

BUILDING A BETTER BIOWALL: A COMPARISON OF TWO DESIGN, CONSTRUCTION, AND OPERATION STRATEGIES

Mike Perlmutter, P.E (mperlmur@ch2m.com) (CH2M HILL, Inc., Atlanta, GA)

Tom Beisel, P.G. (CH2M HILL Constructors, Inc., Atlanta, GA)

Tiffany Swoveland Chapman (CH2M HILL, Inc., St. Louis, MO)

Marvin Eaves (Environmental Restoration Program Manager, Whiteman AFB, MO)

Mark Craig (Remedial Project Manager, Southern Division of Naval Facilities Engineering Command, Charleston, SC)

There has been increased interest in the use of biowalls for enhanced anaerobic bioremediation of chlorinated volatile organic compounds (CVOC) and perchlorate. Biowalls are permeable reactive barriers (PRBs) that use organic media (e.g., mulch, compost, or wood chips) to provide a long-term carbon source to facilitate biodegradation of CVOCs and perchlorate. The walls are an attractive remedial technology because they are relatively inexpensive to construct and, if designed appropriately, may last 10 years or more. To illustrate the diverse ways that biowalls can be applied effectively, this paper compares the design, construction, and operation strategy for two sites with differing contaminants, site characteristics, budgetary objectives, and restoration strategies.

Site 1. Nearly two miles of biowalls have been installed in shallow weathered limestone at Naval Weapons Industrial Reserve Plant (NWIRP) McGregor, Texas to (1) reduce “source area” perchlorate plume mass, (2) remediate perchlorate-contaminated groundwater before it seeps into streams, and (3) expedite offsite property clean-up. Prior to full-scale biowall construction, bench- and pilot-scale studies were conducted to evaluate organic media and potential construction methods. The results from these early studies were used to design and implement the full-scale biowalls. Starting in 2002, excavated trenches were backfilled with an exacting mixture of mushroom compost, ¾-inch pine wood chips, soybean oil, and 1-inch washed, crushed limestone. The data indicate that after nearly 3 years of operation, the biowalls are still effectively treating perchlorate-contaminated groundwater from 1,000 micrograms per liter (µg/L) to below the laboratory detection limit (2 µg/L). However, as anticipated, routinely-collected geochemical indicator parameters suggest that carbon rejuvenation (e.g., injection of emulsified soybean oil via in-place diffuser pipes) may be required in fall 2005 or spring 2006 to sustain biodegradation of the contaminants.

Site 2. Under the pretext of a treatability study to address a CVOC plume in a 5- to 10-foot thick clayey gravelly (weathered bedrock) layer, a “full-scale” 270-foot long, 10- to 20-foot deep biowall was constructed in March 2004 at Whiteman Air Force Base (AFB) using two standard tracked excavators. The biowall, that was backfilled with a mixture of organic mulch (free recycled vegetation from the facility) and clean sand, was implemented to intercept the CVOC plume before it discharged to a nearby ditch. Despite a lean budget (\$74,000), limited hydrogeologic data, and no formal “studies” prior to final design and construction, the biowall was installed as designed and is performing as intended. CVOC concentrations in downgradient wells are more than 88% lower than in upgradient wells, and pre- and post-construction gradient measurements suggest that the biowall has not impacted groundwater flow.