



# 1,1,1-TCA Bioremediation with CL-Out<sup>®</sup>

## Site Summary

CL-Out<sup>®</sup> bioaugmentation was implemented to remediate 1,1,1-TCA in ground water at an operating steel manufacturing facility. The source area was initially treated by ozone injection for two years. Then, a high vacuum extraction system was installed in the source area for two years. These efforts reduced the concentration of contamination in the source area, but the 1,1,1-TCA concentration was still high after the extraction system appeared to reach an asymptote. CL-Out<sup>®</sup> bioremediation was implemented to reduce the contaminant mass in the source area and affect the down gradient plume.

## Geology and Hydrogeology

The site is located on a low-gradient alluvial plane contained in a broad bedrock valley. The alluvial deposits are coarse grained with a high permeability. The impacted ground water is in the upper part of a water-table aquifer. The plume is approximately 6,000 feet long and 1,500 feet wide. However, the highest concentrations are in a core flow path less than 200 feet wide.

## Contamination

Prior to application of bioremediation the maximum 1,1,1-TCA concentration in the source area was 3.5 mg/L. The 1,1,1-TCA concentration in the plume 250 feet down gradient of the source was 0.060 mg/L.

## Remediation

CL-Out<sup>®</sup> was applied by injecting a concentrated microbial solution into the aquifer through injection points in the source area and a row of injection points bisecting the plume down gradient of the source area. The CL-Out<sup>®</sup> was allowed to flush through the aquifer and follow the migration path of the 1,1,1-TCA. There were two injection events – March 2007 and September 2007.

## Results

Following CL-Out<sup>®</sup> bioaugmentation, the concentration of 1,1,1-TCA decreased in the source area and in the down gradient plume. Monitoring wells within the active treatment zone and source area show greater than 99% to 86% contaminant destruction, respectively. The sampling in down gradient monitoring wells showed greater than 97% destruction at 50 feet down gradient, and 57% destruction 250 feet down gradient. The following table summarizes the ground water sampling results.

Sampling Location	1,1,1-TCA Concentration (mg/L)				
	Pre-treatment	30 Days After 1 <sup>st</sup> Treatment	90 Days After 2 <sup>nd</sup> Treatment	One Year Post Treatment	Two Years Post Treatment
	10/30/06	4/10/07	1/9/08	8/27/09	9/16/10
Active Treatment Area	1.1	0.19	<0.005	0.0036	0.0014
Source Area Down Gradient	3.5	2.5	2.0	1.4	0.48
50 ft. Down Gradient	0.027	0.021	0.013	0.0059	<0.001
250 Ft. Down Gradient	0.060	0.069	0.051	0.026	0.026

The treatment was successful in reducing the concentrations of 1,1,1-TCA in the source area and down gradient plume. The source area impact was immediate and lasted for as long as two years. The down gradient impact was first observed after 90 days and may have stalled out after one year. Overall, the application of bioremediation reduced the mass of contamination in the source area and reduced the down gradient exposure risks.

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