ABSTRACT

TILLOTSON, JASON MATTHEW. Laboratory Studies in Chlorinated Solvents and Hydrocarbon Bioremediation. (Under the direction of Robert C. Borden.)

Groundwater contamination is an important and growing issue of environmental concern. Much is known about contaminant degradation at ideal conditions. However, many hazardous waste sites exist at less than ideal conditions, requiring a site-specific analysis to determine the best course of action.

Two different aquifers contaminated with various pollutants were studied for this thesis. The first site is the Maryland Sand, Gravel and Stone Site located in Elkton, Maryland. A former hazardous waste disposal site, the aquifer is contaminated with many different contaminants, which can be classified into four groups: ketones; aromatic hydrocarbons; chlorinated aliphatic hydrocarbons; and 1,4-dioxane. The co-occurrence of these contaminants presents a unique challenge, as some contaminants enhance the degradation of others while other contaminants inhibit the degradation of others. In addition, some contaminants are only aerobically degradable, some are only anaerobically degradable and some are degradable both aerobically and anaerobically. Laboratory microcosm studies were undertaken to determine the best treatment or set of treatments at degrading the contaminants. Ambient conditions were insufficient at degrading any of the contaminants, while a combined aerobic/anaerobic treatment with bioaugmentation was determined to be the most effective. In this treatment an aerobic phase was first initiated to degrade the ketones and aromatic hydrocarbons. Once these contaminants had degraded to below detection limits, the microcosms were converted to an anaerobic phase, and amended with additional organic substrates. A first bioaugmentation culture was added that can degrade chloroform and 1,1,1-TCA. Once chloroform had degraded, a second bioaugmentation culture was added that was able to degrade 1,1,1-TCA and PCE.

The second site is the Naval Weapons Station in Charleston, SC, where the aquifer is contaminated with TCE and *cis*-DCE. A previous pilot test study had been performed to determine the potential of using EOS®, an emulsified soybean oil, to enhance reductive dechlorination of TCE and *cis*-DCE to ethene. Unfortunately, degradation of these contaminants had not progressed, and laboratory microcosm experiments were undertaken to determine the best course of action. Using soil and groundwater taken from the pilot test area, microcosms were constructed and different treatments were run to determine the factor limiting reductive dechlorination. Two factors were found that likely limited reductive dechlorination: the pH of the aquifer was too low, inhibiting microbial growth; and the amount and type of dechlorinators present in the aquifer were not sufficient for complete transformation of TCE to ethene. Raising the pH of the aquifer was the most important need. To raise the pH of the aquifer, magnesium hydroxide ($Mg(OH)_2$) was combined with EOS® to form a buffered organic substrate, and then injected into the subsurface of the original pilot test area. Soil borings collected immediately prior to and three months after injection reveal that the pH and alkalinity of the aquifer have been raised significantly. Additionally, TCE and *cis*-DCE in the monitor wells have both degraded considerably, while vinyl chloride and some ethene has been produced. Additional research is needed to ensure vinyl chloride accumulation does not occur and to determine if bioaugmentation of the aquifer is necessary.

LABORATORY STUDIES IN CHLORINATED SOLVENTS AND HYDROCARBON BIOREMEDIATION

by

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A thesis submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the Degree of
Master of Science

CIVIL ENGINEERING

Raleigh, North Carolina

2007

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BIOGRAPHY

Jason Matthew Tillotson was born on July 18, 1983 in Raleigh, North Carolina. In 1995 he moved with his family to Old Town, Maine, which he now considers his hometown. He completed his secondary education at Old Town High School in 2001. He graduated Cum Laude from the University of Maine in Orono, Maine in May, 2005 with a Bachelor of Arts degree in Mathematics and minors in Water Resources and Environmental Quality.

Jason started as a Graduate Research Assistant in the Department of Civil, Construction, and Environmental Engineering at North Carolina State University in August 2005. He received his Master of Science degree in May 2007.

While at NC State University, Jason twice placed second at the annual Water Resources and Environmental Engineering Graduate Student Spring Symposium. In addition, he was the chair of the 2007 WREE Spring Symposium. Jason's interests and hobbies include hiking, swimming, watching movies and the Boy Scouts.

ACKNOWLEDGEMENTS

First, I would like to thank all of my professors at NC State University, but especially my advisor Robert C. Borden. Your guidance, support and patience throughout my stay here was very much appreciated by this student. I am also grateful for my other thesis committee members, Morton A. Barlaz and Francis de los Reyes, for their active interest in my research. I would also like to thank Aria Amirbahman, my professor at the University of Maine who got me interested in environmental engineering.

I am very appreciative for all those who helped me with laboratory work: Jon McDaniels, for running countless iron extraction experiments; Chris Watson, for help in the lab and in the field; Aaron Weispfenning and Claudia Williams, for help with the soil boring analyses; and David Black, for running countless gas chromatograms, purge and trap and ion analyses for me.

The support of my friends and officemates over the past two years has been greatly appreciated as well. Vivi, Azam, Ahmad, Naresh, Jim, Tarek, Scott and everyone else who kept me relatively sane over the past two years, I thank you very much.

Very special thanks are given to my beautiful and loving girlfriend, Funda Güneş, for putting up with me while I was doing research, writing my thesis and preparing my defense. It is nice to find a person who is able to stand my presence for a few hours, but absolutely amazing to find a person who is willing to be with me for as long as you have.

I am extremely indebted to my family. To my aunt Carol, my brother Scott, sister Kirsten and their families, thank you so much for your help in getting me on my feet once I moved to North Carolina. To my younger brother Seth, thank you for teaching me all the patience I could ever need.

Finally, I would like to thank my parents, Dorothy deBruyne and Darrell Donahue, for making me everything I am today. I could not have done anything without your continued love, support, guidance and encouragement.

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CHAPTER I
INTRODUCTION

1.0 INTRODUCTION

It is estimated that groundwater constitutes 95% of the freshwater in the United States, and that half of the nation's population uses groundwater for domestic purposes (Sargent and Fliermans, 1989). However, contamination of groundwater is an important and growing issue of concern. Some commonly observed groundwater contaminants include: chlorinated aliphatic hydrocarbons, such as tetrachloroethene (PCE), trichloroethene (TCE), chloroform, methylene chloride and 1,1,1-trichloroethane (1,1,1-TCA); aromatic hydrocarbons, such as benzene, toluene, xylene and chlorobenzene; and other chemicals, such as acetone and 1,4-dioxane (Hickey *et al*., 1995; Moran *et al*., 2007; Westrick *et al*., 1984; Zenker *et al*., 2000). All of these chemicals have many industrial uses, including as metal degreasers, dry cleaning agents, solvents, stabilizers and in fuels. Unfortunately, the presence of these and other contaminants pose major concerns to human and environmental health due to acute and chronic toxicity, persistence and bioaccumulation (Smidt *et al*., 2004).

Through laboratory experiments, *in situ* aerobic and anaerobic biodegradation of these different contaminants is reasonably well understood under ideal conditions. However, conditions at many hazardous waste sites are often less than ideal, necessitating site-by-site studies to consider the different factors and parameters affecting biodegradation.

This thesis covers laboratory studies of two different sites where conditions for the biodegradation of different contaminants are less than ideal. The first site is the Maryland Sand, Gravel and Stone Site (MSGS) located in Elkton, Md. A former hazardous waste disposal site, the aquifer is contaminated with a variety of chemicals, which can be categorized into four groups: chlorinated aliphatic hydrocarbons; aromatic hydrocarbons; ketones; and 1,4-dioxane. The co-occurrence of these contaminants presents a unique challenge, as some contaminants enhance the degradation of others while other contaminants inhibit the degradation of others. In addition, some contaminants are only aerobically degradable, some are only anaerobically degradable and some are degradable both aerobically and anaerobically.

The second site is the Naval Weapons Station (NWS) in Charleston, SC, where the aquifer is contaminated with TCE and *cis*-DCE. Organic substrates have previously been used to enhance degradation of these chlorinated solvents through a process known as reductive dechlorination. However, in a previous pilot test study EOS®, an emulsified soybean oil, was injected into the subsurface, but degradation of TCE and *cis*-DCE to ethene had not progressed.

Microcosm studies were conducted on soil and groundwater collected from both of these sites. For the MSGS site, different experiments were run to determine the best treatment or set of treatments for the degradation of all of the contaminants. For the Charleston NWS, microcosm studies were initiated to determine the factors limiting dechlorination of TCE and *cis*-DCE. From these experiments it is hoped a better overall understanding of bioremediation can be achieved.

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CHAPTER II
MARYLAND SAND, GRAVEL AND STONE SITE

1.0 MSGS SITE

Bioremediation is an important and growing method of *in situ* degradation of chlorinated solvents and other groundwater contaminants. However, many laboratory and field studies have focused on the degradation of contaminants only at locations where individual compounds or a single class of compounds exist. However, there are many sites where many different organic contaminants exist together. Some compounds aid in the degradation of others, while other compounds are inhibitory to the degradation others. The degradation of combinations of contaminants needs better understanding for bioremediation to be used in the field. As such, a site-specific study is often needed to ensure degradation of these contaminants.

One such site is the Maryland Sand, Gravel and Stone Superfund Site (MSGS Site). From 1969 to 1974 waste processing water, sludge and drums of solid and semi-solid waste were disposed of at the site (US EPA, 2002). The U.S. Environmental Protection Agency (EPA) conducted a Preliminary Assessment and Site Inspection in 1982. This and future investigations found the presence of many different organic contaminants in the subsurface and groundwater.

Approximately 1,200 drums of hazardous waste were excavated and removed in 1992. In addition, a groundwater recovery and treatment system was installed in the Upper Sand Aquifer to clean up the groundwater. The Upper Sand Aquifer is an upper sand and gravel layer approximately 12 to 19 feet in thickness. Typical hydrogeological parameters in the Upper Sand unit are described as follows:

- Hydraulic Gradient 0.013 ft/ft
- Avg. Hydraulic Conductivity 2.6 ft/day (9 x 10^{-4} cm/sec)
- Est. Effective Porosity 0.36
- Avg. Linear Groundwater Velocity 34 ft/yr

Unfortunately, clean up levels have not been attained, and the treatment system has been running continuously since 1996. Monitoring conducted in the Upper Sand unit has identified groundwater contaminated with elevated concentrations of a relatively diverse

mixture of volatile organic compounds (VOCs). The majority of the compounds of primary concern are aromatic hydrocarbons, chlorinated aliphatic hydrocarbons (CAHs) and ketones (see below). In addition those groups, 1,4-dioxane is a volatile compound of concern.

Ketones: acetone, methyl ethyl ketone (MEK), 4-methyl-2-pentanone (MIBK)

Aromatic Hydrocarbons: benzene, toluene, ethylbenzene, o,m,p-xylenes, chlorobenzene, and dichlorobenzenes

Chlorinated Aliphatic Hydrocarbons: chloroethane (CE), chloroform, 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cis-DCE), methylene chloride (MC), tetrachloroethene (PCE), 1,1,1-trichloroethane (1,1,1-TCA), trichloroethene (TCE) and vinyl chloride (VC)

1.1 CONTAMINANT DEGRADATION

Some contaminants can be biodegraded aerobically, others can be biodegraded anaerobically, and some can be biodegraded under both aerobic and anaerobic conditions. The chemical properties and relative biodegradability of chemicals of concern are shown in **Table II-1**. Another important issue is the potential for one compound to inhibit the biodegradation of another compound, such as chloroform and 1,1,1-TCA inhibiting PCE degradation. Remediation of these conditions will likely require a multi-step approach where one group of compounds is degraded first followed by a subsequent stage where another contaminant group is degraded.

Table II-1. Chemical properties and relative biodegradability of chemicals of concern at MSGS Site.

Compound	Density (g/cm^3)	Log K_{ow}[a]	Solubility[b] (mg/L)	Aerobic Biodegradation[c]	Anaerobic Biodegradation[c]
Acetone	0.79	-0.24	infinite	+++	+++
Methyl ethyl ketone	0.81		353,000	+++	+++
4-methyl-2-pentanone	0.81		17,000	+++	+++
Benzene	0.88	2.13	1,780	+++	+
Chlorobenzene	1.11		490	++	
Toluene	0.87	2.69	515	+++	++
Ethylbenzene	0.87	3.15	152	+++	+
Xylenes (total)	0.86	3.15	175	+++	++
1,1,1-Trichloroethane	1.33		950		+++
Cis-1,2-Dichloroethene	1.25		3,500	++	++
Chloroform	1.49	1.97	8,000	+	+++
1,2-Dichloroethane	1.25		8,690	++	++
1,1-Dichloroethane	1.18		5,500	++	++
Methylene Chloride	1.33		13,000	++	++
Tetrachloroethene	1.63	2.6	150	REC	+++
Trichloroethene	1.46		1,100	Cometabolic	+++
1,4-Dioxane	1.03	-0.27	infinite	Cometabolic	REC

a - Log K_{ow} is base 10 logarithm of the octanol-water partion coefficient, an indicator of the tendency of an organic compound to sorb onto sedimentary organic material.
b - Solubility is the compound solubility in water
c - Biodegradation +++ indicates easily biodegradable
++ indicates moderately biodegradable
+ indicates slowly or poorly biodegradable
REC indicates recalcitrant or non-biodegradable under conditions tested

1.1.1 Ketones

Elevated concentrations of acetone, methyl ethyl ketone (MEK), and 4-methyl-2-pentanone (MIBK) had been previously detected in soil (US EPA, 2002). There are no federal maximum contaminant levels (MCLs) for these compounds. Acetone, MEK and MIBK all have a very high aqueous solubility and low octanol:water partition coefficients (K_{ow}) indicating that they do not appreciably sorb to organic carbon in the aquifer material. Acetone, MEK and MIBK are all readily biodegradable under both aerobic and anaerobic conditions (Tabak ***et al.***, 1981; Boyd ***et al.***, 1983; Shelton and Tiedje, 1984).

While very high concentrations of these compounds can inhibit biological processes, the occurrence and concentrations of these compounds in groundwater at the MSGS Site are well below the concentrations expected to be inhibitory. Under anaerobic conditions, these compounds can be fermented to hydrogen and acetate and, as such, can potentially serve as electron donors for reductive dechlorination of CAH co-contaminants.

1.1.2 Aromatic Hydrocarbons

Benzene (B), toluene (T), chlorobenzene (CB), and 1,4-dichlorobenzene (*p*-DCB) have consistently been detected in groundwater samples at concentrations exceeding their MCLs. Sorption of these compounds to aquifer material can impede downgradient migration of these compounds, but is not expected to permanently immobilize them. However, all of these compounds can potentially be biodegraded under both aerobic and anaerobic conditions (Borden, 1993).

The rate and extent of biodegradation depends on the compound structure and environmental conditions. There have been many studies on the biodegradation of benzene, toluene and other fuel hydrocarbon compounds under different circumstances (Morgan ***et al.***, 1993). A number of microorganisms can mineralize these contaminants in the presence of oxygen through a multi-step process. The aromatic hydrocarbon is converted to a catechol, which can then be cleaved, degraded to pyruvic acid, which is then mineralized (Chapelle, 1993.)

The fuel hydrocarbons can also biodegrade anaerobically under certain conditions. Generally, the aromatic hydrocarbons are degraded to aliphatic acids, which are then mineralized (Chapelle, 1993). Benzene biodegradation under anaerobic conditions is less common and may not occur at every site. Anaerobic biodegradation of toluene, however, is much more common, and toluene can be fermented providing an electron donor for reductive dechlorination. It is not known whether benzene or other aromatic hydrocarbons can serve similarly as electron donors to promote reductive dechlorination.

The chlorobenzenes can be biodegraded under both aerobic and anaerobic conditions. In general, however, the more highly chlorinated compounds are more easily degraded under anaerobic conditions, while the less chlorinated compounds degrade more readily under aerobic conditions (Borden, 1993; Dermietzel and Vieth, 2002).

1.1.3 Chlorinated Solvents and Related Compounds

The following chlorinated solvents and their degradation products have consistently been detected in groundwater at the MSGS site (US EPA, 2002): tetrachloroethene (PCE), trichloroethene (TCE), *cis*-1,2-dichloroethene (*cis*-DCE), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), chloroethane (CA), vinyl chloride (VC), and chloroform (CF) (EA, 2006). These compounds are moderately hydrophobic (moderate solubility and K_{ow}) so they have some potential for sorption onto aquifer material. Sorption is probably not sufficient to permanently immobilize these compounds and it is likely that they will migrate laterally with groundwater flow. Because these solvents have densities heavier than water, all are considered to be dense non-aqueous phase liquids (DNAPLs). These compounds can migrate vertically through the aquifer and, when present in sufficient concentrations, may accumulate as free-phase DNAPL.

Extensive laboratory and field studies are available on the aerobic and anaerobic biodegradation of chlorinated solvents. These studies indicate that more highly chlorinated compounds (PCE and TCE) can be biotransformed to less chlorinated compounds under anaerobic conditions but degrade very poorly, if at all, under aerobic conditions. The less chlorinated compounds (1,1-DCA and methylene chloride) can be biodegraded under both aerobic and anaerobic conditions (Borden, 1999). *cis*-DCE has been observed to degrade aerobically as well, but likely as a result of cometabolism (Broholm *et al.*, 2005).

Under anaerobic conditions, chlorinated solvents are degraded through a process known as reductive dechlorination. In this process, dechlorinating microorganisms remove a chlorine atom from the halogenated organic molecule and replace it with a hydrogen

atom (Bhatt *et al*., 2007). As an example, under this process, PCE is reduced to TCE; TCE can then be reduced to *cis*-DCE; *cis*-DCE can be dechlorinated to VC, which can be dechlorinated one final time to ethene.

Recent research has shown that the presence of mixtures of chlorinated solvents can both enhance and inhibit contaminant biodegradation. Some compounds inhibit the biodegradation of other contaminants, while others can enhance the degradation of other chlorinated compounds. Hughes and Parkin (1992) found that methylene chloride biotransformation was enhanced by the presence of chloroform or 1,1,1-TCA. However, chloroform and 1,1,1-TCA have been found to have an inhibitory effect on the biodegradation of each other (Hughes and Parkin, 1996a; Hughes and Parkin, 1996b). Chloroform and 1,1,1-TCA are both inhibitory to the dechlorination of the chlorinated ethenes (Adamson and Parkin, 1999; Bagley *et al*., 2000; Duhamel *et al*., 2002). It is not yet known whether the daughter products of chloroform and 1,1,1-TCA degradation (specifically methylene chloride and 1,1-DCA, respectively) enhance or inhibit dechlorination of the chlorinated ethenes. Grostern and Edwards (2006) did have *cis*-DCE and VC biotransformation to ethene in the presence of 1,1-DCA; however, it is still suspected that the daughter products of inhibitory compounds are inhibitory as well.

These results suggest that enhancing the simultaneous anaerobic biodegradation of all of these compounds may be difficult. A sequential treatment process may be required where conditions are first optimized for one group of contaminants. Once that contaminant group is degraded below target levels, conditions are shifted to optimize biodegradation of another group of contaminants.

1.1.4 1,4-Dioxane

1,4-Dioxane has been detected in groundwater in multiple wells throughout the site. 1,4-Dioxane is very mobile and persistent in the aquatic environment because of its low Henry's Law constant (K_H), low octanol-water partition coefficient (K_{ow}) and infinite solubility in water. 1,4-Dioxane also tends to be very resistant to abiotic and biologically

mediated degradation (Alexander, 1973; Zenker *et al*., 2000). As a consequence, Roy and Griffin (1985) list 1,4-dioxane first in a ranking of the mobility of more than 100 organic compounds. However, several recent reports have indicated that 1,4-dioxane can be biodegraded by both pure (Parales *et al*., 1994; Burback and Perry, 1993; Bernhardt and Diekmann, 1991) and mixed cultures (Sock, 1993) under aerobic conditions. However, cell yields on 1,4-dioxane are typically low, so very high concentrations or the presence of a co-substrate are required to maintain a viable microbial population.

1.2 RESEARCH OBJECTIVES

Inhibition, co-contamination and the different conditions necessary to degrade the various contaminants all present a challenge for biodegradation at the MSGS Site. In order to evaluate what treatment or set of treatments best enhance biodegradation, laboratory studies were initiated in January 2006. Using the results from these studies, recommendations could then be made for the MSGS Site.

2.0 METHODS

2.1 MICROCOSM SET-UP

In order to determine the best possible treatments for the MSGS Site, batch microcosm experiments were undertaken in January 2006. Microcosms were constructed with aquifer material and groundwater collected at two locations near the Northern Depression Area (NDA), Site A and Site B (**Figure II-1).** Site A (NDA-E100) was selected to be representative of an area with moderate contaminant concentrations. Sediment and groundwater from this location was anticipated to be readily amenable to *in situ* bioremediation. Site B (NDA-F100) was selected to be representative of an area with higher contaminant concentrations where *in situ* bioremediation is expected to be more challenging.

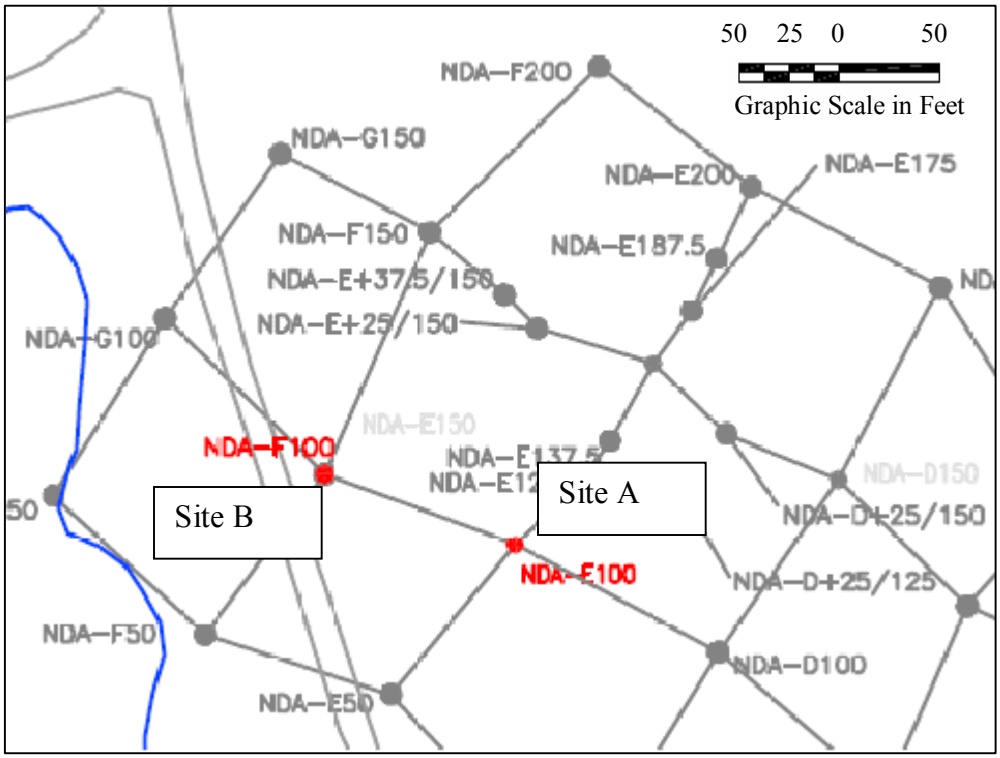

Figure II-1. Location of Site A and Site B at the Maryland Sand, Gravel and Stone (MSGS) Superfund Site.

The following six experimental treatments were prepared for each of the two sites (A and B):

A	Inhibited microbial activity - poisoned control A (3 replicates)
B	Inhibited water with no sediment - poisoned control B (1 replicate)
C	Live ambient (3 replicates)
D	Live ambient amended with nitrogen, phosphorus, yeast extract, vitamin B_{12}, and pH buffer (3 replicates)
E	Live ambient with aerobic headspace first phase followed by an anaerobic second phase with mixed substrates (3 replicates)
F	Live ambient with aerobic headspace first phase followed by an anaerobic second phase with mixed substrates and bioaugmentation cultures (3 replicates)

To prepare the microcosms for the treatments, three liters of wet aquifer sediment were collected from each site and blended seperately. All microcosms, except Treatment B, were constructed in 245 mL serum bottles filled with 50 mL of wet aquifer sediment and 175 mL of groundwater and amended with an oxidation-reduction (redox) indicator (0.0002% resazurin). Treatment B was prepared using groundwater only. Laboratory equipment coming into contact with the aquifer material or groundwater was autoclaved prior to use.

The inhibited microcosms (Treatments A and B) were constructed in the laboratory, poisoned with 250 mg/L $HgCl_2$ and autoclaved for one hour. The microcosm bottles constructed for Treatments C and D were prepared in an anaerobic chamber maintained under a N_2/H_2 (95/5) atmosphere. Prior to being removed from the anaerobic chamber, the live ambient and live-amended microcosms were sealed with a thick butyl rubber stopper and crimped with an aluminum cap to exclude oxygen. The live ambient microcosms (Treatment C) were prepared without any amendments. The live-amended microcosms (Treatment D) received supplemental nutrients in the form of 535 mg/L NH_4Cl, 680 mg/L KH_2PO_4, 20 mg/L yeast extract, 0.05 mg/L vitamin B_{12} and 4200 mg/L $NaHCO_3$. All additions of nutrients to the microcosms were made by penetrating the butyl rubber stopper with a syringe and injecting the amendment. The bottles were incubated in the dark at room temperature (approximately 20 °C) in the laboratory.

The microcosm bottles constructed for Treatments E and F were also prepared in the anaerobic chamber. However, to begin the first phase of aerobic treatment, these six microcosm bottles were removed from the anaerobic chamber after their construction and the headspace was flushed with pure oxygen before being sealed with rubber stoppers. Initial dissolved oxygen (DO) measurements were taken to confirm the dissolved oxygen levels were above 2 mg/L. These bottles were incubated in the laboratory at room temperature.

Under aerobic conditions, the ketones and aromatic hydrocarbons were expected to rapidly biodegrade. The plan intended that after these contaminants degraded to below target concentrations, conditions within these bottles would be made anaerobic. Thus, the anaerobic phase of incubations was begun after the aerobic incubation was determined to be complete, as determined by low concentrations of ketones and aromatic hydrocarbons. The three replicates for Treatments E and F were then returned to the anaerobic chamber, opened and the headspace flushed with the N_2/H_2 mix to drive off any oxygen. These microcosms were then re-sealed with a thick butyl rubber stopper, removed and amended through the stopper with additional organic substrate(s). The Treatment E and F microcosms were then incubated in the dark in the anaerobic chamber at room temperature. Once reducing conditions were established, bioaugmentation cultures were added to the Treatment F microcosms. Additional details of these treatments are described in Section 2.2.

The original plan, as described in the Bioremediation Treatability Study Plan (EA, 2005), was to collect aquifer material and groundwater from a moderately impacted location and a highly impacted location and then incubate them under representative in situ conditions. Three microcosms from Sites A and B were sampled immediately after construction (see "pre-spiked" results in **Table II-2**). These results suggested that concentrations of individual contaminants of concern varied considerably between the two locations and neither site could be considered truly representative of highly contaminated or moderately contaminated conditions. Consequently, it was decided to treat each site the same and to achieve measurable and consistent starting concentrations of the

contaminants of concern by spiking the microcosms with a mixture of organic contaminants. The spiked starting concentrations were targeted to be comparable to some of the highest contaminant concentrations observed on the site. **Table II-2** shows the average background, pre-spike concentration of the different contaminants in each site location and the corresponding concentrations after spiking. Concentrations after spiking were generally similar in the two sites, except for PCE which already was above target concentrations in Site B. The average pre-spike concentrations were calculated from samples collected from three bottles randomly selected from microcosm setups using matrix material from Site A and Site B, respectively. Average post-spike levels were calculated from concentrations measured in all replicates from Treatments C, D, E and F only.

Table II-2. Average concentrations (mg/L) of contaminants before and after spiking.

	Pre-Spiked		Post-Spiked	
	Site A	Site B	Site A	Site B
Acetone	1.6	2.7	2.2	6.4
1,1-DCE	<0.044	<0.044	<0.044	<0.044
Methylene Chloride	<0.044	<0.044	3.0	3.1
trans-DCE	<0.044	<0.044	<0.044	<0.044
1,1-DCA	<0.044	<0.044	<0.044	<0.044
MEK	0.19	<0.048	3.7	3.8
cis-DCE	<0.048	<0.048	<0.048	<0.048
Chloroform	<0.12	<0.12	1.5	1.6
1,2-DCA	<0.044	<0.044	<0.044	<0.044
1,1,1-TCA	0.13	<0.048	11.7	13.1
Benzene	<0.048	<0.048	0.7	0.8
TCE	<0.048	<0.048	<0.048	<0.048
1,4-Dioxane	<0.45	<0.45	1.9	1.9
MIBK	0.082	<0.044	3.7	3.9
Toluene	<0.044	<0.044	3.4	3.7
PCE	0.77	6.7	7.6	14.2
Chlorobenzene	<0.048	<0.048	3.8	3.9
Ethylbenzene	<0.048	<0.048	<0.048	<0.048
p-Xylene	0.15	0.13	0.60	0.6
o-Xylene	0.073	0.046	1.4	1.5
m-DCB	<0.26	<0.26	0.8	0.8
p-DCB	<0.11	<0.11	0.7	0.7

Note: Average pre-spike concentrations calculated from samples collected from three bottles randomly selected from microcosm setups using matrix material from Site A and Site B, respectively. Average post-spike levels calculated from concentrations measured in all replicates from Treatments C, D, E and F, only.

2.2 ANAEROBIC TREATMENT AND BIOAUGMENTATION

At the time of original set up, Treatments E and F were set up similar to ambient Treatment C, which the exception that the headspace was made aerobic. After the initial phase of aerobic degradation was determined to be complete, Treatments E and F were amended with a mixture of organic substrates and nutrients (i.e., 200 mg/L sodium lactate, 2000 mg/L soybean oil, 20 mg/L yeast extract and 0.05 mg/L vitamin B_{12}) and converted to anaerobic conditions by flushing the headspace with N_2/H_2 gas mix. The bottles were re-sealed and placed in the anaerobic chamber at room temperature to continue incubating along with all other treatments. After it was confirmed that the matrix in the Treatment F bottles was anaerobic, several commercially available bioaugmentation cultures were added to these three replicates.

The bioaugmentation cultures used were the ACT-3, CTC and KB-1 cultures, provided by SiRem, Inc. The KB-1 culture is reported to enhance biotransformation of PCE and TCE to *cis*-DCE, then VC, and ultimately to ethene. Performance of this culture has been well documented in both controlled laboratory experiments and in field trials (Chartrand *et al.*, 2005; Duhamel *et al.*, 2004; Duhamel *et al.*, 2006; Morrill *et al.*, 2005). The ACT-3 culture is reported by SiRem, Inc. to stimulate dechlorination of 1,1,1-TCA to 1,1-DCA and then to chloroethane. The CTC culture is reported by SiRem, Inc. to stimulate dechlorination of carbon tetrachloride (CT) to chloroform to methylene chloride to chloromethane followed by complete mineralization. The ACT-3 and CTC cultures have not been extensively evaluated in the field or laboratory. Consequently, there is little publicly available literature on the performance of these two cultures. Based on a recommendation by the SiRem, 2 mL of the CTC culture and 2 mL of the ACT-3 cultures were added first to stimulate degradation of chloroform and 1,1,1-TCA. Once chloroform had degraded below levels expected to be inhibitory, 2 mL of a mixed ACT-3/KB-1 culture were added to stimulate biodegradation of residual 1,1,1-TCA and PCE.

2.3 SAMPLING AND ANALYSES

During sampling, the volume of the intended sample was first displaced by adding a similar volume of N_2 gas into the headspace of the bottle. Then the syringe was lowered into the aqueous phase of the microcosm matrix and the required volume of liquid removed for analysis. For consistency, this method was employed even if the headspace of the particular treatment was aerobic; the small volume of N_2 gas added to the aerobic headspace was not considered sufficient to impact the treatment. However, if the DO level of the aerobic microcosms dropped below 2 mg/L, the headspace was flushed with oxygen instead of N_2 gas.

Water samples from the microcosms were analyzed for VOCs, DO, anions (chloride, nitrate, nitrite and sulfate), total organic carbon (TOC), methane, ethene, ethane, and pH. VOCs that are liquids at room temperature were analyzed by heated purge and trap gas chromatography with flame ionization detection (FID) (heated P&T – GC/FID) following methods equivalent to SW-846 5030B and 8015B. Permanent gases (vinyl chloride, chloroethane, chloromethane, methane, ethane, and ethene) were analyzed by headspace gas chromatography with flame ionization detection (headspace GC/FID) following methods equivalent to SW-846 5021 and 8015B. Anions were analyzed by ion chromatography following methods equivalent to SW-846 9056. TOC was analyzed using a Shimadzu 5000A following methods equivalent to SW-846 9060. **Table II-3** lists the analytical methods for each parameter.

The following sample amounts were collected for each analysis: 1 mL of liquid for the heated P&T – GC/FID, 5 mL of liquid for anion analysis, 1 mL of liquid for TOC analysis, 1 mL of liquid for pH analysis and 1 mL of headspace gas for the headspace GC/FID. For the last sampling (Day 308), 5 mL of liquid were taken for the heated P&T – GC/FID to obtain a lower quantitation limit. **Appendix A** contains the different quantitation limits for the heated P&T – GC/FID.

All microcosms were sampled 1, 9, 33, 60, 96 160 and 285 days after being spiked with the chemical mix. Treatments E and F were also sampled 187, 217, 257 and 308 days after being spiked.

Table II-3. Analytical methods for microcosm treatments.

Analyte	Analytical Method
Acetone	Heated P&T – GC/FID
Benzene (B)	Heated P&T – GC/FID
Methyl ethyl ketone (MEK)	Heated P&T – GC/FID
Chlorobenzene (CB)	Heated P&T – GC/FID
Chloroethane (CE)	Headspace – GC/FID
Chloroform	Heated P&T – GC/FID
Chloromethane	Headspace – GC/FID
1,3- Dichlorobenzene (*m*-DCB)	Heated P&T – GC/FID
1,4- Dichlorobenzene (*p*-DCB)	Heated P&T – GC/FID
1,1- Dichloroethane (1,1-DCA)	Heated P&T – GC/FID
1,2- Dichloroethane (1,2-DCA)	Heated P&T – GC/FID
1,1- Dichloroethene (1,1-DCE)	Heated P&T – GC/FID
cis-1,2-Dichloroethene (*cis*-DCE)	Heated P&T – GC/FID
trans-1,2-Dichloroethene (*trans*-DCE)	Heated P&T – GC/FID
1,4-Dioxane (1,4-D)	Heated P&T – GC/FID
Ethylbenzene (E)	Heated P&T – GC/FID
Methylene chloride	Heated P&T – GC/FID
4-Methyl-2-pentanone (MIBK)	Heated P&T – GC/FID
Tetrachloroethene (PCE)	Heated P&T – GC/FID
Toluene (T)	Heated P&T – GC/FID
1,1,1-Trichloroethane (1,1,1-TCA)	Heated P&T – GC/FID
Trichloroethene (TCE)	Heated P&T – GC/FID
Vinyl chloride	Headspace – GC/FID
o-Xylene	Heated P&T – GC/FID
m-Xylene	Heated P&T – GC/FID
p-Xylene	Heated P&T – GC/FID
Dissolved oxygen (DO)	Chemetrics ampoules
Chloride (Cl^-)	Ion Chromatography
Nitrate (NO_3^-)	Ion Chromatography
Nitrite (NO_2^-)	Ion Chromatography
Sulfate (SO_4^{2-})	Ion Chromatography
Methane	Headspace – GC/FID
Ethane	Headspace – GC/FID
Ethene	Headspace – GC/FID
pH	pH meter
Total Organic Carbon (TOC)	TOC analyzer

3.0 RESULTS

In general, biodegradation patterns were similar in each treatment's replicate microcosms. Consequently, the average value of the replicates for each treatment is graphed. Individual microcosm results can be found in **Appendix D**. Where differences did occur between replicates, it was generally in the lag period prior to biodegradation, not the overall trend. If a contaminant concentration dropped below its quantitation limit, the quantitation limit was plotted. Quantitation limits are shown in **Appendix A**.

An unknown contaminant was present in the Site B microcosms that co-eluted with acetone preventing accurate quantitation. This contaminant was not present in the Site A microcosms. Consequently, acetone results are only reported for Site A.

3.1 INHIBITED MICROBIAL ACTIVITY (TREATMENTS A AND B)

Treatments A and B were autoclaved for one hour followed by an addition of 250 mg/L $HgCl_2$ to poison microbial activity. These treatments were created as controls to measure abiotic losses due to chemical interactions, sorption and/or volatilization, since microbial activity was intentionally destroyed. However, it appears that this treatment was not completely effective in inhibiting aerobic biodegradation. Dissolved oxygen declined from ~6 mg/L to <1 mg/L in Treatment A over the first three months of incubation. During this same period, there was an unexpectedly high loss of the ketones, presumably due to aerobic biodegradation in Treatment A. Once oxygen declined below 1 mg/L, concentrations of these contaminants stabilized. For the other contaminants, losses in Treatments A were more modest and consistent with abiotic losses due to sorption and/or volatilization observed in prior microcosm studies (Hunt *et al.*, 1997). **Figure II-2** shows the average concentration of acetone, toluene and PCE in the Site A inhibited microcosms. The difference in degradation of PCE and toluene compared with acetone is clearly visible. In the autoclaved water microcosms (Treatment B) there was little to no change in concentrations of the more soluble contaminants of concern (i.e., acetone, benzene, etc.).

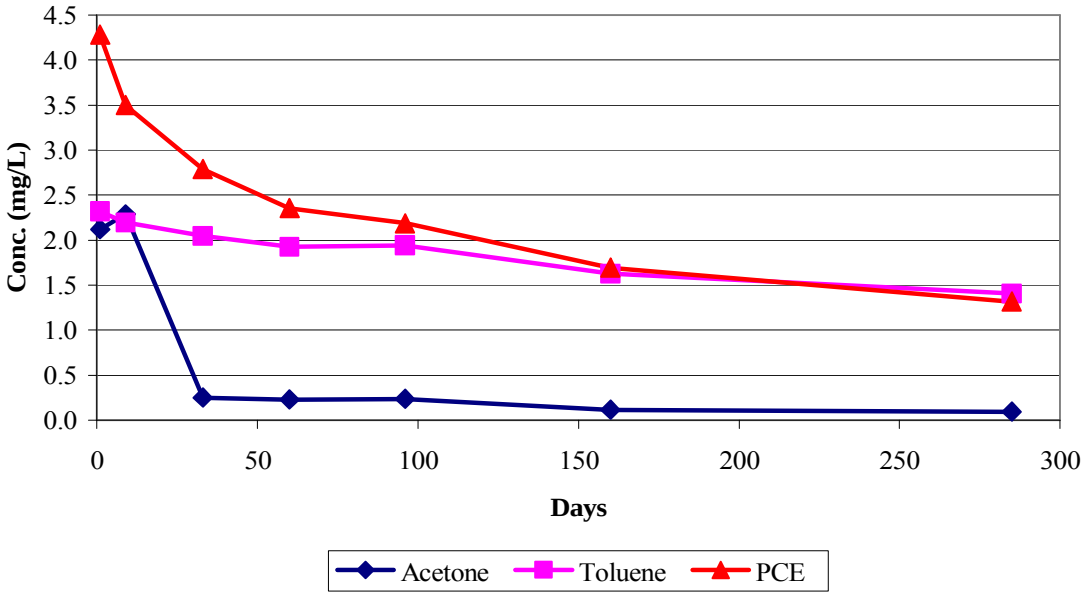

Figure II-2. Average concentration of acetone, toluene and PCE in Site A inhibited microcosms.

3.2 AMBIENT (TREATMENT C)

The ambient condition microcosms (Treatment C) were monitored to evaluate the potential for contaminant biodegradation without any nutrient or electron acceptor addition. There was a gradual decline in the concentration of most contaminants in the ambient microcosms. However, these declines were typically equal to or less than those observed in the inhibited microcosms indicating these losses were likely due to sorption and/or volatilization or other abiotic processes. **Figure II-3** shows the loss PCE for the Site A and B Ambient microcosms compared to the inhibited microcosms. There was a gradual increase in 1,1-DCE in the ambient microcosms indicating that some of the 1,1,1-TCA loss was due to abiotic hydrolysis. The changes in concentration would suggest bioactivity occurring, but taken along with changes seen in the poisoned controls, these results suggest limited biodegradation under ambient conditions.

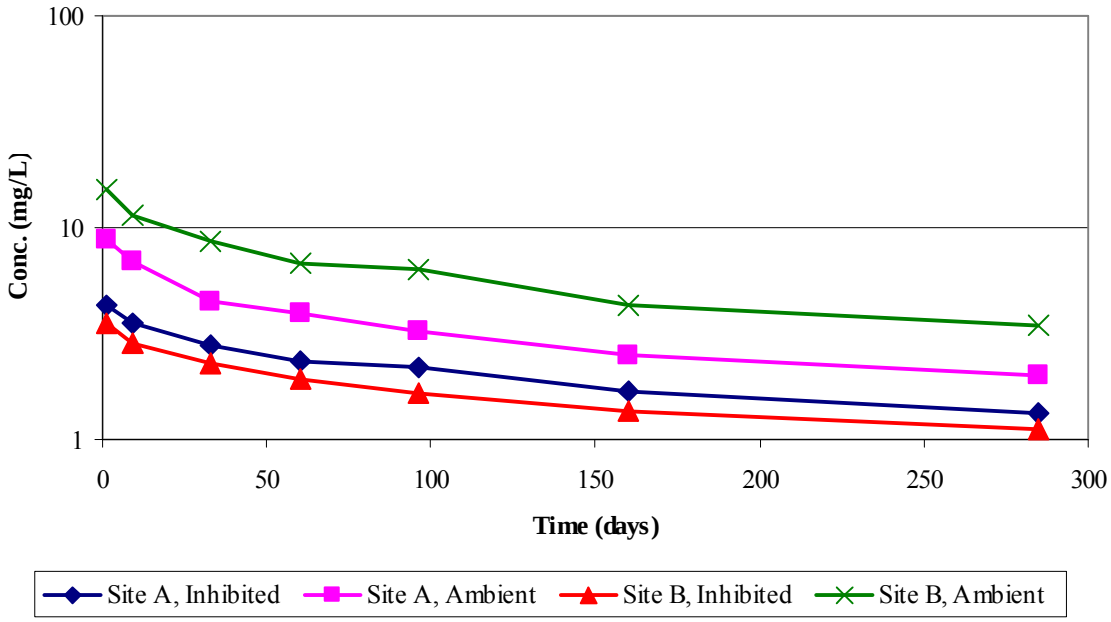

Figure II-3. Average concentration of PCE in Site A and Site B Inhibited and Ambient microcosms.

3.3 NUTRIENT AMENDED (TREATMENT D)

In general, the results for the nutrient-amended microcosms (Treatment D) were very similar to the ambient microcosms suggesting, for the same reasons, limited biodegradation. However, unlike the ambient microcosms, methylene chloride rapidly biodegraded in the nutrient-amended microcosms from Site A, with somewhat slower biodegradation in the nutrient-amended Site B microcosms (**Figure II-4)**. In addition, MEK and MIBK were reduced to low levels toward the end of the incubation period in some replicates from Sites A and B. However, biodegradation of MEK and MIBK was not consistent, with some replicates showing no evidence of biodegradation.

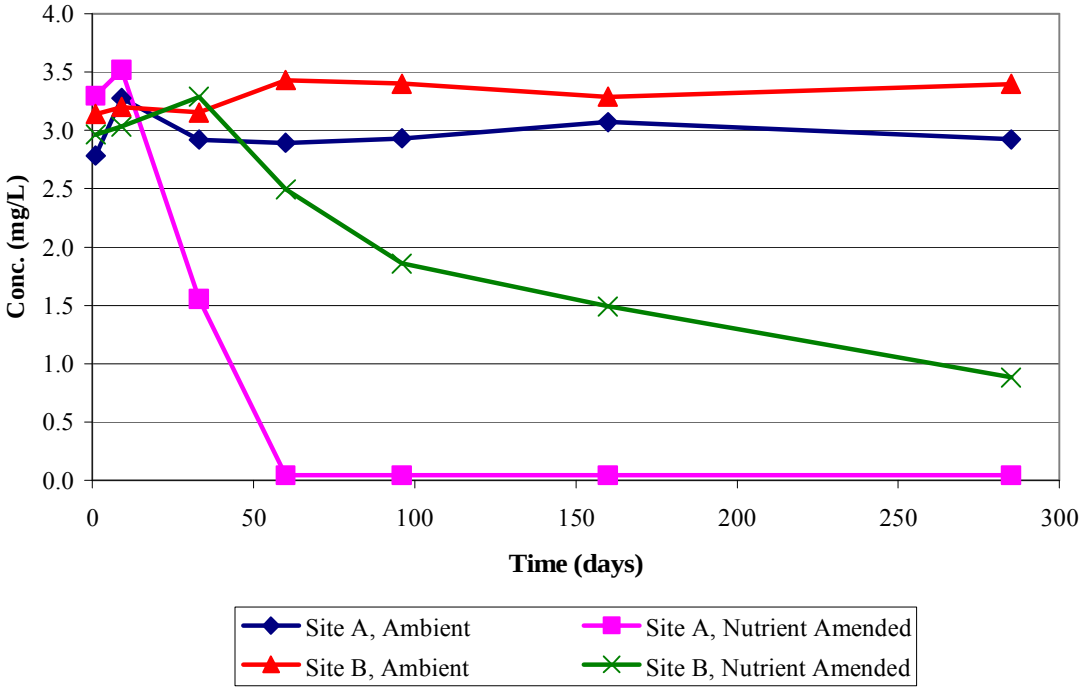

Figure II-4. Average concentration of methylene chloride in Site A and Site B microcosms (Treatment D).

The Treatment D microcosms were treated with a complex nutrient supplement. As a consequence, it is not possible to determine which of these ingredients (or combination of ingredients) was responsible for the observed enhanced methylene chloride biodegradation. The resazurin in the nutrient-amended microcosms indicated reducing conditions, but there was no methane production in the microcosms, indicating the amendments did not result in strongly reducing conditions. However, there was some depletion of sulfate in the amended microcosms, due to addition of the yeast extract and/or contaminant biodegradation.

3.4 AEROBIC/ANAEROBIC (TREATMENTS E AND F)

Microcosm Treatments E and F were designed to simulate a sequential aerobic-anaerobic treatment process. In the first step, biodegradation of the ketones, aromatic hydrocarbons and chlorobenzenes was stimulated by establishing aerobic conditions. Once these contaminants were significantly depleted, the microcosms were shifted over to anaerobic conditions by flushing the headspace with a N_2/H_2 gas mix to remove residual oxygen to

stimulate biodegradation of the chlorinated solvents. However, flushing the headspace with N_2/H_2 gas also enhanced volatilization of several contaminants, resulting in lower contaminant concentrations at the start of the anaerobic phase in Treatments E and F. **Table II-4** shows the average contaminant concentration levels for these microcosms immediately before and after conversion to an anaerobic headspace by flushing with N_2/H_2. Since the bioaugmentation cultures had not yet been added, Treatments E and F were still identical and so the results were averaged. The biggest losses due to volatilization were of PCE, which was reduced by four to five times, and 1,1,1-TCA, which was reduced by a factor of two. The relatively high losses for these two contaminants are believed to be due to their relatively high Henry's Law constants. The concentrations were still sufficient to determine the fate of the contaminants.

Table II-4. Average concentrations of contaminants before and after conversion to anaerobic conditions in Treatments E and F.

		Site A		Site B	
		Before Conversion	After Conversion	Before Conversion	After Conversion
		3/23/06	4/03/06	4/24/06	5/23/06
Acetone	mg/L	<0.044	<0.044	0.056	0.16
1-1 DCE	mg/L	<0.044	<0.044	0.057	0.045
Methylene Chloride	mg/L	1.3	0.073	2.8	2.7
trans-DCE	mg/L	0.098	<0.044	<0.044	<0.044
1,1-DCA	mg/L	<0.044	<0.044	<0.044	<0.044
MEK	mg/L	<0.048	<0.048	<0.048	<0.048
cis-DCE	mg/L	<0.048	<0.048	<0.048	<0.048
Chloroform	mg/L	1.4	0.93	1.3	1.0
1,2-DCA	mg/L	<0.044	<0.044	<0.044	<0.045
1,1,1-TCA	mg/L	8.0	3.1	8.1	3.7
Benzene	mg/L	0.054	<0.048	0.083	0.056
TCE	mg/L	<0.048	<0.048	<0.048	<0.049
1,4-Dioxane	mg/L	2.0	1.9	1.7	1.8
MIBK	mg/L	<0.044	<0.044	<0.044	<0.044
Toluene	mg/L	<0.044	<0.044	<0.044	<0.044
PCE	mg/L	2.9	0.54	4.4	0.98
Chlorobenzene	mg/L	<0.048	<0.048	<0.048	<0.048
Ethylbenzene	mg/L	<0.048	<0.048	<0.048	<0.048
p-Xylene	mg/L	<0.044	<0.044	<0.044	<0.044
o-Xylene	mg/L	0.092	<0.044	0.47	0.15
m-DCB	mg/L	0.17	<0.13	0.18	<0.13
p-DCB	mg/L	<0.11	<0.11	<0.11	<0.11
pH	SU	5.0	6.9	4.9	6.8

The Site A microcosms were changed over from aerobic to anaerobic on Day 64 while the Site B microcosms were changed over on Day 96. The difference in dates for the changeover is due to the somewhat slower degradation rates observed in the Site B microcosms.

The Treatment F microcosms were bioaugmented to determine if addition of specialized microbial cultures would enhance contaminant biodegradation. Once the microcosms were sufficiently reducing, as indicated by a color change in the resazurin redox indicator, the bottles were amended with the chloroform- and 1,1,1-TCA-degrading cultures (CTC and ACT-3, respectively). Once chloroform had decreased below a level expected to be inhibitory, the bottles were then bioaugmented a second time with 1,1,1-TCA- and PCE-degrading cultures (ACT-3 and KB-1, respectively).

Tables II-5 and **II-6** list concentrations of each contaminant during the last sampling event in poisoned control Treatment A, substrate-amended Treatment E and bioaugmented Treatment F using matrices from Sites A and B, respectively.

Table II-5. Concentrations of contaminants in Treatments A (inhibited), E and F in Site A microcosms during final sampling event.

	Treatment A Sampled 10/30/06		Treatment E Sampled 12/22/06		Treatment F Sampled 12/22/06	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Acetone	0.947	0.105	0.072	0.021	0.211	0.181
1-1 DCE	0.086	0.014	0.034	0.020	0.020	0.010
Methylene Chloride	2.139	0.190	<0.009	0.000	0.263	0.243
trans-DCE	<0.044	0.000	<0.009	0.000	<0.009	0.000
1,1-DCA	<0.044	0.000	0.120	0.065	1.417	1.433
MEK	0.402	0.055	0.036	0.010	0.023	0.013
cis-DCE	<0.048	0.000	<0.009	0.000	0.403	0.355
Chloroform	0.808	0.091	0.787	0.307	0.025	0.000
1,2-DCA	<0.044	0.000	<0.009	0.000	<0.009	0.000
1,1,1-TCA	3.454	0.519	1.249	0.722	0.063	0.054
Benzene	0.337	0.039	<0.009	0.000	<0.009	0.000
TCE	<0.048	0.000	0.039	0.017	0.010	0.001
1,4-Dioxane	1.549	0.140	1.371	0.058	0.913	0.714
MIBK	0.386	0.051	<0.009	0.000	<0.009	0.000
Toluene	1.374	0.121	<0.009	0.000	<0.009	0.000
PCE	1.109	0.094	0.325	0.112	0.248	0.274
Chlorobenzene	1.570	0.108	<0.009	0.000	<0.009	0.000
Ethylbenzene	<0.048	0.000	<0.010	0.000	<0.010	0.000
p-Xylene	0.141	0.008	<0.009	0.000	<0.009	0.000
o-Xylene	0.423	0.017	0.010	0.001	<0.009	0.000
m-DCB	<0.13	0.000	0.025	0.000	0.039	0.013
p-DCB	0.136	0.003	<0.022	0.000	<0.022	0.000

Table II-6. Concentrations of contaminants in Treatments A (inhibited), E and F in Site B microcosms during final sampling event.

	Treatment A Sampled 10/30/06		Treatment E Sampled 12/22/06		Treatment F Sampled 12/22/06	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Acetone	0.947	0.105	0.147	0.019	0.092	0.108
1-1 DCE	0.086	0.014	0.046	0.033	0.053	0.016
Methylene Chloride	2.139	0.190	2.173	1.850	1.088	1.341
trans-DCE	<0.044	0.000	<0.009	0.000	<0.009	0.000
1,1-DCA	<0.044	0.000	0.064	0.048	3.739	0.410
MEK	0.402	0.055	<0.009	0.000	0.018	0.015
cis-DCE	<0.048	0.000	<0.009	0.000	1.488	0.571
Chloroform	0.808	0.091	0.505	0.378	0.025	0.000
1,2-DCA	<0.044	0.000	<0.009	0.000	<0.009	0.000
1,1,1-TCA	3.454	0.519	1.646	1.457	0.062	0.092
Benzene	0.337	0.039	0.016	0.012	0.030	0.036
TCE	<0.048	0.000	0.212	0.113	0.085	0.068
1,4-Dioxane	1.549	0.140	1.337	0.192	0.598	0.739
MIBK	0.386	0.051	<0.009	0.000	<0.009	0.000
Toluene	1.374	0.121	<0.009	0.000	<0.009	0.000
PCE	1.109	0.094	0.328	0.211	0.169	0.147
Chlorobenzene	1.570	0.108	<0.009	0.000	<0.009	0.000
Ethylbenzene	<0.048	0.000	0.043	0.015	<0.010	0.000
p-Xylene	0.141	0.008	<0.009	0.000	<0.009	0.000
o-Xylene	0.423	0.017	0.049	0.063	0.165	0.137
m-DCB	<0.13	0.000	0.025	0.000	0.030	0.009
p-DCB	0.136	0.003	<0.022	0.000	<0.022	0.000

3.4.1 Aerobic Degradation

During the aerobic phase, Treatments E and F were treated identically and consequently, biodegradation results were very similar. As expected, acetone, MEK, MIBK, benzene, toluene, *o*-xylene, *p*-xylene, chlorobenzene, *m*-DCB and *p*-DCB rapidly biodegraded under aerobic conditions in the Site A microcosms. Each of these contaminants was reduced to below the quantitation limit within two months of startup. Methylene chloride also showed significant degradation in four of the six Treatment E/F microcosms from Site A.

Similar to Site A, acetone, MEK, MIBK, benzene, toluene, *o*-xylene, *p*-xylene, chlorobenzene, *m*-DCB and *p*-DCB biodegraded under aerobic conditions in the Site B microcosms. However, aerobic biodegradation rates in the Site B microcosms were somewhat lower than for Site A. At 96 days after startup, MEK, MIBK, toluene, *p*-xylene, chlorobenzene, and *p*-DCB were reduced to below quantitation limits in all six Treatment E/F microcosms from Site B. However, quantifiable levels of the following contaminants were still present in selected microcosms: acetone (1 bottle), benzene (4 bottles), *o*-xylene (3 bottles) and *m*-DCB (1 bottle).

Figures II-5 and **II-6** show degradation typical of the aerobically degradable compounds in both the Site A and Site B microcosms. **Figure II-5** shows the degradation of benzene in the Site A and B aerobic microcosms compared to the ambient microcosms. The approximate one-month lag between degradation of benzene in Site A and B is clearly visible. The apparent plateau is due to the quantitation limit being plotted. **Figure II-6** shows the degradation of MEK in all four sets of aerobic microcosms, where there was no discernable lag in degradation between the two sites. These microcosms are again compared to the ambient microcosms.

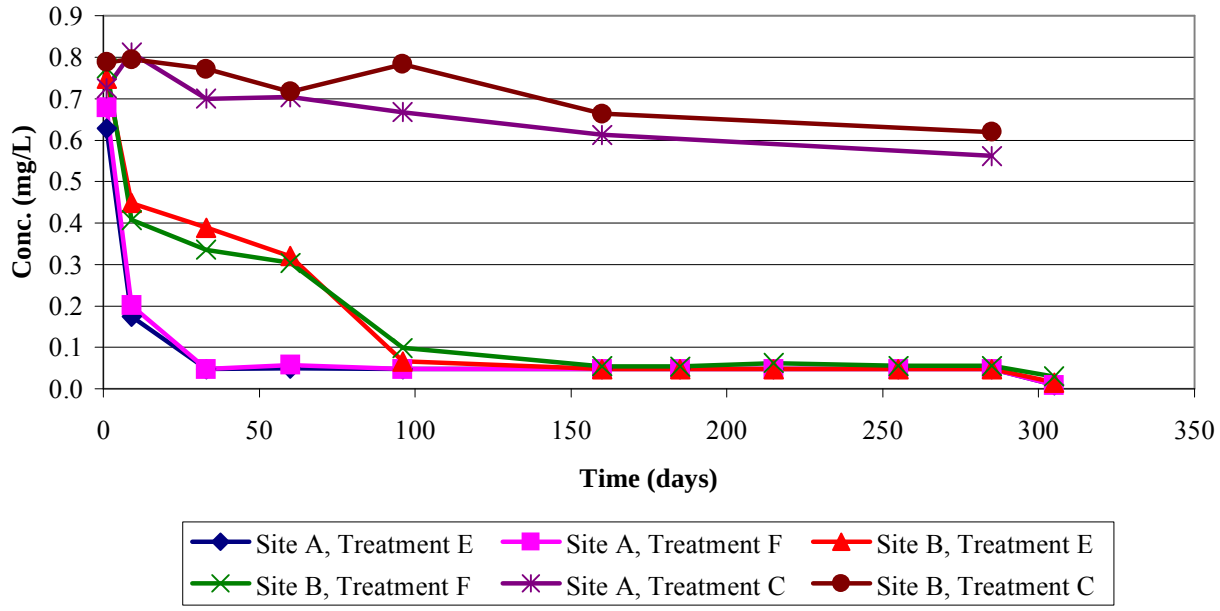

Figure II-5. Concentration of benzene in Site A and Site B microcosms (Treatments C, E and F).

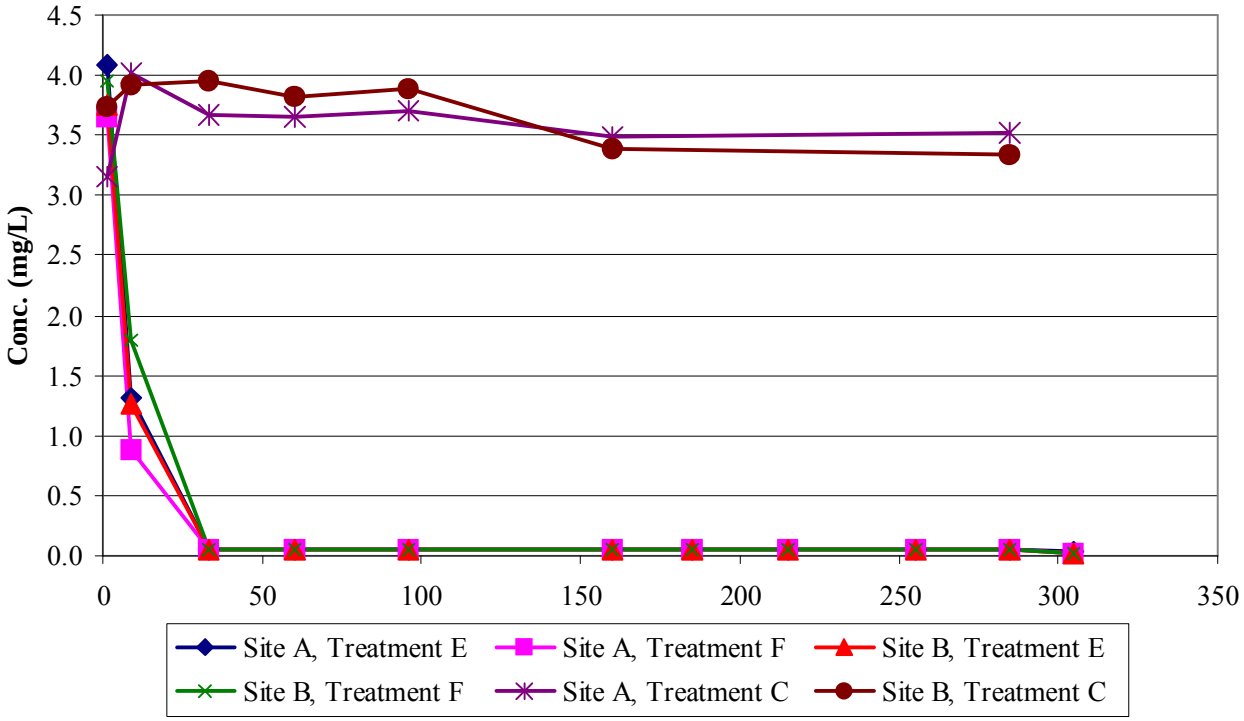

Figure II-6. Concentration of MEK in Site A and Site B microcosms (Treatments C, E and F).

One important difference between the Site A and Site B microcosms was that methylene chloride rapidly biodegraded in the Site A microcosms. In contrast, methylene chloride did not significantly biodegrade under aerobic conditions in the Site B microcosms.

The results of this treatment indicate that the aromatic hydrocarbons, chlorobenzenes and ketones are readily biodegradable under aerobic conditions in soil and groundwater from the two locations sampled at the Site. While aerobic biodegradation rates were somewhat slower in the Site B microcosms, the rates were more than adequate for effective aerobic treatment of these contaminants.

3.4.2 Anaerobic Degradation

Chloromethanes Biodegradation

The Treatment E and F microcosms from Site A were shifted from aerobic to anaerobic conditions by flushing the headspace to remove oxygen on Day 64 and amending the bottles with the mixed organic substrate on Day 66. On Day 93 (29 days after shifting to anaerobic conditions), the resazurin turned clear in the Site A Treatment F microcosms, indicating strongly reducing conditions had been established. At this time, the Treatment F bottles were amended with the CTC and ACT-3 bioaugmentation cultures. Additional organic substrate was added to both the Treatment E and F microcosms on Day 93 to make up for the large amount of material consumed in degrading residual electron acceptors present in the bottles.

Site B microcosms were shifted to anaerobic conditions on Day 96. Like the Site A microcosms, additional mixed substrate and bioaugmentation culture (Treatment F only) was added 29 days after the microcosms were made anaerobic (Day 125). Benzene and *o*-xylene both were present in four of the six Site B microcosms when they were made anaerobic. As a result, the degradation of these compounds slowed considerably. Thus, benzene and *o*-xylene persisted in some microcosms at detectable levels after they were

made anaerobic. This illustrates the potential risk in ending the aerobic biodegradation phase before all target contaminants are completely degraded.

There was little to no degradation of any of the compounds in the non-bioaugmented (Treatment E) microcosms from both sites. Measured contaminant losses can be explained as abiotic loss, as there were little to no production of intermediate degradation products. Also, very little methane was generated in these microcosms.

The bioaugmented microcosms, however, did show degradation of a number of compounds. For Site A, chloroform degraded to below the detection limit one month after bioaugmentation in two of the three bioaugmented bottles. After three months, chloroform had degraded below the detection limit in all three Treatment F microcosms.

As chloroform degraded in these bottles, methylene chloride concentrations began to rise. Three months after bioaugmentation, methylene chloride levels reached their maximum concentration in the microcosms. Methylene chloride concentrations then began to decrease, with complete degradation of methylene chloride occurring in one of the microcosms. Measurable methylene chloride remained in the other two bottles, though concentrations were steadily decreasing.

In the Site B samples, chloroform biodegradation began soon after the microcosms were bioaugmented; however, more time was required to completely degrade chloroform in all three microcosms. Similar to Site A, methylene chloride levels began to rise as chloroform degraded. However, methylene chloride levels had fallen dramatically in two of the three microcosms as of the last sampling. **Figure II-7** shows the average chloroform and methylene chloride concentrations in the bioaugmented microcosms. The high initial methylene chloride concentration in Site B was due to carry over from the aerobic phase, when methylene chloride did not biodegrade.

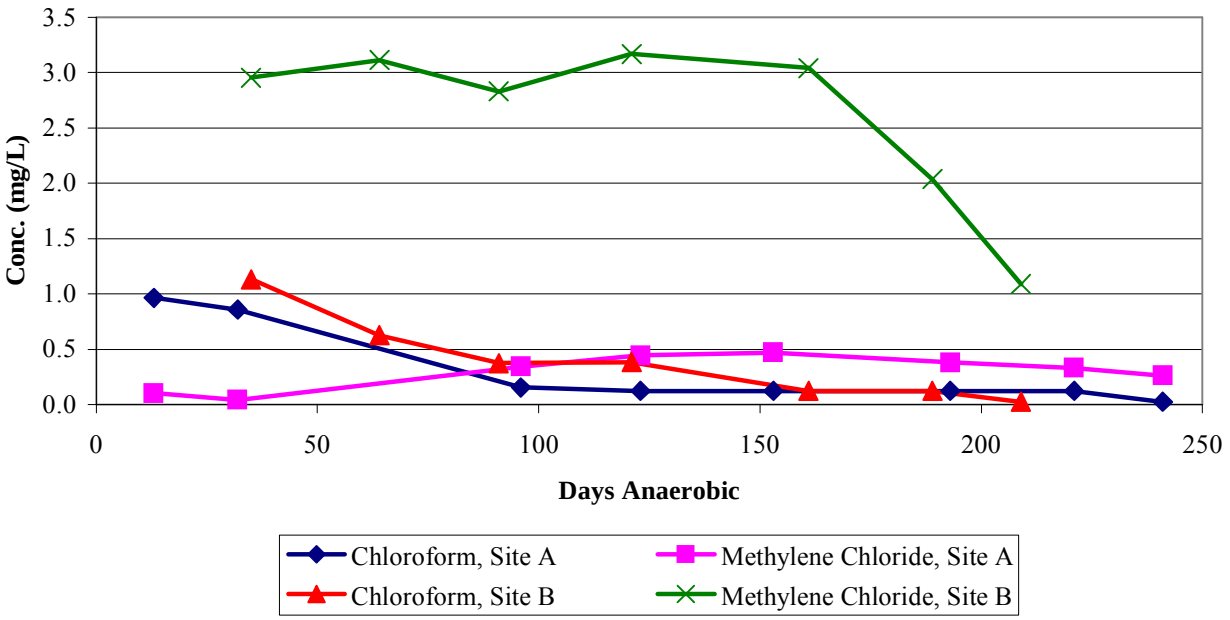

Figure II-7. Average concentrations of chloroform and methylene chloride in Site A and Site B bioaugmented microcosms (Treatment F).

Chloroethanes Biodegradation

Approximately three months after the microcosms were shifted to anaerobic conditions, the Treatment F microcosms were amended with the mixed ACT-3 and KB-1 cultures to stimulate biodegradation of 1,1,1-TCA and PCE. **Figure II-8** shows the average 1,1,1-TCA and 1,1-DCA concentrations in the bioaugmented microcosms from Sites A and B.

For the Site A bioaugmented microcosms, 1,1,1-TCA began biodegrading approximately three months following conversion to anaerobic conditions. Two months after receiving the second bioaugmentation, 1,1,1-TCA concentrations fell below the quantitation limit in two of the three microcosms. 1,1,1-TCA continues to persist in one of the microcosms, though at very low concentrations.

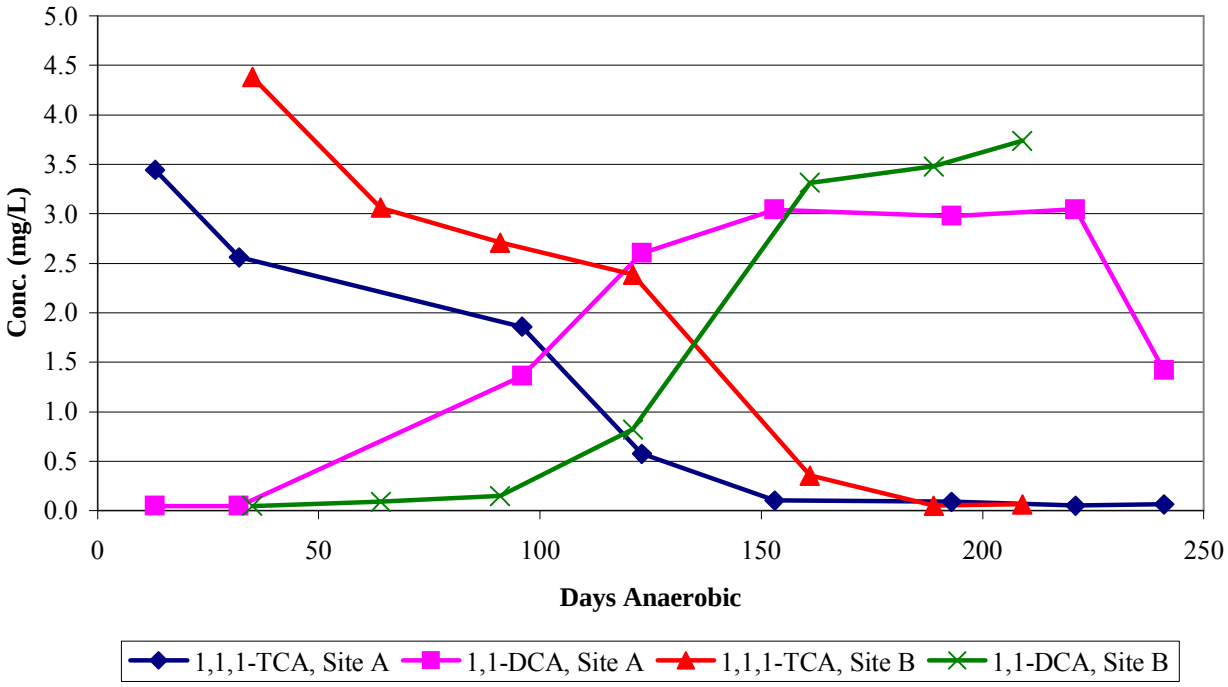

Figure II-8. Average concentrations of 1,1,1-TCA and 1,1-DCA in Site A and Site B bioaugmented microcosms (Treatment F).

As 1,1,1-TCA concentrations declined in the bioaugmented microcosms there was a comparable rise in 1,1-DCA concentrations. However, 1,1-DCA concentrations in Site A significantly declined during the last sampling event (**Figure II-8**). In these two bottles no chloroethane was produced. This was unexpected since chloroethane is the degradation product from 1,1-DCA reduction. The absence of detectable chloroethane could be due to the concurrent production and abiotic or biotic degradation of chloroethane. Additional sampling may be necessary to determine if 1,1-DCA reduction was due to degradation.

Biodegradation of 1,1,1-TCA in the Site B bioaugmented microcosms was similar to Site A. 1,1,1-TCA declined in all three replicate microcosms approximately four months after conditions became anaerobic. After five months, 1,1,1-TCA had degraded to below detection in all three microcosms. As expected, 1,1-DCA accumulated in the Site B microcosms. Unlike Site A, 1,1-DCA concentrations did not decrease in any of the microcosms. However, the Site B microcosms were approximately one month behind the

Site A microcosms due to the extended period of aerobic incubation. Given that 1,1-DCA only declined in the Site A microcosms during the last sampling, it is possible that 1,1-DCA would begin to decline in the Site B with additional incubation time.

Chloroethenes Biodegradation

Figure II-9 shows the average concentration of PCE and *cis*-DCE in the bioaugmented microcosms. PCE began to biodegrade in the Site A bioaugmented microcosms once 1,1,1-TCA had been depleted. This is not unexpected since 1,1,1-TCA is known to inhibit chloroethene biodegradation. Duhamel ***et al.*** (2002) showed that 1,1,1-TCA concentrations between 700 and 3000 µg/L completely inhibited VC dechlorination to ethene in incubations with the KB-1 bioaugmentation culture. In two of the microcosms, PCE had degraded to near the quantitation limit at the last sampling. PCE levels declined more slowly in the third microcosm. *cis*-DCE was produced in the two microcosms where PCE concentrations had been reduced to the detection limit. There was no further degradation of *cis*-DCE in any of the microcosms.

PCE degradation in the Site B bioaugmented microcosms was similar to the Site A microcosms. PCE biodegradation occurred in all three microcosms after 1,1,1-TCA concentrations declined. *cis*-DCE accumulation occurred in all three microcosms. There was no vinyl chloride or ethene produced in any of the Site A or B microcosms.

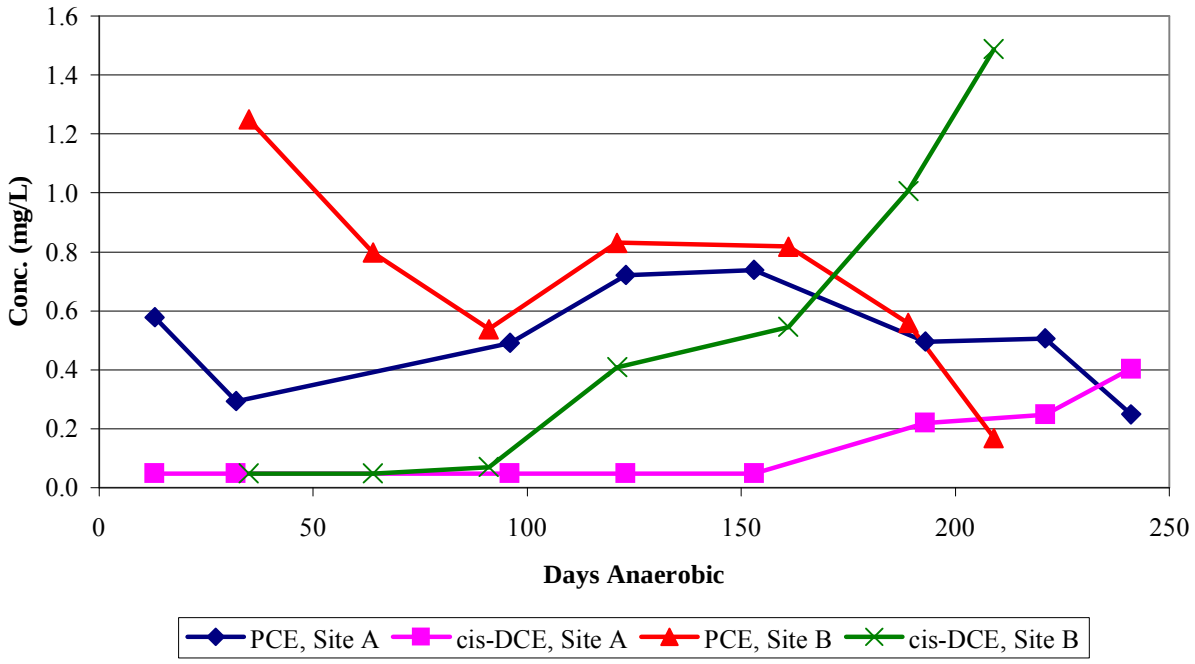

Figure II-9. Average concentrations of PCE and *cis*-DCE in Site A and Site B bioaugmented microcosms (Treatment F).

3.4.3 Acetone Production and pH Effects

Figure II-10 shows the acetone concentration in the Treatment E and F microcosms. A small amount of acetone was produced in both the bioaugmented and non-bioaugmented microcosms from both sites. This is likely due to fermentation of the added substrate to acetone by naturally occurring bacteria. *Clostridium* sp. are known to ferment a wide variety of organic materials to acetone (Jones and Woods, 1986). Towards the end of the incubation, acetone began to decline indicating this material was being consumed as the added substrate was depleted.

During the aerobic phase of treatment, the pH of the microcosms dropped to about 5, presumably due to oxidation of Fe(II) consuming hydroxide. However, the pH of the microcosms returned to near neutral once the microcosms were shifted to anaerobic conditions and Fe(III) was reduced to Fe(II).

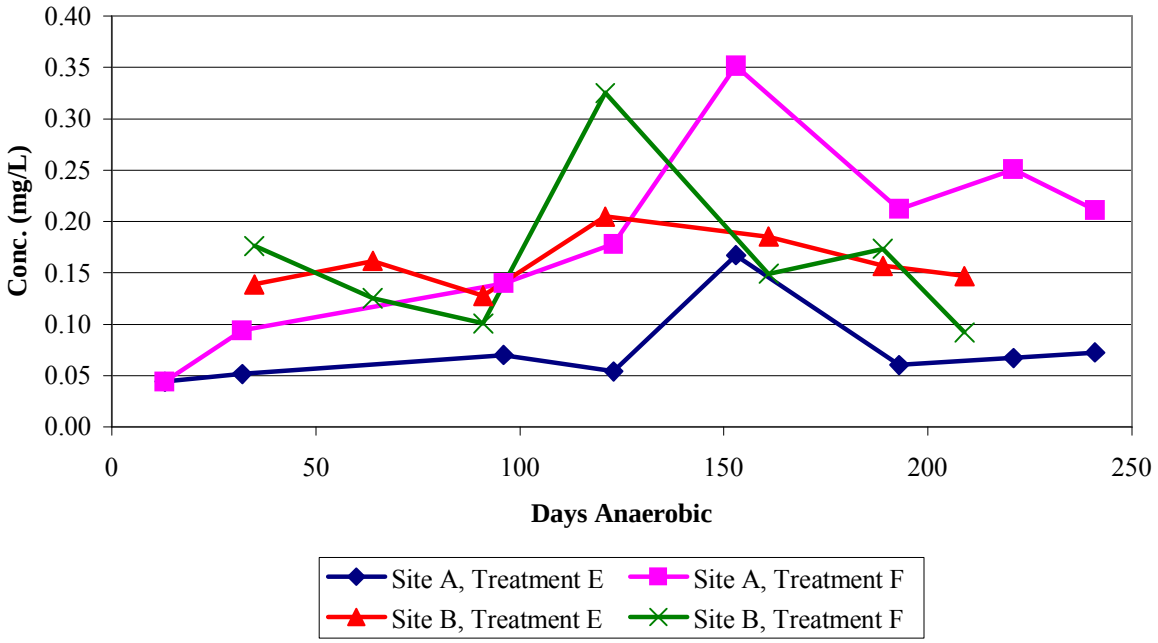

Figure II-10. Average concentration of acetone in anaerobic phase (Treatments E and F).

3.4.4 1,4-Dioxane

Figure II-11 shows the variation in 1,4-dioxane concentration versus time in the Site A microcosms. Over the first 285 days of incubation, 1,4-dioxane concentrations in the live treatments are similar to the inhibited controls indicating negligible biodegradation. On Day 308, Treatment E (aerobic/anaerobic) and Treatment F (bioaugmented) were resampled with a larger sample size to lower the analytical detection limit. On this date, 1,4-dioxane concentrations were lower than previously observed. However, the inhibited controls were not sampled on this date so there is no way to determine if this was an actual decline or a sampling/analysis issue. 1,4-Dioxane results were similar for the Site B microcosms and showed negligible biodegradation.

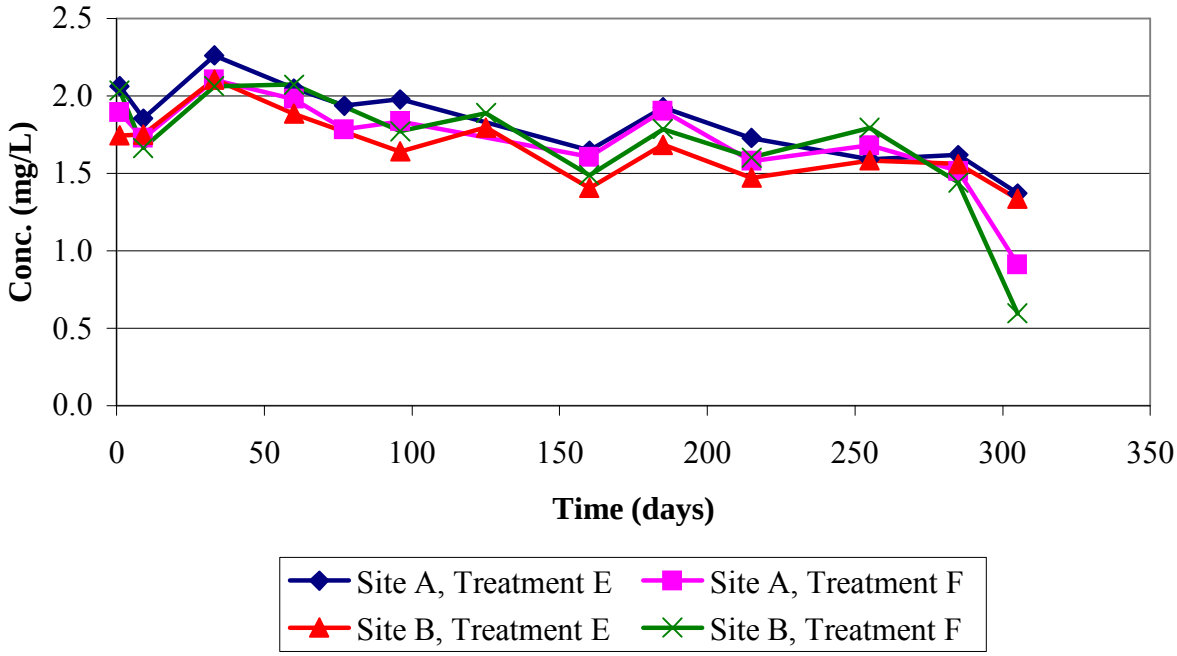

Figure II-11. Variation in 1,4-dioxane concentration over time in Site A and Site B microcosms.

4.0 CONCLUSIONS

Laboratory microcosm studies were conducted to evaluate the effect of different amendments on the rate and extent of contaminant biodegradation in groundwater and aquifer material from two locations at the MSGS site. The primary conclusions of this work are summarized as follows:

1. Under ambient, anaerobic conditions biodegradation was very limited. It is not clear why biodegradation was so limited since several of the contaminants are known to be biodegradable under anaerobic conditions without an external electron acceptor. It may be that the relatively high concentrations of multiple contaminants in the mixture inhibited microbial activity.

2. Amending the aquifer material with inorganic nutrients (nitrogen and phosphorus), yeast extract, vitamin B_{12}, and pH buffer stimulated biodegradation of methylene chloride. However, these amendments did not significantly enhance biodegradation of other contaminants. Addition of these amendments without an external electron acceptor or donor is not expected to be effective in enhancing contaminant biodegradation at the MSGS site.

3. The ketones, aromatic hydrocarbons, and chlorobenzenes all rapidly biodegraded under aerobic conditions without addition of inorganic nutrients or other amendments. Oxygen addition should be an effective strategy for enhancing biodegradation of these contaminants at the MSGS site.

4. Substrate addition without bioaugmentation was not effective in stimulating anaerobic biodegradation of chloroform, 1,1,1-TCA or PCE. The absence of PCE degradation is somewhat surprising given the field evidence for anaerobic biodegradation of PCE and/or TCE at the Site (ERM, 2001). Potential explanations for the lack of microbial activity under anaerobic conditions include: (a) PCE dechlorinating populations were greatly reduced during extended incubation under

aerobic conditions; and/or (b) the presence of high concentrations of chloroform and 1,1,1-TCA inhibited PCE degradation.

5. Chloroform rapidly degraded to methylene chloride in microcosms amended with the mixed organic substrate and the CTC bioaugmentation culture. Methylene chloride subsequently degraded in several of the bottles without extensive chloromethane accumulation. However, methylene chloride degradation was slow in other bottles suggesting complete degradation of chloroform to non-toxic end products may be difficult to achieve in some cases.

6. 1,1,1-TCA eventually degraded to 1,1-DCA in all replicate microcosms amended with the mixed organic substrate and the ACT-3 bioaugmentation culture. However, efficient degradation did not occur until chloroform had been significantly depleted suggesting that inhibition of degradation by co-contaminants could be an issue in some locations at the MSGS site. 1,1-DCA was further degraded in two of the six microcosms. However, 1,1-DCA did not degrade significantly in the remaining four. This indicates that achieving complete degradation of 1,1,1-TCA to non-toxic end products may require a substantial amount of time.

7. PCE eventually degraded to *cis*-DCE in five of six microcosms amended with the mixed organic substrate and the KB-1 bioaugmentation culture. However, efficient degradation did not occur until chloroform and 1,1,1-TCA had been significantly depleted suggesting that inhibition of degradation by co-contaminants could be an issue in some locations at the Site. In addition, *cis*-DCE did not degrade further in any microcosm. Given sufficient incubation time, further degradation of *cis*-DCE may occur. However, this also illustrates the potential difficulties in achieving complete dechlorination of PCE to non-toxic end products at the MSGS site.

8. When the Treatment E and F microcosms were shifted from aerobic to anaerobic conditions, the mixed substrate amendment resulted in rapid depletion of the available dissolved oxygen. However, it took several weeks for the resazurin redox indicator to

turn clear indicating the establishment of strongly reducing conditions. The relatively slow onset of strongly reducing conditions is likely due to the large amount of oxidized iron produced during the aerobic phase of treatment. This same issue could occur in the field at the MSGS site when attempting to stimulate anaerobic biodegradation following an aerobic bioremediation process.

9. In the Treatment E and F microcosms from Site B, the microcosms were shifted over to anaerobic conditions prior to complete depletion of the all the aerobically degradable contaminants. When this occurred, biodegradation of benzene, *o*-xylene and *m*-DCB slowed dramatically, resulting in detectable levels of these contaminants in some bottles at the end of the incubation period. In the field, the aerobic treatment phase should continue until all aerobically degradable contaminants are depleted.

10. 1,4-Dioxane did not biodegrade to any significant extent in any treatment in the Site A or Site B microcosms. This indicates that there is very limited potential for enhanced bioremediation of 1,4-dioxane at the MSGS site.

The concentration and combination of contaminants used in the microcosm studies was selected to represent a worst-case scenario. High concentrations of chloroform, 1,1,1-TCA and PCE are rarely, if ever, present in the same locations at the MSGS site. As a consequence, the inhibitory effects of co-contaminants were more extreme in the laboratory microcosms than would typically occur in the field. However, the microcosm results do clearly indicate the potential challenges associated with stimulating anaerobic biodegradation processes that could occur when multiple chlorinated solvents are present in high concentrations in the same area.

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CHAPTER III
CHARLESTON NAVAL WEAPONS STATION

1.0 INTRODUCTION

Contamination of groundwater by chlorinated solvents is an important and growing issue of environmental concern. It is fairly expensive to use traditional ex-situ treatments, such as air sparging or pump and treat, to remediate an aquifer contaminated with chlorinated ethenes. However, *in situ* bioremediation at many different sites has produced comparable degradation rates while being far less expensive. As such, bioremediation is being used more and more to treat sites contaminated with PCE and TCE.

1.1 REDUCTIVE DECHLORINATION

It is well established that PCE and TCE can cometabolically degrade aerobically using certain nonspecific oxygenases (Maymo-Gatell *et al*., 1999; Rui *et al*., 2004). However, during this process an epoxide is produced which is toxic to the degrading organisms. Thus, using aerobic degradation in an engineered system has not yet proven viable. Additionally, many groundwater systems where PCE and TCE are located are anaerobic and fairly reducing. Under these conditions it is much easier to degrade these compounds through reductive dechlorination.

Reductive dechlorination is a two-electron transfer, involving the removal of a chlorine atom from the halogenated organic molecule and replacing it with a hydrogen atom (Bhatt *et al*., 2007). Under this process, PCE is reduced to TCE; TCE can then be reduced to *cis*-1,2-dichloroethene (*cis*-DCE). *cis*-DCE can, in turn, be dechlorinated to vinyl chloride (VC), which can be dechlorinated one final time to ethene. PCE, TCE and *cis*-DCE are both suspected carcinogens, while VC is a known carcinogen. However, ethene is non-toxic. Thus, the goal of reductive dechlorination is to completely dehalogenate all chlorinated ethenes to non-toxic ethene. Reductive dechlorination of TCE to ethene is shown in **Figure III-1**.

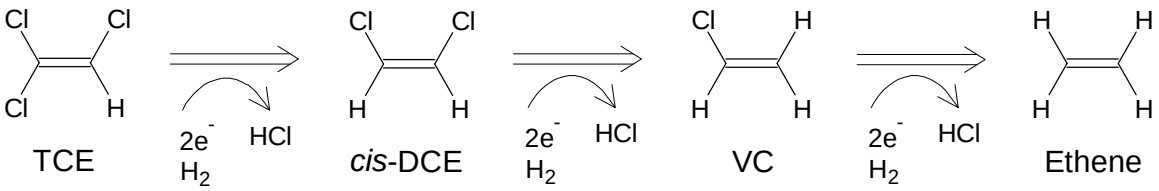

Figure III-1. Typical pathway for reductive dechlorination of TCE to ethene.

Reductive dechlorination of PCE and TCE can be accomplished by many different anaerobic bacteria (Damborsky, 1999). The different dechlorinators can be divided into five metabolic groups: (1) Gram-positive halorespirers, such as ***Dehalococcoides,*** ***Dehalobacter*** and ***Desulfitobacterium***; (2) Gram-negative halorespirers, such as ***Desulfuromonas***, ***Desulfomonile*** and ***Sulfurospirillum***; (3) acetogens, such as ***Acetobacterum woodii*** and ***Sporomusa ovata***; (4) methanogens, such as ***Methanobacterium*** and ***Methanosarcina***; and (5) facultative anaerobes, such as ***Enteeobacteraceae*** strain MS-1. The acetogens, methanogens and facultative anaerobes reductively dechlorinate through cometabolism. The halorespirers, however, reductively dechlorinate by using PCE and TCE as terminal electron acceptors in a process known as halorespiration (Holliger ***et al***., 1999.) Halorespiration is orders of magnitude faster at reductive dechlorination than cometabolic processes (Loffler ***et al***., 2000), making halorespiration much more promising for bioremediation.

Most halorespirers are only able to dechlorinate PCE and TCE to ***cis***-DCE or VC, and accumulation of these less chlorinated ethenes is common at many sites. ***Dehalococcoides*** sp. are the only microorganisms yet identified that are able to completely dechlorinate PCE to ethene. ***Dehalococcoides ethanogenes*** strain 195 was the first pure isolate that was able to dechlorinate PCE to ethene (Maymo-Gatell ***et al***., 1997). However, it was later determined that strain 195 dechlorinated PCE, TCE and ***cis***-DCE via halorespiration while VC was dechlorinated via cometabolism (Maymo-Gatell ***et al***., 1999). ***Dehalococcoides*** strain BAV1 was the first strain discovered that uses VC as a terminal electron acceptor (He ***et al***., 2003). Different ***Dehalococcoides*** strains have since been discovered that use halorespiration to dechlorinate TCE to ethene: strain

KB1/VC (Duhamel *et al*., 2004; Major *et al.*, 2002); strain VS (Cupples *et al*., 2003); and strain GT (Sung *et al*., 2006)).

Dehalococcoides appears to be very pH sensitive. Lower pH limits for dechlorination have been reported to be as high as 5.8-6.0 (Volkering, 2007). Using a pure *Dehalococcoides* culture, Vainberg *et al*. (2006) saw dechlorination occur in a pH range of 5.5-8.5, with an optimal pH between 6.0-6.3. Mixed cultures have shown to be slightly more pH-tolerant. For instance, Rosner *et al*. (1997) found a mixed pH culture that dechlorinated VC in a pH range of 5.0-10.0, with an optimum pH of 8.5. However, this culture could only moderately degrade TCE or *cis*-DCE.

Dehalogenating bacteria usually use hydrogen (H_2) as the electron donor in reductive dechlorination. One of the most common methods of introducing hydrogen into the subsurface is through the fermentation of organic substrates. Organic substrates have been used multiple times to enhance degradation of chlorinated solvents (Morse *et al*., 1998; Ellis *et al*., 2000; AFCEE and NFESC, 2004).

Table III-1 shows the amount of hydrogen released through the fermentation of different organic substrates (Solutions-IES, 2006). The fermentation of edible oils, such as soybean oil and canola oil, is able to release many more electrons per mole and per gram than the fermentation of other organic substrates.

Table III-1. Hydrogen released through the fermentation of different organic substrates.

	H_2 Released	
	per mole	per gram
Acetate	4	0.067
Lactate	6	0.067
Glucose	12	0.067
Soybean Oil	157	0.179
Canola Oil	159	0.180
Lard	156	0.180

Source: Solutions-IES, 2006.

Not only do edible oils provide a high electron yield, but they are also relatively inexpensive and fairly immobile in most aquifers (Hunter ***et al.***, 1997). Long and Borden (2006) cited many instances where edible oils had been used to stimulate ***in situ*** anaerobic bioremediation. Edible oils can be injected either as an oil-in-water emulsion or as a non-aqueous phase liquid (NAPL). Injection as a NAPL, however, can require large amounts of chase water to effectively distribute it, and can result in high residual saturations and high permeability losses.

To overcome these disadvantages, Coulibaly and Borden (2004) developed a process to distribute soybean oil as an oil-in-water emulsion. The emulsion created was non-coalescing with uniformly sized, negatively-charged oil droplets. In doing so, this emulsion has the ability to transport easily in most aquifers without sorbing to the solid surfaces. This emulsion technology has since been licensed to EOS Remediation, Inc., who developed the soybean oil emulsion into an Edible Oil Substrate (EOS®). This emulsion can then be injected into an aquifer to provide the necessary electrons for reductive dechlorination.

1.2 CHARLESTON SITE

Based upon site location, hydrology and contamination, the Naval Weapons Station (NWS) in Charleston, South Carolina was chosen as a pilot test site to determine the ability of EOS® to aid the reductive dechlorination of TCE. As described in a report by

Solutions-IES (2004), a chlorinated solvent plume was located in a site designated as Solid Waste Management Unit 17 (SWMU-17). This site was primarily used for the surface disposal of solid waste; however, oils and missile components were also disposed at the site. Rubble, paint cans and buckets, and missile components were observed at the site during the Initial Assessment Study in 1984.

The depth to water at SWMU-17 is approximately 6 feet below ground surface (bgs). The sediment at SWMU-17 consists of 5 to 8 ft of silty sandy clay underlain by 8 to 10 ft of silty sand, with dense clay acting as a lower confining layer approximately 16 feet bgs. Available groundwater data suggests a groundwater divide exists just to the west of SWMU-17. As a consequence, the hydraulic gradient is low (~ 0.001 ft/ft) and groundwater velocity is also low (~ 5 ft/yr). The hydraulic conductivity varies from 1 to 3 ft/d. Groundwater sampling of different wells located in SWMU-17 in 2003 found TCE concentrations ranging from 2.6 – 95 mg/L.

In May, 2004 a field pilot test was initiated, with EOS® injected into 16 injection wells covering an area 20-ft by 20-ft, approximately 10 feet thick (**Figure III-2**). Monitoring of the test area occurred 3, 6, 9 and 12 months after injection.

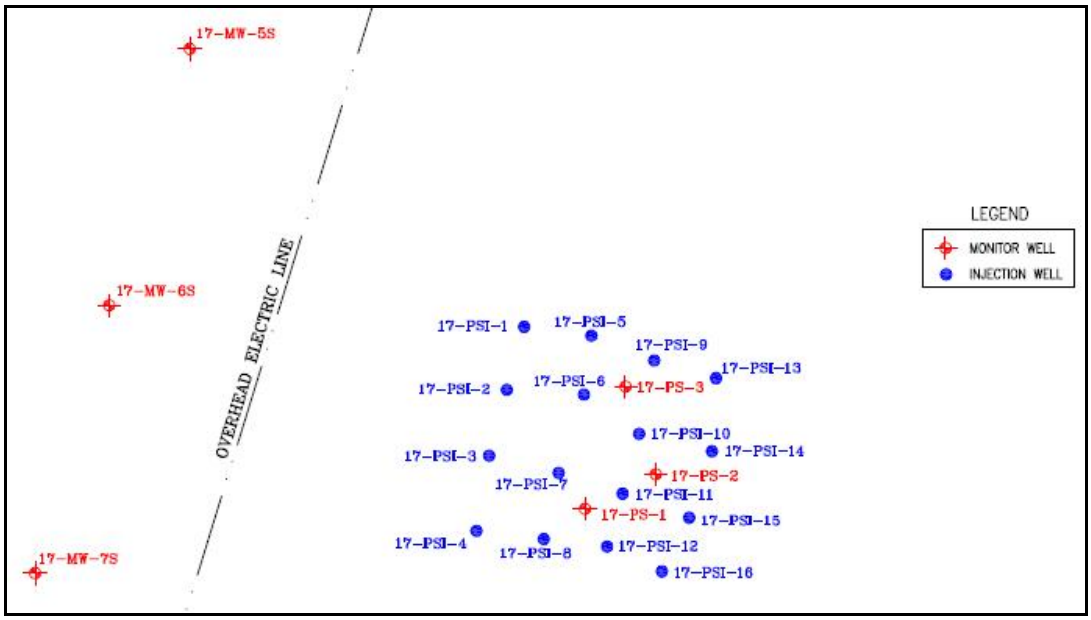

Figure III-2. Monitor and injection well set-up for initial pilot test at SWMU-17.

During the first six months after injection, TCE concentrations dropped while *cis*-DCE concentrations rose; negligible amounts of VC or ethene were produced. Conversion of TCE to *cis*-DCE was extremely variable from well to well, with some wells showing a 20-30% conversion and others an 80-99% conversion. However, after nine months there was little to no additional TCE conversion, suggesting biodegradation of TCE had slowed considerably. It was determined that additional laboratory experiments should be performed to determine why biodegradation had stalled.

1.3 RESEARCH OBJECTIVES

Three hypotheses were generated to explain why TCE degradation slowed and why complete reductive dechlorination did not occur:

1. Low pH – the pH of the aquifer was too low, inhibiting the conversion of TCE to ethene;
2. Microbial Community - the microorganisms necessary for complete reductive dechlorination of TCE did not exist in the aquifer;
3. Low Organic Carbon - not enough dissolved organic carbon existed in the aquifer for reductive dechlorination to proceed.

In order to evaluate these hypotheses, laboratory studies were initiated in August 2005 to: (1) determine the chemical and biological conditions of the subsurface; and (2) evaluate the effect of pH, organic substrate and bioaugmentation on the reductive dechlorination of TCE in batch microcosms. Using these results, additional field experiments could then be performed at SWMU-17 to enhance reductive dechlorination.

2.0 SITE CHARACTERISTICS

2.1 METHODS

In order to perform a site characterization analysis, sediment and groundwater was collected from the field site from both a background location (herein called Background) and a location inside the pilot test area (herein called Test Site). **Figure III-3** shows the locations of the different soil borings, as well as all adjacent groundwater wells.

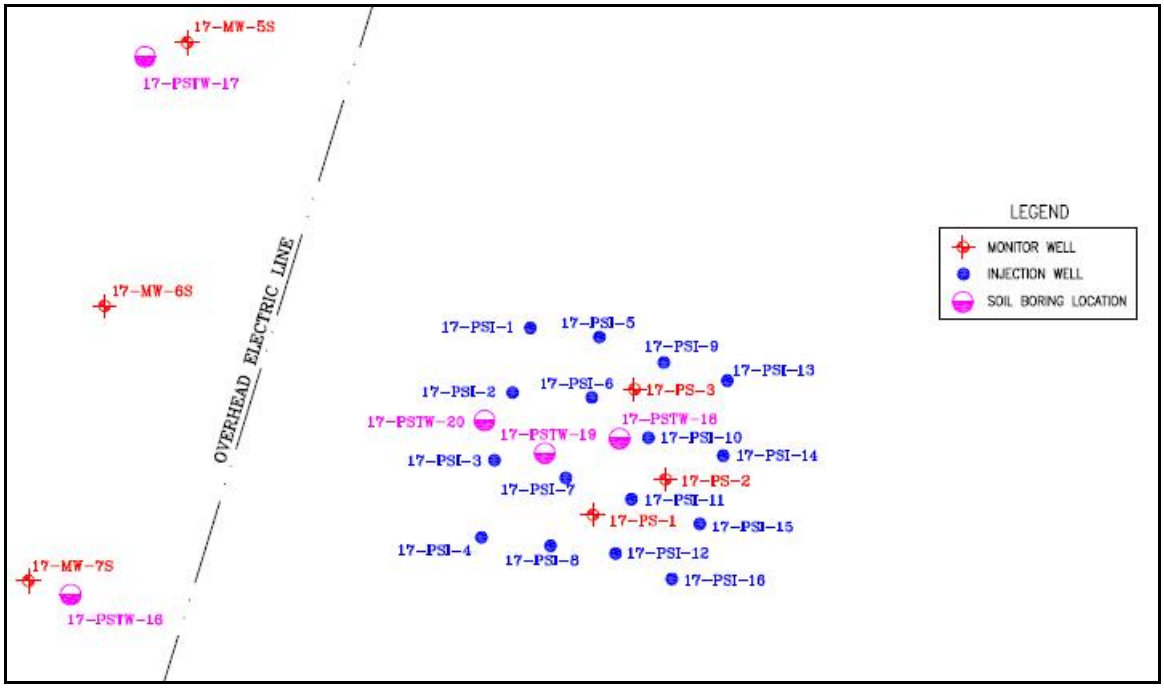

Figure III-3. Soil boring locations at SWMU-17.

Small sub-samples of approximately 100 mL were collected from Background soil borings 17-PSTW-16 and -17 and Test Site soil borings 17-PSTW-18, -19 and -20 at intervals of 10, 12, 14 and 16 feet below ground surface (bgs). These samples were collected in small plastic containers, sealed and taped to exclude air. Additionally, 2 quarts of sediment were collected in Mason jars from borings 17-PSTW-16, -17, -18 and -19. Groundwater from adjacent wells was used to cover the sediment before capping the

jars to exclude air. Unless otherwise stated, all soil characterization analyses were performed on soil from the sub-samples.

In addition to the soil samples, groundwater samples were taken for analyses. Four gallons of groundwater were collected from monitor wells 17-PS-3 (Background) and 17-MW-6S (Test Site).

X-ray diffraction was performed on the 17-PSTW-17 and 17-PSTW-18 borings at intervals of 10 ft, 12 ft and 14 ft (Klute, 1986). The quartz sand particles are first separated and discarded. Then, using centrifugation, the remaining particles are separated into fine clay and coarse clay particles. The particles are washed multiple times and air dried before being analyzed on an x-ray diffractor using the Jade 7 program.

Ferrous and total iron in the groundwater was analyzed according to Method 3500-Fe D from Standard Methods. This method involves adding up to 25 mL of the groundwater to a solution containing an ammonium acetate solution, phenanthroline and, if analyzing total iron, hydroxylamine hydrochloride. After shaking, the solution was read on a spectrophotometer set at an absorbance of 510 nm.

Two experiments were run to determine sediment bound iron. In the first experiment, 2 g of soil was added to 50 mL of a 0.5 N HCl solution, shaken and allowed to sit for 24 hours. An extract was then filtered through a 0.2 μm nylon filter and analyzed for ferrous and total iron using the above method. In the second experiment, 2 g of soil was added to 50 mL of a 5 N HCl solution, shaken and allowed to sit for one month. An extract was then filtered and analyzed using the above method. The 0.5 N HCl extraction removes the bio-available iron, while the 5 N HCl extraction removes the total sediment-bound iron.

pH analyses were run on each of the soil sub-samples by calibrating a pH meter with 4.01, 7 and 10.01 pH standards. Groundwater samples were stirred continuously while measuring for pH. To find the pH of the sediment, 10 mL of sediment were air dried and

then added to 10 mL of DI water. The solution was shaken and allowed to sit overnight. The water over the sediment was then stirred while the pH was measured.

Measurements of dissolved metals, and total sulfur were performed at the Analytical Services Laboratory in the Department of Soil Sciences, North Carolina State University on a Perkins Elmer Plasma II Ion Coupled Plasma Argon Emission Spectrometer (ICP-AES). Samples were filtered prior to dilution in acid through a 0.45 micron syringe filter. No refrigeration was necessary for storing the samples prior to analysis. Groundwater from wells 17-PS-3 and 17-MW-6S were used for the analysis. 20 mL of the 5 N HCl extract from the iron experiments for borings 17-PSTW-16, -17, -18 and -19 were also analyzed.

In order to assess the quantity of dechlorinating microorganisms, groundwater and soil samples were sent to Microbial Insights, Inc. of Rockford, TN for a microbial assay. Quantitative real-time PCR was performed to determine the concentration of dechlorinating microorganisms. Groundwater from wells 17-PS-3 and 17-MW-6S were used for the assay. For sediment, the jars of 17-PSTW-16 and -17 sediment were blended together for a combined Background sample, while jars of 17-PSTW-18 and -19 sediment were blended together for a combined Test Site sample.

2.2 RESULTS

Table III-2 shows the average values of the 24-hour iron extraction on soil cores 17PSTW-16, -17, -18 and -19. Full results can be found in **Appendix B**. The results for the Background and Test Site soil cores are similar for the 10 foot and 16 foot sections, with % Fe(II) contribution lower at the higher level (9-18%) and very high at the lower level (83-91%). However, in the middle depths the % Fe(II) contribution was five to ten times higher in the Test Site locations than in the Background locations. Elevated levels of ferrous iron are a consistent indicator of reducing conditions. Additionally, the dissolved iron concentrations in the Background groundwater (~1 mg/L) were significantly less than the concentrations in the Test Site groundwater (200 – 250 mg/L).

Table III-2. Average bioavailable Fe(II) and Fe(III) content of Background and Test Site sediment samples.

Sample Depth	Background (17PSTW-16 and -17)					Test Site (17PSTW-18 and -19)				
	Fe (II)		Fe(III)		% Fe(II)	Fe (II)		Fe(III)		% Fe(II)
	Mean	Std. Dev.	Mean	Std. Dev.		Mean	Std. Dev.	Mean	Std. Dev.	
	mg/g	mg/g	mg/g	mg/g		mg/g	mg/g	mg/g	mg/g	
10 ft	0.083	0.042	0.38	0.19	18%	0.048	0.026	0.46	0.16	9%
12 ft	0.046	0.014	0.39	0.055	10%	0.52	0.087	0.63	0.64	45%
14 ft	0.056	0.023	0.56	0.11	9%	0.63	0.62	0.10	0.045	87%
16 ft	0.62	0.43	0.13	0.11	83%	0.51	0.13	0.048	0.087	91%
Microcosm Sediment	0.34	0.070	0.48	0.032	41%	0.64	0.11	0.49	0.096	57%

Soil boring 17PSTW-20 was very different from the other test site borings, and as such was not included in **Table III-2**. The % Fe(II) contribution was much lower in the 12, 14 and 16 foot depths (3-28% compared to 45-91%) when compared with the other Test Site soil borings. Additionally, there was twice as much total iron at those depths in 17PSTW-20 than the other two Test Site soil borings. It is unknown why this boring was much different; however, this level of variation is not entirely unexpected for core samples located 50 to 100 ft apart.

Table III-3 details the pH of different soil depths from the Background and Test Site soil borings. Background soil borings 17-PSTW-16 and 17-PSTW-17 are fairly similar, with a low pH (4.9 – 5.2) at depths of 10, 12 and 14 feet. However, at a depth of 16 feet the pH jumps to around 6.0.

Test Site borings 17-PSTW-18 and 17-PSTW-19 are very similar to the Background borings, with low pH values in the 10'-14' increments, leading to a higher pH at a depth of 16 ft. However, for Test Site boring 17-PSTW-20 the pH is much less variable, being between 4.2 and 4.5 for all depths analyzed.

Table III-3. Soil pH Measurements.

		Depth below ground surface			
		10'	12'	14'	16'
Background Borings	17PSTW-16	4.9	5.1	5.2	5.9
	17PSTW-17	4.9	4.9	4.9	6.1
Test Site Borings	17PSTW-18	4.3	4.8	4.8	6.2
	17PSTW-19	4.2	4.8	4.8	5.7
	17PSTW-20	4.4	4.2	4.5	4.4

Table III-4 shows the biological assay performed by Microbial Insights on Background and Test Site groundwater, as well as the homogenized Background and Test Site sediments (Microbial Insights, Inc., 2005). Some *Dehalococcoides* species are able to dechlorinate TCE completely to ethene, while *Desulfurmonas* and *Dehalobacter* are able to dechlorinate TCE to *cis*-DCE.

Table III-4. Biological assay on groundwater and blended Charleston sediment.

	Background Soil (cells/g)	**Background Water (cells/mL)**	**Test Site Soil (cells/g)**	**Test Site Water (cells/mL)**
Dechlorinating Bacteria				
Dehalococcoides	3.10E+03	5.30E+01	< 9.71E+02	2.03E+00
Desulfuromonas	7.10E+00	7.74E-02	1.47E+02	1.95E-02
Dehalobacter	2.28E+04	1.42E+04	1.60E+05	2.17E+03
Functional Genes				
BAV1 VC Reductase	3.14E+02	1.92E+00	< 9.71E+02	1.04E+00
Dissimilatory Sulfite Reductase	3.46E+05	4.62E+05	4.40E+05	1.23E+03
TCE Reductase	< 9.78E+02	< 4.13E-01	< 9.71E+02	1.35E+00
Other Genera				
Geobacter	< 1.47E+03	3.84E+01	< 1.46 E+03	1.64E+02
Phylogenetic Group				
Eubacteria	5.18E+06	1.05E+07	1.48E+07	9.49E+06
Methanogens	1.25E+05	1.68E+04	3.47E+05	2.03E+01

Source: Microbial Insights, Inc., 2005

According to Microbial Insights, a total concentration of $10^3 - 10^4$ cells per gram or milliliter constitutes a low level of dechlorinating biomass. Based upon this, there is a low level of dechlorinators in the Background and Test Site groundwater and the Background sediment, with a slightly higher amount of dechlorinators in the Test Site

soil; however, the vast majority of these are *Dehalobacter* sp., which are only capable of dechlorinating TCE to *cis*-DCE. Also, the amount of VC and TCE reductase genes are fairly low, indicating the available *Dehalococcoides* species may not be able to completely degrade TCE to ethene. The high level of methanogens in the sediment is a consistent indicator of reducing conditions.

Detailed ion analysis and x-ray diffraction results can be found in **Tables III-5** to **III-7**. These analyses revealed no surprising results. The aquifer can be classified as a clay-sand aquifer. The geochemistry found at this site is comparable to what would be expected in a clay-sand aquifer, with no unusually high concentrations of any particular species.

Table III-5. Results of x-ray diffraction analysis.

Boring	Depth	Coarse Clay			Fine Clay		
		Smectite	Kaolinite	Mica	Smectite	Kaolinite	Mica
		%	%	%	%	%	%
17PSTW-17	10 ft	22	78	0	43	57	0
	12 ft	20	62	18	49	51	0
	14 ft	24	76	0	47	53	0
17PSTW-18	10 ft	14	86	0	36	64	0
	12 ft	13	71	16	46	54	0
	14 ft	20	80	0	26	74	0

Table III-6. Detailed ion analysis of Background and Test Site groundwater.

Sample ID	**Al mg/L**	**Ca mg/L**	**Cu mg/L**	**Fe mg/L**	**K mg/L**	**Mg mg/L**
17-MW-6S	< 0.05	65	< 0.05	0.23	2.3	11
17-PS-3	0.17	224	< 0.05	17	3.1	46
Sample ID	**Mn mg/L**	**Na mg/L**	**Tot. S mg SO4/L**	**Si mg/L**	**Zn mg/L**	**Tot. P mg P/L**
17-MW-6S	0.13	133	48	16	< 0.05	< 0.05
17-PS-3	0.5	407	7.9	9.4	0.09	< 0.05

Table III-7. Detailed ion analysis of Background and Test Site soils.

Sample ID	Depth ft	Al mg/g	Ca mg/g	Cd mg/g	Cr mg/g	Cu mg/g	Fe mg/g	K mg/g	Mg mg/g	Mn mg/g	Na mg/g	Ni mg/g	Pb mg/g	tS mg/g	Si mg/g	Zn mg/g
17-PSTW 16	10	3.9	0.30	< 0.001	0.009	< 0.001	4.2	0.15	0.36	0.005	0.068	0.003	0.002	0.016	0.24	0.015
17-PSTW 16	12	6.0	0.95	< 0.001	0.023	0.003	19	0.23	0.69	0.018	0.12	0.013	0.003	0.027	0.20	0.015
17-PSTW 16	14	2.9	0.30	< 0.001	0.010	< 0.001	3.3	0.17	0.28	0.004	0.040	0.003	0.002	0.021	0.25	0.011
17-PSTW 16	16	5.3	1.8	< 0.001	0.011	< 0.001	3.4	0.43	0.65	0.016	0.064	0.005	< 0.001	0.11	0.24	0.026
17-PSTW 17	10	3.0	0.16	< 0.001	0.009	< 0.001	3.9	0.11	0.27	0.006	0.059	0.003	0.002	0.023	0.22	0.009
17-PSTW 17	12	2.9	0.35	< 0.001	0.010	< 0.001	2.8	0.17	0.29	0.005	0.065	0.003	0.002	0.020	0.008	0.008
17-PSTW 17	14	2.3	0.25	< 0.001	0.009	< 0.001	3.1	0.13	0.25	0.006	0.066	0.003	0.002	0.018	0.27	0.008
17-PSTW 17	16	2.0	0.31	< 0.001	0.009	< 0.001	2.7	0.18	0.22	0.004	0.039	0.002	0.002	0.020	0.005	0.010
17-PSTW 18	10	5.3	0.16	< 0.001	0.014	< 0.001	4.4	0.15	0.42	0.006	0.14	0.005	0.002	0.037	0.28	0.010
17-PSTW 18	12	4.1	0.32	< 0.001	0.011	< 0.001	4.0	0.20	0.39	0.006	0.17	0.003	0.002	0.014	0.24	0.010
17-PSTW 18	14	1.1	0.10	< 0.001	0.004	< 0.001	1.2	0.054	0.11	0.002	0.076	0.002	< 0.001	0.016	0.23	0.014
17-PSTW 18	16	3.7	0.75	< 0.001	0.011	< 0.001	2.5	0.31	0.46	0.010	0.12	0.004	< 0.001	0.026	0.25	0.024
17-PSTW 19	10	4.3	0.18	< 0.001	0.011	< 0.001	5.1	0.16	0.42	0.006	0.14	0.004	0.002	0.032	0.26	0.011
17-PSTW 19	12	3.4	0.38	< 0.001	0.010	< 0.001	2.9	0.17	0.31	0.004	0.14	0.003	0.002	0.016	0.25	0.011
17-PSTW 19	14	3.9	0.38	< 0.001	0.015	< 0.001	5.5	0.21	0.44	0.008	0.19	0.005	0.002	0.019	0.23	0.011
17-PSTW 19	16	1.4	0.43	< 0.001	0.006	0.0035	1.1	0.14	0.19	0.003	0.099	0.002	0.002	0.016	0.29	0.016

2.3 SITE CHARACTERIZATION SUMMARY

From analyses of the different soil samples a number of conclusions can be drawn. The aquifer is under sufficiently reducing conditions to allow reductive dechlorination to occur. However, the amount of dechlorinators located in the aquifer is fairly low. There was a moderate amount of *Dehalobacter* sp. in the Test Site blended sediment. However, this microbe is only able to dechlorinate TCE to *cis*-DCE, which would explain why *cis*-DCE has not degraded at the site.

One reason for the lack of available dechlorinators may be the relatively low pH of the aquifer. Most dehalogenating microorganisms are known to dechlorinate in a pH range of 5.5 – 10, with an optimal pH of neutral to slightly basic. However, the pH of the aquifer in the upper 80% of the treatment zone is between 4.2 and 5.2. Aside from the reduced pH, the geochemistry of this aquifer is typical of clay-sand aquifers.

3.0 MICROCOSMS

In order to determine why reductive dechlorination was not proceeding as expected and how best to promote reductive dechlorination, batch microcosm experiments were initiated in August 2005. Soil and groundwater from both the original pilot test site and a background location were be used to construct these microcosms. The microcosms were then subjected to different treatments to determine the effect of pH, organic substrate and bioaugmentation on reductive dechlorination.

3.1 METHODS

Batch microcosms were constructed with aquifer material and groundwater collected at two locations from the site, one a background location (herein called Background) and one from the previous test site (herein called Test Site). The location of the soil borings can be found in Section 2.1. Four liters of soil were collected from each site and blended. Microcosms were constructed in 245 mL serum bottles filled with 100 mL of wet aquifer sediment and 125 mL of groundwater. Any lab equipment coming into contact with the aquifer material or groundwater was autoclaved prior to use.

There were five experimental treatments for each site, with each experiment run in triplicate (resulting in 15 microcosms constructed per site.) The experimental treatments were:

Treatment A – Inhibited
Treatment B – Live Control
Treatment C – Live with pH buffer
Treatment D – Live with pH buffer and EOS®
Treatment E – Live with pH buffer, EOS® and bioaugmentation culture

All microcosms were constructed in an anaerobic chamber maintained under a N_2/H_2 (95/5) atmosphere. Prior to being removed from the anaerobic chamber, the microcosms were sealed with a thick butyl rubber stopper and crimped with an aluminum cap to exclude oxygen.

The inhibited microcosms were then removed and autoclaved twice for one hour at 121°C. 3 mL of 1 N hydrochloric acid was then added to lower the pH to about 4.5. Treatments C, D and E all received 7.5 mL of a 0.2 N NaOH solution to raise their pH to above 6.5. Treatments D and E also received 0.23 mL of EOS® concentrate. All additions to the microcosms were made by piercing the rubber stopper with a needle and injecting the additives into the microcosms. All microcosms were incubated in the dark at room temperature (approximately 20° C) in the laboratory.

The bioaugmentation culture used was the SDC-9 cuture, provided by Shaw Environmental & Infrastructure, Inc. SDC-9 is a mixed culture containing two species of *Dehalococcoides* and a strain of *Desulfovibrio*. *Dehalococcoides* is able to completely dechlorinate PCE to ethene via halorespiration, while *Desulfovibrio* is able to dechlorinate PCE and TCE to *cis*-DCE. The cell density of *Dehalococcoides* was approximately 10^8 cells/mL. 0.1 mL of the bioaugmentation culture was added to the bioaugmented microcosms, as determined through consultation with Shaw.

It was noted that the groundwater and sediment from the Test Site had relatively low TCE concentrations, with the contaminant having already been converted to *cis*-DCE. In order to witness the fate of TCE, each Test Site microcosm was amended with 3 microliters of TCE (approximately 3 mg/L). No TCE was added to the Background microcosms since TCE concentrations were sufficiently high.

Samples from the microcosms were analyzed for VOCs, dissolved oxygen (DO), anions (chloride, nitrate, nitrite and sulfate), total organic carbon (TOC), methane, ethene, ethane, and pH. VOCs that are liquids at room temperature were analyzed by purge and trap gas chromatography with flame ionization detection (FID) (P&T – GC/FID) following methods equivalent to SW-846 5030B and 8015B. Permanent gases (vinyl chloride (VC), chloroethane (CA), chloromethane (CM), methane, ethane, and ethene) were analyzed by headspace gas chromatography with flame ionization detection (headspace GC/FID) following methods equivalent to SW-846 5021 and 8015B. Anions were analyzed by ion chromatography following methods equivalent to SW-846 9056.

Total organic carbon was analyzed using a Shimadzu 5000A following methods equivalent to SW-846 9060. **Table III-8** details how the different species were analyzed.

Table III-8. Analytical requirements for microcosm treatments.

Analyte	Analytical Method
Chloroethane (CA)	Headspace – GC/FID
1,1- Dichloroethene (1,1-DCE)	P&T – GC/FID
cis-1,2-Dichloroethene (cis-DCE)	P&T – GC/FID
trans-1,2-Dichloroethene (trans-DCE)	P&T – GC/FID
Tetrachloroethene (PCE)	P&T – GC/FID
Trichloroethene (TCE)	P&T – GC/FID
Vinyl chloride (VC)	Headspace – GC/FID
Dissolved oxygen (DO)	Chemetrics ampoules
Bromide (Br^-)	Ion Chromatography
Chloride (Cl^-)	Ion Chromatography
Nitrate (NO_3^-)	Ion Chromatography
Nitrite (NO_2^-)	Ion Chromatography
Phosphate (PO_4^{3-})	Ion Chromatography
Sulfate (SO_4^{2-})	Ion Chromatography
Methane	Headspace – GC/FID
Ethane	Headspace – GC/FID
Ethene	Headspace – GC/FID
pH	pH meter
Total Organic Carbon (TOC)	TOC analyzer

In order to obtain an adequate amount of sample for analyses but leave enough liquid for future analyses, 1 mL of liquid was taken for the P&T – GC/FID, 5 mL of liquid for anion analysis, 1 mL of liquid for TOC analysis, 1 mL of liquid for pH analysis and 1 mL of headspace gas for the headspace GC/FID. For the final sampling on day 447, 5 mL of liquid were taken for the P&T – GC/FID in order to obtain a lower quantitation limit.

Analysis of VOCs occurred 2, 19, 75, 125, 250 and 447 days after spiking the microcosms. TOC and pH measurements were taken 19, 75, 125, 250 and 447 days after spiking. Anions were only analyzed 2 and 250 days after spiking.

3.2 RESULTS

For convenience, the microcosm treatments have been given the following names:

Treatment A – Inhibited
Treatment B – Ambient
Treatment C – Buffered
Treatment D – Buffer and EOS®
Treatment E – Bioaugmented

In order to evaluate the extent of dechlorination, the chlorine number (Cl#), a way of determining what the dominant chlorinated ethene is, was calculated. The Cl# is calculated as follows:

$$Cl\# = \frac{4*[PCE]+3*[TCE]+2*[DCE]+[VC]}{[PCE]+[TCE]+[DCE]+[VC]+[ethene]+[ethane]}$$

The brackets indicate concentration in moles per bottle. As an example, if all of the chlorinated ethenes were in the form of TCE, the Cl# would be 3. However, if the chlorinated ethenes were split evenly between TCE and *cis*-DCE, the Cl# would be 2.5. If there were no chlorinated ethenes the Cl# would be 0.

Figure III-4 shows the average pH values of the different treatments for the Background microcosms (individual microcosm results can be found in **Appendix E**). The Ambient treatment pH was usually between 5.5-5.7, which is much higher than most of the soil sub-samples taken from the same borings. It is likely that the soil for the microcosms was taken from the lower levels of the aquifer, where the pH is higher. The Buffered, Buffer and EOS® and Bioaugmented treatments all had a pH near neutral. **Figure III-5** shows the average pH values of the different treatments for the Test Site microcosms. The Ambient treatment pH was slightly higher than the Background microcosms, between 6.0-6.2, again suggesting sediment taken for the microcosms was from the lower levels of the aquifer. The Buffered, Buffer and EOS® and Bioaugmented treatments all had a pH around 6.5. Both the Background and Test Site Inhibited microcosms had hydrochloric acid added to artificially lower the pH to near 4.5.

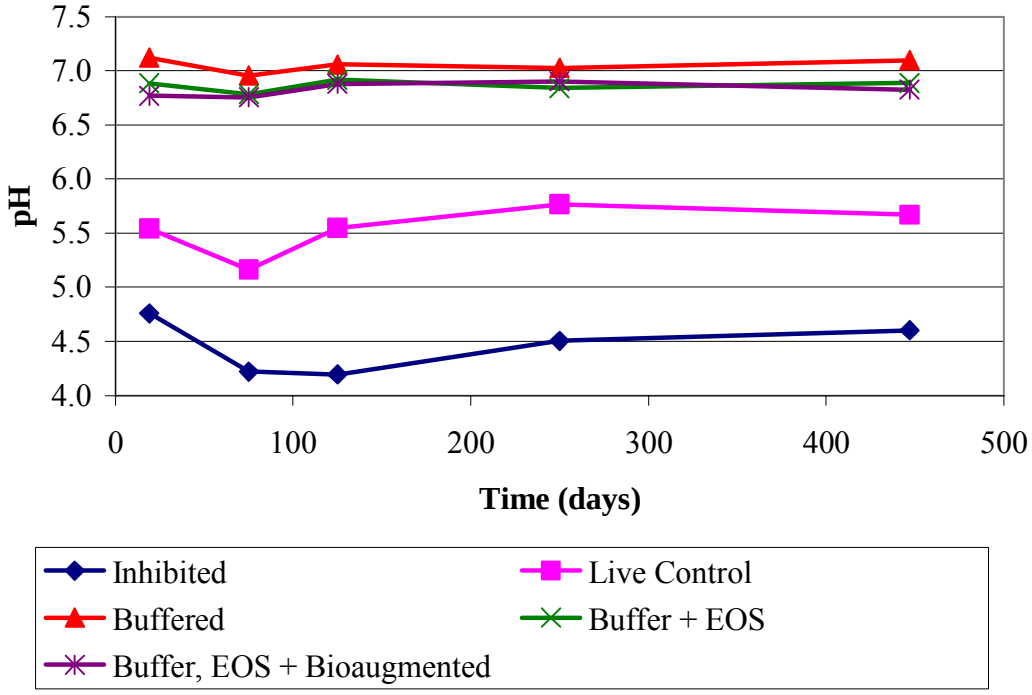

Figure III-4. Average pH values of the different Background microcosm treatments.

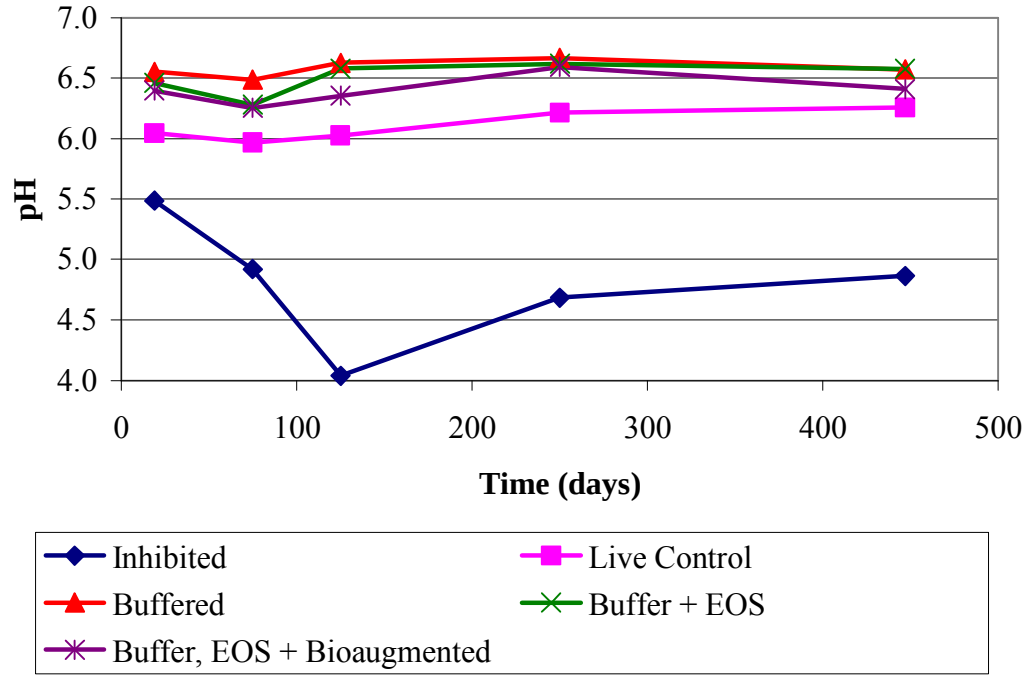

Figure III-5. Average pH values of the different Test Site microcosm treatments.

Figure III-6 shows the average Cl# for the different Background microcosm treatments. The error bars indicate one standard deviation from the mean. Both the Inhibited and Ambient treatments experienced little to no degradation of TCE. For the first 125 days, there was little degradation of TCE in the Buffered treatment. However, 250 days after being constructed one of the microcosms had reduced all the TCE to *cis*-DCE. In the other two microcosms a small amount of TCE had been converted to *cis*-DCE after 447 days. There was no biodegradation of *cis*-DCE in any of the Buffered microcosms.

In the Buffer and EOS® treatment, all of the TCE had been converted to *cis*-DCE 19 days after being constructed. There was a very small amount of *cis*-DCE transformed to VC in all three microcosms. However, it can generally be stated that dechlorination stalled at *cis*-DCE after 19 days.

In the Bioaugmented microcosms all the TCE had degraded by day 19, mostly to *cis*-DCE, but with some VC and ethene formation. 75 days after being constructed, all of the chlorinated ethenes were below detection limit while ethene was produced, indicating a complete conversion of the chlorinated solvents to ethene.

Figure III-7 shows the average Cl# for the different Test Site microcosm treatments, with the error bars indicating one standard deviation from the mean. These microcosms were amended with an additional 3 mg/L TCE since initial analyses indicated that all the TCE had degraded to *cis*-DCE. In the Inhibited microcosms none of the TCE degraded over time. The reason for the lower Cl# was because *cis*-DCE was present when the microcosms were constructed.

There was no TCE present in the Test Site Ambient microcosms at the first sampling event. When compared to the Inhibited microcosms however, there was an additional 3 mg/L of *cis*-DCE present, indicating all of the added TCE had degraded to *cis*-DCE in two days. It is unclear why TCE degraded to *cis*-DCE in the Ambient treatment while this did not occur at the site. As stated above, the pH of these microcosms was higher than most of the soil sub-samples, at a level sufficient for dechlorinating microorganisms.

There was no additional dechlorination of *cis*-DCE to VC or ethene in the Ambient microcosms.

The Test Site Buffered and Buffer and EOS® treatments behaved very similarly to the Ambient microcosms, with conversion of the added TCE to *cis*-DCE by the first sampling event. There was no additional degradation of *cis*-DCE in the Buffered microcosms. In the Buffer and EOS® microcosms, a very small amount of VC was produced, with no ethene production.

The Bioaugmented microcosms also had degraded all the TCE to *cis*-DCE after two days. Some VC was produced after two days. After 19 days, TCE, *cis*-DCE and VC were all below the detection limit, indicating all of the chlorinated solvents had degraded to ethene.

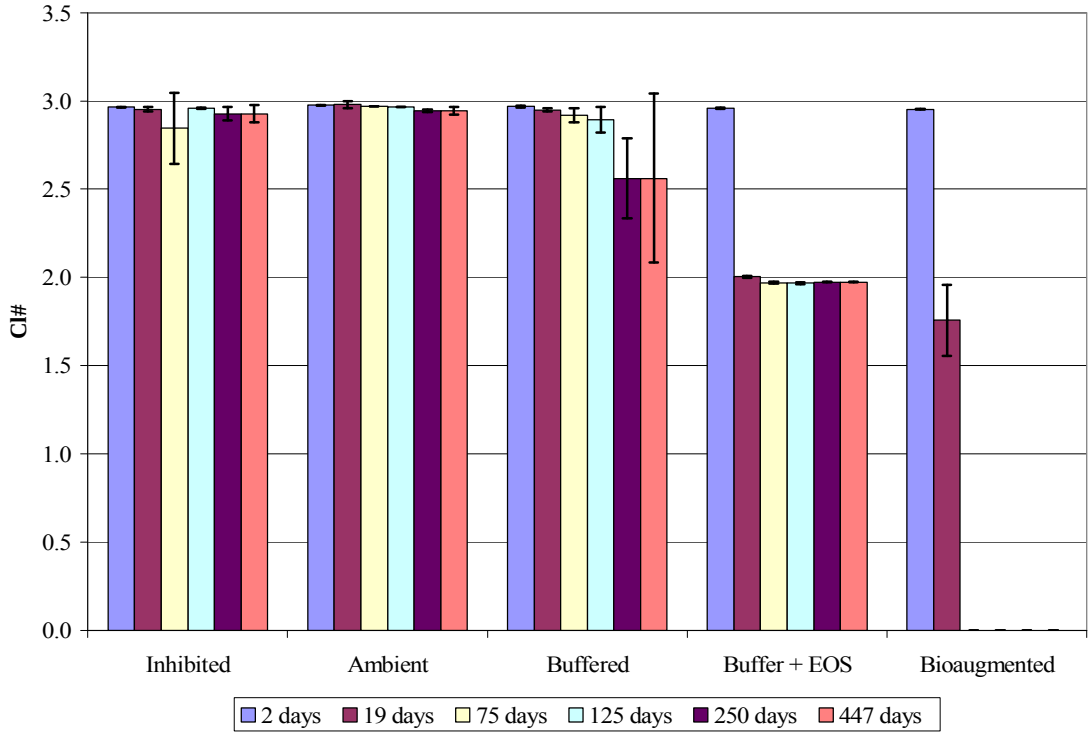

Figure III-6. Average Cl# for the different Background microcosm treatments. The error bars are one standard deviation from the mean.

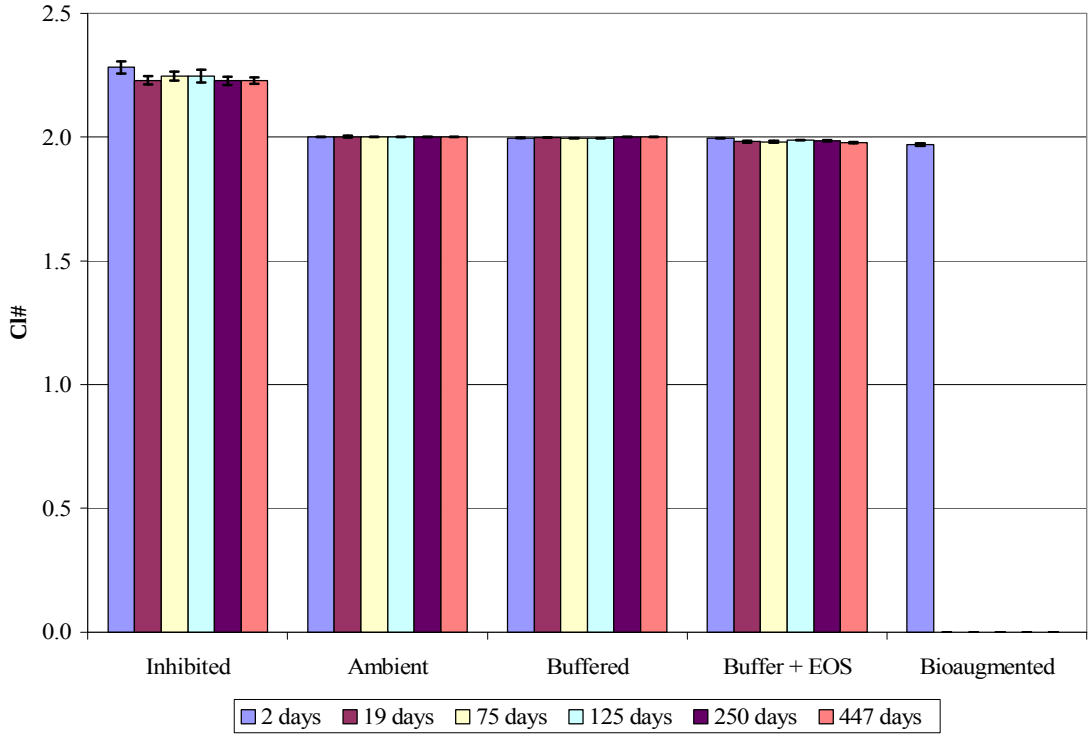

Figure III-7. Average Cl# for the different Test Site microcosm treatments. The error bars are one standard deviation from the mean.

3.3 SUMMARY AND CONCLUSIONS

Laboratory microcosm studies were conducted to evaluate the effect of pH, organic substrate and bioaugmentation on reductive dechlorination in groundwater and sediment from a Background and Test Site location at the Charleston Naval Weapons Station site. The primary conclusions are summarized as follows:

1. Under ambient, anaerobic conditions reductive dechlorination was very limited in the Background microcosms. This is not surprising, and is representative of what is happening on site.

2. In the ambient, anaerobic Test Site microcosms all TCE was reduced to *cis*-DCE after two days. This was surprising, since TCE was not reduced at the actual site. The pH of the microcosms is higher than most of the sub-sample pH values from the same

borings, indicating pH is a limiting factor in reductive dechlorination at this site. Unfortunately, since the Test Site Ambient microcosms have a higher pH than most of the actual aquifer they are non-representative of site conditions.

3. Amending the Background microcosms with a pH buffer encouraged reduction of TCE to *cis*-DCE in one microcosm, with limited transformation in the other two microcosms. However, adding a pH buffer and an organic substrate caused TCE to dechlorinate to *cis*-DCE after only 19 days. Further reduction of *cis*-DCE did not occur in any of the Background microcosms.

4. The Test Site microcosms amended with a pH buffer and a pH buffer and organic substrate all reduced TCE to *cis*-DCE in two days, with little to no subsequent transformation of *cis*-DCE to less chlorinated compounds. These results mirror those of the ambient microcosms.

5. The bioaugmentation culture completely reduced TCE to non-toxic ethene in 19 days for the Test Site microcosms and 75 days for the Background microcosms.

It appears that pH and the amount of dechlorinators are limiting reductive dechlorination. Due to the previous injection of EOS®, organic substrate does not appear to limit reductive dechlorination in the pilot test area, as evidenced by the Ambient microcosms. Once the pH was raised to above 6.0 in those microcosms TCE was dechlorinated to *cis*-DCE. However, *cis*-DCE was degraded only in the bioaugmented microcosms. The low level of dechlorinators present in the sediment suggest that that the pilot test area will need to be buffered and bioaugmented in order to achieve complete reductive dechlorination.

4.0 FIELD pH STUDIES

Analysis of the Charleston Naval Weapon Station (NWS) sediment used to construct batch microcosms showed a low level of dechlorinating microorganisms present in the subsurface. The microcosm studies suggested that the aquifer at NWS will have to be buffered to raise the pH and then bioaugmented to provide the necessary dechlorinating microorganisms to achieve complete dechlorination of TCE to ethene.

However, microbial analyses by Clifton Casey (personal correspondence, 2007) have shown a much higher level of dechlorinators living throughout the pilot test area. The sediment samples taken for constructing the microcosms may have been from an area of low dehalogenating activity. This is not uncommon, as Fennell ***et al***. (2001) reported collecting soil cores containing *Dehalococcoides* sp. approximately one meter away from soil cores containing little to no *Dehalococcoides* sp.

Whether or not a higher level of dechlorinators existed on site, the pH of the aquifer will have to be raised. As an intermediate step, bags of magnesium oxide (MgO) were placed in monitor wells 17-PS-02 and -03 from March 2006 to September 2006. However, the site pH will need to be increased to provide conditions suitable for reductive dechlorination. Since EOS® was last injected two years prior, it was also determined that EOS® should be reinjected to ensure adequate amounts of electron donor were present in the subsurface. After injection of the EOS® and pH buffer, monitoring of the groundwater would determine whether a bioaugmentation of the aquifer was indeed necessary.

4.1 LABORATORY BUFFER STUDIES

Many different alkali were considered to increase the pH of the aquifer, including hydrated lime ($Ca(OH)_2$), magnesium hydroxide ($Mg(OH)_2$), sodium hydroxide (NaOH), bicarbonate of soda ($NaHCO_3$) and soda ash (Na_2CO_3). **Table III-9** shows the properties of these different bases (National Lime Association, 2000).

Table III-9. Properties of different alkalis used in pH adjustment.

Alkali	$Ca(OH)_2$	$Mg(OH)_2$	NaOH	$NaHCO_3$	Na_2CO_3
Alkalinity (lb. $CaCO_3$ / lb. dry solids)	1.32	1.68	1.23	0.60	0.94
Cost ($ / ton)	100	300	280		80
Max. pH of concentrate	12	10	14	8	12

Source: National Lime Association, 2000.

The alkali to be used needed to provide a large amount of alkalinity per pound but not result in an excessively high pH near the point of injection. $Ca(OH)_2$, NaOH and Na_2CO_3 have maximum pH values of 12 or greater, which could result in toxicity due to a very high pH near the injection point. In contrast, $NaHCO_3$ would buffer the pH near optimum (7-8). However, $NaHCO_3$ provides the least alkalinity per pound. Also, addition of $NaHCO_3$ to the acidic aquifer would like result in degassing large amounts of CO_2, which could cause blockage of the aquifer.

Given these different factors, $Mg(OH)_2$ was chosen as a pH buffer. The pH of pure $Mg(OH)_2$ is ~10, so the pH within most of the aquifer can be expected to vary between background (~5) and 9. While a pH of 9 is greater than desired, it is not expected to be acutely toxic. Also, $Mg(OH)_2$ addition would require less material and would not result in CO_2 degassing.

In order to determine how much buffer to add, a titration experiment was conducted using sediment from the Test Site aquifer. 10 g of sediment was placed in vials with 10 mL of deionized (DI) water, with varying amounts of sodium hydroxide (NaOH) added to the vials. Each addition was run in triplicate. The vials were then shaken and left to sit overnight before pH measurements were taken. **Figure III-8** shows the pH of the different NaOH additions.

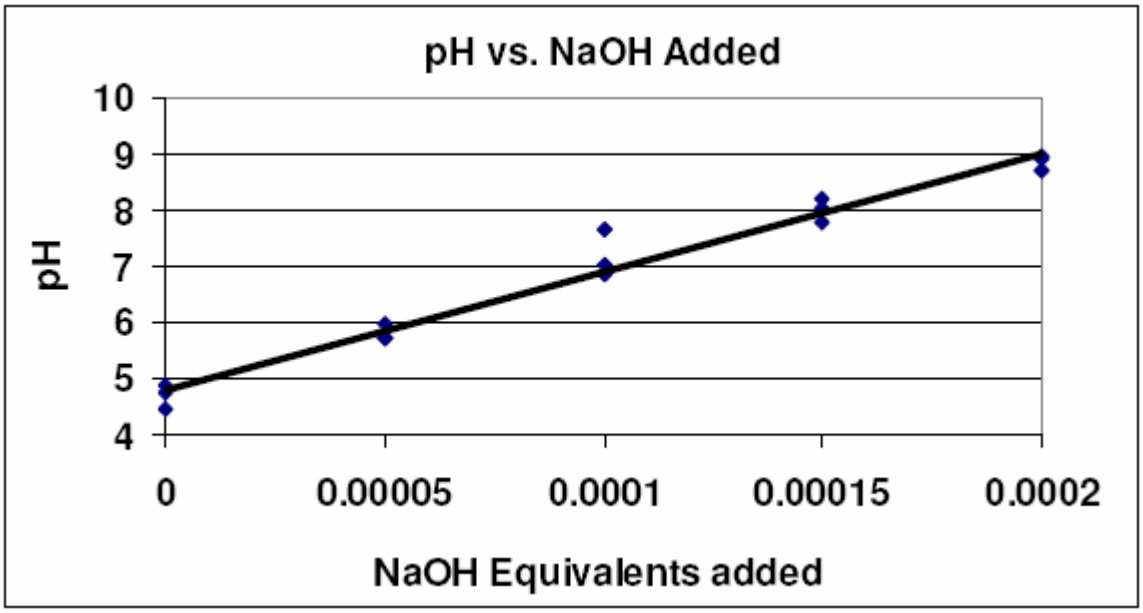

Figure III-8. pH versus amount of NaOH added.

The amount of $Mg(OH)_2$ required to increase the pH of the pilot test area is shown in **Figure III-9**, assuming perfectly uniform mixing of the added base with the aquifer material. $Mg(OH)_2$ addition was calculated assuming a 20 ft x 20 ft x 10 ft treatment volume with a sediment bulk density of 100 lb/ft^3. Using these assumptions, the results in **Figure III-8** were converted into total amount of $Mg(OH)_2$ required to raise the pH within the pilot area. Based on a linear regression of the data, approximately 1200 lb of pure $Mg(OH)_2$ would be required to raise the pH of the pilot test area to around 7.0.

Martin Marietta Magnesia Specialties, LLC provided two different types of $Mg(OH)_2$: FloMag HUS, a 62% $Mg(OH)_2$ slurry by weight with a median particle diameter of 3 microns; and MagChem MH-10 UHF, a $Mg(OH)_2$ powder with a median particle diameter of 1 micron. EOS® was used to make two mixtures, one with FloMag HUS (herein called HUS mixture) and one with the $Mg(OH)_2$ powder (herein called Powdered mixture).

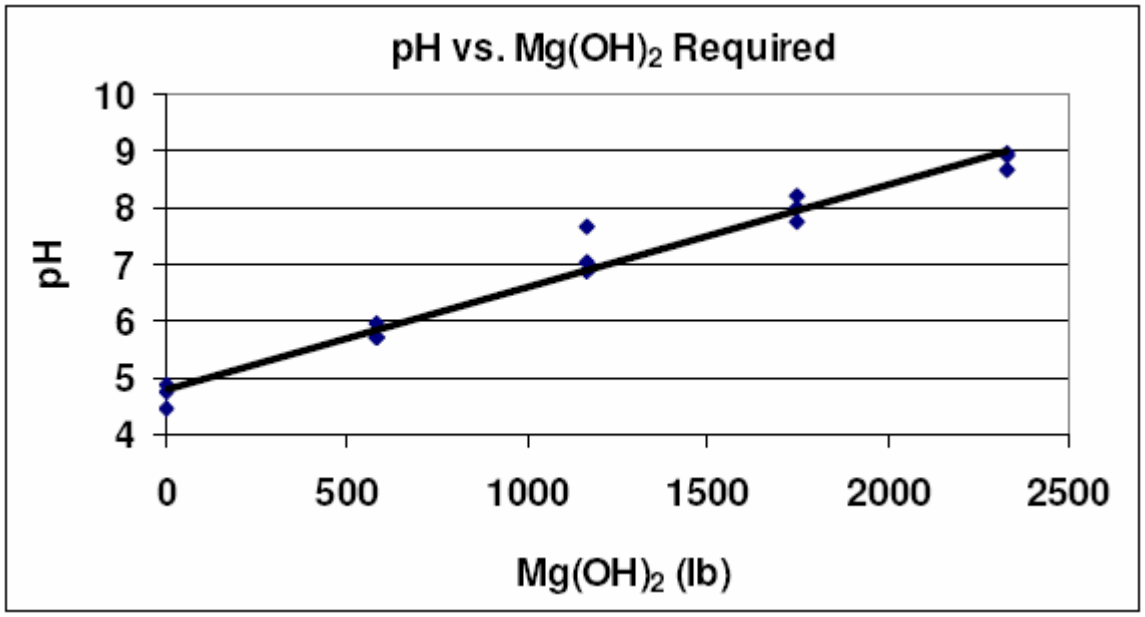

Figure III-9. $Mg(OH)_2$ required to increase the pH within the pilot test area.

Varying amounts of $Mg(OH)_2$ and EOS® were added together to determine the most effective mixture. It was determined that any combination with a ratio higher than 2:3 $Mg(OH)_2$:EOS® by weight produced an unstable mixture, with magnesium hydroxide precipitating. Furthermore, adding powdered $Mg(OH)_2$ to EOS® formed a very viscous mixture. By adding water at a ratio of about 1:2 by weight to the powdered $Mg(OH)_2$, a fluid and stable mixture of powdered $Mg(OH)_2$ and EOS® was formed.

The formulas for making these two separate mixtures were sent to EOS Remediation, Inc. who improved upon the formulas by adding additional surfactants. These mixtures were then sent to the Charleston NWS for injection into the subsurface. Small samples were also sent to North Carolina State University's Environmental Engineering Laboratory for analysis. **Table III-10** shows the average pH and density for the two mixtures as well as pure EOS®.

Table III-10. Density and pH of EOS®, EOS® + FloMag HUS mixture and EOS® + Powdered $Mg(OH)_2$ mixture.

Sample	EOS®	HUS Mixture	Powdered Mixture
pH	3.5	9.3	9.3
Density (kg/m^3)	948	1130	1099

4.2 METHODS

4.2.1 Field Methods

Field injections of the $Mg(OH)_2$/EOS® mixture were first performed in September 2006. **Figure III-10** shows the locations of the injection points in relation to previously installed injection wells. The HUS mixture was introduced into injection points IP 1 to IP 7 and IP 9 to IP 11. **Table III-11** details the amount of the mixture injected into each well, as well as the amount of chase water added.

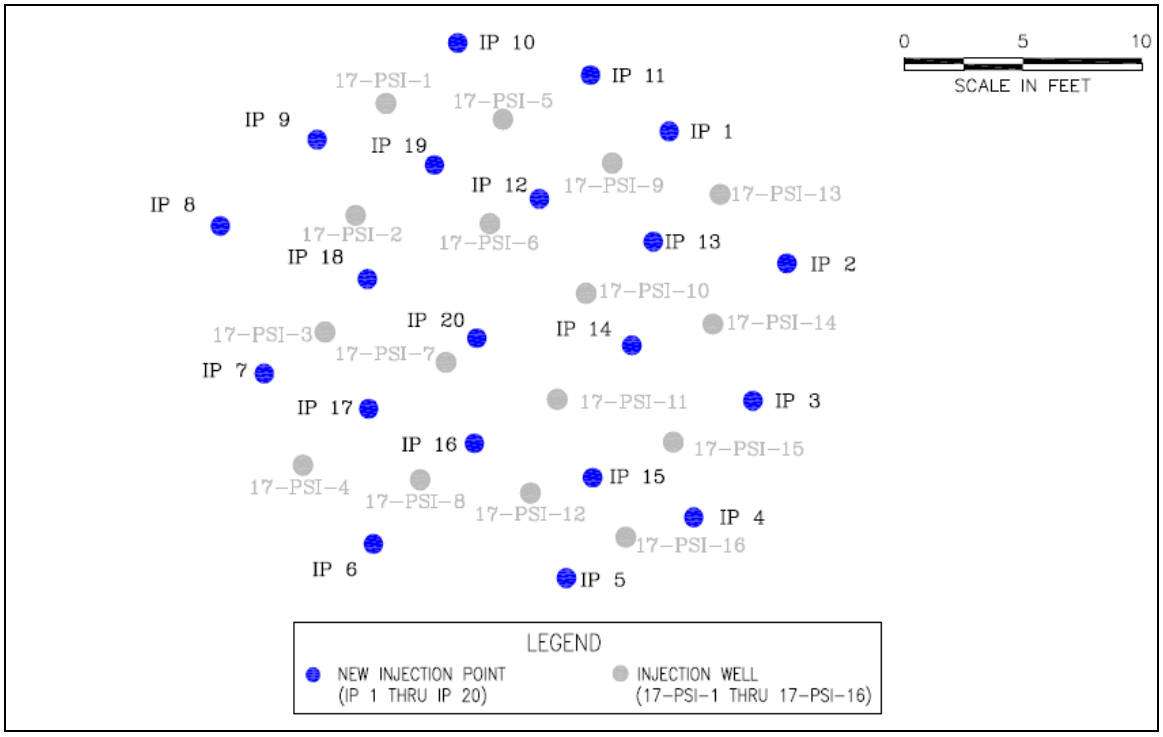

Figure III-10. Location of $Mg(OH)_2$ injection points in relation to previously installed injection wells.

Table III-11. Amount of HUS mixture and chase water injected into NWS pilot test area in September 2006.

Injection Point	HUS Mixture Injected (gal.)	Water Injected (gal.)	Total Injected (gal.)
IP 1	15	55	70
IP 2	15	30	45
IP 3	14	52	66
IP 4	22	78	100
IP 5	22	78	100
IP 6	22	78	100
IP 7	12	23	35
IP 9	8	27	35
IP 10	22	78	100
IP 11	5	10	15

Injections were performed by boring down to 16 feet below ground surface (bgs) and injecting the mixture. Initial plans were to inject a total of 22 gallons of the mixture evenly over the entire saturated zone (6-16 feet bgs) for all twenty injection points. However, while injecting the HUS mixture groundwater was observed being pushed out of monitor wells and the ground due to displacement by the mixture. It was decided that, in order to deliver the total amount of $Mg(OH)_2$ necessary while allowing the aquifer to restabilize, the Powdered mixture injections would be performed one month later. Additionally, injections would occur only at the depths where the hydraulic conductivity was greatest, which for most injection points was approximately 13-16 feet bgs.

In October 2005 the second round of injections was performed, with the Powdered mixture injected into injection points IP 12 to IP 20. In addition, the HUS mixture was injected at this time into injection point IP 8. As before, groundwater was observed being pushed out of the monitor wells and soil due to displacement. **Table III-12** details the amount of mixture and chase water injected into each point for this injection.

Table III-12. Amount of EOS® + $Mg(OH)_2$ and chase water injected into NWS pilot test area.

Injection Point	EOS® + $Mg(OH)_2$ Injected (gal.)	Water Injected (gal.)	Total Injected (gal.)
IP 8	5	10	15
IP 12	33	67	100
IP 13	20	39	59
IP 14	5	10	15
IP 15	Not Performed	N/A	N/A
IP 16	5	11	16
IP 17	15	30	45
IP 18	33	67	100
IP 19	20	40	60
IP 20	33	67	100

In addition to mixture injections, soil borings were collected immediately prior to and three months after the initial injection to determine how well the $Mg(OH)_2$/EOS® mixtures buffered the aquifer. These soil borings were analyzed for pH, alkalinity and volatile solids (VS) content. **Figure III-11** shows the location of the pre- and post-injection soil borings relative to the location of previously installed injection wells.

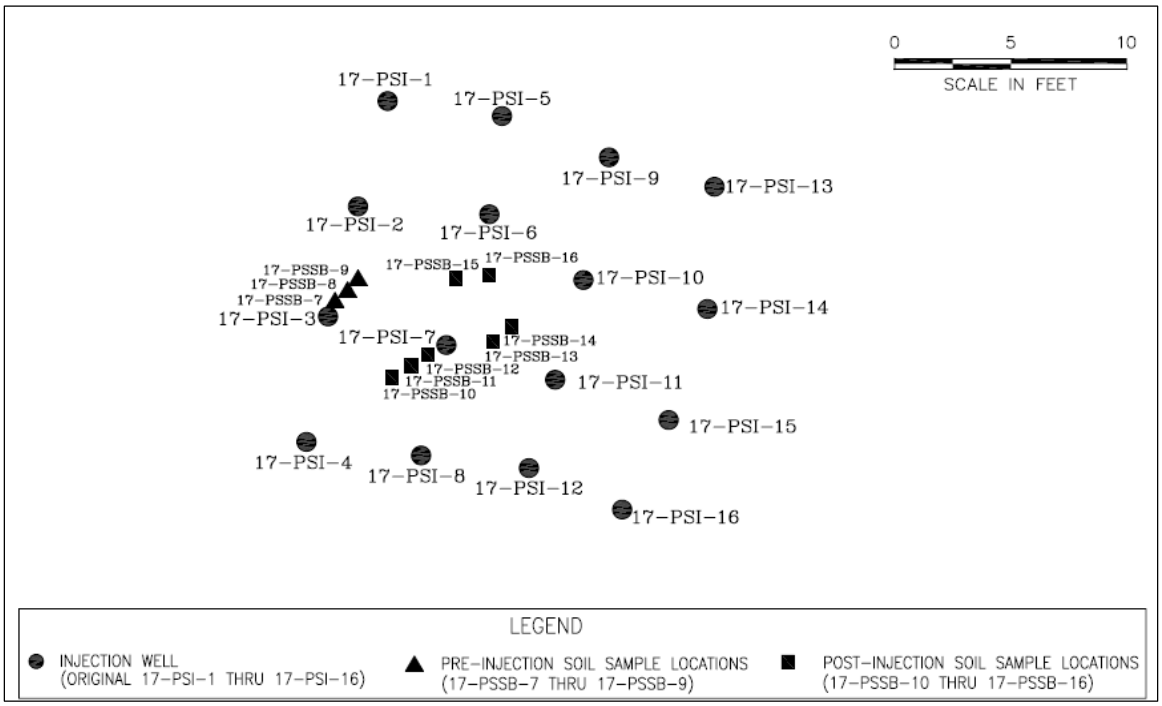

Figure III-11. Location of pre- and post-injection soil borings in relation to previously installed injection wells.

4.2.2 Laboratory Methods

The soil borings were brought to the laboratory, cut into four-inch long segments and analyzed for pH, alkalinity and volatile solids (VS) content. Every segment was analyzed for pH, while every other segment was analyzed for alkalinity. The segments not analyzed for alkalinity were analyzed for VS.

To analyze for pH, 10 mL of soil was extruded from the segment into a container. This container was filled with 40 mL of de-ionized (DI) water, stirred and left to sit for two hours. A pH meter was calibrated using 4.01, 7 and 10.01 pH standards. The water overlying the sediment was then stirred while the pH was measured.

To analyze for alkalinity, 10 g of soil was taken from the segment and placed into a container. This cup was filled with 50 mL of (DI) water, stirred and left to sit for one hour. The sediment-DI mixture was then titrated with hydrochloric acid to an endpoint pH of 4.5. The solution was stirred while the pH was read. The solution was left to sit overnight, with titration to pH 4.5 commencing again in the morning. The total amount of acid added was used to calculate alkalinity of the soil.

To calculate VS content, samples of wet sediment were placed in a ceramic dish, weighed and placed in drying oven at 105^{o}C overnight. The dishes were then weighed again and placed in a furnace at 550^{o}C for two hours. The dishes were weighed a final time. The difference between the dried and burned weights divided by the dry weight of soil gives the VS content of the dry sediment. It should be noted that VS content is not equivalent to organic material, since carbonates and sediment-bound water can also volatilize at 550^{o}C.

4.3 RESULTS

Average results are presented below. For complete results, see **Appendix C**.

4.3.1 Pre-injection

Three soil cores (17-PSSB-7, -8 and -9) were collected from the original pilot test area at Charleston NWS in September 2006 immediately before injection of $Mg(OH)_2$ and EOS®. The soil was collected in two-foot sections from the water table to the underlying clay layer (from 6 to 16 feet below ground surface (bgs).) The samples were cut into four-inch sections for pH analysis, with alternating sections analyzed for alkalinity and volatile solids (VS). **Table III-13a** contains values for pH averaged over one foot segments (where possible), while **Table III-13b** and **Table III-13c**, respectively, contain values for alkalinity and VS averaged over two foot segments.

The pH results mirror earlier pH analyses from the site. At boring 17-PSSB-7 and -8 the pH is fairly low (4.8-5.2) for the first seven feet of the aquifer. The bottom 3 feet of the aquifer has a slightly higher pH (5.5-6.2). Boring 17-PSSB-9 has a low pH (4.5-5.1) from 6 to 15 feet bgs, with a higher pH (5.9) in the bottom foot. The alkalinity values generally correspond with the pH values, with a higher alkalinity located at depths with higher pH values. The top section of the aquifer has a higher VS content. However, since the upper portion of the aquifer is a silty sandy clay while the lower portion is a silty sand this is not surprising.

Table III-13a. pH values of pre-injection soil samples averaged over foot long depths.

Depth	17-PSSB-7		17-PSSB-8		17-PSSB-9	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
6' - 7'	4.9	0.05	4.8	0.12	5.1	0.06
7' - 8'	4.9	0.14	5.0	0.12	4.8	0.12
8' - 9'	5.1	0.00	5.2	0.00	4.8	0.34
9' - 10'					4.5	0.04
10' - 11'	5.3	0.00	5.3	0.28	4.8	0.52
11' - 12'			4.8	0.19	4.8	0.18
12' - 13'	5.2	0.28	5.0	0.05	4.6	0.03
13' - 14'	5.8	0.04	5.5	0.39	4.7	0.09
14' - 15'	6.1	0.19	6.2	0.01	5.1	0.61
15' - 16'	5.9	0.11	6.2	0.06	5.9	0.18

Table III-13b. Alkalinity (in mg $CaCO_3$/kg soil) of pre-injection soil samples averaged over two-foot long depths.

Depth	17-PSSB-7		17-PSSB-8		17-PSSB-9	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
6' - 8'	61	6	38	14	50	13
8' - 10'	151	0	70	0	19	9
10' - 12'	127	0	76	31	41	37
12' - 14'	128	33	161	100	54	26
14' - 16'	291	63	341	208	300	209

Table III-13c. VS content (in % of dry soil) of pre-injection soil samples averaged over two-foot long depths.

Depth	17-PSSB-7		17-PSSB-8		17-PSSB-9	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
6' - 8'	3.3%	0.0044	3.6%	0.0067	3.2%	0.0053
8' - 10'	1.2%	0.0000	0.8%	0.0000	2.2%	0.0079
10' - 12'	1.0%	0.0000	1.2%	0.0031	1.5%	0.0043
12' - 14'	1.4%	0.0051	1.2%	0.0038	1.2%	0.0027
14' - 16'	1.0%	0.0007	1.0%	0.0025	1.1%	0.0019

4.3.2 Post-injection

Seven soil cores (17-PSSB-10, -11, -12, -13, -14, -15 and -16) were collected from the original pilot test area three months after the first $Mg(OH)_2$ and EOS® injection. The soil was collected in two- and four-foot sections from the water table to the underlying clay layer (from 6 to 16 feet below ground surface (bgs).) The samples were cut into four-inch sections for pH analysis, with alternating sections analyzed for alkalinity and volatile solids (VS). **Table III-14a** contains values for pH averaged over one foot segments (where possible), while **Table III-14b** and **Table III-14c**, respectively, contain values for alkalinity and VS averaged over two foot segments (where possible).

The pH changed noticeably in almost every section of the soil borings, with only one boring (17-PSSB-14) recorded pH readings less than 5. The pH levels of the lower levels of the aquifer rose more than the upper levels. The same is true for alkalinity and VS levels.

Table III-14a. pH values of post-injection soil samples averaged over foot long depths.

Depth	17-PSTB-10		17-PSTB-11		17-PSTB-12		17-PSTB-13		17-PSTB-14		17-PSTB-15		17-PSTB-16	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
6' - 7'	5.1	0.17	5.6	0.44	6.1	0.06	5.3	0.06	4.8	0.03	5.9	0.20	6.1	0.03
7' - 8'	5.0	0.05	6.2	0.08	6.1	0.07	5.1	0.15	4.8	0.07	5.8	0.08	5.8	0.15
8' - 9'	7.3	1.87	7.5	0.25	7.6	0.63	5.5	0.56	5.0	0.15	6.3	0.47	5.8	0.05
9' - 10'	8.4	0.78	7.2	0.97							7.0	0.10	6.0	0.01
10' - 11'	7.5	0.57	7.5	0.13							7.1	0.16	6.0	0.12
11' - 12'	6.6	0.06	7.8	1.61							6.9	0.10	6.6	0.30
12' - 13'	8.8	0.13	7.7	0.14	7.1	0.03	6.4	0.10	8.4	0.58	7.0	0.01	-	-
13' - 14'	7.3	0.29							8.6	0.11			-	-
14' - 15'	-	-							8.5	0.12			7.0	0.06
15' - 16'	-	-							8.8	0.42			7.0	0.03

Table III-14b. Alkalinity (in mg $CaCO_3$/kg soil) of post-injection soil samples averaged over two-foot long depths.

Depth	17-PSTB-10		17-PSTB-11		17-PSTB-12		17-PSTB-13		17-PSTB-14		17-PSTB-15		17-PSTB-16	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
6' - 8'	307	12	198	97	104	7	173	6	345	223	299	154	988	852
8' - 10'	33620	30473	1439	1031	4891	5444	384	124	376	115	749	172	201	15
10' - 12'	863	276	2509	2748							930	205	347	146
12' - 14'	6139	8049	1279	298	787	662	465	239	4621	964	425	0	-	-
14' - 16'	-	-							10202	11381			610	52

Table III-14c. VS content (in % of dry soil) of post-injection soil samples averaged over two-foot long depths.

Depth	17-PSTB-10		17-PSTB-11		17-PSTB-12		17-PSTB-13		17-PSTB-14		17-PSTB-15		17-PSTB-16	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
6' - 8'	3.5%	0.0086	3.9%	0.0058	3.7%	0.0040	2.7%	0.0145	3.2%	0.0088	3.7%	0.0107	3.9%	0.0016
8' - 10'	6.1%	0.0219	2.5%	0.0115	1.7%	0.0046	1.1%	0.0013	1.3%	0.0026	2.0%	0.0132	1.4%	0.0050
10' - 12'	1.7%	0.0132	2.9%	0.0224							1.3%	0.0037	1.1%	0.0018
12' - 14'	2.7%	0.0159	1.4%	0.0023	1.2%	0.0027	0.8%	0.0004	4.4%	0.0464	1.6%	0.0000	-	-
14' - 16'	-	-							4.4%	0.0331			0.9%	0.0028

Figure III-12a shows the average Darcy velocity of groundwater at SWMU-17, while **Figures III-12b**, **III-12c** and **III-12d** show the average change in pH, alkalinity and VS content, respectively, between pre- and post-injection soil cores. The change in pH and alkalinity closely mirror the Darcy velocity distribution. More of the $Mg(OH)_2$/EOS® mixture was delivered to the bottom portion of the aquifer because of the higher permeability. This explains why the bottom portion of the aquifer saw a larger increase in pH and alkalinity.

Two different mixtures of $Mg(OH)_2$ and EOS® were used for injection because it was thought one mixture might inject easier than the other. However, both mixtures proved equally difficult to inject. This is likely due to the higher clay content of the aquifer.

Chlorinated ethene data was collected pre- and post-injection to determine if the $Mg(OH)_2$ and EOS® mixture had encouraged reductive dechlorination. Samples were collected from monitor wells 17-PS-01, -02 and -03. **Figure III-13** shows the average concentration of the different chlorinated ethenes in those wells over time. Site operators placed bags of MgO in the monitor wells on Day 727. The buffered EOS® was added at Day 908.

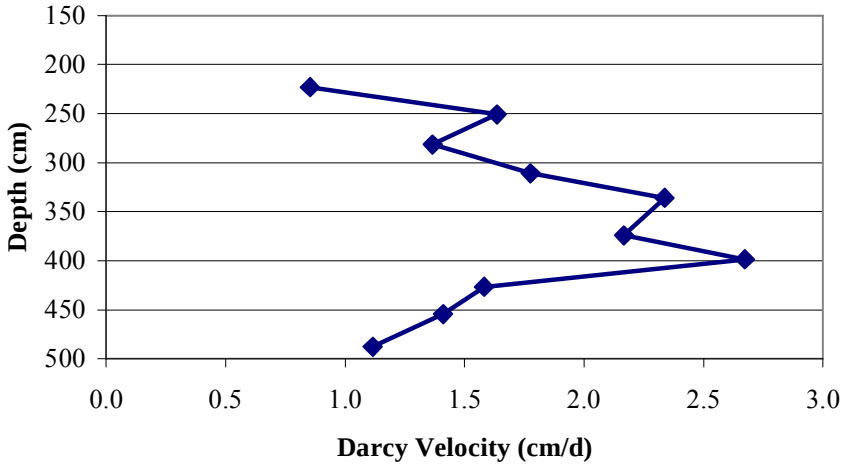

Figure III-12a. Average Darcy velocity in SWMU-17.

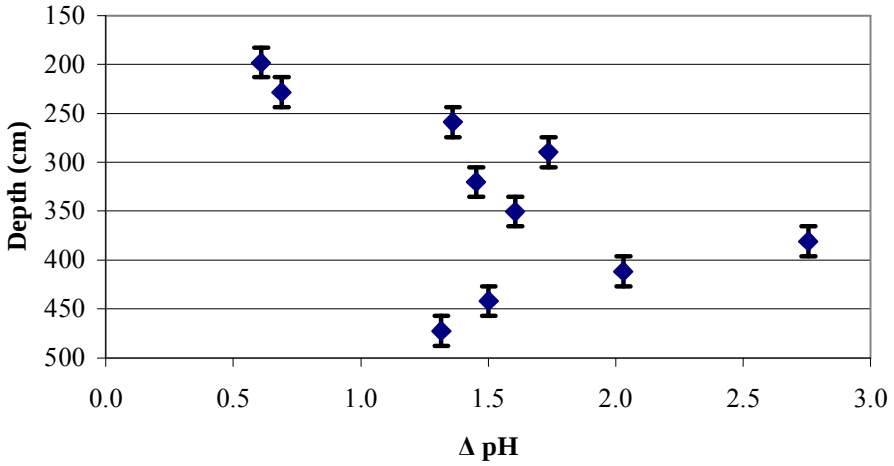

Figure III-12b. Average change in pH values after $Mg(OH)_2$ and EOS® injection. Error bars indicate depths averaged over.

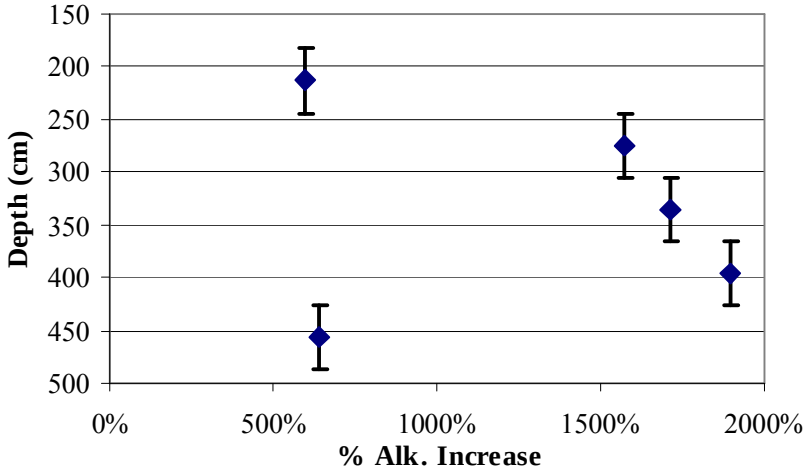

Figure III-12c. Average change in alkalinity after $Mg(OH)_2$ and EOS® injection. Error bars indicate depths averaged over.

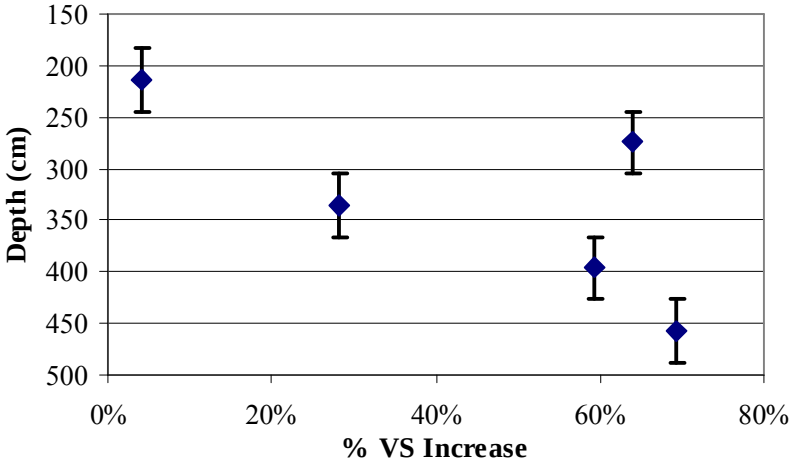

Figure III-12d. Average change in volatile solids after $Mg(OH)_2$ and EOS® injection. Error bars indicate depths averaged over.

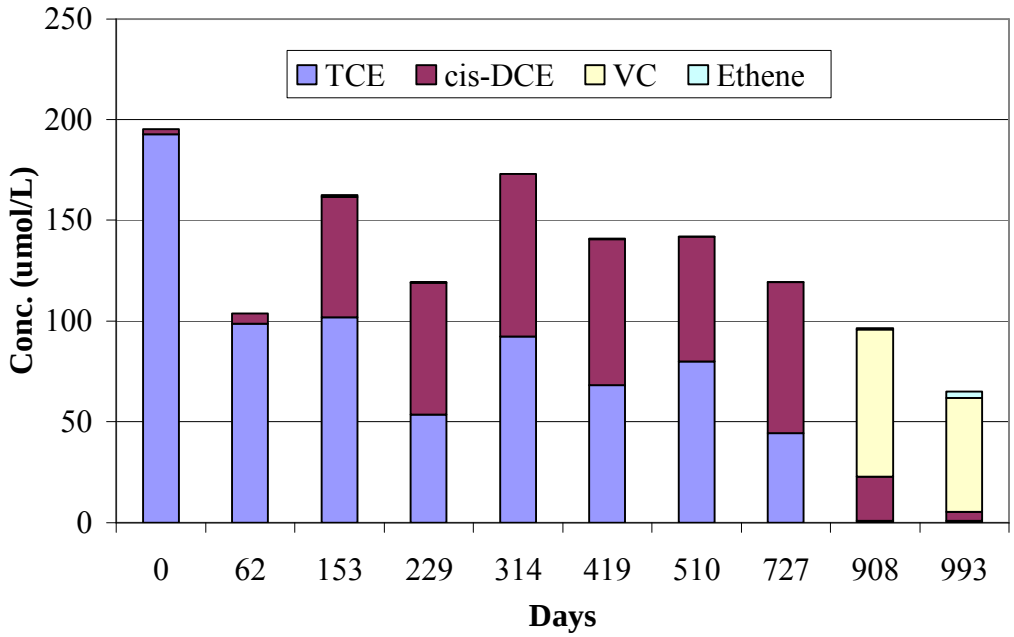

Figure III-13. Average concentrations of chlorinated ethenes in monitor wells 17-PS-01, -02 and -03.

By the time the buffered EOS® was added TCE had completely disappeared from the monitor wells, with *cis*-DCE and VC accumulation. It seems the bags of MgO placed in wells 17-PS-02 and -03 from March 2006 to August 2006 enhanced reductive dechlorination in those wells. Unfortunately, because of this it is impossible to say whether or not the $Mg(OH)_2$ and EOS® injections encouraged reductive dechlorination.

4.4 CONCLUSIONS

A mixture of $Mg(OH)_2$ and EOS® was injected into the NWS aquifer in September 2006 to provide a pH buffer and organic substrate to enhance reductive dechlorination. This mixture successfully buffered the aquifer, raising the pH from an average of 4.9-6.0 to an average of 5.5-7.7. The alkalinity of the system was raised 500% - 1900% as well.

As an intermediate step to buffering the entire aquifer, bags of MgO were placed in monitor wells 17-PS-02 and -03 from March 2006 to August 2006. By the sampling

event immediately prior to buffered EOS® injection, TCE had completely disappeared from the monitor wells, with *cis*-DCE and VC produced. The bags of MgO placed in the wells raised the pH to 8, enhancing reductive dechlorination in those wells. Unfortunately, because of this it is impossible to say whether or not the buffered EOS® injections encouraged reductive dechlorination.

However, three points can be made: the MgO did raise the pH in the monitor wells; after the pH in those wells were raised, TCE and *cis*-DCE were converted to VC; and the $Mg(OH)_2$ and EOS® mixture did raise the pH of the entire pilot test site aquifer. Therefore, it is possible that even if MgO had not been used in the monitor wells reductive dechlorination still would have proceeded.

5.0 SUMMARY

Microcosm studies of the Charleston Naval Weapons Station (NWS) Solid Waste Materials Unit 17 (SWMU-17) suggested that addition of a pH buffer and organic substrate would at least enhance reductive dechlorination of TCE to *cis*-DCE. However, to achieve further dechlorination of *cis*-DCE it appeared a bioaugmentation of the aquifer with *Dehalcoccoides* was necessary.

However, biological assays from SWMU-17 suggested more dechlorinators existed on-site than in the sediment used to create the microcosms. Thus, it was possible that addition of a buffer and organic substrate alone would enhance complete reductive dechlorination. As an intermediate step, bags of magnesium (MgO) were placed in monitor wells on-site. To buffer the entire aquifer, $Mg(OH)_2$ was combined with an emulsified soybean oil (EOS®) and injected into the aquifer.

Three months after injection of this mixture, the pH of the aquifer had risen from about 4.5-5.5 to 5.5-7.5, with the alkalinity increasing 500%-2000%. Additionally, TCE and *cis*-DCE had mostly been converted to vinyl chloride (VC). Unfortunately, the bags of MgO placed in the monitor wells into monitor wells made it impossible to determine if the mixture was responsible for conversion of TCE to VC.

However, there is anecdotal evidence suggesting that, since $Mg(OH)_2$/EOS® mixtures did buffer the aquifer, the mixtures would have lead to the production of VC even if MgO had not been placed in the monitor wells. Additional monitoring of the site is necessary to ensure accumulation of VC does not occur. If VC does accumulate, a bioaugmentation of vinyl chloride reducing microbes may indeed be necessary.

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APPENDIX A

ANALYTICAL QUANTITATION LIMITS FOR HEATED PURGE & TRAP – GC/FID

APPENDIX A
ANALYTICAL QUANTITATION LIMITS FOR HEATED PURGE & TRAP – GC/FID

Sampling Date	Acetone	1-1 DCE	Methylene Chloride	trans-DCE	1,1-DCA	MEK	cis-DCE	Chloroform	1,2-DCA	1,1,1-TCA	Benzene
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
01/27/06	0.022	0.022	0.022	0.022	0.022	0.024	0.024	0.061	0.022	0.024	0.024
02/03/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
02/27/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
03/23/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
04/24/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
05/23/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
05/25/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
06/27/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
07/24/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
08/23/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
10/02/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
10/30/06	0.044	0.044	0.044	0.044	0.044	0.048	0.048	0.12	0.044	0.048	0.048
11/22/06	0.009	0.009	0.009	0.009	0.009	0.010	0.010	0.025	0.009	0.010	0.010

Sampling Date	TCE	1,4-dioxane	MIBK	Toluene	PCE	Chloro benzene	Ethyl benzene	p-xylene	o-xylene	m-DCB	p-DCB
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
01/27/06	0.024	0.23	0.022	0.022	0.024	0.024	0.024	0.022	0.022	0.13	0.055
02/03/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
02/27/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
03/23/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
04/24/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
05/23/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
05/25/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
06/27/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
07/24/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
08/23/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
10/02/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
10/30/06	0.048	0.45	0.044	0.044	0.048	0.048	0.048	0.044	0.044	0.26	0.11
11/22/06	0.010	0.090	0.009	0.009	0.010	0.010	0.010	0.009	0.009	0.052	0.022

APPENDIX B
IRON RESULTS

APPENDIX B1
SEDIMENT IRON EXTRACTIONS

Location	Depth	24 hour Results				1 Month Results			
		Fe_T		Fe(II)		Fe_T		Fe(II)	
	ft	Avg.	St. Dev.	Avg.	St. Dev.	Avg.	St. Dev.	Avg.	St. Dev.
17PSTW-16	10	0.33	0.041	0.12	0.010	8.4	1.6	0.29	0.19
17PSTW-16	12	0.45	0.041	0.056	0.014	25	1.9	1.0	0.21
17PSTW-16	14	0.64	0.12	0.064	0.027	6.0	0.29	0.38	0.082
17PSTW-16	16	1.0	0.082	1.0	0.071	8.1	0.82	4.3	0.68
17PSTW-17	10	0.60	0.041	0.048	0.021	0.70	0.47	0.38	0.041
17PSTW-17	12	0.43	0.071	0.036	0.000	5.8	0.44	0.43	0.12
17PSTW-17	14	0.60	0.11	0.048	0.021	5.9	0.16	0.33	0.041
17PSTW-17	16	0.45	0.11	0.24	0.16	5.8	0.72	0.62	0.041
17PSTW-18	10	0.41	0.073	0.024	0.000	7.3	0.16	0.33	0.082
17PSTW-18	12	0.60	0.041	0.55	0.041	6.6	0.49	1.1	0.071
17PSTW-18	14	0.17	0.041	0.095	0.000	2.1	0.16	0.21	0.000
17PSTW-18	16	0.60	0.041	0.62	0.041	3.7	0.57	2.2	0.36
17PSTW-19	10	0.60	0.22	0.071	0.000	8.6	0.57	0.57	0.12
17PSTW-19	12	1.7	0.19	0.50	0.12	5.5	0.59	0.81	0.16
17PSTW-19	14	1.3	0.33	1.2	0.30	8.9	1.6	1.3	0.48
17PSTW-19	16	0.52	0.11	0.40	0.082	2.7	0.16	1.0	0.22
17PSTW-20	10	0.55	0.11	0.089	0.026	13	4.3	0.43	0.25
17PSTW-20	12	1.9	0.43	0.36	0.000	17	1.9	0.71	0.071
17PSTW-20	14	1.7	0.46	0.057	0.000	22	1.1	0.57	0.14
17PSTW-20	16	1.1	0.30	0.31	0.041	13	1.1	0.76	0.041

All values for iron averages are in mg Fe/ g sediment.
17PSTW-16 and -17 are from the background location.
17PSTW-18, -19 and -20 are from the pilot test area.

APPENDIX B2
AQUEOUS IRON CONCENTRATIONS

	Fe_T		Fe(II)	
Location	Average (mg/L)	St. Dev.	Average (mg/L)	St. Dev.
17-PS-3	244	5.4	229	0.000
17-MW-6S	0.19	0.061	0.11	0.000

17-PS-3 is from the pilot test area.
17-MS-6S is from the background area.

APPENDIX C
SOIL BORING RESULTS

APPENDIX C1
PRE-INJECTION SOIL BORING pH

17-PSSB-7

Depth	pH
6' 0"	4.86
6' 4"	4.86
6' 8"	4.94
7' 0"	5.01
7' 4"	4.85
7' 8"	4.73
9'	5.12
11'	5.31
12' 0"	4.89
12' 4"	5.12
12' 8"	5.44
13' 0"	5.73
13' 4"	5.80
13' 8"	5.79
14' 0"	5.86
14' 4"	6.09
14' 8"	6.23
15' 0"	5.98
15' 4"	5.78
15' 8"	5.96

17-PSSB-8

Depth	pH
6' 0"	4.65
6' 4"	4.80
6' 8"	5.05
7' 0"	5.05
7' 4"	4.88
9'	5.18
10' 0"	5.00
10' 4"	5.52
10' 8"	5.44
11' 0"	4.69
11' 4"	4.77
11' 8"	5.05
12' 0"	5.06
12' 4"	5.01
12' 8"	4.97
13' 0"	5.17
13' 4"	5.37
13' 8"	5.93
14' 0"	6.19
14' 4"	6.19
14' 8"	6.17
15' 0"	6.17
15' 4"	6.22
15' 8"	6.29

17-PSSB-9

Depth	pH
6' 0"	5.12
6' 4"	5.06
6' 8"	5.01
7' 0"	4.75
7' 4"	4.90
7' 8"	4.66
8' 0"	5.21
8' 4"	4.63
8' 8"	4.61
9' 0"	4.55
9' 4"	4.51
9' 8"	4.47
10' 0"	4.54
10' 4"	4.45
10' 8"	5.40
11' 0"	4.54
11' 4"	4.87
11' 8"	4.84
12' 0"	4.57
12' 4"	4.63
12' 8"	4.63
13' 0"	4.62
13' 4"	4.67
13' 8"	4.79
14' 0"	4.67
14' 4"	4.78
14' 8"	5.77
15' 0"	5.72
15' 4"	5.86
15' 8"	6.07

APPENDIX C2
PRE-INJECTION SOIL BORING ALKALINITY

17-PSSB-7

Depth	Alkalinity (mg/kg)
6' 4"	57
7' 0"	68
7' 8"	58
9'	151
11'	127
12' 4"	91
13' 0"	144
13' 8"	150
14' 4"	259
15' 0"	364
15' 8"	251

17-PSSB-8

Depth	Alkalinity (mg/kg)
9'	70
10' 4"	112
11' 0"	58
11' 8"	58
12' 4"	103
13' 0"	104
13' 8"	276
14' 4"	581
15' 0"	217
15' 8"	225

17-PSSB-9

Depth	Alkalinity (mg/kg)
6' 4"	64
7' 0"	46
7' 8"	39
8' 4"	29
9' 0"	18
9' 8"	12
10' 4"	29
11' 0"	11
11' 8"	82
12' 4"	28
13' 0"	53
13' 8"	81
14' 4"	59
15' 0"	434
15' 8"	407

APPENDIX C3
PRE-INEJCTION SOIL BORING VOLATILE SOLIDS CONTENT

17-PSSB-7

Depth	VS Content
6' 0"	3.7%
6' 8"	3.4%
7' 4"	2.8%
9'	1.2%
11'	1.0%
12' 0"	1.9%
12' 8"	1.3%
13' 4"	0.9%
14' 0"	1.0%
14' 8"	0.9%
15' 4"	1.0%

17-PSSB-8

Depth	VS Content
6' 0"	3.9%
6' 8"	4.0%
7' 4"	2.8%
9'	0.8%
10' 0"	1.6%
10' 8"	1.1%
11' 4"	1.0%
12' 0"	1.6%
12' 8"	0.9%
13' 4"	1.0%
14' 0"	1.1%
14' 8"	1.1%
15' 4"	0.7%

17-PSSB-9

Depth	VS Content
6' 0"	3.4%
6' 8"	3.7%
7' 4"	2.7%
8' 0"	2.5%
8' 8"	2.7%
9' 4"	1.3%
10' 0"	1.9%
10' 8"	1.1%
11' 4"	1.4%
12' 0"	1.5%
12' 8"	1.2%
13' 4"	0.9%
14' 0"	1.1%
14' 8"	0.9%
15' 4"	1.3%

APPENDIX C4
POST-INJECTION SOIL BORING pH

17-PSSB-10

Depth	pH
6' 0"	5.25
6' 4"	4.92
6' 8"	5.09
7' 0"	5.08
7' 4"	5.05
7' 8"	4.98
8' 0"	5.22
8' 4"	7.66
8' 8"	8.90
9' 0"	9.08
9' 4"	7.58
9' 8"	8.67
10' 0"	8.15
10' 4"	7.26
10' 8"	7.08
11' 0"	6.58
11' 4"	6.66
12' 0"	8.86
12' 4"	8.88
12' 8"	8.65
13' 0"	7.55
13' 4"	7.28
13' 8"	6.98

17-PSSB-11

Depth	pH
6' 0"	5.29
6' 4"	5.34
6' 8"	6.07
7' 0"	6.21
7' 4"	6.18
7' 8"	6.06
8' 0"	7.30
8' 4"	7.74
8' 8"	7.33
9' 0"	6.26
9' 4"	7.28
9' 8"	8.19
10' 0"	7.60
10' 4"	7.49
10' 8"	7.34
11' 0"	6.68
11' 4"	8.95
12A	7.71
12B	7.52
12C	7.73
12D	7.85

17-PSSB-12

Depth	pH
6' 0"	6.14
6' 4"	6.15
6' 8"	6.05
7' 0"	6.17
7' 4"	6.09
7' 8"	6.04
8A	8.52
8B	8.29
8C	7.44
8D	7.13
8E	7.19
8F	7.09
12A	7.13
12B	7.08
12C	7.07
12D	7.05
12E	7.08

APPENDIX C4 (cont.)
POST-INJECTION SOIL BORING pH

17-PSSB-13

Depth	pH
6' 0"	5.23
6' 4"	5.21
6' 8"	5.32
7' 0"	5.28
7' 4"	5.13
7' 8"	4.98
8A	4.86
8B	4.87
8C	5.12
8D	5.89
8E	5.89
8F	6.07
12A	6.27
12B	6.41
12C	6.44
12D	6.52

17-PSSB-14

Depth	pH
6' 0"	4.73
6' 4"	4.79
6' 8"	4.74
7' 0"	4.90
7' 4"	4.82
7' 8"	4.76
8A	4.94
8B	5.05
8C	4.82
8D	4.95
8E	5.22
12' 0"	8.08
12' 4"	8.07
12' 8"	9.08
13' 0"	8.77
13' 4"	8.58
13' 8"	8.57
14' 0"	8.42
14' 4"	8.63
14' 8"	8.43
15' 0"	8.47
15' 4"	9.06

17-PSSB-15

Depth	pH
6' 0"	5.67
6' 4"	6.03
6' 8"	6.01
7' 0"	5.86
7' 4"	5.75
7' 8"	5.90
8' 0"	5.85
8' 4"	6.20
8' 8"	6.78
9' 0"	6.86
9' 4"	7.03
9' 8"	7.05
10' 0"	7.02
10' 4"	7.06
10' 8"	7.31
11' 0"	7.05
11' 4"	6.90
11' 8"	6.87
12A	6.98
12B	7.00

APPENDIX C4 (cont.)
POST-INJECTION SOIL BORING pH

17-PSSB-16

Depth	pH
6' 0"	6.04
6' 4"	6.09
6' 8"	6.10
7' 0"	5.96
7' 4"	5.80
7' 8"	5.66
8' 0"	5.72
8' 4"	5.81
8' 8"	5.72
9' 0"	5.98
9' 4"	5.98
9' 8"	5.99
10' 0"	6.11
10' 4"	6.01
10' 8"	5.88
11' 0"	6.76
11' 4"	6.73
11' 8"	6.22
14' 0"	6.91
14' 4"	6.95
14' 8"	7.03
15' 0"	6.96
15' 4"	7.01
15' 8"	6.96

APPENDIX C5
POST-INJECTION SOIL BORING ALKALINITY

17-PSSB-10

Depth	Alkalinity (mg/kg)
6' 4"	293
7' 0"	316
7' 8"	311
8' 4"	3154
9' 0"	33607
9' 8"	64100
10' 4"	1119
11' 0"	899
11' 4"	571
12' 4"	15418
13' 0"	1968
13' 8"	1032

17-PSSB-11

Depth	Alkalinity (mg/kg)
6' 4"	310
7' 0"	142
7' 8"	141
8' 4"	2168
9' 0"	260
9' 8"	1890
10' 4"	5679
11' 0"	807
11' 4"	1040
12B	1068
12D	1489

17-PSSB-12

Depth	Alkalinity (mg/kg)
6' 4"	107
7' 0"	109
7' 8"	96
8B	8741
8F	1042
12B	337
12D	1547
12E	477

17-PSSB-13

Depth	Alkalinity (mg/kg)
6' 4"	170
7' 0"	168
7' 8"	179
8B	241
8D	462
8F	450
12B	634
12D	296

17-PSSB-14

Depth	Alkalinity (mg/kg)
6' 4"	603
7' 0"	202
7' 8"	231
8B	441
8D	243
8E	445
12' 4"	4198
13' 0"	3940
13' 8"	5724
14' 4"	3505
15' 0"	3758
15' 4"	23343

17-PSSB-15

Depth	Alkalinity (mg/kg)
6' 4"	285
7' 0"	152
7' 8"	460
8' 4"	928
9' 0"	586
9' 8"	735
10' 4"	1056
11' 0"	1040
11' 8"	694
12B	425

APPENDIX C5 (cont.)
POST-INJECTION SOIL BORING ALKALINITY

17-PSSB-16

Depth	Alkalinity (mg/kg)
6' 4"	1913
7' 0"	813
7' 8"	236
8' 4"	191
9' 0"	195
9' 8"	218
10' 4"	190
11' 0"	372
11' 8"	479
14' 4"	669
15' 0"	594
15' 8"	568

APPENDIX C6
POST-INJECTION SOIL BORING VOLATILE SOLIDS CONTENT

17-PSSB-10

Depth	VS Content
6' 0"	3.4%
6' 8"	4.4%
7' 4"	2.7%
8' 0"	3.8%
8' 8"	8.1%
9' 4"	6.5%
10' 0"	3.2%
10' 8"	0.9%
11' 4"	0.9%
12' 0"	4.4%
12' 8"	2.4%
13' 4"	1.2%

17-PSSB-11

Depth	VS Content
6' 0"	3.7%
6' 8"	4.5%
7' 4"	3.4%
8' 0"	3.8%
8' 8"	2.0%
9' 4"	1.7%
10' 0"	2.0%
10' 8"	1.3%
11' 4"	5.5%
12A	1.6%
12C	1.3%

17-PSSB-12

Depth	VS Content
6' 0"	3.4%
6' 8"	3.6%
7' 4"	4.1%
8A	2.3%
8C	1.5%
8E	1.4%
12A	1.5%
12C	1.0%
12E	1.1%

17-PSSB-13

Depth	VS Content
6' 0"	3.8%
6' 8"	3.3%
7' 4"	1.1%
8A	1.0%
8C	1.3%
8E	1.1%
12A	0.9%
12C	0.8%

17-PSSB-14

Depth	VS Content
6' 0"	4.1%
6' 8"	3.1%
7' 4"	2.4%
8A	1.4%
8C	1.5%
8E	1.0%
12' 0"	1.6%
12' 8"	9.7%
13' 4"	1.7%
14' 0"	2.3%
14' 8"	2.6%
15' 4"	8.2%

17-PSSB-15

Depth	VS Content
6' 0"	3.3%
6' 8"	4.9%
7' 4"	2.8%
8' 0"	3.5%
8' 8"	1.3%
9' 4"	1.1%
10' 0"	0.9%
10' 8"	1.5%
11' 4"	1.6%
12A	1.6%

APPENDIX C6 (cont.)
POST-INJECTION SOIL BORING VOLATILE SOLIDS CONTENT

17-PSSB-16

Depth	VS Content
6' 0"	4.0%
6' 8"	3.8%
7' 4"	3.7%
8' 0"	2.0%
8' 8"	1.3%
9' 4"	1.0%
10' 0"	1.1%
10' 8"	0.9%
11' 4"	1.3%
14' 0"	1.0%
14' 8"	1.1%
15' 4"	0.6%

APPENDIX D
MSGS MICROCOSM RESULTS

Site A, Inhibited, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	2.2	<0.044	1.8	<0.044	<0.044	4.2	<0.048	0.84	<0.044	5.8	0.36
02/03/06	8	2.3	<0.044	1.6	<0.044	<0.044	4.2	<0.048	0.73	<0.044	4.9	0.32
02/27/06	32	0.13	<0.044	1.5	<0.044	<0.044	0.51	<0.048	0.73	<0.044	4.7	0.32
03/23/06	56	0.23	<0.044	1.6	<0.044	<0.044	0.36	<0.048	0.71	<0.044	4.7	0.33
04/24/06	88	0.21	<0.044	2.2	<0.044	<0.044	0.41	<0.048	0.79	<0.044	4.9	0.35
06/27/06	152	<0.044	0.048	1.7	0.077	<0.044	0.40	<0.048	0.70	<0.044	3.8	0.30
10/30/06	277	<0.044	<0.044	1.8	<0.044	<0.044	0.41	<0.048	0.61	<0.044	2.8	0.25

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.7	3.9	2.0	3.4	2.5	<0.048	0.53	1.1	0.68	0.71
02/03/06	8	<0.048	2.0	3.8	1.7	2.5	2.1	<0.048	0.32	0.81	0.47	0.50
02/27/06	32	<0.048	2.0	0.32	1.6	2.1	2.0	<0.048	0.30	0.78	0.42	0.46
03/23/06	56	<0.048	1.9	0.25	1.6	1.9	2.0	<0.048	0.27	0.73	0.35	0.38
04/24/06	88	<0.048	2.3	0.29	1.7	1.9	2.1	<0.048	0.28	0.78	0.36	0.39
06/27/06	152	<0.048	1.9	0.29	1.3	1.4	1.7	<0.048	0.19	0.53	<0.13	0.24
10/30/06	277	<0.048	1.8	0.40	1.2	1.0	1.4	<0.048	0.15	0.44	<0.13	0.17

Site A, Inhibited, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	41
02/03/06	8	0	0	0	0	0	255
02/27/06	32	0	0	0	0	0	392
03/23/06	56	0	0	0	0	0	472
04/24/06	88	0	0	0	0	0	410
06/27/06	152	0	0	0	0	0	429
10/30/06	277	0	0	0	0	0	413

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	115	<0.5	<0.5	5.8	<10	18	16	5.1	5
02/03/06	8	110	<0.5	<0.5	5.7	<10	13	13	4.9	4
02/27/06	32	109	<0.5	<1.0	6.0	<10	13	11	5.1	2
03/23/06	56	108	<0.5	<0.5	5.6	<10	16	11	5.0	2
04/24/06	88	108	<0.5	<0.5	5.9	<10	18	NA	5.1	<1
06/27/06	152	109	<0.5	<0.5	5.9	<10	18	11	5.3	<1
10/30/06	277	113	<0.5	<0.5	5.6	<10	17	10	5.4	<1

Site A, Inhibited, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	1.9	<0.044	1.8	<0.044	<0.044	3.6	<0.048	0.92	<0.044	8.0	0.42
02/03/06	8	2.4	<0.044	1.9	<0.044	<0.044	4.3	<0.048	1.1	<0.044	8.3	0.46
02/27/06	32	0.36	<0.044	1.9	0.053	<0.044	0.67	<0.048	1.0	<0.044	8.0	0.46
03/23/06	56	0.24	<0.044	1.7	<0.044	<0.044	0.51	<0.048	0.83	<0.044	6.6	0.38
04/24/06	88	0.27	<0.044	2.0	<0.044	<0.044	0.65	<0.048	0.93	<0.044	6.7	0.42
06/27/06	152	<0.044	0.077	1.9	<0.044	<0.044	0.68	<0.048	0.86	<0.044	5.5	0.39
10/30/06	277	<0.044	0.12	2.0	<0.044	<0.044	0.74	<0.048	0.78	<0.044	4.5	0.34

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.3	3.5	2.3	4.3	2.7	<0.048	0.57	1.1	0.63	0.65
02/03/06	8	<0.048	2.2	4.0	2.5	4.1	3.0	<0.048	0.47	1.2	0.66	0.69
02/27/06	32	<0.048	2.5	0.44	2.4	3.3	2.8	<0.048	0.42	1.1	0.55	0.59
03/23/06	56	<0.048	1.8	0.34	2.0	2.5	2.3	<0.048	0.32	0.85	0.39	0.42
04/24/06	88	<0.048	2.1	0.43	2.1	2.4	2.4	<0.048	0.32	0.87	0.38	0.41
06/27/06	152	<0.048	1.9	0.44	1.8	1.9	2.1	<0.048	0.25	0.69	0.29	0.31
10/30/06	277	<0.048	1.7	0.53	1.6	1.5	1.8	<0.048	0.20	0.56	<0.13	0.21

Site A, Inhibited, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	0
02/03/06	8	0	0	0	0	0	57
02/27/06	32	0	0	0	0	0	125
03/23/06	56	0	0	0	0	0	144
04/24/06	88	0	0	0	0	0	151
06/27/06	152	0	0	0	0	0	152
10/30/06	277	0	0	0	0	0	158

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	119	<0.5	<0.5	5.9	<10	23	20	4.9	5
02/03/06	8	111	<0.5	<0.5	5.9	<10	15	10	4.9	4
02/27/06	32	109	<0.5	<1.0	6.1	<10	12	14	4.9	3
03/23/06	56	106	<0.5	<0.5	5.8	<10	14	11	4.8	3
04/24/06	88	106	<0.5	<0.5	6.1	<10	16	NA	5.0	1
06/27/06	152	106	<0.5	<0.5	6.0	<10	16	9.4	5.2	<1
10/30/06	277	110	<0.5	<0.5	5.8	<10	16	7.3	5.2	<1

Site A, Inhibited, Bottle 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	2.2	<0.044	2.1	<0.044	<0.044	4.2	<0.048	1.1	<0.044	9.4	0.49
02/03/06	8	2.2	<0.044	1.9	<0.044	<0.044	4.1	<0.048	1.0	<0.044	8.3	0.46
02/27/06	32	0.27	<0.044	1.8	<0.044	<0.044	0.48	<0.048	0.95	<0.044	7.2	0.42
03/23/06	56	0.23	<0.044	1.9	<0.044	<0.044	0.41	<0.048	0.93	<0.044	7.2	0.44
04/24/06	88	0.23	<0.044	1.9	<0.044	<0.044	0.45	<0.048	0.91	<0.044	6.6	0.42
06/27/06	152	0.26	0.082	2.0	0.086	<0.044	0.47	<0.048	0.88	<0.044	5.7	0.40
10/30/06	277	0.20	0.11	1.7	<0.044	<0.044	0.45	<0.048	0.75	<0.044	4.2	0.33

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.8	3.9	2.7	5.2	3.2	<0.048	0.65	1.3	0.78	0.80
02/03/06	8	<0.048	1.9	3.8	2.4	3.9	2.9	<0.048	0.47	1.2	0.64	0.67
02/27/06	32	<0.048	2.3	0.30	2.1	2.9	2.5	<0.048	0.37	0.93	0.46	0.50
03/23/06	56	<0.048	1.9	0.26	2.1	2.6	2.5	<0.048	0.33	0.89	0.40	0.43
04/24/06	88	<0.048	2.2	0.29	2.0	2.3	2.3	<0.048	0.30	0.81	0.34	0.37
06/27/06	152	<0.048	2.0	0.32	1.8	1.8	2.0	<0.048	0.24	0.66	0.27	0.28
10/30/06	277	<0.048	1.4	0.39	1.5	1.4	1.7	<0.048	0.18	0.51	<0.13	0.18

Site A, Inhibited, Bottle 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	31
02/03/06	8	0	0	0	0	0	98
02/27/06	32	0	0	0	0	0	161
03/23/06	56	0	0	0	0	0	237
04/24/06	88	0	0	0	0	0	237
06/27/06	152	0	0	0	0	0	220
10/30/06	277	0	0	10	0	0	201

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	119	<0.5	<0.5	5.9	<10	24	19	4.9	5
02/03/06	8	111	<0.5	<0.5	5.8	<10	16	9.4	4.6	4
02/27/06	32	110	<0.5	<1.0	6.0	<10	13	12	4.7	3
03/23/06	56	109	<0.5	<0.5	5.8	<10	15	12	4.6	3
04/24/06	88	108	<0.5	<0.5	5.9	<10	17	NA	4.8	2
06/27/06	152	109	<0.5	<0.5	6.1	<10	17	7.5	5.0	<1
10/30/06	277	112	<0.5	<0.5	5.7	<10	16	6.9	5.1	<1

Site A, Inhibited Water, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	1.6	<0.044	1.8	<0.044	<0.044	3.3	<0.048	0.84	<0.044	6.9	0.38
02/03/06	8	1.8	<0.044	1.9	<0.044	<0.044	3.8	<0.048	0.93	<0.044	7.6	0.43
02/27/06	32	1.8	<0.044	1.7	<0.044	<0.044	3.6	<0.048	0.87	<0.044	6.4	0.39
03/23/06	56	1.7	<0.044	1.7	<0.044	<0.044	3.6	<0.048	0.81	<0.044	6.2	0.37
04/24/06	88	1.9	<0.044	2.1	<0.044	<0.044	4.0	<0.048	0.91	<0.044	6.4	0.42
06/27/06	152	1.7	0.071	2.0	0.054	<0.044	3.5	<0.048	0.84	<0.044	5.0	0.37
10/30/06	277	1.7	0.11	1.6	<0.044	<0.044	3.4	<0.048	0.72	<0.044	3.9	0.32

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.2	3.2	2.0	3.5	2.2	<0.048	0.47	0.92	0.54	0.57
02/03/06	8	<0.048	1.7	3.6	2.2	3.5	2.5	<0.048	0.39	0.93	0.52	0.56
02/27/06	32	<0.048	1.8	3.4	1.9	2.6	2.1	<0.048	0.31	0.78	0.39	0.43
03/23/06	56	<0.048	1.6	3.4	1.8	2.3	2.0	<0.048	0.28	0.72	0.32	0.36
04/24/06	88	<0.048	1.8	3.9	1.9	2.2	2.2	<0.048	0.28	0.74	0.31	0.35
06/27/06	152	<0.048	1.7	3.4	1.6	1.6	1.7	<0.048	0.20	0.54	<0.13	0.22
10/30/06	277	<0.048	1.5	3.2	1.4	1.3	1.5	<0.048	0.14	0.41	<0.13	0.14

Site A, Inhibited Water, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	0
02/03/06	8	0	0	0	0	0	78
02/27/06	32	0	0	0	0	0	173
03/23/06	56	0	0	0	0	0	203
04/24/06	88	0	0	0	0	0	199
06/27/06	152	0	0	0	0	0	195
10/30/06	277	0	0	0	0	0	206

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	126	<0.5	<0.5	7.1	<10	12	15	6.0	6
02/03/06	8	123	<0.5	<0.5	7.0	<10	11	7.8	5.5	4
02/27/06	32	129	<0.5	<1.0	7.3	<10	12	14	6.1	2
03/23/06	56	126	<0.5	<0.5	7.0	<10	12	12	6.3	2
04/24/06	88	128	<0.5	<0.5	7.1	<10	12	NA	6.0	<1
06/27/06	152	127	<0.5	<0.5	7.2	<10	11	9.5	5.8	<1
10/30/06	277	137	<0.5	<0.5	7.1	<10	13	7.9	5.9	<1

Site A, Ambient, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.2	<0.044	3.3	<0.044	<0.044	3.9	<0.048	1.7	<0.044	15	0.84
01/27/06	9	2.5	0.000	3.8	<0.044	<0.044	4.6	<0.048	2.0	<0.044	17	0.94
02/20/06	33	2.5	0.000	3.3	<0.044	<0.044	4.3	<0.048	1.7	<0.044	13	0.79
03/23/06	64	2.5	0.066	3.4	<0.044	<0.044	4.5	<0.048	1.6	<0.044	13	0.80
04/24/06	96	2.5	0.082	3.4	<0.044	<0.044	4.5	<0.048	1.6	<0.044	11	0.77
06/27/06	160	2.5	0.15	3.8	<0.044	<0.044	4.3	<0.048	1.5	<0.044	9.6	0.73
10/30/06	285	2.4	0.22	3.1	<0.044	<0.044	4.3	<0.048	1.4	<0.044	7.7	0.65

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.0	3.9	4.0	10	4.5	<0.048	0.76	1.7	0.88	0.86
01/27/06	9	<0.048	2.1	4.7	3.9	7.8	4.7	<0.048	0.79	1.7	0.79	0.82
02/20/06	33	<0.048	2.4	4.2	3.1	4.7	3.7	<0.048	0.53	1.3	0.53	0.57
03/23/06	64	<0.048	2.1	4.4	3.1	4.1	3.6	<0.048	0.45	1.2	0.45	0.49
04/24/06	96	<0.048	2.3	4.3	2.8	3.5	3.3	<0.048	0.40	1.0	0.38	0.42
06/27/06	160	<0.048	2.1	4.2	2.5	2.8	2.9	<0.048	0.32	0.85	0.29	0.32
10/30/06	285	<0.048	1.3	4.2	2.2	2.2	2.4	<0.048	0.25	0.68	<0.13	0.22

Site A, Ambient, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	630	0	0	0
01/27/06	9	0	0	339	0	0	0
02/20/06	33	0	0	329	0	0	27
03/23/06	64	0	0	256	0	0	30
04/24/06	96	0	0	205	0	0	31
06/27/06	160	0	0	175	0	0	31
10/30/06	285	0	0	150	0	0	32

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	61	<0.5	<0.5	<0.5	<10	14	25	6.2	1
01/27/06	9	61	<0.5	<0.5	<0.5	<10	16	25	6.6	1
02/20/06	33	62	<0.5	<1.0	<0.5	<10	17	20	6.7	<1
03/23/06	64	62	<0.5	<0.5	<0.5	<10	16	19	6.6	<1
04/24/06	96	63	<0.5	<0.5	<0.5	<10	16	NA	6.5	<1
06/27/06	160	64	<0.5	<0.5	<0.5	<10	16	15	6.4	<1
10/30/06	285	67	<0.5	<0.5	<0.5	<10	16	21	6.9	<1

Site A, Ambient, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	1.9	<0.044	2.8	<0.044	<0.044	2.8	<0.048	1.5	<0.044	13	0.74
01/27/06	9	2.2	<0.044	3.4	<0.044	<0.044	4.4	<0.048	1.8	<0.044	16	0.86
02/20/06	33	2.2	<0.044	3.1	<0.044	<0.044	3.8	<0.048	1.6	<0.044	13	0.76
03/23/06	64	2.1	0.059	3.1	<0.044	<0.044	3.7	<0.048	1.6	<0.044	13	0.78
04/24/06	96	2.1	0.083	3.1	<0.044	<0.044	3.7	<0.048	1.5	<0.044	11	0.72
06/27/06	160	1.9	0.14	3.1	<0.044	<0.044	3.4	<0.048	1.4	<0.044	8.6	0.64
10/30/06	285	1.9	0.22	3.3	<0.044	<0.044	3.5	<0.048	1.3	<0.044	7.4	0.61

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	0.027	1.8	3.6	3.6	9.2	4.0	<0.048	0.70	1.5	0.81	0.80
01/27/06	9	<0.048	1.9	4.5	3.6	7.9	4.6	<0.048	0.80	1.7	0.82	0.85
02/20/06	33	<0.048	2.3	3.7	2.3	5.3	3.8	<0.048	0.56	1.3	0.58	0.62
03/23/06	64	<0.048	1.9	3.6	2.2	4.6	3.6	<0.048	0.49	1.3	0.50	0.54
04/24/06	96	<0.048	2.0	3.6	2.0	3.7	3.2	<0.048	0.42	1.1	0.41	0.45
06/27/06	160	<0.048	1.8	3.3	1.5	2.8	2.7	<0.048	0.31	0.84	0.29	0.32
10/30/06	285	<0.048	1.4	3.4	1.4	2.3	2.4	<0.048	0.24	0.68	<0.13	0.22

Site A, Ambient, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	533	0	0	34
01/27/06	9	0	0	238	0	0	0
02/20/06	33	0	0	240	0	0	34
03/23/06	64	0	0	200	0	0	37
04/24/06	96	0	0	160	0	0	35
06/27/06	160	0	0	135	0	0	36
10/30/06	285	0	0	118	0	0	36

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	61	<0.5	<0.5	<0.5	<10	14	22	6.0	1
01/27/06	9	61	<0.5	<0.5	<0.5	<10	15	20	6.3	1
02/20/06	33	62	<0.5	<1.0	<0.5	<10	15	16	6.4	<1
03/23/06	64	61	<0.5	<0.5	<0.5	<10	16	17	6.4	<1
04/24/06	96	63	<0.5	<0.5	<0.5	<10	17	NA	6.2	<1
06/27/06	160	63	<0.5	<0.5	<0.5	<10	16	14	6.3	<1
10/30/06	285	65	<0.5	<0.5	<0.5	<10	14	21	6.7	<1

Site A, Ambient, Bottle 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	1.7	<0.044	2.3	<0.044	<0.044	2.8	<0.048	1.2	<0.044	11	0.60
01/27/06	9	1.8	<0.044	2.6	<0.044	<0.044	3.1	<0.048	1.3	<0.044	11	0.63
02/20/06	33	1.9	<0.044	2.4	<0.044	<0.044	2.8	<0.048	1.2	<0.044	9.6	0.55
03/23/06	64	1.7	<0.044	2.2	<0.044	<0.044	2.7	<0.048	1.1	<0.044	8.8	0.54
04/24/06	96	1.8	0.051	2.3	<0.044	<0.044	2.9	<0.048	1.1	<0.044	7.8	0.52
06/27/06	160	1.6	0.094	2.3	<0.044	<0.044	2.7	<0.048	1.0	<0.044	6.5	0.47
10/30/06	285	1.6	0.14	2.4	<0.044	<0.044	2.7	<0.048	0.95	<0.044	5.0	0.43

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.5	2.8	2.9	6.9	3.1	<0.048	0.56	1.2	0.63	0.63
01/27/06	9	<0.048	1.4	3.1	2.2	5.0	3.1	<0.048	0.57	1.2	0.54	0.57
02/20/06	33	<0.048	1.6	2.7	1.2	3.4	2.5	<0.048	0.37	0.84	0.35	0.39
03/23/06	64	<0.048	1.1	2.7	1.0	2.9	2.4	<0.048	0.31	0.77	0.30	0.32
04/24/06	96	<0.048	1.5	2.7	0.96	2.5	2.3	<0.048	0.28	0.71	<0.13	0.28
06/27/06	160	<0.048	1.3	2.5	0.74	1.9	1.9	<0.048	0.21	0.54	<0.13	0.18
10/30/06	285	<0.048	1.3	2.5	0.62	1.5	1.7	<0.048	0.17	0.46	<0.13	0.13

Site A, Ambient, Bottle 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	602	0	0	0
01/27/06	9	0	0	309	0	0	0
02/20/06	33	0	0	307	0	0	0
03/23/06	64	0	0	250	0	0	0
04/24/06	96	0	0	199	0	0	0
06/27/06	160	0	0	180	0	0	0
10/30/06	285	0	0	159	0	0	0

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	61	<0.5	<0.5	<0.5	<10	14	18	6.1	1
01/27/06	9	61	<0.5	<0.5	<0.5	<10	15	16	6.4	1
02/20/06	33	62	<0.5	<1.0	<0.5	<10	15	14	6.4	<1
03/23/06	64	61	<0.5	<0.5	<0.5	<10	15	14	6.4	<1
04/24/06	96	62	<0.5	<0.5	<0.5	<10	16	NA	6.4	<1
06/27/06	160	63	<0.5	<0.5	<0.5	<10	15	11	6.3	<1
10/30/06	285	67	<0.5	<0.5	<0.5	<10	15	15	6.7	<1

Site A, Nutrient Amended, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.1	<0.044	3.2	<0.044	<0.044	3.5	<0.048	1.6	<0.044	14	0.78
01/27/06	9	2.4	<0.044	3.6	<0.044	<0.044	4.2	<0.048	1.9	<0.044	16	0.88
02/20/06	33	2.4	<0.044	2.5	<0.044	<0.044	4.0	<0.048	1.6	<0.044	13	0.75
03/23/06	64	2.2	0.057	<0.044	<0.044	<0.044	3.8	<0.048	1.4	<0.044	12	0.70
04/24/06	96	2.6	0.093	<0.044	<0.044	<0.044	4.3	<0.048	1.6	<0.044	12	0.80
06/27/06	160	2.4	0.16	<0.044	<0.044	<0.044	3.9	<0.048	1.5	<0.044	10	0.73
10/30/06	285	2.3	0.22	<0.044	<0.044	0.058	3.8	<0.048	1.3	<0.044	7.5	0.62

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.8	3.6	3.7	8.3	3.9	<0.048	0.62	1.3	0.66	0.66
01/27/06	9	<0.048	1.6	4.3	4.2	7.7	4.4	<0.048	0.77	1.7	0.78	0.81
02/20/06	33	<0.048	2.3	3.8	3.3	4.8	3.5	<0.048	0.52	1.2	0.52	0.56
03/23/06	64	<0.048	1.7	3.8	3.1	3.8	3.2	<0.048	0.41	1.1	0.40	0.45
04/24/06	96	<0.048	2.1	4.2	3.3	3.7	3.4	<0.048	0.42	1.1	0.40	0.45
06/27/06	160	<0.048	1.6	3.9	2.8	2.9	2.9	<0.048	0.33	0.87	0.29	0.33
10/30/06	285	<0.048	1.6	3.6	2.3	2.2	2.4	<0.048	0.24	0.66	<0.13	0.21

Site A, Nutrient Amended, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	572	0	0	35
01/27/06	9	0	0	303	0	0	0
02/20/06	33	0	0	306	0	0	0
03/23/06	64	0	0	246	0	0	0
04/24/06	96	0	0	193	0	0	0
06/27/06	160	0	0	167	0	0	0
10/30/06	285	0	0	150	0	0	0

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	398	<0.5	<0.5	<0.5	373	17	42	5.9	1
01/27/06	9	393	<0.5	<0.5	<0.5	323	14	44	6.8	1
02/20/06	33	402	<0.5	<1.0	<0.5	315	14	23	6.8	<1
03/23/06	64	401	<2.5	<0.5	<0.5	307	13	23	6.7	<1
04/24/06	96	406	<2.5	<2.5	<2.5	273	9.0	NA	6.8	<1
06/27/06	160	399	<2.5	<2.5	<0.5	262	9.8	19	6.9	<1
10/30/06	285	419	<0.5	<0.5	<0.5	282	12	28	6.6	<1

1 mL of 0.5 N NaOH added on 1/19/06

Site A, Nutrient Amended, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.3	<0.044	3.6	<0.044	<0.044	4.2	<0.048	2.0	<0.044	17	0.94
01/27/06	9	2.5	<0.044	3.6	<0.044	<0.044	4.6	<0.048	2.0	<0.044	17	0.95
02/20/06	33	2.6	<0.044	2.1	<0.044	<0.044	4.6	<0.048	1.8	<0.044	15	0.85
03/23/06	64	2.5	0.070	<0.044	<0.044	<0.044	4.6	<0.048	1.7	<0.044	14	0.84
04/24/06	96	2.5	0.095	<0.044	<0.044	<0.044	4.6	<0.048	1.6	<0.044	12	0.78
06/27/06	160	2.3	0.16	<0.044	<0.044	<0.044	4.2	<0.048	1.5	<0.044	9.7	0.71
10/30/06	285	2.2	0.24	<0.044	<0.044	0.065	4.1	<0.048	1.3	<0.044	7.9	0.64

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
												0.94
01/19/06	1	<0.048	2.3	4.3	4.7	13	5.2	<0.048	0.83	1.8	0.97	0.85
01/27/06	9	<0.048	2.0	4.0	4.4	8.2	4.7	<0.048	0.72	1.7	0.82	0.65
02/20/06	33	<0.048	2.5	4.4	3.8	5.7	4.1	<0.048	0.59	1.4	0.61	0.53
03/23/06	64	<0.048	2.1	4.5	3.7	4.6	3.9	<0.048	0.49	1.3	0.49	0.44
04/24/06	96	<0.048	2.3	4.5	3.2	3.6	3.5	<0.048	0.42	1.1	0.40	0.32
06/27/06	160	<0.048	1.9	4.1	2.7	2.8	2.9	<0.048	0.31	0.84	0.29	0.23
10/30/06	285	<0.048	1.9	0.088	2.4	2.2	2.5	<0.048	0.26	0.71	<0.13	

Site A, Nutrient Amended, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	503	0	0	51
01/27/06	9	0	0	173	0	0	31
02/20/06	33	0	0	202	0	0	46
03/23/06	64	0	0	138	0	0	45
04/24/06	96	0	0	109	0	0	41
06/27/06	160	0	0	95	0	0	42
10/30/06	285	0	0	110	0	0	40

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	393	<0.5	<0.5	<0.5	366	17	45	5.8	2
01/27/06	9	389	<0.5	<0.5	<0.5	321	16	48	6.1	1
02/20/06	33	396	<0.5	<1.0	<0.5	297	15	23	6.4	<1
03/23/06	64	400	<2.5	<0.5	<0.5	286	14	21	6.4	<1
04/24/06	96	401	<2.5	<2.5	<2.5	261	11	NA	6.5	<1
06/27/06	160	399	<2.5	<2.5	<0.5	260	12	26	6.7	<1
10/30/06	285	428	<0.5	<0.5	<0.5	237	14	20	6.5	<1

0.5 mL of 0.5 N NaOH added on 1/27/06

Site A, Nutrient Amended, Bottle 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.0	<0.044	3.1	<0.044	<0.044	3.6	<0.048	1.6	<0.044	14	0.79
01/27/06	9	2.4	<0.044	3.4	<0.044	<0.044	4.1	<0.048	1.8	<0.044	15	0.83
02/20/06	33	2.6	<0.044	<0.044	<0.044	<0.044	4.3	<0.048	1.7	<0.044	15	0.82
03/23/06	64	2.5	0.055	<0.044	<0.044	<0.044	4.4	<0.048	1.5	<0.044	12	0.79
04/24/06	96	2.4	0.078	<0.044	<0.044	<0.044	4.1	<0.048	1.4	<0.044	11	0.71
06/27/06	160	2.3	0.16	<0.044	<0.044	<0.044	4.0	<0.048	1.4	<0.044	9.7	0.70
10/30/06	285	2.3	0.22	<0.044	<0.044	0.057	4.0	<0.048	1.3	<0.044	7.6	0.62

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.0	3.6	3.7	8.5	3.9	<0.048	0.61	1.3	0.67	0.66
01/27/06	9	<0.048	1.9	3.5	3.8	6.8	4.1	<0.048	0.62	1.5	0.72	0.75
02/20/06	33	<0.048	2.3	4.1	3.6	5.2	3.8	<0.048	0.54	1.3	0.55	0.59
03/23/06	64	<0.048	2.0	4.2	3.2	3.9	3.4	<0.048	0.42	1.1	0.42	0.46
04/24/06	96	<0.048	2.1	3.8	2.8	3.3	3.1	<0.048	0.37	0.96	0.34	0.39
06/27/06	160	<0.048	1.7	3.8	2.6	2.8	2.7	<0.048	0.30	0.81	0.26	0.30
10/30/06	285	<0.048	1.7	0.049	2.3	2.2	2.4	<0.048	0.25	0.70	<0.13	0.23

Site A, Nutrient Amended, Bottle 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	595	0	0	0
01/27/06	9	0	0	299	0	0	0
02/20/06	33	0	0	296	0	0	0
03/23/06	64	0	0	236	0	0	0
04/24/06	96	0	0	189	0	0	0
06/27/06	160	0	0	160	0	0	0
10/30/06	285	0	0	158	0	0	0

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	397	<0.5	<0.5	<0.5	377	16	43	5.9	1
01/27/06	9	302	<0.5	<0.5	<0.5	314	14	28	6.1	1
02/20/06	33	405	<0.5	<1.0	<0.5	313	12	23	6.5	<1
03/23/06	64	396	<2.5	<0.5	<0.5	304	12	19	6.5	<1
04/24/06	96	397	<2.5	<2.5	<2.5	277	8.2	NA	6.5	<1
06/27/06	160	400	<2.5	<2.5	<0.5	280	9.6	19	6.8	<1
10/30/06	285	427	<0.5	<0.5	<0.5	230	11	19	6.6	<1

0.5 mL of 0.5 N NaOH added on 1/27/06

Site A, Aerobic/Anaerobic Treatment, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.6	<0.044	3.0	<0.044	<0.044	3.7	<0.048	1.5	<0.044	10	0.70
01/27/06	9	0.82	<0.044	3.1	<0.044	<0.044	1.1	<0.048	1.6	<0.044	11	0.090
02/20/06	33	0.11	<0.044	2.8	<0.044	<0.044	<0.048	<0.048	1.4	<0.044	8.7	<0.048
03/23/06	64	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.5	<0.044	8.7	<0.048
04/03/06	75	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.1	<0.044	3.7	<0.048
04/07/06	79	<0.044	<0.044	<0.044	<0.044	<0.044	0.059	<0.048	1.1	<0.044	3.5	<0.048
04/24/06	96	0.054	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.95	<0.044	2.7	<0.048
05/25/06	127	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.0	<0.044	2.6	<0.048
06/27/06	160	0.081	<0.044	<0.044	<0.044	0.058	<0.048	<0.048	0.85	<0.044	2.0	<0.048
07/24/06	187	0.053	<0.044	<0.044	<0.044	0.082	<0.048	<0.048	0.83	<0.044	1.7	<0.048
08/23/06	217	0.14	<0.044	<0.044	<0.044	0.11	<0.048	<0.048	0.85	<0.044	1.7	<0.048
10/02/06	257	0.058	<0.044	0.086	<0.044	0.13	<0.048	<0.048	0.89	<0.044	1.7	<0.048
10/30/06	285	<0.044	<0.044	<0.044	<0.044	0.15	<0.048	<0.048	0.87	<0.044	1.5	<0.048
11/22/06	308	0.048	0.042	<0.009	<0.009	0.17	0.042	<0.009	0.90	<0.009	1.5	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.0	3.6	3.2	6.0	3.5	<0.048	0.56	1.2	0.62	0.61
01/27/06	9	<0.048	1.7	2.7	<0.044	5.6	<0.048	<0.048	0.25	1.4	0.65	<0.11
02/20/06	33	<0.048	2.2	<0.044	<0.044	3.5	<0.048	<0.048	<0.044	0.482	<0.13	<0.11
03/23/06	64	<0.048	2.0	<0.044	<0.044	3.1	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/03/06	75	<0.048	2.0	<0.044	<0.044	0.72	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/07/06	79	<0.048	2.0	<0.044	<0.044	0.62	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/24/06	96	<0.048	2.0	<0.044	<0.044	0.37	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	2.0	<0.044	<0.044	0.27	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.6	<0.044	<0.044	0.33	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	1.9	<0.044	<0.044	0.25	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	<0.048	1.5	<0.044	<0.044	0.34	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	<0.048	1.7	<0.044	<0.044	0.41	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	<0.048	1.6	<0.044	<0.044	0.40	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	308	0.043	1.3	<0.009	<0.009	0.36	<0.009	<0.010	<0.009	<0.009	<0.025	<0.022

Site A, Aerobic/Anaerobic Treatment, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	147	0	0	0
01/27/06	9	0	0	91	0	0	0
02/20/06	33	0	0	90	0	0	0
03/23/06	64	0	0	101	0	0	0
04/24/06	96	0	0	0	0	16	43
05/25/06	127	0	0	0	0	46	45
06/27/06	160	0	0	0	0	42	44
07/24/06	187	0	0	0	0	39	45
08/23/06	217	0	0	0	0	39	43
10/02/06	257	0	0	0	0	29	94
10/30/06	285	0	0	0	0	30	101

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	62	<0.5	<0.5	<0.5	<10	13	19	5.1	>12
01/27/06	9	172	<0.5	<0.5	6.2	<10	<0.5	17	5.0	7
02/20/06	33	63	<0.5	<1.0	<0.5	1.4	18	7.92	4.9	8
03/23/06	64	65	<0.5	<0.5	<0.5	<10	19	6.00	4.8	7
04/24/06	96	64	<0.5	<0.5	<0.5	1.7	20	NA	6.9	<1
05/25/06	127	63	<0.5	<0.5	<0.5	<10	<0.5	NA	6.8	<1
06/27/06	160	65	<0.5	<0.5	<0.5	<10	<0.5	NA	7.0	<1
07/24/06	187	66	<0.5	<0.5	<0.5	<10	<0.5	166	6.9	<1
08/23/06	217	68	<0.5	<1.0	<0.5	<10	<1.0	184	6.7	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.6	<1
10/30/06	285	69	<0.5	<0.5	<0.5	<10	<0.5	250	6.3	<1

Microcosms turned anaerobic and substrate added on 3/23/06

Site A, Aerobic/Anaerobic Treatment, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.1	<0.044	3.7	<0.044	<0.044	4.0	<0.048	1.9	<0.044	12	0.87
01/27/06	9	0.84	<0.044	3.4	<0.044	<0.044	0.95	<0.048	1.7	<0.044	11	0.29
02/20/06	33	0.11	<0.044	3.0	<0.044	<0.044	<0.048	<0.048	1.5	<0.044	9.1	<0.048
03/23/06	64	<0.044	<0.044	0.31	0.050	<0.044	<0.048	<0.048	1.7	<0.044	9.8	<0.048
04/03/06	75	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.1	<0.044	3.5	<0.048
04/07/06	79	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.1	<0.044	3.5	<0.048
04/24/06	96	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.00	<0.044	2.6	<0.048
05/25/06	127	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.96	<0.044	2.4	<0.048
06/27/06	160	0.054	<0.044	<0.044	0.052	<0.044	<0.048	<0.048	0.94	<0.044	2.1	<0.048
07/24/06	187	<0.044	<0.044	<0.044	<0.044	0.050	<0.048	<0.048	0.96	<0.044	2.1	<0.048
08/23/06	217	0.18	<0.044	<0.044	<0.044	0.079	<0.048	<0.048	0.98	<0.044	2.1	<0.048
10/02/06	257	0.060	<0.044	<0.044	<0.044	0.097	<0.048	<0.048	0.98	<0.044	1.9	<0.048
10/30/06	285	0.070	<0.044	<0.044	<0.044	0.10	<0.048	<0.048	0.92	<0.044	1.7	<0.048
11/22/06	308	0.087	0.049	<0.009	<0.009	0.14	0.025	<0.009	1.0	<0.009	1.8	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.2	4.1	4.2	8.4	4.7	<0.048	0.74	1.7	0.87	0.85
01/27/06	9	<0.048	1.9	2.3	0.64	5.1	0.43	<0.048	0.36	1.4	0.62	0.17
02/20/06	33	<0.048	2.2	<0.044	<0.044	3.5	<0.048	<0.048	0.18	1.0	0.36	<0.11
03/23/06	64	<0.048	2.2	<0.044	<0.044	3.1	<0.048	<0.048	<0.044	0.062	<0.13	<0.11
04/03/06	75	<0.048	1.9	<0.044	<0.044	0.61	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/07/06	79	<0.048	2.0	<0.044	<0.044	0.58	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/24/06	96	<0.048	1.9	<0.044	<0.044	0.28	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	1.9	<0.044	<0.044	0.23	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.7	<0.044	<0.044	0.25	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	2.1	<0.044	<0.044	0.34	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	<0.048	1.8	<0.044	<0.044	0.45	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	<0.048	1.7	<0.044	<0.044	0.48	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	<0.048	1.6	<0.044	<0.044	0.46	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	308	0.020	1.3	<0.009	<0.009	0.41	<0.009	<0.010	<0.009	<0.009	<0.025	<0.022

Site A, Aerobic/Anaerobic Treatment, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	171	0	0	0
01/27/06	9	0	0	107	0	0	0
02/20/06	33	0	0	107	0	0	0
03/23/06	64	0	0	86	0	0	0
04/24/06	96	0	0	0	0	28	35
05/25/06	127	0	0	0	0	43	30
06/27/06	160	0	0	0	0	39	27
07/24/06	187	0	0	0	0	39	28
08/23/06	217	0	0	0	0	38	29
10/02/06	257	0	0	0	0	30	80
10/30/06	285	0	0	0	0	37	83

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	61	<0.5	<0.5	<0.5	<10	12	20	5.2	>12
01/27/06	9	177	<0.5	<0.5	6.3	<10	<0.5	12	5.0	7
02/20/06	33	62	<0.5	<1.0	<0.5	<10	10	8.0	4.9	6
03/23/06	64	65	<0.5	<0.5	<0.5	<10	18	7.9	4.9	7
04/24/06	96	65	<0.5	<0.5	<0.5	<10	20	NA	6.9	<1
05/25/06	127	64	<0.5	<0.5	<0.5	<10	<0.5	NA	6.6	<1
06/27/06	160	65	<0.5	<0.5	<0.5	<10	<0.5	NA	6.7	<1
07/24/06	187	68	<0.5	<0.5	<0.5	<10	<0.5	177	6.7	<1
08/23/06	217	68	<0.5	<1.0	<0.5	<10	<1.0	270	6.6	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.5	<1
10/30/06	285	69	<0.5	<0.5	<0.5	<10	<0.5	281	6.2	<1

Microcosms turned anaerobic and substrate added on 3/23/06

Site A, Aerobic/Anaerobic Treatment, Run 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	2.3	<0.044	2.2	<0.044	<0.044	4.5	<0.048	0.80	<0.044	3.5	0.31
02/03/06	9	1.5	<0.044	2.0	<0.044	<0.044	1.9	<0.048	0.76	<0.044	3.0	0.14
02/27/06	33	0.059	<0.044	1.9	<0.044	<0.044	<0.048	<0.048	0.74	<0.044	2.8	<0.048
03/23/06	56	<0.044	<0.044	1.3	0.17	<0.044	<0.048	<0.048	0.73	<0.044	2.6	0.052
04/03/06	67	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.51	<0.044	0.98	<0.048
04/07/06	71	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.52	<0.044	1.1	<0.048
04/24/06	88	0.058	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.48	<0.044	0.84	<0.048
05/25/06	119	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.42	<0.044	0.71	<0.048
06/27/06	152	0.075	<0.044	<0.044	0.076	<0.044	<0.048	<0.048	0.43	<0.044	0.70	<0.048
07/24/06	179	0.065	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.44	<0.044	0.61	<0.048
08/23/06	209	0.19	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.45	<0.044	0.59	<0.048
10/02/06	249	0.063	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.45	<0.044	0.52	<0.048
10/30/06	277	0.088	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.45	<0.044	0.49	<0.048
11/22/06	300	0.082	0.010	<0.009	<0.009	0.048	0.041	<0.009	0.44	<0.009	0.43	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.9	4.4	1.5	2.8	2.2	<0.048	0.37	0.92	0.68	0.71
02/03/06	9	<0.048	1.9	2.7	0.41	2.2	0.38	<0.048	0.25	0.82	0.43	0.23
02/27/06	33	<0.048	2.3	0.40	<0.044	1.7	<0.048	<0.048	0.058	0.61	<0.13	<0.11
03/23/06	64	<0.048	2.0	<0.044	<0.044	1.5	<0.048	<0.048	<0.044	0.31	<0.13	<0.11
04/03/06	75	<0.048	1.9	<0.044	<0.044	0.18	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/07/06	79	<0.048	2.2	<0.044	<0.044	0.28	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/24/06	96	<0.048	2.0	<0.044	<0.044	0.078	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	2.0	<0.044	<0.044	0.062	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.7	<0.044	<0.044	0.091	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	1.8	<0.044	<0.044	0.10	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	<0.048	1.8	<0.044	<0.044	0.15	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	<0.048	1.4	<0.044	<0.044	0.12	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	<0.048	1.7	<0.044	<0.044	0.18	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	300	0.053	1.4	<0.009	<0.009	0.20	<0.009	<0.010	<0.009	0.011	<0.025	<0.022

Site A, Aerobic/Anaerobic Treatment, Run 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	60	0	0	27
02/03/06	9	0	0	49	0	0	42
02/27/06	33	0	0	51	0	0	132
03/23/06	56	0	0	41	0	0	159
04/24/06	88	0	0	0	0	50	50
05/25/06	119	0	0	0	0	49	58
06/27/06	152	0	0	0	0	47	62
07/24/06	179	0	0	0	0	41	61
08/23/06	209	0	0	0	0	39	61
10/02/06	249	0	0	0	0	33	120
10/30/06	277	0	0	0	0	31	128

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	78	<0.5	<0.5	<0.5	59	2.0	15	5.4	>12
02/03/06	9	62	<0.5	<0.5	<0.5	<10	13	6.7	5.3	7
02/27/06	33	62	<0.5	<1.0	<0.5	<10	17	11	5.4	9
03/23/06	56	62	<0.5	<0.5	<0.5	<10	20	7.7	5.4	10
04/24/06	88	61	<0.5	<0.5	<0.5	<10	21	NA	6.9	<1
05/25/06	119	61	<0.5	<0.5	<0.5	<10	<0.5	NA	6.6	<1
06/27/06	152	63	<0.5	<0.5	<0.5	<10	<0.5	NA	6.5	<1
07/24/06	179	64	<0.5	<0.5	<0.5	<10	<0.5	213	6.3	<1
08/23/06	209	65	<0.5	<1.0	<0.5	<10	<1.0	290	6.2	<1
10/02/06	249	NA	NA	NA	NA	NA	NA	NA	6.2	<1
10/30/06	277	65	<0.5	<0.5	<0.5	<10	<0.5	333	5.9	<1

Microcosms turned anaerobic and substrate added on 3/23/06

Site A, Aerobic/Anaerobic Treatment with Bioaugmentation, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.7	<0.044	3.3	<0.044	<0.044	3.8	<0.048	1.7	<0.044	11	0.77
01/27/06	9	1.0	<0.044	3.2	<0.044	<0.044	1.3	<0.048	1.6	<0.044	9.5	0.15
02/20/06	33	0.101	<0.044	3.0	<0.044	<0.044	<0.048	<0.048	1.4	<0.044	8.6	<0.048
03/23/06	64	<0.044	<0.044	2.9	0.096	<0.044	<0.048	<0.048	1.7	<0.044	9.7	<0.048
04/03/06	75	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.1	<0.044	3.4	<0.048
04/07/06	79	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.2	<0.044	3.5	<0.048
04/24/06	96	0.095	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.96	<0.044	2.5	<0.048
05/25/06	127	0.094	<0.044	0.73	<0.044	2.6	<0.048	<0.048	<0.12	<0.044	0.74	<0.048
06/27/06	160	0.12	<0.044	<0.044	<0.044	2.8	<0.048	<0.048	<0.12	<0.044	0.22	<0.048
07/24/06	187	0.21	<0.044	<0.044	<0.044	3.0	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
08/23/06	217	0.38	<0.044	<0.044	<0.044	2.9	<0.048	<0.048	<0.12	<0.044	0.20	<0.048
10/02/06	257	0.28	<0.044	<0.044	<0.044	2.9	<0.048	<0.048	<0.12	<0.044	0.17	<0.048
10/30/06	285	0.36	<0.044	<0.044	<0.044	3.1	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
11/22/06	308	0.36	0.011	0.031	<0.009	3.1	0.032	0.70	<0.025	<0.009	0.13	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.0	3.8	3.4	5.7	3.6	<0.048	0.54	1.2	0.60	0.59
01/27/06	9	<0.048	1.7	3.2	0.21	4.7	0.059	<0.048	0.26	1.3	0.60	<0.11
02/20/06	33	<0.048	2.0	<0.044	<0.044	3.6	<0.048	<0.048	0.084	0.99	0.36	<0.11
03/23/06	64	<0.048	2.2	<0.044	<0.044	3.5	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/03/06	75	<0.048	2.0	<0.044	<0.044	0.56	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/07/06	79	<0.048	1.8	<0.044	<0.044	0.60	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/24/06	96	<0.048	2.0	<0.044	<0.044	0.32	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	2.1	<0.044	<0.044	0.30	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.6	<0.044	<0.044	0.32	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	1.9	<0.044	<0.044	0.53	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	<0.048	1.7	<0.044	<0.044	0.61	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	<0.048	1.7	<0.044	<0.044	0.61	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	<0.048	1.5	<0.044	<0.044	0.68	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	308	<0.009	1.3	<0.009	<0.009	0.088	<0.009	<0.010	<0.009	<0.009	0.043	<0.022

Site A, Aerobic/Anaerobic Treatment with Bioaugmentation, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	101	0	0	0
01/27/06	9	0	0	85	0	0	0
02/20/06	33	0	0	85	0	0	0
03/23/06	64	0	0	71	0	0	29
04/24/06	96	0	0	0	0	54	102
05/25/06	127	0	0	0	0	53	1,249
06/27/06	160	0	0	0	0	49	16,874
07/24/06	187	0	0	0	0	42	30,709
08/23/06	217	16	0	0	0	42	36,339
10/02/06	257	14	0	0	0	32	31,543
10/30/06	285	19	0	0	0	33	32,779

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	62	<0.5	<0.5	<0.5	<10	14	20	5.1	>12
01/27/06	9	178	<0.5	<0.5	5.5	<10	0.60	14	4.8	7
02/20/06	33	63	<0.5	<1.0	<0.5	<10	11	7.0	4.9	7
03/23/06	64	64	<0.5	<0.5	<0.5	<10	20	9.6	5.0	8
04/24/06	96	77	<0.5	<0.5	<0.5	<10	15	NA	7.0	<1
05/25/06	127	79	<0.5	<0.5	<0.5	<10	<0.5	NA	6.6	<1
06/27/06	160	80	<0.5	<0.5	<0.5	<10	<0.5	NA	6.2	<1
07/24/06	187	91	<0.5	<0.5	<0.5	<10	<0.5	307	6.0	<1
08/23/06	217	91	<0.5	<1.0	<0.5	<10	<1.0	358	6.2	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.1	<1
10/30/06	285	93	<0.5	<0.5	<0.5	<10	<0.5	370	6.0	<1

Microcosms turned anaerobic and substrate added on 3/23/06
Bioaugmented with CTC and ACT3 cultures on 4/21/06
Bioaugmented with KB1 and ACT3 cultures on 7/06/06

Site A, Aerobic/Anaerobic Treatment with Bioaugmentation, Run 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	1.9	<0.044	1.9	<0.044	<0.044	2.9	<0.048	1.0	<0.044	7.5	0.46
01/27/06	9	0.58	<0.044	2.3	<0.044	<0.044	0.21	<0.048	1.2	<0.044	8.8	0.20
02/20/06	33	0.10	<0.044	2.0	<0.044	<0.044	<0.048	<0.048	0.96	<0.044	6.9	<0.048
03/23/06	64	<0.044	<0.044	0.095	<0.044	<0.044	<0.048	<0.048	0.97	<0.044	6.6	<0.048
04/03/06	75	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.68	<0.044	2.6	<0.048
04/07/06	79	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.71	<0.044	2.8	<0.048
04/24/06	96	0.086	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.63	<0.044	2.0	<0.048
05/25/06	127	0.11	<0.044	0.29	<0.044	0.32	<0.048	<0.048	0.12	<0.044	1.9	<0.048
06/27/06	160	0.14	<0.044	0.30	0.058	0.47	<0.048	<0.048	<0.12	<0.044	1.9	<0.048
07/24/06	187	0.15	<0.044	0.41	<0.044	1.7	<0.048	<0.048	<0.12	<0.044	0.75	<0.048
08/23/06	217	0.32	<0.044	0.50	<0.044	2.3	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
10/02/06	257	0.13	<0.044	0.44	<0.044	2.2	<0.048	0.56	<0.12	<0.044	<0.048	<0.048
10/30/06	285	0.16	<0.044	0.29	<0.044	2.1	<0.048	0.65	<0.12	<0.044	<0.048	<0.048
11/22/06	308	<0.009	0.017	0.24	<0.009	0.54	<0.009	0.50	<0.025	<0.009	0.029	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.5	2.7	2.2	4.4	2.5	<0.048	0.44	0.95	0.52	0.52
01/27/06	9	<0.048	1.4	0.95	0.37	4.6	0.19	<0.048	0.32	1.1	0.51	<0.11
02/20/06	33	<0.048	1.5	<0.044	<0.044	3.1	<0.048	<0.048	<0.044	0.206	<0.13	<0.11
03/23/06	64	<0.048	1.5	<0.044	<0.044	2.6	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/03/06	75	<0.048	1.2	<0.044	<0.044	0.51	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/07/06	79	<0.048	1.3	<0.044	<0.044	0.52	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/24/06	96	<0.048	1.4	<0.044	<0.044	0.20	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	1.5	<0.044	<0.044	0.27	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.4	<0.044	<0.044	0.42	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	1.5	<0.044	<0.044	0.63	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	<0.048	1.2	<0.044	<0.044	0.68	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	<0.048	1.4	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	<0.048	0.99	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	308	0.011	<0.090	<0.009	<0.009	0.093	<0.009	<0.010	<0.009	<0.009	<0.025	<0.022

Site A, Aerobic/Anaerobic Treatment with Bioaugmentation, Run 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	147	0	0	0
01/27/06	9	0	0	103	0	0	0
02/20/06	33	0	0	101	0	9	0
03/23/06	64	0	0	84	0	9	0
04/24/06	96	0	0	0	0	58	83
05/25/06	127	0	0	0	0	64	1,824
06/27/06	160	0	0	0	0	58	2,465
07/24/06	187	0	0	0	0	47	2,185
08/23/06	217	0	0	0	0	47	3,036
10/02/06	257	0	0	0	0	38	3,565
10/30/06	285	0	0	0	0	39	4,957

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	62	<0.5	<0.5	<0.5	<10	14	16	5.3	>12
01/27/06	9	181	<0.5	<0.5	6.7	<10	<0.5	9.2	4.8	7
02/20/06	33	63	<0.5	<1.0	<0.5	<10	11	6.9	4.9	6
03/23/06	64	64	<0.5	<0.5	<0.5	<10	21	7.1	4.9	6
04/24/06	96	74	<0.5	<0.5	<0.5	<10	22	NA	6.9	<1
05/25/06	127	76	<0.5	<0.5	<0.5	<10	<0.5	NA	6.4	<1
06/27/06	160	77	<0.5	<0.5	<0.5	<10	<0.5	NA	6.2	<1
07/24/06	187	86	<0.5	<0.5	<0.5	<10	<0.5	335	6.2	<1
08/23/06	217	87	<0.5	<1.0	<0.5	<10	<1.0	381	6.2	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.4	<1
10/30/06	285	90	<0.5	<0.5	<0.5	<10	<0.5	397	6.2	<1

Microcosms turned anaerobic and substrate added on 3/23/06
Bioaugmented with CTC and ACT3 cultures on 4/21/06
Bioaugmented with KB1 and ACT3 cultures on 7/06/06

Site A, Aerobic/Anaerobic Treatment with Bioaugmentation, Run 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	2.2	<0.044	3.3	<0.044	<0.044	4.3	<0.048	1.7	<0.044	12	0.81
01/27/06	9	0.87	<0.044	3.3	<0.044	<0.044	1.1	<0.048	1.7	<0.044	13	0.26
02/20/06	33	0.11	<0.044	3.5	<0.044	<0.044	<0.048	<0.048	1.8	<0.044	13	<0.048
03/23/06	64	<0.044	0.048	3.2	0.18	<0.044	<0.048	<0.048	1.6	<0.044	11	0.078
04/03/06	75	<0.044	<0.044	0.22	<0.044	<0.044	<0.048	<0.048	1.2	<0.044	4.3	<0.048
04/07/06	79	<0.044	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	1.2	<0.044	4.5	<0.048
04/24/06	96	0.10	<0.044	<0.044	<0.044	<0.044	<0.048	<0.048	0.99	<0.044	3.1	<0.048
05/25/06	127	<0.044	<0.044	0.60	<0.044	0.39	<0.048	<0.048	0.32	<0.044	3.3	<0.048
06/27/06	160	0.16	<0.044	0.69	<0.044	0.81	<0.048	<0.048	0.22	<0.044	3.4	<0.048
07/24/06	187	0.18	<0.044	0.88	<0.044	3.0	<0.048	<0.048	<0.12	<0.044	0.93	<0.048
08/23/06	217	0.36	<0.044	0.87	<0.044	3.9	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
10/02/06	257	0.23	<0.044	0.66	<0.044	3.9	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
10/30/06	285	0.23	<0.044	0.66	<0.044	3.9	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
11/22/06	308	0.27	0.031	0.52	<0.009	0.64	0.029	<0.009	<0.025	<0.009	0.034	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.2	4.3	4.0	8.7	4.5	<0.048	0.70	1.6	0.81	0.80
01/27/06	9	<0.048	2.1	3.1	0.35	6.7	0.14	<0.048	0.43	1.6	0.73	<0.11
02/20/06	33	<0.048	2.8	<0.044	<0.044	5.3	<0.048	<0.048	0.20	1.3	0.53	<0.11
03/23/06	64	<0.048	2.2	<0.044	<0.044	3.9	<0.048	<0.048	<0.044	<0.044	0.26	<0.11
04/03/06	75	<0.048	2.2	<0.044	<0.044	0.66	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/07/06	79	<0.048	2.2	<0.044	<0.044	0.72	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
04/24/06	96	<0.048	2.1	<0.044	<0.044	0.36	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	2.0	<0.044	<0.044	0.49	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.8	<0.044	<0.044	0.73	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	2.3	<0.044	<0.044	1.0	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	<0.048	1.8	<0.044	<0.044	0.93	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	<0.048	2.0	<0.044	<0.044	0.83	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	<0.048	2.0	<0.044	<0.044	0.79	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	308	<0.009	1.4	<0.009	<0.009	0.56	<0.009	<0.010	<0.009	<0.009	0.050	<0.022

Site A, Aerobic/Anaerobic Treatment with Bioaugmentation, Run 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	194	0	0	0
01/27/06	9	0	0	102	0	0	0
02/20/06	33	0	0	103	0	0	0
03/23/06	64	0	0	79	0	0	0
04/24/06	96	0	0	0	0	61	114
05/25/06	127	0	0	0	0	64	914
06/27/06	160	0	0	0	0	59	934
07/24/06	187	0	0	0	0	45	758
08/23/06	217	0	0	0	0	47	891
10/02/06	257	0	0	0	0	37	1,088
10/30/06	285	0	0	0	0	36	1,871

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	61	<0.5	<0.5	<0.5	<10	14	21	5.1	>12
01/27/06	9	114	<0.5	<0.5	<0.5	<10	4.2	13	4.9	7
02/20/06	33	62	<0.5	<1.0	<0.5	<10	9.7	6.5	4.9	6
03/23/06	64	63	<0.5	<0.5	<0.5	<10	19	11	4.9	4
04/24/06	96	78	<0.5	<0.5	<0.5	<10	11	NA	6.8	<1
05/25/06	127	78	<0.5	<0.5	<0.5	<10	<0.5	NA	6.5	<1
06/27/06	160	81	<0.5	<0.5	<0.5	<10	<0.5	NA	6.1	<1
07/24/06	187	92	<0.5	<0.5	<0.5	<10	<0.5	399	6.0	<1
08/23/06	217	92	<0.5	<1.0	<0.5	<10	<1.0	409	6.2	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.4	<1
10/30/06	285	93	<0.5	<0.5	<0.5	<10	<0.5	372	6.2	<1

Microcosms turned anaerobic and substrate added on 3/23/06
Bioaugmented with CTC and ACT3 cultures on 4/21/06
Bioaugmented with KB1 and ACT3 cultures on 7/06/06

Site B, Inhibited, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	2.6	<0.044	2.3	<0.044	<0.044	4.0	<0.048	1.1	<0.044	6.4	0.47
02/03/06	8	3.0	<0.044	2.3	<0.044	<0.044	4.4	<0.048	1.1	<0.044	6.4	0.49
02/27/06	32	1.1	<0.044	2.2	<0.044	<0.044	0.38	<0.048	1.0	<0.044	5.6	0.45
03/23/06	56	1.0	<0.044	2.2	<0.044	<0.044	0.32	<0.048	0.93	<0.044	5.1	0.41
04/24/06	88	0.99	<0.044	2.2	<0.044	<0.044	0.30	<0.048	0.94	<0.044	4.8	0.41
06/27/06	152	0.90	0.051	2.2	<0.044	<0.044	0.30	<0.048	0.88	<0.044	4.0	0.37
10/30/06	277	1.1	0.089	2.0	<0.044	<0.044	0.43	<0.048	0.86	<0.044	3.4	0.36

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.6	4.0	2.2	3.2	2.6	<0.048	0.38	0.94	0.57	0.60
02/03/06	8	<0.048	1.9	4.4	2.3	2.9	2.7	<0.048	0.36	0.93	0.50	0.55
02/27/06	32	<0.048	2.3	0.35	2.0	2.2	2.4	<0.048	0.29	0.76	0.36	0.40
03/23/06	56	<0.048	1.9	0.34	1.8	1.8	2.2	<0.048	0.24	0.67	0.28	0.32
04/24/06	88	<0.048	1.9	0.32	1.8	1.6	2.1	<0.048	0.22	0.62	<0.13	0.27
06/27/06	152	<0.048	1.5	0.31	1.5	1.3	1.7	<0.048	0.16	0.47	<0.13	0.18
10/30/06	277	<0.048	1.7	0.38	1.5	1.1	1.7	<0.048	0.14	0.42	<0.13	0.13

Site B, Inhibited, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	0
02/03/06	8	0	0	0	0	0	0
02/27/06	32	0	0	0	0	0	0
03/23/06	56	0	0	0	0	0	0
04/24/06	88	0	0	0	0	0	0
06/27/06	152	0	0	0	0	0	0
10/30/06	277	0	0	0	0	0	0

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	61	<0.5	<0.5	<0.5	<10	16	15	4.7	6
02/03/06	8	172	<0.5	<0.5	6.1	<10	1.8	7.6	4.7	4
02/27/06	32	171	<0.5	<1.0	6.4	<10	0.9	9.8	4.6	3
03/23/06	56	168	<0.5	<0.5	6.1	<10	1.9	7.4	4.6	2
04/24/06	88	168	<0.5	<0.5	6.3	<10	2.9	NA	4.7	<1
06/27/06	152	167	<0.5	<0.5	6.3	<10	3.3	7.6	4.8	<1
10/30/06	277	175	<0.5	<0.5	6.1	<10	4.1	3.4	4.8	<1

Site B, Inhibited, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	2.6	<0.044	2.2	<0.044	<0.044	4.2	<0.048	1.1	<0.044	7.7	0.47
02/03/06	8	2.8	<0.044	2.1	<0.044	<0.044	4.2	<0.048	1.0	<0.044	6.8	0.44
02/27/06	32	0.98	<0.044	2.1	<0.044	<0.044	0.43	<0.048	1.0	<0.044	6.4	0.43
03/23/06	56	0.89	<0.044	2.1	0.18	<0.044	0.37	<0.048	0.91	<0.044	5.7	0.39
04/24/06	88	0.92	<0.044	2.0	<0.044	<0.044	0.33	<0.048	0.87	<0.044	5.2	0.38
06/27/06	152	0.83	0.053	2.0	0.077	<0.044	0.35	<0.048	0.84	<0.044	4.4	0.35
10/30/06	277	0.90	0.098	2.4	<0.044	<0.044	0.44	<0.048	0.86	<0.044	4.0	0.35

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.5	4.1	2.3	4.0	2.7	<0.048	0.41	0.99	0.58	0.61
02/03/06	8	<0.048	1.8	4.1	2.1	3.1	2.4	<0.048	0.35	0.85	0.46	0.50
02/27/06	32	<0.048	2.1	0.39	2.0	2.5	2.3	<0.048	0.30	0.76	0.35	0.40
03/23/06	56	<0.048	1.8	0.39	1.8	2.0	2.1	<0.048	0.24	0.64	0.27	0.30
04/24/06	88	<0.048	1.9	0.35	1.7	1.7	1.9	<0.048	0.21	0.57	<0.13	0.23
06/27/06	152	<0.048	1.5	0.35	1.4	1.4	1.6	<0.048	0.16	0.46	<0.13	0.17
10/30/06	277	<0.048	1.6	0.44	1.4	1.2	1.6	<0.048	0.15	0.44	<0.13	0.14

Site B, Inhibited, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	45
02/03/06	8	0	0	0	0	0	82
02/27/06	32	0	0	0	0	0	216
03/23/06	56	0	0	0	0	0	255
04/24/06	88	0	0	0	0	0	265
06/27/06	152	0	0	0	0	0	290
10/30/06	277	0	0	0	0	0	299

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	62	<0.5	<0.5	<0.5	<10	9.5	16	4.7	6
02/03/06	8	174	<0.5	<0.5	6.1	<10	1.6	9.7	4.6	4
02/27/06	32	172	<0.5	<1.0	6.4	<10	0.9	9.5	4.7	3
03/23/06	56	169	<0.5	<0.5	6.1	<10	1.8	7.3	4.5	2
04/24/06	88	172	<0.5	<0.5	6.2	<10	2.9	NA	4.6	<1
06/27/06	152	172	<0.5	<0.5	6.4	<10	3.3	5.4	4.5	<1
10/30/06	277	176	<0.5	<0.5	6.2	<10	4.3	3.6	4.5	<1

Site B, Inhibited, Bottle 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	2.7	<0.044	2.1	<0.044	<0.044	4.1	<0.048	0.97	<0.044	6.3	0.42
02/03/06	8	2.6	<0.044	1.9	<0.044	<0.044	3.9	<0.048	0.90	<0.044	5.3	0.38
02/27/06	32	1.00	<0.044	2.0	<0.044	<0.044	0.44	<0.048	0.94	<0.044	5.2	0.41
03/23/06	56	0.99	<0.044	2.1	<0.044	<0.044	0.39	<0.048	0.85	<0.044	5.2	0.39
04/24/06	88	0.94	<0.044	2.0	<0.044	<0.044	0.35	<0.048	0.81	<0.044	4.4	0.36
06/27/06	152	0.81	0.051	2.1	<0.044	<0.044	0.37	<0.048	0.83	<0.044	4.0	0.35
10/30/06	277	0.87	0.070	2.0	<0.044	<0.044	0.34	<0.048	0.70	<0.044	2.9	0.29

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.7	4.0	2.1	3.2	2.5	<0.048	0.36	0.90	0.547	0.58
02/03/06	8	<0.048	1.7	3.8	1.8	2.5	2.2	<0.048	0.31	0.77	0.436	0.48
02/27/06	32	<0.048	1.9	0.39	1.8	2.2	2.1	<0.048	0.27	0.70	0.343	0.39
03/23/06	56	<0.048	1.9	0.41	1.8	1.9	2.1	<0.048	0.25	0.67	0.298	0.34
04/24/06	88	<0.048	1.6	0.38	1.6	1.6	1.9	<0.048	0.21	0.58	<0.13	0.26
06/27/06	152	<0.048	1.4	0.38	1.5	1.4	1.8	<0.048	0.18	0.51	<0.13	0.21
10/30/06	277	<0.048	1.4	0.34	1.2	1.0	1.5	<0.048	0.13	0.41	<0.13	0.14

Site B, Inhibited, Bottle 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	0
02/03/06	8	0	0	0	0	0	0
02/27/06	32	0	0	0	0	0	49
03/23/06	56	0	0	0	0	0	54
04/24/06	88	0	0	0	0	0	61
06/27/06	152	0	0	0	0	0	71
10/30/06	277	0	0	0	0	0	69

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	62	<0.5	<0.5	<0.5	<10	12	14	4.7	6
02/03/06	8	178	<0.5	<0.5	5.3	<10	1.5	6.5	4.8	4
02/27/06	32	175	<0.5	<1.0	5.5	<10	0.9	9.8	4.8	3
03/23/06	56	172	<0.5	<0.5	5.3	<10	1.7	7.3	4.8	2
04/24/06	88	173	<0.5	<0.5	5.6	<10	2.5	NA	4.7	<1
06/27/06	152	173	<0.5	<0.5	5.5	<10	2.8	4.5	4.8	<1
10/30/06	277	178	<0.5	<0.5	5.4	<10	4.0	4.0	4.3	<1

Site B, Inhibited Water, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	1.9	<0.044	2.1	<0.044	<0.044	3.8	<0.048	1.00	<0.044	6.3	0.44
02/03/06	8	1.8	<0.044	1.8	<0.044	<0.044	3.5	<0.048	0.90	<0.044	5.3	0.39
02/27/06	32	1.9	<0.044	2.1	<0.044	<0.044	3.9	<0.048	0.98	<0.044	5.4	0.43
03/23/06	56	1.9	<0.044	2.1	0.17	<0.044	3.8	<0.048	0.89	<0.044	5.1	0.39
04/24/06	88	1.9	<0.044	2.2	<0.044	<0.044	3.9	<0.048	0.90	<0.044	4.6	0.40
06/27/06	152	1.8	0.055	2.2	<0.044	<0.044	3.7	<0.048	0.88	<0.044	4.2	0.38
10/30/06	277	1.6	0.077	2.2	<0.044	<0.044	3.5	<0.048	0.77	<0.044	3.1	0.32

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.4	3.7	2.2	3.4	2.6	<0.048	0.39	0.94	0.56	0.59
02/03/06	8	<0.048	1.6	3.5	1.9	2.6	2.2	<0.048	0.33	0.78	0.42	0.46
02/27/06	32	<0.048	2.1	3.8	1.9	2.3	2.2	<0.048	0.28	0.72	0.34	0.38
03/23/06	56	<0.048	1.8	3.8	1.8	2.0	2.1	<0.048	0.25	0.69	0.30	0.33
04/24/06	88	<0.048	1.6	3.9	1.7	1.7	2.0	<0.048	0.22	0.61	<0.13	0.26
06/27/06	152	<0.048	1.5	3.6	1.6	1.5	1.8	<0.048	0.19	0.53	<0.13	0.21
10/30/06	277	<0.048	1.5	3.4	1.3	1.0	1.5	<0.048	0.14	0.41	<0.13	0.12

Site B, Inhibited Water, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	0	0	0	59
02/03/06	8	0	0	0	0	0	112
02/27/06	32	0	0	0	0	0	278
03/23/06	56	0	0	0	0	0	320
04/24/06	88	0	0	0	0	0	327
06/27/06	152	0	0	0	0	0	371
10/30/06	277	0	0	0	0	0	361

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	62	<0.5	<0.5	<0.5	<10	13	13	6.5	6
02/03/06	8	181	<0.5	<0.5	6.8	<10	<0.5	6.2	5.7	4
02/27/06	32	187	<0.5	<1.0	6.9	<10	<0.5	12	6.6	2
03/23/06	56	184	<0.5	<0.5	6.7	<10	<0.5	9.3	6.4	2
04/24/06	88	188	<0.5	<0.5	6.9	<10	<0.5	NA	5.8	<1
06/27/06	152	185	<0.5	<0.5	6.9	<10	<0.5	7.3	6.0	<1
10/30/06	277	195	<0.5	<0.5	6.8	<10	1.6	7.2	6.0	<1

Site B, Ambient, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	5.6	<0.044	3.6	<0.044	<0.044	3.9	<0.048	1.8	<0.044	15	0.86
01/27/06	9	9.8	<0.044	3.1	<0.044	<0.044	4.3	<0.048	1.7	<0.044	14	0.79
02/20/06	33	12	<0.044	3.1	<0.044	<0.044	4.5	<0.048	1.6	<0.044	12	0.78
03/23/06	64	11	0.049	3.1	<0.044	0.066	4.1	<0.048	1.5	<0.044	11	0.74
04/24/06	96	11	0.070	3.1	<0.044	0.11	4.3	<0.048	1.5	<0.044	9.3	0.75
06/27/06	160	9.4	0.109	3.2	0.14	0.19	3.7	<0.048	1.3	<0.044	6.3	0.65
10/30/06	285	11	0.127	3.1	<0.044	0.28	3.7	<0.048	1.1	<0.044	3.8	0.57

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.1	4.0	4.3	17	4.6	<0.048	0.72	1.6	0.82	0.80
01/27/06	9	<0.048	1.7	4.4	3.5	13	4.3	<0.048	0.67	1.6	0.79	0.80
02/20/06	33	<0.048	2.3	4.5	2.7	9.4	3.9	<0.048	0.56	1.4	0.59	0.62
03/23/06	64	<0.048	2.0	4.4	2.0	7.3	3.5	<0.048	0.45	1.2	0.46	0.49
04/24/06	96	<0.048	2.1	4.6	1.7	6.4	3.5	<0.048	0.43	1.1	0.42	0.46
06/27/06	160	<0.048	1.5	4.0	1.2	4.5	2.7	<0.048	0.30	0.80	0.27	0.29
10/30/06	285	<0.048	1.6	3.9	0.91	3.5	2.3	<0.048	0.25	0.69	<0.13	0.22

Site B, Ambient, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	528	0	9	38
01/27/06	9	0	0	217	0	12	0
02/20/06	33	0	0	225	0	14	0
03/23/06	64	0	0	174	0	12	0
04/24/06	96	0	0	133	0	9	0
06/27/06	160	0	0	112	0	0	0
10/30/06	285	0	0	106	0	0	0

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	114	<0.5	<0.5	<0.5	<10	4.1	24	5.4	2
01/27/06	9	63	<0.5	<0.5	<0.5	<10	14	32	5.8	1
02/20/06	33	117	<0.5	<1.0	<0.5	<10	5.7	16	6.1	<1
03/23/06	64	117	<0.5	<0.5	<0.5	<10	5.9	16	6.2	<1
04/24/06	96	119	<0.5	<0.5	<0.5	<10	6.2	NA	6.3	<1
06/27/06	160	120	<0.5	<0.5	<0.5	<10	6.3	13	6.3	<1
10/30/06	285	126	<0.5	<0.5	<0.5	<10	6.7	17	6.4	<1

Site B, Ambient, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	8.2	<0.044	3.1	<0.044	<0.044	3.6	<0.048	1.7	<0.044	14	0.80
01/27/06	9	9.1	<0.044	3.0	<0.044	<0.044	3.7	<0.048	1.6	<0.044	13	0.74
02/20/06	33	9.3	<0.044	2.8	<0.044	<0.044	3.5	<0.048	1.5	<0.044	12	0.69
03/23/06	64	9.2	0.058	3.1	0.095	<0.044	3.6	<0.048	1.4	<0.044	11	0.68
04/24/06	96	9.9	0.079	3.1	<0.044	<0.044	3.8	<0.048	1.4	<0.044	9.8	0.71
06/27/06	160	9.1	0.13	3.1	0.068	<0.044	3.6	<0.048	1.3	<0.044	7.5	0.66
10/30/06	285	9.4	0.18	3.1	<0.044	0.056	3.4	<0.048	1.2	<0.044	5.7	0.58

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.9	3.8	3.8	16	4.0	<0.048	0.64	1.4	0.73	0.71
01/27/06	9	<0.048	1.7	4.1	3.4	9.2	3.8	<0.048	0.55	1.3	0.64	0.66
02/20/06	33	<0.048	2.0	3.8	2.6	7.3	3.3	<0.048	0.46	1.1	0.48	0.50
03/23/06	64	<0.048	1.6	4.0	2.2	5.5	3.0	<0.048	0.36	0.94	0.36	0.38
04/24/06	96	<0.048	1.9	4.2	2.0	5.6	3.2	<0.048	0.38	1.01	0.36	0.39
06/27/06	160	<0.048	1.9	3.9	1.3	4.1	2.7	<0.048	0.29	0.77	0.27	0.28
10/30/06	285	<0.048	1.6	3.7	1.0	3.3	2.3	<0.048	0.23	0.62	<0.13	0.19

Site B, Ambient, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	534	0	12	42
01/27/06	9	0	0	183	0	8	0
02/20/06	33	0	0	205	0	11	27
03/23/06	64	0	0	163	0	10	0
04/24/06	96	0	0	130	0	0	0
06/27/06	160	0	0	109	0	0	0
10/30/06	285	0	0	98	9	0	0

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	114	<0.5	<0.5	<0.5	<10	0.7	24	6.2	1
01/27/06	9	114	<0.5	<0.5	<0.5	<10	0.7	21	6.5	1
02/20/06	33	116	<0.5	<1.0	<0.5	<10	1.7	18	6.5	<1
03/23/06	64	115	<0.5	<0.5	<0.5	<10	3.0	18	6.6	<1
04/24/06	96	117	<0.5	<0.5	<0.5	<10	3.5	NA	6.5	<1
06/27/06	160	120	<0.5	<0.5	<0.5	<10	3.8	14	6.4	<1
10/30/06	285	124	<0.5	<0.5	<0.5	<10	4.5	17	6.3	<1

Site B, Ambient, Bottle 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	8.4	<0.044	2.8	<0.044	<0.044	3.7	<0.048	1.5	<0.044	12	0.71
01/27/06	9	5.5	<0.044	3.5	<0.044	<0.044	3.8	<0.048	1.9	<0.044	16	0.85
02/20/06	33	6.3	<0.044	3.5	<0.044	<0.044	3.9	<0.048	1.8	<0.044	14	0.85
03/23/06	64	1.3	0.064	4.1	<0.044	<0.044	0.86	<0.048	1.7	<0.044	10	0.73
04/24/06	96	6.1	0.094	3.9	<0.044	<0.044	3.5	<0.048	1.8	<0.044	12	0.89
06/27/06	160	5.1	0.11	3.5	0.059	0.13	2.9	<0.048	1.4	<0.044	6.9	0.69
10/30/06	285	5.5	0.17	4.0	<0.044	0.32	2.9	<0.048	1.4	<0.044	5.0	0.70

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.9	3.7	3.2	12	3.4	<0.048	0.52	1.1	0.59	0.58
01/27/06	9	<0.048	1.9	4.5	3.8	12	3.9	<0.048	0.64	1.6	0.74	0.74
02/20/06	33	<0.048	2.2	4.6	3.4	8.9	3.9	<0.048	0.56	1.4	0.58	0.61
03/23/06	64	<0.048	0.50	2.8	2.9	7.4	3.5	<0.048	0.25	0.63	<0.13	0.21
04/24/06	96	<0.048	2.3	5.1	1.3	6.9	3.7	<0.048	0.46	1.2	0.45	0.48
06/27/06	160	<0.048	1.8	4.3	0.40	4.1	2.7	<0.048	0.29	0.75	0.26	0.28
10/30/06	285	<0.048	2.0	4.6	0.42	3.7	2.6	<0.048	0.24	0.67	<0.13	0.21

Site B, Ambient, Bottle 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	515	9	13	48
01/27/06	9	0	0	223	0	0	0
02/20/06	33	0	0	231	0	9	0
03/23/06	64	0	0	158	0	0	0
04/24/06	96	0	0	127	0	0	0
06/27/06	160	0	0	117	0	0	0
10/30/06	285	0	0	96	0	0	0

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	114	<0.5	<0.5	<0.5	<10	4.4	26	5.3	1
01/27/06	9	114	<0.5	<0.5	<0.5	<10	3.5	20	5.6	1
02/20/06	33	117	<0.5	<1.0	<0.5	<10	1.8	15	5.8	1
03/23/06	64	115	<0.5	<0.5	<0.5	<10	3.1	15	6.0	2
04/24/06	96	118	<0.5	<0.5	<0.5	<10	4.2	NA	6.1	<1
06/27/06	160	120	<0.5	<0.5	<0.5	<10	5.0	11	6.0	<1
10/30/06	285	126	<0.5	<0.5	<0.5	<10	5.9	13	6.1	<1

Site B, Nutrient Amended, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	8.8	<0.044	2.6	<0.044	<0.044	3.6	<0.048	1.4	<0.044	12	0.69
01/27/06	9	6.1	<0.044	2.8	<0.044	<0.044	4.0	<0.048	1.5	<0.044	14	0.72
02/20/06	33	11	<0.044	2.9	<0.044	<0.044	3.6	<0.048	1.6	<0.044	13	0.74
03/23/06	64	0.71	<0.044	2.8	<0.044	<0.044	0.24	<0.048	1.3	<0.044	11	0.60
04/24/06	96	11	0.064	2.7	<0.044	<0.044	3.1	<0.048	1.3	<0.044	8.8	0.62
06/27/06	160	10	0.13	1.8	<0.044	<0.044	3.2	<0.048	1.3	<0.044	7.8	0.62
10/30/06	285	11	0.16	0.48	<0.044	<0.044	3.3	<0.048	1.1	<0.044	5.7	0.53

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.9	3.7	3.5	14	3.7	<0.048	0.60	1.3	0.70	0.68
01/27/06	9	<0.048	1.6	4.3	3.8	12	4.0	<0.048	0.60	1.5	0.73	0.74
02/20/06	33	<0.048	2.2	4.4	3.7	9.5	3.8	<0.048	0.55	1.4	0.59	0.63
03/23/06	64	<0.048	<0.45	0.96	1.9	7.4	2.2	<0.048	<0.044	0.91	<0.13	0.21
04/24/06	96	<0.048	1.7	3.9	2.2	5.7	2.8	<0.048	<0.044	0.97	0.36	0.38
06/27/06	160	<0.048	1.5	3.8	2.5	4.8	2.7	<0.048	0.29	0.79	0.27	0.29
10/30/06	285	<0.048	1.5	3.8	1.7	3.5	2.1	<0.048	0.11	0.59	<0.13	0.19

Site B, Nutrient Amended, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	515	0	0	35
01/27/06	9	0	0	211	0	0	27
02/20/06	33	0	0	232	0	0	38
03/23/06	64	0	0	216	0	0	40
04/24/06	96	0	0	118	0	0	33
06/27/06	160	0	0	107	0	0	36
10/30/06	285	0	0	103	0	0	36

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	439	<0.5	<0.5	<0.5	357	3.9	43	4.8	1
01/27/06	9	422	<0.5	<0.5	<0.5	300	5.3	28	6.6	1
02/20/06	33	435	<0.5	<1.0	<0.5	291	6.0	22	6.3	<1
03/23/06	64	426	<2.5	<0.5	<0.5	292	4.2	19	6.2	<1
04/24/06	96	433	<2.5	<2.5	<2.5	261	<2.5	NA	6.2	<1
06/27/06	160	443	<2.5	<2.5	<0.5	275	<2.5	17	6.2	<1
10/30/06	285	464	<0.5	<0.5	<0.5	237	2.2	39	6.1	<1

1 mL of 0.5 N NaOH added on 1/19/06

Site B, Nutrient Amended, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	8.5	<0.044	3.5	<0.044	<0.044	4.4	<0.048	1.9	<0.044	15	0.89
01/27/06	9	6.9	<0.044	3.6	<0.044	<0.044	2.7	<0.048	1.9	<0.044	17	0.28
02/20/06	33	10	<0.044	3.8	<0.044	<0.044	4.2	<0.048	2.1	<0.044	16	0.74
03/23/06	64	8.9	0.058	2.1	<0.044	<0.044	3.6	<0.048	1.6	<0.044	13	0.63
04/24/06	96	8.7	0.089	0.42	<0.044	<0.044	3.6	<0.048	1.6	<0.044	12	0.65
06/27/06	160	0.16	0.16	<0.044	<0.044	<0.044	1.5	<0.048	1.5	<0.044	9.7	0.64
10/30/06	285	0.069	0.24	<0.044	<0.044	0.061	0.88	<0.048	1.5	<0.044	7.6	0.60

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.1	4.6	4.7	18	5.2	<0.048	0.78	1.8	0.94	0.90
01/27/06	9	<0.048	2.0	5.0	<0.044	14	<0.048	<0.048	0.20	1.7	0.83	<0.11
02/20/06	33	<0.048	2.8	5.4	1.5	11	1.2	<0.048	0.56	1.7	0.71	0.57
03/23/06	64	<0.048	2.4	4.7	1.3	7.2	1.3	<0.048	0.29	1.3	0.50	0.43
04/24/06	96	<0.048	2.3	4.7	1.4	6.0	1.4	<0.048	0.40	1.1	0.41	0.36
06/27/06	160	<0.048	2.0	4.3	1.4	4.9	1.7	<0.048	0.31	0.88	0.30	0.28
10/30/06	285	<0.048	1.9	4.3	1.2	4.0	1.4	<0.048	0.17	0.72	<0.13	0.20

Site B, Nutrient Amended, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	485	0	0	45
01/27/06	9	0	0	198	0	0	28
02/20/06	33	0	0	204	0	0	35
03/23/06	64	0	0	170	0	0	36
04/24/06	96	0	0	136	0	0	32
06/27/06	160	0	0	123	0	0	34
10/30/06	285	0	0	122	0	0	31

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	446	<0.5	<0.5	<0.5	353	4.4	31	5.1	1
01/27/06	9	439	<0.5	<0.5	<0.5	324	5.0	175	5.4	1
02/20/06	33	444	<0.5	<1.0	<0.5	271	3.7	30	6.6	<1
03/23/06	64	440	<2.5	<0.5	<0.5	277	2.9	16	6.4	<1
04/24/06	96	451	<2.5	<2.5	<2.5	249	<2.5	NA	6.3	<1
06/27/06	160	454	<2.5	<2.5	<0.5	226	<2.5	16	6.4	<1
10/30/06	285	474	<0.5	<0.5	<0.5	104	<0.5	40	6.5	<1

1 mL of 0.5 N NaOH added on 1/27/06

Site B, Nutrient Amended, Bottle 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	8.7	<0.044	2.8	<0.044	<0.044	3.6	<0.048	1.6	<0.044	14	0.75
01/27/06	9	9.0	<0.044	2.7	<0.044	<0.044	3.8	<0.048	1.5	<0.044	13	0.69
02/20/06	33	11	<0.044	3.1	<0.044	<0.044	3.9	<0.048	1.6	<0.044	13	0.75
03/23/06	64	11	0.053	2.7	<0.044	<0.044	3.7	<0.048	1.4	<0.044	11	0.69
04/24/06	96	6.0	0.075	2.5	<0.044	<0.044	3.4	<0.048	1.4	<0.044	9.9	0.66
06/27/06	160	0.86	0.15	2.6	<0.044	<0.044	2.5	<0.048	1.4	<0.044	8.5	0.67
10/30/06	285	<0.044	0.21	2.1	<0.044	<0.044	0.25	<0.048	1.2	<0.044	6.1	0.59

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.8	3.7	3.6	13	3.8	<0.048	0.60	1.3	0.70	0.67
01/27/06	9	<0.048	1.5	3.9	3.0	9.7	3.0	<0.048	0.57	1.4	0.67	0.65
02/20/06	33	<0.048	2.3	4.3	3.2	7.7	3.6	<0.048	0.51	1.3	0.54	0.57
03/23/06	64	<0.048	2.0	4.1	2.8	5.9	3.2	<0.048	0.40	1.1	0.40	0.44
04/24/06	96	<0.048	1.7	4.0	2.6	5.3	3.0	<0.048	0.38	1.0	0.36	0.40
06/27/06	160	<0.048	1.6	2.3	2.5	4.3	2.8	<0.048	0.29	0.77	<0.13	0.28
10/30/06	285	<0.048	1.4	<0.044	2.1	3.4	2.3	<0.048	0.22	0.61	<0.13	0.19

Site B, Nutrient Amended, Bottle 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	509	0	10	56
01/27/06	9	0	0	188	0	0	34
02/20/06	33	0	0	197	0	0	43
03/23/06	64	0	0	163	0	0	41
04/24/06	96	0	0	128	0	0	39
06/27/06	160	0	0	107	0	0	36
10/30/06	285	0	0	88	0	0	46

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	443	<0.5	<0.5	<0.5	347	3.7	31	5.4	1
01/27/06	9	431	<0.5	<0.5	0.6	314	3.4	30	5.8	1
02/20/06	33	435	<0.5	<1.0	<0.5	247	3.2	21	6.5	1
03/23/06	64	431	<2.5	<0.5	<0.5	252	2.3	18	6.5	2
04/24/06	96	440	<2.5	<2.5	<2.5	229	<2.5	NA	6.4	<1
06/27/06	160	442	<2.5	<2.5	<0.5	201	<2.5	21	6.5	<1
10/30/06	285	463	<0.5	<0.5	<0.5	64	<0.5	21	6.6	<1

1 mL of 0.5 N NaOH added on 1/27/06

Site B, Aerobic/Anaerobic Treatment, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	4.7	<0.044	2.8	<0.044	<0.044	3.5	<0.048	1.5	<0.044	10	0.68
01/27/06	9	1.8	<0.044	3.0	0.063	<0.044	0.95	<0.048	1.5	<0.044	9.6	0.22
02/20/06	33	0.27	<0.044	2.5	<0.044	<0.044	0.051	<0.048	1.1	<0.044	3.7	0.11
03/23/06	64	0.12	<0.044	1.7	<0.044	<0.044	<0.048	<0.048	0.70	<0.044	1.2	<0.048
04/24/06	96	0.12	<0.044	1.9	<0.044	<0.044	<0.048	<0.048	0.64	<0.044	0.86	<0.048
05/23/06	125	0.21	<0.044	1.2	<0.044	<0.044	<0.048	<0.048	0.34	<0.044	0.25	<0.048
05/25/06	127	0.14	<0.044	1.2	<0.044	<0.044	<0.048	<0.048	0.35	<0.044	0.21	<0.048
06/27/06	160	0.15	<0.044	0.63	<0.044	<0.044	<0.048	<0.048	0.15	<0.044	0.16	<0.048
07/24/06	187	0.098	<0.044	0.44	<0.044	<0.044	<0.048	<0.048	<0.12	<0.044	0.12	<0.048
08/23/06	217	0.23	<0.044	0.42	<0.044	<0.044	<0.048	<0.048	0.12	<0.044	0.12	<0.048
10/02/06	257	0.14	<0.044	0.24	<0.044	<0.044	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
10/30/06	285	<0.044	<0.044	0.23	<0.044	<0.044	<0.048	<0.048	<0.12	<0.044	0.086	<0.048
11/22/06	308	0.12	<0.009	0.25	<0.009	<0.009	<0.009	<0.009	0.081	<0.009	0.086	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.8	3.4	3.3	9.9	3.6	<0.048	0.57	1.3	0.70	0.68
01/27/06	9	<0.048	1.5	3.7	0.098	6.8	<0.048	<0.048	0.12	1.2	0.56	0.14
02/20/06	33	<0.048	1.9	3.4	0.051	2.9	<0.048	<0.048	0.050	0.75	0.34	<0.11
03/23/06	64	<0.048	1.7	3.0	<0.044	1.5	<0.048	<0.048	<0.044	0.53	<0.13	<0.11
04/24/06	96	<0.048	1.3	<0.044	<0.044	1.3	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/23/06	125	<0.048	1.7	<0.044	<0.044	0.12	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	1.7	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.2	<0.044	<0.044	0.099	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	1.6	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	<0.048	1.3	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	0.096	1.5	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	<0.048	1.4	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	308	0.15	1.1	<0.009	<0.009	0.085	<0.009	0.041	<0.009	0.010	<0.025	<0.022

Site B, Aerobic/Anaerobic Treatment, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	101	0	0	0
01/27/06	9	0	0	33	0	0	0
02/20/06	33	0	0	0	0	0	0
03/23/06	64	0	0	0	0	0	0
04/24/06	96	0	0	0	0	0	0
05/25/06	127	0	0	0	0	36	810
06/27/06	160	0	0	0	0	42	690
07/24/06	187	0	0	0	0	38	617
08/23/06	217	0	0	0	0	39	636
10/02/06	257	0	0	0	0	30	556
10/30/06	285	0	0	0	0	29	535

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	116	<0.5	<0.5	<0.5	<10	1.2	19	5.2	>12
01/27/06	9	116	<0.5	<0.5	<0.5	<10	2.2	14	5.1	8
02/20/06	33	122	<0.5	<1.0	<0.5	<10	3.3	6.3	5.0	7
03/23/06	64	119	<0.5	<0.5	<0.5	<10	3.7	7.5	5.0	6
04/24/06	96	NA	NA	NA	NA	NA	NA	NA	5.1	<1
05/25/06	127	118	<0.5	<0.5	<0.5	<10	5.5	NA	6.8	<1
06/27/06	160	118	<0.5	<0.5	<0.5	<10	<0.5	NA	6.9	<1
07/24/06	187	119	<0.5	<0.5	<0.5	<10	<0.5	80	7.0	<1
08/23/06	217	120	<0.5	<1.0	<0.5	<10	<1.0	123	6.9	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.6	<1
10/30/06	285	122	<0.5	<0.5	<0.5	<10	<0.5	177	6.5	<1

Microcosms turned anaerobic and substrate added on 4/24/06

Site B, Aerobic/Anaerobic Treatment, Run 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	3.5	<0.044	2.7	<0.044	<0.044	3.4	<0.048	1.4	<0.044	10	0.66
01/27/06	9	1.5	<0.044	2.8	<0.044	<0.044	0.93	<0.048	1.4	<0.044	10.0	0.27
02/20/06	33	0.11	<0.044	2.8	<0.044	<0.044	<0.048	<0.048	1.4	<0.044	9.1	0.23
03/23/06	64	<0.044	<0.044	2.5	<0.044	<0.044	<0.048	<0.048	1.3	<0.044	8.5	0.17
04/24/06	96	<0.044	<0.044	2.7	<0.044	<0.044	<0.048	<0.048	1.2	<0.044	7.5	0.10
05/23/06	125	0.056	<0.044	2.6	<0.044	<0.044	<0.048	<0.048	0.97	<0.044	3.5	<0.048
05/25/06	127	0.059	<0.044	2.5	<0.044	<0.044	<0.048	<0.048	0.86	<0.044	2.7	<0.048
06/27/06	160	0.18	<0.044	2.6	<0.044	<0.044	<0.048	<0.048	0.82	<0.044	2.4	<0.048
07/24/06	187	0.17	<0.044	2.2	<0.044	<0.044	<0.048	<0.048	0.73	<0.044	2.0	<0.048
08/23/06	217	0.34	<0.044	2.5	<0.044	<0.044	<0.048	<0.048	0.77	<0.044	2.0	<0.048
10/02/06	257	0.12	<0.044	2.5	<0.044	<0.044	<0.048	<0.048	0.76	<0.044	1.8	<0.048
10/30/06	285	0.23	<0.044	2.4	<0.044	0.049	<0.048	<0.048	0.84	<0.044	1.9	<0.048
11/22/06	308	0.16	0.053	2.3	<0.009	0.085	<0.009	<0.009	0.81	<0.009	1.9	0.029

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.8	3.4	3.3	14	3.6	<0.048	0.61	1.4	0.76	0.73
01/27/06	9	<0.048	1.5	3.8	0.30	9.2	0.060	<0.048	0.33	1.2	0.56	0.14
02/20/06	33	<0.048	1.8	3.4	0.27	6.8	0.13	<0.048	0.13	1.0	0.42	<0.11
03/23/06	64	<0.048	1.6	3.1	0.075	5.9	<0.048	<0.048	0.049	0.92	0.35	<0.11
04/24/06	96	<0.048	1.6	<0.044	<0.044	4.6	<0.048	<0.048	<0.044	0.74	<0.13	<0.11
05/23/06	125	<0.048	1.8	<0.044	<0.044	0.92	<0.048	<0.048	<0.044	0.18	<0.13	<0.11
05/25/06	127	<0.048	1.6	<0.044	<0.044	0.56	<0.048	<0.048	<0.044	0.11	<0.13	<0.11
06/27/06	160	<0.048	1.3	<0.044	<0.044	0.53	<0.048	<0.048	<0.044	0.093	<0.13	<0.11
07/24/06	187	<0.048	1.5	<0.044	<0.044	0.50	<0.048	<0.048	<0.044	0.11	<0.13	<0.11
08/23/06	217	0.11	1.5	<0.044	<0.044	0.51	<0.048	<0.048	<0.044	0.12	<0.13	<0.11
10/02/06	257	<0.048	1.6	<0.044	<0.044	0.51	<0.048	<0.048	<0.044	0.11	<0.13	<0.11
10/30/06	285	0.30	1.4	<0.044	<0.044	0.58	<0.048	<0.048	<0.044	0.12	<0.13	<0.11
11/22/06	308	0.15	1.3	<0.009	<0.009	0.47	<0.009	0.028	<0.009	0.12	<0.025	<0.022

Site B, Aerobic/Anaerobic Treatment, Run 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	0	0	0	29
01/27/06	9	0	0	108	0	0	0
02/20/06	33	0	0	117	0	0	0
03/23/06	64	0	0	94	0	0	0
04/24/06	96	0	0	58	0	0	0
05/25/06	127	0	0	0	0	16	1,032
06/27/06	160	0	0	0	0	72	920
07/24/06	187	0	0	0	0	59	731
08/23/06	217	0	0	0	0	59	738
10/02/06	257	0	0	0	0	47	669
10/30/06	285	0	0	0	0	47	754

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	116	<0.5	<0.5	<0.5	<10	2.5	18	4.9	>12
01/27/06	9	114	<0.5	<0.5	<0.5	<10	1.4	10	5.0	9
02/20/06	33	117	<0.5	<1.0	<0.5	<10	<0.5	6.2	5.1	8
03/23/06	64	117	<0.5	<0.5	<0.5	<10	2.6	5.6	5.1	8
04/24/06	96	NA	NA	NA	NA	NA	NA	NA	5.0	<1
05/25/06	127	115	<0.5	<0.5	<0.5	<10	4.6	NA	6.9	<1
06/27/06	160	116	<0.5	<0.5	<0.5	<10	<0.5	NA	6.8	<1
07/24/06	187	118	<0.5	<0.5	<0.5	<10	<0.5	37	7.0	<1
08/23/06	217	118	<0.5	<1.0	<0.5	<10	<1.0	NA	7.0	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.5	<1
10/30/06	285	120	<0.5	<0.5	<0.5	<10	<0.5	198	6.4	<1

Microcosms turned anaerobic and substrate added on 4/24/06

Site B, Aerobic/Anaerobic Treatment, Run 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/27/06	1	1.9	<0.044	3.9	<0.044	<0.044	4.3	<0.048	2.1	<0.044	19	0.91
02/03/06	9	0.84	<0.044	3.3	<0.044	<0.044	1.9	<0.048	1.9	<0.044	15	0.86
02/27/06	33	<0.044	<0.044	3.9	<0.044	<0.044	<0.048	<0.048	2.0	<0.044	15	0.83
03/23/06	56	<0.044	0.052	3.6	0.057	<0.044	<0.048	<0.048	1.9	<0.044	15	0.74
04/24/06	88	<0.044	0.066	3.4	<0.044	<0.044	<0.048	<0.048	1.7	<0.044	12	<0.048
05/23/06	117	0.15	<0.044	3.3	<0.044	<0.044	<0.048	<0.048	1.3	<0.044	5.5	<0.048
05/25/06	119	0.17	<0.044	3.1	<0.044	<0.044	<0.048	<0.048	1.1	<0.044	4.1	<0.048
06/27/06	152	0.16	<0.044	3.6	<0.044	<0.044	<0.048	<0.048	0.99	<0.044	3.8	<0.048
07/24/06	179	0.12	<0.044	3.8	<0.044	<0.044	<0.048	<0.048	0.69	<0.044	3.4	<0.048
08/23/06	209	<0.044	<0.044	3.4	<0.044	<0.044	<0.048	<0.048	0.61	<0.044	3.1	<0.048
10/02/06	249	0.30	0.046	2.7	<0.044	<0.044	<0.048	<0.048	0.60	<0.044	3.0	<0.048
10/30/06	277	0.20	0.058	3.2	<0.044	0.057	<0.048	<0.048	0.66	<0.044	3.2	<0.048
11/22/06	300	0.16	0.074	3.9	<0.009	0.097	<0.009	<0.009	0.63	<0.009	3.0	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/27/06	1	<0.048	1.7	4.8	3.3	13	2.5	<0.048	0.71	1.8	0.93	0.80
02/03/06	9	<0.048	2.2	4.6	3.5	9.8	3.2	<0.048	0.60	1.7	0.82	0.74
02/27/06	33	<0.048	2.6	4.6	2.4	7.7	1.9	<0.048	0.33	1.5	0.62	0.52
03/23/06	64	<0.048	2.4	4.4	1.6	6.3	1.2	<0.048	0.12	1.4	0.53	0.40
04/24/06	96	<0.048	2.1	<0.044	<0.044	4.9	<0.048	<0.048	<0.044	0.15	<0.13	<0.11
05/23/06	125	<0.048	1.9	<0.044	<0.044	1.1	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	2.3	<0.044	<0.044	0.59	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.6	<0.044	<0.044	0.55	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	0.083	1.9	<0.044	<0.044	0.54	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	0.53	1.6	<0.044	<0.044	0.59	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	0.58	1.6	<0.044	<0.044	0.56	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	0.37	1.9	<0.044	<0.044	0.56	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	300	0.34	1.5	<0.009	<0.009	0.43	<0.009	0.058	<0.009	0.016	<0.025	<0.022

Site B, Aerobic/Anaerobic Treatment, Run 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/27/06	1	0	0	56	0	0	129
02/03/06	9	0	0	53	0	0	163
02/27/06	33	0	0	51	0	0	308
03/23/06	56	0	0	44	0	0	318
04/24/06	88	0	0	29	0	0	249
05/25/06	119	0	0	0	0	29	1,104
06/27/06	152	0	0	0	0	73	997
07/24/06	179	0	0	0	0	62	866
08/23/06	209	0	0	0	0	60	814
10/02/06	249	0	0	0	0	53	783
10/30/06	277	0	0	0	0	50	727

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/27/06	1	114	<0.5	<0.5	<0.5	<10	<0.5	19	5.2	>12
02/03/06	9	115	<0.5	<0.5	<0.5	<10	<0.5	6.8	4.8	8
02/27/06	33	118	<0.5	<1.0	<0.5	<10	1.9	8.5	4.6	6
03/23/06	56	117	<0.5	<0.5	<0.5	<10	3.5	7.3	4.6	6
04/24/06	88	NA	NA	NA	NA	NA	NA	NA	4.7	<1
05/25/06	119	118	<0.5	<0.5	<0.5	<10	5.3	NA	6.8	<1
06/27/06	152	119	<0.5	<0.5	<0.5	<10	<0.5	NA	6.8	<1
07/24/06	179	119	<0.5	<0.5	<0.5	<10	<0.5	62	7.0	<1
08/23/06	209	120	<0.5	<1.0	<0.5	<10	<1.0	102	7.0	<1
10/02/06	249	NA	NA	NA	NA	NA	NA	NA	6.6	<1
10/30/06	277	122	<0.5	0.7	<0.5	<10	<0.5	170	6.4	<1

Microcosms turned anaerobic and substrate added on 4/24/06

Site B, Aerobic/Anaerobic Treatment with Bioaugmentation, Bottle 1

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	6.2	<0.044	3.7	<0.044	<0.044	4.3	<0.048	1.9	<0.044	13	0.88
01/27/06	9	4.3	<0.044	3.4	<0.044	<0.044	2.5	<0.048	1.8	<0.044	14	0.53
02/20/06	33	0.12	<0.044	3.3	<0.044	<0.044	<0.048	<0.048	1.6	<0.044	11	0.44
03/23/06	64	<0.044	0.053	3.2	<0.044	<0.044	<0.048	<0.048	1.7	<0.044	12	0.43
04/24/06	96	<0.044	0.080	3.2	<0.044	<0.044	<0.048	<0.048	1.6	<0.044	11	0.074
05/23/06	125	0.19	0.049	3.3	<0.044	<0.044	<0.048	<0.048	1.3	<0.044	5.0	<0.048
05/25/06	127	0.17	<0.044	2.9	<0.044	<0.044	<0.048	<0.048	1.1	<0.044	3.6	<0.048
06/27/06	160	0.17	<0.044	3.2	0.053	<0.044	<0.048	<0.048	1.0	<0.044	3.3	<0.048
07/24/06	187	0.060	0.048	2.8	<0.044	<0.044	<0.048	<0.048	0.78	<0.044	3.1	<0.048
08/23/06	217	0.30	0.056	3.4	<0.044	0.097	<0.048	<0.048	0.79	<0.044	3.2	<0.048
10/02/06	257	0.13	0.051	4.1	<0.044	3.6	<0.048	<0.048	<0.12	<0.044	0.43	<0.048
10/30/06	285	0.16	0.051	3.6	<0.044	3.9	<0.048	<0.048	<0.12	<0.044	<0.048	<0.048
11/22/06	308	0.21	0.069	0.66	<0.009	4.2	0.035	1.4	<0.025	<0.009	0.17	0.010

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.2	4.4	4.0	13	4.2	<0.048	0.61	1.4	0.72	0.71
01/27/06	9	<0.048	1.7	4.6	0.89	11	0.41	<0.048	0.28	1.5	0.73	0.34
02/20/06	33	<0.048	2.3	2.4	0.56	6.0	0.33	<0.048	0.10	1.0	0.42	0.17
03/23/06	64	<0.048	2.2	0.24	0.34	6.8	0.15	<0.048	<0.044	1.2	0.46	0.14
04/24/06	96	<0.048	1.9	<0.044	<0.044	5.3	<0.048	<0.048	<0.044	0.96	<0.13	<0.11
05/23/06	125	<0.048	1.9	<0.044	<0.044	1.3	<0.048	<0.048	<0.044	0.29	<0.13	<0.11
05/25/06	127	<0.048	2.0	<0.044	<0.044	0.69	<0.048	<0.048	<0.044	0.15	<0.13	<0.11
06/27/06	160	<0.048	1.6	<0.044	<0.044	0.66	<0.048	<0.048	<0.044	0.12	<0.13	<0.11
07/24/06	187	<0.048	2.0	<0.044	<0.044	0.67	<0.048	<0.048	<0.044	0.16	<0.13	<0.11
08/23/06	217	0.096	1.8	<0.044	<0.044	0.86	<0.048	<0.048	<0.044	0.21	<0.13	<0.11
10/02/06	257	<0.048	1.9	<0.044	<0.044	1.0	<0.048	<0.048	<0.044	0.24	<0.13	<0.11
10/30/06	285	<0.048	1.6	<0.044	<0.044	1.1	<0.048	<0.048	<0.044	0.26	<0.13	<0.11
11/22/06	308	0.14	1.4	<0.009	<0.009	0.20	<0.009	<0.010	<0.009	0.27	<0.025	<0.022

Site B, Aerobic/Anaerobic Treatment with Bioaugmentation, Bottle 1

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	221	0	0	30
01/27/06	9	0	0	114	0	0	0
02/20/06	33	0	0	119	0	0	30
03/23/06	64	0	0	102	0	0	32
04/24/06	96	0	0	61	0	0	0
05/25/06	127	0	0	0	0	48	1,286
06/27/06	160	0	0	0	0	81	2,141
07/24/06	187	0	0	0	0	63	1,789
08/23/06	217	0	0	0	0	63	1,937
10/02/06	257	0	0	0	0	48	1,626
10/30/06	285	0	0	0	0	46	1,641

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	116	<0.5	<0.5	<0.5	<10	1.3	23	5.0	>12
01/27/06	9	116	<0.5	<0.5	<0.5	<10	0.8	16	5.1	9
02/20/06	33	118	<0.5	<1.0	<0.5	<10	0.5	8.0	4.9	8
03/23/06	64	118	<0.5	<0.5	<0.5	<10	3.0	6.0	4.9	6
04/24/06	96	NA	NA	NA	NA	NA	NA	NA	4.9	<1
05/25/06	127	128	<0.5	<0.5	<0.5	<10	5.0	NA	6.9	<1
06/27/06	160	129	<0.5	<0.5	<0.5	<10	<0.5	NA	6.7	<1
07/24/06	187	128	<0.5	<0.5	<0.5	<10	<0.5	143	6.8	<1
08/23/06	217	139	<0.5	<1.0	<0.5	<10	<1.0	247	6.7	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.4	<1
10/30/06	285	141	<0.5	<0.5	<0.5	<10	<0.5	320	6.2	<1

Microcosms turned anaerobic and substrate added on 4/24/06
Bioaugmented with CTC and ACT3 cultures on 5/23/06
Bioaugmented with ACT3 and KB1 cultures on 8/10/06

Site B, Aerobic/Anaerobic Treatment with Bioaugmentation, Bottle 2

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	6.4	<0.044	3.0	<0.044	<0.044	3.7	<0.048	1.5	<0.044	11	0.71
01/27/06	9	2.7	<0.044	3.0	<0.044	<0.044	1.4	<0.048	1.5	<0.044	11	0.34
02/20/06	33	0.16	<0.044	3.0	<0.044	<0.044	<0.048	<0.048	1.5	<0.044	9.7	0.30
03/23/06	64	<0.044	<0.044	3.0	<0.044	<0.044	<0.048	<0.048	1.6	<0.044	10	0.27
04/24/06	96	<0.044	0.052	3.1	<0.044	<0.044	<0.048	<0.048	1.4	<0.044	8.6	0.13
05/23/06	125	0.21	<0.044	2.8	<0.044	<0.044	<0.048	<0.048	1.1	<0.044	4.1	0.086
05/25/06	127	0.21	<0.044	2.8	<0.044	<0.044	<0.048	<0.048	0.98	<0.044	3.0	0.068
06/27/06	160	<0.044	<0.044	2.9	0.055	<0.044	<0.048	<0.048	0.73	<0.044	3.0	0.069
07/24/06	187	0.096	<0.044	2.7	<0.044	0.13	<0.048	0.11	0.23	<0.044	2.5	0.066
08/23/06	217	0.34	<0.044	3.1	<0.044	0.18	<0.048	0.085	0.24	<0.044	2.8	0.072
10/02/06	257	0.17	<0.044	2.0	<0.044	3.1	<0.048	0.60	<0.12	<0.044	0.36	0.068
10/30/06	285	0.21	<0.044	<0.044	<0.044	3.4	<0.048	2.1	<0.12	<0.044	<0.048	0.071
11/22/06	308	0.054	0.053	0.017	<0.009	3.4	<0.009	2.1	<0.025	<0.009	<0.009	0.072

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	2.0	3.7	3.5	14	3.9	<0.048	0.61	1.4	0.75	0.73
01/27/06	9	<0.048	1.6	4.1	0.56	9.9	0.23	<0.048	0.36	1.3	0.64	0.23
02/20/06	33	<0.048	1.9	3.8	0.45	7.2	0.26	<0.048	0.17	1.1	0.45	0.14
03/23/06	64	<0.048	2.1	4.1	0.18	6.2	0.063	<0.048	0.047	1.0	0.36	<0.11
04/24/06	96	<0.048	1.7	<0.044	<0.044	5.1	<0.048	<0.048	<0.044	0.87	0.27	<0.11
05/23/06	125	<0.048	1.8	<0.044	<0.044	1.5	<0.048	<0.048	<0.044	0.30	<0.13	<0.11
05/25/06	127	<0.048	1.6	<0.044	<0.044	0.65	<0.048	<0.048	<0.044	0.14	<0.13	<0.11
06/27/06	160	0.160	1.4	<0.044	<0.044	1.0	<0.048	<0.048	<0.044	0.15	<0.13	<0.11
07/24/06	187	<0.048	1.9	<0.044	<0.044	0.67	<0.048	<0.048	<0.044	0.15	<0.13	<0.11
08/23/06	217	<0.048	1.6	<0.044	<0.044	1.1	<0.048	<0.048	<0.044	0.26	<0.13	<0.11
10/02/06	257	<0.048	1.8	<0.044	<0.044	0.84	<0.048	<0.048	<0.044	0.25	<0.13	<0.11
10/30/06	285	<0.048	1.4	<0.044	<0.044	<0.048	<0.048	<0.048	<0.044	0.27	<0.13	<0.11
11/22/06	308	<0.009	0.26	<0.009	<0.009	<0.009	<0.009	<0.010	<0.009	0.22	0.041	<0.022

Site B, Aerobic/Anaerobic Treatment with Bioaugmentation, Bottle 2

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	159	0	0	0
01/27/06	9	0	0	108	0	0	0
02/20/06	33	0	0	110	0	0	0
03/23/06	64	0	0	95	0	0	0
04/24/06	96	0	0	57	0	0	0
05/25/06	127	0	0	0	0	36	1,073
06/27/06	160	0	0	0	0	76	1,356
07/24/06	187	0	0	0	0	62	1,736
08/23/06	217	0	0	0	0	63	1,889
10/02/06	257	0	0	0	0	49	1,890
10/30/06	285	0	0	0	0	45	3,029

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	115	<0.5	<0.5	<0.5	<10	1.5	20	5.0	>12
01/27/06	9	115	<0.5	<0.5	<0.5	<10	1.0	15	5.0	9
02/20/06	33	117	<0.5	<1.0	<0.5	<10	<0.5	7.9	5.0	7
03/23/06	64	117	<0.5	<0.5	<0.5	<10	2.8	6.6	5.0	7
04/24/06	96	NA	NA	NA	NA	NA	NA	NA	5.1	<1
05/25/06	127	126	<0.5	<0.5	<0.5	<10	4.9	NA	6.9	<1
06/27/06	160	127	<0.5	<0.5	<0.5	<10	<0.5	NA	6.8	<1
07/24/06	187	128	<0.5	<0.5	<0.5	<10	<0.5	159	6.8	<1
08/23/06	217	137	<0.5	<1.0	<0.5	<10	<1.0	308	6.6	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.3	<1
10/30/06	285	144	<0.5	<0.5	<0.5	<10	<0.5	376	6.1	<1

Microcosms turned anaerobic and substrate added on 4/24/06
Bioaugmented with CTC and ACT3 cultures on 5/23/06
Bioaugmented with ACT3 and KB1 cultures on 8/10/06

Site B, Aerobic/Anaerobic Treatment with Bioaugmentation, Run 3

Date of Sample	Days	Acetone mg/L	1-1 DCE mg/L	M Chloride mg/L	trans-DCE mg/L	1,1-DCA mg/L	MEK mg/L	cis-DCE mg/L	Chloroform mg/L	1,2-DCA mg/L	1,1,1-TCA mg/L	Benzene mg/L
01/19/06	1	5.4	<0.044	3.1	<0.044	<0.044	3.9	<0.048	1.5	<0.044	12	0.74
01/27/06	9	2.6	<0.044	2.9	<0.044	<0.044	1.5	<0.048	1.5	<0.044	11	0.36
02/20/06	33	0.11	<0.044	2.9	<0.044	<0.044	<0.048	<0.048	1.4	<0.044	9.7	0.27
03/23/06	64	<0.044	<0.044	2.8	<0.044	<0.044	<0.048	<0.048	1.4	<0.044	9.9	0.21
04/24/06	96	<0.044	0.056	2.8	<0.044	<0.044	<0.048	<0.048	1.3	<0.044	8.6	0.092
05/23/06	125	0.13	<0.044	2.8	<0.044	<0.044	<0.048	<0.048	1.0	<0.044	4.0	0.058
05/25/06	127	0.17	<0.044	2.6	<0.044	<0.044	<0.048	<0.048	0.91	<0.044	3.2	0.049
06/27/06	160	0.16	<0.044	3.3	0.069	0.17	<0.048	<0.048	<0.12	<0.044	2.9	0.047
07/24/06	187	0.15	<0.044	3.0	0.050	0.26	<0.048	<0.048	<0.12	<0.044	2.5	<0.048
08/23/06	217	0.34	0.047	3.0	<0.044	2.2	<0.048	1.1	<0.12	<0.044	1.2	0.068
10/02/06	257	0.15	<0.044	3.1	<0.044	3.3	<0.048	0.99	<0.12	<0.044	0.27	0.051
10/30/06	285	0.15	<0.044	2.4	<0.044	3.1	0.50	0.91	<0.12	<0.044	<0.048	<0.048
11/22/06	308	<0.009	0.037	2.6	<0.009	3.6	<0.009	0.99	<0.025	<0.009	<0.009	<0.009

Date of Sample	Days	TCE mg/L	1,4-dioxane mg/L	MIBK mg/L	Toluene mg/L	PCE mg/L	Chloro benzene mg/L	Ethyl benzene mg/L	p-xylene mg/L	o-xylene mg/L	m-DCB mg/L	p-DCB mg/L
01/19/06	1	<0.048	1.9	3.9	3.9	16	4.4	<0.048	0.70	1.6	0.87	0.84
01/27/06	9	<0.048	1.8	4.1	0.72	9.8	0.41	<0.048	0.26	1.4	0.65	0.25
02/20/06	33	<0.048	2.0	3.3	0.34	6.8	0.21	<0.048	0.066	1.1	0.44	0.12
03/23/06	64	<0.048	1.9	2.7	0.12	6.5	<0.048	<0.048	<0.044	1.1	0.41	<0.11
04/24/06	96	<0.048	1.7	<0.044	<0.044	5.0	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/23/06	125	<0.048	1.9	<0.044	<0.044	1.0	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
05/25/06	127	<0.048	1.8	<0.044	<0.044	0.66	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
06/27/06	160	<0.048	1.5	<0.044	<0.044	0.71	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
07/24/06	187	<0.048	1.5	<0.044	<0.044	0.27	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
08/23/06	217	0.098	1.5	<0.044	<0.044	0.49	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/02/06	257	0.058	1.6	<0.044	<0.044	0.60	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
10/30/06	285	0.050	1.3	<0.044	<0.044	0.54	<0.048	<0.048	<0.044	<0.044	<0.13	<0.11
11/22/06	308	0.11	<0.090	<0.009	<0.009	0.30	<0.009	<0.010	<0.009	<0.009	<0.025	<0.022

Site B, Aerobic/Anaerobic Treatment with Bioaugmentation, Run 3

Date of Sample	Days	CA ppmv	VC ppmv	CM ppmv	Ethene ppmv	Ethane ppmv	Methane ppmv
01/19/06	1	0	0	179	0	0	0
01/27/06	9	0	0	114	0	0	0
02/20/06	33	0	0	113	0	0	37
03/23/06	64	0	0	101	0	0	47
04/24/06	96	0	0	59	0	0	35
05/25/06	127	0	0	0	0	33	1,260
06/27/06	160	0	0	0	0	72	2,436
07/24/06	187	0	0	0	0	55	3,668
08/23/06	217	0	9	0	0	55	5,696
10/02/06	257	0	9	0	0	47	10,117
10/30/06	285	0	10	0	0	44	10,788

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	DO mg/L
01/19/06	1	116	<0.5	<0.5	<0.5	<10	1.9	19	4.8	>12
01/27/06	9	116	<0.5	<0.5	<0.5	<10	0.9	13	4.9	8
02/20/06	33	119	<0.5	<1.0	<0.5	<10	<0.5	6.2	4.8	7
03/23/06	64	117	<0.5	<0.5	<0.5	<10	3.3	5.3	4.8	6
04/24/06	96	NA	NA	NA	NA	NA	NA	NA	4.9	<1
05/25/06	127	127	<0.5	<0.5	<0.5	<10	5.6	NA	6.8	<1
06/27/06	160	128	<0.5	<0.5	<0.5	<10	<0.5	NA	6.7	<1
07/24/06	187	130	<0.5	<0.5	<0.5	<10	<0.5	124	6.9	<1
08/23/06	217	141	<0.5	<1.0	<0.5	<10	<1.0	256	6.6	<1
10/02/06	257	NA	NA	NA	NA	NA	NA	NA	6.2	<1
10/30/06	285	141	<0.5	<0.5	<0.5	<10	<0.5	347	6.1	<1

Microcosms turned anaerobic and substrate added on 4/24/06
Bioaugmented with CTC and ACT3 cultures on 5/23/06
Bioaugmented with ACT3 and KB1 cultures on 8/10/06

APPENDIX E
CHARLESTON MICROCOSM RESULTS

Background, Inhibited, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	17	0.51	< 0.044	< 0.044	< 8	< 8	< 8	< 8	92
10/17/05	19	< 0.044	17	0.54	< 0.044	< 0.044	< 8	< 8	< 8	< 8	81
12/12/05	75	< 0.044	12	0.36	< 0.044	< 0.044	< 8	< 8	546	12	96
01/31/06	125	< 0.044	11	0.35	< 0.044	< 0.044	< 8	< 8	< 8	8	53
06/05/06	250	< 0.044	9.5	0.33	< 0.044	< 0.044	< 8	< 8	62	9	92
12/19/06	447	< 0.009	8.8	0.34	< 0.009	< 0.009	< 8	< 8	65	< 8	319

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	510	< 0.5	1.4	< 0.5	< 1.0	51	-	-	3.0
10/17/05	19	-	-	-	-	-	-	34	4.7	3.0
12/12/05	75	-	-	-	-	-	-	29	4.1	2.6
01/31/06	125	-	-	-	-	-	-	32	4.4	3.0
06/05/06	250	760	< 1.0	< 1.0	< 1.0	< 20	56	48	4.7	2.9
12/19/06	447	-	-	-	-	-	-	47	4.8	2.9

Background, Inhibited, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	18	0.50	< 0.044	< 0.044	< 8	< 8	< 8	< 8	89
10/17/05	19	< 0.044	19	0.56	< 0.044	< 0.044	< 8	< 8	< 8	< 8	81
12/12/05	75	< 0.044	12	0.37	< 0.044	< 0.044	< 8	< 8	< 8	< 8	83
01/31/06	125	< 0.044	12	0.37	< 0.044	< 0.044	< 8	< 8	< 8	< 8	83
06/05/06	250	< 0.044	10	0.34	< 0.044	< 0.044	< 8	< 8	< 8	< 8	88
12/19/06	447	< 0.009	8.5	0.33	< 0.009	< 0.009	< 8	< 8	< 8	< 8	80

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	512	< 0.5	1.5	< 0.5	< 1.0	51	-	-	3.0
10/17/05	19	-	-	-	-	-	-	36	4.7	3.0
12/12/05	75	-	-	-	-	-	-	29	4.1	3.0
01/31/06	125	-	-	-	-	-	-	33	4.2	3.0
06/05/06	250	783	< 1.0	< 1.0	< 1.0	< 20	51	54	4.5	3.0
12/19/06	447	-	-	-	-	-	-	48	4.5	3.0

Background, Inhibited, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	17	0.48	< 0.044	< 0.044	< 8	< 8	< 8	< 8	95
10/17/05	19	< 0.044	13	0.71	< 0.044	< 0.044	< 8	< 8	< 8	< 8	73
12/12/05	75	< 0.044	12	0.36	< 0.044	< 0.044	< 8	< 8	< 8	9	95
01/31/06	125	< 0.044	11	0.36	< 0.044	< 0.044	< 8	< 8	< 8	9	89
06/05/06	250	< 0.044	10	0.35	< 0.044	< 0.044	< 8	< 8	< 8	< 8	90
12/19/06	447	< 0.009	8.8	0.33	< 0.009	< 0.009	< 8	< 8	< 8	< 8	82

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	464	< 0.5	1.5	< 0.5	< 1.0	48	-	-	3.0
10/17/05	19	-	-	-	-	-	-	34	4.9	2.9
12/12/05	75	-	-	-	-	-	-	21	4.5	3.0
01/31/06	125	-	-	-	-	-	-	33	4.0	3.0
06/05/06	250	1004	< 1.0	< 1.0	< 1.0	< 20	48	43	4.3	3.0
12/19/06	447	-	-	-	-	-	-	50	4.5	3.0

Background, Ambient, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	36	0.62	< 0.044	< 0.044	< 8	< 8	< 8	< 8	179
10/17/05	19	< 0.044	19	0.53	< 0.044	< 0.044	< 8	< 8	< 8	< 8	127
12/12/05	75	< 0.044	17	0.41	< 0.044	< 0.044	< 8	< 8	< 8	< 8	127
01/31/06	125	< 0.044	14	0.39	< 0.044	< 0.044	< 8	< 8	< 8	< 8	115
06/05/06	250	< 0.044	11	0.35	< 0.044	< 0.044	< 8	< 8	< 8	< 8	124
12/19/06	447	< 0.009	9.5	0.35	< 0.009	< 0.009	< 8	< 8	< 8	< 8	87

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	273	< 0.5	1.4	< 0.5	< 1.0	34	-	-	3.0
10/17/05	19	-	-	-	-	-	-	7.5	5.5	3.0
12/12/05	75	-	-	-	-	-	-	4.0	5.3	3.0
01/31/06	125	-	-	-	-	-	-	13	5.5	3.0
06/05/06	250	271	< 1.0	1.3	< 1.0	< 20	41	4.6	5.9	3.0
12/19/06	447	-	-	-	-	-	-	15	5.9	3.0

Background, Ambient, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	28	0.53	< 0.044	< 0.044	< 8	< 8	< 8	< 8	199
10/17/05	19	< 0.044	22	0.52	< 0.044	< 0.044	< 8	< 8	< 8	< 8	148
12/12/05	75	< 0.044	16	0.41	< 0.044	< 0.044	< 8	< 8	< 8	< 8	212
01/31/06	125	< 0.044	12	0.35	< 0.044	< 0.044	< 8	< 8	< 8	< 8	121
06/05/06	250	< 0.044	11	0.45	< 0.044	< 0.044	< 8	< 8	< 8	< 8	118
12/19/06	447	< 0.009	10	0.75	< 0.009	< 0.009	< 8	< 8	< 8	< 8	91

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	270	< 0.5	1.4	< 0.5	< 1.0	35	-	-	3.0
10/17/05	19	-	-	-	-	-	-	7.2	5.6	3.0
12/12/05	75	-	-	-	-	-	-	13	5.0	3.0
01/31/06	125	-	-	-	-	-	-	22	5.6	3.0
06/05/06	250	276	< 1.0	1.3	< 1.0	< 20	42	5.7	5.7	3.0
12/19/06	447	-	-	-	-	-	-	14	5.6	2.9

Background, Ambient, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	28	0.55	< 0.044	< 0.044	< 8	< 8	< 8	< 8	198
10/17/05	19	< 0.044	21	0.52	< 0.044	< 0.044	< 8	< 8	< 8	< 8	138
12/12/05	75	< 0.044	17	0.41	< 0.044	< 0.044	< 8	< 8	< 8	< 8	140
01/31/06	125	< 0.044	15	0.39	< 0.044	< 0.044	< 8	< 8	< 8	< 8	130
06/05/06	250	< 0.044	13	0.37	< 0.044	< 0.044	< 8	< 8	< 8	< 8	117
12/19/06	447	< 0.009	10	0.38	< 0.009	< 0.009	< 8	< 8	< 8	< 8	91

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	267	< 0.5	1.4	< 0.5	< 1.0	35	-	-	3.0
10/17/05	19	-	-	-	-	-	-	6.0	5.6	3.0
12/12/05	75	-	-	-	-	-	-	3.6	5.2	3.0
01/31/06	125	-	-	-	-	-	-	11	5.5	3.0
06/05/06	250	274	< 1.0	1.3	< 1.0	< 20	43	8.0	5.7	3.0
12/19/06	447	-	-	-	-	-	-	16	5.5	3.0

Background, Buffered, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	25	0.50	< 0.044	< 0.044	< 8	< 8	< 8	14	57
10/17/05	19	< 0.044	21	0.82	< 0.044	< 0.044	< 8	< 8	< 8	10	44
12/12/05	75	< 0.044	14	0.84	< 0.044	< 0.044	< 8	< 8	< 8	10	41
01/31/06	125	< 0.044	14	0.95	< 0.044	< 0.044	< 8	< 8	< 8	9	39
06/05/06	250	< 0.044	11	1.1	< 0.044	< 0.044	< 8	< 8	< 8	8	40
12/19/06	447	< 0.009	8.3	1.6	< 0.009	< 0.009	< 8	< 8	< 8	< 8	31

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	254	< 0.5	1.4	< 0.5	< 1.0	42	-	-	3.0
10/17/05	19	-	-	-	-	-	-	7.9	7.1	2.9
12/12/05	75	-	-	-	-	-	-	7.5	6.9	2.9
01/31/06	125	-	-	-	-	-	-	28	7.0	2.9
06/05/06	250	258	< 1.0	1.2	< 1.0	< 20	42	7.0	7.0	2.9
12/19/06	447	-	-	-	-	-	-	91	7.0	2.8

Background, Buffered, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	16	0.39	< 0.044	< 0.044	< 8	< 8	< 8	17	28
10/17/05	19	< 0.044	12	0.53	< 0.044	< 0.044	< 8	< 8	< 8	12	< 8
12/12/05	75	< 0.044	8.7	0.88	< 0.044	< 0.044	< 8	< 8	< 8	12	< 8
01/31/06	125	< 0.044	8.4	1.5	< 0.044	< 0.044	< 8	< 8	< 8	11	< 8
06/05/06	250	< 0.044	4.7	3.4	< 0.044	< 0.044	< 8	< 8	< 8	10	< 8
12/19/06	447	< 0.009	0.094	7.0	< 0.009	< 0.009	< 8	< 8	< 8	< 8	< 8

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	255	< 0.5	1.3	< 0.5	< 1.0	40	-	-	3.0
10/17/05	19	-	-	-	-	-	-	13	7.3	2.9
12/12/05	75	-	-	-	-	-	-	7.5	7.1	2.9
01/31/06	125	-	-	-	-	-	-	35	7.2	2.8
06/05/06	250	261	< 1.0	1.2	< 1.0	< 20	43	57	7.1	2.5
12/19/06	447	-	-	-	-	-	-	72	7.1	2.0

Background, Buffered, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	28	0.54	< 0.044	< 0.044	< 8	< 8	< 8	15	50
10/17/05	19	< 0.044	18	0.53	< 0.044	< 0.044	< 8	< 8	< 8	11	39
12/12/05	75	< 0.044	15	0.45	< 0.044	< 0.044	< 8	< 8	< 8	15	53
01/31/06	125	< 0.044	14	0.50	< 0.044	< 0.044	< 8	< 8	< 8	9	34
06/05/06	250	< 0.044	10	0.56	< 0.044	< 0.044	< 8	< 8	< 8	9	35
12/19/06	447	< 0.009	8.8	1.1	< 0.009	< 0.009	< 8	< 8	< 8	< 8	< 8

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	252	< 0.5	1.3	< 0.5	< 1.0	43	-	-	3.0
10/17/05	19	-	-	-	-	-	-	8.9	7.0	3.0
12/12/05	75	-	-	-	-	-	-	6.5	6.8	3.0
01/31/06	125	-	-	-	-	-	-	-0.65	7.0	3.0
06/05/06	250	258	< 1.0	1.2	< 1.0	< 20	43	12	7.0	2.9
12/19/06	447	-	-	-	-	-	-	102	7.2	2.9

Background, Buffer + EOS, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	16	0.44	< 0.044	< 0.044	< 8	< 8	< 8	14	41
10/17/05	19	< 0.044	0.30	18	< 0.044	< 0.044	< 8	10	< 8	10	32
12/12/05	75	< 0.044	< 0.044	14	< 0.044	< 0.044	< 8	39	14	11	35
01/31/06	125	< 0.044	< 0.044	13	< 0.044	< 0.044	< 8	38	14	11	1,036
06/05/06	250	< 0.044	< 0.044	13	< 0.044	< 0.044	< 8	42	11	9	171,907
12/19/06	447	< 0.009	< 0.009	9.4	< 0.009	< 0.009	< 8	34	< 8	< 8	833,273

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	250	< 0.5	1.3	< 0.5	< 1.0	35	-	-	3.0
10/17/05	19	-	-	-	-	-	-	66	6.9	2.0
12/12/05	75	-	-	-	-	-	-	47	6.8	2.0
01/31/06	125	-	-	-	-	-	-	100	6.9	2.0
06/05/06	250	262	< 1.0	1.3	< 1.0	< 20	< 1.0	34	6.9	2.0
12/19/06	447	-	-	-	-	-	-	228	7.0	2.0

Background, Buffer + EOS, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	18	0.53	< 0.044	< 0.044	< 8	< 8	< 8	21	66
10/17/05	19	< 0.044	0.14	19	< 0.044	< 0.044	< 8	14	11	10	34
12/12/05	75	< 0.044	< 0.044	15	< 0.044	0.052	< 8	61	22	13	41
01/31/06	125	< 0.044	< 0.044	14	< 0.044	< 0.044	< 8	59	21	12	1,016
06/05/06	250	< 0.044	< 0.044	14	< 0.044	< 0.044	< 8	46	14	8	403,791
12/19/06	447	< 0.009	< 0.009	10	< 0.009	< 0.009	< 8	36	< 8	< 8	868,799

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	257	< 0.5	1.4	< 0.5	< 1.0	40	-	-	3.0
10/17/05	19	-	-	-	-	-	-	70	6.9	2.0
12/12/05	75	-	-	-	-	-	-	80	6.7	2.0
01/31/06	125	-	-	-	-	-	-	126	6.9	2.0
06/05/06	250	266	< 1.0	1.3	< 1.0	< 20	< 1.0	66	6.8	2.0
12/19/06	447	-	-	-	-	-	-	203	6.9	2.0

Background, Buffer + EOS, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	20	0.50	< 0.044	< 0.044	< 8	< 8	< 8	14	49
10/17/05	19	< 0.044	0.51	22	< 0.044	< 0.044	< 8	24	9	11	44
12/12/05	75	< 0.044	< 0.044	16	< 0.044	0.057	< 8	61	21	13	51
01/31/06	125	< 0.044	< 0.044	15	< 0.044	0.044	< 8	64	22	13	1,866
06/05/06	250	< 0.044	< 0.044	14	< 0.044	< 0.044	< 8	53	15	10	260,222
12/19/06	447	< 0.009	< 0.009	10	< 0.009	< 0.009	< 8	42	< 8	< 8	808,410

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	257	< 0.5	1.3	< 0.5	< 1.0	37	-	-	3.0
10/17/05	19	-	-	-	-	-	-	63	6.9	2.0
12/12/05	75	-	-	-	-	-	-	46	6.8	2.0
01/31/06	125	-	-	-	-	-	-	173	6.9	2.0
06/05/06	250	265	< 1.0	1.2	< 1.0	< 20	< 1.0	69	6.9	2.0
12/19/06	447	-	-	-	-	-	-	240	6.9	2.0

Background, Bioaugmented, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	16	0.48	< 0.044	< 0.044	< 8	< 8	< 8	15	45
10/17/05	19	< 0.044	0.095	19	< 0.044	< 0.044	< 8	84	< 8	11	42
12/12/05	75	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	6,808	22	56
01/31/06	125	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	6,833	58	60
06/05/06	250	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	6,153	124	2,092
12/19/06	447	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 8	< 8	4,884	103	21,826

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	254	< 0.5	1.3	< 0.5	< 1.0	18	-	-	3.0
10/17/05	19	-	-	-	-	-	-	67	6.9	2.0
12/12/05	75	-	-	-	-	-	-	60	6.9	0.0
01/31/06	125	-	-	-	-	-	-	156	6.9	0.0
06/05/06	250	276	< 1.0	1.2	< 1.0	< 20	< 1.0	363	6.9	0.0
12/19/06	447	-	-	-	-	-	-	341	6.8	0.0

Background, Bioaugmented, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	16	0.56	< 0.044	< 0.044	< 8	< 8	< 8	15	55
10/17/05	19	< 0.044	0.083	15	< 0.044	< 0.044	< 8	743	1,012	11	49
12/12/05	75	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	6,913	79	56
01/31/06	125	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	6,807	88	55
06/05/06	250	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	6,469	83	89
12/19/06	447	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 8	< 8	5,070	63	9,527

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	256	< 0.5	1.3	< 0.5	< 1.0	22	-	-	3.0
10/17/05	19	-	-	-	-	-	-	104	6.8	1.6
12/12/05	75	-	-	-	-	-	-	101	6.7	0.0
01/31/06	125	-	-	-	-	-	-	132	6.9	0.0
06/05/06	250	277	< 1.0	1.2	< 1.0	< 20	< 1.0	324	6.9	0.0
12/19/06	447	-	-	-	-	-	-	321	6.9	0.0

Background, Bioaugmented, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	15	0.54	< 0.044	< 0.044	< 8	< 8	< 8	14	50
10/17/05	19	< 0.044	0.098	17	< 0.044	< 0.044	< 8	666	521	12	53
12/12/05	75	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	7,321	53	79
01/31/06	125	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	8,052	66	90
06/05/06	250	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	7,040	55	162
12/19/06	447	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 8	< 8	5,414	41	24,108

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	257	< 0.5	1.3	< 0.5	< 1.0	18	-	-	3.0
10/17/05	19	-	-	-	-	-	-	125	6.7	1.7
12/12/05	75	-	-	-	-	-	-	107	6.7	0.0
01/31/06	125	-	-	-	-	-	-	131	6.9	0.0
06/05/06	250	279	< 1.0	1.2	< 1.0	< 20	< 1.0	275	6.9	0.0
12/19/06	447	-	-	-	-	-	-	383	6.9	0.0

Test Site, Inhibited, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	3.4	6.2	< 0.044	< 0.044	< 8	< 8	< 8	< 8	355
10/17/05	19	< 0.044	2.9	7.1	< 0.044	< 0.044	< 8	< 8	< 8	< 8	643
12/12/05	75	< 0.044	2.0	4.6	< 0.044	< 0.044	< 8	< 8	< 8	< 8	301
01/31/06	125	< 0.044	2.3	4.9	< 0.044	< 0.044	< 8	< 8	< 8	< 8	327
06/05/06	250	< 0.044	1.8	4.3	< 0.044	< 0.044	< 8	< 8	18	< 8	4,301
12/19/06	447	< 0.009	1.4	3.6	< 0.009	< 0.009	< 8	< 8	12	< 8	5,361

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.4	< 0.5	< 1.0	1.7	-	-	2.3
10/17/05	19	-	-	-	-	-	-	43	5.6	2.2
12/12/05	75	-	-	-	-	-	-	40	5.0	2.3
01/31/06	125	-	-	-	-	-	-	34	4.1	2.3
06/05/06	250	High Cl^- Interference		4.2	< 0.5	< 10	< 0.5	69	4.7	2.2
12/19/06	447	-	-	-	-	-	-	66	5.0	2.2

Test Site, Inhibited, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	3.7	7.2	< 0.044	< 0.044	< 8	< 8	< 8	< 8	740
10/17/05	19	< 0.044	2.9	7.6	< 0.044	< 0.044	< 8	< 8	< 8	< 8	873
12/12/05	75	< 0.044	2.2	5.0	< 0.044	< 0.044	< 8	< 8	< 8	< 8	805
01/31/06	125	< 0.044	2.2	5.0	< 0.044	< 0.044	< 8	< 8	< 8	< 8	892
06/05/06	250	< 0.044	2.0	5.1	< 0.044	< 0.044	< 8	< 8	< 8	< 8	808
12/19/06	447	< 0.009	1.6	4.1	< 0.009	< 0.009	< 8	< 8	< 8	< 8	722

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.0	< 0.5	< 1.0	1.9	-	-	2.3
10/17/05	19	-	-	-	-	-	-	49	5.4	2.2
12/12/05	75	-	-	-	-	-	-	21	4.9	2.3
01/31/06	125	-	-	-	-	-	-	42	4.0	2.3
06/05/06	250	High Cl^- Interference		3.8	< 0.5	< 10	< 0.5	72	4.6	2.2
12/19/06	447	-	-	-	-	-	-	62	4.8	2.2

Test Site, Inhibited, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	2.9	6.7	< 0.044	< 0.044	< 8	< 8	< 8	< 8	951
10/17/05	19	< 0.044	2.4	7.0	< 0.044	< 0.044	< 8	< 8	< 8	< 8	643
12/12/05	75	< 0.044	1.7	4.7	< 0.044	< 0.044	< 8	< 8	< 8	< 8	631
01/31/06	125	< 0.044	1.4	4.0	< 0.044	< 0.044	< 8	< 8	< 8	< 8	671
06/05/06	250	< 0.044	1.3	3.9	< 0.044	< 0.044	< 8	< 8	< 8	< 8	607
12/19/06	447	< 0.009	1.2	3.5	< 0.009	< 0.009	< 8	< 8	< 8	< 8	506

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		3.6	< 0.5	1.6	1.9	-	-	2.3
10/17/05	19	-	-	-	-	-	-	71	5.5	2.2
12/12/05	75	-	-	-	-	-	-	21	4.9	2.2
01/31/06	125	-	-	-	-	-	-	36	4.1	2.2
06/05/06	250	High Cl^- Interference		3.2	< 0.5	< 10	< 0.5	87	4.7	2.2
12/19/06	447	-	-	-	-	-	-	74	4.8	2.2

Test Site, Ambient, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	11	< 0.044	< 0.044	< 8	< 8	< 8	< 8	1,547
10/17/05	19	< 0.044	< 0.044	12	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,400
12/12/05	75	< 0.044	< 0.044	8.4	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,567
01/31/06	125	< 0.044	< 0.044	8.3	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,359
06/05/06	250	< 0.044	< 0.044	7.6	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,237
12/19/06	447	< 0.009	< 0.009	6.1	< 0.009	< 0.009	< 8	< 8	< 8	< 8	2,152

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.6	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	10	6.0	2.0
12/12/05	75	-	-	-	-	-	-	6.3	6.0	2.0
01/31/06	125	-	-	-	-	-	-	38	5.9	2.0
06/05/06	250	High Cl^- Interference		3.8	< 0.5	< 10	19	46	6.1	2.0
12/19/06	447	-	-	-	-	-	-	46	6.3	2.0

Test Site, Ambient, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	12	< 0.044	< 0.044	< 8	< 8	< 8	< 8	1,746
10/17/05	19	< 0.044	0.077	12	< 0.044	< 0.044	< 8	< 8	< 8	< 8	4,785
12/12/05	75	< 0.044	< 0.044	8.3	< 0.044	< 0.044	< 8	< 8	< 8	< 8	5,747
01/31/06	125	< 0.044	< 0.044	7.8	< 0.044	< 0.044	< 8	< 8	< 8	< 8	5,678
06/05/06	250	< 0.044	< 0.044	7.9	< 0.044	< 0.044	< 8	< 8	< 8	< 8	5,238
12/19/06	447	< 0.009	< 0.009	6.0	< 0.009	< 0.009	< 8	< 8	< 8	< 8	4,135

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.5	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	16	6.0	2.0
12/12/05	75	-	-	-	-	-	-	7.3	6.0	2.0
01/31/06	125	-	-	-	-	-	-	18	6.1	2.0
06/05/06	250	High Cl^- Interference		3.6	< 0.5	< 10	0.9	56	6.3	2.0
12/19/06	447	-	-	-	-	-	-	67	6.3	2.0

Test Site, Ambient, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	13	< 0.044	< 0.044	< 8	< 8	< 8	< 8	1,422
10/17/05	19	< 0.044	< 0.044	11	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,964
12/12/05	75	< 0.044	< 0.044	8.8	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,844
01/31/06	125	< 0.044	< 0.044	12	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,647
06/05/06	250	< 0.044	< 0.044	7.6	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,508
12/19/06	447	< 0.009	< 0.009	6.4	< 0.009	< 0.009	< 8	< 8	< 8	< 8	2,777

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.6	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	11	6.1	2.0
12/12/05	75	-	-	-	-	-	-	6.5	6.0	2.0
01/31/06	125	-	-	-	-	-	-	58	6.1	2.0
06/05/06	250	High Cl^- Interference		3.6	< 0.5	< 10	14	47	6.2	2.0
12/19/06	447	-	-	-	-	-	-	44	6.2	2.0

Test Site, Buffered, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	12	< 0.044	< 0.044	< 8	< 8	< 8	12	764
10/17/05	19	< 0.044	< 0.044	12	< 0.044	< 0.044	< 8	< 8	< 8	9	3,094
12/12/05	75	< 0.044	< 0.044	8.2	< 0.044	< 0.044	< 8	< 8	< 8	9	3,420
01/31/06	125	< 0.044	< 0.044	7.5	< 0.044	< 0.044	< 8	< 8	< 8	9	3,285
06/05/06	250	< 0.044	< 0.044	7.4	< 0.044	< 0.044	< 8	< 8	< 8	< 8	2,883
12/19/06	447	< 0.009	< 0.009	5.9	< 0.009	< 0.009	< 8	< 8	< 8	< 8	2,464

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.2	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	16	6.5	2.0
12/12/05	75	-	-	-	-	-	-	9.9	6.5	2.0
01/31/06	125	-	-	-	-	-	-	45	6.6	2.0
06/05/06	250	High Cl^- Interference		3.4	< 0.5	< 10	12	67	6.7	2.0
12/19/06	447	-	-	-	-	-	-	94	6.6	2.0

Test Site, Buffered, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	13	< 0.044	< 0.044	< 8	< 8	< 8	12	721
10/17/05	19	< 0.044	< 0.044	12	< 0.044	< 0.044	< 8	< 8	< 8	9	2,946
12/12/05	75	< 0.044	< 0.044	8.3	< 0.044	< 0.044	< 8	< 8	< 8	9	2,853
01/31/06	125	< 0.044	< 0.044	7.8	< 0.044	< 0.044	< 8	< 8	< 8	9	2,839
06/05/06	250	< 0.044	< 0.044	7.1	< 0.044	< 0.044	< 8	< 8	< 8	< 8	2,323
12/19/06	447	< 0.009	< 0.009	6.0	< 0.009	< 0.009	< 8	< 8	< 8	< 8	1,935

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.2	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	14	6.5	2.0
12/12/05	75	-	-	-	-	-	-	9.6	6.4	2.0
01/31/06	125	-	-	-	-	-	-	31	6.6	2.0
06/05/06	250	High Cl^- Interference		3.5	< 0.5	< 10	17	69	6.6	2.0
12/19/06	447	-	-	-	-	-	-	102	6.5	2.0

Test Site, Buffered, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	11	< 0.044	< 0.044	< 8	< 8	< 8	13	801
10/17/05	19	< 0.044	< 0.044	13	< 0.044	< 0.044	< 8	< 8	< 8	9	3,395
12/12/05	75	< 0.044	< 0.044	8.1	< 0.044	< 0.044	< 8	< 8	< 8	10	3,579
01/31/06	125	< 0.044	< 0.044	7.9	< 0.044	< 0.044	< 8	< 8	< 8	9	3,313
06/05/06	250	< 0.044	< 0.044	6.2	< 0.044	< 0.044	< 8	< 8	< 8	< 8	3,014
12/19/06	447	< 0.009	< 0.009	6.1	< 0.009	< 0.009	< 8	< 8	< 8	< 8	2,545

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.1	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	17	6.6	2.0
12/12/05	75	-	-	-	-	-	-	9.3	6.5	2.0
01/31/06	125	-	-	-	-	-	-	3.3	6.7	2.0
06/05/06	250	High Cl^- Interference		3.4	< 0.5	< 10	12	36	6.7	2.0
12/19/06	447	-	-	-	-	-	-	102	6.6	2.0

Test Site, Buffer + EOS, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	10	< 0.044	< 0.044	< 8	< 8	< 8	13	755
10/17/05	19	< 0.044	< 0.044	11	< 0.044	< 0.044	< 8	25	< 8	10	16,474
12/12/05	75	< 0.044	< 0.044	7.2	< 0.044	< 0.044	< 8	21	< 8	< 8	169,217
01/31/06	125	< 0.044	< 0.044	7.4	< 0.044	< 0.044	< 8	16	< 8	< 8	505,278
06/05/06	250	< 0.044	< 0.044	7.3	< 0.044	< 0.044	< 8	20	< 8	< 8	585,001
12/19/06	447	< 0.009	< 0.009	5.7	< 0.009	< 0.009	< 8	22	< 8	< 8	570,912

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.1	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	116	6.5	2.0
12/12/05	75	-	-	-	-	-	-	101	6.3	2.0
01/31/06	125	-	-	-	-	-	-	66	6.6	2.0
06/05/06	250	High Cl^- Interference		3.4	< 0.5	< 10	< 0.5	103	6.6	2.0
12/19/06	447	-	-	-	-	-	-	137	6.7	2.0

Test Site, Buffer + EOS, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	10	< 0.044	< 0.044	< 8	< 8	< 8	13	841
10/17/05	19	< 0.044	< 0.044	11	< 0.044	< 0.044	< 8	33	< 8	10	20,278
12/12/05	75	< 0.044	< 0.044	7.6	< 0.044	< 0.044	< 8	20	< 8	< 8	376,702
01/31/06	125	< 0.044	< 0.044	6.7	< 0.044	< 0.044	< 8	15	< 8	< 8	725,823
06/05/06	250	< 0.044	< 0.044	6.4	< 0.044	< 0.044	< 8	15	< 8	< 8	813,154
12/19/06	447	< 0.009	< 0.009	5.2	< 0.009	< 0.009	< 8	17	< 8	< 8	755,736

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		3.9	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	177	6.4	2.0
12/12/05	75	-	-	-	-	-	-	136	6.3	2.0
01/31/06	125	-	-	-	-	-	-	128	6.7	2.0
06/05/06	250	High Cl^- Interference		3.5	< 0.5	< 10	< 0.5	121	6.6	2.0
12/19/06	447	-	-	-	-	-	-	179	6.5	2.0

Test Site, Buffer + EOS, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	13	< 0.044	< 0.044	< 8	< 8	< 8	12	921
10/17/05	19	< 0.044	< 0.044	12	< 0.044	< 0.044	< 8	24	< 8	9	12,332
12/12/05	75	< 0.044	< 0.044	7.6	< 0.044	< 0.044	< 8	25	< 8	9	60,384
01/31/06	125	< 0.044	< 0.044	7.6	< 0.044	< 0.044	< 8	17	< 8	< 8	358,122
06/05/06	250	< 0.044	< 0.044	7.3	< 0.044	< 0.044	< 8	16	< 8	< 8	527,563
12/19/06	447	< 0.009	< 0.009	6.0	< 0.009	< 0.009	< 8	18	< 8	< 8	578,274

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		3.8	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	117	6.5	2.0
12/12/05	75	-	-	-	-	-	-	37	6.2	2.0
01/31/06	125	-	-	-	-	-	-	126	6.5	2.0
06/05/06	250	High Cl^- Interference		3.4	< 0.5	< 10	< 0.5	115	6.6	2.0
12/19/06	447	-	-	-	-	-	-	152	6.5	2.0

Test Site, Bioaugmented, Bottle 1

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	7.6	< 0.044	< 0.044	< 8	43	< 8	14	798
10/17/05	19	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	2,821	84	6,507
12/12/05	75	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	3,130	145	17,698
01/31/06	125	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	3,023	140	53,118
06/05/06	250	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	1,613	78	475,759
12/19/06	447	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 8	< 8	906	44	806,398

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		3.9	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	148	6.4	0.0
12/12/05	75	-	-	-	-	-	-	95	6.3	0.0
01/31/06	125	-	-	-	-	-	-	154	6.4	0.0
06/05/06	250	High Cl^- Interference		3.5	< 0.5	< 10	< 0.5	190	6.6	0.0
12/19/06	447	-	-	-	-	-	-	184	6.5	0.0

Test Site, Bioaugmented, Bottle 2

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	10	< 0.044	< 0.044	< 8	42	< 8	13	674
10/17/05	19	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	2,854	96	6,426
12/12/05	75	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	3,210	171	31,252
01/31/06	125	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	2,948	161	105,912
06/05/06	250	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	1,289	73	613,837
12/19/06	447	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 8	< 8	908	54	733,048

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		3.9	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	129	6.4	0.0
12/12/05	75	-	-	-	-	-	-	126	6.2	0.0
01/31/06	125	-	-	-	-	-	-	192	6.3	0.0
06/05/06	250	High Cl^- Interference		3.5	< 0.5	< 10	< 0.5	98	6.7	0.0
12/19/06	447	-	-	-	-	-	-	219	6.3	0.0

Test Site, Bioaugmented, Bottle 3

Date of Sample	Days	PCE mg/L	TCE mg/L	cis-DCE mg/L	trans-DCE mg/L	1,1-DCE mg/L	CA ppm	VC ppm	Ethene ppm	Ethane ppm	Methane ppm
09/30/05	2	< 0.044	< 0.044	11	< 0.044	< 0.044	< 8	45	< 8	13	880
10/17/05	19	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	2,981	89	5,427
12/12/05	75	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	3,251	146	12,827
01/31/06	125	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	3,076	139	60,718
06/05/06	250	< 0.044	< 0.044	< 0.044	< 0.044	< 0.044	< 8	< 8	1,558	73	490,801
12/19/06	447	< 0.009	< 0.009	< 0.009	< 0.009	< 0.009	< 8	< 8	1,028	50	851,046

Date of Sample	Days	Chloride mg/L	Nitrite mg/L	Bromide mg/L	Nitrate mg/L	Phosphate mg/L	Sulfate mg/L	TOC mg/L	pH S. U.	Cl#
09/30/05	2	High Cl^- Interference		4.3	< 0.5	< 1.0	< 0.5	-	-	2.0
10/17/05	19	-	-	-	-	-	-	129	6.4	0.0
12/12/05	75	-	-	-	-	-	-	121	6.3	0.0
01/31/06	125	-	-	-	-	-	-	212	6.4	0.0
06/05/06	250	High Cl^- Interference		3.3	< 0.5	< 10	< 0.5	260	6.6	0.0
12/19/06	447	-	-	-	-	-	-	207	6.4	0.0