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**FY02 Final Report on Phytoremediation of Chlorinated
Ethenes in Southern Sector Seepage Sediments of the
Savannah River Site**

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EXECUTIVE SUMMARY

This final report details the operations and results of a 3-year Seepline Phytoremediation Project performed adjacent to Tims Branch, which is located in the Southern Sector of the Savannah River Site (SRS) A/M Area. Phytoremediation is a process where interactions between vegetation, associated microorganisms, and the host substrate combine to effectively degrade contaminated soils, sediments, and groundwater. Phytoremediation is a rapidly developing technology that shows promise for the effective and safe cleanup of certain hazardous wastes. It has the potential to remediate numerous volatile organic compounds (VOCs). Extensive characterization work has demonstrated that two VOCs, tetrachloroethylene (PCE) and trichloroethylene (TCE) are the major components of the VOC-contaminated groundwater that is migrating through the Southern Sector and Tims Branch seepline area (WSRC, 1999). The PCE and TCE are chlorinated ethenes (CE), and have been detected in seepline soils and groundwater adjacent to the ecologically-sensitive Tims Branch seepline area. To determine how native and introduced plants and microorganisms might remove and/or degrade PCE and TCE in the existing groundwater plume, an experimental treatability study was conducted. A simulated, vegetated seepline was engineered and constructed, and three years of experiments were systematically performed to evaluate varying phytoremediation processes. The phytoremediation project was initiated in October 1999 (Fiscal Year 2000, i.e., FY00). A pilot-scale treatability system comprised of three phytoreactors was initially constructed. The field research focused on measuring and evaluating the efficiency of selected plants and soils to achieve *in situ* bioremediation of CE's under conditions simulating Tims Branch seepline. The initial three phytoreactors were constructed, filled with seepline soil, and supplied with CE-contaminated groundwater pumped from the nearby, upgradient monitoring well MSB-88C. Phytoreactor 1 was planted with loblolly pines (*Pinus taeda*), and Phytoreactor 2 was planted with hybrid poplars (*Trichocarpa X deltoides*). Phytoreactor 3 was left as an un-vegetated soil control that served to evaluate the soil substrate's ability to remediate CE

via monitored natural attenuation (MNA) processes. In Fiscal Year 2001 (FY01), two additional phytoreactors were added to the treatability study. Phytoreactor 4 was planted with sterile *Vetiver* grass, a species from Southeast Asia, and Phytoreactor 5 was set up as a wetland system, utilizing seepage sediments and native plants excavated from Upper Three Runs Creek (UTRC), located approximately 2 miles south of the Tims Branch seepage area. As the Phytoremediation Project progressed, both hybrid poplars and wetland treatments were found to be most effective at removing/biodegrading CE from groundwater pumped through the treatment system.

The Phytoremediation Project produced significant evidence for CE's being removed by plants. A statistical analysis of the Phytoremediation Project analytical data obtained during FY00, FY01, and FY02, confirmed that TCE and PCE were removed from groundwater in phytoreactors charged with UTRC seepage soils and associated vegetation. These removals were significantly higher in the phytoreactors engineered with poplar and wetland systems, as compared to those phytoreactors planted or equipped with loblolly pine, *Vetiver* grass, or a nonvegetated soil control. No statistically significant differences were obtained from a comparison of PCE amounts removed from the soil control phytoreactor with all other phytoreactors. A possible explanation for this finding is that subsurface MNA processes in the CE-source supply well (MSB-88C) may be operating, and therefore responsible for the observed, 3-year CE concentration decreases. Biochemical analyses performed during this Phytoremediation Project study, demonstrate that organic matter (OM) in the soils (i.e., lignin) plays a critical role in attenuation of groundwater CE. The lignin portion of seepage soils used in this study, is an integral part of rhizosphere matrices, and was found to readily bind and remove TCE. This facet of the 3-year Phytoremediation Project was maintained under saturated conditions, with the goal of simulating TCE- and PCE-impacted groundwater that currently flows along a portion of the Tims Branch seepage. The effects of plants, soil microbial communities, geochemical interactions, and biochemical processes were evaluated during this period.

The analytical results obtained from this Phytoremediation Project also demonstrated that loblolly pines and hybrid poplars, removed up to 90% and 100%, respectively, of total volatile organic compounds (VOCs) detected in the source groundwater. A major finding of remedial significance is the observation that the bulk of VOCs removed by these trees occurred in the last months of each of the three growing seasons encompassed by this study. Similarly, during their two years in the study, the Vetiver and wetland systems achieved up to 100% removal of groundwater contaminants. No detectable amounts of CE were found in transpiration or in the soil volatilization testing. Microbial activity in the wetland sediments and seep soils for MNA was found to be a significant factor in VOC removal. Sediment and groundwater microbial activity was evaluated in microcosms to assess soil biotransformation of CE moving through phytoreactors charged with seep and wetland sediments. These microcosms achieved up to 100% TCE removal over a 10-month period. MNA processes were clearly evident during this period, as were the generation of biodegradation products such as cis-1,2-dichloroethylene (c-DCE). VOCs were detected in geochemical analysis of samples from all of the plants utilized in this study (loblolly pine, hybrid poplar, Vetiver grass, and wetland species). These results confirm that VOCs were removed from the soil substrate and taken up into plant tissues. The loblolly pines and hybrid poplars took up more TCE than the Vetiver or wetlands species tested. Analyses also indicated that the highest concentrations of c-DCE were taken up by loblolly pines. No CE metabolites, including trichloroacetate (TCA), were detected in the Vetiver, hybrid poplars, wetland species, or loblolly pine tissues.

The success of MNA as an effective remediation approach, is based on a combination of several parameters, including the microbial degradation of CE. To evaluate the existence of such a process, effluent groundwater samples were collected from the phytoreactors. These groundwater samples were analyzed for geochemical and microbiological parameters that are indicative of microbial CE degradation. A polymerase chain reaction (PCR)-based analysis was performed to assess the presence of known CE-degrading populations (e.g., *Dehalococcoides*, *Desulfuromonas*, and *Dehalobacter*). Specific

primers were utilized to target the 16S rRNA genes of dechlorinating *Dehalococcoides*, *Desulfuromonas*, and *Dehalobacter* populations. The positive results obtained from most of these analyses indicated that these important CE-dechlorinating bacteria exist in the phytoreactors, and therefore are a likely component of the CE-impacted groundwater sourced from MSB-88C. Additional, culture-based microbial techniques were also performed to monitor microbial densities of live sulfate-reducing bacteria (SRBs), their total counts, and the presence of colony forming units (CFUs). A significant increase ($p < 0.05$) in groundwater leachate densities was observed during the five month period April to August 2002, indicating that the activity of these organisms has a seasonal component.

In summary, this treatability study has confirmed that CE can be removed from Tims Branch area groundwater and seepage sediments through the interaction of phytoremediation and MNA processes. Such results hold promise for the implementation of full-scale phytoremediation systems at SRS. The levels of CE removal from the seepage soils and associated vegetation are significant (greater than 90% in most tests performed). In addition, VOCs were also removed by uptake processes in all of the plant types tested in the phytoreactors. The VOC removals were also the greatest in the hybrid poplars, as well as those wetland phytoreactor systems containing the most biomass. The findings and conclusions of this Phytoremediation Project will be applied in FY03 to investigate and test several potential natural remedial approaches for VOC-impacted groundwater and soils along the Tims Branch flood plain and seepage.

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TABLE OF CONTENTS

<u>SECTION:</u>	<u>PAGE NO.:</u>
LIST OF FIGURES.....	ii
LIST OF TABLES.....	iii
LIST OF ACRONYMS/AND ABBREVIATIONS.....	iv
1.0 BACKGROUND.....	1
2.0 STUDY ACTIVITIES.....	6
2.1 Field Treatability Study.....	6
2.1.1 System Modifications.....	12
2.2 Surface Soil.....	12
2.3 Weather Station.....	16
2.4 Startup.....	16
2.5 Sample Collection.....	16
2.5.1 Groundwater Flow Measurements.....	17
2.5.2 Gas Chromatography.....	17
2.5.3 Transrespiration Measurements.....	18
2.5.4 Plant Tissue Analysis.....	18
2.5.5 Ion Chromatography.....	18
2.5.6 Microbial Densities.....	19
2.6 Microcosm Studies.....	20
2.7 Molecular Analysis of Phytoreactor Effluent.....	22
2.7.1 Extraction of DNA.....	22
2.7.2 Polymerase Chain Reaction Analysis.....	22
2.7.3 Organic Matter Profiles of Phytoreactor Effluents.....	23
2.7.4 Organic binding of TCE.....	23
3.0 FY02 STUDY RESULTS.....	24
3.1 Results.....	24
3.1.1 Weather Station.....	24
3.1.2 Flow Measurements.....	26
3.1.3 Removal of TCE and PCE from Groundwater.....	30
3.1.4 Statistical Analysis.....	32
3.1.5 Statistical Analysis of Water Sample Data.....	41
3.1.6 Statistical Analysis of Soil Sample Data.....	42
3.1.7 Statistical Analysis of Plant Tissue Data.....	43
3.1.8 Transrespiration Measurements.....	52
3.1.9 Microcosm Studies.....	52
3.1.10 Soil Metabolic Rates.....	59
3.1.11 Ion Chromatography.....	59

3.1.12	Microbial Densities.....	62
3.1.13	Molecular Results.....	66
3.1.14	Organic Matter Analysis.....	67
3.2	Discussion.....	72
4.0	CONCLUSION.....	73
4.1	Acknowledgements.....	75
5.0	REFERENCES.....	75
6.0	Appendices.....	81

LIST OF FIGURES

Figure 1.	The Phytoremediation System in the A/M Area Southern Sector.....	8
Figure 2a.	Phytoreactor 1 - Pine Trees.....	9
Figure 2b.	Phytoreactor 2 - Poplar Trees.....	10
Figure 2c.	Phytoreactor 3 - Non-Vegetated Control.....	11
Figure 2d.	Phytoreactor 4 - Vetiver Grass.....	14
Figure 2e.	Phytoreactor 5 - Wetland System.....	15
Figure 3.	Weather Data in Vicinity of MSB-88C (January 9, 2001 to September 1, 2002).....	25
Figure 4.	Groundwater Influent Flow Data for Phytoreactors (January 9, 2001 to September 1, 2002).....	27
Figure 5.	Rain Versus Flow.....	29
Figure 6.	TCE and PCE Groundwater Concentrations in MCB-88C from February 1998 until August 2002 (Source: GIMS).....	31
Figure 7a.	1,1-Dichloroethylene Water Samples: Influent-Effluent Differences by Treatment (Delta).....	34
Figure 7b.	c-DCE Water Samples: Influent-Effluent Differences by Treatment (Delta)....	36
Figure 7c.	TCE Water Samples: Influent-Effluent Differences by Treatment (Delta).....	38
Figure 7d.	PCE Water Samples: Influent-Effluent Differences by Treatment (Delta).....	40
Figure 8a.	Soil Samples Depth and Treatment Comparisons for TCE.....	44
Figure 8b.	Soil Samples Depth and Treatment Comparisons for PCE.....	45
Figure 8c.	Soil Samples Depth and Treatment Comparisons for c-DCE.....	46
Figure 8d.	Soil Samples Depth and Treatment Comparisons for Vinyl Chloride.....	46
Figure 9a.	Analysis of Plant Material TCE by Treatment.....	48
Figure 9b.	Analysis of Plant Material PCE by Treatment.....	49
Figure 9c.	Analysis of Plant Material c-DCE by Treatment.....	50
Figure 9d.	Analysis of Plant Material Vinyl Chloride by Treatment.....	51
Figure 10a.	Microbial Degradation of TCE in Control Wetland Sediments.....	54
Figure 10b.	Microbial Degradation of TCE in Unamended Wetland Sediments.....	54
Figure 10c.	Microbial Degradation of TCE in Wetland Sediments Amended with Soybean Oil.....	55

Figure 10e. Microbial Degradation of TCE in Wetland Sediments with Oil and
Osmocotex 56

Figure 12a. Total Microbial Densities for Phytoreactor Soils (April 14, 2002 and August
15, 2002) 63

Figure 12b. Total Colony-Forming Units in Phytoreactor Soils (April 14, 2002 and
August 15, 2002) 63

Figure 13a. Total Microbial Densities for Phytoreactor Groundwater (April 14, 2002
and August 15, 2002) 64

Figure 13b. Total Colony-Forming Units in Phytoreactor Groundwater (April 14, 2002
and August 15, 2002) 64

Figure 14. Pyrolysis GCMS Analysis 69

Figure 15a. Test of TCE Binding to Lignosulfonates 70

Figure 15b. Test of TCE Binding to Lignosulfonates at Equivalent Molar Ratios..... 71

LIST OF TABLES

Table 1. Average Rainfall for 2002 and Groundwater Flows for 2001 and 2002 28

Table 2. Percentage of Groundwater, Plant, and Soil Data Below Minimum Detectable
Limit (MDL) 32

Table 3. Phytoreactor Soil Metabolic Rates: Oxygen Consumption and Carbon
Dioxide Production 59

Table 4a. Anion Results for Southern Sector Soil and Influent and Effluent
Groundwater 60

Table 4b. Cation Results for Southern Sector Soil and Influent and Effluent
Groundwater 61

Table 5. Sulfate-Reducing Bacteria for Rhizosphere and Deep Soils and Groundwater
Effluent..... 65

Table 6. Analysis of Phytoreactor Samples Using the Nested PCR Approach 66

Table 7. PCR Using Environmental DNA as a Template (Direct PCR)..... 67

Table 8. Dry Mass of Phytoreactor Leachate Supernatant Dissolved Solids and
Sediment..... 67

LIST OF ACRONYMS/AND ABBREVIATIONS

ANOVA	analysis of variance
AODC	acridine orange direct count
ASCII	American Standard Code for Information Interchange
BDL	below detection level
bp	bacterial populations
°C	centigrade
c-DCE	cis-1,2-dichloroethylene
CE	chlorinated ethene
CFU	colony-forming units
DC	direct current
DCA	dichloroacetic acid
EBS	Environmental Biotechnology Section
FID	flame ionization detector
g	gram
gal/d	gallon per day
gC	gram Carbon
GC	gas chromatography
GCMS	gas chromatography mass spectrometry
GIMS	Geochemical Information Management System
GT	Georgia Institute of Technology
ID	inner diameter
k_d	linear partitioning coefficient
kg	kilogram
K_{oc}	organic carbon partition coefficient
L	liter
LS	lignosulfonate
m	meter
M	Molar
μg	microgram
mg/L	milligrams per liter
mL	milliliter
μL	microliter
μm	micrometer
mL/min	milliliter per minute
MPN	most probable number
mm	millimeter
mM	millimolar
m/min	meter per minute
MCB	Miscellaneous Chemical Basin
MNA	monitored natural attenuation
MS	mass spectrometry

N	Normal
OM	organic matter
PCE	perchloroethylene (or tetrachloroethylene)
PCR	polymerase chain reaction
ppb	parts per billion
PTYG	peptone-trypticase-Yeast Extract-Glucose
pyro-GCMS	pyrolysis gas chromatography – mass spectrometry
rpm	revolutions per minute
SRB	sulfate-reducing bacteria
SRS	Savannah River Site
SRTC	Savannah River Technology Center
TCA	trichloroacetic acid
TCE	trichloroethylene
TE	TRIS + EDTA
TSCF	transpiration stream concentration factor
UTRC	Upper Three Runs Creek
VC	vinyl chloride
VOC	volatile organic compound
WSRC	Westinghouse Savannah River Company LLC

1.0 BACKGROUND

It has been estimated that over 13 million pounds of chlorinated degreasing solvents, including trichloroethylene (TCE) and perchloroethylene (PCE), were used at Savannah River Site (SRS) during reactor operations (WSRC 1996). Although much of the waste volume was reduced by evaporation, over 3 million pounds of the solvents, including 317,000 pounds of TCE, were discharged to the M-Area Settling Basin and the A-014 outfall. The M-Area Settling Basin and A-014 outfall were unlined, and much of these solvents seeped into the subsurface, contaminating the groundwater. The associated groundwater zones in A/M Area (i.e., M Area and Lost Lake aquifers) discharge to seepages adjacent to Tims Branch and Upper Three Runs Creek (UTRA) (WSRC 1999). As part of the ongoing compliance and research activities at SRS, evaluations of the nature and extent of groundwater contamination in the A/M Area are ongoing in the Southern Sector. There were early concerns that due to site hydrogeology and topography, the volatile organic compound- (VOC-) contaminated groundwater would emerge as surface water along the Southern Sector Area seepage region.

Natural remediation options such as phytoremediation and monitored natural attenuation (MNA) are alternatives for fringe areas of contaminant plumes (WSRC 2000). In A/M Area, SRS is investigating the potential for implementing these techniques in combination with aggressive source zone treatments in higher plume concentration areas. These efforts include examination of MNA as well as accelerated MNA and phytoremediation. Identifying the predicted location of contaminated groundwater discharges, magnitudes, and structure in the plume fringe is critical to the long-term performance of MNA (WSRC 2000). The treatability study for this projected impact zone is an important component to providing baseline data necessary for long-term remedial assessment. In this investigation, phytoremediation and MNA for seepage soils and groundwater from an area impacted by large chlorinated ethene (CE) plumes were evaluated.

The success of phytoremediation is based on a combination of parameters, including the impact of subsurface microbial activity, vegetation interactions, organic matter (OM), and physical factors such as groundwater flow. In this study, these concepts were integrated and used to design the treatability study. These results provided detailed information on the fate of contamination in the groundwater and successfully demonstrated uptake by tested vegetation and microbial transformation of VOCs in seepage sediments.

Recent sampling of seepage groundwater monitoring wells indicates the presence of low level (1 to 50 ppb) concentrations of CE at the seepage, which demonstrates that the plume is approaching the seepage (Burdick 2002). Samples from additional monitoring wells installed in this region further substantiated this finding. The concentrations associated with this outcrop region are in the low ppb range (2 to 25 µg/L) for TCE and PCE, with the width of region affected on the order of 2,000 feet. No VOCs were detected in the stream through December 2002.

SRS will continue monitoring of seepage groundwater and sediment VOC concentrations associated with the identified seepage outcrop region to effectively monitor these discharges and confirm MNA. In the FY02 study, the biological features of the seepage were considered in conjunction with fundamentals of groundwater flow, rhizosphere chemistry, and contaminant transport to directly characterize phytoremediation and MNA. Contaminant fate can be more accurately predicted by integrating the important characteristics of phytoremediation, groundwater flow, OM impact, and MNA. The study emphasizes the importance of understanding the role of combining groundwater characterization and biological interactions during remedial strategy planning. These baseline measurements and characterization approaches will be of significant benefit in assessing the long-term performance of MNA and phytoremediation activities in the Southern Sector seepage.

The seep is presently heavily covered with a variety of vegetation and several soil types (Brigmon et al. 1998). The area has a wide variety of trees, including bald cypress (*Taxodium distichum*), tupelo (*Nyssa aquatica*), loblolly pine (*Pinus taeda*), oak (*Quercus* spp.), and sweet gum (*Liquidambar styraciflua*), all of which have been shown to take up CE (Vroblesky et al. 1999). SRS is covered by some 126,000 acres of pine, which includes 39,336 acres of longleaf, 63,920 acres of loblolly, and 22,983 acres of other pines (Dan Hitchcock USFS, Personal Communication). Walton and Anderson (1990) previously observed accelerated microbial degradation of TCE in SRS pine rhizosphere soils. They also found that pine rhizosphere soils mineralized TCE several times faster than soils from adjacent areas. The extent to which VOC remediation occurs in rhizosphere soils in this area varies depending on the soil type and vegetation (WSRC 2002). However, a better understanding of such variability is necessary since MNA responds to seasonal changes including plant growth, rainfall, and temperature. All of these can significantly influence potential VOC bioremediation.

It has been suggested that a possible mechanism for the enhanced microbial mineralization of TCE in the pine rhizosphere is excretion of phenolic compounds in root exudates. Since phenol is a known inducer of toluene mono-oxygenase, an enzyme responsible for degradation of TCE, the natural plant exudates could play a role in biodegradation of TCE in the rhizosphere (Anderson et al. 1993). Select plants, including hybrid poplars, are capable of TCE metabolism and transformation (Newman et al. 1997, Schnabel et al. 1997). The two tree species selected for this study based on their phytoremediation potential were the loblolly pine, *Pinus taeda*, and a hybrid poplar, *Trichocarpa X deltoides*. In this project, CE attenuation by both soil rhizosphere and vegetation interactions was monitored.

One of the primary functions of root exudates is to mobilize inorganic nutrients in the rhizosphere (Fletcher and Hedge 1995). Exudates also contain natural chelating agents (citric, acetic, and other organic acids) that increase the soil mobility of both nutrients and contaminants. Exudates may also contain enzymes including dehalogenases (Hedge and

Fletcher 1996). These enzymes have important natural functions and may also degrade organic contaminants (Fliermans et al. 1988). Some rhizosphere microorganisms secrete hormones that stimulate root growth, thereby increasing the secretion of root exudates that contain metabolites, including proteins and carbohydrates also used by the bacteria (Shann 1995). Exudation of organics by plant roots and turnover of organic root biomass have also been found to increase the TCE sorption capacity of soil (Schnabel et al. 1997). There are knowledge gaps as to which mechanism provides the higher degree of VOC removal in phytoremediation systems, the plants or the associated rhizospheric bacteria (Orchard et al. 2000a). The microbial ecology of soils associated with bioremediation in mycorrhizal roots such as pine has not been well characterized even though this environment forms a large habitat and provides extensive surface area for bacterial colonization. It was previously observed that the rhizosphere soils in the SRS Miscellaneous Chemical Basin (MCB) contained higher quantities of potential TCE-degrading bacteria than did SRS soils not exposed to TCE (Brigmon et al. 1999). Nichols et al. (1997) demonstrated higher microbial densities in organic-contaminated rhizosphere soils than in similar but non-contaminated soils. The microbial analysis from this year confirms the bioremediation potential of the seep soils and provides tools for more focused field biodegradation work.

Increased microbial activity is evident in outcropping zones where available organic carbon in soils and groundwater can stimulate microbial action and lower redox potential (WSRC 2002). This plume outcrop area may support microbial activity to degrade TCE degradation products such as cis-1, 2-dichloroethylene (c-DCE) or vinyl chloride (VC), but the rates could be seasonally or nutrient dependent. Contaminants in soil and groundwater must be bioavailable to be remediated (absorbed, modified, degraded, transformed, sequestered, etc.) by either plants or microorganisms (Shimp et al. 1993). Thus, groundwater movement and nutrient availability in the rhizosphere is a critical factor for phytoremediation. Plants take up more water than is needed for growth. This excess water is transpired through the leaves as the final step in plant metabolism. Transpiration stream concentration factors (TSCFs) are important for predicting the plant

uptake of TCE-contaminated groundwater (Orchard et al. 2000b). The groundwater and dissolved contaminants move through the rhizosphere, where they are subjected to bioremediation by microorganisms and soil interactions before entering plant roots. In some instances, the magnitude of microbial transformation of TCE can be significantly larger than plant influence (Anderson and Walton 1995) although this depends on the site and plants used (Nichols et al. 1997 and Schnabel et al. 1997).

Microbial characterization events at SRS confirmed the presence of potential TCE-degrading sulfate-reducing bacteria (SRBs) in seepage sediments (WSRC 2000b). The work in FY02 both quantified and identified the SRBs in soil and groundwater. The occurrence of these bacteria *in situ* indicates favorable bioremediation potential. Questions remain as to how active these SRBs and other CE-degrading species are in the seepage. The focus of the microcosm studies employed in this study proved the effectiveness of MNA and carbon-source/nutrient additions to stimulate *in situ* microbial degradation of TCE.

It has long been known that PCE and TCE are toxic and that the daughter product VC is a carcinogen (Dougherty 2000). Recent investigations focusing on the kinetics, metabolism, and toxicology of two metabolites of TCE, dichloroacetate (DCA), and chloral hydrate (CH) have proven these compounds to be potential endocrine disruptors (Cornett et al. 1999). The studies are focusing on *in vivo* kinetics and biotransformation of CH, and the influence of CH and DCA on metabolism and toxicity (James et al. 1997). The findings have demonstrated that children are at greater risk than adults to this class of endocrine disruptors. Both CH and DCA can be potential byproducts of microbial degradation of TCE (Brigmon 2000). The risk to human health grows as more of this material moves to surface waters, is taken up by plants, and increases animal and human exposure to these chemicals.

A better understanding of the mechanisms that enhance CE biodegradation in the rhizosphere and the interaction between plants, microorganisms, and contaminants can be

useful in phytoremediation deployments (Nelson et al. 1988). This information can lead to improved practices for phytoremediation deployments, including plant selection, soil amendments, and irrigation systems. A recent treatability study at the SRS D Area proved the efficiency of drip irrigation for a low-concentration (<100 ppb) TCE plume (WSRC 2002a). In that project, TCE-contaminated water was drip-irrigated to pine, poplar, and non-vegetated control plots, and no TCE was found to break through the rhizosphere or migrate beyond a depth of two feet, regardless of plot type.

Future work based on these results can be used to determine phytoremediation deployments and strategies in response to TCE/PCE-contaminated groundwater movement through the Southern Sector seepline. The techniques described here in conjunction with other applications should provide tools for screening plant species and soils for phytoremediation and MNA activity. Phytoremediation applications have proven advantageous over conventional remediation techniques for CE-contaminated groundwater at Argonne National Laboratory East (Quinn et al. 2001). The metabolic actions of the plants and soils in combination with physical reductions of VOCs by volatilization and dilution will enable active remediation at the rhizosphere of the seepline.

2.0 STUDY ACTIVITIES

2.1 Field Treatability Study

A simulated seepline study was developed near a readily accessible water source in Southern Sector to aid in the evaluation of seepline phytoremediation and MNA. The soil (very sandy with red clay) in the area of study, monitoring well MSB-88C, was not representative of the seepline. Therefore, soil was brought from the seepline to the study site for use in the original three phytoreactors in 2000. Surface soil (0 to 1.64 feet below surface) and rhizospheric soil (1.64 to 3.28 feet below surface) were collected in the vicinity of Well MSB-50 (located just above the Tims Branch seepline area) for the study. An additional load of soil (2 cubic yards) was brought to the site in 2001 to add a

phytoreactor to the system. Three cubic yards of wetland-type soils were brought to the site from Upper Three Runs Creek (UTRC) in 2002 for a wetland phytoreactor.

Double-insulated boxes (72 x 48 x 30 inches) (Bonar Inc., Atlanta, GA) were brought to and set up at the site as phytoreactors. Figure 1 shows a diagram of the field deployment configuration. The phytoreactors were developed with an upflow pattern of groundwater flow to simulate seepage flow. A 3-inch layer of gravel was placed in the bottom to support a two-line influent-distribution system in each phytoreactor. The gravel layer was then covered with seepage soil. Groundwater from MSB-88C was pumped into the tank that supplies the phytoreactors through a gravity-fed system.

Two separate effluent collection systems were included in each phytoreactor. The effluent collection lines are located 10 inches and 18 inches (i.e., immediately below the soil surface) above the influent lines and parallel to them. The combination of the influent and effluent systems produced simulated seepage groundwater up flow to the root zone where the water was collected and removed. This design allowed contaminated groundwater contact time with the soil and plant roots. The effluent collection system at the 10-inch depth was used in all phytoreactors and provided a 10-inch saturated flow zone and a 10-inch vadose zone for the phytoreactors. A 1,000-gallon steel tank was used for effluent collection downhill from the site and emptied every other week.

Three phytoreactors were first set up for the project in FY00. Loblolly pine (*Pinus taeda*) was planted in Phytoreactor 1 (Figure 2a) and the hybrid poplar (*Trichocarpa X deltoides*) was planted in Phytoreactor 2 (Figure 2b). Phytoreactor 3 (Figure 2c) contained only seepage soil as a non-vegetated control (Figures 2c). Phytoreactor 1 originally had nine pine trees and Phytoreactor 2 had seven poplars planted at the beginning of the 2000 season. At the end of 2000, Phytoreactor 1 had been thinned to six pines, and Phytoreactor 2 had been thinned to four poplars based on growth. At the end of 2001, Phytoreactor 1 had been thinned to three pines, and Phytoreactor 2 had been thinned to three poplars. In 2001, Phytoreactors 4 and 5 were added to the system

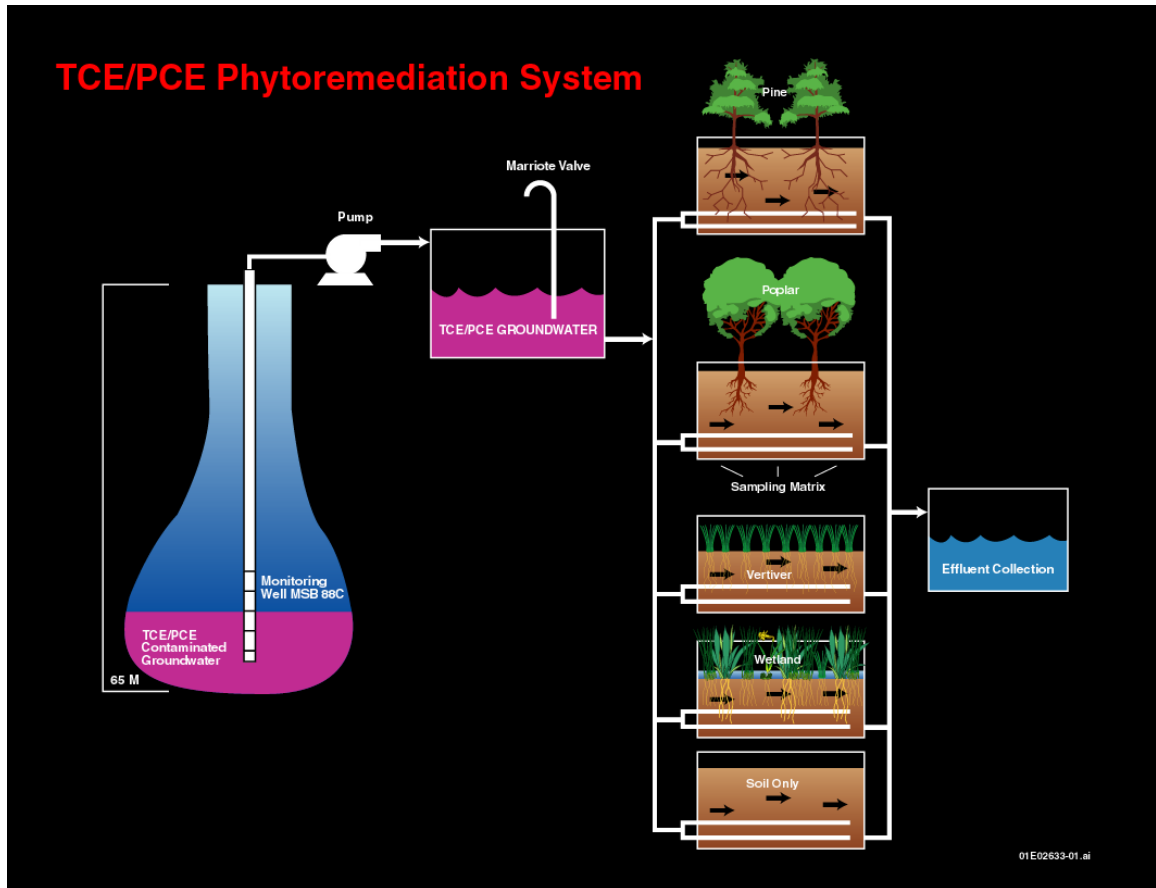


Figure 1. The Phytoremediation System in the A/M Area Southern Sector



Figure 2a. Phytoreactor 1 - Pine Trees



Figure 2b. Phytoreactor 2 - Poplar Trees



Figure 2c. Phytoreactor 3 - Non-Vegetated Control.

(Figures 2d and 2e). Phytoreactor 4 contained a sterile exotic grass species, Vetiver (Figure 2d). Phytoreactor 5 was a simulated wetland system (Figure 2e). A freeze in the winter of FY01 killed the wetland plants in Phytoreactor 5. However, new plants naturally emerged from the wetland sediments in the spring of FY02. Within one month of initiation, the system was doing well with several plant species growing. Plant types were similar to the previous year and included a cattail type grass, “burr-reed” (*Sparganium americanum*); a morning glory-type plant called “lizards tail” (*Saururus cernuus*); a thin-leaved spreading species, “alligator weed” (*Alternanthera philoxeroides*); a grass-type “maiden cane” (*Panicum hemitomon*); and an arrowhead leaf individual commonly known as “arrow arum” (*Peltandra virginica*). As in FY01, the *P. virginica* and *A. philoxeroides* dominated the growth in the phytoreactor. In FY02, the *P. virginica* put down an extensive root system. The Vetiver grass in Phytoreactor 4 also died back over the winter but put out new leaves in the spring.

2.1.1 System Modifications

A number of changes were made to the test site in FY01 based on observations, field experience, and conclusions from the project. These modifications were previously described in detail in the FY01 report (WSRC 2001). The system was not modified in FY02 with the exception of flow meter replacements in April 2002.

2.2 Surface Soil

In March 2001, the top three inches of soil in each phytoreactor was carefully leveled and graded toward the surface drains. Additional seepage soil was added where necessary due to settling. The surface soil was supplemented with “mulch” (pine straw and wood chips) to enhance drainage and runoff as well as to provide a means for incorporation of amendments to surface soils. The “mulch” supplement was materials (pine straw, etc.)

collected from the adjacent wooded area. The fertilizer amendment Osmocote® (Scotts-Sierra Horticultural Products Co., Marysville, OH), a slow release fertilizer, was applied



Figure 2d. Phytoreactor 4 - Vetiver Grass



Figure 2e. Phytoreactor 5 - Wetland System

in April and June 2002 at the manufacturer's recommended rate of 6 tablespoons per phytoreactor.

2.3 Weather Station

A Dynamet™ stand-alone, weather station was installed at the site in the spring of 2001. The weather station continually monitored eight environmental parameters (average air temperature, average soil temperature, solar radiation, wind speed, wind direction, rain fall, organic soil moisture, and mineral soil moisture), two internal system parameters (data logger temperature and battery voltage), and the time and date. Each environmental parameter was calculated and/or summed and recorded hourly on an internal data logger. The data was recorded in a comma-delineated American Standard Code for Information Interchange (ASCII) file, which is accessible and down-loadable using a laptop personal computer with software supplied with the weather station. The software provides standard report formats; however, the data is easily accessible by Microsoft Excel and hence can be evaluated, manipulated, and combined with other relevant data by the user.

2.4 Startup

For this FY on March 20, 2002, the replacement of the flow meters was completed. All phytoreactors were placed in operation, receiving contaminated groundwater in the new configuration. The flow rates were initially adjusted to around 20 mL/min. The treatability study concluded in September 2002 at the MSB-88C location.

2.5 Sample Collection

Sampling groundwater from the phytoreactors for chemical and microbial analysis began on March 30, 2002. The phytoreactors soil and groundwater influent and effluent, were sampled monthly from April to August 2002 for VOC and ion analysis. Samples for microbial analysis were taken in April and August 2002. Plant tissue samples were taken in June and August 2002.

2.5.1 Groundwater Flow Measurements

In addition to the collection of weather data, electronic flow meters were installed in the system to collect and ensure that the intended flow to each phytoreactor was maintained. Due to the low pressure head driving the flow (approximately 2 to 3 feet of water), only one flow meter (McMillan S-112) was identified as capable of operating within the flow and pressure ranges of the system. This flow meter utilizes a Pelton-type turbine wheel in conjunction with an electro-optical device to produce a 0 to 5 DC volt output signal (corresponding to a 0 to 100 mL/min flow). Early problems with the data collection system and flow meter clogging resulted in sporadic data collection. These problems were corrected and flow meter measurements were continuously collected during FY02.

The flow (mL/min) for each phytoreactor was collected every fifteen minutes. Flow data was collected in the spring and summer of 2001 during system operation to evaluate the effectiveness of the water supply system. Following a period of operational difficulty, data was again collected from the winter of 2001 through the summer of 2002.

2.5.2 Gas Chromatography

Analysis for VOCs was accomplished as previously described (WSRC 2001). Samples were taken monthly from phytoreactor groundwater influent and effluent for VOC analysis. Soil samples were collected with a stainless steel hand auger from four locations in each phytoreactor, two shallow (1.64 feet) and two deep (3.28 feet). Individual soil samples were collected from the auger with a modified plastic syringe and placed directly into a 20- mL glass vial with 5-mL deionized water and immediately sealed for subsequent VOC analysis. CE analysis was performed on samples in sealed glass vials using headspace gas chromatography (GC). The headspace GC method minimizes VOC losses through less sample handling and preparation, and measures the bulk VOC content of the sample. Samples were analyzed using an Agilent 5890 GC equipped with a 5972 series mass selective detector and a 60-m DB-624 column (0.25-mm inner diameter (ID), 1- μ m thick; Agilent, www.chem.agilent.com).

2.5.3 Transrespiration Measurements

For transrespiration gas, large (25 L) Tedlar gasbags were used to cover and seal large areas of plants to measure VOC phytovolatilization. Plant sections were covered for 30 minutes and multiple gas samples taken and placed in 2-L Tedlar gasbags. Tedlar gasbag samples were taken to the laboratory and processed the same day. Gas samples were injected into the GC with a 250- μ L gas-tight syringe.

2.5.4 Plant Tissue Analysis

In June and August 2002, plant tissues (roots, stems, and leaves) from the pine, poplar, Vetiver, and select wetland species were collected for analysis of PCE, TCE and potential metabolic breakdown products, including trichloroacetic acid (TCA) and dichloroacetic acid (DCA). Plant samples taken from Phytoreactor 5, the wetland system, were the thin-leaved spreading species "alligator weed" (*A. philoxeroides*) and arrowhead leaf known as "arrow arum" (*P. virginica*). These species were chosen because they appeared to be the dominant species at the time of collection, and they made up most of the biomass. This analysis provided useful information on the potential fate of the VOCs in the plants. The plant tissue samples for VOC testing were obtained in the field, sealed in 20 mL GC vials, and immediately processed as described by Vroblesky et al. (1999). Plant samples for metabolite analysis were placed on dry ice in the field and brought back to the laboratory where they were stored at -70° C until processing. Plant samples were then processed and analyzed for metabolites as described by Newman et al. (1999).

2.5.5 Ion Chromatography

Anion and cation groundwater and sediment concentrations were measured with a Dionex DX500 ion chromatograph equipped with a conductivity detector and a 250-mm Dionex IonPac AS14 and a CS12 analytical column (4-mm ID, 16- μ m bead; Dionex Corp., Sunnyvale, CA), operated at ambient temperatures. A 0.5 millimolar (mM) sodium carbonate/0.5 molar (M) sodium bicarbonate buffer solution was used as the

eluent (1.2 mL/min) for anion analyses and a 1 Normal (N) sulfuric acid solution was used as the eluent (1.0 mL/min) for cation analyses. Samples were taken from the supernatant of a solution prepared from groundwater or 5 g of dry soil (dried at 121°C for 24 hours) and 5-mL of deionized water, vortexed for 1 minute, and then centrifuged for 5 minutes at 2,500 revolutions per minute (rpm).

2.5.6 *Microbial Densities*

Comprehensive analysis of specific microbial populations and characterization of the metabolic activity of whole microbial communities can be an effective tool to predict the bioremediation potential of a natural system. These analyses monitor the activity of specific microorganisms important for bioremediation of groundwater and soil contaminants. Groundwater samples, including influent and effluent phytoreactor samples, were collected in sterile 50-mL centrifuge tubes and transported to the laboratory for immediate microbiological processing. Sediment samples were collected with a stainless steel auger and handled aseptically for subsequent analysis. Total microbial population densities in phytoreactor influent and effluent groundwater and soils were determined by the Acridine Orange Direct Count (AODC) Method (Balkwill 1989). The viable microbial population densities of aerobic and facultative heterotrophic bacteria in groundwater and soils were determined using spread plate techniques. Low concentrations (1%) of Peptone-Trypticase-Yeast extract-Glucose (PTYG) media were used (Balkwill 1989).

The numbers of viable SRB in seepline groundwater and sediment samples were estimated by using the Most Probable Number (MPN) method of bacterial enumeration. The MPN method of enumeration is useful since it can detect even low concentrations of sulfate reducers in environmental samples. The basis of the SRB MPN method used is the dilution of a sample to such a degree that inocula will sometimes but not always contain some viable sulfate-reducing organisms. The numbers of inocula producing sulfate reducers at each dilution will give an estimate of the original, undiluted

concentration of SRB in the sample. In order to obtain estimates over a broad range of possible concentrations, serial dilutions (10^{-1} through 10^{-6}) with three tubes at each dilution were used in the SRB MPN technique. The media used for the SRB MPN technique contained sodium lactate (.0035 g/mL), beef extract (.001 g/mL), peptone (.002 g/mL), magnesium sulfate (.002 g/mL), sodium sulfate (.0015 g/mL), dipotassium hydrogen phosphate (.0005 g/mL), calcium chloride (.001 g/mL), sodium ascorbate (.0001 g/mL), and ferrous ammonium sulfate (.0004 g/mL). For inoculation, Hungate Type Anaerobic Culture Tubes were used with butyl rubber stoppers and screw caps and were filled to capacity to decrease available oxygen. Tubes were incubated at room temperature in the dark for 3 months. The presence of SRB in the media is noted when the media changes from golden to black (reduced).

2.6 Microcosm Studies

Microcosm tests were set up to assess the microbial activity and ability of seepline soils and wetland sediments to transform PCE, TCE, and daughter products in 2001. The electron acceptor (chlorinated compound) employed was TCE. Anaerobic microcosms were used to assess activity for transformation of TCE to degradation products as well as the presence of bacterial populations indicative of other favorable bioprocesses (e.g., halorespiration and methanogenesis). This experimental approach determines potential enhancements (i.e., carbon-source/nutrients) required to promote the microbial degradation of TCE and daughter products (i.e., c-DCE and VC). Results from this study can be used to evaluate applicable field methods for bioremediation with the contaminated seepline.

Microcosms were prepared using rhizospheric soils from the seepline, wetlands (UTRC), and groundwater obtained from MSB-88C. Since the soils were used directly and not screened or sorted, associated root material was included. After collection, soil and groundwater were transferred immediately to the Environmental Biotechnology Section (EBS) laboratory where all subsequent handling was performed in an anaerobic glovebox (5% H₂ / 5% CO₂ /90%N₂).

The bench-scale study consisted of three sets of microcosms per sample: (1) live, active microcosms with varying nutrient and TCE amendments; (2) live control microcosms with TCE but without nutrient amendments; and (3) killed control microcosms (with nutrient amendments and TCE amendment). The killed controls had microbial activity stopped by autoclaving the soil, filter-sterilizing the groundwater, and a sodium azide addition. Nutrient amendments tested included soybean oil and a commercial fertilizer.

Microcosms were assembled in sterile glass 240-mL serum bottles sealed with screw cap mininert valves. Each test microcosm was prepared with approximately 50 grams (wet weight) of cored wetland or rhizosphere sediments and MSB-88C groundwater with varying nutrient amendment(s) and TCE (1,000 ppb). Liquid components of each microcosm totaled 100 mL. The groundwater was used unfiltered and unsterilized (except in killed controls) and was “degassed” by stirring in the anaerobic chamber overnight before it was added to microcosms. Resazurin (1 mg/L) was added to groundwater as an indicator of anaerobiosis. Cored sediments were mixed for homogeneity in the controlled atmosphere of an anaerobic glovebox before being added to the microcosms. The fertilizer amendment added was Osmocote[®] (Scotts-Sierra Horticultural Products Co., Marysville, OH), a slow release fertilizer, which is 14-14-14 (N-P-K). One bead of Osmocote[®] was added to each microcosm. The beads were found to weigh on the average 32 mg each. The soybean oil and fertilizer amendments were 0.5% of the total liquid volume. Sodium azide (0.1%) was added to autoclaved groundwater in the killed control microcosms. Sediments and groundwater used in killed control microcosms were autoclaved three times over seven days before preparation. All microcosms were incubated shielded from light at 25° C.

After six weeks, six months, and 10 months, 1 mL samples from the microcosms were withdrawn through mininert valves and added to 9 mL of distilled water in a gas GC vial, capped, and analyzed for VOCs. The concentration of VOCs was determined by analysis of headspace samples from the vials using a GC Mass Spectrometry (MS) as previously described.

2.7 Molecular Analysis of Phytoreactor Effluent

2.7.1 Extraction of DNA

One liter of groundwater from each phytoreactor collected in June 2002 was filtered through a series of 1.7, 1, 0.8, 0.5, 0.2 μm sterile nitrocellulose filters to directly concentrate microbial biomass. After all groundwater biomass had been collected on filters, they were frozen and stored at -70°C . For testing, the cake of biomass was removed by aseptically placing filters into 2-mL microcentrifuge tubes and adding 1 mL of TE buffer (10 mM TRIS and 1 mM EDTA at pH 8), followed by horizontal shaking at high speed on a vortex mixer for 5 minutes. The suspended cells were concentrated by centrifugation at 13,000 rpm for 15 minutes in a microcentrifuge. Microscopic examination of the supernatant verified that all biomass was collected. The DNA was extracted from the pellet using the UltraClean Soil DNA Kit from Mo Bio Laboratories, Inc. (Solana Beach, CA), and the concentration of isolated DNA was determined spectrophotometrically.

2.7.2 Polymerase Chain Reaction Analysis

DNA extracted from the filters was screened for the presence of known reductively dechlorinating populations (e.g., *Dehalococcoides*, *Desulfuromonas*, and *Dehalobacter* spp.) with 16S rRNA gene primers targeting regions of the 16S rRNA gene that are specific for each individual group (Löffler et al. 2000, Bunge et al. 2001). The *Dehalococcoides*-, *Desulfuromonas*-, and *Dehalobacter*-targeted primer pairs yielded 620 bacterial populations (bp), 815 bp, and 828 bp amplicons, respectively. For increased sensitivity of detection, an initial amplification of the community DNA was performed with bacterial-specific primers 8F (5'-AGAGTTTGATCC TGGCTCAG) and 1525R (5'-AAGGAGGTGATCCAGCCGCA). A 1:50 dilution of amplified 16S rRNA genes was used as template for a second (nested) polymerase chain reaction (PCR) with the specific primers. Positive controls included genomic DNA of *Dehalococcoides* sp. strain FL2, *Desulfuromonas michiganensis* strain BB1, and *Dehalobacter restrictus* (DSM 9455) for

the *Dehalococcoides*-, *Desulfuromonas*-, and *Dehalobacter*-targeted primers, respectively.

Community DNA was also analyzed for the presence of the *tceA* gene encoding for the TCE reductive dehalogenase of *Dehalococcoides ethenogenes* strain 195 that catalyzes the reductive dechlorination of trichloroethene (Magnuson et al. 2000). A *tceA* gene was also identified in the TCE-dechlorinating *Dehalococcoides* sp. strain FL2 (GenBank accession number AY165309) and in a TCE-to-ethene-dechlorinating enrichment culture containing a *Dehalococcoides* population (accession number AY165310). Genomic DNA, as well as the cloned *tceA* gene of strain FL2, served as positive controls.

2.7.3 Organic Matter Profiles of Phytoreactor Effluents

Phytoreactor effluent groundwater samples (leachates) were analyzed for their organic matter (OM) nature using pyrolysis-GCMS. Due to the visible presence of sediment, samples were divided into suspended "sediment" (including colloidal material) and "supernatant" fractions. Leachates from the five phytoreactors were collected in August 2001 and sent within 24 hours on ice to University of California Davis in sterile 2x50 mL "Falcon" centrifuge tubes (Fisher Scientific, Fairlawn, NJ). The samples were processed and then analyzed by pyrolysis-GCMS as described previously (Fan et al. 2000).

2.7.4 Organic binding of TCE

A study was undertaken to estimate the potential SRS Southern Sector seep sediments to naturally attenuate TCE based on previous results (Brigmon et al. 1998). Microcosms were set up to evaluate both biotic and abiotic attenuation of TCE. Results demonstrated that sorption to soil was the dominant mechanism during the first week of incubation, with as much as 90% of the TCE removed from the aqueous phase. Linear partitioning coefficients (K_d) ranged from 0.83 to 7.4 mL/g, while organic carbon partition coefficients (K_{oc}) ranged from 72 to 180 mL/g. Diffusional losses from the microcosms appeared to be a dominant fate mechanism during the remainder of the experiment, as

indicated by results from the water controls. A limited amount of TCE biodegradation was observed over the six-week study. The appearance of c-DCE confirmed the potential for anaerobic reductive dechlorination. The sorption results indicated that MNA represents a viable remediation option for the CE plume as it passes through the seepage. Increased anaerobic activity might be better promoted with the use of a different electron donor, perhaps after buffering the soils to near neutral. The role of natural sulfate compounds [e.g., lignosulfonate (LS)] in controlling reductive dechlorination also needs to be assessed for these sediments. There is evidence that reductive dechlorination proceeds well under sulfate-reducing conditions (Bagley and Gossett 1990; Beeman *et al.* 1994). Factors that may be limiting the activity of halo-respiring organisms present in the seepage also need to be addressed before drawing firm conclusions about the efficacy of MNA in these particular soils.

3.0 FY02 STUDY RESULTS

3.1 Results

3.1.1 Weather Station

The daily averaged data shown in Figure 3 allows a visual comparison of the weather data collected during study. The data represented are self explanatory except for the organic and mineral soil-moisture values. These parameters are determined by measuring the soil dielectric constant and converting it to percent moisture. One soil moisture probe was provided with the weather station and was placed in Phytoreactor 4. The soil moisture remained steady throughout the year, indicating the constancy of the groundwater flow of the system. The few fluctuations in soil moisture were correlated to rainfall events. Swings in humidity levels from night to day were greater in the spring. The rainfall was spread out through the summer. Temperature peaks were also distributed throughout the summer. There were no major heat waves or inversions during this summer. Although the weather station can be programmed for site-specific soil

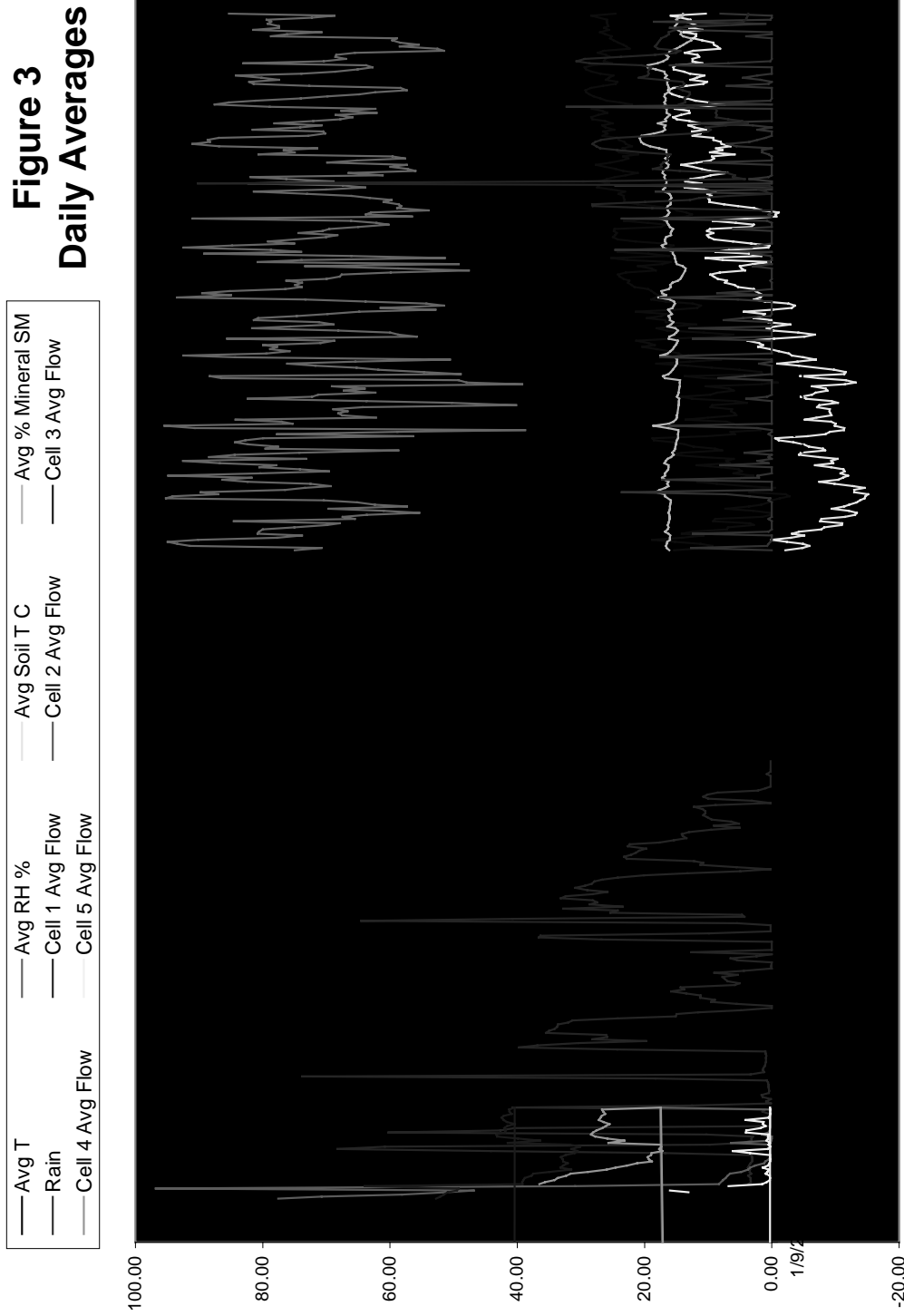


Figure 3. Weather Data in Vicinity of MSB-88C (January 9, 2001 to September 1, 2002)

moisture conversions, the generalizations used by the weather station are valid for most soil types.

3.1.2 Flow Measurements

Groundwater supplying the phytoreactors was measured with flowmeters interfaced with a datalogger powered by solar cells. The flow data alone is displayed on Figure 4. Figure 3 shows the flow data in relation to weather data. As shown on Figure 4, the initial watering system configuration (January through August 2001) was unable to provide a constant flow. During this time, the mean flows for the five cells ranged from 0.62 mL/min to over 27 mL/min. The flows within each cell varied as much as 96 mL/min. The target flow range was 20 to 30 mL/min to simulate the flow expected at the Southern Sector seepage. The initial variability inherent in the flow system was unacceptable. In addition to flow variability in early 2002, there was a power supply problem. Various modifications, such as the Mariotte system in FY01 and flow meter replacement, were made to enhance the flow in the system. Due to these changes made in 2002, the flow variations were greatly reduced. For this period, mean flows ranged from 7 to 15 mL/min, which more closely matched the target flows. The individual ranges within the phytoreactors were greatly reduced ranging from 20 to 30 mL/min. There was one period of excessive flow during this time. There are some small peaks in flow rate when the supply tank is filled but the Mariotte system, installed in FY01, seems to have reduced the variability of the tank filling effect compared to 2001 (WSRC 2000a).

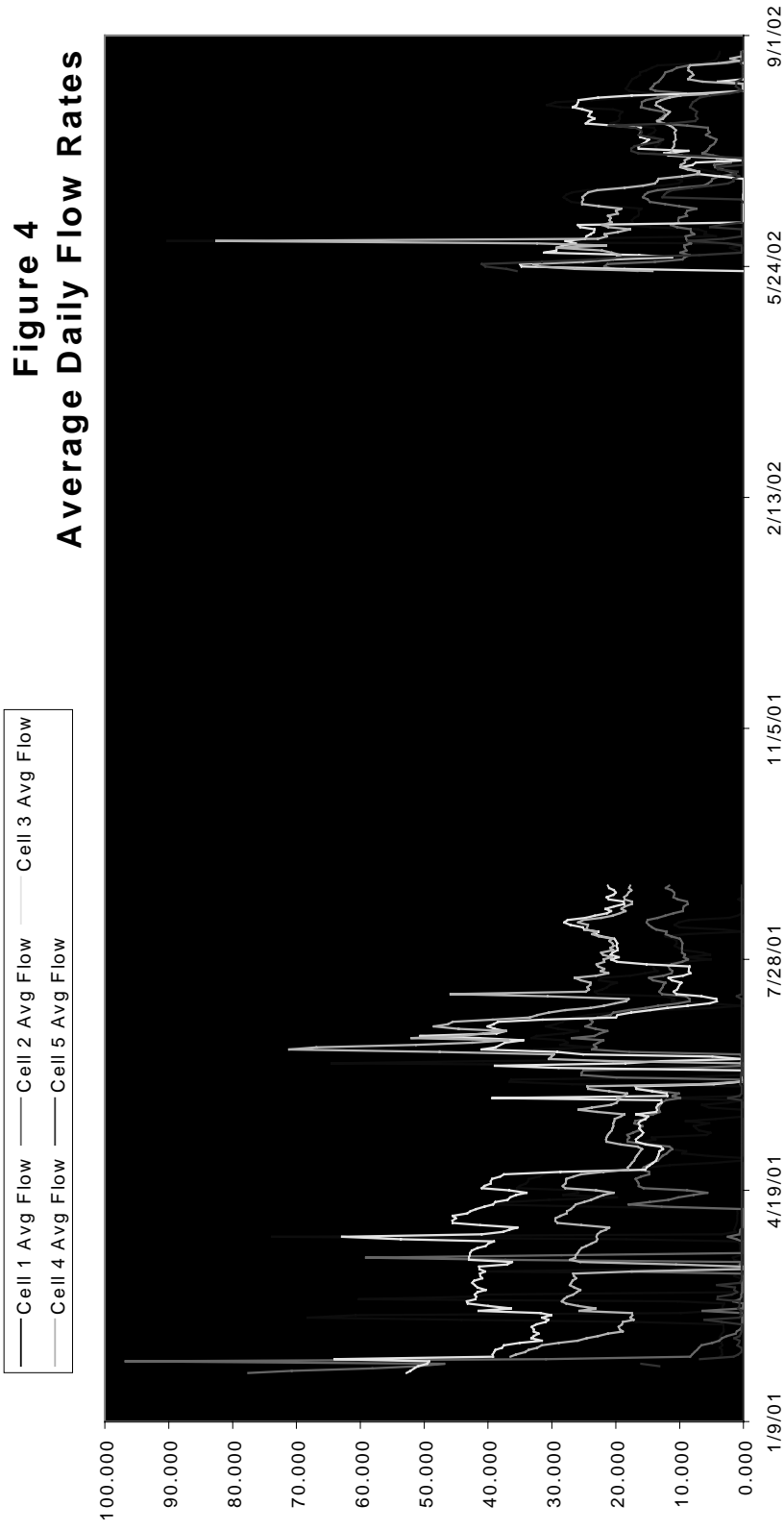


Figure 4. Groundwater Influent Flow Data for Phytoreactors (January 9, 2001 to September 1, 2002)

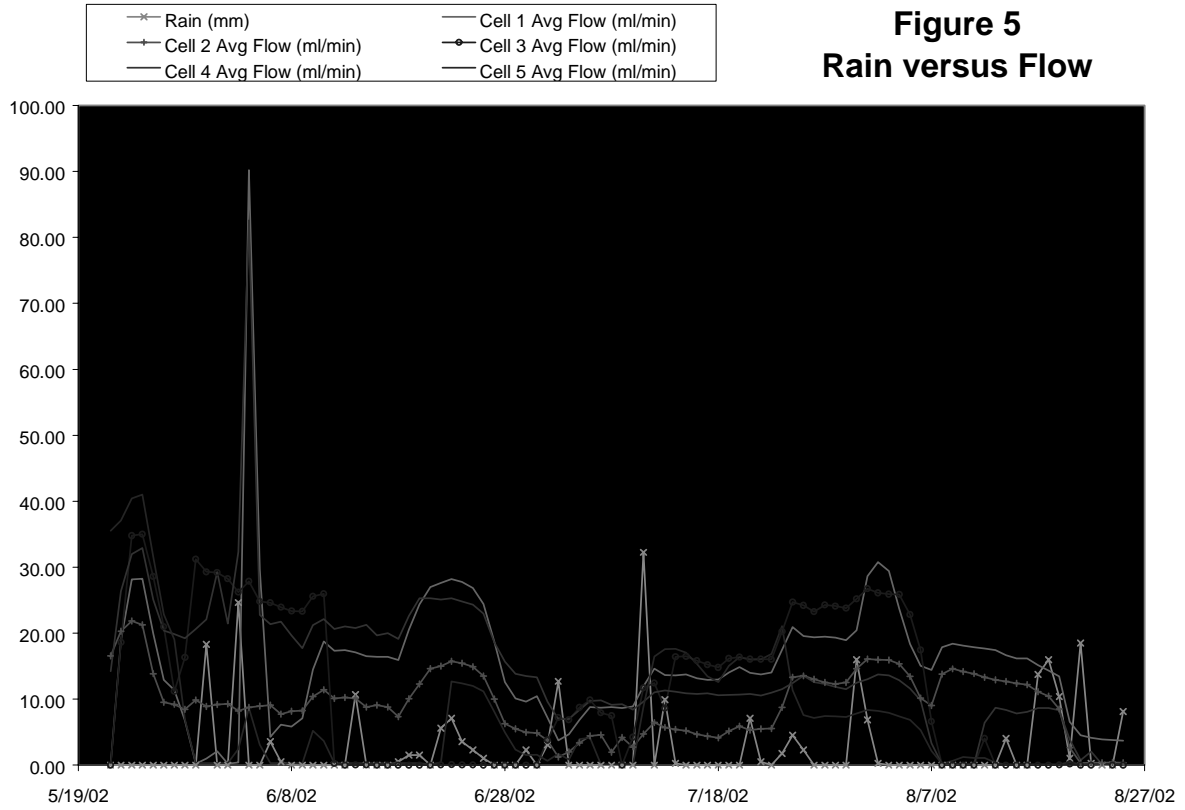
Average groundwater flows for 2001 and 2002 are shown in Table 1. After modifications to the flow system, the daily flows for 2002 were closer to the target flows. Based on the average daily flows shown, the estimated total flow through each phytoreactor is presented. Rainfall data is also included in Table 1.

Table 1. Average Rainfall for 2002 and Groundwater Flows for 2001 and 2002

	Phytoreactor				
	1	2	3	4	5
Avg Flow 2001 (mL/min)	12	12	27	24	1
Total Est 2001 Flow (L)	6,561	6,351	14,430	12,454	327
Total Est 2001 Flow (Gal)	1,733	1,678	3,812	3,290	86
Avg Flow 2002 (mL/min)	15	9	12	15	7
Total Est 2002 Flow (L)	8,090	4,899	6,239	7,803	3,673
Total Est 2002 Flow (Gal)	2,137	1,294	1,648	2,062	971
Rainfall 2002 [01/02 to 08/02] (L)	969	969	969	969	969
Rainfall 2002 [01/02 to 08/02] (Gal)	256	256	256	256	256
*ESTIMATED TOTAL FOR PROJECT (L)	15,620	12,219	21,638	21,226	4,970
ESTIMATED TOTAL FOR PROJECT (Gal)	4,127	3,228	5,717	5,608	1,313

*These are only estimates because there were intervals when data was not collected due to power supply problems.

Finally, phytoreactors flow versus rainfall was investigated to determine what rain effects can be expected in actual field applications (Figure 5). In addition, a correlation analysis was performed on the rain and phytoreactor flows. As would be expected, there is a slight negative correlation (-0.04 to -0.12) between the rain and the phytoreactor flow. Therefore, normal rain events should not unduly influence the phytoremediation process in field applications.



**Figure 5
Rain versus Flow**

Figure 5. Rain Versus Flow

3.1.3 Removal of TCE and PCE from Groundwater

When the supply tank was filled in 2002, it was found that well MSB-88C had decreased TCE and PCE groundwater concentrations. During the three years of study, the groundwater CE concentrations in MSB-88C decreased. This was confirmed by groundwater monitoring data (Figure 6) supplied by Geochemical Information Management System (GIMS).

Analytical data obtained from the 2000 to 2002 treatability study were re-coded, using the information in their Sample ID, for statistical analysis in this final report. The seven analytes displayed in Table 2 were of primary interest. One-half the detection limit was used for all “less-than” results while one half the method detection limit (MDL in Table 2) was used for replacing results recorded as below detect. Both the original results and results adjusted for below detects are displayed in Appendices A through H. The statistical analysis for plant, soil, and water samples are presented in detail in Appendices A through D. The plant material data file is in Appendix F, the soil sample data file is in Appendix G and the water samples data file is in Appendix H.

The percentage of data below the MDL is presented in Table 2 for each sample type and analyte. The water samples for TCE and PCE have 16.2% and 21.8%, respectively, of their results below the MDL and as such offer reasonably reliable statistical results. The TCE and PCE results for soil samples contain 56.3% and 67.1%, respectively, of results below the MDL while the TCE and PCE results for plant material samples contain 84.9% and 88.5%, respectively, of results below the MDL.

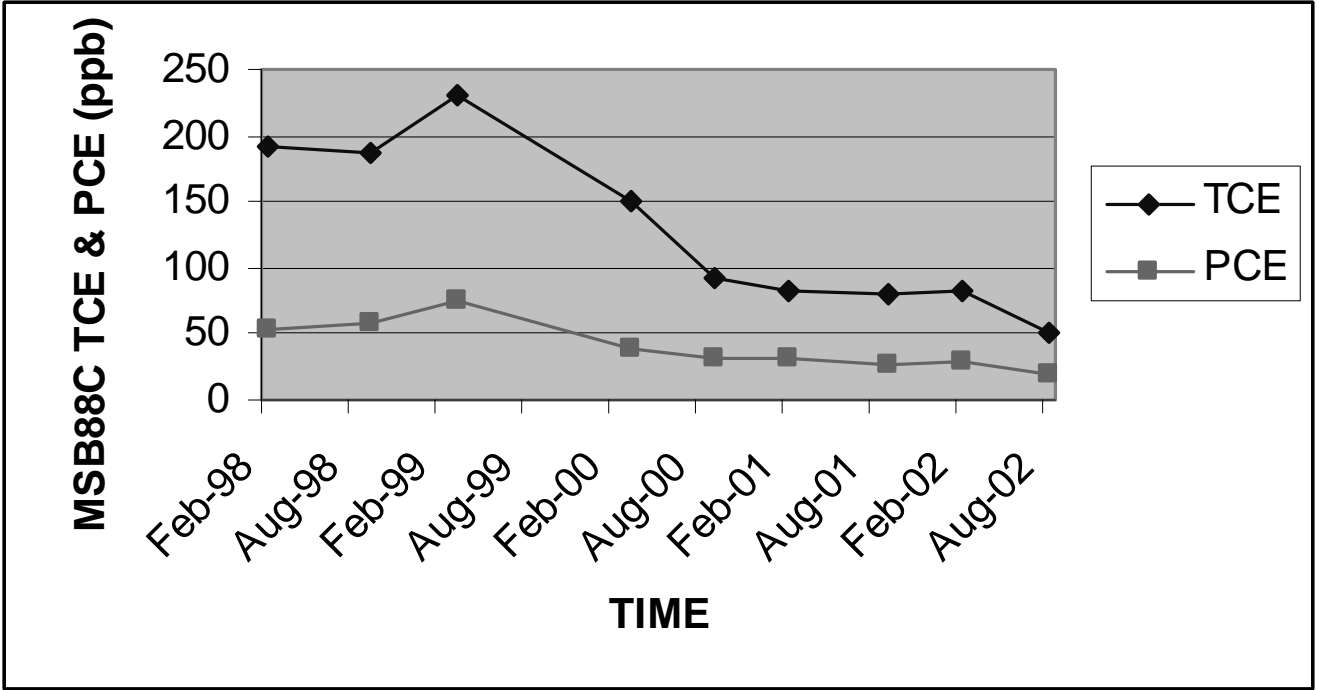


Figure 6. TCE and PCE Groundwater Concentrations in MCB-88C from February 1998 until August 2002 (Source: GIMS)

Table 2. Percentage of Groundwater, Plant, and Soil Data Below Minimum Detectable Limit (MDL)

Analyte	MDL (µg/kg)	Plant Material (%)	Soil Samples (%)	Water Samples (%)
VC	5.0	98.6	97.7	95.3
1,1 DCE	5.0	100.0	97.7	94.9
t-DCE	5.0	98.9	97.7	95.3
c-DCE	5.0	95.0	69.0	77.8
Chloroform	1.0	93.2	88.7	91.5
TCE	1.0	84.9	56.3	16.2
PCE	1.0	88.5	67.1	21.8
Number of Samples		279	213	234

3.1.4 Statistical Analysis

Graphical comparisons using *mean diamonds* to illustrate the sample effluent concentration means and the corresponding 95% confidence intervals are shown in Figures 7a through 7d. The line across the mid-part of each diamond represents the group mean. The vertical span of each diamond represents the 95% confidence interval for each group. Overlap marks are also shown above and below the group mean. For groups with approximately equal sample sizes, overlapping marks indicate that the means for the two groups are not significantly different with a false positive error rate of 5% (*i.e.*: $p \leq 0.05$).

The Box-and Whisker Plots are also used to present a visual comparison of treatment groups. A Box-and-Whisker plot displays the minimum and maximum values, the 25th, 50th (median) and 75th percentiles. The box is aligned vertically and encloses the interquartile range (the 25th to 75th percentile). The upper part of the box represents the 75th percentile while the lower part represents the 25th percentile. Extreme points will also be shown extending from the box.

Color-Coded by Year

Year

- 2000
- + 2001
- × 2002

One-Way Analysis of 1,1 DCE-Delta (µg/L) By Treatment

One-Way ANOVA Summary of Fit

Rsquare	0.121008
Adj Rsquare	0.027498
Root Mean Square Error	1.332361
Mean of Response	-0.82179
Observations (or Sum Wgts)	53

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Treatment	5	11.486026	2.29721	1.2941	0.2825
Error	47	83.433729	1.77519		
C. Total	52	94.919755			

Means for One-Way ANOVA

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Pine	10	-0.4960	0.42133	-1.344	0.3516
Poplar	10	-0.5000	0.42133	-1.348	0.3476
Soil Control	9	-0.4500	0.44412	-1.343	0.4435
Tank	6	-0.8333	0.54393	-1.928	0.2609
Vetiver	9	-1.7622	0.44412	-2.656	-0.8688
Wetland	9	-0.9650	0.44412	-1.858	-0.0715

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Pine	10	-0.4960	1.15477	0.36517	-1.322	0.3301
Poplar	10	-0.5000	1.15470	0.36515	-1.326	0.3260
Soil Control	9	-0.4500	1.23390	0.41130	-1.398	0.4985
Tank	6	-0.8333	0.51640	0.21082	-1.375	-0.2914
Vetiver	9	-1.7622	2.34069	0.78023	-3.561	0.0370
Wetland	9	-0.9650	0.51091	0.17030	-1.358	-0.5723

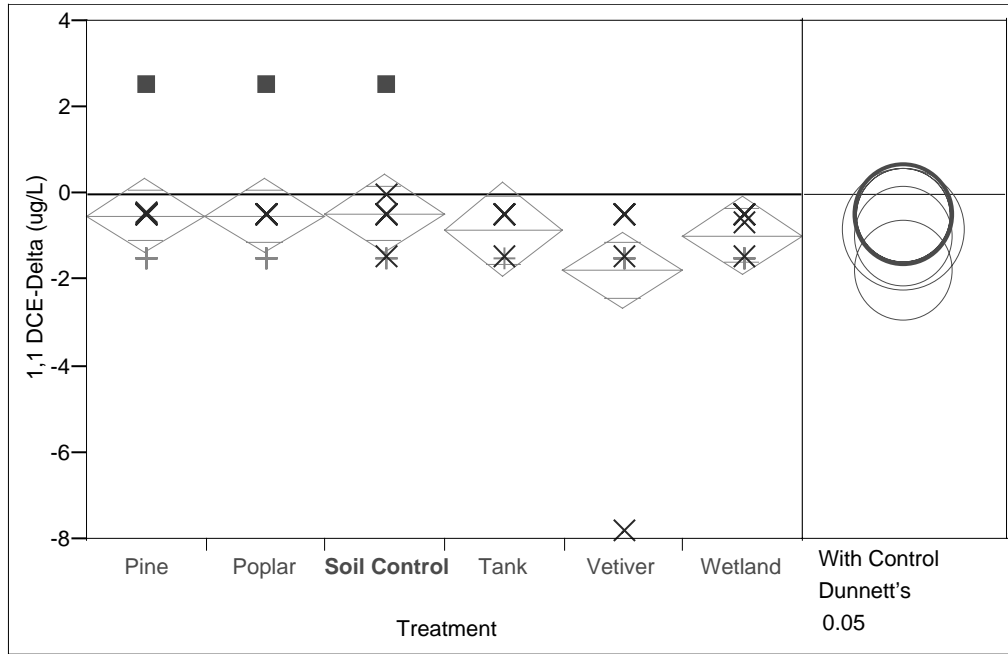


Figure 7a. 1,1-Dichloroethylene Water Samples: Influent-Effluent Differences by Treatment (Delta)

Color-Coded by Year

- Year
 ■ 2000
 + 2001
 x 2002

One Way Analysis of c-DCE Delta (µg/L) By Treatment

One-Way ANOVA Summary of Fit

Rsquare	0.1345
Adj Rsquare	0.042425
Root Mean Square Error	3.475839
Mean of Response	-0.95925
Observations (or Sum Wgts)	53

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Treatment	5	88.24109	17.6482	1.4608	0.2206
Error	47	567.82843	12.0815		
C. Total	52	656.06952			

Means for One-Way ANOVA

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Pine	10	-1.0200	1.0992	-3.231	1.191
Poplar	10	-1.1755	1.0992	-3.387	1.036
Soil Control	9	-0.2700	1.1586	-2.601	2.061
Tank	6	0.2333	1.4190	-2.621	3.088
Vetiver	9	-3.5011	1.1586	-5.832	-1.170
Wetland	9	0.4061	1.1586	-1.925	2.737

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Pine	10	-1.0200	1.39567	0.4413	-2.018	-0.022
Poplar	10	-1.1755	5.93577	1.8771	-5.422	3.071
Soil Control	9	-0.2700	0.69936	0.2331	-0.808	0.268
Tank	6	0.2333	0.66213	0.2703	-0.462	0.928
Vetiver	9	-3.5011	5.27528	1.7584	-7.556	0.554
Wetland	9	0.4061	0.74701	0.2490	-0.168	0.980

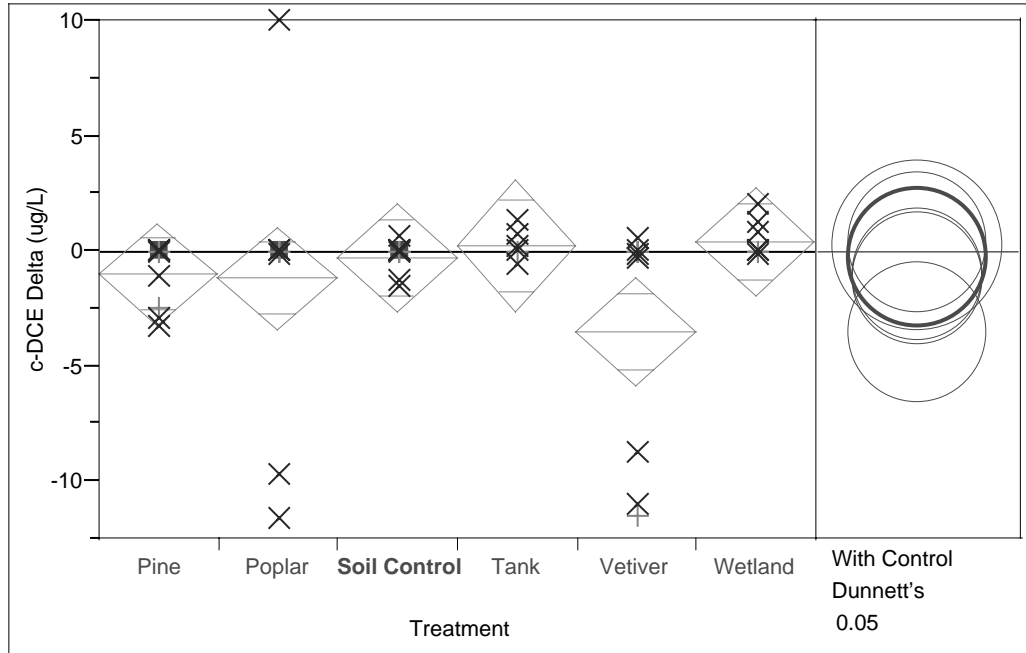


Figure 7b. c-DCE Water Samples: Influent-Effluent Differences by Treatment (Delta)

Color-Coded by Year

- Year
 ■ 2000
 + 2001
 × 2002

One-Way Analysis of TCE Delta (µg/L) By Treatment

One-Way ANOVA Summary of Fit

Rsquare	0.352577
Adj Rsquare	0.283703
Root Mean Square Error	10.00125
Mean of Response	10.92683
Observations (or Sum Wgts)	53

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Treatment	5	2560.1947	512.039	5.1191	0.0008
Error	47	4701.1735	100.025		
C. Total	52	7261.3682			

Means for One-Way ANOVA

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Pine	10	4.4117	3.1627	-1.95	10.774
Poplar	10	19.3660	3.1627	13.00	25.728
Soil Control	9	6.7050	3.3337	-0.00	13.412
Tank	6	11.8333	4.0830	3.62	20.047
Vetiver	9	3.3389	3.3337	-3.37	10.046
Wetland	9	19.9944	3.3337	13.29	26.701

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Pine	10	4.4117	9.2346	2.9202	-2.19	11.018
Poplar	10	19.3660	9.7896	3.0957	12.36	26.369
Soil Control	9	6.7050	11.7005	3.9002	-2.29	15.699
Tank	6	11.8333	12.6316	5.1568	-1.42	25.089
Vetiver	9	3.3389	9.5771	3.1924	-4.02	10.700
Wetland	9	19.9944	7.4531	2.4844	14.27	25.723

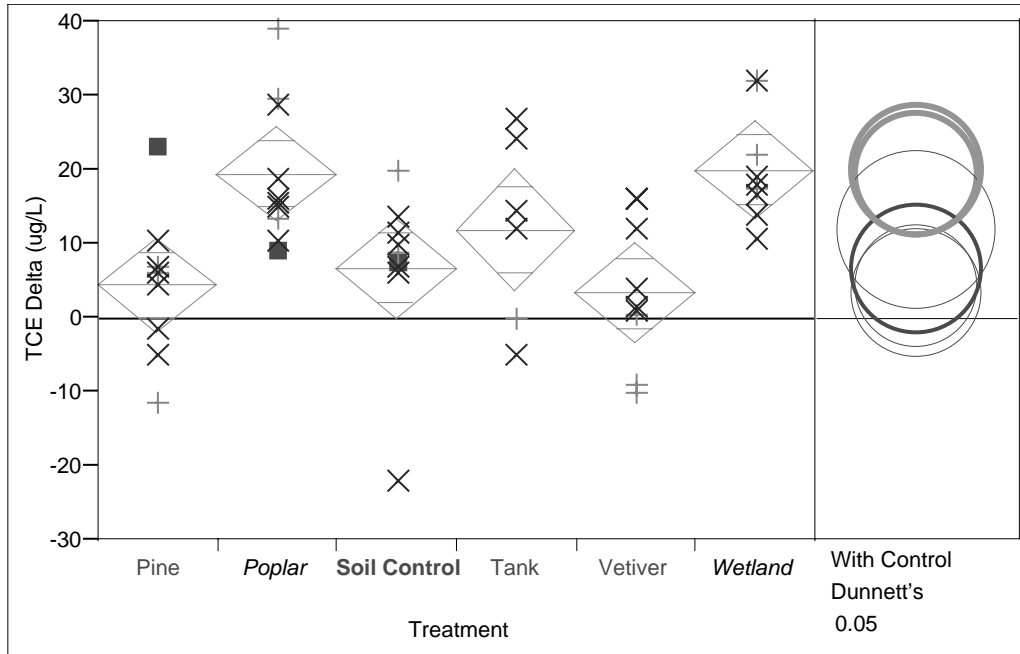


Figure 7c. TCE Water Samples: Influent-Effluent Differences by Treatment (Delta)

Color-Coded by Year

Year
 ■ 2000
 + 2001
 × 2002

One-Way Analysis of PCE Delta (µg/L) By Treatment

One-Way ANOVA Summary of Fit

Rsquare	0.329899
Adj Rsquare	0.258611
Root Mean Square Error	6.254275
Mean of Response	6.789636
Observations (or Sum Wgts)	53

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Treatment	5	905.0908	181.018	4.6277	0.0016
Error	47	1838.4501	39.116		
C. Total	52	2743.5410			

Means for One-Way ANOVA

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Pine	10	3.7536	1.9778	-0.225	7.732
Poplar	10	12.3170	1.9778	8.338	16.296
Soil Control	9	6.3628	2.0848	2.169	10.557
Tank	6	6.4833	2.5533	1.347	11.620
Vetiver	9	0.5322	2.0848	-3.662	4.726
Wetland	9	10.9100	2.0848	6.716	15.104

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Pine	10	3.7536	5.62186	1.7778	-0.268	7.775
Poplar	10	12.3170	8.48562	2.6834	6.247	18.387
Soil Control	9	6.3628	5.45804	1.8193	2.167	10.558
Tank	6	6.4833	5.68495	2.3209	0.517	12.449
Vetiver	9	0.5322	4.17203	1.3907	-2.675	3.739
Wetland	9	10.9100	6.77116	2.2571	5.705	16.115

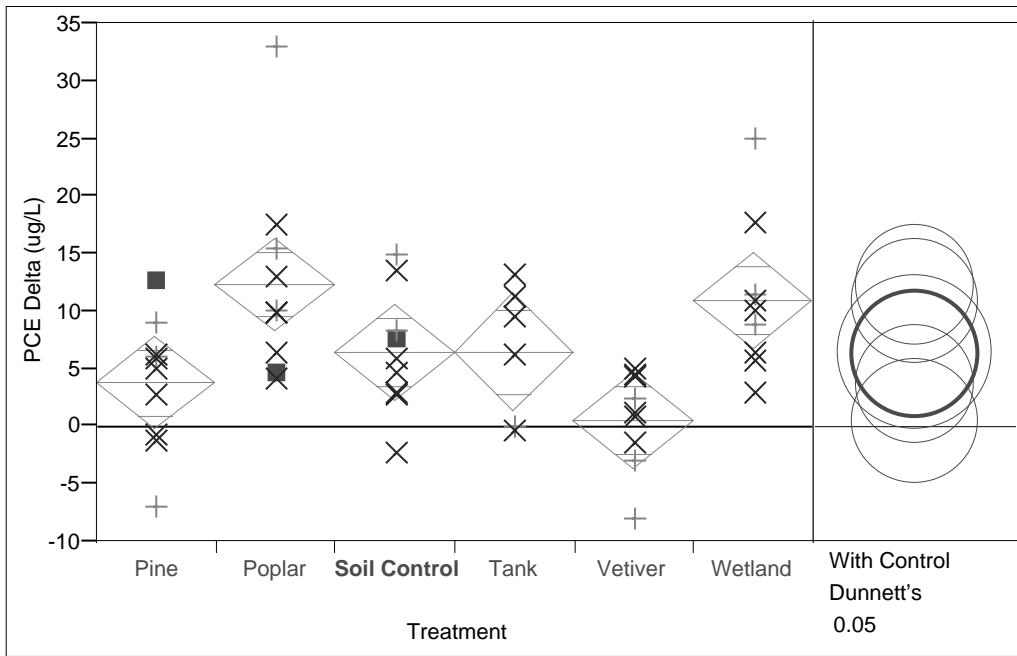


Figure 7d. PCE Water Samples: Influent-Effluent Differences by Treatment (Delta)

Dunnett's procedure (Dunnett 1955) was also performed on the analyte data that is most informative when the percent of results below detection is less than 25%. The procedure performs a simultaneous test comparison of the control group versus treatment group mean concentrations. Specifically, Dunnett's procedure tests whether the soil control group mean results are different from the mean of the treatment groups (pine, poplar, Vetiver and wetlands) and is a multiple comparison test that is recommended by Hsu (1989) for a situation in which repeated comparisons to a control group are needed. The test uses a *comparison circles* plot, which is a visual representation of group mean comparisons.

The vertical diameter spans the 95% confidence interval for the mean. Group means are compared visually by examining how the comparison circles intersect. The outside angle of intersection shows whether group means are significantly different. Circles for means that are significantly different either do not intersect or intersect slightly so that the outside angle of intersection is less than 90 degrees. If the circles intersect by an angle of more than 90 degrees or if they are nested, the means are not significantly different. The circles that are not significantly different are red on JMP[®] (Statistical Software, SAS Institute) color plots. Circles representing means that are significantly different are displayed with a thick gray pattern.

3.1.5 Statistical Analysis of Water Sample Data

The difference between influent and effluent concentrations for water samples ($\Delta = \text{Influent} - \text{Effluent}$) was calculated from the data in Appendix H for each treatment and date of the sample. The differences are presented in Appendix E. Statistical analyses of the difference data for each of the seven analytes are presented in Figures 7a through 7d. The figures display an implementation of Dunnett's procedure using the soil control as the basis for comparison. In addition, Box-and-Whisker Plots are presented along with mean diamonds. The plot characters are color-coded according to the year the sample was taken. The figures also include statistical results from analysis of variance

(ANOVA) along with sample means and standard deviations for each treatment. There were treatment differences noted for VC (Figure 7a) and c-DCE (Figure 7b). The most credible results are for TCE (Figure 7c) and PCE (Figure 7d) where the percentage of data below the MDL is less than 22%.

ANOVA results indicate that there are significant ($p=0.002$) differences in PCE and TCE among the six treatments (Figure 7c). However, for PCE none of the pair-wise comparisons with the soil control were significant as indicated by the comparison circles in Figure 7d. There PCE groundwater influent concentrations were greater than effluent groundwater for the poplar, soil control, tank, and wetland treatment. Both the poplar and wetland treatment provided the greatest difference between influent and effluent. However, the difference among the various treatments was not statistically significant.

The ANOVA test results indicate that there are significant differences in TCE concentrations among the six treatments in addition to statistically pair-wise comparisons using the soil control group. In particular, the statistical results for TCE show that both the wetland and poplar treatment are significantly different from the soil control. The TCE influent concentration is greater than effluent concentration for both the wetland and poplar treatment (Figure 7c). No differences among the treatments or between influent and effluent are apparent for VC or c-DCE. However, the extremely high percentage of effluent results below the MDL interferes with quoting the appropriate confidence levels.

3.1.6 Statistical Analysis of Soil Sample Data

Generally, soil VOC concentrations were extremely low to non-detect. A typical statistical analysis by comparing means is not reliable for any of these analyte results from the soil samples. This is because the percentage of results at or below the MDL was 98%, 98%, 98%, 69%, 89%, 56% and 67% for VC, 1,1 DCE, t-DCE, c-DCE, chloroform, TCE and PCE, respectively.

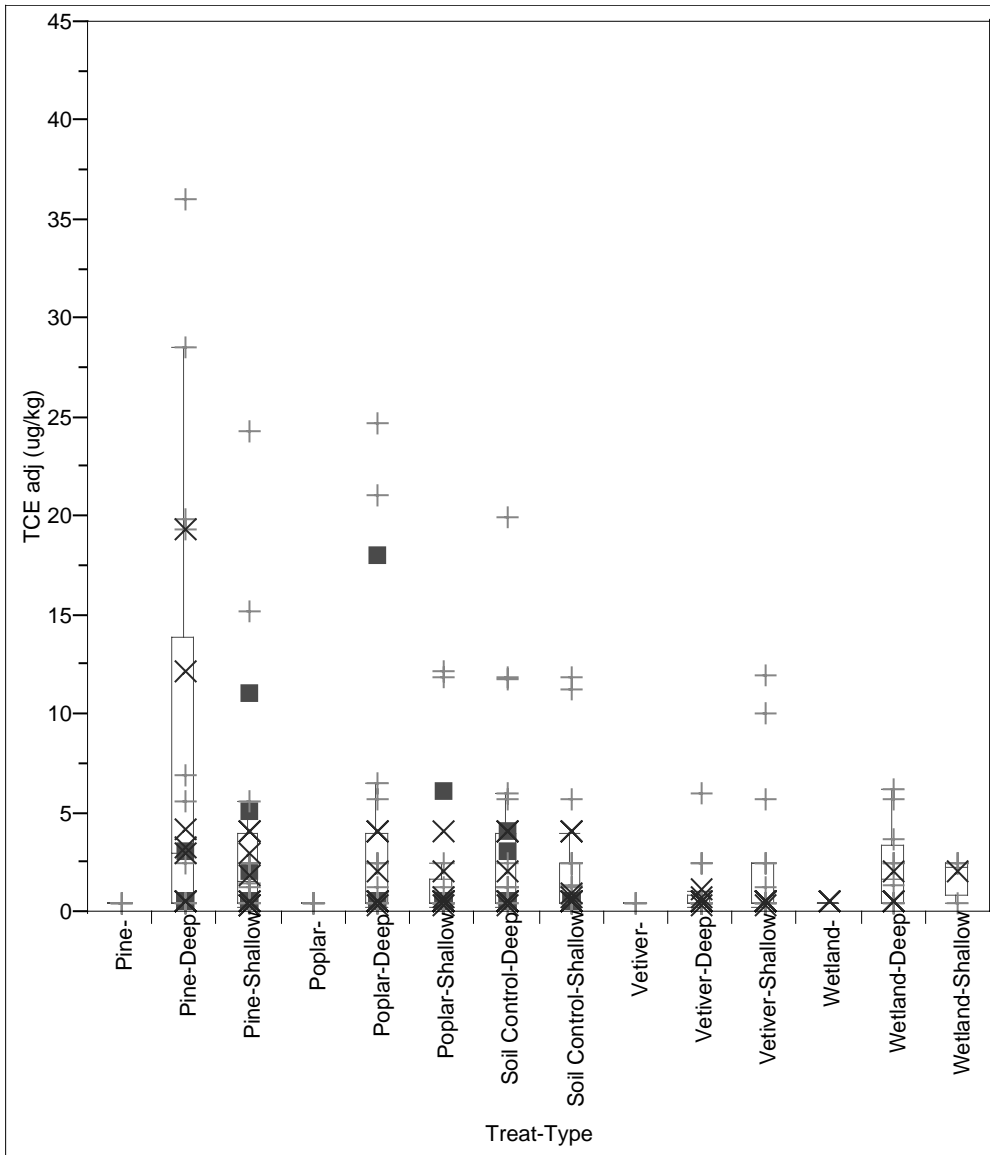
Figure 8 (8a through 8d) contains Box-and-Whisker plots for TCE, PCE, c-DCE and VC color-coded by sample year. The plots suggest that pine, poplar and soil control treatments have higher concentrations of TCE (Figure 8a) and PCE (Figure 8b) in the deep soil samples than in the shallow soil samples. This pattern cannot be seen for c-DCE (Figure 8c) while the plot for VC (Figure 8d) (Percent BLD= 98%) is uninformative. Although this pattern is similar for TCE and PCE, the data do not warrant any more rigorous statistical analysis.

3.1.7 Statistical Analysis of Plant Tissue Data

VOCs were found in plant material samples from all treatments tested (pine, poplar, Vetiver, and wetland). The sample results are displayed in the Box-and-Whisker Plots (Figure 9a through 9d) for TCE (Figure 9a), PCE (Figure 9b), c-DCE (Figure 9c), and VC (Figure 9d). The plots are color-coded by type of material sampled. Because the measurements cross several orders of magnitude, the common logarithm of the concentration was used. This useful and widely accepted data scale transformation should stabilize the variability portrayed in the data plot from one data group to another. As with the soil sample data, a typical statistical analysis by comparing means is not reliable for any of the analyte results from plant tissue samples. This is because the percentage of results at or below the MDL was 99%, 100%, 99%, 95%, 93%, 85% and 89% for VC, 1,1 DCE, t-DCE, c-DCE, chloroform, TCE and PCE, respectively. It is of interest that the pine trees had the highest concentrations of c-DCE (Figure 9b). Furthermore, the greatest concentrations of TCE, PCE, and VC appear in the leaf material. The TCE plot in Figure 9a also suggests that pine and poplar takes up more TCE than Vetiver or wetlands. In June and August, samples were taken for soil volatilization and plant transrespiration. No detectable TCE or PCE (<5 ppb) was found in soil volatilization from any of the phytoreactors.

Color-Coded by Year
Year
■ 2000
+ 2001
x 2002

One-Way Analysis of TCE adj ($\mu\text{g}/\text{kg}$) By Treat-Type



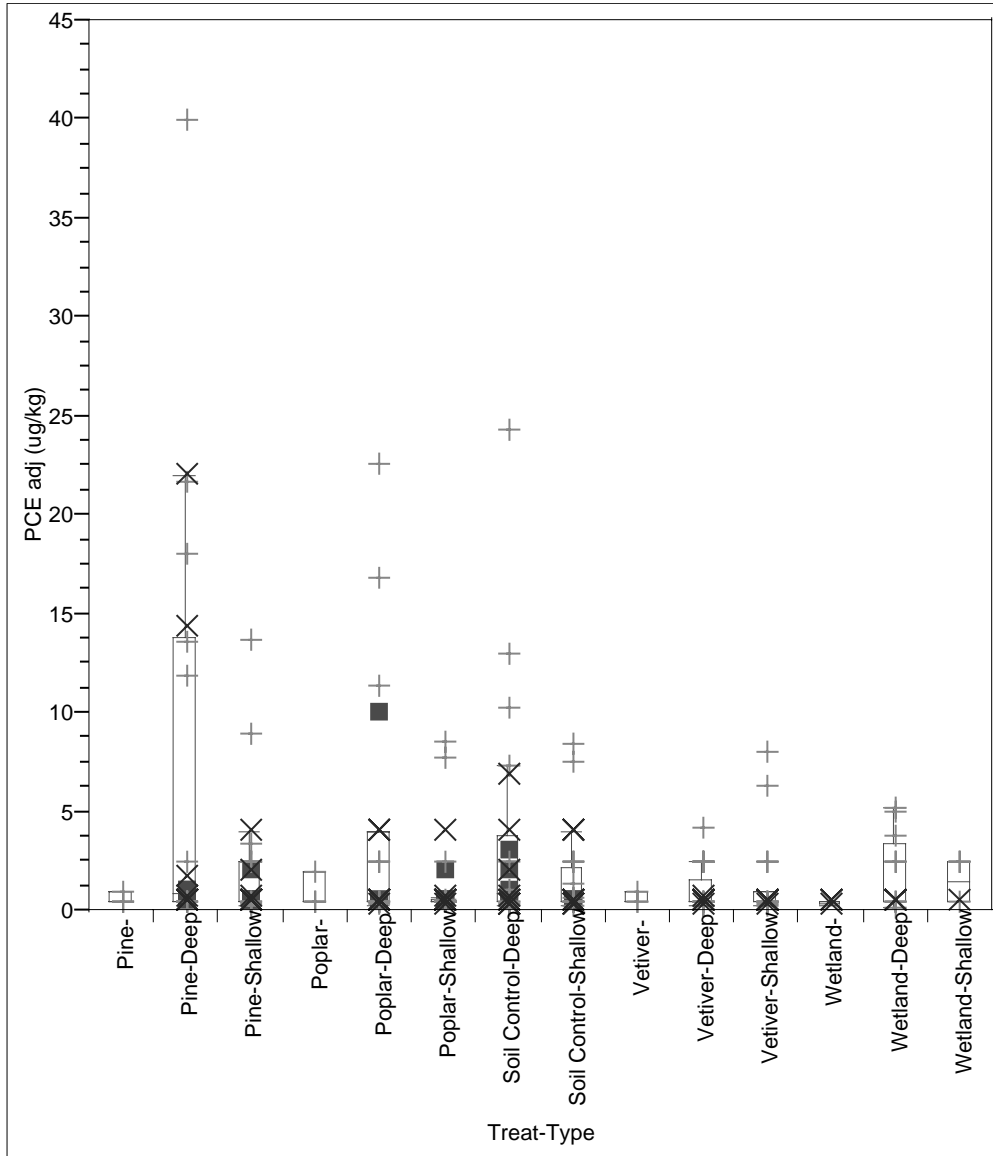
(Results adjusted (adj) for Below Detects)

Figure 8a. Soil Samples Depth and Treatment Comparisons for TCE

Color-Coded by Year

Year
■ 2000
+ 2001
x 2002

One-Way Analysis of PCE adj ($\mu\text{g}/\text{kg}$) By Treat-Type



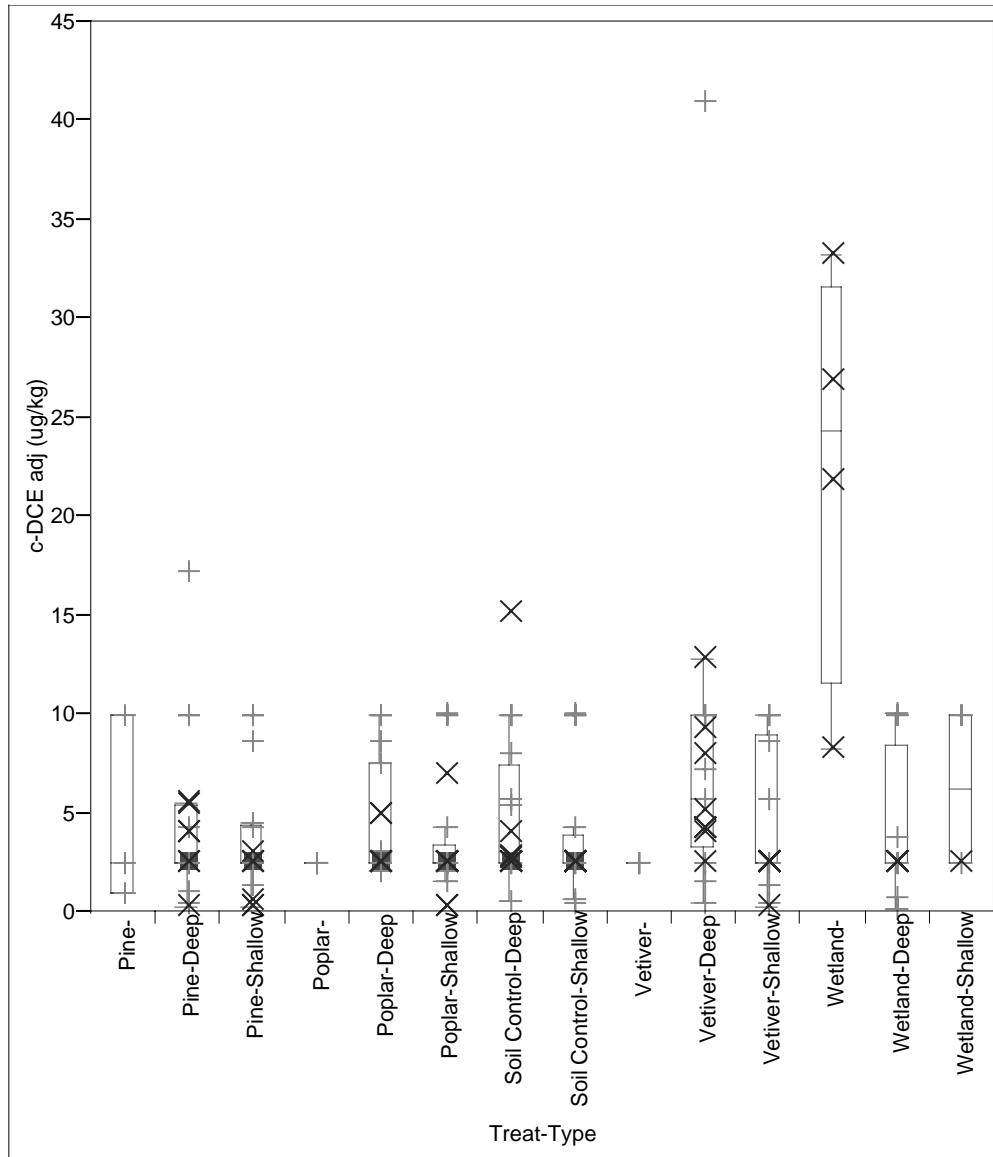
(Results adjusted (adj) for Below Detects)

Figure 8b. Soil Samples Depth and Treatment Comparisons for PCE

Color-Coded by Year

Year
■ 2000
+ 2001
x 2002

One-Way Analysis of c-DCE adj ($\mu\text{g}/\text{kg}$) By Treat-Type



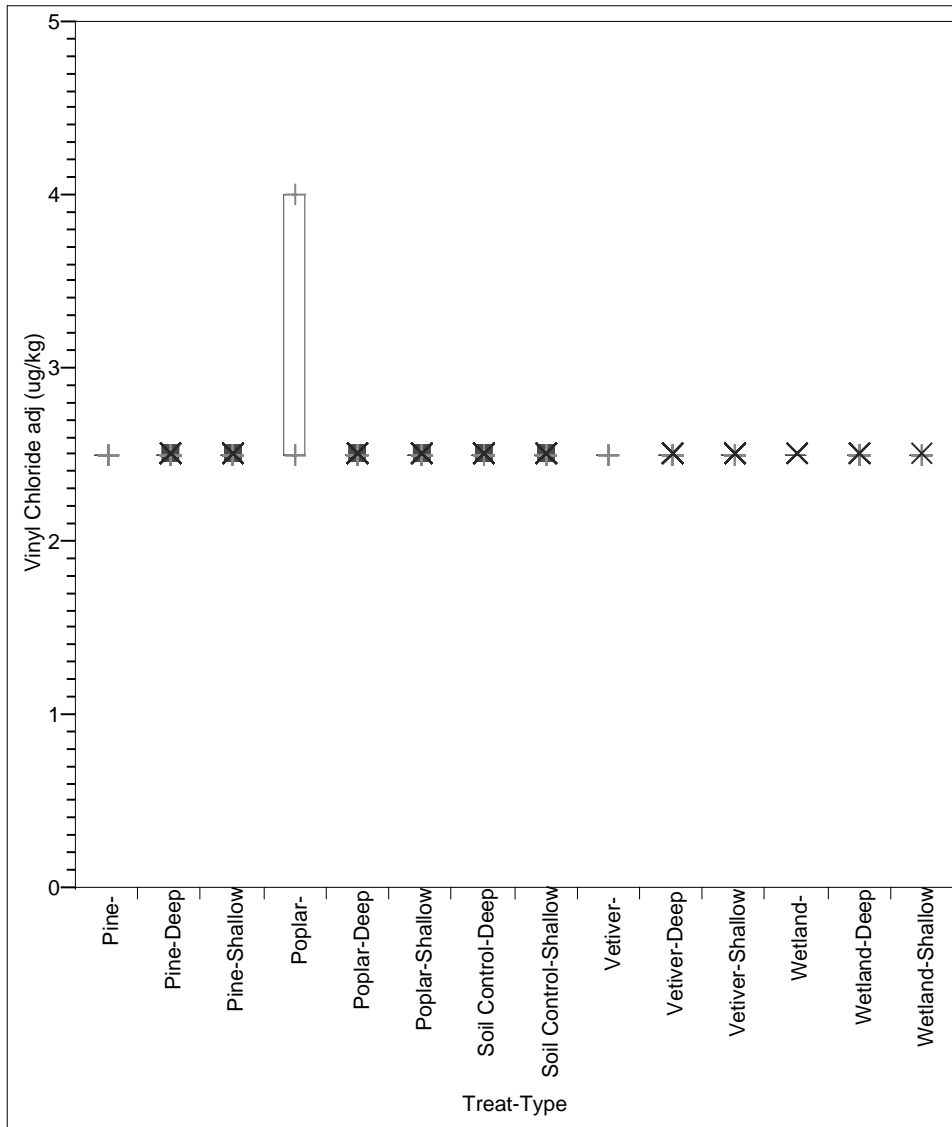
(Results adjusted (adj) for Below Detects)

Figure 8c. Soil Samples Depth and Treatment Comparisons for c-DCE

Color-Coded by Year

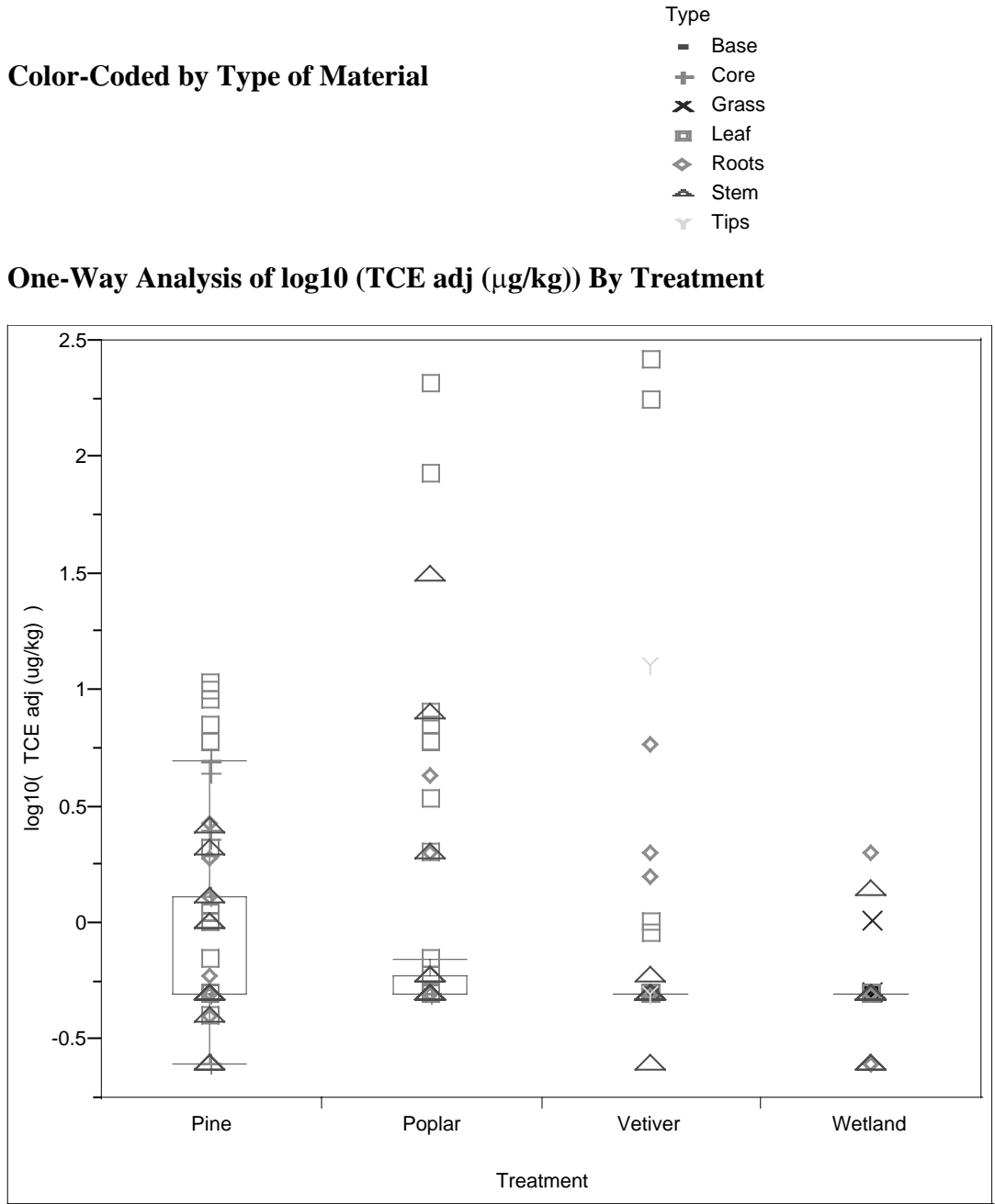
Year
■ 2000
+ 2001
x 2002

One-Way Analysis of Vinyl Chloride adj ($\mu\text{g}/\text{kg}$) By Treat-Type



(Results adjusted (adj) for Below Detects)

Figure 8d. Soil Samples Depth and Treatment Comparisons for Vinyl Chloride



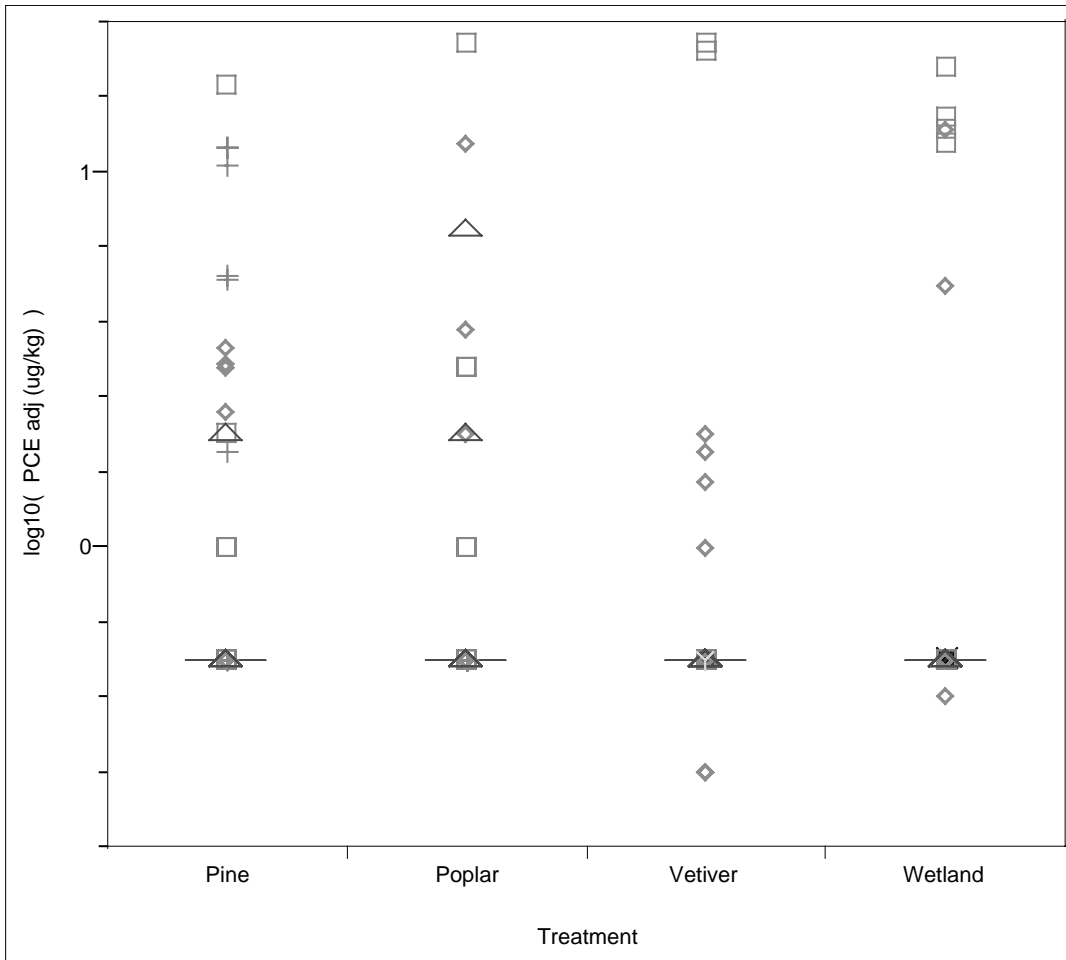
(Results adjusted (adj) for Below Detects)

Figure 9a. Analysis of Plant Material TCE by Treatment

Color-Coded by Type of Material

- Type
- Base
- + Core
- x Grass
- Leaf
- ◇ Roots
- △ Stem
- ▽ Tips

One-Way Analysis of log₁₀ (PCE adj (μg/kg)) By Treatment



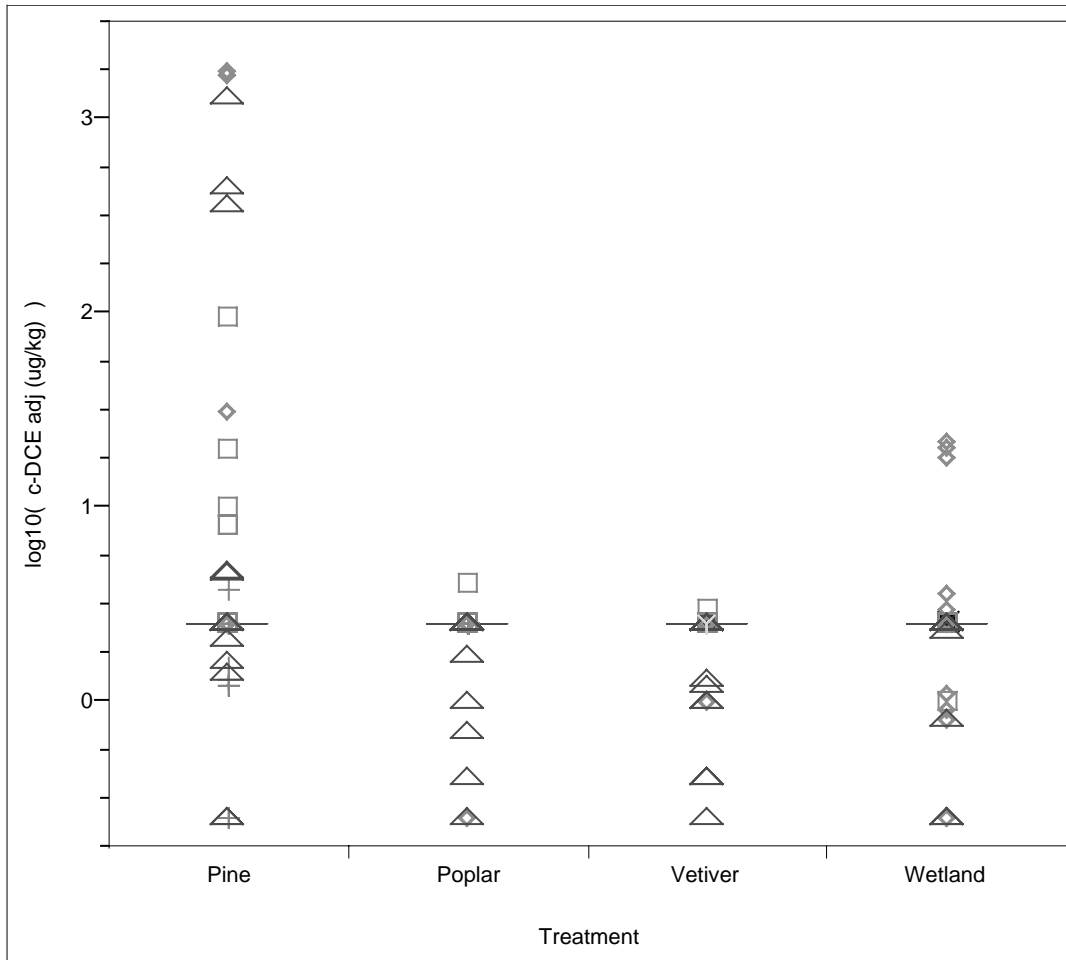
(Results adjusted (adj) for Below Detects)

Figure 9b. Analysis of Plant Material PCE by Treatment

Color-Coded by Type of Material

- Type
- Base
- + Core
- × Grass
- Leaf
- ◇ Roots
- ▲ Stem
- ∇ Tips

One-Way Analysis of $\log_{10}(\text{c-DCE adj } (\mu\text{g/kg}))$ By Treatment



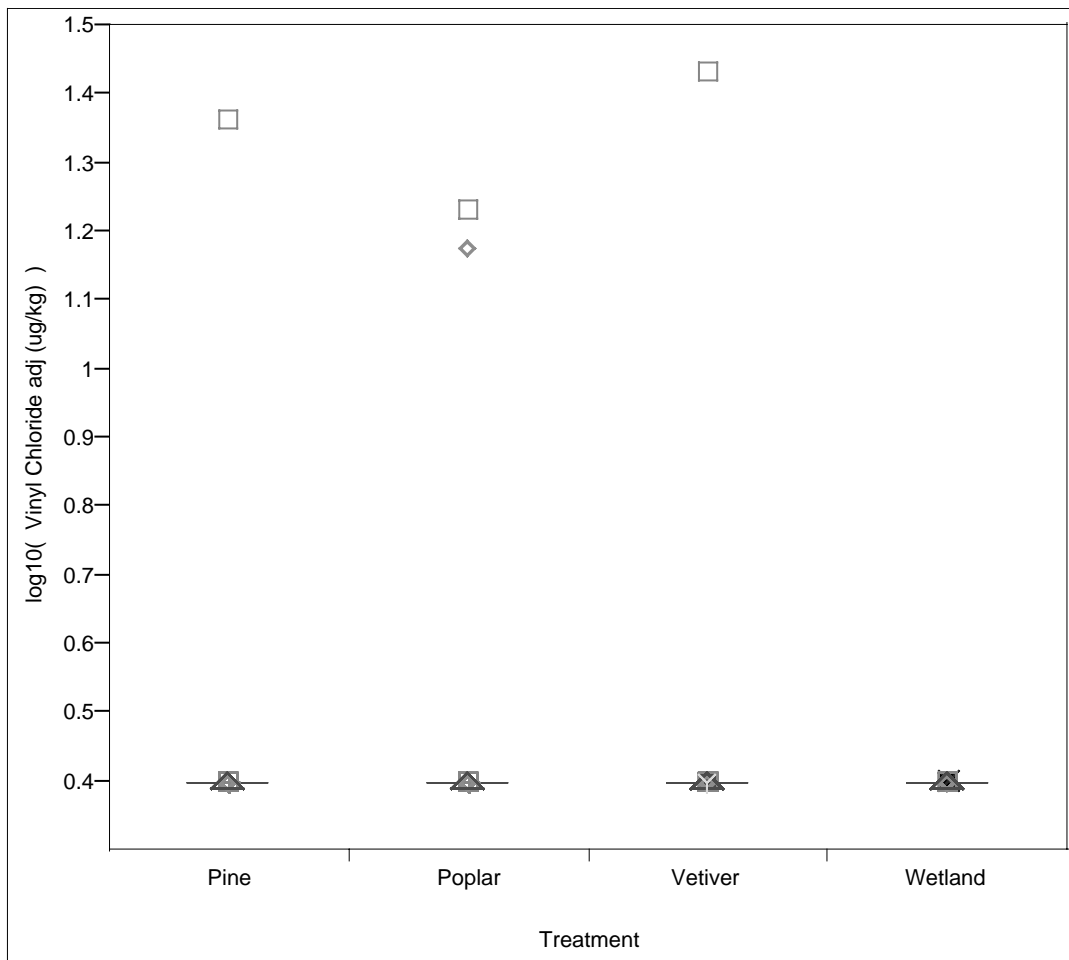
(Results adjusted (adj) for Below Detects)

Figure 9c. Analysis of Plant Material c-DCE by Treatment

Color-Coded by Type of Material

- Type
- Base
 - + Core
 - x Grass
 - ▣ Leaf
 - ◇ Roots
 - ▲ Stem
 - γ Tips

One-Way Analysis of log₁₀ (Vinyl Chloride adj (μg/kg)) By Treatment



(Results adjusted (adj) for Below Detects)

Figure 9d. Analysis of Plant Material Vinyl Chloride by Treatment

3.1.8 Transrespiration Measurements

Transrespiration measurements taken in June and August 2002 from the plants (pine, poplar, and Vetiver) did not show transrespiration of any detectable TCE and PCE. Wetland species were not measured because the wetland plants did not have leaves large enough to measure.

3.1.9 Microcosm Studies

Previous investigations of microbial activity in the wetland and seepine soils were described in an FY01 study of phytoremediation of CE in Southern Sector sediments (WSRC 2001). Anaerobic microcosms were employed to assess both natural and amended activity for transformation of TCE and PCE to degradation products.

Samples were obtained from the seepine and wetland sediments at the site in July 2001. Soil samples were kept under refrigeration at 4°C prior to microcosm preparation and then handled in an anaerobic glove box at all times. Soil samples were prepared in the following manner.

Sample	Description	Source
Wetland	Mixture of 3 samples of soil from UTRC Wetland sediments	Seepine area at UTRC and at same location of site for soil in the Phytoreactor 5
Rhizosphere	Rhizosphere soil	Mixed soils taken as soil cores (2 cores /reactor) from Phytoreactors 1, 2, 3, and 4.

After 6 weeks, all TCE- and PCE-containing microcosms established with rhizosphere and wetland sediments were analyzed as reported in the FY01 phytoremediation study (WSRC 2001). Additional measurements were made at six months and 10 months and are reported herein. The wetland controls showed no TCE losses over 10 months (Figure 10a). In the unamended wetland microcosms it was evident that TCE had been removed and some c-DCE had been produced (Figure 10a). These data indicate that the microbial populations present are capable of biotransforming TCE in the wetland soils (Figure

10b). This response is compatible with the porewater and effluent groundwater data, indicating in general an anaerobic environment within the saturated soil zone. Compared to the unamended microcosm in the short term, the amendments to the wetland sediments seemed to enhance the biodegradation of TCE (Figures 10c and 10d). The Osmocote[®] and oil appeared to work comparably (Figures 10c and 10d). The oil could influence TCE bioavailability of the TCE. The combination of oil and fertilizer had the same effect (Figure 10e). The dechlorination product c-DCE was found in the later samplings for all amendments.

The rhizosphere control indicated some diffusional losses (Figure 11a). Unlike the wetland microcosms, the rhizosphere soils used in the phytoreactors showed TCE degradation with production of c-DCE within six weeks (Figures 11a through 11e). The oil amendment (Figure 11c) seemed to work better than the Osmocote[®] (Figure 11d) or the vegetable oil combined with Osmocote[®] as less daughter product (c-DCE) was produced (Figure 11e). With no amendment, it appeared all the TCE went to c-DCE (Figure 11b). It appears the populations of bacteria present in the rhizosphere are different from those in the wetland sediments. This would explain the different results. It is also possible that the rates of biodegradation are faster in the wetland soils since a greater quantity of organic matter is present. Because these are closed systems, a nutrient limitation could have prevented full dechlorination of the c-DCE to ethene. It is possible that in another few months, it may have fully degraded. Further microbial characterization and biodegradation testing would help probe these differences.

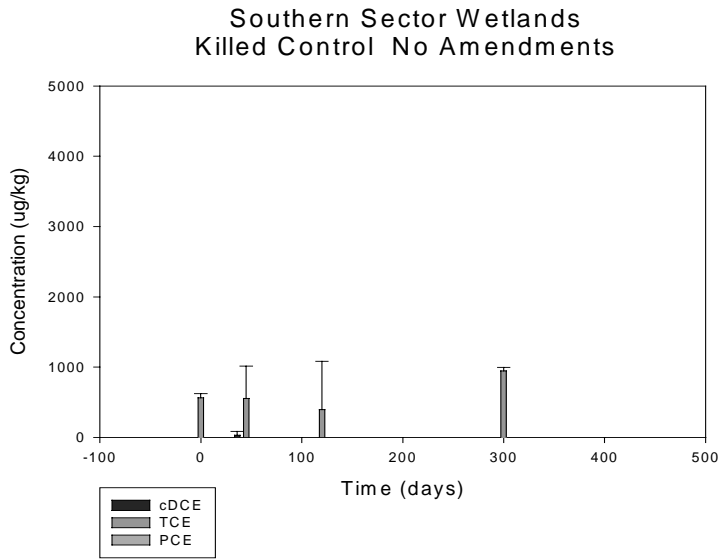


Figure 10a. Microbial Degradation of TCE in Control Wetland Sediments

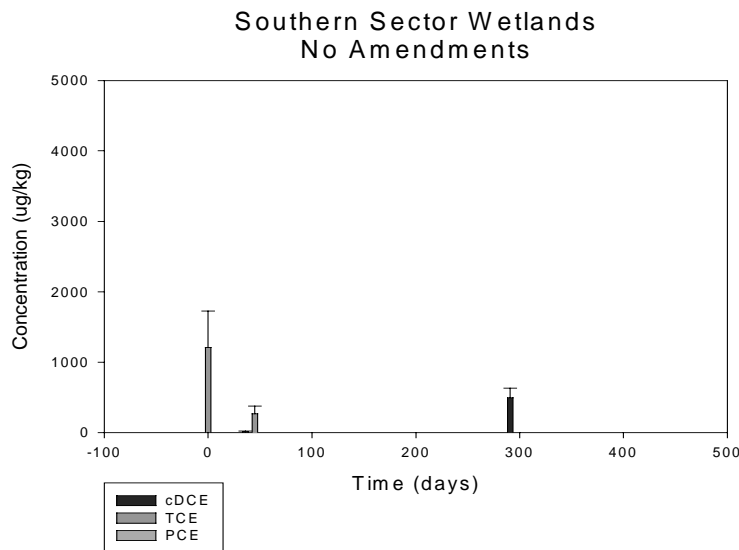


Figure 10b. Microbial Degradation of TCE in Unamended Wetland Sediments.

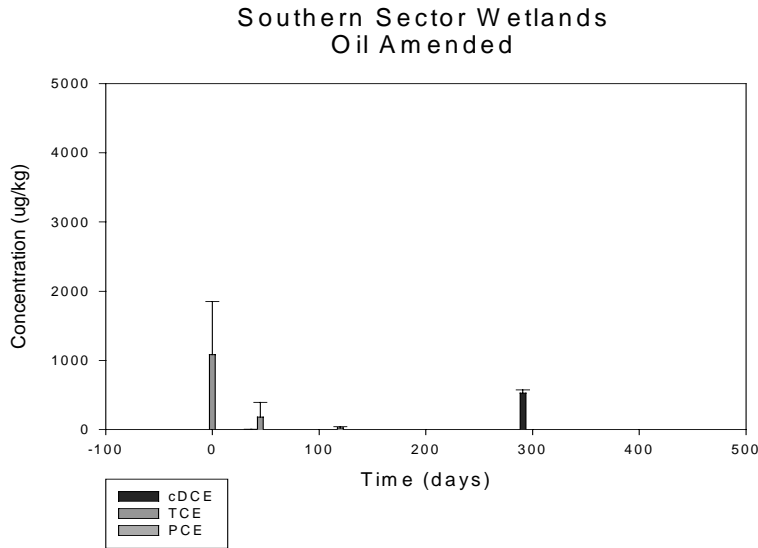


Figure 10c. Microbial Degradation of TCE in Wetland Sediments Amended with Soybean Oil

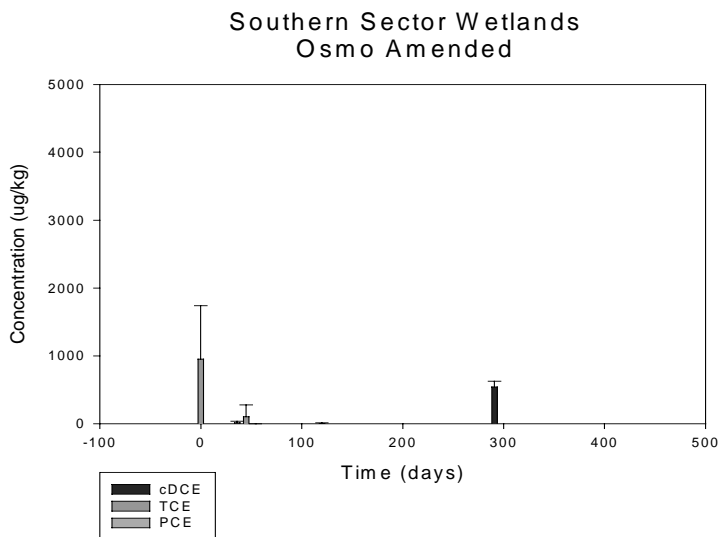


Figure 10d. Microbial Degradation of TCE in Wetland Sediments Amended with Osmocote[®]

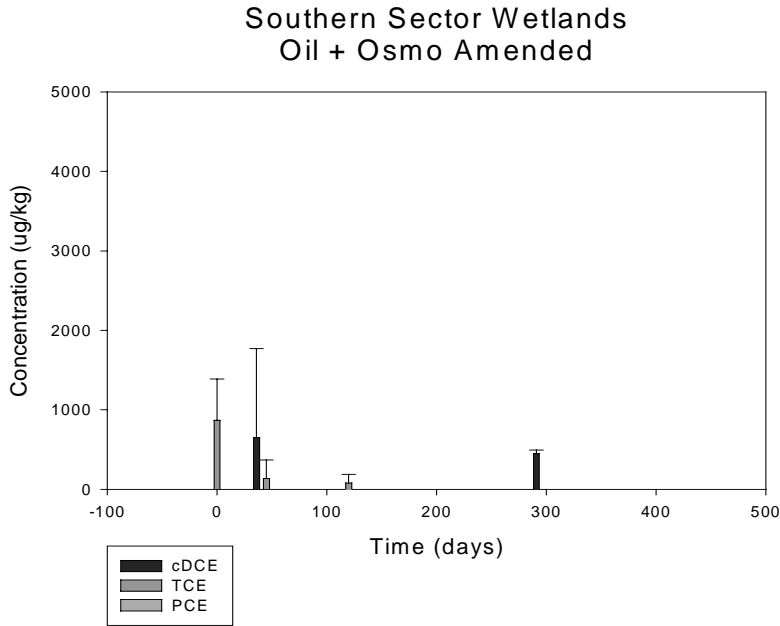


Figure 10e. Microbial Degradation of TCE in Wetland Sediments with Oil and Osmocote[®].

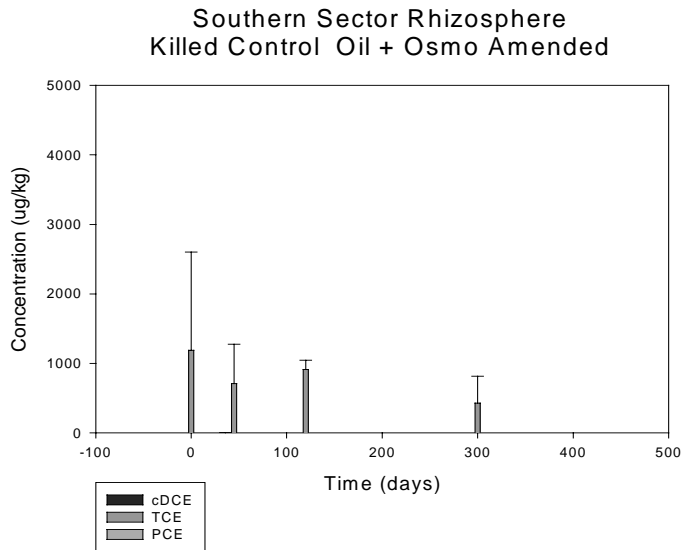


Figure 11a. Microbial Degradation of TCE in Control Rhizosphere Sediments

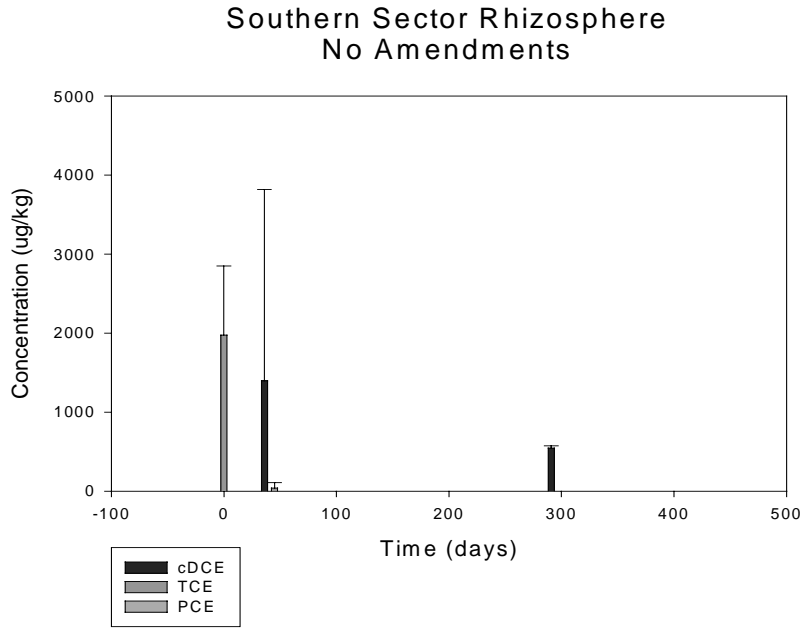


Figure 11b. Microbial Degradation of TCE in Unamended Rhizosphere Sediments

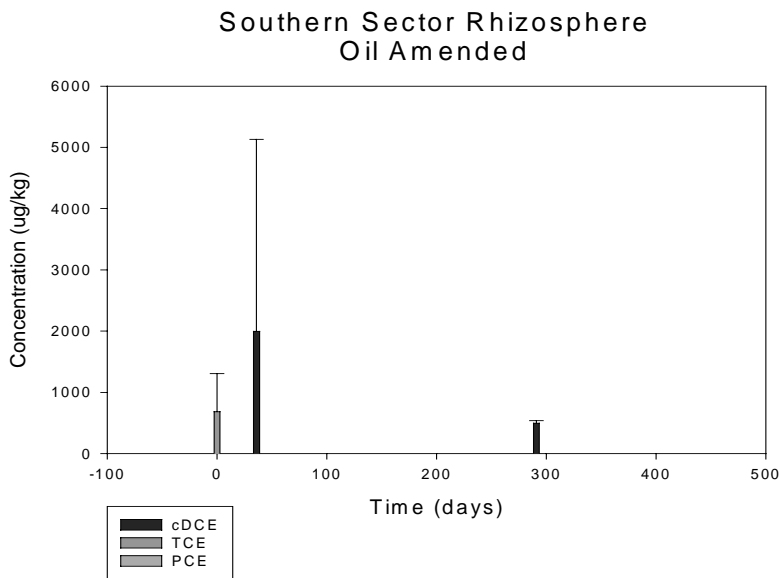


Figure 11c. Microbial Degradation of TCE in Oil-Amended Rhizosphere Sediments

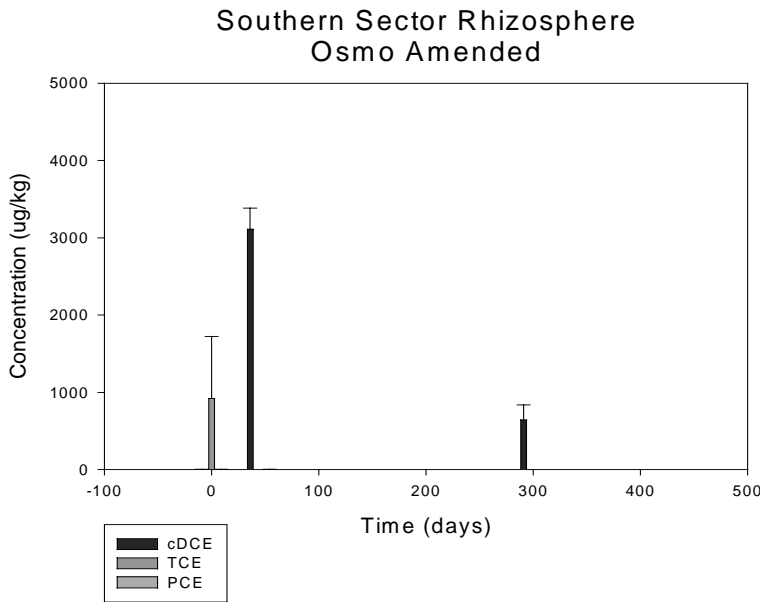


Figure 11d. Microbial Degradation of TCE in Osmocote-Amended Rhizosphere Sediments

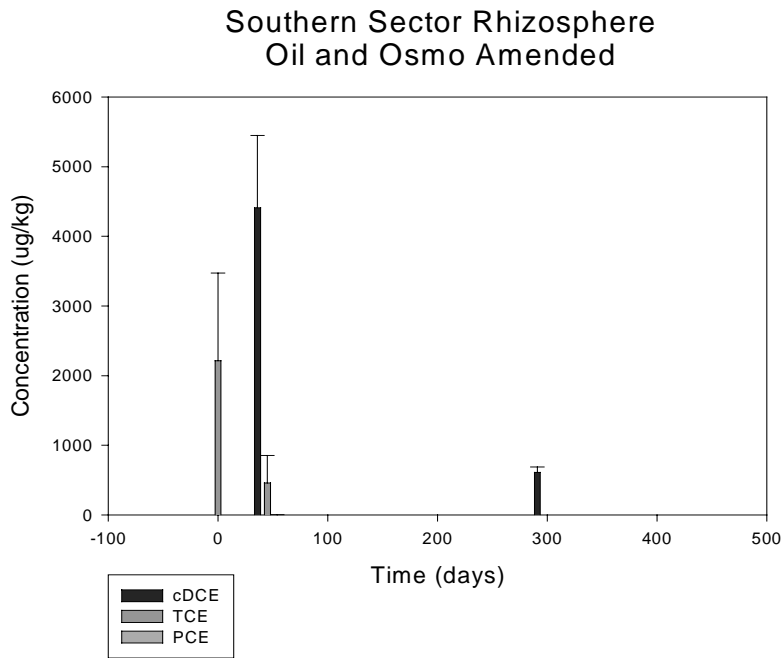


Figure 11e. Microbial Degradation of TCE in Oil + Osmocote-Amended Rhizosphere Sediments

3.1.10 Soil Metabolic Rates

Table 3 shows the soil-gas metabolic rates for the five phytoreactors. The rates of oxygen uptake were wetland>poplar>Vetiver>control>pine. It is also of interest that the CO₂ production followed the same pattern (Table 3). The ranking for the first three, wetland, poplar, and Vetiver, pretty much follows the biomass (roots) in the associated soil. The pine and control metabolic rates were close although it should be mentioned that pines did not have as much root mass. A fair amount of c-DCE was detected in the pine phytoreactor (Figure 7). The presence of c-DCE is indicative of anaerobic conditions. The pine trees do not have the extensive roots required to transport excess oxygen into the subsurface, which could allow the anaerobic conditions to prevail.

Table 3. Phytoreactor Soil Metabolic Rates: Oxygen Consumption and Carbon Dioxide Production

Soil Type	Oxygen Utilization ($\mu\text{L/g dry wt/hr}^*$)	Carbon Dioxide Production ($\mu\text{L/g dry wt/hr}$)
Pine	0.006	0.043
Poplar	0.167	0.116
Nonvegetated	0.082	0.053
Vetiver	0.131	0.101
Wetland	0.323	0.251

* stands for “micrograms per gram dry weight per hour”

3.1.11 Ion Chromatography

Tables 4a and 4b show the influent and effluent groundwater chloride, nitrite, nitrate, phosphate, and sulfate cation concentrations. The composite water flows, and resulting flow of soluble ions, for the phytoreactors include influent groundwater, influent rainwater, subsurface discharge of groundwater and evaporative losses at the soil surface (Phytoreactors 1, 2, 3, and 4), and evapotranspiration by plants (in Phytoreactors 1, 2, 4, and 5). In addition, the soil placed in the phytoreactors contained pore water moisture

with dissolved minerals as well as minerals sorbed to soil surfaces. These flows and sources need to be considered in the assessment of the ion data to date.

Chloride ion should be conservative in the phytoreactors and, except for an initial perturbation in March 2002 for the initial effluent, the influent and effluent data for chloride appear to be similar.

Table 4a. Anion Results for Southern Sector Soil and Influent and Effluent Groundwater

Sample Name	Cl Chloride (mg/L)	NO₂ Nitrite (mg/L)	NO₃ Nitrate (mg/L)	PO₄ Phosphate (mg/L)	SO₄ Sulfate (mg/L)
Box # 1 In	3.3	ND	6.7	ND	ND
Box # 1 Ef	2.9	ND	11	ND	ND
Box # 2 In	3.1	ND	8.1	ND	ND
Box # 2 Ef	2.2	ND	6.0	ND	1.8
Box # 3 In	2.9	ND	7.9	ND	< 1.0
Box # 3 Ef	2.9	< 1.0	5.3	ND	1.1
Box # 4 In	2.9	ND	7.7	ND	< 1.0
Box # 4 Ef	2.9	BDL	5.4	ND	< 1.0
Box # 5 In	2.9	ND	7.8	ND	BDL
Box # 5 Ef	9.5	ND	1.7	ND	< 1.0
Box # 1 Soil	BDL	ND	ND	ND	ND
Box # 2 Soil	BDL	ND	1.5	ND	ND
Box # 3 Soil	BDL	ND	ND	ND	ND
Box # 4 Soil	BDL	ND	ND	ND	ND
Box # 5 Soil	1.9	ND	ND	ND	ND

ND - "Not Detected"

Box - Phytoreactor

BDL - "Below Detection Limit"

Table 4b. Cation Results for Southern Sector Soil and Influent and Effluent Groundwater

Sample Name	Li <i>Lithium</i> (mg/L)	Na <i>Sodium</i> (mg/L)	NH ₄ <i>Ammonium</i> (mg/L)	K <i>Potassium</i> (mg/L)	Mn <i>Manganese</i> (mg/L)	Ca <i>Calcium</i> (mg/L)
Box # 1 In	ND	5.0	ND	BDL	< 1.0	< 1.0
Box # 1 Ef	BDL	4.4	BDL	BDL	2.3	< 1.0
Box # 2 In	ND	5.1	ND	BDL	BDL	< 1.0
Box # 2 Ef	ND	1.4	ND	BDL	2.5	1.4
Box # 3 In	ND	4.8	ND	BDL	BDL	1.1
Box # 3 Ef	ND	10.5	ND	1.8	ND	2.1
Box # 4 In	ND	5.5	ND	BDL	BDL	< 1.0
Box # 4 Ef	ND	5.2	ND	BDL	BDL	1.4
Box # 5 In	ND	5.0	ND	BDL	BDL	< 1.0
Box # 5 Ef	ND	5.6	ND	BDL	ND	1.9
Box # 1 Soil	ND	< 1.0	ND	BDL	BDL	< 1.0
Box # 2 Soil	ND	< 1.0	ND	BDL	2.7	< 1.0
Box # 3 Soil	ND	< 1.0	ND	BDL	BDL	0.93
Box # 4 Soil	ND	2.3	ND	BDL	BDL	BDL
Box # 5 Soil	ND	4	ND	BDL	BDL	1.8

ND - "Not detected"

Box - Phytoreactor

BDL - "Below Detection Limit"

The initial phosphate concentration data in March 2002 may represent cross contamination of the influent tank but thereafter, influent and effluent phosphate concentrations were at trace levels.

Sulfate levels in the effluent of the phytoreactors appear to be elevated relative to the influent in all cases. Sulfate elution from the soils would appear to be the most plausible assessment of this increase, although it is possible that sulfide oxidation is taking place in the saturated zone.

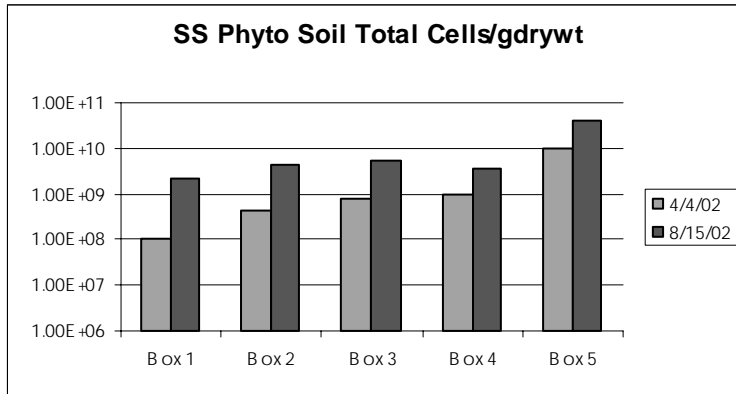
Nitrogen species in the system in 2001 were nitrate and nitrite. Nitrite appear at non-detect levels in 2002. The transformations of nitrate and nitrite are indicative of plant

uptake of nitrogen species and denitrification by soil microbes. Plants will use nitrate as a primary source of nitrogen and this decrease is likely related to plant growth. Phytoreactor 3 has no trees, so the changes in this phytoreactor would be entirely microbially based. The occasional presence of nitrite in effluents would indicate that anaerobic respiration was in process and that nitrate conversion to nitrite and ultimately to nitrogen (N₂) was occurring in the phytoreactors. Finally, the importance of nutrient addition is supported by these nitrogen and phosphorus data (i.e., phosphorus and nitrogen are at low levels and supplementation is warranted). Across time, no significant difference between treatments was found.

3.1.12 Microbial Densities

In all five phytoreactors both the total soil microbial densities, as measured by AODC and colony-forming units (CFUs) were higher in August 2002 than in the April 2002 sampling (Figure 12a and 12b). The source of the influent bacteria was from the groundwater supply in MSB-88C and any microbial growth in the influent tank, particulate filter, and associated supply lines. Since the phytoreactors are open systems the bacteria within the system are from many sources. The sources are influent groundwater, rhizosphere growth, and environmental origin (air, rain, insects, etc.). In addition, the plants themselves carried a certain amount of bacteria inoculum on their roots when first planted.

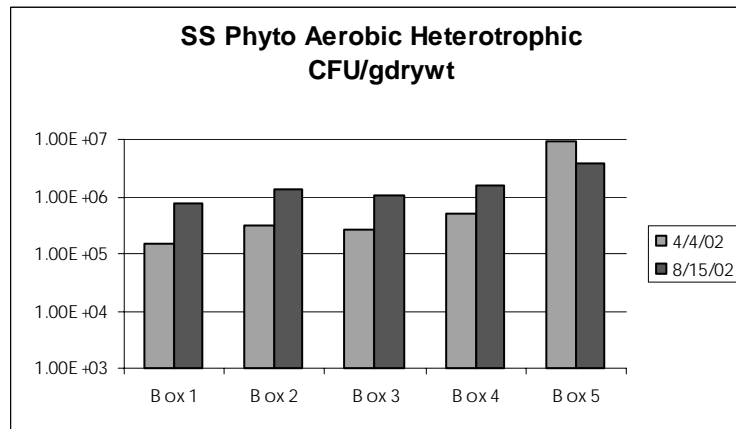
For all five phytoreactors, a similar trend was demonstrated for the groundwater microbial densities, as measured by AODC and CFUs. The microbial densities were nearly all higher in August 2002 than in the April 2002 sampling (Figure 13a and 13b). The vegetated phytoreactor groundwater samples or leachates all showed at least an order of magnitude increase in CFUs from April 4, 2002 to August 7, 2002 (Figure 13b). The wetland and poplars actually doubled in CFUs during this time. This increase could be correlated to the increased removal of CE seen in these phytoreactor systems. This demonstrates the seasonal nature of biological activity.



1=Pine
2=Poplar
3=Soil Control
4=Vetiver
5=Wetland

microbial densities - bacteria/gram dry weight

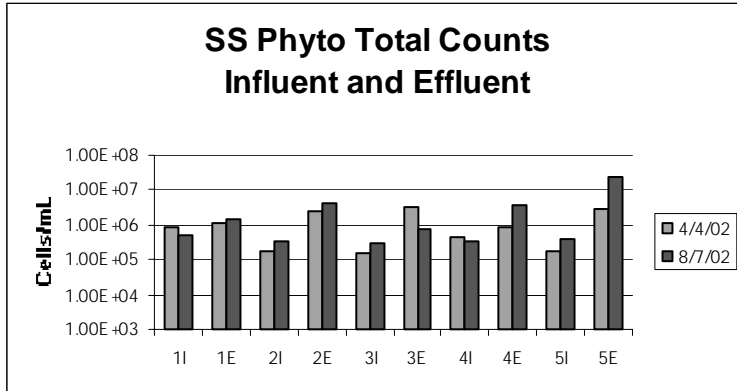
Figure 12a. Total Microbial Densities for Phytoreactor Soils (April 14, 2002 and August 15, 2002)



1=Pine
2=Poplar
3=Soil Control
4=Vetiver
5=Wetland

CFU – bacteria/gram dry weight

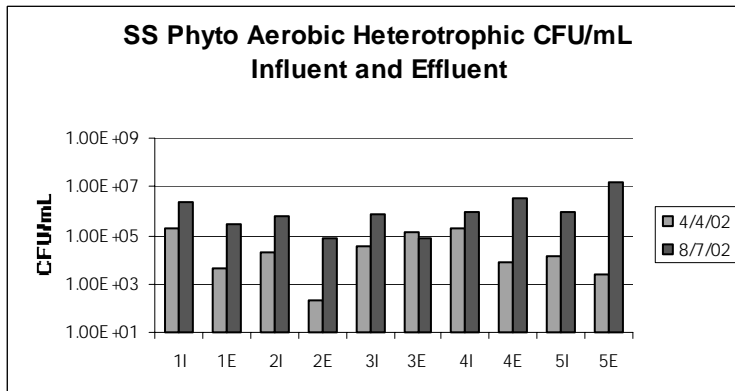
Figure 12b. Total Colony-Forming Units in Phytoreactor Soils (April 14, 2002 and August 15, 2002)



1=Pine
2=Poplar
3=Soil Control
4=Vetiver
5=Wetland

microbial densities – cells/mL

Figure 13a. Total Microbial Densities for Phytoreactor Groundwater (April 14, 2002 and August 15, 2002)



1=Pine
2=Poplar
3=Soil Control
4=Vetiver
5=Wetland

CFU – cells/mL

Figure 13b. Total Colony-Forming Units in Phytoreactor Groundwater (April 14, 2002 and August 15, 2002)

For detection of SRB, samples were taken from the soil cores as well as from root mass or rhizosphere samples. The SRB samples were taken in August 2002 when the plants were harvested. Rhizospheric samples were randomly taken from two different plants within each phytoreactor. The two plants selected from each phytoreactor have the Rhizosphere 1 and Rhizosphere 2 designation in Table 5. The results showed that the poplar and wetland systems had the highest densities of SRBs (Table 5). The fact that the groundwater effluent and soil from Phytoreactor 3, the soil control, had fewer SRBs than the plant systems (Table 5) is of particular interest.

Table 5. Sulfate-Reducing Bacteria for Rhizosphere and Deep Soils and Groundwater Effluent

Location	Sample Type	Sulfate Reducing Bacteria SRB/ml (water) or SRB/gram dry wt (soil)
Soil Box 1 Deep	soil	1.88E+06
Soil Box 2 Deep	soil	8.47E+07
Soil Box 3 Deep	soil	7.00E+04
Soil Box 4 Deep	soil	1.60E+06
Soil Box 5 Deep	soil	3.25E+07
Pine Rhizosphere 1	soil	1.70E+05
Pine Rhizosphere 2	soil	8.25E+06
Poplar Rhizosphere 1	soil	1.08E+06
Poplar Rhizosphere 2	soil	2.26E+05
Vetiver Rhizosphere 1	soil	2.05E+06
Vetiver Rhizosphere 2	soil	3.42E+06
Wetland Rhizosphere 1	soil	2.02E+07
Wetland Rhizosphere 2	soil	2.81E+07
Effluent Box 1	water	5.81E+03
Effluent Box 2	water	1.50E+04
Effluent Box 3	water	1.00E+03
Effluent Box 4	water	4.69E+04
Effluent Box 5	water	9.38E+03

1=Pine
2=Poplar
3=Soil Control
4=Vetiver
5=Wetland

SRB in soils – SRB/gram dry weight
SRB in groundwater – SRB/mL

Box - Phytoreactor

3.1.13 Molecular Results

A PCR-based analysis was utilized to assess the presence of *Dehalococcoides*, *Desulfuromonas*, and *Dehalobacter* populations. Extracted DNA from filtered phytoreactor biomass was used as a template for PCR with bacterial 16S rDNA primers. The amplicons obtained in this initial PCR were appropriately diluted and served as templates for a second (nested) PCR with specific primers. The specific primers targeted the 16S rRNA genes of *Dehalococcoides*, *Desulfuromonas*, and *Dehalobacter*.

With optimized technical procedures false positive results are unlikely for the *Dehalococcoides* and *Dehalobacter* groups (Loeffler et al. 2000). The *Desulfuromonas* group comprises PCE-to-c-DCE-dechlorinating and non-dechlorinating strains. The PCR primers were designed to specifically target the PCE-dechlorinating *Desulfuromonas* group; however, there is the possibility that the presence of as yet unidentified non-dechlorinating strains could result in a positive PCR signal. Results that indicate halo-respiring bacteria were present in four of the five phytoreactor groundwater samples are shown in Table 6.

Table 6. Analysis of Phytoreactor Samples Using the Nested PCR Approach

Sample	16SrRNA gene	<i>Dehalococcoides</i>	<i>Desulfuromonas</i>	<i>Dehalobacter</i>
Box 1	+	+	+	-
Box 2	+	-	-	-
Box 3	+	-	+	-
Box 4	+	+	-	-
Box 5	+	+	+	-

1=Pine
2=Poplar
3=Soil Control
4=Vetiver
5=Wetland

Box - Phytoreactor

The nested PCR approach is orders of magnitude more sensitive than the direct approach. Samples that tested positive (+) for *Dehalococcoides* in the nested approach were also

tested with the direct PCR approach (no initial amplification with bacterial primers). The comparison of direct PCR and nested PCR results can indicate how much target DNA (= target cells) was present in the samples. In addition, the presence of the *tceA* gene was tested using the isolated DNA as template. The *tceA* gene is implicated in chloroethene degradation in *Dehalococcoides ethenogenes*. Table 7 shows that the *Dehalococcoides* gave a strong signal in the wetland groundwater for the direct PCR.

Table 7. PCR Using Environmental DNA as a Template (Direct PCR)

Sample	<i>tceA</i> -targeted primers	<i>Dehalococcoides</i> 16s Rrna Gene-Targeted Primers
Box 1	-	-
Box 4	-	-
Box 5	-	+

1=Pine
2=Poplar
3=Soil Control
4=Vetiver
5=Wetland
Box - Phytoreactor

3.1.14 Organic Matter Analysis

The phytoreactor leachate samples were centrifuged at 4000xg for 30 minutes to fractionate into "sediment" and "supernatant." This was judged to be sufficient to separate particulate and even colloidal material from supernatant since the latter was clear of signal when examined by photon correlation spectrometry (<1 nm particle size in supernatant). The mass obtained from each sample is shown in Table 8. The dry samples of supernatant residue and sediment were then analyzed by pyrolysis-GCMS as described previously (Fan et al. 2000).

Table 8. Dry Mass of Phytoreactor Leachate Supernatant Dissolved Solids and Sediment

Sample	Supernatant Residue, mg	Sediment mass, mg
Influent	4.65	0.00
Box#1 / pine	5.55	8918.56
Box #2 / poplar	4.45	1.32
Box #3 / soil	3.65	9.04
Box #4 / Vetiver	4.74	4.94

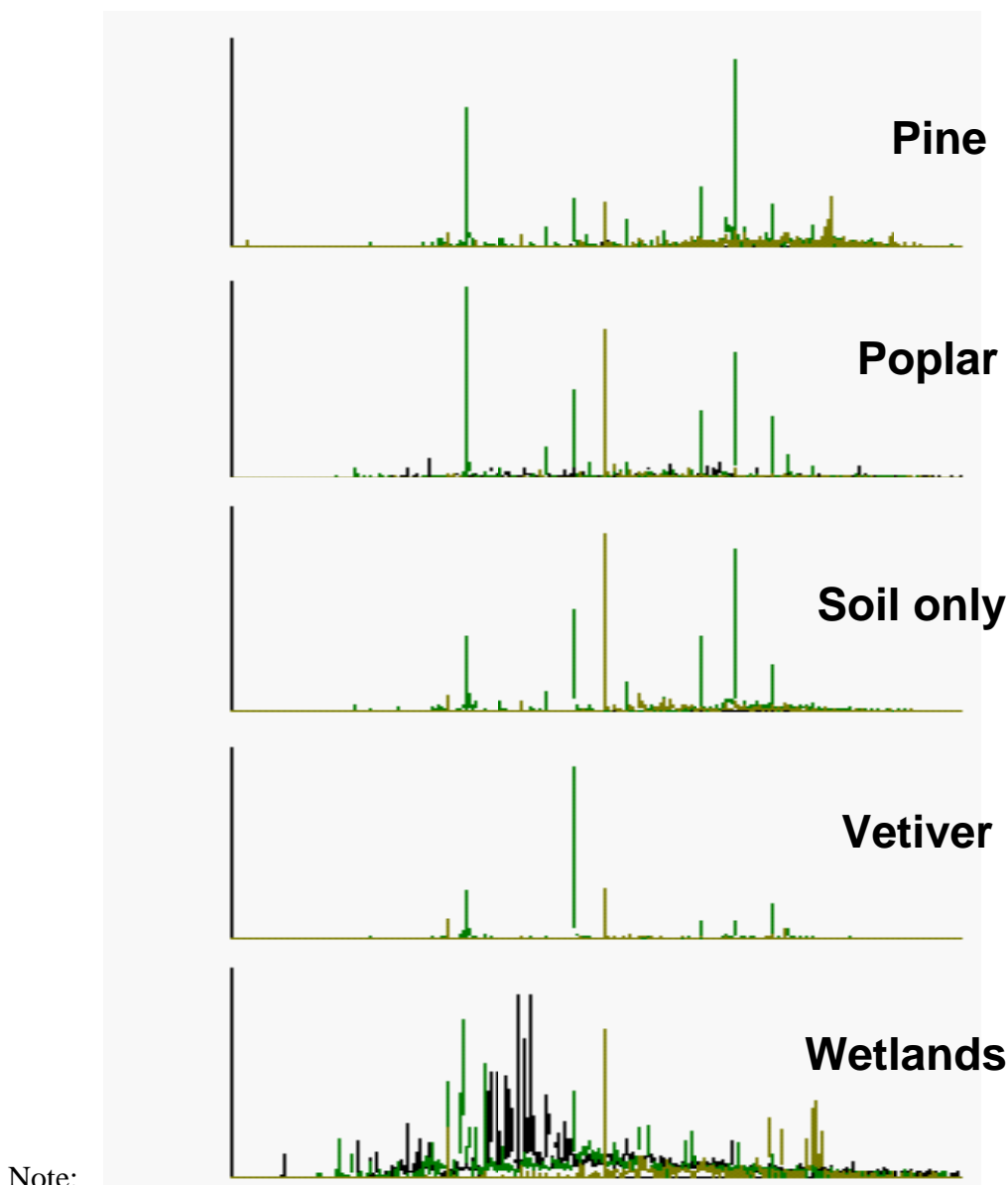
Box #5 / wetland	6.23	12.44
Box - Phytoreactor		

Terminology - keep in mind the following:

<u>Fraction</u>	<u>Fact</u>	<u>Interpretation</u>
Supernatant or water	Nonparticulate, noncolloidal (<1nm)	Soluble
Sediment	Particulate, includes colloidal matter	Insoluble

The chemical nature of leachates from different vegetation in the seepage area was characterized using pyrolysis gas chromatography-mass spectrometry (pyro-GCMS). As illustrated in Figure 14, different vegetation both quantitatively and qualitatively changed the leaching profile of phenolic-related compounds relative to the soil only system. Wetland plants, Vetiver, and poplar stimulated phenolic leaching while loblolly pine reduced the process over the soil-only system (Figure 14). It is reasonable to assume that these leachates, including LS, reflect, to some extent, root exudation activity. Whether and how these differences in organic matter (OM) leachate profiles influence microbial activity and community in conjunction with CE degradation and sorption should be examined.

In addition, a preliminary study was undertaken to test the potential of OM (in this case it was sugared LS) to bind TCE. The basic assay for TCE binding to LS was depression of confined headspace concentration of TCE relative to a control. These experiments were conducted as static batch experiments. The rationale for the assay is that the water concentration of "free" CE would decrease in the presence of an adsorbent, thereby decreasing the static headspace concentration. Figures 15a and 15b, at two different TCE concentrations, show how salt or even a general adsorbent such as SRS sediment actually increased TCE in the static headspace by shifting Henry's Law parameter for TCE. However, in the presence of LS, the opposite result, depression of headspace TCE, occurred. This phenomenon can be reasonably interpreted as decreased free TCE in water, probably due to binding to LS and/or the LS-soil complex.



Note:

Pyrolysis GCMS analysis for lignin remnants in SRS phytoreactor leachates is shown above. This analysis shows typical patterns of lignin remnants in leachate under different vegetation, illustrating just one aspect of OM source characterization and fate. For example, these techniques have been used to track lignin breakdown and relate to microbial communities altered by contaminant concentrations. LS can be tracked in a similar fashion.

Figure 14. Pyrolysis GCMS Analysis

In a preliminary test, the headspace concentration of 50 ppb TCE in water was measured in replicated closed vials. This shows the reduction of TCE in the headspace by the addition of LS with and without SRS soil. The molar ratio LS:TCE was about 26 (LS mol.wt. = ~50,000 Da). The concentration of LS chosen is typical of soil applications. The concentration of TCE used is realistic for the SRS plume fringe. As expected, the headspace TCE was increased by the addition of soil or salt, which tends to drive TCE out of the water.

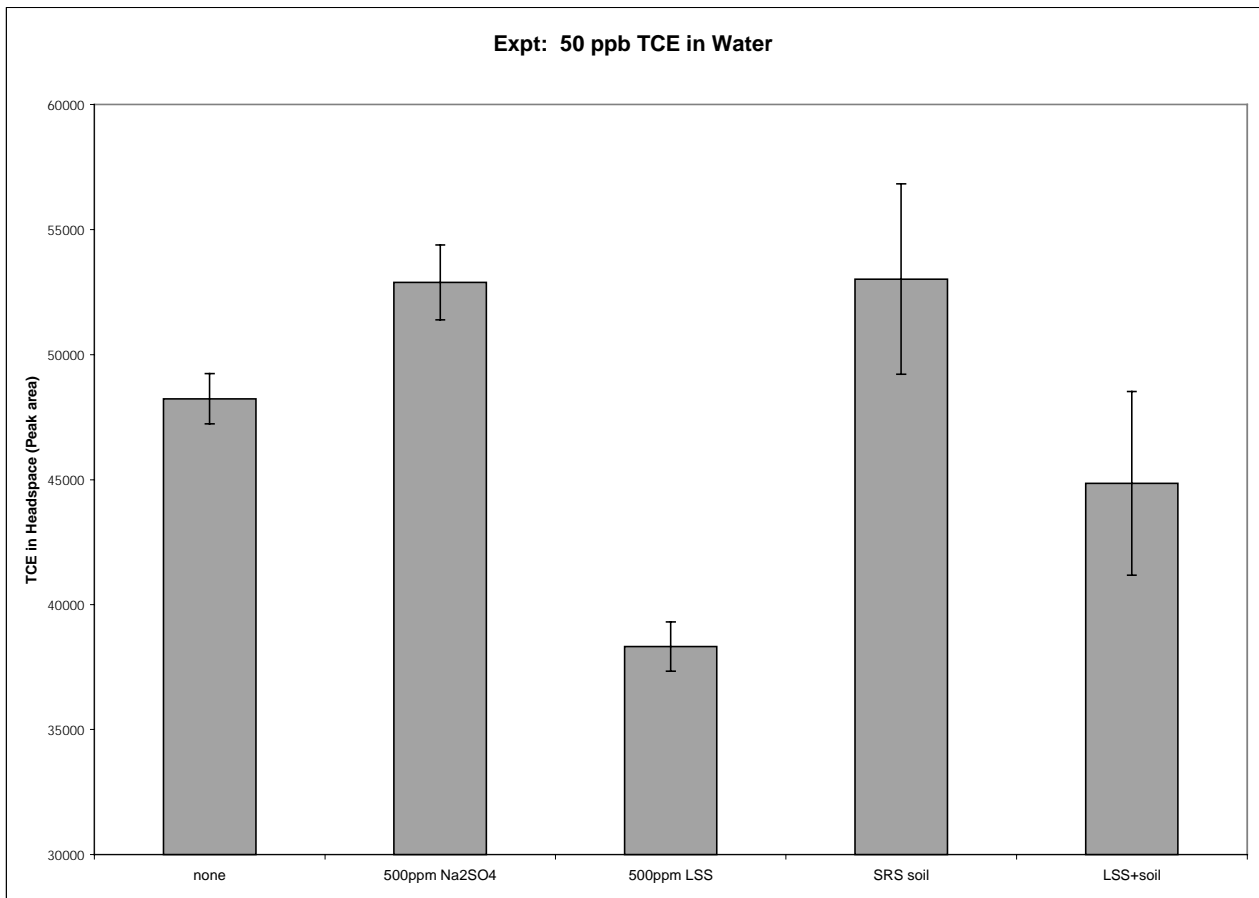


Figure 15a. Test of TCE Binding to Lignosulfonates

The 50 ppb TCE experiment was repeated for a tenfold increase in the TCE concentration, so now the molar ratio was LS: TCE = 2.6. Clearly, there was still reduction of TCE in the headspace by the addition of LS, with and without SRS soil. This indicates that the binding of TCE by LS may approach or exceed 1:1 molar ratio and thus is very efficient. Again, the concentration of LS chosen is typical of soil applications. The dissolved TCE concentration chosen matches the range found near the seepage at SRS.

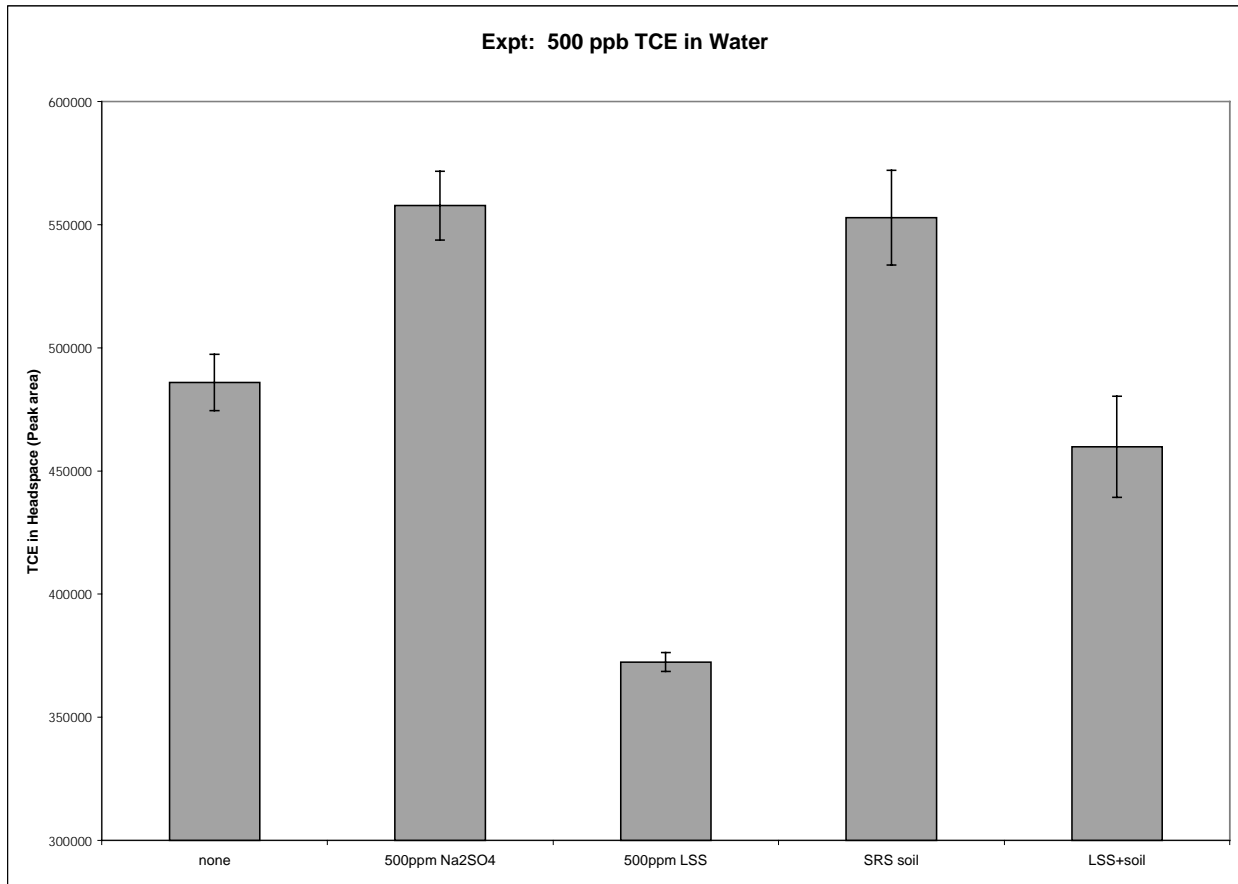


Figure 15b. Test of TCE Binding to Lignosulfonates at Equivalent Molar Ratios

3.2 Discussion

All phytoreactors were treated the same way in terms of how fertilization and groundwater were supplied to the plants and soil microorganisms. However, as seen from the groundwater flow data, there was some variability over time (Figure 3). Most of this variability was due to the biomass the plants produced which influenced water flow and uptake. The CE uptake by all the plants tested was encouraging. While no metabolites of CE were found in plant tissues, this was not surprising as the influent concentration was in the low ppb range. Previous findings have shown that plant metabolites found in plant tissues in other phytoremediation studies are less than one percent of the CE in the groundwater supply (Newman et al. 1999). Both the poplars and the pines had the highest CE concentrations. The poplar and wetland phytoreactors were statistically rated the best for TCE removal in the project. The poplar did require more management as there were several episodes of insect attacks on the trees that had to be treated as well as a possible “blight” of fungus influencing the trees (Eric Nelson, Savannah River Technology Center (SRTC) Personal Communication). The other plants were not influenced by any plant disease and did not require treatment.

The results of the microbial and microcosm studies here prove there is an active community at the seepline capable of biodegrading CE. The seepline is saturated in many areas and has reducing conditions in the sediments and groundwater. The majority of molecular microbiological examinations of reductive dechlorination of ethenes have relied on the PCR primer pairs used here designed by Loeffler et al. (2000) for specific detection of key CE degrading genera, including *Dehalococcoides* (PCE/TCE → ethene), *Desulfuromonas* and *Dehalobacter* (both convert PCE → c-DCE) species. Molecular detection of these taxa has been demonstrated in PCE/TCE-contaminated aquifers, soils and sediments, and batch reactors having dechlorination activities (Hendrickson et al. 2002; Loeffler et al. 2000). Likewise here, DNA extracts from potential TCE-reducing groundwater within the SRS Southern Sector, including seepline influenced groundwater, demonstrated the presence of these species (Tables 6 and 7). Field studies have only

detected *Dehalococcoides ethenogenes* in samples supporting complete dechlorination reactions, consistent with its described physiology. Sites like the Southern Sector seepine reveal intermediates including c-DCE of partial dechlorination (Burdick 2002). Biodegradation of these compounds may be kinetically driven. PCE/TCE are often preferred terminal electron acceptors, but may also be catalyzed by specific microbial populations (Brigmon et al. 2002). A microbial community analysis is needed to characterize known halorespiring species that may also play a significant remedial role as well as other dehalogenating species that may involve synergistic interactions. This analysis would include other halorespiring microbes that may facilitate turnover/removal of less chlorinated products.

4.0 CONCLUSION

The findings of this treatability study indicate that both MNA and phytoremediation processes are important for TCE and PCE seepine groundwater remediation. Rhizosphere microbial activities tested here clearly demonstrate the degradation and transformation of TCE. The plants tested here, both indigenous (pine and wetland species) and introduced (hybrid poplar and Vetiver) species, demonstrated an uptake of CEs. Compared to the other species, the poplar and Vetiver took up more TCE while the pine had the highest amounts of c-DCE in tissues. The order of c-DCE concentrations in the pine tissues was root>stem>needle.

As measured by the microcosm studies, there is potential for complete CE remediation by MNA for the rhizosphere and wetland soils. The addition of low-cost amendments to sediment microcosms, including commercial fertilizer and vegetable oil, demonstrated accelerated TCE biodegradation rates. Recent groundwater characterization demonstrated diverse microbial populations including sulfate-reducers in seepine regions of CE contamination.

Phytoremediation and MNA are viewed to be “natural” or non-intrusive remediation technologies. Overall, they are safer and present potential lower costs. The Southern

Sector seepline area is naturally vegetated and has a diverse range of habitats. Questions remain in terms of long-term predictability of these natural remediation technologies. In addition, there are “data gaps” concerning the complex seepline mixing zone environment. This treatability study was actively addressing some of these issues at the Southern Sector seepline. Additional information on the potential transpiration rates and groundwater uptake by specific plants and MNA rates are needed to improve field-scale estimates of bioremediation potential.

Both biochemical and microbiological testing confirmed MNA potential of CE in these seepline soils and groundwater. The addition of a slow-release fertilizer was found to augment MNA as well as plant growth. Results of analyzing three years of data proved that wetlands and poplars have a selective advantage for CE removal in the seepline soils. Both MNA and phytoremediation have been demonstrated here. In FY02, the groundwater influent and output was monitored more stringently to better evaluate the contaminant removal.

This project was highly significant since most work in the phytoremediation area has been associated with laboratory studies with significantly greater concentrations of VOCs (Burken and Schnoor 1998, Newman et al. 1999, and Doty et al. 2000). At SRS, much of the VOCs in the groundwater, with the exception of source areas, are in lower (ppb) concentrations, especially in the fringe areas of contaminant plumes (WSRC 2000b). The results of this project, with concurrent groundwater characterization studies, will enable better predictions of the VOC removal at the seepline. The analysis of FY02 growing season seepline phyto- and bio- activity is complete. Results to date indicate that with the right management practices phytoremediation and MNA have the potential to remediate TCE and PCE in the Tims Branch flood plain and seepline.

This treatability study has shown that phytoremediation coupled with MNA is feasible for enhanced biodegradation of chlorinated solvents at SRS in Southern Sector seepline soils. These studies have shown rapid removal conditions after nutrient addition. A

comparison of vegetation types indicated that poplar and wetlands have the greatest potential for phytoremediation of CE in these SRS soils.

Through MNA and accelerated biostimulation (MNA), chlorinated solvent degradation was observed by indigenous seepage and rhizosphere microorganisms for up to 300 days following their incubation in microcosms containing seepage sediments and groundwater. The presence of halo-respiring bacteria indicates potential rapid and complete biodegradation of chlorinated solvents. Combining MNA and phytoremediation may provide a safe, cost-effective, and efficient alternative for *in situ* biodegradation of chlorinated solvents at SRS. Further field investigation within the Tims Branch seepage is needed.

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6.0 APPENDICES

Appendix A Plant Material by Type of Material, Year and Treatment

Appendix B Plant Material Treatment and Type

Appendix C Soil Samples by Depth, Year and Treatment

Appendix D Water Samples for Each Treatment by Year

Appendix E Joined Water Data File - Influent-Effluent

Appendix F Plant Material Data File

Appendix G Soil Sample Data File

Appendix H Water Sample Data File

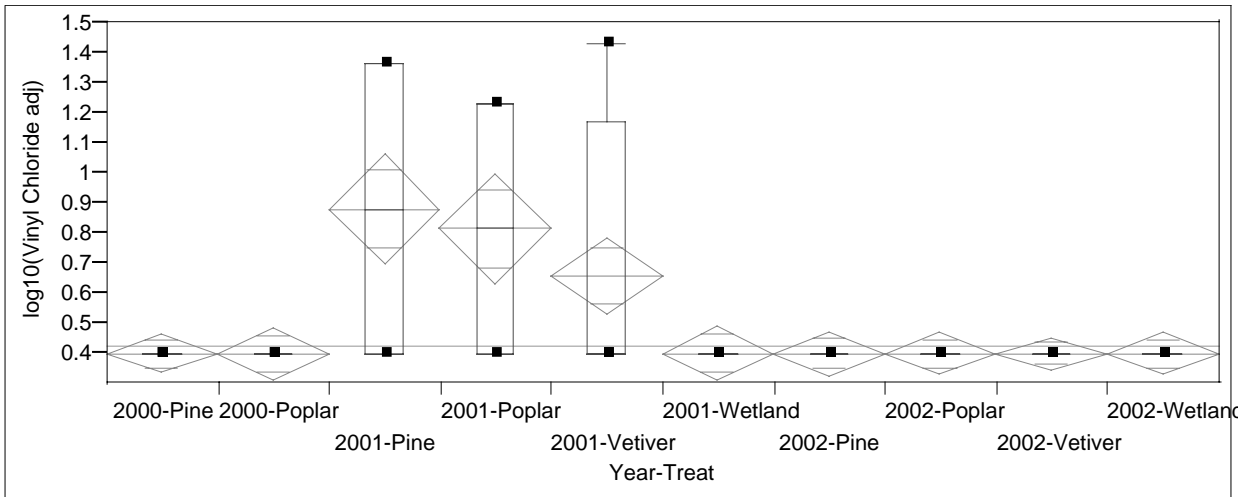
Appendix A

Plant Material by Type of Material, Year and Treatment

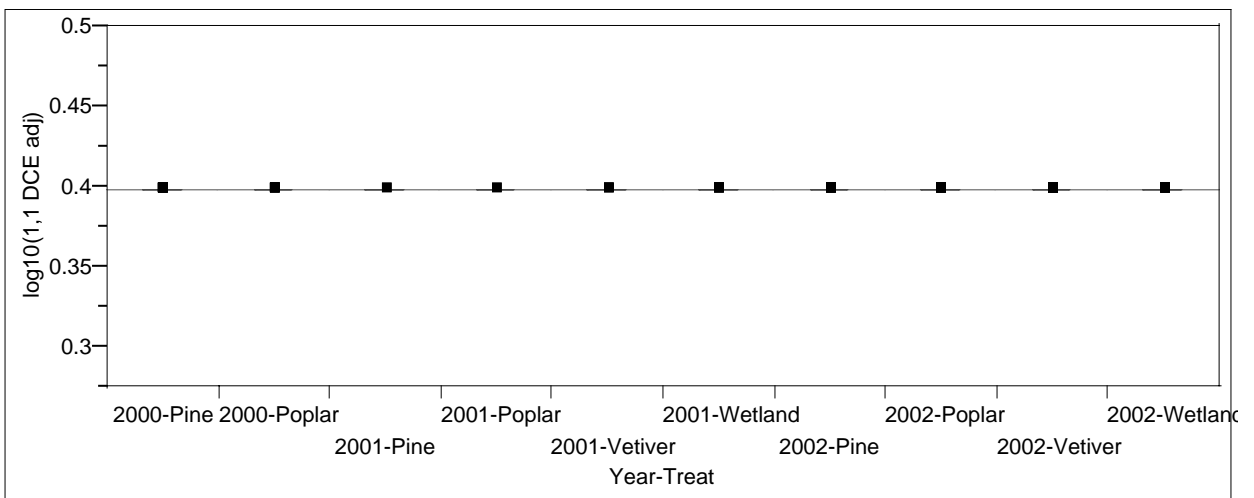
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Leaf

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat



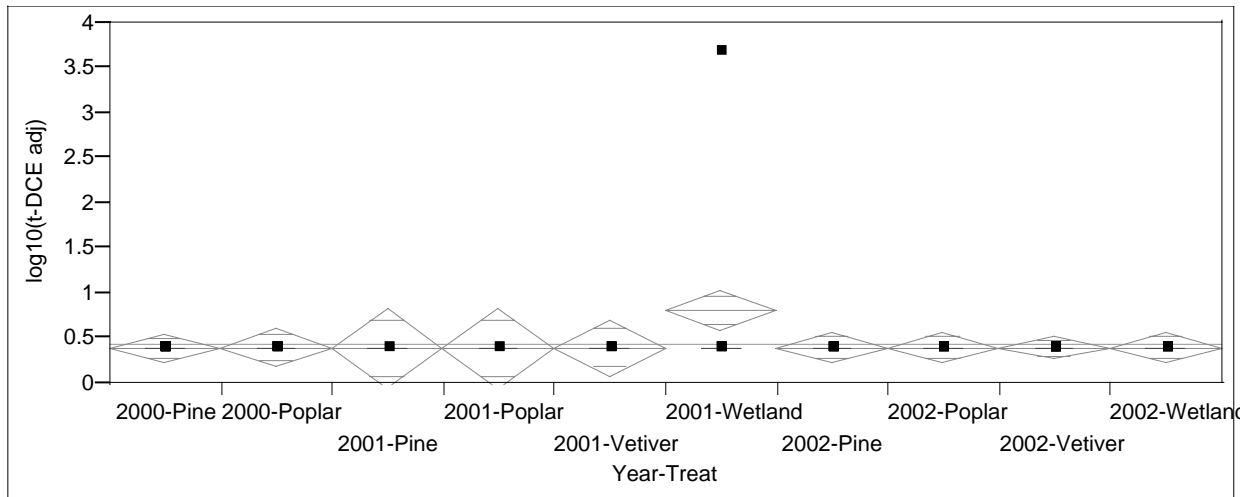
One-Way Analysis of \log_{10} (1,1 DCE adj) By Year-Treat



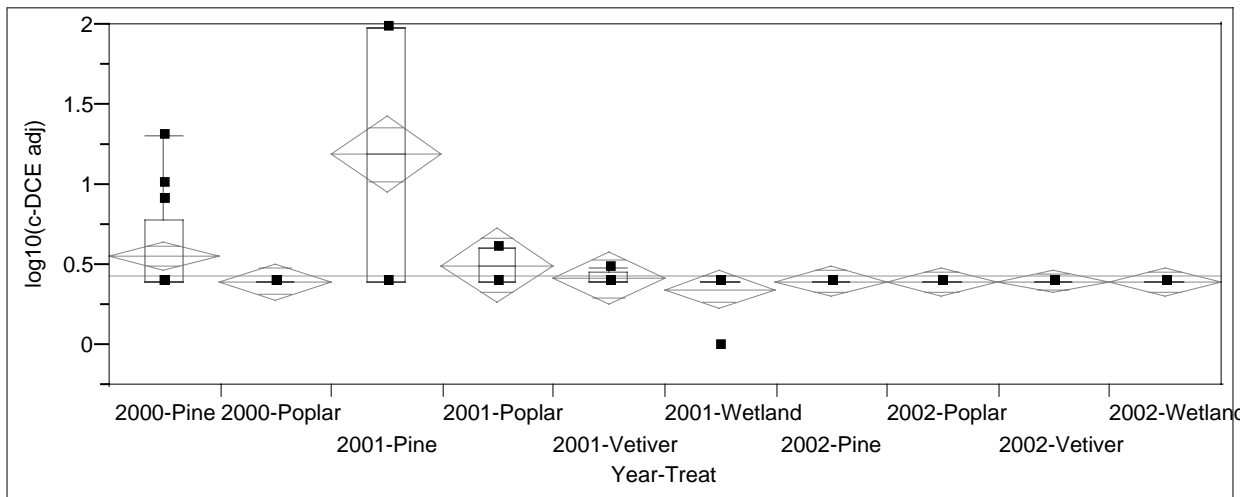
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Leaf

One-Way Analysis of $\log_{10}(\text{t-DCE adj})$ By Year-Treat



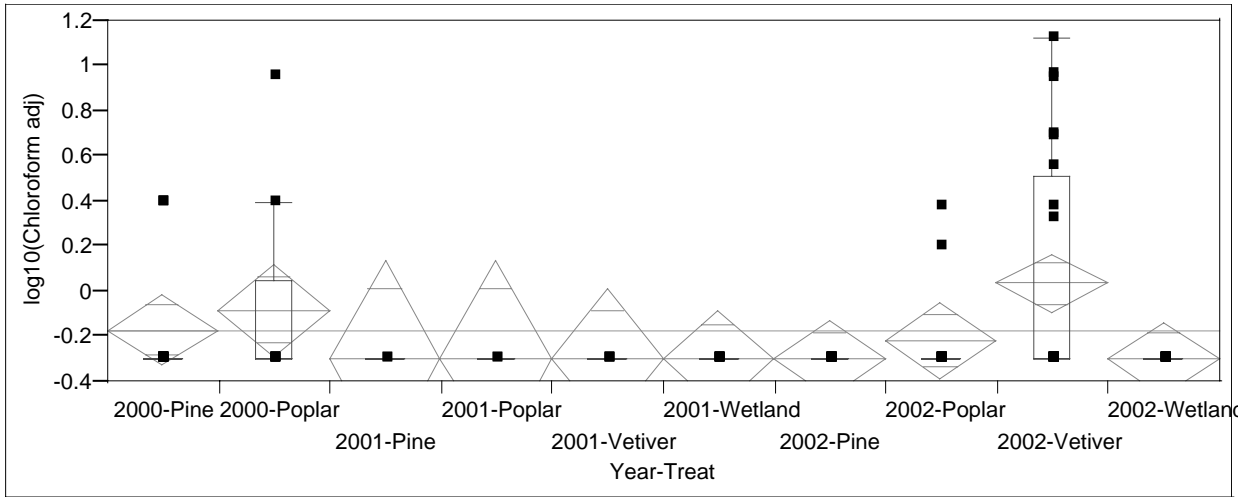
One Way Analysis of $\log_{10}(\text{c-DCE adj})$ By Year-Treat



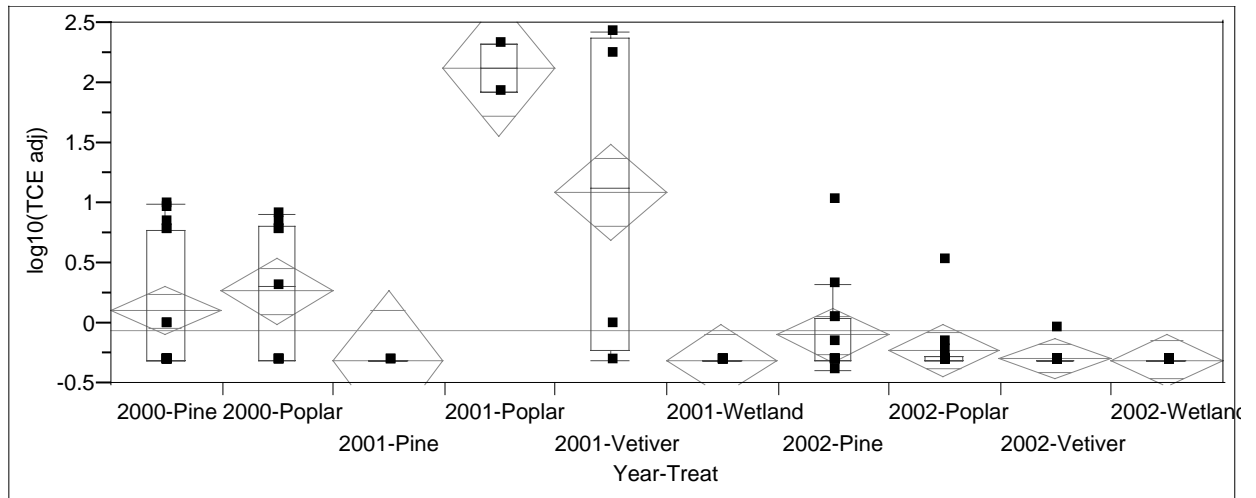
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Leaf

One-Way Analysis of \log_{10} (Chloroform adj) By Year-Treat



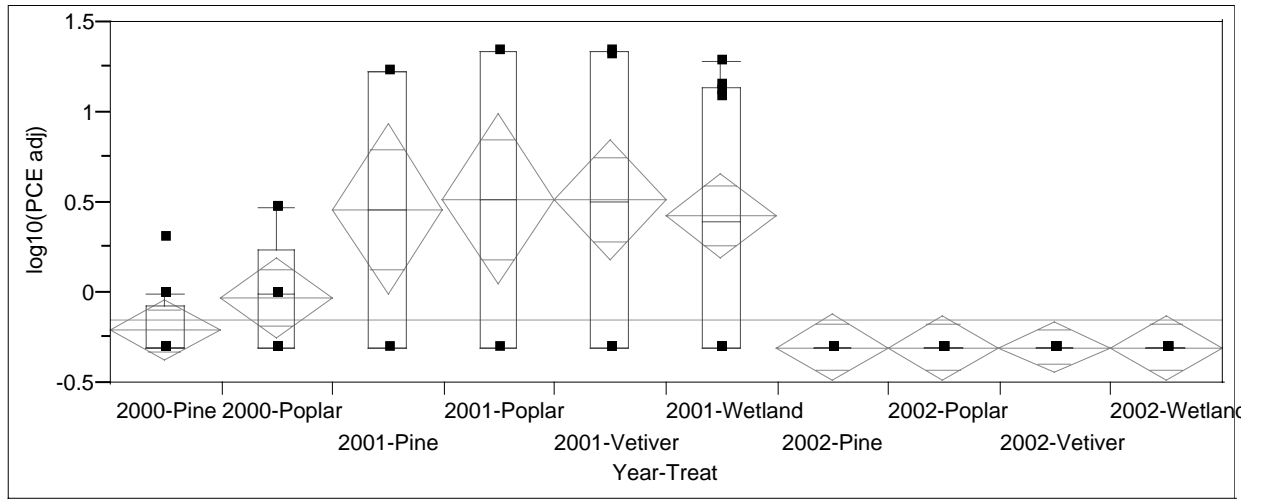
One-Way Analysis of \log_{10} (TCE adj) By Year-Treat



Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

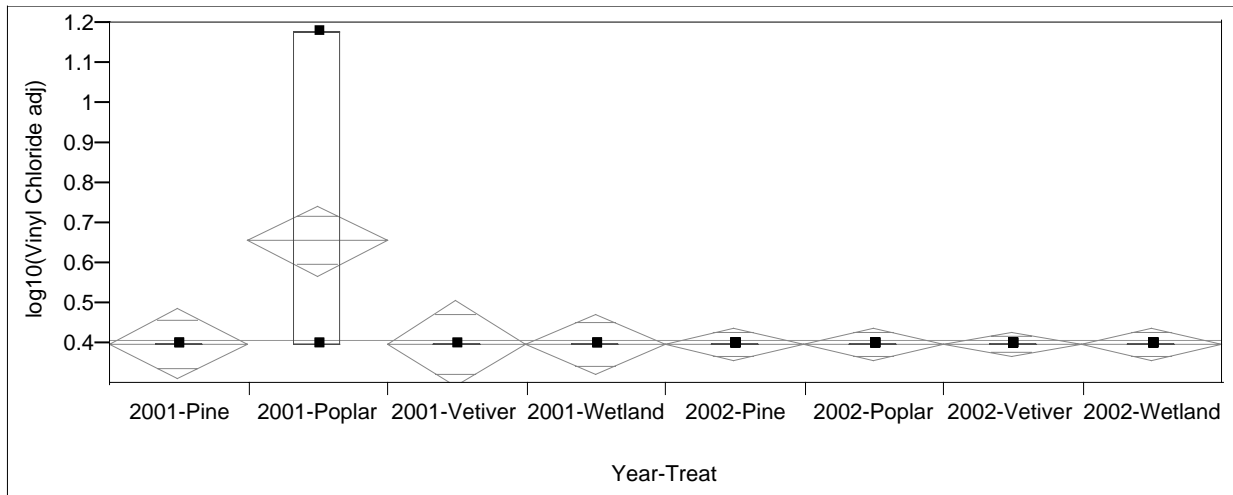
Type=Leaf

One-Way Analysis of \log_{10} (PCE adj) By Year-Treat



Type=Roots

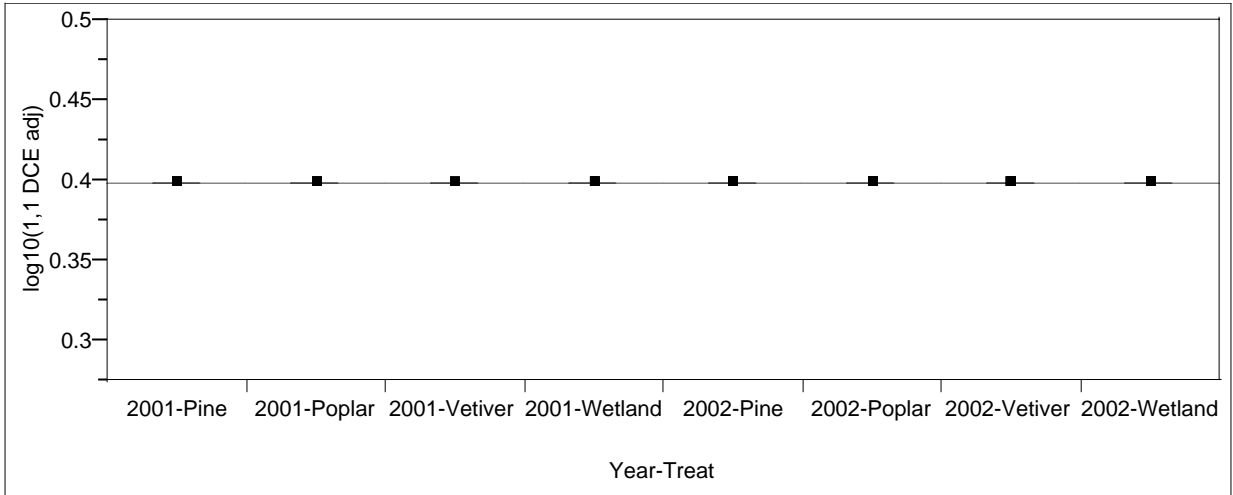
One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat



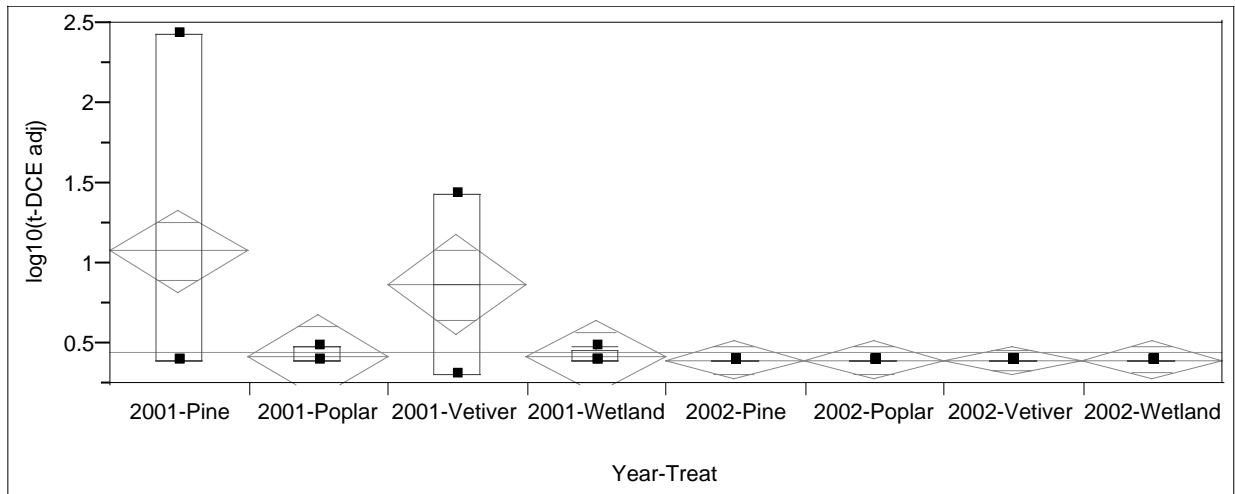
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Roots

One-Way Analysis of \log_{10} (1,1 DCE adj) By Year-Treat



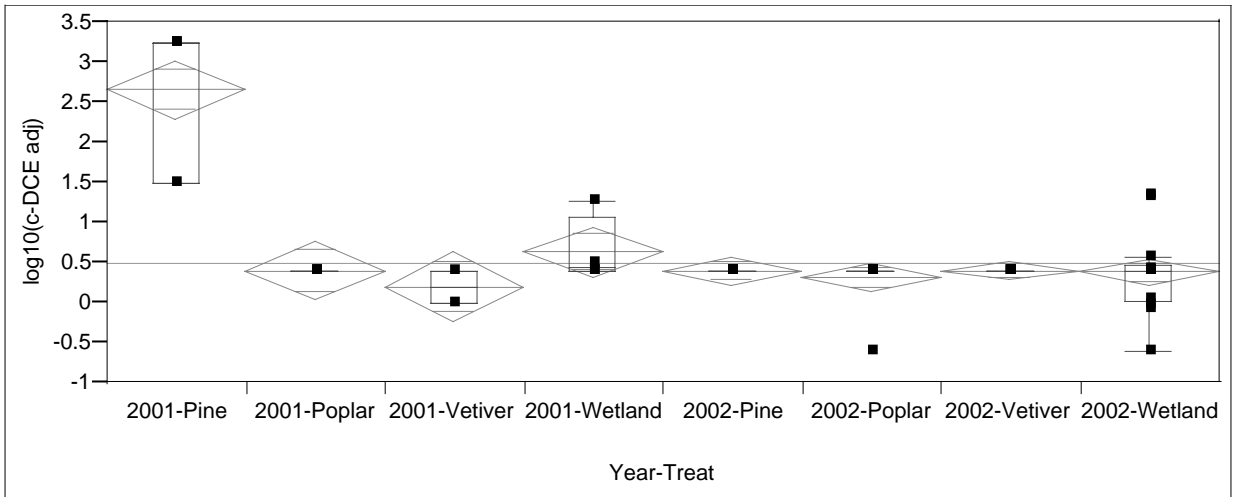
One-Way Analysis of \log_{10} (t-DCE adj) By Year-Treat



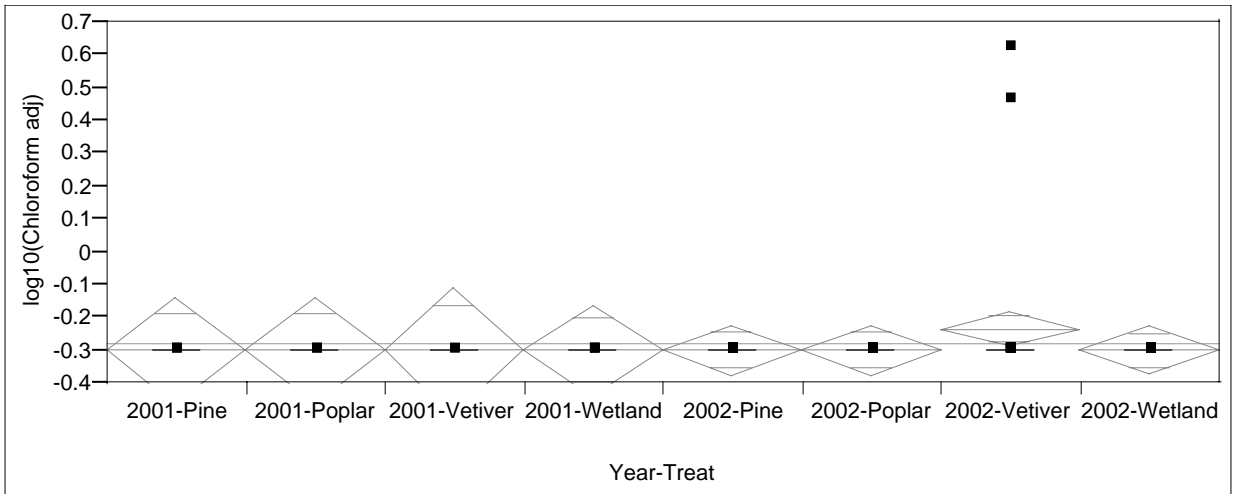
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Roots

One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat



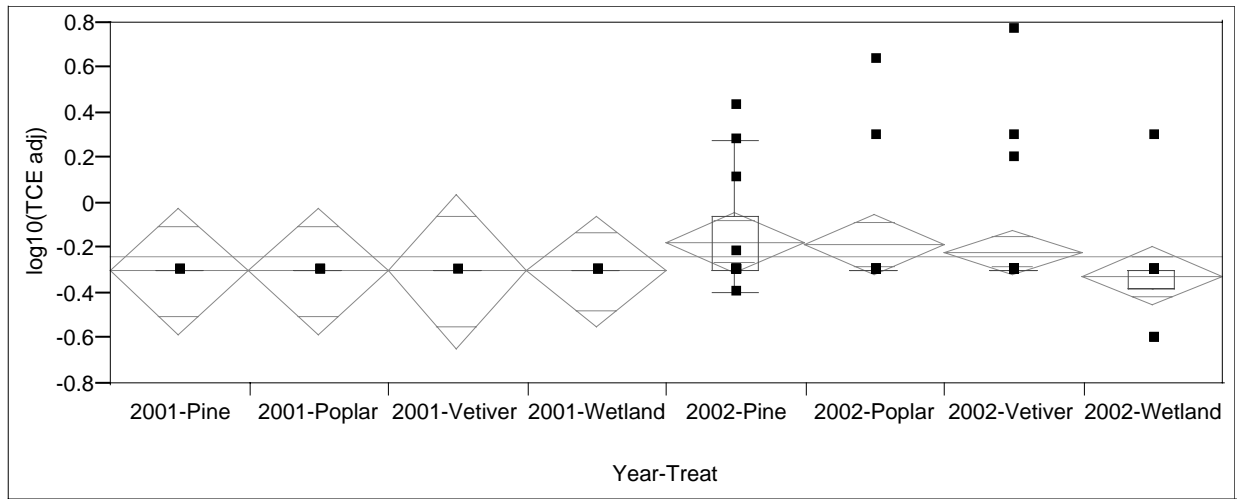
One-Way Analysis of \log_{10} (Chloroform adj) By Year-Treat



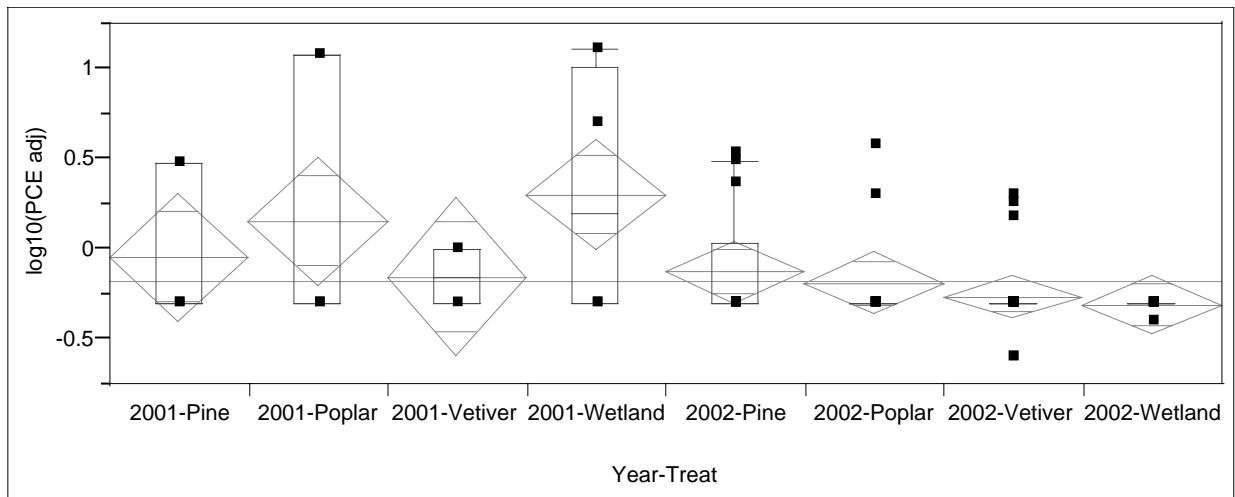
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Roots

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat



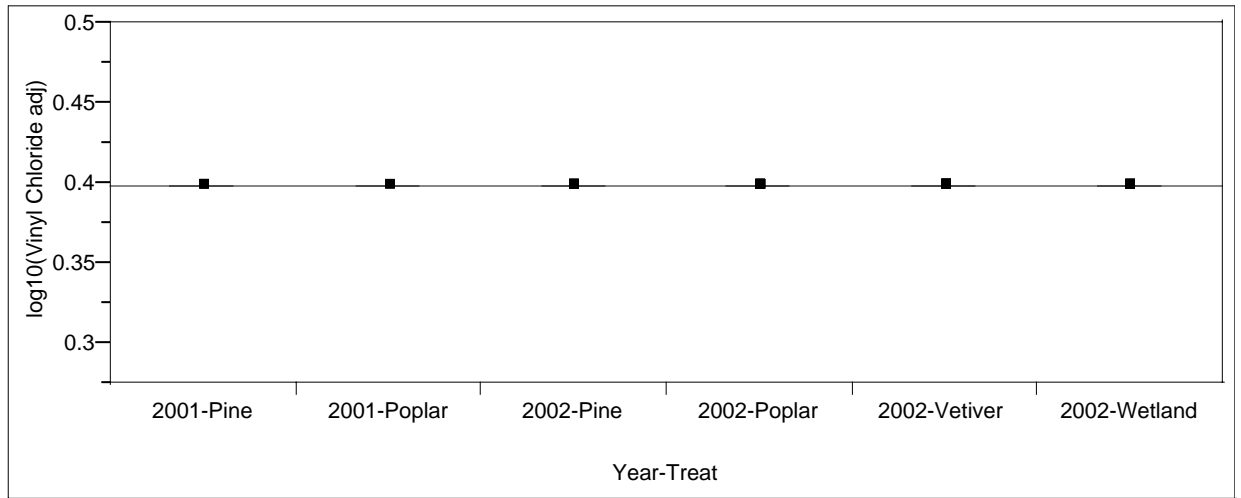
One-Way Analysis of \log_{10} (PCE adj) By Year-Treat



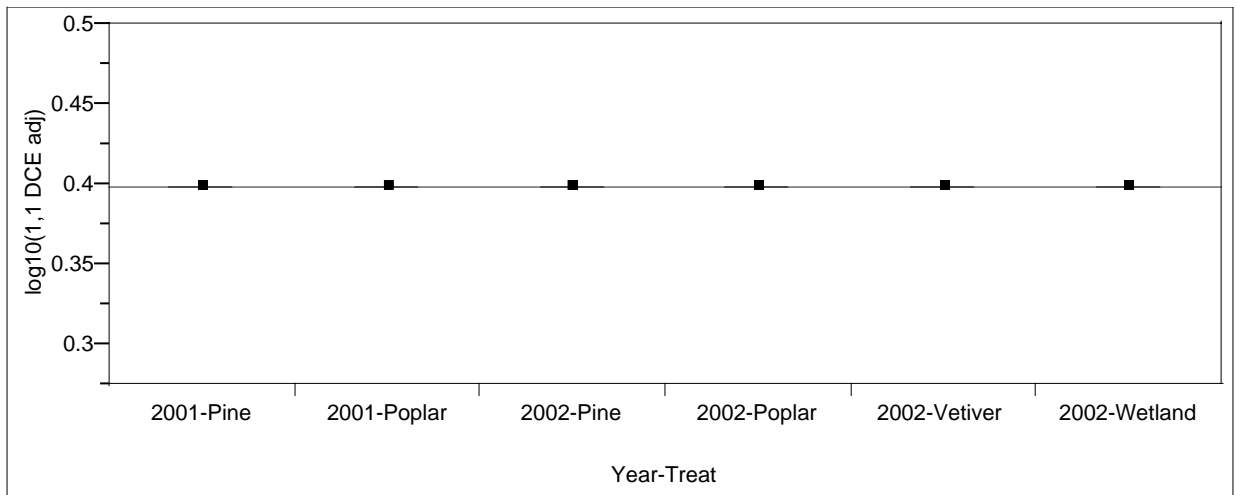
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Stem

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat



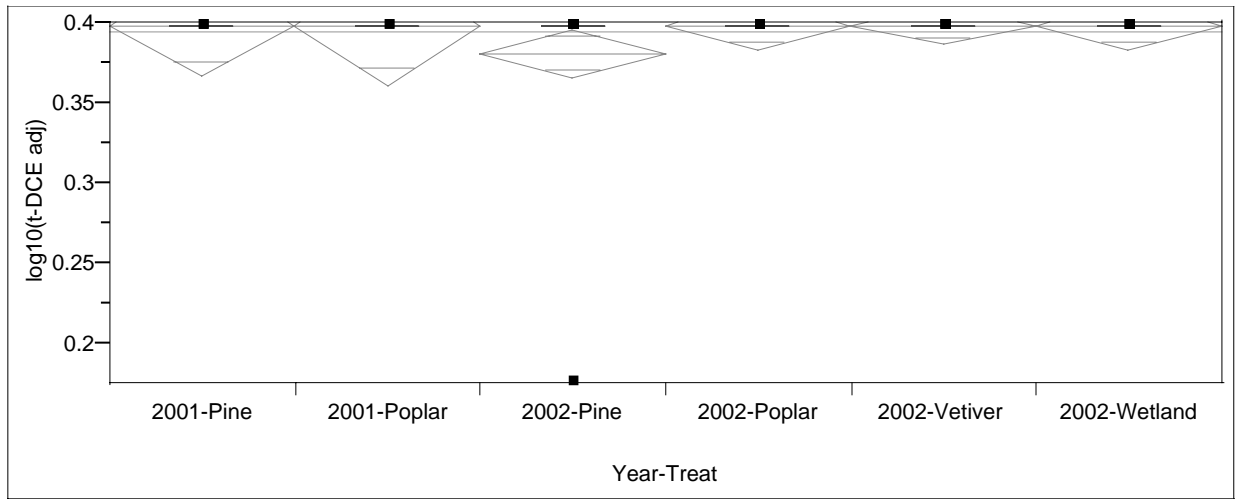
One-Way Analysis of \log_{10} (1,1 DCE adj) By Year-Treat



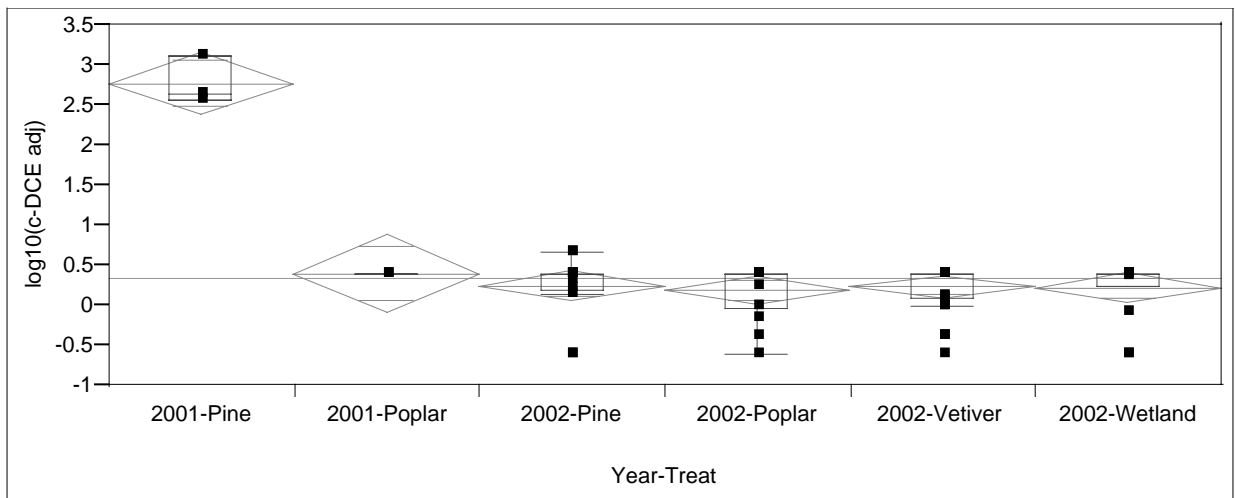
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Stem

One-Way Analysis of \log_{10} (t-DCE adj) By Year-Treat



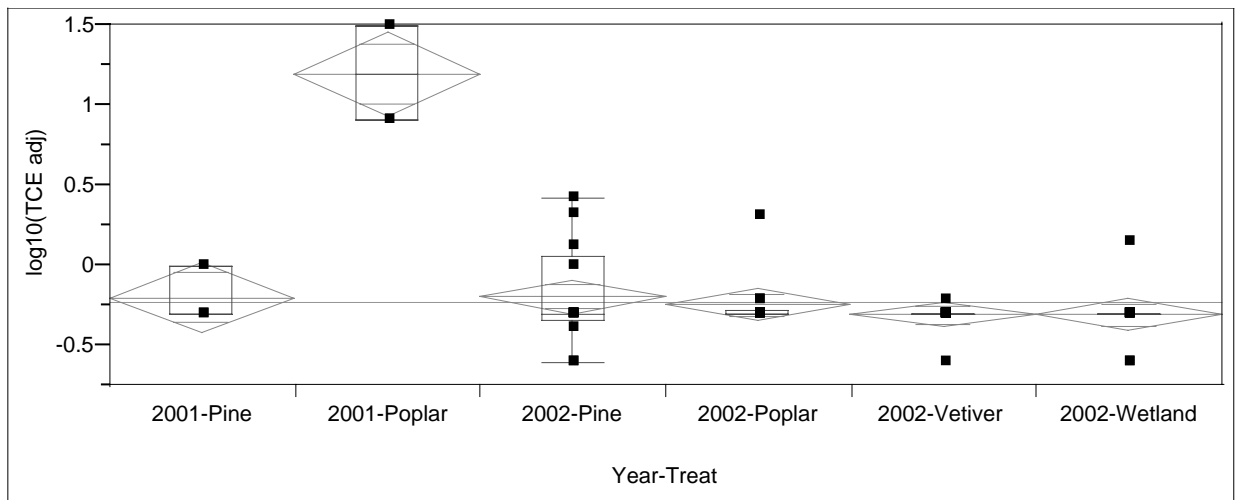
One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat



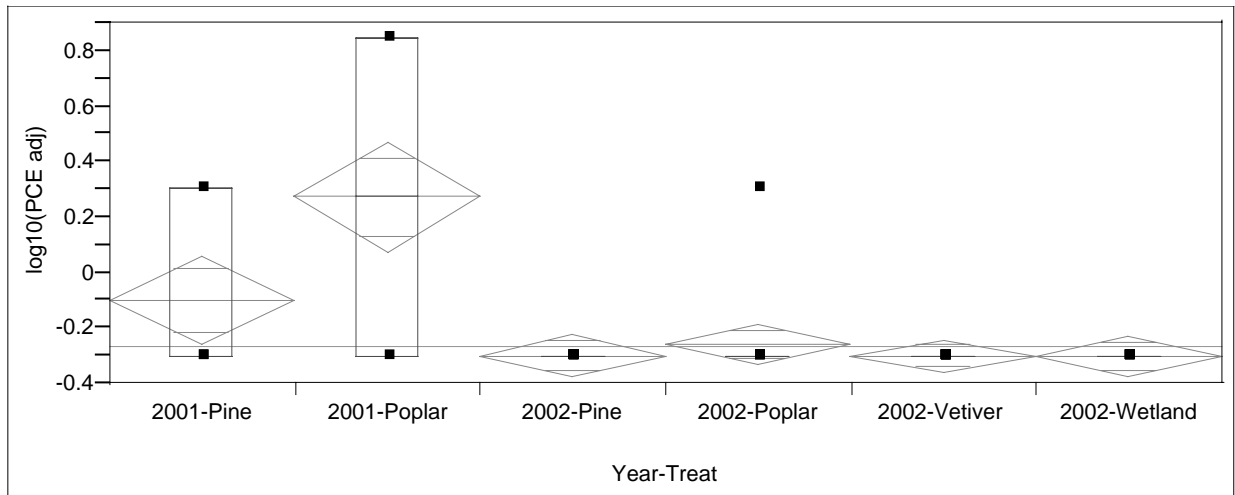
Results for Plant Material ($\mu\text{g}/\text{kg}$) by Type of Material, Year and Treatment

Type=Stem

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat



One-Way Analysis of \log_{10} (PCE adj) By Year-Treat



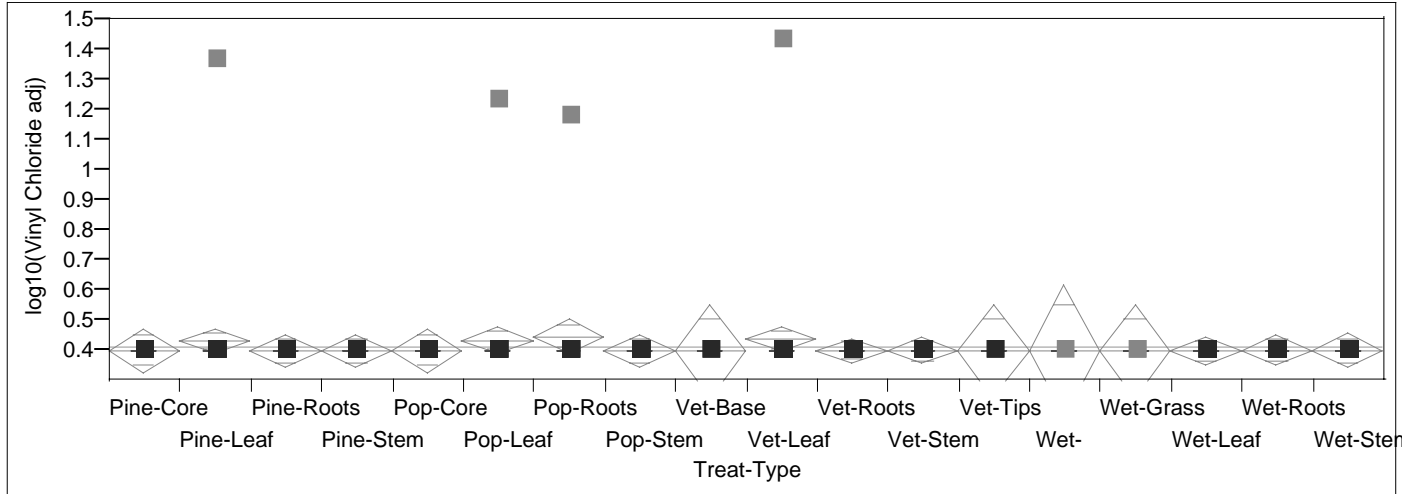
Appendix B

Plant Material by Treatment and Type

(Sample Year is Color Coded)

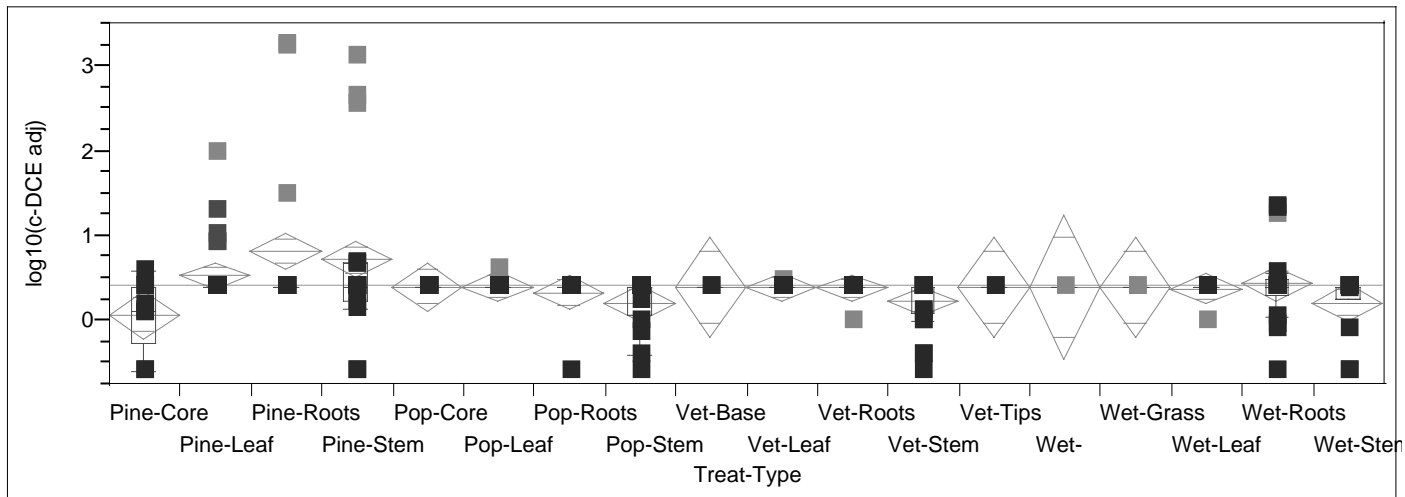
Year
 ■ 2000
 ■ 2001
 ■ 2002

One-Way Analysis of log₁₀(Vinyl Chloride adj) By Treat-Type



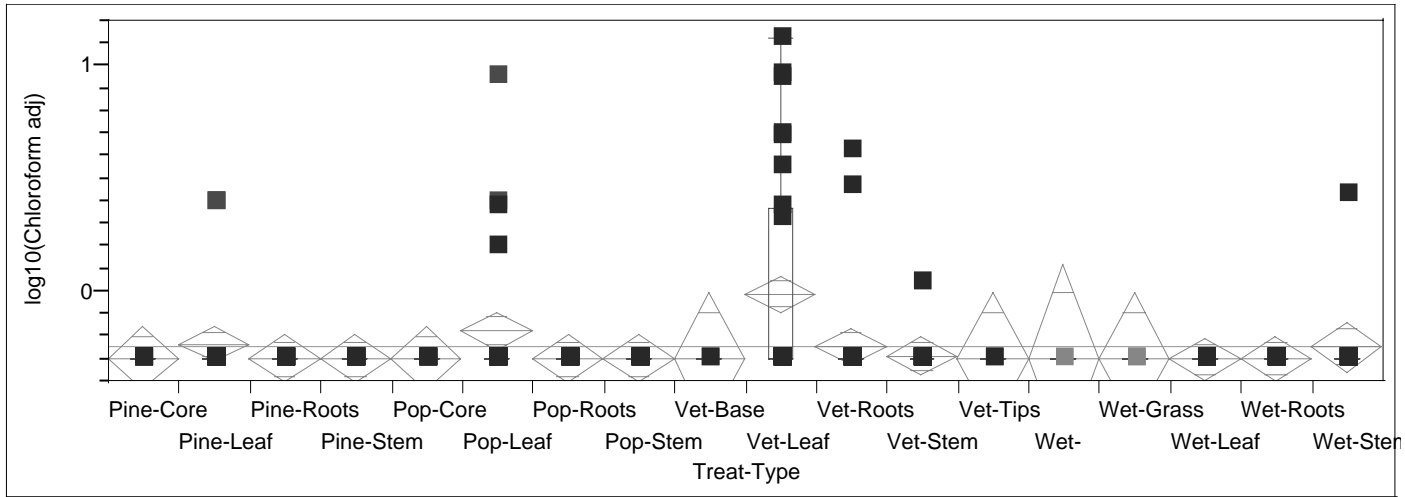
Year
 ■ 2000
 ■ 2001
 ■ 2002

One-Way Analysis of log₁₀(c-DCE adj) By Treat-Type

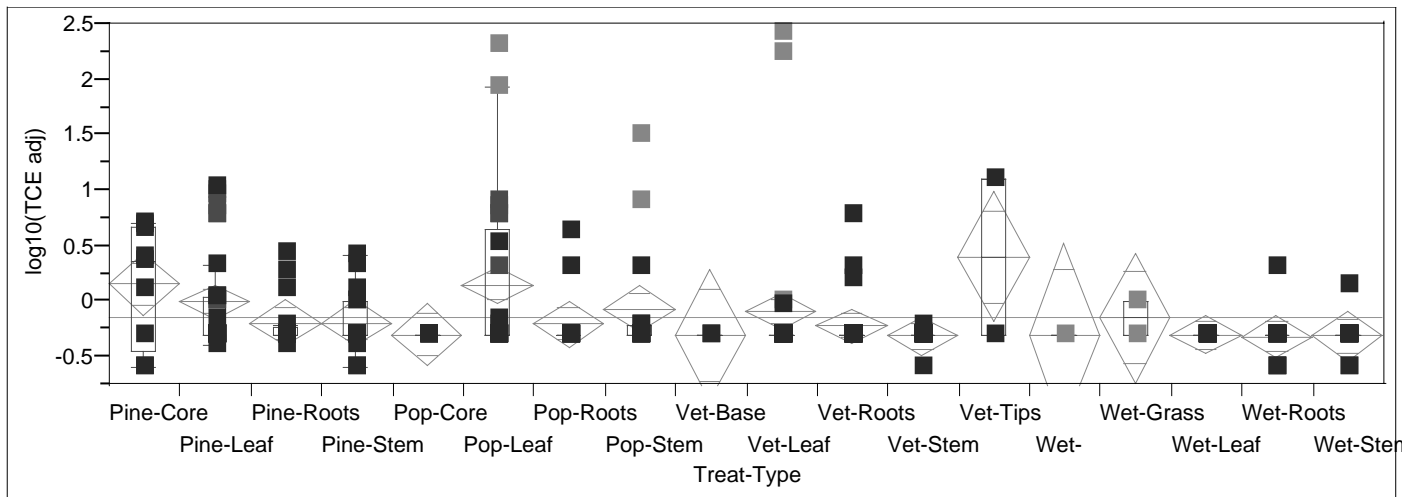


- Year
- 2000
 - 2001
 - 2002

One-Way Analysis of log₁₀ (Chloroform adj) By Treat-Type

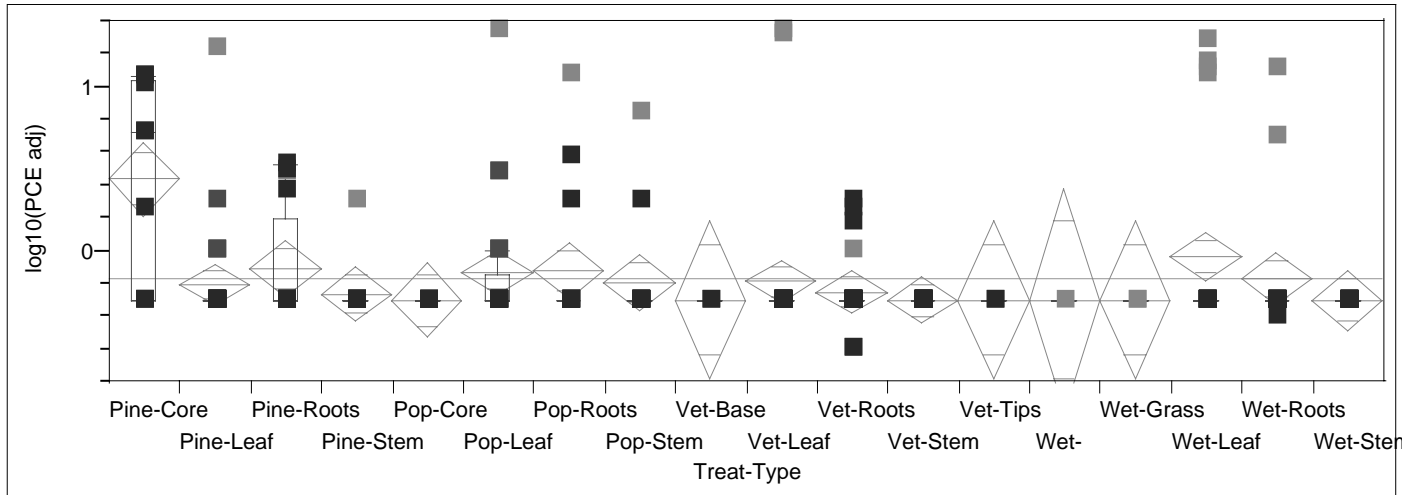


One-Way Analysis of log₁₀ (TCE adj) By Treat-Type



- Year
- 2000
 - 2001
 - 2002

One-Way Analysis of log₁₀ (PCE adj) By Treat-Type



Appendix C

Soil Samples by Depth, Year and Treatment

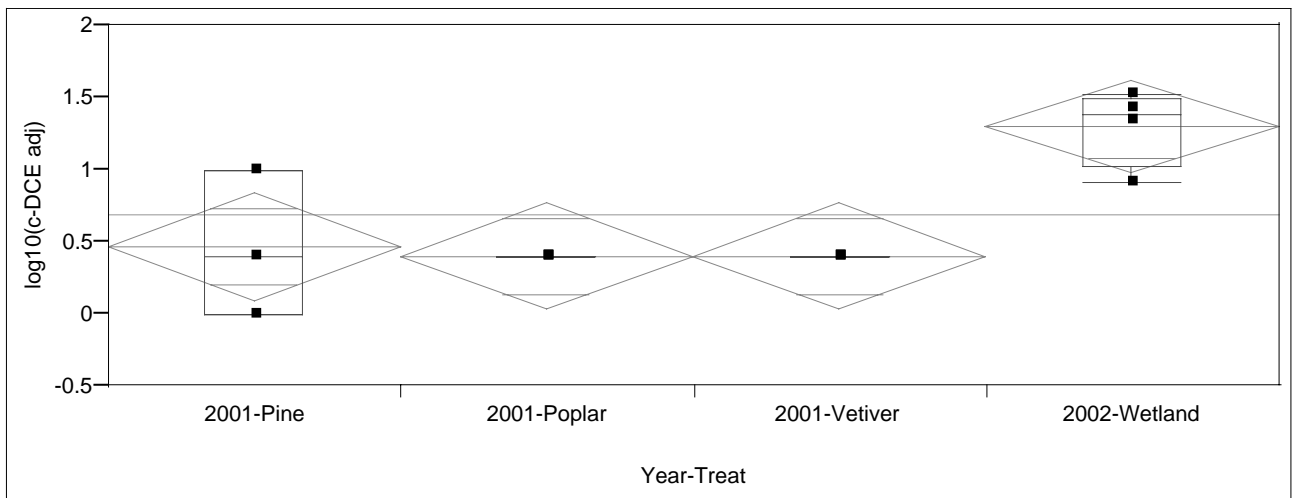
Soil Samples Results ($\mu\text{g}/\text{kg}$) by Depth, Year and Treatment

Type= Shallow and Deep Combined

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat



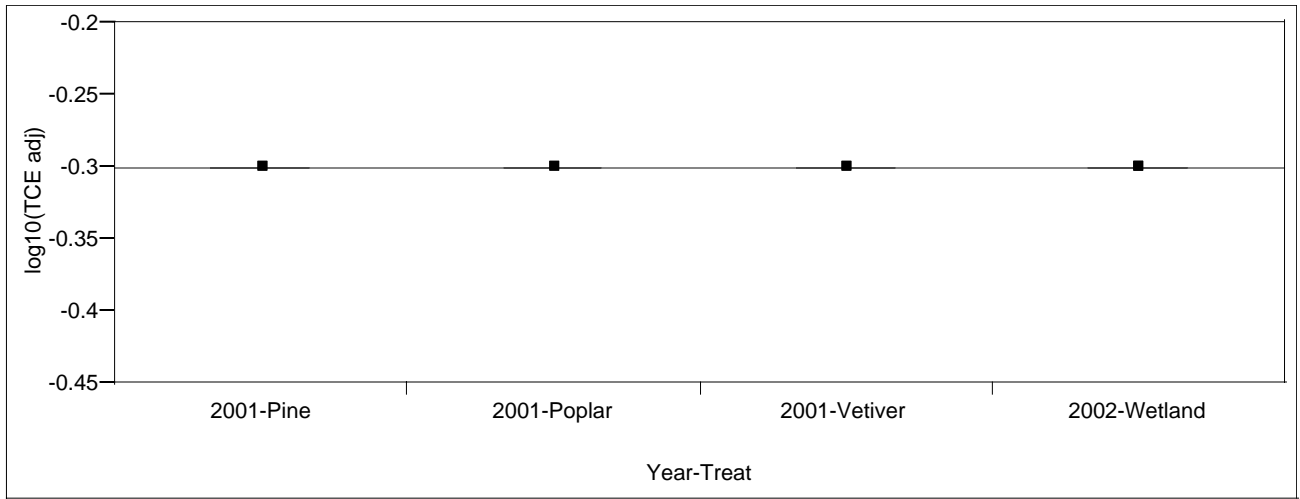
One Way Analysis of \log_{10} (c-DCE adj) By Year-Treat



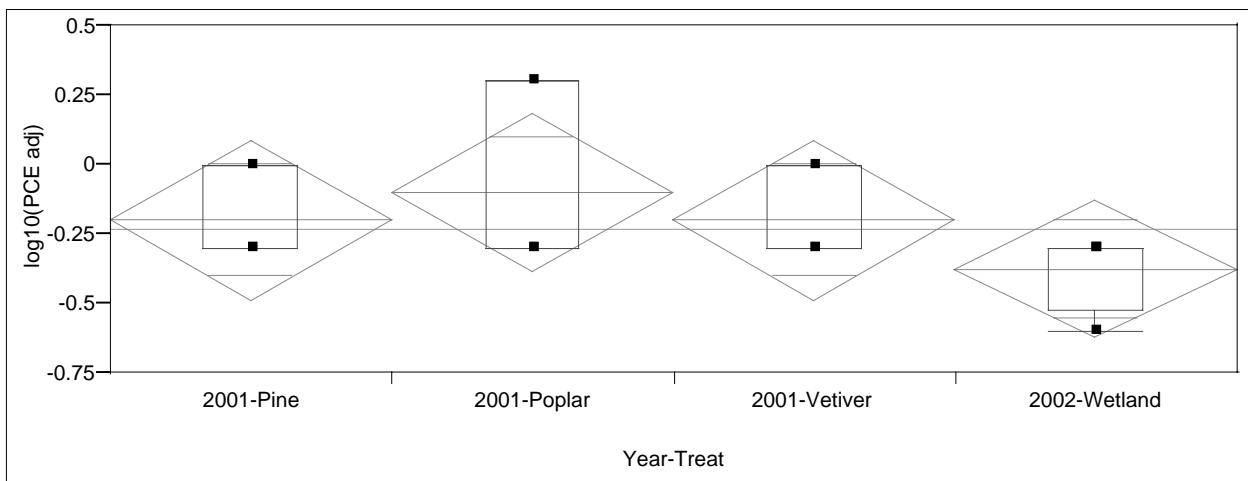
Soil Samples Results ($\mu\text{g}/\text{kg}$) by Depth, Year and Treatment

Type= Shallow and Deep Combined

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat



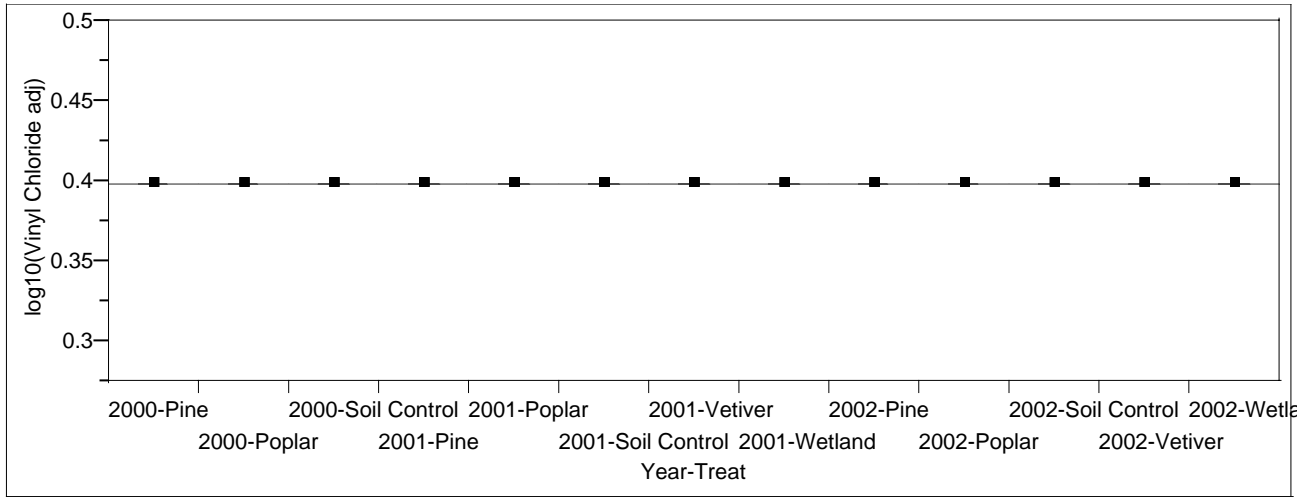
One-Way Analysis of \log_{10} (PCE adj) By Year-Treat



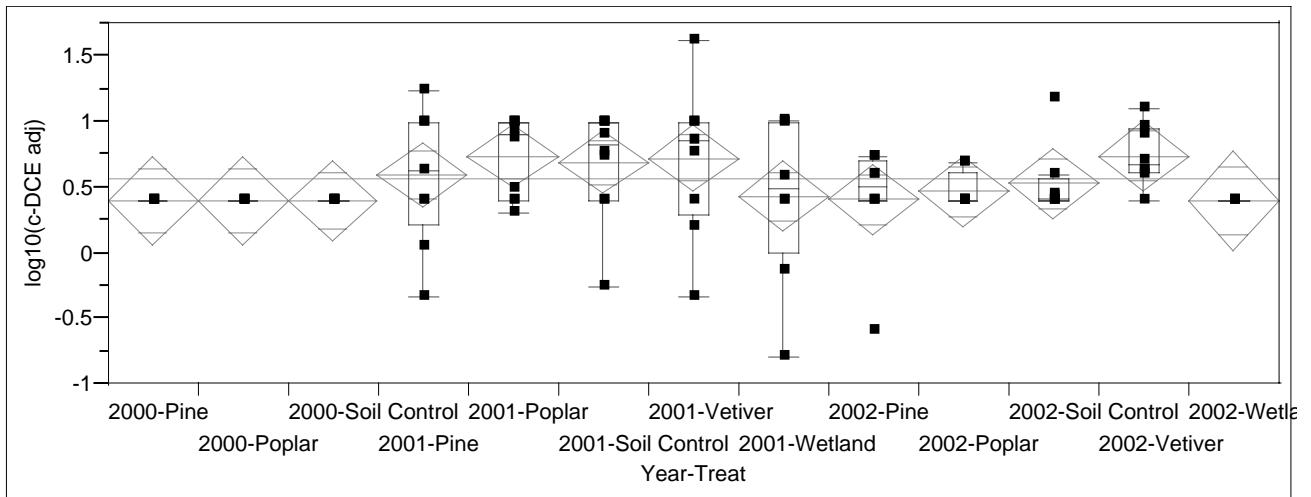
Soil Samples Results ($\mu\text{g}/\text{kg}$) by Depth, Year and Treatment

Type=Deep

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat



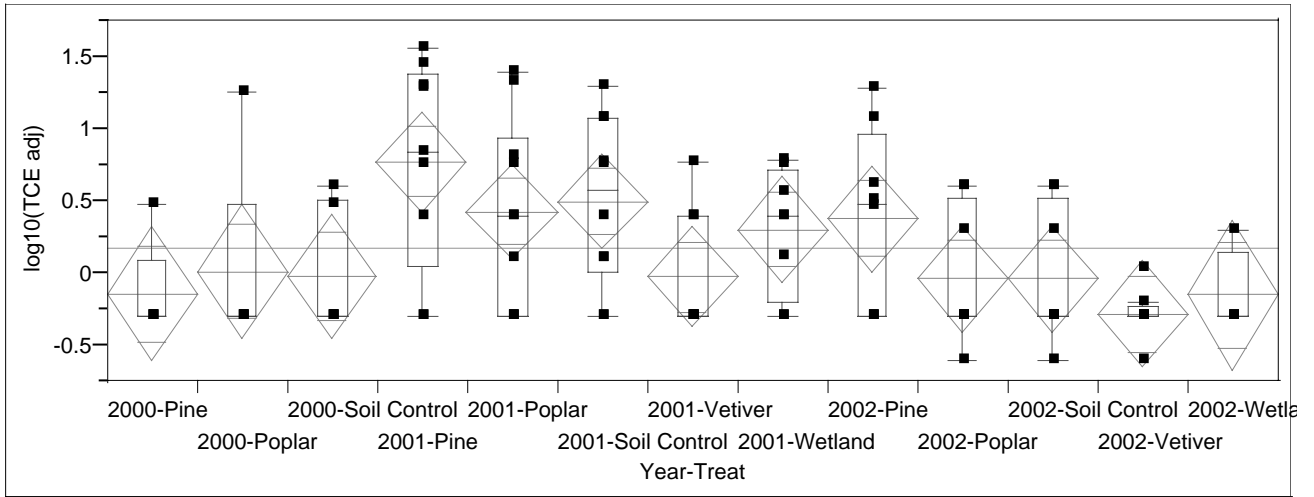
One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat



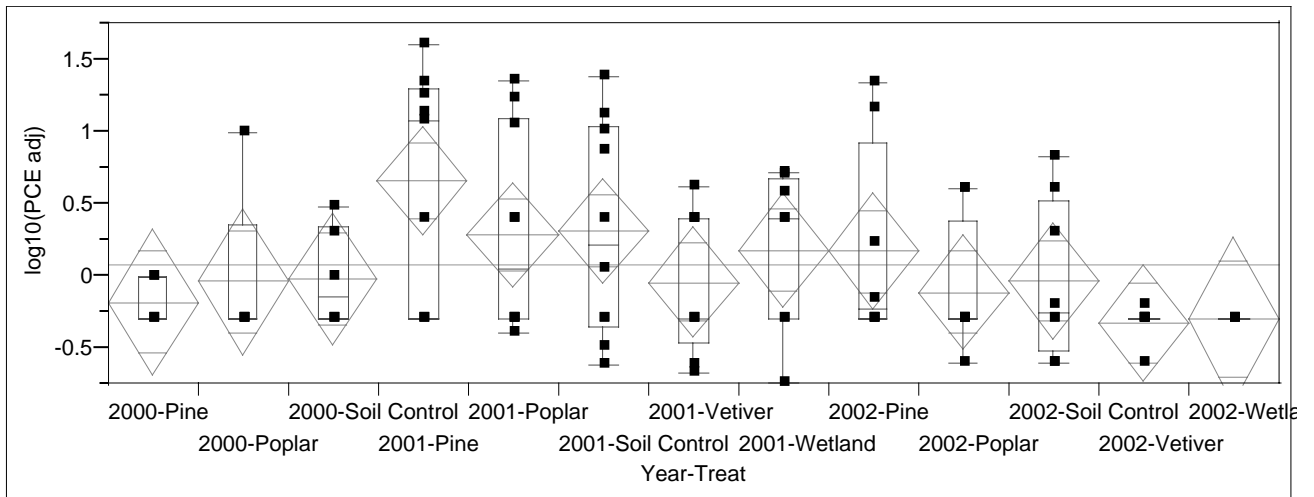
Soil Samples Results ($\mu\text{g}/\text{kg}$) by Depth, Year and Treatment

Type=Deep

One-Way Analysis of $\log_{10}(\text{TCE adj})$ By Year-Treat



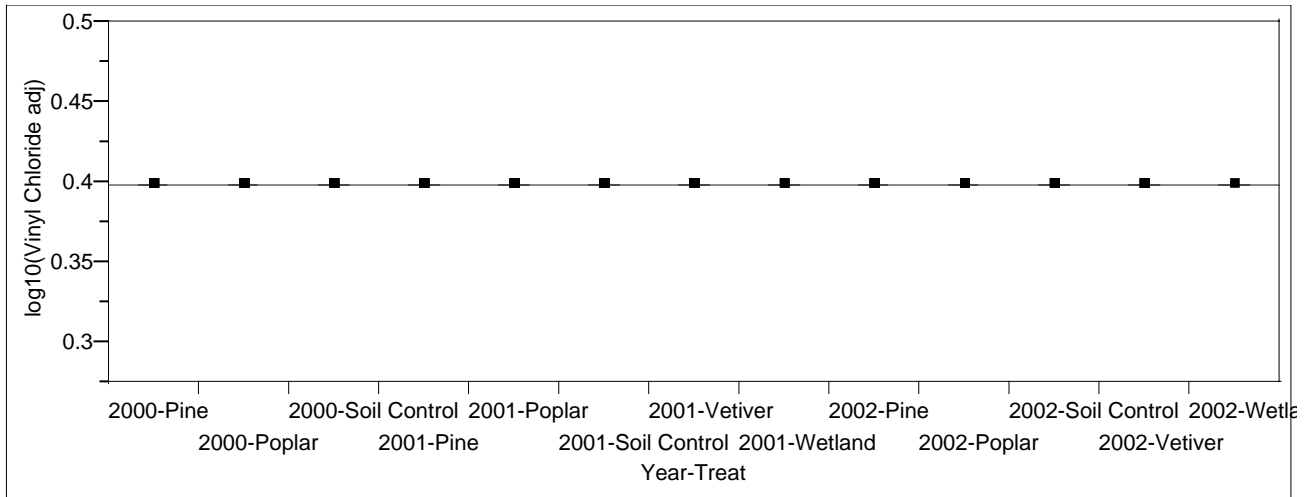
One-Way Analysis of $\log_{10}(\text{PCE adj})$ By Year-Treat



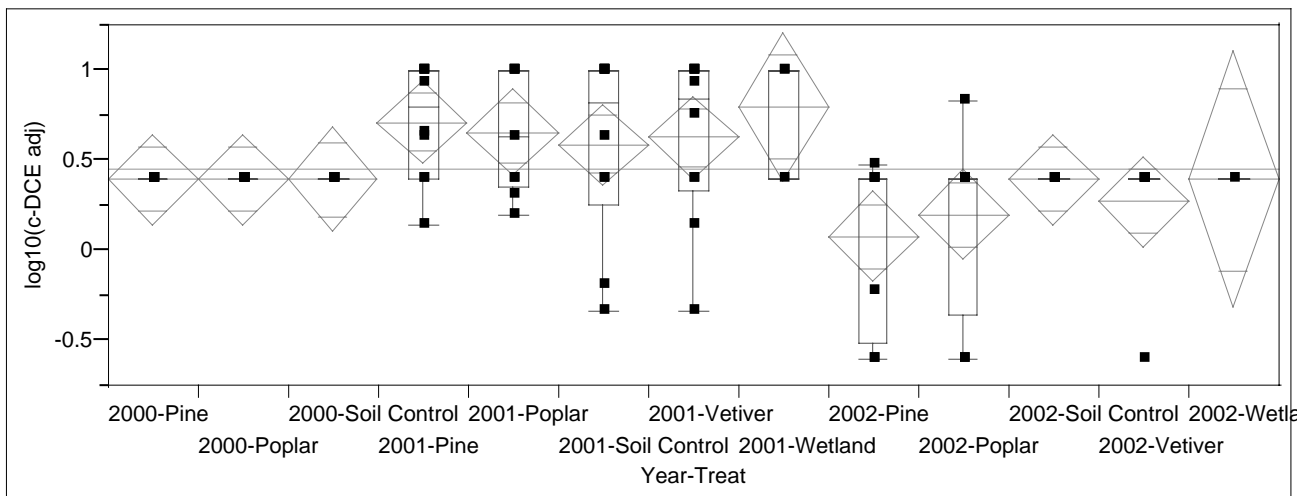
Soil Samples Results ($\mu\text{g}/\text{kg}$) by Depth, Year and Treatment

Type=Shallow

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat



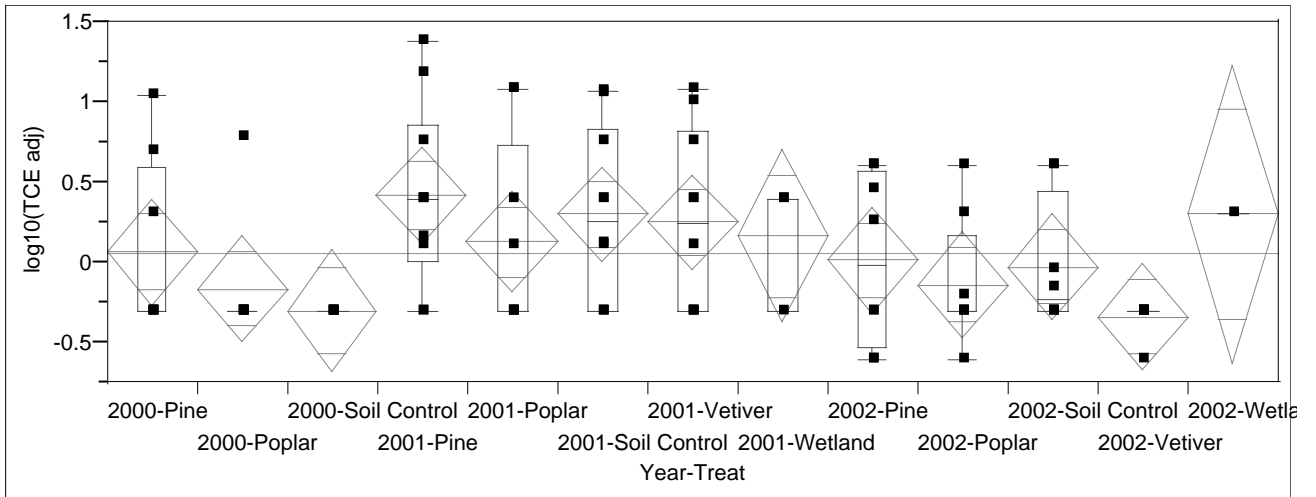
One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat



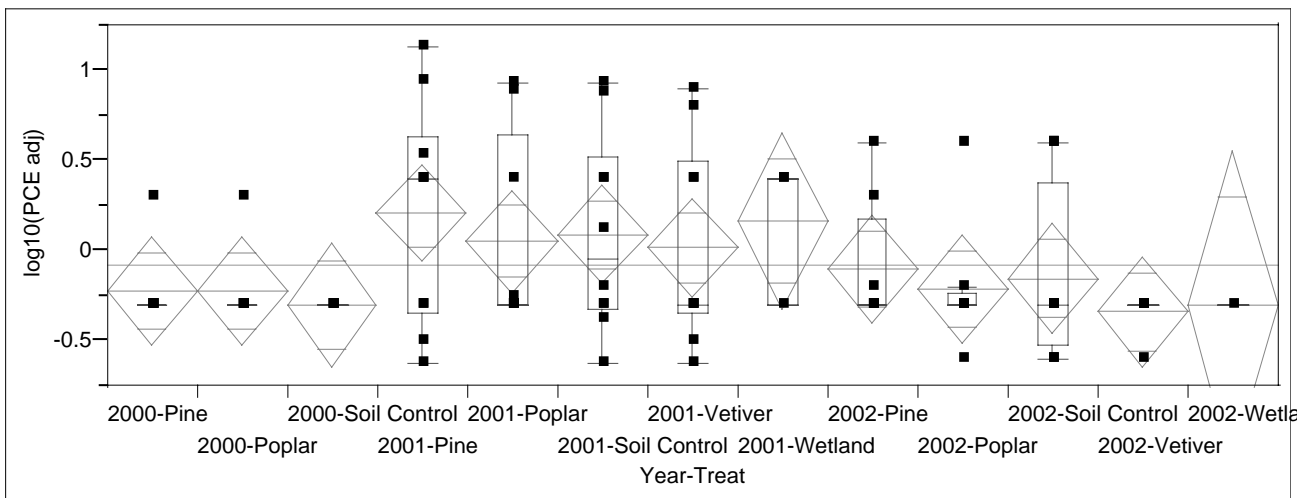
Soil Samples Results ($\mu\text{g}/\text{kg}$) by Depth, Year and Treatment

Type=Shallow

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat



One-Way Analysis of \log_{10} (PCE adj) By Year-Treat



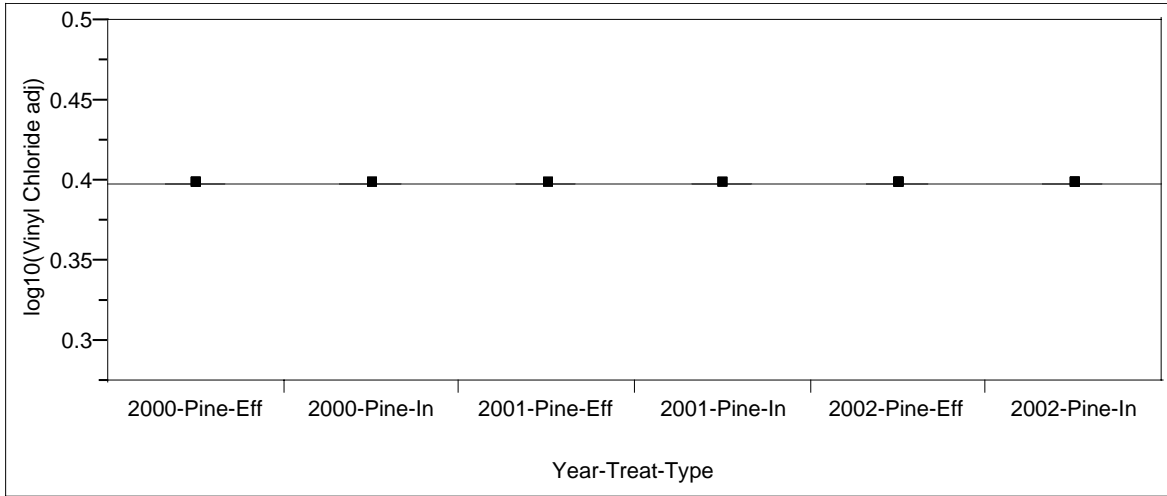
Appendix D

Water Samples for Each Treatment by Year

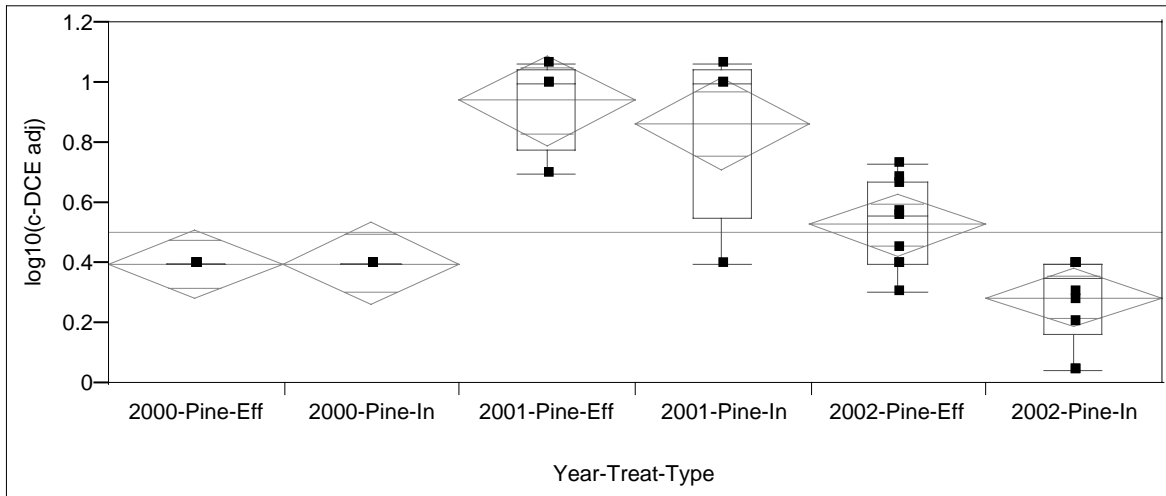
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Pine

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat-Type



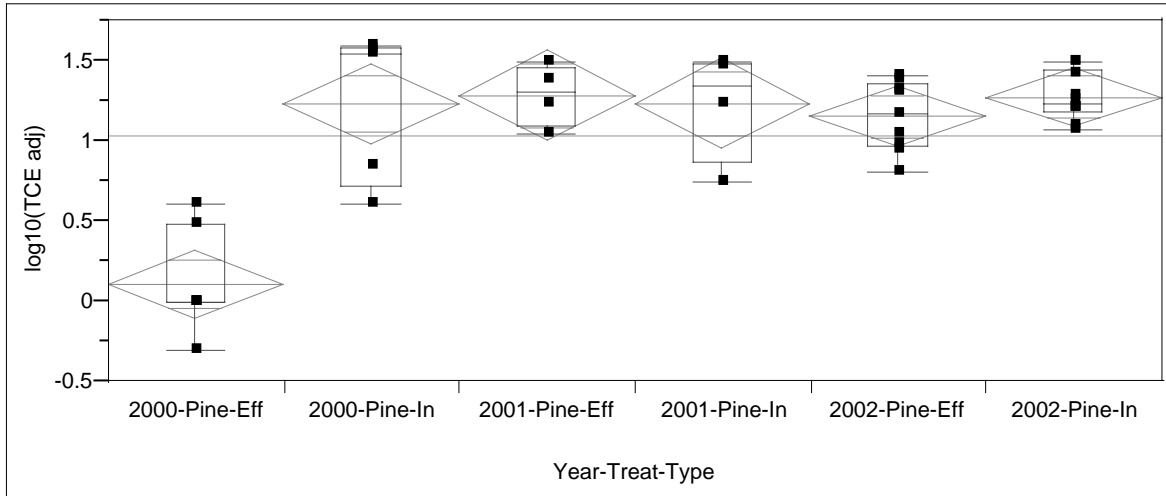
One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat-Type



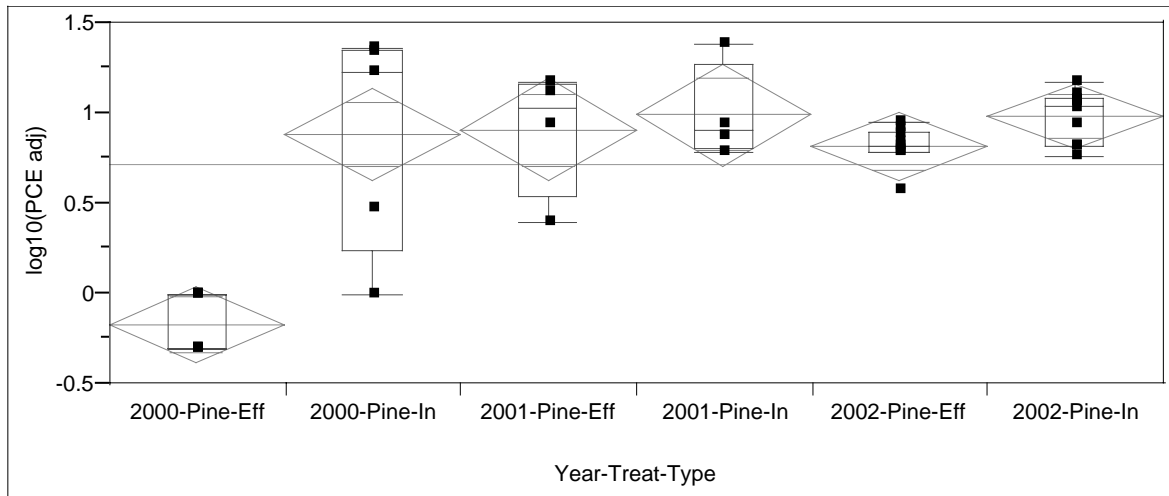
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Pine

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat-Type



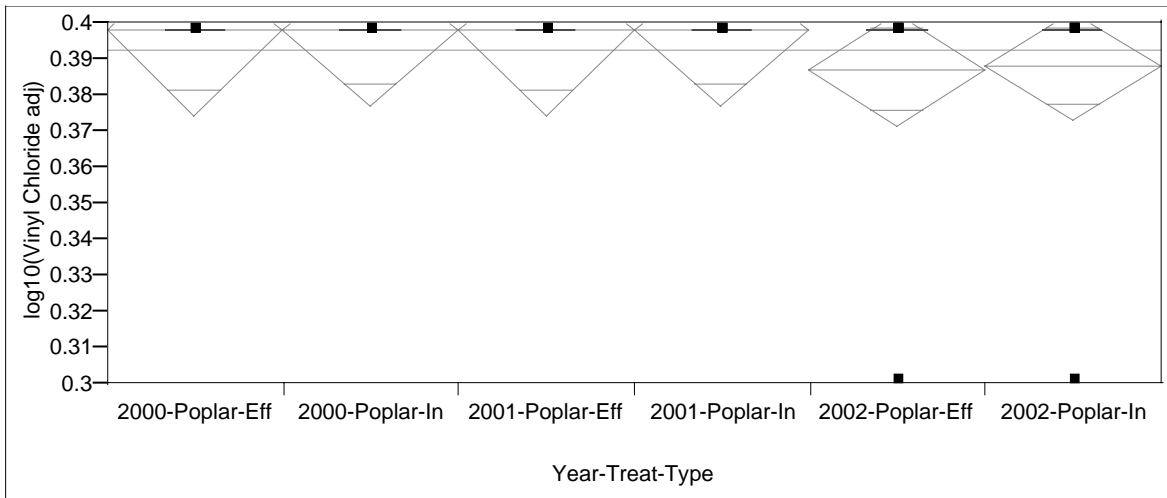
One-Way Analysis of \log_{10} (PCE adj) By Year-Treat-Type



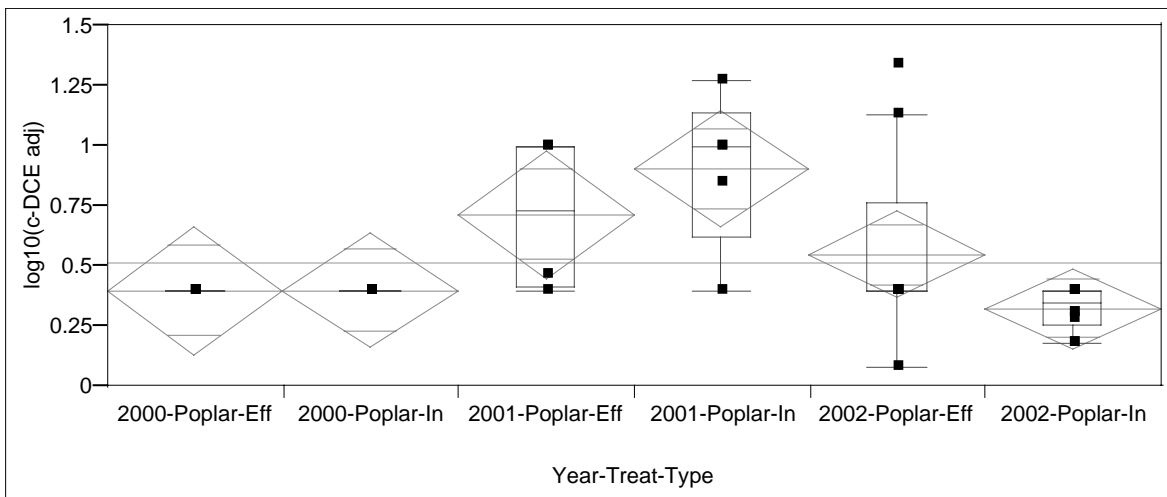
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Poplar

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat-Type



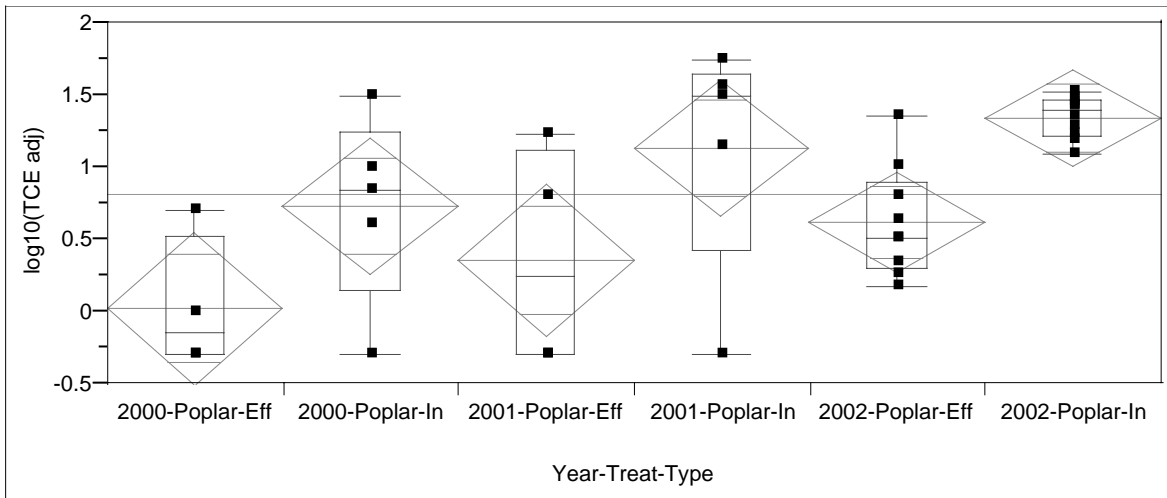
One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat-Type



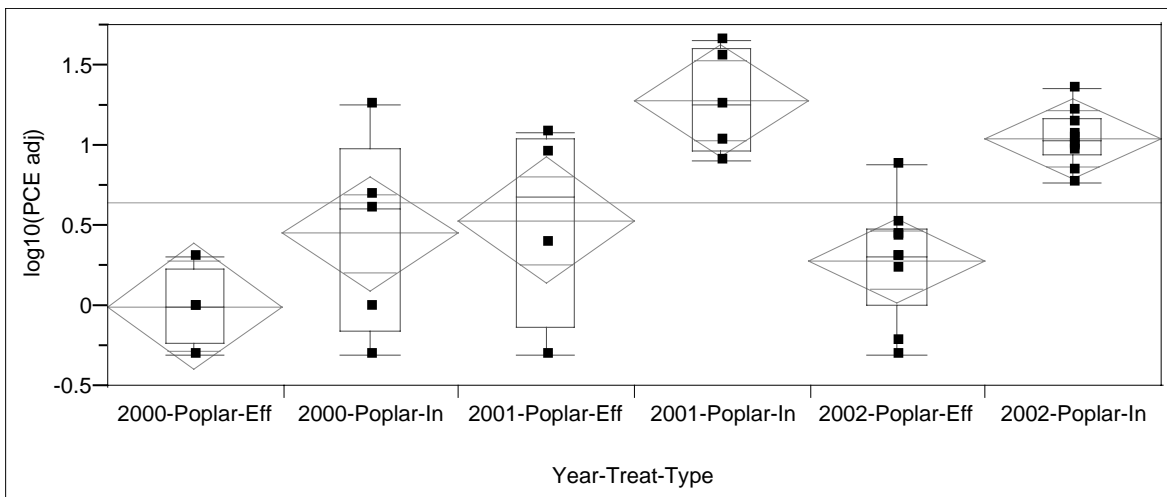
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Poplar

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat-Type



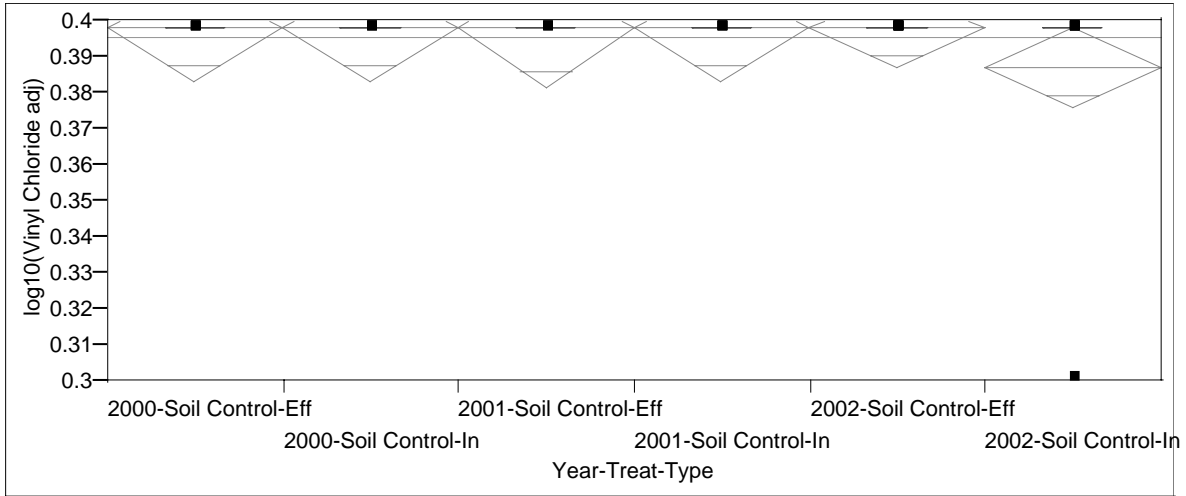
One-Way Analysis of \log_{10} (PCE adj) By Year-Treat-Type



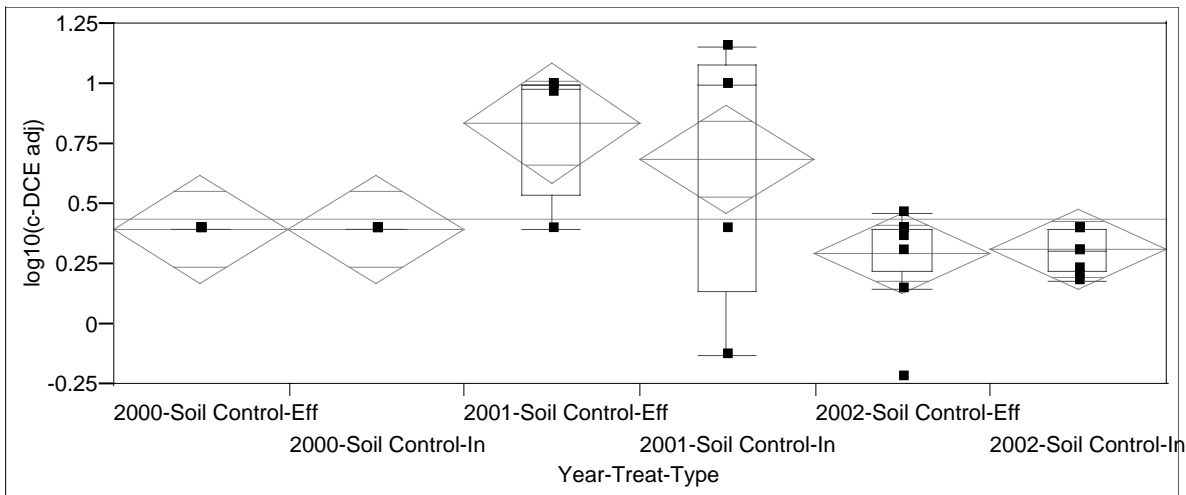
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Soil Control

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat-Type



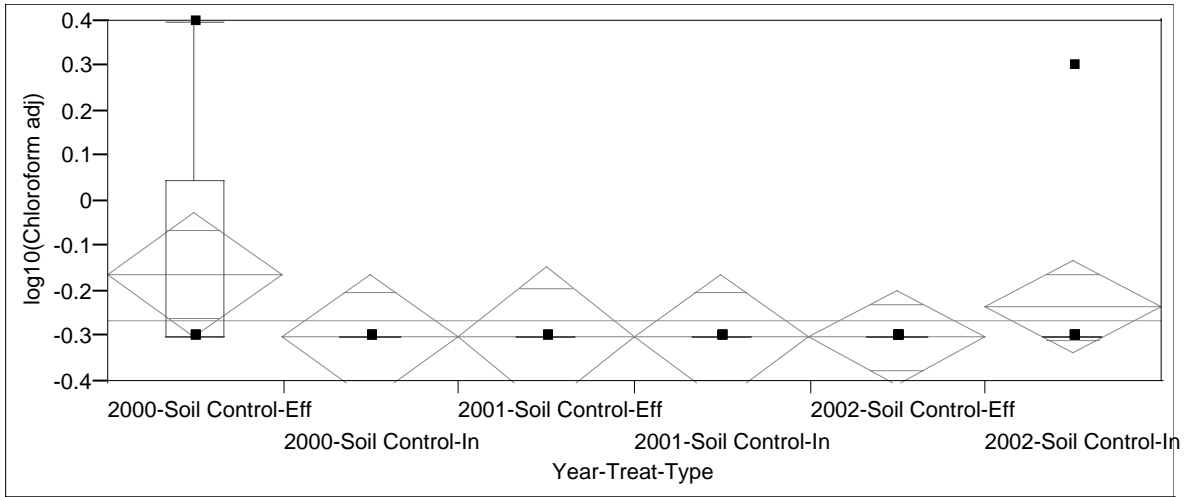
One Way Analysis of \log_{10} (c-DCE adj) By Year-Treat-Type



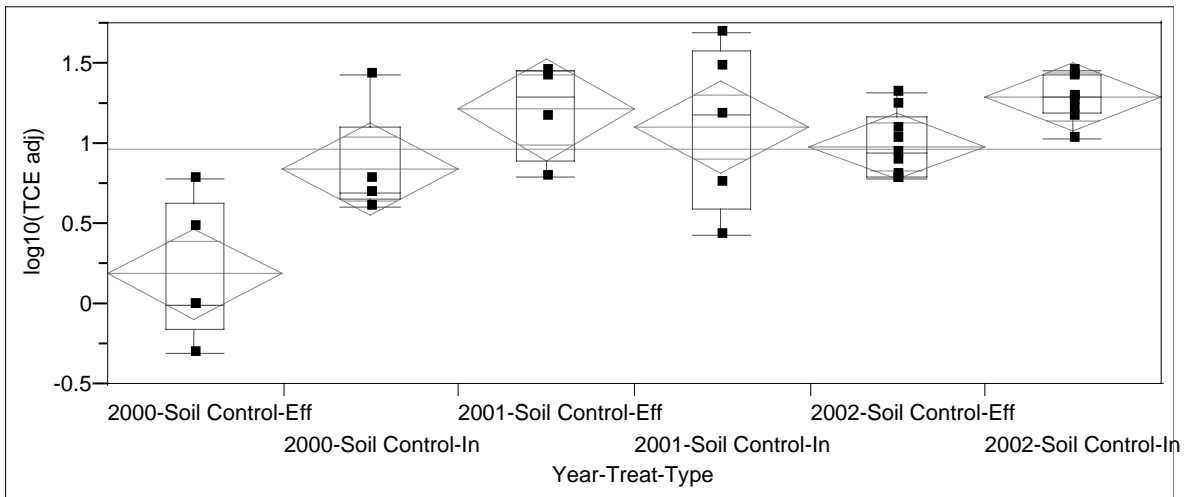
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Soil Control

One-Way Analysis of \log_{10} (Chloroform adj) By Year-Treat-Type



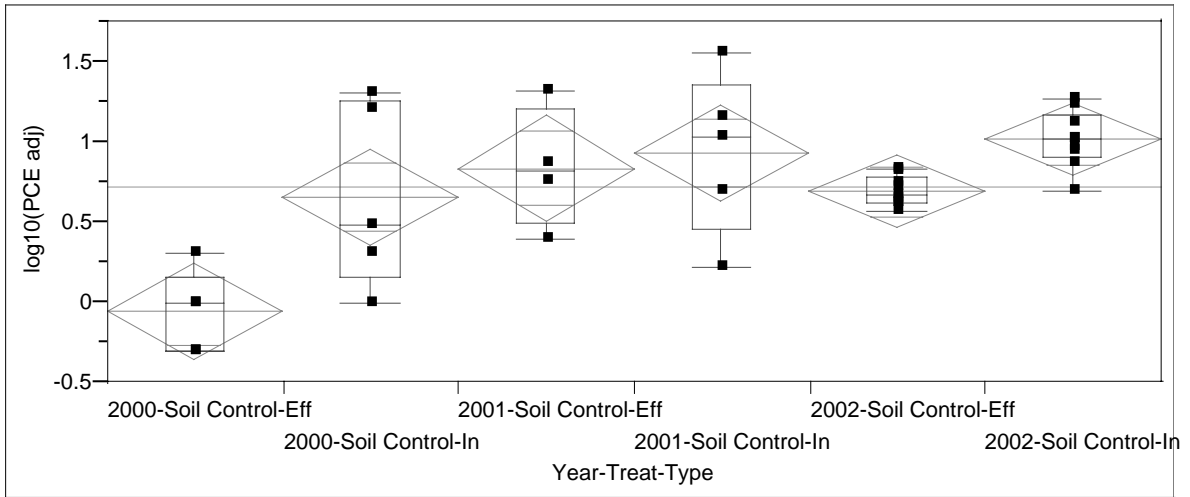
One-Way Analysis of \log_{10} (TCE adj) By Year-Treat-Type



Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

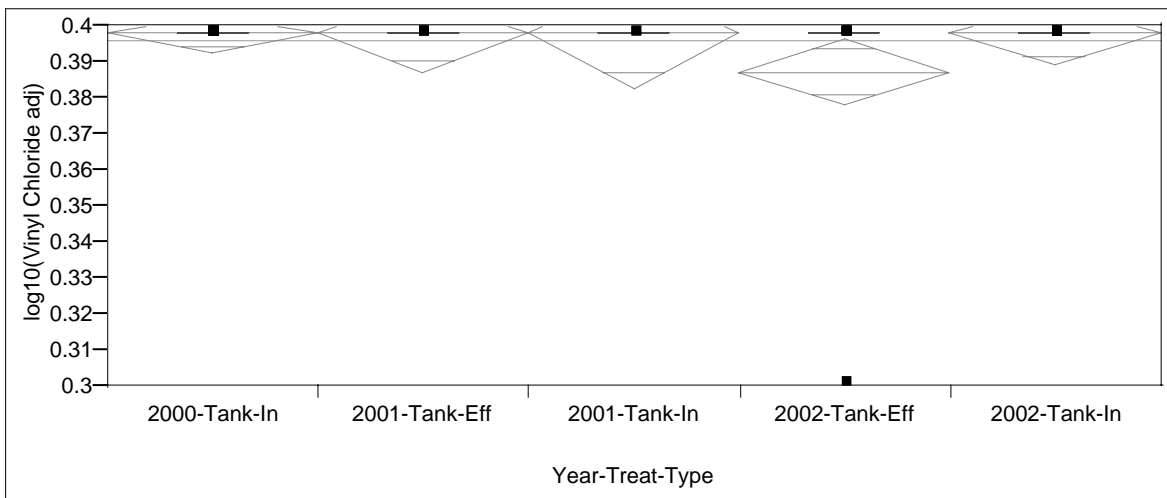
Treatment=Soil Control

One-Way Analysis of \log_{10} (PCE adj) By Year-Treat-Type



Treatment=Tank

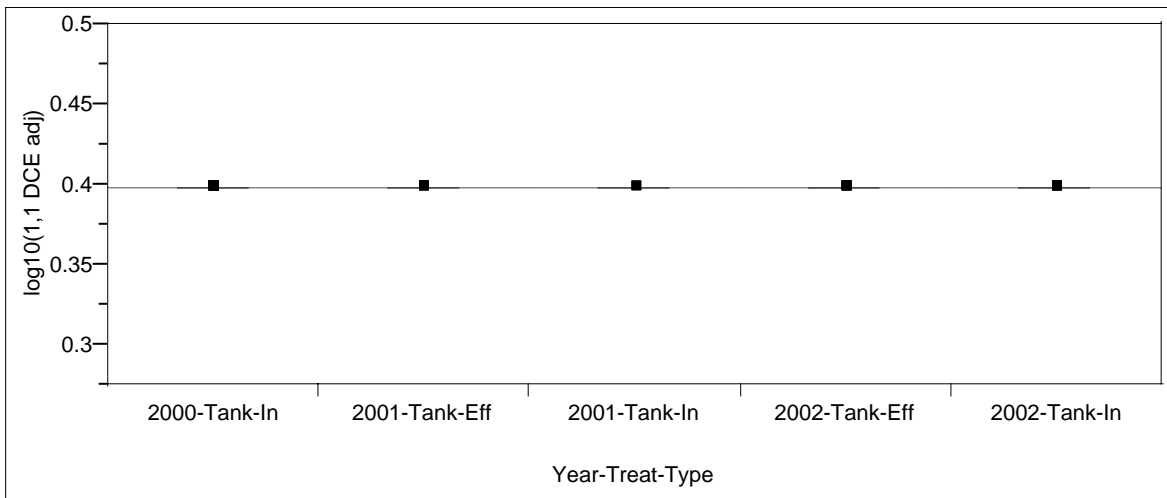
One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat-Type



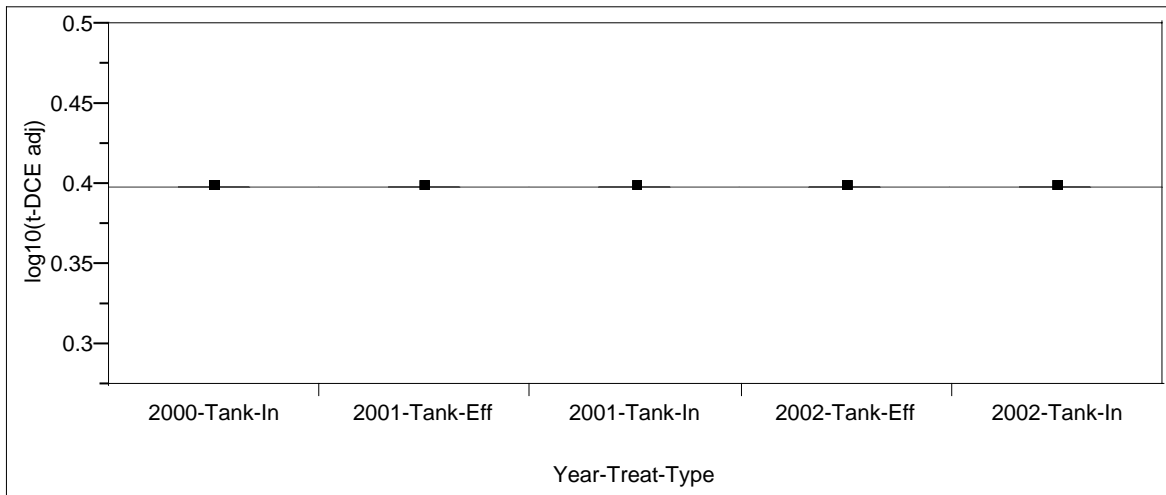
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Tank

One-Way Analysis of \log_{10} (1,1 DCE adj) By Year-Treat-Type



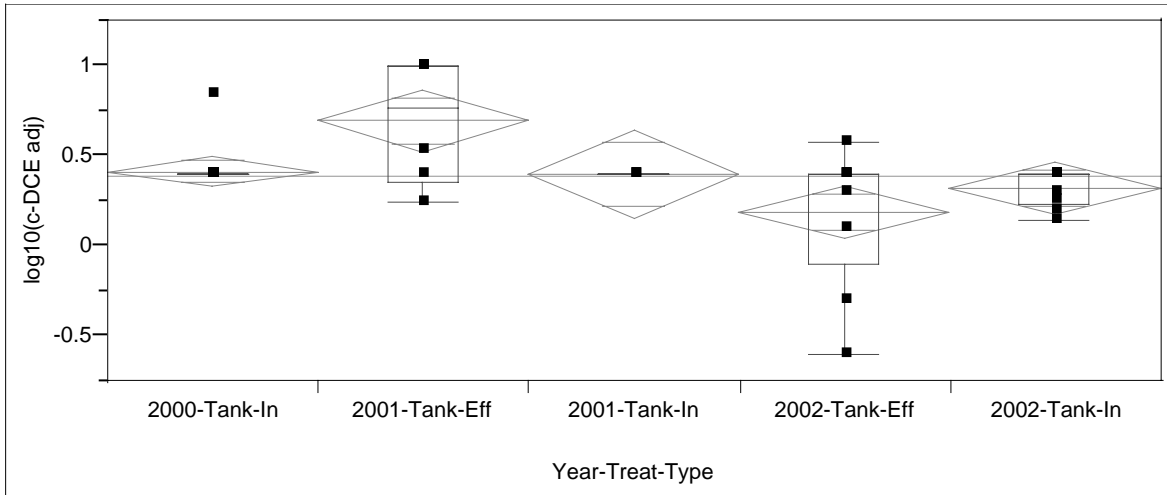
One-Way Analysis of \log_{10} (t-DCE adj) By Year-Treat-Type



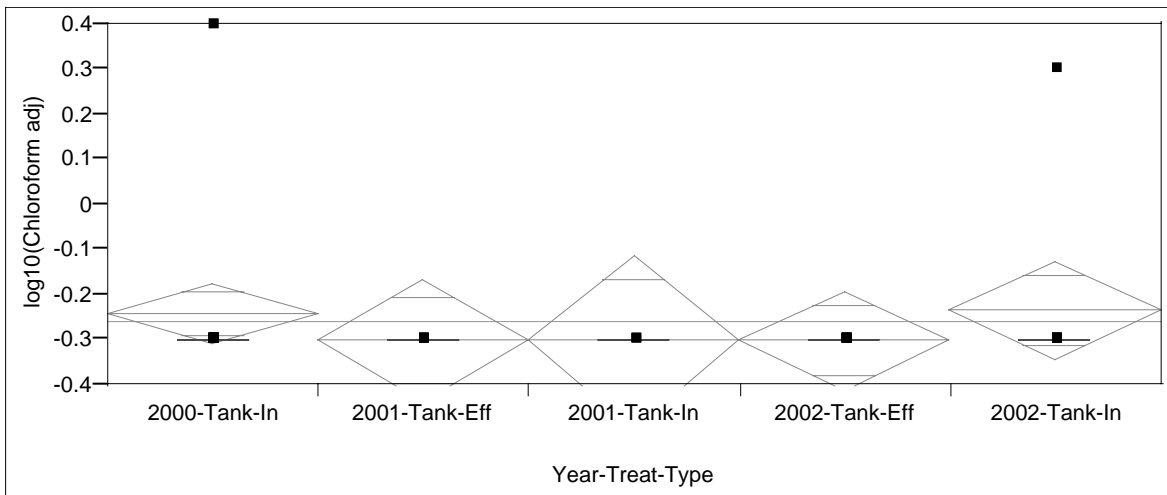
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Tank

One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat-Type



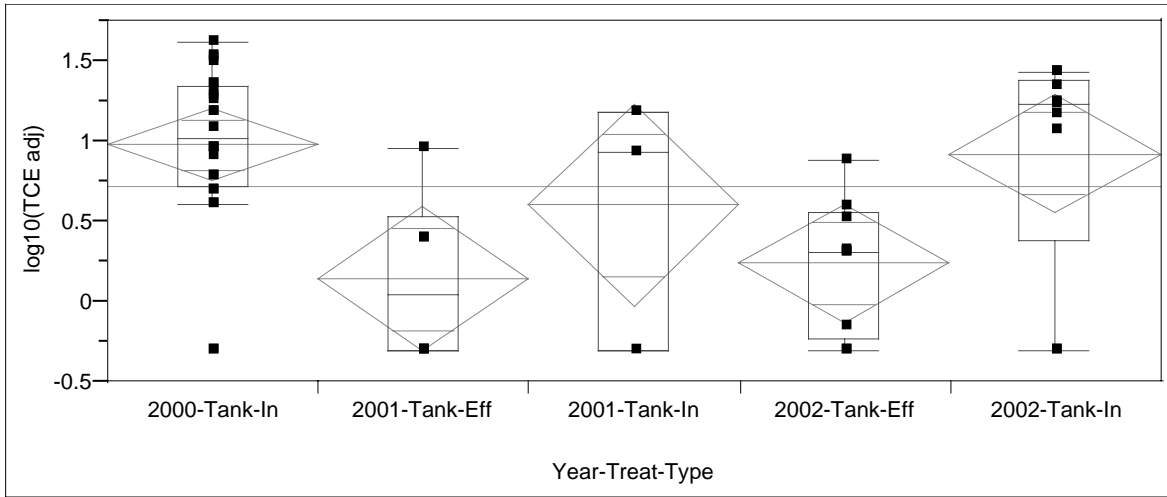
One-Way Analysis of \log_{10} (Chloroform adj) By Year-Treat-Type



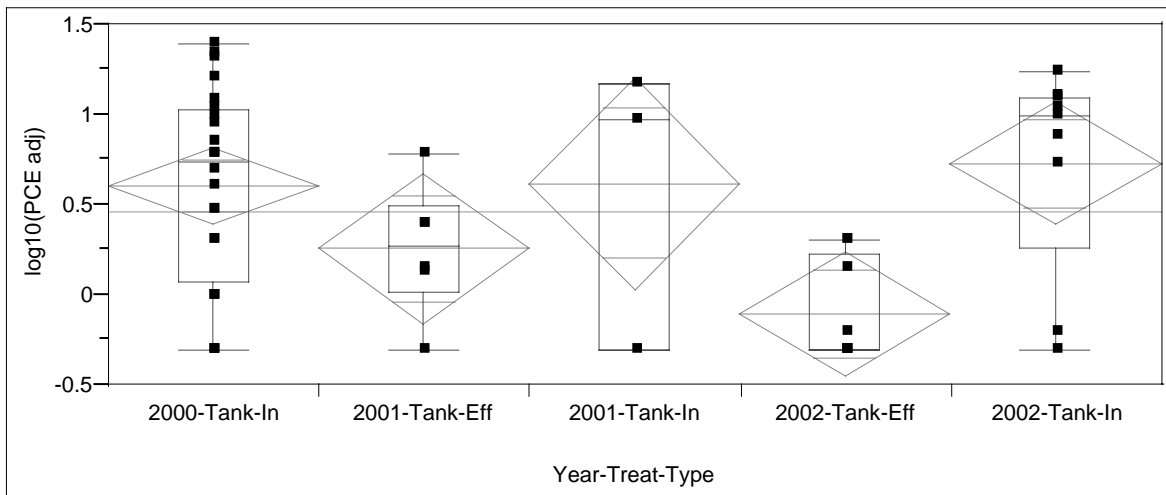
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Tank

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat-Type



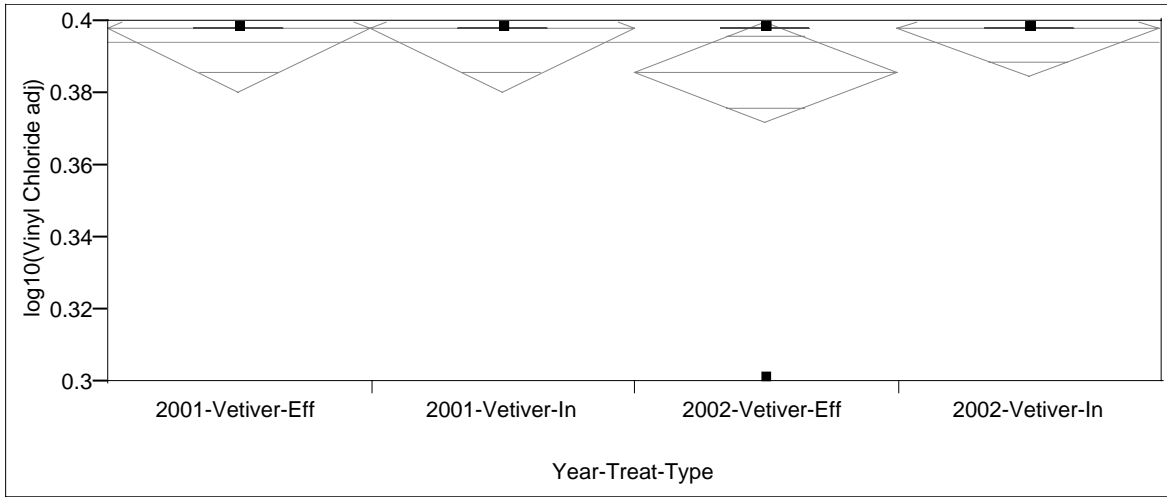
One-Way Analysis of \log_{10} (PCE adj) By Year-Treat-Type



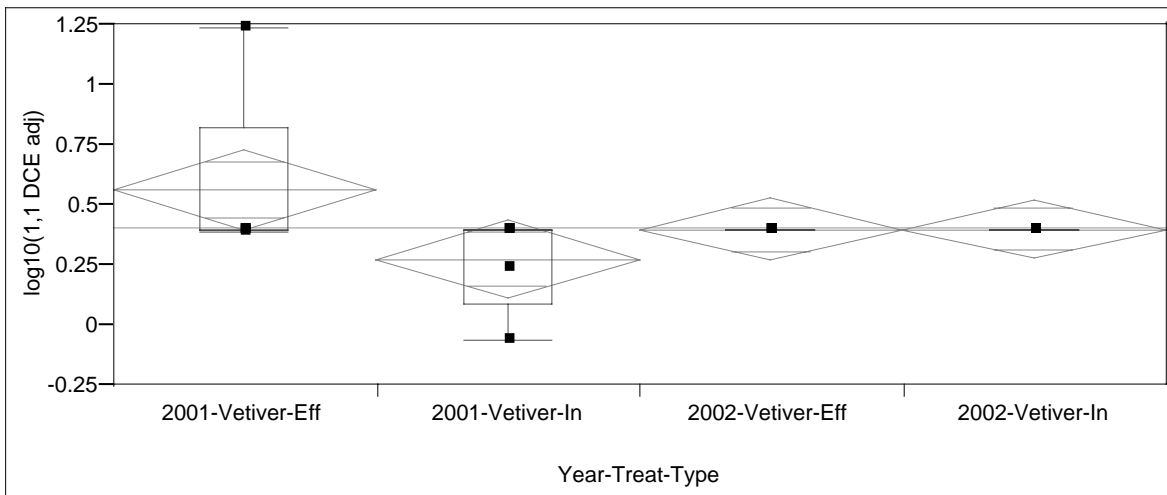
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Vetiver

One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat-Type



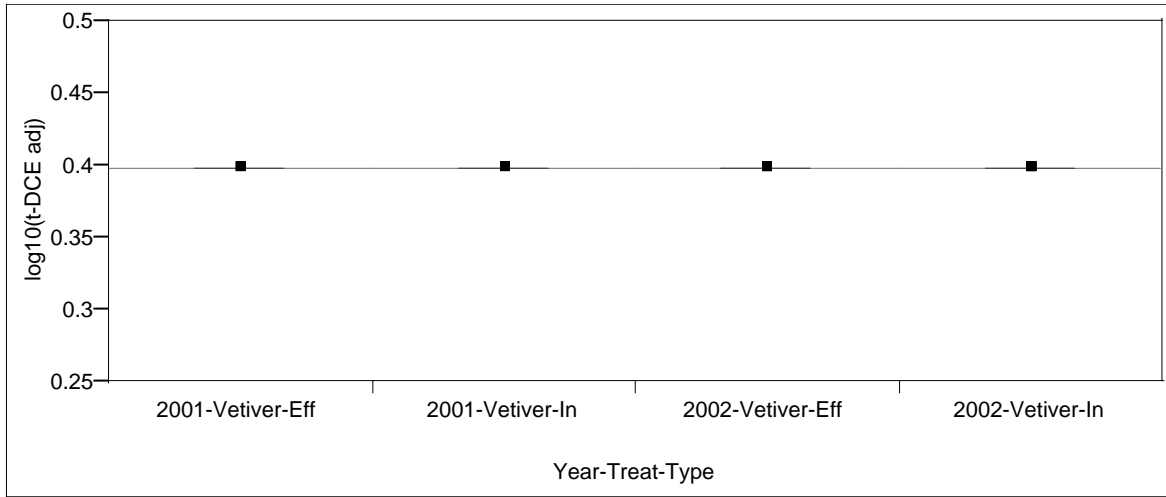
One-Way Analysis of \log_{10} (1,1 DCE adj) By Year-Treat-Type



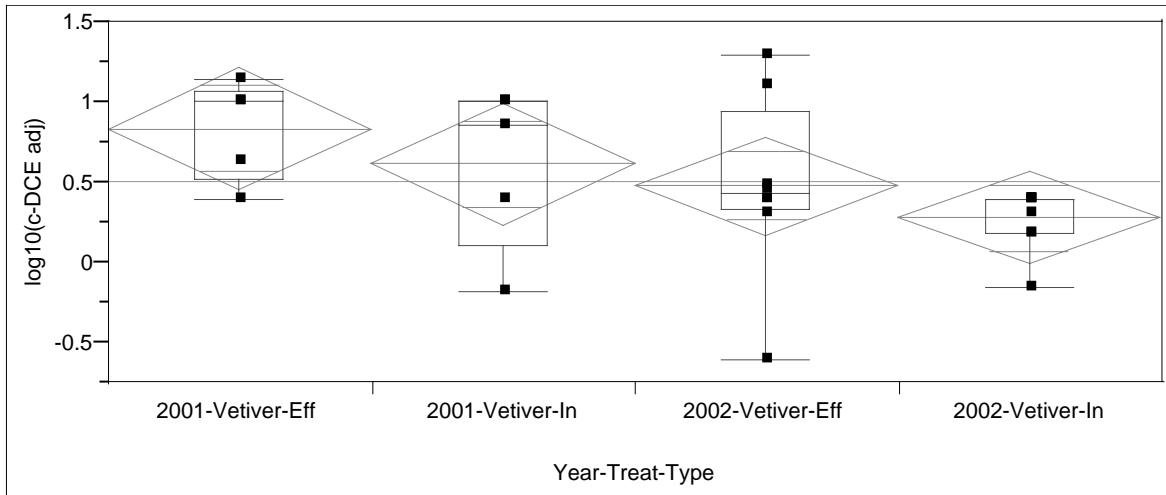
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Vetiver

One-Way Analysis of \log_{10} (t-DCE adj) By Year-Treat-Type



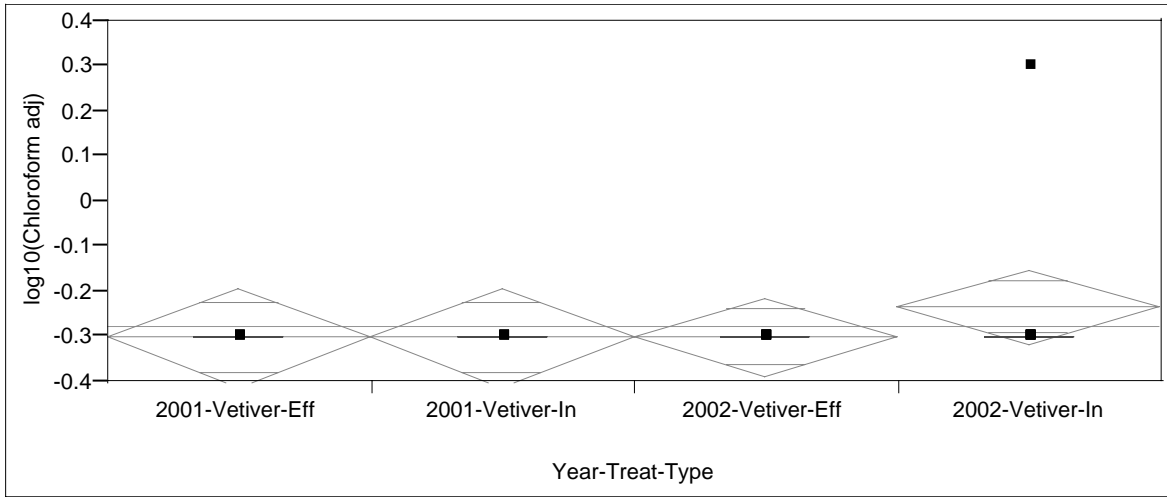
One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat-Type



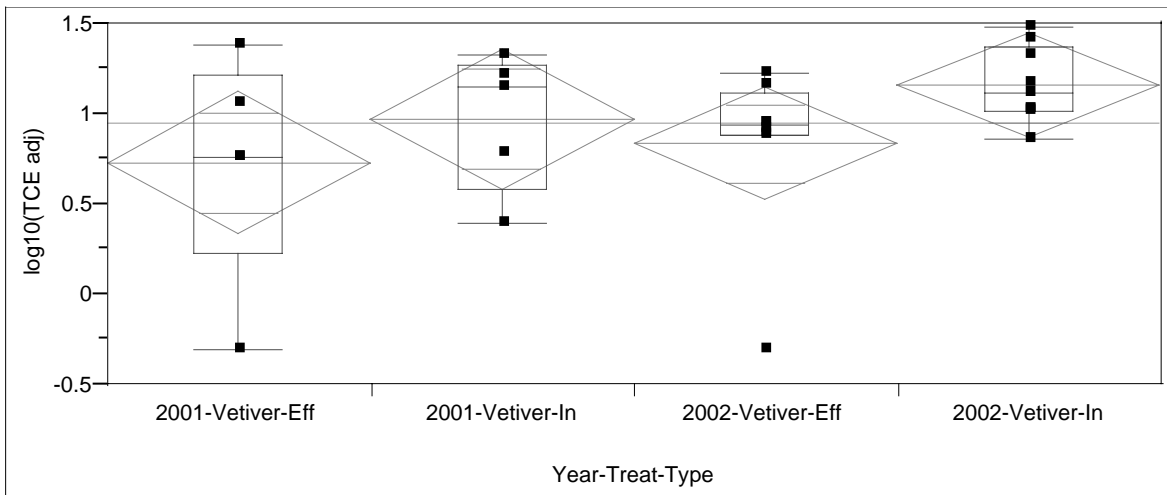
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Vetiver

One-Way Analysis of \log_{10} (Chloroform adj) By Year-Treat-Type



One-Way Analysis of \log_{10} (TCE adj) By Year-Treat-Type



Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

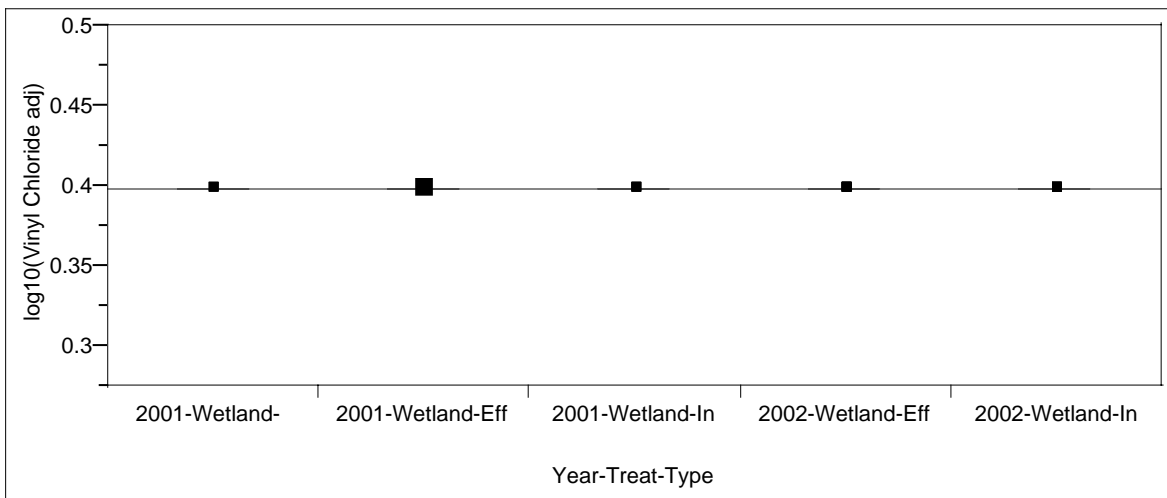
Treatment=Vetiver

One-Way Analysis of \log_{10} (PCE adj) By Year-Treat-Type



Treatment=Wetland

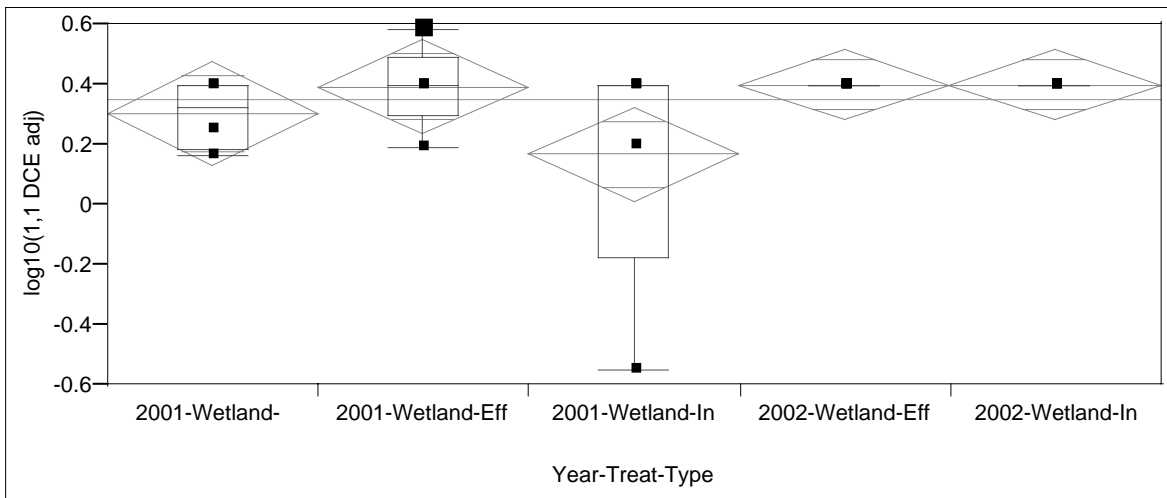
One-Way Analysis of \log_{10} (Vinyl Chloride adj) By Year-Treat-Type



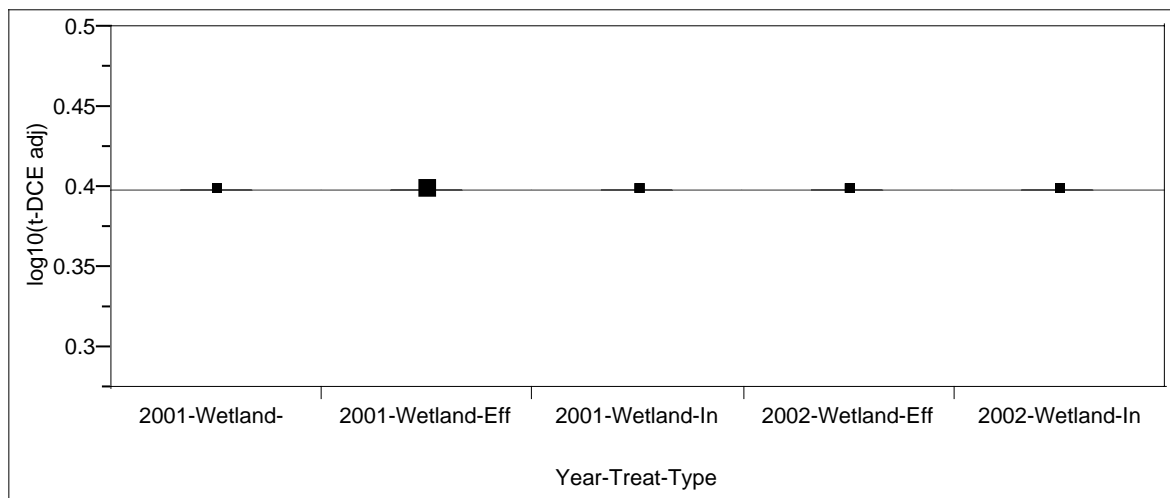
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Wetland

One-Way Analysis of \log_{10} (1,1 DCE adj) By Year-Treat-Type



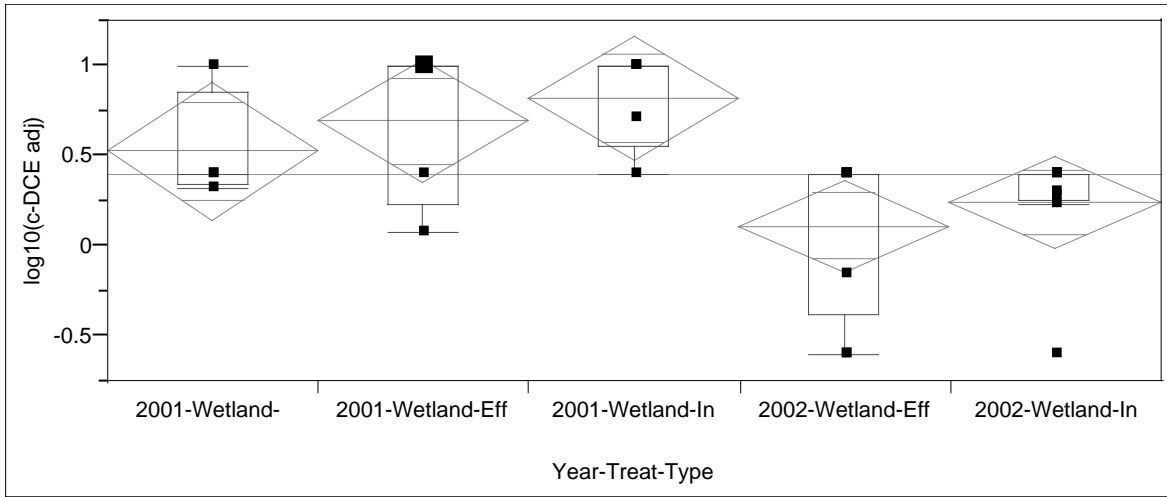
One-Way Analysis of \log_{10} (t-DCE adj) By Year-Treat-Type



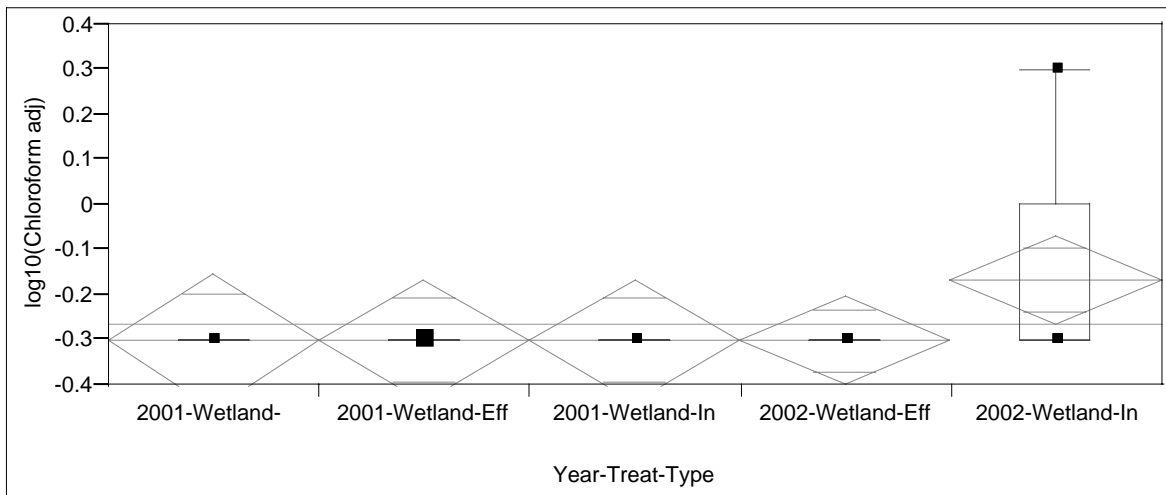
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Wetland

One-Way Analysis of \log_{10} (c-DCE adj) By Year-Treat-Type



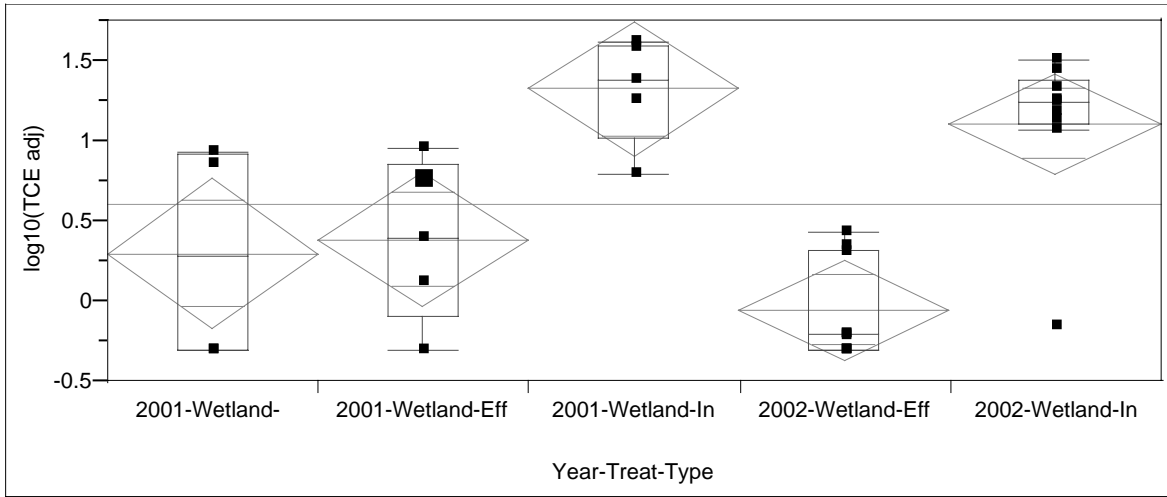
One-Way Analysis of \log_{10} (Chloroform adj) By Year-Treat-Type



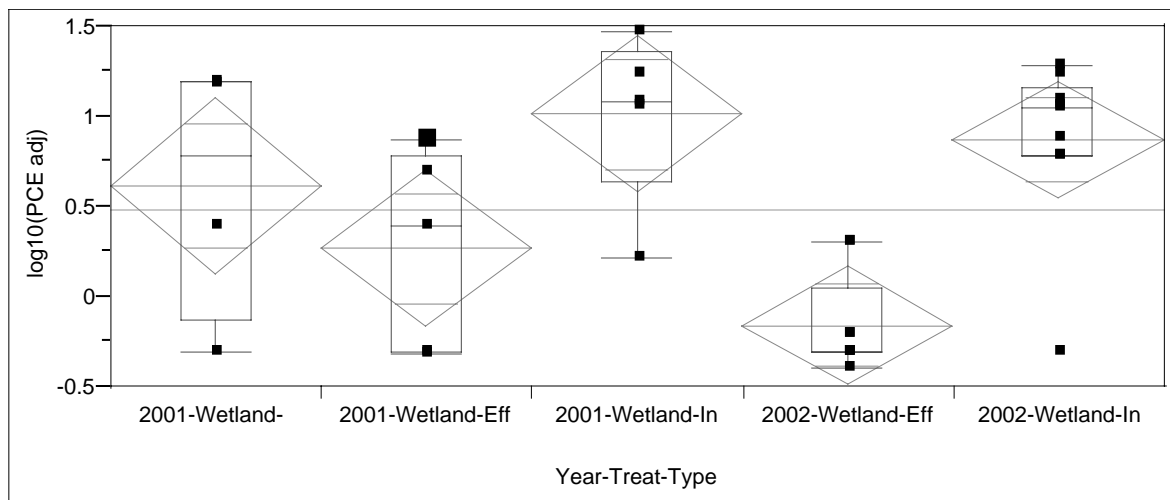
Water Samples Results ($\mu\text{g/L}$) for Each Treatment by Year

Treatment=Wetland

One-Way Analysis of \log_{10} (TCE adj) By Year-Treat-Type



One-Way Analysis of \log_{10} (PCE adj) By Year-Treat-Type



Appendix E

Joined Water Data File

Influent and Effluent

Joined Water Data File: Influent-Effluent (µg/L)

Year	Treatment	Date	Mean eff VC	Mean eff c-DCE	Mean eff TCE	Mean eff PCE	Mean inf VC	Mean inf c-DCE	Mean inf TCE	Mean inf PCE	Delta VC	Delta c- DCE	Delta TCE	Delta PCE
2000	Pine	12/31/2000	2.50	2.50	1.64	0.71	2.50	2.50	24.40	13.20	0.00	0.00	22.76	12.49
2001	Pine	05/23/2001	2.50	10.00	24.00	15.00	2.50	10.00	31.00	24.00	0.00	0.00	7.00	9.00
2001	Pine	06/16/2001	2.50	10.00	11.00	2.50	2.50	10.00	17.00	8.60	0.00	0.00	6.00	6.10
2001	Pine	07/26/2001	2.50	5.00	17.00	13.00	2.50	2.50	5.60	6.00	0.00	-2.50	-11.40	-7.00
2002	Pine	04/01/2002	2.50	11.51	30.87	8.74	2.50	11.51	29.23	7.39	0.00	0.00	-1.64	-1.35
2002	Pine	04/03/2002	2.50	2.40	8.05	7.10	2.50	2.25	13.95	13.15	0.00	-0.15	5.90	6.05
2002	Pine	05/06/2002	2.50	3.70	14.70	3.70	2.50	2.50	24.75	8.60	0.00	-1.20	10.05	4.90
2002	Pine	06/03/2002	2.50	2.50	9.95	6.50	2.50	2.50	14.20	12.20	0.00	0.00	4.25	5.70
2002	Pine	07/10/2002	2.50	5.10	22.35	7.60	2.50	1.75	28.95	10.15	0.00	-3.35	6.60	2.55
2002	Pine	08/07/2002	2.50	4.10	23.20	7.05	2.50	1.10	17.80	6.15	0.00	-3.00	-5.40	-0.90
2000	Poplar	12/31/2000	2.50	2.50	1.75	1.13	2.50	2.50	10.50	5.70	0.00	0.00	8.75	4.58
2001	Poplar	05/23/2001	2.50	10.00	17.00	12.00	2.50	10.00	56.00	45.00	0.00	0.00	39.00	33.00
2001	Poplar	06/16/2001	2.50	10.00	6.30	2.50	2.50	10.00	36.00	18.00	0.00	0.00	29.70	15.50
2001	Poplar	07/26/2001	2.50	2.50	0.50	0.50	2.50	2.50	14.00	10.60	0.00	0.00	13.50	10.10
2002	Poplar	04/01/2002	2.50	2.91	0.50	8.96	2.50	12.86	15.66	21.81	0.00	9.95	15.16	12.85
2002	Poplar	04/03/2002	2.25	2.50	3.75	3.05	2.25	2.25	13.90	12.85	0.00	-0.25	10.15	9.80
2002	Poplar	05/06/2002	2.50	2.50	8.15	2.20	2.50	2.50	22.80	8.45	0.00	0.00	14.65	6.25
2002	Poplar	06/03/2002	2.50	2.50	2.70	2.00	2.50	2.50	21.15	19.40	0.00	0.00	18.45	17.40
2002	Poplar	07/10/2002	2.50	11.50	12.30	4.00	2.50	1.75	28.05	8.00	0.00	-9.75	15.75	4.00
2002	Poplar	08/07/2002	2.50	13.40	1.50	0.60	2.50	1.70	30.05	10.30	0.00	-11.70	28.55	9.70
2000	Soil Control	12/31/2000	2.50	2.50	2.30	1.00	2.50	2.50	9.40	8.40	0.00	0.00	7.10	7.40
2001	Soil Control	05/23/2001	2.50	10.00	29.00	21.00	2.50	10.00	49.00	36.00	0.00	0.00	20.00	15.00
2001	Soil Control	07/26/2001	2.50	2.50	6.20	2.50	2.50	2.50	15.00	10.90	0.00	0.00	8.80	8.40
2002	Soil Control	04/01/2002	2.50	9.14	26.48	5.72	2.50	7.56	4.23	3.34	0.00	-1.58	-22.26	-2.39
2002	Soil Control	04/03/2002	2.50	2.15	6.95	6.20	2.25	2.00	12.70	11.85	-0.25	-0.15	5.75	5.65
2002	Soil Control	05/06/2002	2.50	2.50	14.05	4.45	2.50	2.50	23.65	8.90	0.00	0.00	9.60	4.45
2002	Soil Control	06/03/2002	2.50	2.50	6.25	4.35	2.50	2.50	19.75	17.80	0.00	0.00	13.50	13.45
2002	Soil Control	07/10/2002	2.50	1.00	10.50	4.30	2.50	1.60	21.65	6.90	0.00	0.60	11.15	2.60

Joined Water Data File: Influent-Effluent (µg/L) (Continued)

Year	Treatment	Date	Mean eff VC	Mean eff c-DCE	Mean eff TCE	Mean eff PCE	Mean inf VC	Mean inf c-DCE	Mean inf TCE	Mean inf PCE	Delta VC	Delta c-DCE	Delta TCE	Delta PCE
2002	Soil Control	08/07/2002	2.50	2.90	20.60	6.60	2.50	1.60	27.30	9.30	0.00	-1.30	6.70	2.70
2001	Tank	07/09/2001	2.50	2.50	0.50	0.50	2.50	2.50	0.50	0.50	0.00	0.00	0.00	0.00
2002	Tank	04/03/2002	2.25	2.90	2.65	2.00	2.50	2.25	14.30	15.00	0.25	-0.65	11.65	13.00
2002	Tank	05/06/2002	2.50	1.88	5.70	1.01	2.50	2.50	0.50	0.56	0.00	0.63	-5.20	-0.45
2002	Tank	06/03/2002	2.50	2.50	2.05	0.50	2.50	2.50	16.15	11.55	0.00	0.00	14.10	11.05
2002	Tank	07/10/2002	2.50	1.38	0.50	0.50	2.50	1.50	24.35	6.50	0.00	0.13	23.85	6.00
2002	Tank	08/07/2002	2.50	0.50	0.70	0.50	2.50	1.80	27.30	9.80	0.00	1.30	26.60	9.30
2001	Vetiver	05/23/2001	2.50	10.00	24.00	17.00	2.50	10.00	14.00	9.00	0.00	0.00	-10.00	-8.00
2001	Vetiver	06/20/2001	2.50	10.00	11.50	5.50	2.50	10.00	2.50	2.50	0.00	0.00	-9.00	-3.00
2001	Vetiver	07/26/2001	2.50	14.00	5.70	2.50	2.50	2.50	6.00	5.00	0.00	-11.50	0.30	2.50
2002	Vetiver	04/01/2002	2.50	3.41	3.14	4.28	2.50	3.92	18.84	2.72	0.00	0.52	15.70	-1.56
2002	Vetiver	04/03/2002	2.25	2.50	8.30	6.55	2.50	2.25	11.85	10.85	0.25	-0.25	3.55	4.30
2002	Vetiver	05/06/2002	2.50	2.90	16.90	5.60	2.50	2.50	18.15	6.60	0.00	-0.40	1.25	1.00
2002	Vetiver	06/03/2002	2.50	2.50	8.40	7.30	2.50	2.50	8.95	7.90	0.00	0.00	0.55	0.60
2002	Vetiver	07/10/2002	2.50	9.88	4.35	2.60	2.50	1.10	20.25	6.75	0.00	-8.78	15.90	4.15
2002	Vetiver	08/07/2002	2.50	12.60	14.60	4.30	2.50	1.50	26.40	9.10	0.00	-11.10	11.80	4.80
2001	Wetland	05/23/2001	2.50	10.00	9.00	5.00	2.50	10.00	41.00	30.00	0.00	0.00	32.00	25.00
2001	Wetland	06/20/2001	2.50	10.00	2.50	2.50	2.50	10.00	24.40	11.40	0.00	0.00	21.90	8.90
2001	Wetland	07/26/2001	2.50	2.50	0.50	0.50	2.50	2.50	18.00	12.00	0.00	0.00	17.50	11.50
2002	Wetland	04/01/2002	2.50	5.64	3.52	3.96	2.50	7.62	22.34	9.43	0.00	1.98	18.83	5.47
2002	Wetland	04/03/2002	2.50	2.50	2.45	2.00	2.50	2.25	12.75	11.95	0.00	-0.25	10.30	9.95
2002	Wetland	05/06/2002	2.50	2.50	0.63	0.63	2.50	2.50	18.20	6.85	0.00	0.00	17.58	6.23
2002	Wetland	06/03/2002	2.50	2.50	1.25	0.50	2.50	2.50	17.70	18.10	0.00	0.00	16.45	17.60
2002	Wetland	07/10/2002	2.50	0.25	0.50	0.50	2.50	0.98	14.20	3.25	0.00	0.73	13.70	2.75
2002	Wetland	08/07/2002	2.50	0.70	0.60	0.40	2.50	1.90	32.30	11.20	0.00	1.20	31.70	10.80

Appendix F

Plant Material Data File

Plant Material Data File (µg/kg)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
REP 1 PINE B	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	<1	<1	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SOUTH. SEC. REP 1, PINE, B	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	<5	6	<2	2.5	2.5	2.5	2.5	2.5	6	1
SOUTH. SEC. REP 3, PINE, A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	20	BDL	6	<2	2.5	2.5	2.5	20	0.5	6	1
SOUTH. SEC. REP 2, PINE, A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	8	BDL	7	<2	2.5	2.5	2.5	8	0.5	7	1
SS REP 1 PINE A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	<5	<5	9	2	2.5	2.5	2.5	2.5	2.5	9	2
SOUTH. SEC. REP 2, PINE, B	Pine	Leaf	12/31/2001	BDL	BDL	BDL	10	<5	10	BDL	2.5	2.5	2.5	10	2.5	10	0.5
pine rep 1 A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	<5	BDL	<2	BDL	2.5	2.5	2.5	2.5	0.5	1	0.5
Southern Sector Rep 3 Pine B	Pine	Leaf	12/31/2001	BDL	BDL	BDL	8	BDL	0	BDL	2.5	2.5	2.5	8	0.5	0.5	0.5
pinerep 1 A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	<2	BDL	2.5	2.5	2.5	2.5	0.5	1	0.5
REP2 PINE B	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
REP 2, PINE, A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
REP 3, PINE, A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
pine rep 1 A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
Pine rep 2 A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
pine rep 2 A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
pine rep 3 A	Pine	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
Southern Sector Rep 3 Poplar A	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	2	<2	2.5	2.5	2.5	2.5	0.5	2	1
SOUTH. SEC., REP 1, POPLAR B,	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	6	<2	2.5	2.5	2.5	2.5	0.5	6	1
SS REP 1 POPLAR A	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	<5	<5	6	1	2.5	2.5	2.5	2.5	2.5	6	1
SOUTH. SEC., REP 2, POPLAR B	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	9	8	3	2.5	2.5	2.5	2.5	9	8	3
SOUTH. SEC., REP 3, POPLAR B,	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	7	3	2.5	2.5	2.5	2.5	0.5	7	3
SOUTH. SEC., REP 2, POPLAR A,	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
poplar rep 1	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
poplar rep 1	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
poplar rep 1 A	Poplar	Leaf	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c-DCE adj	Chloroform adj	TCE adj	PCE adj
A pine needles	Pine	Leaf	07/26/2001	23		ND	ND		ND	17		2.5	2.5	2.5	0.5	0.5	17
SS pine needles B	Pine	Leaf	07/26/2001	ND		ND	96		ND	ND		2.5	2.5	2.5	0.5	0.5	0.5
SS pine roots B	Pine	Roots	07/26/2001	ND		ND	1763		ND	3		2.5	2.5	1763	0.5	0.5	3
SS pine roots C	Pine	Roots	07/26/2001	ND		ND	1701		ND	ND		2.5	2.5	1701	0.5	0.5	0.5
A pine roots	Pine	Roots	07/26/2001	ND		270	31		ND	ND		2.5	2.5	270	0.5	0.5	0.5
SS pine stem B	Pine	Stem	07/26/2001	ND		ND	1309		1	2		2.5	2.5	1309	0.5	1	2
A pine stem	Pine	Stem	07/26/2001	ND		ND	359		ND	ND		2.5	2.5	359	0.5	0.5	0.5
SS pine stem C	Pine	Stem	07/26/2001	ND		ND	444		ND	ND		2.5	2.5	444	0.5	0.5	0.5
a poplar leaves	Poplar	Leaf	07/26/2001	ND		ND	ND		84	22		2.5	2.5	2.5	0.5	84	22
B Poplar leaves	Poplar	Leaf	07/26/2001	17		ND	4		208	ND		2.5	2.5	4	0.5	208	0.5
a poplar roots	Poplar	Roots	07/26/2001	ND		ND	ND		ND	12		2.5	2.5	2.5	0.5	0.5	12
B Poplar roots	Poplar	Roots	07/26/2001	15		3	ND		ND	ND		2.5	3	2.5	0.5	0.5	0.5
SS poplar roots C 7.26.01	Poplar	Roots	07/26/2001	ND		ND	ND		ND	ND		2.5	2.5	2.5	0.5	0.5	0.5
a poplar stems	Poplar	Stem	07/26/2001	ND		ND	ND		8	7		2.5	2.5	2.5	0.5	8	7
B Poplar stems	Poplar	Stem	07/26/2001	ND		ND	ND		31	ND		2.5	2.5	2.5	0.5	31	0.5
a vitiver leave base	Vetiver	Leaf	07/26/2001	ND		ND	ND		ND	21		2.5	2.5	2.5	0.5	0.5	21
a vitiver leave	Vetiver	Leaf	07/26/2001	ND		ND	ND		263	22		2.5	2.5	2.5	0.5	263	22
B Vitiver leave	Vetiver	Leaf	07/26/2001	ND		ND	3		175	ND		2.5	2.5	3	0.5	175	0.5
B Vitiver leave base	Vetiver	Leaf	07/26/2001	27		ND	ND		1	ND		2.5	2.5	2.5	0.5	1	0.5
a vitiver root	Vetiver	Roots	07/26/2001	ND		2	ND		ND	1		2.5	2.5	2	0.5	0.5	1
B Vitiver root	Vetiver	Roots	07/26/2001	ND		27	1		ND	ND		2.5	2.5	27	0.5	0.5	0.5
SS soil pn C	Wetland		07/26/2001	ND		ND	ND		ND	ND		2.5	2.5	2.5	0.5	0.5	0.5
Box 5 grass soil	Wetland	Grass	07/26/2001	ND		ND	ND		1	0		2.5	2.5	2.5	0.5	1	0.5
Box 5 grass soil B	Wetland	Grass	07/26/2001	ND		0	ND		ND	ND		2.5	2.5	2.5	0.5	0.5	0.5
box 5 A grass leaves base	Wetland	Leaf	07/26/2001	ND		ND	ND		ND	12		2.5	2.5	2.5	0.5	0.5	12
box 5 A grass leaves	Wetland	Leaf	07/26/2001	ND		4807	ND		ND	13		2.5	2.5	4807	0.5	0.5	13
box 5 A leaves pn	Wetland	Leaf	07/26/2001	ND		ND	ND		ND	14		2.5	2.5	2.5	0.5	0.5	14

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
A leave base pn or pr	Wetland	Leaf	07/26/2001	ND		ND	ND		ND	19	2.5	2.5	2.5	2.5	0.5	0.5	19
SS leave base pn B	Wetland	Leaf	07/26/2001	ND		ND	1		ND	ND	2.5	2.5	2.5	1	0.5	0.5	0.5
SS grass leaves base box5 B	Wetland	Leaf	07/26/2001	ND		ND	ND		ND	ND	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS grass leaves box5 B	Wetland	Leaf	07/26/2001	ND		ND	ND		ND	ND	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS leaves pn box5 B	Wetland	Leaf	07/26/2001	ND		ND	ND		ND	ND	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS grass roots box5 B	Wetland	Roots	07/26/2001	ND		ND	ND		ND	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
box 5 A grass	Wetland	Roots	07/26/2001	ND	3	ND	ND		ND	13	2.5	2.5	3	2.5	0.5	0.5	13
A roots pn	Wetland	Roots	07/26/2001	ND		ND	3		ND	5	2.5	2.5	2.5	3	0.5	0.5	5
SS roots pn B	Wetland	Roots	07/26/2001	ND		ND	18		ND	ND	2.5	2.5	2.5	18	0.5	0.5	0.5
SS Pine 1 Core	Pine	Core	07/15/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 3 Core	Pine	Core	07/15/2002	0	0	0	<0.5	0	<0.5	0	2.5	2.5	2.5	0.25	0.5	0.3	0.5
SS Pine 2 Core	Pine	Core	07/15/2002	0	0	0	<0.5	0	<0.5	0	2.5	2.5	2.5	0.25	0.5	0.3	0.5
SS Pine 3 Core - B	Pine	Core	08/12/2002	0	0	0	1.5	0	1.3	1.8	2.5	2.5	2.5	1.5	0.5	1.3	1.8
SS Pine 3 Core - A	Pine	Core	08/12/2002	0	0	0	0	0	4.4	10.4	2.5	2.5	2.5	2.5	0.5	4.4	10.4
SS Pine 2 Core - B	Pine	Core	08/12/2002	0	0	0	3.8	0	5.0	11.6	2.5	2.5	2.5	3.8	0.5	5	11.6
SS Pine 1 Core - B	Pine	Core	08/12/2002	0	0	0	1.2	0	4.9	11.7	2.5	2.5	2.5	1.2	0.5	4.9	11.7
SS Pine 1 Core - A	Pine	Core	08/12/2002	0	0	0	1.3	0	2.5	5.2	2.5	2.5	2.5	1.3	0.5	2.5	5.2
SS Pine 2 Core - A	Pine	Core	08/12/2002	0	0	0	1.2	0	2.3	5.3	2.5	2.5	2.5	1.2	0.5	2.3	5.3
SS pine leaf - A	Pine	Leaf	06/03/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 1 Leaf - A	Pine	Leaf	07/15/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 3 Leaf - A	Pine	Leaf	07/15/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 2 Leaf - A	Pine	Leaf	07/15/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 1 Leaf - B	Pine	Leaf	07/15/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 3 Leaf - B	Pine	Leaf	07/15/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 2 Leaf - B	Pine	Leaf	07/15/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 2 Leaf - B	Pine	Leaf	08/12/2002	0	0	0	0	0	0.4	0.0	2.5	2.5	2.5	2.5	0.5	0.4	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Pine 1 Leaf - A	Pine	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.7	0.0	2.5	2.5	2.5	2.5	0.5	0.7	0.5
SS Pine 3 Leaf - A	Pine	Leaf	08/12/2002	0	0	0.0	0.0	0.0	1.1	0.0	2.5	2.5	2.5	2.5	0.5	1.1	0.5
SS Pine 2 Leaf - A	Pine	Leaf	08/12/2002	0	0	0.0	0.0	0.0	1.1	0.0	2.5	2.5	2.5	2.5	0.5	1.1	0.5
SS Pine 3 Leaf - B	Pine	Leaf	08/12/2002	0	0	0.0	0.0	0.0	10.6	0.0	2.5	2.5	2.5	2.5	0.5	11	0.5
SS Pine 1 Leaf - B	Pine	Leaf	08/12/2002	0	0	0.0	0.0	0.0	2.1	0.0	2.5	2.5	2.5	2.5	0.5	2.1	0.5
SS pine roots - A	Pine	Roots	06/03/2002	0	0	0	0	0	2.7	3.1	2.5	2.5	2.5	2.5	0.5	2.7	3.1
SS Pine 2 Root - A	Pine	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 1 Root - A	Pine	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 3 Root - A	Pine	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 2 Root - B	Pine	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 1 Root - B	Pine	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 3 Root - B	Pine	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 1 Root - A	Pine	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 1 Root - B	Pine	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.4	0.0	2.5	2.5	2.5	2.5	0.5	0.4	0.5
SS Pine 2 Root - A	Pine	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.6	0.0	2.5	2.5	2.5	2.5	0.5	0.6	0.5
SS Pine 2 Root - B	Pine	Roots	08/12/2002	0	0	0.0	0.0	0.0	1.3	0.0	2.5	2.5	2.5	2.5	0.5	1.3	0.5
SS Pine 3 Root - A	Pine	Roots	08/12/2002	0	0	0.0	0.0	0.0	1.9	2.3	2.5	2.5	2.5	2.5	0.5	1.9	2.3
SS Pine 3 Root - B	Pine	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.5	3.4	2.5	2.5	2.5	2.5	0.5	0.5	3.4
SS pine stem - A	Pine	Stem	06/03/2002	0	0	0	0	0	0.0	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 1 Stem - A	Pine	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 3 Stem - A	Pine	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 3 Stem - B	Pine	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pine 2 Stem - B	Pine	Stem	07/15/2002	0	0	0	1.4	0	<0.5	0.0	2.5	2.5	2.5	1.4	0.5	0.3	0.5
SS Pine 2 Stem - A	Pine	Stem	07/15/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Pine 1 Stem - B	Pine	Stem	07/15/2002	0	0	0	<0.5	0	<0.5	0.0	2.5	2.5	2.5	0.25	0.5	0.3	0.5
SS Pine 1 Stem - B	Pine	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.4	0.0	2.5	2.5	2.5	2.5	0.5	0.4	0.5
SS Pine 1 Stem - A	Pine	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.5	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Pine 3 Stem - B	Pine	Stem	08/12/2002	0	0	0.0	1.6	0.0	1.3	0.0	2.5	2.5	2.5	1.6	0.5	1.3	0.5
SS Pine 3 Stem - A	Pine	Stem	08/12/2002	0	0	1.5	2.1	0.0	2.6	0.0	2.5	2.5	1.5	2.1	0.5	2.6	0.5
SS Pine 2 Stem - A	Pine	Stem	08/12/2002	0	0	0.0	4.5	0.0	1.0	0.0	2.5	2.5	2.5	4.5	0.5	1	0.5
SS Pine 2 Stem - B	Pine	Stem	08/12/2002	0	0	0.0	4.7	0.0	2.1	0.5	2.5	2.5	2.5	4.7	0.5	2.1	0.5
SS Pop 3 Core	Poplar	Core	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Core	Poplar	Core	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Core	Poplar	Core	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Core - B	Poplar	Core	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Core - A	Poplar	Core	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Core - B	Poplar	Core	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Core - A	Poplar	Core	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Core - B	Poplar	Core	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Core - A	Poplar	Core	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS pop leaf - A	Poplar	Leaf	06/03/2002	0	0	0	0	0	3.4	BDL	2.5	2.5	2.5	2.5	0.5	3.4	0.5
SS pop leaf - B	Poplar	Leaf	06/03/2002	0	0	0	0	0	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Leaf - A	Poplar	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Leaf - A	Poplar	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Leaf - A	Poplar	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Leaf - B	Poplar	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Leaf - B	Poplar	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Leaf - B	Poplar	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Leaf - A	Poplar	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Leaf - B	Poplar	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Leaf - B	Poplar	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.5	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Leaf - B	Poplar	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.6	0.0	2.5	2.5	2.5	2.5	0.5	0.6	0.5
SS Pop 3 Leaf - A	Poplar	Leaf	08/12/2002	0	0	0.0	0.0	1.6	0.7	0.0	2.5	2.5	2.5	2.5	1.6	0.7	0.5
SS Pop 1 Leaf - A	Poplar	Leaf	08/12/2002	0	0	0.0	0.0	2.4	0.0	0.0	2.5	2.5	2.5	2.5	2.4	0.5	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS pop roots - A	Poplar	Roots	06/03/2002	0	0	0	0	0	4.3	3.8	2.5	2.5	2.5	2.5	0.5	4.3	3.8
SS pop roots - B	Poplar	Roots	06/03/2002	0	0	0	0	0	<4	<4	2.5	2.5	2.5	2.5	0.5	2	2
SS Pop 2 Root - A	Poplar	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Root - B	Poplar	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Root - B	Poplar	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Root - B	Poplar	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Root - A	Poplar	Roots	07/15/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Pop 3 Root - A	Poplar	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Root - A	Poplar	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Root - B	Poplar	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Root - B	Poplar	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Root - B	Poplar	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Root - A	Poplar	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.5	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS pop stem - B	Poplar	Stem	06/03/2002	0	0	0	0	0	<4	<4	2.5	2.5	2.5	2.5	0.5	2	2
SS pop stem - A	Poplar	Stem	06/03/2002	0	0	0	0	0	0.0	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Stem - A	Poplar	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Stem - A	Poplar	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Stem - B	Poplar	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 2 Stem - B	Poplar	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Stem - B	Poplar	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Stem - A	Poplar	Stem	07/15/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Pop 3 Stem - B	Poplar	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 1 Stem - B	Poplar	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Pop 3 Stem - A	Poplar	Stem	08/12/2002	0	0	0.0	0.4	0.0	0.0	0.0	2.5	2.5	2.5	0.4	0.5	0.5	0.5
SS Pop 2 Stem - B	Poplar	Stem	08/12/2002	0	0	0.0	0.7	0.0	0.6	0.0	2.5	2.5	2.5	0.7	0.5	0.6	0.5
SS Pop 1 Stem - A	Poplar	Stem	08/12/2002	0	0	0.0	1.0	0.0	0.0	0.0	2.5	2.5	2.5	1	0.5	0.5	0.5
SS Pop 2 Stem - A	Poplar	Stem	08/12/2002	0	0	0.0	1.7	0.0	0.6	0.0	2.5	2.5	2.5	1.7	0.5	0.6	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS vet base - A	Vetiver	Base	06/03/2002	0	0	0	0	0	0.0	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS vet base - B	Vetiver	Base	06/03/2002	0	0	0	0	0	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 6 Leaf - A	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Leaf - A	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Leaf - A	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 3 Leaf - A	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Leaf - A	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Leaf - A	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 6 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 3 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 6 Leaf - B	Vetiver	Leaf	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Leaf - B	Vetiver	Leaf	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Leaf - B	Vetiver	Leaf	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 3 Leaf - B	Vetiver	Leaf	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Leaf - B	Vetiver	Leaf	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Leaf - B	Vetiver	Leaf	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Leaf - A	Vetiver	Leaf	08/12/2002	0	0	0	0.0	13.3	0.0	0.0	2.5	2.5	2.5	2.5	13.3	0.5	0.5
SS Vet 5 Leaf - A	Vetiver	Leaf	08/12/2002	0	0	0	0.0	2.1	0.0	0.0	2.5	2.5	2.5	2.5	2.1	0.5	0.5
SS Vet 6 Leaf - A	Vetiver	Leaf	08/12/2002	0	0	0	0.0	2.4	0.0	0.0	2.5	2.5	2.5	2.5	2.4	0.5	0.5
SS Vet 3 Leaf - A	Vetiver	Leaf	08/12/2002	0	0	0	0.0	3.6	0.0	0.0	2.5	2.5	2.5	2.5	3.6	0.5	0.5
SS Vet 2 Leaf - A	Vetiver	Leaf	08/12/2002	0	0	0	0.0	4.9	0.0	0.0	2.5	2.5	2.5	2.5	4.9	0.5	0.5
SS Vet 4 Leaf - B	Vetiver	Leaf	08/12/2002	0	0	0	0.0	5.0	0.0	0.0	2.5	2.5	2.5	2.5	5	0.5	0.5
SS Vet 1 Leaf - B	Vetiver	Leaf	08/12/2002	0	0	0	0.0	8.8	0.0	0.0	2.5	2.5	2.5	2.5	8.8	0.5	0.5
SS Vet 4 Leaf - A	Vetiver	Leaf	08/12/2002	0	0	0	0.0	9.3	0.9	0.0	2.5	2.5	2.5	2.5	9.3	0.9	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS vet roots - A	Vetiver	Roots	06/03/2002	0	0	0	0	0	5.9	1.5	2.5	2.5	2.5	2.5	0.5	5.9	1.5
SS vet roots - B	Vetiver	Roots	06/03/2002	0	0	0	0	0	<4	<4	2.5	2.5	2.5	2.5	0.5	2	2
SS Vet 6 Root - A	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Root - A	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Root - A	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 3 Root - A	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Root - A	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Root - A	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Root - B	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Root - B	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	<0.5	2.5	2.5	2.5	2.5	0.5	0.5	0.25
SS Vet 5 Root - B	Vetiver	Roots	07/15/2002	0	0	0	0.0	0	0.0	<0.5	2.5	2.5	2.5	2.5	0.5	0.5	0.25
SS Vet 2 Root - A	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Root - A	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 6 Root - B	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Root - B	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Root - B	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 3 Root - B	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Root - B	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Root - B	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Root - A	Vetiver	Roots	08/12/2002	0	0	0	0.0	0	1.6	0.0	2.5	2.5	2.5	2.5	0.5	1.6	0.5
SS Vet 6 Root - A	Vetiver	Roots	08/12/2002	0	0	0	0.0	2.9	0.0	0.0	2.5	2.5	2.5	2.5	2.9	0.5	0.5
SS Vet 5 Root - A	Vetiver	Roots	08/12/2002	0	0	0	0.0	4.2	0.0	0.0	2.5	2.5	2.5	2.5	4.2	0.5	0.5
SS Vet 3 Root - A	Vetiver	Roots	08/12/2002	0	0	0	0.0	0.0	0.0	1.8	2.5	2.5	2.5	2.5	0.5	0.5	1.8

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Vet 6 Stem - A	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Stem - A	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Stem - A	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 3 Stem - A	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Stem - A	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Stem - B	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 1 Stem - A	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 6 Stem - B	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Stem - B	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Stem - B	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 3 Stem - B	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Stem - B	Vetiver	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Stem - B	Vetiver	Stem	07/15/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Vet 6 Stem - A	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Stem - A	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 6 Stem - B	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Stem - B	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 4 Stem - B	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 2 Stem - B	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Vet 5 Stem - B	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	<0.5	2.5	2.5	2.5	2.5	0.5	0.3	0.5
SS Vet 3 Stem - B	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	0.4	0.5	0.5	0.5
SS Vet 1 Stem - B	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	0.4	0.5	0.5	0.5
SS Vet 3 Stem - A	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	1	0.5	0.5	0.5
SS Vet 4 Stem - A	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.6	2.5	2.5	2.5	1	0.5	0.6	0.5
SS Vet 5 Stem - A	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	1.2	0.5	0.5	0.5
SS Vet 1 Stem - A	Vetiver	Stem	08/12/2002	0	0	0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	1.3	1.1	0.5	0.5
SS vet tips - A	Vetiver	Tips	06/03/2002	0	0	0	0	0	12.7	0.0	2.5	2.5	2.5	2.5	0.5	13	0.5
SS vet tips - B	Vetiver	Tips	06/03/2002	0	0	0	0	0	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS wet leaf - A	Wetland	Leaf	06/03/2002	0	0	0	0	0	0.0	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS wet leaf - B	Wetland	Leaf	06/03/2002	0	0	0	0	0	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 3 Leaf - A	Wetland	Leaf	07/15/2002	0	0	0.0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Leaf - A	Wetland	Leaf	07/15/2002	0	0	0.0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Leaf - A	Wetland	Leaf	07/15/2002	0	0	0.0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 3 Leaf - B	Wetland	Leaf	07/15/2002	0	0	0.0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Leaf - B	Wetland	Leaf	07/15/2002	0	0	0.0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Leaf - B	Wetland	Leaf	07/15/2002	0	0	0.0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 3 Leaf - A	Wetland	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Leaf - A	Wetland	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Leaf - A	Wetland	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 3 Leaf - B	Wetland	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Leaf - B	Wetland	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Leaf - B	Wetland	Leaf	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS wet roots - A	Wetland	Roots	06/03/2002	0	0	0	0	0	0.0	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS wet roots - B	Wetland	Roots	06/03/2002	0	0	0	0	0	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Root - B	Wetland	Roots	07/15/2002	0	0	0.0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Root - A	Wetland	Roots	07/15/2002	0	0	2.6	0	0	0.0	0.0	2.5	2.5	2.5	2.6	0.5	0.5	0.5
SS Wet 3 Root - B	Wetland	Roots	07/15/2002	0	0	20.5	0	0	<0.5	0.0	2.5	2.5	2.5	20.5	0.5	0.3	0.5
SS Wet 3 Root - A	Wetland	Roots	07/15/2002	0	0	21.8	0	0	0.0	0.0	2.5	2.5	2.5	21.8	0.5	0.5	0.5
SS Wet 2 Root - B	Wetland	Roots	07/15/2002	0	0	3.6	0	0	<0.5	0.0	2.5	2.5	2.5	3.6	0.5	0.3	0.5
SS Wet 1 Root - A	Wetland	Roots	07/15/2002	0	0	<0.5	0	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Wet 2 Root - B	Wetland	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Root - B	Wetland	Roots	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Root - A	Wetland	Roots	08/12/2002	0	0	0.0	0.0	0.0	2.0	0.0	2.5	2.5	2.5	2.5	0.5	2	0.5
SS Wet 2 Root - A	Wetland	Roots	08/12/2002	0	0	0.0	0.8	0.0	<0.5	0.0	2.5	2.5	2.5	0.8	0.5	0.3	0.5

Plant Material Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Wet 3 Root - A	Wetland	Roots	08/12/2002	0	0	0.0	1.1	0.0	0.0	0.0	2.5	2.5	2.5	1.1	0.5	0.5	0.5
SS Wet 3 Root - B	Wetland	Roots	08/12/2002	0	0	0.0	0.9	0.0	0.0	0.4	2.5	2.5	2.5	0.9	0.5	0.5	0.4
SS wet stem - A	Wetland	Stem	06/03/2002	0	0	0	0	0	0.0	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS wet stem - B	Wetland	Stem	06/03/2002	0	0	0	0	0	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Stem - A	Wetland	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Stem - B	Wetland	Stem	07/15/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Stem - A	Wetland	Stem	07/15/2002	0	0	0	0.0	0	<0.5	0.0	2.5	2.5	2.5	2.5	0.5	0.3	0.5
SS Wet 3 Stem - A	Wetland	Stem	07/15/2002	0	0	0	2.3	0	0.0	0.0	2.5	2.5	2.5	2.3	0.5	0.5	0.5
SS Wet 3 Stem - B	Wetland	Stem	07/15/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Wet 1 Stem - B	Wetland	Stem	07/15/2002	0	0	0	<0.5	0	<0.5	0.0	2.5	2.5	2.5	0.25	0.5	0.3	0.5
SS Wet 3 Stem - A	Wetland	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Stem - A	Wetland	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 3 Stem - B	Wetland	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 1 Stem - B	Wetland	Stem	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Wet 2 Stem - A	Wetland	Stem	08/12/2002	0	0	0.0	0.8	0.0	1.4	0.0	2.5	2.5	2.5	0.8	0.5	1.4	0.5
SS Wet 2 Stem - B	Wetland	Stem	08/12/2002	0	0	0.0	0.0	2.7	0.0	0.0	2.5	2.5	2.5	2.5	2.7	0.5	0.5

Appendix G

Soil Sample Date File

Soil Sample Data File (µg/kg)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
BOX 1, DEEP, A	Pine	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	*<2	2.5	2.5	2.5	2.5	0.5	0.5	1
BOX 1, DEEP, B	Pine	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	*<2	2.5	2.5	2.5	2.5	0.5	0.5	1
REP 1 SOIL	Pine	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	3	BDL	2.5	2.5	2.5	2.5	0.5	3	0.5
BOX 1 BD	Pine	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 1 AD	Pine	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 1 SHALLOW B	Pine	Shallow	12/31/2001	BDL	BDL	*<5	*<5	*<5	11	2	2.5	2.5	2.5	2.5	2.5	11	2
BOX 1 SHALLOW A	Pine	Shallow	12/31/2001	BDL	BDL	BDL	*<5	*<5	5	<1	2.5	2.5	2.5	2.5	2.5	5	0.5
BOX1 SOILB	Pine	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	2	BDL	2.5	2.5	2.5	2.5	0.5	2	0.5
BOX 1, SHALLOW, A	Pine	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 1, SHALLOW, B	Pine	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 1 BS	Pine	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 1 AS 4/28/00	Pine	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX1 SOIL A	Pine	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2 DEEP	Poplar	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	18	10	2.5	2.5	2.5	2.5	0.5	18	10
BOX 2, DEEP, A	Poplar	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2, DEEP, B	Poplar	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2 BD	Poplar	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2 AD	Poplar	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX2	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	6	2	2.5	2.5	2.5	2.5	0.5	6	2

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
BOX2 SOIL B	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2 SHALLOW A	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2, SHALLOW, B	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2, SHALLOW, A	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2, SHALLOW, B	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2 BS	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2 AS	Poplar	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3, DEEP, A	Soil Control	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	1
BOX 3, DEEP, A	Soil Control	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	3	2	2.5	2.5	2.5	2.5	0.5	3	2
BOX 3, DEEP, B	Soil Control	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	4	3	2.5	2.5	2.5	2.5	0.5	4	3
BOX 3, DEEP, B	Soil Control	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3 BD	Soil Control	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3 AD	Soil Control	Deep	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3, SHALLOW, A	Soil Control	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3, SHALLOW, B	Soil Control	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3, SHALLOW, A	Soil Control	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3, SHALLOW, B	Soil Control	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5

Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
BOX 3 BS	Soil Control	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 3 AS	Soil Control	Shallow	12/31/2001	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
soil pine	Pine		07/26/2001	ND		ND	10		ND	0	2.5	2.5	2.5	10	0.5	0.5	0.5
A pine soil	Pine		07/26/2001	ND		1	1		ND	1	2.5	2.5	1	1	0.5	0.5	1
SS pine soil B	Pine		07/26/2001	ND		ND	ND		ND	ND	2.5	2.5	2.5	2.5	0.5	0.5	0.5
Box # 1 Deep C	Pine	Deep	05/23/2001				< 20		19.32	18.05	2.5	2.5	2.5	10	0.5	19.3	18.05
Box # 1 Deep B	Pine	Deep	05/23/2001				< 20		19.9	21.66	2.5	2.5	2.5	10	0.5	19.9	21.66
Box 1, Deep, SS, A	Pine	Deep	05/23/2001				BDL		36	40	2.5	2.5	2.5	2.5	0.5	36	40
SS Box #1 Deep A	Pine	Deep	06/20/2001				< 20		< 5.0	< 5.0	2.5	2.5	2.5	10	0.5	2.5	2.5
SS Box #1 Deep B	Pine	Deep	06/20/2001				ND		ND	ND							
SS Box # 1 Soil Deep B	Pine	Deep	07/09/2001								2.5	2.5	2.5	2.5	0.5	0.5	0.5
Box # 1 Deep (D)	Pine	Deep	04/01/2002		0.87		17.26		28.59	11.86	2.5	0.87	2.5	17.3	0.5	28.6	11.86
Box # 1 Deep (C)	Pine	Deep	04/01/2002		0.66		0.46		6.96	13.65	2.5	0.66	2.5	0.46	0.5	6.96	13.65
Box # 1 Deep (A)	Pine	Deep	04/01/2002		1.57		1.11		ND	ND	2.5	1.57	2.5	1.11	0.5	0.5	0.5
Box # 1 Deep (B)	Pine	Deep	04/01/2002		0.28		4.31		5.66	ND	2.5	0.28	2.5	4.31	0.5	5.66	0.5
Box # 1 Shallow C	Pine	Shallow	05/23/2001				< 20		24.3	13.68	2.5	2.5	2.5	10	0.5	24.3	13.68
Box # 1 Shallow B	Pine	Shallow	05/23/2001				< 20		15.23	8.91	2.5	2.5	2.5	10	0.5	15.2	8.91
Box 1, Shallow, SS, A	Pine	Shallow	05/23/2001				BDL		< 5	< 5	2.5	2.5	2.5	2.5	0.5	2.5	2.5
SS Box #1 Shallow B	Pine	Shallow	06/20/2001				< 20		< 5.0	< 5.0	2.5	2.5	2.5	10	0.5	2.5	2.5
SS Box #1 Shallow A	Pine	Shallow	06/21/2001				< 20		< 5.0	< 5.0	2.5	2.5	2.5	10	0.5	2.5	2.5

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box # 1 Soil Shallow B	Pine	Shallow	07/09/2001									2.5	2.5	2.5	0.5	0.5	0.5
Box # 1 Shallow (C)	Pine	Shallow	04/01/2002		1.55		1.38		1.43	0.24		1.55	2.5	1.38	0.5	1.43	0.24
Box # 1 Shallow (A)	Pine	Shallow	04/01/2002		1.79		4.52		1.28	0.32		1.79	2.5	4.52	0.5	1.28	0.32
Box # 1 Shallow (D)	Pine	Shallow	04/01/2002		1.46		8.63		5.66	3.4		1.46	2.5	8.63	0.5	5.66	3.4
Box # 1 Shallow (B)	Pine	Shallow	04/01/2002		2.05		4.31		ND	ND		2.05	2.5	4.31	0.5	0.5	0.5
a poplar soil	Poplar		07/26/2001	ND		ND	ND		ND	2		2.5	2.5	2.5	0.5	0.5	2
B Poplar Soil	Poplar		07/26/2001	4	0	ND	ND		ND	ND		2.5	2.5	2.5	0.5	0.5	0.5
SS poplar soil C	Poplar		07/26/2001	ND		ND	ND		ND	ND		2.5	2.5	2.5	0.5	0.5	0.5
Box # 2 Deep C	Poplar	Deep	05/23/2001				< 20		21.08	16.83		2.5	2.5	10	0.5	21.1	16.83
Box # 2 Deep B	Poplar	Deep	05/23/2001				< 20		24.71	22.59		2.5	2.5	10	0.5	24.7	22.59
Box 2, Deep, SS, A	Poplar	Deep	05/23/2001				BDL		BDL	BDL		2.5	2.5	2.5	0.5	0.5	0.5
SS Box #2 deep B	Poplar	Deep	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5
SS Box #2 Deep A	Poplar	Deep	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5
SS Box # 2 Soil Deep B	Poplar	Deep	07/09/2001									2.5	2.5	2.5	0.5	0.5	0.5
Box # 2 Deep (C)	Poplar	Deep	04/01/2002		1.57		2.03		1.26	0.4		1.57	2.5	2.03	0.5	1.26	0.4
Box # 2 Deep (B)	Poplar	Deep	04/01/2002		BDL		7.53		6.49	11.33		2.5	2.5	7.53	0.5	6.49	11.33
Box # 2 Deep (A)	Poplar	Deep	04/01/2002		1.68		3.04		ND	ND		1.68	2.5	3.04	0.5	0.5	0.5
Box # 2 Deep (D)	Poplar	Deep	04/01/2002		0.28		8.63		5.68	ND		0.28	2.5	8.63	0.5	5.68	0.5
Box # 2 Shallow B	Poplar	Shallow	05/23/2001				< 20		11.89	7.73		2.5	2.5	10	0.5	11.9	7.73
Box # 2 Shallow C	Poplar	Shallow	05/23/2001				< 20		12.16	8.55		2.5	2.5	10	0.5	12.2	8.55

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
Box 2, Shallow, SS, A	Poplar	Shallow	05/23/2001				<5		BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box #2 Shallow A	Poplar	Shallow	06/20/2001				<20		<5.0	<5.0	2.5	2.5	2.5	10	0.5	2.5	2.5
SS Box # 2 Soil Shallow B	Poplar	Shallow	07/09/2001								2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box #2 Shallow B	Poplar	Shallow	12/31/2001				ND		ND	ND							
Box # 2 Shallow (A)	Poplar	Shallow	04/01/2002		1.74		1.57		1.26	0.56	2.5	1.74	2.5	1.57	0.5	1.26	0.56
Box # 2 Shallow (D)	Poplar	Shallow	04/01/2002		3.23		10.07		ND	ND	2.5	3.23	2.5	10.1	0.5	0.5	0.5
Box # 2 Shallow (C)	Poplar	Shallow	04/01/2002		1.55		2.03		ND	ND	2.5	1.55	2.5	2.03	0.5	0.5	0.5
Box # 2 Shallow (B)	Poplar	Shallow	04/01/2002		2.05		4.31		ND	ND	2.5	2.05	2.5	4.31	0.5	0.5	0.5
Box # 3 Deep C	Soil Control	Deep	05/23/2001				<20		11.87	24.28	2.5	2.5	2.5	10	0.5	11.9	24.28
Box # 3 Deep B	Soil Control	Deep	05/23/2001				<20		11.75	7.35	2.5	2.5	2.5	10	0.5	11.8	7.35
Box 3, Deep, SS, A	Soil Control	Deep	05/23/2001				BDL		BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box #3 Deep A	Soil Control	Deep	06/20/2001				<20		20	13	2.5	2.5	2.5	10	0.5	20	13
SS Box #3 Deep B	Soil Control	Deep	06/20/2001				<20		<5.0	<5.0	2.5	2.5	2.5	10	0.5	2.5	2.5
SS Box # 3 Soil Deep B	Soil Control	Deep	07/09/2001								2.5	2.5	2.5	2.5	0.5	0.5	0.5
Box # 3 Deep (C)	Soil Control	Deep	04/01/2002		1.66		0.55		1.28	0.24	2.5	1.66	2.5	0.55	0.5	1.28	0.24
Box # 3 Deep (A)	Soil Control	Deep	04/01/2002		1.79		5.44		1.26	0.32	2.5	1.79	2.5	5.44	0.5	1.26	0.32
Box # 3 Deep (D)	Soil Control	Deep	04/01/2002		0.28		8.06		5.68	1.11	2.5	0.28	2.5	8.06	0.5	5.68	1.11
Box # 3 Deep (B)	Soil Control	Deep	04/01/2002		0.87		5.75		5.98	10.28	2.5	0.87	2.5	5.75	0.5	5.98	10.28
Box # 3 Shallow C	Soil Control	Shallow	05/23/2001				<20		11.85	7.54	2.5	2.5	2.5	10	0.5	11.9	7.54

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj	
Box # 3 Shallow B	Soil Control	Shallow	05/23/2001				< 20		11.27	8.48		2.5	2.5	10	0.5	11.3	8.48	
Box 3, Shallow, SS, A	Soil Control	Shallow	05/23/2001				BDL		BDL	BDL		2.5	2.5	2.5	0.5	0.5	0.5	
SS Box #3 Shallow A	Soil Control	Shallow	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5	
SS Box #3 Shallow B	Soil Control	Shallow	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5	
SS Box # 3 Soil Shallow B	Soil Control	Shallow	07/09/2001									2.5	2.5	2.5	0.5	0.5	0.5	
Box # 3 Shallow (C)	Soil Control	Shallow	04/01/2002		1.44		0.65		1.33	0.24		2.5	1.44	2.5	0.65	0.5	1.33	0.24
Box # 3 Shallow (D)	Soil Control	Shallow	04/01/2002		2.05		10.07		ND	0.42		2.5	2.05	10.1	0.5	0.5	0.5	0.42
Box # 3 Shallow (A)	Soil Control	Shallow	04/01/2002		1.6		0.46		1.28	0.63		2.5	1.6	0.46	0.5	1.28	0.63	
Box # 3 Shallow (B)	Soil Control	Shallow	04/01/2002		BDL		4.31		5.71	1.32		2.5	2.5	4.31	0.5	5.71	1.32	
a vitiver soil	Vetiver		07/26/2001	ND		ND	ND		ND	1		2.5	2.5	2.5	0.5	0.5	1	
B Vitiver leave soil	Vetiver		07/26/2001	ND		1	ND		ND	ND		2.5	2.5	1	0.5	0.5	0.5	
B Vitiver soil	Vetiver		07/26/2001	ND		ND	ND		ND	ND		2.5	2.5	2.5	0.5	0.5	0.5	
Box 4, Deep, SS, A	Vetiver	Deep	05/23/2001				41		BDL	< 5		2.5	2.5	41	0.5	0.5	2.5	
Box # 4 Deep B	Vetiver	Deep	05/23/2001				< 20		BDL	BDL		2.5	2.5	10	0.5	0.5	0.5	
Box # 4 Deep C	Vetiver	Deep	05/23/2001				ND		ND	ND								
SS Box #4 Deep B	Vetiver	Deep	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5	
SS Box #4 Deep A	Vetiver	Deep	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5	
SS Box # 4 Soil Deep B	Vetiver	Deep	07/09/2001				*					2.5	2.5	2.5	0.5	0.5	0.5	

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
Box # 4 Deep (D)	Vetiver	Deep	04/01/2002		3.23		7.19		ND	0.21		3.23	2.5	7.19	0.5	0.5	0.21
Box # 4 Deep (A)	Vetiver	Deep	04/01/2002		2.1		1.57		ND	0.24		2.1	2.5	1.57	0.5	0.5	0.24
Box # 4 Deep (B)	Vetiver	Deep	04/01/2002		0.87		5.75		5.98	4.17		0.87	2.5	5.75	0.5	5.98	4.17
Box # 4 Deep (C)	Vetiver	Deep	04/01/2002		1.49		0.46		ND	ND		1.49	2.5	0.46	0.5	0.5	0.5
Box # 4 Shallow B	Vetiver	Shallow	05/23/2001				< 20		10.07	6.3		2.5	2.5	10	0.5	10.1	6.3
Box # 4 Shallow C	Vetiver	Shallow	05/23/2001				< 20		11.98	8.01		2.5	2.5	10	0.5	12	8.01
Box 4, Shallow, SS, A	Vetiver	Shallow	05/23/2001				BDL		BDL	BDL		2.5	2.5	2.5	0.5	0.5	0.5
SS Box #4 Shallow A	Vetiver	Shallow	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5
SS Box #4 Shallow B	Vetiver	Shallow	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5
SS Box # 4 Soil Shallow B	Vetiver	Shallow	07/09/2001									2.5	2.5	2.5	0.5	0.5	0.5
Box # 4 Shallow (A)	Vetiver	Shallow	04/01/2002		1.63		0.46		ND	0.24		1.63	2.5	0.46	0.5	0.5	0.24
Box # 4 Shallow (C)	Vetiver	Shallow	04/01/2002		1.44		1.38		1.26	0.32		1.44	2.5	1.38	0.5	1.26	0.32
Box # 4 Shallow (D)	Vetiver	Shallow	04/01/2002		3.82		5.75		ND	ND		3.82	2.5	5.75	0.5	0.5	0.5
Box # 4 Shallow (B)	Vetiver	Shallow	04/01/2002		2.64		8.63		5.68	ND		2.64	2.5	8.63	0.5	5.68	0.5
Box 5, Deep, SS, A	Wetland	Deep	05/23/2001				< 5		BDL	BDL		2.5	2.5	2.5	0.5	0.5	0.5
Box # 5 Deep B	Wetland	Deep	05/23/2001				ND		ND	ND							
Box # 5 Deep C	Wetland	Deep	05/23/2001				ND		ND	ND							
SS Box #5 Deep A	Wetland	Deep	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5
SS Box #5 Deep B	Wetland	Deep	06/20/2001				< 20		< 5.0	< 5.0		2.5	2.5	10	0.5	2.5	2.5

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c-DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box # 5 Soil Deep B	Wetland	Deep	07/09/2001								2.5	2.5	2.5	2.5	0.5	0.5	0.5
Box # 5 Deep (D)	Wetland	Deep	04/01/2002		BCL		0.16		6.17	0.18	2.5	2.5	2.5	0.16	0.5	6.17	0.18
Box # 5 Deep (B)	Wetland	Deep	04/01/2002		0.87		10.07		5.71	3.75	2.5	0.87	2.5	10.1	0.5	5.71	3.75
Box # 5 Deep (A)	Wetland	Deep	04/01/2002		1.55		3.78		3.71	5	2.5	1.55	2.5	3.78	0.5	3.71	5
Box # 5 Deep (C)	Wetland	Deep	04/01/2002		1.68		0.74		1.32	5.16	2.5	1.68	2.5	0.74	0.5	1.32	5.16
SS Box #5 Shallow A	Wetland	Shallow	06/20/2001				< 20		< 5.0	< 5.0	2.5	2.5	2.5	10	0.5	2.5	2.5
SS Box #5 Shallow B	Wetland	Shallow	06/20/2001				< 20 *		< 5.0	< 5.0	2.5	2.5	2.5	10	0.5	2.5	2.5
SS Box # 5 Soil Shallow B	Wetland	Shallow	07/09/2001								2.5	2.5	2.5	2.5	0.5	0.5	0.5
Box 1 SS Soil Deep A	Pine	Deep	04/03/2002	0	0	0	<8	<8	12.1	14.3	2.5	2.5	2.5	4	4	12.1	14.3
Box 1 SS Soil Deep B	Pine	Deep	04/03/2002	0	0	0	<8	<8	19.3	22	2.5	2.5	2.5	4	4	19.3	22
Box 1 Soil Deep	Pine	Deep	05/06/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 1 (d)	Pine	Deep	06/03/2002	0	0	0	0	0	BDL	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 1 D - A	Pine	Deep	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 1 D - B	Pine	Deep	07/10/2002	0	0	0	<0.5	0	2.9	0.0	2.5	2.5	2.5	0.25	0.5	2.9	0.5
SS Box 1 D - B	Pine	Deep	08/12/2002	0	0	0.0	5.4	0.0	3.2	0.7	2.5	2.5	2.5	5.4	0.5	3.2	0.7
SS Box 1 D - A	Pine	Deep	08/12/2002	0	0	0.0	5.5	0.0	4.1	1.7	2.5	2.5	2.5	5.5	0.5	4.1	1.7
Box 1 SS Soil Shallow A	Pine	Shallow	04/03/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
Box 1 SS Soil Shallow B	Pine	Shallow	04/03/2002	0	0	0	0	<8	<8	<8	2.5	2.5	2.5	2.5	4	4	4
Box 1 Soil Shallow	Pine	Shallow	05/06/2002	0	0	0	0	0	1.8	<1.25	2.5	2.5	2.5	2.5	0.5	1.8	0.625

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box 1 (s)	Pine	Shallow	06/03/2002	0	0	0	0	0	2.9	<4	2.5	2.5	2.5	2.5	0.5	2.9	2
SS Box 1 S - B	Pine	Shallow	07/10/2002	0	0	0	0.6	0	4.0	0.0	2.5	2.5	2.5	0.6	0.5	4	0.5
SS Box 1 S - A	Pine	Shallow	07/10/2002	0	0	0	3.0	0	0.0	0.0	2.5	2.5	2.5	3	0.5	0.5	0.5
SS Box 1 S - A	Pine	Shallow	08/12/2002	0	0	0.0	<0.5	0.0	<0.5	0.0	2.5	2.5	2.5	0.25	0.5	0.25	0.5
SS Box 1 S - B	Pine	Shallow	08/12/2002	0	0	0.0	<0.5	0.0	<0.5	0.0	2.5	2.5	2.5	0.25	0.5	0.25	0.5
Box 2 SS Soil Deep A	Poplar	Deep	04/03/2002	0	0	0	0	<8	<8	<8	2.5	2.5	2.5	2.5	4	4	4
Box 2 SS Soil Deep B	Poplar	Deep	04/03/2002	0	0	0	0	<8	<8	<8	2.5	2.5	2.5	2.5	4	4	4
Box 2 Soil Deep	Poplar	Deep	05/06/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 2 (d)	Poplar	Deep	06/03/2002	0	0	0	0	0	<4	BDL	2.5	2.5	2.5	2.5	0.5	2	0.5
SS Box 2 D - A	Poplar	Deep	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 2 D - B	Poplar	Deep	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 2 D - B	Poplar	Deep	08/12/2002	0	0	0.0	4.9	0.0	0.5	0.0	2.5	2.5	2.5	4.9	0.5	0.5	0.5
SS Box 2 D - A	Poplar	Deep	08/12/2002	0	0	0.0	4.9	0.0	<0.5	<0.5	2.5	2.5	2.5	4.9	0.5	0.25	0.25
Box 2 SS Soil Shallow A	Poplar	Shallow	04/03/2002	0	0	0	0	<8	0	0.0	2.5	2.5	2.5	2.5	4	0.5	0.5
Box 2 SS Soil Shallow B	Poplar	Shallow	04/03/2002	0	0	0	0	<8	<8	<8	2.5	2.5	2.5	2.5	4	4	4
Box 2 Soil Shallow	Poplar	Shallow	05/06/2002	0	0	0	0	0	<1.25	<1.25	2.5	2.5	2.5	2.5	0.5	0.63	0.625
SS Box 2 (s)	Poplar	Shallow	06/03/2002	0	0	0	0	0	<4	BDL	2.5	2.5	2.5	2.5	0.5	2	0.5
SS Box 2 S - A	Poplar	Shallow	07/10/2002	0	0	0	6.9	0	0.0	0.0	2.5	2.5	2.5	6.9	0.5	0.5	0.5
SS Box 2 S - B	Poplar	Shallow	07/10/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box 2 S - B	Poplar	Shallow	08/12/2002	0	0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 2 S - A	Poplar	Shallow	08/12/2002	0	0	0.0	<0.5	0.0	<0.5	<0.5	2.5	2.5	2.5	0.25	0.5	0.25	0.25
Box 3 SS Soil Deep B	Soil Control	Deep	04/03/2002	0	0	0	15.1	<8	<8	6.8	2.5	2.5	2.5	15.1	4	4	6.8
Box 3 SS Soil Deep A	Soil Control	Deep	04/03/2002	0	0	0	<8	<8	<8	<8	2.5	2.5	2.5	4	4	4	4
Box 3 Soil Deep	Soil Control	Deep	05/06/2002	0	0	0	0	0	0	<1.25	2.5	2.5	2.5	2.5	0.5	0.5	0.625
SS Box 3 (d)	Soil Control	Deep	06/03/2002	0	0	0	0	0	<4	<4	2.5	2.5	2.5	2.5	0.5	2	2
SS Box 3 D - A	Soil Control	Deep	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 3 D - B	Soil Control	Deep	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 3 D - A	Soil Control	Deep	08/12/2002	0	0	0.0	2.7	0.0	<0.5	<0.5	2.5	2.5	2.5	2.7	0.5	0.25	0.25
SS Box 3 D - B	Soil Control	Deep	08/12/2002	0	0	0.3	2.8	0.0	0.0	<0.5	2.5	2.5	0.3	2.8	0.5	0.5	0.25
Box 3 SS Soil Shallow A	Soil Control	Shallow	04/03/2002	0	0	0	0	<8	<8	<8	2.5	2.5	2.5	2.5	4	4	4
Box 3 SS Soil Shallow B	Soil Control	Shallow	04/03/2002	0	0	0	0	<8	<8	<8	2.5	2.5	2.5	2.5	4	4	4
Box 3 Soil Shallow	Soil Control	Shallow	05/06/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 3 (s)	Soil Control	Shallow	06/03/2002	0	0	0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 3 S - A	Soil Control	Shallow	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 3 S - B	Soil Control	Shallow	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 3 S - A	Soil Control	Shallow	08/12/2002	0	0	0.0	0.0	0.0	0.7	<0.5	2.5	2.5	2.5	2.5	0.5	0.7	0.25
SS Box 3 S - B	Soil Control	Shallow	08/12/2002	0	0	0.0	0.0	0.0	0.9	<0.5	2.5	2.5	2.5	2.5	0.5	0.9	0.25

Soil Sample Data File (µg/kg) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
Box 4 SS Soil Deep A	Vetiver	Deep	04/03/2002	0	0	0	7.9	<8	0	0.0	2.5	2.5	2.5	7.9	4	0.5	0.5
Box 4 SS Soil Deep B	Vetiver	Deep	04/03/2002	0	0	0	<8	<8	0	0.0	2.5	2.5	2.5	4	4	0.5	0.5
Box 4 Soil Deep	Vetiver	Deep	05/06/2002	0	0	0	4.2	0	<1.25	<1.25	2.5	2.5	2.5	4.2	0.5	0.63	0.625
SS Box 4 (d)	Vetiver	Deep	06/03/2002	0	0	0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 4 D - B	Vetiver	Deep	07/10/2002	0	0	0	12.8	0	1.1	0.0	2.5	2.5	2.5	12.8	0.5	1.1	0.5
SS Box 4 D - A	Vetiver	Deep	07/10/2002	0	0	0	5.1	0	0.0	0.0	2.5	2.5	2.5	5.1	0.5	0.5	0.5
SS Box 4 D - B	Vetiver	Deep	08/12/2002	0	0	0.0	4.2	0.0	0.0	0.0	2.5	2.5	2.5	4.2	0.5	0.5	0.5
SS Box 4 D - A	Vetiver	Deep	08/12/2002	0	0	0.3	9.3	0.0	<0.5	<0.5	2.5	2.5	0.3	9.3	0.5	0.25	0.25
Box 4 SS Soil Shallow A	Vetiver	Shallow	04/03/2002	0	0	0	0	<8	0	0.0	2.5	2.5	2.5	2.5	4	0.5	0.5
Box 4 SS Soil Shallow B	Vetiver	Shallow	04/03/2002	0	0	0	0	<8	0	0.0	2.5	2.5	2.5	2.5	4	0.5	0.5
Box 4 Soil Shallow	Vetiver	Shallow	05/06/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 4 (s)	Vetiver	Shallow	06/03/2002	0	0	0	0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 4 S - B	Vetiver	Shallow	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 4 S - A	Vetiver	Shallow	07/10/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Box 4 S - B	Vetiver	Shallow	08/12/2002	0	0	0.0	0.0	0.0	<0.5	0.0	2.5	2.5	2.5	2.5	0.5	0.25	0.5
SS Box 4 S - A	Vetiver	Shallow	08/12/2002	0	0	0.0	0.0	0.0	0.0	<0.5	2.5	2.5	2.5	2.5	0.5	0.5	0.25
SS Box 5 S - A	Wetland		07/10/2002	0	0	0	26.8	0	0.0	0.0	2.5	2.5	2.5	26.8	0.5	0.5	0.5
SS Box 5 S - B	Wetland		07/10/2002	0	0	0	33.2	0	0.0	0.0	2.5	2.5	2.5	33.2	0.5	0.5	0.5
SS Box 5 S - A	Wetland		08/12/2002	0	0	0.5	21.8	0.0	0.0	0.0	2.5	2.5	0.5	21.8	0.5	0.5	0.5
SS Box 5 S - B	Wetland		08/12/2002	0	0	0.0	8.2	0.0	0.0	<0.5	2.5	2.5	2.5	8.2	0.5	0.5	0.25

Soil Sample Data File ($\mu\text{g}/\text{kg}$) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
Box 5 SS Soil Deep A	Wetland	Deep	04/03/2002	0	0	0	0	<8	0	0.0	2.5	2.5	2.5	2.5	4	0.5	0.5
Box 5 SS Soil Deep B	Wetland	Deep	04/03/2002	0	0	0	0	<8	0	0.0	2.5	2.5	2.5	2.5	4	0.5	0.5
Box 5 Soil Deep	Wetland	Deep	05/06/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 5 (d)	Wetland	Deep	06/03/2002	0	0	0	0	0	<4	0.0	2.5	2.5	2.5	2.5	0.5	2	0.5
SS Box 5 (s)	Wetland	Shallow	06/03/2002	0	0	0	0	0	<4	0.0	2.5	2.5	2.5	2.5	0.5	2	0.5

Appendix H

Water Sample Data File

Water Samples Data File (µg/L)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
BOX 1 EFFLUENT	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	*<2	2.5	2.5	2.5	2.5	0.5	1	1
BOX 1 EFFLUENT	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	3	*<2	2.5	2.5	2.5	2.5	0.5	3	1
BOX 1 EFFLUENT	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	4	*<2	2.5	2.5	2.5	2.5	0.5	4	1
cell 1 effluent	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	BDL	2.5	2.5	2.5	2.5	0.5	1	0.5
cell 1 effluent	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	BDL	2.5	2.5	2.5	2.5	0.5	1	0.5
cell 1 effluent	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	BDL	2.5	2.5	2.5	2.5	0.5	1	0.5
BOX 1 EFFLUENT	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	BDL	2.5	2.5	2.5	2.5	0.5	1	0.5
BOX 1 INFLUENT	Pine	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 1 INFLUENT	Pine	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	4	*<2	2.5	2.5	2.5	2.5	0.5	4	1
cell 1 influent	Pine	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	35	17	2.5	2.5	2.5	2.5	0.5	35	17
cell 1 influent	Pine	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	37	22	2.5	2.5	2.5	2.5	0.5	37	22
cell 1 influent	Pine	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	39	23	2.5	2.5	2.5	2.5	0.5	39	23
BOX 1 INFLUENT	Pine	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	7	3	2.5	2.5	2.5	2.5	0.5	7	3
BOX 2 EFFLUENT	Poplar	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	*<2	2.5	2.5	2.5	2.5	0.5	1	1
BOX 2 EFFLUENT	Poplar	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	0	*<2	2.5	2.5	2.5	2.5	0.5	0.5	1
BOX 2 EFFLUENT	Poplar	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	5	2	2.5	2.5	2.5	2.5	0.5	5	2
BOX 2 EFFLUENT	Poplar	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
BOX 2 INFLUENT	Poplar	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	4	*<2	2.5	2.5	2.5	2.5	0.5	4	1
cell 2 influent	Poplar	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	31	18	2.5	2.5	2.5	2.5	0.5	31	18
BOX 2 INFLUENT	Poplar	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	7	4	2.5	2.5	2.5	2.5	0.5	7	4
BOX 2 INFLUENT	Poplar	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	10	5	2.5	2.5	2.5	2.5	0.5	10	5
BOX 2 IN	Poplar	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
EFFLUENT BOX3	Soil Control	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	3	*<1	2.5	2.5	2.5	2.5	0.5	3	0.5
BOX 3 EFFLUENT	Soil Control	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	*<2	2.5	2.5	2.5	2.5	0.5	1	1
BOX 3 EFFLUENT	Soil Control	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<2	*<2	2.5	2.5	2.5	2.5	0.5	1	1
BOX 3 EFFLUENT	Soil Control	Eff	12/31/2000	BDL	BDL	BDL	BDL	BDL	6	2	2.5	2.5	2.5	2.5	0.5	6	2
BOX 3 EFFLUENT A	Soil Control	Eff	12/31/2000	BDL	BDL	BDL	BDL	*<5	<1	BDL	2.5	2.5	2.5	2.5	2.5	0.5	0.5

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
BOX 3 INFLUENT	Soil Control	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	4	*<2	2.5	2.5	2.5	2.5	0.5	4	1
cell 3 influent	Soil Control	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	27	16	2.5	2.5	2.5	2.5	0.5	27	16
BOX 3 INFLUENT	Soil Control	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	5	2	2.5	2.5	2.5	2.5	0.5	5	2
cell 3 influent	Soil Control	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	6	20	2.5	2.5	2.5	2.5	0.5	6	20
BOX 3 INFLUENT	Soil Control	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	5	3	2.5	2.5	2.5	2.5	0.5	5	3
REP 2 INFLUENT	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<1	*<1	2.5	2.5	2.5	2.5	0.5	0.5	0.5
REP 1 INFLUENT	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	*<1	*<1	2.5	2.5	2.5	2.5	0.5	0.5	0.5
INFLUENT REP 2	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	5	*<1	2.5	2.5	2.5	2.5	0.5	5	0.5
influent rep 1	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	5	*<2	2.5	2.5	2.5	2.5	0.5	5	1
INFLUENT REP 1	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	4	1	2.5	2.5	2.5	2.5	0.5	4	1
INFLUENT REP1	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	4	1	2.5	2.5	2.5	2.5	0.5	4	1
influent rep2	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	19	10	2.5	2.5	2.5	2.5	0.5	19	10
influent	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	20	11	2.5	2.5	2.5	2.5	0.5	20	11
INFLUENT REP 3	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	42	12	2.5	2.5	2.5	2.5	0.5	42	12
influent rep 2	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	31	16	2.5	2.5	2.5	2.5	0.5	31	16
INFLUENT REP 3	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	9	2	2.5	2.5	2.5	2.5	2.5	9	2
INFLUENT REP 1	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	6	2	2.5	2.5	2.5	2.5	0.5	6	2
influent rep 1	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	34	21	2.5	2.5	2.5	2.5	0.5	34	21
INFLUENT REP2	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	8	22	2.5	2.5	2.5	2.5	0.5	8	22
influent rep3	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	33	25	2.5	2.5	2.5	2.5	0.5	33	25
INFLUENT REP 1	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	6	3	2.5	2.5	2.5	2.5	0.5	6	3
INFLUENT REP1	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	9	3	2.5	2.5	2.5	2.5	0.5	9	3
INFLUENT REP 2	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	12	4	2.5	2.5	2.5	2.5	0.5	12	4
INFLUENT REP 2	Tank	In	12/31/2000	BDL	BDL	BDL	7	BDL	9	5	2.5	2.5	2.5	7	0.5	9	5
INFLUENT REP 3	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	15	6	2.5	2.5	2.5	2.5	2.5	15	6
INFLUENT REP 3	Tank	In	12/31/2000	BDL	BDL	BDL	*<5	BDL	15	6	2.5	2.5	2.5	2.5	0.5	15	6

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c-DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
INFLUENT	Tank	In	12/31/2000	BDL	BDL	BDL	*≤5	BDL	23	6	BDL	2.5	2.5	2.5	0.5	23	6
INFLUENT REP 2	Tank	In	12/31/2000	BDL	BDL	BDL	BDL	BDL	18	7	BDL	2.5	2.5	2.5	0.5	18	7
INFLUENT REP 3	Tank	In	12/31/2000	BDL	BDL	BDL	*≤5	BDL	23	9	BDL	2.5	2.5	2.5	0.5	23	9
Box # 1 Effluent	Pine	Eff	05/23/2001				<20		24	15		2.5	2.5	10	0.5	24	15
SS Box #1 Ef	Pine	Eff	06/16/2001				<20*		11	<5*		2.5	2.5	10	0.5	11	2.5
Box 1 Eff SS	Pine	Eff	07/26/2001				5		17	13		2.5	2.5	5	0.5	17	13
Box # 1 Effluent (B)	Pine	Eff	04/01/2002	1.46			11.51		30.87	8.74		2.5	1.46	11.51	0.5	30.87	8.74
Box # 1 Influent	Pine	In	05/23/2001				<20		31	24		2.5	2.5	10	0.5	31	24
SS Box #1 In	Pine	In	06/16/2001				<20		17	8.6		2.5	2.5	10	0.5	17	8.6
Box 1 In SS	Pine	In	07/26/2001				<5		5.6	6		2.5	2.5	2.5	0.5	5.6	6
Box # 1 Influent (B)	Pine	In	04/01/2002	0.28			11.51		29.23	7.39		2.5	0.28	11.51	0.5	29.23	7.39
Box # 2 Effluent	Poplar	Eff	05/23/2001				<20		17	12		2.5	2.5	10	0.5	17	12
SS Box #2 Ef	Poplar	Eff	06/16/2001				<20*		6.3	<5*		2.5	2.5	10	0.5	6.3	2.5
Box 2 Eff SS	Poplar	Eff	07/26/2001				BDL		BDL	BDL		2.5	2.5	2.5	0.5	0.5	0.5
Box # 2 Effluent (A)	Poplar	Eff	04/01/2002	BDL			2.91		ND	8.96		2.5	2.5	2.91	0.5	0.5	8.96
Box # 2 Influent	Poplar	In	05/23/2001				<20		56	45		2.5	2.5	10	0.5	56	45
SS Box #2 In	Poplar	In	06/16/2001				<20		36	18		2.5	2.5	10	0.5	36	18
Box 2 In SS	Poplar	In	07/26/2001				<5		14	10.6		2.5	2.5	2.5	0.5	14	10.6
Box # 2 Influent (C)	Poplar	In	04/01/2002	BDL			7.01		ND	35.61		2.5	2.5	7.01	0.5	0.5	35.6
Box # 2 Influent (B)	Poplar	In	04/01/2002	3.82			18.7		30.82	8		2.5	3.82	18.7	0.5	30.82	8
Box # 3 Effluent	Soil Control	Eff	05/23/2001				<20		29	21		2.5	2.5	10	0.5	29	21
SS Box #3 Ef	Soil Control	Eff	06/16/2001				<20		14.9	7.4		2.5	2.5	10	0.5	14.9	7.4
Box 3 Eff SS	Soil Control	Eff	07/26/2001				<5		6.2	<5		2.5	2.5	2.5	0.5	6.2	2.5
Box # 3 Effluent (B)	Soil Control	Eff	04/01/2002	2.05			9.14		26.48	5.72		2.5	2.05	9.14	0.5	26.48	5.72
Box # 3 Influent	Soil Control	In	05/23/2001				<20		49	36		2.5	2.5	10	0.5	49	36
SS Box #3 In	Soil Control	In	06/20/2001				<20*		30.4	14.4		2.5	2.5	10	0.5	30.4	14.4

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t-DCE	c-DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t-DCE adj	c-DCE adj	Chloroform adj	TCE adj	PCE adj	
Box 3 In SS	Soil Control	In	07/26/2001				<5		15	10.9		2.5	2.5	2.5	0.5	15	10.9	
Box # 3 Influent (A)	Soil Control	In	04/01/2002		1.79		0.74		2.69	1.67		2.5	1.79	2.5	0.74	0.5	2.69	1.67
Box # 3 Influent (B)	Soil Control	In	04/01/2002		0.87		14.38		5.76	5		2.5	0.87	2.5	14.38	0.5	5.76	5
Effluent Tank	Tank	Eff	05/23/2001				<20		9	6		2.5	2.5	10	0.5	9	6	
SS Tank Ef B	Tank	Eff	06/20/2001				<20		<5.0	<5.0		2.5	2.5	10	0.5	2.5	2.5	
SS Tank? Ef A	Tank	Eff	06/20/2001				<20		<5.0	<5.0		2.5	2.5	10	0.5	2.5	2.5	
SS H2O Ef Tank B	Tank	Eff	07/09/2001									2.5	2.5	2.5	0.5	0.5	0.5	
Effluent Tank (A)	Tank	Eff	04/01/2002	BDL			1.75		ND	1.34		2.5	2.5	1.75	0.5	0.5	1.34	
Effluent Tank (B)	Tank	Eff	04/01/2002	BDL			3.38		ND	1.41		2.5	2.5	3.38	0.5	0.5	1.41	
SS H2O In Tank A	Tank	In	07/09/2001									2.5	2.5	2.5	0.5	0.5	0.5	
In Tank SS A	Tank	In	07/26/2001				<5		15	15		2.5	2.5	2.5	0.5	15	15	
In Tank SS B	Tank	In	07/26/2001				<5		8.5	9.5		2.5	2.5	2.5	0.5	8.5	9.5	
Box # 4 Effluent	Vetiver	Eff	05/23/2001				<20		24	17		2.5	2.5	10	0.5	24	17	
SS Box #4 Ef	Vetiver	Eff	06/20/2001				<20*		11.5	5.5		2.5	2.5	10	0.5	11.5	5.5	
Box 4 Eff SS	Vetiver	Eff	07/26/2001				14		5.7	<5		2.5	2.5	14	0.5	5.7	2.5	
Box # 4 Effluent (B)	Vetiver	Eff	04/01/2002		17.29		4.31		5.78	8.06		2.5	17.29	2.5	4.31	0.5	5.78	8.06
Box # 4 Effluent (A)	Vetiver	Eff	04/01/2002		2.43		BCL		BCL	BCL		2.5	2.43	2.5	0.5	0.5	0.5	
Box # 4 Influent	Vetiver	In	05/23/2001				<20		14	9		2.5	2.5	10	0.5	14	9	
SS Box #4 In	Vetiver	In	06/20/2001				<20		<5.0	<5.0		2.5	2.5	10	0.5	2.5	2.5	
Box 4 In SS	Vetiver	In	07/26/2001				BDL		6	5		2.5	2.5	2.5	0.5	6	5	
Box # 4 Influent (B)	Vetiver	In	04/01/2002		0.87		7.19		16.42	4.94		2.5	0.87	2.5	7.19	0.5	16.42	4.94
Box # 4 Influent (A)	Vetiver	In	04/01/2002		1.74		0.65		21.26	BCL		2.5	1.74	2.5	0.65	0.5	21.26	0.5
Box 5 inside B	Wetland		07/26/2001				BDL		BDL	<5		2.5	2.5	2.5	0.5	0.5	2.5	
Box 5 inside A	Wetland		07/26/2001				<5		BDL	BDL		2.5	2.5	2.5	0.5	0.5	0.5	
Box # 5 (B)	Wetland		04/01/2002		1.46		10.07		7.24	15.08		2.5	1.46	2.5	10.07	0.5	7.24	15.1
Box # 5 (A)	Wetland		04/01/2002		1.79		2.12		8.55	15.64		2.5	1.79	2.5	2.12	0.5	8.55	15.6
Box # 5 Effluent	Wetland	Eff	05/23/2001				<20		9	5		2.5	2.5	10	0.5	9	5	

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box #5 ef	Wetland	Eff	06/20/2001				< 20		< 5.0		2.5	2.5	2.5	10	0.5	2.5	2.5
Box #5 Eff SS	Wetland	Eff	07/26/2001				BDL		BDL		2.5	2.5	2.5	2.5	0.5	0.5	0.5
Box # 5 Effluent (A)	Wetland	Eff	04/01/2002		1.55		1.2		1.32	0.48	2.5	1.55	2.5	1.2	0.5	1.32	0.48
Box # 5 Effluent (B)	Wetland	Eff	04/01/2002		3.82		10.07		5.71	7.44	2.5	3.82	2.5	10.07	0.5	5.71	7.44
Box # 5 Inflow	Wetland	In	05/23/2001				< 20		41	30	2.5	2.5	2.5	10	0.5	41	30
SS Box #5 In	Wetland	In	06/20/2001				< 20		24.4	11.4	2.5	2.5	2.5	10	0.5	24.4	11.4
Box # 5 In SS	Wetland	In	07/26/2001				< 5		18	12	2.5	2.5	2.5	2.5	0.5	18	12
Box # 5 Inflow (A)	Wetland	In	04/01/2002		1.57		5.16		6.17	1.65	2.5	1.57	2.5	5.16	0.5	6.17	1.65
Box # 5 Inflow (B)	Wetland	In	04/01/2002		0.28		10.07		38.51	17.2	2.5	0.28	2.5	10.07	0.5	38.51	17.2
Box 1 Eff SS B	Pine	Eff	04/03/2002	0	0	0	2.8	0.0	6.4	6.0	2.5	2.5	2.5	2.8	0.5	6.4	6
Box 1 Eff SS A	Pine	Eff	04/03/2002	0	0	0	< 4	0.0	9.7	8.2	2.5	2.5	2.5	2	0.5	9.7	8.2
Box 1 Eff SS A	Pine	Eff	05/06/2002	0	0	0	3.7	0	14.7	3.7	2.5	2.5	2.5	3.7	0.5	14.7	3.7
Box 1 Eff SS B	Pine	Eff	05/06/2002	NA	NA	NA	NA	NA	NA	NA							
SS Box 1 Ef - B	Pine	Eff	06/03/2002	0	0	0	0	0	11.2	6.9	2.5	2.5	2.5	2.5	0.5	11.2	6.9
SS Box 1 Ef - A	Pine	Eff	06/03/2002	0	0	0	0	0	8.7	6.1	2.5	2.5	2.5	2.5	0.5	8.7	6.1
SS Box 1 Ef - B	Pine	Eff	07/10/2002	0	0	0	4.8	0	20.3	6.2	2.5	2.5	2.5	4.8	0.5	20.3	6.2
SS Box 1 Ef - A	Pine	Eff	07/10/2002	0	0	0	5.4	0	24.4	9.0	2.5	2.5	2.5	5.4	0.5	24.4	9
SS Box 1 Ef - A	Pine	Eff	08/07/2002	0	0	0	3.6	0	21.0	6.5	2.5	2.5	2.5	3.6	0.5	21	6.5
SS Box 1 Ef - B	Pine	Eff	08/07/2002	0	0	0	4.6	0	25.4	7.6	2.5	2.5	2.5	4.6	0.5	25.4	7.6
Box 1 In SS B	Pine	In	04/03/2002	0	0	0	0	< 4	11.7	11.4	2.5	2.5	2.5	2.5	2	11.7	11.4
Box 1 In SS A	Pine	In	04/03/2002	0	0	0	< 4	0.0	16.2	14.9	2.5	2.5	2.5	2	0.5	16.2	14.9
Box 1 In SS A	Pine	In	05/06/2002	0	0	0	0	0	31.4	10.6	2.5	2.5	2.5	2.5	0.5	31.4	10.6
Box 1 In SS B	Pine	In	05/06/2002	0	0	0	0	0	18.1	6.6	2.5	2.5	2.5	2.5	0.5	18.1	6.6
SS Box 1 In - B	Pine	In	06/03/2002	0	0	0	0	0	12.5	11.8	2.5	2.5	2.5	2.5	0.5	12.5	11.8
SS Box 1 In - A	Pine	In	06/03/2002	0	0	0	0	0	15.9	12.6	2.5	2.5	2.5	2.5	0.5	15.9	12.6
SS Box 1 In - A	Pine	In	07/10/2002	0	0	0	1.9	0	31.5	11.7	2.5	2.5	2.5	2.5	0.5	31.5	11.7
SS Box 1 In - B	Pine	In	07/10/2002	0	0	0	1.6	0	26.4	8.6	2.5	2.5	2.5	2.5	0.5	26.4	8.6

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box 1 In - A	Pine	In	08/07/2002	0	0	0	1.1	0	16.3	5.7	2.5	2.5	2.5	1.1	0.5	16.3	5.7
SS Box 1 In - B	Pine	In	08/07/2002	0	0	0	1.1	0	19.3	6.6	2.5	2.5	2.5	1.1	0.5	19.3	6.6
Box 2 Eff B	Poplar	Eff	04/03/2002	0	0	0	0	0	3.2	2.8	2.5	2.5	2.5	2.5	0.5	3.2	2.8
Box 2 Eff A	Poplar	Eff	04/03/2002	<4	0	0	0	0	4.3	3.3	2	2.5	2.5	2.5	0.5	4.3	3.3
Box 2 Eff B	Poplar	Eff	05/06/2002	0	0	0	0	0	6.2	1.7	2.5	2.5	2.5	2.5	0.5	6.2	1.7
Box 2 Eff A	Poplar	Eff	05/06/2002	0	0	0	0	0	10.1	2.7	2.5	2.5	2.5	2.5	0.5	10.1	2.7
SS Box 2 Ef - A	Poplar	Eff	06/03/2002	0	0	0	0	0	2.2	<4	2.5	2.5	2.5	2.5	0.5	2.2	2
SS Box 2 Ef - B	Poplar	Eff	06/03/2002	0	0	0	0	0	3.2	<4	2.5	2.5	2.5	2.5	0.5	3.2	2
SS Box 2 Ef - B	Poplar	Eff	07/10/2002	0	0	0	21.8	0	1.8	0.0	2.5	2.5	2.5	21.8	0.5	1.8	0.5
SS Box 2 Ef - A	Poplar	Eff	07/10/2002	0	0	0	1.2	0	22.8	7.5	2.5	2.5	2.5	1.2	0.5	22.8	7.5
SS Box 2 Ef - A	Poplar	Eff	08/07/2002	0	0	0	13.4	0	1.5	0.6	2.5	2.5	2.5	13.4	0.5	1.5	0.6
SS Box 2 Ef - B	Poplar	Eff	08/07/2002	na	na	na	na	na	na	na							
Box 2 In B	Poplar	In	04/03/2002	0	0	0	<4	0	12.4	11.7	2.5	2.5	2.5	2	0.5	12.4	11.7
Box 2 In A	Poplar	In	04/03/2002	<4	0	0	0	0	15.4	14.0	2	2.5	2.5	2.5	0.5	15.4	14
Box 2 In B	Poplar	In	05/06/2002	0	0	0	0	0	17.1	7.0	2.5	2.5	2.5	2.5	0.5	17.1	7
Box 2 In A	Poplar	In	05/06/2002	0	0	0	0	0	28.5	9.9	2.5	2.5	2.5	2.5	0.5	28.5	9.9
SS Box 2 In - B	Poplar	In	06/03/2002	0	0	0	0	0	19.4	16.4	2.5	2.5	2.5	2.5	0.5	19.4	16.4
SS Box 2 In - A	Poplar	In	06/03/2002	0	0	0	0	0	22.9	22.4	2.5	2.5	2.5	2.5	0.5	22.9	22.4
SS Box 2 In - A	Poplar	In	07/10/2002	0	0	0	2.0	0	29.7	10.2	2.5	2.5	2.5	2	0.5	29.7	10.2
SS Box 2 In - B	Poplar	In	07/10/2002	0	0	0	1.5	0	26.4	5.8	2.5	2.5	2.5	1.5	0.5	26.4	5.8
SS Box 2 In - B	Poplar	In	08/07/2002	0	0	0	1.9	0	33.2	11.2	2.5	2.5	2.5	1.9	0.5	33.2	11.2
SS Box 2 In - A	Poplar	In	08/07/2002	0	0	0	1.5	0	26.9	9.4	2.5	2.5	2.5	1.5	0.5	26.9	9.4
Box 3 Eff B	Soil Control	Eff	04/03/2002	0	0	0	2.3	0	6.1	5.6	2.5	2.5	2.5	2.3	0.5	6.1	5.6
Box 3 Eff A	Soil Control	Eff	04/03/2002	0	0	0	<4	0	7.8	6.8	2.5	2.5	2.5	2	0.5	7.8	6.8
Box 3 Eff B	Soil Control	Eff	05/06/2002	0	0	0	0	0	10.8	3.7	2.5	2.5	2.5	2.5	0.5	10.8	3.7
Box 3 Eff A	Soil Control	Eff	05/06/2002	0	0	0	0	0	17.3	5.2	2.5	2.5	2.5	2.5	0.5	17.3	5.2
SS Box 3 Ef - B	Soil Control	Eff	06/03/2002	0	0	0	0	0	6.4	4.1	2.5	2.5	2.5	2.5	0.5	6.4	4.1

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box 3 Ef - A	Soil Control	Eff	06/03/2002	0	0	0	0	0	6.1	4.6	2.5	2.5	2.5	2.5	0.5	6.1	4.6
SS Box 3 Ef - B	Soil Control	Eff	07/10/2002	0	0	0	1.4	0	12.3	4.2	2.5	2.5	2.5	1.4	0.5	12.3	4.2
SS Box 3 Ef - A	Soil Control	Eff	07/10/2002	0	0	0	0.6	0	8.7	4.4	2.5	2.5	2.5	0.6	0.5	8.7	4.4
SS Box 3 Ef - A	Soil Control	Eff	08/07/2002	0	0	0	2.9	0	20.6	6.6	2.5	2.5	2.5	2.9	0.5	20.6	6.6
SS Box 3 Ef - B	Soil Control	Eff	08/07/2002	na	na	na	na	na	na	na							
Box 3 In B	Soil Control	In	04/03/2002	0	0	0	<4	<4	10.8	10.5	2.5	2.5	2.5	2	2	10.8	10.5
Box 3 In A	Soil Control	In	04/03/2002	<4	0	0	<4	0	14.6	13.2	2	2.5	2.5	2	0.5	14.6	13.2
Box 3 In A	Soil Control	In	05/06/2002	0	0	0	0	0	28.9	10.5	2.5	2.5	2.5	2.5	0.5	28.9	10.5
Box 3 In B	Soil Control	In	05/06/2002	0	0	0	0	0	18.4	7.3	2.5	2.5	2.5	2.5	0.5	18.4	7.3
SS Box 3 In - B	Soil Control	In	06/03/2002	0	0	0	0	0	19.7	16.9	2.5	2.5	2.5	2.5	0.5	19.7	16.9
SS Box 3 In - A	Soil Control	In	06/03/2002	0	0	0	0	0	19.8	18.7	2.5	2.5	2.5	2.5	0.5	19.8	18.7
SS Box 3 In - A	Soil Control	In	07/10/2002	0	0	0	1.7	0	16.7	5.0	2.5	2.5	2.5	1.7	0.5	16.7	5
SS Box 3 In - B	Soil Control	In	07/10/2002	0	0	0	1.5	0	26.6	8.8	2.5	2.5	2.5	1.5	0.5	26.6	8.8
SS Box 3 In - A	Soil Control	In	08/07/2002	0	0	0	1.6	0	27.3	9.3	2.5	2.5	2.5	1.6	0.5	27.3	9.3
SS Box 3 In - B	Soil Control	In	08/07/2002	na	na	na	na	na	na	na							
Eff Tank SS A	Tank	Eff	04/03/2002	0	0	0	3.8	0	3.3	2.0	2.5	2.5	2.5	3.8	0.5	3.3	2
Eff Tank SS B	Tank	Eff	04/03/2002	<4	0	0	<4	0	2.0	<4	2	2.5	2.5	2	0.5	2	2
Eff Tank SS A	Tank	Eff	05/06/2002	0	0	0	<2.5	0	7.5	1.4	2.5	2.5	2.5	1.25	0.5	7.5	1.4
Eff Tank SS B	Tank	Eff	05/06/2002	0	0	0	0	0	3.9	<1.25	2.5	2.5	2.5	2.5	0.5	3.9	0.63
SS Ef Tank - B	Tank	Eff	06/03/2002	0	0	0	0	0	2.1	BDL	2.5	2.5	2.5	2.5	0.5	2.1	0.5
SS Ef Tank - A	Tank	Eff	06/03/2002	0	0	0	0	0	<4	BDL	2.5	2.5	2.5	2.5	0.5	2	0.5
SS Ef Tank - B	Tank	Eff	07/10/2002	0	0	0	0.0	0	0.0	0.0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Ef Tank - A	Tank	Eff	07/10/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Ef Tank - A	Tank	Eff	08/07/2002	0	0	0	0.5	0	0.7	0.5	2.5	2.5	2.5	0.5	0.5	0.7	0.5
SS Ef Tank - B	Tank	Eff	08/07/2002	na	na	na	na	na	na	na							
In Tank SS B	Tank	In	04/03/2002	0	0	0	0	0	11.7	12.8	2.5	2.5	2.5	2.5	0.5	11.7	12.8

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
In Tank SS A	Tank	In	04/03/2002	0	0	0	<4	<4	16.9	17.2	2.5	2.5	2.5	2	2	16.9	17.2
In Tank SS B	Tank	In	05/06/2002	0	0	0	0	0	0	0	2.5	2.5	2.5	2.5	0.5	0.5	0.5
In Tank SS A	Tank	In	05/06/2002	0	0	0	0	0	0	<1.25	2.5	2.5	2.5	2.5	0.5	0.5	0.63
SS In Tank - A	Tank	In	06/03/2002	0	0	0	0	0	14.8	10.8	2.5	2.5	2.5	2.5	0.5	14.8	10.8
SS In Tank - B	Tank	In	06/03/2002	0	0	0	0	0	17.5	12.3	2.5	2.5	2.5	2.5	0.5	17.5	12.3
SS In Tank - B	Tank	In	07/10/2002	0	0	0	1.4	0	21.9	5.4	2.5	2.5	2.5	1.4	0.5	21.9	5.4
SS In Tank - A	Tank	In	07/10/2002	0	0	0	1.6	0	26.8	7.6	2.5	2.5	2.5	1.6	0.5	26.8	7.6
SS In Tank - A	Tank	In	08/07/2002	0	0	0	1.8	0	27.3	9.8	2.5	2.5	2.5	1.8	0.5	27.3	9.8
SS In Tank - B	Tank	In	08/07/2002	na	na	na	na	na	na	na							
Box 4 Eff B	Vetiver	Eff	04/03/2002	0	0	0	<4	0	7.6	6.1	2.5	2.5	2.5	2	0.5	7.6	6.1
Box 4 Eff A	Vetiver	Eff	04/03/2002	<4	0	0	3.0	0	9.0	7.0	2	2.5	2.5	3	0.5	9	7
Box 4 Eff A	Vetiver	Eff	05/06/2002	0	0	0	2.9	0	16.9	5.6	2.5	2.5	2.5	2.9	0.5	16.9	5.6
Box 4 Eff B	Vetiver	Eff	05/06/2002	NA	NA	NA	NA	NA	NA	NA							
SS Box 4 Ef - A	Vetiver	Eff	06/03/2002	0	0	0	0	0	7.8	6.9	2.5	2.5	2.5	2.5	0.5	7.8	6.9
SS Box 4 Ef - B	Vetiver	Eff	06/03/2002	0	0	0	0	0	9.0	7.7	2.5	2.5	2.5	2.5	0.5	9	7.7
SS Box 4 Ef - A	Vetiver	Eff	07/10/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Box 4 Ef - B	Vetiver	Eff	07/10/2002	0	0	0	19.5	0	8.2	4.7	2.5	2.5	2.5	19.5	0.5	8.2	4.7
SS Box 4 Ef - A	Vetiver	Eff	08/07/2002	0	0	0	12.6	0	14.6	4.3	2.5	2.5	2.5	12.6	0.5	14.6	4.3
SS Box 4 Ef - B	Vetiver	Eff	08/07/2002	na	na	na	na	na	na	na							
Box 4 In B	Vetiver	In	04/03/2002	0	0	0	<4	0	10.6	10.0	2.5	2.5	2.5	2	0.5	10.6	10
Box 4 In A	Vetiver	In	04/03/2002	0	0	0	0	<4	13.1	11.7	2.5	2.5	2.5	2.5	2	13.1	11.7
Box 4 In B	Vetiver	In	05/06/2002	0	0	0	0	0	15.0	5.8	2.5	2.5	2.5	2.5	0.5	15	5.8
Box 4 In A	Vetiver	In	05/06/2002	0	0	0	0	0	21.3	7.4	2.5	2.5	2.5	2.5	0.5	21.3	7.4
SS Box 4 In - A	Vetiver	In	06/03/2002	0	0	0	0	0	7.2	6.5	2.5	2.5	2.5	2.5	0.5	7.2	6.5
SS Box 4 In - B	Vetiver	In	06/03/2002	0	0	0	0	0	10.7	9.3	2.5	2.5	2.5	2.5	0.5	10.7	9.3
SS Box 4 In - B	Vetiver	In	07/10/2002	0	0	0	0.7	0	10.4	3.6	2.5	2.5	2.5	0.7	0.5	10.4	3.6
SS Box 4 In - A	Vetiver	In	07/10/2002	0	0	0	1.5	0	30.1	9.9	2.5	2.5	2.5	1.5	0.5	30.1	9.9

Water Samples Data File (µg/L) (Continued)

Sample ID	Treatment	Type	Sample Date	Vinyl Chloride	1,1 DCE	t- DCE	c- DCE	Chloroform	TCE	PCE	Vinyl Chloride adj	1,1 DCE adj	t- DCE adj	c- DCE adj	Chloroform adj	TCE adj	PCE adj
SS Box 4 In - A	Vetiver	In	08/07/2002	0	0	0	1.5	0	26.4	9.1	2.5	2.5	2.5	1.5	0.5	26.4	9.1
SS Box 4 In - B	Vetiver	In	08/07/2002	na	na	na	na	na	na	na							
Box 5 Eff A	Wetland	Eff	04/03/2002	0	0	0	0	0	2.7	2.0	2.5	2.5	2.5	2.5	0.5	2.7	2
Box 5 Eff B	Wetland	Eff	04/03/2002	0	0	0	0	0	2.2	<4	2.5	2.5	2.5	2.5	0.5	2.2	2
Box 5 Eff A	Wetland	Eff	05/06/2002	0	0	0	0	0	<1.25	<1.25	2.5	2.5	2.5	2.5	0.5	0.625	0.63
Box 5 Eff B	Wetland	Eff	05/06/2002	0	0	0	0	0	<1.25	<1.25	2.5	2.5	2.5	2.5	0.5	0.625	0.63
SS Box 5 Ef - B	Wetland	Eff	06/03/2002	0	0	0	0	0	<4	BDL	2.5	2.5	2.5	2.5	0.5	2	0.5
SS Box 5 Ef - A	Wetland	Eff	06/03/2002	0	0	0	0	0	BDL	BDL	2.5	2.5	2.5	2.5	0.5	0.5	0.5
SS Box 5 Ef - A	Wetland	Eff	07/10/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Box 5 Ef - B	Wetland	Eff	07/10/2002	0	0	0	<0.5	0	0.0	0.0	2.5	2.5	2.5	0.25	0.5	0.5	0.5
SS Box 5 Ef - A	Wetland	Eff	08/07/2002	0	0	0	0.7	0	0.6	0.4	2.5	2.5	2.5	0.7	0.5	0.6	0.4
SS Box 5 Ef - B	Wetland	Eff	08/07/2002	na	na	na	na	na	na	na							
Box 5 In B	Wetland	In	04/03/2002	0	0	0	0	<4	11.8	11.6	2.5	2.5	2.5	2.5	2	11.8	11.6
Box 5 In A	Wetland	In	04/03/2002	0	0	0	<4	<4	13.7	12.3	2.5	2.5	2.5	2	2	13.7	12.3
Box 5 In B	Wetland	In	05/06/2002	0	0	0	0	0	15.0	6.0	2.5	2.5	2.5	2.5	0.5	15	6
Box 5 In A	Wetland	In	05/06/2002	0	0	0	0	0	21.4	7.7	2.5	2.5	2.5	2.5	0.5	21.4	7.7
SS Box 5 In - B	Wetland	In	06/03/2002	0	0	0	0	0	18.0	17.2	2.5	2.5	2.5	2.5	0.5	18	17.2
SS Box 5 In - A	Wetland	In	06/03/2002	0	0	0	0	0	17.4	19.0	2.5	2.5	2.5	2.5	0.5	17.4	19
SS Box 5 In - A	Wetland	In	07/10/2002	0	0	0	<0.5	0	0.7	0.0	2.5	2.5	2.5	0.25	0.5	0.7	0.5
SS Box 5 In - B	Wetland	In	07/10/2002	0	0	0	1.7	0	27.7	6.0	2.5	2.5	2.5	1.7	0.5	27.7	6
SS Box 5 In - A	Wetland	In	08/07/2002	0	0	0	1.9	0	32.3	11.2	2.5	2.5	2.5	1.9	0.5	32.3	11.2