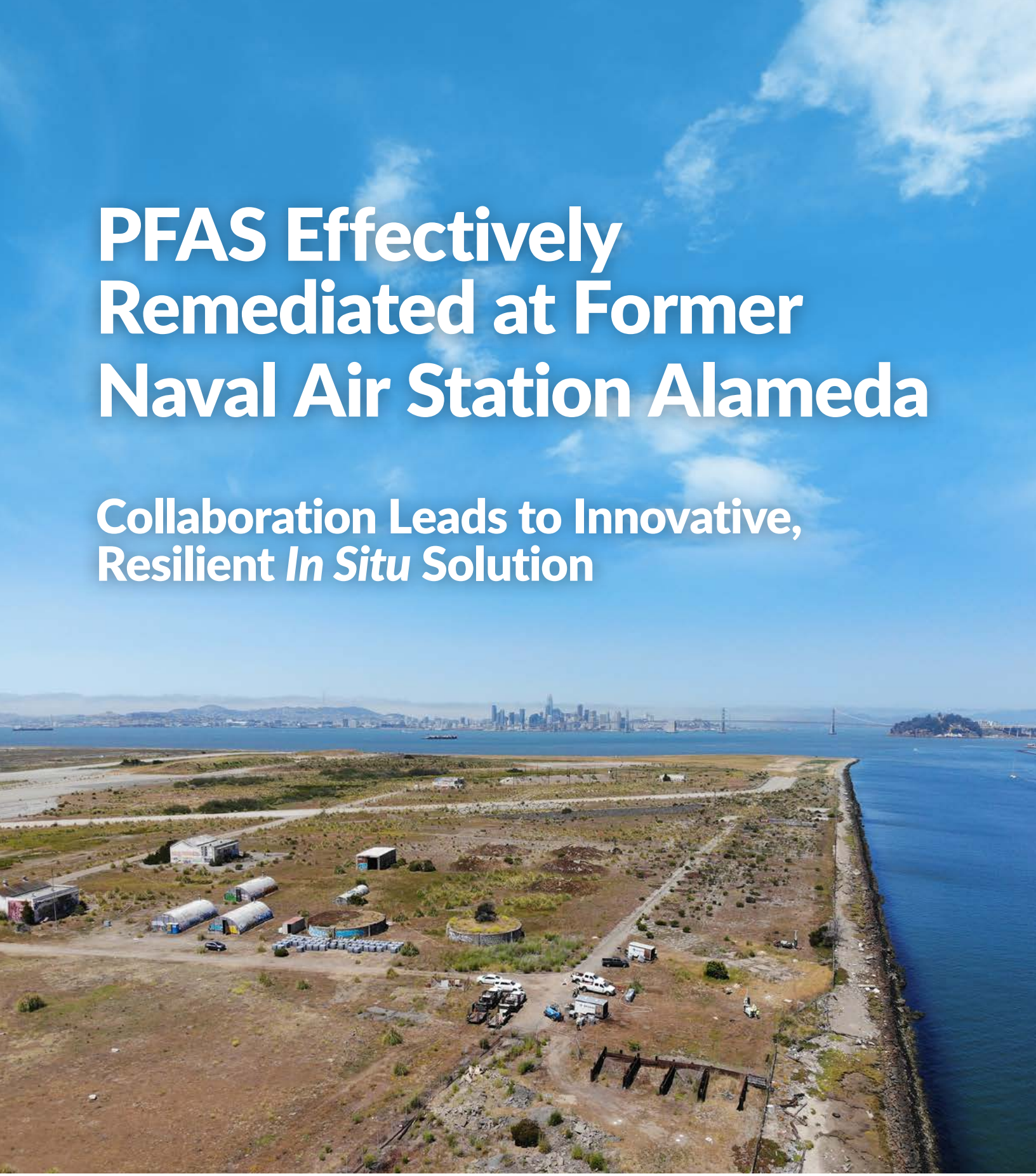
PFAS Effectively Remediated at Former Naval Air Station Alameda

Collaboration Leads to Innovative, Resilient *In Situ* Solution



REGENESIS®

APTIM

BAYSIDE Engineering Construction

REGENESIS®

Highlights

Site Type:
Military

Project Driver:
Sensitive Receptor (Oakland Inner Harbor)

Contaminants:
PFAS, including up to 1,100,000 ng/L PFOA, 302,000 ng/L PFOS, and 16,000 ng/L PFBS

Geology:
Sand and fill material

Treatment:
Sorption

Technologies:
PlumeStop

Quantity Injected:
340,000 lbs

Other Site Considerations

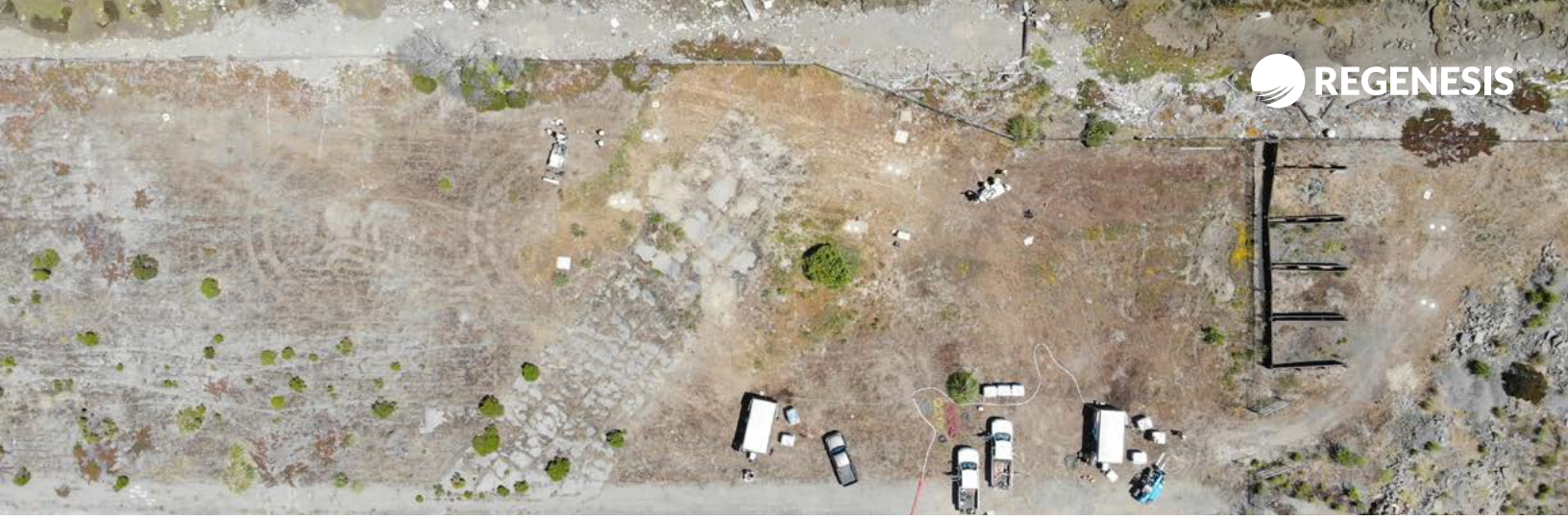
Summary

Historical firefighting activities at the former Naval Air Station (NAS) Alameda resulted in high PFAS (per- and polyfluoroalkyl substances) concentrations in the groundwater, threatening the Oakland Inner Harbor. In response, the project team, comprising Bayside Engineering, Construction, Inc. (Bayside), APTIM Federal Services (APTIM), and REGENESIS®, collaboratively implemented a 720-foot in situ permeable reactive barrier (PRB) using PlumeStop® colloidal activated carbon (CAC) technology.

This innovative approach created an adsorptive barrier within the polluted aquifer, effectively capturing PFAS and preventing their migration. After one year, the target PFAS compounds were reduced by more than 99% in the treatment zone with significant decreases in the downgradient wells.

Results

- **Within one year of implementation, >99% PFAS reductions achieved within treatment zone**



Background

The site, designated as Installation Restoration (IR) Site 14, was formerly used for firefighter training activities at NAS Alameda. Historical use of PFAS-containing fire suppression foam resulted in significant groundwater contamination into the First Water Bearing Zone composed of sand and artificial fill approximately 1 to 8 feet below the ground surface.

Initial testing revealed contamination levels of PFOA (1,100,000 ng/L), PFOS (302,000 ng/L), and PFBS (16,000 ng/L), threatening the adjacent Oakland Inner Harbor and a proposed shoreline park. These findings prompted the U.S. Navy to conduct a remedial investigation (RI) for PFAS from 2021 to 2022. Based on the RI, a design verification study and pilot test were initiated to evaluate a PlumeStop CAC barrier as a mitigation strategy to minimize the flow of PFAS-impacted groundwater into the harbor.

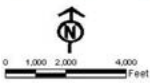
Figure 1 Site Location Map

Map depicting site location and surrounding area. Original figure provided by Bayside

Department of Veterans Affairs Property Boundary

Installation Restoration (IR) Site 14 Boundary

Alameda Point Boundary



Objectives

The primary objective was to prevent further PFAS migration into the Oakland Inner Harbor. Additionally, the project team sought an innovative, cost-effective solution that could immobilize PFAS in place without producing secondary waste streams. A collaborative effort among Bayside, APTIM, and REGENESIS resulted in the design of a PlumeStop PRB to achieve this objective. The team leveraged its expertise in environmental remediation, project management, and advanced chemical technologies to create a replicable, efficient, and environmentally friendly solution that would significantly reduce PFAS concentrations while establishing a model for future military sites facing similar challenges.

Remediation Strategy

The selected solution involved a PlumeStop PRB which halts PFAS migration by transforming the aquifer matrix into a filter that adsorbs contaminants, protecting the harbor. The 720-foot PRB was strategically placed along the shoreline in two parallel rows.

PlumeStop, containing <2 micron-size particles of activated carbon mixed with a proprietary polymer solution, distributes evenly in the subsurface, maximizing contact with PFAS in the groundwater and forming a barrier that prevents migration of these contaminants. By eliminating waste and the need for continuous operation, the PlumeStop barrier delivers a maintenance free, low-cost, and zero-waste alternative to traditional (i.e., pump-and-treat) methods.

Design Verification and Testing

Before full-scale implementation, a thorough design verification and testing phase ensured the PlumeStop barrier would meet project goals. This phase included both laboratory and field testing to optimize performance.

Column Study

A column study evaluated PlumeStop concentrations (0.0%, 0.5%, and 2.0%) for PFAS adsorption. At 2.0% concentration, PFAS levels dropped below 200 ng/L by Day 47, validating the material's effectiveness and informing dosing strategies for varying contamination levels.

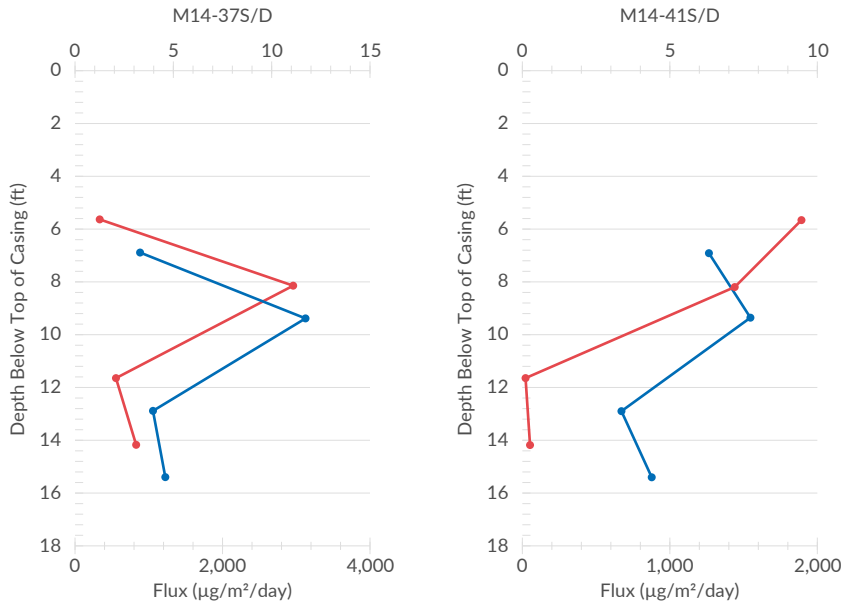
Passive Flux Meters (PFMs)

PFMs installed in monitoring wells provided critical data on groundwater flow rates and PFAS flux. These segmented devices, incorporating activated carbon and resin layers, ensured precise PRB placement and dosing while informing barrier design and performance evaluation.

Figure 2 Passive Flux Meter Data

Passive flux meter data output showing variability in PFOS flux with depth

- Perfluorooctane sulfonic acid (PFOS)
- Darcy Velocity



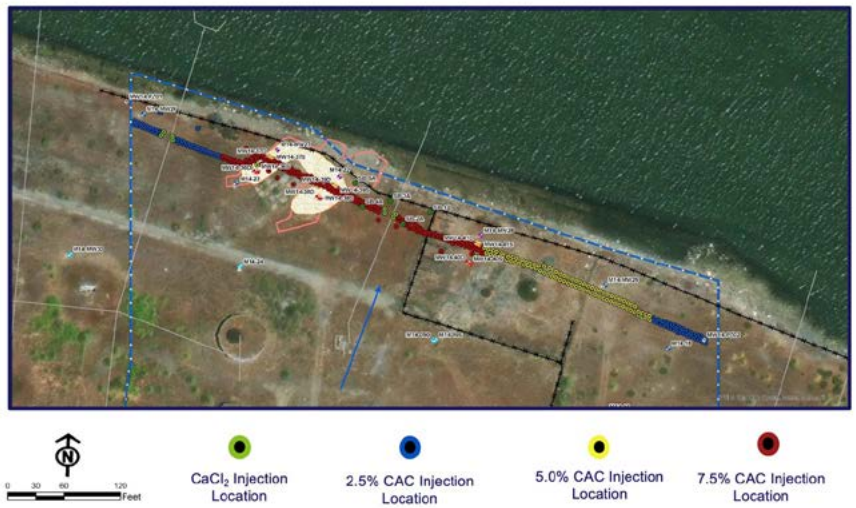
Based on these studies, CAC injection concentrations of 2.5%, 5.0%, and 7.5% were assigned to specific sections of the PRB, tailored to local PFAS flux rates.

Implementation

The PRB installation spanned 28 days (June 21–July 31, 2023). Two injection trailers and two direct-push rigs were deployed to inject 340,000 pounds of PlumeStop mixed with water for a liquid volume of over 100,000 gallons applied through 290 injection points.

Figure 3 PlumeStop PRB Layout

PlumeStop PRB layout



Injection Details	
Barrier Length	720 feet
Injection Depth	1 to 15 feet below ground surface
Injection Points	290
PlumeStop Quantity Applied	340,000 lbs (over 100,000 gallons diluted with water)

To address potential migration challenges, calcium chloride ($CaCl_2$) was added in certain areas to prevent the CAC from entering nearby storm sewer lines. This “bottom-up” injection approach, performed in five 3-foot intervals per boring, maximized contact between the CAC and PFAS-contaminated groundwater.

Despite challenges posed by wildlife burrows, uneven terrain, and a shallow application zone, the team completed the project on schedule, delivering a stable and effective *in situ* barrier.

Results

PFAS Reduction

In the first year following implementation, the PRB achieved nearly 100% PFOS and PFOA reduction within the treatment zone across all three transects:

- **Transect 1:** 99.0% to >99.9% reduction in the PRB; >99% in downgradient wells.
- **Transect 2:** 99.7% to >99.9% reduction in the PRB; 40% to 77% in downgradient wells.
- **Transect 3:** 99–100% reduction in the PRB; 63–99.9% in downgradient wells.

PFBS concentrations were also reduced by similar percentages.

Figure 4 PFAS Reductions

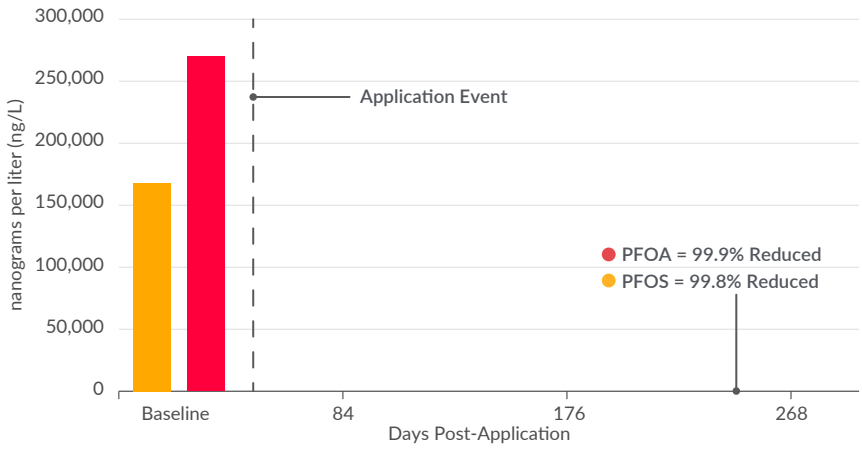
Median PFOS, and PFOA Concentrations in PlumeStop Barrier Wells: 37S/D, 39S/D, and 41S/D

99.8%

PFOA concentrations reduced by 99.8%

99.9%

PFOS concentrations reduced by 99.9%



PFM Analysis

PFMs were installed in a subset of transect 1 and 3 wells prior to the installation of the CAC barrier and after one year to evaluate the change in PFOS contaminant flux. The PFM results demonstrate PFOS flux reduced more than 99.9%, consistent with the monitoring well sampling findings.

These results indicate a near-complete halt of PFAS migration into the estuary, with consistent reductions observed over the first year of monitoring.

Monitoring and Sustainability

Quarterly groundwater monitoring across 18 wells ensures continued barrier performance. PlumeStop has been detected only within the PRB, confirming its stability and containment effectiveness. A third-party DOD-funded modeling study of the PlumeStop approach at US aviation sites and backed by REGENESIS' own internal modeling, suggests that this approach can be effective for decades, offering a ready-to-implement solution for PFAS remediation at similar sites.

Conclusion

The Alameda Point remediation project demonstrates the power of collaboration and innovative technology in addressing complex environmental challenges. By utilizing PlumeStop CAC, combined with extensive remediation project experience, the team achieved significant PFAS reductions while minimizing environmental impact and operational costs.

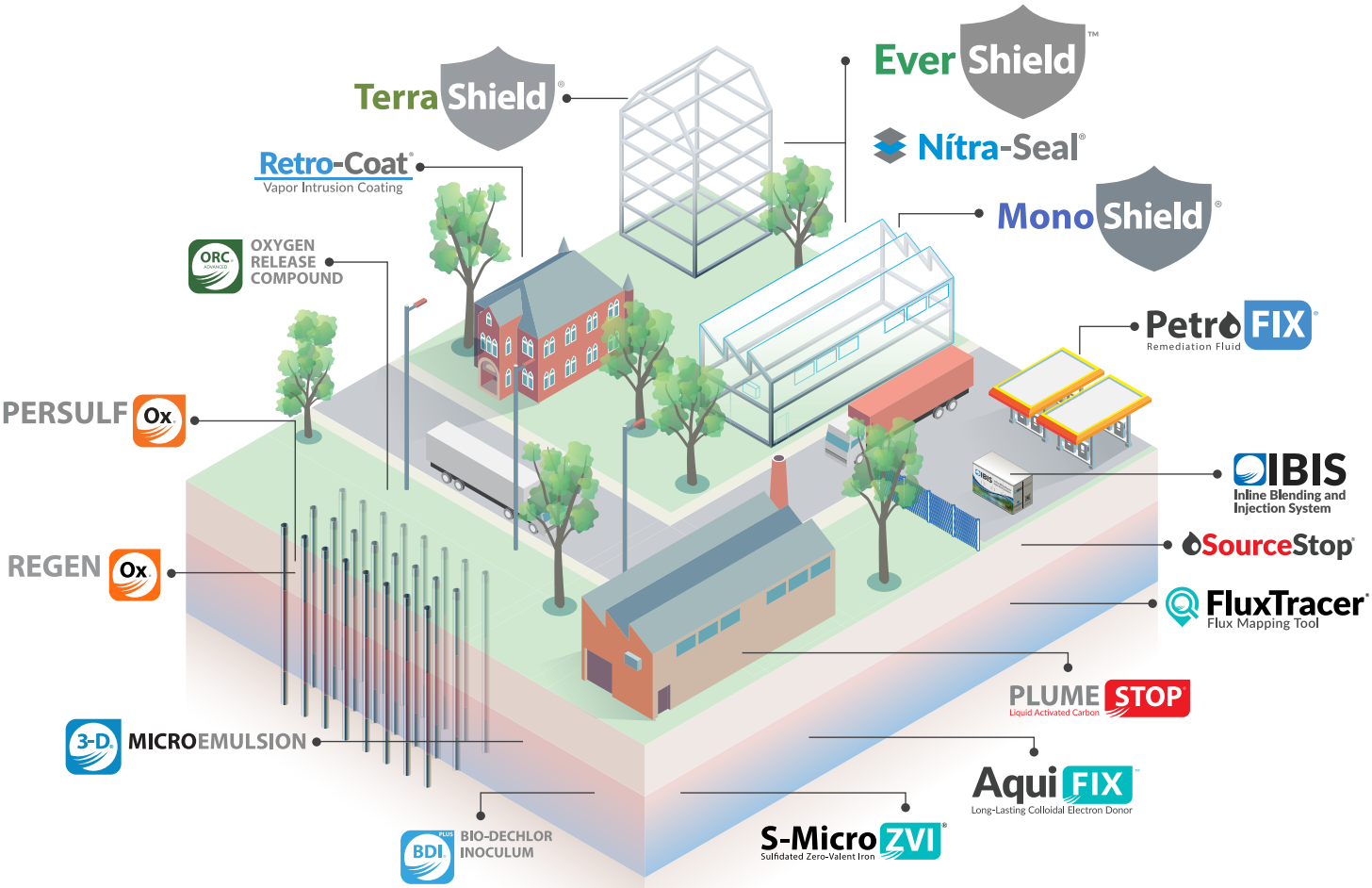
The *in situ* CAC barrier developed for this project has proven highly effective in reducing PFAS migration, establishing a precedent for easy-to-implement, low-cost, and zero-waste PFAS remediation at military sites. Looking ahead, this project serves as a blueprint for future projects at Alameda Point and beyond that prioritize both environmental health and operational efficiency.

About the Consultants

APTIM is a global industry leader headquartered in Baton Rouge, Louisiana, specializing in critical infrastructure, technical and data solutions, program management, environmental services, resilience, and sustainability and energy solutions. With proven experience and expertise, APTIM provides integrated services to government agencies, as well as commercial, industrial, and energy customers. APTIM is committed to accelerating the transition toward a clean and efficient energy economy, building a sustainable future for our communities and natural world, and fostering an inclusive, equitable environment that celebrates the diversity of its people.

Bayside Engineering Construction brings decades of experience delivering innovative solutions for complex and challenging projects across the country. With a strong track record of service to federal government clients—including the U.S. Army Corps of Engineers, U.S. Navy, U.S. Air Force, National Nuclear Security Administration, and NASA—Bayside also serves utilities and commercial sector clients. Our in-house team of professionals ensures all projects meet rigorous local, state, and federal guidelines.

Bayside is a certified participant in the SBA's 8(a) Business Development Program through 2030, meeting the program's social disadvantage requirements. Additionally, Bayside is certified as a Disadvantaged Business Enterprise (DBE), Minority Business Enterprise (MBE), and Small Local Business Enterprise (SLBE). With Class-A General Engineering, Class-B General Building, and C-8 Concrete Contractor licenses, as well as Hazardous Substances Removal Certification, Bayside is committed to delivering high-quality, compliant, and sustainable solutions for its clients.



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.

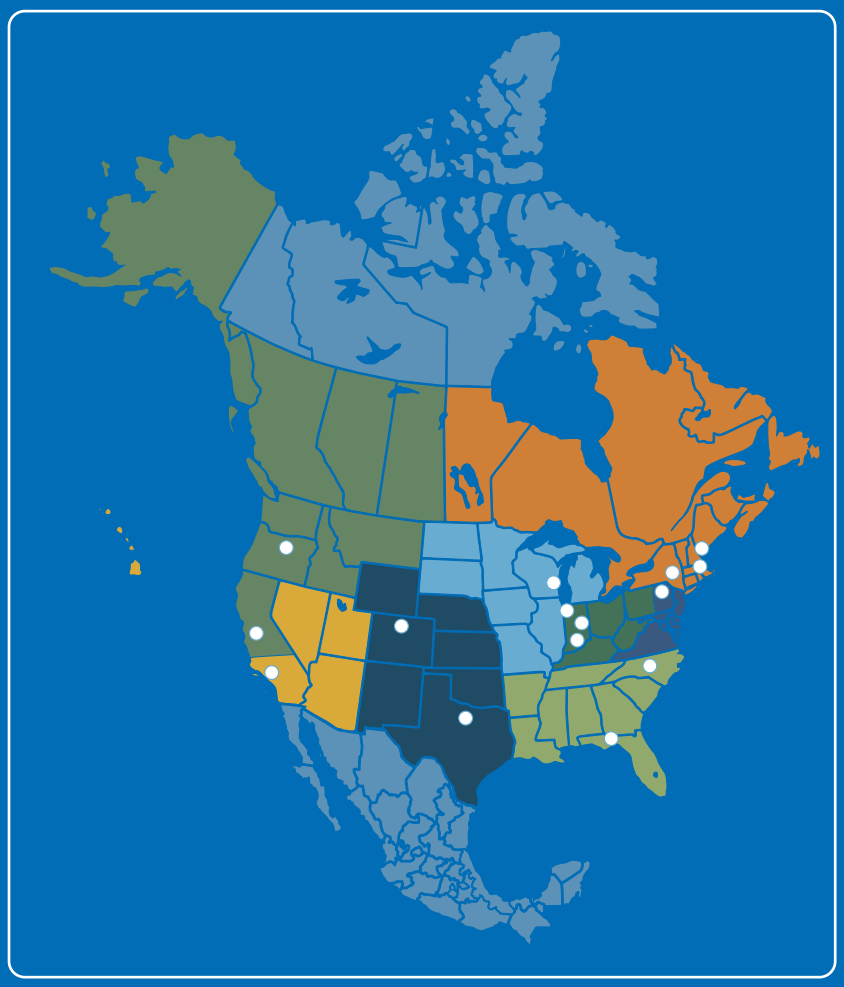
Inherently, innovation imparts new and better ways of thinking and doing. For us, this means delivering expert environmental solutions in the form of the most advanced and effective technologies and services available today.

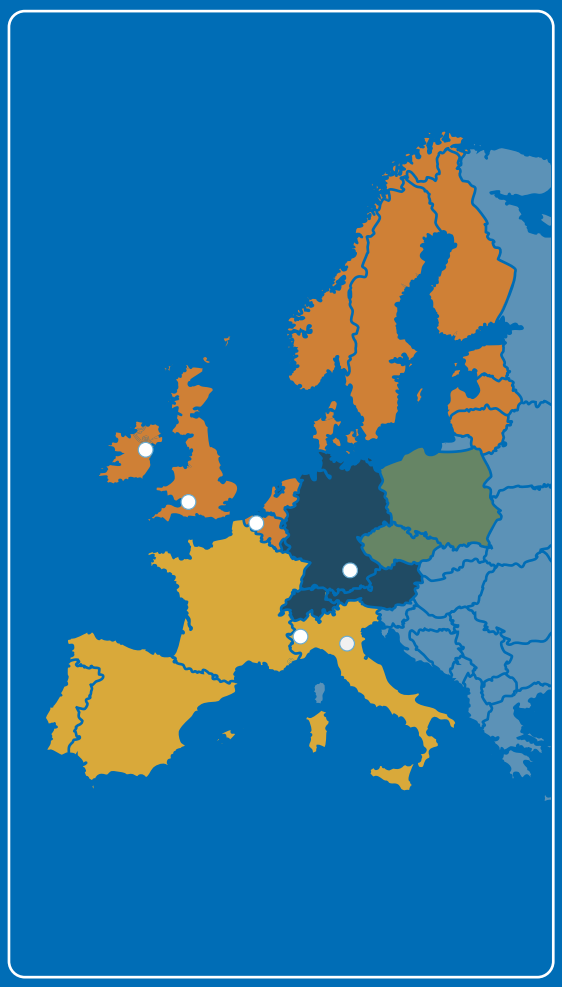
We value expertise, both our customers' and our own. We find that when our experienced staff collaborates directly with customers on complex problems, there is a high potential for success including savings in time, resources and cost.

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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