WSRC-TR-2003-00486
Revision 0

KEY WORDS:
Sulfate Reduction
D-Area Coal Pile Runoff Basin

D-AREA SULFATE REDUCTION
DIW-1 ORGANIC APPLICATION FIELD STUDY (U)
OCTOBER 31, 2003

PREPARED BY:
Mark A. Phifer[a]
Frank C. Sappington[a]
Margaret R. Millings[a]
Charles E. Turick[a]
Pamela C. McKinsey[a]

Westinghouse Savannah River Company LLC[a]

ADC and Reviewing Official

M. K. Harris, Manager, Geo-Modeling
Environmental Restoration Technology Section

Westinghouse Savannah River Company LLC
Savannah River Site
Aiken, SC 29808

Prepared for the U.S. Department of Energy under Contract No. DE-AC09-96SR1850

This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.

THIS PAGE INTENTIONALLY LEFT BLANK

REVIEWS AND APPROVALS

Authors:

Mark A. Phifer, Environmental Restoration Technology Section Date

---

Frank C. Sappington, Environmental Restoration Technology Section Date

---

Margaret R. Millings, Environmental Restoration Technology Section Geo-Modeling Date

---

Charles E. Turick, Environmental Biotechnology Section Date

Pamela C. McKinsey, Environmental Biotechnology Section Date

Approval:

R. S. Aylward, Level 3 Manager, Environmental Restoration Technology Section Date

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYMS

ADS	Analytical Development Section
BOS	bottom of screen
DCPRB	D-Area Coal Pile Runoff Basin
DIW-1	D-Area Interceptor Well
DO	dissolved oxygen
EBS	Environmental Biotechnology Section
ERTS	Environmental Restoration Technology Section
GC-MS	Gas Chromatography-Mass Spectrometer
GCU	Gordon Confining Unit or the “green clay”
HDPE	high density polyethylene
HRC	Hydrogen Release Compound
IC	Ion Chomotagraphy
ICP-AES	Inductively Coupled Plasma – Atomic Emission Spectroscopy
MNA	monitored natural attenuation
MSDS	Material Safety Data Sheet
SC	specific conductance
SRB	sulfate reducing bacteria
SRS	Savannah River Site
MDL	method detection limit
MMDC	Microscopic Microbial Direct Counts
MPN-SRA	Most Probable Number – Sulfate-Reducing Assay
NA	not applicable
SRTC Mobile Lab	Savannah River Technology Center Mobile Laboratory
TOCg	top of casing
TOR	top of riser
TOS	top of screen
UIC	Underground Injection Control Permit
UTRA	Upper Three Runs Aquifer
VFA	volatile fatty acid
WSRC	Westinghouse Savannah River Company

LIST OF ACRONYMS AND ABBREVIATIONS

ABBREVIATIONS

aq	aqueous
cells/ml	bacterial cells per milliliter
cfu/g	colony forming units per gram
cm/s	centimeters per second
C:N:P	carbon:nitrogen:phosphorous
e.g.	for example
Eh	redox potential relative to the hydrogen couple
ft	feet
ft-msl	feet above mean sea level
Gal	gallons
g/cm^3	grams per cubic centimeter
g/L	grams per liter
gpm/ft	specific capacity in gallons per minute per foot of drawdown
id	identification
i.e.	that is
K_h	horizontal saturated hydraulic conductivity
K_v	vertical saturated hydraulic conductivity
L	liter
m	meter
M	molar
mg/L	milligram per liter
mL	milliliter
mM	millimolar
mol/L	moles per liter
mV	millivolt
org/g	organisms per gram
ORP	oxidation-reduction potential
pe	negative logarithm of the electron (e^-) activity (pe = 16.9 Eh at 25 ^oC)
pH	negative logarithm of the hydrogen ion (H^+) activity
ppm	part per million
redox	reduction-oxidation
s	solid
SRB/ml	sulfate reducing bacteria per milliliter
^oC	degrees Celsius
^oF	degrees Fahrenheit
%	percent
μg/L	micrograms per liter
μmhos/cm	microsiemens per centimeter

D-AREA SULFATE REDUCTION
DIW-1 ORGANIC APPLICATION FIELD STUDY

1.0 EXECUTIVE SUMMARY

An acidic/metals/sulfate, groundwater contaminant plume emanates from the D-Area Coal Pile Runoff Basin (DCPRB) at the Savannah River Site (SRS), due to the contaminated runoff the basin receives from the D-Area coal pile. From a previous feasibility evaluation and laboratory testing, it was concluded that the plume could be remediated with sulfate reduction remediation combined with Monitored Natural Attenuation (MNA). Additionally these previous studies recommended that soybean oil and sodium lactate be utilized as organic substrates for sulfate reducing bacteria (SRB) during a subsequent sulfate reduction, pilot scale, field demonstration. The soybean oil was to be tested as a long-term, slow release, organic substrate, and the sodium lactate was to be tested as a short-term, immediately available, organic substrate.

The subsequent sulfate reduction, pilot scale, field demonstration consisted of the following:

- Approximately 825 gallons of soybean oil was injected into both the south and north wings of the existing D-Area Interceptor Well (DIW-1).
- Approximately 227.5 gallons of sodium lactate and 1169 gallons of groundwater from background well DCB-8 were injected into the DIW-1 south wing only. The groundwater was used to reduce the viscosity of the sodium lactate for injection, to flush the sodium lactate out of the injection point screen zones, and to provide bioaugmentation (i.e. the addition of SRB).
- Both pre-injection and post-injection monitoring and sampling and analysis were conducted in order to evaluate the impact of organic substrate injection on soluble organic, sulfate, nutrient, microbe, hydrogen sulfide, pH, Eh, and metal concentrations (i.e. the ability to promote sulfate reduction remediation of the plume).

Overall it is clear from this field demonstration that both soybean oil and sodium lactate provided a suitable organic substrate to promote SRB growth. The SRB growth promoted by both soybean oil and sodium lactate resulted in sulfate reduction remediation as evidenced by the decrease in sulfate and increase in hydrogen sulfide concentrations, the subsequent increase in pH and decrease in Eh, and finally the subsequent decrease in metal concentrations.

It has been concluded that soybean oil does provide a relatively long-term, slow release, organic substrate for the SRB, and that the current sulfate reduction remediation occurring within DIW-1 could be maintained by injecting 1200 gallons of soybean oil every two years. Additionally soybean oil is significantly cheaper than sodium lactate both in terms of material costs and injection costs. The soybean oil for this demonstration cost approximately $175 per 55-gallon drum versus $770 per 55-gallon drum for 60% sodium lactate. During this demonstration only two soybean oil injections were conducted for the injection of 825 gallons, whereas fifteen sodium lactate injection were required for the injection of 227.5 gallons. Finally it was concluded that the distribution and proximity of soybean oil are the primary factors that influence the overall effectiveness of sulfate reduction remediation promoted by soybean oil injection.

It has also been concluded that sodium lactate does provide a short-term, immediately available, organic substrate. Injection of sodium lactate, however, must take into consideration the inhibitory SRB response to elevated sodium lactate concentrations and the quick lactate depletion. Together these considerations require that low quantities of sodium lactate be injected on a frequent basis. Therefore it has been concluded that the best use of sodium lactate is to quickly initiate sulfate reduction and facilitate the subsequent utilization of soybean oil. However it is not entirely clear whether sodium lactate is necessary for the initiation of sulfate reduction and to facilitate soybean oil utilization.

Recommendations based upon the results of this demonstration have been made concerning continuation of this study, the potential for an interim action, and the final remediation once discharge to the DCPRB has been discontinued. It is recommended that the sulfate reduction, pilot scale, field demonstration continue in order to further evaluate whether sodium lactate is necessary for use in combination with soybean oil, and to evaluate the impact of soybean oil distribution upon sulfate reduction remediation.

2.0 INTRODUCTION

An acidic/metals/sulfate, groundwater contaminant plume emanates from the D-Area Coal Pile Runoff Basin (DCPRB) at the Savannah River Site (SRS), due to the contaminated runoff the basin receives from the D-Area coal pile. A feasibility study (Phifer et al. 2001) and the laboratory testing (Turick et al. 2002) were previously conducted to assess the feasibility and potential of in situ sulfate reduction to serve as a remedial technology for this groundwater plume. In situ sulfate reduction entails the oxidation of organic carbon by sulfate-reducing bacteria (SRB) for energy and growth and the use of sulfate as an electron acceptor, which results in the production of hydrogen sulfide and the subsequent in situ precipitation of metal sulfides. The geochemical conditions of the plume appeared to be favorable for the promotion of sulfate reduction. The sulfate concentrations are two to four orders of magnitude greater than that of the electron acceptors (i.e. O_2, NO_3^-, Mn^{+4}, Fe^{+3}, and CO_2) of potential microbial competitors (i.e. aerobes, nitrate reducers, manganese reducers, iron reducers, and methanogens). Therefore SRB should out compete these microbial competitors for available organic substrate and micronutrients (nitrogen and phosphate). However at a minimum an organic substrate must be added to promote in situ sulfate reduction remediation. Additionally base, nitrogen, and phosphate amendments may also be required to produce optimal conditions for SRB growth. Based upon the feasibility study and the laboratory testing, soybean oil and sodium lactate were selected for injection into the plume through the existing D-Area Interceptor Well (DIW-1) as part of a pilot scale field demonstration. The existing DIW-1 is located at the northwest corner of DCPRB over the most contaminated portion of the plume.

This report describes the pilot scale field demonstration in terms of its background, objectives, implementation, results, and conclusions. Additionally recommendations are made regarding continuation of this study, the potential for an interim action, and the final remediation once discharge to the DCPRB has been discontinued.

THIS PAGE INTENTIONALLY LEFT BLANK

3.0 BACKGROUND

A literature review and feasibility evaluation (Phifer et al. 2001) and laboratory study (Turick et al. 2002) were conducted to determine the feasibility and practicability of sulfate reduction remediation of the D-area acidic/metals/sulfate groundwater plume. Pertinent background information derived predominately from these studies is provided in the sections below

3.1 DCRPB WATER TABLE AQUIFER HYDROGEOLOGY

The water table or unconfined aquifer (also called the lower Upper Three Runs Aquifer (UTRA)) beneath D-Area (see Figure 1 for a map of D-Area) varies in thickness from 40 to 60 feet. The aquifer consists of interbedded sand, calcareous sand, clayey sand, silt, and clay layers, which are laterally discontinuous. The average horizontal hydraulic conductivity is approximately 5.0E-4 cm/s, but the saturated hydraulic conductivities of individual layers range from 1E-3 to 1E-7 cm/s. The average ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity (K_h / K_v) is approximately 10. Soils in the upper portion of the aquifer are generally at the lower end of the hydraulic conductivity range, whereas the soils in the lower portion generally contain more sand and are at the higher end of the hydraulic conductivity range. The green clay (also called the Gordon Confining Unit (GCU)) is the aquitard below the water table aquifer. The green clay consists of fine-grained glauconitic clayey sand interbedded with lenses of green and gray clay.

Groundwater flow in the D-Area water table aquifer is predominantly east to west toward the Savannah River. The general depth of the water table below the ground surface decreases until the groundwater emerges in wetlands to the east of the Savannah River. The most shallow groundwater flow is influenced by local features such as the DCPRB, the unnamed tributary to Beaver Dam Creek (i.e., the discharge ditch), the wetlands between the DCPRB and the ash basins, the ash basins, Beaver Dam Creek, and other wetland/swamp areas. The DCPRB is located approximately 6000 feet from the Savannah River, and it is a groundwater recharge area that greatly influences local groundwater flow. The free surface of the water table ranges from grade in the basin to 15 feet (4.6 m) below grade surrounding the basin. Groundwater flow in the DCPRB vicinity is both downward and horizontally away from the DCPRB, within the low permeability, upper portion of the water table aquifer. However, the bulk of the groundwater flow occurs in the higher permeability, lower portion of the aquifer toward the Savannah River.

(Phifer et al. 1996; Lowry et al. 1999; Phifer et al. 2000; WSRC 1999; Phifer et al. 2001; Brewer and Sochor 2002)

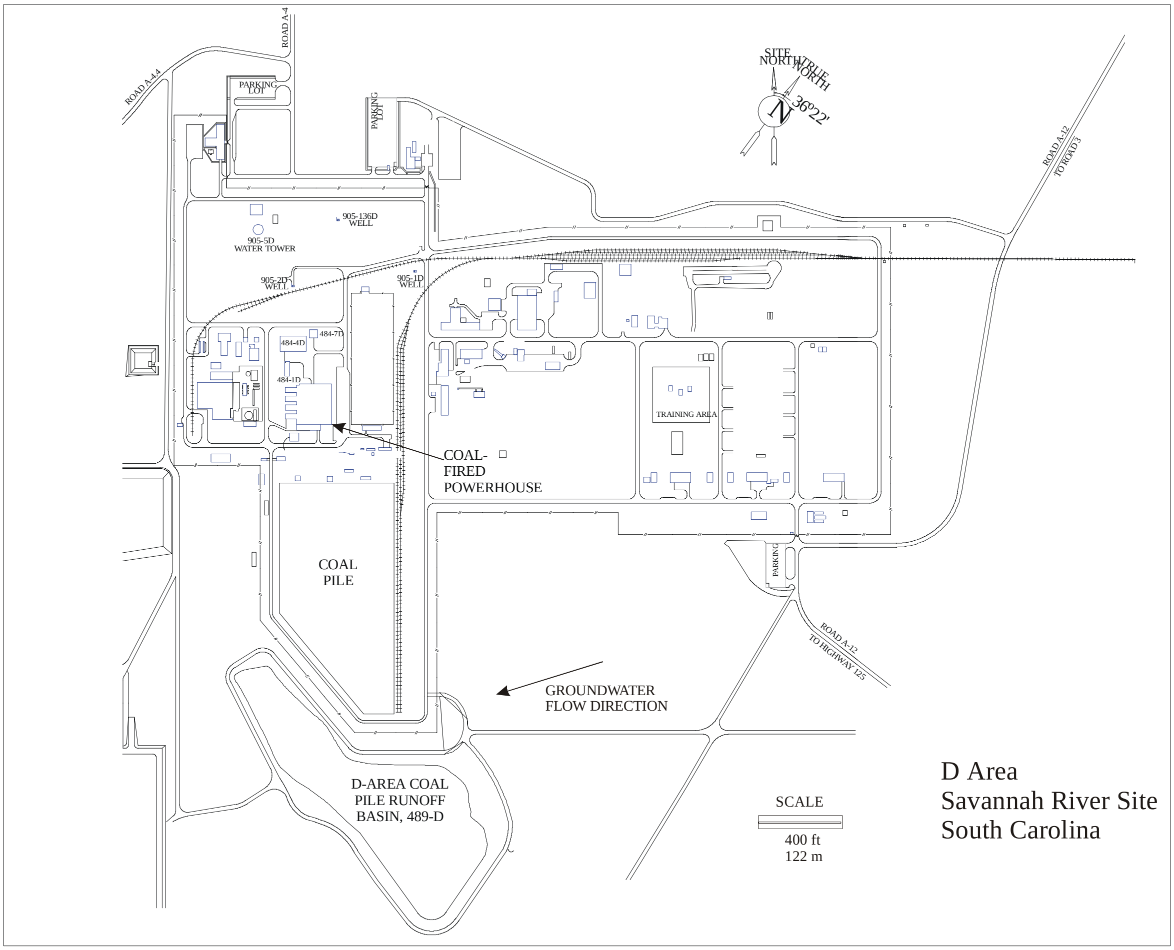

Figure 1. D-Area Map

3.2 DCPRB CONTAMINATION AND GEOCHEMISTRY

The 12.5-acre DCPRB was built in 1978 as a sedimentation basin to receive the runoff from the adjacent 8.9-acre coal pile and prevent direct discharge of the runoff to an adjacent creek. An acidic/metals/sulfate groundwater plume emanates from the basin. Shallow groundwater at the northwestern corner (SRS grid) of the DCPRB is among the most contaminated groundwater emanating from the DCPRB (see Figure 2 for a map of DCPRB). In 1995 a demonstration of an experimental subsurface construction technique was conducted in this northwest corner of the basin. The demonstration consisted of the construction of a groundwater extraction system, designated DIW-1, in this location.

In general, groundwater contamination decreases to the south along the western side of the basin and with depth. Table 1 provides historical and groundwater data collected during this study from wells in the vicinity of DIW-1 (see Figure 3 for a map of DIW-1). These data show that the plume consists of acidic groundwater with elevated metal and sulfate concentrations. Iron and aluminum are among the most important metals affecting groundwater geochemistry. In addition, metals that have exceeded drinking water standards include beryllium, cadmium, chromium, and uranium. Manganese, copper, nickel, and zinc concentrations have also often exceeded background concentrations. Further details concerning the geochemistry of groundwater in the vicinity of the DCPRB and DIW-1 can be found in earlier studies (Phifer et al. 2001; Phifer et al. 2003b; Washburn et al. 1998; Washburn et al. 1999).

Table 1. DCPRB Groundwater Geochemistry

Parameter [1]	Historical Groundwater Concentrations in the Vicinity of DIW-1 [2]			Groundwater Concentrations from this study in the Vicinity of DIW-1 [3]		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Aluminum (mg/L)	8	1354	560	47	563	194
Chromium (mg/L)	<0.040	1.260	0.428	<0.002	0.254	0.107
Copper (mg/L)	0.165	1.780	0.599	0.053	1.504	0.307
Iron (mg/L)	1.23	9237	2136	<0.04	559	156
Lead (mg/L)	<0.002	0.310	0.039	<0.017	<0.017	<0.017
Manganese (mg/L)	0.48	336	38.70	1.52	15.00	7.53
Nickel (mg/L)	<0.050	14.44	4.712	0.107	1.927	0.784
Zinc (mg/L)	0.06	28.33	8.96	0.28	6.60	2.46
pH	1.55	3.88	2.46	1.94	3.29	2.74
Eh (mV)	506	817	628	556	858	686
Sulfate (mg/L)	326	33400	7877	473	4865	2099

Notes to Table 1:
[1] Metal values are dissolved metal concentrations.
[2] Groundwater data come from wells DCB-1A, 10, 18A, 18B, 19A, 19B, 21A, 21B, 22A, and 22B (1984-1997); for wells DCB-1A, 18A, 18B, 22A, and 22B data were collected before DIW-1 was installed (Sources: GIMS database and unpublished data collected for the D-Area Mag Sep project).
[3] Groundwater data collected and analyzed during this study from upgradient wells DCB-19A, 19B, 21A, and 21B; data from wells downgradient of the wall (DCB-18A, 18B, 22A, and 22B) and piezometers in the wall are not included.

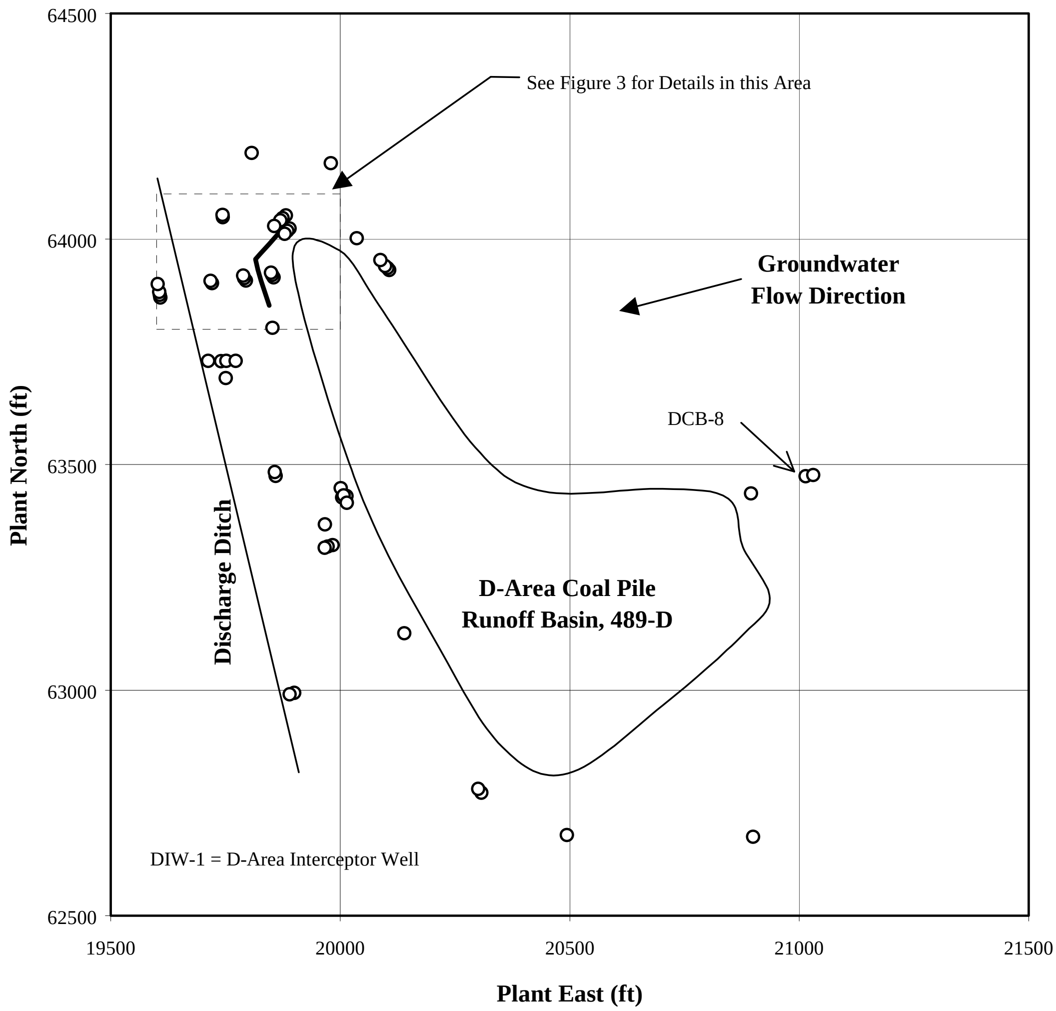

Figure 2. D-Area Coal Pile Runoff Basin Map

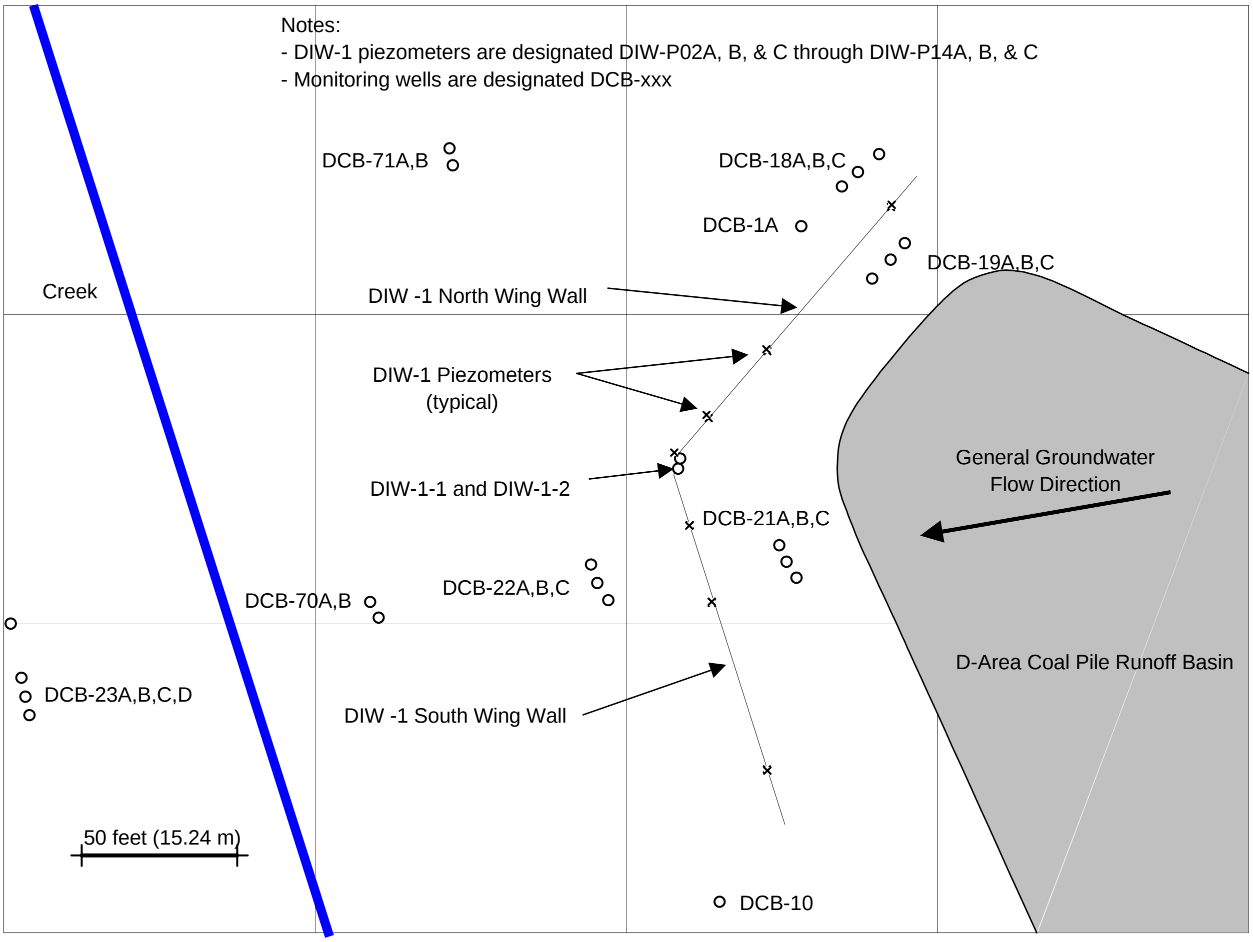

Figure 3. D-Area Interceptor Well (DIW-1) Map

3.3 SULFATE REDUCTION OVERVIEW

Microorganisms that couple the oxidation of carbon substrates to the reduction of sulfate for energy production and growth are known as SRB. In this process sulfate serves the same function as oxygen does for aerobic respiration (i.e. terminal electron acceptor). However SRB cannot use oxygen as terminal electron acceptors. In fact oxygen is toxic to SRB above trace levels.

For sulfate to be reduced by SRB either hydrogen or a carbon substrate must be oxidized. While hydrogen oxidation provides energy, a carbon substrate provides both energy and carbon for growth. Lactate and pyruvate are almost universally used as carbon sources and electron donors by SRB (Fauque 1995; Ehrlich 1996). In addition, SRB have also been shown to use malate, formate, fatty acids and some alcohols for growth and energy production (Fauque 1995; Ehrlich 1996).

Other more complex carbon sources can ultimately be utilized by SRB. For this to occur SRB must rely on other non-sulfate reducers to partially breakdown the more complex carbon sources. For instance complex organic compounds can be degraded to short chain fatty acids by other bacteria and then utilized by SRB. Vegetable oil has been used in the bioremediation industry as a slow release carbon source and based on results to date is viewed favorably. Vegetable oil can provide a significant amount of carbon to SRB as a result of its breakdown by fermentative bacteria. Additionally the breakdown of more complex carbon sources may also result in conditions more favorable to SRB. For instance fermenting decreases Eh values to between 0 and –150 mV (Fenchel et al. 1998; Thomas et al. 1999). This Eh range is most favorable for SRB. Also, if oxygen is present, aerobic heterotrophs scavenge the oxygen during carbon oxidation, thereby creating anaerobic conditions that are suitable for SRB growth.

The ubiquity of SRB in the environment and their ability to catalyze biogeochemical transformation of minerals has been exploited for use in bioremediation. During growth of SRB a carbon substrate such as lactate is oxidized and sulfate is reduced to H2S. H2S can also react with metals in the environment and result in their immobilization via the formation of reduced minerals. When SRB oxidize a carbon source the resulting HCO_3^- can serve to buffer the system and help to increase pH. The increased pH can also result in metal immobilization through metal hydroxide formation. Under certain conditions, the production of carbonate in turn can react with metals to form carbonate minerals. In a 91-day continuous-flow column study, lactate was used as a carbon source and added to synthetic river water that passed through columns consisting of fluvioglacial silica (SiO_2) and calcite sands (von Gunten and Zobrist 1993). Furrer et al (1996) later modeled steady-state conditions for this experiment focusing on turnovers of carbon and sulfur in relation to calcium and iron. They determined that after the addition of 3.6 mM of lactate into a soil column, 1.1 mM of carbonate resulted from lactate oxidation. The remaining carbon was in the form of proprionate (0.8 mM) and acetate (1.5 mM). Presumably if this study were carried out longer than 91 days or if initial lactate concentrations were lower, some other strains of SRB would have oxidized the remaining acetate and proprionate. The microbially mediated sulfate reduction process can be expressed in simplified form as follows:

$$2CH_3CHOHCOO^- + 3SO_4^{-2} + 2H^+ \rightarrow 6HCO_3^- + 3H_2S$$ (Benner et al. 1999).

Though the conditions of the Furrer et al (1996) study are different from this study, it does illustrate one possibility for stabilization of metals.

In addition to a carbon substrate SRBs require nitrogen and phosphorous. These elements are important in cellular growth and energy production. The amounts needed depend on the bacterial density at a given site and the bacteria's physiological state (i.e. growing or just maintaining activity). Assuming growth conditions are being met, if 1 gram of sediment contains 10^8 bacteria, approximately 0.02 mM of phosphorus per kilogram is required for the population to double. Phosphorous is often assimilated as phosphate (PO_4^{-3}). Nitrogen requirements are usually 5 times that of phosphorous, so for 10^8 cells/kilogram of soil, about 0.1 mM of nitrogen is required. Supplemental nitrogen is usually in the form of ammonium (NH_4^+) but can also be in the form of nitrate (NO_3^-). Overall, the required ratio of carbon:nitrogen:phosphorous (C:N:P) is generally considered to be 100:5:1. So if 670 mM of lactate can result in the reduction of 1 M of SO_4^{-2} over a length of time, the cumulative amounts of nitrogen and phosphorous required are 33.5 and 6.7 mM, respectively. In an aquifer where groundwater is continuously moving past the sediment, a constant influx nitrogen and phosphorus source is likely.

SRB grow best in a pH range from 5.5 – 9.0. However sulfate reduction has been recorded from acid mine drainage and a fresh water peat bog with pH values as low as 2.5. Similarly, SRB activity can occur under Eh conditions higher than the optimal Eh. Growth under non-optimal conditions may be due to the formation of biofilms of SRB around geologic substrates that provide a more alkaline microenvironment and therefore allow sulfate reduction to occur under otherwise harsh conditions

Competition for carbon and energy sources is also a part of the ecology of SRB. SRB compete for carbon substrates and micronutrients with both aerobic bacteria and other anaerobic bacteria that can utilize terminal electron acceptors other than sulfate. The major anaerobic competitors use the following as terminal electron acceptors; NO_3^- (nitrate reducers), Mn^{+4} (manganese reducers), Fe^{+3} (iron reducers) and CO_2 (methanogens). The thermodynamic favorability for each class of bacteria proceeds in the following order: aerobic bacteria ($O_2 \rightarrow H_2O$), nitrate reducers ($NO_3^- \rightarrow NO_2^- \rightarrow N_2O \rightarrow N_2$), manganese reducers ($MnO_2 \rightarrow MnCO_3$), iron reducers ($FeOOH \rightarrow FeCO_3$), sulfate reducers ($SO_4^{-2} \rightarrow HS^-$), and methanogens ($CO_2 \rightarrow CH_4$). While thermodynamics play a part in determining which organisms out-compete for carbon substrates, other factors also must be considered. Some SRB have been shown to assimilate nitrate as a building block for protein production and thereby decrease the available nitrate for competing anaerobes. In addition the concentration of terminal electron acceptors also plays a significant part. Oxygen is not only a terminal electron acceptor for competing aerobic bacteria, but it is toxic to many SRB even though they have been reported to tolerate small quantities of oxygen (Fauque 1995). When sulfate concentrations are high, SRB are expected to predominate. Another competitive advantage of SRB is the toxic nature of their end product, H_2S, to other bacteria. In addition, H_2S is a highly reductive compound, which has the potential of reducing terminal electron acceptors and thereby rendering them thermodynamically useless for competing microbes.

3.4 SULFATE REDUCTION VERSUS DCPRB GEOCHEMISTRY

Remediation by sulfate reduction would aid in reducing metal concentrations and raising the pH of the contaminated groundwater emanating from the DCPRB. The high sulfate concentrations relative to concentrations of other constituents needed by microbial competitors (e.g. O2, NO3-, Mn+4, and Fe+3) favors the growth of SRB. However, the low organic carbon, low pH and high Eh present in the plume are not advantageous for SRB growth. The rate at which SRB growth occurs is largely dependent on the type and amount of organic carbon entering the system as well as the concentration of available terminal electron acceptors (i.e. sulfate). Due to the low organic carbon concentrations at this site, SRB growth is expected to be slow. In which case the rate of metal biotransformation is also expected to be slow. In order to accelerate metal transformation rates under low carbon conditions, at a minimum the addition of organic substrates is required. Based upon the literature review and feasibility evaluation (Phifer et al. 2001) Hydrogen Release Compound (HRC), sodium lactate, and soybean oil were selected for further evaluation as organic substrates through laboratory testing. The addition of organic substrates to promote microbially mediated sulfate reduction would result in an increase in pH and decrease in Eh (i.e. toward conditions more favorable to SRB growth). In addition to a carbon source, other amendments such as a base, nitrogen, and phosphate may be beneficial to SRB growth. Additional information concerning optimal conditions for sulfate reduction versus groundwater chemistry is provided in the literature review and feasibility report completed prior to this study (Phifer et al. 2001).

3.5 DIW-1 CONFIGURATION AND HYDROGEOLOGY

As outlined previously the location, configuration, and physical condition of DIW-1 makes it one of the best possible installations for the injection of liquid organic substrates into the most highly contaminated portion of the plume (Phifer et al. 2001 and Sappington et al. 2002). The following sections provide background information on the DIW-1 configuration and the hydrology in the immediate vicinity of DIW-1.

3.5.1 DIW-1 Configuration

In 1995 an experimental subsurface construction technique was demonstrated adjacent to the northwest corner the DCPRB. The demonstration consisted of the construction of a groundwater extraction system, designated DIW-1. DIW-1 was constructed within in the water table aquifer in the most highly contaminated portion of the plume. A plan view of DIW-1 and adjacent monitoring wells is provided in Figure 3. It consists of a 2-foot wide by 30-foot deep by 240-foot long trench divided into two 120-foot long wings designated the south and north wings. A vertical high-density polyethylene (HDPE) membrane was installed down the middle of the trench with coarse gravel pack on either side of the membrane. Multiple vertical and horizontal screened zones assessable from the land surface were embedded in the gravel pack on either side of the membrane. A generalization (to scale) of the upgradient cross-section of DIW-1 is provided in Figure 4. The following provides a detailed description of the components of DIW-1:

- An approximately 30-feet deep by 240-feet long by 80 mil vertical HDPE membrane,
- Coarse gravel pack (Foster-Dixianna FX-99) on either side of the membrane with a measured saturated hydraulic conductivity of 0.45 centimeters per second (cm/s),
- Four 6-inch diameter, stainless steel, vertical well screens connected to the central sump and located within the gravel pack on the upgradient side of the membrane. Two of the vertical well screens, which are accessible from above grade, are designated DIW-1-1 and DIW-1-2 and are shown on Figure 4. The other two vertical well screens, which are not accessible from above grade, are not shown on Figure 4. Detailed information concerning the two accessible DIW-1 well screens is provided in Table 2.
- Four 3-inch diameter, HDPE, horizontal slotted drainage pipes (laterals) connected to the central sump located within the gravel pack on the upgradient side of the membrane. Two laterals extend out along each of the two wings of the HDPE membrane from its center point. One lateral (not shown on Figure 4) is located within the gravel pack on the downgradient side of the membrane. Each lateral is accessible from above grade through its own vertical riser. The laterals are designated laterals 1, 2, 3, 4, and 5. Detailed information concerning these laterals is provided in Table 3.
- The vertical well screens and laterals are all attached to one central sump
- Six piezometer clusters (three piezometers each) are located within the gravel pack on the upgradient side of the membrane, and seven piezometer clusters (three piezometers each) are located within the gravel pack on the downgradient side of the membrane. Only the upgradient piezometers are shown on Figure 4. All piezometers are vertical and accessible from above grade. The clusters are spread out along the length of the membrane, and the piezometers in each cluster are screened at different elevations within the gravel pack. The

piezometers are designated DIW-P02A, B, and C through DIW-P14A, B, and C. Detailed information concerning these DIW-1 piezometers is provided in Table 2.

(Phifer et al. 1996)

Table 4 provides detailed information concerning the monitoring wells adjacent to DIW-1.

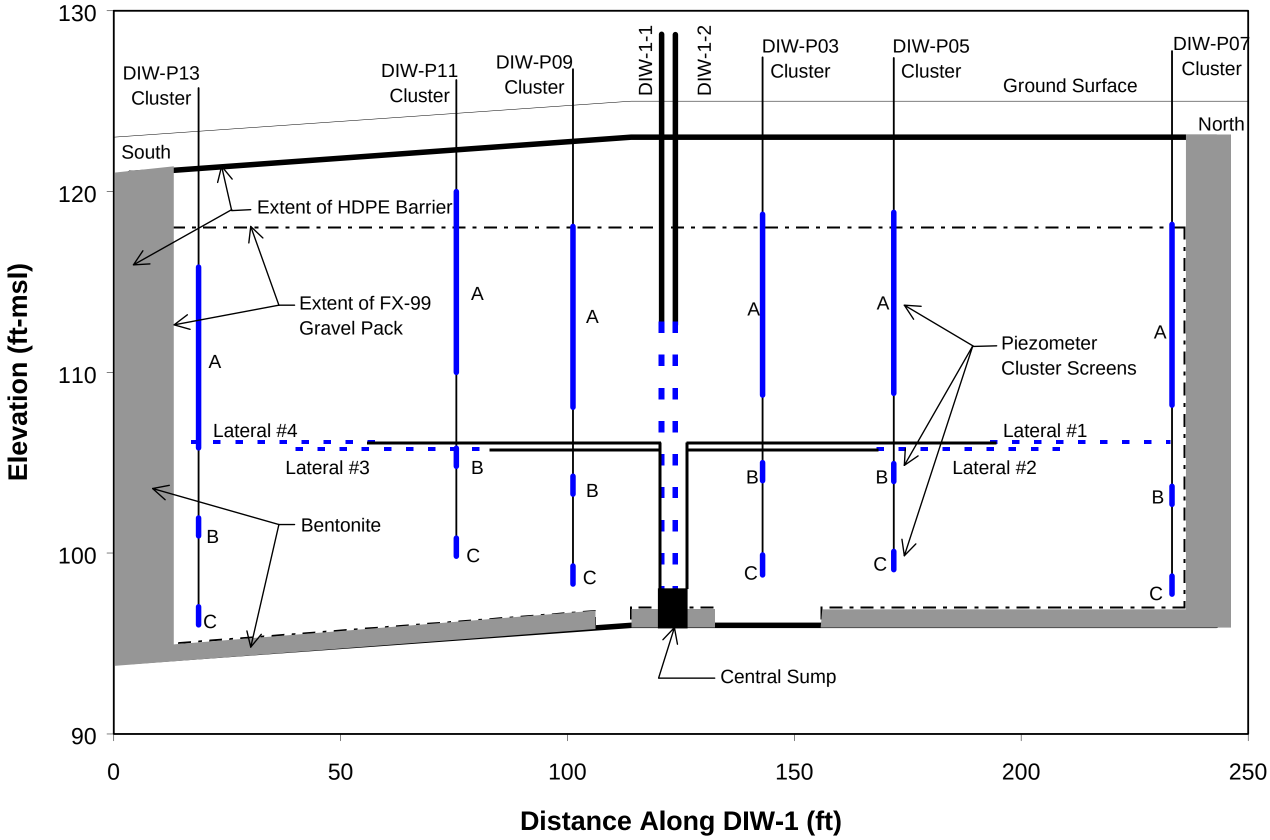

Figure 4. DIW-1 Upgradient Cross-Section

Table 2. DIW-1 Well Screens and Piezometers

Well Screen or Piezometer	Coordinates (ft)		Diameter (inches)	Elevation (ft-msl)			Location
	North	East		TOCg	TOS	BOS	
Wells Screens							
DIW-1-1	63950.06	19816.72	6	128.69	~113	~98	Up; Central
DIW-1-2	63953.41	19817.36	6	128.68	~113	~98	Up; Central
Piezometers							
DIW-P02A	63955.33	19815.47	2	128.47	119.57	109.57	Down; Central
DIW-P02B	63955.38	19815.76	1	128.47	105.66	104.66	Down; Central
DIW-P02C	63955.49	19815.38	1	128.48	100.72	99.72	Down; Central
DIW-P03A	63966.49	19826.34	2	127.42	118.74	108.74	Up; North
DIW-P03B	63966.47	19826.54	1	127.44	105.00	104.00	Up; North
DIW-P03C	63966.32	19826.48	1	127.42	99.90	98.90	Up; North
DIW-P04A	63967.54	19825.79	2	127.39	119.04	109.04	Down; North
DIW-P04B	63967.33	19825.74	1	127.43	105.14	104.14	Down; North
DIW-P04C	63967.58	19825.92	1	127.41	100.27	99.27	Down; North
DIW-P05A	63988.31	19845.14	2	127.41	118.84	108.84	Up; North
DIW-P05B	63988.12	19845.39	1	127.42	104.96	103.96	Up; North
DIW-P05C	63988.27	19845.40	1	127.39	100.09	99.09	Up; North
DIW-P06A	63988.70	19845.07	2	127.44	119.03	109.03	Down; North
DIW-P06B	63988.75	19845.23	1	127.44	105.13	104.13	Down; North
DIW-P06C	63988.38	19845.07	1	127.45	100.33	99.33	Down; North
DIW-P07A	64034.84	19885.04	2	127.77	118.18	108.18	Up; North
DIW-P07B	64034.74	19885.10	1	127.76	103.70	102.70	Up; North
DIW-P07C	64034.97	19885.09	1	127.76	98.73	97.73	Up; North
DIW-P08A	64035.44	19885.30	2	127.27	117.27	107.27	Down; North
DIW-P08B	64035.63	19885.34	1	127.78	103.53	102.53	Down; North
DIW-P08C	64035.33	19885.40	1	127.80	98.48	97.48	Down; North
DIW-P09A	63931.68	19820.54	2	126.80	118.07	108.07	Up; South
DIW-P09B	63931.85	19820.39	1	126.81	104.26	103.26	Up; South
DIW-P09C	63931.55	19820.52	1	126.76	99.29	98.29	Up; South
DIW-P10A	63931.72	19820.24	2	126.77	117.84	107.84	Down; South
DIW-P10B	63931.59	19820.25	1	126.77	104.06	103.06	Down; South
DIW-P10C	63931.77	19820.08	1	126.79	99.07	98.07	Down; South
DIW-P11A	63906.85	19827.54	2	126.19	120.00	110.00	Up; South
DIW-P11B	63906.69	19827.58	1	126.19	105.80	104.80	Up; South
DIW-P11C	63906.80	19827.52	1	126.17	100.83	99.83	Up; South
DIW-P12A	63907.06	19827.44	2	126.20	119.02	109.02	Down; South
DIW-P12B	63907.06	19827.19	1	126.19	105.17	104.17	Down; South
DIW-P12C [1]	63906.89	19827.37	1	126.17	101.33	100.33	Down; South
DIW-P13A	63852.96	19845.35	2	125.74	115.82	105.82	Up; South
DIW-P13B	63852.87	19845.22	1	125.71	101.95	100.95	Up; South
DIW-P13C	63852.87	19845.41	1	125.72	97.03	96.03	Up; South
DIW-P14A	63852.43	19845.34	2	125.52	115.52	105.52	Down; South
DIW-P14B	63852.64	19845.19	1	125.72	101.62	100.62	Down; South
DIW-P14C	63852.37	19845.51	1	125.68	96.64	95.64	Down; South

Notes to Table 2:
TOCg = top of casing; TOS = top of screen; BOS = bottom of screen; Up = upgradient side of DIW-1; Down = downgradient side of DIW-1; Central = center of DIW-1; North = north DIW-1 wing wall; South = south DIW-1 wing wall
The odd numbered piezometer clusters are on the upgradient side of DIW-1 and the even are on the downgradient side. Piezometer clusters 9, 10, 11, 12, 13, and 14 are in the DIW-1 South wing wall, and clusters 3, 4, 5, 6, 7, and 8 are in the North DIW-1 wing wall. The DIW-P02 piezometer cluster is in the center of DIW-1 on the downgradient side. DIW-1-1 and DIW-1-2 are in the center of DIW-1 on the upgradient side of DIW-1.
[1] DIW-12C does not respond to DIW-1 pumping, therefore it is assumed that the DIW-12C screen is plugged with bentonite

Table 3. Perforated Zones of DIW-1 Laterals

Laterals	Coordinates (ft)		Coordinates (ft)		Diameter (inches)	Elevation (ft-msl)
	North	East	North	East		
1	~64,034	~19,885	~64,005	~19859	3	~106
2	~64,018	~19,870	~63,986	~19,843	3	~106
3	~63,914	~19,826	~63,874	~19,839	3	~106
4	~63,890	~19,834	~63,852	~19,846	3	~106
5	~63,948	~19,815	~63,874	~19,839	3	~106

Note to Table 3: Laterals 1 through 4 are on the upgradient side of DIW-1 and 5 is on the downgradient side

Table 4. Monitoring Wells

Well Id	Coordinates (ft)		Diameter (inches)	Elevation (ft-msl)			
	North	East		TOR	TOCg	TOS	BOS
DCB-8	63473.9	21014.1	4	137.2	-	130.3	110.3
DCB-1A	64028.5	19856.3	4	127.3	-	120.1	90.1
DCB-10	63803.1	19852.3	4	124.11	-	119.8	99.8
DCB-18A	64051.83	19881.29	2	-	127.03	119.79	109.79
DCB-18B	64046.05	19874.46	2	-	127.01	101.958	99.458
DCB-18C	64041.36	19869.38	2	-	126.95	89.821	87.321
DCB-19A	64023.03	19889.59	2	-	128.44	120.33	110.33
DCB-19B	64017.71	19885.02	2	-	128.19	102.28	99.78
DCB-19C	64011.57	19879.06	2	-	128.17	90.18	87.68
DCB-21A	63914.82	19854.71	2	-	128.22	119.659	109.659
DCB-21B	63920.02	19851.54	2	-	128.23	104.869	102.369
DCB-21C	63925.28	19849.19	2	-	128.44	91.012	88.512
DCB-22A	63907.57	19794.23	2	-	127.15	119.5	109.5
DCB-22B	63913.1	19790.73	2	-	126.87	103.1	100.6
DCB-22C	63919.08	19788.73	2	-	127.24	90.3	87.8
DCB-23A	19608.26	63870.38	2	-	121.13	115.489	105.5
DCB-23B	19606.95	63876.31	2	-	121.23	96.613	94.113
DCB-23C	19605.68	63882.48	2	-	120.99	90.96	88.46
DCB-23D	19602.21	63899.96	2	-	120.88	51.6	49.1
DCB-70A	19720.47	63901.87	2	119.22	118.9	115.08	105.08
DCB-70B	19717.73	63907.03	2	118.93	118.61	95.77	90.74
DCB-71A	19744.3	64048.23	2	119	118.63	114.4	104.38
DCB-71B	19743.28	64053.71	2	118.63	118.3	95.2	90.18

Notes for Table 4:
TOR = top of riser; TOCg = top of casing; TOS = top of screen; BOS = bottom of screen

Monitoring well clusters DCB-19A, B, & C and DCB-21A, B, & C are upgradient of DIW-1; all other wells, except DCB-8, which is a DCPRB background monitoring well, are considered downgradient of DIW-1

3.5.2 DIW-1 Hydrology

DIW-1 is a partially penetrating well screened within the upper most contaminated portion of the water table aquifer. DIW-1 extends from the ground surface at an approximate elevation of 125 ft-msl to an approximate elevation of 96-ft-msl. Within DIW-1 itself the water table elevation ranges from 110 to 117 ft-msl, therefore DIW-1 intercepts the top 14 to 21 feet of the water table aquifer. The “green clay” aquitard is at an approximate elevation of 67-ft-msl, approximately 29 feet below the bottom of DIW-1. DIW-1 is divided into two wings, the South and North wings (see Figure 3 (Phifer et al. 1996). The South wing is essentially perpendicular to the primary direction of groundwater flow, whereas the North wing is close to a forty five-degree angle to the primary direction of groundwater flow. Additionally the South wing typically is closer to the standing water in DCPRB. All this implies that the South wing intercepts a higher flux of groundwater than intercepted by the North wing.

Well clusters and piezometers DCB-20, DCB-21, DIW-P11A, DIW-P12A, DCB-22, and DCB-23 form a line across the northern corner of the DCPRB, which intersects DIW-1 and the discharge ditch. Piezometers DIW-P11A and DIW-P12A are installed on the upgradient and downgradient sides of the DIW-1 HDPE membrane, respectively, within the DIW-1 gravel pack. The water table surface profile along this line of wells and DIW-1 piezometers is shown in Figure 5. This profile is based upon the Table 5 water levels obtained on January 25, 1996, after DIW-1 had been installed but prior to pumping the well. When DIW-1 is not being pumped, it blocks horizontal groundwater flow from DCPRB toward the discharge ditch and directs contaminated groundwater flow from the upper, low hydraulic conductivity zone to the lower, high hydraulic conductivity, sand layers below, as shown in Figure 5. Groundwater flow on either side of DIW-1, even on the “downgradient” side for some small distance, is toward DIW-1 and then downward through DIW-1 (Phifer et al. 1996). The estimated residence time of contaminated groundwater within the system is eleven days under these conditions (Phifer et al. 2003a).

During December 2001 each DIW-1 lateral was pumped and drawdown measurements were made in order to determine if there had been any significant reduction in its hydraulic performance over its initial 1996 performance (Phifer et al. 1996). Based upon specific capacity measurements no significant degradation in hydraulic performance occurred from 1996 to 2001. The 1996 and 2001 specific capacities were essentially the same at 1.60 gpm/ft and 1.67 gpm/ft, respectively (Sappington et al. 2002).

Additionally the testing was performed to determine the efficacy of utilizing DIW-1 for the injection of an organic carbon substrate into the DCPRB acidic/metals/sulfate plume. It was determined that significant interconnection exists throughout the entire upgradient side of DIW-1, due to the coarse gravel pack and the multiple interconnected vertical and horizontal screen zones. Based upon this it was concluded that injection of a liquid organic carbon substrate should be relatively easy and that even distribution of the substrate across the entire cross section of DIW-1 should occur (Sappington et al. 2002).

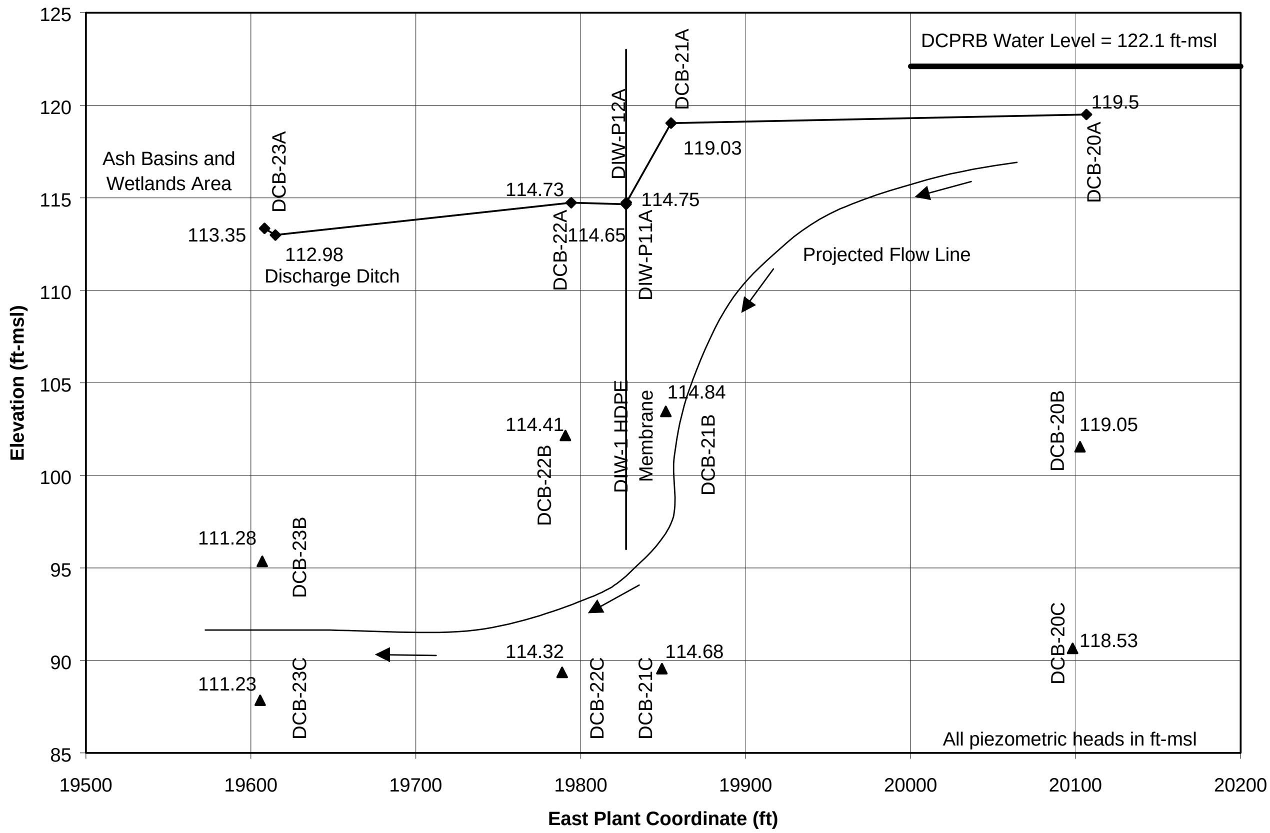

Figure 5. Water Table Profile and Projected Flow Line across DIW-1

Table 5. Selected DCPRB Water Levels (1/25/96)

Well/Location	TOS (ft-msl)	BOS (ft-msl)	1/25/96 Water Elevation (ft-msl)
DCPRB	NA	NA	122.10
DCB-20A	120.9	110.9	119.50
DCB-20B	102.8	100.3	119.05
DCB-20C	91.9	89.4	118.53
DCB-20D	48.7	46.2	117.18
DCB-21A	120.1	110.1	119.03
DCB-21B	104.7	102.2	114.84
DCB-21C	90.8	88.3	114.68
DIW-P11A	120.0	110.0	114.75
DIW-P12A	119.02	109.02	114.65
DCB-22A	119.8	109.8	114.73
DCB-22B	103.4	100.9	114.41
DCB-22C	90.6	88.1	114.32
Discharge Ditch	NA	NA	112.98
DCB-23A	115.7	105.7	113.35
DCB-23B	96.6	94.1	111.28
DCB-23C	89.1	86.6	111.23
DCB-23D	51.6	49.1	114.31

Notes to Table 5:
TOS = Top of screen; BOS = Bottom of screen
1) The top of the green clay is at an approximate elevation of 65 to 69 ft-msl
2) The wells highlighted in gray are screened in the Gordon aquifer
(Phifer et al. 1996)

3.6 LABORATORY TESTING RESULTS AND CONCLUSIONS

Laboratory testing was conducted to assess the D-Area subsurface physical, chemical and biological parameters for bioremediation potential. The potential for microbial growth was also examined for several organic carbon substrates. This laboratory testing was documented in Turick et al. (2002).

The goal of bioremediation at D-Area is immobilization of soluble metals by in-situ hydrogen sulfide production. This approach requires an existing population of SRB. In addition to a carbon substrate, a mixed microbial population of sufficient size is required to support the growth and activity of SRB. Conditions that support SRB activity include anaerobic conditions and a pH near neutrality. Based on the test results the following have been determined:

1) SRB are present in the vicinity of DIW-1 ranging in population size from 1-30 cells per milliliter of water or grams of sediment.

2) SRB are associated with the groundwater near DIW-1.

3) The mixed microbial community is capable of both anaerobic and aerobic growth with rich or minimal nutrient media at a pH range from 4-7. This indicates a robust population capable of establishing anaerobic conditions in the D-Area subsurface.

Aerobic bacteria decrease oxygen concentrations in the subsurface and create anaerobic conditions. The presence of anaerobic heterotrophic bacteria indicated that nutrient breakdown is possible, thus ensuring nutrient requirements of SRB will be met. Based upon this laboratory study, it was determined that microbial growth, including sulfate reduction will occur with the addition of the proper carbon and energy sources.

The potential for microbial growth was examined in this laboratory study by the addition of either lactate, HRC or soybean oil to sealed, anaerobic microcosms containing groundwater and sediment from D-Area. Sodium lactate and the lactate containing commercial compound, HRC, were chosen because lactate is regarded as a universal carbon and energy source for SRB. The addition of lactate into the subsurface should therefore elicit a rapid increase in SRB activity and growth due to its high level of solubility in water. Soybean oil and HRC were regarded as a "slow-release" nutrients that could be injected in high volume periodically and gradually dissolve into the groundwater due to their low solubility in water. This laboratory study examined the feasibility of using these carbon sources for bioremediation at D-area and the following conclusions were reached:

1) Both lactate and HRC demonstrated inhibitory effects on SRB activity. HRC decreased the pH of the microcosms and appeared to have a negative effect on microbial growth in general. Sodium lactate inhibited SRB activity but was capable of stimulating non-SRB microbial activity. In addition, the pH increased upon addition of sodium lactate. Inhibitory conditions resulting from lactate were concentration dependent with no inhibition evident with less than 1% of a 60% sodium lactate solution (i.e. 6.3 g/L lactate). Soybean oil was capable of stimulating the microbial population as a whole including SRB. Hydrogen sulfide was detected in soybean oil amended microcosms. Lactate does serve as a carbon and energy source to D-Area SRB but may have inhibitory effects above 1-% concentrations. In both lactate and soybean oil treated microcosms, volatile fatty acid (VFA) production was detected, indicating bacterial activity as well as carbon source breakdown. VFA production reached an apparent steady state concentration that indicates that SRBs are utilizing VFAs as carbon sources. Soybean oil will serve as an effective carbon and energy source to the mixed population, including SRB.

2) SRB were detected in microcosms under typical subsurface pH conditions. However, pH amended microcosms demonstrated increased SRB density and activity indicating that pH adjustment as a function of bacterial growth would increase the rate of SRB growth and hence hydrogen sulfide production.

3.7 BACKGROUND SUMMARY

A literature review and feasibility evaluation (Phifer et al. 2001) and laboratory study (Turick et al. 2002) were conducted to determine the feasibility and practicability of sulfate reduction remediation of the D-area acidic/metals/sulfate groundwater plume. From these studies it has been determined that remediation by sulfate reduction would aid in reducing metal concentrations and raising the pH of the contaminated groundwater. The high sulfate concentrations relative to concentrations of other constituents needed by microbial competitors favors the growth of SRB. Additionally SRB are naturally present within the groundwater in the vicinity of DIW-1. However, the low organic carbon, low pH and high Eh present in the plume are not advantageous for SRB growth. At a minimum the addition of an organic substrate(s) is required to promote sulfate reduction remediation. Both sodium lactate and soybean oil are capable of stimulating the microbial population as a whole including SRB. However sodium lactate may have inhibitory effects above concentrations of 1% (i.e. 6.3 g/L of lactate).

Based upon these studies it was concluded that the plume could be remediated with sulfate reduction combined with Monitored Natural Attenuation (MNA). Soybean oil and sodium lactate were selected as the organic substrates for injection during the subsequent pilot scale field demonstration described within the remainder of this report. The soybean oil is intended to provide a long-term, slow release, carbon source for the SRB, and the sodium lactate is intended to provide a short-term, immediately available carbon source. Due to the location, configuration, and physical condition of DIW-1, it was decided to use it as the injection system for injection of sodium lactate and soybean oil during the subsequent field demonstration.

4.0 STUDY OBJECTIVE AND FOCUS

As outlined within the Treatability Study Work Plan (WSRC 2001) and the Field Scoping Plan (Phifer et al. 2002), the DIW-1 Field Organic Application focused upon answering the following questions:

1. Does the field application of sodium lactate and/or soybean oil (substrates) promote long-term sulfate reduction, a subsequent increase in the SRB population and pH level, and a subsequent decrease in metals concentration in the vicinity of DIW-1?
2. What is the optimal application frequency and mass of the substrates to inject into the DCPRB contaminated groundwater through DIW-1?
3. How does the SRB population change in the DCPRB contaminated groundwater with the application of the substrates?
4. How do the total bacteria population and bacteria type change in the DCPRB contaminated groundwater with the application of the substrates?
5. How do the soluble organic concentrations change in the DCPRB contaminated groundwater with the application of the substrates?
6. How do the pH and Eh change in the DCPRB contaminated groundwater with the application of the substrates?
7. How do the heavy metal and sulfate concentrations change in the DCPRB contaminated groundwater with the application of the substrates?
8. Does there appear to be a sufficient, continual influx of micronutrients (nitrogen as ammonia or nitrate and phosphate) to support SRB?

THIS PAGE INTENTIONALLY LEFT BLANK

5.0 STUDY IMPLEMENTATION

5.1 ORGANIC SUBSTRATE FIELD APPLICATION

5.1.1 Application Overview

Soybean oil and sodium lactate were injected into the contaminated aquifer through selected Table 2 and 3 DIW-1 well screens, piezometers, and laterals. Section 3.5 provides a detailed description of DIW-1, and Figure 4 provides an upgradient cross-sectional view of DIW-1. Additionally groundwater from existing monitoring well DCB-8 (see Figure 2) was used in conjunction with the 60% sodium lactate injection to reduce its viscosity and flush it out of the DIW-1 well screens, piezometers, and laterals. Finally sampling purge water from the piezometers and downgradient wells, which could contain the injected organics, was reinjected into DIW-1 through DIW 1-2. Table 6 provides a summary of the injected volumes during this phase of the project by date. The use of potable water in lieu of DCB-8 groundwater was authorized in the permitting documents however no potable water was utilized.

Table 7 provides pertinent properties of the soybean oil and sodium lactate. Table 8 provides the maximum quantities of organic substrates, DCB-8 groundwater and/or potable water, and purge water that could be injected during this field study phase per the approved Underground Injection Control Permit (UIC). Table 8 also includes the actual injected volumes. As seen in the table the maximum quantities were not exceeded. Injection details including information on the injection points, total quantity injected per injection event, the method of injection, and the injection event frequency/schedule are provided below.

Soybean oil was injected by pumping into the upgradient side of both the North and South DIW-1 wing walls. Soybean oil was injected through DIW-1-2 and the upgradient DIW-1 "A" piezometers (see Table 9). The actual injection points could have been any of the upgradient Table 2 or 3 DIW-1 laterals, wells, and piezometers. A total of 825 gallons of soybean oil was injected during two separate injections events, to the maximum amount of soybean oil allowed by the UIC permit.

Sodium lactate was injected by pumping into the upgradient side of the South DIW-1 wing wall only. Sodium lactate was injected through upgradient DIW-1 "A" piezometers and laterals in the South wing wall (see Table 10). The actual injection points could have been any of the upgradient South wing wall laterals, wells, and piezometers listed in Tables 2 or 3. When lateral 3 was used for injection, it was isolated from the DIW-1 central sump with a packer. Fifteen gallons of sodium lactate was injected per injection event for the first 14 events and 17.5 gallons of sodium lactate for 15th and final injection (Table 11). Sodium lactate injection events were conducted a maximum of once a week for eight weeks, 12-16 days apart for the next 4 events, approximately 3 weeks apart for the next 2 events, followed by a final event approximately one month later, which equates to fifteen injection events. Fourteen injection events at fifteen gallons each and one at seventeen and one half gallons equates to a total of 227.5 gallons of sodium lactate. The UIC permit allowed the injection of a maximum 2000 gallons of 60% sodium lactate.

The 60% Sodium Lactate was blended with an approximately equal volume of DCB-8 groundwater prior to injection to reduce its viscosity and concentration, in order to facilitate injection and subsequent sulfate reduction. DCB-8 groundwater was also injected after the sodium lactate to flush it out of the well screens, piezometers or laterals. Approximately 5 gallons and 55 gallons of DCB-8 groundwater were used to flush the piezometers and laterals, respectively. Based upon the actual injection points and volume of sodium lactate injected per injection event, 82 to 90 gallons of DCB-8 groundwater were injected for 13 of the 15 injection events. During 8th and 9th events when only DIW-1 piezometers were used for injection, 30 and 34.5 gallons respectively, of DCB-8 groundwater were injected. For the fifteen events a total of 1,169 gallons of DCB-8 groundwater was injected. The UIC permit allowed the injection of a maximum 10,000 gallons of DCB-8 groundwater or potable water (see Table 8).

Monitoring well DCB-8 is screened in the water table aquifer (Upper Three Runs Aquifer (UTRA)), adjacent to and upgradient of DCPRB (i.e., the same aquifer containing the DCPRB low pH/metals/sulfate plume, See Figure 2). The use of DCB-8 groundwater with the sodium lactate had the added benefit of augmenting the SRB population (i.e. bioaugmentation) of the groundwater in the vicinity of DIW-1.

Downgradient monitoring well purge water including DIW-1 piezometer sampling, which could contain the injected organics or their degradation products, was recycled back into the system by injection into DIW-1 through DIW-1-2. All DIW-1 piezometers (see Table 2) and all monitoring wells (see Figure 3 and Table 3) located immediately downgradient of DIW-1 were assumed to contain the injected organics or their degradation products.

Table 6. Field Task and Injection Summary

Field Task	Actual Dates	Purge Water [1] (gallons)	Sodium Lactate (gallons)	DCB- 8 Ground-water (gallons)	Soybean Oil (gallons)
Pre-Injection Tier 2 and 3 Monitoring and Sampling	6/24/02 - 7/3/02	0.0			
1st Soybean Oil Injection	7/15/02				440
1st Sodium Lactate Injection	7/16/02		15	90	
2nd Sodium Lactate Injection	7/23/02		15	85	
Tier 1 Monitoring and 3rd Sodium Lactate Injection	7/30/02	0.0	15	85	
4th Sodium Lactate Injection	8/6/02		15	85	
Tier 1 Monitoring and 5th Sodium Lactate Injection	8/13/02	5.4	15	87	
6th Sodium Lactate Injection	8/20/02		15	85	
7th Sodium Lactate Injection	8/27/02		15	85	
Tier 1 Monitoring and 8th Sodium Lactate Injection	9/3/02	11.0	15	30	
1st Post-Injection Tier 2 and 3 Monitoring and Sampling	9/9/02 – 9/12/02	92.3			
9th Sodium Lactate Injection	9/19/02		15	34.5	
Tier 1 Monitoring and	9/24/02	5.5			
10th Sodium Lactate Injection	10/1/02		15	85	
Tier 1 Monitoring	10/7/02	5.5			
11th Sodium Lactate Injection	10/17/02		15	85	
Tier 1 Monitoring	10/22/02	6.3			
12th Sodium Lactate Injection	10/29/02		15	82	
2nd Post-Injection Tier 2 and 3 Monitoring and Sampling	11/4 – 11/6/02	72.0			
Tier 1 Monitoring and 13th Sodium Lactate Injection	11/18/02	8.0	15	83	
2nd Soybean Oil Injection	11/19 & 11/21/02				385
Tier 1 Monitoring	12/2 – 12/3/02	8.5			
14th Sodium Lactate Injection	12/9/02		15	83	
Tier 1 Monitoring	12/16/02	10.5			
15th and Sodium Lactate Injection	1/7/03		17.5	84.5	
3rd Post-Injection Tier 2 and 3 Monitoring and Sampling	1/13 – 1/14/03	110.0			
Tier 1 Monitoring	2/4/03	13.0			
Tier 1 Monitoring	3/4/03	10.0			
4th Post-Injection Tier 2 and 3 Monitoring and Sampling	3/31 – 4/4/03	85.0			
Tier 1 Monitoring	4/24/03	6.0			
Tier 1 Monitoring	6/4/03	6.5			
5th Post-Injection Tier 2 and 3 Monitoring and Sampling	7/14 – 7/15/03	60.0			
Total Part 1		96.2	227.5	1169.0	825.0

Notes to Table 6:
[1] Purge water produced from DIW-1 piezometer and downgradient monitoring well sampling, which could contain the injected organics, was reinjected into DIW-1 through DIW 1-2.

Table 7. Organic Substrate Properties

Property	Organic Substrate	
	Refined Soybean Oil [1]	Sodium Lactate [2]
Manufacture and Material Name	Cargill, Inc. (Cargill Technical Oils) Alkali Refined Soy Bean Oil Manufacture ID Code 452	Pfanstiehl Laboratories, Inc Sodium D-L Lactate Solution 60%, U.S.P. Product Code S-110
Composition	>99 Triglycerides: ~14.8% Saturated ~84.2% Unsaturated ~0.003-0.045% Phosphatides ~0.3% Unsaponifiable matter ~0.05% Free Fatty acids	~60% $C_3H_5O_3Na$ ~40% H_2O
Density, g/cm^3	0.920 – 0.925	1.323 at 20 °C (density can be reduced by adding water)
Physical Phase at 25 °C	Liquid	Aqueous solution
Viscosity, centipoises [3]	50.9 at 25 °C	80 – 160 at 20 °C (viscosity can be reduced by adding water)
Water Solubility	Negligible, less than 5%	Completely soluble
Flash Point, °F	>500 may be a Class IIIB Combustible Liquid	Not applicable
pH	Not relevant	6.8 – 8

Notes to Table 7:
[1] Data taken from Cargill, Inc. MSDS for alkali refined soybean oil (Manufacturer Identity Code 452), and Hui, 1996
[2] Data taken from Pfanstiehl Laboratories, Inc. MSDS for Sodium DL-Lactate Solution 60%, U.S.P. (Product Code or Stock Item S-110). The viscosity was taken from PURAC MSDS for Sodium-L-Lactate, PURASAL® S.
[3] Water viscosity at 25 °C is 0.894 centipoises

Table 8. Maximum UIC Permit Versus Actual Injection Volumes

Material	Maximum UIC Permit Injection Volume (gallons)	Actual Injection Volumes (gallons)
Soybean Oil	825	825
60% Sodium Lactate	2,200	227.5
DCB-8 Groundwater [1]	10,000	1169 [3]
Purge Water [2]	1,200	515.5

Notes to Table 8:
[1] Groundwater from monitoring well DCB-8 and/or potable water
[2] Purge water produced from DIW-1 piezometer and downgradient monitoring well sampling, which is likely to contain the injected organics, was reinjected into DIW-1 through DIW 1-2.
[3] Only DCB-8 groundwater was injected. No Potable water was injected.

Table 9. Soybean Oil Injection Details

Injection Point	Injection Method	1st Soybean Oil Injection 7/15/02 (gallons)	2nd Soybean Oil Injection 11/19/02 and 11/21/02 (gallons)
DIW-P13A	Pump	55	27.5
DIW-P11A	Pump	82.5	55
DIW-P09A	Pump	55	55
DIW-1-2	Pump	55	110
DIW-P03A	Pump	55	55
DIW-P05A	Pump	82.5	55
DIW-P07A	Pump	55	27.5
	Total	440	385

Table 10. Sodium Lactate Injection Details

Injection Number	Injection Date	Injection point																	
		Lateral 3			DIW-P13A			DIW-P09A			DIW-P11A			DIW-P11B			DIW-1-2		
		Sodium Lactate (gal)	DCB-8 Mix (gal)	DCB-8 Flush (gal)	Sodium Lactate (gal)	DCB-8 Mix (gal)	DCB-8 Flush (gal)	Sodium Lactate (gal)	DCB-8 Mix (gal)	DCB-8 Flush (gal)	Sodium Lactate (gal)	DCB-8 Mix (gal)	DCB-8 Flush (gal)	Sodium Lactate (gal)	DCB-8 Mix (gal)	DCB-8 Flush (gal)	Sodium Lactate (gal)	DCB-8 Mix (gal)	DCB-8 Flush (gal)
1st	7/16/02	3	3	60	3	3	5	3	3	5	-	-	-	6	6	5	-	-	-
2nd	7/23/02	6	6	60	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
3rd	7/30/02	6	6	60	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
4th	8/6/02	6	6	60	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
5th	8/13/02	6	6	60	3	3	6	6	6	6	-	-	-	-	-	-	-	-	-
6th	8/20/02	6	6	60	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
7th	8/27/02	6	6	58	3	3	6	6	6	6	-	-	-	-	-	-	-	-	-
8th	9/3/02	-	-	-	3	3	5	6	6	5	6	6	5	-	-	-	-	-	-
9th	9/19/02	-	-	-	3	3	6.5	6	6	6.5	6	6	6.5	-	-	-	-	-	-
10th	10/1/02	6	6	60	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
11th	10/17/02	6	6	60	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
12th	10/29/02	6	6	57	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
13th	11/18/02	6	6	58	3	3	5	6	6	5	-	-	-	-	-	-	-	-	-
14th	12/9/02	5.75	5.75	58	3	3	5	6	6	5	-	-	-	-	-	-	0.25	0.25	-
15th	1/7/03	7	7	57	3.5	3.5	5	7	7	5	-	-	-	-	-	-	-	-	-
Total		75.75	75.75	768	45.5	45.5	78.5	88	88	78.5	12	12	11.5	6	6	5	0.25	0.25	0

Table 11. Sodium Lactate Injection Summary

Injection Number	Injection Date	Duration between Injections (days)	Sodium Lactate (gal)	DCB-8 Mix (gal)	DCB-8 Flush (gal)	Total DCB-8 (gal)
1st	7/16/02	0	15	15	75	90
2nd	7/23/02	7	15	15	70	85
3rd	7/30/02	7	15	15	70	85
4th	8/6/02	7	15	15	70	85
5th	8/13/02	7	15	15	72	87
6th	8/20/02	7	15	15	70	85
7th	8/27/02	7	15	15	70	85
8th	9/3/02	7	15	15	15	30
9th	9/19/02	16	15	15	19.5	34.5
10th	10/1/02	12	15	15	70	85
11th	10/17/02	16	15	15	70	85
12th	10/29/02	12	15	15	67	82
13th	11/18/02	20	15	15	68	83
14th	12/9/02	21	15	15	68	83
15th	1/7/03	29	17.5	17.5	67	84.5
		Total	227.5	227.5	941.5	1169

5.1.2 Application Technique

Because of the configuration and hydraulic properties of the existing DIW-1 (see Section 3.5) the two soybean oil injections and fifteen sodium lactate injections required minimal equipment and could be conducted with relative ease. Section 5.1.2.1 provides a list of the primary equipment needed, Sections 5.1.2.2, 5.1.2.3, and 5.1.2.4 describe the soybean oil, sodium lactate and purge water injections, respectively.

5.1.2.1 Materials and Equipment

The primary materials and equipment required included the following:

- Soybean oil supplied in 55 gallon drums
- 60% sodium lactate supplied in 55 gallon drums
- 25 liter (6.6 gallon) HDPE carboys
- 200 gallon polyethylene tank
- Industrial process peristaltic pumps

- Tygon tubing
- Polyethylene tubing
- Packer
- Nitrogen cylinder (for packer inflation)
- Portable generators
- Water-oil interface meter
- All required safety equipment and supplies

5.1.2.2 Soybean Oil Injection

Soybean oil was injected into the upgradient side of both the North and South DIW-1 wing walls during two injection events. The soybean oil was pumped directly from the vendor’s 55-gallon drums with a peristaltic pump and allowed to gravity feed/drain into the injection points (see Figure 6). At the completion of each injection point the soybean oil was allowed to drain from the tubing prior to moving to the next injection point. The injection method, injection start, injection completion, and actual injection volumes were recorded. The depth to oil and water were measured with a water-oil interface meter after all soybean oil injection has been completed. The depth to oil and water and subsequent changes in the soybean oil layer over time were periodically measured and recorded. The two soybean oil injection events were conducted approximately 4 months apart. Table 9 provides a summary of the total volumes of soybean oil injected over the two injection events.

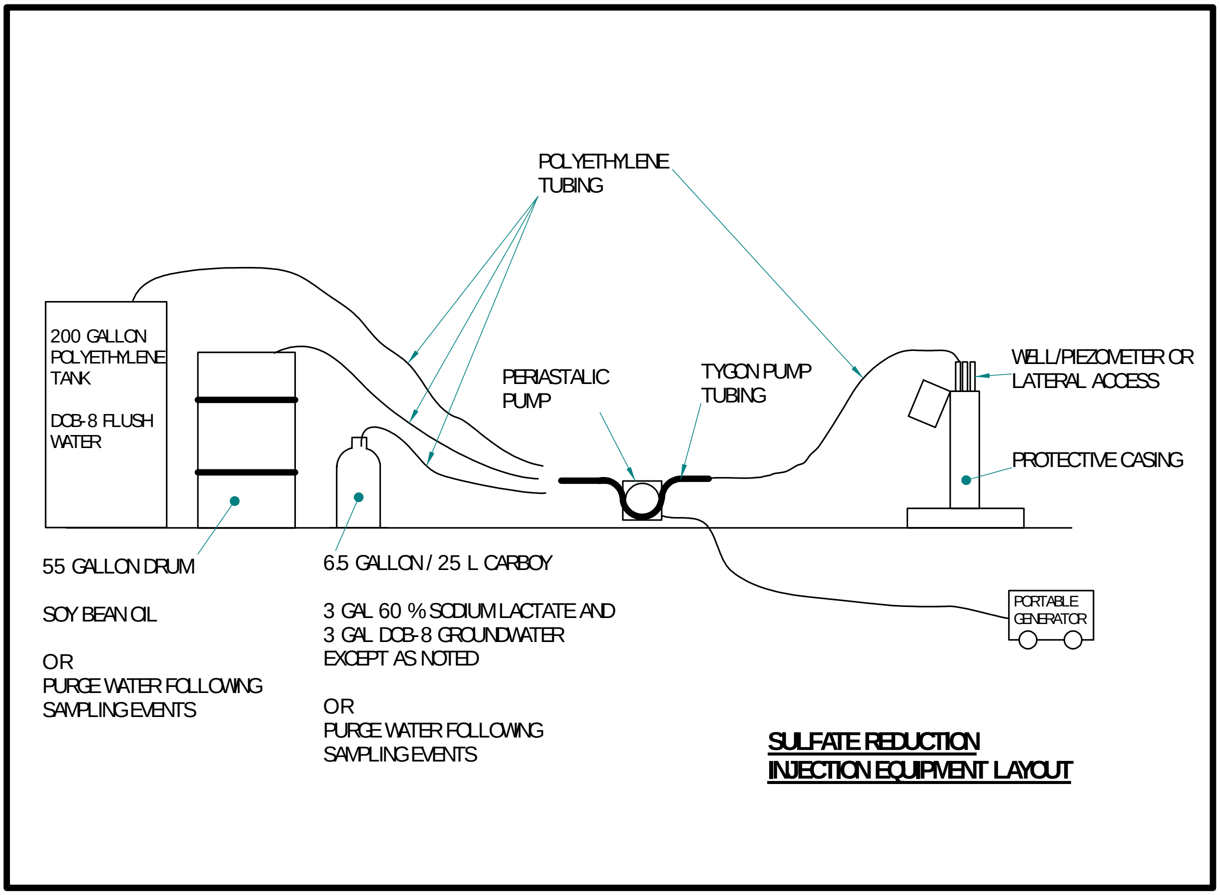

Figure 6. Injection Equipment Layout

5.1.2.3 Sodium Lactate Injection

Sodium lactate was mixed with DCB-8 groundwater and the mixture was injected into the upgradient side of the South DIW-1 wing wall only, over the fifteen injection events. Approximately 3 gallons of 60% sodium lactate was placed in a 25 liter (6.6 gallon) HDPE carboy followed by 3 gallons of DCB-8 groundwater (Table 10). Rotating and/or shaking the carboy then mixed the carboy contents. The sodium lactate/water mixture was pumped directly from the carboy into the injection points with a peristaltic pump (see Figure 6). Lateral 3 was isolated from the DIW-1 central sump with a packer prior to injection. Table 10 and 11 provide the injection points and the 60% sodium lactate and DCB-8 groundwater volumes for each injection point. To flush the sodium lactate/water mixture out of the piezometers and laterals DCB-8 groundwater was injected after the mixture by pumping with a peristaltic pump. Approximately 5 gallons of DCB-8 groundwater was used to flush the piezometers and approximately 55 gallons was used to flush the laterals (Table 10). The injection event number, injection start, injection completion, and actual flush volumes were recorded. Fifteen sodium lactate injection events were conducted over a 6-month period. Table 11 provides a summary of the total volumes of 60% sodium lactate and DCB-8 groundwater injected over the fifteen injection events.

5.1.2.4 Purge Water Injections

After completion of each Tier 1, 2, and/or 3 sampling event, any purge water collected from any DIW-1 well or piezometer or any down gradient well, which could potentially contain injected organic material, was reinjected into the DIW-1-2 well screen. The purge water was pumped with a peristaltic pump directly from the 6.6-gallon carboys or 55 gallon drum used to collect it (see Figure 6). Table 6 provides the injection volumes of purge water after each sampling event.

5.2 SAMPLING AND ANALYSIS

Baseline (pre-injection) and post-injection groundwater monitoring was conducted in a tiered structure utilizing monitoring wells upgradient and downgradient of DIW-1 and piezometers within DIW-1 (see Tables 2 and 4). Sampling and analysis was performed to evaluate the impact of organic substrate (lactate and soybean oil) injection on microbial populations, pH, Eh, and concentrations of metals, sulfate/sulfide, soluble organics and nutrients.

The tiered sampling structure included three tiers:

- Tier 1 sampling consisted of field measurements from specific wells and piezometers to monitor the occurrence of bulk geochemical changes. For the first five months, sampling occurred approximately every two weeks. Thereafter, Tier 1 sampling was conducted approximately monthly. Table 6 provides specific dates for Tier 1 events. Table 12 shows the field parameters measured.
- Tier 2 sampling consisted of more extensive field measurements to evaluate trends in bulk chemistry. These field measurements were conducted at the same time as the Tier 3 sampling but included more wells than those sampled for Tier 3 parameters. Tier 2 parameters were collected for the baseline sampling and five post-injection sampling events (approximately every two months after the initial injection). Table 6 provides specific dates for Tier 2 events. Table 12 shows the field parameters measured.
- Tier 3 sampling consisted of comprehensive analyses on key wells or piezometers to evaluate the impact of organic substrate injection on microbial populations and concentrations of metals, sulfate/sulfide, soluble organics and nutrients. Like the Tier 2 events, sampling was conducted for a baseline and approximately every two months after the initial injection. Table 6 provides specific dates for Tier 3 events. Table 12 shows the field parameters measured.

Prior to Tier 1 and Tier 2 sampling, depth to water was measured using a water level meter tape. For piezometers containing soybean oil, the oil/water interface was also measured using an oil/water interface meter. Multiparameter and single parameter probes/meters were used to collect indicator parameters. Field turbidity was also measured at selected locations using a portable turbidimeter.

Samples were collected using peristaltic pumps except for wells DCB-8, DCB-70 cluster and DCB-71 cluster, which have dedicated pumps. Prior to sampling, a minimum of 5 gallons was purged from the monitoring wells (DCB) and 2 gallons from the middle (B) and lower (C) piezometers (DIW). For the A piezometers in DIW-1 that would likely contain soybean oil, one liter was purged at a low flow rate prior to sampling in order to minimize the amount of oil collected in the samples. Purge water was appropriately dispositioned according to the approved Waste Management Plan and UIC permit by discharging onto the ground, containment, or injection into DIW-1.

Samples collected for indicator parameters and microbial parameters were not filtered whereas samples collected for analyses of metals, anions, and organics were filtered. Duplicates and unfiltered samples were also collected from selected locations (DCB-21B, DCB-22C, and DIW-P11B) for comparison with filtered samples. In addition, one replicate sample (DIW-P11B) and a blank were collected during each Tier 3 sampling event to be analyzed by an EPA certified laboratory for metals and anions. Anions were analyzed using ion chromotagraphy (IC); organics (volatile fatty acids) by gas chromatography and mass spectrometry (GC-MS); elemental (metal) analyses by inductively coupled plasma atomic emission spectroscopy (ICP-AES); and iron speciation and hydrogen sulfide by spectrometry methods. Table 12 provides a more complete list of analytical parameters, methods, and approximate detection limits for samples collected in this study. A further description of Tier 1, 2, and 3 sampling can be found in the *D-Area Sulfate Reduction Study Field Scoping Plan (U)* (Phifer et al. 2002).

Table 12. Field Study Analytical Parameters and Methods

Analytical Suite; Primary Laboratory	Sample Volume, Bottle, and Preservative	Analytical Parameter	Analytical Method	Approximate Detection Limit
Tier 1 and 2 Monitoring: Field Indicator Parameter Monitoring				
Field Indicator Parameters; ERTS	Not Applicable	Field pH	Field probe/meter	-
		Field Eh	Field probe/meter	-
		Field Dissolved Oxygen (DO)	Field probe/meter	0.1 mg/L
		Field Specific Conductance (SC)	Field probe/meter	15 µmhos/cm
		Field Temperature	Field probe/meter	-
		Field Turbidity	Field probe/meter	-
Tier 3 Sampling and Analysis: Comprehensive Parameter Sampling and Analysis				
Lab Indicator Parameters; EBS	125 mL HDPE bottle; Eliminate headspace	Lab pH	meter	-
Anions & Cations EBS	30 mL HDPE bottle; Eliminate headspace	Phosphate	IC	0.5 mg/L
		Chloride	IC	0.5 mg/L
		Nitrate	IC	0.5 mg/L
		Nitrite	IC	0.5 mg/L
		Sulfate	IC	0.5 mg/L
		Ammonium	IC	0.5 mg/L
		Lactate	IC	6.3 mg/L
		Sodium	IC	0.5 mg/L
Volatile Fatty Acids; EBS	30 mL HDPE bottle; 1 mL HCl; Eliminate headspace	Acetic Acid	GC-MS	6 mg/L
		Propanoic Acid	GC-MS	7 mg/L
		Formic Acid	GC-MS	5 mg/L
		Isobutyric Acid	GC-MS	9 mg/L
		Butyric Acid	GC-MS	9 mg/L
		Isovaleric Acid	GC-MS	10 mg/L
		Valeric Acid	GC-MS	10 mg/L
		Isocaproic Acid	GC-MS	10 mg/L
		Hexanoic Acid	GC-MS	10 mg/L
		Heptanoic Acid	GC-MS	10 mg/L
Hydrogen Sulfide; EBS	125 mL HDPE bottle; Eliminate headspace	Hydrogen Sulfide	UV-vis Spectrometer	0.001 mg/L
Microbial Parameters; EBS	1 L polypropylene bottle and eliminate headspace	MMDC	Microbial direct count using a microscope	3 cfu/g
		MPN-SRA	Microbial Assay	7.2 cells/mL
Total Organic Carbon; ADS	125 mL HDPE bottle; Eliminate headspace	Total Organic Carbon	SW-846 Method 9060	0.001 mg/L

Table 12. Field Study Analytical Parameters and Methods (continued)

Analytical Suite; Primary Laboratory	Sample Volume, Bottle, and Preservative	Analytical Parameter	Analytical Method	Approximate Detection Limit
Tier 3 Sampling and Analysis: Comprehensive Parameter Sampling and Analysis (continued)				
Elemental (Metals); SRTC Mobile Lab	30 mL HDPE bottle; 1 mL HCl and eliminate headspace	Aluminum	ICP-AES	0.009 mg/L
		Barium	ICP-AES	0.002 mg/L
		Beryllium	ICP-AES	0.100 mg/L
		Cadmium	ICP-AES	0.003 mg/L
		Calcium	ICP-AES	0.006 mg/L
		Chromium	ICP-AES	0.002 mg/L
		Copper	ICP-AES	0.010 mg/L
		Iron	ICP-AES	0.040 mg/L
		Lead	ICP-AES	0.017 mg/L
		Magnesium	ICP-AES	0.004 mg/L
		Manganese	ICP-AES	0.001 mg/L
		Nickel	ICP-AES	0.010 mg/L
		Silicon	ICP-AES	0.079 mg/L
		Sodium	ICP-AES	0.010 mg/L
		Zinc	ICP-AES	0.001 mg/L
Iron Speciation; SRTC Mobile Lab	30 mL Amber HDPE bottle; Eliminate headspace	Iron Speciation (Fe(II) / Fe(total))	UV-vis Spectrometer	-

Notes to Table 12:
ERTS = Environmental Restoration Technology Section; EBS = Environmental Biotechnology Section; ADS = Analytical Development Section; SRTC Mobile Lab = Savannah River Technology Center Mobile Laboratory; MMDC = Microscopic Microbial Direct Counts; MPN-SRA = Most Probable Number – Sulfate-Reducing Assay; IC = Ion Chromatography; GC-MS = Gas Chromatography-Mass Spectrometer; µmhos/cm = microsiemens per centimeter, cfu/g = colony forming units per gram, org/g = organisms per gram, ICP-AES = Inductively Coupled Plasma – Atomic Emission Spectroscopy

THIS PAGE INTENTIONALLY LEFT BLANK

6.0 RESULTS AND DISCUSSION

As detailed in Section 5.1 825 gallons of soybean oil was injected during two events (July 15, 2002 and November 19-21, 2002) into both the south and north wings of DIW-1 (see Figures 3 and 4). Approximately 227.5 gallons of 60% sodium lactate was injected during fifteen events of approximately 15 gallons each (July 16, 2002 through January 7, 2003) into the south wing only (see Figures 3 and 4). Finally 1169 gallons of groundwater from background well DCB-8 was injected in conjunction with the sodium lactate in the south wing only. The groundwater was used to reduce the viscosity of the sodium lactate for injection, to flush the sodium lactate out of the injection point screen zones, and to provide bioaugmentation (i.e. the addition of SRB).

As detailed in Section 5.2 both pre-injection and post-injection monitoring and sampling and analysis was conducted in order to evaluate the impact of organic substrate (lactate and soybean oil) injection on soluble organic, sulfate, nutrient, microbe, hydrogen sulfide, pH, Eh, and metal concentrations. These impacts are discussed in terms of general trends, geochemical impacts, and microbiological impacts in the following sections. All associated data is provided as appendices.

6.1 GENERAL TRENDS

This section presents general trends observed during this pilot scale field demonstration. Trends associated with DIW-1 hydrology, organic substrates, sulfate and hydrogen sulfide, SRB, pH and Eh, and metals are presented. Many of the figures presented within this section include data over time from background, upgradient, and injection zone locations (i.e. DIW-1 piezometers). The upgradient influent data is presented both as an average (i.e. average from wells DCB-19A, DCB-19B, DCB-21A, and DCB-21B) and as the worse case (i.e. data from well DCB-21A, which typically has the highest contaminant levels). The data associated with the DIW-1 piezometers are further segregated by wing (i.e. South and North wings) and by depth (i.e. the "A" piezometers are screened across the water table, the "B" piezometers between the "A" and "C" piezometers, and the "C" piezometers are at the bottom of DIW-1). Representation by wing is important since as noted previously the South wing received both sodium lactate and soybean oil, whereas only soybean oil was injected into the North wing. Depth determinations are important since the soybean oil formed a layer floating on top of the water table.

6.1.1 DIW-1 Hydrology Trends

During the course of the study the quantity of rainfall changed from that of drought conditions to greater than average conditions. This caused water elevations to dramatically increase particularly from November 2002 to April 2003 as seen in Figure 7. This resulted in an increased flux of groundwater and contaminants through DIW-1 particularly within the South wing. As noted in Section 3.5.2 the South wing is essentially perpendicular to the primary direction of groundwater flow, whereas the North wing is close to a forty five degree angle to the primary direction of groundwater flow. Additionally the South wing typically is closer to the standing water in DCPRB. These factors indicate that the South wing intercepts a higher flux of groundwater than the North wing.

Figure 7 confirms the DCPRB hydrology and DIW-1 hydrology, respectively, presented in Sections 3.1 and 3.5.2. As can be seen water elevations decrease with depth and distance from the DCPRB (i.e. groundwater flow is downward and horizontally away from the DCPRB). Water elevations in all DIW-1 piezometers are always essentially the same regardless of depth and typically lower than those in adjacent wells screened across the water table (i.e. upgradient "A" wells, DCB-18A, and DCB-22A) regardless of whether the wells are upgradient or "downgradient" of DIW-1. Water elevations in wells DCB-22C and DCB-18C, which are located downgradient of DIW-1 and screened within the higher permeability, lower portion of the aquifer, are typically lower than that in DIW-1. These two facts confirm that groundwater flow is toward DIW-1 from its immediate vicinity on either side, downward through DIW-1 to the higher permeability, lower portion of the aquifer, and then toward the Savannah River.

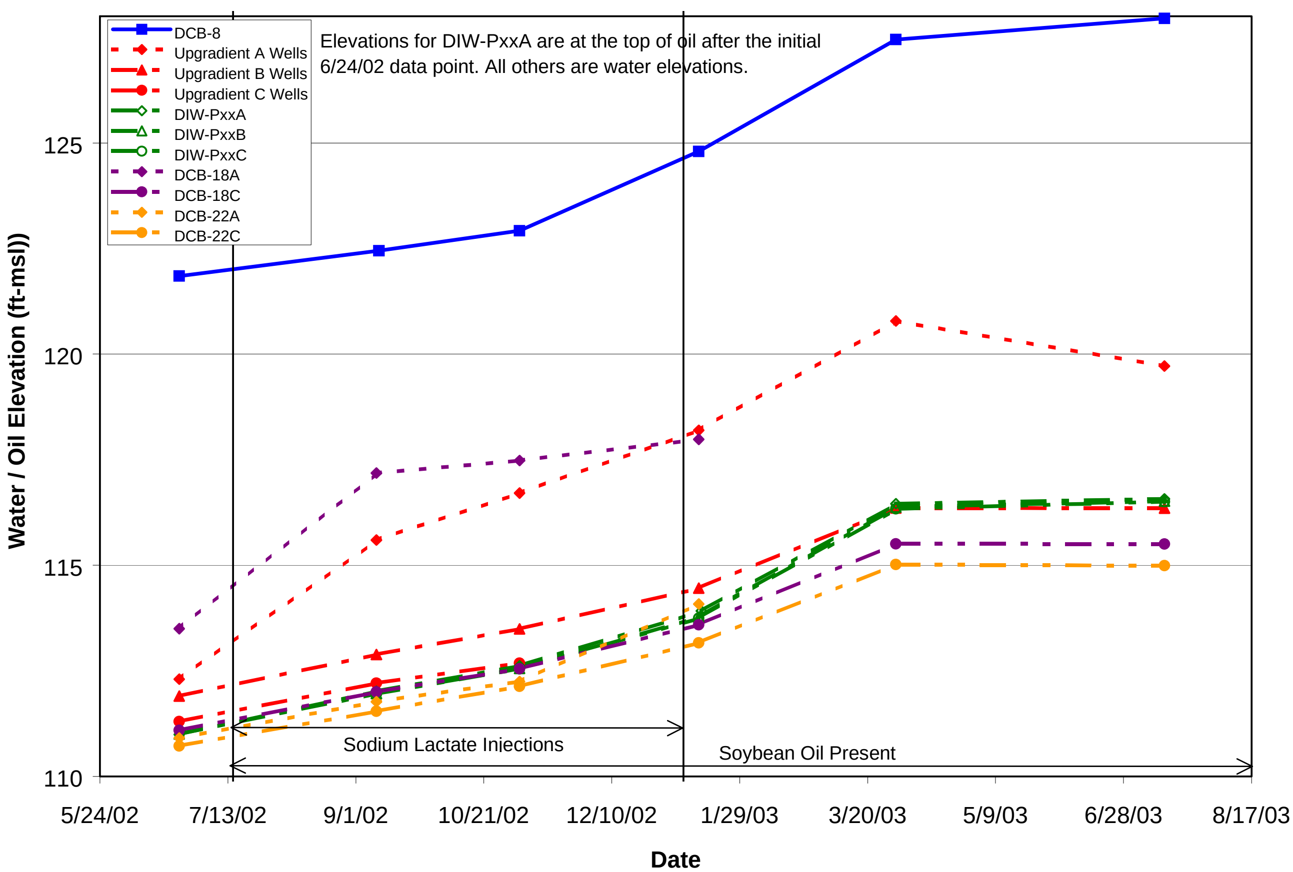

Figure 7. Water Elevation Trends

6.1.2 Organic Substrate Trends

The soybean oil and sodium lactate were injected into DIW-1 as outlined in Section 5.1. The soybean oil was intended to provide a long-term, slow release, carbon source for the SRB, since it is essentially insoluble and lighter than water. In contrast the sodium lactate was intended to provide a short-term, immediately available carbon source, since it is completely soluble and a known direct carbon source for SRB. As anticipated the soybean oil floated on and slightly depressed the top of the water table surface within the coarse gravel pack of DIW-1 (see Figure 8). In contrast the sodium lactate, as anticipated, mixed with and was transported with the groundwater downward through DIW-1 toward the higher permeability, lower portion of the aquifer. Some downward migration of the sodium lactate may also be due to the fact that the solution has a greater density than water (see Table 7).

Figure 9 provides the soybean oil thickness within DIW-1 over time associated with both injections. The first portion of each curve is interpreted to be reductions in thickness due to soybean oil flow from the injection points and subsequent leveling within DIW-1. The second portion of each curve is interpreted to be reductions in thickness due to microbial utilization of the soybean oil. It is not anticipated that the soybean oil migrated from the DIW-1 gravel pack into the adjacent formation for the following reasons:

- The soybean oil was injected across the top of the water table.
- The soybean oil is essentially insoluble and lighter than water. Therefore it floats on top of and depresses the water table and little is lost through dissolution.
- The DIW-1 HDPE membrane prevents migration of the soybean oil in the direction away from the DCPRB.
- The water elevation is greater on the DCPRB side of DIW-1 than within DIW-1 itself, therefore there is no driving force for the soybean oil to migrate toward the DCPRB.
- The soybean oil has a viscosity greater than water (see Table 7), it is located within the coarse DIW-1 gravel pack surrounded by low permeability, saturated, fine grained sediment, and it slightly depresses the water table over which it floats. Therefore there is no suction force to pull the soybean oil out of the gravel pack.

Based upon the second portion of the curve estimated soybean oil microbial utilization rates (i.e. estimated soybean oil depletion rates) have been determined. Rates of 1.81 gallons/day and 1.54 gallons/day were estimated respectively based upon the data associated with the first and second injections. The oil thickness values taken from March through May 2003 appear to be less than would have been expected. This is probably due to the rise in water levels (see Figure 7), which probably resulted in significant quantities of soybean oil being retained within water filled pores of the gravel pack. The soybean oil retained as described was not measurable. Over time the bulk of this oil migrated upward to the remainder of the floating soybean oil layer, where it could be measured. Figure 10 provides the same information as Figure 9 except that the soybean oil thicknesses taken from March through May 2003 have been deleted. This results in an estimated soybean oil microbial utilization rate of 1.43 gallons/day for the data after the second injection. Based upon this utilization rate it is estimated that the soybean oil will be completely utilized and depleted sometime during January 2004. If so this would mean that the 825 gallons of soybean oil injected would have lasted approximately 18 months. This confirms that soybean oil provides a relatively long-term carbon source.

As outlined in Section 5.1 the sodium lactate was only injected into the South wing of DIW-1. Figure 11 provides the results of this injection in terms of lactate concentration trends. As seen there was no detectable lactate in any location prior to injection, and after injection there continued to be essentially no lactate within the background and upgradient locations. Lactate concentrations were greatest within the South wing piezometers, and the greatest South wing concentrations were within the lowest piezometers (“C” piezometers). At times the concentrations within the South wing “C” piezometers, particularly DIW-P13C, were greater than the inhibitory lactate concentration of 6300 mg/L, determined from the laboratory study (see Section 3.6). Even though lactate was not directly injected into the DIW-1 North wing, slightly elevated lactate concentrations were detected within the North wing piezometers for a brief period of time. After sodium lactate injections were completed on January 7, 2003, lactate concentration quickly returned to pre-injection non-detectable levels. This confirms that sodium lactate is a short-term carbon source.

As discussed in Section 3.3, it was anticipated that the breakdown of soybean oil by fermentative bacteria would produce short chain fatty acids that could be utilized by SRB. Figure 12 provides the total VFA concentrations over time. As shown prior to injection there were essentially no VFAs detected. However after injection VFAs were quickly detected within the piezometers of the South wing followed by detection within the piezometers of the North wing several months later. The quick production of VFAs within the South wing is probably due primarily to the fermentation of lactate rather than soybean oil. It is clear that later VFA production was from soybean oil degradation since sodium lactate was no longer present (see Figure 12). From Figure 12 the total VFA data for July 2003 appears to have decreased from previous sampling periods for several locations, however formic acid, which is a major component of the total VFA values was not available in July 2003 due to analytical error. The South wing “B” and “C” piezometers (the July VFA data for the South wing “B” and “C” piezometers came exclusively from DIW-P11B and DIW-P11C) showed a dramatic decrease in total VFAs after sodium lactate injection ceased. The likely explanation for this is that the bulk of VFA production in the South wing lower zone was initially primarily due to sodium lactate degradation. With cessation of lactate injection, the concentrations of lactate quickly diminished (see Figure 11), and the rate of VFA production in this wing was greatly reduced. Essentially concurrent with cessation of sodium lactate injections, a significant rise in water levels occurred (see Figure 7). The water level rise resulted in both an increased flux of contaminated groundwater and an increased distance of the lower zone from the soybean oil, both of which served to further dilute VFA concentrations in this zone. With cessation of sodium lactate injection and the rise in water levels, the DIW-P11 piezometer cluster as a whole demonstrated the worse sulfate reduction response of any other upgradient DIW-1 piezometer cluster, based upon the field parameter results (see Section 6.1.5). This is probably due to the fact that significant bentonite exists near the DIW-P13 piezometer cluster, which serves as a buffer, and that the DIW-P11 cluster is typically closer to the standing water in DCPRB than the DIW-P09 cluster (i.e. it is closer to the source of contamination). Due to these factors the soybean oil could not effectively replace the sodium lactate for VFA production within this zone. Overall, however, it is clear that VFA production occurred due to both the degradation of soybean oil and sodium lactate, where they were present, making short chain fatty acids available as a carbon source.

Additional information concerning the organic substrates and their microbiological impacts are provided in Section 6.3.

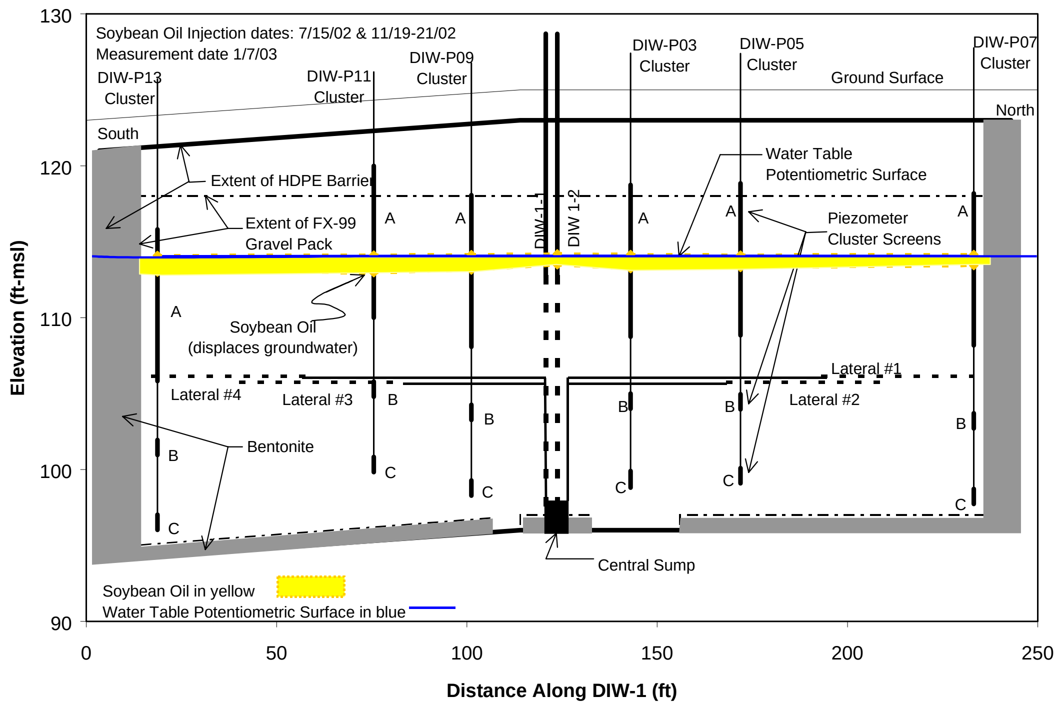

Figure 8. Soybean Oil within DIW-1

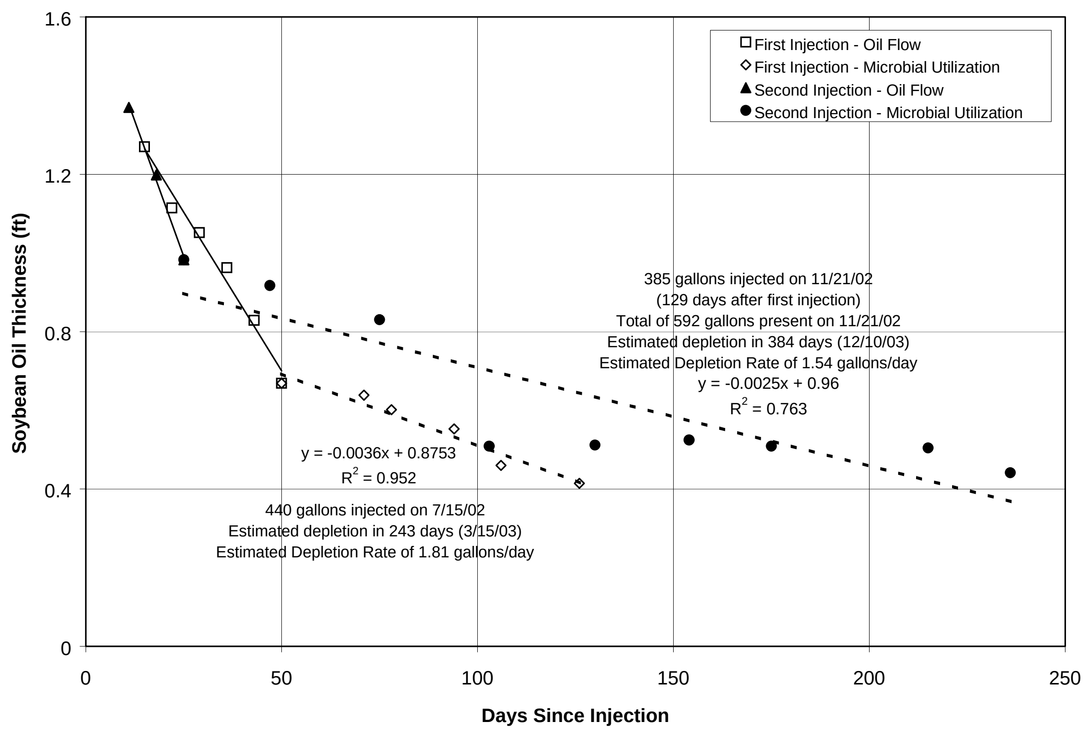

Figure 9. Soybean Oil Flow and Depletion

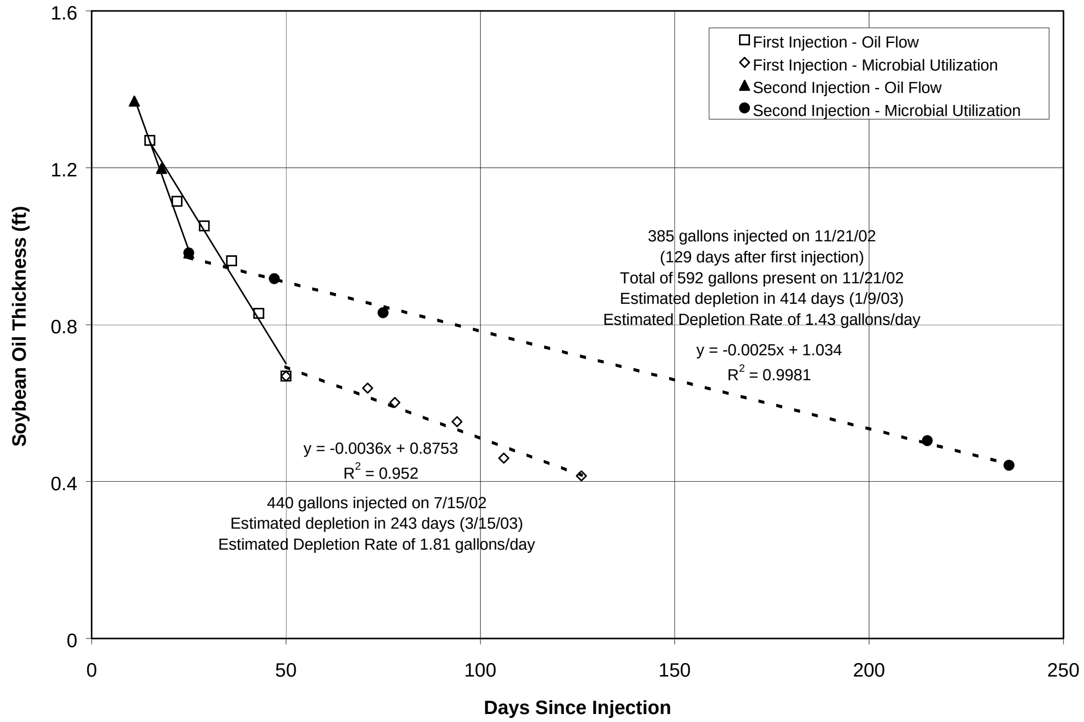

Figure 10. Soybean Oil Flow and Depletion - Revised

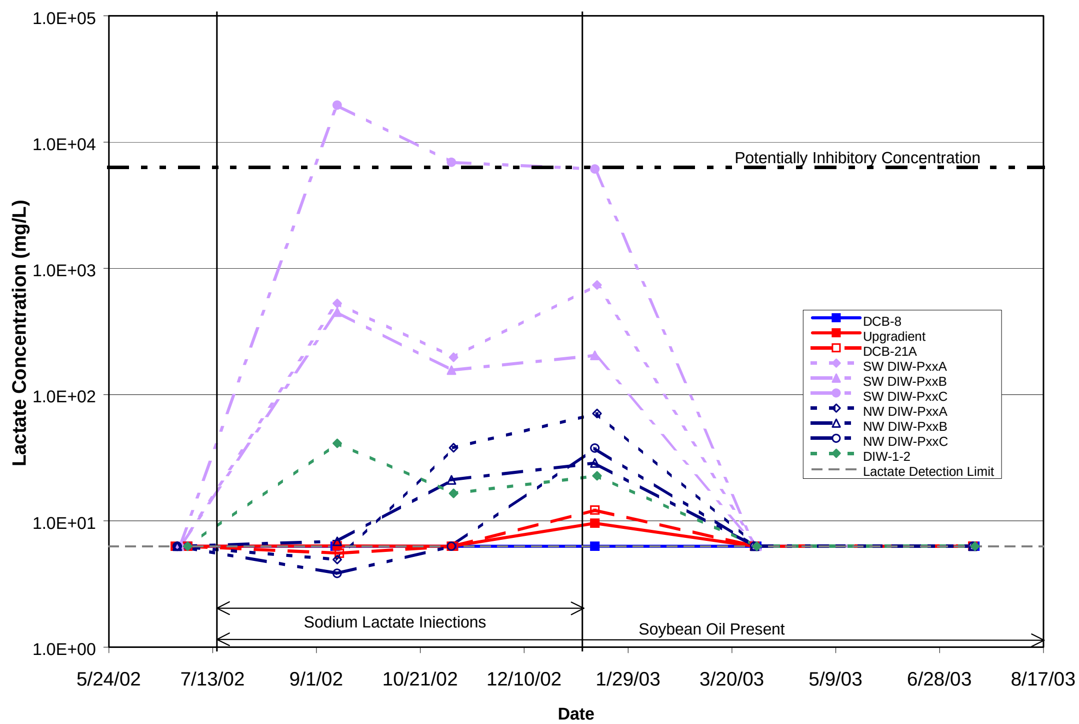

Figure 11. Lactate Concentration Trends

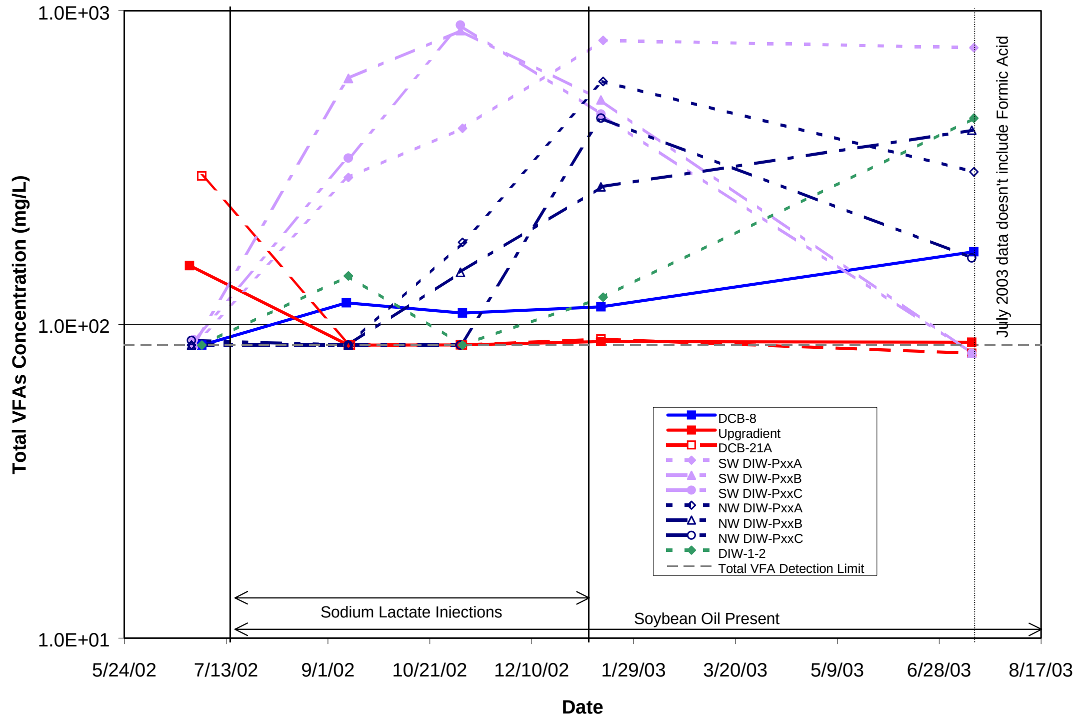

Figure 12. Total VFA Concentration Trends

6.1.3 SRB Trends

The entire purpose of the organic substrate injection was to promote the growth of SRB and subsequent sulfate reduction. Figure 13 presents the SRB concentration trends in groundwater. The background well, DCB-8, contained varying concentrations of SRB over time, whereas the SRB concentrations in the upgradient influent wells were always below detection. The initial pre-injection concentrations of SRB within DIW-1 were either below detection or fairly low. However after organic injections the SRB concentrations increased dramatically by five to six orders of magnitude within the "A" piezometers of both wings, with the quickest and greatest increase in the South wing "A" piezometers. The "A" piezometers were screened across the water table upon which the soybean oil floated, and the South wing was the wing into which the sodium lactate was injected. SRB within the lower zone of the South wing have only increased one to two orders of magnitude. This is probably due to the water level rise, which resulted to an increase contaminated groundwater flux to this zone, and to the concentrations of lactate within the South wing "C" piezometers, which were greater than the inhibitory lactate concentration of 6300 mg/L at times (see Section 6.1.2). On the other hand SRB concentrations have increased over time in the deeper portions of the North wing, indicating that the zone of influence of the soybean oil has increased with time in this wing.

From this it is clear that both the soybean oil and sodium lactate have provided a carbon source for SRB growth. Additional information concerning SRB growth and that of other associated microorganisms is provided in Section 6.3.

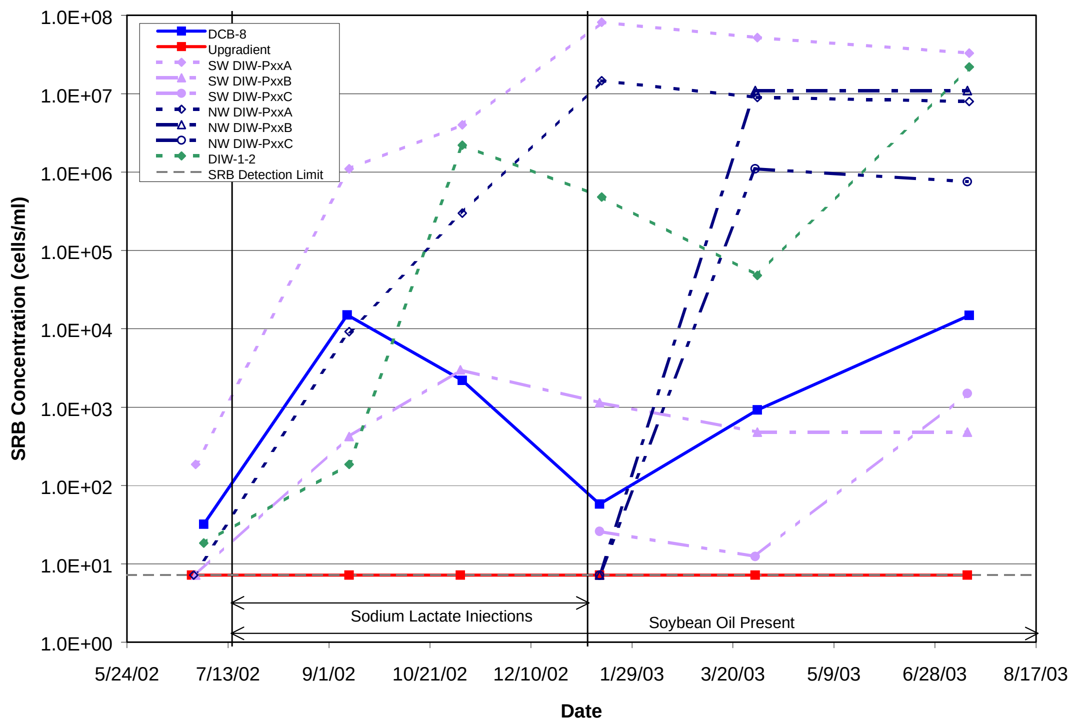

Figure 13. SRB Concentration Trends

6.1.4 Sulfate and Hydrogen Sulfide Trends

As discussed in Section 3.3 SRB utilize sulfate as the terminal electron acceptor and produce hydrogen sulfide during respiration. Figures 14 and 15 provide the sulfate and hydrogen sulfide concentration trends, respectively. As seen in Figure 14 the upgradient influent sulfate concentrations remained in the thousands of ppm over the entire period whereas the background concentrations were typically below 10 ppm. Sulfate concentrations in the "A" piezometers within both wings, where the soybean oil was located, began declining rapidly after about 2 months, and concentrations in the lower portions of the North wing began to decline after four months. Sulfate concentrations in these areas of DIW-1 declined from the thousands of ppm to the tens to hundreds of ppm. Concentrations within the lower portion of the South wing are seen to remain essentially at upgradient input concentrations, which is consistent with the lower levels of SRB seen within this zone (see Section 6.1.3).

As seen in Figure 15 the pre-injection hydrogen sulfide concentrations were essentially the same for all locations except for DIW-1-2. It was previously known that some level of sulfate reduction was occurring in the vicinity of DIW-1-2, probably due to an organic coating on some steel components installed near DIW-1-2 during DIW-1 construction. Hydrogen sulfide concentrations throughout DIW-1 quickly increased over those in background and upgradient locations, and they continued to remain above background and upgradient concentrations even though the background and upgradient locations showed a decreasing trend with time, probably due to the increased flux of water as the water level rose. As with VFA production trends as described above (see Section 6.1.2), the South wing "B" and "C" piezometers showed a dramatic decrease in hydrogen sulfide after sodium lactate injection ceased. The hydrogen sulfide trends within the lower zone of the South wing seem to be impacted similarly to those of the VFAs with the concurrent cessation of sodium lactate injection and water level rise. That is they appear to have increased and then subsequently decreased. On the other hand hydrogen sulfide concentrations have seemed to increase over time in the deeper portions of the North wing relative to background and upgradient concentrations. This indicates that the zone of influence of the soybean oil has increased with time in this wing.

It is clear that both the soybean oil and sodium lactate have resulted in the promotion of sulfate reduction as evidenced by the decrease in sulfate concentration and increase in hydrogen sulfide concentrations. Additional information concerning the geochemical aspects of sulfate and hydrogen sulfide is provided in Sections 6.2.1 and 6.2.3.1, respectively. Additional information concerning the microbiological aspects of sulfate and hydrogen sulfide is provided in Section 6.3.

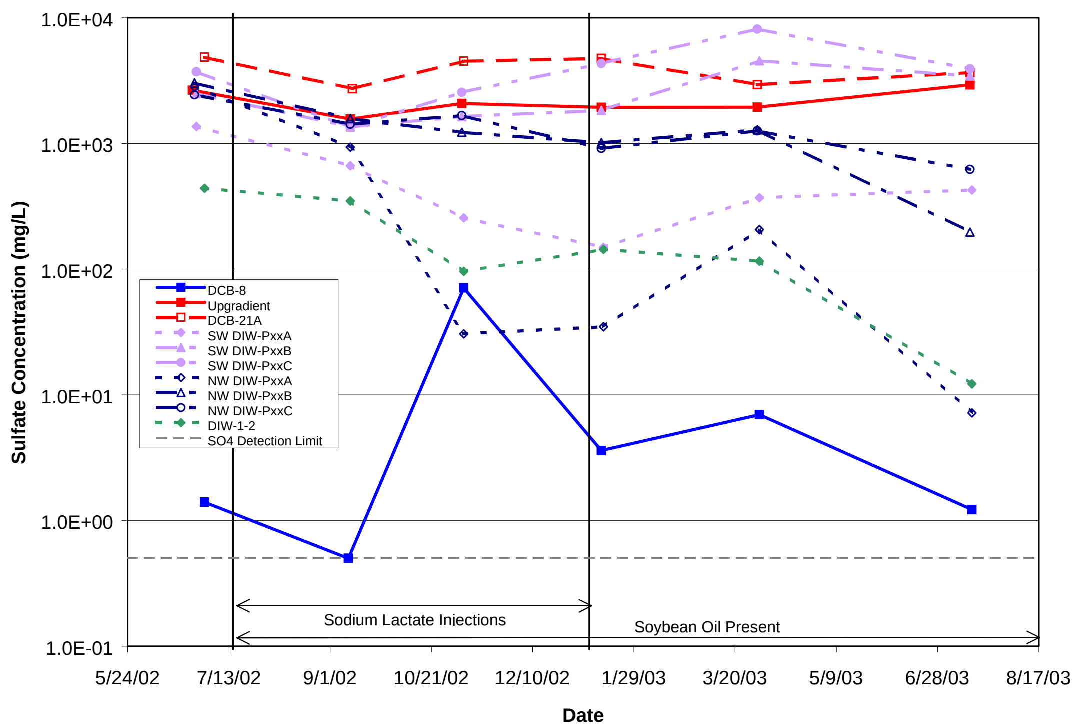

Figure 14. Sulfate Concentration Trends

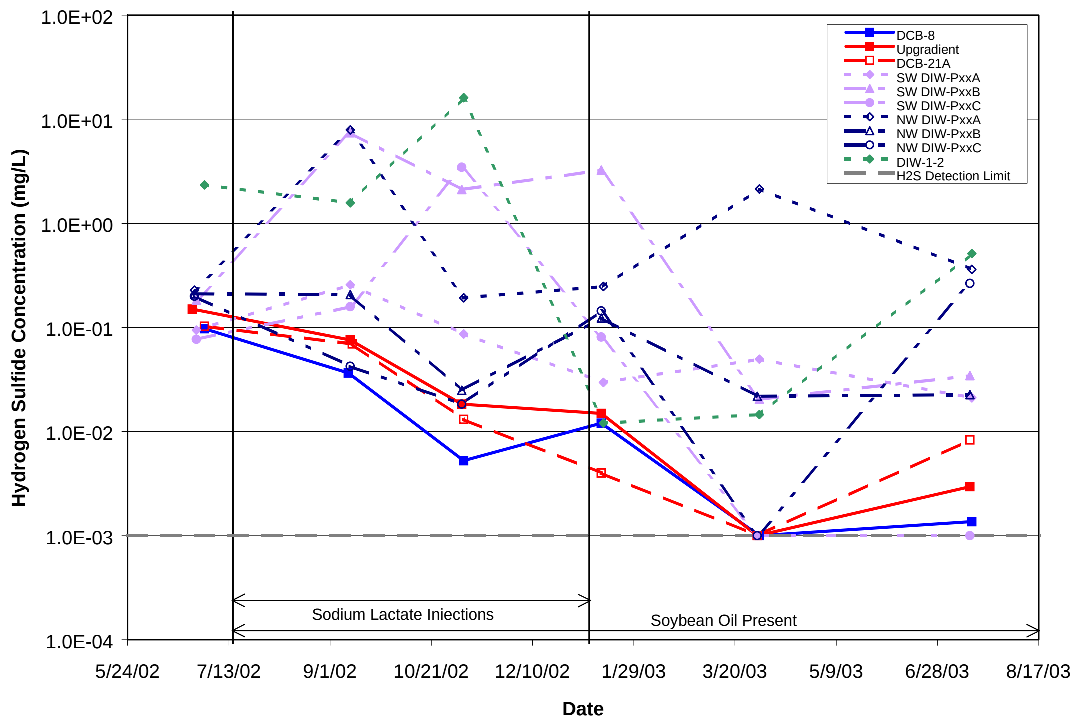

Figure 15. Hydrogen Sulfide Concentration Trends

6.1.5 pH and Eh Trends

As discussed in Section 3.3 it was anticipated that the promotion of sulfate reduction would result in an increase in pH and a decrease in Eh. Figures 16 and 17 present the pH and Eh trends, respectively. Figure 16 shows that the upgradient wells have pHs consistently between 2 and 3 whereas the background well has a pH around 5. Initial pre-injection pHs within DIW-1 were between 2 and 4 except for DIW-1-2 which was around 5. Again as outlined in Section 6.1.4 some level of sulfate reduction was already occurring in the vicinity of DIW-1-2, which likely resulted in its initial elevated pH. However after organic injections the pH increased to between 5 and 6 (i.e. at or greater than background pHs) for both wings within the “A” piezometers. Again the pH trends within the lower zone of the South wing seem to be impacted similarly to those of other parameters with the concurrent cessation of sodium lactate injections and water level rise. That is they appear to have increased and then subsequently decreased. The worst declines were noted within the DIW-P11 cluster. On the other hand the pH has increased over time to around 5 in the deeper portions of the North wing, indicating that the zone of influence of the soybean oil has increased with time in this wing.

Figure 17 shows that the upgradient wells have Ehs (i.e. redox potential relative to the hydrogen couple) greater than 600 mV whereas the background well has Ehs ranging from 300 to 500 mV. Initial pre-injection Ehs within DIW-1 were between 400 and 600 mV except for DIW-1-2, which was around 0 mV. Again as previously outlined some level of sulfate reduction was already occurring in the vicinity of DIW-1-2, which likely resulted in its initial low Eh. However after organic injections the Eh decreased to between 100 and 200 mV for both wings within the “A” piezometers. Again the Eh trends within the lower zone of the South wing seem to be impacted by the concurrent cessation of sodium lactate injection and water level rise. The Eh initially decreased and then subsequently increased. The worse increases were noted within the DIW-P11 cluster. On the other hand the Eh has decreased over time to between 100 and 200 in the deeper portions of the North wing, indicating that the zone of influence of the soybean oil has increased with time in this wing.

From this it is clear that both the soybean oil and sodium lactate have promoted the growth of SRB, sulfate reduction, and the subsequent increase in pH and decrease in Eh. Additional information concerning the geochemical aspects of pH and Eh are provided in Section 6.2.

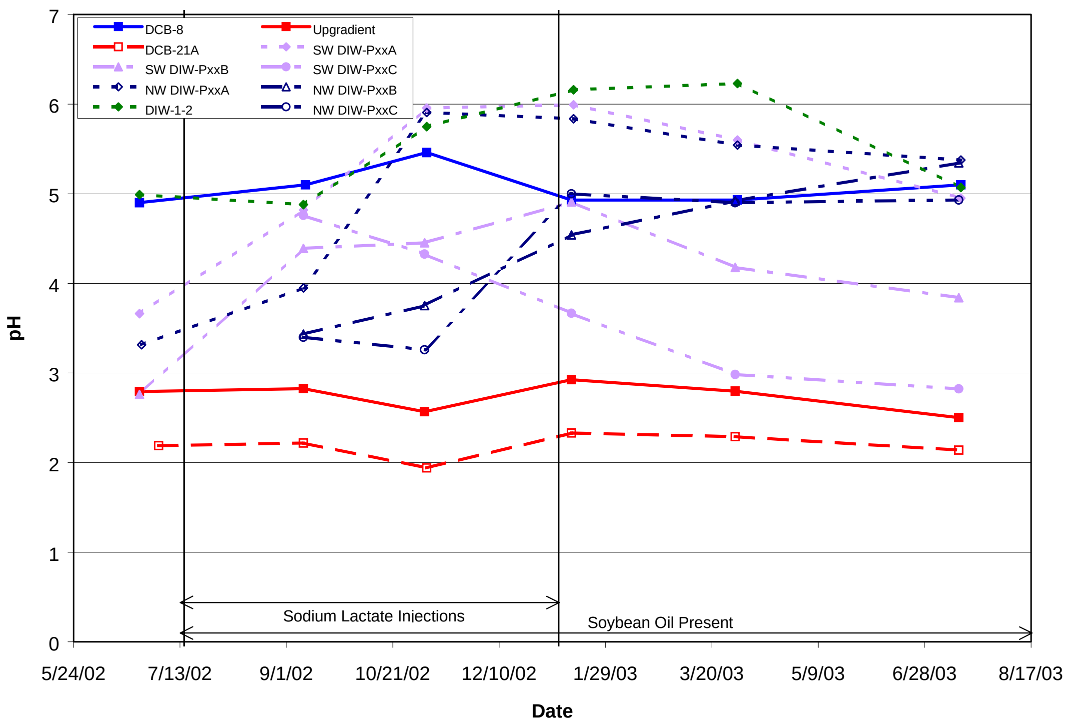

Figure 16. pH Trends

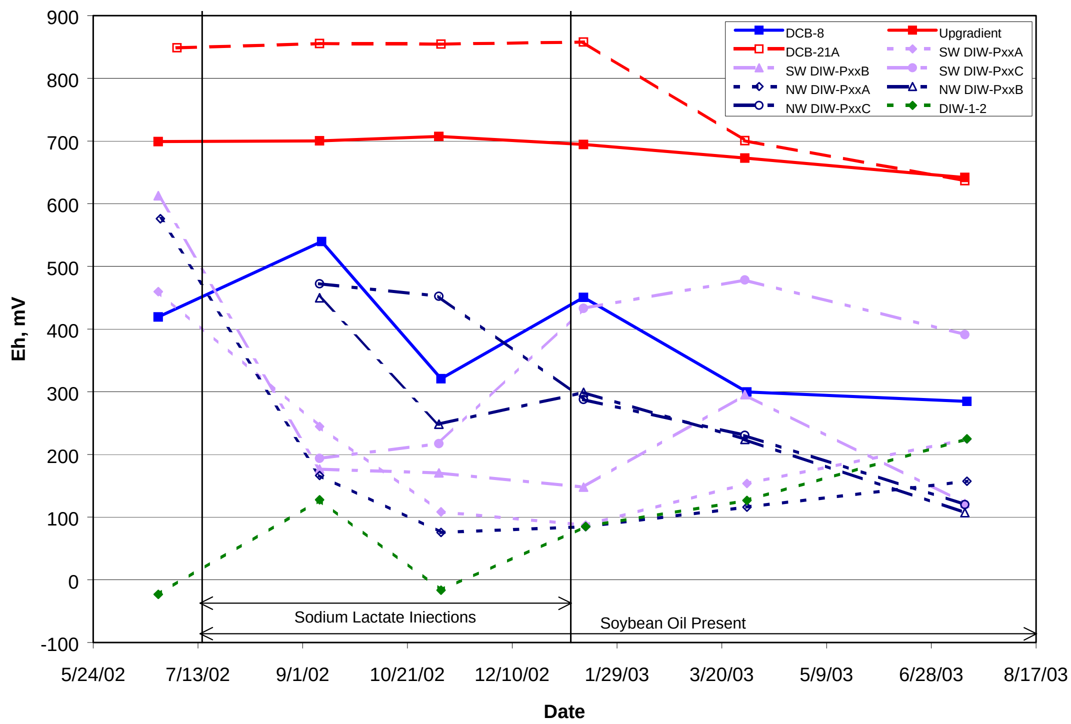

Figure 17. Eh Trends

6.1.6 Metal Concentration Trends

As discussed in Section 3.3 it was anticipated that the promotion of sulfate reduction would result in the precipitation of metals, and as discussed in Section 3.2 aluminum and iron are the most important metals impacting the groundwater geochemistry. Figure 18 presents the aluminum trends. This figure shows that the upgradient influent aluminum concentrations remained in the hundreds of ppm over the entire period whereas the background concentrations were typically below 1 ppm. As shown in Figure 18 aluminum concentrations in the "A" piezometers within both wings, where the soybean oil was located, began to immediately decline rapidly, and concentrations in the lower portions of the North wing began to decline after two months. Concentrations within the lower portion of the South wing are seen to initially decline and then increase to essentially upgradient influent concentrations. Again the concurrent cessation of sodium lactate injections and water level rise seem to have impacted the aluminum concentration within the lower portion of the South wing.

Figure 19 presents the iron trends. This figure shows that the average upgradient influent iron concentrations increased from slightly over 100 ppm to slightly over 200 ppm and that the concentration in well DCB-21A increased from slightly below 200 ppm to over 500 ppm. Well DCB-21A is the upgradient influent well to the DIW-1 South wing. The background concentrations were typically below 1 ppm. As shown iron concentrations in the North wing began to decline below upgradient influent concentrations after approximately 6 months. Declines were seen at all depths with the greatest declines occurring closest to the soybean oil. Iron concentrations in the South wing "A" piezometers remained below 300 ppm even though the associated upgradient influent well increased in concentration to greater than 500 ppm. The South wing "B" and "C" piezometers have remained at essentially upgradient influent concentrations. Also having an impact upon iron concentrations is the iron speciation (i.e. whether the dissolved iron exist as ferric (Fe^{+3}) or ferrous (Fe^{+2})) iron. Figure 20 presents the ferrous to total iron ratio trend. As seen the average upgradient influent ferrous to total iron ratio was 0.58. However the DCB-21A ratio went from 0 (meaning all ferric iron) to approximately 1 (meaning all ferrous iron) during the course of the demonstration. It appears that this change resulted from the rising water levels. In general the iron within DIW-1 was predominately ferrous, with the exception of the lower zone of the South wing, which appeared to mimic DCB-21A, once the water levels started to rise. A geochemical explanation for the iron trends is provided in Sections 6.2.3.1 and 6.2.3.4.

Table 13 provides the average pre-injection and July 15, 2003 metals concentrations from DIW-1 locations DIW-P09A, DIW-1-2, and DIW-P07A. Each of these locations was sampled and analyzed during every sampling event, and together they represent one "A" piezometer from each wing and a central location (see Figure 4). As seen a near 90 percent concentration reduction was seen for aluminum, chromium, copper, nickel, and zinc, a greater than 50 percent reduction was seen for calcium, magnesium, and manganese, and a significant reduction was seen for iron and silica. The only metal that demonstrated an increase was barium. Beryllium, cadmium, and lead were essentially below the detection limits throughout the field demonstration. Geochemical explanations for these observations are provided in Section 6.2.3.

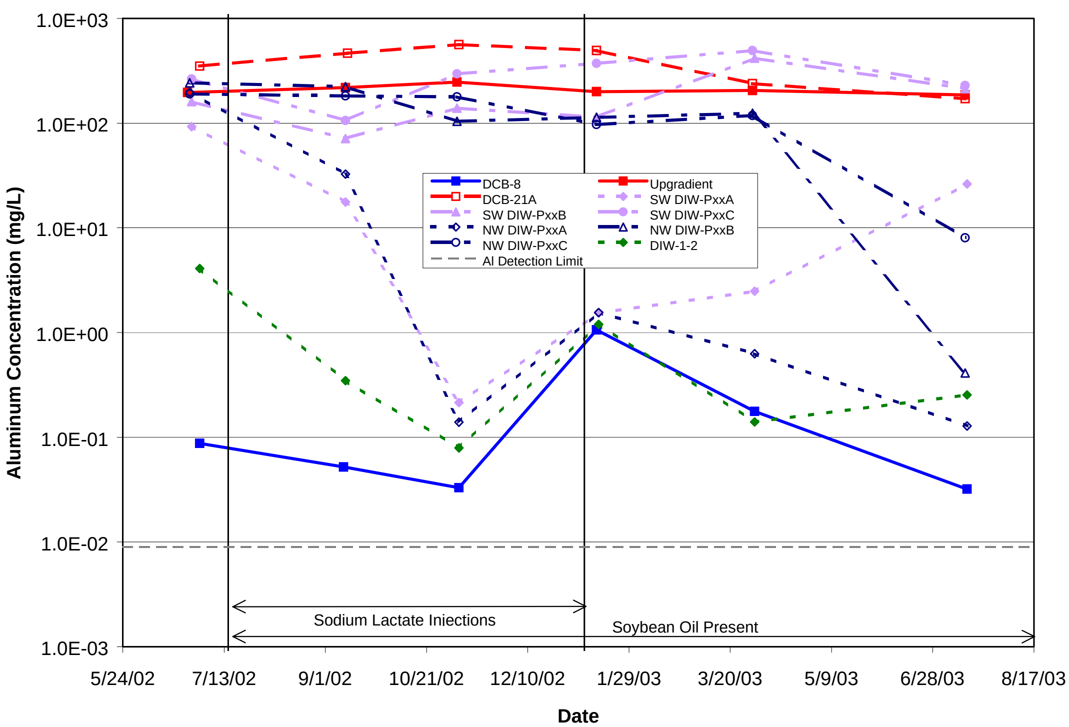

Figure 18. Aluminum Concentration Trends

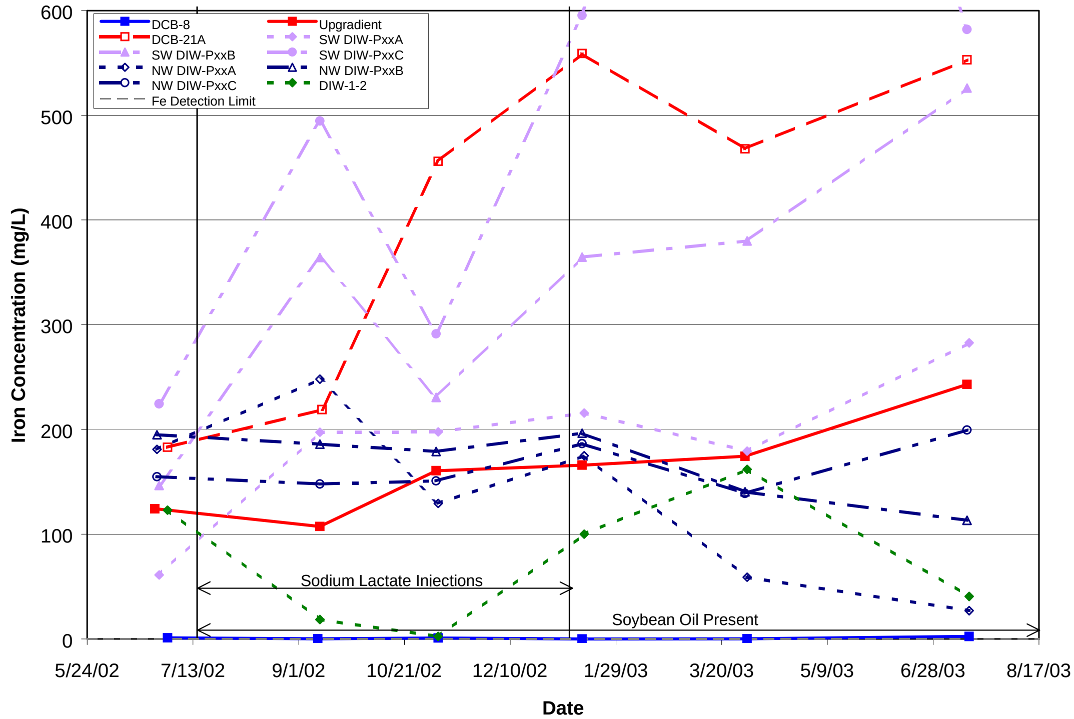

Figure 19. Iron Concentration Trends

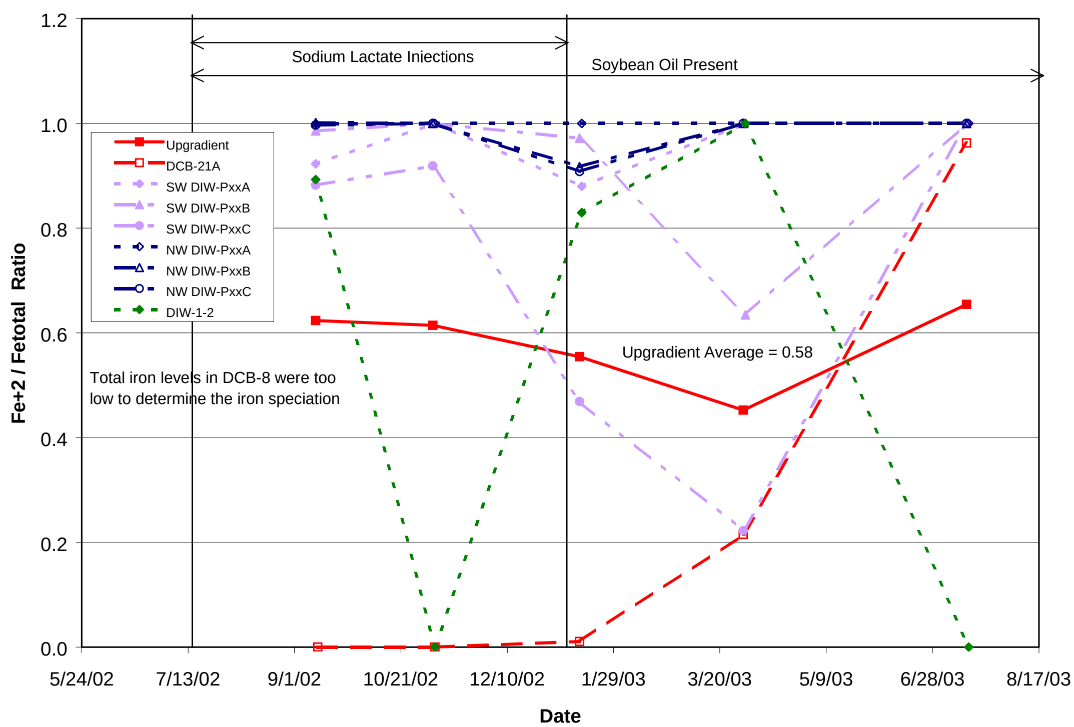

Figure 20. Iron Speciation Trends

Table 13. Average Metal Concentration Trends from Selected DIW-1 Locations

Sample Date	Aluminum (mg/L)	Barium (mg/L)	Calcium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)
6/26/02	87.814	0.002	65.367	0.039	0.072	102.380
7/15/03	0.446	0.014	19.967	0.002	0.009	62.167
Percent Reduction	99.5	NA	69.5	94.8	87.6	39.3
Percent Increase	NA	592.5	NA	NA	NA	NA
Sample Date	Magnesium (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Silicon (mg/L)	Zinc (mg/L)	
6/26/02	37.212	12.380	0.467	30.467	0.849	
7/15/03	14.967	4.571	0.010	16.639	0.001	
Percent Reduction	59.8	63.1	97.9	45.4	99.9	
Percent Increase	NA	NA	NA	NA	NA	

Notes to Table 13:
1) Average concentrations from locations DIW-P11A, DIW-1-2, and DIW-P07A.
2) NA = not applicable

6.2 GEOCHEMICAL

During this field demonstration, mineral precipitation, co-precipitation and adsorption are likely mechanisms controlling the mobility of metals near the DIW-1. Factors that influence these processes include changes in pH, redox conditions, and concentrations of various chemical species. Fluctuations in rainfall and DCPRB water levels, heterogeneities within aquifer sediments and within DIW-1, and the implementation methods of this field study add to the geochemical complexity of the groundwater. However, chemical relationships and trends can help to explain some of the observed changes in major constituents (e.g. SO_4, Al, and Fe) and trace metals (e.g. Cu, Ni, and Zn) at DIW-1. Some of these relationships and processes are described below for the chemical constituents monitored at DIW-1 during this field study.

6.2.1 Sulfate

Sulfate (SO_4^{-2}) is generated from the oxidation of sulfur, which is prevalent in many coal deposits as elemental sulfur (S^o) or as sulfide minerals (e.g. pyrite). Under oxidizing conditions, sulfate is the predominant sulfur species for a large range of pH conditions (pH 2 – 11). The process of reducing sulfate can include intermediate sulfur species (e.g. sulfite SO_3^{-2}, thiosulfate $S_2O_3^{-2}$, polysulfides S_n^{-2}) in addition to the final formation of sulfide species (H_2S, HS^-). Figure 21 shows a simplified pe-pH diagram for the sulfur system without these intermediate species. A pe-pH diagram shows the chemical species that are stable or predominant under various pH and redox (pe) conditions. Low pe reflects reducing conditions whereas high pe reflects oxidizing conditions. Although pe-pH diagrams are based on assumptions (e.g. the groundwater is under equilibrium conditions) that may not accurately reflect natural conditions, they can aid in understanding stability relationships among chemical species.

The decrease in sulfate concentrations and pe in addition to the sporadic increases in hydrogen sulfide (H_2S) concentrations and pH indicate that sulfate reduction has been occurring within

DIW-1 during this study. Evidence of sulfate reduction in DIW-1 was observed prior to this study, but the process of sulfate reduction was likely occurring very slowly. Figure 21 and study data suggest that redox and pH conditions within DIW-1 are becoming more favorable for the stability of a reduced sulfate species (S^{-2}) such as H_2S or HS^-. These conditions presumably are the result of organic substrate injection (lactate and/or soybean oil) and sulfate reducing bacteria.

Figure 22 provides a solubility curve for H_2S, which is useful in determining whether the groundwater in DIW-1 is undersaturated or oversaturated with respect to H_2S. Although sporadic increases in hydrogen sulfide concentrations were found during this study, these data appear to be below the solubility curve for H_2S. These data imply that on a large-scale the sulfate reducing bacteria were not generating more H_2S than could be dissolved in the groundwater. The precipitation of metal sulfides such as iron monosulfide (FeS) may contribute to keeping hydrogen sulfide below saturation.

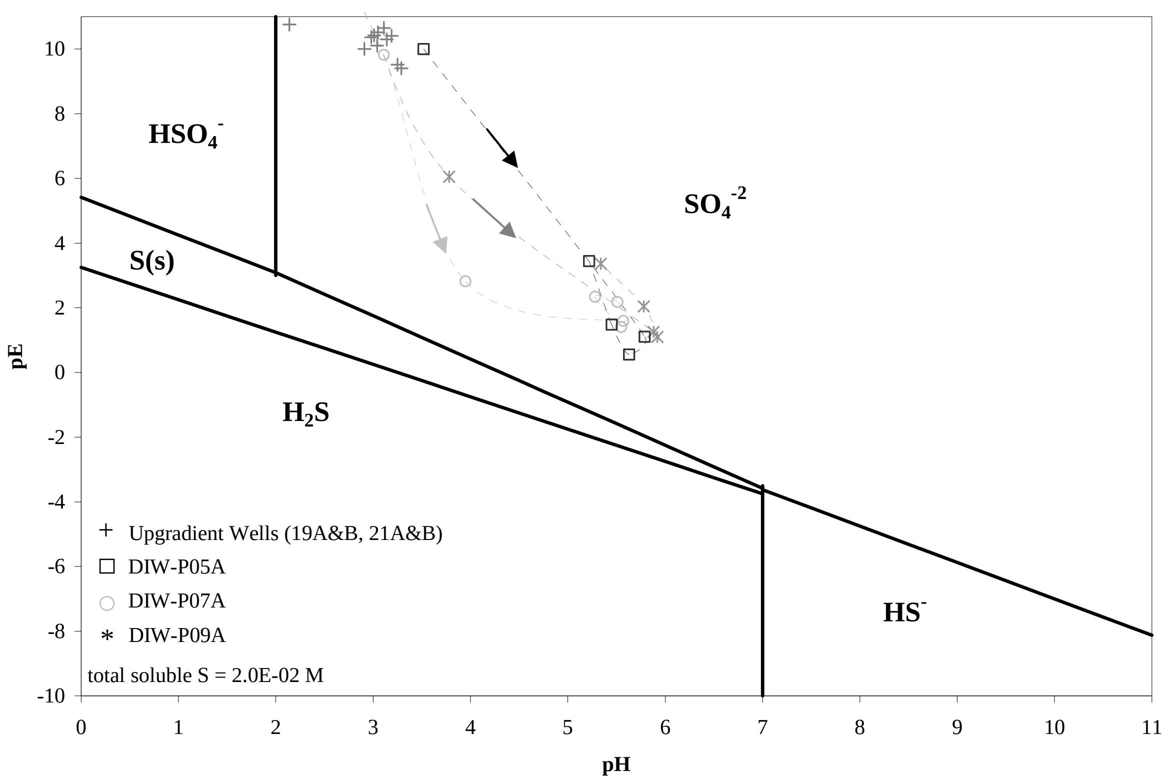

Figure 21. pE-pH Diagram for Sulfur Species

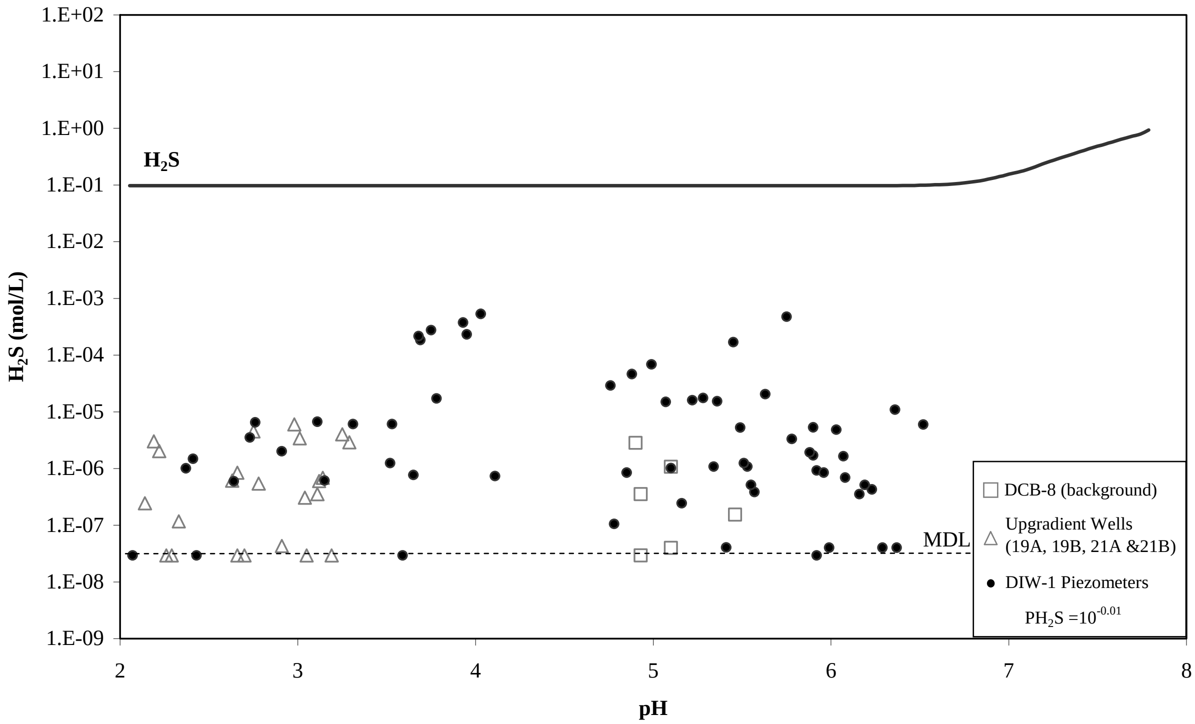

Figure 22. Solubility Curve for H_2S

6.2.2 Acidity

Besides generating sulfate, chemical and biological oxidation of elemental sulfur and pyrite (FeS_2) in the coal generates acidity (H^+) (decreasing pH). This acidity results in the leaching of metals (e.g. Al, Cu, Fe, Ni, and Zn) from minerals present within the coal and the nearby aquifer formation. The following equations describe some of the reactions responsible for the increase in acidity (H^+) observed at coal waste sites such as the DCPRB:

Sulfur (in pyrite) oxidation by O_2:

$$2FeS_2(s) + 7O_2(aq) + 2H_2O \rightarrow 2Fe^{+2} + 4H^+ + 4SO_4^{-2}$$

Sulfur (in pyrite) oxidation by Fe^{+3}:

$$FeS_2(s) + 14Fe^{+3} + 8H_2O \rightarrow 15Fe^{+2} + 16H^+ + 2SO_4^{-2}$$

Elemental sulfur (S^o) oxidation by bacteria:

$$S^o + 4H_2O \rightarrow SO_4^{-2} + 8H^+ + 6e^-$$

Oxidation of ferrous iron (Fe^{+2}) by chemically and biologically mediated reactions contributes more acidity to the system through hydrolysis and precipitation of ferric hydroxides and sulfates. The following equations describe some examples of these precipitation reactions:

Precipitation of ferric hydroxides and oxyhydroxides (e.g. $Fe(OH)_3$ (a), geothite, ferrihydrite):

$$Fe^{+3} + 3H_2O \rightarrow Fe(OH)_3(s) + 3H^+$$

Precipitation of ferric sulfates (e.g. jarosite, schwertmannite):

$$Na^+ + 3Fe^{+3} + 6H_2O + 2SO_4^{-2} \rightarrow NaFe_3(SO_4)_2(OH)_6(s) + 6H^+$$

Sulfate reduction at DIW-1 creates conditions favorable for the consumption of acid (H^+), and the removal of sulfate from the DCPRB influent groundwater. Through the oxidation of a carbon source, sulfate-reducing bacteria consume H^+ ions and reduce sulfate forming intermediate sulfur species and sulfide. An example of this process with lactate is:

$$2CH_3CHOHCOO^- + 3SO_4^{-2} + 2H^+ \rightarrow 6HCO_3^- + 3H_2S$$ (Benner et al. 1999)

$$2CH_3CHOHCOO^- + SO_4^{-2} + H^+ \rightarrow 2C_2H_3O_2^- + 2CO_2 + 2H_2O + HS^-$$ (Neal et al. 2001)

The sulfide produced may then degas (as H_2S(gas)) or form metal sulfides. Reducing conditions generated at DIW-1 would also favor the presence of ferrous iron (Fe^{+2}) over ferric iron (Fe^{+3}). These conditions minimize acidity generated from iron oxidation and ferric hydroxide precipitation (shown in the above equations).

6.2.3 Metal Precipitates

The increase in pH and reduction of metal and sulfate concentrations observed in the piezometers at DIW-1 during this study indicate that sulfate reduction has occurred. Described below are some of the metal precipitates that may have resulted from sulfate reduction at DIW-1.

6.2.3.1 Metal Sulfides

With the formation of sulfides produced from sulfate reduction, metals may precipitate as sulfide minerals thereby decreasing metal concentrations in the groundwater. The decrease in metal concentrations observed in piezometers at DIW-1 suggests that mineral precipitation may have been occurring during this study. The following equations describe some of the precipitation reactions that may have occurred in the vicinity of DIW-1:

Monosulfide (FeS)	$Fe^{+2} + H_2S \rightarrow FeS(s) + 2H^+$
Pyrite (FeS_2)	$Fe^{+2} + 2H_2S \rightarrow FeS_2(s) + 4H^+$
Chalcopyrite ($CuFeS_2$)	$Cu^{+2} + Fe^{+2} + 2H_2S \rightarrow CuFeS_2(s) + 4H^+$
Covellite (CuS)	$Cu^{+2} + H_2S \rightarrow CuS(s) + 2H^+$
Chalcocite (Cu_2S)	$2Cu^{+1} + H_2S \rightarrow Cu_2S(s) + 2H^+$
Sphalerite (ZnS)	$Zn^{+2} + H_2S \rightarrow ZnS(s) + 2H^+$

Sulfide minerals such as CdS, HgS, and PbS may also form with elevated cadmium (Cd), mercury (Hg), and lead (Pb) levels. However, during this study, Cd, Hg, Pb did not significantly contribute to the metal concentrations near DIW-1.

Figure 23 shows solubility curves for copper and zinc sulfide minerals potentially precipitating near DIW-1. The curves were constructed based on DIW-P11A baseline groundwater data and maximum copper and nickel concentrations. At a fixed pH, the addition of hydrogen sulfide to the system decreases the solubility of these metal sulfides favoring their precipitation. In addition, with increasing sulfide concentrations the precipitation of different metal sulfide phases may be favored. For example, at low sulfide concentrations, chalcocite has a lower solubility than covellite and chalcopyrite. This trend reverses as hydrogen sulfide concentrations increase and chalcopyrite has a lower solubility than chalcocite and covellite. Sphalerite has the highest solubility of the minerals presented. At higher sulfide concentrations, the solubilities of these minerals increase due to the metals complexing with sulfide species (e.g. $Cu(HS)_3^-$ and $Zn(HS)_2$) in the groundwater.

Various metastable iron sulfide phases are thought to exist and be precursors to a more stable phase such as pyrite. Some of these phases may have formed near DIW-1 and include iron monosulfide (FeS), mackinawite ($FeS_{(1-x)}$), and greigite (Fe_3S_4). Figure 24 shows solubility curves for two iron sulfide minerals (pyrite and greigite) potentially forming near DIW-1. The curves are based on DIW-P11A baseline groundwater data. With increasing hydrogen sulfide concentrations, the solubility of both minerals decreases. In addition, the solubility of pyrite is much lower than the solubility of greigite, favoring the precipitation of pyrite over greigite. However, intermediate phases such as greigite are more likely to precipitate because of kinetics. This figure also demonstrates that with increasing pH, the solubility curves shift to the left and less hydrogen sulfide is needed to support mineral precipitation.

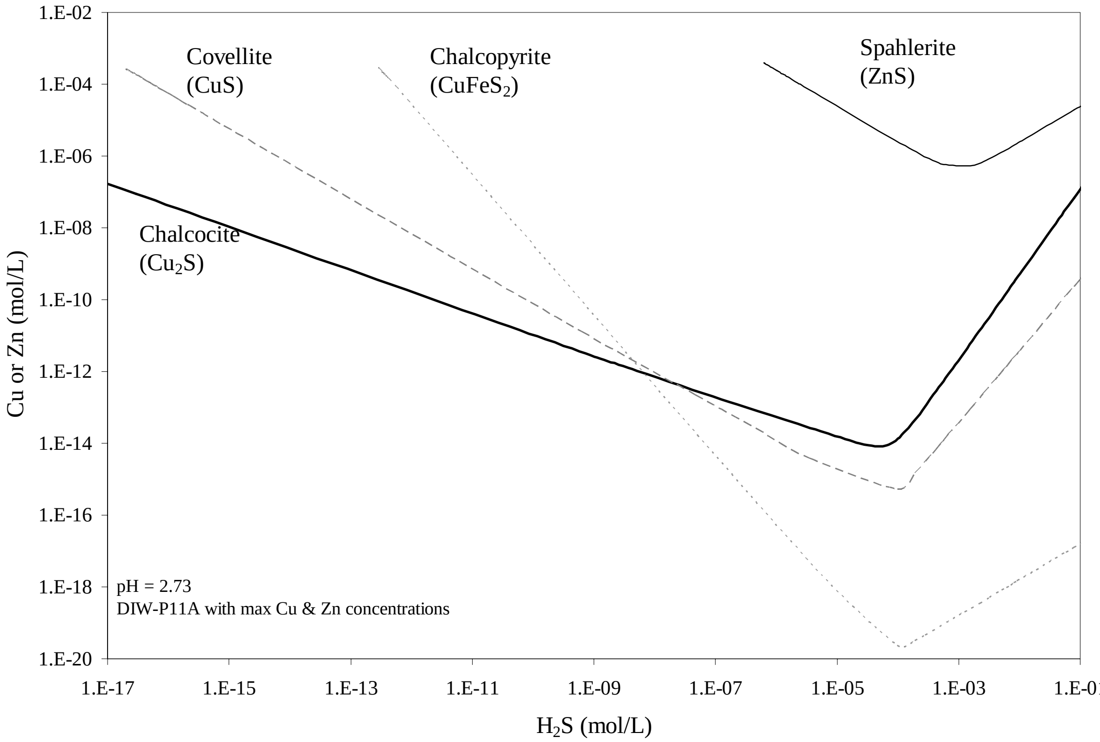

Figure 23. Solubility Curve for CuS, Cu_2S, $CuFeS_2$, and ZnS

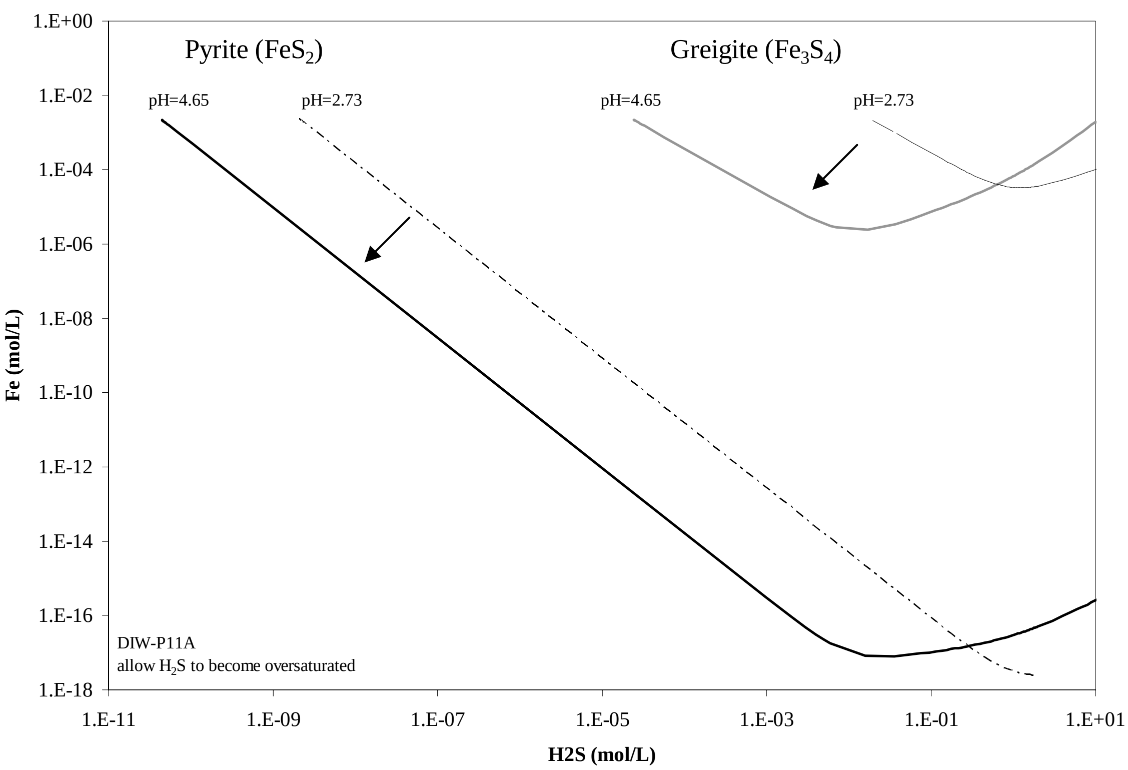

Figure 24. Solubility Curve for FeS_2 and Fe_3S_4

6.2.3.2 Metal Hydroxides

In portions of DIW-1 where aluminum concentrations and pH are elevated, it is likely that precipitation of aluminum hydroxides has occurred. Figure 25 shows a solubility curve for two potential aluminum hydroxide precipitates, constructed using DIW-P11A baseline (pre-injection) geochemical data. This figure suggests that aluminum and pH conditions are conducive for aluminum hydroxide precipitation. In the upgradient wells (triangle symbols) and the baseline samples from the DIW-1 piezometers (black circles), acidic conditions do not favor the precipitation of aluminum hydroxides despite the elevated aluminum concentrations. However, a rise in pH created during this study has made conditions more favorable in portions of DIW-1 for aluminum hydroxide precipitation (star symbols). Although not a significant contributor to metal concentrations during this study, chromium (Cr) may also precipitate as $Cr(OH)_3$ with elevated pH and Cr concentrations.

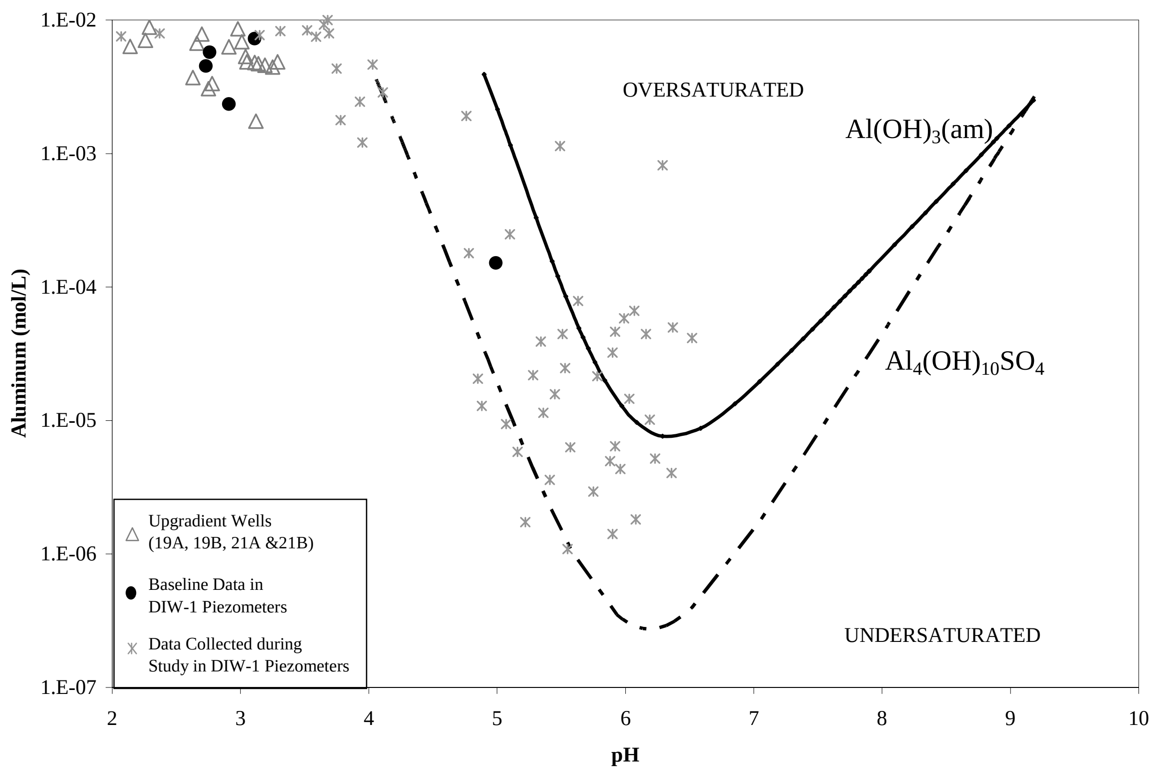

Figure 25. Solubility Curve for $Al(OH)_3(am)$ and $Al_4(OH)_{10}SO_4$

6.2.3.3 Carbonates

Based on collected pH data, the precipitation of carbonates in DIW-1 during this study is unlikely. In general, pH increased to between 5 and 6 in both wings of DIW-1. In this pH range, carbonic acid (H_2CO_3) and dissolved carbon dioxide (CO_2 aq) tend to be the dominant species rather than bicarbonate (HCO_3^-) or carbonate (CO_3^{-2}) (see Figure 26). Under these conditions, bicarbonate produced from SRB processes would convert to H_2CO_3 and dissolved CO_2 aq. In addition, calcium concentrations and calculated bicarbonate concentrations for samples collected during this study indicate that the groundwater in DIW-1 is undersaturated with respect to calcite. Figure 27 shows calcite solubility in relation to bicarbonate and calcium concentrations for water with a pH of 6.5 and a pH of 5.5. This figure suggests that high concentrations of bicarbonate would need to be generated by the SRB in order to reach calcite saturation.

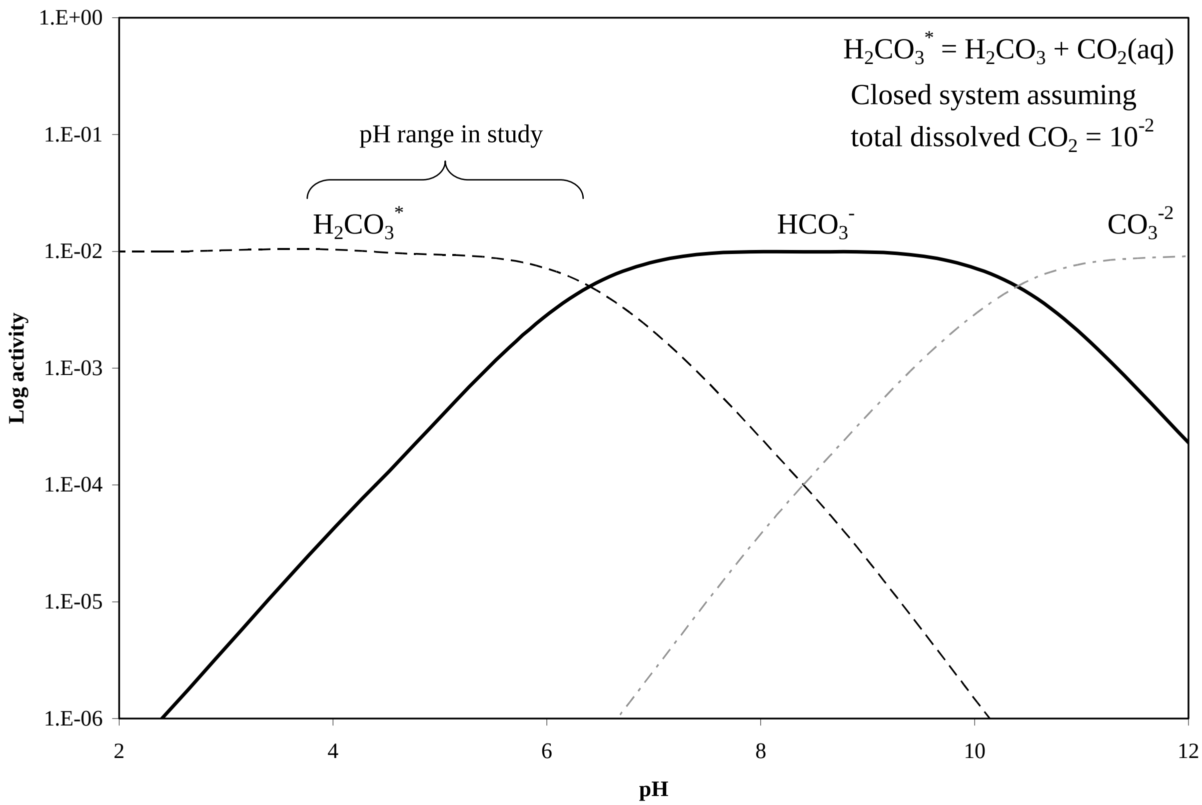

Figure 26. Species in the Carbonate System vs pH

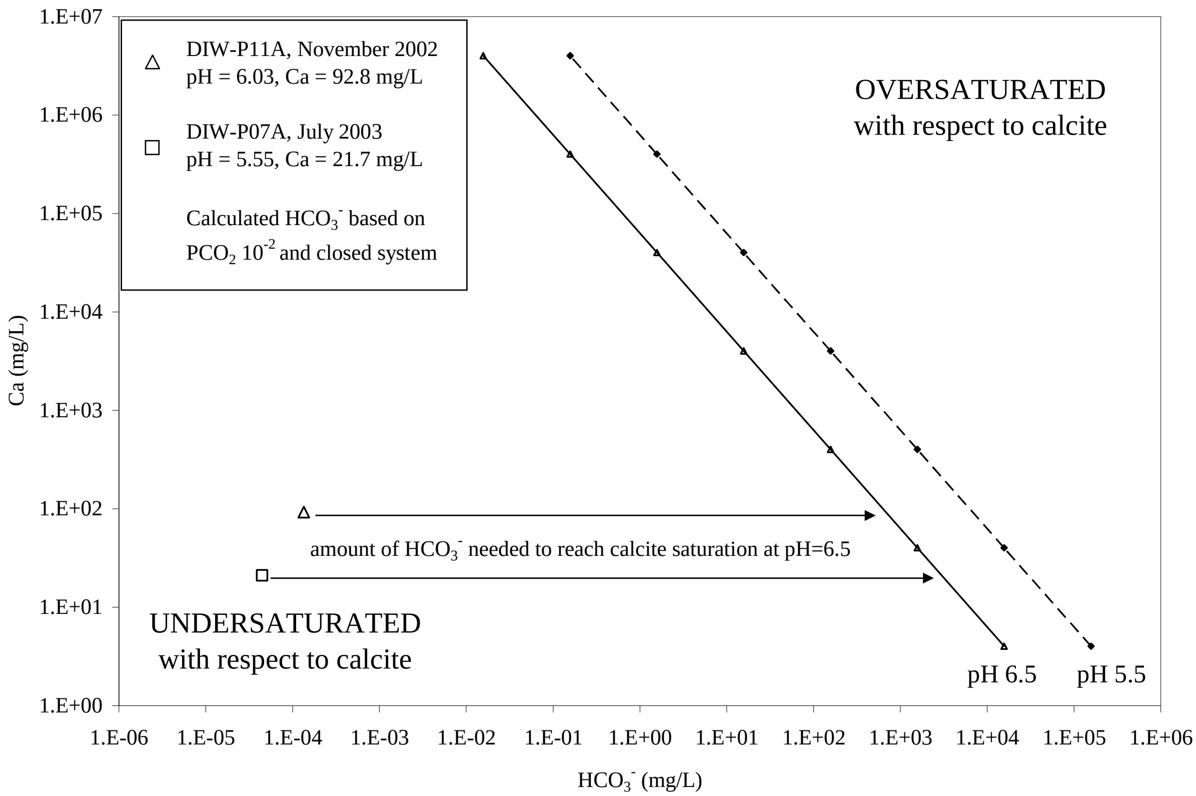

Figure 27. Relationship between Calcium and Bicarbonate for Water in Equilibrium with Calcite

6.2.3.4 Metal Adsorption

The mobility of metals near DIW-1 is also likely controlled by adsorption. Mineral surfaces interact with dissolved chemical species (e.g. H^+ ions, dissolved metal ions, and metal complexes) in the groundwater adsorbing chemical species through the formation of surface complexes. These mineral-water interactions and surface complexes are dependent on solution pH, redox, temperature, chemical species, mineral properties (e.g. mineralogy, surface area) and reaction time.

Numerous studies have shown the importance of aluminum and iron oxides and (oxy)hydroxides (e.g. ferrihydrite, goethite, schwertmannite) in the adsorption of metals including Ca, Cd, Co, Cu, Mg, Mn, Ni, Pb, Zn (Ali and Dzombak, 1996; Buerge-Weirich et al., 2002; Randall et al., 1999; Stumm and Morgan, 1996; Swedlund and Webster, 2001; Swedlund et al., 2003). These minerals often occur as coatings on mineral grains and have high surface areas with numerous sorption sites. Although kaolinite has different properties than iron oxides, studies have also provided evidence of metal removal by kaolinite through adsorption processes (Angove et al. 1997; Yavuz et al. 2003). Iron oxides and kaolinite are minerals prevalent in SRS soils including near the DCPRB. X-ray diffraction analyses from core collected near monitoring wells DCB-18 and DCB-22 reveal that kaolinite and iron oxides are prevalent in the top 30 feet of soils.

Scanning electron microscopy also indicates that much of the iron oxides exists as coatings on mineral grains (Freeman, 1997).

Figure 28 shows a basic example of how metal concentrations can be affected by adsorption near the DIW-1. The figure was constructed using groundwater data from DIW-P11A, surface property values for hydrous ferric oxide, and assuming no mineral precipitation. Although a simplified example, this figure does demonstrate that adsorption of trace metals is favored with increasing pH. Consequently, with increasing pH at DIW-1, it is likely that adsorption is decreasing the mobility of some trace metals.

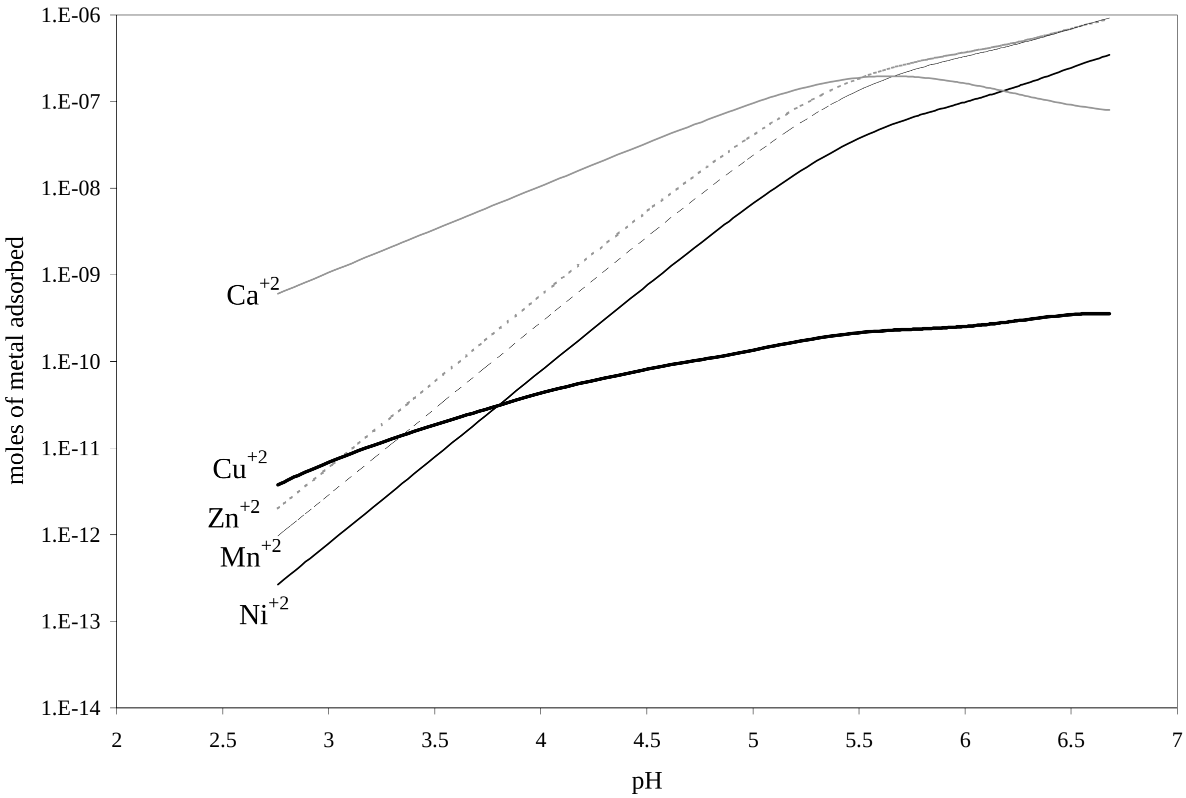

Figure 28. Adsorption of Trace Metals on Hydrous Iron Oxide as a Function of pH

6.2.3.5 Mineral Dissolution

During this field study, slight increases in barium concentrations were detected. This increase may be a function of the dissolution of barite ($BaSO_4$). Figure 29 provides an example of barite dissolution for DIW-P11A with decreasing sulfate concentrations and increasing pH. As sulfate is removed from the system, the solubility of barite increases and barium and sulfate are released into solution.

Mineral dissolution may also help to explain dissolved iron concentrations monitored during this study. Unlike other metals, such as copper nickel and zinc, which decreased in portions of DIW-1, iron concentrations were observed to sporadically increase and decrease in some of the piezometers in DIW-1. Reductive dissolution of existing iron oxides and iron (oxy)hydroxides would have contributed additional iron to the system. Examples of reducing reactions are presented below in which ferric iron (Fe^{+3}) is reduced to ferrous iron (Fe^{+2}) by the dissolved sulfide.

Reductive dissolution of hematite (Neal et al. 2001):

$$8Fe_2O_3 + 8H_2S + 32H^+ \rightarrow 16Fe^{+2} + 8S^o + 24H_2O$$

Reductive dissolution of goethite in marine sediments (Appelo and Postma 1996):

$$2FeOOH + 3HS^- \rightarrow 2FeS + S^o + H_2O + 3OH^-$$

Figure 30 shows a simplified pe-pH diagram for iron species and iron concentrations with groundwater data from DCB-21A, DIW-P09A and DIW-P11A. Initial redox and pH conditions for these locations suggest that ferric oxide was likely the predominant species. Under these conditions, the precipitation of a solid ferric oxide or (oxy)hydroxide would be favored resulting in relatively low dissolved iron concentrations (< 200 mg/L). With the initiation of the study, a decrease in pe and an increase in pH were observed which corresponded to increases in iron concentrations. The early increase in iron concentrations at DIW-P09A and 11A may be attributed to reductive dissolution in or near DIW-1. Later increases in iron concentrations (or lack of decrease) may be attributed to reductive dissolution occurring near the basin or upgradient wells resulting in additional iron in the influent waters.

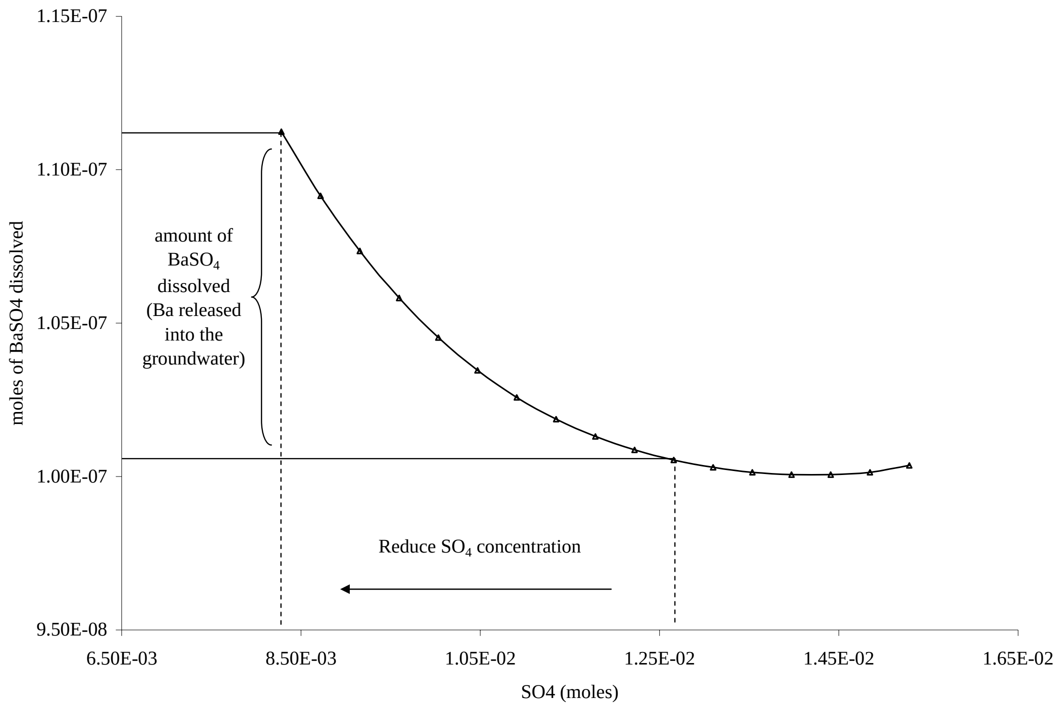

Figure 29. Solubility of Barite ($BaSO_4$)

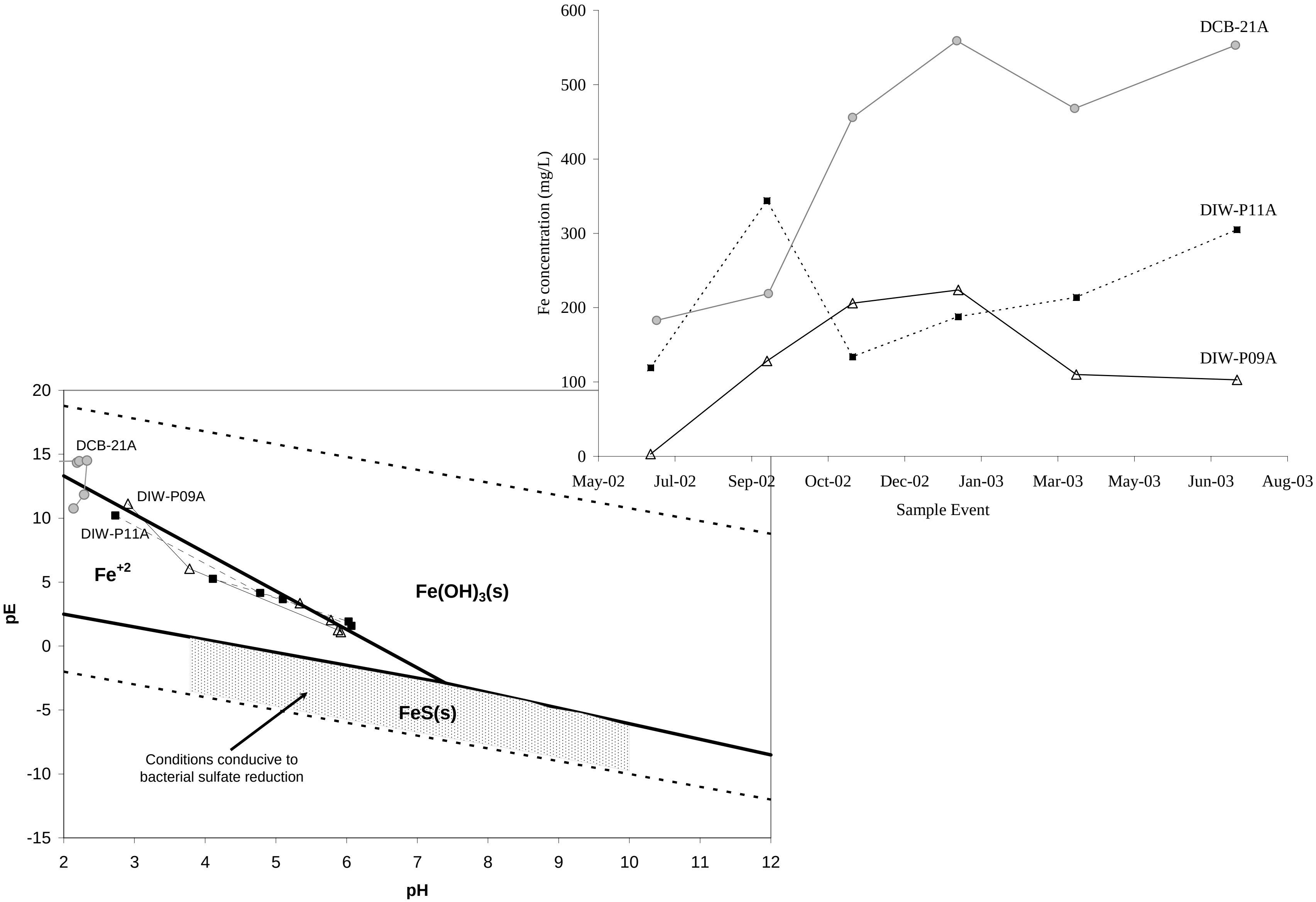

Figure 30. pe-pH diagram for Iron & Trends in Iron Concentrations

6.3 MICROBIOLOGICAL

Total bacterial counts demonstrated an increase of the overall bacterial population as a function of carbon substrate addition (see Figure 31). As a result Eh values decreased as expected (see Figure 17) and dissolved oxygen values remained generally below 1 mg/L (see Figure 32). The Eh decrease and low dissolved oxygen were likely due to the increased physiological activity of aerobic bacteria as a result of nutrient addition. Similarly, bacterial activity probably also resulted in an increase of the pH in the wells receiving nutrient additions. These changes in pH, Eh and DO provided conditions more conducive to SRB activity. Values from total bacterial counts and MPN-SRAs (see Figures 31 and 13, respectively) were not in agreement as the field study progressed. It is often difficult to compare results between two different analytical techniques and this may explain why SRB values were slightly higher than total direct counts. Another possibility is that a high percentage of the SRB may be spore formers. If SRB were in the spore stage direct counts would not have detected them, but the MPN-SRA method would.

The increase in SRB population density occurred shortly after initial substrate additions, with no detectable lag in growth (see Figure 33). The SRB therefore responded quickly to the added carbon sources. Based on our preliminary studies and pre-injection H_2S concentrations, SRB were likely active at parts of the study site prior to the addition of carbon sources. Whether SRB were active (to a minor degree) throughout the entire study site is unknown. Considering that the conditions were far from optimal for SRB, they may have been present as non-metabolically active spores. A small fraction of SRB may have been added to the aquifer during nutrient addition. This is because lactate was diluted with water from the non-contaminated background well DCB-8. SRB were detected in that well prior to the field trials and likely contributed to a minor degree of the SRB activity. Considering the low volume of water and the low SRB concentrations from DCB-8, it is not likely that these SRB served as a sole inoculum to this aquifer. Both sodium lactate and soybean oil addition resulted in increased bacterial population density, including SRB (see Figure 33). SRB activity promoted by soybean oil was similar to or slightly better than that promoted by lactate. In addition, hydrogen sulfide was detected at levels significantly above background in the waters receiving nutrients (see Figure 34). Hydrogen sulfide is expected to be transient in the aquifer due to its high degree of reactivity with heavy metals and is therefore not a good quantitative measurement of SRB growth or metabolic activity over time. While sulfate concentrations also vary over time, sulfate is not as reactive as hydrogen sulfide and therefore is a better overall measure of SRB activity. Low sulfate concentrations were detected in a majority of treated wells with apparent declines in sulfate over time (see Figure 35), relative to the untreated wells.

Sufficient data were available from 5 wells for estimation of SRB growth rates. Growth was calculated from the portion of the data that demonstrated logarithmic growth and converted to provide an estimate of the length of time it took the bacterial population to double in number. The wells and SRB doubling times (in parentheses) are as follows; DIW-P13A (32 days), DIW-P11B (23 days), DIW-P09A (18 days), DIW-1-2 (21 days), and DIW-7A (11 days). DIW-13A had the slowest growth rate and also demonstrated the highest concentration of lactate during January 2003 (see Figure 36). The high lactate concentration may have resulted in inhibition of SRB growth during this time. Although SRB density was high, their growth rate may not have kept up with nutrient availability. Whether the high lactate concentration caused inhibition or low SRB activity resulted in a decreased rate of lactate utilization is unknown, however both are plausible scenarios.

VFAs are breakdown products from the degradation of larger organic compounds. The production of VFAs indicates bacterial activity in the wells that received nutrients (see Figure 37). Ultimately the lower molecular weight VFAs , acetate and propionate are utilized by SRB for carbon and energy. The presence of VFAs throughout the study demonstrates carbon utilization in the subsurface (see Figure 37). If SRB or other anaerobic respiring bacteria are inactive or insufficient in number VFA concentrations may accumulate. This was detected in only one well in the study. DIW-13A demonstrated higher VFA concentrations than the other wells (see Figure 37). The VFAs in this well consisted almost entirely of acetate and propionate indicating a decreased rate of SRB activity. DIW-13A also had the lowest detected SRB growth rate and high lactate concentrations. These VFA data further corroborate that SRB activity was inhibited to some degree in DIW-13A.

Nitrogen and phosphorous are important inorganic nutrients for bacterial growth. Based on the data available for nitrate, nitrite and ammonia, nitrogen concentrations (see Figures 38) should be sufficient to maintain growth. Phosphate concentrations were below detectable limits in a majority of the wells receiving nutrients, however these wells were capable of supporting increases of SRB by 5 logs. The capacity to support bacterial densities of that magnitude indicates sufficient nutrients. Nitrogen and phosphate are expected to enter the biologically active zone as groundwater transits through, thereby adding inorganic nutrients to the system. In addition, microbial density has leveled off, as expected in the nutrient amended wells. A steady state of bacterial activity is expected to follow. Factors such as protozoan predation contribute to steady-state conditions, including biomass turnover. Nitrogen and phosphate are then expected to cycle through the system. It is likely therefore that nitrogen and phosphate concentrations will be maintained or exceed the concentrations encountered during the start of the project.

Based on these data both soybean oil and lactate supported growth of SRB and consequentially hydrogen sulfide production to a similar degree. Because SRB inhibition may have resulted in at least one of the lactate treated piezometers, addition of lactate to the subsurface must be done with some precision, otherwise, inhibitory conditions may result. Evidence for SRB activity persisted for months after soybean oil treatments ceased, indicating that soybean oil was released into the aquifer gradually over time. Based on the economics of bioremediation, soybean oil appears to be the most cost-effective approach while minimizing the risk of approaching inhibitory concentrations in the aquifer.

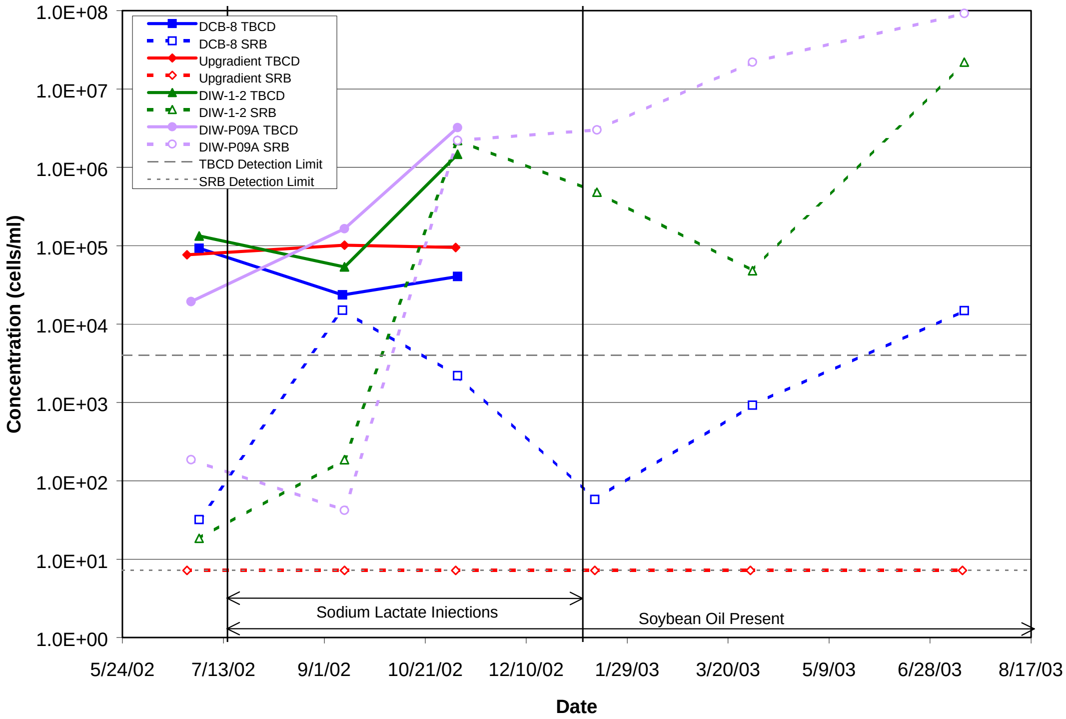

Figure 31. Total Bacteria Cell Density (TBCD) Versus SRB Trends

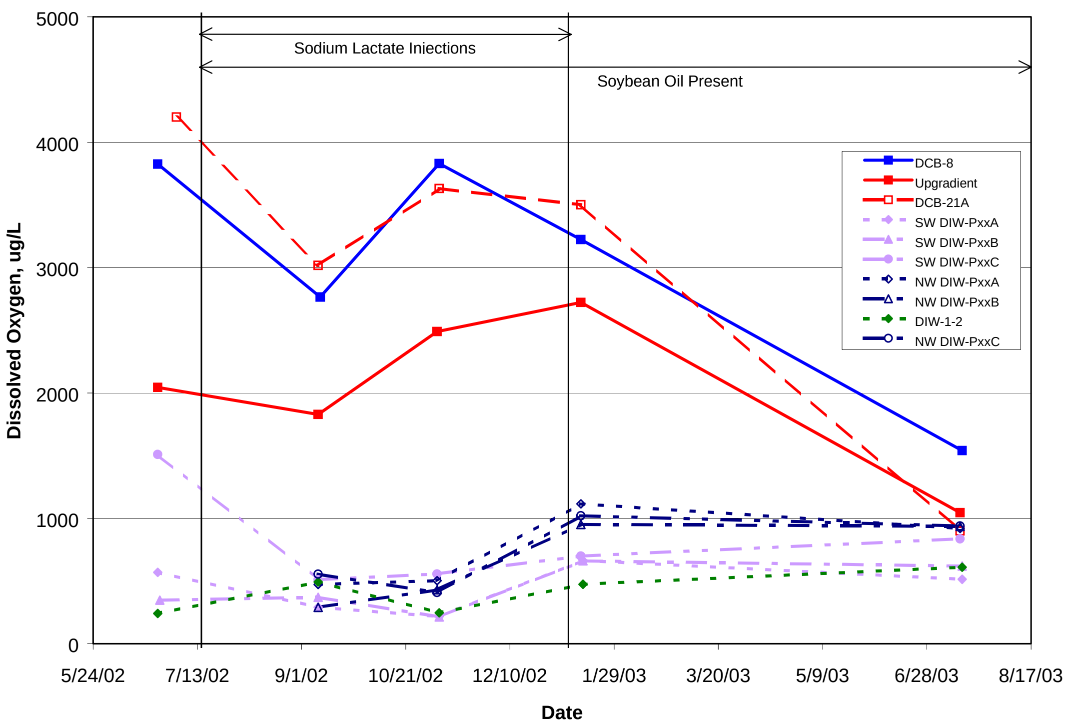

Figure 32. Dissolved Oxygen Trends

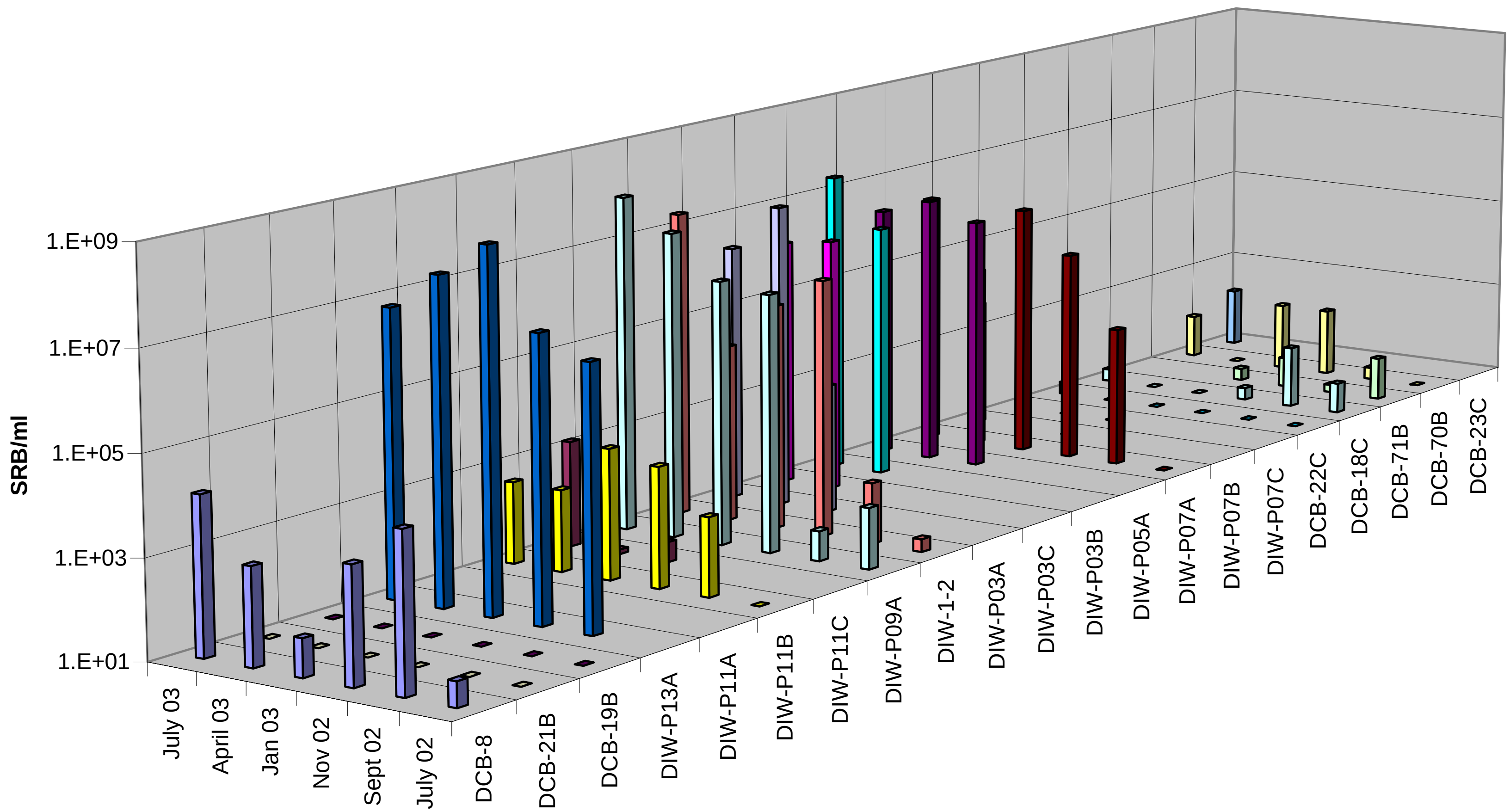

Figure 33. SRB Density in the D–Area Aquifer over Time

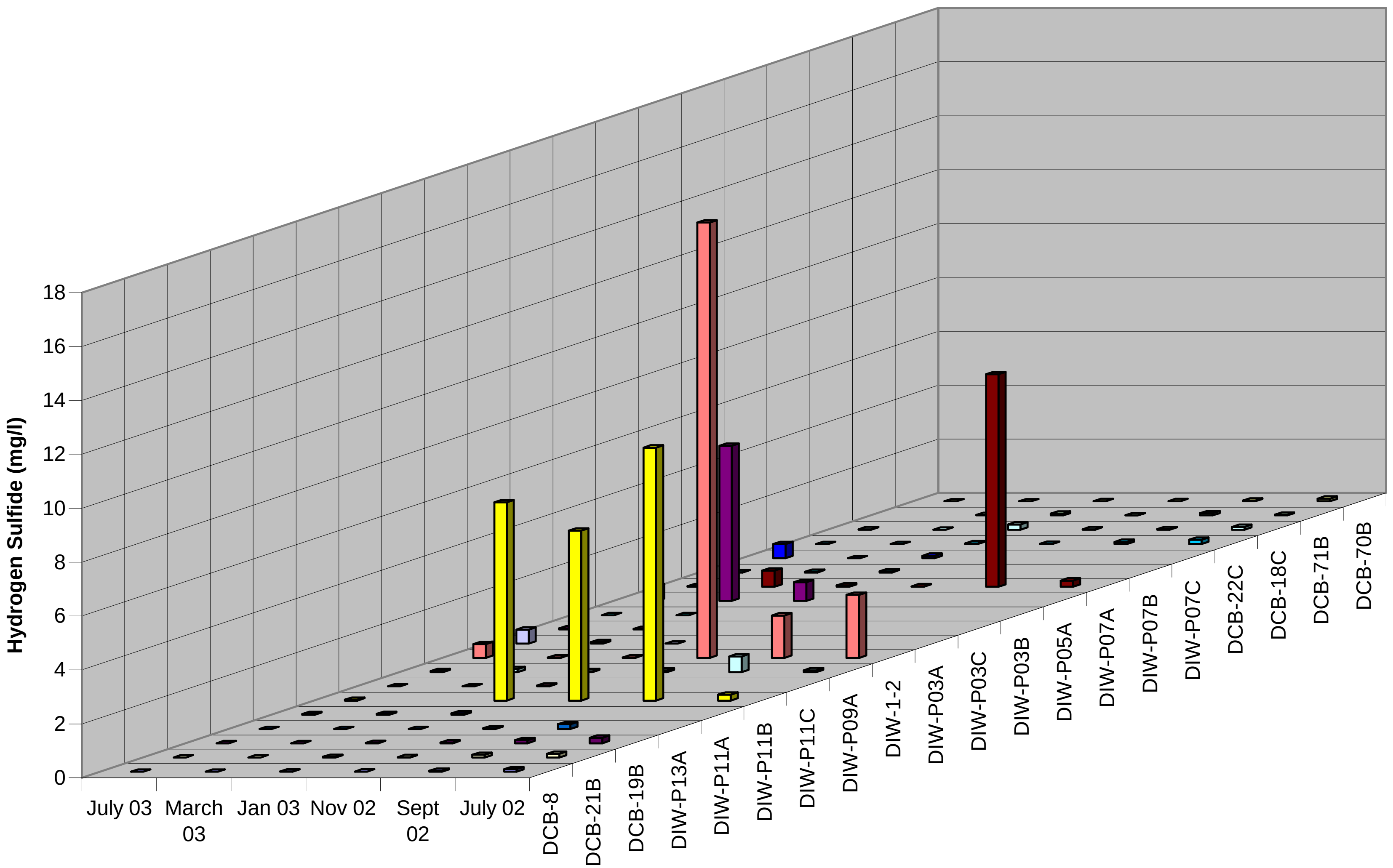

Figure 34. Hydrogen Sulfide Concentrations in the D–Area Aquifer over Time

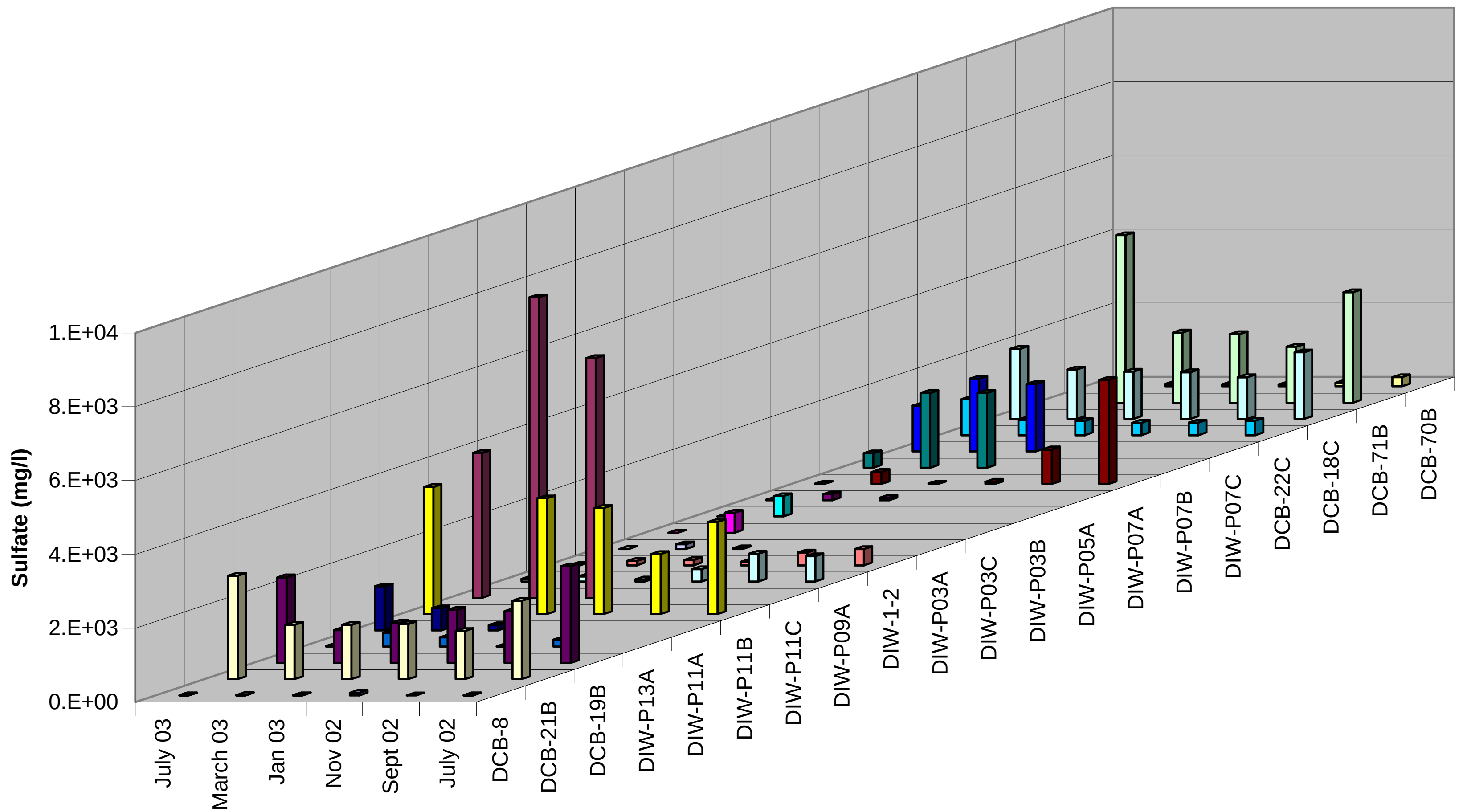

Figure 35. Sulfate Concentrations in the D–Area Aquifer over Time

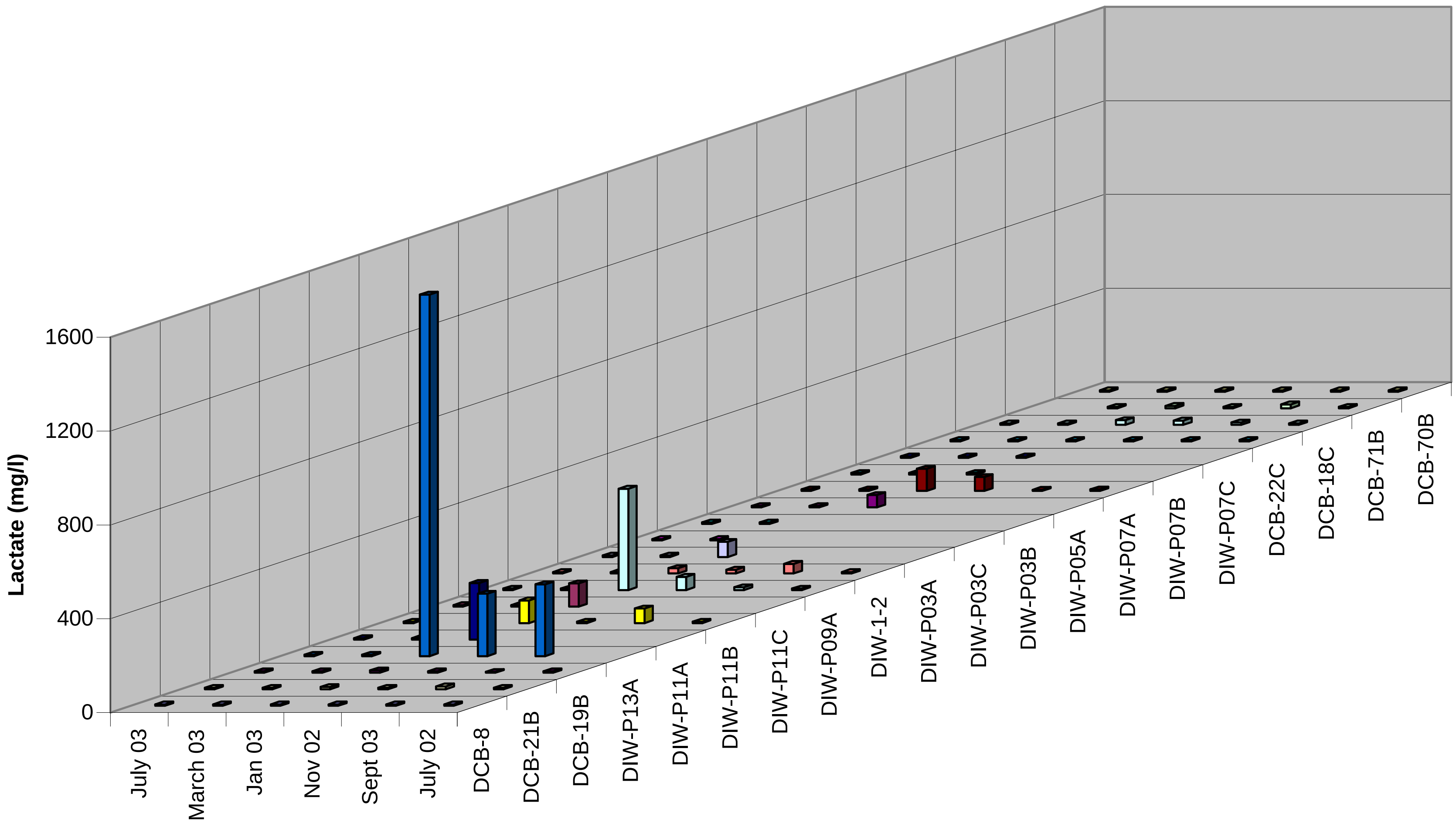

Figure 36. Lactate Concentrations in the D–Area Aquifer over Time

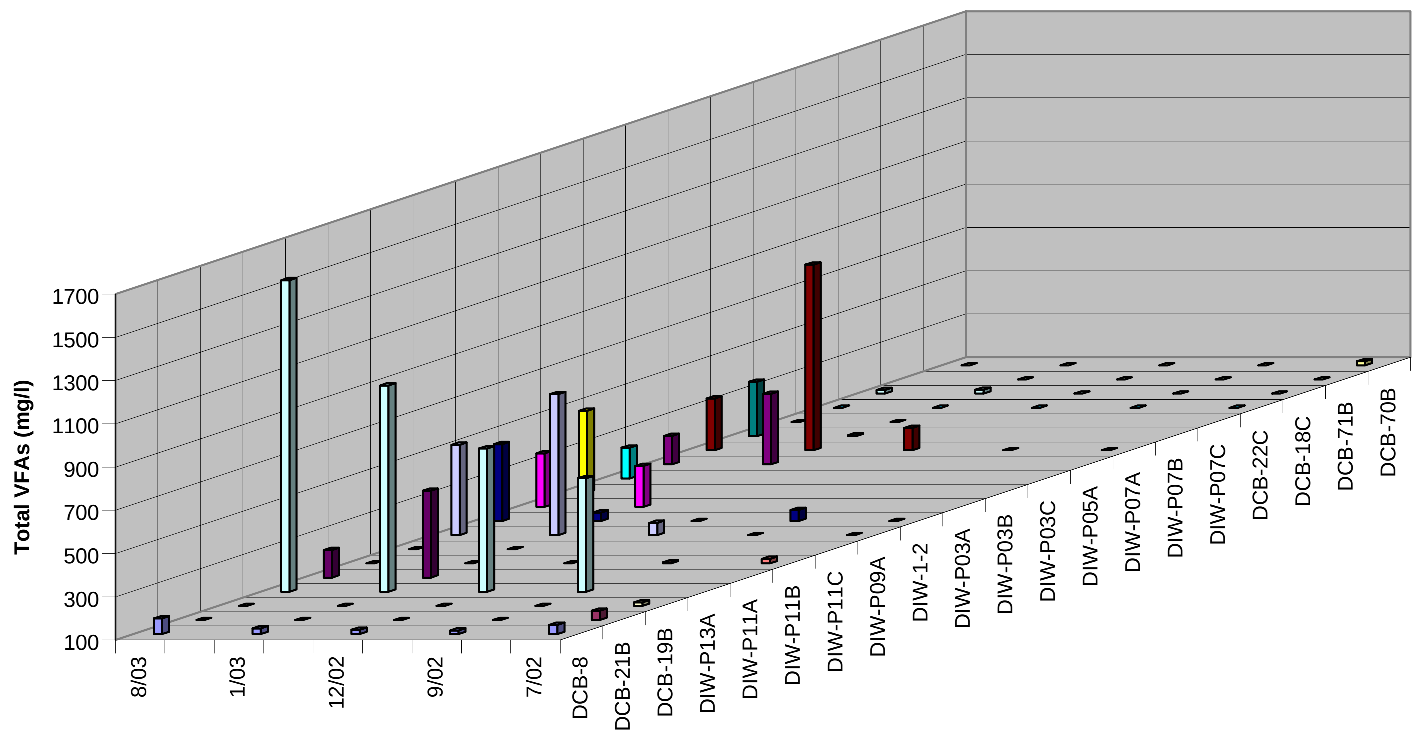

Figure 37. Total Volatile Fatty Acid Concentrations in the D–Area Aquifer over Time

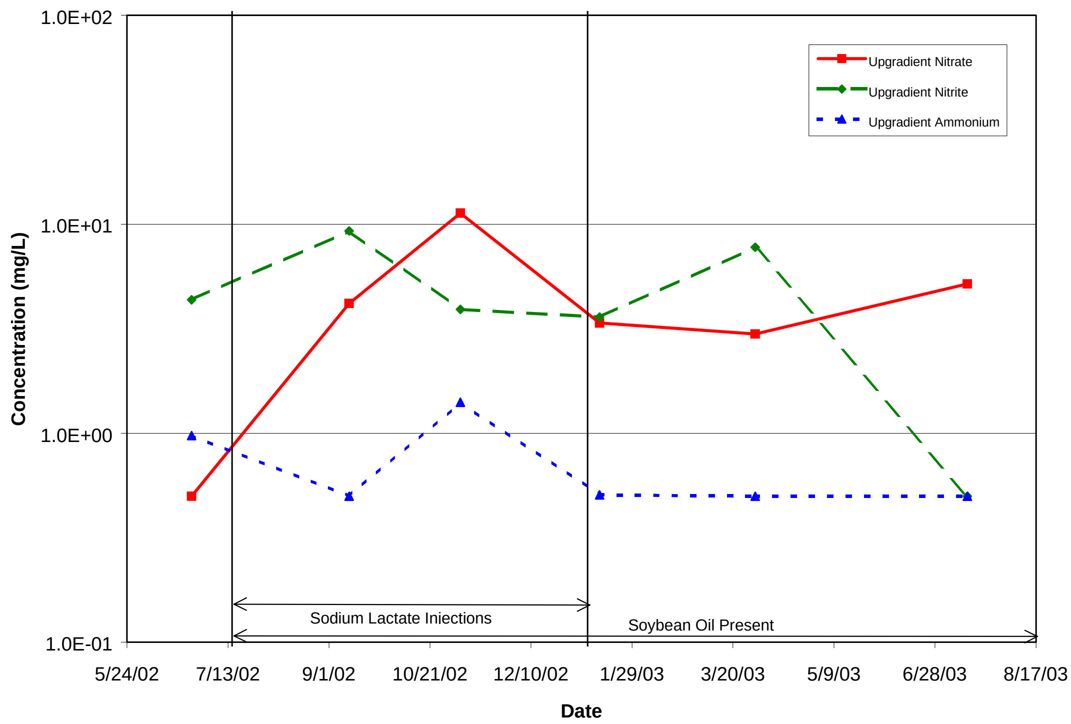

Figure 38. Upgradient Influent Nitrate, Nitrite, and Ammonia

THIS PAGE INTENTIONALLY LEFT BLANK

7.0 SUMMARY AND CONCLUSIONS

The summary and conclusions presented herein address the questions outlined in Section 4.0, which are listed as the objective and focus of this study.

In the immediate vicinity of DIW-1 groundwater flow is toward DIW-1 from either side, then downward through DIW-1 to the higher permeability, lower portion of the aquifer, and finally toward the Savannah River. The soybean oil was injected into both DIW-1 wings and formed a floating layer on top of and slightly depressing the water table surface within the coarse gravel pack of DIW-1 over its entire upgradient side. Soybean oil was present throughout the duration of the field demonstration (i.e. from July 2002 through July 2003). The sodium lactate, on the other hand, was only injected into the DIW-1 South wing. The sodium lactate mixed with and was transported by the groundwater downward through DIW-1 toward the higher permeability, lower portion of the aquifer. Lactate concentrations quickly returned to below detection after the last lactate injection in January 2003.

Overall it is clear from this field demonstration that both soybean oil and sodium lactate provided a suitable carbon source to promote SRB growth either directly or indirectly through degradation and the subsequent production of short chain VFAs. The SRB growth promoted by both soybean oil and sodium lactate has resulted in sulfate reduction remediation as evidenced by the decrease in sulfate and increase in hydrogen sulfide concentrations, the subsequent increase in pH and decrease in Eh, and finally the subsequent decrease in metal concentrations. In general the level of sulfate reduction, as evidenced by the above changes, was seen to be greatest within the upper portion of DIW-1 closest to the floating soybean oil. A delayed but increasing response over time was seen within the lower portions of the North wing. Finally an initial very positive response was seen within the lower portions of the South wing followed by a decreasing response, after sodium lactate injections were discontinued and water levels increased dramatically. Additionally no evidence of micronutrient limitations was detected during this field demonstration.

Prior to injection the SRB population was a minor component of the total bacterial population, however after injection, SRB became the major component of the total bacteria population. The SRB population increased dramatically by five to six orders of magnitude after organic injections within the water of the upper portion of DIW-1 closest to the floating soybean oil. SRB within the lower portion of the North wing have also increased by five to six orders of magnitude over a longer period of time, indicating that the soybean oil zone of influence has increased with time in this wing. SRB within the lower portion of the South wing have increased one to two orders of magnitude. The calculated SRB doubling times (i.e. length of time it took the bacterial population to double in number) ranged from 11 to 32 days. In addition to the SRB, it is assumed that a significant fermentative bacteria population also exists due to the degradation and breakdown of the lactate and soybean oil to VFAs.

Significant soluble organic substrates were available after the injections began. Lactate was immediately available upon injection in the South wing, but it was only available while the injections were on going. VFAs, on the other hand, were immediately available in the South wing where the sodium lactate was injected and then available after 4 months in the North wing. VFAs continued to be available throughout the duration of this field demonstration due to soybean oil degradation, with the greatest concentrations in the upper portion of DIW-1 closest to the floating soybean oil after sodium lactate injections ceased. After sodium lactate injection ceased, VFA levels in the remainder of DIW-1 were consistent with the general pattern of sulfate reduction noted above.

As noted earlier, the decrease in sulfate concentrations and the sporadic increases in hydrogen sulfide concentrations indicate that sulfate reduction has been occurring within DIW-1 during this field demonstration. Sulfate concentrations declined from the thousands of ppm to the tens to hundreds of ppm within the upper portion of DIW-1 closest to the floating soybean oil. Patterns of sulfate concentration changes within the remainder of DIW-1 were consistent with the general pattern of sulfate reduction noted above. Increases in the level of hydrogen sulfide did not directly correspond to the sulfate decrease, since hydrogen sulfide is transient. However hydrogen sulfide levels within DIW-1 in general remained above upgradient levels after injections began.

Sulfate reduction through the oxidation of a carbon source consumes hydrogen ions (H^+) through the reduction of sulfate and formation of hydrogen sulfide, which may then degas (as H_2S (gas)) or form metal sulfides. This generally resulted in an increase in pH to between 5 and 6 (i.e. background levels or higher) within the upper portion of DIW-1 closest to the floating soybean oil. Patterns of pH changes within the remainder of DIW-1 were consistent with the general pattern of sulfate reduction noted above. Sulfate reduction also results in a decrease in Eh. In general the Eh within the upper portion of DIW-1 closest to the floating soybean oil decreased to between 100 and 200 mV. Again patterns of Eh changes within the remainder of DIW-1 were consistent with the general pattern of sulfate reduction noted above.

The greatest reductions in metals concentrations occurred within the upper portion of DIW-1 closest to the floating soybean oil. Near 90 percent reductions in aluminum, chromium, copper, nickel, and zinc concentrations and greater than 50 percent reductions in calcium, magnesium, and manganese concentrations occurred. Significant reductions in iron and silica concentrations also occurred. Patterns of metal concentration changes within the remainder of DIW-1 were consistent with the general pattern of sulfate reduction noted above. It is anticipated that the reduction in metal concentrations were due to the following:

- The precipitation of iron, copper, and zinc sulfides,
- The precipitation of aluminum and chromium hydroxides, and
- The adsorption of calcium, copper, magnesium, manganese, nickel, and zinc onto kaolinite and aluminum and iron oxides and (oxy)hydroxides.

The only metal that demonstrated a consistent but slight increase was barium. This increase may be a function of the dissolution of barite ($BaSO_4$). As sulfate is removed from the system, the solubility of barite increases and barium and sulfate are released into solution.

Based on the data available nitrogen concentrations should be sufficient to maintain SRB growth. While phosphate concentrations were below detectable limits in a majority of the wells receiving nutrients, these wells were capable of supporting increases of SRB by 5 orders of magnitude. The capacity to support bacterial densities of that magnitude indicates sufficient nutrients. It is likely that sufficient nitrogen and phosphate concentrations will be maintained due to a continual groundwater influent and biological cycling.

Based upon promotion of sulfate reduction by soybean oil injection and the anticipated 18 month longevity of the 825 gallons of injected soybean oil, it has been demonstrated that soybean oil does provide a relatively long-term, slow release, carbon source for the SRB. Based upon this data it is anticipated that the current sulfate reduction remediation occurring within DIW-1 could be maintained by injecting 1200 gallons of soybean oil every two years. Based upon promotion of sulfate reduction by sodium lactate, the quick sulfate reduction response to sodium lactate injection, and the quick depletion of the lactate, it has been demonstrated that sodium lactate does provide a short-term, immediately available carbon source for SRB. Injection of sodium lactate, however, must take into consideration the inhibitory SRB response to elevated sodium lactate concentrations and the quick lactate depletion. These facts mean that sodium lactate, if utilized, must be injected frequently in low quantities, which results in increased costs over that of soybean oil injection, which can be performed infrequently in high quantities as noted above. Therefore the best use of sodium lactate is to quickly initiate sulfate reduction and facilitate the subsequent utilization of soybean oil for continuation of sulfate reduction.

From the demonstration it is not clear whether or not the sodium lactate played a significant role in initiating sulfate reduction and facilitating the utilization of the soybean oil for sulfate reduction. Essentially concurrent with cessation of sodium lactate injections in the South wing, a significant rise in water levels occurred. The water level rise resulted in both an increased flux of contaminated groundwater, particularly to the South wing, and an increased distance of the DIW-1 lower zone from the soybean oil. This resulted in decreased levels of sulfate reduction within the South wing over that initially experienced. Additionally although sodium lactate was not injected directly into the North wing, slightly elevated lactate concentrations were detected within the North wing for a brief period of time. The North wing, which was assumed to have received a lesser flux of contaminated groundwater than the South wing, demonstrated an increased depth of sulfate reduction influence with time. These occurrences make the role of sodium lactate relative to initiating sulfate reduction and facilitating the utilization of soybean oil for sulfate reduction somewhat unclear.

Finally the following are apparent from this field demonstration relative to the use of soybean oil to promote sulfate reduction remediation within the DCPRB acidic/metals/sulfate groundwater plume:

- Soybean oil alone has promoted sulfate reduction remediation. Sodium lactate may not be necessary for the initiation of sulfate reduction and to facilitate soybean oil utilization.
- Soybean oil does provide a long-term, slow release, carbon source for SRB, and it is significantly cheaper than sodium lactate in terms of both material costs and injection costs. The soybean oil for this demonstration cost approximately $175 per 55-gallon drum versus $770 per 55-gallon drum for 60% sodium lactate.
- The distribution and proximity of soybean oil are the primary factors that influence the overall effectiveness of sulfate reduction remediation promoted by soybean oil injection.

THIS PAGE INTENTIONALLY LEFT BLANK

8.0 RECOMMENDATIONS

The following are recommendations made based upon the results of the D-Area Sulfate Reduction Study to date. Recommendations are made concerning continuation of this study, the potential for an interim action, and the final remediation once discharge to the DCPRB has been discontinued.

8.1 D-AREA SULFATE REDUCTION STUDY

It is recommended that the D-Area sulfate reduction, pilot scale, field demonstration continue in order to further evaluate the following:

- A more definitive determination should be made as to whether sodium lactate is necessary for use in combination with soybean oil.
- The impact of soybean oil distribution upon sulfate reduction remediation.

It is recommended that these issues be further addressed in the field by injection of soybean oil alone into lower zones of DIW-1 while addressing the answers to the following questions:

1) Does the field application of soybean oil alone promote long-term sulfate reduction, a subsequent increase in the SRB population and pH level, and a subsequent decrease in metals concentration in DIW-1 or is sodium lactate also required?
2) Does soybean oil injection into lower portions of DIW-1 substantially increase the area impacted by sulfate reduction remediation, and what is the residence time of soybean oil within the lower portions of DIW-1?
3) What is the optimal application frequency, mass of the soybean oil to inject, and DIW-1 injection locations?

8.2 INTERIM ACTION

As outlined within Section 7.0, Summary and Conclusions, soybean oil does provide a relatively long-term, slow release, carbon source for the SRB, and it is anticipated that the current sulfate reduction remediation occurring within DIW-1 could be maintained by injecting 1200 gallons of soybean oil every two years. Additional confirmation of this assumption would be provided with continuation of the D-Area sulfate reduction field demonstration as recommended above (see Section 8.1). While continued soybean oil injections into DIW-1 would not result in complete remediation of the plume, it would be a relatively cheap method to retard plume growth in the most heavily contaminated portion of the plume, prior to the discontinuance of discharges to the DCPRB (i.e. assumed shutdown of the powerhouse). It is recommended that consideration be given to such an interim action. It is further recommended that minimal monitoring in conjunction with the current D-Area groundwater monitoring program accompany such an action.

8.3 FINAL REMEDIATION

It is finally recommended that consideration be given to final remediation of the DCPRB acidic/metals/sulfate plume that consists of the following once discharges to the DCPRB have been discontinued DCPRB (i.e. assumed that the powerhouse has been shutdown):

- DCPRB decommissioning
- Groundwater source area treatment utilizing soybean oil induced sulfate reduction
- Distal plume remediation utilizing MNA

DCPRB decommissioning is required in order to discontinue the influent of contaminated water to the basin and subsequently to the groundwater. Sulfate reduction conducted adjacent to the DCPRB in the source area will raise the pH and significantly reduce the iron, aluminum, and other metal concentrations commensurate with the subsequent use of MNA for complete plume remediation (Phifer et al. 2001 and Ross et al. 2003).

8.3.1 DCPRB Decommissioning

It is assumed that the DCPRB will remain in service and receive a continual influent of contaminated water as long as the D-Area powerhouse and associated open coal pile are operational. Once the powerhouse has been shut down it is assumed that the DCPRB will be decommissioned. It is recommended that consideration be given to the following basin decommissioning steps:

1) Remove the coal pile,
2) Divert the basin influent, possibly through the current “clean” water storm drainage system around the coal pile that is discharged into the discharge ditch located west of the basin,
3) Dewater the basin,
4) Remove the coal and coal fines from the basin along with possible removal of contaminated soil containing elevated levels of arsenic,
5) Blend limestone chips into the basin soils to stabilize the soil and create an alkaline infiltrating water, and
6) Remove the berms, cover and grade the area to promote positive drainage off of the basin area, and vegetate the surface.

While the DCPRB is an active operating facility and continues to receive contaminated runoff from the D-Area coal pile, it is recommended that neither limestone nor any other solid basic material be placed within the basin. Since the basin water contains significant ferric iron (Fe^{+3}), the placement of any solid basic material within the water would result in the in the precipitation of ferric hydroxide and the subsequent coating and deactivation of the solid basic material within a short period of time. This could also result in plugging the basin bottom (Phifer et al. 2001).

As part of the DCPRB decommissioning limestone is recommended over lime as the base material placed in the basin due to the elevated pHs that could be produced by the lime that could lead to remobilization of some metals from the basin soils. Limestone would produce a pH more in line with the minimum solubility of most metal hydroxides. A leach test should be performed to evaluate the effectiveness of this stabilization method prior to implementing it (Phifer et al. 2001). An organic substrate should not be placed directly in the basin, since this could have negative impacts upon redox sensitive metals and radionuclides contained within the basin soils such as arsenic, iron, chromium, uranium, and selenium (WSRC, 1999 and Phifer et al. 2001).

8.3.2 Groundwater Source Area Treatment

Once the DCPRB has been decommissioned, the water table levels in the immediate vicinity of the decommissioned basin will drop to pre-basin levels (i.e. the water table level will no longer intersect the basin bottom) and the groundwater flow direction will return to a predominantly horizontal direction toward the Savannah River, rather than the current combined vertical and horizontal directions away from the basin. This must be appropriately considered for the source area treatment design.

Groundwater source area treatment utilizing soybean oil induced sulfate reduction can be implemented in one of the following methods:

- Source area containment through the use of sulfate reduction reaction zones, or
- Area-wide source area treatment.

Sulfate reduction remediation through source area containment can be accomplished by injecting either straight or emulsified soybean oil to form both vertical and horizontal sulfate reduction reaction zones in the path of groundwater flow from the source area. Emulsified soybean oil probably has a greater injection radius of influence and can be injected into lower permeability material than straight soybean oil. The use of emulsified soybean oil may be beneficial depending upon the injection system utilized. The vertical reaction zone can be formed by injecting the soybean oil into the low permeability, upper portion of the water table aquifer through GeoProbe or Cone Penetrometer injection points, injection wells, or an injection trench. Emulsified soybean oil should be considered for injection through GeoProbe or Cone Penetrometer injection points or injection wells. Straight soybean oil should probably be used in conjunction with an injection trench. The horizontal reaction zone can be formed by injecting the soybean oil into the top of the higher permeability, lower portion of the aquifer through GeoProbe or Cone Penetrometer injection points or injection wells. In addition DIW-1 could probably continue to be utilized in the northwest corner of the basin. The use of straight soybean oil would probably be best to form the horizontal reaction zone. This will potentially form a soybean oil layer, which floats up against clay layers of the overlying low permeability, upper portion of the aquifer. It is not absolutely necessary to achieve complete soybean oil coverage in either the vertical or horizontal zones since the influence of the soybean oil extends some distance from the soybean oil itself. The bulk of the contamination is located within the upper low hydraulic conductivity zone. Placement of these vertical and horizontal reaction zones would contain and treat the contaminated groundwater flow out of the upper low hydraulic conductivity zone.

Sulfate reduction remediation through area-wide source area treatment can be accomplished by injecting emulsified soybean oil through GeoProbe or Cone Penetrometer injection points or injection wells into the upper low hydraulic conductivity zone which contains the bulk of the contamination. As outlined above it is not necessary to achieve complete soybean oil coverage throughout the treatment area (i.e. it is not necessary to achieve soybean oil overlap between injection points), since the influence of the soybean oil extends some distance from the soybean oil itself. However due to the low hydraulic conductivity of the upper low hydraulic conductivity zone of the water table aquifer formation in which the bulk of the contamination is located fairly close spacing of the injection grid would be required.

Prior to implementation of source area treatment, it is recommended that the injection method and form of soybean oil to be utilized be tested. Consideration should also be given to whether the injection will be into the upper low permeability and/or the lower higher permeability portions of the aquifer.

8.3.3 Distal Plume Remediation

Once groundwater source area treatment utilizing soybean oil induced sulfate reduction has been implemented, MNA should be able to handle remediation of the distal portions of the acid/metals/sulfate plume (Phifer et al. 2001 and Ross et al. 2003). Information concerning the MNA potential within the D-Area water table aquifer has been documented within Powell et al. 2003.

9.0 REFERENCES

Ali, M. A. and Dzombak, D. A., 1996. *Interactions of Copper, Organic Acids and Sulfate in Goethite Suspensions*, Geochimica et Cosmochimica Acta, v. 60, p. 5045-5053.

Angove, M. J., Johnson, B. B, and Wells, J. D., 1997. *Adsorption of Cadmium(II) on Kaolinite*, Colloids and Surfaces A: Physiochemical and Engineering Aspects, v. 126, p. 137-147.

Appelo, C. A. J. and Postma, D., 1996. Geochemistry, Groundwater and Pollution, A. A. Balkema, Rotterdam.

Benner, S. G., Blowes, D. W., and Gould, W. D., 1999. *Geochemistry of a Permeable Reactive Barrier for Metals and Acid Mine Drainage*, Environmental Science and Technology, v. 33, p. 2793-2799.

Benner, S.G., W.D. Gould and D.W. Blowes. 2000. Microbial populations associated with the generation and treatment of acid mine drainage. Chemical Geology. 169: 435-448.

Brewer, K. E. and Sochor, C. S., 2002. Flow and Transport Modeling for D-Area Groundwater (U), WSRC-RP-2002-4166, Rev. 0, October, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808

Buerge-Weirich, D., Hari, R., Xue, H., Behra, P. and Sigg, L., 2002. *Adsorption of Cu, Cd, and Ni on Geothite in the Presence of Natural Groundwater Ligands*, Environmental Science and Technology, v. 36, p. 328-336.

Ehrlich, H. L. 1996. *In.* Geomicrobiology. pp. 312-367. Marcel Decker Inc. N.Y., N.Y.

Fauque, G. D. 1995. Ecology of sulfate reducing bacteria. pp. 217-235. *In.* Sulfate-reducing bacteria. (ed) L. L. Barton. Plenum Press. N.Y., N.Y.

Fenchel, T., G. M. King and T. H. Blackburn. 1998. *In*, Bacterial Biogeochemistry: the Ecophysiology of Mineral Cycling. Pp. 26-28. Academic Press, NY, NY.

Furrer, G., U. von Gunten and J. Zobrist. 1996. Steady-state modeling of biogeochemical processes in columns with aquifer material: 1. Speciation and mass balances. Chemical Geology. 133:15-28.

Freeman, M. K., 1997. *Geochemical Interactions Between Coal-Pile Leachate and Alluvial Deposits, Savannah River Site, South Carolina*, M.S. Thesis, University of Memphis.

Hui, Y. H. (editor), 1996. Bailey's Industrial Oil and Fat Products, 5th edition, Volume 2, Edible Oil and Fat Products: Oils and Oilseeds, John Wiley & Sons, Inc., NY, NY

Lowry, W., Mason, N., Chipman, V., Kisiel, K., and Stockton, J., 1999. *In-Situ Permeability Measurements with Direct Push Techniques: Phase II Topical Report*, SEASF-TR-98-207, March, Science and Engineering Associates, Inc., Santa Fe, New Mexico.

Neal, A. L., Techkarnjanaruk, S., Dohnalkova, A., McCready, D., Peyton, B. M., and Geesey, G., 2001. *Iron Sulfides and Sulfur Species Produced at Hematite Surfaces in the Presence of Sulfate-Reducing Bacteria*, Geochimica et Cosmochimica Acta, v. 65, p. 223-235.

Phifer, M. A., Sappington, F. C., Pemberton, B. E., and Nichols, R. L., 1996. *Interim Report D-Area Interceptor Well, DIW-1 Water Table Aquifer (U)*, WSRC-TR-99-00017, Revision 0, September 30, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808

Phifer, M. A. and Denham, M. E., 2000. DEXOU Low pH Plume Baseline Permeable Reactive Barrier Options, WSRC-TR-2000-00146, Revision 0, May 5, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808.

Phifer, M. A., Sappington, F. C., and Jones, W. E., 2000. *DCB-8C Step and Constant Rate Pump Tests – D-Area Unconfined Aquifer Hydraulic Parameter Estimation*, SRT-EST-2000-00226, July 18, Savannah River Site, Aiken SC 29808.

Phifer, M. A., Turick, C. E., and Millings, M. R., 2001. *D-Area Coal Pile Runoff Basin Sulfate Reduction Literature Review and Feasibility Report (U)*, WSRC-TR-2001-00371, Revision 0, September 25, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808

Phifer, M. A., Sappington, F. C., Millings, M. R., Turick, C. E., and McKinsey P., 2002. *D-Area Sulfate Reduction Study, Field Scoping Plan*, Q-TPL-D-00006, May 20, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808

Phifer, M. A., Turick, C. E., Millings, M. R., Sappington, F. C., McKinsey P. C., Bayer, C. L., and Ross, J. A., 2003a. *Sulfate Reduction Remediation of a Metals Plume through Organic Injection*, WSRC-MS-2002-00684, February 27, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808 (Presented at the 2003 Battelle Bioremediation Symposium held in Orlando, Florida from June 2 to June 5, 2003)

Phifer, M. A., Sappington, F. C., Millings, M. R., Turick, C. E., and McKinsey, P., 2003b. *D-Area Treatment Trench (DTT-1) Evaluation (U)*, WSRC-TR-2003-00133, Revision 0, March 31, Savannah River Site, Aiken SC 29808.

Powell, K. R., Serkiz, S., Pishko, A., Fliermans, C., and Kaplan, D. I., 2003. *Monitored Natural Attenuation of Inorganic Constituents of Concern in Upland Soil from the DEXOU*, WSRC-TR-2003-00414, September 11, Savannah River Site, Aiken SC 29808.

Randall S. R., Sherman, D. M., Ragnarsdottir, K. V., and Collins, C. R., 1999. *The Mechanism of Cadmium Surface Complexation on Iron Oxyhydroxide Minerals*, Geochimica et Cosmochimica Acta, v. 63, p. 2971-2987.

Ross, J. A., Bayer, C. L., Socha, R. P., Sochor, C. S., Fliermans, C. B., Mckinsey, P. C., Millings, M. R., Phifer, M. A., Powell, K. R., Serkiz, S. M., Sappington, F. C., and Turick, C. E., 2003. Evaluation of Natural and In-Situ Remediation Technologies for a Coal-Related Metals Plume, Waste Management '03 Symposium Proceedings, February 23-27, Tucson AZ.

Sappington, F. C., Phifer, M. A., Millings, M. R., Turick, C. E., and McKinsey, P., 2002. *D-Area Sulfate Reduction Study D-Area Interceptor Well (DIW-1) Redevelopment Report*, SRT-EST-2002-00057, January 16, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808

Stumm, W., and Morgan, J. J., 1996. *Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters*, 3rd ed, John Wiley and Sons, New York.

Swedlund, P. J. and Webster, J. G., 2001. *Cu and Zn Ternary Surface Complex Formation with SO4 on Ferrihydrite and Schwertmannite*, Applied Geochemistry, v. 16, p. 503-511.

Swedlund, P. J., Webster, J. G., and Miskelly, G. M., 2003. *The Effect of SO4 on the Ferrihydrite Adsorption of Co, Pb, and Cd: Ternary Complexes and Site Heterogeneity*, Applied Geochemistry, v. 18, p. 1671-1689.

Thomas, R. C., Romanek, C. S., Coughlin, D. P., and Crowe, D. E., 1999. "Treatment of Acid Mine Drainage Using Anaerobic Constructed Wetlands: Predicting Longevity with Substrate Neutralization Potential," Proceedings of Sudbury '99 Mining and Environmental II Conference, Sudbury, Ontario, Canada, pages 449-458.

Turick, C. E., McKinsey, P. C., Phifer, M. A., Sappington, F. C., and Millings, M. R., 2002. *D-Area Sulfate Reduction Study, Bacteria Population and Organic Selection Laboratory Testing (U)*, WSRC-TR-2002-00346, September 20, Westinghouse Savannah River Company, Savannah River Site, Aiken SC 29808

Von Guten, U. and Zobrist, J. 1993. *Biogeochemical Changes in Groundwater – Infiltration Systems: Column Studies*, Geochimica, Cosmochimica Acta, v. 57, p. 3895-3906.

Washburn, F. A., Denham, M. E., Phifer, M. A., and Sappington, F. C., 1998. *D-Area Coal Pile Runoff Basin Groundwater Treatability Study Preliminary Report (U)*, WSRC-RP-98-01138, Revision 0, September, Savannah River Site, Aiken SC.

Washburn, F. A., Denham, M. E., Jones, W. E., Phifer, M. A., and Sappington, F. C., 1999. *Permeable Reactive Barrier/GeoSiphon Treatment System for Metals Contaminated Groundwater Final Report*, WSRC-RP-99-01063, Revision 0, November 17, Savannah River Site, Aiken SC 29808.

WSRC, 1999. *RCRA Facility Investigation/Remedial Investigation Work Plan – Addendum for the D-Area Expanded Operable Unit (U)*, WSRC-RP-99-4067, Revision 0, October, Savannah River Site, Aiken SC 29808.

WSRC, 2001. *D-Area Coal Pile Runoff Basin Sulfate-Reduction Remediation Treatability Study Work Plan* (U), WSRC-RP-2001-00923, Rev. 0, December, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC 29808

WSRC, 2002. *Underground Injection Control Permit Application for D-Area Coal Pile Runoff Basin Sulfate-Reduction Treatability Study (U)*, WSRC-RP-2002-4069, Revision 0, April, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC 29808

Yavuz, O., Altunkaynak, Y., and Guzel, F., 2003. *Removal of Copper, Nickel, Cobalt, and Manganese from Aqueous Solution by Kaolinite*, Water Research, v. 37, p. 948-952.

THIS PAGE INTENTIONALLY LEFT BLANK

10.0 APPENDICES

THIS PAGE INTENTIONALLY LEFT BLANK

Pre-Injection Field Parameter Results

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Temperature (oF)	Temperature (oC)	pH	Conductivity (uS/cm)	Dissolved Oxygen (ug/L)	ORP (mV)	Eh Calculated (mV)	Comments
DCB-8	DSR-00001	Field	6/24/2002	9:35	67.5	19.72	4.9	17.69	38.25	220	419	
DCB-21A	DSR-00002	Field	7/3/2002	9:10	73.43	23.02	2.19	3590	4200	652	849	
DCB-21B	DSR-00003	Field	6/24/2002	11:32	68.01	20.01	3.25	1121	207	364	563	
DCB-21C	DSR-00004	Field	6/24/2002	11:39	68.78	20.43	4.22	703.4	198	303	502	
DCB-22A	DSR-00005	Field	7/3/2002	9:30	67.18	19.54	2.85	1594	1824	599	799	
DCB-22B	DSR-00006	Field	6/24/2002	11:57	66.52	19.18	3.44	1633	224	302	502	
DCB-22C	DSR-00007	Field	6/24/2002	12:07	67.56	19.76	4.48	367.3	206	293	492	
DCB-70A	DSR-00008	Field	6/25/2002	14:32	66.35	19.08	3.39	1186	2527	443	643	
DCB-70B	DSR-00009	Field	6/25/2002	13:51	64.95	18.31	4.29	223.1	294	114	315	
DCB-19A	DSR-00010	Field	6/24/2002	12:19	70.33	21.29	2.75	1015	3280	573	771	
DCB-19B	DSR-00011	Field	6/24/2002	12:27	67.87	19.93	2.98	1430	490	414	613	
DCB-19C	DSR-00012	Field	6/24/2002	13:06	77.38	25.21	3.17	1343	1289	394	589	
DCB-18A	DSR-00013	Field	6/24/2002	12:46	71.48	21.93	2.64	2149	3768	595	792	
DCB-18B	DSR-00014	Field	6/24/2002	12:56	68.62	20.34	2.66	2127	388	603	802	
DCB-18C	DSR-00015	Field	6/24/2002	13:12	69.53	20.85	3.14	1310	192	388	586	
DCB-71A	DSR-00016	Field	6/25/2002	13:32	66.12	18.96	4.1	485.3	3680	410	610	
DCB-71B	DSR-00017	Field	6/25/2002	12:55	66.34	19.08	3.62	1555	151	289	489	
DIW-P13A	DSR-00018	Field	6/24/2002	10:36	67.4	19.67	5.35	1233	598	-84	115	
DIW-P14A	DSR-00019	Field	6/24/2002	10:45	67.09	19.49	3.76	1295	407	54	254	
DIW-P11A	DSR-00020	Field	6/24/2002	10:22	69.7	20.94	2.73	1422	670	406	604	
DIW-P11B	DSR-00021	Field	6/24/2002	10:08	73.14	22.86	2.76	1775	1510	416	613	
DIW-P12A	DSR-00022	Field	6/24/2002	10:30	69.3	20.72	2.96	1148	560	370	568	
DIW-P09A	DSR-00023	Field	6/24/2002	10:58	70.02	21.12	2.91	811	438	461	659	
DIW-P10A	DSR-00024	Field	6/24/2002	10:54	68.83	20.46	2.95	625.4	502	397	596	
DIW-1-2	DSR-00025	Field	6/24/2002	11:09	68.62	20.34	4.99	419.6	241	-222	-23	
DIW-P02A	DSR-00026	Field	6/24/2002	11:18	69.81	21.01	6.28	147.1	322	-19	179	
DIW-P03A	DSR-00027	Field	6/25/2002	12:06	69.55	20.86	3.32	459.2	527	357	555	
DIW-P04A	DSR-00028	Field	6/25/2002		69.24	20.69	3.72	227.5	1008	346	545	
DIW-P05A	DSR-00029	Field	6/25/2002	11:53	69.19	20.66	3.52	1436	260	393	592	
DIW-P06A	DSR-00030	Field	6/25/2002	11:44	69.93	21.07	3.17	1011	299	374	572	
DIW-P07A	DSR-00031	Field	6/25/2002	13:22	70.1	21.17	3.11	1634	255	383	581	
DIW-P08A	DSR-00032	Field	6/25/2002	13:05	75.24	24.02	3.71	1660	500	272	468	

Gray highlight means that there is no data

APPENDIX A
Field Indicator Parameters

First Post-Injection Field Parameter Results

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Temperature (oF)	Temperature (oC)	pH	Conductivity (uS/cm)	Dissolved Oxygen (ug/L)	ORP (mV)	Eh Calculated (mV)	Comments
DCB-8	DSR-00050	Field	9/10/2002	8:40	75.39	24.11	5.1	31.6	2765	344	540	
DCB-21A	DSR-00051	Field	9/9/2002	10:54	77.77	25.43	2.22	6529	3017	661	855	
DCB-21B	DSR-00052	Field	9/9/2002	10:42	71.49	21.94	3.29	1704	161	359	556	
DCB-21C	DSR-00053	Field	9/9/2002	10:33	69.24	20.69	4.33	1042	190	268	467	
DCB-22A	DSR-00054	Field	9/9/2002	10:12	70.67	21.48	2.9	2525	834	568	766	
DCB-22B	DSR-00055	Field	9/9/2002	10:19	68.39	20.22	3.56	2381	186	276	475	
DCB-22C	DSR-00056	Field	9/9/2002	10:25	67.85	19.92	4.77	485.5	189	232	431	
DCB-70A	DSR-00057	Field	9/10/2002	11:45	72.85	22.69	3.04	1851	738	479	676	
DCB-70B	DSR-00058	Field	9/10/2002	12:07	70.63	21.46	5.65	222	1060	182	380	
DCB-19A	DSR-00059	Field	9/9/2002	9:34	77.86	25.48	2.78	1789	3662	578	772	
DCB-19B	DSR-00060	Field	9/9/2002	9:21	71.22	21.79	3.01	2044	476	419	617	
DCB-19C	DSR-00061	Field	9/9/2002	13:57	74.93	23.85	2.84	1434	762	457	653	
DCB-18A	DSR-00062	Field	9/9/2002	9:47	75.65	24.25	2.65	3646	2716	607	802	
DCB-18B	DSR-00063	Field	9/9/2002	9:54	71.99	22.22	2.78	2121	3290	619	816	
DCB-18C	DSR-00064	Field	9/9/2002	10:04	69.1	20.61	3.74	1884	208	272	471	
DCB-71A	DSR-00065	Field	9/10/2002	9:40	68.58	20.32	4.02	983	515	257	456	
DCB-71B	DSR-00066	Field	9/10/2002	10:00	71.6	22.00	3.65	910	1282	438	635	
DIW-P14C	DSR-00067	Field	9/9/2002	12:23	74.53	23.63	6.01	14600	1173	-165	31	
DIW-P13B	DSR-00068	Field	9/9/2002	12:29	74.42	23.57	5.49	4672	509	-133	63	
DIW-P13C	DSR-00069	Field	9/9/2002	12:35	73.03	22.79	5.75	31530	355	-94	103	
DIW-P12B	DSR-00070	Field	9/9/2002	12:40	75.51	24.17	4.03	2851	526	-69	127	
DIW-P11B	DSR-00071	Field	9/9/2002	12:44	75.12	23.96	3.75	2800	534	34	230	
DIW-P11C	DSR-00072	Field	9/9/2002	12:48	74.75	23.75	4	4586	270	74	270	
DIW-P10C	DSR-00073	Field	9/9/2002	12:52	75	23.89	3.52	3281	320	157	353	
DIW-P09B	DSR-00074	Field	9/9/2002	12:56	75.9	24.39	3.93	2650	489	42	237	
DIW-P09C	DSR-00075	Field	9/9/2002	13:00	75.78	24.32	4.53	5777	247	13	208	
DIW-P02C	DSR-00076	Field	9/9/2002	13:05	75.74	24.30	4.23	2720	396	-51	144	
DIW-P03B	DSR-00077	Field	9/9/2002	13:10	76.1	24.50	3.53	1638	469	230	425	
DIW-P04C	DSR-00078	Field	9/9/2002	13:14	75.11	23.95	3.31	1968	353	270	466	
DIW-P05B	DSR-00079	Field	9/9/2002	13:20	77.07	25.04	3.46	2290	490	278	473	
DIW-P06C	DSR-00080	Field	9/9/2002	13:24	76.14	24.52	3.45	2608	327	279	474	
DIW-P07B	DSR-00081	Field	9/9/2002	13:43	76.97	24.98	3.31	2391	458	257	452	
DIW-P07C	DSR-00082	Field	9/9/2002	13:47	75.85	24.36	3.4	2146	556	277	472	
DIW-P08C	DSR-00083	Field	9/9/2002	13:51	73.76	23.20	3.41	2154	346	271	467	May have been DIW-P08B instead
DIW-P14A	DSR-00084	Field	9/9/2002	11:02	71.52	21.96	6.18	2076	259	-252	-55	
DIW-P10A	DSR-00085	Field	9/9/2002	14:05	77.55	25.31	3.09	1045	560	345	540	
DIW-P08A	DSR-00086	Field	9/9/2002	11:11	73.85	23.25	4.1	1601	220	-112	84	
DIW-P13A	DSR-00087	Field	9/9/2002	14:31	78.96	26.09	5.9	3284	369	-64	130	
DIW-P11A	DSR-00088	Field	9/9/2002	14:22	81.29	27.38	4.78	2876	260	53	246	
DIW-P12A	DSR-00089	Field	9/9/2002	14:16	80.22	26.79	4.51	2127	500	50	243	
DIW-P09A	DSR-00090	Field	9/9/2002	14:09	80.44	26.91	3.78	1357	241	165	358	
DIW-1-2	DSR-00091	Field	9/9/2002	14:39	76.95	24.97	4.88	774.3	493	-67	128	
DIW-P07A	DSR-00092	Field	9/9/2002	14:50	79.69	26.49	3.95	1713	371	-27	166	

APPENDIX A
Field Indicator Parameters

Second Post-Injection Field Parameter Results

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Temperature (oF)	Temperature (oC)	pH	Conductivity (uS/cm)	Dissolved Oxygen (ug/L)	ORP (mV)	Eh Calculated (mV)	Comments
DCB-8	DSR-00101	Field	11/6/2002	11:55	71.02	21.68	5.46	24.75	3830	123	321	
DCB-21A	DSR-00102	Field	11/6/2002	9:55	73.46	23.03	1.94	6595	3630	658	855	
DCB-21B	DSR-00103	Field	11/6/2002	10:16	72.59	22.55	3.04	1514	457	401	598	
DCB-21C	DSR-00104	Field	11/6/2002	10:43	70.11	21.17	4.16	938.9	485	298	496	
DCB-22A	DSR-00105	Field	11/6/2002	9:25	69.87	21.04	2.66	2281	1359	560	758	
DCB-22B	DSR-00106	Field	11/6/2002	9:07	69.36	20.76	3.32	1970	755	294	492	
DCB-22C	DSR-00107	Field	11/6/2002	8:37	67.87	19.93	4.59	513	885	212	411	
DCB-70B	DSR-00108	Field	11/6/2002	10:54	67.41	19.67	5.21	94.94	644	225	424	
DCB-19A	DSR-00109	Field	11/5/2002	10:22	71.82	22.12	2.63	1510	4114	528	725	
DCB-19B	DSR-00110	Field	11/5/2002	10:51	71.31	21.84	2.66	1696	1756	454	652	
DCB-19C	DSR-00111	Field	11/5/2002	10:08	68.13	20.07	2.92	1684	700	381	580	
DCB-18A	DSR-00112	Field	11/6/2002	9:46	73.93	23.29	2.22	5252	2562	614	810	
DCB-18B	DSR-00113	Field	11/6/2002	9:20	72.59	22.55	2.51	2607	2400	575	772	
DCB-18C	DSR-00114	Field	11/6/2002	8:43	69.36	20.76	3.45	1957	308	264	462	
DCB-71B	DSR-00115	Field	11/6/2002	10:34	67.66	19.81	3.44	1697	674	327	526	
DIW-P14C	DSR-00116	Field	11/5/2002	8:47	68.73	20.41	6.01	4957	415	-105	94	
DIW-P13B	DSR-00117	Field	11/5/2002	9:15	69.31	20.73	6.08	3860	394	-95	103	
DIW-P13C	DSR-00118	Field	11/5/2002	9:00	67.73	19.85	6.1	29510	225	-146	53	
DIW-P12B	DSR-00119	Field	11/5/2002	9:23	70.34	21.30	3.53	2715	570	158	356	
DIW-P11B	DSR-00120	Field	11/5/2002	9:38	70.28	21.27	3.69	2616	645	-13	185	
DIW-P11C	DSR-00121	Field	11/5/2002	10:14	69.01	20.56	3.31	3029	570	136	335	
DIW-P10C	DSR-00122	Field	11/5/2002	10:40	70.33	21.29	3.58	2797	439	19	217	
DIW-P09B	DSR-00123	Field	11/5/2002	10:47	70.67	21.48	3.59	2308	634	25	223	
DIW-P09C	DSR-00124	Field	11/5/2002	11:02	68.75	20.42	3.57	2938	495	65	264	
DIW-P02C	DSR-00125	Field	11/5/2002	11:07	70.1	21.17	3.97	2547	1008	-2	196	
DIW-P03B	DSR-00126	Field	11/5/2002	8:38	69.15	20.64	4.85	1085	400	-117	82	
DIW-P04C	DSR-00127	Field	11/5/2002	8:56	70.12	21.18	4.7	1026	616	17	215	
DIW-P05B	DSR-00128	Field	11/5/2002	9:03	70.05	21.14	3.26	1940	625	69	267	
DIW-P06C	DSR-00129	Field	11/5/2002	9:08	69.31	20.73	3.21	2080	421	104	302	
DIW-P07B	DSR-00130	Field	11/5/2002	9:15	70.94	21.63	3.15	2050	486	198	396	
DIW-P07C	DSR-00131	Field	11/5/2002	9:28	69.61	20.89	3.26	1864	409	254	452	
DIW-P08C	DSR-00132	Field	11/5/2002	9:45	70.81	21.56	3.33	2062	272	195	393	May have been DIW-P08B instead
DIW-P14A	DSR-00133	Field	11/6/2002	11:05	70.45	21.36	5.93	1833	742	-116	82	
DIW-P10A	DSR-00134	Field	11/6/2002	11:13	72.34	22.41	3.21	1139	480	264	461	
DIW-P08A	DSR-00135	Field	11/6/2002	11:19	73.22	22.90	3.59	2043	449	233	430	
DIW-P13A	DSR-00136	Field	11/6/2002	12:56	72.15	22.31	5.96	1987	236	-59	138	
DIW-P12A	DSR-00137	Field	11/6/2002	12:27	72.85	22.69	6.22	1861	163	-119	78	
DIW-P11A	DSR-00138	Field	11/6/2002	12:59	72.49	22.49	6.03	2250	135	-84	113	
DIW-P09A	DSR-00139	Field	11/6/2002	11:33	73.72	23.18	5.88	1388	280	-122	74	
DIW-1-2	DSR-00140	Field	11/6/2002	12:16	73.24	22.91	5.75	735.7	247	-213	-16	
DIW-P03A	DSR-00141	Field	11/6/2002	11:52	71.43	21.91	6.36	615.7	210	-130	67	
DIW-P05A	DSR-10001	Field	11/6/2002	12:03	73.67	23.15	5.79	961.4	144	-131	65	Additional unschedule sample taken for field parameters
DIW-P07A	DSR-00142	Field	11/6/2002	11:24	74.17	23.43	5.57	636.8	290	-102	94	

APPENDIX A
Field Indicator Parameters

Third Post-Injection Field Parameter Results

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Temperature (oF)	Temperature (oC)	pH	Conductivity (uS/cm)	Dissolved Oxygen (ug/L)	ORP (mV)	Eh Calculated (mV)	Comments
DCB-8	DSR-00151	Field	1/13/2003	12:58	67.17	19.54	4.93	40.16	3223	251	451	
DCB-21A	DSR-00152	Field	1/13/2003	8:40	60.26	15.70	2.33	5776	3500	655	858	
DCB-21B	DSR-00153	Field	1/13/2003	8:54	65.29	18.49	3.14	1887	792	409	609	
DCB-22A	DSR-00154	Field	1/13/2003	9:17	59.89	15.49	2.96	2013	2423	481	684	
DCB-22B	DSR-00155	Field	1/13/2003	9:35	63.5	17.50	3.46	2152	793	318	519	
DCB-22C	DSR-00156	Field	1/13/2003	10:08	64.39	17.99	4.56	621.6	750	99	300	
DCB-70B	DSR-00157	Field	1/13/2003	11:56	62.49	16.94	5.54	119.8	3310	154	356	
DCB-19A	DSR-00158	Field	1/13/2003	10:10	58.9	14.94	3.12	830.5	4330	476	679	
DCB-19B	DSR-00159	Field	1/13/2003	10:27	67.37	19.65	3.11	1418	2264	431	630	
DCB-18A	DSR-00160	Field	1/13/2003	10:42	62.28	16.82	2.24	6440	4263	618	820	
DCB-18B	DSR-00161	Field	1/13/2003	10:55	68.14	20.08	2.28	6672	2625	622	821	
DCB-18C	DSR-00162	Field	1/13/2003	11:15	68.7	20.39	3.66	1717	658	290	489	
DCB-71B	DSR-00163	Field	1/13/2003	12:30	65.63	18.68	3.65	2085	823	287	487	
DIW-P14C	DSR-00164	Field	1/13/2003	8:56	64.33	17.96	5	3090	760	-176	25	
DIW-P13B	DSR-00165	Field	1/13/2003	9:24	65.11	18.39	6.29	4694	595	-145	55	
DIW-P13C	DSR-00166	Field	1/13/2003	9:11	65.83	18.79	6.26	30520	563	-256	-56	
DIW-P12B	DSR-00167	Field	1/13/2003	9:38	63.97	17.76	2.41	5077	980	471	672	
DIW-P11B	DSR-00168	Field	1/13/2003	9:59	63.34	17.41	3.68	2718	633	-4	197	
DIW-P11C	DSR-00169	Field	1/13/2003	10:14	66.16	18.98	2.33	6199	1135	490	690	
DIW-P10C	DSR-00170	Field	1/13/2003	10:30	66.96	19.42	2.39	5729	1049	480	680	
DIW-P09B	DSR-00171	Field	1/13/2003	10:44	66.13	18.96	4.76	1873	868	-9	191	
DIW-P09C	DSR-00172	Field	1/13/2003	10:58	66.14	18.97	2.41	5887	1157	465	665	
DIW-P02C	DSR-00173	Field	1/13/2003	11:46	65.85	18.81	4.13	2223	574	-17	183	
DIW-P03B	DSR-00174	Field	1/13/2003	11:11	66.27	19.04	6.52	1036	1053	-102	98	
DIW-P03C	DSR-00175	Field	1/13/2003	11:23	66.09	18.94	6.44	1021	1107	-90	110	
DIW-P04C	DSR-00176	Field	1/13/2003	11:36	67.38	19.66	5.98	1033	1012	-51	148	
DIW-P05B	DSR-00177	Field	1/13/2003	11:54	66.95	19.42	3.58	2115	1180	143	343	
DIW-P06C	DSR-00178	Field	1/13/2003	12:02	68.76	20.42	3.62	2277	1098	174	373	
DIW-P07B	DSR-00179	Field	1/13/2003	12:13	69.23	20.68	3.52	2307	1115	258	457	
DIW-P07C	DSR-00180	Field	1/13/2003	12:25	69.19	20.66	3.56	2126	935	267	466	
DIW-P08C	DSR-00181	Field	1/13/2003	12:30	69.73	20.96	3.56	2198	931	263	461	
DIW-P14A	DSR-00182	Field	1/14/2003	9:06	60.39	15.77	5.89	1544	880	-26	177	
DIW-P10A	DSR-00183	Field	1/14/2003	8:45	62.95	17.19	3.77	453.3	820	288	490	
DIW-P08A	DSR-00184	Field	1/14/2003	8:54	64.44	18.02	3.87	2039	600	203	404	
DIW-P13A	DSR-00185	Field	1/14/2003	9:20	58.48	14.71	5.99	2868	908	-100	104	
DIW-P11A	DSR-00186	Field	1/14/2003	9:45	61.5	16.39	6.07	884.6	559	-109	93	
DIW-P12A	DSR-00187	Field	1/14/2003	10:00	62.93	17.18	5.95	615	448	-108	94	
DIW-P09A	DSR-00188	Field	1/14/2003	10:22	62.41	16.89	5.92	3038	523	-137	65	
DIW-1-2	DSR-00189	Field	1/14/2003	10:13	65.58	18.66	6.16	805.5	474	-115	85	
DIW-P03A	DSR-00190	Field	1/14/2003	9:52	64.6	18.11	6.37	747.9	625	-108	93	
DIW-P05A	DSR-00191	Field	1/14/2003	9:30	64.29	17.94	5.63	628.1	692	-168	33	
DIW-P07A	DSR-00192	Field	1/14/2003	9:15	62.12	16.73	5.51	781.6	664	-73	129	

Forth Post-Injection Field Parameter Results

Well / Piezometer	Sample Number	Sample Type	Date	Time	Temperature (F)	Temperature (C)	pH	Conductivity (uS/cm)	DO (ug/L)	ORP (mV)	Eh Calculated (mV)	Comments
DCB-8	DSR-00201	Field	4/1/2003	9:19	62.59	16.99	4.93	47		98	300	
DCB-21A	DSR-00202	Field	3/31/2003	11:51	63.1	17.28	2.29	4760		499	700	
DCB-21B	DSR-00203	Field	3/31/2003	11:55	65.75	18.75	3.05	2133		422	622	
DCB-22C	DSR-00204	Field	3/31/2003	13:13	68.83	20.46	4.59	752		298	497	
DCB-70B	DSR-00205	Field	3/31/2003	13:32	65.2	18.44	5.24	146		140	340	
DCB-19A	DSR-00206	Field	3/31/2003	13:43	62.03	16.68	2.66	3279		550	752	
DCB-19B	DSR-00207	Field	3/31/2003	13:18	66.59	19.22	3.19	1321		416	616	
DCB-18C	DSR-00208	Field	3/31/2003	14:00	69.97	21.09	3.64	1959		314	512	
DCB-71B	DSR-00209	Field	3/31/2003	13:57	66.8	19.33	3.65	2308		306	506	
DIW-P14C	DSR-00210	Field	3/31/2003	14:29	66.53	19.18	4.31	1855		-148	52	
DIW-P13B	DSR-00211	Field	3/31/2003	14:13	66.16	18.98	4.91	5633		-112	88	
DIW-P13C	DSR-00212	Field	3/31/2003	14:21	67.58	19.77	4.45	8168		-143	56	
DIW-P12B	DSR-00213	Field	4/1/2003	8:24	59.5	15.28	2.43	4489		478	681	
DIW-P11B	DSR-00214	Field	4/1/2003	8:33	59.89	15.49	2.64	3805		445	648	
DIW-P11C	DSR-00215	Field	3/31/2003	14:42	64.73	18.18	2.29	7443		483	684	
DIW-P10C	DSR-00216	Field	4/1/2003	8:58	64.03	17.79	2.48	4703		461	662	
DIW-P09B	DSR-00217	Field	4/1/2003	9:03	62.48	16.93	4.99	1265		-52	150	
DIW-P09C	DSR-00218	Field	4/1/2003	9:07	63.8	17.67	2.21	6603		494	695	
DIW-P02C	DSR-00219	Field	4/1/2003	9:11	63.52	17.51	5.96	736		-97	104	
DIW-P03B	DSR-00220	Field	4/1/2003	8:29	61.97	16.65	6.19	933		-12	190	
DIW-P03C	DSR-00221	Field	4/1/2003	8:47	63.15	17.31	6.2	966		-50	151	
DIW-P04C	DSR-00222	Field	4/1/2003	8:38	63.24	17.36	5.47	1054		-62	139	
DIW-P07B	DSR-00223	Field	3/31/2003	13:17	67.79	19.88	3.65	2391		59	258	
DIW-P07C	DSR-00224	Field	3/31/2003	14:26	69.21	20.67	3.6	2371		111	310	
DIW-P08C	DSR-00225	Field	3/31/2003	14:32	69.72	20.96	3.63	2430		75	273	
DIW-P13A	DSR-00226	Field	4/1/2003	9:20	60.44	15.80	5.92	1608		-79	124	
DIW-P11A	DSR-00227	Field	4/1/2003	9:43	60.61	15.89	5.1	952		14	217	
DIW-P09A	DSR-00228	Field	4/1/2003	10:03	62.33	16.85	5.78	427		-81	121	
DIW-1-2	DSR-00229	Field	4/1/2003	10:11	64.62	18.12	6.23	763		-74	127	
DIW-P03A	DSR-00230	Field	4/1/2003	10:07	63.89	17.72	5.9	432		-79	122	
DIW-P05A	DSR-00231	Field	4/1/2003	9:50	63.22	17.34	5.45	408		-114	87	
DIW-P07A	DSR-00232	Field	4/1/2003	9:38	63.16	17.31	5.28	540		-63	138	

Gray highlight means that there is no data

APPENDIX A
Field Indicator Parameters

Fifth Post-Injection Field Parameter Results

Well / Piezometer	Sample Number	Sample Type	Date	Time	Temperature (F)	Temperature (C)	pH	Conductivity (uS/cm)	DO (ug/L)	ORP (mV)	Eh Calculated (mV)	Comments
DCB-8	DSR-00250	Field	7/15/2003	8:15	71.26	21.81	5.1	48.05	1540	87	285	
DCB-21A	DSR-00251	Field	7/14/2003	10:25	79.72	26.51	2.14	5705	900	443	636	
DCB-21B	DSR-00252	Field	7/14/2003	10:43	72.64	22.58	2.91	2799	790	395	592	
DCB-22C	DSR-00253	Field	7/14/2003	10:05	70.59	21.44	4.34	773.4	1940	253	451	
DCB-70B	DSR-00254	Field	7/14/2003	9:56	68.77	20.43	4.59	247.03	1050	101	300	
DCB-23C	DSR-00255	Field	7/14/2003	12:54	69.87	21.04	4.6	1988	1130	86	284	
DCB-19A	DSR-00256	Field	7/14/2003	11:11	77.04	25.02	2.26	3898	1040	489	684	
DCB-19B	DSR-00257	Field	7/14/2003	11:34	73.56	23.09	2.7	2491	1450	458	654	
DCB-18C	DSR-00258	Field	7/14/2003	11:46	72.36	22.42	3.42	2039	870	181	378	
DCB-71B	DSR-00259	Field	7/14/2003	9:33	69.28	20.71	3.87	949.8	1300	113	312	
DIW-P14C	DSR-00260	Field	7/14/2003	11:18	71.39	21.88	4.35	2485	890	-60	137	
DIW-P13B	DSR-00261	Field	7/14/2003	11:07	71.76	22.09	5.26	2116	890	-212	-15	
DIW-P13C	DSR-00262	Field	7/14/2003	11:14	72.76	22.64	3.99	2300	950	-121	76	
DIW-P12B	DSR-00263	Field	7/14/2003	12:11	73.62	23.12	2.07	5270	920	418	614	
DIW-P11B	DSR-00264	Field	7/14/2003	11:38	74.86	23.81	2.37	4341	670	96	292	
DIW-P11C	DSR-00265	Field	7/14/2003	11:57	72.93	22.74	2.11	5051	860	397	594	
DIW-P10C	DSR-00266	Field	7/14/2003	12:34	70.84	21.58	2.68	3383	1150	122	320	
DIW-P09B	DSR-00267	Field	7/14/2003	12:25	72.45	22.47	3.89	1395	950	-109	88	
DIW-P09C	DSR-00268	Field	7/14/2003	12:27	70.63	21.46	2.37	4341	1000	306	504	
DIW-P02C	DSR-00269	Field	7/14/2003	12:44	70.04	21.13	5.91	566.2	980	-88	110	
DIW-P03B	DSR-00270	Field	7/14/2003	12:13	71.7	22.06	5.53	383.8	830	-141	56	
DIW-P03C	DSR-00271	Field	7/14/2003	12:31	70.71	21.51	5.57	399.4	880	-98	100	
DIW-P04C	DSR-00272	Field	7/14/2003	12:02	70.28	21.27	4.46	756.6	1000	-95	103	
DIW-P07B	DSR-00273	Field	7/14/2003	10:39	70.91	21.62	5.16	918.8	1010	-40	158	
DIW-P07C	DSR-00274	Field	7/14/2003	10:53	72.02	22.23	4.29	1543	1000	-57	140	
DIW-P08C	DSR-00275	Field	7/14/2003	10:24	70.67	21.48	4.27	1738	1850	42	240	
DIW-P13A	DSR-00276	Field	7/15/2003	8:28	71.53	21.96	5.41	1802	470	-34	163	
DIW-P11A	DSR-00277	Field	7/15/2003	8:48	74.78	23.77	4.11	1542	590	115	311	
DIW-P09A	DSR-00278	Field	7/15/2003	9:00	72.88	22.71	5.34	552.9	480	2	199	
DIW-1-2	DSR-00279	Field	7/15/2003	9:17	74.34	23.52	5.07	286.2	610	29	225	
DIW-P03A	DSR-00280	Field	7/15/2003	9:13	73.64	23.13	5.36	264.4	410	-11	185	
DIW-P05A	DSR-00281	Field	7/15/2003	8:52	73.46	23.03	5.22	242	710	7	204	
DIW-P07A	DSR-00282	Field	7/15/2003	8:09	72.44	22.47	5.55	430.6	740	-114	83	

dissolved oxygen measurements taken with a YSI 95 DO meter

APPENDIX B
SRTC EBS Analytical Results

Pre-Injection EBS Analytical Results

Well / Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Lab pH	Analysis Date	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	DSR-00001	7/1/2002	Sample	7/3/2002	4.54	7/15/2002	5.2	<0.5	3.4	1.4	1.4
DCB-21A	DSR-00002	7/1/2002	Sample	7/3/2002	2.42	7/15/2002	4.7	<0.5	3.6	2.4	4864.56
DCB-21B	DSR-00003	6/27/2002	Sample	7/3/2002	3.05	7/15/2002	7.7	<0.5	<0.5	1.3	2121.94
DCB-21C	DSR-00004	6/27/2002	Sample	7/3/2002	3.92	7/15/2002	6.0	<0.5	<0.5	<0.5	590
DCB-22A	DSR-00005	6/27/2002	Sample	7/3/2002	2.95	7/15/2002	6.6	<0.5	10	<0.5	2654.61
DCB-22B	DSR-00006	6/27/2002	Sample	7/3/2002	2.97	7/15/2002	2.9	<0.5	0.7	<0.5	3067.87
DCB-22C	DSR-00007	6/27/2002	Sample	7/3/2002	4.04	7/15/2002	5.5	<0.5	<0.5	<0.5	390
DCB-70A	DSR-00008	7/1/2002	Sample	7/3/2002	3.23	7/15/2002	7.0	<0.5	2.1	<0.5	2383.19
DCB-70B	DSR-00009	7/1/2002	Sample	7/3/2002	4.15	7/15/2002	4.8	<0.5	3.2	1.4	250
DCB-19A	DSR-00010	6/26/2002	Sample	7/3/2002	2.87	7/15/2002	4.4	<0.5	11	<0.5	994.18
DCB-19B	DSR-00011	6/25/2002	Sample	7/3/2002	3.1	7/15/2002	4.3	<0.5	2.3	<0.5	2617
DCB-19C	DSR-00012	6/26/2002	Sample	7/3/2002	3.01	7/15/2002	4.1	<0.5	<0.5	<0.5	2493.55
DCB-18A	DSR-00013	6/27/2002	Sample	7/3/2002	2.74	7/15/2002	2.5	<0.5	5.9	<0.5	3226.71
DCB-18B	DSR-00014	6/26/2002	Sample	7/3/2002	2.75	7/15/2002	3.2	<0.5	4.3	<0.5	4038.62
DCB-18C	DSR-00015	6/26/2002	Sample	7/3/2002	3.01	7/15/2002	7.3	<0.5	<0.5	1.3	1807.67
DCB-71A	DSR-00016	7/1/2002	Sample	7/3/2002	3.88	7/15/2002	5.5	<0.5	2.0	1.3	760
DCB-71B	DSR-00017	7/1/2002	Sample	7/3/2002	3.09	7/15/2002	4.2	<0.5	<0.5	<0.5	2989.31
DIW-P11A	DSR-00020	6/27/2002	Sample	7/3/2002	3.01	7/15/2002	2.7	<0.5	<0.5	<0.5	2033.48
DIW-P11B	DSR-00021	6/27/2002	Sample	7/3/2002	3.03	7/15/2002	2.8	<0.5	1.8	<0.5	2489.65
DIW-1-2	DSR-00025	7/1/2002	Sample	7/3/2002	2.72	7/15/2002	3.1	<0.5	<0.5	<0.5	440
DIW-P07A	DSR-00031	6/26/2002	Sample	7/3/2002	3.89	7/15/2002	3.9	<0.5	1.8	<0.5	2817.64
DCB-21B	DSR-00033	6/27/2002	Duplicate			7/15/2002	8.4	<0.5	<0.5	1.3	2083.28
DCB-21B	DSR-00034	6/27/2002	Unfiltered								
DCB-22C	DSR-00035	6/27/2002	Duplicate			7/15/2002	5.6	<0.5	<0.5	<0.5	380
DCB-22C	DSR-00036	6/27/2002	Unfiltered								
DIW-P11B	DSR-00037	6/27/2002	Duplicate			7/15/2002	2.7	<0.5	1.7	<0.5	2474.66
DIW-P11B	DSR-00039	6/27/2002	Unfiltered								
DIW-P11C	DSR-00040	6/27/2002	Sample	7/3/2002	2.73	7/15/2002	3.1	<0.5	<0.5	<0.5	3827.21
DIW-P12B	DSR-00041	6/27/2002	Sample	7/3/2002	3.03	7/15/2002	2.8	<0.5	<0.5	<0.5	2375.6
DIW-P09A	DSR-00042	6/27/2002	Sample	7/3/2002	3.04	7/15/2002	4.1	<0.5	4.1	<0.5	690
DIW-P09B	DSR-00043	6/27/2002	Sample	7/3/2002	2.95	7/15/2002	2.7	<0.5	<0.5	1.3	2504.2
DIW-P09C	DSR-00044	6/27/2002	Sample	7/3/2002	2.73	7/15/2002	2.5	<0.5	1.9	<0.5	3615.71
DIW-P10C	DSR-00045	6/27/2002	Sample			7/15/2002	2.5	<0.5	1.8	1.5	2863.38
DIW-P07B	DSR-00046	6/26/2002	Sample	7/3/2002	2.93	7/15/2002	3.5	<0.5	<0.5	1.4	3034.17
DIW-P07C	DSR-00047	6/26/2002	Sample	7/3/2002	3.05	7/15/2002	3.9	<0.5	1.8	1.3	2432.24
DIW-P08C	DSR-00048	6/26/2002	Sample	7/3/2002	3.03	7/15/2002	3.5	<0.5	<0.5	1.3	2596.6

Gray highlight means that there is no data

APPENDIX B
SRTC EBS Analytical Results

Pre-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Lithium (mg/L)	Sodium (mg/L)	Ammonium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Analysis Date	Hydrogen Sulfide (mg/L)	Analysis Date	Lactate (%)	Lactate (mg/L)
DCB-8	7/18/2002	<0.5	3.6	<0.5	<0.5	2.2	0.7	7/9/2002	0.096921323	7/15/2002	<0.001	<6.3
DCB-21A	7/18/2002	0.6	7.4	2.4	65	<0.5	> 100	7/9/2002	0.102622577	7/15/2002	<0.001	<6.3
DCB-21B	7/18/2002	<0.5	7.5	<0.5	61	<0.5	> 100	7/9/2002	0.136830103	7/15/2002	<0.001	<6.3
DCB-21C	7/18/2002	<0.5	4.4	<0.5	39	<0.5	> 100	7/9/2002	0.074116306	7/15/2002	<0.001	<6.3
DCB-22A	7/18/2002	<0.5	16	<0.5	46	<0.5	78	7/9/2002	0.131128848	7/15/2002	<0.001	<6.3
DCB-22B	7/18/2002	<0.5	27	<0.5	53	<0.5	> 100	7/9/2002	0.165336374	7/15/2002	<0.001	<6.3
DCB-22C	7/18/2002	<0.5	3.8	<0.5	21	<0.5	91	7/9/2002	0.15963512	7/15/2002	<0.001	<6.3
DCB-70A	7/18/2002	<0.5	20	2.0	40	<0.5	65	7/9/2002	0.399087799	7/15/2002	<0.001	<6.3
DCB-70B	7/18/2002	<0.5	60	<0.5	11	<0.5	19	7/9/2002	0.096921323	7/15/2002	<0.001	<6.3
DCB-19A	7/18/2002	<0.5	4.5	<0.5	17	<0.5	39	7/9/2002	0.153933865	7/15/2002	<0.001	<6.3
DCB-19B	7/18/2002	<0.5	17	<0.5	38	<0.5	90	7/9/2002	0.205245154	7/15/2002	<0.001	<6.3
DCB-19C	7/18/2002	<0.5	13	<0.5	39	<0.5	> 100	7/9/2002	0.205245154	7/15/2002	<0.001	<6.3
DCB-18A	7/18/2002	<0.5	3.9	0.8	43	<0.5	87	7/9/2002	0.091220068	7/15/2002	<0.001	<6.3
DCB-18B	7/18/2002	<0.5	6.3	1.1	54	<0.5	> 100	7/9/2002	0.148232611	7/15/2002	<0.001	<6.3
DCB-18C	7/18/2002	<0.5	5.3	<0.5	40	<0.5	> 100	7/9/2002	0.102622577	7/15/2002	<0.001	<6.3
DCB-71A	7/18/2002	<0.5	7.1	<0.5	21	<0.5	34	7/9/2002	0.091220068	7/15/2002	<0.001	<6.3
DCB-71B	7/18/2002	<0.5	7.8	<0.5	57	<0.5	> 100	7/9/2002	0.028506271	7/15/2002	<0.001	<6.3
DIW-P11A	7/18/2002	<0.5	16	1.3	38	<0.5	> 100	7/9/2002	0.11972634	7/15/2002	<0.001	<6.3
DIW-P11B	7/18/2002	<0.5	16	1.3	44	<0.5	> 100	7/9/2002	0.222348917	7/15/2002	<0.001	<6.3
DIW-1-2	7/18/2002	<0.5	10	<0.5	13	<0.5	23	7/9/2002	2.337514253	7/15/2002	<0.001	<6.3
DIW-P07A	7/18/2002	<0.5	22	1.5	42	<0.5	> 100	7/9/2002	0.228050171	7/15/2002	<0.001	<6.3
DCB-21B	7/18/2002	<0.5	6.2	<0.5	54	<0.5	> 100			7/15/2002	<0.001	<6.3
DCB-21B								7/9/2002	0.182440137			
DCB-22C	7/18/2002	<0.5	3.8	<0.5	20	<0.5	90			7/15/2002	<0.001	<6.3
DCB-22C								7/9/2002	0.193842645			
DIW-P11B	7/18/2002	<0.5	16	1.3	42	<0.5	> 100			7/15/2002	<0.001	<6.3
DIW-P11B								7/9/2002	0.148232611			
DIW-P11C	7/18/2002	<0.5	16	2.7	46	<0.5	> 100	7/9/2002	0.062713797	7/15/2002	<0.001	<6.3
DIW-P12B	7/18/2002	<0.5	56	3.8	37	<0.5	98	7/9/2002	0.005701254	7/15/2002	<0.001	<6.3
DIW-P09A	7/18/2002	<0.5	12	<0.5	14	<0.5	29	7/9/2002	0.068415051	7/15/2002	<0.001	<6.3
DIW-P09B	7/18/2002	<0.5	14	1.7	40	<0.5	> 100	7/9/2002	0.142531357	7/15/2002	<0.001	<6.3
DIW-P09C	7/18/2002	<0.5	15	2.9	43	<0.5	> 100	7/9/2002	0.091220068	7/15/2002	<0.001	<6.3
DIW-P10C	7/18/2002	<0.5	24	2.4	38	<0.5	82	7/9/2002	<0.005	7/15/2002	<0.001	<6.3
DIW-P07B	7/18/2002	<0.5	16	<0.5	37	<0.5	> 100	7/9/2002	0.210946408	7/15/2002	<0.001	<6.3
DIW-P07C	7/18/2002	<0.5	9.7	0.6	34	<0.5	93	7/9/2002	0.1995439	7/15/2002	<0.001	<6.3
DIW-P08C	7/18/2002	<0.5	13	<0.5	36	<0.5	95	7/9/2002	0.193842645	7/15/2002	<0.001	<6.3

Gray highlight means that there is no data

Pre-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Acetic Acid (mg/L)	Propanoic Acid (mg/L)	Formic Acid (mg/L)	Isobutyric Acid (mg/L)	Butyric Acid (mg/L)	Isovaleric Acid (mg/L)	Valeric Acid (mg/L)	Isocaproic Acid (mg/L)	Hexanoic Acid (mg/L)	Heptanoic Acid (mg/L)	Analysis Date	TBCD (cells/ml)	Analysis Date	SRB (cells/ml)
DCB-8	7/25/2002	2.6	6.3	<1.0	7.5	6.4	10.0	7.0	6.9	7.4	8.0	7/2/2002	9.29E+04	9/23/2002	3.20E+01
DCB-21A	7/25/2002	7.8	32.2	11.6	36.8	28.0	44.9	36.1	36.7	33.3	30.1				
DCB-21B	7/25/2002	6.0	18.3	7.1	15.2	14.1	18.6	16.7	15.9	15.5	15.2	7/3/2002	1.20E+05	9/23/2002	7.20E+00
DCB-21C	7/25/2002	4.2	11.3	4.9	8.3	8.4	10.1	9.3	8.4	9.0	9.4				
DCB-22A	7/25/2002	9.0	35.8	12.7	20.6	21.1	22.0	23.3	18.2	18.0	14.8				
DCB-22B	7/25/2002	8.1	26.9	9.6	11.2	13.8	12.2	14.6	10.6	11.4	10.0				
DCB-22C	7/25/2002	5.7	16.4	6.6	6.5	8.9	7.4	9.2	6.7	7.9	<5.0	7/3/2002	3.33E+04	9/23/2002	7.20E+00
DCB-70A	7/25/2002	7.0	16.7	6.7	5.2	8.0	6.2	8.0	5.7	6.9	<5.0				
DCB-70B	7/25/2002	4.1	8.7	<1.0	2.5	4.8	3.7	5.0	3.8	5.1	<5.0	7/2/2002	4.39E+04	9/23/2002	<7.20E+00
DCB-19A	7/25/2002	4.4	9.6	<1.0	2.5	4.5	3.4	4.6	3.4	4.7	<5.0				
DCB-19B	7/25/2002	4.4	8.9	<1.0	2.1	4.4	3.2	4.5	3.4	4.6	<5.0	7/2/2002	3.27E+04	9/23/2002	<7.20E+00
DCB-19C	7/25/2002	3.8	7.0	<1.0	1.5	3.6	2.8	4.0	3.2	4.4	<5.0				
DCB-18A	7/25/2002	3.3	5.8	<1.0	<1.5	3.1	2.4	3.5	<2.0	<2.0	<5.0				
DCB-18B	7/25/2002	2.8	4.5	<1.0	<1.5	2.8	<2.0	3.1	<2.0	<2.0	<5.0				
DCB-18C	7/25/2002	2.5	4.1	<1.0	<1.5	2.6	<2.0	<2.0	<2.0	<2.0	<5.0	7/3/2002	1.17E+04	9/23/2002	4.60E+01
DCB-71A	7/25/2002	2.2	3.8	<1.0	<1.5	2.5	<2.0	<2.0	<2.0	<2.0	<5.0				
DCB-71B	7/25/2002	2.1	3.8	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	7/2/2002	7.84E+04	9/23/2002	8.60E+01
DIW-P11A	7/25/2002	2.5	4.8	<1.0	1.2	3.1	2.4	3.1	<2.0	<2.0	<5.0				
DIW-P11B	7/25/2002	4.1	8.4	<1.0	3.2	5.2	4.3	5.4	4.3	5.2	<5.0	7/3/2002	5.86E+04	9/23/2002	7.20E+00
DIW-1-2	7/25/2002	<1.0	2.2	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	7/2/2002	1.33E+05	9/23/2002	1.84E+01
DIW-P07A	7/25/2002	<1.0	1.8	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0			9/23/2002	<7.20E+00
DCB-21B	7/25/2002	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	7/3/2002	1.10E+05		
DCB-21B															
DCB-22C	7/25/2002	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DCB-22C															
DIW-P11B	7/25/2002	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DIW-P11B															
DIW-P11C	7/25/2002	2.4	13.3	5.6	3.1	3.7	3.1	4.4	<2.0	<2.0	<5.0				
DIW-P12B	7/25/2002	<1.0	4.4	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DIW-P09A	7/25/2002	<1.0	2.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0	7/3/2002	1.93E+04	9/23/2002	1.86E+02
DIW-P09B	7/25/2002	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DIW-P09C	7/25/2002	<1.0	1.4	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DIW-P10C	7/25/2002	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DIW-P07B	7/25/2002	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DIW-P07C	7/25/2002	2.8	10.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				
DIW-P08C	7/25/2002	<1.0	2.3	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0				

Gray highlight means that there is no data

SRB = Sulfate Reducing Bacteria

TBCD = Total Bacterial Cell Density

Pre-Injection EBS Analytical Results

Well / Piezometer	Comments
DCB-8	
DCB-21A	
DCB-21B	
DCB-21C	
DCB-22A	
DCB-22B	
DCB-22C	
DCB-70A	
DCB-70B	
DCB-19A	
DCB-19B	
DCB-19C	
DCB-18A	
DCB-18B	
DCB-18C	
DCB-71A	
DCB-71B	
DIW-P11A	
DIW-P11B	
DIW-1-2	
DIW-P07A	
DCB-21B	The TBCD was suppost to be for DIW-P07A; may be mis-labeled
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	
DIW-P11C	
DIW-P12B	
DIW-P09A	
DIW-P09B	
DIW-P09C	
DIW-P10C	
DIW-P07B	
DIW-P07C	
DIW-P08C	May have been DIW-P08B instead

First Post-Injection EBS Analytical Results

Well / Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Lab pH	Analysis Date	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	DSR-00050	9/10/2002	Sample	9/10/2002	4.52	9/18/2002	3.35	3.77	< 0.5	< 0.5	< 0.5
DCB-21A	DSR-00051	9/12/2002	Sample	9/12/2002	2.33	9/18/2002	4.73	2.25	16.47	< 0.5	2728.62
DCB-21B	DSR-00052	9/11/2002	Sample	9/11/2002	2.82	9/18/2002	2.61	< 0.5	5.70	< 0.5	1301.23
DCB-21C	DSR-00053	9/11/2002	Sample	9/11/2002	4.06	9/18/2002	4.14	< 0.5	< 0.5	< 0.5	534.45
DCB-22A	DSR-00054	9/11/2002	Sample	9/11/2002	3.31	9/18/2002	2.66	< 0.5	9.41	< 0.5	1598.26
DCB-22B	DSR-00055	9/12/2002	Sample	9/12/2002	2.6	9/18/2002	5.46	8.48	11.64	< 0.5	1539.71
DCB-22C	DSR-00056	9/11/2002	Sample	9/12/2002	4.47	9/18/2002	4.41	< 0.5	< 0.5	< 0.5	340.66
DCB-70A	DSR-00057	9/10/2002	Sample	9/10/2002	2.92	9/19/2002	5.41	0.73	8.17	< 0.5	1204.01
DCB-70B	DSR-00058	9/10/2002	Sample	9/10/2002	4.84	9/19/2002	3.15	< 0.5	< 0.5	< 0.5	97.91
DCB-19A	DSR-00059	9/12/2002	Sample	9/12/2002	2.75	9/18/2002	0.87	12.43	5.18	< 0.5	808.67
DCB-19B	DSR-00060	9/11/2002	Sample	9/11/2002	2.91	9/18/2002	3.20	1.53	9.79	< 0.5	1402.10
DCB-19C	DSR-00061	9/11/2002	Sample	9/11/2002	3.2	9/18/2002	3.32	0.00	8.96	< 0.5	1403.57
DCB-18A	DSR-00062	9/12/2002	Sample	9/12/2002	2.49	9/18/2002	2.43	3.71	16.07	< 0.5	2111.57
DCB-18B	DSR-00063	9/11/2002	Sample	9/11/2002	2.68	9/18/2002	1.83	3.54	13.38	< 0.5	1557.13
DCB-18C	DSR-00064	9/11/2002	Sample	9/11/2002	3.53	9/18/2002	2.40	0.00	5.06	< 0.5	1128.16
DCB-71A	DSR-00065	9/10/2002	Sample	9/10/2002	3.29	9/19/2002	1.63	< 0.5	3.62	< 0.5	658.29
DCB-71B	DSR-00066	9/10/2002	Sample	9/10/2002	3.52	9/19/2002	3.10	< 0.5	8.51	< 0.5	1513.43
DIW-P14C	DSR-00067	9/11/2002	Sample	9/11/2002	6.31	9/19/2002	< 0.5	< 0.5	48.63	11.23	227.92
DIW-P13B	DSR-00068	9/11/2002	Sample	9/11/2002	5.5	9/19/2002	10.12	< 0.5	18.33	< 0.5	961.42
DIW-P13C	DSR-00069	9/11/2002	Sample	9/11/2002	6.02	9/19/2002	< 0.5	< 0.5	< 0.5	< 0.5	465.53
DIW-P12B	DSR-00070	9/11/2002	Sample	9/11/2002	3.88	9/19/2002	2.95	< 0.5	10.51	< 0.5	1582.23
DIW-P11B	DSR-00071	9/11/2002	Sample	9/11/2002	3.76	9/19/2002	2.57	< 0.5	9.75	< 0.5	1623.21
DIW-P11C	DSR-00072	9/11/2002	Sample	9/11/2002	3.87	9/19/2002	3.55	< 0.5	12.54	< 0.5	1888.21
DIW-P10C	DSR-00073	9/11/2002	Sample	9/11/2002	3.47	9/19/2002	3.08	0.92	9.96	< 0.5	1595.32
DIW-P09B	DSR-00074	9/11/2002	Sample	9/11/2002	3.91	9/19/2002	2.18	< 0.5	8.29	< 0.5	1476.91
DIW-P09C	DSR-00075	9/11/2002	Sample	9/11/2002	4.33	9/19/2002	3.49	< 0.5	10.99	< 0.5	1670.11
DIW-P07B	DSR-00081	9/11/2002	Sample	9/11/2002	3.34	9/19/2002	2.89	< 0.5	10.65	< 0.5	1575.03
DIW-P07C	DSR-00082	9/11/2002	Sample	9/11/2002	3.4	9/19/2002	3.08	< 0.5	9.22	< 0.5	1420.39
DIW-P08C	DSR-00083	9/11/2002	Sample	9/11/2002	3.46	9/19/2002	3.45	< 0.5	9.96	< 0.5	1518.85
DIW-P13A	DSR-00087	9/11/2002	Sample	9/11/2002	6.1	9/19/2002	5.94	2.79	15.75	< 0.5	183.75
DIW-P11A	DSR-00088	9/11/2002	Sample	9/11/2002	4.88	9/19/2002	4.84	< 0.5	1.92	< 0.5	1053.84
DIW-P09A	DSR-00090	9/11/2002	Sample	9/11/2002	3.81	9/19/2002	0.77	0.55	4.35	< 0.5	753.48
DIW-1-2	DSR-00091	9/11/2002	Sample	9/11/2002	5.24	9/19/2002	0.77	< 0.5	5.08	< 0.5	348.46
DIW-P07A	DSR-00092	9/11/2002	Sample	9/11/2002	4.08	9/19/2002	1.40	< 0.5	4.52	< 0.5	933.92
DCB-21B	DSR-00093	9/11/2002	Duplicate	9/11/2002	2.82						
DCB-21B	DSR-00094	9/11/2002	Unfiltered	9/11/2002	2.82						
DCB-22C	DSR-00095	9/11/2002	Duplicate								
DCB-22C	DSR-00096	9/11/2002	Unfiltered	9/11/2002	4.47						
DIW-P11B	DSR-00097	9/11/2002	Duplicate								
DIW-P11B	DSR-00099	9/11/2002	Unfiltered	9/11/2002	3.76						

na* - sodium interferrent; na^ - lactate interferrent

Gray highlight means that there is no data

First Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Lithium (mg/L)	Sodium (mg/L)	Ammonium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Analysis Date	Hydrogen Sulfide (mg/L)	Analysis Date	Lactate (%)	Lactate (mg/L)
DCB-8	9/18/2002	< 0.5	1.45	< 0.5	0.55	0.54686469	0.70	9/13/2002	0.036461447	9/18/2002	<0.001	<6.3
DCB-21A	9/18/2002	0.83	11.51	< 0.5	27.40	27.4028302	113.80	9/13/2002	0.069336521	9/18/2002	0.000882	5.5545
DCB-21B	9/18/2002	< 0.5	7.58	< 0.5	36.16	36.1630363	83.89	9/13/2002	0.099222953	9/18/2002	0.001966	12.3879
DCB-21C	9/18/2002	< 0.5	3.88	< 0.5	26.82	26.8158416	78.03	9/13/2002	0.031978482	9/18/2002	0.000595	3.7480891
DCB-22A	9/18/2002	< 0.5	31.66	< 0.5	26.49	26.4886792	88.54	9/13/2002	0.121637776	9/18/2002	0.001993	12.554713
DCB-22B	9/18/2002	< 0.5	18.26	< 0.5	37.53	37.5280528	54.88	9/13/2002	0.021518231	9/18/2002	0.000868	5.4654326
DCB-22C	9/18/2002	< 0.5	3.36	< 0.5	21.50	21.4993399	56.09	9/13/2002	0.078302451	9/18/2002	<0.001	<6.3
DCB-70A	9/19/2002	< 0.5	18.02	< 0.5	35.55	35.5491749	36.69	9/13/2002	0.048416019	9/19/2002	0.000638	4.0203587
DCB-70B	9/19/2002	< 0.5	45.49	< 0.5	1.81	1.80957096	2.21	9/13/2002	0.026001195	9/19/2002	<0.001	<6.3
DCB-19A	9/18/2002	< 0.5	4.44	< 0.5	17.01	17.0085809	32.57	9/13/2002	0.018529588	9/18/2002	0.000596	3.7536587
DCB-19B	9/18/2002	< 0.5	16.56	< 0.5	27.65	27.6537954	55.55	9/13/2002	0.11566049	9/18/2002	0.000585	3.6834913
DCB-19C	9/18/2002	< 0.5	14.94	< 0.5	27.34	27.3432343	81.71	9/13/2002	0.03945009	9/18/2002	0.000799	5.0355261
DCB-18A	9/18/2002	0.73	7.51	< 0.5	5.74	5.74488449	81.30	9/13/2002	0.018529588	9/18/2002	0.000684	4.3086522
DCB-18B	9/18/2002	0.44	4.77	< 0.5	29.31	29.3125413	46.66	9/13/2002	0.021518231	9/18/2002	0.000843	5.3105804
DCB-18C	9/18/2002	< 0.5	6.09	< 0.5	31.97	31.9719472	95.20	9/13/2002	0.023012552	9/18/2002	0.001545	9.7339109
DCB-71A	9/19/2002	< 0.5	4.79	< 0.5	26.36	26.3643564	26.99	9/13/2002	0.026001195	9/19/2002	0.000664	4.1829717
DCB-71B	9/19/2002	< 0.5	9.22	< 0.5	61.44	61.4443396	94.52	9/13/2002	0.085774059	9/19/2002	0.002688	16.932391
DIW-P14C	9/19/2002	< 0.5	1876.85	< 0.5	< 0.5	62.0154242	59.93	9/13/2002	0.442916916	9/19/2002	0.691181	4354.4389
DIW-P13B	9/19/2002	< 0.5	772.39	na*	25.65	62.0482424	38.24	9/13/2002	0.179916318	9/19/2002	0.189444	1193.5001
DIW-P13C	9/19/2002	na*	na*	na*	na*	65.015553	na*	9/13/2002	0.043933054	9/19/2002	8.781929	55326.15
DIW-P12B	9/19/2002	< 0.5	96.04	na*	45.96	70.4196136	58.91	9/13/2002	18.16377764	9/19/2002	0.025414	160.10528
DIW-P11B	9/19/2002	< 0.5	79.41	na*	47.68	75.9877652	60.61	9/13/2002	9.389121339	9/19/2002	0.009997	62.981794
DIW-P11C	9/19/2002	< 0.5	301.36	na*	67.96	98.2795152	73.44	9/13/2002	0.274058577	9/19/2002	0.20918	1317.8351
DIW-P10C	9/19/2002	< 0.5	245.91	na*	49.27	68.5763258	62.54	9/13/2002	0.226240287	9/19/2002	0.164169	1034.2616
DIW-P09B	9/19/2002	< 0.5	76.93	< 0.5	45.31	45.3146226	53.60	9/13/2002	12.78421996	9/19/2002	0.01549	97.585094
DIW-P09C	9/19/2002	< 0.5	557.74	na*	79.85	83.7574697	78.30	9/13/2002	0.156007173	9/19/2002	0.367363	2314.3867
DIW-P07B	9/19/2002	< 0.5	15.44	< 0.5	37.32	37.3193396	77.21	9/13/2002	0.206814106	9/19/2002	0.001095	6.8960348
DIW-P07C	9/19/2002	< 0.5	10.38	< 0.5	32.66	32.6641509	76.90	9/13/2002	0.042438733	9/19/2002	0.000609	3.837887
DIW-P08C	9/19/2002	< 0.5	33.83	< 0.5	40.84	40.8419811	82.20	9/13/2002	0.075313808	9/19/2002	0.000821	5.1720717
DIW-P13A	9/19/2002	< 0.5	517.63	na*	14.50	44.9691136	21.14	9/13/2002	0.18141064	9/19/2002	0.048644	306.4555
DIW-P11A	9/19/2002	< 0.5	254.58	na*	28.25	46.5252424	42.77	9/13/2002	0.003586372	9/19/2002	0.200738	1264.6474
DIW-P09A	9/19/2002	< 0.5	37.51	< 0.5	23.90	23.9029703	26.37	9/13/2002	0.584877466	9/19/2002	0.001901	11.978857
DIW-1-2	9/19/2002	< 0.5	86.44	< 0.5	21.18	21.1762376	22.49	9/13/2002	1.575612672	9/19/2002	0.00654	41.205104
DIW-P07A	9/19/2002	< 0.5	21.70	< 0.5	24.85	24.8462264	53.57	9/13/2002	7.88643156	9/19/2002	0.000785	4.945637
DCB-21B								9/13/2002	0.024506874			
DCB-21B								9/13/2002	0.082785415			
DCB-22C												
DCB-22C								9/13/2002	0.072325164			
DIW-P11B												
DIW-P11B								9/13/2002	17.04004782			

na* - sodium interferrent; na^ - lactate interferrent

Gray highlight means that there is no data

First Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Acetic Acid (mg/L)	Propanoic Acid (mg/L)	Formic Acid (mg/L)	Isobutyric Acid (mg/L)	Butyric Acid (mg/L)	Isovaleric Acid (mg/L)	Valeric Acid (mg/L)	Isocaproic Acid (mg/L)	Hexanoic Acid (mg/L)	Heptanoic Acid (mg/L)	Analysis Date	TBCD (cells/ml)	Analysis Date	SRB (cells/ml)
DCB-8	9/18/2002	< 6.0	< 7.0	36.22	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	2.35E+04	12/10/2002	1.50E+04
DCB-21A	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-21B	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	1.03E+05	12/10/2002	<7.20E+00
DCB-21C	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-22A	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-22B	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-22C	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	1.05E+06	12/10/2002	<7.20E+00
DCB-70A	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-70B	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	4.91E+04	12/10/2002	1.84E+01
DCB-19A	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-19B	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	9.95E+04	12/10/2002	<7.20E+00
DCB-19C	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-18A	9/18/2002	< 6.0	< 7.0	7.61	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-18B	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-18C	9/18/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	4.42E+03	12/10/2002	2.20E+02
DCB-71A	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-71B	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	7.11E+04	12/10/2002	1.48E+01
DIW-P14C	9/19/2002	1274.08	730.10	48.66	62.71	1298.92	< 10.0	62.39	< 10.0	123.78	< 10.0				
DIW-P13B	9/19/2002	655.57	476.97	8.81	< 9.0	256.46	< 10.0	12.27	< 10.0	< 10.0	< 10.0				
DIW-P13C	9/19/2002	347.95	69.29	5.61	57.24	172.79	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P12B	9/19/2002	137.60	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P11B	9/19/2002	104.64	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	4.73E+05	12/10/2002	4.20E+02
DIW-P11C	9/19/2002	58.04	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P10C	9/19/2002	59.35	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P09B	9/19/2002	102.34	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P09C	9/19/2002	97.39	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P07B	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P07C	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P08C	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P13A	9/19/2002	437.83	165.53	21.42	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			12/10/2002	2.20E+06
DIW-P11A	9/19/2002	11.98	< 7.0	11.61	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P09A	9/19/2002	11.33	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	1.65E+05	12/10/2002	4.20E+01
DIW-1-2	9/19/2002	57.65	12.16	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	#######	5.36E+04	12/10/2002	1.86E+02
DIW-P07A	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			12/10/2002	9.20E+03
DCB-21B	9/19/2002	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-21B															
DCB-22C	9/19/2002	8.03	< 7.0	6.33	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-22C															
DIW-P11B	9/19/2002	81.08	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P11B															

na* - sodium interferrent; na^ - lactate interferrent

Gray highlight means that there is no data

SRB = Sulfate Reducing Bacteria TBCD = Total Bacterial Cell Density

First Post-Injection EBS Analytical Results

Well / Piezometer	Comments
DCB-8	
DCB-21A	
DCB-21B	
DCB-21C	
DCB-22A	
DCB-22B	
DCB-22C	
DCB-70A	
DCB-70B	
DCB-19A	
DCB-19B	
DCB-19C	
DCB-18A	
DCB-18B	
DCB-18C	
DCB-71A	
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	
DIW-P11B	
DIW-P11C	
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P07B	
DIW-P07C	
DIW-P08C	May have been DIW-P08B instead
DIW-P13A	
DIW-P11A	
DIW-P09A	
DIW-1-2	
DIW-P07A	
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	

Second Post-Injection EBS Analytical Results

Well / Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Lab pH	Analysis Date	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8 *	DSR-00101	11/6/2002	Sample	11/6/02	5	11/21/2002	3.72	< 0.5	2.61	< 0.5	70.88
DCB-21A	DSR-00102	11/6/2002	Sample	11/6/02	2.19	11/22/2002	3.03	14.50	< 0.5	< 0.5	4514.00
DCB-21B	DSR-00103	11/6/2002	Sample	11/6/02	3.02	11/23/2002	2.42	10.37	< 0.5	< 0.5	1486.97
DCB-21C	DSR-00104	11/6/2002	Sample	11/6/02	4.44	11/24/2002	< 0.5	< 0.5	< 0.5	< 0.5	532.52
DCB-22A	DSR-00105	11/6/2002	Sample	11/6/02	2.92	11/25/2002	< 0.5	12.93	6.77	< 0.5	1902.34
DCB-22B	DSR-00106	11/6/2002	Sample	11/6/02	3.46	11/26/2002	2.00	10.10	< 0.5	< 0.5	1845.97
DCB-22C	DSR-00107	11/6/2002	Sample	11/6/02	4.51	11/27/2002	4.54	< 0.5	< 0.5	< 0.5	336.67
DCB-70B	DSR-00108	11/6/2002	Sample	11/6/02	5.04	11/28/2002	2.82	< 0.5	< 0.5	< 0.5	53.26
DCB-19A	DSR-00109	11/5/2002	Sample	11/5/2002	2.96	11/29/2002	1.51	7.66	10.52	< 0.5	890.53
DCB-19B	DSR-00110	11/5/2002	Sample	11/5/2002	3.1	11/30/2002	1.75	12.71	4.15	< 0.5	1432.62
DCB-19C	DSR-00111	11/5/2002	Sample	11/5/2002	3.47	12/1/2002	2.30	8.80	< 0.5	< 0.5	1609.96
DCB-18A	DSR-00112	11/6/2002	Sample	11/6/02	2.47	12/2/2002	1.48	17.11	< 0.5	< 0.5	3643.28
DCB-18B	DSR-00113	11/6/2002	Sample	11/6/02	2.7	12/3/2002	1.81	14.72	< 0.5	< 0.5	2806.49
DCB-18C	DSR-00114	11/6/2002	Sample	11/6/02	3.73	12/4/2002	< 0.5	6.28	< 0.5	< 0.5	1265.47
DCB-71B	DSR-00115	11/6/2002	Sample	11/6/02	3.47	12/5/2002	2.11	9.90	< 0.5	< 0.5	1856.20
DIW-P14C	DSR-00116	11/5/2002	Sample	11/5/2002	6.23	12/6/2002	6.31	11.14	< 0.5	< 0.5	133.01
DIW-P13B	DSR-00117	11/5/2002	Sample	11/5/2002	6.39	12/7/2002	4.99	10.84	< 0.5	< 0.5	8.60
DIW-P13C	DSR-00118	11/5/2002	Sample	11/5/2002	6.46	12/8/2002	< 0.5	354.37	< 0.5	< 0.5	82.75
DIW-P12B	DSR-00119	11/5/2002	Sample	11/5/2002	3.79	12/9/2002	9.31	< 0.5	< 0.5	< 0.5	3356.52
DIW-P11B	DSR-00120	11/5/2002	Sample	11/5/2002	3.94	12/10/2002	2.57	< 0.5	< 0.5	< 0.5	2871.69
DIW-P11C	DSR-00121	11/5/2002	Sample	11/5/02	3.59	12/11/2002	20.17	< 0.5	< 0.5	< 0.5	3947.55
DIW-P10C	DSR-00122	11/5/2002	Sample	11/5/2002	3.9	12/12/2002	3.56	< 0.5	< 0.5	< 0.5	3282.49
DIW-P09B	DSR-00123	11/5/2002	Sample	11/5/2002	3.99	12/13/2002	1.98	10.96	< 0.5	< 0.5	2030.19
DIW-P09C	DSR-00124	11/5/2002	Sample	11/5/2002	3.85	12/14/2002	5.11	< 0.5	< 0.5	< 0.5	3622.36
DIW-P03B	DSR-00126	11/5/2002	Sample	11/5/2002	5.28	12/15/2002	1.00	4.92	< 0.5	< 0.5	626.81
DIW-P07B	DSR-00130	11/5/2002	Sample	11/5/02	3.52	12/16/2002	< 0.5	10.92	< 0.5	< 0.5	1819.83
DIW-P07C	DSR-00131	11/5/2002	Sample	11/5/2002	3.45	12/17/2002	2.04	10.16	< 0.5	< 0.5	1662.59
DIW-P08C	DSR-00132	11/5/2002	Sample	11/5/2002	3.63	12/18/2002	2.28	8.73	< 0.5	< 0.5	1784.34
DIW-P13A	DSR-00136	11/6/2002	Sample	11/6/02	6.13	12/19/2002	5.20	< 0.5	< 0.5	< 0.5	7.48
DIW-P11A	DSR-00138	11/6/2002	Sample	11/6/02	6.15	12/20/2002	0.70	< 0.5	< 0.5	< 0.5	421.99
DIW-P09A	DSR-00139	11/6/2002	Sample	11/6/02	6.09	12/21/2002	1.25	5.64	< 0.5	< 0.5	338.16
DIW-1-2	DSR-00140	11/6/2002	Sample	11/6/02	6.13	12/22/2002	0.81	< 0.5	< 0.5	< 0.5	95.97
DIW-P03A	DSR-00141	11/6/2002	Sample	11/6/02	6.49	12/23/2002	1.87	< 0.5	< 0.5	< 0.5	< 0.5
DIW-P07A	DSR-00142	11/6/2002	Sample	11/6/02	5.68	12/24/2002	1.46	6.28	< 0.5	< 0.5	60.52
DCB-21B	DSR-00143	11/6/2002	Dulicate			12/25/2002	2.47	10.37	< 0.5	< 0.5	1400.80
DCB-21B	DSR-00144	11/6/2002	Unfiltered								
DCB-22C	DSR-00145	11/6/2002	Dulicate			12/27/2002	4.31	< 0.5	< 0.5	< 0.5	291.53
DCB-22C	DSR-00146	11/6/2002	Unfiltered								
DIW-P11B	DSR-00147	11/5/2002	Dulicate			12/29/2002	2.08	< 0.5	< 0.5	< 0.5	2637.72
DIW-P11B	DSR-00149	11/5/2002	Unfiltered								

Gray highlight means that there is no data

Second Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Lithium (mg/L)	Sodium (mg/L)	Ammonium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Analysis Date	Hydrogen Sulfide (mg/L)	Analysis Date	Lactate (%)	Lactate (mg/L)
DCB-8 *	11/12/2002	< 0.5	2.09	< 0.5	< 0.5	< 0.5	0.61	11/12/2002	0.0052	11/21/2002	<0.001	<6.3
DCB-21A	11/12/2002	< 0.5	14.25	4.13	< 0.5	163.81	240.91	11/12/2002	0.0131	11/22/2002	<0.001	<6.3
DCB-21B	11/12/2002	< 0.5	9.23	< 0.5	1.28	88.06	132.06	11/12/2002	0.0105	11/23/2002	<0.001	<6.3
DCB-21C	11/12/2002	< 0.5	4.50	< 0.5	1.76	63.88	144.29	11/12/2002	0.0079	11/24/2002	0.0018	11.334465
DCB-22A	11/12/2002	< 0.5	14.95	< 0.5	1.03	67.08	83.15	11/12/2002	0.0079	11/25/2002	0.0028	17.662479
DCB-22B	11/12/2002	< 0.5	27.04	1.61	2.28	105.01	149.42	11/12/2002	0.0733	11/26/2002	<0.001	<6.3
DCB-22C	11/12/2002	< 0.5	4.35	< 0.5	1.47	26.06	100.09	11/12/2002	0.0105	11/27/2002	<0.001	<6.3
DCB-70B	11/12/2002	< 0.5	29.72	< 0.5	0.82	< 0.5	1.02	11/12/2002	0.0052	11/28/2002	<0.001	<6.3
DCB-19A	11/12/2002	< 0.5	4.92	< 0.5	1.37	27.19	52.29	11/12/2002	0.0209	11/29/2002	<0.001	<6.3
DCB-19B	11/12/2002	< 0.5	12.61	< 0.5	1.66	53.07	87.09	11/12/2002	0.0288	11/30/2002	<0.001	<6.3
DCB-19C	11/12/2002	< 0.5	751.73	< 0.5	2.02	66.75	148.57	11/12/2002	0.0183	12/1/2002	<0.001	<6.3
DCB-18A	11/12/2002	< 0.5	12.39	2.66	0.89	119.34	166.66	11/12/2002	0.0131	12/2/2002	<0.001	<6.3
DCB-18B	11/12/2002	< 0.5	9.27	1.89	1.05	91.36	133.85	11/12/2002	0.0183	12/3/2002	<0.001	<6.3
DCB-18C	11/12/2002	< 0.5	6.70	0.58	3.24	73.65	178.80	11/12/2002	0.0183	12/4/2002	0.0029	18.435689
DCB-71B	11/12/2002	< 0.5	10.33	< 0.5	4.64	113.07	164.43	11/12/2002	0.0131	12/5/2002	<0.001	<6.3
DIW-P14C	11/12/2002	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	11/12/2002	0.0864	12/6/2002	0.1087	685.07808
DIW-P13B	11/12/2002	< 0.5	1292.02	112.75	33.12	33.34	51.78	11/12/2002	0.0236	12/7/2002	0.0723	455.53409
DIW-P13C	11/12/2002	< 0.5	17102.25	790.72	< 0.5	49.12	92.29	11/12/2002	0.0131	12/8/2002	3.2429	20430.456
DIW-P12B	11/12/2002	< 0.5	98.15	15.24	2.08	99.36	177.48	11/12/2002	0.2069	12/9/2002	<0.001	<6.3
DIW-P11B	11/12/2002	< 0.5	165.27	12.47	8.57	92.36	174.23	11/12/2002	6.3106	12/10/2002	<0.001	<6.3
DIW-P11C	11/12/2002	< 0.5	78.08	8.56	1.74	107.21	194.37	11/12/2002	3.0610	12/11/2002	<0.001	<6.3
DIW-P10C	11/12/2002	< 0.5	116.74	8.86	3.98	97.87	178.16	11/12/2002	2.6839	12/12/2002	<0.001	<6.3
DIW-P09B	11/12/2002	< 0.5	104.29	< 0.5	6.88	85.41	120.36	11/12/2002	0.0001	12/13/2002	<0.001	<6.3
DIW-P09C	11/12/2002	< 0.5	160.01	12.31	3.55	107.81	191.25	11/12/2002	7.2794	12/14/2002	0.0477	300.65618
DIW-P03B	11/12/2002	< 0.5	68.34	< 0.5	3.09	37.40	56.52	11/12/2002	0.0288	12/15/2002	0.0057	35.899736
DIW-P07B	11/12/2002	< 0.5	15.78	< 0.5	2.08	71.28	134.22	11/12/2002	0.0209	12/16/2002	<0.001	<6.3
DIW-P07C	11/12/2002	< 0.5	12.63	< 0.5	2.35	70.75	142.59	11/12/2002	0.0183	12/17/2002	<0.001	<6.3
DIW-P08C	11/12/2002	< 0.5	34.22	< 0.5	3.05	80.60	160.62	11/12/2002	0.0314	12/18/2002	<0.001	<6.3
DIW-P13A	11/12/2002	< 0.5	480.39	30.79	8.98	41.43	71.91	11/12/2002	0.0288	12/19/2002	0.0424	266.88307
DIW-P11A	11/12/2002	< 0.5	470.23	38.72	5.90	72.01	127.07	11/12/2002	0.1650	12/20/2002	0.0428	269.57482
DIW-P09A	11/12/2002	< 0.5	201.28	< 0.5	6.67	41.35	58.49	11/12/2002	0.0655	12/21/2002	0.0090	56.402617
DIW-1-2	11/12/2002	< 0.5	167.85	< 0.5	3.82	22.84	31.09	11/12/2002	16.1561	12/22/2002	0.0026	16.524214
DIW-P03A	11/12/2002	< 0.5	17.23	0.64	1.78	9.16	23.11	11/12/2002	0.3718	12/23/2002	0.0026	16.381404
DIW-P07A	11/12/2002	< 0.5	27.85	< 0.5	2.34	34.83	63.79	11/12/2002	0.0131	12/24/2002	0.0094	59.425524
DCB-21B	11/12/2002	< 0.5	8.23	0.73	1.42	98.23	141.96			12/25/2002	<0.001	<6.3
DCB-21B								11/12/2002	0.0236			
DCB-22C	11/12/2002	< 0.5	3.89	< 0.5	1.54	24.05	103.54			12/27/2002	<0.001	<6.3
DCB-22C								11/12/2002	0.0052			
DIW-P11B	11/12/2002	< 0.5	170.58	10.60	7.58	95.21	166.32			12/29/2002	<0.001	<6.3
DIW-P11B								11/12/2002	7.3318			

Gray highlight means that there is no data

Second Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Acetic Acid (mg/L)	Propanoic Acid (mg/L)	Formic Acid (mg/L)	Isobutyric Acid (mg/L)	Butyric Acid (mg/L)	Isovaleric Acid (mg/L)	Valeric Acid (mg/L)	Isocaproic Acid (mg/L)	Hexanoic Acid (mg/L)	Heptanoic Acid (mg/L)	Analysis Date	TBCD (cells/ml)	Analysis Date	SRB (cells/ml)
DCB-8	12/6/2002	4.70	8.54	26.24	<9	<9	<10	<10	<10	<10	<10	#######	4.04E+04	2/10/2003	2.20E+03
DCB-21A	12/6/2002	<6	<7	3.96	<9	<9	<10	<10	<10	<10	<10				
DCB-21B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	7.96E+04	2/10/2003	<7.20E+00
DCB-21C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DCB-22A	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DCB-22B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DCB-22C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	1.74E+04	2/10/2003	<7.20E+00
DCB-70B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	2.17E+04	2/10/2003	3.00E+02
DCB-19A	12/6/2002	<6	<7	5.51	<9	<9	<10	<10	<10	<10	<10				
DCB-19B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	1.10E+05	2/10/2003	<7.20E+00
DCB-19C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DCB-18A	12/6/2002	<6	<7	23.63	<9	<9	<10	<10	<10	<10	<10				
DCB-18B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DCB-18C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	1.59E+04	2/10/2003	1.84E+01
DCB-71B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	3.42E+04	2/10/2003	4.60E+01
DIW-P14C	12/6/2002	1320.92	701.98	25.70	42.83	268.92	0.00	17.60	<10	37.64	<10				
DIW-P13B	12/6/2002	800.08	831.97	28.07	648.44	62.88	0.00	12.19	<10	<10	<10				
DIW-P13C	12/6/2002	579.88	635.33	42.24	557.78	635.71	0.00	33.91	<10	16.98	<10				
DIW-P12B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P11B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	4.04E+05	2/10/2003	3.00E+03
DIW-P11C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P10C	12/6/2002	7.02	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P09B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P09C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P03B	12/6/2002	32.08	<7	31.63	<9	<9	<10	<10	19.65	25.07	54.13				
DIW-P07B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P07C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P08C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P13A	12/6/2002	301.40	281.62	20.42	119.75	17.29	0.00	22.20	<10	<10	<10	#######	3.31E+06	2/10/2003	5.80E+06
DIW-P11A	12/6/2002	68.13	53.94	<5	57.30	<9	<10	<10	<10	<10	<10				
DIW-P09A	12/6/2002	79.14	41.46	<5	35.61	<9	<10	<10	<10	<10	<10	#######	3.21E+06	2/10/2003	>2.20E+06
DIW-1-2	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10	#######	1.47E+06	2/10/2003	>2.20E+06
DIW-P03A	12/6/2002	27.97	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P07A	12/6/2002	97.87	55.36	<5	38.85	10.77	<10	<10	<10	<10	<10	#######	5.25E+06	2/10/2003	3.00E+05
DCB-21B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DCB-21B															
DCB-22C	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DCB-22C															
DIW-P11B	12/6/2002	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10				
DIW-P11B															

Gray highlight means that there is no data

SRB = Sulfate Reducing Bacteria

TBCD = Total Bacterial Cell Density

Second Post-Injection EBS Analytical Results

Well / Piezometer	Comments
DCB-8	
DCB-21A	
DCB-21B	
DCB-21C	
DCB-22A	
DCB-22B	
DCB-22C	
DCB-70B	SRB count was previously listed as 8.60E+01; this was preliminary data
DCB-19A	
DCB-19B	
DCB-19C	
DCB-18A	
DCB-18B	
DCB-18C	SRB count was previously listed as <7.20E+00; this was preliminary data
DCB-71B	SRB count was previously listed as 1.84E+01; this was preliminary data
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	
DIW-P11B	
DIW-P11C	
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P03B	
DIW-P07B	
DIW-P07C	
DIW-P08C	May have been DIW-P08B instead
DIW-P13A	
DIW-P11A	
DIW-P09A	SRB count was previously listed as 2.20E+06; this was preliminary data
DIW-1-2	SRB count was previously listed as 4.80E+05; this was preliminary data
DIW-P03A	
DIW-P07A	SRB count was previously listed as >2.20E+07; this was preliminary data
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	

Third Post-Injection EBS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Lab pH	Analysis Date	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	DSR-00151	1/13/2003	Sample	1/16/2003	4.48	1/23/2002	7.38	1.58	< 0.5	< 0.5	3.60
DCB-21A	DSR-00152	1/13/2003	Sample	1/16/2003	2.38	1/23/2002	3.87	< 0.5	< 0.5	< 0.5	4733
DCB-21B	DSR-00153	1/13/2003	Sample	1/16/2003	3.03	1/23/2002	3.49	< 0.5	7.03	< 0.5	1466
DCB-22A	DSR-00154	1/13/2003	Sample	1/16/2003	2.94	1/23/2002	3.72	8.35	8.40	< 0.5	1852
DCB-22B	DSR-00155	1/13/2003	Sample	1/16/2003	3.42	1/23/2002	2.84	< 0.5	8.36	< 0.5	1889
DCB-22C	DSR-00156	1/13/2003	Sample	1/16/2003	4.25	1/23/2002	4.82	< 0.5	< 0.5	< 0.5	381.7
DCB-70B	DSR-00157	1/13/2003	Sample	1/16/2003	5.23	1/23/2002	3.13	< 0.5	< 0.5	< 0.5	50.65
DCB-19A	DSR-00158	1/13/2003	Sample	1/16/2003	3.18	1/23/2002	6.60	6.20	< 0.5	< 0.5	472.6
DCB-19B	DSR-00159	1/13/2003	Sample	1/16/2003	3.13	1/23/2002	2.12	6.28	6.38	< 0.5	1081
DCB-18A	DSR-00160	1/13/2003	Sample	1/16/2003	2.23	1/23/2002	3.77	< 0.5	< 0.5	< 0.5	5313
DCB-18B	DSR-00161	1/13/2003	Sample	1/16/2003	2.25	1/23/2002	4.14	< 0.5	< 0.5	< 0.5	5609
DCB-18C	DSR-00162	1/13/2003	Sample	1/16/2003	3.41	1/23/2002	2.85	< 0.5	< 0.5	< 0.5	1285
DCB-71B	DSR-00163	1/13/2003	Sample	1/16/2003	3.43	1/23/2002	3.04	< 0.5	8.11	< 0.5	1899
DIW-P14C	DSR-00164	1/13/2003	Sample	1/16/2003	4.8	1/23/2002	2.10	< 0.5	< 0.5	< 0.5	2017
DIW-P13B	DSR-00165	1/13/2003	Sample	1/16/2003	6.71	1/23/2002	23.15	< 0.5	< 0.5	< 0.5	835.4
DIW-P13C	DSR-00166	1/13/2003	Sample	1/16/2003	6.4	1/23/2002	141.35	< 0.5	< 0.5	< 0.5	242.8
DIW-P12B	DSR-00167	1/13/2003	Sample	1/16/2003	2.23	1/23/2002	2.45	2.80	< 0.5	< 0.5	4965
DIW-P11B	DSR-00168	1/13/2003	Sample	1/16/2003	3.47	1/23/2002	3.05	< 0.5	< 0.5	< 0.5	3135
DIW-P11C	DSR-00169	1/13/2003	Sample	1/16/2003	2.19	1/23/2002	20.05	3.85	< 0.5	< 0.5	6493
DIW-P10C	DSR-00170	1/13/2003	Sample	1/16/2003	2.39	1/23/2002	18.60	3.25	< 0.5	< 0.5	5791
DIW-P09B	DSR-00171	1/13/2003	Sample	1/16/2003	4.48	1/23/2002	2.12	< 0.5	3.26	< 0.5	1260
DIW-P09C	DSR-00172	1/13/2003	Sample	1/16/2003	2.43	1/23/2002	2.70	< 0.5	< 0.5	< 0.5	6245
DIW-P03B	DSR-00174	1/13/2003	Sample	1/16/2003	6.36	1/23/2002	3.22	< 0.5	< 0.5	< 0.5	< 0.5
DIW-P03C	DSR-00175	1/13/2003	Sample	1/16/2003	6.31	1/23/2002	3.99	< 0.5	< 0.5	< 0.5	0.00
DIW-P07B	DSR-00179	1/13/2003	Sample	1/16/2003	3.39	1/23/2002	2.96	< 0.5	8.58	< 0.5	2025
DIW-P07C	DSR-00180	1/13/2003	Sample	1/16/2003	3.42	1/23/2002	3.33	< 0.5	7.81	< 0.5	1825
DIW-P08C	DSR-00181	1/13/2003	Sample	1/16/2003	3.24	1/23/2002	3.35	< 0.5	7.83	< 0.5	1861
DIW-P13A	DSR-00185	1/14/2003	Sample	1/16/2003	5.95	1/23/2002	41.20	< 0.5	< 0.5	< 0.5	252.8
DIW-P11A	DSR-00186	1/14/2003	Sample	1/16/2003	5.88	1/23/2002	4.80	< 0.5	< 0.5	< 0.5	139.2
DIW-P09A	DSR-00188	1/14/2003	Sample	1/16/2003	5.83	1/23/2002	13.40	< 0.5	16.73	< 0.5	55.14
DIW-1-2	DSR-00189	1/14/2003	Sample	1/16/2003	6.07	1/23/2002	2.46	< 0.5	< 0.5	< 0.5	143.2
DIW-P03A	DSR-00190	1/14/2003	Sample	1/16/2003	6.24	1/23/2002	< 0.5	< 0.5	< 0.5	< 0.5	20.28
DIW-P05A	DSR-00191	1/14/2003	Sample	1/16/2003	5.47	1/23/2002	4.84	< 0.5	< 0.5	< 0.5	68.23
DIW-P07A	DSR-00192	1/14/2003	Sample	1/16/2003	5.25	1/23/2002	3.39	< 0.5	< 0.5	< 0.5	15.80
DCB-21B	DSR-00193	1/13/2003	Duplicate			1/23/2002	3.63	< 0.5	7.25	< 0.5	1441
DCB-21B	DSR-00194	1/13/2003	Unfiltered								
DCB-22C	DSR-00195	1/13/2003	Duplicate			1/23/2002	5.00	< 0.5	7.97	< 0.5	435.3
DCB-22C	DSR-00196	1/13/2003	Unfiltered								
DIW-P11B	DSR-00197	1/13/2003	Duplicate			1/23/2002	< 0.5	< 0.5	< 0.5	< 0.5	369.7
DIW-P11B	DSR-00199	1/13/2003	Unfiltered								

Gray highlight means that there is no data

APPENDIX B
SRTC EBS Analytical Results

Third Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Lithium (mg/L)	Sodium (mg/L)	Ammonium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Analysis Date	Hydrogen Sulfide (mg/L)	Analysis Date	Lactate (%)	Lactate (mg/L)
DCB-8	1/22/2003	< 0.5	3.95	< 0.5	< 0.5	< 0.5	< 0.5	1/16/2003	0.0120	1/23/2002	<0.001	<6.3
DCB-21A	1/22/2003	< 0.5	10.81	< 0.5	0.85	116.17	162.96	1/16/2003	0.0040	1/23/2002	0.0019	12.172664
DCB-21B	1/22/2003	< 0.5	7.73	0.53	1.72	72.62	121.27	1/16/2003	0.0233	1/23/2002	0.0016	9.8946952
DCB-22A	1/22/2003	< 0.5	17.62	< 0.5	1.38	56.72	71.31	1/16/2003	0.0014	1/23/2002	0.0016	9.854176
DCB-22B	1/22/2003	< 0.5	26.84	1.27	2.88	74.80	132.43	1/16/2003	0.0973	1/23/2002	<0.001	<6.3
DCB-22C	1/22/2003	< 0.5	4.10	< 0.5	1.95	28.64	109.71	1/16/2003	0.0233	1/23/2002	<0.001	<6.3
DCB-70B	1/22/2003	< 0.5	28.74	0.63	1.88	< 0.5	< 0.5	1/16/2003	0.0040	1/23/2002	<0.001	<6.3
DCB-19A	1/22/2003	< 0.5	3.28	< 0.5	1.82	13.59	28.45	1/16/2003	0.0206	1/23/2002	<0.001	<6.3
DCB-19B	1/22/2003	< 0.5	6.25	< 0.5	1.84	35.89	61.38	1/16/2003	0.0120	1/23/2002	0.0016	10.029853
DCB-18A	1/22/2003	< 0.5	11.86	0.92	< 0.5	137.22	180.07	1/16/2003	0.0315	1/23/2002	0.0024	14.994636
DCB-18B	1/22/2003	< 0.5	12.90	0.70	< 0.5	136.40	198.25	1/16/2003	0.0315	1/23/2002	0.0025	15.872833
DCB-18C	1/22/2003	< 0.5	6.17	< 0.5	3.33	57.13	157.65	1/16/2003	0.1960	1/23/2002	0.0033	20.48612
DCB-71B	1/22/2003	< 0.5	11.19	0.60	4.74	81.63	147.85	1/16/2003	0.0671	1/23/2002	0.0016	10.260388
DIW-P14C	1/22/2003	< 0.5	621.40	7.70	43.15	63.60	88.50	1/16/2003	0.2452	1/23/2002	0.0462	291.29477
DIW-P13B	1/22/2003	< 0.5	1536.35	< 0.5	12.85	53.15	72.20	1/16/2003	0.0014	1/23/2002	0.1553	978.69524
DIW-P13C	1/22/2003	< 0.5	15259.75	< 0.5	NA	44.30	62.35	1/16/2003	0.1356	1/23/2002	2.8795	18140.663
DIW-P12B	1/22/2003	< 0.5	29.30	1.40	< 0.5	119.20	119.85	1/16/2003	0.0507	1/23/2002	<0.001	<6.3
DIW-P11B	1/22/2003	< 0.5	52.65	< 0.5	< 0.5	82.75	96.15	1/16/2003	7.3562	1/23/2002	0.0154	97.230111
DIW-P11C	1/22/2003	< 0.5	27.15	0.55	< 0.5	153.20	147.80	1/16/2003	0.0315	1/23/2002	0.0158	99.595594
DIW-P10C	1/22/2003	< 0.5	28.50	1.40	< 0.5	137.55	142.45	1/16/2003	0.0781	1/23/2002	<0.001	<6.3
DIW-P09B	1/22/2003	< 0.5	150.67	2.35	7.26	47.66	65.84	1/16/2003	0.9904	1/23/2002	0.0041	25.789202
DIW-P09C	1/22/2003	< 0.5	38.25	1.50	< 0.5	148.40	148.50	1/16/2003	0.0753	1/23/2002	0.0166	104.75202
DIW-P03B	1/22/2003	< 0.5	118.27	< 0.5	1.79	16.05	23.86	1/16/2003	0.2041	1/23/2002	0.0081	51.150933
DIW-P03C	1/22/2003	< 0.5	113.46	0.75	4.54	17.85	26.84	1/16/2003	0.1960	1/23/2002	0.0110	69.022945
DIW-P07B	1/22/2003	< 0.5	18.24	< 0.5	2.33	61.63	131.51	1/16/2003	0.0425	1/23/2002	<0.001	<6.3
DIW-P07C	1/22/2003	< 0.5	14.12	< 0.5	3.71	59.00	130.25	1/16/2003	0.0918	1/23/2002	<0.001	<6.3
DIW-P08C	1/22/2003	< 0.5	17.81	< 0.5	4.48	60.22	134.38	1/16/2003	0.0918	1/23/2002	<0.001	<6.3
DIW-P13A	1/22/2003	< 0.5	1132.95	3.90	< 0.5	22.00	30.15	1/16/2003	0.0014	1/23/2002	0.2447	1541.7157
DIW-P11A	1/22/2003	< 0.5	104.80	< 0.5	< 0.5	7.75	15.15	1/16/2003	0.0562	1/23/2002	0.0384	242.17
DIW-P09A	1/22/2003	< 0.5	328.83	< 0.5	0.63	25.12	26.73	1/16/2003	0.0315	1/23/2002	0.0686	431.94
DIW-1-2	1/22/2003	< 0.5	99.93	2.10	5.33	20.90	33.73	1/16/2003	0.0120	1/23/2002	0.0036	22.77
DIW-P03A	1/22/2003	< 0.5	44.39	22.07	2.68	6.41	16.16	1/16/2003	0.0014	1/23/2002	0.0103	64.85
DIW-P05A	1/22/2003	< 0.5	24.71	< 0.5	2.81	25.19	34.74	1/16/2003	0.6973	1/23/2002	0.0084	53.09
DIW-P07A	1/22/2003	< 0.5	22.60	< 0.5	3.84	27.91	50.48	1/16/2003	0.0425	1/23/2002	0.0151	94.84
DCB-21B	1/22/2003	< 0.5	8.32	0.63	1.29	76.06	125.25			1/23/2002	0.0016	9.95
DCB-21B								1/16/2003	0.0808			
DCB-22C	1/22/2003	< 0.5	4.71	< 0.5	1.35	24.29	106.35			1/23/2002	<0.001	<6.3
DCB-22C								1/16/2003	0.0343			
DIW-P11B	1/22/2003	< 0.5	5.55	< 0.5	< 0.5	8.42	9.75			1/23/2002	0.0016	9.8165769
DIW-P11B								1/16/2003	6.5069			

Gray highlight means that there is no data

Third Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Acetic Acid (mg/L)	Propanoic Acid (mg/L)	Formic Acid (mg/L)	Isobutyric Acid (mg/L)	Butyric Acid (mg/L)	Isovaleric Acid (mg/L)	Valeric Acid (mg/L)	Isocaproic Acid (mg/L)	Hexanoic Acid (mg/L)	Heptanoic Acid (mg/L)	Analysis Date	TBCD (cells/ml)	Analysis Date	SRB (cells/ml)
DCB-8	1/22/2003	9.88	8.07	27.91	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	5.80E+01
DCB-21A	1/22/2003	< 6.0	< 7.0	8.85	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-21B	1/22/2003	< 6.0	< 7.0	5.67	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	<7.20E+00
DCB-22A	1/22/2003	< 6.0	< 7.0	< 5.0	10.43	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-22B	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-22C	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	<7.20E+00
DCB-70B	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	3.00E+02
DCB-19A	1/22/2003	< 6.0	< 7.0	6.64	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-19B	1/22/2003	< 6.0	< 7.0	7.52	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	<7.20E+00
DCB-18A	1/22/2003	< 6.0	< 7.0	32.02	< 9.0	7.44	< 10.0	14.88	19.08	25.08	49.57				
DCB-18B	1/22/2003	< 6.0	< 7.0	18.11	< 9.0	< 9.0	< 10.0	< 10.0	12.98	12.22	24.14				
DCB-18C	1/22/2003	< 6.0	< 7.0	20.32	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	16.46			4/15/2003	<7.20E+00
DCB-71B	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	1.84E+01
DIW-P14C	1/22/2003	102.95	< 7.0	30.10	50.32	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P13B	1/22/2003	521.76	809.25	71.34	850.79	40.17	11.81	99.15	< 10.0	25.34	< 10.0				
DIW-P13C	1/22/2003	399.44	< 7.0	59.18	< 9.0	572.33	10.53	94.05	< 10.0	51.45	13.80				
DIW-P12B	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P11B	1/22/2003	< 6.0	< 7.0	5.62	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	4.80E+03
DIW-P11C	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	2.60E+01
DIW-P10C	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P09B	1/22/2003	90.59	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P09C	1/22/2003	11.19	< 7.0	7.11	8.00	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P03B	1/22/2003	160.25	128.35	7.40	101.39	< 9.0	< 10.0	12.84	< 10.0	< 10.0	< 10.0				
DIW-P03C	1/22/2003	297.92	237.39	7.32	215.22	8.89	< 10.0	17.41	< 10.0	< 10.0	< 10.0				
DIW-P07B	1/22/2003	< 6.0	< 7.0	< 5.0	11.49	< 9.0	< 10.0	11.57	< 10.0	< 10.0	< 10.0			4/15/2003	<7.20E+00
DIW-P07C	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	<7.20E+00
DIW-P08C	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P13A	1/22/2003	443.91	< 7.0	56.01	295.39	79.07	< 10.0	123.63	< 10.0	38.68	16.83			4/15/2003	2.20E+08
DIW-P11A	1/22/2003	120.28	184.78	21.12	160.11	< 9.0	< 10.0	< 10.0	< 10.0	15.49	< 10.0			4/15/2003	2.20E+07
DIW-P09A	1/22/2003	312.68	127.72	18.42	242.11	18.12	< 10.0	19.64	< 10.0	14.03	< 10.0			4/15/2003	3.00E+06
DIW-1-2	1/22/2003	35.82	7.72	< 5.0	14.61	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			4/15/2003	4.80E+05
DIW-P03A	1/22/2003	164.14	< 7.0	< 5.0	85.59	11.76	< 10.0	16.45	< 10.0	11.51	< 10.0			4/15/2003	4.80E+03
DIW-P05A	1/22/2003	126.79	156.90	6.18	106.70	16.42	< 10.0	13.74	< 10.0	< 10.0	< 10.0			4/15/2003	>2.20E+07
DIW-P07A	1/22/2003	267.16	331.60	19.49	222.18	60.23	< 10.0	43.59	< 10.0	14.29	< 10.0			4/15/2003	>2.20E+07
DCB-21B	1/22/2003	< 6.0	< 7.0	6.17	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-21B															
DCB-22C	1/22/2003	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-22C															
DIW-P11B	1/22/2003	< 6.0	< 7.0	6.81	9.34	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P11B															

Gray highlight means that there is no data

SRB = Sulfate Reducing Bacteria

TBCD = Total Bacterial Cell Density

Third Post-Injection EBS Analytical Results

Well / Piezometer	Comments
DCB-8	
DCB-21A	
DCB-21B	
DCB-22A	
DCB-22B	
DCB-22C	
DCB-70B	
DCB-19A	
DCB-19B	
DCB-18A	
DCB-18B	
DCB-18C	
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	
DIW-P11B	
DIW-P11C	
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P03B	
DIW-P03C	
DIW-P07B	
DIW-P07C	
DIW-P08C	
DIW-P13A	
DIW-P11A	
DIW-P09A	
DIW-1-2	
DIW-P03A	
DIW-P05A	
DIW-P07A	SRB count was previously listed as >2.20E+08; this was preliminary data
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	

APPENDIX B

SRTC EBS Analytical Results

Fourth Post-Injection EBS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Lab pH	Analysis Date	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	DSR-00201	4/1/2003	Sample	4/01/03	5.01	4/11/2003	12.52	0.56	0.22	< 0.5	6.94
DCB-21A	DSR-00202	3/31/2003	Sample	3/31/03	2.37	4/11/2003	24.43	< 0.5	0.00	< 0.5	2936.28
DCB-21B	DSR-00203	3/31/2003	Sample	3/31/03	2.98	4/11/2003	15.85	< 0.5	7.68	< 0.5	1470.59
DCB-22C	DSR-00204	3/31/2003	Sample	3/31/03	4.46	4/11/2003	0.87	< 0.5	0.55	< 0.5	413.16
DCB-70B	DSR-00205	3/31/2003	Sample	3/31/03	4.98	4/11/2003	3.52	0.46	0.24	< 0.5	65.70
DCB-19A	DSR-00206	3/31/2003	Sample	3/31/03	2.36	4/11/2003	17.99	5.35	15.85	< 0.5	2484.03
DCB-19B	DSR-00207	3/31/2003	Sample	3/31/03	3.14	4/11/2003	12.15	5.61	7.01	< 0.5	887.87
DCB-18C	DSR-00208	3/31/2003	Sample	3/31/03	3.52	4/11/2003	13.95	0.24	6.01	< 0.5	1337.39
DCB-71B	DSR-00209	3/31/2003	Sample								
DIW-P14C	DSR-00210	3/31/2003	Sample								
DIW-P13B	DSR-00211	3/31/2003	Sample								
DIW-P13C	DSR-00212	3/31/2003	Sample								
DIW-P12B	DSR-00213	4/1/2003	Sample	4/01/03	2.53	4/11/2003	30.64	7.96	50.22	< 0.5	4907.71
DIW-P11B	DSR-00214	4/1/2003	Sample	4/01/03	2.74	4/11/2003	26.60	4.57	48.39	< 0.5	4539.62
DIW-P11C	DSR-00215	3/31/2003	Sample	3/31/03	1.96	4/11/2003	100.89	5.09	84.20	< 0.5	8137.55
DIW-P10C	DSR-00216	4/1/2003	Sample								
DIW-P09B	DSR-00217	4/1/2003	Sample								
DIW-P09C	DSR-00218	4/1/2003	Sample								
DIW-P02C	DSR-00219	4/1/2003	Sample								
DIW-P03B	DSR-00220	4/1/2003	Sample	4/01/03	5.99	4/11/2003	4.35	0.47	0.63	< 0.5	542.33
DIW-P03C	DSR-00221	4/1/2003	Sample	4/01/03	6.22	4/11/2003	4.24	0.24	0.56	< 0.5	552.11
DIW-P04C	DSR-00222	4/1/2003	Sample	4/01/03	5.48	4/11/2003	2.67	0.32	7.44	< 0.5	743.79
DIW-P07B	DSR-00223	3/31/2003	Sample	3/31/03	3.23	4/11/2003	15.23	0.21	10.31	< 0.5	2025.50
DIW-P07C	DSR-00224	3/31/2003	Sample	3/31/03	3.38	4/11/2003	16.05	0.48	10.98	< 0.5	1967.98
DIW-P08C	DSR-00225	3/31/2003	Sample	3/31/03	3.25	4/11/2003	16.11	< 0.5	10.82	< 0.5	1972.64
DIW-P13A	DSR-00226	4/1/2003	Sample	4/01/03	5.88	4/11/2003	8.22	2.49	4.69	< 0.5	375.33
DIW-P11A	DSR-00227	4/1/2003	Sample	4/01/03	5.14	4/11/2003	0.00	2.29	5.09	< 0.5	598.02
DIW-P09A	DSR-00228	4/1/2003	Sample	4/01/03	5.57	4/11/2003	0.00	2.48	2.54	< 0.5	135.99
DIW-1-2	DSR-00229	4/1/2003	Sample	4/01/03	6.32	4/11/2003	5.25	0.00	4.47	< 0.5	115.80
DIW-P03A	DSR-00230	4/1/2003	Sample	4/01/03	6.06	4/11/2003	0.00	4.61	2.58	< 0.5	126.99
DIW-P05A	DSR-00231	4/1/2003	Sample	4/01/03	5.49	4/11/2003	< 0.5	5.05	6.70	< 0.5	163.28
DIW-P07A	DSR-00232	4/1/2003	Sample	4/01/03	5.34	4/11/2003	< 0.5	< 0.5	2.45	< 0.5	326.85
DCB-21B	DSR-00233	3/31/2003	Duplicate			4/11/2003	15.12	0.53	8.35	< 0.5	1432.48
DCB-21B	DSR-00234	3/31/2003	Unfiltered								
DCB-22C	DSR-00235	3/31/2003	Duplicate			4/11/2003	0.88	0.52	0.26	< 0.5	422.77
DCB-22C	DSR-00236	3/31/2003	Unfiltered								
DIW-P11B	DSR-00237	4/1/2003	Duplicate			4/11/2003	24.57	6.63	22.85	< 0.5	4563.63
DIW-P11B	DSR-00239	4/1/2003	Unfiltered								

Gray highlight means that there is no data

Fourth Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Lithium (mg/L)	Sodium (mg/L)	Ammonium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Analysis Date	Hydrogen Sulfide (mg/L)	Analysis Date	Lactate (%)	Lactate (mg/L)
DCB-8	4/12/2003	< 0.5	6.86	< 0.5	< 0.5	1.23	3.19	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-21A	4/12/2003	< 0.5	6.07	< 0.5	0.00	98.96	83.64	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-21B	4/12/2003	< 0.5	7.61	< 0.5	1.15	73.71	111.58	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-22C	4/12/2003	< 0.5	3.91	< 0.5	1.27	21.31	111.55	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-70B	4/12/2003	< 0.5	23.06	< 0.5	0.81	1.92	4.36	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-19A	4/12/2003	< 0.5	4.96	< 0.5	1.04	78.44	88.21	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-19B	4/12/2003	< 0.5	4.81	< 0.5	0.80	22.81	48.20	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-18C	4/12/2003	< 0.5	6.85	< 0.5	2.56	48.33	139.17	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DCB-71B												
DIW-P14C												
DIW-P13B												
DIW-P13C												
DIW-P12B	4/12/2003	< 0.5	7.16	< 0.5	< 0.5	116.95	83.37	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DIW-P11B	4/12/2003	< 0.5	11.56	< 0.5	< 0.5	104.06	78.42	4/4/2003	0.020	4/11/2003	<0.001	<6.3
DIW-P11C	4/12/2003	< 0.5	17.83	< 0.5	< 0.5	190.80	139.52	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DIW-P10C												
DIW-P09B												
DIW-P09C												
DIW-P02C												
DIW-P03B	4/12/2003	< 0.5	30.13	< 0.5	2.16	32.48	93.79	4/4/2003	0.017	4/11/2003	<0.001	<6.3
DIW-P03C	4/12/2003	< 0.5	30.97	< 0.5	2.20	33.10	90.08	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DIW-P04C	4/12/2003	< 0.5	13.74	< 0.5	1.85	37.38	74.81	4/4/2003	0.121	4/11/2003	<0.001	<6.3
DIW-P07B	4/12/2003	< 0.5	16.94	< 0.5	1.77	68.10	117.32	4/4/2003	0.026	4/11/2003	<0.001	<6.3
DIW-P07C	4/12/2003	< 0.5	14.64	< 0.5	1.68	65.36	117.29	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DIW-P08C	4/12/2003	< 0.5	19.10	< 0.5	1.85	70.02	126.51	4/4/2003	0.009	4/11/2003	<0.001	<6.3
DIW-P13A	4/12/2003	< 0.5	238.92	< 0.5	< 0.5	18.06	19.18	4/4/2003	<0.001	4/11/2003	<0.001	<6.3
DIW-P11A	4/12/2003	< 0.5	35.50	< 0.5	< 0.5	31.42	40.09	4/4/2003	0.035	4/11/2003	<0.001	<6.3
DIW-P09A	4/12/2003	< 0.5	30.82	< 0.5	< 0.5	6.14	12.23	4/4/2003	0.113	4/11/2003	<0.001	<6.3
DIW-1-2	4/12/2003	< 0.5	58.96	< 0.5	0.00	23.64	31.91	4/4/2003	0.015	4/11/2003	<0.001	<6.3
DIW-P03A	4/12/2003	< 0.5	21.22	< 0.5	0.00	23.83	50.31	4/4/2003	0.058	4/11/2003	<0.001	<6.3
DIW-P05A	4/12/2003	< 0.5	20.75	< 0.5	0.00	21.56	42.70	4/4/2003	5.755	4/11/2003	<0.001	<6.3
DIW-P07A	4/12/2003	< 0.5	12.82	< 0.5	0.00	15.17	37.12	4/4/2003	0.598	4/11/2003	<0.001	<6.3
DCB-21B	4/12/2003	< 0.5	7.48	< 0.5	0.95	72.75	109.77			4/11/2003	<0.001	<6.3
DCB-21B								4/4/2003	<0.001			
DCB-22C	4/12/2003	< 0.5	4.73	< 0.5	1.24	23.57	112.49			4/11/2003	<0.001	<6.3
DCB-22C								4/4/2003	<0.001			
DIW-P11B	4/12/2003	< 0.5	7.98	< 0.5	< 0.5	103.56	79.84			4/11/2003	<0.001	<6.3
DIW-P11B								4/4/2003	0.075			

Gray highlight means that there is no data

Fourth Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Acetic Acid (mg/L)	Propanoic Acid (mg/L)	Formic Acid (mg/L)	Isobutyric Acid (mg/L)	Butyric Acid (mg/L)	Isovaleric Acid (mg/L)	Valeric Acid (mg/L)	Isocaproic Acid (mg/L)	Hexanoic Acid (mg/L)	Heptanoic Acid (mg/L)	Analysis Date	TBCD (cells/ml)	Analysis Date	SRB (cells/ml)
DCB-8	4/12/2003													7/3/2003	9.20E+02
DCB-21A	4/12/2003														
DCB-21B	4/12/2003													7/3/2003	<7.20E+00
DCB-22C	4/12/2003													7/3/2003	<7.20E+00
DCB-70B	4/12/2003													7/3/2003	7.20E+00
DCB-19A	4/12/2003														
DCB-19B	4/12/2003													7/3/2003	<7.20E+00
DCB-18C	4/12/2003													7/3/2003	7.20E+00
DCB-71B															
DIW-P14C															
DIW-P13B															
DIW-P13C															
DIW-P12B	4/12/2003														
DIW-P11B	4/12/2003													7/3/2003	4.80E+02
DIW-P11C	4/12/2003													7/3/2003	1.24E+01
DIW-P10C															
DIW-P09B															
DIW-P09C															
DIW-P02C															
DIW-P03B	4/12/2003													7/3/2003	>2.20E+07
DIW-P03C	4/12/2003													7/3/2003	2.20E+06
DIW-P04C	4/12/2003														
DIW-P07B	4/12/2003													7/3/2003	4.20E+01
DIW-P07C	4/12/2003													7/3/2003	<7.20E+00
DIW-P08C	4/12/2003														
DIW-P13A	4/12/2003													7/3/2003	4.20E+07
DIW-P11A	4/12/2003													7/3/2003	9.20E+07
DIW-P09A	4/12/2003													7/3/2003	2.20E+07
DIW-1-2	4/12/2003													7/3/2003	4.80E+04
DIW-P03A	4/12/2003													7/3/2003	2.20E+07
DIW-P05A	4/12/2003													7/3/2003	4.80E+06
DIW-P07A	4/12/2003													7/3/2003	7.20E+04
DCB-21B	4/12/2003														
DCB-21B															
DCB-22C	4/12/2003														
DCB-22C															
DIW-P11B	4/12/2003														
DIW-P11B															

Gray highlight means that there is no data

SRB = Sulfate Reducing Bacteria

TBCD = Total Bacterial Cell Density

Fourth Post-Injection EBS Analytical Results

Well / Piezometer	Comments
DCB-8	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-21A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-21B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-22C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-70B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-19A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-19B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-18C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P11B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P11C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P02C	
DIW-P03B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P03C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P04C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P07B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P07C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P08C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P13A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P11A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P09A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-1-2	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P03A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P05A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P07A	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-21B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-21B	
DCB-22C	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DCB-22C	
DIW-P11B	VFA (Acetic Acid through Heptanoic Acid) data invalid due to an analytical error
DIW-P11B	

APPENDIX B

SRTC EBS Analytical Results

Fifth Post-Injection EBS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Lab pH	Analysis Date	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	DSR-00250	7/15/2003	Sample	7/15/2003	4.34	8/13/2003	7.75	< 0.5	0.56	< 0.5	1.22
DCB-21A	DSR-00251	7/14/2003	Sample	7/14/2003	2.05	8/13/2003	< 0.5	10.84	< 0.5	< 0.5	3668.56
DCB-21B	DSR-00252	7/14/2003	Sample	7/14/2003	3.06	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	2799.44
DCB-22C	DSR-00253	7/14/2003	Sample	7/14/2003	4.49	8/13/2003	4.15	< 0.5	< 0.5	< 0.5	975.68
DCB-70B	DSR-00254	7/14/2003	Sample	7/14/2003	4.12	8/13/2003	3.59	< 0.5	< 0.5	< 0.5	115.42
DCB-23C	DSR-00255	7/14/2003	Sample	7/14/2003	4.73	8/13/2003	1.20	< 0.5	< 0.5	< 0.5	2181.57
DCB-19A	DSR-00256	7/14/2003	Sample	7/14/2003	2.21	8/13/2003	3.80	8.92	< 0.5	< 0.5	2934.61
DCB-19B	DSR-00257	7/14/2003	Sample	7/14/2003	2.7	8/13/2003	4.82	< 0.5	< 0.5	< 0.5	2313.44
DCB-18C	DSR-00258	7/14/2003	Sample	7/14/2003	3.14	8/13/2003	3.90	< 0.5	< 0.5	< 0.5	1901.46
DCB-71B	DSR-00259										
DIW-P14C	DSR-00260										
DIW-P13B	DSR-00261										
DIW-P13C	DSR-00262										
DIW-P12B	DSR-00263	7/14/2003	Sample	7/14/2003	2.04	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	3885.55
DIW-P11B	DSR-00264	7/14/2003	Sample	7/14/2003	2.52	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	3440.81
DIW-P11C	DSR-00265	7/14/2003	Sample	7/14/2003	2.42	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	3919.53
DIW-P10C	DSR-00266										
DIW-P09B	DSR-00267										
DIW-P09C	DSR-00268										
DIW-P02C	DSR-00269										
DIW-P03B	DSR-00270	7/14/2003	Sample	7/14/2003	5.08	8/13/2003	2.29	< 0.5	< 0.5	< 0.5	< 0.5
DIW-P03C	DSR-00271	7/14/2003	Sample	7/14/2003	5.55	8/13/2003	2.69	< 0.5	< 0.5	< 0.5	< 0.5
DIW-P04C	DSR-00272	7/14/2003	Sample	7/14/2003	4.02	8/13/2003	0.82	< 0.5	< 0.5	< 0.5	510.68
DIW-P07B	DSR-00273	7/14/2003	Sample	7/14/2003	5.1	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	393.35
DIW-P07C	DSR-00274	7/14/2003	Sample	7/14/2003	4.25	8/13/2003	1.51	< 0.5	< 0.5	< 0.5	1238.99
DIW-P08C	DSR-00275	7/14/2003	Sample	7/14/2003	3.94	8/13/2003	1.98	< 0.5	< 0.5	< 0.5	1509.18
DIW-P13A	DSR-00276	7/15/2003	Sample	7/15/2003	5.08	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	13.56
DIW-P11A	DSR-00277	7/15/2003	Sample	7/15/2003	3.77	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	1192.16
DIW-P09A	DSR-00278	7/15/2003	Sample	7/15/2003	4.73	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	72.38
DIW-1-2	DSR-00279	7/15/2003	Sample	7/15/2003	4.51	8/13/2003	0.75	< 0.5	< 0.5	< 0.5	12.21
DIW-P03A	DSR-00280	7/15/2003	Sample	7/15/2003	4.83	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	3.61
DIW-P05A	DSR-00281	7/15/2003	Sample	7/15/2003	4.76	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	8.55
DIW-P07A	DSR-00282	7/15/2003	Sample	7/15/2003	4.97	8/13/2003	< 0.5	< 0.5	< 0.5	< 0.5	9.37
DCB-21B	DSR-00283	7/14/2003	Duplicate								
DCB-21B	DSR-00284	7/14/2003	Unfiltered								
DCB-22C	DSR-00285	7/14/2003	Duplicate								
DCB-22C	DSR-00286	7/14/2003	Unfiltered								
DIW-P11B	DSR-00287	7/14/2003	Duplicate								
DIW-P11B	DSR-00289	7/14/2003	Unfiltered								

Gray highlight means that there is no data

Fifth Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Lithium (mg/L)	Sodium (mg/L)	Ammonium (mg/L)	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Analysis Date	Hydrogen Sulfide (mg/L)	Analysis Date	Lactate (%)	Lactate (mg/L)
DCB-8	7/23/2003	<0.5	2.96	<0.5	1.07	<0.5	<0.5	7/17/2003	0.0014	8/13/2003	<0.001	<6.3
DCB-21A	7/23/2003	<0.5	1.31	<0.5	<0.5	<0.5	60.60	7/17/2003	0.0083	8/13/2003	<0.001	<6.3
DCB-21B	7/23/2003	<0.5	5.17	<0.5	<0.5	<0.5	<0.5	7/17/2003	0.0015	8/13/2003	<0.001	<6.3
DCB-22C	7/23/2003	<0.5	10.47	<0.5	54.90	<0.5	122.27	7/17/2003	<0.001	8/13/2003	<0.001	<6.3
DCB-70B	7/23/2003	<0.5	15.22	<0.5	8.94	<0.5	5.94	7/17/2003	<0.001	8/13/2003	<0.001	<6.3
DCB-23C	7/23/2003	<0.5	8.13	<0.5	<0.5	<0.5	<0.5	7/17/2003	0.0013	8/13/2003	<0.001	<6.3
DCB-19A	7/23/2003	<0.5	1.81	<0.5	<0.5	<0.5	63.99	7/17/2003	<0.001	8/13/2003	<0.001	<6.3
DCB-19B	7/23/2003	<0.5	5.14	<0.5	<0.5	<0.5	53.09	7/17/2003	<0.001	8/13/2003	<0.001	<6.3
DCB-18C	7/23/2003	<0.5	4.92	<0.5	<0.5	<0.5	<0.5	7/17/2003	0.0190	8/13/2003	<0.001	<6.3
DCB-71B												
DIW-P14C												
DIW-P13B												
DIW-P13C												
DIW-P12B	7/23/2003	<0.5	<0.5	<0.5	11.21	<0.5	5.23	7/17/2003	<0.001	8/13/2003	<0.001	<6.3
DIW-P11B	7/23/2003	<0.5	<0.5	<0.5	9.31	<0.5	4.52	7/17/2003	0.0343	8/13/2003	<0.001	<6.3
DIW-P11C	7/23/2003	<0.5	<0.5	<0.5	12.99	<0.5	6.78	7/17/2003	<0.001	8/13/2003	<0.001	<6.3
DIW-P10C												
DIW-P09B												
DIW-P09C												
DIW-P02C												
DIW-P03B	7/23/2003	<0.5	6.94	<0.5	27.98	<0.5	21.86	7/17/2003	0.0368	8/13/2003	<0.001	<6.3
DIW-P03C	7/23/2003	<0.5	7.27	<0.5	25.14	<0.5	17.74	7/17/2003	0.0015	8/13/2003	<0.001	<6.3
DIW-P04C	7/23/2003	<0.5	3.41	<0.5	36.43	<0.5	30.01	7/17/2003	0.5702	8/13/2003	<0.001	<6.3
DIW-P07B	7/23/2003	<0.5	10.16	<0.5	19.30	<0.5	17.97	7/17/2003	0.0083	8/13/2003	<0.001	<6.3
DIW-P07C	7/23/2003	<0.5	9.21	<0.5	<0.5	<0.5	40.30	7/17/2003	0.5292	8/13/2003	<0.001	<6.3
DIW-P08C	7/23/2003	<0.5	18.16	<0.5	<0.5	<0.5	50.94	7/17/2003	0.0037	8/13/2003	<0.001	<6.3
DIW-P13A	7/23/2003	<0.5	12.56	<0.5	0.83	<0.5	0.77	7/17/2003	0.0014	8/13/2003	<0.001	<6.3
DIW-P11A	7/23/2003	<0.5	<0.5	<0.5	0.98	<0.5	<0.5	7/17/2003	0.0252	8/13/2003	<0.001	<6.3
DIW-P09A	7/23/2003	<0.5	0.54	<0.5	1.14	<0.5	<0.5	7/17/2003	0.0367	8/13/2003	<0.001	<6.3
DIW-1-2	7/23/2003	<0.5	0.54	<0.5	0.75	<0.5	<0.5	7/17/2003	0.5113	8/13/2003	<0.001	<6.3
DIW-P03A	7/23/2003	<0.5	0.65	<0.5	<0.5	<0.5	1.80	7/17/2003	0.5218	8/13/2003	<0.001	<6.3
DIW-P05A	7/23/2003	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	7/17/2003	0.5446	8/13/2003	<0.001	<6.3
DIW-P07A	7/23/2003	<0.5	1.29	<0.5	<0.5	<0.5	<0.5	7/17/2003	0.0176	8/13/2003	<0.001	<6.3
DCB-21B												
DCB-21B								7/17/2003	<0.001			
DCB-22C												
DCB-22C								7/17/2003	0.0014			
DIW-P11B												
DIW-P11B								7/17/2003	0.5450			

Gray highlight means that there is no data

Fifth Post-Injection EBS Analytical Results

Well / Piezometer	Analysis Date	Acetic Acid (mg/L)	Propanoic Acid (mg/L)	Formic Acid (mg/L)	Isobutyric Acid (mg/L)	Butyric Acid (mg/L)	Isovaleric Acid (mg/L)	Valeric Acid (mg/L)	Isocaproic Acid (mg/L)	Hexanoic Acid (mg/L)	Heptanoic Acid (mg/L)	Analysis Date	TBCD (cells/ml)	Analysis Date	SRB (cells/ml)
DCB-8	8/1/2003	71	23		< 9.0	14	< 10.0	12	< 10.0	13	< 10.0			10/16/2003	1.48E+04
DCB-21A	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DCB-21B	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			10/16/2003	7.20E+00
DCB-22C	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	12	< 10.0	< 10.0			10/16/2003	4.60E+01
DCB-70B	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			10/16/2003	8.60E+01
DCB-23C	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	10	< 10.0	< 10.0			10/16/2003	1.86E+02
DCB-19A	8/1/2003	< 6.0	17		< 9.0	< 9.0	11	< 10.0	23	< 10.0	13				
DCB-19B	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			10/16/2003	<7.20E+00
DCB-18C	8/1/2003	18	17		< 9.0	< 9.0	11	< 10.0	19	< 10.0	14			10/16/2003	1.84E+01
DCB-71B															
DIW-P14C															
DIW-P13B															
DIW-P13C															
DIW-P12B	8/1/2003	17	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P11B	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			10/16/2003	4.80E+02
DIW-P11C	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			10/16/2003	1.50E+03
DIW-P10C															
DIW-P09B															
DIW-P09C															
DIW-P02C															
DIW-P03B	8/1/2003	214	164		< 9.0	28	< 10.0	17	17	< 10.0	< 10.0			10/16/2003	2.20E+07
DIW-P03C	8/1/2003	114	51		< 9.0	16	< 10.0	11	12	< 10.0	< 10.0			10/16/2003	1.50E+06
DIW-P04C	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	15	< 10.0	< 10.0				
DIW-P07B	8/1/2003	66	189		11	22	< 10.0	25	< 10.0	< 10.0	< 10.0			10/16/2003	4.80E+03
DIW-P07C	8/1/2003	< 6.0	9		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0			10/16/2003	4.80E+03
DIW-P08C	8/1/2003	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0				
DIW-P13A	8/1/2003	586	690		13	123	< 10.0	81	< 10.0	18	< 10.0			10/16/2003	7.00E+06
DIW-P11A	8/1/2003	69	90		< 9.0	< 9.0	< 10.0	10	< 10.0	< 10.0	< 10.0			10/16/2003	1.86E+03
DIW-P09A	8/1/2003	181	245		< 9.0	25	< 10.0	17	< 10.0	11	< 10.0			10/16/2003	9.20E+07
DIW-1-2	8/1/2003	199	134		< 9.0	55	< 10.0	15	< 10.0	13	< 10.0			10/16/2003	2.20E+07
DIW-P03A	8/1/2003	132	131		< 9.0	21	< 10.0	15	< 10.0	< 10.0	< 10.0			10/16/2003	>2.20E+07
DIW-P05A	8/1/2003	69	76		< 9.0	23	< 10.0	15	< 10.0	< 10.0	< 10.0			10/16/2003	2.20E+06
DIW-P07A	8/1/2003	143	103		< 9.0	25	< 10.0	18	< 10.0	12	< 10.0			10/16/2003	>2.20E+07
DCB-21B															
DCB-21B															
DCB-22C															
DCB-22C															
DIW-P11B															
DIW-P11B															

Gray highlight means that there is no data

Fifth Post-Injection EBS Analytical Results

Well / Piezometer	Comments
DCB-8	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-21A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-21B	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-22C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-70B	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-23C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-19A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-19B	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-18C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P11B	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P11C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P02C	
DIW-P03B	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P03C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P04C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P07B	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P07C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P08C	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P13A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P11A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P09A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-1-2	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P03A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P05A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DIW-P07A	Formic acid results invalid due to standard and method problems & ambiguous peaks
DCB-21B	Duplicates were not run by the laboratory
DCB-21B	
DCB-22C	Duplicates were not run by the laboratory
DCB-22C	
DIW-P11B	Duplicates were not run by the laboratory
DIW-P11B	

Pre-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Aluminum (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
DCB-8	DSR-00001	7/1/2002	Sample	7/1/2002	0.088	<0.002		0.556	<0.003	<0.002	0.068	1.01	0.406	<0.001
DCB-21A	DSR-00002	7/1/2002	Sample	7/1/2002	351	<0.002		114.0	0.010	0.199	0.994	183	94.2	9.03
DCB-21B	DSR-00003	6/27/2002	Sample	6/27/2002	120	<0.002		116	<0.003	<0.002	0.161	94.2	98.9	12.4
DCB-21C	DSR-00004	6/27/2002	Sample	6/27/2002	1.99	<0.002		111	<0.003	<0.002	0.024	1.94	57.5	6.47
DCB-22A	DSR-00005	6/27/2002	Sample	6/27/2002	269	<0.002		71.4	<0.003	0.019	0.190	3.80	68.2	7.24
DCB-22B	DSR-00006	6/27/2002	Sample	6/27/2002	200	<0.002		128	<0.003	<0.002	0.158	248	96.4	13.4
DCB-22C	DSR-00007	6/27/2002	Sample	6/27/2002	2.12	<0.002		84.9	<0.003	<0.002	0.027	2.32	23.4	1.48
DCB-70A	DSR-00008	7/1/2002	Sample	7/1/2002	240	<0.002		59.9	<0.003	0.127	0.147	8.24	60.9	7.47
DCB-70B	DSR-00009	7/1/2002	Sample	7/1/2002	2.21	0.018		19.0	<0.003	<0.002	0.026	1.87	12.1	0.352
DCB-19A	DSR-00010	6/26/2002	Sample	6/26/2002	82.8	<0.002		38.5	<0.003	<0.002	0.133	2.27	23.6	2.13
DCB-19B	DSR-00011	6/25/2002	Sample	6/26/2002	232	<0.002		90.2	<0.003	<0.002	0.295	218	58.4	5.48
DCB-19C	DSR-00012	6/26/2002	Sample	6/26/2002	199	<0.002		122	<0.003	<0.002	0.264	168	63.1	15.6
DCB-18A	DSR-00013	6/27/2002	Sample	6/27/2002	298	<0.002		78.4	<0.003	0.046	0.468	8.47	67.8	6.88
DCB-18B	DSR-00014	6/26/2002	Sample	6/26/2002	413	<0.002		121	<0.003	0.066	0.506	26.4	102	10.10
DCB-18C	DSR-00015	6/26/2002	Sample	6/26/2002	103	<0.002		139	<0.003	0.014	0.175	117	69.8	19.0
DCB-71A	DSR-00016	7/1/2002	Sample	7/1/2002	84.9	0.036		32.4	<0.003	<0.002	0.189	1.07	31.0	4.23
DCB-71B	DSR-00017	7/1/2002	Sample	7/1/2002	222	<0.002		130	<0.003	<0.002	0.085	106	106	21.7
DIW-P11A	DSR-00020	6/27/2002	Sample	6/27/2002	122	<0.002		98.6	<0.003	<0.002	0.069	119	64.9	11.3
DIW-P11B	DSR-00021	6/27/2002	Sample	6/27/2002	155	<0.002		118	<0.003	0.009	0.110	154	78.2	13.3
DIW-1-2	DSR-00025	7/1/2002	Sample	7/1/2002	4.08	<0.002		28.9	<0.003	0.112	0.023	123	16.6	3.63
DIW-P07A	DSR-00031	6/26/2002	Sample	6/26/2002	196	<0.002		136	<0.003	<0.002	0.092	181	73.5	28.2
DCB-21B	DSR-00033	6/27/2002	Duplicate	6/27/2002	126	<0.002		117	<0.003	<0.002	0.171	95.3	100	12.6
DCB-21B	DSR-00034	6/27/2002	Unfiltered	6/27/2002	129	<0.002		116	<0.003	<0.002	0.182	92.8	99.5	21.5
DCB-22C	DSR-00035	6/27/2002	Duplicate	6/27/2002	2.40	<0.002		86.0	<0.003	<0.002	0.028	2.50	28.9	1.57
DCB-22C	DSR-00036	6/27/2002	Unfiltered	6/27/2002	2.88	<0.002		87.4	<0.003	<0.002	0.029	2.64	31.2	1.87
DIW-P11B	DSR-00037	6/27/2002	Duplicate	6/27/2002	157	<0.002		119	<0.003	0.007	0.110	154	77.6	13.5
DIW-P11B	DSR-00039	6/27/2002	Unfiltered	6/27/2002	156	<0.002		118	<0.003	0.009	0.111	152	77.6	13.3
DIW-P11C	DSR-00040	6/27/2002	Sample	6/27/2002	263	<0.002		126	0.007	0.060	0.353	255	93.5	13.1
DIW-P12B	DSR-00041	6/27/2002	Sample	6/27/2002	120	<0.002		108	<0.003	<0.002	0.084	240	70.5	15.5
DIW-P09A	DSR-00042	6/27/2002	Sample	6/27/2002	63.4	<0.002		31.2	<0.003	<0.002	0.102	3.14	21.5	5.31
DIW-P09B	DSR-00043	6/27/2002	Sample	6/27/2002	165	<0.002		108	<0.003	0.009	0.129	139	74.2	21.4
DIW-P09C	DSR-00044	6/27/2002	Sample	6/27/2002	264	<0.002		118	<0.003	0.074	0.395	194	85.2	12.9
DIW-P10C	DSR-00045	6/27/2002	Sample	6/27/2002	193	<0.002		106	<0.003	0.053	0.269	158	71.2	11.7
DIW-P07B	DSR-00046	6/26/2002	Sample	6/26/2002	243	<0.002		118	<0.003	<0.002	0.123	195	69.2	16.4
DIW-P07C	DSR-00047	6/26/2002	Sample	6/26/2002	190	<0.002		115	<0.003	<0.002	0.096	155	62.7	17.6
DIW-P08C	DSR-00048	6/26/2002	Sample	6/26/2002	199	<0.002		117	<0.003	<0.002	0.157	169	65.4	16.8

Gray highlight means that there is no data

Pre-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Nickel (mg/L)	Lead (mg/L)	Silicon (mg/L)	Zinc (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Sulfur (mg/L)	Analysis Date	Average Fe(2+)/ Fe(total)	Ferrous Iron (mg/L)	Analysis Date	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	<0.010	<0.017	5.28	<0.001												
DCB-21A	1.52	<0.017	113	6.49												
DCB-21B	0.625	<0.017	27.8	1.75												
DCB-21C	0.139	<0.017	16.4	<0.001												
DCB-22A	1.12	<0.017	81.1	2.63												
DCB-22B	1.05	<0.017	29.1	2.61												
DCB-22C	0.010	<0.017	11.8	<0.001												
DCB-70A	1.02	<0.017	74.4	2.31												
DCB-70B	<0.010	<0.017	8.53	<0.001												
DCB-19A	0.344	<0.017	77.7	0.822												
DCB-19B	0.941	<0.017	41.8	1.99												
DCB-19C	0.903	<0.017	33.0	2.16												
DCB-18A	1.08	<0.017	94.9	2.78												
DCB-18B	1.35	<0.017	87.8	3.48												
DCB-18C	0.698	<0.017	18.4	1.66												
DCB-71A	0.459	<0.017	31.2	1.52												
DCB-71B	1.18	<0.017	14.4	2.91												
DIW-P11A	0.609	<0.017	37.9	1.56												
DIW-P11B	0.736	<0.017	39.4	2.02												
DIW-1-2	0.239	<0.017	17.2	<0.001												
DIW-P07A	0.863	<0.017	35.5	1.86												
DCB-21B	0.646	<0.017	29.2	1.79												
DCB-21B	0.649	<0.017	30.0	1.80												
DCB-22C	0.013	<0.017	11.9	<0.001												
DCB-22C	0.019	<0.017	12.1	<0.001												
DIW-P11B	0.735	<0.017	39.4	2.01												
DIW-P11B	0.737	<0.017	39.2	2.00												
DIW-P11C	1.17	<0.017	68.3	3.48												
DIW-P12B	0.626	<0.017	36.7	1.56												
DIW-P09A	0.298	<0.017	38.7	0.685												
DIW-P09B	0.769	<0.017	47.3	2.10												
DIW-P09C	1.11	<0.017	73.6	3.43												
DIW-P10C	0.856	<0.017	62.0	2.61												
DIW-P07B	1.05	<0.017	36.4	2.24												
DIW-P07C	0.888	<0.017	28.5	1.86												
DIW-P08C	0.946	<0.017	25.4	2.07												

Gray highlight means that there is no data

APPENDIX C
SRTC Mobile Laboratory Analytical Results

Pre-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Comments
DCB-8	
DCB-21A	
DCB-21B	
DCB-21C	
DCB-22A	
DCB-22B	
DCB-22C	
DCB-70A	
DCB-70B	
DCB-19A	
DCB-19B	
DCB-19C	
DCB-18A	
DCB-18B	
DCB-18C	
DCB-71A	
DCB-71B	
DIW-P11A	
DIW-P11B	
DIW-1-2	
DIW-P07A	
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	
DIW-P11C	
DIW-P12B	
DIW-P09A	
DIW-P09B	
DIW-P09C	
DIW-P10C	
DIW-P07B	
DIW-P07C	
DIW-P08C	May have been DIW-P08B instead

First Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Aluminum (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
DCB-8 *	DSR-00050	9/10/2002	Sample	9/16/2002	0.052	<0.002		0.215	<0.003	<0.002	<0.009	0.239	0.383	<0.001
DCB-21A	DSR-00051	9/12/2002	Sample	9/16/2002	465	<0.002		147	<0.003	0.160	1.07	219	114	9.6
DCB-21B	DSR-00052	9/11/2002	Sample	9/16/2002	131	<0.002		106	<0.003	<0.002	0.149	78.2	87.9	9.2
DCB-21C	DSR-00053	9/11/2002	Sample	9/16/2002	2.12	<0.002		111	<0.003	<0.002	<0.009	2.65	54.3	5.93
DCB-22A	DSR-00054	9/11/2002	Sample	9/16/2002	253	<0.002		68.6	<0.003	<0.002	0.102	3.15	66.0	6.63
DCB-22B	DSR-00055	9/12/2002	Sample	9/16/2002	182	<0.002		122	<0.003	<0.002	0.075	244	90.2	10.1
DCB-22C	DSR-00056	9/11/2002	Sample	9/16/2002	1.54	<0.002		84.8	<0.003	<0.002	<0.009	1.96	23.9	1.130
DCB-70A	DSR-00057	9/10/2002	Sample	9/16/2002	181	<0.002		49.7	<0.003	<0.002	0.064	31.2	42.7	5.53
DCB-70B	DSR-00058	9/10/2002	Sample	9/16/2002	0.132	<0.002		1.86	<0.003	<0.002	<0.009	0.382	1.08	<0.001
DCB-19A	DSR-00059	9/12/2002	Sample	9/16/2002	90.2	<0.002		38.5	<0.003	<0.002	0.058	1.94	22.5	2.35
DCB-19B	DSR-00060	9/11/2002	Sample	9/16/2002	185	<0.002		76.3	<0.003	<0.002	0.187	131	49.2	4.79
DCB-19C	DSR-00061	9/11/2002	Sample	9/16/2002	176	<0.002		116	<0.003	<0.002	0.171	146	56.8	10.2
DCB-18A	DSR-00062	9/12/2002	Sample	9/16/2002	432	<0.002		274	<0.003	0.025	0.725	10.9	76.7	7.67
DCB-18B	DSR-00063	9/11/2002	Sample	9/16/2002	267	<0.002		65.9	<0.003	<0.002	0.391	6.93	53.6	5.24
DCB-18C	DSR-00064	9/11/2002	Sample	9/16/2002	92.2	<0.002		131	<0.003	<0.002	0.079	106	62.3	13.2
DCB-71A	DSR-00065	9/10/2002	Sample	9/16/2002	83.2	<0.002		27.5	<0.003	<0.002	0.239	7.60	24.3	3.98
DCB-71B	DSR-00066	9/10/2002	Sample	9/16/2002	196	<0.002		125	<0.003	<0.002	<0.009	92.2	99.7	15.2
DIW-P14C	DSR-00067	9/11/2002	Sample	9/16/2002	56.3	<0.002		85.2	<0.003	0.021	<0.009	146	50.9	8.1
DIW-P13B	DSR-00068	9/11/2002	Sample	9/16/2002	30.7	<0.002		75.0	<0.003	<0.002	<0.009	149	49.5	7.06
DIW-P13C	DSR-00069	9/11/2002	Sample	9/16/2002	53.5	0.071		63.1	<0.003	<0.002	<0.009	334	39.7	5.37
DIW-P12B	DSR-00070	9/11/2002	Sample	9/16/2002	125	<0.002		104	<0.003	<0.002	<0.009	387	69.1	7.72
DIW-P11B	DSR-00071	9/11/2002	Sample	9/16/2002	117	<0.002		261	<0.003	<0.002	<0.009	426	69.2	7.65
DIW-P11C	DSR-00072	9/11/2002	Sample	9/16/2002	153	<0.002		141	<0.003	<0.002	<0.009	544	90.2	9.56
DIW-P10C	DSR-00073	9/11/2002	Sample	9/16/2002	130	<0.002		104	<0.003	<0.002	<0.009	297	61.8	7.91
DIW-P09B	DSR-00074	9/11/2002	Sample	9/16/2002	65.8	<0.002		88.3	<0.003	<0.002	<0.009	518	61.0	7.79
DIW-P09C	DSR-00075	9/11/2002	Sample	9/16/2002	111	<0.002		127	<0.003	<0.002	<0.009	606	79.8	9.3
DIW-P07B	DSR-00081	9/11/2002	Sample	9/16/2002	223	<0.002		111	<0.003	<0.002	<0.009	186	63.7	11.5
DIW-P07C	DSR-00082	9/11/2002	Sample	9/16/2002	182	<0.002		113	<0.003	<0.002	0.025	148	59.7	13.5
DIW-P08C	DSR-00083	9/11/2002	Sample	9/16/2002	175	<0.002		126	<0.003	<0.002	0.010	219	66.8	15.6
DIW-P13A	DSR-00087	9/11/2002	Sample	9/16/2002	0.038	0.022		43.6	<0.003	<0.002	<0.009	120	34.0	5.57
DIW-P11A	DSR-00088	9/11/2002	Sample	9/16/2002	4.85	<0.002		199	<0.003	<0.002	<0.009	344	47.7	7.17
DIW-P09A	DSR-00090	9/11/2002	Sample	9/16/2002	48.0	<0.002		27.0	<0.003	<0.002	<0.009	128	11.3	2.54
DIW-1-2	DSR-00091	9/11/2002	Sample	9/16/2002	0.347	<0.002		25.1	<0.003	0.052	<0.009	18.6	16.7	2.48
DIW-P07A	DSR-00092	9/11/2002	Sample	9/16/2002	32.6	<0.002		83.1	<0.003	<0.002	<0.009	248	42.8	15.0
DCB-21B	DSR-00093	9/11/2002	Duplicate	9/16/2002	133	<0.002		107	<0.003	<0.002	0.156	78.5	88.5	9.42
DCB-21B	DSR-00094	9/11/2002	Unfiltered	9/16/2002	134	<0.002		108	<0.003	<0.002	0.152	79.7	89.8	9.41
DCB-22C	DSR-00095	9/11/2002	Duplicate	9/16/2002	1.54	<0.002		83.2	<0.003	<0.002	<0.009	2.03	23.1	1.11
DCB-22C	DSR-00096	9/11/2002	Unfiltered	9/16/2002	1.58	<0.002		84.6	<0.003	<0.002	<0.009	1.97	24.2	1.22
DIW-P11B	DSR-00097	9/11/2002	Duplicate	9/16/2002	123	<0.002		106	<0.003	<0.002	<0.009	432	69.7	7.92
DIW-P11B	DSR-00099	9/11/2002	Unfiltered	9/16/2002	124	<0.002		105	<0.003	<0.002	<0.009	430	71.2	7.98

Gray highlight means that there is no data

First Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Nickel (mg/L)	Lead (mg/L)	Silicon (mg/L)	Zinc (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Sulfur (mg/L)	Analysis Date	Average Fe(2+)/ Fe(total)	Ferrous Iron (mg/L)	Analysis Date	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8 *	<0.010	<0.017	5.05	<0.001		0.981		9/16/2002	< detect	< detect						
DCB-21A	1.49	<0.017	122	5.82		11.0		9/16/2002	0	0						
DCB-21B	0.519	<0.017	36.2	1.58		6.97		9/16/2002	0.907	70.98						
DCB-21C	0.059	<0.017	15.5	<0.001		3.44		9/16/2002	0.974	2.58						
DCB-22A	0.919	<0.017	78.2	2.12		16.3		9/16/2002	0	0						
DCB-22B	0.806	<0.017	27.9	1.96		27.1		9/16/2002	0.996	242.93						
DCB-22C	<0.010	<0.017	10.8	<0.001		3.02		9/16/2002	0.893	1.75						
DCB-70A	0.627	<0.017	77.7	1.49		16.7		9/16/2002	0.846	26.36						
DCB-70B	<0.010	<0.017	7.48	<0.001		41.1		9/16/2002	< detect	< detect						
DCB-19A	0.269	<0.017	83.0	0.732		4.27		9/16/2002	< detect	< detect						
DCB-19B	0.691	<0.017	36.9	1.46		13.4		9/16/2002	0.963	125.75						
DCB-19C	0.691	<0.017	32.9	1.62		12.7		9/16/2002	0.991	144.90						
DCB-18A	1.12	<0.017	101	3.21		7.26		9/16/2002	0	0						
DCB-18B	0.728	<0.017	84.2	2.05		5.16		9/16/2002	0	0						
DCB-18C	0.504	<0.017	16.6	1.21		5.55		9/16/2002	0.991	105.17						
DCB-71A	0.314	<0.017	35.4	1.76		4.52		9/16/2002	0.836	6.35						
DCB-71B	0.877	<0.017	12.7	2.06		9.09		9/16/2002	0.987	91.00						
DIW-P14C	<0.010	<0.017	6.63	<0.001		2690		9/16/2002	0.976	142.39						
DIW-P13B	0.092	<0.017	7.25	<0.001		1020		9/16/2002	0.958	142.67						
DIW-P13C	<0.010	<0.017	13.5	<0.001		8840		9/16/2002	0.646	215.41						
DIW-P12B	0.57	<0.017	48.5	0.263		135		9/16/2002	1.000	387.19						
DIW-P11B	0.476	<0.017	52.7	0.077		11.5		9/16/2002	1.000	426.00						
DIW-P11C	0.765	<0.017	52.6	0.934		39.6		9/16/2002	1.000	544.00						
DIW-P10C	0.536	<0.017	43.5	0.825		291		9/16/2002	1.001	297.44						
DIW-P09B	0.495	<0.017	46.9	0.005		110		9/16/2002	1.000	517.79						
DIW-P09C	0.619	<0.017	47.6	0.271		534		9/16/2002	1.000	606.00						
DIW-P07B	0.840	<0.017	35.6	1.58		15.2		9/16/2002	1.001	186.23						
DIW-P07C	0.735	<0.017	28.0	1.51		10.4		9/16/2002	0.997	147.51						
DIW-P08C	0.742	<0.017	21.6	1.47		34.2		9/16/2002	0.996	218.13						
DIW-P13A	<0.010	<0.017	3.80	<0.001		524		9/16/2002	0.991	118.60						
DIW-P11A	<0.010	<0.017	18.4	<0.001		307		9/16/2002	0.950	326.88						
DIW-P09A	0.138	<0.017	54.5	0.363		2460		9/16/2002	0.827	106.04						
DIW-1-2	<0.010	<0.017	7.89	<0.001		129		9/16/2002	0.893	16.58						
DIW-P07A	0.199	<0.017	16.1	<0.001		20.9		9/16/2002	0.999	247.78						
DCB-21B	0.523	<0.017	36.7	1.57		7.09		9/16/2002	0.898	70.51						
DCB-21B	0.521	<0.017	36.9	1.56		7.03										
DCB-22C	0.072	<0.017	10.7	<0.001		3.03		9/16/2002	0.816	1.66						
DCB-22C	0.069	<0.017	10.9	<0.001		3.11										
DIW-P11B	0.498	<0.017	53.0	0.101		121		9/16/2002	0.998	431.13						
DIW-P11B	0.509	<0.017	54.3	0.071		121										

Gray highlight means that there is no data

First Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Comments
DCB-8 *	
DCB-21A	
DCB-21B	
DCB-21C	
DCB-22A	Bottles used for the collection of DCB-22A were marked as 22B. Data corrected in this table
DCB-22B	Bottles used for the collection of DCB-22B were marked as 22A. Data corrected in this table
DCB-22C	
DCB-70A	
DCB-70B	
DCB-19A	
DCB-19B	
DCB-19C	
DCB-18A	
DCB-18B	
DCB-18C	
DCB-71A	
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	
DIW-P11B	
DIW-P11C	
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P07B	
DIW-P07C	
DIW-P08C	May have been DIW-P08B instead
DIW-P13A	
DIW-P11A	
DIW-P09A	
DIW-1-2	
DIW-P07A	
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	

Second Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Aluminum (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
DCB-8 *	DSR-00101	11/6/2002	Sample	11/18/2002	0.033	<0.002	<0.100	0.034	<0.003	<0.002	<0.010	0.930	0.280	<0.001
DCB-21A	DSR-00102	11/6/2002	Sample	11/18/2002	563	<0.002	4.28	164	<0.003	0.240	1.50	456	138	15.0
DCB-21B	DSR-00103	11/6/2002	Sample	11/18/2002	144	<0.002	2.39	105	<0.003	<0.002	0.161	91.3	87.8	8.75
DCB-21C	DSR-00104	11/6/2002	Sample	11/18/2002	2.75	<0.002	0.128	105	<0.003	<0.002	<0.010	3.73	54.8	5.86
DCB-22A	DSR-00105	11/6/2002	Sample	11/18/2002	273	<0.002	2.62	78.6	<0.003	<0.002	0.099	3.28	73.8	7.29
DCB-22B	DSR-00106	11/6/2002	Sample	11/18/2002	172	<0.002	3.38	110	<0.003	<0.002	0.067	226	85.5	9.67
DCB-22C	DSR-00107	11/6/2002	Sample	11/18/2002	1.66	<0.002	0.260	80.3	<0.003	<0.002	<0.010	1.99	27.6	1.45
DCB-70B	DSR-00108	11/6/2002	Sample	11/18/2002	0.088	<0.002	<0.100	<0.006	<0.003	<0.002	<0.010	0.050	0.160	<0.001
DCB-19A	DSR-00109	11/5/2002	Sample	11/18/2002	100	<0.002	0.987	40.0	<0.003	<0.002	0.086	1.02	26.6	2.83
DCB-19B	DSR-00110	11/5/2002	Sample	11/18/2002	181	<0.002	4.86	67.5	<0.003	<0.002	0.187	94.1	48.6	4.42
DCB-19C	DSR-00111	11/5/2002	Sample	11/18/2002	171	<0.002	7.28	110	<0.003	<0.002	0.166	171	57.0	12.1
DCB-18A	DSR-00112	11/6/2002	Sample	11/18/2002	578	<0.002	4.35	122	<0.003	0.217	1.21	50.6	99.5	12.0
DCB-18B	DSR-00113	11/6/2002	Sample	11/18/2002	456	<0.002	3.46	97.0	<0.003	0.110	0.828	25.3	78.4	8.16
DCB-18C	DSR-00114	11/6/2002	Sample	11/18/2002	95.1	<0.002	5.54	129	<0.003	<0.002	0.079	111	62.9	16.6
DCB-71B	DSR-00115	11/6/2002	Sample	11/18/2002	212	<0.002	3.76	126	<0.003	<0.002	0.032	103	99.2	19.0
DIW-P14C	DSR-00116	11/5/2002	Sample	11/18/2002	0.516	0.154	<0.100	63.2	<0.003	<0.002	<0.010	74.6	34.7	6.56
DIW-P13B	DSR-00117	11/5/2002	Sample	11/18/2002	0.049	0.120	<0.100	39.5	<0.003	<0.002	<0.010	170	29.2	4.69
DIW-P13C	DSR-00118	11/5/2002	Sample	11/18/2002	43.2	0.547	<0.100	80.4	<0.003	<0.002	<0.010	418	34.7	4.22
DIW-P12B	DSR-00119	11/5/2002	Sample	11/18/2002	360	<0.002	2.48	128	<0.003	0.052	<0.010	170	90.2	9.23
DIW-P11B	DSR-00120	11/5/2002	Sample	11/18/2002	214	<0.002	1.62	117	<0.003	<0.002	<0.010	262	84.0	9.12
DIW-P11C	DSR-00121	11/5/2002	Sample	11/18/2002	477	<0.002	3.26	143	<0.003	0.151	<0.010	170	98.5	9.90
DIW-P10C	DSR-00122	11/5/2002	Sample	11/18/2002	355	<0.002	2.62	125	<0.003	0.023	<0.010	256	85.6	9.14
DIW-P09B	DSR-00123	11/5/2002	Sample	11/18/2002	202	<0.002	1.95	91.7	<0.003	<0.002	<0.010	260	69.6	7.86
DIW-P09C	DSR-00124	11/5/2002	Sample	11/18/2002	367	<0.002	3.09	138	<0.003	0.035	<0.010	286	95.6	9.53
DIW-P03B	DSR-00126	11/5/2002	Sample	11/18/2002	0.555	<0.002	<0.100	45.3	<0.003	<0.002	<0.010	194	32.9	4.41
DIW-P07B	DSR-00130	11/5/2002	Sample	11/18/2002	208	<0.002	4.60	104	<0.003	<0.002	<0.010	164	60.5	11.9
DIW-P07C	DSR-00131	11/5/2002	Sample	11/18/2002	178	<0.002	4.99	104	<0.003	<0.002	0.016	151	58.3	15.5
DIW-P08C	DSR-00132	11/5/2002	Sample	11/18/2002	169	<0.002	4.59	115	<0.003	<0.002	0.023	194	65.2	18.3
DIW-P13A	DSR-00136	11/6/2002	Sample	11/18/2002	0.117	0.171	<0.100	51.0	<0.003	<0.002	<0.010	253	35.1	4.89
DIW-P11A	DSR-00138	11/6/2002	Sample	11/18/2002	0.392	<0.002	<0.100	92.8	<0.003	<0.002	<0.010	134	65.1	6.99
DIW-P09A	DSR-00139	11/6/2002	Sample	11/18/2002	0.134	<0.002	<0.100	49.8	<0.003	<0.002	<0.010	206	37.0	4.44
DIW-1-2	DSR-00140	11/6/2002	Sample	11/18/2002	0.079	<0.002	<0.100	24.9	<0.003	<0.002	<0.010	2.32	20.6	2.49
DIW-P03A	DSR-00141	11/6/2002	Sample	11/18/2002	0.109	0.242	<0.100	18.5	<0.003	<0.002	<0.010	153	7.45	4.08
DIW-P07A	DSR-00142	11/6/2002	Sample	11/18/2002	0.170	0.094	<0.100	54.9	<0.003	<0.002	<0.010	106	32.5	14.9
DCB-21B	DSR-00143	11/6/2002	Dulicate	11/18/2002	136	<0.002	2.34	100	<0.003	<0.002	0.138	93.6	85.8	8.60
DCB-21B	DSR-00144	11/6/2002	Unfiltered	11/18/2002	141	<0.002	2.21	102	<0.003	<0.002	0.153	89.9	88.6	8.77
DCB-22C	DSR-00145	11/6/2002	Dulicate	11/18/2002	1.40	<0.002	0.228	77.4	<0.003	<0.002	<0.010	1.81	26.3	1.29
DCB-22C	DSR-00146	11/6/2002	Unfiltered	11/18/2002	1.26	<0.002	0.217	77.6	<0.003	<0.002	<0.010	1.84	25.2	1.13
DIW-P11B	DSR-00147	11/5/2002	Dulicate	11/18/2002	211	<0.002	1.66	113	<0.003	<0.002	<0.010	252	83.1	10.5
DIW-P11B	DSR-00149	11/5/2002	Unfiltered	11/18/2002	211	<0.002	1.47	126	<0.003	<0.002	<0.010	260	83.2	10.5

Gray highlight means that there is no data

Second Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Nickel (mg/L)	Lead (mg/L)	Silicon (mg/L)	Zinc (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Sulfur (mg/L)	Analysis Date	Average Fe(2+)/ Fe(total)	Ferrous Iron (mg/L)	Analysis Date	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8 *	<0.010	<0.017	5.45	<0.001	<0.001	0.704		11/18/2002	< detect	< detect						
DCB-21A	1.93	<0.017	121	6.60	7.44	17.3		11/18/2002	0	0						
DCB-21B	0.572	<0.017	37.8	1.80	1.96	8.27		11/18/2002	0.8743688	79.83						
DCB-21C	0.066	<0.017	16.0	<0.001	<0.001	3.29		11/18/2002	0	0						
DCB-22A	1.01	<0.017	81.5	2.42	2.65	19.7		11/18/2002	< detect	< detect						
DCB-22B	0.784	<0.017	27.3	1.95	2.19	27.4		11/18/2002	1	226.00						
DCB-22C	<0.010	<0.017	11.1	<0.001	<0.001	2.67		11/18/2002	< detect	< detect						
DCB-70B	<0.010	<0.017	7.80	<0.001	<0.001	32.3		11/18/2002	< detect	< detect						
DCB-19A	0.307	<0.017	71.4	0.909	0.941	3.15		11/18/2002	< detect	< detect						
DCB-19B	0.680	<0.017	39.5	1.48	1.62	14.1		11/18/2002	0.9684685	91.13						
DCB-19C	0.724	<0.017	29.3	1.76	1.93	14.6		11/18/2002	1	171.00						
DCB-18A	1.48	<0.017	102	4.41	4.85	12.8		11/18/2002	0	0						
DCB-18B	1.17	<0.017	90.7	3.52	3.87	9.67		11/18/2002	0	0						
DCB-18C	0.531	<0.017	16.4	1.36	1.49	6.42		11/18/2002	1	111.00						
DCB-71B	1.06	<0.017	12.7	2.41	2.70	10.3		11/18/2002	1	103.00						
DIW-P14C	<0.010	<0.017	2.79	<0.001	<0.001	1330		11/18/2002	1	74.60						
DIW-P13B	<0.010	<0.017	2.84	<0.001	<0.001	1080		11/18/2002	1	170.00						
DIW-P13C	<0.010	<0.017	11.1	<0.001	<0.001	18200		11/18/2002	0.7561663	316.08						
DIW-P12B	0.823	<0.017	71.0	5.44	5.92	84.7		11/18/2002	1	170.00						
DIW-P11B	0.538	<0.017	41.8	<0.001	<0.001	136		11/18/2002	1	262.00						
DIW-P11C	1.13	<0.017	94.5	4.98	5.51	80.0		11/18/2002	1	170.00						
DIW-P10C	0.890	<0.017	65.9	2.91	3.29	101		11/18/2002	1	256.00						
DIW-P09B	0.536	<0.017	55.5	0.342	0.371	93.1		11/18/2002	1	260.00						
DIW-P09C	0.988	<0.017	73.8	0.110	0.122	139		11/18/2002	1	286.00						
DIW-P03B	<0.010	<0.017	23.8	<0.001	<0.001	64.2		11/18/2002	1	194.00						
DIW-P07B	0.792	<0.017	32.0	1.60	1.80	16.6		11/18/2002	1	164.00						
DIW-P07C	0.722	<0.017	24.4	1.52	1.68	11.7		11/18/2002	1	151.00						
DIW-P08C	0.730	<0.017	18.7	1.54	1.72	31.4		11/18/2002	1	194.00						
DIW-P13A	<0.010	<0.017	4.46	<0.001	<0.001	423		11/18/2002	1	253.00						
DIW-P11A	<0.010	<0.017	8.03	<0.001	<0.001	421		11/18/2002	1	134.00						
DIW-P09A	<0.010	<0.017	12.7	<0.001	<0.001	167		11/18/2002	1	206.00						
DIW-1-2	<0.010	<0.017	5.39	<0.001	<0.001	137		11/18/2002	< detect	< detect						
DIW-P03A	<0.010	<0.017	4.52	<0.001	<0.001	18.9		11/18/2002	1	153.00						
DIW-P07A	<0.010	<0.017	7.00	<0.001	<0.001	26.8		11/18/2002	1	106.00						
DCB-21B	0.518	<0.017	33.6	1.66	1.84	7.91		11/18/2002	0.9035423	84.57						
DCB-21B	0.530	<0.017	37.1	1.72	1.90	7.84										
DCB-22C	<0.010	<0.017	10.4	<0.001	<0.001	3.06		11/18/2002	1	1.81						
DCB-22C	<0.010	<0.017	10.4	<0.001	<0.001	2.46										
DIW-P11B	0.553	<0.017	39.9	<0.001	<0.001	135		11/18/2002	1	252						
DIW-P11B	0.476	<0.017	40.7	<0.001	<0.001	690										

Gray highlight means that there is no data

Second Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Comments
DCB-8 *	
DCB-21A	
DCB-21B	
DCB-21C	
DCB-22A	
DCB-22B	
DCB-22C	
DCB-70B	
DCB-19A	
DCB-19B	
DCB-19C	
DCB-18A	
DCB-18B	
DCB-18C	
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	
DIW-P11B	
DIW-P11C	
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P03B	
DIW-P07B	
DIW-P07C	
DIW-P08C	May have been DIW-P08B instead
DIW-P13A	
DIW-P11A	
DIW-P09A	
DIW-1-2	
DIW-P03A	
DIW-P07A	
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	

Third Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Aluminum (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
DCB-8	DSR-00151	1/13/2003	Sample	1/28/2003	1.06	<0.002	<0.100	<0.006	<0.003	<0.002	0.043	<0.040	<0.004	<0.001
DCB-21A	DSR-00152	1/13/2003	Sample	1/28/2003	494	<0.002	<0.100	117	<0.003	0.254	1.34	559	137	10.0
DCB-21B	DSR-00153	1/13/2003	Sample	1/28/2003	127	<0.002	<0.100	96.1	<0.003	0.025	0.180	88	83.5	7.38
DCB-22A	DSR-00154	1/13/2003	Sample	1/28/2003	243	<0.002	<0.100	72.2	<0.003	0.041	0.129	2.78	64.5	6.06
DCB-22B	DSR-00155	1/13/2003	Sample	1/28/2003	167	<0.002	<0.100	105	<0.003	<0.002	0.117	236	84.9	9.05
DCB-22C	DSR-00156	1/13/2003	Sample	1/28/2003	2.31	<0.002	<0.100	94.8	<0.003	<0.002	0.007	1.68	30.8	1.69
DCB-70B	DSR-00157	1/13/2003	Sample	1/28/2003	1.24	<0.002	<0.100	<0.006	<0.003	<0.002	0.003	<0.040	<0.004	<0.001
DCB-19A	DSR-00158	1/13/2003	Sample	1/28/2003	47.2	<0.002	<0.100	28.2	<0.003	<0.002	0.053	<0.040	13.8	1.52
DCB-19B	DSR-00159	1/13/2003	Sample	1/28/2003	130	<0.002	<0.100	56.6	<0.003	<0.002	0.173	17.2	37.9	3.21
DCB-18A	DSR-00160	1/13/2003	Sample	1/28/2003	570	<0.002	<0.100	127	<0.003	0.372	1.72	587	139	12.1
DCB-18B	DSR-00161	1/13/2003	Sample	1/28/2003	645	<0.002	<0.100	133	<0.003	0.381	1.83	651	149	12.8
DCB-18C	DSR-00162	1/13/2003	Sample	1/28/2003	90.5	<0.002	<0.100	120	<0.003	<0.002	0.116	113	62.0	12.7
DCB-71B	DSR-00163	1/13/2003	Sample	1/28/2003	208	<0.002	<0.100	117	<0.003	<0.002	0.075	97.9	99.4	15.0
DIW-P14C	DSR-00164	1/13/2003	Sample	1/28/2003	12.1	<0.002	<0.100	102	<0.003	<0.002	<0.009	472	73.7	9.79
DIW-P13B	DSR-00165	1/13/2003	Sample	1/28/2003	22.0	0.059	<0.100	85.9	<0.003	<0.002	<0.009	365	60.6	6.95
DIW-P13C	DSR-00166	1/13/2003	Sample	1/28/2003	40.5	0.389	<0.100	57.3	<0.003	0.085	0.013	462	33.2	3.89
DIW-P12B	DSR-00167	1/13/2003	Sample	1/28/2003	407	<0.002	<0.100	121	<0.003	0.229	0.994	454	117	10.0
DIW-P11B	DSR-00168	1/13/2003	Sample	1/28/2003	270	<0.002	<0.100	104	<0.003	0.109	<0.009	316	88.2	9.27
DIW-P11C	DSR-00169	1/13/2003	Sample	1/28/2003	537	<0.002	<0.100	137	<0.003	0.305	1.50	693	141	11.0
DIW-P10C	DSR-00170	1/13/2003	Sample	1/28/2003	489	<0.002	<0.100	132	<0.003	0.300	1.32	525	132	11.1
DIW-P09B	DSR-00171	1/13/2003	Sample	1/28/2003	51.6	<0.002	<0.100	67.7	<0.003	<0.002	<0.009	413	49.4	5.37
DIW-P09C	DSR-00172	1/13/2003	Sample	1/28/2003	536	<0.002	<0.100	135	<0.003	0.303	1.67	631	138	11.1
DIW-P03B	DSR-00174	1/13/2003	Sample	1/28/2003	1.12	0.984	<0.100	24.8	<0.003	<0.002	<0.009	223	15.2	2.92
DIW-P03C	DSR-00175	1/13/2003	Sample	1/28/2003	6.56	0.624	<0.100	29.0	<0.003	<0.002	<0.009	213	18.6	3.12
DIW-P07B	DSR-00179	1/13/2003	Sample	1/28/2003	226	<0.002	<0.100	109	<0.003	0.010	<0.009	170	66.0	9.06
DIW-P07C	DSR-00180	1/13/2003	Sample	1/28/2003	187	<0.002	<0.100	108	<0.003	<0.002	0.062	160	62.9	11.3
DIW-P08C	DSR-00181	1/13/2003	Sample	1/28/2003	181	<0.002	<0.100	107	<0.003	<0.002	0.122	167	60.6	11.2
DIW-P13A	DSR-00185	1/14/2003	Sample	1/28/2003	1.57	0.254	<0.100	49.5	<0.003	<0.002	<0.009	235	33.9	4.48
DIW-P11A	DSR-00186	1/14/2003	Sample	1/28/2003	1.79	0.231	<0.100	30.2	<0.003	<0.002	<0.009	188	22.7	3.79
DIW-P09A	DSR-00188	1/14/2003	Sample	1/28/2003	1.25	0.039	<0.100	29.2	<0.003	<0.002	<0.009	224	24.7	2.12
DIW-1-2	DSR-00189	1/14/2003	Sample	1/28/2003	1.20	0.016	<0.100	33.4	<0.003	<0.002	<0.009	100	21.0	3.11
DIW-P03A	DSR-00190	1/14/2003	Sample	1/28/2003	1.34	0.163	<0.100	21.2	<0.003	<0.002	<0.009	226	9.85	2.14
DIW-P05A	DSR-00191	1/14/2003	Sample	1/28/2003	2.12	0.026	<0.100	34.8	<0.003	<0.002	<0.009	117	23.5	5.32
DIW-P07A	DSR-00192	1/14/2003	Sample	1/28/2003	1.20	0.141	<0.100	53.6	<0.003	<0.002	<0.009	182	27.0	9.58
DCB-21B	DSR-00193	1/13/2003	Duplicate	1/28/2003	112	<0.002	<0.100	94.6	<0.003	0.019	0.181	87.1	81.1	7.34
DCB-21B	DSR-00194	1/13/2003	Unfiltered	1/28/2003	116	<0.002	<0.100	96.3	<0.003	<0.002	0.157	87.5	82.1	7.55
DCB-22C	DSR-00195	1/13/2003	Duplicate	1/28/2003	2.32	<0.002	<0.100	91.7	<0.003	<0.002	0.010	1.68	29.6	1.71
DCB-22C	DSR-00196	1/13/2003	Unfiltered	1/28/2003	2.45	<0.002	<0.100	92.2	<0.003	<0.002	0.009	1.76	29.8	1.81
DIW-P11B	DSR-00197	1/13/2003	Duplicate	1/28/2003	284	<0.002	<0.100	102	<0.003	0.098	<0.009	322	85.7	9.08
DIW-P11B	DSR-00199	1/13/2003	Unfiltered	1/28/2003	272	<0.002	<0.100	103	<0.003	0.103	<0.009	312	88.4	9.22

Gray highlight means that there is no data

Third Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Nickel (mg/L)	Lead (mg/L)	Silicon (mg/L)	Zinc (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Sulfur (mg/L)	Analysis Date	Average Fe(2+)/ Fe(total)	Ferrous Iron (mg/L)	Analysis Date	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	<0.010	<0.017	4.30	<0.001		3.81	<0.100	1/28/2003	<detect	<detect	2/11/2003	7.43	<1.00	1.52	<1.00	2.67
DCB-21A	1.76	<0.017	93.2	6.48		11.6	1940	1/28/2003	0.0104884	5.86	2/11/2003	4.46	<1.00	6.87	<1.00	5550
DCB-21B	0.501	<0.017	32.8	1.69		7.47	523	1/28/2003	0.8526784	75.04						
DCB-22A	0.879	<0.017	75.7	2.27		15.0	665	1/28/2003	0	0						
DCB-22B	0.747	<0.017	29.8	2.08		24.8	673	1/28/2003	1	236.00						
DCB-22C	<0.010	<0.017	12.4	<0.001		3.80	112	1/28/2003	1	1.68	2/11/2003	5.08	<1.00	<1.00	<1.00	377
DCB-70B	<0.010	<0.017	7.80	<0.001		24.2	16.4	1/28/2003	<detect	<detect	2/11/2003	3.19	<1.00	<1.00	<1.00	52.4
DCB-19A	0.107	<0.017	45.5	0.279		2.64	142	1/28/2003	<detect	<detect						
DCB-19B	0.507	<0.017	54.7	1.11		5.90	356	1/28/2003	0.8	13.76						
DCB-18A	1.83	<0.017	102.0	6.56		12.9	2140	1/28/2003	0	0						
DCB-18B	1.92	<0.017	104.0	6.90		14.0	2350	1/28/2003	0	0						
DCB-18C	0.504	<0.017	16.5	1.36		6.77	428	1/28/2003	1	113.00						
DCB-71B	0.900	<0.017	13.3	2.53		9.61	676	1/28/2003	1	97.90						
DIW-P14C	<0.010	<0.017	2.49	<0.001		402	691	1/28/2003	1	472.00						
DIW-P13B	<0.010	<0.017	50.3	<0.001		1170	283	1/28/2003	0.9144525	333.78						
DIW-P13C	<0.010	<0.017	12.4	0.009		9310	55.3	1/28/2003	0.7406	342.16						
DIW-P12B	1.32	<0.017	80.2	5.14		28.9	1550	1/28/2003	0.3880813	176.19						
DIW-P11B	0.679	<0.017	59.5	1.07		49.6	1200	1/28/2003	1	316.00	2/11/2003	<1.00	<1.00	<1.00	<1.00	2910
DIW-P11C	1.65	<0.017	91.2	6.96		28.3	2120	1/28/2003	0.2475583	171.56	2/11/2003	5.47	<1.00	2.41	<1.00	6390
DIW-P10C	1.54	<0.017	92.3	6.24		28.5	1850	1/28/2003	0.3062082	160.76						
DIW-P09B	0.098	<0.017	28.5	<0.001		122	499	1/28/2003	1	413.00						
DIW-P09C	1.58	<0.017	96.8	8.22		39.4	2010	1/28/2003	0.4189131	264.33						
DIW-P03B	<0.010	<0.017	6.58	<0.001		104	2.69	1/28/2003	0.8347701	186.15						
DIW-P03C	<0.010	<0.017	22.8	<0.001		102.0	3.23	1/28/2003	0.8157895	173.76						
DIW-P07B	0.828	<0.017	39.6	1.82		17.1	732	1/28/2003	1	170.00						
DIW-P07C	0.750	<0.017	32.7	1.76		12.8	648	1/28/2003	1	160.00						
DIW-P08C	0.747	<0.017	27.5	1.77		15.8	628	1/28/2003	1	167.00						
DIW-P13A	<0.010	<0.017	6.74	<0.001		901	75.9	1/28/2003	0.7790686	183.08	2/11/2003	3.43	<1.00	<1.00	<1.00	212
DIW-P11A	<0.010	<0.017	12.2	<0.001		128	26.6	1/28/2003	0.9093893	170.97	2/11/2003	2.31	<1.00	<1.00	<1.00	49.8
DIW-P09A	<0.010	<0.017	17.2	<0.001		267	39.7	1/28/2003	0.9507598	212.97						
DIW-1-2	<0.010	<0.017	8.35	<0.001		246	66.2	1/28/2003	0.8294853	82.95	2/11/2003	2.96	<1.00	<1.00	<1.00	139
DIW-P03A	<0.010	<0.017	6.38	<0.001		42.2	8.26	1/28/2003	1	226.00	2/11/2003	2.26	<1.00	<1.00	<1.00	23.9
DIW-P05A	<0.010	<0.017	12.2	<0.001		23.8	102	1/28/2003	1	117.00						
DIW-P07A	<0.010	<0.017	9.25	<0.001		21.4	83.8	1/28/2003	1	182.00						
DCB-21B	0.501	<0.017	32.7	1.69		7.64	461	1/28/2003	0.9031119	78.66						
DCB-21B	0.446	<0.017	30.7	1.55		7.33	505									
DCB-22C	<0.010	<0.017	12.1	<0.001		3.57	113	1/28/2003	1	1.68						
DCB-22C	<0.010	<0.017	12.1	<0.001		3.74	116									
DIW-P11B	0.669	<0.017	58.8	1.00		52.3	1190	1/28/2003	1	322.00						
DIW-P11B	0.688	<0.017	68.9	1.14		64.6	1160									

Gray highlight means that there is no data

Third Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Comments
DCB-8	
DCB-21A	
DCB-21B	
DCB-22A	
DCB-22B	
DCB-22C	
DCB-70B	
DCB-19A	
DCB-19B	
DCB-18A	
DCB-18B	
DCB-18C	
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	
DIW-P11B	
DIW-P11C	
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P03B	
DIW-P03C	
DIW-P07B	
DIW-P07C	
DIW-P08C	
DIW-P13A	
DIW-P11A	
DIW-P09A	
DIW-1-2	
DIW-P03A	
DIW-P05A	
DIW-P07A	
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	

Fourth Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Aluminum (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
DCB-8	DSR-00201	4/1/2003	Sample	4/8/2003	0.177	<0.002	<0.001	2.12	<0.003	0.007	0.051	0.226	1.50	<0.001
DCB-21A	DSR-00202	3/31/2003	Sample	4/9/2003	239	<0.002	<0.001	74.7	<0.003	0.140	0.678	468	97.7	7.04
DCB-21B	DSR-00203	3/31/2003	Sample	4/10/2003	131	<0.002	<0.001	96.2	<0.003	0.049	0.141	106	83.5	7.20
DCB-22C	DSR-00204	3/31/2003	Sample	4/11/2003	0.937	<0.002	<0.001	101	<0.003	0.011	<0.009	2.06	29.5	1.51
DCB-70B	DSR-00205	3/31/2003	Sample	4/12/2003	0.339	<0.002	<0.001	4.41	<0.003	0.008	<0.009	0.102	2.50	<0.001
DCB-19A	DSR-00206	3/31/2003	Sample	4/13/2003	324	<0.002	<0.001	79.9	<0.003	0.140	0.559	118	84.0	6.13
DCB-19B	DSR-00207	3/31/2003	Sample	4/14/2003	124	<0.002	<0.001	49.4	<0.003	0.037	0.131	5.63	33.9	2.99
DCB-18C	DSR-00208	3/31/2003	Sample	4/15/2003	102	<0.002	<0.001	123	<0.003	0.029	0.119	110	62.4	12.7
DCB-71B	DSR-00209													
DIW-P14C	DSR-00210													
DIW-P13B	DSR-00211													
DIW-P13C	DSR-00212													
DIW-P12B	DSR-00213	4/1/2003	Sample	4/20/2003	374	<0.002	<0.001	95.3	<0.003	0.223	0.924	516	123	9.72
DIW-P11B	DSR-00214	4/1/2003	Sample	4/21/2003	417	<0.002	<0.001	93.9	<0.003	0.231	0.827	380	134	9.89
DIW-P11C	DSR-00215	3/31/2003	Sample	4/22/2003	494	<0.002	<0.001	172	<0.003	0.291	1.65	1280	121	12.6
DIW-P10C	DSR-00216													
DIW-P09B	DSR-00217													
DIW-P09C	DSR-00218													
DIW-P02C	DSR-00219													
DIW-P03B	DSR-00220	4/1/2003	Sample	4/27/2003	0.274	0.097	<0.001	86.3	<0.003	0.014	<0.009	115	237	14.1
DIW-P03C	DSR-00221	4/1/2003	Sample	4/28/2003	0.139	0.187	<0.001	87.3	<0.003	0.011	<0.009	114	46.4	14.1
DIW-P04C	DSR-00222	4/1/2003	Sample	4/29/2003	2.09	<0.002	<0.001	75.2	<0.003	0.009	<0.009	207	47.7	11.0
DIW-P07B	DSR-00223	3/31/2003	Sample	4/30/2003	249	<0.002	<0.001	106	<0.003	0.042	<0.009	166	46.5	9.53
DIW-P07C	DSR-00224	3/31/2003	Sample	5/1/2003	236	<0.002	<0.001	105	<0.003	0.036	0.032	164	63.9	10.1
DIW-P08C	DSR-00225	3/31/2003	Sample	5/2/2003	221	<0.002	<0.001	114	<0.003	0.033	0.082	188	62.0	11.0
DIW-P13A	DSR-00226	4/1/2003	Sample	5/3/2003	0.173	0.074	<0.001	37.7	<0.003	0.007	<0.009	214	66.2	7.85
DIW-P11A	DSR-00227	4/1/2003	Sample	5/4/2003	6.70	0.013	<0.001	51.0	<0.003	0.014	<0.009	214	22.0	9.21
DIW-P09A	DSR-00228	4/1/2003	Sample	5/5/2003	0.579	<0.002	<0.001	20.4	<0.003	0.014	<0.009	110	39.3	2.14
DIW-1-2	DSR-00229	4/1/2003	Sample	5/6/2003	0.140	0.041	<0.001	34.4	<0.003	0.016	<0.009	162	15.3	2.96
DIW-P03A	DSR-00230	4/1/2003	Sample	5/7/2003	0.871	<0.002	<0.001	40.2	<0.003	0.014	<0.009	52.7	23.8	6.21
DIW-P05A	DSR-00231	4/1/2003	Sample	5/8/2003	0.424	0.043	<0.001	41.2	<0.003	0.008	<0.009	18.9	24.0	7.35
DIW-P07A	DSR-00232	4/1/2003	Sample	5/9/2003	0.590	<0.002	<0.001	40.1	<0.003	0.007	<0.009	105	17.7	7.34
DCB-21B	DSR-00233	3/31/2003	Duplicate	5/10/2003	127	<0.002	<0.001	99.4	<0.003	0.055	0.147	96.4	87.4	7.14
DCB-21B	DSR-00234	3/31/2003	Unfiltered	5/11/2003	131	<0.002	<0.001	101	<0.003	0.054	0.138	104	90.2	7.30
DCB-22C	DSR-00235	3/31/2003	Duplicate	5/12/2003	0.929	<0.002	<0.001	104	<0.003	0.009	<0.009	2.07	31.6	1.47
DCB-22C	DSR-00236	3/31/2003	Unfiltered	5/13/2003	1.27	<0.002	<0.001	105	<0.003	0.010	<0.009	1.98	33.8	1.83
DIW-P11B	DSR-00237	4/1/2003	Duplicate	5/14/2003	401	<0.002	<0.001	94.1	<0.003	0.231	0.833	361	118	9.82
DIW-P11B	DSR-00239	4/1/2003	Unfiltered	5/15/2003	408	<0.002	<0.001	91.9	<0.003	0.228	0.810	364	116	9.75

Gray highlight means that there is no data

Fourth Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Nickel (mg/L)	Lead (mg/L)	Silicon (mg/L)	Zinc (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Sulfur (mg/L)	Analysis Date	Average Fe(2+)/ Fe(total)	Ferrous Iron (mg/L)	Analysis Date	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	<0.010	<0.017	4.33	<0.001		6.19		4/2/2003	<detect	<detect						
DCB-21A	1.30	<0.017	71.4	4.18		5.44		4/2/2003	0.2151453	100.69						
DCB-21B	0.518	<0.017	26.7	1.62		6.74		4/2/2003	0.9111831	96.59						
DCB-22C	0.031	<0.017	11.8	<0.001		3.45		4/2/2003	1	2.06						
DCB-70B	<0.010	<0.017	6.56	<0.001		22.4		4/2/2003	<detect	<detect						
DCB-19A	1.10	<0.017	60.2	3.50		3.74		4/2/2003	0	0						
DCB-19B	0.489	<0.017	49.4	1.04		4.22		4/2/2003	0.6833333	3.85						
DCB-18C	0.578	<0.017	17.1	1.47		6.2		4/2/2003	1	110.00						
DCB-71B																
DIW-P14C																
DIW-P13B																
DIW-P13C																
DIW-P12B	1.58	<0.017	92.8	5.32		8.17		4/2/2003	0.3377018	174.25						
DIW-P11B	1.65	<0.017	107	7.90		8.36		4/2/2003	0.6342134	241.00						
DIW-P11C	2.23	0.045	84.2	8.54		10.6		4/2/2003	0.2220866	284.27						
DIW-P10C																
DIW-P09B																
DIW-P09C																
DIW-P02C																
DIW-P03B	<0.010	<0.017	8.64	<0.001		31.4		4/2/2003	1	115.00						
DIW-P03C	<0.010	<0.017	8.51	<0.001		34.0		4/2/2003	1	114.00						
DIW-P04C	<0.010	<0.017	6.60	<0.001		18.9		4/2/2003	1	207.00						
DIW-P07B	0.861	<0.017	38.8	1.63		16.6		4/2/2003	1	166.00						
DIW-P07C	0.851	<0.017	34.9	1.98		14.3		4/2/2003	1	164.00						
DIW-P08C	0.835	<0.017	30.2	1.91		18.8		4/2/2003	1	188.00						
DIW-P13A	<0.010	<0.017	6.84	<0.001		295		4/2/2003	1	214.00						
DIW-P11A	0.054	<0.017	16.1	0.07		50.9		4/2/2003	1	214.00						
DIW-P09A	<0.010	<0.017	13.0	<0.001		43.2		4/2/2003	1	110.00						
DIW-1-2	<0.010	<0.017	9.28	<0.001		53.8		4/2/2003	1	162.00						
DIW-P03A	<0.010	<0.017	6.16	<0.001		13.9		4/2/2003	1	52.70						
DIW-P05A	<0.010	<0.017	9.34	<0.001		16.5		4/2/2003	1	18.90						
DIW-P07A	<0.010	<0.017	8.20	<0.001		18.1		4/2/2003	1	105.00						
DCB-21B	0.520	<0.017	28.3	1.63		6.84		4/2/2003	0.8959664	86.37						
DCB-21B	0.520	<0.017	27.5	1.60		6.60										
DCB-22C	0.031	<0.017	12.4	<0.001		3.38		4/2/2003	1	2.07						
DCB-22C	0.040	<0.017	12.8	<0.001		3.51										
DIW-P11B	1.62	<0.017	108	7.82		8.59		4/2/2003	0.6142286	221.74						
DIW-P11B	1.64	<0.017	107	7.81		8.31										

Gray highlight means that there is no data

Fourth Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Comments
DCB-8	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-21A	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-21B	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-22C	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-70B	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-19A	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-19B	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-18C	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P11B	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P11C	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P02C	
DIW-P03B	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P03C	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P04C	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P07B	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P07C	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P08C	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P13A	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P11A	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P09A	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-1-2	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P03A	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P05A	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P07A	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-21B	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-21B	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-22C	Chromium and copper were rerun on 4/8/03 due to standards problems
DCB-22C	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P11B	Chromium and copper were rerun on 4/8/03 due to standards problems
DIW-P11B	Chromium and copper were rerun on 4/8/03 due to standards problems

APPENDIX C
SRTC Mobile Laboratory Analytical Results

Fifth Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Aluminum (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
DCB-8	DSR-00250	7/15/2003	Sample	7/22/2003	0.032	<0.002	<0.010	0.771	<0.003	<0.002	<0.009	2.36	0.817	<0.004
DCB-21A	DSR-00251	7/14/2003	Sample	7/22/2003	171	<0.002	<0.010	74.7	<0.003	0.044	0.822	553	71.9	6.36
DCB-21B	DSR-00252	7/14/2003	Sample	7/22/2003	170	<0.002	<0.010	128	<0.003	<0.002	0.171	179	219	14.4
DCB-22C	DSR-00253	7/14/2003	Sample	7/22/2003	5.25	<0.002	<0.010	144	<0.003	<0.002	<0.009	60.7	59.1	4.01
DCB-70B	DSR-00254	7/14/2003	Sample	7/22/2003	1.07	0.049	<0.010	11.5	<0.003	<0.002	<0.009	1.35	8.60	0.116
DCB-23C	DSR-00255	7/14/2003	Sample	7/22/2003	1.76	<0.002	<0.010	300	<0.003	<0.002	<0.009	161	152	9.20
DCB-19A	DSR-00256	7/14/2003	Sample	7/22/2003	190	<0.002	<0.010	71.2	<0.003	0.026	0.552	217	71.4	8.92
DCB-19B	DSR-00257	7/14/2003	Sample	7/22/2003	212	<0.002	<0.010	57.5	<0.003	<0.002	0.352	23.1	60.8	5.35
DCB-18C	DSR-00258	7/14/2003	Sample	7/22/2003	115	<0.002	<0.010	121	<0.003	<0.002	0.113	126	72.4	18.4
DCB-71B	DSR-00259													
DIW-P14C	DSR-00260													
DIW-P13B	DSR-00261													
DIW-P13C	DSR-00262													
DIW-P12B	DSR-00263	7/14/2003	Sample	7/22/2003	204	<0.002	<0.010	75.3	<0.003	0.069	0.782	572	76.5	7.50
DIW-P11B	DSR-00264	7/14/2003	Sample	7/22/2003	214	<0.002	<0.010	74.4	<0.003	0.064	<0.009	526	74.5	8.59
DIW-P11C	DSR-00265	7/14/2003	Sample	7/22/2003	229	<0.002	<0.010	78.5	<0.003	0.078	0.306	582	79.8	8.20
DIW-P10C	DSR-00266													
DIW-P09B	DSR-00267													
DIW-P09C	DSR-00268													
DIW-P02C	DSR-00269													
DIW-P03B	DSR-00270	7/14/2003	Sample	7/22/2003	0.668	<0.002	<0.010	25.3	<0.003	<0.002	<0.009	22.4	25.0	6.79
DIW-P03C	DSR-00271	7/14/2003	Sample	7/22/2003	0.288	0.129	<0.010	21.6	<0.003	<0.002	<0.009	48.0	19.4	5.51
DIW-P04C	DSR-00272	7/14/2003	Sample	7/22/2003	10.0	<0.002	<0.010	37.3	<0.003	<0.002	<0.009	84.5	34.3	8.28
DIW-P07B	DSR-00273	7/14/2003	Sample	7/22/2003	0.157	0.09	<0.010	34.2	<0.003	<0.002	<0.009	204	30.5	7.17
DIW-P07C	DSR-00274	7/14/2003	Sample	7/22/2003	15.8	<0.002	<0.010	52.3	<0.003	<0.002	<0.009	351	47.3	8.51
DIW-P08C	DSR-00275	7/14/2003	Sample	7/22/2003	37.5	<0.002	<0.010	63.5	<0.003	<0.002	<0.009	360	51.4	11.7
DIW-P13A	DSR-00276	7/15/2003	Sample	7/22/2003	0.10	0.466	<0.010	35.8	<0.003	<0.002	<0.009	440	26.2	5.03
DIW-P11A	DSR-00277	7/15/2003	Sample	7/22/2003	77.6	0.025	<0.010	41.0	<0.003	<0.002	<0.009	305	39.5	10.9
DIW-P09A	DSR-00278	7/15/2003	Sample	7/22/2003	1.06	0.038	<0.010	18.4	<0.003	<0.002	<0.009	103	17.7	4.53
DIW-1-2	DSR-00279	7/15/2003	Sample	7/22/2003	0.254	<0.002	<0.010	19.8	<0.003	<0.002	<0.009	40.5	10.9	2.43
DIW-P03A	DSR-00280	7/15/2003	Sample	7/22/2003	0.308	0.108	<0.010	23.6	<0.003	<0.002	<0.009	17.1	12.5	5.61
DIW-P05A	DSR-00281	7/15/2003	Sample	7/22/2003	0.047	0.008	<0.010	20.7	<0.003	<0.002	<0.009	20.6	11.4	4.49
DIW-P07A	DSR-00282	7/15/2003	Sample	7/22/2003	0.029	<0.002	<0.010	21.7	<0.003	<0.002	<0.009	43.0	16.3	6.75
DCB-21B	DSR-00283	7/14/2003	Duplicate	7/22/2003	180	<0.002	<0.010	134	<0.003	<0.002	0.179	183	133	14.2
DCB-21B	DSR-00284	7/14/2003	Unfiltered	7/22/2003	173	<0.002	<0.010	135	<0.003	<0.002	0.157	188	135	14.4
DCB-22C	DSR-00285	7/14/2003	Duplicate	7/22/2003	5.14	<0.002	<0.010	143	<0.003	<0.002	<0.009	59.7	59.1	4.10
DCB-22C	DSR-00286	7/14/2003	Unfiltered	7/22/2003	5.76	<0.002	<0.010	144	<0.003	<0.002	<0.009	64.1	60.9	4.36
DIW-P11B	DSR-00287	7/14/2003	Duplicate	7/22/2003	208	<0.002	<0.010	74.1	<0.003	0.070	<0.009	516	74.6	8.91
DIW-P11B	DSR-00289	7/14/2003	Unfiltered	7/22/2003	213	<0.002	<0.010	76.5	<0.003	0.066	<0.009	524	75.0	8.71

Gray highlight means that there is no data

Fifth Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Nickel (mg/L)	Lead (mg/L)	Silicon (mg/L)	Zinc (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Sulfur (mg/L)	Analysis Date	Average Fe(2+)/ Fe(total)	Ferrous Iron (mg/L)	Analysis Date	Chloride (mg/L)	Nitrite (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)
DCB-8	<0.010	<0.017	5.44	<0.001		4.45		7/21/2003	<detect	<detect						
DCB-21A	1.06	<0.017	87.0	3.50		3.35		7/21/2003	0.9623436	532.18						
DCB-21B	0.866	<0.017	32.9	2.59		8.61		7/21/2003	1	179.00						
DCB-22C	0.051	<0.017	14.0	0.068		14.1		7/21/2003	1	60.70						
DCB-70B	<0.010	<0.017	7.11	<0.001		24.6		7/21/2003	<detect	<detect						
DCB-23C	0.443	<0.017	17.7	1.52		12.4		7/21/2003	1	161.00						
DCB-19A	0.948	<0.017	79.4	2.97		3.88		7/21/2003	0.2555405	55.45						
DCB-19B	0.895	<0.017	75.9	2.30		8.50		7/21/2003	0.3989575	9.22						
DCB-18C	0.715	<0.017	19.2	1.80		8.61		7/21/2003	1	126.00						
DCB-71B																
DIW-P14C																
DIW-P13B																
DIW-P13C																
DIW-P12B	1.18	<0.017	94.7	3.78		3.79		7/21/2003	1	572.00						
DIW-P11B	1.08	<0.017	95.8	2.81		3.30		7/21/2003	1	526.00						
DIW-P11C	1.19	<0.017	100	3.68		3.30		7/21/2003	1	582.00						
DIW-P10C																
DIW-P09B																
DIW-P09C																
DIW-P02C																
DIW-P03B	<0.010	<0.017	6.63	<0.001		10.4		7/21/2003	<detect	<detect						
DIW-P03C	<0.010	<0.017	7.76	<0.001		11.4		7/21/2003	1	48.00						
DIW-P04C	<0.010	<0.017	11.5	<0.001		5.86		7/21/2003	1	84.50						
DIW-P07B	<0.010	<0.017	4.67	<0.001		16.3		7/21/2003	1	204.00						
DIW-P07C	0.012	<0.017	10.2	<0.001		14.9		7/21/2003	1	351.00						
DIW-P08C	0.286	<0.017	12.5	0.077		26.7		7/21/2003	1	360.00						
DIW-P13A	<0.010	<0.017	11.4	<0.001		185		7/21/2003	1	440.00						
DIW-P11A	0.406	<0.017	44.9	1.04		10.1		7/21/2003	1	305.00						
DIW-P09A	<0.010	<0.017	19.3	<0.001		11.0		7/21/2003	1	103.00						
DIW-1-2	<0.010	<0.017	22.2	<0.001		3.78		7/21/2003	<detect	<detect						
DIW-P03A	<0.010	<0.017	7.74	<0.001		9.83		7/21/2003	1	17.10						
DIW-P05A	<0.010	<0.017	11.6	<0.001		5.68		7/21/2003	<detect	<detect						
DIW-P07A	<0.010	<0.017	8.42	<0.001		18.1		7/21/2003	<detect	<detect						
DCB-21B	0.898	<0.017	33.5	2.71		9.54		7/21/2003	1	183.00						
DCB-21B	0.880	<0.017	30.7	2.64		9.70										
DCB-22C	0.050	<0.017	13.9	0.079		15.3		7/21/2003	<detect	<detect						
DCB-22C	0.061	<0.017	14.2	0.092		15.0										
DIW-P11B	1.13	<0.017	95.2	2.90		3.36		7/21/2003	1	516.00						
DIW-P11B	1.10	<0.017	96.7	2.87		3.56										

Gray highlight means that there is no data

Fifth Post-Injection SRTC Mobile Laboratory Analytical Results

Well/ Piezometer	Comments
DCB-8	
DCB-21A	
DCB-21B	
DCB-22C	
DCB-70B	
DCB-23C	
DCB-19A	
DCB-19B	
DCB-18C	
DCB-71B	
DIW-P14C	
DIW-P13B	
DIW-P13C	
DIW-P12B	
DIW-P11B	
DIW-P11C	
DIW-P10C	
DIW-P09B	
DIW-P09C	
DIW-P02C	
DIW-P03B	
DIW-P03C	
DIW-P04C	
DIW-P07B	
DIW-P07C	
DIW-P08C	
DIW-P13A	
DIW-P11A	
DIW-P09A	
DIW-1-2	
DIW-P03A	
DIW-P05A	
DIW-P07A	
DCB-21B	
DCB-21B	
DCB-22C	
DCB-22C	
DIW-P11B	
DIW-P11B	

APPENDIX D
SRTC ADS Analytical Results

Pre-Injection SRTC ADS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Total Inorganic Carbon (ug/ml)	Total Organic Carbon (ug/ml)
DCB-8	DSR-00001	7/1/2002	Sample	8/8/2002	1.23	31.40
DCB-21B	DSR-00003	6/27/2002	Sample	8/13/2002	15.40	49.60
DCB-22C	DSR-00007	6/27/2002	Sample	8/21/2002	2.08	1.44
DCB-70B	DSR-00009	7/1/2002	Sample	8/8/2002	0.82	20.80
DCB-19B	DSR-00011	6/25/2002	Sample	7/2/2002	9.58	4.13
DCB-18C	DSR-00015	6/26/2002	Sample	7/2/2002	7.89	2.41
DCB-71B	DSR-00017	7/1/2002	Sample	8/8/2002	0.86	83.60
DIW-P11B	DSR-00021	6/27/2002	Sample	8/21/2002	17.00	7.50
DIW-1-2	DSR-00025	7/1/2002	Sample	8/8/2002	0.68	17.90
DIW-P07A	DSR-00031	6/26/2002	Sample	7/2/2002	14.20	8.22
DIW-P09A	DSR-00042	6/27/2002	Sample	8/13/2002	2.08	1.44

First Post-Injection SRTC ADS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Total Inorganic Carbon (ug/ml)	Total Organic Carbon (ug/ml)
DCB-8	DSR-00050	9/10/2002	Sample	9/30/2002	7.11	5.29
DCB-21B	DSR-00052	9/11/2002	Sample	10/29/2002	0.962	1.36
DCB-22C	DSR-00056	9/11/2002	Sample	9/30/2002	<1	<1
DCB-70B	DSR-00058	9/10/2002	Sample	9/30/2002	17.4	6.3
DCB-19B	DSR-00060	9/11/2002	Sample	9/23/2002	12.8	4.1
DCB-18C	DSR-00064	9/11/2002	Sample	10/11/2002	10.7	2.3
DCB-71B	DSR-00066	9/10/2002	Sample	9/30/2002	11.8	7.7
DIW-P11B	DSR-00071	9/11/2002	Sample	9/23/2002	74	67
DIW-P13A	DSR-00087	9/11/2002	Sample	9/23/2002	380	514
DIW-P09A	DSR-00090	9/11/2002	Sample	9/30/2002	61.4	5090
DIW-1-2	DSR-00091	9/11/2002	Sample	9/30/2002	38.1	33.5
DIW-P07A	DSR-00092	9/11/2002	Sample	10/22/2002	48.1	3.5

Second Post-Injection SRTC ADS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Total Inorganic Carbon (ug/ml)	Total Organic Carbon (ug/ml)
DCB-8	DSR-00101	11/6/2002	Sample	11/13/2002	9.02	<1
DCB-21B	DSR-00103	11/6/2002	Sample	11/13/2002	6.92	1.66
DCB-22C	DSR-00107	11/6/2002	Sample	11/13/2002	8.52	<1
DCB-70B	DSR-00108	11/6/2002	Sample	11/13/2002	13.10	1
DCB-19B	DSR-00110	11/5/2002	Sample	11/13/2002	14.20	6.4
DCB-18C	DSR-00114	11/6/2002	Sample	11/13/2002	9.44	0.76
DCB-71B	DSR-00115	11/6/2002	Sample	11/13/2002	8.80	3.5
DIW-P11B	DSR-00120	11/5/2002	Sample	11/13/2002	36.00	62.8
DIW-P13A	DSR-00136	11/6/2002	Sample	11/13/2002	316.00	602
DIW-P09A	DSR-00139	11/6/2002	Sample	11/13/2002	195.00	135
DIW-1-2	DSR-00140	11/6/2002	Sample	11/13/2002	95.20	30.8
DIW-P07A	DSR-00142	11/6/2002	Sample	11/13/2002	115.00	177

APPENDIX D
SRTC ADS Analytical Results

Third Post-Injection SRTC ADS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Total Inorganic Carbon (ug/ml)	Total Organic Carbon (ug/ml)
DCB-8	DSR-00151	1/13/2003	Sample	1/21/2003	8.25	3.05
DCB-21B	DSR-00153	1/13/2003	Sample	1/21/2003	7.53	3.87
DCB-22C	DSR-00156	1/13/2003	Sample	1/21/2003	7.36	1.57
DCB-70B	DSR-00157	1/13/2003	Sample	1/21/2003	10.7	2.9
DCB-19B	DSR-00159	1/13/2003	Sample	1/21/2003	6.68	2.76
DCB-18C	DSR-00162	1/13/2003	Sample	1/21/2003	6.95	2.3
DCB-71B	DSR-00163	1/13/2003	Sample	1/21/2003	7.42	5.58
DIW-P11B	DSR-00168	1/13/2003	Sample	1/21/2003	44.6	43.5
DIW-P13A	DSR-00185	1/14/2003	Sample	1/21/2003	380	1760
DIW-P09A	DSR-00188	1/14/2003	Sample	1/21/2003	202	742
DIW-1-2	DSR-00189	1/14/2003	Sample	1/21/2003	134	70
DIW-P07A	DSR-00192	1/14/2003	Sample	1/21/2003	148	542

Fourth Post-Injection SRTC ADS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Total Inorganic Carbon (ug/ml)	Total Organic Carbon (ug/ml)

No TIC or TOC were performed for this sampling event

Fifrth Post-Injection SRTC ADS Analytical Results

Well/ Piezometer	Sample Number	Sample Date	Sample Type	Analysis Date	Total Inorganic Carbon (ug/ml)	Total Organic Carbon (ug/ml)

No TIC or TOC were performed for this sampling event

APPENDIX E
Field Turbidity Results

Pre-Injection Field Turbidity Results

Well/ Piezometer	Sample #	Type Sample	Date	Time	Turbidity (NTU)
DCB-21B	DSR-00003	Sample	6/27/2002	9:47	0.03
DCB-22C	DSR-00007	Sample	6/27/2002	10:30	0.08
DIW-P11B	DSR-00021	Sample	6/27/2002	9:55	0.6
DCB-21B	DSR-00034	Unfiltered	6/27/2002	9:30	0.02
DCB-22C	DSR-00036	Unfiltered	6/27/2002	10:15	0.6
DIW-P11B	DSR-00039	Unfiltered	6/27/2002	9:55	2.8

First Post-Injection Field Turbidity Results

Well/ Piezometer	Sample #	Type Sample	Date	Time	Turbidity (NTU)
DCB-8	DSR-00050	Unfiltered	9/10/2002	9:50	1.14
DCB-21B	DSR-00052	Filtered	9/11/2002	10:00	9.35
DCB-21B	DSR-00094	Unfiltered	9/11/2002	10:05	0.07
DCB-22C	DSR-00056	Filtered	9/11/2002	10:25	0.05
DCB-22C	DSR-00096	Unfiltered	9/11/2002	10:21	7.78
DCB-70B	DSR-00058	Unfiltered	9/10/2002	12:15	15.6
DCB-19B	DSR-00060	Unfiltered	9/11/2002	11:21	0.52
DCB-18C	DSR-00064	Unfiltered	9/11/2002	12:03	0.52
DCB-71B	DSR-00066	Unfiltered	9/10/2002	11:00	53.5
DIW-P11B	DSR-00071	Filtered	9/11/2002	10:00	0.1
DIW-P11B	DSR-00099	Unfiltered	9/11/2002	9:50	3.71
DIW-P13A	DSR-00087	Unfiltered	9/11/2002	13:52	3.34
DIW-P09A	DSR-00090	Unfiltered	9/11/2002	13:10	6.44
DIW-1-2	DSR-00091	Unfiltered	9/11/2002	13:00	2.99
DIW-P07A	DSR-00092	Unfiltered	9/11/2002	12:31	2.16

Second Post-Injection Field Turbidity Results

Well/ Piezometer	Sample #	Type Sample	Date	Time	Turbidity (NTU)
DCB-8	DSR-00101	Unfiltered	11/6/2002	11:58	13
DCB-21B	DSR-00103	Filtered	11/6/2002	10:28	0.16
DCB-21B	DSR-00144	Unfiltered	11/6/2002	10:13	0.29
DCB-22C	DSR-00107	Filtered	11/6/2002	8:46	0.11
DCB-22C	DSR-00146	Unfiltered	11/6/2002	8:35	0.16
DCB-70B	DSR-00108	Unfiltered	11/6/2002	10:53	22.6
DCB-19B	DSR-00110	Unfiltered	11/5/2002	10:57	0.25
DCB-18C	DSR-00114	Unfiltered	11/6/2002	8:55	0.16
DCB-71B	DSR-00115	Unfiltered	11/6/2002	10:32	7.45
DIW-P11B	DSR-00120	Filtered	11/5/2002	9:44	0.16
DIW-P11B	DSR-00149	Unfiltered	11/5/2002	9:51	2.68
DIW-P13A	DSR-00136	Unfiltered	11/6/2002	12:52	2.79
DIW-P09A	DSR-00139	Unfiltered	11/6/2002	12:30	5.69
DIW-1-2	DSR-00140	Unfiltered	11/6/2002	12:19	2.73
DIW-P07A	DSR-00142	Unfiltered	11/6/2002	11:32	2.76

APPENDIX E
Field Turbidity Results

Third Post-Injection Field Turbidity Results

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Turbidity (NTU)
DCB-8	DSR-00151	Unfiltered	1/13/2003	12:58	1.73
DCB-21B	DSR-00153	Filtered	1/13/2003	9:03	0.21
DCB-21B	DSR-00194	Unfiltered	1/13/2003	8:54	0.88
DCB-22C	DSR-00156	Filtered	1/13/2003	9:53	0.24
DCB-22C	DSR-00196	Unfiltered	1/13/2003	9:58	0.16
DCB-70B	DSR-00157	Unfiltered	1/13/2003	11:56	82
DCB-19B	DSR-00159	Unfiltered	1/13/2003	10:27	0.36
DCB-18C	DSR-00162	Unfiltered	1/13/2003	11:13	0.41
DCB-71B	DSR-00163	Unfiltered	1/13/2003	12:15	18.7
DIW-P11B	DSR-00168	Filtered	1/13/2003	9:58	0.12
DIW-P11B	DSR-00199	Unfiltered	1/13/2003	9:59	6.38
DIW-P13A	DSR-00185	Unfiltered	1/14/2003	10:45	23.8
DIW-P09A	DSR-00188	Unfiltered	1/14/2003	10:50	28.9
DIW-1-2	DSR-00189	Unfiltered	1/14/2003		
DIW-P07A	DSR-00192	Unfiltered	1/14/2003	11:02	13.4

Gray highlight means that there is no data

Forth Post-Injection Field Turbidity Results

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Turbidity (NTU)
DCB-8	DSR-00201	Unfiltered	4/1/2003	9:00	3.46
DCB-21B	DSR-00203	Filtered	3/31/2003	12:57	0.09
DCB-21B	DSR-00234	Unfiltered	3/31/2003	12:55	0.12
DCB-22C	DSR-00204	Filtered	3/31/2003	13:15	0.08
DCB-22C	DSR-00236	Unfiltered	3/31/2003	13:12	0.15
DCB-70B	DSR-00205	Unfiltered	3/31/2003	13:32	13.1
DCB-19B	DSR-00207	Unfiltered	3/31/2003	13:10	0.68
DCB-18C	DSR-00208	Unfiltered	3/31/2003	13:56	0.54
DIW-P11B	DSR-00214	Filtered	4/1/2003	8:43	0.16
DIW-P11B	DSR-00239	Unfiltered	4/1/2003	8:34	0.63
DIW-P13A	DSR-00226	Unfiltered	4/1/2003	9:20	12
DIW-P11A	DSR-00227	Unfiltered	4/1/2003	9:45	3.92
DIW-P09A	DSR-00228	Unfiltered	4/1/2003	10:03	8.66
DIW-1-2	DSR-00229	Unfiltered	4/1/2003	10:09	2.18
DIW-P07A	DSR-00232	Unfiltered	4/1/2003	10:15	4.15

Fifth Post-Injection Field Turbidity Results

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Turbidity (NTU)
DCB-8	DSR-00250	Unfiltered	7/15/2003	8:15	7.28
DCB-21B	DSR-00252	Filtered	7/14/2003	10:49	0.21
DCB-21B	DSR-00284	Unfiltered	7/14/2003	10:46	0.25
DCB-22C	DSR-00253	Filtered	7/14/2003	10:12	0.08
DCB-22C	DSR-00286	Unfiltered	7/14/2003	10:05	1.86
DCB-70B	DSR-00254	Unfiltered	7/14/2003	9:56	8.76
DCB-19B	DSR-00257	Unfiltered	7/14/2003	11:43	0.2
DCB-18C	DSR-00258	Unfiltered	7/14/2003	11:46	0.11
DIW-P11B	DSR-00264	Filtered	7/14/2003	11:48	0.2
DIW-P11B	DSR-00289	Unfiltered	7/14/2003	11:48	1.42
DIW-P13A	DSR-00276	Unfiltered	7/15/2003	8:28	21.4
DIW-P09A	DSR-00278	Unfiltered	7/15/2003	9:00	6.95
DIW-1-2	DSR-00279	Unfiltered	7/15/2003	9:17	3.86
DIW-P07A	DSR-00282	Unfiltered	7/15/2003	8:09	5.45

APPENDIX F
Field Oil and Water Levels

Pre-Injection Field Oil and Water Levels

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Depth to Oil (ft)	Depth to Water (ft)	Comments
DCB-8	DSR-00001	Field	6/24/2002	7:37	no oil	15.35	
DCB-21A	DSR-00002	Field	6/24/2002	7:42	no oil	16.14	
DCB-21A	DSR-00002	Field	7/3/2002	9:04	no oil	14.30	Rain 7/2-7/3
DCB-21B	DSR-00003	Field	6/24/2002	7:44	no oil	16.89	
DCB-21C	DSR-00004	Field	6/24/2002	7:45	no oil	17.23	
DCB-22A	DSR-00005	Field	6/24/2002	7:47	no oil	16.24	
DCB-22A	DSR-00005	Field	7/3/2002	9:06	no oil	15.58	Rain 7/2-7/3
DCB-22B	DSR-00006	Field	6/24/2002	7:48	no oil	16.04	
DCB-22C	DSR-00007	Field	6/24/2002	7:49	no oil	16.52	
DCB-70A	DSR-00008	Field	7/3/2002	9:40	no oil	7.37	3.42' Approx. stick up. Rain 7/2-7/3
DCB-70B	DSR-00009	Field	7/3/2002	9:42	no oil	11.22	4.56' Approx. stick up. Rain 7/2-7/3
DCB-19A	DSR-00010	Field	6/24/2002	7:53	no oil	15.91	
DCB-19B	DSR-00011	Field	6/24/2002	7:55	no oil	15.73	
DCB-19C	DSR-00012	Field	6/24/2002	7:56	no oil	16.78	
DCB-18A	DSR-00013	Field	6/24/2002	7:57	no oil	13.53	
DCB-18B	DSR-00014	Field	6/24/2002	7:58	no oil	15.17	
DCB-18C	DSR-00015	Field	6/24/2002	7:59	no oil	15.86	
DCB-71A	DSR-00016	Field	7/3/2002	9:45	no oil	4.75	3.00' Approx. stick up. Rain 7/2-7/3
DCB-71B	DSR-00017	Field	7/3/2002	9:47	no oil	11.30	4.1' Approx. stick up. Rain 7/2-7/3
DIW-P13A	DSR-00018	Field	6/24/2002	8:25	no oil	14.82	
DIW-P14A	DSR-00019	Field	6/24/2002	8:26	no oil	14.54	
DIW-P11A	DSR-00020	Field	6/24/2002	8:20	no oil	15.23	
DIW-P11B	DSR-00021	Field	6/24/2002	8:21	no oil	15.19	
DIW-P12A	DSR-00022	Field	6/24/2002	8:22	no oil	15.20	
DIW-P09A	DSR-00023	Field	6/24/2002	8:18	no oil	15.79	
DIW-P10A	DSR-00024	Field	6/24/2002	8:19	no oil	15.76	
DIW-1-2	DSR-00025	Field	6/24/2002	8:14	no oil	17.21	
DIW-P02A	DSR-00026	Field	6/24/2002	8:13	no oil	17.45	
DIW-P03A	DSR-00027	Field	6/24/2002	8:09	no oil	16.40	
DIW-P04A	DSR-00028	Field	6/24/2002	8:10	no oil	16.38	
DIW-P05A	DSR-00029	Field	6/24/2002	8:06	no oil	16.40	
DIW-P06A	DSR-00030	Field	6/24/2002	8:07	no oil	16.49	
DIW-P07A	DSR-00031	Field	6/24/2002	8:02	no oil	16.78	
DIW-P08A	DSR-00032	Field	6/24/2002	8:03	no oil	16.38	

APPENDIX F
Field Oil and Water Levels

First Post-Injection Field Oil and Water Levels

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Depth to Oil (ft)	Depth to Water (ft)	Comments
DCB-8	DSR-00050	Field	9/10/2002	8:38	no oil	14.75	
DCB-21A	DSR-00051	Field	9/9/2002	9:30	no oil	11.67	
DCB-21B	DSR-00052	Field	9/9/2002	9:25	no oil	15.95	
DCB-21C	DSR-00053	Field	9/9/2002	9:23	no oil	16.34	
DCB-22A	DSR-00054	Field	9/9/2002	9:08	no oil	15.38	
DCB-22B	DSR-00055	Field	9/9/2002	9:09	no oil	15.16	
DCB-22C	DSR-00056	Field	9/9/2002	9:10	no oil	15.70	
DCB-70A	DSR-00057	Field	9/9/2002	10:04	no oil	7.21	
DCB-70B	DSR-00058	Field	9/9/2002	10:03	no oil	7.86	
DCB-19A	DSR-00059	Field	9/9/2002	8:57	no oil	13.80	
DCB-19B	DSR-00060	Field	9/9/2002	8:58	no oil	14.70	
DCB-19C	DSR-00061	Field	9/9/2002	8:59	no oil	15.85	
DCB-18A	DSR-00062	Field	9/9/2002	9:01	no oil	9.85	
DCB-18B	DSR-00063	Field	9/9/2002	9:03	no oil	14.10	
DCB-18C	DSR-00064	Field	9/9/2002	9:04	no oil	14.95	
DCB-71A	DSR-00065	Field	9/9/2002	10:01	no oil	7.08	
DCB-71B	DSR-00066	Field	9/9/2002	10:02	no oil	9.41	
DIW-P14C	DSR-00067	Field	9/9/2002	9:32	no oil	13.78	
DIW-P13B	DSR-00068	Field	9/9/2002	9:33	no oil	13.81	
DIW-P13C	DSR-00069	Field	9/9/2002	9:35	no oil	13.82	
DIW-P12B	DSR-00070	Field	9/9/2002	9:37	no oil	14.24	
DIW-P11B	DSR-00071	Field	9/9/2002	9:38	no oil	14.21	
DIW-P11C	DSR-00072	Field	9/9/2002	9:39	no oil	14.21	
DIW-P10C	DSR-00073	Field	9/9/2002	9:40	no oil	14.82	
DIW-P09B	DSR-00074	Field	9/9/2002	9:42	no oil	14.82	
DIW-P09C	DSR-00075	Field	9/9/2002	9:43	no oil	14.80	
DIW-P02C	DSR-00076	Field	9/9/2002	9:45	no oil	16.48	
DIW-P03B	DSR-00077	Field	9/9/2002	9:47	no oil	15.46	
DIW-P04C	DSR-00078	Field	9/9/2002	9:48	no oil	15.41	
DIW-P05B	DSR-00079	Field	9/9/2002	9:50	no oil	15.44	
DIW-P06C	DSR-00080	Field	9/9/2002	9:52	no oil	15.47	
DIW-P07B	DSR-00081	Field	9/9/2002	9:55	no oil	15.82	
DIW-P07C	DSR-00082	Field	9/9/2002	9:56	no oil	15.77	
DIW-P08C	DSR-00083	Field	9/9/2002	9:57	no oil	15.87	May have been DIW-P08B instead
DIW-P14A	DSR-00084	Field	9/9/2002	10:35	no oil	13.55	
DIW-P10A	DSR-00085	Field	9/9/2002	10:14	*	14.79	* May have thin oil film
DIW-P08A	DSR-00086	Field	9/9/2002	10:18	no oil	15.31	
DIW-P13A	DSR-00087	Field	9/9/2002	10:31	13.81	14.43	
DIW-P11A	DSR-00088	Field	9/9/2002	10:27	14.17	15.00	
DIW-P12A	DSR-00089	Field	9/9/2002	10:29	14.18	14.72	
DIW-P09A	DSR-00090	Field	9/9/2002	10:25	14.76	15.58	
DIW-1-2	DSR-00091	Field	9/9/2002	10:23	16.21	16.58	
DIW-P07A	DSR-00092	Field	9/9/2002	10:20	15.72	16.70	

Second Post-Injection Field Oil and Water Levels

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Depth to Oil (ft)	Depth to Water (ft)	Comments
DCB-8	DSR-00101	Field	11/4/2002	12:02	no oil	14.28	
DCB-21A	DSR-00102	Field	11/4/2002	11:38	no oil	11.21	
DCB-21B	DSR-00103	Field	11/4/2002	11:39	no oil	15.40	
DCB-21C	DSR-00104	Field	11/4/2002	11:40	no oil	15.88	
DCB-22A	DSR-00105	Field	11/4/2002	11:41	no oil	14.90	
DCB-22B	DSR-00106	Field	11/4/2002	11:42	no oil	14.68	
DCB-22C	DSR-00107	Field	11/4/2002	11:43	no oil	15.11	
DCB-70B	DSR-00108	Field	11/4/2002	11:48	no oil	7.17	
DCB-19A	DSR-00109	Field	11/4/2002	11:31	no oil	12.03	
DCB-19B	DSR-00110	Field	11/4/2002	11:32	no oil	14.04	
DCB-19C	DSR-00111	Field	11/4/2002	11:33	no oil	15.37	
DCB-18A	DSR-00112	Field	11/4/2002	11:34	no oil	9.55	
DCB-18B	DSR-00113	Field	11/4/2002	11:35	no oil	13.55	
DCB-18C	DSR-00114	Field	11/4/2002	11:36	no oil	14.40	
DCB-71B	DSR-00115	Field	11/4/2002	11:52	no oil	8.85	
DIW-P14C	DSR-00116	Field	11/4/2002	12:00	no oil	13.21	
DIW-P13B	DSR-00117	Field	11/4/2002	12:01	no oil	13.20	
DIW-P13C	DSR-00118	Field	11/4/2002	12:02	no oil	13.28	
DIW-P12B	DSR-00119	Field	11/4/2002	12:05	no oil	13.63	
DIW-P11B	DSR-00120	Field	11/4/2002	12:06	no oil	13.61	
DIW-P11C	DSR-00121	Field	11/4/2002	12:06	no oil	13.59	
DIW-P10C	DSR-00122	Field	11/4/2002	12:08	no oil	14.21	
DIW-P09B	DSR-00123	Field	11/4/2002	12:08	no oil	14.22	
DIW-P09C	DSR-00124	Field	11/4/2002	12:09	no oil	14.18	
DIW-P02C	DSR-00125	Field	11/4/2002	12:11	no oil	15.87	
DIW-P03B	DSR-00126	Field	11/4/2002	12:12	no oil	14.88	
DIW-P04C	DSR-00127	Field	11/4/2002	12:13	no oil	14.81	
DIW-P05B	DSR-00128	Field	11/4/2002	12:10	no oil	14.87	
DIW-P06C	DSR-00129	Field	11/4/2002	12:11	no oil	14.89	
DIW-P07B	DSR-00130	Field	11/4/2002	12:09	no oil	15.23	
DIW-P07C	DSR-00131	Field	11/4/2002	12:10	no oil	15.17	
DIW-P08C	DSR-00132	Field	11/4/2002	12:08	no oil	15.22	May have been DIW-P08B instead
DIW-P14A	DSR-00133	Field	11/4/2002	11:59	no oil	12.97	
DIW-P10A	DSR-00134	Field	11/4/2002	12:07	no oil	14.17	
DIW-P08A	DSR-00135	Field	11/4/2002	12:14	no oil	14.68	
DIW-P13A	DSR-00136	Field	11/4/2002	11:41	13.18	13.47	
DIW-P12A	DSR-00137	Field	11/4/2002	11:44	13.59	13.74	
DIW-P11A	DSR-00138	Field	11/4/2002	11:42	13.57	14.18	
DIW-P09A	DSR-00139	Field	11/4/2002	11:46	14.16	14.73	
DIW-1-2	DSR-00140	Field	11/4/2002	11:48	15.62	15.81	
DIW-P03A	DSR-00141	Field	11/4/2002	11:38	14.8	15.35	
DIW-P05A	DSR-10001	Field	11/4/2002	11:50	14.79	15.23	
DIW-P07A	DSR-00142	Field	11/4/2002	11:52	15.14	15.48	

APPENDIX F
Field Oil and Water Levels

Third Post-Injection Field Oil and Water Levels

Well/ Piezometer	Sample Number	Sample Type	Date	Time	Depth to Oil (ft)	Depth to Water (ft)	Comments
DCB-8	DSR-00151	Field	1/13/2003	8:33	no oil	12.4	
DCB-21A	DSR-00152	Field	1/13/2003	8:11	no oil	10.11	
DCB-21B	DSR-00153	Field	1/13/2003	8:12	no oil	14.38	
DCB-22A	DSR-00154	Field	1/13/2003	8:18	no oil	13.07	
DCB-22B	DSR-00155	Field	1/13/2003	8:18	no oil	13.58	
DCB-22C	DSR-00156	Field	1/13/2003	8:19	no oil	14.08	
DCB-70B	DSR-00157	Field	1/13/2003	11:56	no oil	6.2	
DCB-19A	DSR-00158	Field	1/13/2003	8:23	no oil	10.16	
DCB-19B	DSR-00159	Field	1/13/2003	8:23	no oil	13.13	
DCB-18A	DSR-00160	Field	1/13/2003	8:26	no oil	9.05	
DCB-18B	DSR-00161	Field	1/13/2003	8:27	no oil	12.46	
DCB-18C	DSR-00162	Field	1/13/2003	8:27	no oil	13.36	
DCB-71B	DSR-00163	Field	1/13/2003	12:15	no oil	7.76	
DIW-P14C	DSR-00164	Field	1/13/2003	8:13	no oil	11.92	
DIW-P13B	DSR-00165	Field	1/13/2003	8:14	no oil	11.95	
DIW-P13C	DSR-00166	Field	1/13/2003	8:14	no oil	12.12	
DIW-P12B	DSR-00167	Field	1/13/2003	8:15	no oil	12.38	
DIW-P11B	DSR-00168	Field	1/13/2003	8:15	no oil	12.44	
DIW-P11C	DSR-00169	Field	1/13/2003	8:16	no oil	12.36	
DIW-P10C	DSR-00170	Field	1/13/2003	8:16	no oil	12.98	
DIW-P09B	DSR-00171	Field	1/13/2003	8:17	no oil	12.97	
DIW-P09C	DSR-00172	Field	1/13/2003	8:17	no oil	13.01	
DIW-P02C	DSR-00173	Field	1/13/2003	8:19	no oil	14.66	
DIW-P03B	DSR-00174	Field	1/13/2003	8:20	no oil	13.69	
DIW-P03C	DSR-00175	Field	1/13/2003	8:21	no oil	13.62	
DIW-P04C	DSR-00176	Field	1/13/2003	8:22	no oil	13.6	
DIW-P05B	DSR-00177	Field	1/13/2003	8:22	no oil	13.63	
DIW-P06C	DSR-00178	Field	1/13/2003	8:22	no oil	13.66	
DIW-P07B	DSR-00179	Field	1/13/2003	8:24	no oil	14.02	
DIW-P07C	DSR-00180	Field	1/13/2003	8:25	no oil	13.98	
DIW-P08C	DSR-00181	Field	1/13/2003	8:26	no oil	13.98	
DIW-P14A	DSR-00182	Field	1/14/2003	8:06	no oil	11.71	
DIW-P10A	DSR-00183	Field	1/14/2003	8:07	no oil	12.92	
DIW-P08A	DSR-00184	Field	1/14/2003	8:08	no oil	13.43	
DIW-P13A	DSR-00185	Field	1/14/2003	8:26	11.9	12.88	
DIW-P11A	DSR-00186	Field	1/14/2003	8:19	12.3	13.1	
DIW-P12A	DSR-00187	Field	1/14/2003	8:22	12.4	12.45	
DIW-P09A	DSR-00188	Field	1/14/2003	8:18	12.9	13.95	
DIW-1-2	DSR-00189	Field	1/14/2003	8:16	14.3	15	
DIW-P03A	DSR-00190	Field	1/14/2003	8:13	13.4	14.44	
DIW-P05A	DSR-00191	Field	1/14/2003	8:11	13.51	14.35	
DIW-P07A	DSR-00192	Field	1/14/2003	8:09	13.85	14.73	

Forth Post-Injection Field Oil and Water Levels

Well / Piezometer	Sample Number	Sample Type	Date	Time	Depth to Oil (ft)	Depth to Water (ft)	Comments
DCB-8	DSR-00201	Field	3/31/2003	10:40	no oil	9.75	
DCB-21A	DSR-00202	Field	3/31/2003	10:45	no oil	7.11	
DCB-21B	DSR-00203	Field	3/31/2003	10:50	no oil	12.5	
DCB-22C	DSR-00204	Field	3/31/2003	10:55	no oil	12.22	
DCB-70B	DSR-00205	Field	3/31/2003	11:00	no oil	4.4	
DCB-19A	DSR-00206	Field	3/31/2003	11:03	no oil	7.98	
DCB-19B	DSR-00207	Field	3/31/2003	11:04	no oil	11.21	
DCB-18C	DSR-00208	Field	3/31/2003	11:05	no oil	11.44	
DCB-71B	DSR-00209	Field	3/31/2003	11:02	no oil	5.98	
DIW-P14C	DSR-00210	Field	3/31/2003	11:38	no oil	9.33	
DIW-P13B	DSR-00211	Field	3/31/2003	10:45	no oil	9.35	
DIW-P13C	DSR-00212	Field	3/31/2003	11:38	no oil	9.48	
DIW-P12B	DSR-00213	Field	3/31/2003	11:39	no oil	9.85	
DIW-P11B	DSR-00214	Field	3/31/2003	10:48	no oil	9.82	
DIW-P11C	DSR-00215	Field	3/31/2003	11:39	no oil	9.84	
DIW-P10C	DSR-00216	Field	3/31/2003	11:41	no oil	10.43	
DIW-P09B	DSR-00217	Field	3/31/2003	10:49	no oil	10.41	
DIW-P09C	DSR-00218	Field	3/31/2003	11:40	no oil	10.43	
DIW-P02C	DSR-00219	Field	3/31/2003	11:42	no oil	12.09	
DIW-P03B	DSR-00220	Field	3/31/2003	10:50	no oil	11.05	
DIW-P03C	DSR-00221	Field	3/31/2003	11:43	no oil	11.05	
DIW-P04C	DSR-00222	Field	3/31/2003	11:43	no oil	11.04	
DIW-P07B	DSR-00223	Field	3/31/2003	10:52	no oil	11.38	
DIW-P07C	DSR-00224	Field	3/31/2003	11:44	no oil	11.35	
DIW-P08C	DSR-00225	Field	3/31/2003	11:45	no oil	11.4	
DIW-P13A	DSR-00226	Field	3/31/2003	11:02	9.31	9.8	
DIW-P11A	DSR-00227	Field	3/31/2003	11:55	9.75	10.43	
DIW-P09A	DSR-00228	Field	3/31/2003	11:07	10.35	10.91	Estimated based upon measurement on 4/2/03
DIW-1-2	DSR-00229	Field	3/31/2003	11:10	11.75	12.37	
DIW-P03A	DSR-00230	Field	3/31/2003	11:13	10.97	11.58	
DIW-P05A	DSR-00231	Field	3/31/2003	11:15	10.96	11.47	
DIW-P07A	DSR-00232	Field	3/31/2003	11:27	11.3	11.41	

Fifth Post-Injection Field Oil and Water Levels

Well / Piezometer	Sample Number	Sample Type	Date	Time	Depth to Oil (ft)	Depth to Water (ft)	Comments
DCB-8	DSR-00250	Field	7/14/2003	9:38	no oil	9.25	
DCB-21A	DSR-00251	Field	7/14/2003	8:30	no oil	8.61	
DCB-21B	DSR-00252	Field	7/14/2003	8:31	no oil	12.51	
DCB-22C	DSR-00253	Field	7/14/2003	8:35	no oil	12.25	
DCB-70B	DSR-00254	Field	7/14/2003	8:37	no oil	4.42	
DCB-23C	DSR-00255	Field	7/14/2003	9:31	no oil	9.25	
DCB-19A	DSR-00256	Field	7/14/2003	8:43	no oil	8.62	
DCB-19B	DSR-00257	Field	7/14/2003	8:45	no oil	11.21	
DCB-18C	DSR-00258	Field	7/14/2003	8:47	no oil	11.45	
DCB-71B	DSR-00259	Field	7/14/2003	8:40	no oil	5.94	
DIW-P14C	DSR-00260	Field	7/14/2003	9:11	no oil	9.27	
DIW-P13B	DSR-00261	Field	7/14/2003	9:11	no oil	9.19	
DIW-P13C	DSR-00262	Field	7/14/2003	9:12	no oil	9.22	
DIW-P12B	DSR-00263	Field	7/14/2003	9:13	no oil	9.71	
DIW-P11B	DSR-00264	Field	7/14/2003	9:14	no oil	9.69	
DIW-P11C	DSR-00265	Field	7/14/2003	9:15	no oil	9.68	
DIW-P10C	DSR-00266	Field	7/14/2003	9:16	no oil	10.28	
DIW-P09B	DSR-00267	Field	7/14/2003	9:17	no oil	10.28	
DIW-P09C	DSR-00268	Field	7/14/2003	9:18	no oil	10.26	
DIW-P02C	DSR-00269	Field	7/14/2003	9:19	no oil	11.95	
DIW-P03B	DSR-00270	Field	7/14/2003	9:21	no oil	10.92	
DIW-P03C	DSR-00271	Field	7/14/2003	9:22	no oil	10.91	
DIW-P04C	DSR-00272	Field	7/14/2003	9:20	no oil	10.88	
DIW-P07B	DSR-00273	Field	7/14/2003	9:26	no oil	11.26	
DIW-P07C	DSR-00274	Field	7/14/2003	9:26	no oil	11.23	
DIW-P08C	DSR-00275	Field	7/14/2003	9:25	no oil	11.26	
DIW-P13A	DSR-00276	Field	7/14/2003	9:44	9.2	9.66	
DIW-P11A	DSR-00277	Field	7/14/2003	9:47	9.65	10.15	
DIW-P09A	DSR-00278	Field	7/14/2003	9:49	10.23	10.7	
DIW-1-2	DSR-00279	Field	7/14/2003	9:51	11.59	12.19	
DIW-P03A	DSR-00280	Field	7/14/2003	9:54	10.88	11.23	
DIW-P05A	DSR-00281	Field	7/14/2003	9:56	10.85	11.23	
DIW-P07A	DSR-00282	Field	7/14/2003	9:59	11.2	11.53	

APPENDIX G

Subcontractor Data extracted from ERDMS / BIEDMS

Sampling Event	Well/ Piezometer	Sample Number	Sample Date	Sample Type	Lab	Aluminum (mg/L)	Barium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)
Pre-Injection	DIW-P11B	DSR-00038	6/27/2002	Replicate	Subcontractor	139.5	0.01095	113	0.00425	0.0274	0.082
Pre-Injection	DEXOU-FB	DSR-00049	6/27/2002	Field Blank	Subcontractor	<0.322	0.0025	<0.0471	<0.0041	<0.011	0.00094
First Post-Injection	DIW-P11B	DSR-00098	9/11/2002	Replicate	Subcontractor	128	0.05215	102.5	0.0024	0.03925	0.0012
First Post-Injection	DEXOU-FB	DSR-00100	9/12/2002	Field Blank	Subcontractor	<0.322	<0.0083	<0.0676	<0.0041	0.0012	0.00082
Second Post-Injection	DIW-P11B	DSR-00148	11/5/2002	Replicate	Subcontractor	217.5	0.0479	118.5	0.0041	0.0764	0.0055
Second Post-Injection	DEXOU-FB	DSR-00150	11/5/2002	Field Blank	Subcontractor	<0.322	<0.0083	<0.296	<0.0041	<0.011	0.00074
Third Post-Injection	DIW-P11B	DSR-00198	1/14/2003	Replicate	Subcontractor	289	0.0278	107.5	0.0019	0.1405	0.0055
Third Post-Injection	DEXOU-FB	DSR-00200	1/14/2003	Field Blank	Subcontractor	<0.322	<0.0083	<0.0368	<0.0041	<0.011	<0.0055
Fourth Post-Injection	DIW-P11B	DSR-00238	4/1/2003	Replicate	Subcontractor	399.5	0.00915	94.3	0.0363	0.209	0.9675
Fourth Post-Injection	DEXOU-FB	DSR-00240	4/1/2003	Field Blank	Subcontractor	<0.322	<0.0083	0.0553	<0.0041	<0.011	<0.0055
Fifth Post-Injection	DIW-P11B	DSR-00288	7/14/2003	Replicate	Subcontractor	223	0.0329	82.5	0.0051	0.139	0.00056
Fifth Post-Injection	DEXOU-FB	DSR-00290	7/14/2003	Field Blank	Subcontractor	0.0501	<0.0083	<0.296	<0.0041	<0.011	<0.0055

Iron (mg/L)	Magnesium (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Lead (mg/L)	Silica (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)	Ammonium (mg/L)
141.5	70.95	12.1	0.7505	0.015	72.85	1.995		0.057	0.0374	1960	1.23
0.0908	<0.019	<0.00088	<0.0041	<0.015	<0.0508	<0.058		<0.057	<0.101	<0.32	0.09
410.5	69.75	9.82	0.7515	0.015	109.5	0.234	119.5	0.33	0.101	2240	0.108
<0.192	0.0184	0.00036	0.0013	<0.015	<0.0705	<0.058	<0.134	<0.057	<0.101	0.097	0.055
252	88.4	11.55	0.8	0.0084	102.5	0.08555	145	0.057	0.0511	4540	0.826
0.0377	<0.17	0.0013	0.00079	<0.003	12.3	<0.058	19.1	<0.057	<0.101	0.056	0.5195
294.5	90.6	12.55	1.01	0.00905	120.5	1.315	49.35	0.114	1.15	5700	1.25
<0.192	<0.0186	0.00072	<0.0041	<0.015	0.0522	<0.0103	<0.214	<0.057	<0.101	0.25	0.05
346.5	111.5	12.35	2.28	0.0035	226.5	8.25	10.3	0.242	0.56	6450	1.02
0.0204	0.0376	<0.0015	<0.0041	<0.015	<0.132	<0.0088	<0.214	<0.057	0.0189	<0.32	<1
470	64.7	9.04	1.23	0.0075	176	2.83	3.32	<0.285	0.791	3120	0.425
<0.192	<0.17	<0.0015	0.00055	<0.015	0.0241	<0.058	0.0272	0.048	0.00364	<0.32	0.067

Gray highlight means that there is no data

SRTC ML, SRTC EBS, and Subcontractor Intra-Laboratory Comparison

Sampling Event	Well/ Piezometer	Sample Number	Sample Date	Sample Type	Lab	Aluminum (mg/L)	Barium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)
Pre-Injection	DIW-P11B	DSR-00021	6/27/2002	Sample	SRTC ML	155	<0.002	118	<0.003	0.009	0.110	154	78.2
Pre-Injection	DIW-P11B	DSR-00021	6/27/2002	Sample	SRTC EBS			> 100					<0.5
Pre-Injection	DIW-P11B	DSR-00037	6/27/2002	Duplicate	SRTC ML	157	<0.002	119	<0.003	0.007	0.110	154	77.6
Pre-Injection	DIW-P11B	DSR-00037	6/27/2002	Duplicate	SRTC EBS			> 100					<0.5
Pre-Injection	DIW-P11B	DSR-00038	6/27/2002	Replicate	Subcontractor	139.5	0.01095	113	0.00425	0.0274	0.082	141.5	70.95
Pre-Injection	DIW-P11B	DSR-00039	6/27/2002	Unfiltered	SRTC ML	156	<0.002	118	<0.003	0.009	0.111	152	77.6
First Post-Injection	DIW-P11B	DSR-00071	9/11/2002	Sample	SRTC ML	117	<0.002	261	<0.003	<0.002	<0.009	426	69.2
First Post-Injection	DIW-P11B	DSR-00071	9/12/2002	Sample	SRTC EBS			60.61					75.98776515
First Post-Injection	DIW-P11B	DSR-00097	9/11/2002	Duplicate	SRTC ML	123	<0.002	106	<0.003	<0.002	<0.009	432	69.7
First Post-Injection	DIW-P11B	DSR-00098	9/11/2002	Replicate	Subcontractor	128	0.05215	102.5	0.0024	0.03925	0.0012	410.5	69.75
First Post-Injection	DIW-P11B	DSR-00099	9/11/2002	Unfiltered	SRTC ML	124	<0.002	105	<0.003	<0.002	<0.009	430	71.2
Second Post-Injection	DIW-P11B	DSR-00120	11/5/2002	Sample	SRTC ML	214	<0.002	117	<0.003	<0.002	<0.010	262	84.0
Second Post-Injection	DIW-P11B	DSR-00120	11/5/2002	Sample	SRTC EBS			174.23					92.36
Second Post-Injection	DIW-P11B	DSR-00147	11/5/2002	Dulicate	SRTC ML	211	<0.002	113	<0.003	<0.002	<0.010	252	83.1
Second Post-Injection	DIW-P11B	DSR-00147	11/5/2002	Dulicate	SRTC EBS			166.32					95.21
Second Post-Injection	DIW-P11B	DSR-00148	11/5/2002	Replicate	Subcontractor	217.5	0.0479	118.5	0.0041	0.0764	0.0055	252	88.4
Second Post-Injection	DIW-P11B	DSR-00149	11/5/2002	Unfiltered	SRTC ML	211	<0.002	126	<0.003	<0.002	<0.010	260	83.2
Third Post-Injection	DIW-P11B	DSR-00168	1/13/2003	Sample	SRTC ML	270	<0.002	104	<0.003	0.109	<0.009	316	88.2
Third Post-Injection	DIW-P11B	DSR-00168	1/13/2003	Sample	SRTC EBS			96.15					82.75
Third Post-Injection	DIW-P11B	DSR-00197	1/13/2003	Duplicate	SRTC ML	284	<0.002	102	<0.003	0.098	<0.009	322	85.7
Third Post-Injection	DIW-P11B	DSR-00197	1/13/2003	Duplicate	SRTC EBS			9.75					8.42
Third Post-Injection	DIW-P11B	DSR-00198	1/14/2003	Replicate	Subcontractor	289	0.0278	107.5	0.0019	0.1405	0.0055	294.5	90.6
Third Post-Injection	DIW-P11B	DSR-00199	1/13/2003	Unfiltered	SRTC ML	272	<0.002	103	<0.003	0.103	<0.009	312	88.4
Fourth Post-Injection	DIW-P11B	DSR-00214	4/1/2003	Sample	SRTC ML	417	<0.002	93.9	<0.003	0.231	0.827	380	134
Fourth Post-Injection	DIW-P11B	DSR-00214	4/1/2003	Sample	SRTC EBS			78.42					104.06
Fourth Post-Injection	DIW-P11B	DSR-00237	4/1/2003	Duplicate	SRTC ML	401	<0.002	94.1	<0.003	0.231	0.833	361	118
Fourth Post-Injection	DIW-P11B	DSR-00237	4/1/2003	Duplicate	SRTC EBS			79.84					103.56
Fourth Post-Injection	DIW-P11B	DSR-00238	4/1/2003	Replicate	Subcontractor	399.5	0.00915	94.3	0.0363	0.209	0.9675	346.5	111.5
Fourth Post-Injection	DIW-P11B	DSR-00239	4/1/2003	Unfiltered	SRTC ML	408	<0.002	91.9	<0.003	0.228	0.810	364	116
Fifth Post-Injection	DIW-P11B	DSR-00264	7/14/2003	Sample	SRTC ML	214	<0.002	74.4	<0.003	0.064	<0.009	526	74.5
Fifth Post-Injection	DIW-P11B	DSR-00264	7/14/2003	Sample	SRTC EBS			4.52					<0.5
Fifth Post-Injection	DIW-P11B	DSR-00287	7/14/2003	Duplicate	SRTC ML	208	<0.002	74.1	<0.003	0.070	<0.009	516	74.6
Fifth Post-Injection	DIW-P11B	DSR-00287	7/14/2003	Duplicate	SRTC EBS								
Fifth Post-Injection	DIW-P11B	DSR-00288	7/14/2003	Replicate	Subcontractor	223	0.0329	82.5	0.0051	0.139	0.00056	470	64.7
Fifth Post-Injection	DIW-P11B	DSR-00289	7/14/2003	Unfiltered	SRTC ML	213	<0.002	76.5	<0.003	0.066	<0.009	524	75.0

Gray highlight means that there is no data

SRTC ML, SRTC EBS, and Subcontractor Intra-Laboratory Comparison

Lab	Manganese (mg/L)	Nickel (mg/L)	Lead (mg/L)	Silica (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Nitrate (mg/L)	Phosphate or Phosphorus (mg/L)	Sulfate (mg/L)	Ammonium (mg/L)	Chloride (mg/L)	Nitrite (mg/L)
SRTC ML	13.3	0.736	<0.017	39.4	2.02							
SRTC EBS						16	<0.5	<0.5	2489.65	1.3		
SRTC ML	13.5	0.735	<0.017	39.4	2.01							
SRTC EBS						16	<0.5	<0.5	2474.66	1.3		
Subcontractor	12.1	0.7505	0.015	72.85	1.995		0.057	0.0374	1960	1.23		
SRTC ML	13.3	0.737	<0.017	39.2	2.00							
SRTC ML	7.65	0.476	<0.017	52.7	0.077							
SRTC EBS						79.41	< 0.5	< 0.5	1623.21	na*		
SRTC ML	7.92	0.498	<0.017	53.0	0.101							
Subcontractor	9.82	0.7515	0.015	109.5	0.234	119.5	0.33	0.101	2240	0.108		
SRTC ML	7.98	0.509	<0.017	54.3	0.071							
SRTC ML	9.12	0.538	<0.017	41.8	<0.001							
SRTC EBS						165.27	< 0.5	< 0.5	2871.69	12.47		
SRTC ML	10.5	0.553	<0.017	39.9	<0.001							
SRTC EBS						170.58	< 0.5	< 0.5	2637.72	10.60		
Subcontractor	11.55	0.8	0.0084	102.5	0.08555	145	0.057	0.0511	4540	0.826		
SRTC ML	10.5	0.476	<0.017	40.7	<0.001							
SRTC ML	9.27	0.679	<0.017	59.5	1.07	49.6	<1.00	<1.00	2910		<1.00	<1.00
SRTC EBS						52.65	< 0.5	< 0.5	3135	< 0.5	3.05	< 0.5
SRTC ML	9.08	0.669	<0.017	58.8	1.00							
SRTC EBS						5.55	< 0.5	< 0.5	369.7	< 0.5		
Subcontractor	12.55	1.01	0.00905	120.5	1.315	49.35	0.114	1.15	5700	1.25		
SRTC ML	9.22	0.688	<0.017	68.9	1.14							
SRTC ML	9.89	1.65	<0.017	107	7.90							
SRTC EBS						11.56	4.57	< 0.5	4539.62	< 0.5		
SRTC ML	9.82	1.62	<0.017	108	7.82							
SRTC EBS						7.98	6.63	< 0.5	4563.63	< 0.5		
Subcontractor	12.35	2.28	0.0035	226.5	8.25	10.3	0.242	0.56	6450	1.02		
SRTC ML	9.75	1.64	<0.017	107	7.81							
SRTC ML	8.59	1.08	<0.017	95.8	2.81							
SRTC EBS						<0.5	< 0.5	< 0.5	3440.81	<0.5		
SRTC ML	8.91	1.13	<0.017	95.2	2.90							
SRTC EBS												
Subcontractor	9.04	1.23	0.0075	176	2.83	3.32	<0.285	0.791	3120	0.425		
SRTC ML	8.71	1.10	<0.017	96.7	2.87							

Gray highlight means that there is no data

APPENDIX H
Laboratory QA/QC Data

SRTC EBS Inter-Laboratory Comparison

Sampling Event	Well / Piezometer	Sample Number	Sample Date	Sample Type	Lab	Chloride (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)	Lithium (mg/L)	Sodium (mg/L)	Ammonium (mg/L)
Pre-Injection	DCB-21B	DSR-00003	6/27/2002	Sample	SRTC EBS	7.7	<0.5	<0.5	1.3	2121.94	<0.5	7.5	<0.5
Pre-Injection	DCB-21B	DSR-00033	6/27/2002	Duplicate	SRTC EBS	8.4	<0.5	<0.5	1.3	2083.28	<0.5	6.2	<0.5
Pre-Injection	DCB-21B	DSR-00034	6/27/2002	Unfiltered	SRTC EBS								
Pre-Injection	DCB-22C	DSR-00007	6/27/2002	Sample	SRTC EBS	5.5	<0.5	<0.5	<0.5	390	<0.5	3.8	<0.5
Pre-Injection	DCB-22C	DSR-00035	6/27/2002	Duplicate	SRTC EBS	5.6	<0.5	<0.5	<0.5	380	<0.5	3.8	<0.5
Pre-Injection	DCB-22C	DSR-00036	6/27/2002	Unfiltered	SRTC EBS								
First Post-Injection	DCB-21B	DSR-00052	9/11/2002	Sample	SRTC EBS	2.61	< 0.5	5.70	< 0.5	1301.23	< 0.5	7.58	< 0.5
First Post-Injection	DCB-21B	DSR-00093	9/11/2002	Duplicate	SRTC EBS								
First Post-Injection	DCB-21B	DSR-00094	9/11/2002	Unfiltered	SRTC EBS								
First Post-Injection	DCB-22C	DSR-00056	9/11/2002	Sample	SRTC EBS	4.41	< 0.5	< 0.5	< 0.5	340.66	< 0.5	3.36	< 0.5
First Post-Injection	DCB-22C	DSR-00095	9/11/2002	Duplicate	SRTC EBS								
First Post-Injection	DCB-22C	DSR-00096	9/11/2002	Unfiltered	SRTC EBS								
Second Post-Injection	DCB-21B	DSR-00103	11/6/2002	Sample	SRTC EBS	2.42	10.37	< 0.5	< 0.5	1486.97	< 0.5	9.23	< 0.5
Second Post-Injection	DCB-21B	DSR-00143	11/6/2002	Dulicate	SRTC EBS	2.47	10.37	< 0.5	< 0.5	1400.80	< 0.5	8.23	0.73
Second Post-Injection	DCB-21B	DSR-00144	11/6/2002	Unfiltered	SRTC EBS								
Second Post-Injection	DCB-22C	DSR-00107	11/6/2002	Sample	SRTC EBS	4.54	< 0.5	< 0.5	< 0.5	336.67	< 0.5	4.35	< 0.5
Second Post-Injection	DCB-22C	DSR-00145	11/6/2002	Dulicate	SRTC EBS	4.31	< 0.5	< 0.5	< 0.5	291.53	< 0.5	3.89	< 0.5
Second Post-Injection	DCB-22C	DSR-00146	11/6/2002	Unfiltered	SRTC EBS								
Third Post-Injection	DCB-21B	DSR-00153	1/13/2003	Sample	SRTC EBS	3.49	< 0.5	7.03	< 0.5	1466	< 0.5	7.73	0.53
Third Post-Injection	DCB-21B	DSR-00193	1/13/2003	Duplicate	SRTC EBS	3.63	< 0.5	7.25	< 0.5	1441	< 0.5	8.32	0.63
Third Post-Injection	DCB-21B	DSR-00194	1/13/2003	Unfiltered	SRTC EBS								
Third Post-Injection	DCB-22C	DSR-00156	1/13/2003	Sample	SRTC EBS	4.82	< 0.5	< 0.5	< 0.5	381.7	< 0.5	4.10	< 0.5
Third Post-Injection	DCB-22C	DSR-00195	1/13/2003	Duplicate	SRTC EBS	5.00	< 0.5	7.97	< 0.5	435.3	< 0.5	4.71	< 0.5
Third Post-Injection	DCB-22C	DSR-00196	1/13/2003	Unfiltered	SRTC EBS								
Fourth Post-Injection	DCB-21B	DSR-00203	3/31/2003	Sample	SRTC EBS	15.85	< 0.5	7.68	< 0.5	1470.59	< 0.5	7.61	< 0.5
Fourth Post-Injection	DCB-21B	DSR-00233	3/31/2003	Duplicate	SRTC EBS	15.12	0.53	8.35	< 0.5	1432.48	< 0.5	7.48	< 0.5
Fourth Post-Injection	DCB-21B	DSR-00234	3/31/2003	Unfiltered	SRTC EBS								
Fourth Post-Injection	DCB-22C	DSR-00204	3/31/2003	Sample	SRTC EBS	0.87	< 0.5	0.55	< 0.5	413.16	< 0.5	3.91	< 0.5
Fourth Post-Injection	DCB-22C	DSR-00235	3/31/2003	Duplicate	SRTC EBS	0.88	0.52	0.26	< 0.5	422.77	< 0.5	4.73	< 0.5
Fourth Post-Injection	DCB-22C	DSR-00236	3/31/2003	Unfiltered	SRTC EBS								
Fifth Post-Injection	DCB-21B	DSR-00252	7/14/2003	Sample	SRTC EBS	< 0.5	< 0.5	< 0.5	< 0.5	2799.44	<0.5	5.17	<0.5
Fifth Post-Injection	DCB-21B	DSR-00283	7/14/2003	Duplicate	SRTC EBS								
Fifth Post-Injection	DCB-21B	DSR-00284	7/14/2003	Unfiltered	SRTC EBS								
Fifth Post-Injection	DCB-22C	DSR-00253	7/14/2003	Sample	SRTC EBS	4.15	< 0.5	< 0.5	< 0.5	975.68	<0.5	10.47	<0.5
Fifth Post-Injection	DCB-22C	DSR-00285	7/14/2003	Duplicate	SRTC EBS								
Fifth Post-Injection	DCB-22C	DSR-00286	7/14/2003	Unfiltered	SRTC EBS								

Gray highlight means that there is no data

APPENDIX H
Laboratory QA/QC Data

SRTC EBS Inter-Laboratory Comparison

Lab	Potassium (mg/L)	Magnesium (mg/L)	Calcium (mg/L)	Hydrogen Sulfide (mg/L)	Lactate (mg/L)	Acetic Acid (mg/L)	Propanoic Acid (mg/L)	Formic Acid (mg/L)	Isobutyric Acid (mg/L)	Butyric Acid (mg/L)	Isovaleric Acid (mg/L)	Valeric Acid (mg/L)	Isocaproic Acid (mg/L)	Hexanoic Acid (mg/L)	Heptanoic Acid (mg/L)
SRTC EBS	61	<0.5	> 100	0.13683	<6.3	6.0	18.3	7.1	15.2	14.1	18.6	16.7	15.9	15.5	15.2
SRTC EBS	54	<0.5	> 100		<6.3	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0
SRTC EBS				0.18244											
SRTC EBS	21	<0.5	91	0.159635	<6.3	5.7	16.4	6.6	6.5	8.9	7.4	9.2	6.7	7.9	<5.0
SRTC EBS	20	<0.5	90		<6.3	<1.0	<1.0	<1.0	<1.5	<2.0	<2.0	<2.0	<2.0	<2.0	<5.0
SRTC EBS				0.193843											
SRTC EBS	36.16	36.16304	83.89	0.099223	12.3879	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS				0.024507		< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS				0.082785											
SRTC EBS	21.50	21.49934	56.09	0.078302	<6.3	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS						8.03	< 7.0	6.33	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS				0.072325											
SRTC EBS	1.28	88.06	132.06	0.0105	<6.3	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10
SRTC EBS	1.42	98.23	141.96		<6.3	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10
SRTC EBS				0.0236											
SRTC EBS	1.47	26.06	100.09	0.0105	<6.3	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10
SRTC EBS	1.54	24.05	103.54		<6.3	<6	<7	<5	<9	<9	<10	<10	<10	<10	<10
SRTC EBS				0.0052											
SRTC EBS	1.72	72.62	121.27	0.0233	9.894695	< 6.0	< 7.0	5.67	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS	1.29	76.06	125.25		9.95	< 6.0	< 7.0	6.17	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS				0.0808											
SRTC EBS	1.95	28.64	109.71	0.0233	<6.3	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS	1.35	24.29	106.35		<6.3	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS				0.0343											
SRTC EBS	1.15	73.71	111.58	<0.001	<6.3	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS	0.95	72.75	109.77		<6.3	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS				<0.001											
SRTC EBS	1.27	21.31	111.55	<0.001	<6.3	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS	1.24	23.57	112.49		<6.3	< 6.0	< 7.0	< 5.0	< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS				<0.001											
SRTC EBS	<0.5	<0.5	<0.5	0.0015	<6.3	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
SRTC EBS															
SRTC EBS				<0.001											
SRTC EBS	54.90	<0.5	122.27	<0.001	<6.3	< 6.0	< 7.0		< 9.0	< 9.0	< 10.0	< 10.0	12	< 10.0	< 10.0
SRTC EBS															
SRTC EBS				0.0014											

Gray highlight means that there is no data

SRTC ML Inter-Laboratory Comparison

Sampling Event	Well/ Piezometer	Sample Number	Sample Date	Sample Type	Lab	Aluminum (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)
Pre-Injection	DCB-21B	DSR-00003	6/27/2002	Sample	SRTC ML	120	<0.002		116	<0.003	<0.002	0.161	94.2
Pre-Injection	DCB-21B	DSR-00033	6/27/2002	Duplicate	SRTC ML	126	<0.002		117	<0.003	<0.002	0.171	95.3
Pre-Injection	DCB-21B	DSR-00034	6/27/2002	Unfiltered	SRTC ML	129	<0.002		116	<0.003	<0.002	0.182	92.8
Pre-Injection	DCB-22C	DSR-00007	6/27/2002	Sample	SRTC ML	2.12	<0.002		84.9	<0.003	<0.002	0.027	2.32
Pre-Injection	DCB-22C	DSR-00035	6/27/2002	Duplicate	SRTC ML	2.40	<0.002		86.0	<0.003	<0.002	0.028	2.50
Pre-Injection	DCB-22C	DSR-00036	6/27/2002	Unfiltered	SRTC ML	2.88	<0.002		87.4	<0.003	<0.002	0.029	2.64
First Post-Injection	DCB-21B	DSR-00052	9/11/2002	Sample	SRTC ML	131	<0.002		106	<0.003	<0.002	0.149	78.2
First Post-Injection	DCB-21B	DSR-00093	9/11/2002	Duplicate	SRTC ML	133	<0.002		107	<0.003	<0.002	0.156	78.5
First Post-Injection	DCB-21B	DSR-00094	9/11/2002	Unfiltered	SRTC ML	134	<0.002		108	<0.003	<0.002	0.152	79.7
First Post-Injection	DCB-22C	DSR-00056	9/11/2002	Sample	SRTC ML	1.54	<0.002		84.8	<0.003	<0.002	<0.009	1.96
First Post-Injection	DCB-22C	DSR-00095	9/11/2002	Duplicate	SRTC ML	1.54	<0.002		83.2	<0.003	<0.002	<0.009	2.03
First Post-Injection	DCB-22C	DSR-00096	9/11/2002	Unfiltered	SRTC ML	1.58	<0.002		84.6	<0.003	<0.002	<0.009	1.97
Second Post-Injection	DCB-21B	DSR-00103	11/6/2002	Sample	SRTC ML	144	<0.002	2.39	105	<0.003	<0.002	0.161	91.3
Second Post-Injection	DCB-21B	DSR-00143	11/6/2002	Dulicate	SRTC ML	136	<0.002	2.34	100	<0.003	<0.002	0.138	93.6
Second Post-Injection	DCB-21B	DSR-00144	11/6/2002	Unfiltered	SRTC ML	141	<0.002	2.21	102	<0.003	<0.002	0.153	89.9
Second Post-Injection	DCB-22C	DSR-00107	11/6/2002	Sample	SRTC ML	1.66	<0.002	0.260	80.3	<0.003	<0.002	<0.010	1.99
Second Post-Injection	DCB-22C	DSR-00145	11/6/2002	Dulicate	SRTC ML	1.40	<0.002	0.228	77.4	<0.003	<0.002	<0.010	1.81
Second Post-Injection	DCB-22C	DSR-00146	11/6/2002	Unfiltered	SRTC ML	1.26	<0.002	0.217	77.6	<0.003	<0.002	<0.010	1.84
Third Post-Injection	DCB-21B	DSR-00153	1/13/2003	Sample	SRTC ML	127	<0.002	<0.100	96.1	<0.003	0.025	0.180	88
Third Post-Injection	DCB-21B	DSR-00193	1/13/2003	Duplicate	SRTC ML	112	<0.002	<0.100	94.6	<0.003	0.019	0.181	87.1
Third Post-Injection	DCB-21B	DSR-00194	1/13/2003	Unfiltered	SRTC ML	116	<0.002	<0.100	96.3	<0.003	<0.002	0.157	87.5
Third Post-Injection	DCB-22C	DSR-00156	1/13/2003	Sample	SRTC ML	2.31	<0.002	<0.100	94.8	<0.003	<0.002	0.007	1.68
Third Post-Injection	DCB-22C	DSR-00195	1/13/2003	Duplicate	SRTC ML	2.32	<0.002	<0.100	91.7	<0.003	<0.002	0.010	1.68
Third Post-Injection	DCB-22C	DSR-00196	1/13/2003	Unfiltered	SRTC ML	2.45	<0.002	<0.100	92.2	<0.003	<0.002	0.009	1.76
Fourth Post-Injection	DCB-21B	DSR-00203	3/31/2003	Sample	SRTC ML	131	<0.002	<0.001	96.2	<0.003	0.049	0.141	106
Fourth Post-Injection	DCB-21B	DSR-00233	3/31/2003	Duplicate	SRTC ML	127	<0.002	<0.001	99.4	<0.003	0.055	0.147	96.4
Fourth Post-Injection	DCB-21B	DSR-00234	3/31/2003	Unfiltered	SRTC ML	131	<0.002	<0.001	101	<0.003	0.054	0.138	104
Fourth Post-Injection	DCB-22C	DSR-00204	3/31/2003	Sample	SRTC ML	0.937	<0.002	<0.001	101	<0.003	0.011	<0.009	2.06
Fourth Post-Injection	DCB-22C	DSR-00235	3/31/2003	Duplicate	SRTC ML	0.929	<0.002	<0.001	104	<0.003	0.009	<0.009	2.07
Fourth Post-Injection	DCB-22C	DSR-00236	3/31/2003	Unfiltered	SRTC ML	1.27	<0.002	<0.001	105	<0.003	0.010	<0.009	1.98
Fifth Post-Injection	DCB-21B	DSR-00252	7/14/2003	Sample	SRTC ML	170	<0.002	<0.010	128	<0.003	<0.002	0.171	179
Fifth Post-Injection	DCB-21B	DSR-00283	7/14/2003	Duplicate	SRTC ML	180	<0.002	<0.010	134	<0.003	<0.002	0.179	183
Fifth Post-Injection	DCB-21B	DSR-00284	7/14/2003	Unfiltered	SRTC ML	173	<0.002	<0.010	135	<0.003	<0.002	0.157	188
Fifth Post-Injection	DCB-22C	DSR-00253	7/14/2003	Sample	SRTC ML	5.25	<0.002	<0.010	144	<0.003	<0.002	<0.009	60.7
Fifth Post-Injection	DCB-22C	DSR-00285	7/14/2003	Duplicate	SRTC ML	5.14	<0.002	<0.010	143	<0.003	<0.002	<0.009	59.7
Fifth Post-Injection	DCB-22C	DSR-00286	7/14/2003	Unfiltered	SRTC ML	5.76	<0.002	<0.010	144	<0.003	<0.002	<0.009	64.1

Gray highlight means that there is no data

SRTC ML Inter-Laboratory Comparison

Lab	Magnesium (mg/L)	Manganese (mg/L)	Nickel (mg/L)	Lead (mg/L)	Silica (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Average Fe(2+)/ Fe(total)	Ferrous Iron (mg/L)
SRTC ML	98.9	12.4	0.625	<0.017	27.8	1.75			
SRTC ML	100	12.6	0.646	<0.017	29.2	1.79			
SRTC ML	99.5	21.5	0.649	<0.017	30.0	1.80			
SRTC ML	23.4	1.48	0.010	<0.017	11.8	<0.001			
SRTC ML	28.9	1.57	0.013	<0.017	11.9	<0.001			
SRTC ML	31.2	1.87	0.019	<0.017	12.1	<0.001			
SRTC ML	87.9	9.2	0.519	<0.017	36.2	1.58	6.97	0.907	70.98
SRTC ML	88.5	9.42	0.523	<0.017	36.7	1.57	7.09	0.898	70.51
SRTC ML	89.8	9.41	0.521	<0.017	36.9	1.56	7.03		
SRTC ML	23.9	1.130	<0.010	<0.017	10.8	<0.001	3.02	0.893	1.75
SRTC ML	23.1	1.11	0.072	<0.017	10.7	<0.001	3.03	0.816	1.66
SRTC ML	24.2	1.22	0.069	<0.017	10.9	<0.001	3.11		
SRTC ML	87.8	8.75	0.572	<0.017	37.8	1.80	8.27	0.87436882	79.83
SRTC ML	85.8	8.60	0.518	<0.017	33.6	1.66	7.91	0.903542251	84.57
SRTC ML	88.6	8.77	0.530	<0.017	37.1	1.72	7.84		
SRTC ML	27.6	1.45	<0.010	<0.017	11.1	<0.001	2.67	< detect	< detect
SRTC ML	26.3	1.29	<0.010	<0.017	10.4	<0.001	3.06	1	1.81
SRTC ML	25.2	1.13	<0.010	<0.017	10.4	<0.001	2.46		
SRTC ML	83.5	7.38	0.501	<0.017	32.8	1.69	7.47	0.852678356	75.04
SRTC ML	81.1	7.34	0.501	<0.017	32.7	1.69	7.64	0.903111866	78.66
SRTC ML	82.1	7.55	0.446	<0.017	30.7	1.55	7.33		
SRTC ML	30.8	1.69	<0.010	<0.017	12.4	<0.001	3.80	1	1.68
SRTC ML	29.6	1.71	<0.010	<0.017	12.1	<0.001	3.57	1	1.68
SRTC ML	29.8	1.81	<0.010	<0.017	12.1	<0.001	3.74		
SRTC ML	83.5	7.20	0.518	<0.017	26.7	1.62	6.74	0.911183106	96.59
SRTC ML	87.4	7.14	0.520	<0.017	28.3	1.63	6.84	0.895966421	86.37
SRTC ML	90.2	7.30	0.520	<0.017	27.5	1.60	6.60		
SRTC ML	29.5	1.51	0.031	<0.017	11.8	<0.001	3.45	1	2.06
SRTC ML	31.6	1.47	0.031	<0.017	12.4	<0.001	3.38	1	2.07
SRTC ML	33.8	1.83	0.040	<0.017	12.8	<0.001	3.51		
SRTC ML	219	14.4	0.866	<0.017	32.9	2.59	8.61	1	179.00
SRTC ML	133	14.2	0.898	<0.017	33.5	2.71	9.54	1	183.00
SRTC ML	135	14.4	0.880	<0.017	30.7	2.64	9.70		
SRTC ML	59.1	4.01	0.051	<0.017	14.0	0.068	14.1	1	60.70
SRTC ML	59.1	4.10	0.050	<0.017	13.9	0.079	15.3	<detect	<detect
SRTC ML	60.9	4.36	0.061	<0.017	14.2	0.092	15.0		

Gray highlight means that there is no data

Field Blanks

Sampling Event	Well/ Piezometer	Sample Number	Sample Date	Sample Type	Lab	Aluminum (mg/L)	Barium (mg/L)	Calcium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Magnesium (mg/L)
Pre-Injection	DEXOU-FB	DSR-00049	6/27/2002	Field Blank	Subcontractor	<0.322	0.0025	<0.0471	<0.0041	<0.011	0.00094	0.0908	<0.019
First Post-Injection	DEXOU-FB	DSR-00100	9/12/2002	Field Blank	Subcontractor	<0.322	<0.0083	<0.0676	<0.0041	0.0012	0.00082	<0.192	0.0184
Second Post-Injection	DEXOU-FB	DSR-00150	11/5/2002	Field Blank	Subcontractor	<0.322	<0.0083	<0.296	<0.0041	<0.011	0.00074	0.0377	<0.17
Third Post-Injection	DEXOU-FB	DSR-00200	1/14/2003	Field Blank	Subcontractor	<0.322	<0.0083	<0.0368	<0.0041	<0.011	<0.0055	<0.192	<0.0186
Fourth Post-Injection	DEXOU-FB	DSR-00240	4/1/2003	Field Blank	Subcontractor	<0.322	<0.0083	0.0553	<0.0041	<0.011	<0.0055	0.0204	0.0376
Fifth Post-Injection	DEXOU-FB	DSR-00290	7/14/2003	Field Blank	Subcontractor	0.0501	<0.0083	<0.296	<0.0041	<0.011	<0.0055	<0.192	<0.17

Gray highlight means that there is no data

APPENDIX H
Laboratory QA/QC Data

Field Blanks

Lab	Manganese (mg/L)	Nickel (mg/L)	Lead (mg/L)	Silica (mg/L)	Zinc (mg/L)	Sodium (mg/L)	Nitrate (mg/L)	Phosphate (mg/L)	Sulfate (mg/L)	Ammoniu m (mg/L)
Subcontractor	<0.00088	<0.0041	<0.015	<0.0508	<0.058		<0.057	<0.101	<0.32	0.09
Subcontractor	0.00036	0.0013	<0.015	<0.0705	<0.058	<0.134	<0.057	<0.101	0.097	0.055
Subcontractor	0.0013	0.00079	<0.003	12.3	<0.058	19.1	<0.057	<0.101	0.056	0.5195
Subcontractor	0.00072	<0.0041	<0.015	0.0522	<0.0103	<0.214	<0.057	<0.101	0.25	0.05
Subcontractor	<0.0015	<0.0041	<0.015	<0.132	<0.0088	<0.214	<0.057	0.0189	<0.32	<1
Subcontractor	<0.0015	0.00055	<0.015	0.0241	<0.058	0.0272	0.048	0.00364	<0.32	0.067

Gray highlight means that there is no data