

Case study: Eagleford Shale, North America

Versa-Drive plug milling service drilled, cleaned out two unique unconventional wells, each in one run, saved \$150k USD

Drilling longer horizontal wells has become common among operators for maximizing production from the reservoir. However, tight lease boundaries can limit the feasibility of this strategy in some acreages mitigating access to parts of the reservoir.

A customer in the Eagleford Shale Basin had two unique wells where a second lateral had been created parallel to the first one in the same formation. Standard unconventional shale wells are generally L-shaped in layman's terms. However, one of their wells resembled a "w"-shaped lateral, while the other resembled a "u"-shape. These extraordinarily shaped laterals were created with the objective of obtaining equivalent treatable lateral lengths in a lease with short widths.

The customer required a thru-tubing service that would drill out 32 frac plugs in the w-shaped well with a measured depth (MD) of 17,846 ft, and drill out 38 frac plugs in the u-shaped well with an MD of 21,064 ft respectively.

The major concern, however, was getting to bottom to drill and clean out all frac plugs to ensure production from all stages.

Baker Hughes recommended a holistic solution that factored in multiple components. **CIRCA™ simulation software** was utilized to provide tubing force analysis and modeling for wellbore hydraulics, solids transport, and optimal well cleaning. The software confirmed that the string

selection used by the coiled-tubing provider would successfully reach total depth (TD). A hole cleaning/solids transport analysis, also performed by the CIRCA software, allowed engineers to plan for flow rates, run-in-hole speed, and wiper trip speed to effectively remove sand and plug debris during operation.

To mill through composite frac plugs and dissolvable frac plugs, Baker Hughes recommended the **Versa-Drive™ plug milling service**, which leverages a full kit of fit-for-purpose tools backed by accurate modeling to reach TD in a single trip, reliable and cost effectively.

The bottomhole assembly (BHA) consisted of a 4 ½-in. sealed bearing tricone bit, a 3 1/8-in. **ULTRAMAX™ ADL workover motor**, flex joint, a **Hydropull™ extended reach tool** and screen sub, a high strength hydraulic disconnect, a quad-flapper back pressure valve, and an external coiled tubing connector for 2 5/8-in. coiled tubing. The wells had 5 ½-in., 23 lb/ft long string.

By selecting Baker Hughes Versa-Drive plug milling service, the operator was able to overcome challenges where conventional technology had previously proved insufficient. Customer expectations were surpassed in all areas—reaching desired depths, going through all stages in each well in one trip, and reducing rig time and associated costs, all with zero health, safety or environmental (HSE) issues.

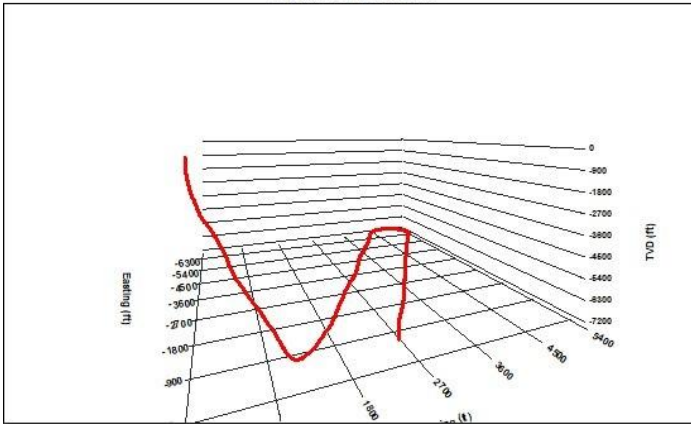
Challenges

- Remove 32 frac plugs in a w-shaped well with one BHA in one trip without NPT
- Remove 38 frac plugs in a u-shaped well with one BHA in one trip without NPT
- Maximize hole cleaning and solids transport
- Drive operational efficiency

Results

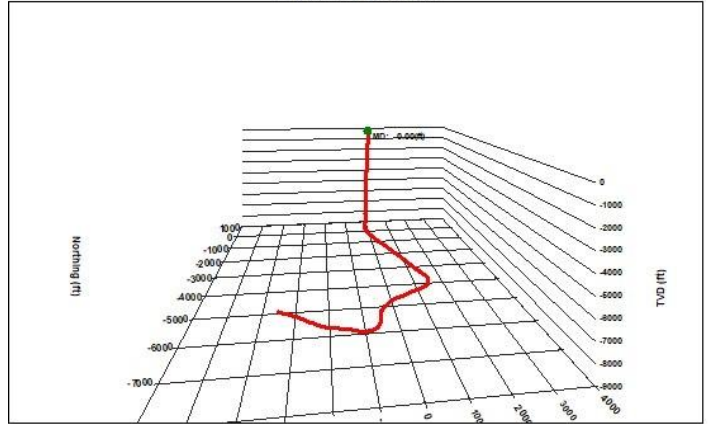
- Saved \$150,000 USD by eliminating an additional thru-tubing fishing BHA run to reach TD
- Experienced no health, safety, and environmental (HSE) issues or nonproductive time (NPT)

3-D Plot Of Well Profile



3-D Line Plot

3-D Plot Of Well Profile



3-D Line Plot

Selected Point

CIRCA software was used to analyze trajectory and tubing force analysis in both u-shaped and w-shaped wells.

Plug drill out and Clean Out Parameters

Parameters	'W' Well	'U' Well
# of plugs	32	38
Wellhead Pressures (avg.)	2,600 psi	4,500 psi
Circulating Pressures	6,500 psi	7,500 psi
Single BHA/Well?	Yes, One Trip	Yes, One Trip
Total Time in Hole	34.9 hrs.	80.2 hrs.
Max Flow Rate	4.5 bpm	5.0 bpm
# of motor stalls	1	0
Total savings	USD 60,000	USD 90,000