HDD ENGINEERED TO MINIMIZE FRAC-OUT IN NEW ZEALAND

By David Horton and Sam Rowdon

HDD crossing of the Tauranga Harbor, New Zealand, for the installation of a new sewer pipeline.

THE PAST DECADES

have seen the rapid development of horizontal directional drilling (HDD) technologies and services for a wide array of applications and locations. Advancements in additives, polymers, equipment for mixing drilling fluid, and even the packaging of the additives have all offered improvements to efficiency in operations while helping to minimize environmental impact.

However, the biggest game-changer in HDD operations has been realizing the full potential that data can offer. Today, innovations have the assistance of simulated drilling scenarios using software. Virtual drilling environments can now be created to optimize the engineering and the planning of projects. Fluid behavior in rheology, hole cleaning ability, and pressure management can also be modeled and predicted with the use of drilling fluid software.

THE TAURANGA HDD CROSSING COLLABORATION

In 2017, AJ Lucas, a trenchless in-stallation specialty company, and M-ISWACO were challenged with drilling two horizontal directional drilling crossings under the Tauranga Harbor, New Zealand at lengths of 1,530 m and 1,560 m to allow for the instal-lation of a 36-in. steel trunk sewer pipeline. The formations ranged from very soft silt, loose sand, stiff silt, and dense sand.

The Port of Tauranga is a natural harbor located in the Bay of Plenty on the North Island's East Coast. It is the only deep water port between the cities of Auckland and Wellington. Since the drilling would take place under a highly sensitive marine environment, extra care had to be taken to prevent the occurrence of hydro-fracture or inadvertent returns into the harbor. Subsurface conditions were known to contain challenges to hole cleaning and borehole stability, and would require a fluid with exceptional rheological properties to complete successfully.

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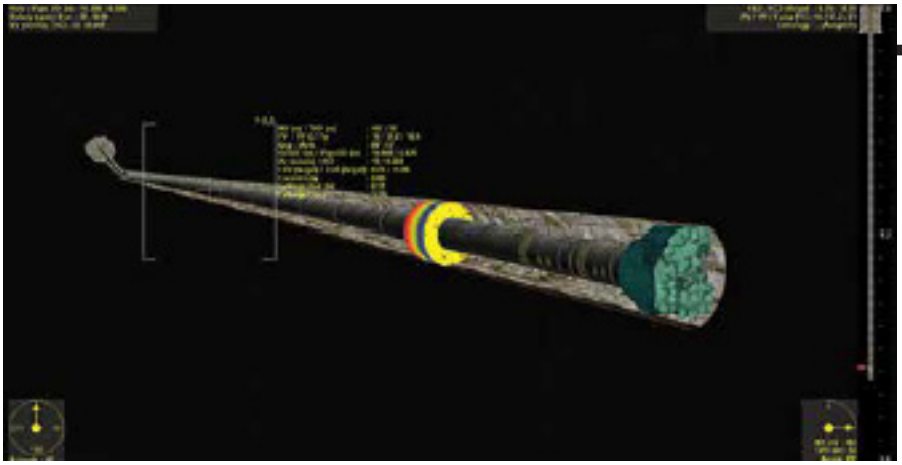

VIRTUAL HYDRAULICS helps maximize drilling fluid performance and minimize drilling costs. The pressure analysis generated by the software was used to mitigate risk of soil failure as a result of hydro-fracture and maintain stability of the borehole.

HYDRO-FRACTURE PREDICTION

To paint a clear picture of the predicted circulating pressures required for hole cleaning on each crossing, VIRTUAL HYDRAULICS drilling fluid simulation software was utilized.

The software is designed to evaluate the critical drilling fluid hydraulics under simulated borehole con-ditions. Multiple scenarios of fluid properties and flow rates were evaluated at the expected rate of penetration to verify if cuttings could be removed fast enough to keep the borehole stable and clean. Different sizes, types, and shapes of cuttings were also considered to further validate results.

The highly shear-thinning DRILPLEX HDD fluid system was selected over a more conventional system for its ability to maximize hole cleaning and minimize circulating pressures.

With the optimized fluid plan in place, circulating pressures could then be analyzed against geotechnical data, an accurate soil model, and the maximum allowable pressure the borehole could withstand to prevent hydro-fracture.

By having accurate predictions of both minimum fluid pressures and maximum soil pressures, the engineers were confident the crossings were engineered for both overall efficiency and environmental safety.

A PLAN CENTERED ON FLUID PROPERTIES AND PRESSURES

In August 2017, AJ Lucas success-fully completed both the 12.5-in. pilot crossings for the mud return and main lines. For the duration of the drilling, the predicted circulating pressures de-termined by the VIRTUAL HYDRAULICS software closely matched the actual recorded circulating pressures.

As a result, full fluid returns were maintained for the duration of drilling, and hydro-fracture did not occur. The shear-thinning and hole cleaning ability of the DRILPLEX HDD fluid system was displayed as actual circulating pressures recorded throughout drilling of the pilots never exceeding the predicted circulating pressures. Together, the engineering teams were able to utilize sophisticated planning tools resulting in a successful and safe operation.

High productivity levels and increased efficiencies can be achieved in HDD operations when the right information is put in the right hands at the right time. This is only possible if technologies are backed by technical knowledge and teamwork.

Combining technology with new ways of working and advanced inte-grated systems offers many new exciting opportunities for HDD going forward.

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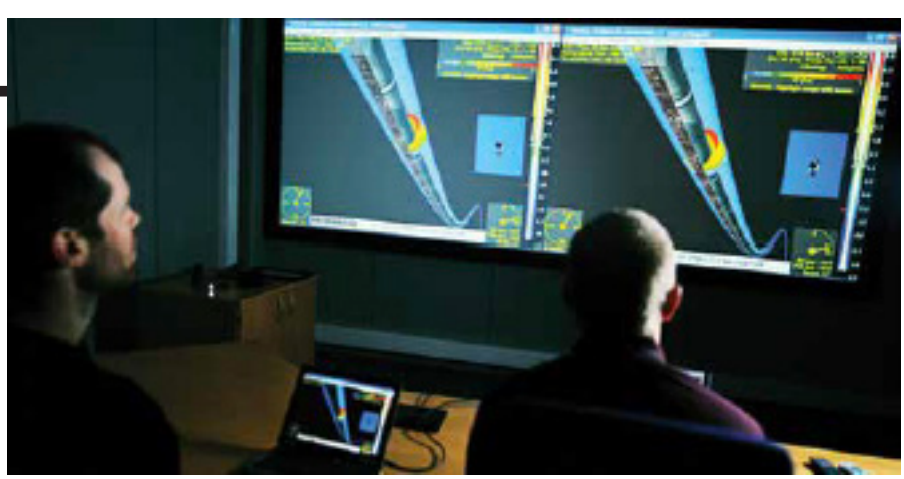

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