

## **Air and Ozone Sparging of TCE Using a Directionally Drilled Horizontal Well**

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A one year pilot test was performed at Marine Corps Base, Camp Lejeune to evaluate the performance of air and ozone-enhanced air sparging via a horizontal well. The primary contaminant at the site is trichloroethylene (TCE), with concentrations ranging from 200 to 800 µg/L at a primary target depth of 40 to 45 feet below ground surface (bgs). Site geology consists of silty clay overburden, to a depth of about 35 feet bgs, underlain by partially cemented silty sand and gravel, with thin, discontinuous clay lenses within the transition zone (generally 35 to 40 feet bgs). Horizontal directional drilling (HDD) was selected for subsurface gas delivery because of site constraints, including an active flight line and buried underground utilities; as well as configuration of the plume, which is elongated and relatively deep. The HDD well was constructed of six-inch-diameter SDR 11 HDPE, with a slotted section measuring 350 feet in length, positioned at approximately 60 feet bgs. Monitoring wells were installed at select depth intervals on both sides of the well. The objectives of the test were to 1) evaluate the distribution of air using a horizontal well, 2) compare the relative performance of mass transfer (in situ air stripping) to combined in-situ oxidation and air stripping, using ozone enhanced air sparging. Air sparging was conducted for the first three months, at a flow rate of approximately 140 scfm. TCE concentrations were reduced by 90% or more in several wells within this period of time. Based on dissolved oxygen measurements, the distance of influence of air sparging was at least 50 feet on both sides of the well. Subsequent combined air and ozone sparging for approximately five months at a concentration of approximately 7,000 ppm<sub>v</sub> produced little change in TCE concentrations, dissolved chloride, or ORP. However, because of various mechanical problems, operation of the ozone generator was intermittent. At the conclusion of the one year pilot study, TCE concentrations were reduced by 99% in all monitoring wells with baseline concentrations exceeding 50 µg/L. The Maximum Contaminant Level for TCE has also been achieved in 14 of 16 wells sampled, with the exception of two deep wells positioned immediately above the slotted portion of the sparge well.