



Project Highlights

- **ERDENHANCED™ Remediated >99% cVOC source zone [TCE] 100,000 to < 1 µg/L**
- **ERDENHANCED™ Realized Complete Biotransformation with no evidence of rebound**
- **ERDENHANCED™ Provides Multi-Year Sustainability after single deployment event.**
- **ERDENHANCED™ Minimizes Site, Monitoring, and Overall Remediation Costs, saving Client dollars.**



DNAPL Source Zone **Green & Sustainable** Remediation Optics Manufacturing Facility Lebanon, New Hampshire

BioStryke® Remediation Products, LLC, provide innovative and cost-effective amendment formulations designed to biostimulate treatment zone conditions and enhance the in-situ destruction of Site contaminants. **BioStryke® ERDENHANCED™** leverages existing conditions facilitating passive-aggressive destruction of cVOC dissolved, sorbed, residual source mass eliminating above-ground, energy-consuming emissions-generating equipment. **ERDENHANCED™** is proven effective in terms of cost and performance, allowing Site compliance with less environmental impact, working with Mother Nature, not against.

Source zone contamination was generated via poor site housekeeping to include the unauthorized release of spent trichloroethylene (TCE). Baseline TCE concentrations approached 100,000 µg/L indicating residual non-aqueous phase liquid (NAPL) present. In 2001, beta-**ERDENHANCED™** was deployed via direct injection, and 9-1/2 years later, [TCE] had decreased by >99% to < 1 µg/L. Today, the treatment zone remains a reducing environment demonstrating the sustainability of **ERDENHANCED™**, a Green solution.

Using **BioStryke® ERDENHANCED™** the project attained study objectives, passive-aggressively and without operational shut-downs, **decreasing source area [TCE] >99% to < 1,000 µg/L** within 5-years, allowing monitored natural attenuation (MNA) to manage the now contracting solute plume. **ERDENHANCED™** cost-effectively leveraged existing site conditions, enhancing the creation of preferential conditions for native microbial populations, facilitating the expedited biotransformation of dissolved, sorbed, and residual source mass contaminants *without* repeated deployment events.

To accomplish Site objectives, approximately 2,600 pounds of **ERDENHANCED™** was injected over a 25-point grid pattern using direct push technology (DPT). Estimate rates approached 100 pounds amendment per injection point, to include vertical and angle borings to facilitate amendment deployment under the site building.

Source area groundwater baseline concentrations of the parent products TCE and tetrachloroethylene (PCE) approximated 100,000 µg/L; with total concentrations of the daughter products cis- and trans-1,2-dichloroethene (DCE), 1,1-DCE, and vinyl chloride approximating 400 µg/L. On a molar basis baseline parent product contaminants represented 99.6% of the total cVOC signature. As a result of **ERDENHANCED™** deployment, the parent molar ratio is now <1% and ethene concentrations have increased over 400% demonstrating enhanced residual source mass bioavailability and complete cVOC biotransformation.

BioStryke® amendments are suitable for any type of deployment such as Direct Push Technology (DPT), infiltrations gallery, and direct application due to enhanced solubility.

BioStryke® amendments are easy to handle, requiring less water, less pore space displacement, less site time, less overall remedial costs.

BioStryke® amendments maximize project margins while minimizing project impacts.

Analytical testing of performance groundwater samples collected and analyzed shortly (< 3 months) after the *single* injection event documented an approximate 83% reduction in baseline [TCE] from 97,400 µg/L to 16,100 µg/L. During the next four years post the *single* deployment, source area [TCE] ranged between 11,600 µg/L to 29,800 µg/L. This increase in [TCE] indicated the continued flux overtime (contaminant transfer) of sorbed phase and residual source mass into the dissolved phase. During this same period, concentrations of *cis*-1,2-DCE also increased, indicating a similar flux of sorbed and residual daughter contaminant mass and enhanced parent contaminant biotransformation. Given that during growth coupled dehalorespiration native microflora tend to preferentially dechlorinate the more oxidized parent cVOCs (*e.g.* TCE) than the less oxidized daughter products (*e.g.* *cis*-1,2-DCE), it is expected that significant dechlorination of *cis*-1,2-DCE would be delayed until the bulk of sorbed phase and residual TCE source mass was dechlorinated.

BioStryke® **ERDENHANCED™** stimulates the ability of the native microflora to scavenge competing terminal electron acceptors (TEAs) such as oxygen, nitrate, oxidized iron/manganese, and sulfate which can limit cVOC dechlorination. **ERDENHANCED™** is a proprietary blend of micro-macro nutrients and superior sources of terminal electron donors to include complex carbohydrates and unique sources of organic carbon. **ERDENHANCED™** is proven to facilitate native microflora fermentation, the yielding of volatile fatty acids, molecular hydrocarbon, and expedited dechlorination.

- **ERDENHANCED™** expedites the degradation of dissolved contaminants.
- **ERDENHANCED™** expedites creation of concentration gradient between groundwater and sorbed/residual mass.
- **ERDENHANCED™** expedites contaminant flux and increasing contaminant bioavailability.
- **ERDENHANCED™** expedites desorption of source mass contaminants by transforming parent cVOCs (TCE/PCE) to less-chlorinated daughter products (DCE, VC, and ethene), each with significantly lower sorption coefficients and greater degradation rates under aerobic conditions found outside the anaerobic treatment zone, supporting MNA for long-term plume management.
- **ERDENHANCED™** expedites contaminant dissolution by enhancing microbial generation of fatty acids which serve as a co-solvent, increasing contaminant bioavailability and increasing rates of dechlorination.

The **ERD** remediation program was designed to address TCE source mass DNAPL, and did so by achieving a greater than 99% decrease in [TCE] in 5 years, and **no** indication of rebound over 10 years. Our products demonstrate that by enhancing existing conditions, working with Mother Nature not against, one can expedite site compliance, redevelopment, and reuse with less impact to the environment, and less cost to the client.