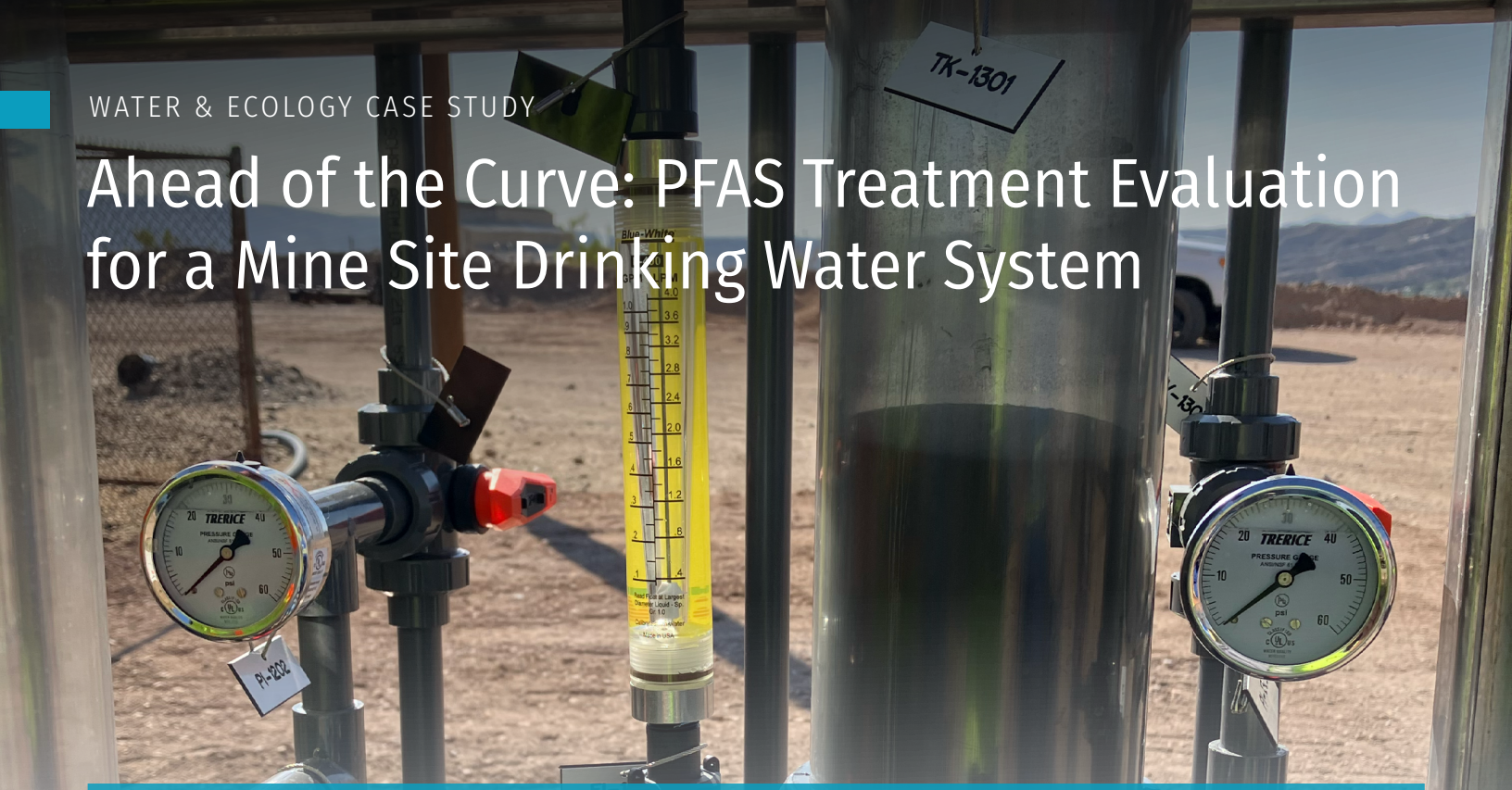
WATER & ECOLOGY CASE STUDY

Ahead of the Curve: PFAS Treatment Evaluation for a Mine Site Drinking Water System



CHALLENGE

A remote copper mine in the southwestern U.S. detected PFAS compounds in its drinking water system. With regulations evolving and workforce safety at stake, the mine needed a proactive treatment strategy before compliance deadlines forced their hand.

SOLUTION

WestLand, a Trinity Consultants team, evaluated treatment technologies against site-specific water chemistry, and conducted a pilot study using adsorptive media-filled columns equipped with dual effluent sampling ports to accelerate performance data acquisition and shorten the study duration. Two media were tested, GAC and FS-200.

RESULT

The pilot study confirmed both media as effective for PFHxS removal, with GAC breakthrough at ~20,000 bed volumes and FS-200 at ~50,000. Completed in under six months, preliminary cost estimates favor FS-200 at ~$100,000 less than GAC for full-scale design.

PROACTIVE PFAS TREATMENT AT A REMOTE MINING FACILITY

A remote copper mine in the southwestern U.S. operates its own public water supply (PWS) system for its on-site workforce—a common arrangement at isolated mine sites. Though the facility no longer actively mines ore, it is responsible for the safety of its smelter and environmental workforce, including the provision of safe drinking water.

In 2023, anticipating tightening EPA regulations around per- and polyfluoroalkyl substances (PFAS), the facility proactively sampled its drinking water wells. PFAS compounds were detected—not at extreme concentrations, but sufficient to warrant the need for mitigation. Rather than waiting for a regulatory notice to act, the facility engaged WestLand, a Trinity Consultants team, to develop a treatment evaluation and pilot study.

There are approximately 40 different PFAS compounds in the environment, each behaving differently depending on water chemistry and treatment approach. Because these compounds are chemically persistent and not biodegradable, they have accumulated in groundwater over decades—and are now appearing in drinking water systems that were never previously required to monitor for them. This project illustrates how a proactive, data-driven approach can help facilities navigate such challenges efficiently and cost-effectively.

Trinity Consultants WestLand

CHALLENGE

Having identified PFAS in its drinking water supply, the mine faced a treatment decision complicated by the evolving regulatory landscape. At the time, only seven PFAS compounds had proposed maximum contaminant levels (MCLs) and PWSs were encouraged to initiate monitoring for PFAS but not yet mandated to treat; however, given the elevated levels of PFHxS detected and the desire to protect the workforce, the environmental manager chose to act.

The technical challenge of treating PFAS is significant. Given differences observed in the physiochemical behavior of the many PFAS compounds in a given environment, selecting the right treatment approach requires rigorous evaluation. WestLand assessed three primary treatment technologies: granulated activated carbon (GAC), anion exchange, and reverse osmosis (RO). Each presents distinct trade-offs in footprint, operational cost and complexity, and waste management. RO, while comprehensive, demands highly trained operators and generates a concentrated waste stream requiring additional handling—a poor fit for a remote site. Anion exchange was ruled out initially due to the site's elevated sulfate concentrations, which were expected to compete with PFAS for adsorption sites, reducing effectiveness and increasing media replacement frequency. Initially, GAC emerged as the most viable path forward.

SOLUTION

WestLand developed a comprehensive sampling plan for the mine's drinking water supply wells and conducted a high-level evaluation of treatment costs and methods before confirming the GAC adsorption approach. Prior to initiating the pilot study, pre-study modeling was performed using EPA tools, which predicted PFHxS breakthrough for GAC at approximately 7,000 gallons treated.

The pilot study used vendor-supplied column systems configured to sample at three points: the influent, an intermediate sampling port set at approximately 25% the column bed depth, and the effluent. The inclusion of the intermediate sampling port—recommended by regulators—was a deliberate design decision. By observing breakthrough earlier in the column, the team was able to significantly compress the study timeline without sacrificing data quality. The team was also able to test a second, surface-modified bentonite adsorptive media, FS-200, known to effectively treat PFHxS, within the same timeframe.

RESULT

Treatment of the mine's water with GAC produced results that diverged meaningfully from pre-study modeling. Initial PFHxS breakthrough occurred at approximately 20,000 gallons—nearly three times the EPA model's 7,000-gallon prediction. Had engineers designed a full-scale system based solely on the model, it would have been significantly oversized, inflating capital costs unnecessarily. This reinforced a core principle of WestLand's approach: models provide a useful starting point, but pilot studies using site water allow engineers to capture the actual physio-chemistry occurring in the system enabling more appropriate full-scale design.

FS-200 demonstrated superior PFAS removal, with initial breakthrough at 50,000 bed volumes versus 20,000 for GAC—nearly twice the adsorptive capacity. Operational issues emerged during the study, including high pressure buildup, frequent backwashing, media clumping, and discoloration. Scanning electron microscopy and elemental analysis revealed accumulation of iron, barium, and magnesium, indicating site water chemistry was physically altering the media. Prefeasibility cost estimates nonetheless favor FS-200, at approximately $100,000 less than GAC for full-scale design. Detailed engineering will address the anomalies observed to ensure treatment effectiveness is not compromised.

The intermediate sampling port proved its value throughout: without it, breakthrough observation at the effluent alone could have extended the study beyond a year. With it, the team reached actionable conclusions in approximately six months—and the facility is now equipped with site-specific data to inform accurate system sizing, media replacement frequency, and lifecycle cost projections.

ABOUT TRINITY CONSULTANTS

Trinity Consultants, a leading global environmental consulting firm, provides services and solutions in the EHS Regulatory Compliance, Built Environment, Life Sciences, and Water & Ecology markets. Founded in 1974, Trinity has the technical expertise, industry depth, and capabilities to help clients achieve their goals across the natural and built environments.

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