REGENESIS®

Stringent Site Closure Goals Achieved Using PetroFix

Petroleum Impacts Effectively Remediated at University Recreation Facility Site

Highlights

Site Type:
University
Recreational Facility

Project Driver:
State-funded (FDEP) project, performance-based contract (PBC)

Contaminants:
Up to 8,700 µg/L TRPH
>4,000 µg/L BTEX
150 µg/L MTBE, >200 µg/L naphthalenes in groundwater

Geology:
Clayey sand to sandy clay in treated area

Treatment:
Excavation of impacted soils, Sorption-enhanced bioremediation

Technologies:
PetroFix®

Quantity Injected:
11,600 lbs/20,000 gals

Low Pressure Injection
PetroFix was applied under low pressures <30 PSI

Summary

Terracon, a leading environmental engineering and consulting firm, completed the remediation of a university recreational facility in Florida impacted by historic petroleum hydrocarbon (PHC) contamination. Under stringent contractual timelines and performance benchmarks set by the Florida Department of Environmental Protection (FDEP), Terracon excavated PHC-impacted soils and applied PetroFix® in situ to address residual contamination in the saturated zone. The injection area needed to be restored to its original condition to accommodate upcoming seasonal use. A reliable injection technology was required to achieve the project goals, minimize disruption to the athletic fields, and avoid the need for remobilization. This comprehensive approach successfully met FDEP's cleanup goals for soil and groundwater where the amendment was applied in the treatment area.

Results

- **Project goals met in the treated areas within budget and time constraints**
- **Low-impact, single injection event minimized disturbance to athletic fields**

Background

Located near a university student recreational facility, the site had formerly housed a building supply business, operating an underground storage tank (UST) system that was removed in 1990 along with a limited volume of impacted soils. No further remediation was recorded until site assessments from 2017 to 2023 revealed contamination in the soil and groundwater exceeding Florida's cleanup target levels (CTLs). The highest contaminant levels were found near the former UST area, requiring remediation.

The site was included in Florida's Petroleum Restoration Program (PRP), designed to address contamination from gasoline, diesel, and other petroleum products through financial assistance and technical oversight. Terracon was awarded the project through a competitive bid, coordinated with FDEP, local city officials, and the university to develop a remediation strategy.

Remediation

Design and Performance Goals

Terracon implemented a dual approach: excavation of impacted soils and the *in situ* application of PetroFix® for sorption-enhanced bioremediation. This involved:

- Excavating petroleum-impacted soils from the vadose and smear zones;
- Spray-applying PetroFix to excavation sidewalls and base; and
- Injecting PetroFix into the saturated zone.

PetroFix is engineered to effectively adsorb and break down petroleum hydrocarbon compounds such as BTEX, MTBE, and PAHs, commonly released through leaks or spills of gasoline, diesel, jet fuel, and other petroleum-based products into the environment. It has been successfully used to achieve cleanup goals on hundreds of projects and reductions in contaminant concentrations are known to be achieved in days to months.

The remediation aimed to achieve:

- Soil cleanup meeting residential exposure and leachability CTLs per Chapter 62-777 of Florida's Administrative Code; and
- A 75% reduction in groundwater contaminant levels for two consecutive quarters under static conditions.

A reliable injection technology was required to achieve the project goals, minimize disruption to the athletic fields, and avoid the need for remobilization. With a tight budget and schedule, Terracon leveraged its prior successes with PetroFix on similar projects to instill stakeholder confidence that the approach would achieve rapid and effective remediation.

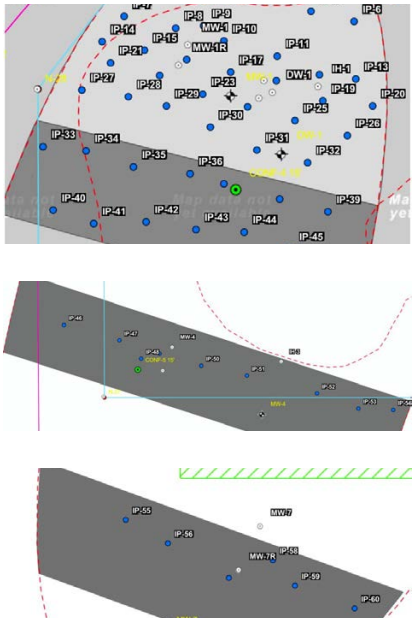
PetroFix Remediation Fluid

REGENESIS has developed a range of helpful technical resources to assist remediation professionals in the application and implementation of a PetroFix application to address petroleum impacts. Resources available include application instructions, technical bulletins, product literature and safety data sheets.

PetroFix Technical Resources

Remediation Training Portal

Implementation



Figures showing injection point locations in grid and barrier arrays.

Excavation and PetroFix Application

Focusing on the source area where organic vapor analyzer readings exceeded 1,000 ppm, Terracon removed 1,054 tons of PHC-impacted soil for offsite disposal. A total of 2,800 lbs of PetroFix® and 140 lbs of electron acceptor were spray-applied to the excavation's bottom and sidewalls to inhibit any further contaminant leaching into groundwater. The application was carefully managed to ensure even placement. PetroFix's micron-scale activated carbon particles easily penetrate through the soil pores, preventing treatment gaps.

PetroFix Injection

To address groundwater contamination, 11,600 lbs of PetroFix, combined with 580 lbs of a sulfate-based electron acceptor and make-up water, were injected. This created a 20,000-gallon solution applied through 60 direct-push points, covering both a grid in the source zone and permeable reactive barriers (PRBs) downgradient. Injection depths ranged from 19 to 34 feet below ground surface, aligned with the contaminant distribution. Care was taken to minimize disruptions to the surrounding recreational fields.

The grid treatment included injection points on six-foot spacing, while PRBs were strategically placed to intercept groundwater flow and facilitate the breakdown of contaminants via sorption and biodegradation. Additionally, two PRBs were installed in the mid-plume and distal-plume areas, relying on advection to transport the remaining dissolved-phase contaminants into the PRBs to treat the remaining NADC plume zone.

Low Pressure Injection

At nearly all injection intervals, pressures were less than 30 pounds per square inch (psi). Injection locations were spaced out to minimize pressure buildup in discrete zones.

Application Details

January 2024 Excavation Application	
PetroFix Spray-Applied to Excavation	2,800 lbs
Electron Acceptor Spray-Applied	140 lbs

February 2024 PetroFix Injection	
PetroFix Injected into Saturated Zone	11,600 lbs
Electron Acceptor Injected	580 lbs
Number of Injection Points	60
Total Fluid Volume Injected	19,876 gal

REGENESIS Technical Support: Turning Clients into Experts

During the project, REGENESIS Technical Service experts worked closely with the Terracon team to provide on-site training and technical support, ensuring the application process adhered to best practices. This training covered critical aspects such as determining volumetric injection speeds, maintaining proper flow rates and pressures, achieving even distribution, and performing distribution verification testing. These hands-on lessons equipped the Terracon team with the skills to effectively apply PetroFix and optimize its performance. Additionally, the team was directed to REGENESIS' comprehensive online library for further guidance, allowing them to continue developing expertise beyond the project.

Results

With the application of over 23,000 gallons of PetroFix solution, combined with excavation, the project successfully met the cleanup goals within the treated areas. Key monitoring wells within the treated areas showed no remaining contaminants of concern, confirming that the site met Florida's stringent groundwater cleanup targets. A determination that no further remediation is required is anticipated from the Florida DEP.

Figure 1

Benzene and Total BTEX in PetroFix Injection Zone

Benzene and Total BTEX (benzene, toluene, ethylbenzene and xylenes) in groundwater in two most impacted treatment area wells – MW-1 and MW-4 – before and after remediation.

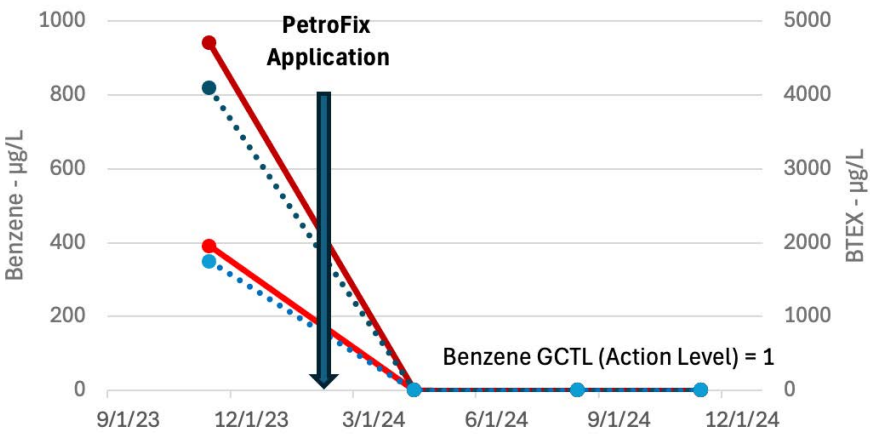


Figure 2

TRPH in PetroFix Injection Zone

TRPH in groundwater in two most impacted treatment area wells – MW-1 and MW-4 – before and after remediation.

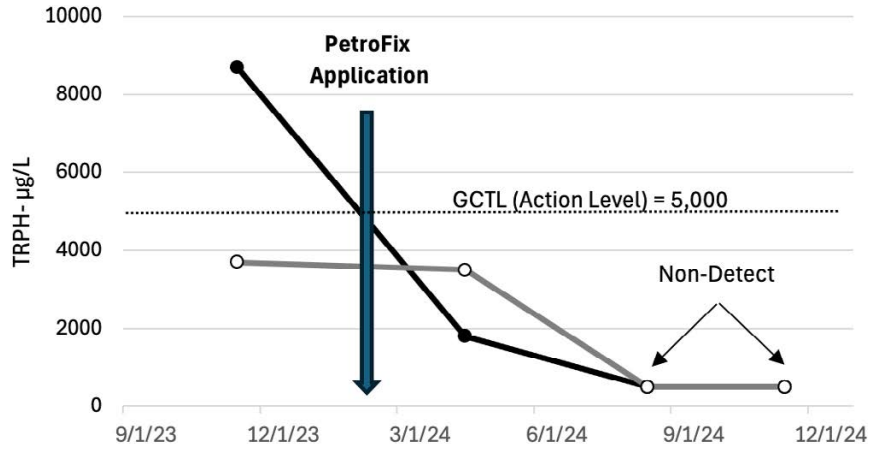
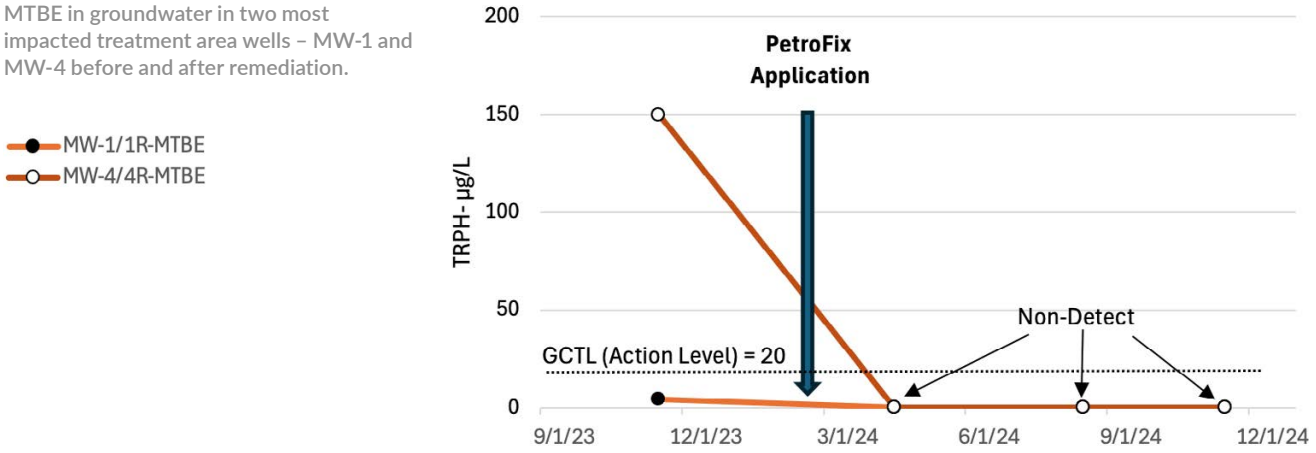


Figure 3 MTBE in PetroFix Injection Zone

MTBE in groundwater in two most impacted treatment area wells – MW-1 and MW-4 before and after remediation.

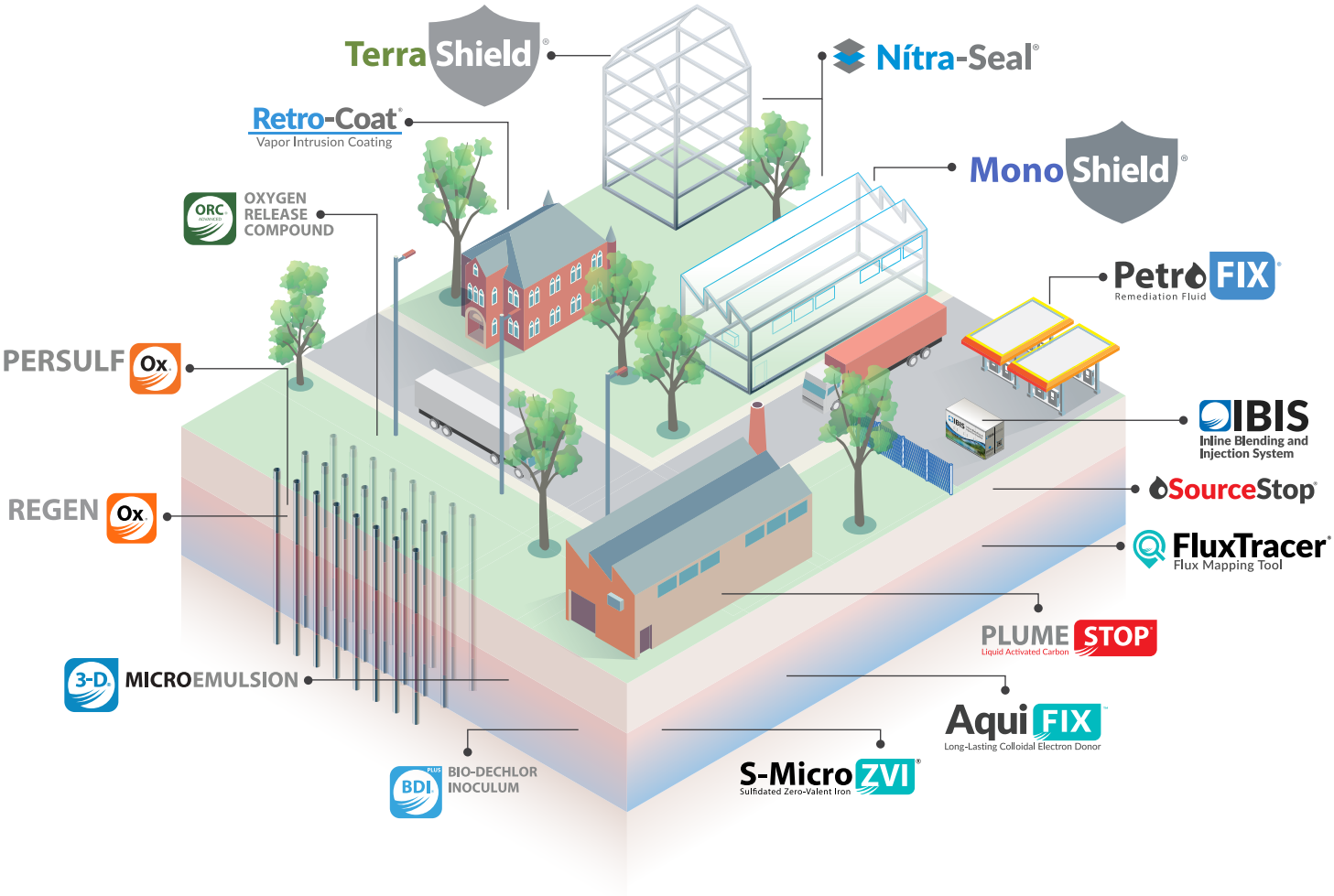


Conclusion

Terracon's use of PetroFix and a strategic, multi-faceted approach allowed for efficient project completion, meeting the regulatory requirements within budget constraints. This project underscores the effectiveness of flexible, advanced colloidal technologies like PetroFix in remediating complex contamination scenarios *in situ*. Terracon's partnership with REGENESIS contributed to sustained contaminant reduction, making this site a successful case study in practical, performance-driven remediation.

About the Consultant

Terracon's nationwide network of environmental professionals offer a range of services including environmental site assessments, site investigations and remediation, environmental planning (natural and cultural resources), regulatory compliance, industrial hygiene and occupational safety, and solid waste planning and design. Terracon works closely with communities to return blighted areas into thriving areas of opportunity and redevelopment.



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.

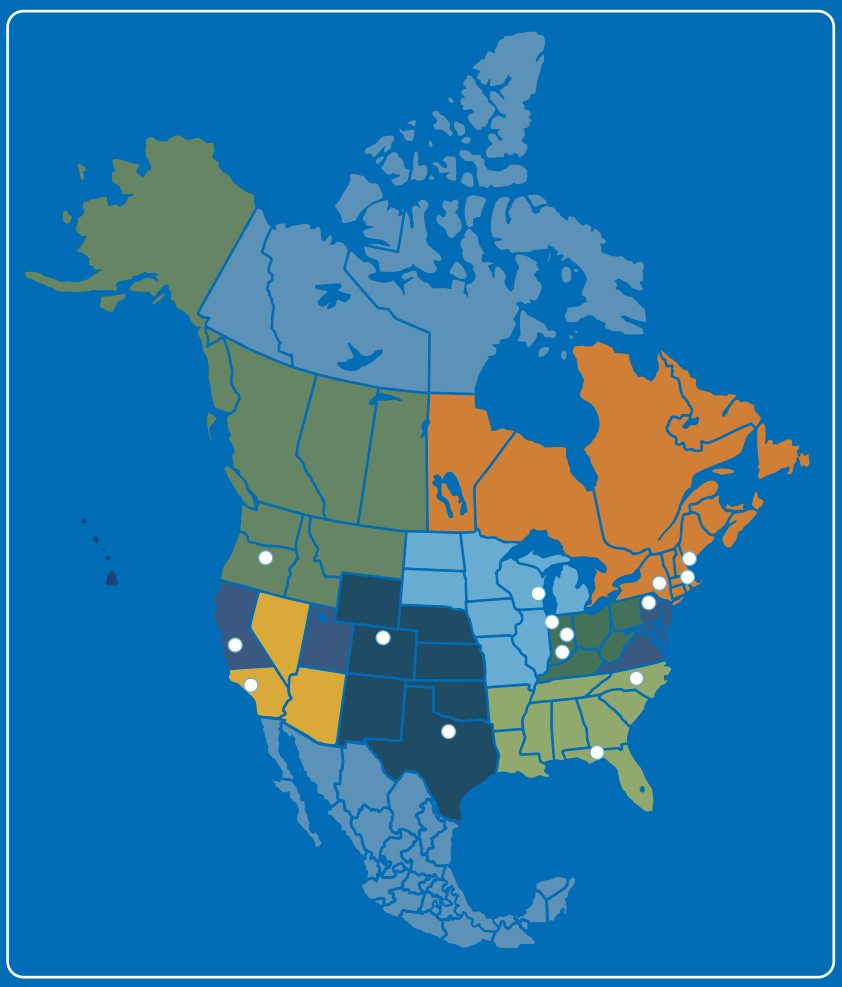
We value expertise, both our customers' and our own. We find that when our experienced staff collaborates directly with customers on complex problems, there is a high potential for success including savings in time, resources and cost.

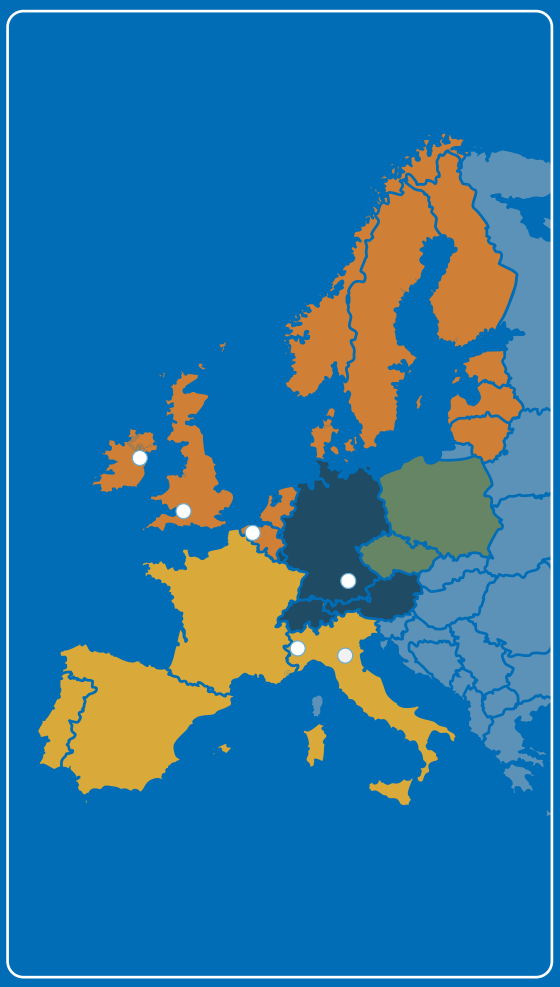
At REGENESIS we are driven by a strong sense of responsibility to the people charged with managing the complex environmental problems we encounter and to the people involved in developing and implementing our technology-based solutions. We are committed to investing in lasting relationships by taking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

REGENESIS®

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





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