REGENESIS®

Remediation of TCE Plume Speeds Sale of Brownfield Site

Monitoring Confirms TCE Reduced 99.7% for 4.5 Years Following Low-Pressure Injections of Sulfidated ZVI

Highlights

Site Type:
Industrial

Project Driver:
Site redevelopment

Contaminants:
TCE - 26,000 µg/L maximum

Geology:
Low-permeability sands and silty sands

Treatment:
In situ chemical reduction

Technologies:
Sulfidated, micro-scale zero valent iron

Low-Pressure:
Pressures maintained below 80 psi throughout application

Regulatory Needs:
Regulatory agencies required a low-pressure approach to avoid uncontrolled fracturing

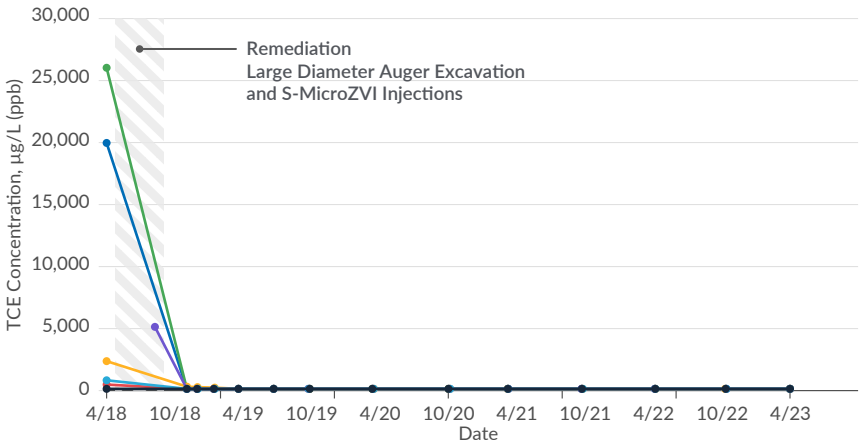
Summary

At a former manufacturing site in Fullerton, California, a trichloroethylene (TCE) plume in groundwater prevented the sale of the brownfield site despite past remediation efforts, including excavation and thermal treatment. Within a month following the completion of a combined remedy incorporating large-diameter auger (LDA) excavation and injection of 50,000 gallons of S-MicroZVI®, TCE concentrations were reduced by an average of 98.5%, facilitating the property's sale and redevelopment. Through 4.5 years of monitoring, TCE remains at 99.7%, reduced in the treatment zone, confirming the remediation's long-term effectiveness.

S-MicroZVI is designed for injecting under low pressure, which avoids fracking in the subsurface, leading to regulatory approval of the approach.

Results

- **Average TCE concentrations reduced by 98.5% within 1 month**
- **TCE maintained a 99.7% reduction through 4.5 years of monitoring**



Project Timeline

- **2013-2016**
  Previous remedial efforts are completed including thermal and excavation
- **May-August 2018**
  Large diameter auger excavation takes place
- **September 2018**
  Hargis + Associates gain approval to inject ZVI under low pressure
- **September-October 2018**
  S-MicroZVI injections conducted
- **November 2018**
  Post-injection monitoring begins, showing TCE Reduced below required levels
- **March 2023**
  Quarterly post-injection groundwater monitoring shows TCE reduced by 99.7% through 4.5 years post-injection

Background

Uniquely Challenging Site Conditions

This location was a former manufacturing site. TCE was used onsite and historic spills and leaks created a groundwater plume. Remediation of the plume was required in order to complete a real estate transaction.

The site lithology consisted of low to medium-permeability sands and silty sands. In the deeper zones, the lithology became finer with less permeability. Previously, ZVI was injected into the plume using pressures exceeding 200 pounds per square inch (psi). Consequently, Hargis + Associates to conduct additional ZVI injections, regulatory agencies required a lower-pressure remedial application to avoid uncontrolled fracturing of the subsurface near the existing buildings. These injections would occur in a groundwater source area that was previously inaccessible to remedial injections.

Treatment

Unique ZVI Product Chemistry Provides A Perfect Low-Pressure Solution

Application Details

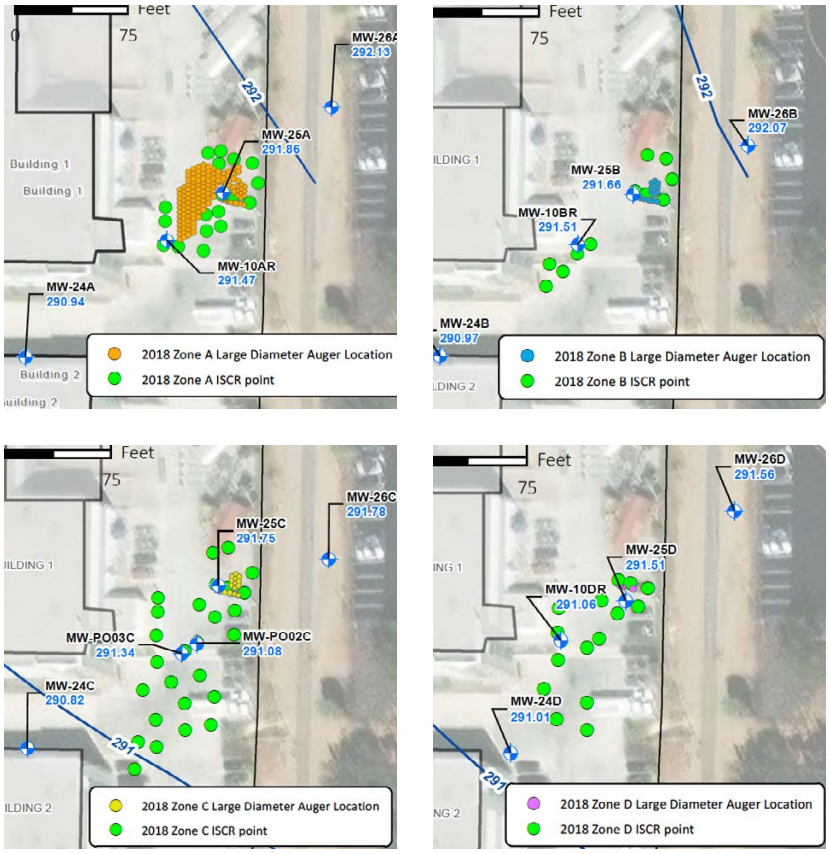
Amendment	S-MicroZVI
Quantity	50,000 gal.
Application Pressure	80 psi
Flow Rate	1-8 gpm
Injection points	37
Injection interval	10-80 ft bgs

Due to the regulatory concerns of daylighting, which would lead to shutting down the project if it occurred, the injection rates had to be maintained below 80 psi. To satisfy the regulatory agency's limits on injection pressure, Hargis + Associates and REGENESIS completed a suitability study. S-MicroZVI differs from other ZVI products due to its micron-scale particle size and colloidal chemistry. These features enable it to be applied under low pressure, promoting even distribution in the subsurface.

50,000 gallons of ZVI were made in 150-gallon stainless steel mix tanks. The ZVI amendment was injected at a flow rate of 1-8 gallons per minute and at less than 80 psi. There were 37 injection points spaced 15 feet apart. The injections ranged from 10 to 80 feet below ground surface (bgs) and the remedial solution was injected into as many as 10 points simultaneously. The low-pressure injection approach prevented fracturing or daylighting throughout the application as mandated by the local regulatory authority.

Figure 1 Treatment Areas

Maps showing S-MicroZVI injection and large diameter auger locations.



Technology Used

S-MicroZVI

S-MicroZVI is an advanced zero-valent iron technology proven to accomplish *In Situ* Chemical Reduction (ISCR) of contaminants within the subsurface environment. S-MicroZVI is delivered as a colloidal suspension, containing 40% ZVI by weight in glycerol with a particle size of less than 5 microns. S-MicroZVI is manufactured using a state-of-the-art sulfidation process, resulting in a particle coating which increases activation toward specific contaminants and extends performance longevity. S-MicroZVI destroys contaminants abiotically and is applied to stimulate ISCR-enhanced bioremediation.

Results

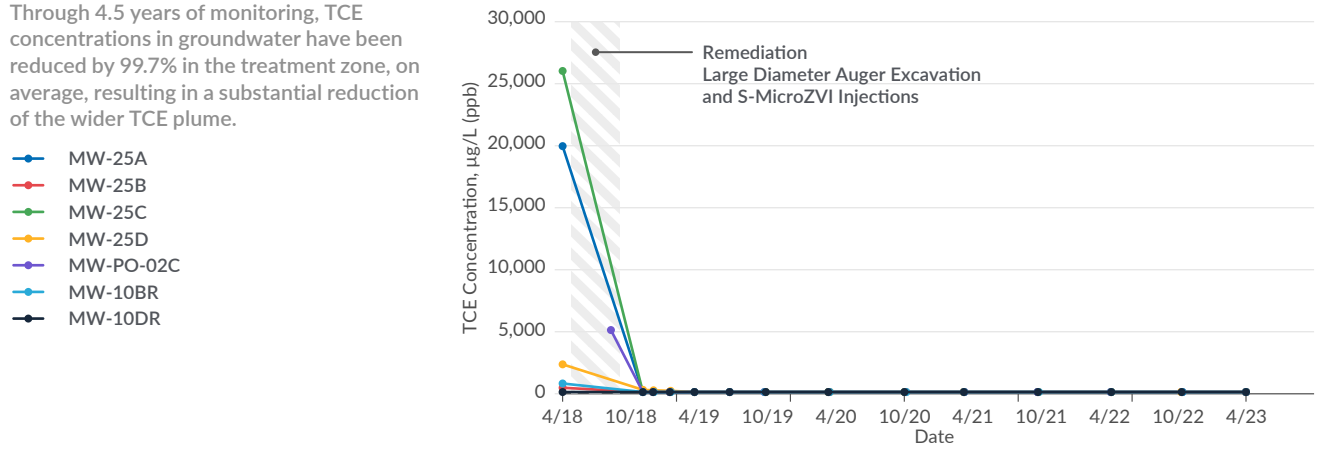
Combined Remedy Facilitates Sale of the Property

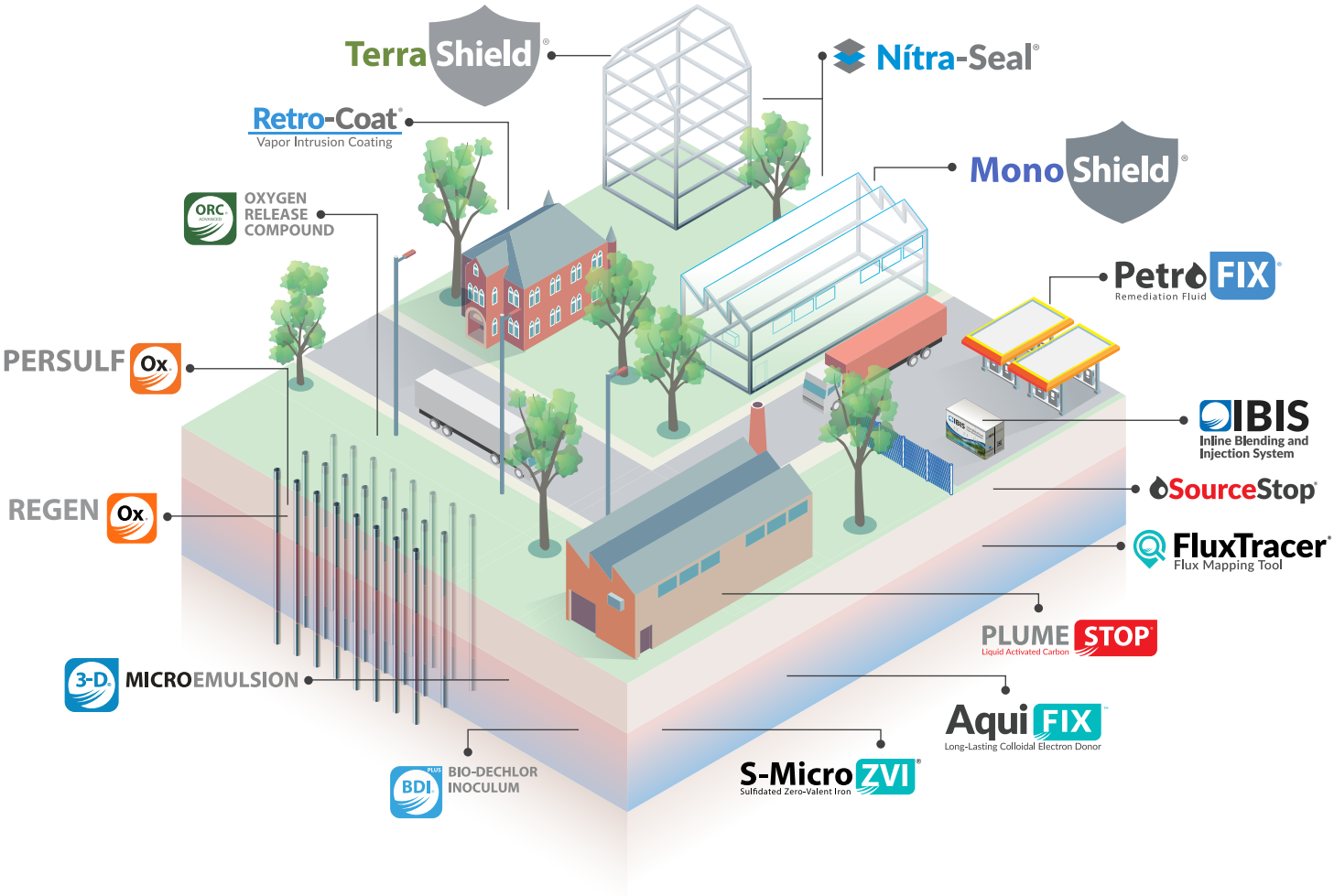
After the first month following remediation, monitoring results showed TCE concentrations were reduced by 98.5%. Based on these results, the real estate transaction could move forward and the site was sold. The remediation has demonstrated persistence. Through 4.5 years of monitoring, TCE concentrations in groundwater have been reduced by 99.7% in the treatment zone, on average, resulting in a substantial reduction of the wider TCE plume.

Figure 2

TCE Concentrations

Through 4.5 years of monitoring, TCE concentrations in groundwater have been reduced by 99.7% in the treatment zone, on average, resulting in a substantial reduction of the wider TCE plume.





About REGENESIS

At REGENESIS we value innovation, technology, expertise and people which together form the unique framework we operate in as an organization. We see innovation and technology as inseparably linked with one being born out of the other.

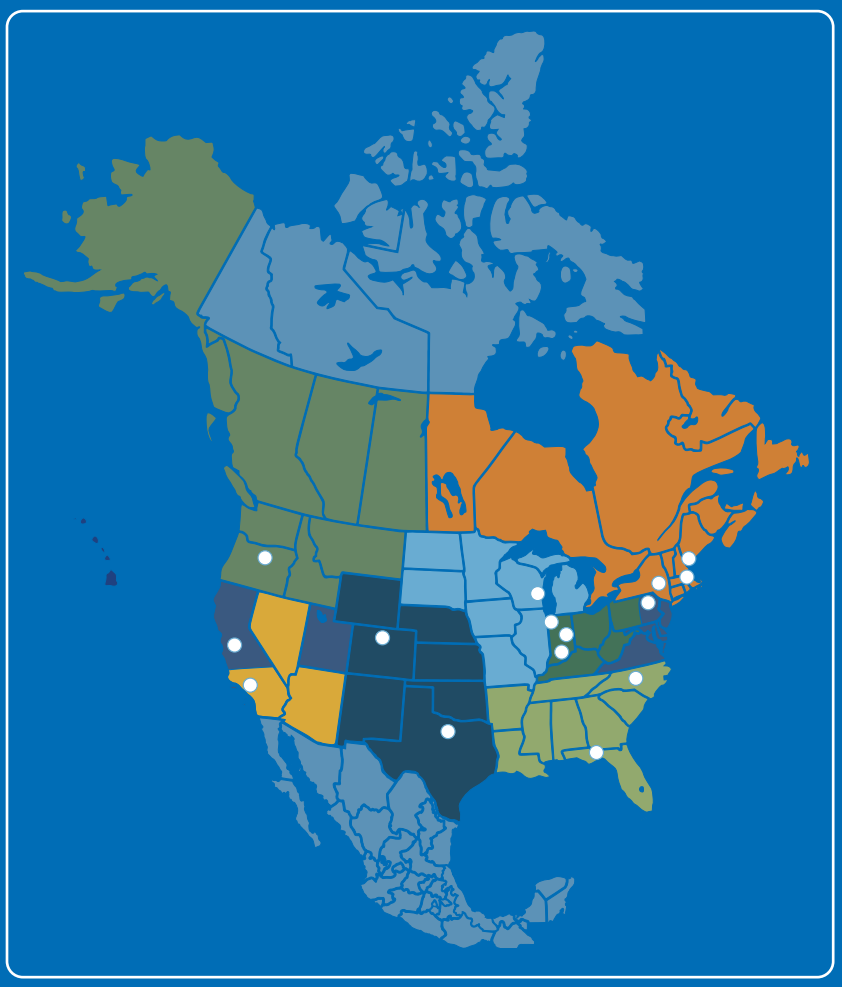
Inherently, innovation imparts new and better ways of thinking and doing. For us, this means delivering expert environmental solutions in the form of the most advanced and effective technologies and services available today.

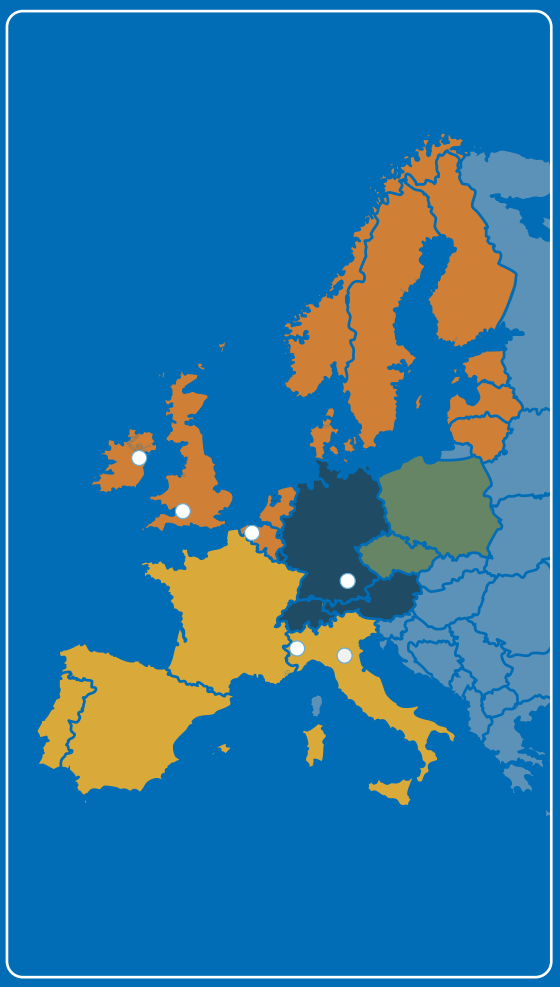
We value expertise, both our customers' and our own. We find that when our experienced staff collaborates directly with customers on complex problems, there is a high potential for success including savings in time, resources and cost.

At REGENESIS we are driven by a strong sense of responsibility to the people charged with managing the complex environmental problems we encounter and to the people involved in developing and implementing our technology-based solutions. We are committed to investing in lasting relationships by taking time to understand the people we work with and their circumstances. We believe this is a key factor in achieving successful project outcomes.

We believe that by acting under this set of values, we can work with our customers to achieve a cleaner, healthier, and more prosperous world.

We're Ready to Help You Find the Right Solution for Your Site





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