COST AND PERFORMANCE REPORT

Phytoremediation at Edward Sears Site
New Gretna, NJ

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Phytoremediation at Edward Sears Site, New Gretna, NJ
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1. INTRODUCTION

The efficacy and cost of phytoremediation to clean up shallow groundwater contaminated with chlorinated solvents (primarily trichloroethylene), is being evaluated at the field scale in demonstration projects at Aberdeen Proving Grounds Edgewood Area J-Field Site in Edgewood, Maryland, the Edward Sears site in New Gretna, New Jersey, and Carswell Air Force Base in Fort Worth, Texas. These projects will demonstrate the use of hybrid poplars to hydraulically control the sites and ultimately to remove the volatile organic compounds (VOCs) from the groundwater. When completed, these projects will allow a comparison of phytoremediation at three sites under varied conditions within different climatic regions.

2. SUMMARY AND LATEST OBSERVATIONS

At the Edward Sears site, deep rooting was used to maximize groundwater uptake. Beginning in December 1996, hybrid poplar trees were planted nine feet below ground surface. In addition, some trees were planted along the boundary of the site at depth of only 3 feet to minimize groundwater and rainwater infiltration from off-site. Groundwater monitoring will continue in 2000. A November sampling is scheduled to determine if contaminant concentrations recover during the dormant season.

There were substantial reductions in dichloromethane and trimethylbenzene concentrations during the 1998 growing season. For example, dichloromethane was reduced to 615 parts per billion (ppb) from 490,000 ppb at one location and to a non-detect level from up to 12,000 ppb at another location; trimethylbenzene was reduced to 50 ppb from 1,900 at one location. There is also indication of anaerobic dechlorination in the root zone as the level of PCE dropped and TCE increased.

There seems to have been an adverse impact on tree growth in areas with high VOCs concentrations during the initial two growing seasons. However, in the third growing season, the rate of growth has increased significantly but the trees have yet to achieve the height and diameter of trees planted in uncontaminated areas. Evapotranspiration gasses were collected in sampling bags during the hottest periods of the day and were analyzed for target compounds. Only low levels of toluene (8 to 11 ppb) were detected. Soil gas flux measurements indicated that no contaminants are released into the air from the soil.

3. SITE DESCRIPTION

From the mid-1960s to the early 1990s, Edward Sears repackaged and sold expired paints, adhesives, paint thinners, and various military surplus materials out of his backyard in New Gretna, NJ. As a result, toxic materials were stored in leaky drums and containers on his property for many years. The soil and

groundwater were contaminated with numerous hazardous wastes, including dichloromethane (up to 490,000 ppb), tetrachloroethylene (up to 160 ppb), trichloroethylene (up to 390 ppb), trimethylbenzene (up to 2,000 ppb), and xylenes (up to 2,700 ppb). There is a highly permeable sand layer from 0 to 5 ft (0 to 1.6 m) below ground surface (bgs). Below that exists a much less permeable layer of sand, silt, and clay from 5 to 18 (1.6 to 6 m) ft bgs. This silt, sand, and clay layer acts as a semi-confining unit for water and contaminants percolating down toward an unconfined aquifer from 18 to 80 ft (6 to 26 m) bgs. This unconfined aquifer is composed primarily of sand and is highly permeable. The top of the aquifer is about 9 ft (3 m) bgs, which lies in the less permeable sand, silt, and clay layer. The top of the aquifer is relatively shallow and most of the contamination is confined from 5 to 18 ft 1.6 to 6 m) bgs.

4. DESCRIPTION OF THE PROCESS

In December 1996, 118 hybrid poplar saplings (*Populus charkowiiensis x incrassata*, NE 308) were planted in a plot approximately one-third of an acre in size.

Poplar trees that were left over after the deep rooting was completed were planted to a depth of 3 ft (1 m), or shallow rooted. These trees were planted along the boundary of the site to the north, west, and east sides of the site. These trees will minimize groundwater and rainwater infiltration from off-site.

Process Description—
The trees were planted 10 ft (3 m) apart on the axis running from north to south and 12.5 ft (4 m) apart on the east-west axis. The trees were planted using a process called deep rooting: 12-ft (4 m) trees were buried nine feet under the ground so that only about 2 to 3 ft (0.6 to 1 m) remained on the surface. This was done to enhance deep rooting of poplar trees in the zone of contamination, and to maximize uptake of groundwater compared to surface water.

Monitoring of the site includes semi-annual analysis of groundwater, soils, soil gas, and evapotranspiration gas. Continued growth measurements will also be made as the trees mature. Site maintenance also involves fertilization, and control of insects, deer and unwanted vegetation.

5. RESULTS AND EVALUATION

Over 40 direct push microwells were installed to monitor groundwater instead of temporary direct push wells. This will enable frequent, seasonal monitoring of groundwater, at specific locations for comparable costs.

Substantial reductions in dichloromethane identified after the second growing season in August 1998 have been sustained as of August 1999. Concentrations at four locations were reduced from 490,000 down to 615 ppb, 12,000 ppb to ND, 680 ppb to ND, and 420 to 1.2 ppb. At one location PCE dropped from 100 to 56 ppb, while TCE increased from 9 to 35 ppb. This may be indicative of anaerobic dechlorination in the root zone. At other locations TCE concentrations remained stable over the past three years, although a decrease from 99 to 42 ppb was noted at one well point. Trimethylbenzene (TMB) was reduced from 147 to 2 ppb, 246 to ND, 1900 to 50 ppb, and 8 to 1 ppb at four microwell points in the treated area. At another well point within the treated area, concentrations of TMB were relatively unaffected, 102 ppb in August 1997 compared to 128 in August 1999. Xylenes were also unaffected or slightly increased at this same location, 26 ppb in August 1997 compared to 34 ppb in August 1999. At two other locations, xylene concentrations dropped from 590 to 17 ppb, and from 56 to 1.4 ppb.

The groundwater monitoring program will continue in 2000, with samples being collected in May, August and November. November sampling is being added to see if concentrations recover slightly during the dormant season.

Sampling of evapotranspiration gases was conducted by placing Tedlar bags over branches on 6 selected trees. Five trees were in areas where groundwater was contaminated with different concentrations of target contaminants. The sixth tree was in an area known to be free of contamination. Evapotranspiration gasses were collected on an hourly basis, for four hours during the hottest period of the day. Low levels of toluene 8 to 11 ppb were detected in three of four samples from one tree and one of four discrete gas samples from another tree. No other target compounds were detected (DL of 8 ppb/v) in any other samples.

Soil gas flux measurements were collected in conjunction with the evapotranspiration gas study. Samples collected indicated no contaminants being released to the air from the soils.

During the initial two growing seasons, tree height and diameter were substantially lower in areas containing high concentrations of VOCs in groundwater. This adverse impact appears to have been reduced during the third (1999) growing season. Rate of growth increased significantly in the contaminated areas; however, these trees have yet to achieve the overall height and diameter of trees planted in uncontaminated areas. Overall the trees in August 1998 averaged 17 ft (22 m) in height with a range from 3.5 to 25 ft (1 to 8 m).

6. COSTS

Site Preparation:	$24,000
Planting:	$65,700
Maintenance:	$15,300
Total:	$105,000
1997 Maintenance:	$26,000
1998 Maintenance:	$14,000 (Maintenance cost will drop substantially after trees are established)

Monitoring/analysis: 50 groundwater stations, soil gas, soils, hydrogeological parameters, weather, transpiration gas, reports, etc. Monitoring costs should also reduce annually as study techniques become more refined.

1997:	$72,800
1998:	$61,600
1999:	$42,000

7. REFERENCE

Eberts, S., G. Harvey, S. Jones, and S. Beckman, In press. A Multiple Process Assessment of Phtoremediation of a Chlorinated Solvent Plume at a Subhumid Field Site, John Wiley and Sons.