REGENESIS®

PlumeStop Protects Public Water Supply From PFAS

Colloidal Activated Carbon Barrier Halts PFAS Migration at Property Boundary of Former Fire Training Site



Highlights

Site Type
Former fire training facility

Location
Barnstable County, Massachusetts

Site Conditions
Former AFFF training area within a sensitive groundwater setting, including a public water supply protection area and sole source aquifer

Contaminants
Mass DEP PFAS 6 compounds: PFOS, PFOA, PFHxS, PFNA, PFHpA, and PFDA[1]

Project Driver
Stop off-site PFAS migration threatening nearby public water supply resources

Remedial Approach
PlumeStop permeable adsorptive barrier

Results
Early results show PFAS reduced 99% within four months

Summary

Historical firefighting foam use left behind residual PFAS source in soil and groundwater at a former fire training site, with migration threatening nearby public water supply resources. Following years of interim response actions, Barnstable County, GZA, and REGENESIS implemented a phased PlumeStop® in situ permeable adsorptive barrier approach to control the plume. Pilot testing of an initial barrier segment installed through the plume core showed total PFAS 6 reduced by 97% within four months, while nearby downgradient wells declined to near or below detection limits in subsequent rounds. Those results supported installation of the remainder of the 617-foot full-scale barrier, where early monitoring of 18 wells spanning a 70-ft vertical treatment interval showed a median 99% reduction after 90 days. This in situ PFAS containment solution provided a significantly more cost-effective alternative to expansion of pump-and-treat, which can result in costs in the hundreds of millions of dollars for complex projects. The County's existing system already costs roughly $450,000 per year.

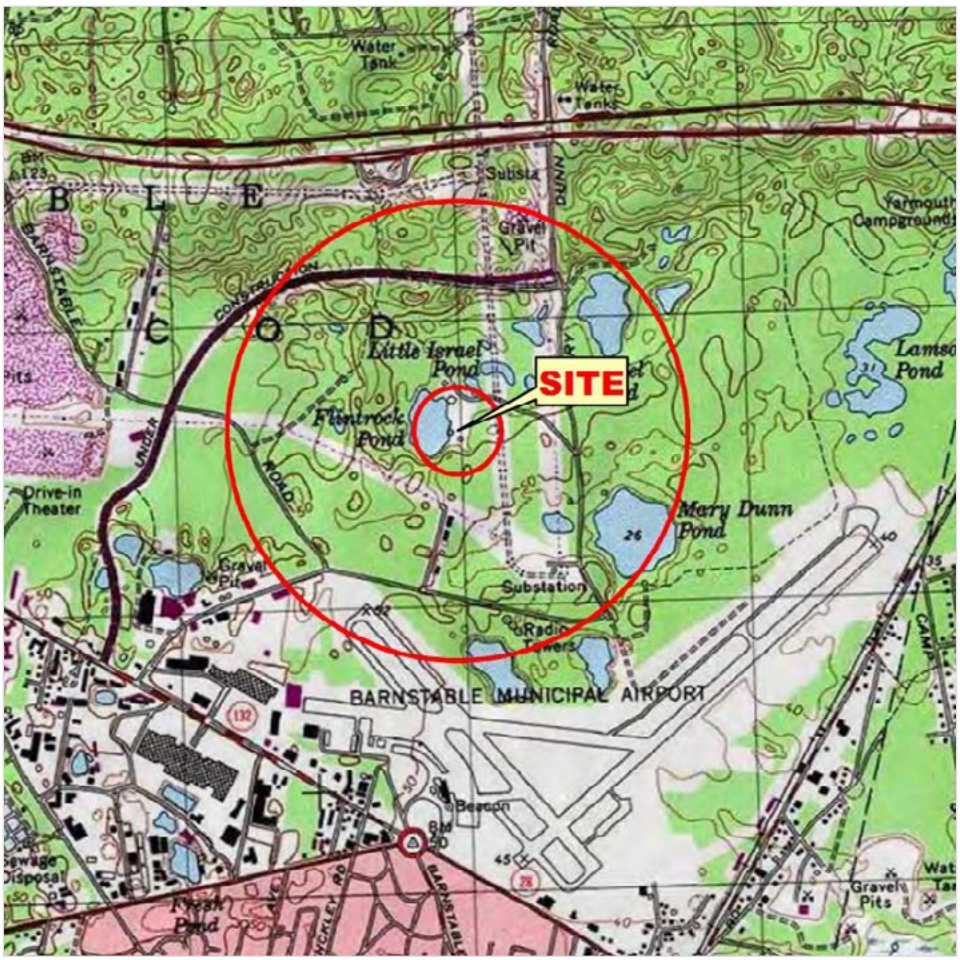


Project Background and Remedial Objective

The former Barnstable County Municipal Fire Training Facility in Massachusetts was used for public safety training from the 1950s until operations ceased in 2009. Figure 1 shows the site location. Historical, firefighting training at the site included the use of aqueous film-forming foam, resulting in significant PFAS impacts in soil and groundwater.

Figure 1 Site Location Map

Map depicting site location



The site is located in a sensitive hydrogeologic setting within a public water supply protection area and sole source aquifer. Over time, site investigations and response actions confirmed that residual PFAS in soil and groundwater remained a continuing source of off-site plume migration, creating concern for downstream groundwater quality and nearby public water supply resources.

Before the colloidal activated carbon barrier was considered, multiple interim response actions had already been completed at the site, including source-area excavation, soil amendment placement, stormwater controls, property-wide capping, demolition of former fire training structures, operation of two groundwater treatment (i.e., pump-and-treat) systems and one groundwater extraction well. However, despite these measures, a more effective downgradient plume-control strategy was needed.

In response, the project team engaged REGENESIS to pilot test, design, and install a PlumeStop colloidal activated carbon barrier along the downgradient edge of the property to limit further PFAS migration in groundwater, reduce long-term exposure risk, and support a substantially lower cost alternative to expanded pump-and-treat operations. The treatment goal was to reduce PFAS 6 below 20 nanograms per liter (ng/L).





Remedial Approach

To limit further downgradient migration of PFAS from the former fire training facility, the project team selected a phased in situ plume-control strategy based on installation of an approximate 600-feet long PlumeStop permeable adsorptive barrier transecting the plume. Placed along the downgradient edge of the facility, the barrier allows groundwater to continue flowing through it while sorbing dissolved PFAS onto aquifer materials coated with activated carbon. This process effectively filters PFAS out of the groundwater, thereby limiting further off-site plume migration and reducing exposure risk.

Given the site's sensitive groundwater setting, the ongoing source contribution from residual impacts, and the high projected cost of expanded pump-and-treat operations, the barrier approach offered a practical, lower-cost, zero-waste alternative for plume management.

To support performance evaluation of the full-scale barrier, additional downgradient multi-level validation wells were installed prior to implementation to establish baseline conditions and provide a monitoring network for post-application assessment. This phased progression—from pilot test to refined full-scale design—helped reduce uncertainty and position the project for more reliable facility-wide plume control.

Application

Pilot Test

Prior to full-scale barrier installation, a pilot-scale barrier application was initiated in October 2024 to evaluate and optimize PFAS emplacement under site conditions and provide measurable PFAS reductions in the target treatment zone. REGENESIS Remediation Services executed the pilot by injecting PlumeStop in a focused treatment area downgradient of the former hot spot where PFAS concentrations had historically been among the highest observed at the site.

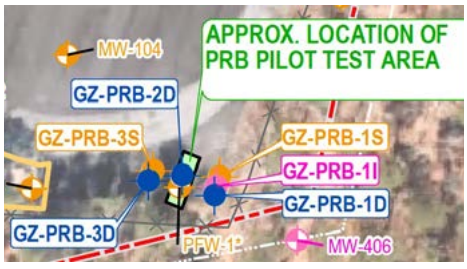
The pilot test, initiated in October 2024, demonstrated successful amendment emplacement within the targeted saturated interval, supported by carbon detections in treatment-zone monitoring points. This is generated early performance data showing substantial reductions in monitored PFAS concentrations following injection of PlumeStop carbon into the aquifer matrix.

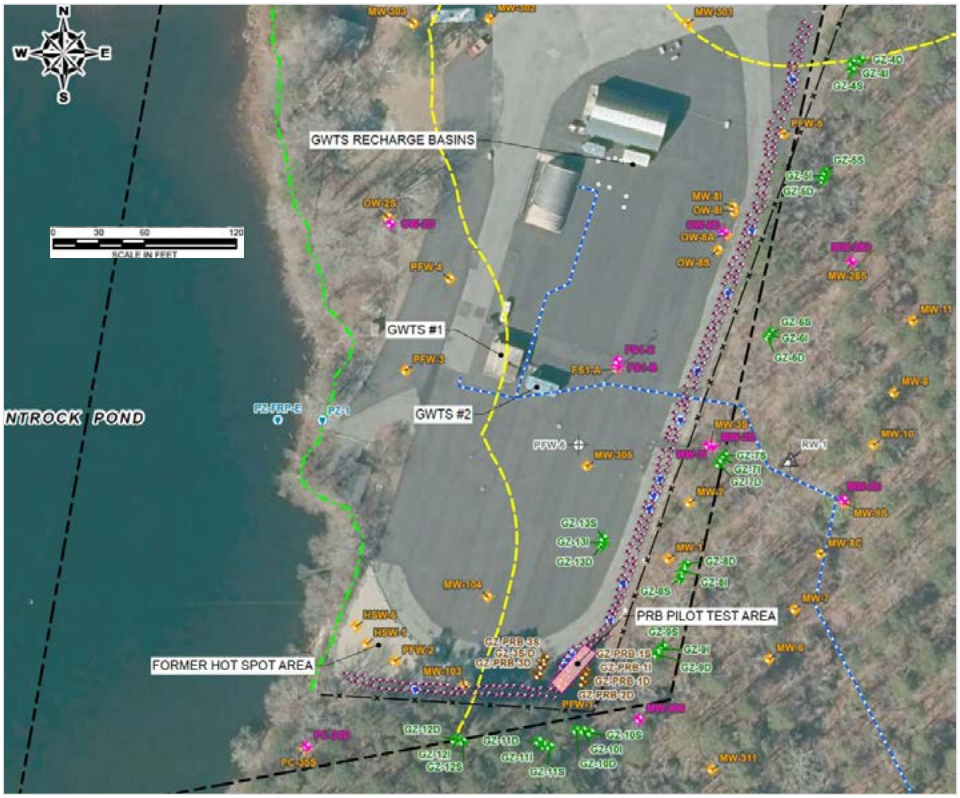
Just as importantly, the pilot provided field-scale information on injection behavior, lithologic variability, and interval-specific dosing needs, which helped guide refinement of the full-scale barrier design.

Figure 2 Site Map

Right: Site map showing barrier location with site features and monitoring well network.

Below: Enlargement of pilot test area and performance monitoring wells





"We have a small pump-and-treat system that's costing the County roughly $450,000 a year. ... So, we realized that the cost-effectiveness of a PRB was the way to go versus a pump-and-treat system, which in our case could amount to hundreds of millions of dollars."

Paul Ruszala
Barnstable County Assets and Infrastructure Manager

Application Details

Pilot Test

Barrier Segment Length	30 feet
Vertical Treatment Interval	15 to 70 feet below ground surface
Injection Points	12
Application Method	Direct-push injection
PlumeStop Applied	24,000 pounds (26,150 gallons)

Full Scale

Completed Barrier Length	617 linear feet
Vertical Treatment Interval	15 to 86 feet below ground surface
Injection Points	247
Application Method	Direct-push injection with Inline Blending and Injection System (IBIS) and injection trailer amendment delivery platforms
PlumeStop Applied	406,400 pounds (604,135 gallons)

Full-Scale Application

Based on the pilot test findings and additional investigations to support the remedial design, REGENESIS advanced a full-scale barrier along the eastern and southern downgradient boundaries of the property, where groundwater generally flows to the east and southeast. Figure 2

Informed by the pilot test and remedial design investigations, the barrier was configured with variable dosing, with a higher treatment dosage assigned to the southern and source-proximal portions of the alignment where PFAS concentrations were greatest. The final design established between upper and deeper treatment intervals to account for changing subsurface conditions observed during the pilot and subsequent field work, including deeper fines-bearing zones and higher-porosity running sands.

Full-scale implementation was completed in October 2025, with project dates spanning July 16 through November 5, 2025. REGENESIS mobilized multiple delivery platforms, including two IBIS (Inline Blending Injection Systems) units and an injection trailer, along with two drilling rigs to support concurrent installation activities. By using two IBIS systems to inject PlumeStop at 247 points, REGENESIS greatly accelerated barrier installation and cut project time by more than half compared to traditional batch injection.

In-Field Design Adaptations

As with many in situ applications, design refinements were made in the field to optimize remedial performance. Injection point placement, tooling selection, and volume redistribution were adjusted as needed to address buried utilities, clogging, lithologic variability, and occasional surfacing. Early in the project, 48-inch exposed screened tooling was used, but due to clogging associated with fine sediments and flowing sands, the team transitioned to expendable-tip tooling with 2-foot injection intervals. Selected intervals at a small number of points were redistributed into adjacent points to maintain barrier continuity.

Field observations and validation efforts played a central role during implementation. Monitoring included daily groundwater parameter checks and carbon testing, while strategically placed piezometers were used to verify amendment distribution and support the assumed injection lateral influence. Later in the project, additional soil coring confirmed that the confining layer was deeper than expected in some barrier sections, prompting extension of the treatment depth in those areas.

Results

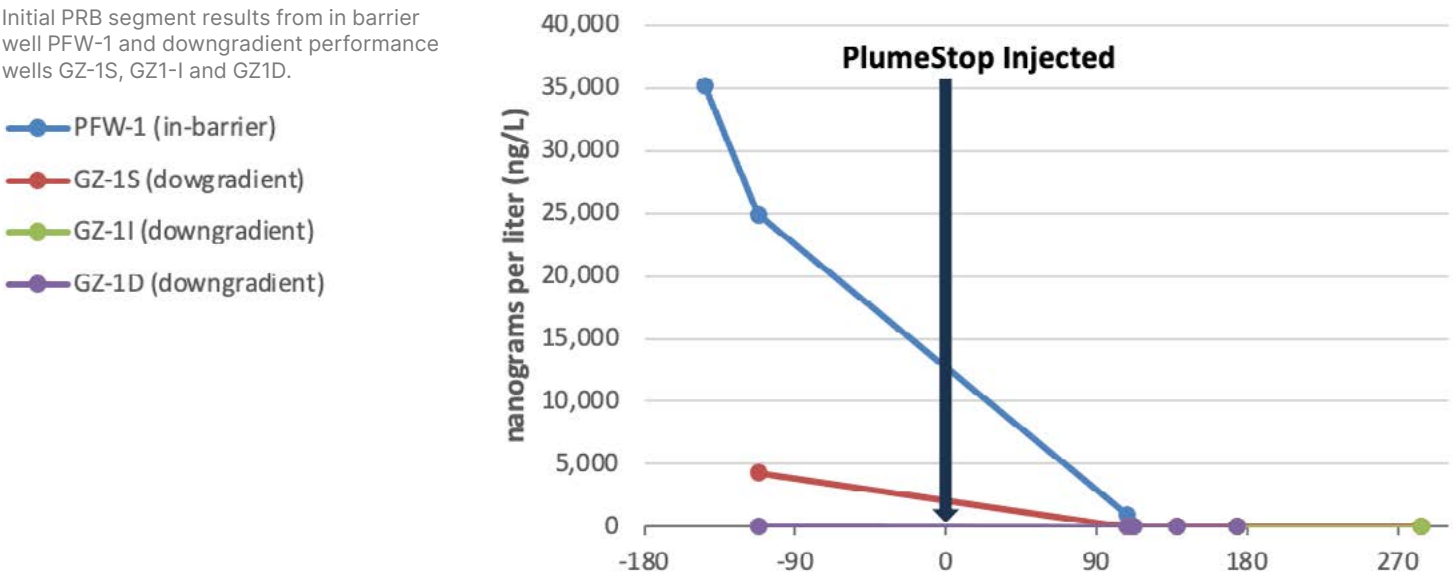
Initial results following the pilot test application showed the barrier approach worked as intended. Amendment placement was confirmed within the treatment zone and following an acclimation period where carbon attached to the aquifer matrix, strong PFAS reductions were observed in the monitoring network. Those results provided the performance basis for implementing the full-scale downgradient barrier.

Initial Barrier Segment Application Results (Pilot Test)

- PlumeStop was detected in treatment-zone monitoring points, with carbon concentrations up to 29,000 mg/L, confirming successful amendment emplacement across the targeted interval.
- At in-barrier well PFW-1, PFAS 6 was reduced by more than 97% within four months, decreasing from 35,199 ng/L at baseline to 1,003 ng/L. PFOS at the same well decreased from 32,600 ng/L to 560 ng/L.
- In the downgradient well cluster (GZ-1S, GZ1I, and GZ-1D), PFAS 6 was reduced from up to 4,322 ng/L to below detection limits (<2 nanograms per liter), effectively eliminating these compounds as treated water exiting the barrier migrated into these zones.

Figure 3 Initial PRB (Pilot Segment) Performance Results

Initial PRB segment results from in barrier well PFW-1 and downgradient performance wells GZ-1S, GZ1-I and GZ1D.



Downgradient Mon. Wells	Baseline PFAS 6	90 Days Post-Ins.	Percent Reduced
GZ-4S	173	1	99%
GZ-4I	14	1	92%
GZ-4D	45	23	49%
GZ-5S	659	20	97%
GZ-5I	43	1	97%
GZ-5D	38	5	87%
GZ-6S	890	4	100%
GZ-6I	26	1	96%
GZ-6D	32	4	88%
GZ-7S	3944	147	96%
GZ-7I	455	6	99%
GZ-7D	25	1	96%
GZ-8S	3524	1	100%
GZ-8I	165	1	99%
GZ-8D	9	1	88%
GZ-9S	1322	56	96%
GZ-9I	120	1	99%
GZ-9D	34	1	97%
Median	**83**	**1**	**99%**

PFAS 6 monitoring results approximately 3 months after the full-scale barrier installation. Values reported as 1 represent concentrations below the method detection limit for PFAS 6 compounds.

Full-Scale Application Results

Based on these initial results, the project team proceeded with installation of the 617-foot full-scale barrier, completed in November 2025. Early performance monitoring conducted approximately 90 days post-installation and encompassing 18 downgradient monitoring wells (6 well clusters spanning shallow, intermediate and deep zones) demonstrates the following:

- PFAS 6 concentrations were reduced by a median of 99%.
- Reductions were observed across all barrier segments and screened intervals, demonstrating effective treatment across shallow, intermediate, and deep zones.
- Modeling suggests that further concentration reductions below the 20 ppt goal are expected to be observed in the down gradient monitoring wells.

Conclusion

99% Median Reduction Across 18 Downgradient Monitoring Wells

The innovative, two-phased approach underscores the value of a strategic PFAS plume control strategy. A targeted barrier segment was initially installed in a high concentration plume area, showing that it could be effectively placed and deliver a strong early response. Following this successful application, the remainder of the 617-foot full-scale barrier was installed.

Initial monitoring approximately 90 days after full-scale application showed a median PFAS 6 reduction of 99% across 18 downgradient monitoring wells spanning shallow, intermediate, and deep zones. Fifteen of the eighteen wells have already met the 20 ng/L PFAS 6 remediation target level at this early stage of monitoring, with modeling indicating further concentration reductions over time. Together, these results show that the barrier is effectively controlling plume migration, protecting nearby groundwater resources, and providing a zero-waste, lower-cost alternative to expanding the pump-and-treat system.

GZA Known for excellence. Built on trust.

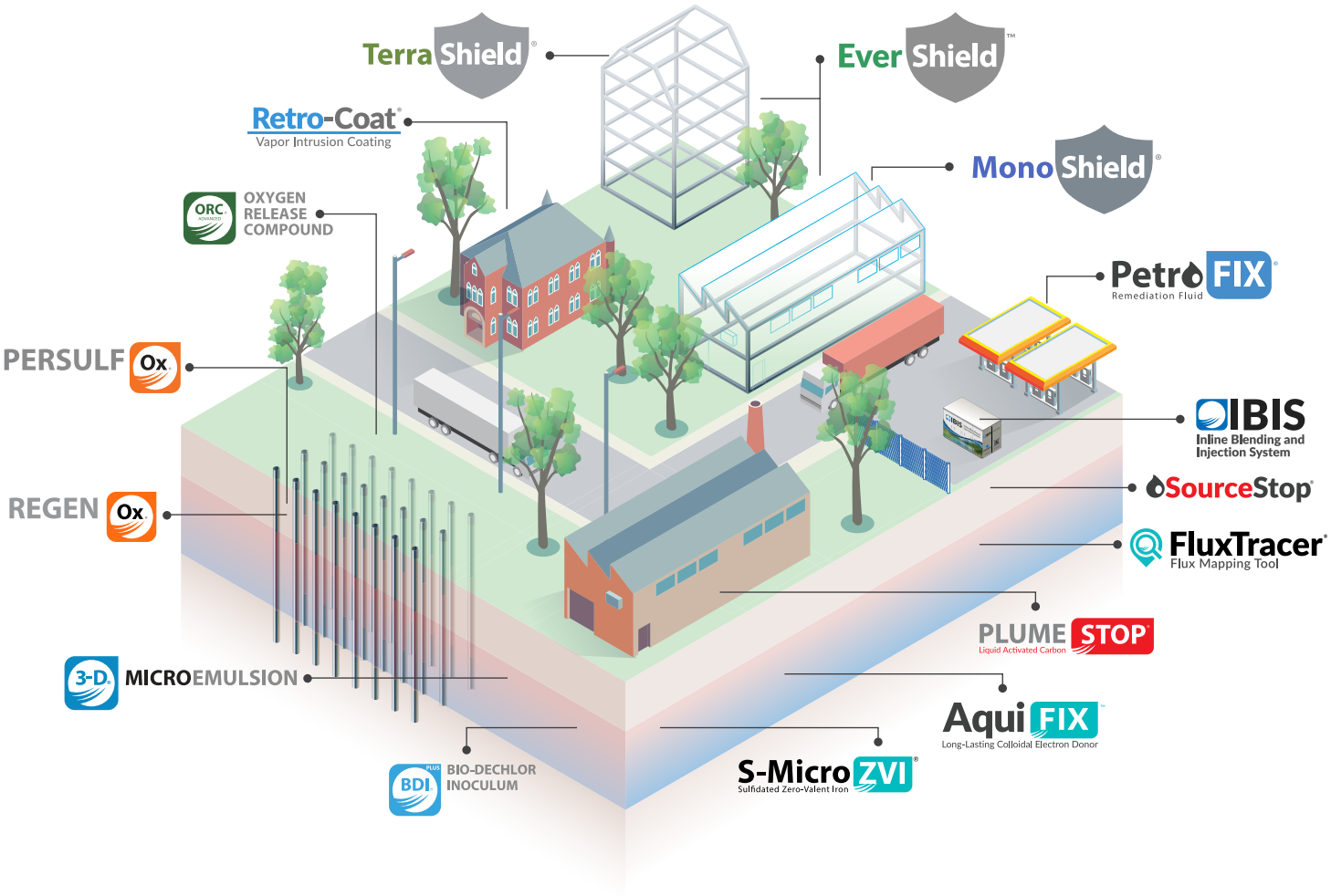
About the Consultant

Founded in 1964, GZA is a leading multi-disciplinary, employee-owned consulting firm providing environmental, geotechnical, ecological, water, and construction management services nationwide. With more than 800 professionals in 35 offices across the United States, GZA has delivered thousands of successful projects for public and private sector clients over the past 61 years.

GZA has extensive experience supporting municipalities, water suppliers, industries, developers, and legal teams with PFAS investigation, testing, regulatory compliance, remediation, and risk management. Using stringent sampling protocols, agency-approved QAPPs and SOPs, and a science-based approach, GZA provides technically defensible solutions for complex PFAS challenges. GZA also contributes to PFAS industry guidance through participation in the National Groundwater Association, Interstate Technology & Regulatory Council, and ASTM International.

Representative PFAS projects include GZA's work for Barnstable County at the former Municipal Fire Training Facility in Hyannis, where GZA conducted PFAS site investigations, groundwater testing, remediation evaluations, and implementation of a Colloidal Activated Carbon (CAC) permeable reactive barrier (PRB) system to limit PFAS migration.





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.

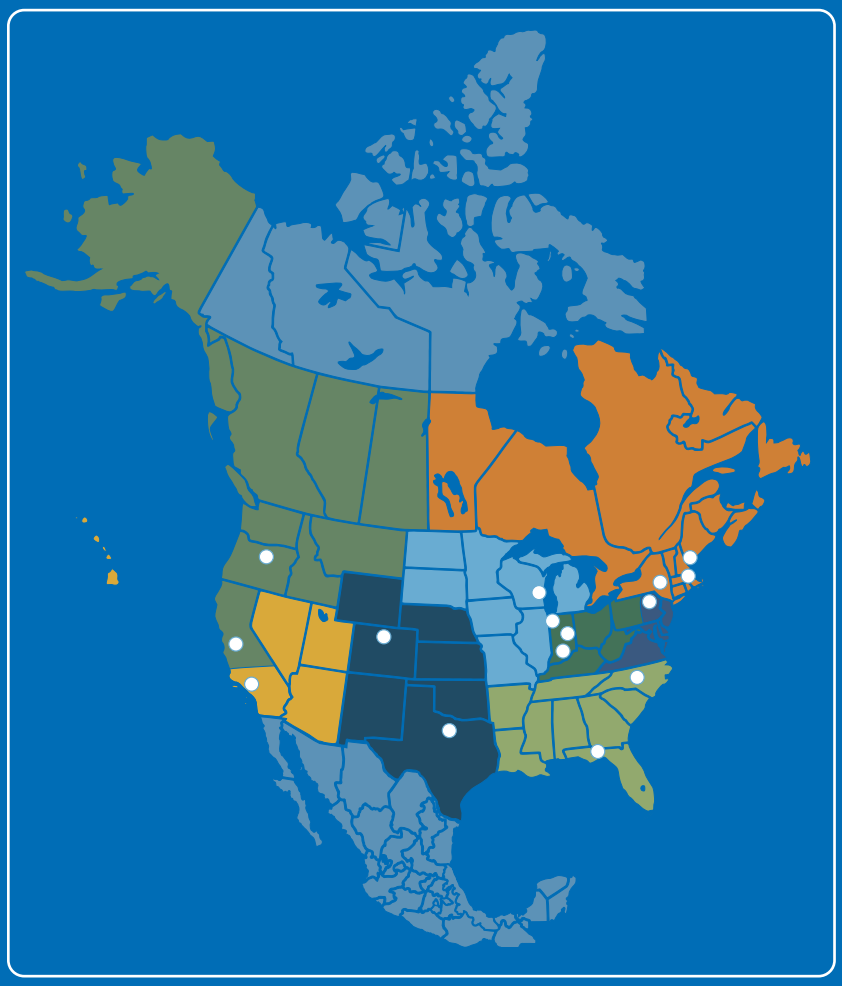
We value expertise, both our customers' and our own. We find that when our experienced staff collaborates directly with customers on complex problems, there is a high potential for success including savings in time, resources and cost.

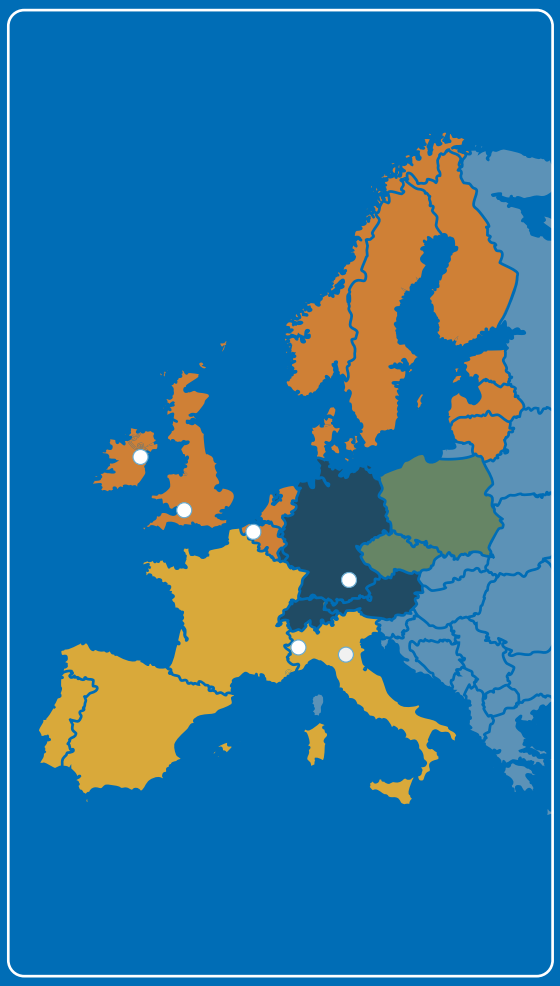
At REGENESIS we are driven by a strong sense of responsibility to the people charged with managing the complex environmental problems we encounter and to the people involved in developing and implementing our technology-based solutions. We are committed to investing in lasting relationships by taking 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.

Have a challenge? Let's solve it together.

Contact us today to discuss your specific needs.





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