

COMBINED REMEDY CHOSEN FOR THE FDEP INNOVATIVE TECHNOLOGIES PROGRAM

CASE STUDY:
Large Dilute BTEX Plume
Successfully Treated To
Meet Concentration
Milestones

OVERVIEW

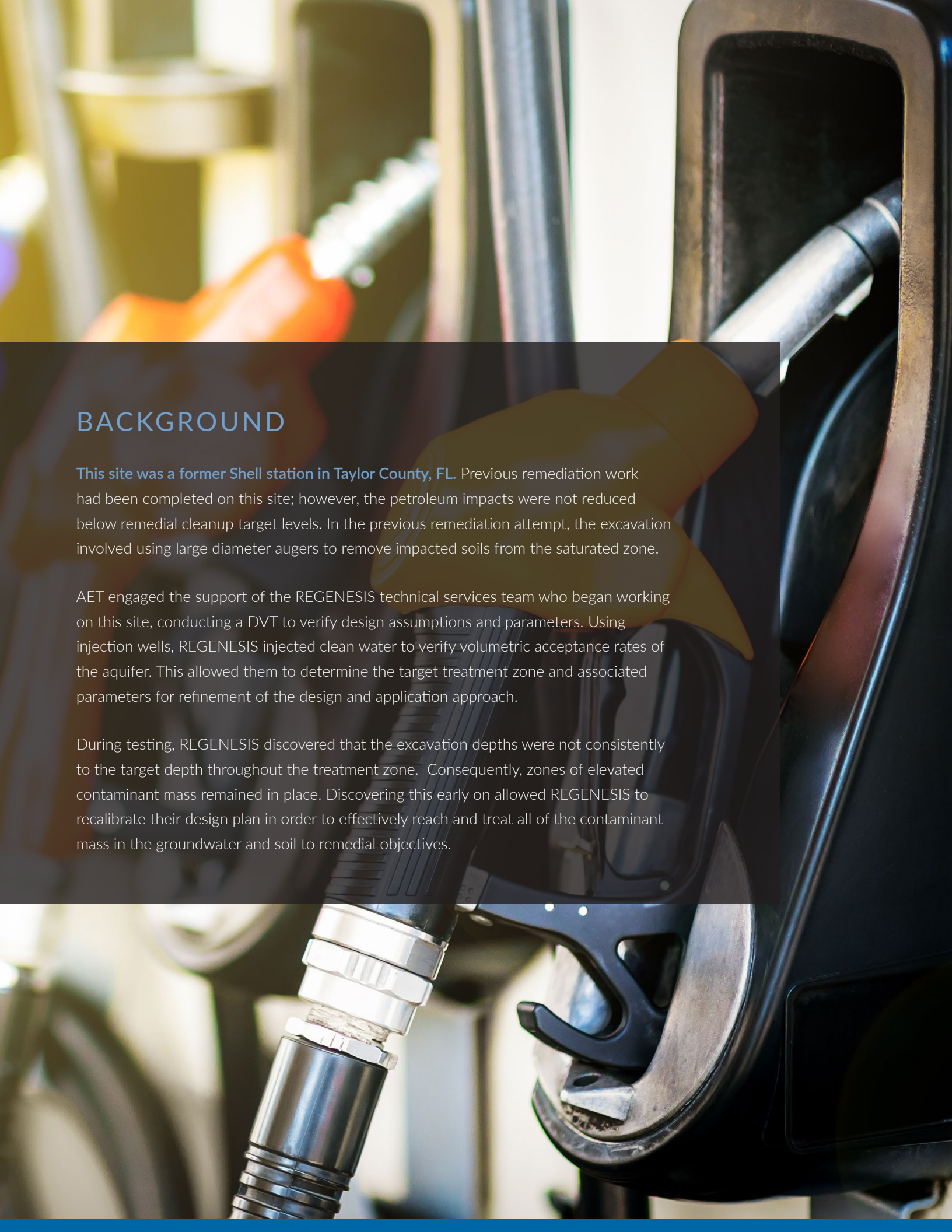
A former gas station site in Taylor County Florida had undergone prior remedial efforts over the years. The Florida Department of Environmental Protection (FDEP), through its Innovative Technologies Program, engaged the environmental consulting firm, Advanced Environmental Technologies LLC (AET) to design an alternative combined remedial approach employing PlumeStop®, RegenOx® and ORC Advanced®, to sorb, degrade, and destroy the existing petroleum contaminant plume. Prior to full-scale implementation, treatment of this site began with a thorough Design Verification Testing (DVT). The DVT results revealed that previous remediation work, which included the physical removal of impacted media via large diameter auger, had not successfully removed all of the contaminated soil and groundwater impacts. It was also determined that the excavation depths did not reach as far as originally reported.

Ultimately, the DVT led to the identification and elimination of data gaps that would allow for improved remedial outcomes and performance. Additionally, this site presented unique challenges over more “traditional” service station sites due to complexities like the presence of a flowable fill layer over the treatment area, difficult geology (i.e., clays and limestone), and close proximity to structures, utilities and the roadway.

The treatment began with a RegenOx injection. Forty-five days later, a combined injection of PlumeStop Liquid Activated Carbon™ and ORC Advanced was applied. The combination of these technologies has proven to successfully reduce contaminant levels to-date.

HIGHLIGHTS

- ➔ Chosen as the most technically-feasible and cost-effective strategy in a competitive bid scenario for the Florida Department of Environmental Protection’s Innovative Technologies Program with PlumeStop, RegenOx, and ORC Advanced considered as innovative technologies
- ➔ Unique site challenges like the presence of a flowable fill layer over the treatment area, difficult geology (i.e., clays and limestone), and close proximity to structures, utilities and the roadway made this site especially complex
- ➔ Combination of PlumeStop, RegenOx, and ORC Advanced successfully addressed the large BTEX plume



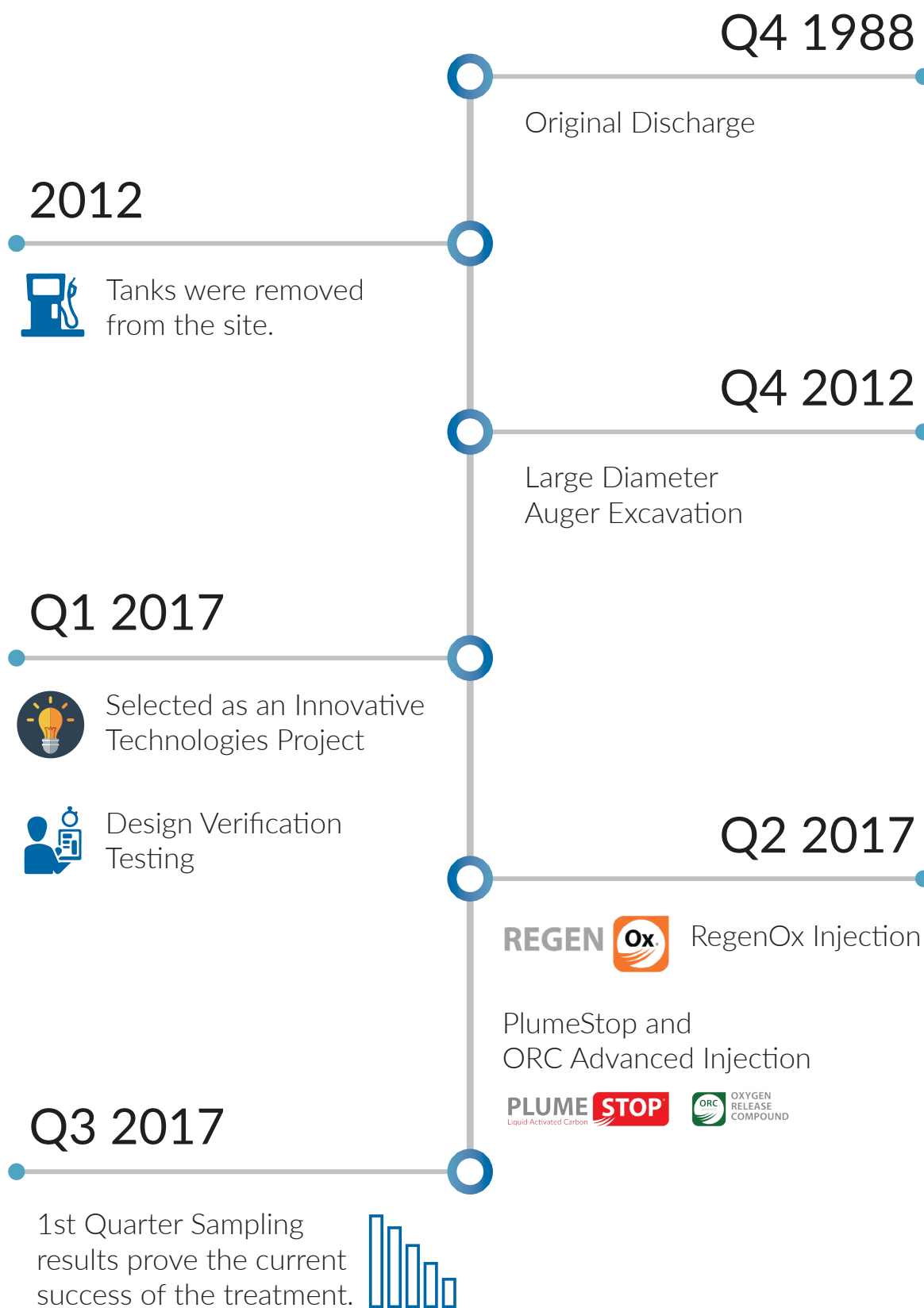
BACKGROUND

This site was a former Shell station in Taylor County, FL. Previous remediation work had been completed on this site; however, the petroleum impacts were not reduced below remedial cleanup target levels. In the previous remediation attempt, the excavation involved using large diameter augers to remove impacted soils from the saturated zone.

AET engaged the support of the REGENESIS technical services team who began working on this site, conducting a DVT to verify design assumptions and parameters. Using injection wells, REGENESIS injected clean water to verify volumetric acceptance rates of the aquifer. This allowed them to determine the target treatment zone and associated parameters for refinement of the design and application approach.

During testing, REGENESIS discovered that the excavation depths were not consistently to the target depth throughout the treatment zone. Consequently, zones of elevated contaminant mass remained in place. Discovering this early on allowed REGENESIS to recalibrate their design plan in order to effectively reach and treat all of the contaminant mass in the groundwater and soil to remedial objectives.

TIMELINE





DESIGN EFFORTS

DESIGN VERIFICATION TESTING (DVT)

REGENESIS conducted a thorough Design Verification Test (DVT) to verify the design assumptions and confirm site conditions. In this test, REGENESIS Remediation Services used 3 permanent injection wells which were later used in the full-scale application. The REGENESIS Technical Services Team injected clean water to verify flow rates and pressure. This allowed them to accurately map where the flowable fill depths were and how to effectively treat the contaminated area. After conducting this test, they discovered that the flowable fill depths were 13 to 15 feet, not the anticipated 16 feet. Additionally, REGENESIS evaluated the contaminant mass distribution during the DVT event in an effort to identify flux transport zones and impacted strata. Screening tools were utilized to gather real-time data to map the contaminant distribution and associated geology.



APPLICATION

The first goal was an overall mass reduction of the plume. RegenOx was injected to directly oxidize and destroy the target contaminants.

- ➔ RegenOx: 40 lb (5 gallon) pails and 40 lb bags, 367 lbs. per well.
- ➔ 45 days after RegenOx injection, PlumeStop was injected to reduce the dissolved phase plume concentrations. ORC Advanced was then injected separately to aid in the aerobic biodegradation of the petroleum hydrocarbons.
- ➔ PlumeStop: 275 gallon totes, dilution required. 10,400 lbs. injected,
- ➔ ORC Advanced: 40 pound bags, mixing required. 1,280 lbs. injected

APPLICATION DETAILS

In order to achieve a mass reduction of the plume, RegenOx was injected to directly oxidize and destroy the target contaminants. Some of the injection wells had to be hand installed due to the proximity of overhead power lines.

45 days after RegenOx injection, PlumeStop was injected to reduce the dissolved phase plume. ORC Advanced was then injected separately to aid in the aerobic biodegradation of the petroleum hydrocarbons.

APPLICATION INFORMATION

Date	Benzene	Toluene	Ethyl-benzene	Xylenes	Napthalene
Baseline	44	120	570	820	390
45 Days Post RegenOx / Pre-Plumestop	35	1,800	650	3,100	NS
90 Days Post-PlumeStop	4.9 U	25	16	49	32 U
Natural Attenuation Default Concentration (NADC)'s (µg/L)	100	400	300	200	140

RegenOx is an ISCO reagent that creates an alkaline chemistry which enhances desorption of solid phase hydrocarbons. Due to this chemistry, it is possible to mobilize some contaminant mass during treatment, as observed in the 45-day sampling event results. The transfer of mass from the sorbed to dissolved phase is beneficial for the overall remediation at the site as this mass would serve as a long-term source and is now available for capture and subsequent biodegradation in the PlumeStop biomatrix.

RESULTS

This treatment has already met preliminary mass concentration milestones after just 90 days. Based on first quarter results, the treatment is working effectively, and it is anticipated that remedial objectives will be met on an expedited timeline for this multi-year contract.



ABOUT THE ENVIRONMENTAL CONSULTANT

Founded in 1998 with offices across the Southeast, Advanced Environmental Technologies, LLC provides a wide range of environmental services to property owners, purchasers, residential and commercial developers, financial institutions, government agencies, medical facilities, industrial operators, attorneys, and real estate lenders; and state funded preapproval programs for petroleum contamination cleanup.

The company also provides environmental insurance liaison services to ensure timely processing for insurance companies; evaluating risk and liability; direct field oversight for environmental projects; claims review; negotiating state funded site rehabilitation funding allocation agreements; and liaison between regulatory agencies, insurance companies, and clients. Additionally, their in-house expertise extends to remedial construction, operation, and maintenance services, including contaminated soil excavation, monitor-only plan implementation, remediation system construction, remediation system management, system operation and maintenance, removal of outdated equipment, and on-site soil treatment; petroleum storage system compliance; and soil and groundwater remediation services, such as large diameter auger excavation, enhanced bio-remediation, chemical oxidation, air and bio-sparging, ozone injection, multi-phase extraction, ISCO oxygen diffusion, and in-situ and ex-situ soil treatment. Further, the company provides storage tank installation, upgrade, and removal services at retail service stations, bulk storage and fueling facilities, and emergency generator sites.

PLUME STOP®

Liquid Activated Carbon

PlumeStop rapidly removes contaminants from groundwater and stimulates their permanent degradation.

KEY BENEFITS:

- Rapid reduction of dissolved-phase plumes.
- Distribution of widely under low injection pressures.
- Achievement of stringent groundwater clean-up standards.
- Providing a long-term means of addressing matrix back-diffusion, so contaminants do not return.
- Elimination of excessive time and end-point uncertainty associated with groundwater remediation

REGEN Ox.

RegenOx is designed specifically for the rapid, *in situ* and/or *ex situ* chemical oxidation of a broad range of contaminants including both chlorinated solvents and petroleum hydrocarbons. RegenOx delivers rapid and effective contaminant mass reduction using a solid alkaline oxidant that is activated to a very high performance level through the action of a unique catalytic complex.

KEY BENEFITS:

- Promotes rapid and sustained *in situ* oxidation of a wide-range of organic contaminants.
- Provides a unique catalytic surface on which oxidants and contaminants react in a process known as “surface mediated oxidation.”
- Non-corrosive, with minimal heat and pressure compatible with underground infrastructure, tanks, piping, etc.
- Creates a significant, short-term oxygen footprint to quickly establish follow-on aerobic biodegradation conditions.
- Readily desorbs contaminants from soil surfaces allowing for more effective ISCO and/or mechanical removal/extraction.



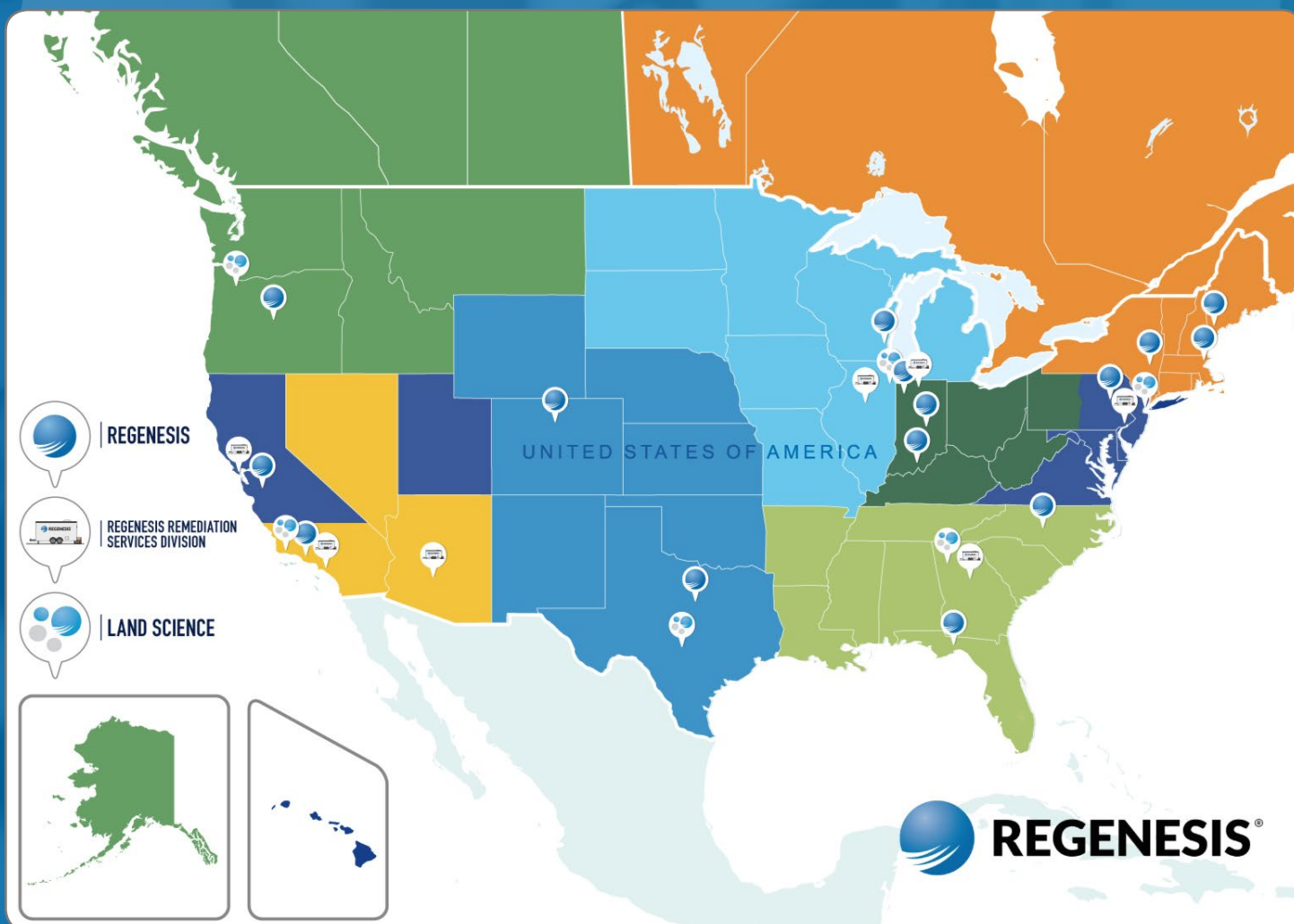
OXYGEN RELEASE COMPOUND

Oxygen Release Compound (ORC Advanced) is specifically designed and used for the enhanced or accelerated, *in situ* aerobic biodegradation of a wide-range of petroleum hydrocarbons or any aerobically degradable substance.

KEY BENEFITS:

- Decreased time to site closure, degradation rates accelerated up to 100 times faster than natural attenuation.
- A single application can support aerobic biodegradation for up to 12 months.
- Minimal site disturbance, no permanent or emplaced aboveground equipment, piping, tanks, and power sources.
- Lower costs and greater efficiency/reliability than engineered mechanical systems, oxygen emitters and bubblers.
- Simple and easy application using a variety of available methods.

REGENESIS IS READY TO ASSIST YOU IN DETERMINING THE RIGHT SOLUTION FOR YOUR SITE



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