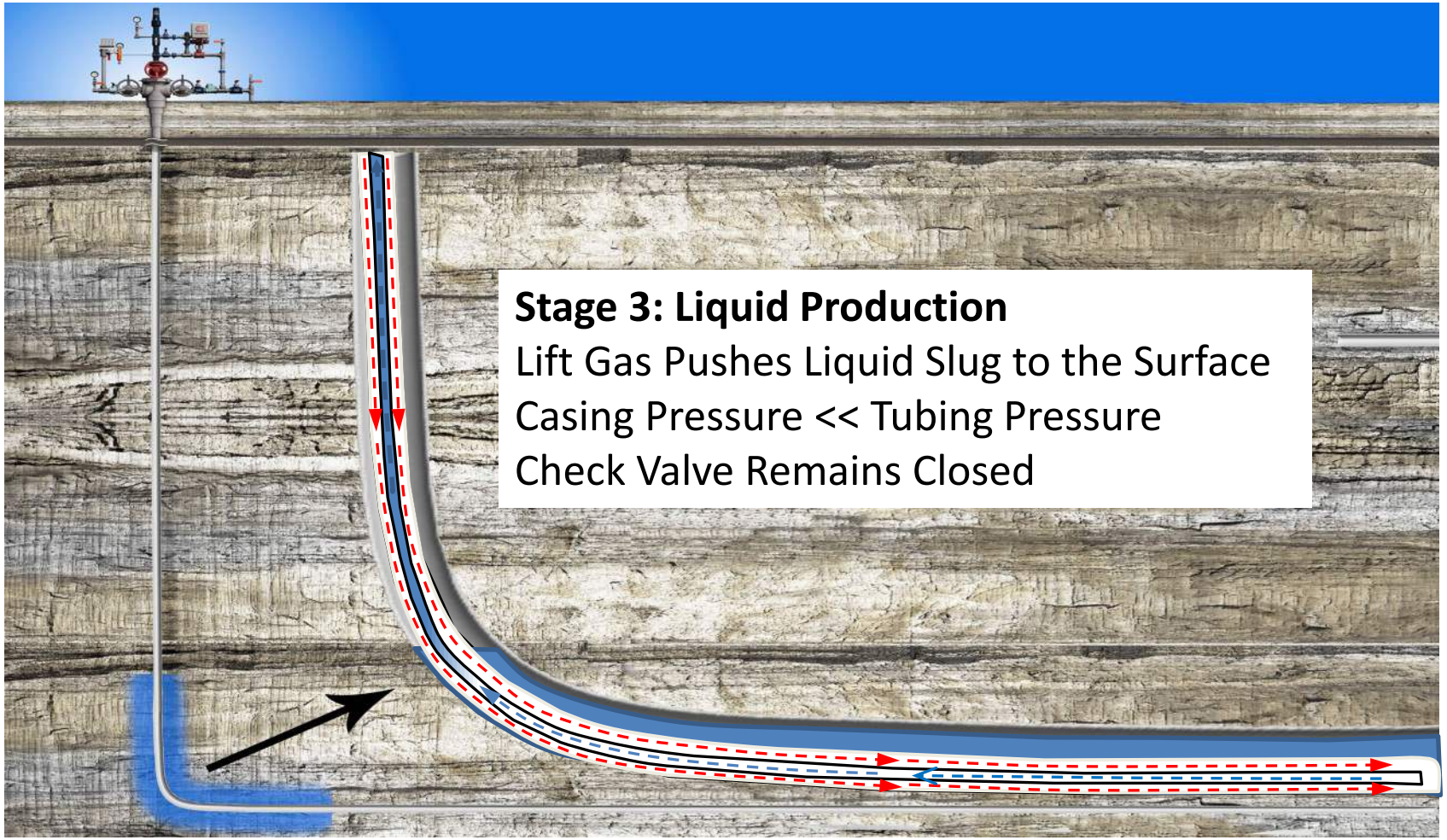
- 4-Stages per Cycle
  - **Fill** – Check valve allows sump liquids to fill horizontal section of DT
  - **Gas Injection** – Pressurized gas is injected into one side of DT at surface
  - **Liquid Production** – Lift gas moves liquid slug to opposite side of DT at surface
  - **Pressure Down** – DT pressure is relieved to Flowline, check valve re-opens
- Original concept used dual Flatpak™ coiled tubing
- Concentric tubing strings are more practical
  - Improved reliability and availability
  - Improved cost

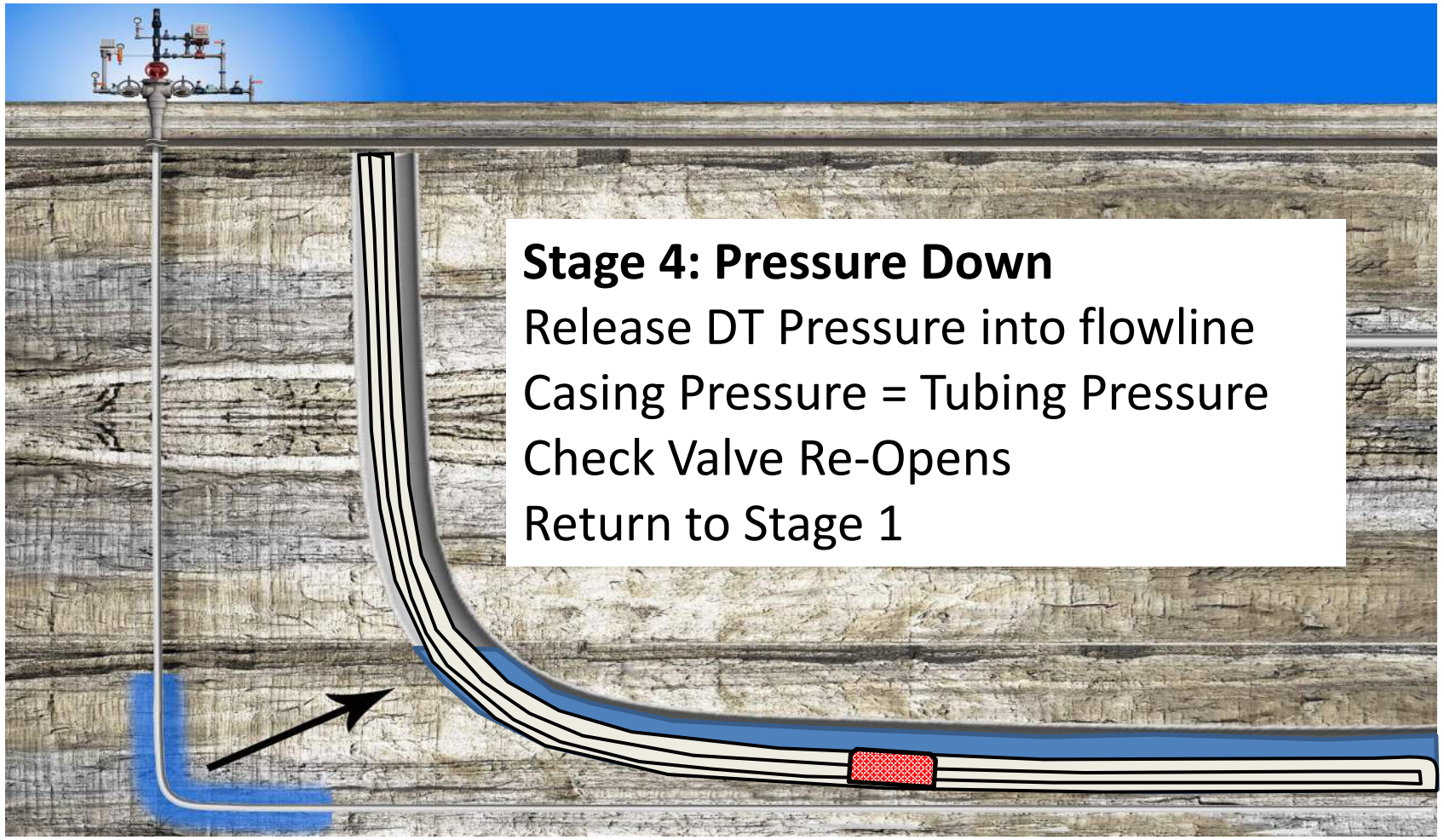

Gas Production Through Annulus
Inner: 1.315” OD
Outer: 2 3/8” OD
Outer Tubing is Intermittently Pressurized
Inner String Flows Liquid Slug to Surface
Screened Check Valve Allows Flow From Annulus into DT.

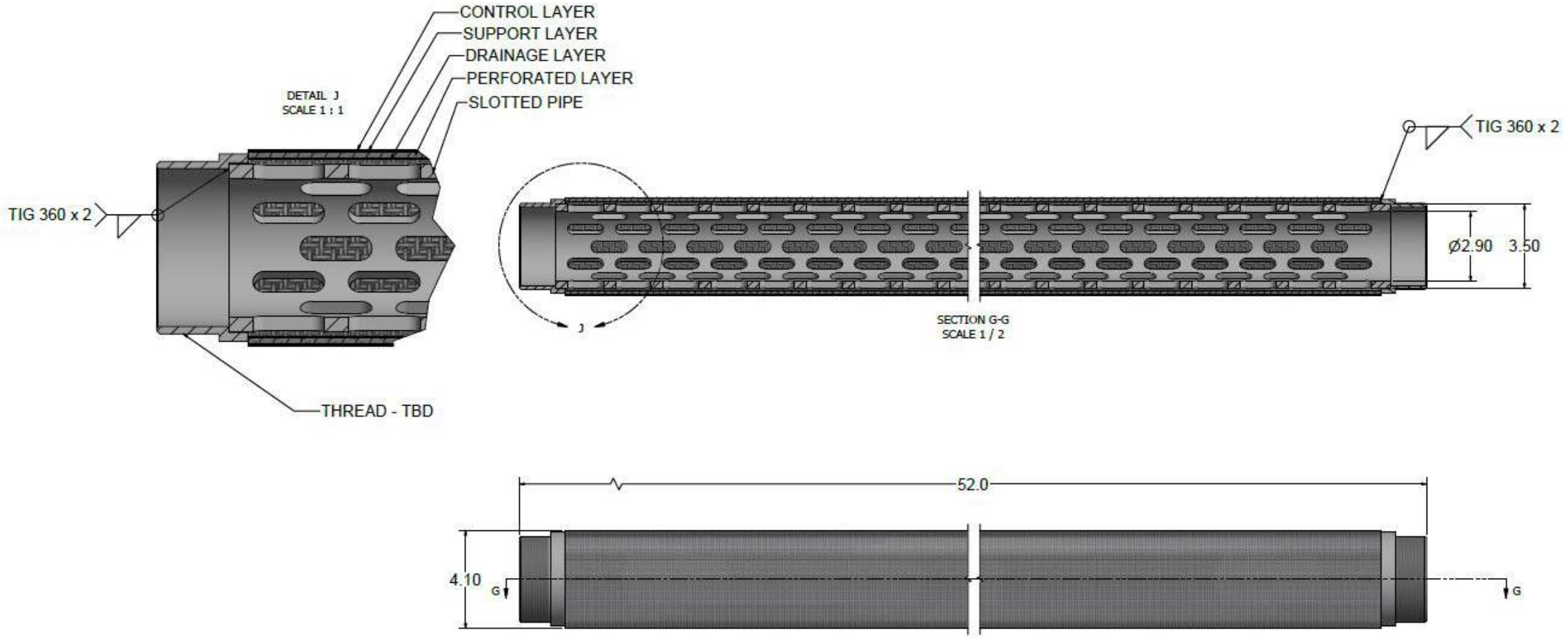

Stage 1: Fill Stage
DT String starts nearly empty
Casing Pressure > Tubing Pressure
Check Valve is Open
DT Starts to fill with liquids


Stage 1: Fill Stage
Casing Pressure > Dual Tubing (DT) Pressure
Check Valve Open
Liquid Enters both portions of DT String
DT Fills Until Casing Pressure = Tubing Pressure


Stage 2: Gas Injection
High Pressure Lift Gas Fills Outer DT Line
Casing Pressure << Tubing Pressure
Check Valve Closes, Isolates High Pressure
Displaced Liquid Fills Inner Vertical DT Line


Stage 3: Liquid Production
Lift Gas Pushes Liquid Slug to the Surface
Casing Pressure << Tubing Pressure
Check Valve Remains Closed


Stage 4: Pressure Down
Release DT Pressure into flowline
Casing Pressure = Tubing Pressure
Check Valve Re-Opens
Return to Stage 1


CONTROL LAYER
SUPPORT LAYER
DRAINAGE LAYER
PERFORATED LAYER
SLOTTED PIPE
DETAIL J
SCALE 1 : 1
TIG 360 x 2
THREAD - TBD
J
TIG 360 x 2
Ø2.90
3.50
SECTION G-G
SCALE 1 / 2
52.0
4.10
G
G

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From the Lab to the Wellbore

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Summary and Conclusions

- Horizontal loading is a known problem, with few proven solutions.
- The inventory of loading horizontal wells grows larger each year.
- GALLOP is not a complex solution, but does require complex piping.
- Field test is in progress. Details are confidential.
- Next steps:
  - –interpret field test data,
  - –identify improvements,
  - –Implement and expand.

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Questions?

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